Support Study for the

Impact assessment on the revision of the Directive on the Deployment of Alternative Fuels Infrastructure (2014/94/EC)

Final report

Written by Achilleas Tsamis, Rui Neiva, Ben Baxter, Peter Weldon, Alexander Kauffman, Nik Hill, Denis Naberezhnykh, Charlotte Brannigan (Ricardo), Pelopidas Siskos, Ioannis Tsiropoulos (E3M), Ian Skinner (TEPR)
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Contact: Kai Tullius

E-mail: MOVE-B4-SECRETARIAT@ec.europa.eu

European Commission
B-1049 Brussels

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EXECUTIVE SUMMARY

Introduction

This report presents the findings of the support study for the impact assessment of the Deployment of Alternative Fuels Infrastructure Directive (2014/19/EU) commissioned by DG MOVE under contract MOVE/B4/SER/2019-528/SI2.827513. The work was performed by Ricardo, TEPR and E3-Modelling, between July 2020 and March 2021.

Objective and scope of the study

The Alternative Fuels Infrastructure Directive (the Directive), adopted in 2014, creates a common framework of measures for the deployment of alternative fuels infrastructure in the EU. It requires Member States (MSs) to set up long-term National Policy Frameworks (NPFs) for the development of the market as concerns alternative fuels and the planning of the deployment of relevant alternative fuels infrastructure. It also sets common technical specifications for recharging and refuelling stations and for consumer information. It aims at ensuring that sufficient publicly accessible recharging and refuelling infrastructure is in place for all modes to ensure that the low and zero emission vehicles and vessels coming into the market are supported by a sufficient number and full geographic coverage of interoperable infrastructure. Building-up an infrastructure network for vehicles and vessels is meant to facilitate transition to alternative fuel vehicles (AFVs), reduce oil dependence and mitigate environmental impacts of road transport, to develop a single market for alternative fuels infrastructure (AFI) along urban areas and nodes and the core network of the Trans European Transport Network (TEN-T).

In the context of the EU Green Deal and European Climate Law climate neutrality objective by 2050, the target for a 55% reduction of greenhouse gas emissions by 2030 and the action plan set in the Sustainable and Smart Mobility Strategy, the Commission undertook an impact assessment addressing the needs, options and benefits for revising Directive 20014/94/EU on the deployment of the Directive in order to ensure the necessary deployment of interoperable and user-friendly public accessible infrastructure for recharging and refuelling zero- and low-emission vehicles. It is part of a package of initiatives adopted by the Commission in July 2021[1]. The purpose of this study was to support action to address the problems identified and assess the impact of measures under consideration.

Methodology and process followed

The methodology for the impact assessment comprised of three different phases:

- A **design phase** that included a detailed definition of the problem, including an analysis of the different problem areas the associated drivers and the expected evolution, the definition of the relevant policy objectives to address the problem in view of the broader EU policy objectives and the identification, screening and selection of policy measures, eventually incorporated into a set of three policy options.

- An **analytical phase** that included the definition of the "no-policy change" scenario, against which all alternative policy options were compared and the analysis of the

[1] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

economic, social and environmental impacts of the different policy measures under consideration for each problem area.

- A **synthesis phase**, were we compared the policy options, assessing their effectiveness and efficiency against each other using a multi-criteria analysis framework, and based on that comparison, we identified the preferred policy option.

The main research tools used to support the analysis included:

- Extensive desk research and data collection based on review of relevant documents (including Member State National Policy Frameworks (NPF), National Implementation Reports (NIRs), relevant studies and data-sources (including EAFO, EUROSTAT, TenTEC, Open Charge Map, NGVA Europe, ACEA Statistics, H2 stations, World Ports Climate Initiative, and Observatory of European Inland Navigation) to support the qualitative and quantitative assessment of the impacts of the measures under consideration;

- Extensive stakeholder input based on a combination of targeted survey and interviews (24 interviews and 42 survey responses) including national, regional and local authorities, industry representatives, NGOs and transport/fuel experts and a 12-week Open Public Consultation running from 6 April 2020 to 12 June 2020, which attracted 324 responses; and

- Modelling analysis of the impacts of the alternative policy options using the PRIMES-TREMOVE model, calibrated to reflect the fundamental socio-economic, technological and policy developments as included in the EU Reference Scenario 2020, enriched with desk research and data collection to support the development of the baseline scenario and the assessment of the impacts of the relevant policy measures.

Problem definition, policy measures and policy options

The problem analysis was based on the findings of the ex-post evaluation and additional analysis, and including further input from stakeholders. It found that the existing policy framework does not deliver towards the development of a commonly available infrastructure to support the accelerated take up of alternative fuelled vehicles and vessels. Four problem areas were identified with a number of underlying drivers:

- **Problem Area A:** Planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network (at least in terms of TEN and comprehensive networks) and has not led to a complete network of infrastructure allowing seamless travel across the EU. This is in particular the case for electric recharging points and hydrogen refuelling stations and in terms of on-shore power supply (OPS) and LNG infrastructure in ports. Furthermore, infrastructure for zero emission heavy-duty vehicles (HDV) is largely missing across the EU.

- **Problem Area B:** There are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services. While standards have been developed and prescribed to ensure interoperability between the vehicles and infrastructure, new technologies are emerging requiring further common technical specifications to ensure interoperability.

- **Problem Area C:** Consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees. As such, user information is not complete and uniform and there are no easy to use payment methods and full price transparency across the EU.

- **Problem Area D:** Integration of electro-mobility into the electricity system is not efficient.

As a result, the Directive is not considered adequate to support the delivery of the revised climate ambition for 2030 and climate neutrality by 2050 in view of the necessary significant increase of zero and low-emission light and heavy-duty vehicles and vessels. Without further EU level intervention, lack of recharging and refuelling infrastructure is likely to become a barrier towards the Sustainable and Smart Mobility Strategy target of at least 30 million zero-emission cars and 80,000 zero-emission lorries in operation by 2030 and nearly all cars, vans, buses as well as new heavy-duty vehicles being zero-emission by 2050.

In view of the above, the general objective of the intervention was to establish a robust policy framework in the area of alternative fuels and infrastructure to deliver on the following:

- Drive the uptake of alternative fuels in all transport modes across Europe in line with the overall long-term climate and zero pollution objectives.
- Ensure that recharging or refuelling of vehicles/vessels is easy, seamless, safe and transparent for consumers everywhere in the EU.
- Ensure availability of sufficient AFI throughout the EU at competitive costs, to remove barriers to the uptake of alternatively fuelled vehicles/vessels/aircraft that ensures that all AFVs can circulate with ease across the EU and that key infrastructure such as motorways, ports and airports enable operation of AFVs.
- Minimise dependence on oil in the transport sector and mitigate the environmental impact of transport by reducing CO_2/GHG and pollutant emissions to air.

Specific objectives were also set in relation to the problem areas identified.

A long list of measures was initially developed aiming to address problem drivers of each problem area and serve the policy objectives. Screening was undertaken on the long list of policy measures, based on legal feasibility, effectiveness and efficiency, technical feasibility, political feasibility and subsidiarity and proportionality. Furthermore, a detailed analysis of AFI concerning road transport to identify sufficiency levels was undertaken on the basis of desk research and stakeholder input (see Annex A). This resulted in a final set of measures, which were packaged into three policy options and assessed against the baseline ("no policy change") scenario. The policy options are outlined as follows:

- **Policy Option 1 (PO1):** This option introduces a number of significant changes to the Directive to fully deliver on the 2030 Climate Target Plan objectives. While the national target setting and reporting under the National Policy Framework remain an important pillar, this approach is strengthened by mandatory fleet based targets for electric recharging points for Light Duty Vehicles (LDVs) on the basis of minimum installed capacity per registered electric vehicle (1.0 kW installed capacity per registered battery electric car/van and 0.66 kW installed capacity per every registered plug in hybrid car/van). This option also introduces mandatory distance-based targets for recharging and refuelling infrastructure on the TEN-T core network for hydrogen refuelling stations and electric recharging points for Heavy Duty Vehicles (HDV), with an increase in ambition over time. Member States will also be required to update their National Policy Framework with a view to detailing their planning for implementation of infrastructure rollout, including identification of emerging needs in rail and aviation, and corresponding monitoring and reporting. Mandatory targets are also introduced for stationary aircrafts and OPS in maritime and inland waterway ports. In addition, some quality aspects of the infrastructure are addressed to improve interoperability and user information.

- **Policy option 2 (PO2):** This policy option thoroughly revises the Directive. It sets the same mandatory national fleet-based targets for electric LDV as PO1 but also adds distance-based targets for all road vehicles infrastructure on the TEN-T network and strengthens targets in urban nodes for heavy duty vehicles. It equally includes more detailed provisions for ports and airports. It includes a greater level of harmonisation on payment options, physical and communication standards and rights of consumers while charging and substantiates provisions on price transparency and other user information, including physical signposting of recharging and refuelling infrastructure.

- **Policy option 3 (PO3):** This policy option includes a change to the legal instrument by replacing the current Directive with a Regulation while also increasing further the level of ambition (in comparison to PO2). It extends the mandatory targets of PO2 infrastructure on TEN-T core and comprehensive network corridors, with additional mandatory deployment targets for electric recharging points on petrol stations and earlier deployment targets for hydrogen stations and increases considerably the ambition of installation of alternative fuels infrastructure in ports. Strict deployment targets are also introduced for waterborne transport and aviation and foresees shortening of the NPF reporting cycle from 3 to 2 years. At the same time, the option reduces flexibility for charge point operators by making terminal payment at fast chargers the standard ad-hoc payment solution.

A detailed description of the targets sets under each policy option is provided in Section 6 with further discussion on the justification of these targets in case of road transport in Annex B.

Impact assessment findings

The economic, social and environmental impacts of all policy options under consideration were assessed, where the expected impact of a set of measures falling under policy options PO1 to PO3 were compared with the baseline scenario. The assessment has been undertaken for the 2025-2050 period (in five-year period steps). The measures that are part of the POs are assumed to be implemented from 2025 onwards, with a particular emphasis on understanding impacts for 2030.

Economic impacts

In terms of the road transport related infrastructure, Table 1 summarises the expected number of charging points and fuelling facilities under the three policy options. They point to a significant increase in comparison to the baseline for LDV and HDV charging infrastructure as well as for hydrogen fuelling station for all three options. In comparison, the level of LNG and CNG infrastructure is expected to reduce relative to the baseline.

In the case of LDVs the number of charging points is projected to reach 3.5 million by 2030 and 16.3 million by 2050, driven by the requirement for a minimum average recharging capacity and providing sufficient recharging infrastructure for the expected fleet uptake. However, in the case of PO1, in the absence of relevant targets, there is a risk that recharging infrastructure will not be evenly distributed along the TEN-T network. For PO2 and PO3, 11,363 charging points for LDVs are estimated to be deployed on the TEN-T network (including urban nodes) by 2030 and 12,112 by 2040.

For HDVs, the three options provide for 6,100 charging points in PO1, 6,500 under PO2 and more than 7,600 under PO3 on the TEN-T network, sufficient to meet the expected vehicle uptake. Additional targets in PO2 (urban nodes for delivery trucks) and PO3 (fast recharging points in all petrol stations along TEN-T) add extra convenience for the users.

In the case of hydrogen infrastructure, while the baseline already includes some very ambitious Member State plans (e.g. DE), many Member States currently do not plan sufficient investments in hydrogen refuelling infrastructure. The three policy options will provide a similar and sufficient number of refuelling stations but PO3 ensures that the infrastructure required for the vehicle numbers in 2030 is already available in 2025 to provide more investment security for the sector. In the case of gaseous fuels the deployment of refuelling stations is largely market driven. As such, relevant investment is expected under the baseline building on the requirement under the current AFID. In the future, a gradual decline in the respective number of CNG and LNG vehicles is expected to lead to a reduction in the number of refuelling points relative to the baseline.

Table 1: Expected AFI deployment in the baseline and in the policy options for 2030-2050 (number of recharging points/facilities)

Infrastructure at EU27 level	Baseline			PO1		
	2030	2040	2050	2030	2040	2050
LDVs recharging points	2,304,552	4,228,772	6,905,744	3,500,690	11,398,548	16,259,467
HDVs charging points	58	526	636	6,173	10,340	12,694
Hydrogen fuelling facilities	1,371	3,004	4,603	1,852	8,222	20,153
CNG fuelling facilities	8,299	9,042	8,760	7,642	4,741	587
LNG fuelling facilities	3,527	4,505	4,850	2,904	3,914	2,896
Infrastructure at EU27 level	**PO2**			**PO3**		
	2030	**2040**	**2050**	**2030**	**2040**	**2050**
LDVs recharging points	3,512,053	11,410,660	16,268,705	3,573,579	11,472,221	16,330,266
HDVs charging points	6,493	10,660	13,014	7,612	11,779	14,134
Hydrogen fuelling facilities	1,993	8,341	20,154	1,990	8,337	20,104
CNG fuelling facilities	7,642	4,741	587	7,645	4,741	587
LNG fuelling facilities	2,904	3,914	2,896	2,904	3,914	2,896

The measures concerning road transport will ensure that sufficient infrastructure is deployed in all Member States and that infrastructure does not form a barrier for the expected vehicle fleet. As such, the vehicle fleet is expected to be the same under all policy options, driven by the policy initiatives under the "Fit for 55" package, in particular the revision of the CO_2 emission performance standards for cars and vans. Table 2 summarises the expected vehicle uptake.

Table 2: Uptake of vehicles in the baseline and in the policy options (in thousands)

Number of vehicles (in thousands)	Baseline			PO1 / PO2 / PO3		
	2030	2040	2050	2030	2040	2050
Electric BEV LDV	29,941	67,420	97,033	36,851	140,261	235,076
Electric PHEV LDV	13,987	41,007	54,157	14,343	40,950	14,897

Number of vehicles (in thousands)	Baseline			PO1 / PO2 / PO3		
	2030	2040	2050	2030	2040	2050
Electric HDV	50	161	231	110	1,022	2,405
Fuel Cell Electric LDV	306	3,906	10,301	416	12,824	38,727
Fuel Cell Electric HDV	3	63	102	60	549	1,877
CNG LDV	4,376	6,265	6,580	3,954	3,237	431
LNG	621	1,246	1,536	510	1,082	918

In terms of **maritime transport**, in the case of LNG bunkering facilities, the impact is expected to be very limited (see Table 3). The new measure under PO3 on LNG bunkering for maritime ports is expected to lead to the deployment of 19 additional facilities such that all 90 core TEN-T ports would be covered by 2030 while the removal of the provision for LNG bunkering in inland ports in PO3 could stop further deployment of this infrastructure for inland ports. In the case of OPS infrastructure in maritime ports, the total installed capacity is expected to grow significantly compared to the baseline, especially under PO3 which covers all EU ports that meet the minimum requirements. In the case of inland ports, the new measures could contribute to 18-106 additional ports in the EU having OPS depending on the policy option (values represent the upper bound of each option).

Table 3: Expected AFI deployment in 2030 by PO and in the Baseline regarding OPS in maritime ports

Type of AFI	Baseline	PO1		PO2		PO3	
		Total	Net	Total	Net	Total	Net
Total OPS installed capacity in maritime ports (MW)	174	856	682	3,676	3,502	4,239	4,065
Number of inland ports with OPS	139	157	18	245	106	245	106
TEN-T core	67	85	18	85	18	85	18
TEN-T comprehensive	72	72	-	160	88	160	88

In the case of the mandatory targets for electricity supply for stationary aircraft, the net impact is expected to be relatively limited as a large number of airports, mainly major ones, already provide this type of infrastructure (see Table 4). The impact will be greater in the case of medium-sized airports and, particularly, in the case of PO2/PO3 requiring FEGP in outfield positions.

Table 4: Expected AFI deployment in 2030 by PO and in the Baseline regarding electricity supply in airports

FEGP deployment	Baseline	PO1		PO2/PO3	
		Total	Net	Total	Net
Passenger Gates	3,832	4,910	1,078	4,910	1,078
Outfield positions	6,141	6,141	0	9,819	3,678
Total	9,973	11,051	1,078	14,729	4,756

Measures focusing on promoting interoperability are all expected to positively impact customer experience through improved convenience and reliability of recharging services. The impact of each of the measures separately may be relatively small but combined, they could be expected to have a higher positive impact, making the entire experience of using an AFV and AFI easier and thus enabling a higher level of uptake of AFVs. In relative terms, option PO3 is expected to have the highest level of impact as it includes a greater number and more demanding relevant measures.

Turning to the costs of the proposed measures, the major costs of the policy options come in the form of capital and operation costs for the installation and maintenance of public accessible recharging and refuelling infrastructure and measures related to interoperability and user information. A summary of these costs for each policy option is provided in Table 5 below. At Member State level, the capital and operation costs vary significantly since some Member States have already very ambitious plans under the baseline (e.g. Germany for recharging points and hydrogen).

Table 5: Summary of capital and operation costs related to infrastructure – present value for 2021-2050 compared to the baseline (in €billion '2015)

	PO1	PO2	PO3
Capital and oparation costs related to infrastructure			
Road transport			
LDVs recharging points	24.4	25.3	30.3
HDVs charging points	2.9	2.9	3.1
Hydrogen fuelling facilities	25.2	27.7	28.0
CNG fuelling facilities	-1.6	-1.6	-1.6
LNG fuelling facilities	-1.0	-1.0	-1.0
Waterborne transport			
LNG installations for maritime ports			1.1 - 3
OPS installations for maritime ports	1.2	5.5	6.5
OPS installations for inland ports	0.1	0.4	0.4
Aviation			
Electricity supply to aircraft	0.2	0.9	0.9
Interoperability			
Ad-hoc payments	6.7-10.2	7.0-10.4	7.2-10.6
Mandatory fixed cables	-	-	0.2
User information			
Roadside indicators	-	0.001	0.004
Total capital and operation costs	58.1 - 61.6	67.1 - 70.5	75.2 - 80.5

The total costs will be shared between the public and the private sector. Meeting the AFI targets will require a significant level of public support and contribution to the total investment cost presented in the section above. Depending on the type of infrastructure under consideration, the level of public support (and thus the association) costs to authorities may vary from 10% (in the case of CNG/LNG fuelling) to 50% (Hydrogen fuelling stations)[2]. The level of support is also expected to decrease after 2030 once a sufficient level of demand has been ensured.

No additional **administrative costs** are expected under PO1 and PO2 in comparison to the baseline, as there are no changes to the reporting and monitoring requirements. Costs of €126,000 per Member State are estimated under the baseline. In PO3, as the reporting cycle is shortened from three to two years, slight increases in the overall costs are

[2] The assumptions on the level of public support for each type of infrastructure have been based on information on the current level of public funding.

expected. Monitoring costs may increase for public authorities to report on compliance with the strict targets set under the different policy options.

Other economic impacts of the measures include the **increased business opportunities** that will arise from the much faster deployment of AFI infrastructure and the development of relevant support services and the increased market certainty provided by all policy options. All three policy options are also expected to have a **positive impact on the functioning of the internal market**, through increasing the even spread of the infrastructure and through simplifying its use throughout the Union, including through better ad-hoc payment services. They will also **facilitate competition among operators** and service providers, by enable customers to better understand and compare available services and their cost at charging points of different operators and by improved requirements for data sharing through the national access points. In both cases, options PO2 and PO3 are expected to have greater positive impacts on the basis of more demanding requirements concerning standardisation and the sharing of static and dynamic data. Along the same lines, all options are expected to have a **positive impact on innovation**, with PO2 and PO3 having greater impact on the basis of the requirements on data sharing.

Social impacts

In terms of the social impacts, **benefits will arise for consumers** from all policy options from improved information on infrastructure adding certainty about location, accessibility and use (pricing) conditions. Price transparency requirement through bank card payments will also reduce informational cost of households and allow consumers to take informed choices and reduce costs. These benefits will counterbalance the negative impact on mobility from any costs passed to consumers to cover the investment needed for PIN terminals (up to around €800 per charger for a PIN terminal). The further standardisation of infrastructure and infrastructure use services and the resulting possibilities for smart recharging services will benefit consumers who are in a position to offer their vehicle to support such smart recharging services and receive remuneration in return.

Positive impacts on **employment and skills** are also expected by all policy options associated with the increased demand for new infrastructure and supporting services. Only on the basis of the estimated level of investment for charging infrastructure for LDVs and HDVs, a cumulative net job creation in comparison to the baseline in the range of 67.2k under PO1 to 119.6k under PO3 for the period 2021-2030 is expected. For the period 2021-2050 this is estimated in the range of 0.52 million for PO1 to 0.62 million for PO3. The new measures proposed can lead to the creation of new jobs in construction, manufacturing, electricity. The impact is expected to increase with the level of ambition of the targets through the policy options. Those jobs are highly location-specific and cannot easily be relocated outside the EU, meaning a full benefit to the European employment market.

Environmental impacts

In the case of measures related to road transport, investments in the quantity and quality of AFI will not directly lead to the uptake of alternatively fuelled vehicles, as these are determined by other policies. Nonetheless, only if sufficient and interoperable infrastructure is available the the vehicles considered necessary to achieve the EU's Climate Target Plan objective will make it into the market. On a tank to wheel basis, the CO_2 emissions from road transport are projected to decrease by 5.3% in 2030 in all policy options relative to the baseline and even higher post 2030 (65.1% decrease in 2040 and 99% decrease in 2050), due to the higher uptake of zero-emission vehicles and renewable and low carbon fuels in road freight transport. In terms of air pollutants, NOx and PM emissions from road transport are projected to decrease in 2030 by 6.6% and 7.6% for all policy options relative to the baseline. The reductions in air pollution emissions relative to the baseline are much higher post-2030, due to the larger penetration of the zero emission vehicles for both LDVs and HDVs (i.e. 60.5% decrease for NOx and 62.3% decrease for PM emissions in 2040 and over 90% decrease in 2050 for both NOx and PM emissions).

In the case of maritime transport, emissions reductions associated with OPS are greater under PO3, driven by the higher numer of replacement of marine gasoil with electricity supply for auxiliary engines in all maritime ports and is directly correlated with the number of vessels that are capable of using OPS. For the period up to 2050, the cumulative reduction of CO_2 emissions on well to wheel basis is between 48.4 million tonnes of CO_2 in PO1 and 83 million tonnes of CO_2 in PO3, which corresponds to 1.5 to 2.5% of total maritime emissions during that period. In the case on inland waterways, the level of impact is smaller due to smaller and lower number of vessels. The provisions for LNG bunkering (under PO2 and PO3) will impact the CO_2 emissions in ports when vessels are at berth and when vessels are in operation. The impact assessment accompanying the FuelEU maritime initiative has shown that fossil LNG will be gradually replaced with liquified biomethane (or bio-LNG) from 2030 onwards and renewable low-carbon synthetic e-gas from 2035 onwards. By 2050, renewable and low carbon fuels are projected to represent the large majority of gaseous fuels used in maritime. Such decarbonised gases (bio-LNG and e-gas) use the same infrastructure as the LNG.

In terms of **pollutant emissions**, all policy options supporting OPS are expected to have a positive impact, with the effect increasing as the policy options become more ambitious and the frequency of use of OPS from vessels more widespread. In the case of LNG, a reduction of air pollutants under PO3 is expected as a result of the uptake of LNG vessels. In the case of aviation, the requirements concerning auxiliary power units (APU) under the different options are not expected to have significant impacts on CO_2 emission since APUs account for a small proportion of CO_2 emissions in aviation (approximately 1% or 1.4 Mt of CO_2 in 2018). However, it has not been possible to assess the exact level of impact. In terms of impact on air pollutants (NOx, HC, CO and PM10), a positive impact is also expected. While it has not been possible to assess the overall level of impact, in the case of a major European airport a reduction of NOX emissions by up to 96% was estimated (based on the analysis of data available for the Zurich airport).

In monetary terms, all policy options show a very significant reduction in the external costs of CO_2 emissions relative to the baseline over the 2021-2050 period (€445 billion), with additional reduction in the external costs of air pollution emissions estimated at around €75 billion over the same period. However, as indicated, these impacts are related to the uptake of clean vehicles that are driven by other initiatives part of the “Fit for 55” package (e.g. CO_2 emission performance standards) and enabled by the deployment of infrastructure.

Comparison of options

The comparison of the options examined the relative effectiveness, efficiency and coherence of the options.

In terms of **ensuring sufficient infrastructure** to support the required uptake of alternatively fuelled vehicles across all modes and in all MS to meet the EU’s climate objectives (specific objective 1), all policy options are effective in linking road vehicle fleet demand and overall infrastructure deployment on the basis of the requirement for minimum installed capacity per registered electric vehicle and they also ensure sufficient infrastructure across the TEN-T to enable circulation of heavy-duty vehicles. However, PO1 is less effective with regard to LDV recharging infrastructure on the TEN-T network as it leaves public authorities and operators greater flexibility for the allocation of infrastructure

- not setting specific requirements for LDV recharging infrastructure on the TEN-T core and comprehensive network. These are set in PO2 and PO3.

PO1 is also less effective in view of OPS installation in ports, as it only addresses TEN-T core ports. PO2 is more effective than PO1, as it ensures minimum charging infrastructure across the TEN-T for LDVs, recharging infrastructure for HDV in urban nodes and OPS in TEN-T core and comprehensive ports. PO3 is even more effective, since it also provides recharging points in all larger petrol stations for LDV and HDV. It also ensures greater equipment of ports with alternative fuels infrastructure than PO2.

Furthermore, PO2 and PO3 are more effective compared to PO1, when it comes to ensuring full interoperability of the infrastructure (Specific objective 2) and ensuring full user information and adequate payment options (Specific objective 3). They include a greater level of harmonisation on payment options, physical and communication protocols and interfaces standards and rights of consumers while charging. Those options also better substantiate provisions for adequate consumer information and payment options, notably through making available full static and dynamic user information and better harmonised payment options. PO3 can be considered slightly more effective in comparison to PO2, as it includes a more comprehensive approach to physical signposting of recharging and refuelling infrastructure. Thus, while all policy options meet the overall effectiveness criteria, PO3 ranks first as it enables the strongest rollout of infrastructure in ports compared to PO2, followed by PO2 and, then, PO1.

As regards efficiency, the POs meet the requirement for sufficient infrastructure deployment at different costs. With total capital and operation costs in the range of €75.2billion - €80.5 billion over the period 2020-2050, PO3 is less efficient than PO2 (€67.1 billion - €70.5 billion) and PO1 (€58.1 billion - €61.6 billion). This is mainly related to the mandatory targets for charging points for LDVs in specific locations (petrol station) that risk that part of the infrastructure for LDVs is underutilised since it will not be in the optimal location. For hydrogen refuelling infrastructure the higher capacity for each refuelling point (under PO2 and PO3) also adds to the cost but this is offset by the greater convenience for consumers and less waiting times.

Considered against the other two objectives (SO2 and SO3), PO2 and PO3 are more efficient that PO1 on the basis of the wider set of stanards prescribed and benefits arising from the provision of full static and dynamic data. PO2 is expected to be more efficient than PO3 with regard to payment services, by providing for user-friendly payment options based on bank card payment (terminal or NFC) for fast recharging points while still allowing enough flexibility to market actors to consider their appropriate use in view of the specific market conditions.

In terms of the coherence of the three policy options, there are no specific problematic issues identified. All three are considered to be internally coherent, especially by ensuring common requirements for electric charging and hydrogen infrastructure. They also strengthen the coherence of the Directive with key policy objectives and ambitions of the EU, outlined by the European Green Deal, the Climate Target Action Plan and the Sustainable and Smart Mobility Strategy. The three options also ensure greater coherence with EU objectives on consumer rights and functioning of the internal markets. In relative terms, PO2 and PO3 can be considered more coherent than PO1 on the basis of the more demanding mandates and the more comprehensive provisions covering all modes.

1 INTRODUCTION

This is the final report for the support study "Impact Assessment on the revision of the Directive on the Deployment of Alternative Fuels Infrastructure (2014/94/EU)" (hereafter, the 'study'). The work was performed by Ricardo, TEPR, and E3-Modelling, the consultants appointed to conduct this study, between July 2020 and March 2021.

1.1 Purpose of the Impact Assessment

The Alternative Fuels Infrastructure Directive (AFID) creates a common framework of measures for deployment of alternative fuels infrastructure in the EU. Building-up an infrastructure network for vehicles and vessels is meant to facilitate transition to alternative fuel vehicles, reduce oil dependence and mitigate environmental impacts of road transport, to develop a single market for alternative fuels infrastructure along urban areas and nodes and the core network of the Trans European Transport Network (TEN-T). Having a commonly available infrastructure supported by a framework of measures is expected to support accelerated take up of alternative fuelled vehicles and vessels.

The Directive requires Member States (MSs) to set up long-term National Policy Frameworks (NPFs) for the development of the market as concerns alternative fuels and the planning of the deployment of relevant alternative fuels infrastructure. The Directive sets common technical specifications for recharging and refuelling stations and for consumer information. It aimed to address issues such as lack of coordinated development of infrastructure across the EU which has been seen to hinder the long-term security required for investment in the technology for alternative fuels and alternative fuel vehicles.

The European Parliament called upon the Commission to bring forward a revision of the AFID in its October 2018 plenary. The Commission also proposed to review the Alternative Fuels Infrastructure Directive in the December 2019 European Green Deal Communication. The Commission stressed the need for a renewed focus on speeding up the shift to sustainable and smart transport and the use of alternative fuels in the Green Deal, and identified the need for one million public recharging and refuelling stations in the EU by 2025 to meet the needs of the 13 million zero- and low emission vehicles expected on European roads and wider decarbonisation targets. The purpose of this study is therefore to support action to address key problems that the Commission has detected and analysed as part of the evaluation of AFID, as well as deliberations with public and private stakeholders.

1.2 Impact Assessment Report

The report includes the following:

1. Method and approach to evidence collection (Section 2).

2. Presentation of the policy context and problem definition (Section 3).

3. Presentation of the baseline scenario that was the reference point for analysing the impacts of the policy options (Section 4).

4. Definition of policy objectives (Section 5) and the policy measures and policy packages under consideration (Section 6).

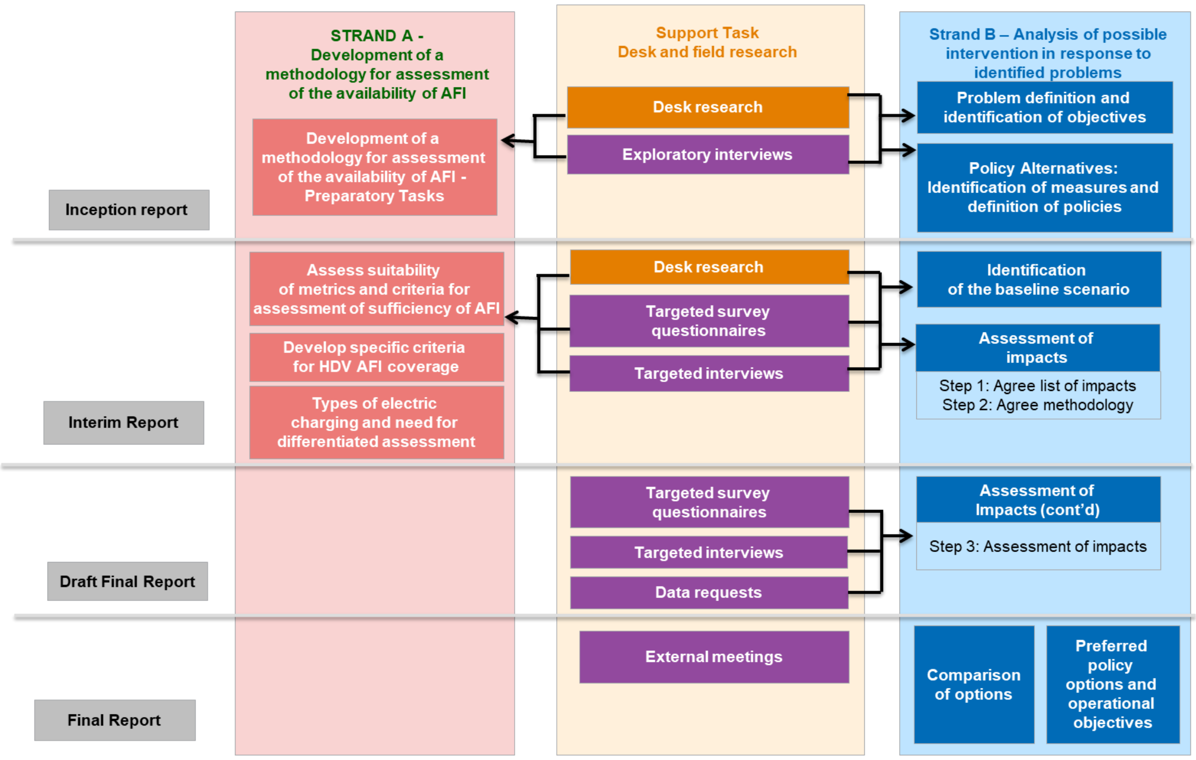
5. Analysis of the expected impacts of each proposed policy measure and the policy packages (Section 7).

6. Comparison of the policy options in terms of the effectiveness, efficiency and coherence (Section 8).

2 METHOD AND APPROACH TO EVIDENCE COLLECTION

This section provides an overview of the research tools used in the study. The diagram below (Figure 2-1) provides an overview of the methodology to the study, indicating how each of the tasks are linked together.

Figure 2-1: Overview of the impact assessment methodology



2.1 Strand A: Development of a methodology for assessment of the availability of Alternative Fuel Infrastructure

The aim of Strand A was to develop a methodology for the assessment of availability of Alternative Fuels Infrastructure (AFI). As the impact assessment is being undertaken for AFID, the development of metrics and criteria to establish targets to assess sufficient AFI provision for **road transport** has been explored, considering different fuel types and geographic areas.

Strand A investigated the metrics and criteria that could be used to refine targets for AFI provision, and uses the combined research outputs to suggest numerical targets for AFI for different categories of alternative fuels, **should a target be implemented** in any of the policy options considered (which is investigated in the Impact Assessment, i.e. Strand B).

Strand A was divided into three sub-tasks, each of which assess the criteria and metrics used to measure AFI provision for a specific subject topic area:

- Task 1.1 focuses on assessing the suitability of metrics and criteria for the assessment of sufficiency of AFI provision, focusing on road transport.

- Task 1.2 assesses whether specific criteria need to be developed for Heavy Duty Vehicles (HDV) AFI coverage that differ from the criteria for Light Duty Vehicles (LDVs).
- Task 1.3 explores different types of electric charging points and a possible need for a differential assessment for targets for charging infrastructure provision.

For each sub-task, there are three overarching types of metrics that have been explored in greater detail, which are as follows:

- Distance-based: maximum distance between recharging or refuelling stations (km).
- Fleet-based: number of vehicles per recharging or refuelling station.
- Traffic volume-based: vehicle kilometres per recharging or refuelling station.

The methodology for Strand A involved a stepped approach to determining the optimum metrics to be used for different fuel types and geographic areas, culminating with the specification of the numerical targets for alternative fuel infrastructure. The methodology for Strand A was updated as the project progressed, and ultimately comprised the following steps:

- Step 1: Establish the context by assessing existing approaches adopted by Member States to set targets and monitor deployment of infrastructure for each sub-task.
- Step 2: Desk-based review of research relevant to setting targets and metrics related to each of the sub-tasks.
- Step 3: Engagement with targeted stakeholders, consisting of academics, R&I institutions, NGOs, representatives of the HDV industry, and representatives specifically for ERS (as it is considered a new and innovative technology for which metrics and criteria may need to be developed) to contribute to the overall understanding of strengths and weaknesses of different metrics and criteria for each sub-task.
- Step 4: Initial assessment of metrics and criteria for each sub-task, undertaken via an internal workshop with Ricardo experts and the European Commission, informed by the desk research and targeted stakeholder interviews.
- Step 5: Survey of national authorities, local / regional authorities and select industry stakeholders ('Alternative Fuels Infrastructure Survey Strand A') on the optimum metrics and criteria to be used to assess sufficient AFI provision and their relative strengths and weaknesses, informed by the outputs of the desk research, stakeholder engagement and internal workshop.
- Step 6: Synthesis of desk research, stakeholder engagement, workshop outputs and survey results to undertake a full assessment of different metrics and criteria to be used to measure sufficient AFI provision, and develop numerical targets for different categories of AFI. Additionally, some of the numerical targets were informed by inputs from the overall Impact Assessment survey (i.e. Strand B).

The overall output of Strand A comprises more granular numerical targets for the provision of different categories of AFI than those in the current AFID. The resulting metrics and numerical targets were then combined with the overall AFID Impact Assessment, within the different policy options – **the AFI metrics and numerical targets are shown alongside the policy options in Section 6**. Where appropriate, the numerical targets are provided for both national level and at a more granular geographic level.

The detailed description of the Strand A methodology, including learnings from each of the steps for Strand A is presented in Annex A, whereas the rationale for numerical targets for different categories of AFI and different geographic areas is presented in Annex B.

2.2 Strand B: Impact assessment methodology

The impact assessment part of the study was composed of three different phases: the design phase, the analytical phase and the synthesis phase.

The design phase consisted of:

- The definition of the problem areas and the associated drivers (see section 3).
- The definition of the relevant policy objectives that are linked to these problem areas (see section 5).
- The identification, definition and screening of policy measures, which would eventually be incorporated into a set of three policy options with increasing level of ambition (see section 6).

The analytical phase consisted of a further two steps:

- The definition of the baseline (section 4) that forms the "no-policy change" scenario, against which all alternative policy options are compared, and it includes relevant socio-economic developments, as well as the impacts of endogenous and exogenous factors.
- The assessment of impacts (section 6). The assessment of impacts includes the analysis of the economic, social and environmental impacts of the different policy options under consideration. This assessment makes use of the desk and field research (sections 2.4 and 2.5, respectively), as well as the modelling results, using the PRIMES-TREMOVE model (section 2.3).

Finally, in the synthesis phase, we conducted a comparison of the policy options, assessing their effectiveness and efficiency against each other using a multi-criteria analysis framework (section 8), and, based on that comparison, we identified the preferred policy option (Section 8).

2.3 Modelling

The PRIMES-TREMOVE model was used to help quantify the baseline and the policy options, and subsequently to assist in the assessment of impacts. Section 4 provides a detailed overview of the development of both the baseline and alternative scenarios and the results.

The model provides the quantitative analysis for the transport sector in the EU27, covering transport activity, equipment, energy and emissions.

2.4 Desk research and data collection

The desk research continued throughout the course of the study (alongside Strands A and B) to support the different stages of the analysis and help address any gaps in evidence. Assembling the evidence has been important to triangulate our findings, inform and support the analysis of all the other tasks, and cross-check input from stakeholders. As a basic principle, the preference has been to use quantitative data such as the one used by the Commission. This includes, e.g., the most recent Statistical Pocketbook (for indicators such as numbers of vehicles in operation by mode) and Eurostat data (for transport activity and energy use in transport).

Three areas of desk research were undertaken alongside the field research (see below):

- **General desk research:** General desk research included the review of relevant literature, which built upon the review undertaken for the Evaluation study.

- **Data collection:** Relevant data from a range of sources was identified and used as inputs for the different tasks and in support of the analysis, including EAFO and other select data bases. Although the EAFO is the most relevant source for this study, other data sources provide useful information on the spatial distribution of infrastructure across Europe. For this we used TENtec for information on alternative fuels infrastructure located on the TEN-T network, which has been supplemented with Open Charge Map (location of electric charging stations) and NGVA Europe (location of LNG/CNG refuelling stations for road) for urban agglomerations and other areas. Other databases considered include: ACEA statistics (road vehicle registrations), H_2 stations (hydrogen refuelling stations), World Ports Climate Initiative (ports' AF infrastructure), Observatory of European Inland Navigation (inland waterways fleet).

- **Analysis of key reports:** In addition to the material identified from the NPFs and NIRs for the evaluation study, infrastructure targets, information on the supporting methodology and metrics used by MSs when determining infrastructure targets, and measures specific to the HDV sector were identified, extracted and presented.

2.5 Field research / stakeholder consultation

The field research, incorporating stakeholder engagement, played a broad role within the study. The field research was thus broken down into a number of different consultation tools and activities that were used as inputs to various stages of the project. These tools are summarised in Table 2-1 below and described in more detail in subsequent sections.

Table 2-1: Overview of field research tools used

Tool / Activity	Stakeholders involved	Role within the study
Exploratory interviews	EU level representatives of key stakeholder groups – AVERE, NGVA Europe, T&E, ACEA.	Refining problem definition and policy options Developing field research tools
Targeted surveys	Covering the full range of affected stakeholders, from industry to consumer organisations.	Supporting the assessment of impacts
Targeted interviews	Covering the full range of affected stakeholders, from industry to consumer organisations.	Supporting the assessment of impacts
OPC	Open public consultation – responses open to all stakeholders / public	Supporting the assessment of impacts

2.5.1 Targeted surveys and interviews

Four **exploratory interviews** were undertaken with selected stakeholders during the inception phase of the study, including with AVERE, NGVA Europe, T&E and ACEA. The purpose of the exploratory interviews was to assist in refining the problem definition and the policy options, as well as supporting developing the field research tools. These interviews assisted in ensuring that all issues that could be relevant to the problem definition and the definition of the policy options were correctly identified early in the process, as well as supporting us in identifying all relevant information sources for the study. Furthermore, these interviews have contributed to the process of designing the draft survey questions and interview guides.

Further **interviews** were conducted and an **online survey** was distributed. Both the interviews and the survey were aimed at a range of relevant stakeholders representing public authorities and other public bodies (national, regional and local authorities, EU bodies) industry representatives (including relevant associations), and members of the civil society (NGOs, consumer groups). The interviews and surveys focused on obtaining detailed input on the expected impacts (economic, social and environmental) of the measures under consideration in comparison to the baseline, the possible issues that may arise and identifying the level of support for specific measures. Where relevant, stakeholders were asked for input on the cost implications of each measure. Surveys and interviews commenced end October 2020 and concluded January 2021.

Table 2-2 outlines the interviews conducted and responses received to the online survey.

Table 2-2: Summary of stakeholder interviews and surveys

Type of stakeholder	Number of interviews conducted	Number of additional surveys received	Total
Public authorities and other public bodies	3	17	20
Industry and associations	16	25	41
Civic society	5	n/a	5
TOTAL	**24**	**42**	**66**

The full list of stakeholders interviewed is included in Annex D, and those that responded to the online survey are listed in Annex E.

2.5.2 Open Public Consultation

The OPC went live on 6th April 2020 and closed on 29th June 2020 (12 weeks). The OPC took account of both the Impact Assessment and the Evaluation of the Directive. In total, 324 responses were received. The breakdown by stakeholder type is shown in Table 2-3.

Table 2-3: Classification and number of stakeholders responding to the OPC

Stakeholder group	Number of responses	% of responses
Company/business organisation	107	33%
Business association	80	24.7%
Public authority	28	8.6%
Non-governmental organisation	22	6.8%
Consumer organisation	7	2.2%
Environmental organisation	1	0.3%
Academic/research institute	1	0.3%

Stakeholder group	Number of responses	% of responses
EU citizen	70	21.6%
Non-EU citizen	1	0.3%
Other	7	2.2%

In terms of geographical/Member State distribution, the majority of respondents indicated that their country of origin was one of the EU Member States (315 respondents). Nine respondents were based outside of the EU. The number and percentage of respondents by country of origin is shown in Table 2-4.

Table 2-4: Geographical distribution of responses received

Country of origin	Number of responses	% of responses	Country of origin	Number of responses	% of responses
Belgium	60	18.5	Slovakia	2	0.6
France	53	16.4	Denmark	1	0.3
Italy	50	15.4	Estonia	1	0.3
Germany	49	15.1	Greece	1	0.3
Sweden	19	5.9	Luxembourg	1	0.3
Netherlands	17	5.2	Malta	1	0.3
Spain	11	3.4	Romania	1	0.3
Austria	10	3.1	Canada	1	0.3
Czech Republic	8	2.5	Grenada	1	0.3
Poland	8	2.5	Israel	1	0.3
Finland	6	1.9	Japan	1	0.3
Hungary	6	1.9	Norway	1	0.3
Ireland	5	1.5	Switzerland	1	0.3
Slovenia	3	0.9	United Kingdom	2	0.6
Latvia	2	0.6	United States	1	0.3

The analysis of the responses to the OPC covers the responses to the closed questions, which have been analysed quantitatively and presented in graphs, the responses to the open questions, which have been analysed qualitatively, and any *ad hoc* contributions that were submitted, which have also been analysed qualitatively. The analysis of the responses to the OPC is presented in Annex H, and the results have been drawn upon where appropriate in the assessment of impacts in this report.

2.6 Research limitations – robustness of findings

There were a few challenges in the study and limitations inherent to the methodology. The main limitations are described below, together with a summary of the measures taken to mitigate the impacts.

2.6.1 Stakeholder consultation

2.6.2 Difficulty to ensure input from all relevant stakeholders

The wide scope of the Directive (in terms of transport modes and types of technologies covered) and the broad range and scope of the policy measures under consideration meant that input from a large number of stakeholders was required to obtain relevant input and to allow to cross check or triangulate input provided. It also required input from stakeholders at both EU and national level and across multiple Member States to reflect the very different circumstances, development of the AFI market and needs in each Member States. This posed challenges in the context of the timetable available to the study team and it was not always possible to ensure input from multiple sources. For some questions the analysis is based on a small number of respondents that may introduce bias either because of their interest or because they may have an incomplete picture of relevant issues and developments.

We tried to mitigate this by using multiple stakeholder engagement tools including semi-structured interviews, survey, an Open Public Consultation and targeted data requests. The interviews were designed to bring together expertise from the various players active in the market as well as stakeholders with direct and indirect interest on the topic. These were supplemented with input through the survey of national and local authorities to provide a more complete picture. We also used additional targeted desk research to cross-check information provided and also used our own expert judgment on the validity of specific points made.

2.6.3 Limitations in Member State reporting

The national implementation reports (NIRs) were a key input to this study and allowed us to build a picture of the state of implementation of the AFID and the development of the AFV network. However, there were a number of limitations:

- The level of detail provided in the NIRs varied significantly among MS both in terms of the measures adopted as well as to the financial allocations along different types of measures.

- As the focus was on reporting on the progress in relation to the targets, there was less information on the progress in terms of other aspects (interoperability, access to information) that were relevant for understanding the nature of the problem.

In order to fill the data gaps, we used input from the national authorities through the survey that was supplemented by desk research.

2.6.4 Limitations of the analysis using PRIMES-TREMOVE model

The PRIMES-TREMOVE model was used to define the baseline and assess the policy options under consideration. However, the model does only allow to assess certain aspects (mainly focusing on the adoption of AFVs, the impact on the transport sector and the associated environment impacts). Other aspects (e.g. related to ensuring interoperability, access to information) were not covered by relevant parameters in the model.

As such, we relied on other tools, including the desk research and stakeholders input to assess certain type of impacts in more detail. Nonetheless, in some cases this was only possible on a qualitative basis.

3 PROBLEM DEFINITION

3.1 Problem areas

As recommended by the Better Regulation Guidelines (Tool #14), a clear understanding of the problem is important for the development of policy measures that are both relevant and proportionate to the issues at hand.

The Terms of Reference (ToR) for this study initially identified four problem areas. These were further developed throughout the life of the study, based on the results from the evaluation support study, input from the Sustainable Transport Forum (STF) survey, input from stakeholders during the exploratory interviews (see section 2.5), and feedback from the Commission services.

The four problem areas under consideration in the study were:

- **Problem Area A:** Planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network (at least in terms of TEN and comprehensive networks).

- **Problem Area B:** There are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services.

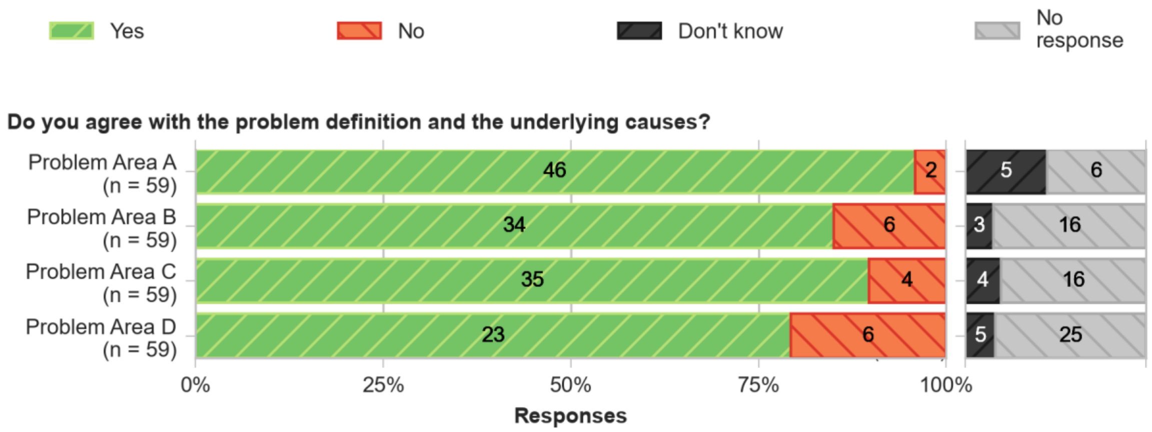
- **Problem Area C:** Consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees.

- **Problem Area D:** Integration of electro-mobility into the electricity system is not efficient.

This section explores in detail each of these problem areas, what is the nature and scale of each of the four problems identified, the drivers behind each problem, who is affected and the rationale for EU intervention. The expected evolution of each problem under the baseline is explored in the baseline section (Section 4).

As part of the surveys and interviews conducted for this study, all stakeholder groups were also enquired on whether they agree with the problem definition and the underlying causes. In general, a vast majority of respondents agree with the problem definition for each of the problem areas (Figure 3-1). Except for Problem Area C, most of those who disagreed were industry stakeholders (2 out of 2 for Problem Area A; 5 out of 6 for Problem Area B; 5 out of 6 for Problem Area D), the rest being public authorities and other public bodies (for Problem Area C, two that disagreed were industry, two others public authorities).

Figure 3-1: Stakeholders' agreement with the problem definition for the four problem areas



Among those that did not agree with the problem definition, a few explanations were provided:

- For **Problem Area A**, the only explanation provided was by ESPO, representing maritime ports, which indicated that while they do agree that there are differences in coverage across the EU, those variations could be the results of differing local circumstances and the different needs of each Member State.

- For **Problem Area B**, CHAdeMO Association Europe indicated that they did not agree because there are various communication protocols that are already in use and, at most, high-level harmonisation, leaving specific choices to the market in order to avoid technological lock-ins and allowing for new and upcoming technology (e.g. 5G) is recommended. IONITY noted that standards are already in place or in development and that legislation has probably very limited impact. Among non-industry stakeholders, Eurocities indicated that they felt that communication standards mandated by legislation were counter-productive, and that it would be best to leave this to the market to decide, as there is a risk that any legislated standard does not work as it was expected to[3].

- For **Problem Area C**, no explanations were provided by those stakeholders that disagreed with the problem definition.

- For **Problem Area D**, CHAdeMO Association Europe explained that they were not clear to what extent the integration was "not efficient". ChargeUp indicated that their disagreement was based on the fact that the problem is much broader and should include aspects such as implementation of the electricity market design, clarification of the role of aggregators and DSO recharging managing charging stations, need for clarity on access to in-vehicles data. IONITY indicated that this was not problem as the issue should not be regulated and should be left to the market to develop. Finally, ESPO indicated that their disagreement was based on the fact that for inland water transport the same issues do not apply, and issues like lack of digitalisation are more relevant.

[3] Eurocities provided the example of ISO 15118 for V2G communication, which they view as "unworkable, unless you strip out a lot of the elements" and that because of that ISO 15118/20 is now being developed to replace it.

3.1.1 Problem area A: Planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network (at least in terms of TEN and comprehensive networks)

What is the nature and scale of the problem?

Recognising that refuelling infrastructure is critical to support the market adoption of alternatively fuelled vehicles, the AFID requires Member States to plan for a minimum set of targets for certain alternative fuels. However, the evaluation support study found that there is still no comprehensive and consistent policy framework. The evaluation support study also found significant differences in the level of ambition, targets set, and comprehensiveness of the measures adopted among MS, with potential implications for market fragmentation at EU level and even among neighbouring MS. A previous study by the Commission had also found that the overall targets were insufficient to support the expected growth in the number of alternatively-fuelled vehicles (European Commission, 2017). Furthermore, those targets are in many cases not consistent with market developments and the increased urgency to reduce the environmental impact of transport, including GHG emissions and pollutants. This jeopardises the uptake of low and zero-emission vehicles and the EU decarbonisation goals.

What are the drivers and root causes of the problem?

Driver A1: Different and fragmented approach to the roll out of AFI for different fuels across Member States

Although the importance of having sufficient refuelling infrastructure to support the market adoption of alternatively-fuelled vehicles has been recognised, there has not been coherent development of that infrastructure. The evaluation support study concluded that the implementation of the AFID did not fully succeed in the development of a clear and consistent policy framework for the promotion of the AFI across the EU that removes inconsistencies and ensures harmonisation of polices and measures.

Furthermore, analysis of the NPFs concluded that they were not coherent at EU level. The evaluation support study found that the NPFs diverged when it comes to prioritising different alternative fuels and included very different ambition levels across MS, both in terms of projected future deployment of alternative fuels and corresponding infrastructure.

In terms of actual implementation of infrastructure, Table 3-1 summarises the evolution of the AFI in relation to road transport in the period since the adoption of the Directive for the different fuel types. It points to an overall increase in the level of AFI since 2014 (adoption of the Directive). The evolution of the electric charging network (both in absolute terms and in terms of the coverage of the highway network) has been much greater and more widespread than that of other AFI, and by 2019 all MS had both normal and fast chargers in place. In comparison, the development of the natural gas (CNG/LNG), LPG and hydrogen infrastructure has been much more moderate.

Table 3-1: Evolution of alternative fuel infrastructure for road transport in EU27 by type

Type	Indicator	2014	2015	2016	2017	2018	2019
Electricity	Number of Normal chargers (≤22kW)	24,917	44,786	93,721	97,287	107,502	148,035
	Number of Fast chargers (>22kW)	1,331	3,396	8,124	8,784	11,155	17,071
	Total	26,248	48,182	101,845	106,071	118,657	165,106

Type	Indicator	2014	2015	2016	2017	2018	2019
	% of fast chargers in total	5.1%	7.0%	8.0%	8.3%	9.4%	10.3%
	Number of MS with stations	25 (21 fast)	27 (25 fast)	28 (26 fast)	28 (26 fast)	28 (26 fast)	28
	Fast chargers per 100 km highway	2	5	7	12	15	20
	Vehicle per charging point (average)	5.1	5.7	4.0	5.4	7.2	7.5
LPG	Number of filling stations	29,343	29,733	29,969	31,174	32,196	33,724
	Number of MS with stations	26	26	26	26	27	27
	per 100 km highway	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Vehicle per filling station (average)	248.2	255.9	258.2	251.7	246.5	237.6
CNG	Number of CNG filling stations	-	2,957	3,091	3,111	3,216	3,519
	Number of MS with stations	n.d.	25	25	25	24	26
	per 100 km highway	n.d.	3.9	4.1	4.1	4.2	4.6
	Vehicle per filling station (average)	n.d.	408.9	405.3	409.6	411.0	391.6
LNG	Number of LNG filling stations	n.d.	63	80	110	133	242
	Number of MS with stations	n.d.	9	11	12	13	16
	per 100 km highway	n.d.	0.08	0.11	0.15	0.17	0.32
	Vehicle per filling station (average)	n.d.	95.4	79.6	57.5	11.8	10.1
H2	Number of filling stations	n.d.	n.d.	35	39	39	127
	Number of MS with stations	n.d.	9	11	11	11	11
	per 100 km highway	n.d.	n.d.	0.05	0.05	0.05	0.15
	Vehicle per filling station (average)	n.d.	n.d.	12.3	16.2	20.9	9.5

Source: EAFO and own elaboration

However, while there was progress in the implementation of electric charging infrastructure, a JRC analysis of the 2020 targets revealed large differences among neighbouring MS regarding their density (AFI/km) of recharging point targets which could also imply that cross-border continuity could not be ensured (JRC, 2020).

In terms of maritime transport, the evaluation support study identified that plans to deploy LNG in maritime and inland ports for 2025 varied greatly between a few countries with high ambition (e.g. Spain, with a target of 42 maritime ports and Italy with a target of 12 maritime ports and 20 inland ports) and for most others there was no consideration of bunkering facilities for LNG.

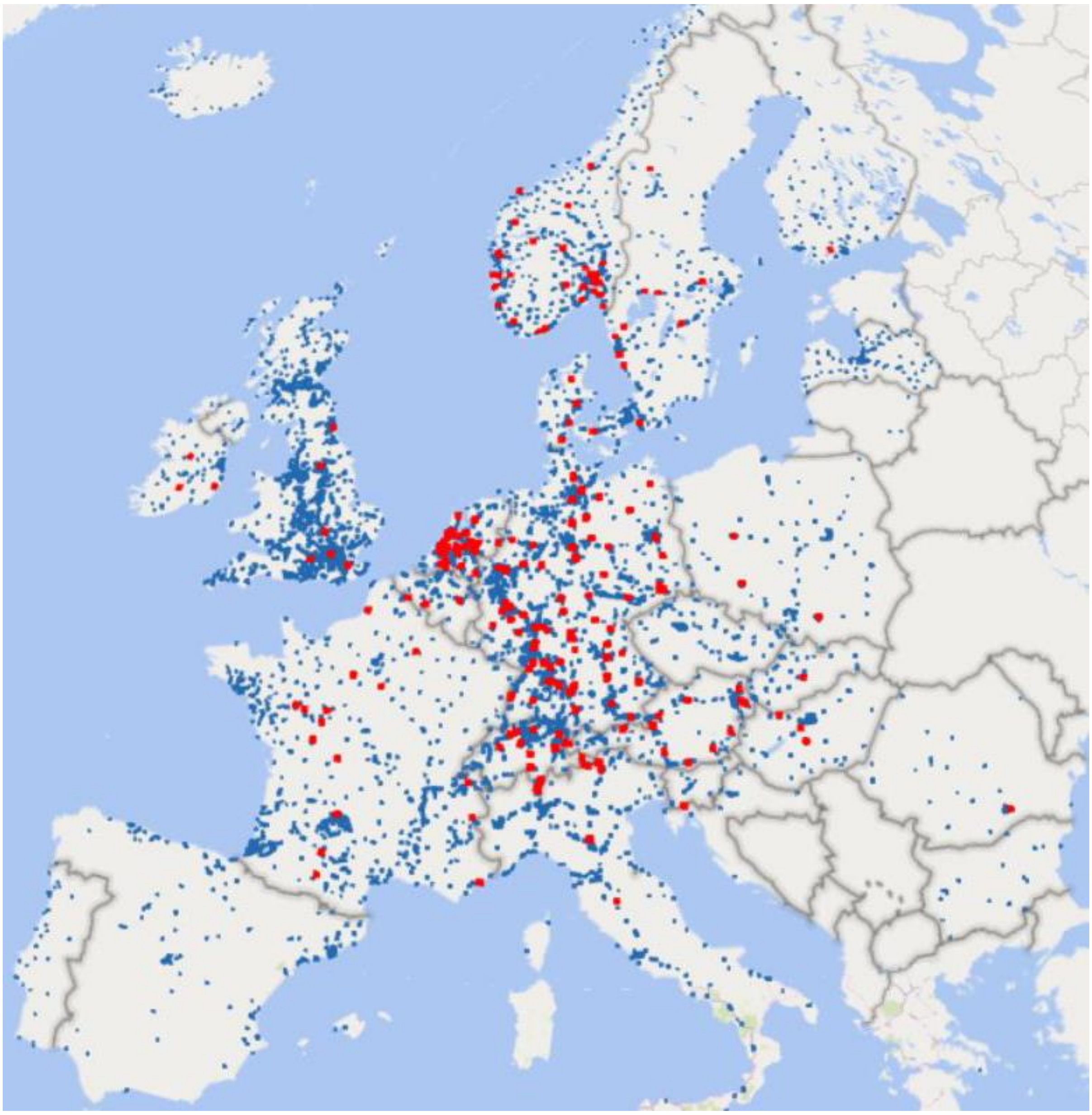
Driver A2: Setting of targets for the roll out of alternative fuel infrastructure is not consistent with market developments and the increased urgency to reduce the environmental impact of transport

The survey of the Sustainable Transport Forum (STF) identified that the lack of clear minimum requirements for the alternative fuels infrastructure was contributing to the lack of coherence. It also identified that the metrics used in the recommendations contained in the AFID, related to the number of recharging points per vehicle, did not reflect variations in market requirements and that the metrics should be reviewed and elaborated further, including consideration of traffic volumes and demand for alternatively-fuelled vehicles. In the evaluation support study, it was found that while progress has been made towards increasing provision of relevant alternative fuels infrastructure, in the cases of some MS and regions within MS supply still remains[4]. Also, infrastructure for hydrogen and gas is lacking.

The evaluation support study identified that, while in some cases national roll-outs of AF infrastructure have been extensive, there is still a lack of comprehensive and coordinated deployment at European level. On this point, a recent analysis by T&E pointed (T&E, 2020a) to the significant differences among MS in terms of the share of fast charging points with fast chargers mostly located in the urban corridor stretching from the southern UK to the Netherlands, through German Rhineland, Southern Germany and Switzerland. The map below (Figure 3-2) illustrates the presence of gaps when it comes to fast charging network, especially in Central and Eastern Europe and in South Europe.

[4] ACEA's 2019 report on the progress of uptake of electric and alternatively powered cars in the EU considered the provision of relevant infrastructure (ACEA, 2019). Although data for 2018 indicated that there has been strong growth in the deployment of electric vehicle infrastructure since 2014 (increase of 317%, from low base), the report indicates that the total number of charging points across the EU (144,000) falls short of what is required.

Figure 3-2: Distribution of CCS fast (blue) and CCS ultra-fast (red) public charge points



Source: (T&E, 2020a)

Infrastructure is also missing in rural areas and TEN-T corridors – which presents problems for the haulage industry, which is typically required to travel longer distances. The STF found similar results: STF asked stakeholders whether the current publicly accessible recharging and refuelling points in urban agglomerations and other densely populated areas are sufficient. Generally (across a range of alternative fuels) respondents agreed that the current situation is insufficient or somewhat insufficient, although some differences can be detected for different fuels in different settings.

The Commission's 2017 assessment of Member State NPFs identified that the overall targets were already insufficient to support the expected growth in alternatively-fuelled vehicles. Since then, the adoption of the European Green Deal has increased the urgency of taking action on climate change and zero pollution. As a result, the evaluation support found that the AFID objectives are not sufficient to meet the infrastructure requirements of fleet renewal targets linked to the new EU decarbonisation objectives under the Green

Deal. More action (in terms of inclusion fuels and modes, as well as AFI targets) will be needed with respect to AFVs and AFIs that accelerates adoption and deployment, respectively.

Driver A3: No common framework for all alternative fuels

In its recital, the AFID identifies the importance of electricity for stationary aircraft in airports and shore-side electrical power for ships in ports; however, beyond that mention in the recital, there is no common framework established in the provisions of the AFID. It should be noted, however, that for shore-side electricity, Article 4 (5) requires that each NPF assesses the need for shore-side electricity – at sea and inland ports – and that this be installed, unless there is no demand or costs are disproportionate.

As a consequence, the approach followed by Member States for these fuels has been scant, with the 2017 assessment of the NPFs identifying that they were 'scarcely covered in the various NPFs and very few NPF contain any targets or measures for an increase of these alternative fuel sources' (European Commission, 2017). In the evaluation support study, it was found that 23 MS assessed the need for shore-side electricity supply for inland waterway vessels and seagoing ships in their NPFs. Following their assessment, BE decided to increase on-shore power supply (OPS) in all ports, EL aimed to install supply at tourist ports and major maritime ports, while EE, FR, MT, and RO all established specific targets either for the year 2025 or 2030. Several MS concluded that it is not economically viable to install OPS supply considering the current market demand and as such no objectives were set. Furthermore, AT, BG and SI noted the need for further studies to be carried out to better understand the benefits. Regarding supply to stationary aircraft, 24 MS considered the issue, but most MS decided not to take any further action. AT, DK, EE and LT stated that an electricity supply is already in place in a sufficient number of airports, while EL and PL concluded that it was not economically viable to install such supply. SI was the only MS that explicitly stated an objective to install an electricity supply in airports, in which it has aimed for two airports to be equipped by 2025. SK did not mention a specific number of airports to be equipped but noted that they expect to install a supply in the future.

The evaluation support study also concluded that additional modes could be included/emphasised further in the AFID, including in relation to public transport buses, trucks for freight transport(particularly electric trucks) and aviation (for both ground movements and electricity supply to static airplanes).

Driver A4: Scope of the policy framework is not consistent with market and technological developments

The development of the marketplace for electric and other alternatively-fuelled vehicles has been very rapid in recent years. For example in road transport, amongst other developments, recent years saw an increasing variability in battery size and charging power, which could require a deeper consideration of the type of AFI that is provided; at the same time there has been a move away from CNG LDVs, and the development of fuel cell vehicles has not been as fast as expected. For HDVs, the evaluation support study also noted that there has been limited progress in terms of the availability of public AFI (as opposed to private AFI in depots, etc.) for electric or hydrogen HDVs, perhaps as a result of the very limited offers in the markets of AFV HDVs. Away from road transport, an electric ferry entered commercial service in 2019, while multiple companies are developing electric aircraft technology, at least for short-haul operations. However, biofuels, biogas and e-fuels are also expected to assume a significant role, especially in the aviation and maritime sector where electrification is expected to be more challenging, especially for larger vessels and aircraft.

As a result of these rapid developments, as well as those related to other alternative fuels, the current scope and focus of the AFID on specific fuels and transport modes needs to be reviewed and updated to reflect the latest technological developments and the expectations for future market developments. The evaluation support study analysed some of these developments and how they could affect the implementation of AFI and the uptake of AFVs:

- Connectivity and digitisation of vehicles and new mobility patterns and business models: new mobility patterns and business models like mobility as a service (MaaS, integrating various forms of transport services into a single mobility service accessible on demand) are likely to have an indirect impact on the uptake of AFVs – through their use in selected fleets and subsequent impact on raising awareness. The integration/standardisation of information and data related to AFI is important for its full integration into the transport and energy sectors.

- New alternatively fuelled technologies and increasing use of renewables: most of them are still in development phase (e.g. synthetic/e-fuels). Nonetheless, they are likely to impact positively on uptake of AFI and AFVs and contribute towards the objectives of decarbonisation and, for some of them (e.g. advanced biofuels), there will not be a need for specific infrastructure which means that they may be easier/less costly to implement.

- Smart electricity grid management technologies: presents the opportunity to reduce barriers relating to electricity network capacity and integration with renewable generation, and subsequently enable increased deployment of AFI and AFVs.

- Improved quality of vehicles and overall reduction in price: increased quality and reduced price of AFIs will increase their attractiveness to potential consumers. As the uptake of AFV increases, further investment in AFI is likely and/or required.

- Changes in consumer behaviour and e-commerce: increasing e-commerce and online shopping presents an opportunity for logistic firms to reduce the environmental impacts of their fleets through the use of AFVs. Larger fleets and the use of consolidation centres may see increased implementation of AFI. May represent an increased focus on road freight sector than at the time of adoption of the original AFID.

- Adoption of restrictions for the use of vehicles: urban vehicle restrictions based on vehicle type (e.g., low emission zones) may encourage an increase in use of AFVs whilst increasing consumer awareness, whilst simultaneously increasing the demand for AFI, particularly where parking is limited.

Who is affected by the problem?

This problem affects entities responsible to deploy AFI, like Member States, authorities at Member State level (including cities) and fuel infrastructure operators. In turn, these affect transport operators and consumers.

Why does the problem need action at EU level?

To ensure the correct functioning of the internal market, Article 114 of the Treaty on the Functioning of the EU (TFEU) establishes the EU's prerogative to act on setting standards related to environmental performance and the protection of health. Furthermore, Title VI (Articles 90-91) makes provisions for the Common Transport Policy and Title XVI (Articles 170-171) for the trans-European networks. With this legal framework in mind, EU action allows better coordination for even and widespread deployment of AFI, instead of relying on Member States only. This facilitates travel across the EU for consumers and transport operators. It also helps to remove lack of AFI as a potential barrier, encouraging the vehicle industry to commit to vehicle production knowing the infrastructure is in place.

At the time of the development of the AFID, the impact assessment (European Commission, 2013) identified an EU initiative in this field as necessary - Member States did not have the instruments to achieve pan-European coordination (among vehicle manufacturers, infrastructure providers, national authorities and final users) in terms of technical specifications of infrastructure and timing of investments, and AF technology standards were not common EU-wide, thereby discouraging potential industry players, and leading to the fragmentation of the internal market.

According to the Directive itself, establishing a common framework of measures and promoting a broad market development of AFs for different transport modes and fuel types "cannot be sufficiently achieved by the Member States individually, but can rather, by reason of the need for action to meet the demand for a critical mass of alternatively fuelled vehicles and for cost-efficient developments by European industry, and to allow Union-wide mobility of alternatively fuelled vehicles, be better achieved at Union level". Subsequent documents have provided further justification of the ongoing need and added value for action at EU level. According to the Commission's Clean transport good practice examples published in 2016, EU intervention in the case of AFI was justified by the fact that the build-up of a European AFI "allows for free movement of goods and persons, with vehicles running on alternative fuels across the whole EU" and "facilitates the development of a single EU market for alternative fuels and vehicles which will permit the industry to benefit from economies of scale".

The evaluation support study also assessed the EU added value of the intervention in the sector, in terms of its effectiveness, efficiency and synergies that it brings. These results are summarised in Table 3-2, which also includes the assessment of stakeholders regarding this issue.

Table 3-2: The role and EU added value of the AFID in relation to effectiveness, efficiency and possible synergies for Problem Area A

Criterion	Rationale for EU added value
Effectiveness	Without EU action, some Member States would develop frameworks whilst many would not. The NPFs support the presence of coordinated frameworks, the setting of national targets for an appropriate number of infrastructure, and the consideration of different modes and fuels, all of which some Member States have adopted. While most stakeholders recognise some role towards a consistent and common framework of action across the EU, there was still scepticism among some of the stakeholders, with only 14 out of 33 respondents of the relevant question in the field research conducted for the evaluation support study indicating that the presence of an EU legal framework contributed towards the presence of a consistent and common framework of action across the EU to a significant or full extent. A further 13 indicated to some extent and six respondents indicated it contributed to a limited extent.
Efficiency	The NPFs can support the setting of clear targets for AFI deployment at similar timescales, creating clear market demand and facilitate economies of scale for manufacturers for AFI and AFVs. Views of stakeholders were mixed on whether EU action created cost-savings and better value for money (for authorities, industry and/or consumers) by avoiding duplication of effort and resources. Only 4 out of 28 respondents of the relevant question felt it helped to a significant or full extent, whereas 10 indicated to some

Criterion	Rationale for EU added value
	extent another 14 out of 28 stated it has only helped to a limited extent or not at all (four stating 'not at all').
Synergies	The AFID supports the collaboration and cooperation of best practices between the Commission, Member States and industry experts which would most likely not exist without it. Eleven out of 28 stakeholders agreed that EU intervention in the form of the AFID contributed towards cooperation and information exchange to a full or significant extent (four and seven, respectively).

Source: Evaluation support study of the AFID

3.1.2 Problem area B: There are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services

Interoperability of physical connections, communication standards and payment services has to date hindered wider use of alternatively-fuelled vehicles. While over time standards have been developed for physical connections and communication standards for some alternative fuels (namely electromobility), for other alternative fuels standards are still under development (for example, for natural gas).

Still, there has been some positive progress. For electromobility, a recent analysis of interoperability of electric vehicle infrastructure conducted on behalf of the European Parliament (Spöttle, et al., 2018) concluded that in terms of the technical hardware, the standards for Plug-in Electric Vehicle (PEV) charging modes and types in place in the EU are sufficient to guarantee uniform quality, safety of charging and investor security for market actors. The analysis suggests that the Directive – and the associated measures adopted since – have played a positive role in this direction. Still, input from stakeholders in the context of STF survey points to areas where further progress is needed, namely in relation to the need for the development of standards for heavy-duty vehicles, standards for smart charging, and communication protocols between different elements/actors in the recharging infrastructure. In the case of the LNG network, input provided in the context of the STF survey did not suggest specific issues: between 67% and 82% of respondents indicated that the relevant standard for both road transport and for water transport are sufficient and complete. In relation to hydrogen fuelling, between 59% and 69% of respondents considered that the relevant standards are complete. Issues identified concerned the standards related to LNG pressure at the nozzle and safety aspects in the hydrogen standards.

In relation to payments, AFID requires that users must be able to recharge their electric vehicle at any publicly accessible recharging point on an ad hoc basis. However, the evaluation support study concluded that progress in harmonisation is still lacking, with a high number of payment systems (MS often having a minimum of two billing systems in place) that may be confusing to customers. Similarly, the report on the STF survey identified that this requirement had been implemented in very diverse ways across Member States, and even within Member States, with some ad-hoc payment options being considered much less user friendly than others. This is also in line with the review of the NIRs made in the context of the evaluation support study, which identified gaps among MS in the way the specific requirements for payments were adopted.

<u>What are the drivers and root causes of the problem?</u>

Driver B1: Technical specifications for refuelling/recharging are still varied and cover only the physical connection of vehicle and infrastructure

While there has been progress in creating standards for physical connectors, the number of standards in existence (e.g., for electromobility) is still large and can create confusion amongst users (more details are provided in the section on the nature and scale of the problem, above). Still, the evaluation support study concluded that the technical standards adopted in the context of the AFID's Delegated acts have had a positive role in improving the levels of interoperability of AFI and the AFID has ensured a common reference framework in the development of the market for light-duty vehicles. This shows that better standardisation on areas where it is lacking has the potential to improve the consumer experience and support the uptake of AFVs.

Furthermore, on communication protocols, the STF survey identified a lack of interoperability and the need for harmonised communication protocols to support consumers using recharging/refuelling points – it should be noted, however, that evaluation support study concluded that this is an area without major problematic issues identified despite a high number of different protocols. Still, one particular area that the STF survey identified was the need to ensure data interoperability between electric vehicles and recharging points for authentication and payment.

This positive experience of standards on the context of AFI for EVs shows the potential that it could offer to other fuels (e.g. LNG or H2 for road transport) or modes (e.g. maritime) where standards are still lacking.

Driver B2: Framework (provisions/requirements/standards) concerning ad hoc payment options at charging points not in place

The AFID requires that users must be able to recharge their electric vehicle at any publicly accessible recharging point on an ad hoc basis, i.e. without needing to enter into a long-term contract with the operator or energy supplier. However, as noted, this requirement had been implemented in very diverse ways across Member States, and even within Member States. The respondents in the STF survey considered that this disparity in ad hoc recharging requirements was not consumer-friendly and that arrangements for contract-based payments varied and that drivers who travel long distances would need an array of smartphone apps or cards for authentication to ensure that they can use the charging points on all their routes.

At an MS level, a recent overview of various aspects on price transparency across a small number of countries in Europe [5] (NKL, 2020) found that ad-hoc payments payment systems are not widely used or offered in the Netherlands, but it is more common to use dedicated cards or web-based apps. The report concluded that ad-hoc payment is better developed in Germany and Austria but less so in France. Still, a test of 53 recharging points in Germany conducted by the German automotive club ADAC in May 2018 found that ad hoc charging was not possible in 23% of the cases (ADAC, 2018). Considering that these MS considered are among the leading countries with the larger markets in terms of AFI services, we can conclude that across the EU the situation is even less developed.

Furthermore, across MS, it is not always possible to charge the vehicle based on the contract with a supplier in the home country when travelling in another EU country. This is particularly the case between Western and Eastern Europe countries (e.g. Belgian user travelling in Hungary, Bulgaria or Romania). Still, there are also positive developments, including roaming solutions at national or local level, e.g. the industry joint venture Hubject that aims to harmonising roaming, and the widely used communication protocol Open Charge Point Protocol (OCPP). This could suggest that part of the issues/problem should

[5] The study examined the situation in four Member States (DE, NL, FR, AT) and Norway.

be expected to be addressed over time as the level of development of the network increases.

Who is affected by the problem?

This problem affects consumers, AFI service providers (including the providers of payment services) and vehicle manufacturers (as lack of standardisation harms uptake of AFVs).

Why does the problem need action at EU level?

While action by Member States can help address issues of interoperability of AFI at national level, only EU action can ensure the creation of a level playing field where vehicle and equipment manufacturers are able to produce at scale, using pan-EU standards and technical specifications, for the EU internal market. This was a result confirmed in the evaluation support study, with 41 out of 45 stakeholders that answered the relevant question in the field research conducted for that study indicating that stopping EU action would have a negative impact in ensuring product standards and interoperability of infrastructure. EU action can also be expected to provide cost savings and better value for money including by facilitating economies of scale, avoiding duplication of effort and resources. Action at national level alone would see bilateral effort and burden as various standards would exist, and production costs would be higher.

EU intervention under the AFID also encourages harmonisation and interoperability of AFI, helping address the ongoing issue of lack of interoperability in terms of physical connections, communication standards and payment services. This creates a clear market demand and encourages proportional investment. This EU action ensures the proper functioning of the internal market and is more efficient and effective than comparable action at the Member State level.

3.1.3 Problem area C: Consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees

What is the nature and scale of the problem?

Consumers using an alternatively-fuelled vehicle face the issue of not being able to easily identify where they can recharge their vehicles, as the AFID requires such information to be shared, but does not impose quality requirements for that data nor does it specify where such information needs to be displayed. On this topic, the evaluation support study concluded that there are still gaps and limitations in terms of ensuring access to adequate and relevant consumer information on AFI availability. This is despite the increasing availability of online platforms and applications providing location and other relevant information (primarily for electromobility). Information on pricing and price comparison are even less advanced, albeit which differences among MS.

What are the drivers and root causes of the problem?

Driver C1: No uniform rules on user information for alternative fuel recharging/refuelling along highways or in other areas

The STF survey found considerable differences between the transparency of pricing between ad-hoc recharging and contract-based recharging. The survey found that, in principle, ad-hoc recharging had the potential to provide more transparent pricing to consumers, as it should be possible to check the price to be paid at the recharging point or online/in an app before commencing charging. However, it found that the calculation and presentation of the price varied considerably between stations (time-based, kWh-based, flat-rate, etc.) and this reduced the transparency. For contract-based charging, the survey found that, although the consumer may have a standard rate included in their contract, the actual invoiced amount often included extra charges, such as roaming charges.

Another key issue for consumers is the concern that it may not be possible to find a suitable refuelling/recharging station before running out of fuel/electricity. Contributing to this, particularly on long-distance journeys on highways, is the lack of information on the distance to the next suitable recharging/refuelling station. The STF survey found that most stakeholders felt that the obligation to provide static and dynamic data on publicly accessible alternative fuels infrastructure should be EU-wide. Although the AFID requires that '*the data indicating the geographic location of the refuelling and recharging points accessible to the public of alternative fuels covered by this Directive are accessible on an open and non-discriminatory basis to all users'*, it does not specify where such information needs to be displayed. As noted above, the evaluation support study confirmed these results and concluded that consumers do not have full access to relevant information. Furthermore, the evaluation support study also found out that action by some MS (individually and on basis of EU funded activities) should be expected to contribute towards improving the availability and quality of information, but that this will probably not ensure consistent access across the EU network. Furthermore, the responses to STF survey also suggest that the *overwhelming majority of stakeholders consider that there is a need for roadside indicators / road signs for alternative fuels infrastructure to be harmonised across the EU*'.

Driver C2: Recharging/refuelling stations are not digitally connected

There is currently no obligation for recharging/refuelling points to be digitally connected. The provision of information to users on the availability of a recharging/refuelling station (covering both technical availability and the current occupancy), as well as pricing information, would depend on the station being digitally connected. The ability to manage contract-based payments for electric charging at other stations (i.e. when roaming) also requires stations to be digitally connected. According to estimates, by 2019 around 45% of the 1.3 million public, semi-public and private EV charging points across Europe were digitally connected; by 2024 it is expected that over 60% of the 5.2 million charging points that will exist by then will be digitally connected (Berg Insight, 2020).

The STF survey found near-unanimous agreement that there should be an obligation for all publicly accessible alternative fuels infrastructure to be digitally connected. This was also a conclusion of the recent JRC report, which noted that in order for consumers to experience mobility seamlessly, the infrastructure needs to be digitally connected, and the consumers should have real-time access to reliable information about the location and availability of recharging points (Sustainable Transport Forum, 2019).

<u>Who is affected by the problem?</u>

This problem ultimately affects consumers. It also affects AFI services providers and entities that operate in the market of supplying AFI data to consumers.

<u>Why does the problem need action at EU level?</u>

Without EU action, MS would pursue their own strategy regarding availability of information on AFI for consumers. This fragment approach would have negative impacts in terms of effectiveness and efficiency. EU action ensures that information sharing and standards are consistent across all Member States, ensuring a level playing field for industry and consumers across the EU. This EU action is more efficient (by reducing effort needed for use of AFI, therefore enhancing customer uptake of AFVs) and effective (with consumers having access to more and more transparent information across the EU; availability of clear information should raise awareness, improving customer uptake of AFVs) than comparable action at the Member State level. Action at EU level also bring synergies in the form of information exchange (geographic location and information on real-time accessible refuelling and recharging points), with positive impacts on the efficiency of the intervention. This assessment was confirmed in the evaluation support study, with 34 out of 45 stakeholders that answered the relevant question in the field research conducted for that study indicating that no EU action would have a negative impact on the availability of appropriate consumer information and awareness regarding AFs.

3.1.4 Problem area D: Integration of electro-mobility into the electricity system is not efficient

<u>What is the nature and scale of the problem?</u>

Smart charging is the management of the electricity demand for the purpose of EV charging, in order to avoid network load and to reduce charging costs. The STF survey identified that there is a wide consensus that smart charging as well as vehicle to grid (V2G) functionalities will be essential for an efficient integration of electric vehicles into the electricity system, as it presents the opportunity to reduce barriers relating to electricity network capacity and integration with renewable generation, and subsequently enable increased deployment of AFI and AFVs. However, the AFID does not require recharging points to provide these functionalities. The further development of smart grid management technologies presents an opportunity in terms of addressing emerging concerns about electricity network capacity as the uptake of electric vehicles increases. Further uptake of smart grids may therefore reduce barriers to future uptake of AFI, particularly where capacity was the main concern. However, the AFID needs to ensure that relevant technical requirements for smart charging, supported by appropriate standards, are developed.

Given the lack of requirement in the AFID for these areas and the absence of systematic reporting, it has not been possible to develop a clear understanding of the measures taken in this area by MS in the context of the evaluation study. Still, some MS identified in their NPFs and NIRs measures taken in relation to the integration of electromobility into the electricity system, including in aspects such as intelligent metering, allowing freedom of changing electricity supplier, and ensure that distribution system operators (DSOs) cooperate with entities operating public charging points.

<u>What are the drivers and root causes of the problem?</u>

Driver D1: EV charging points are not required to have smart charging functionalities

The STF survey identified that there is a wide consensus that smart charging functionalities will be essential for an efficient integration of electric vehicles into the electricity system. However, the AFID does not require recharging points to provide these functionalities. Respondents to the survey identified the Electricity Directive (2019/944) as providing the framework to allow such an integration if the smart charging infrastructure was deployed – in the evaluation support study, stakeholders considered that this Electricity Directive would probably play a greater role in this field than AFID. This is an issue most significant for private charging, where the grid-integration of electro-mobility is necessary to create synergies with the transport sector with smart charging functionalities; for public charging, especially for fast public charging, the need to have smart charging is less relevant.

<u>Who is affected by the problem?</u>

This problem affects charge point operators, together with grid operators and, ultimately, consumers (by affecting the vehicles they use). Services providers are also affected, e.g., as they can offer services reliant on the availability of smart charging capabilities.

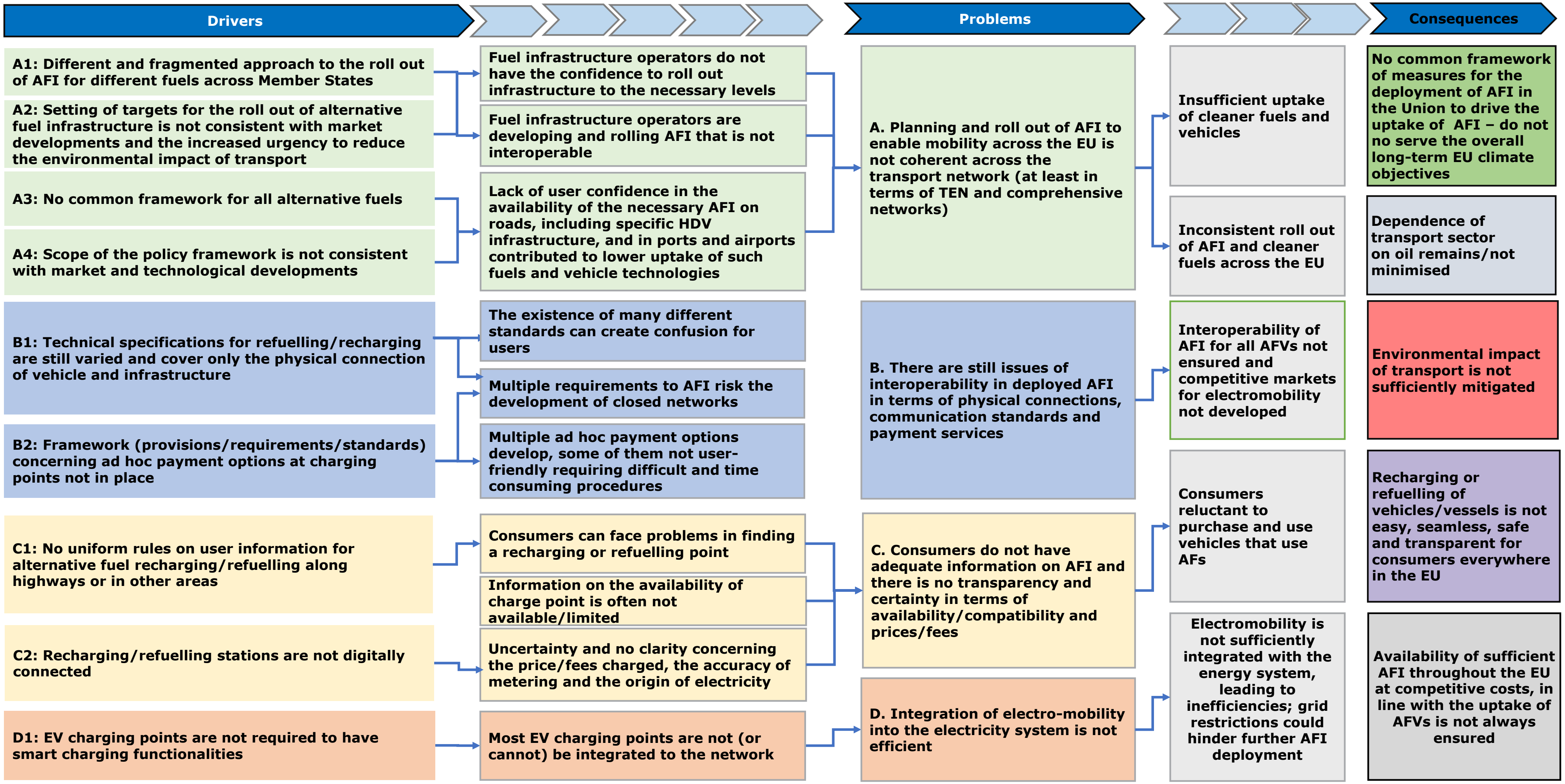
Why does the problem need action at EU level?

Article 194 of the Treaty on the Functioning of the European Union (TFEU) gives competences to the EU in the field of energy, including in energy efficiency, the development of new and renewable forms of energy and support decarbonisation targets. Under this framework, EU action is expected to support efficient integration of electro-mobility into the electricity system and compliance with electricity market rules in a more effective and efficient action than comparable action at MS level. The evaluation support study found some support for continuous intervention with this 22 out of 35 stakeholders that answer the relevant question in the field research conducted for that study indicating that stopping EU action would have a negative impact in the issue; a further 10 indicated that stopping EU action would have no impact.

3.2 Problem tree

The problem tree for the study is presented below (Figure 3-3). This problem tree was developed together with the Commission services, and also incorporates input from stakeholders that participated in exploratory interviews (see section 2.5).

Figure 3-3: Problem tree diagram



4 DEVELOPMENT OF THE BASELINE SCENARIO

4.1 Introduction

The analysis of the impacts of a possible revision of the AFID requires the development of a baseline scenario that represent the "no-policy change" scenario, upon which the alternative policy options will be compared.

The Baseline scenario should also consider other relevant socio-economic and policy developments. The former are related to technological developments and evolution of macro-economic trends and oil prices. The policy developments refer to the associated impacts of other related legislation in place.

Our approach for defining the baseline scenario combines a qualitative approach focusing on providing a description of the expected evolution of the problem in the absence of any change to the current legal framework (i.e. the provisions of the Directive remain the same) and a model-based analysis using the PRIMES-TREMOVE model.

The baseline scenario is based on the EU Reference scenario 2020[6] which projects energy, transport and greenhouse gas emissions trends in the EU up until 2050 taking into account EU level policies adopted by the end of 2019[7]. It also reflects the range of foreseen national policies and measures of the final NECPs that Member States submitted in 2019 according to the Governance Regulation. The EU Reference scenario 2020 also takes into account the impacts of the COVID-19 pandemic that had a significant impact on the transport sector.

For AFI the baseline assumes that the level of infrastructure developed will be the one resulting from the targets set by the MS in their NPFs/NIRs, where such targets have been set by MS. Where such targets for 2030 have not been set, assumptions concerning the expected distribution of AFI have been made for each MS on the basis of available information (see more details in 4.3).

In the following sections we present:

- A qualitative description of how the problem drivers under each of the problem areas are expected to evolve.
- A quantitative description based on PRIMES-TREMOVE model reflecting the expected development of key parameters, including the evolution of AFI deployment and AFV uptake.

4.2 Expected evolution of the problem

In this section we present how we expect that the different problems identified (as presented in section 3.1) are expected to evolve under the baseline scenario (i.e. in the absence of any changes to the AFID).

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6 EU Reference Scenario 2020 | Energy (europa.eu)

7 The spectrum of policies covered by the model involve financial, regulatory, soft and infrastructure measures. Key information comes from the NIRs and final NECPs, which have already been reviewed and used in the AFID evaluation support study. These policy inputs were converted into a suitable form for the model.

4.2.1 Problem area A: Planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network

While there has been continuous development of AFI across the EU, progress has been very uneven across Member States, both in terms of planning and actual deployment of AFI (see the description of driver A1 in section 3.1.1). Deployment has been fragmented resulting in some well served hotspots but also large gaps in coverage leading to a network that is not sufficiently uniform to remove concerns around AFI availability. Furthermore, there are also indications that, for some fuels and some MS, the roll out of AFI is not consistent with market and technological developments, as planning and deployment of AFI occurs at a different (slower) pace than the market.

In the absence of further EU level intervention, these problems and limitation are likely to continue to exist, with rapid developments in the marketplace not accompanied with an effective deployment of the needed (and desirable) AFI in a coherent manner throughout the EU.

Additionally, AFI deployment might not be ambitious enough to align with other policies related to the increased urgency to reduce the environmental impact of transport (as outlined in the European Green Deal and the 2030 Climate Target Plan e.g.), thus jeopardising the ultimate goal of reducing that impact by the use of alternatively-fuelled vehicles.

Table 4-1 summarises, qualitatively, the expected evolution of the underlying drivers of the problem under the baseline scenario.

Table 4-1: Expected evolution of problem drivers under the baseline scenario for Problem Area A

Driver	Expected evolution under baseline
Driver A1: Different and fragmented approach to the roll out of AFI for different fuels across Member States	• MS will continue to deploy AFI across the EU, based on local market demand, their decarbonisation goals and the funding available. • This will support the uptake of AFVs by consumers, with positive impacts on the reduction of CO_2 emissions in transport (as well as air pollutants) and consumption of oil products in transport. While there is evidence that the AFID has been successful in creating a common framework that supported the development of the AFI network, the evaluation support study also showed that there has been uneven implementation of AFI across the EU leading to a fragmented approach. • In the future this is expected to continue, as MS have different priorities for their transport infrastructure, their markets evolve in different ways, and the funding available for AFI differs. • Market-driven AFI deployment will look to maximise utilisation of the infrastructure and return on investment, likely prioritising investments in lower investment risk areas and leading to lack of AFI coverage in some areas. • This will negatively impact free/easy circulation of alternative fuel vehicles and vessels throughout the EU.
Driver A2: Setting of targets for the roll out of alternative fuel infrastructure is not	• Results from the evaluation support study show that the role of the AFID in supporting the development of AFI is growing. For example, the baseline for this study, projects an uptake of around

Driver	Expected evolution under baseline
consistent with market developments and the increased urgency to reduce the environmental impact of transport	44 million electric light duty vehicles (30 million battery electric and 14 plug-in hybrid vehicles) by 2030. • In terms of infrastructure, by 2030 2.3 million total electric charging points (normal and fast) for road transport are expected to be operational. For other types of AFI for road transport, 8,299 CNG fuelling points, 3,527 for LNG and 1,317 for hydrogen are expected. In relation to waterborne transport, the analysis in this study suggests that by 2030 the EU will reach 71 LNG bunkering terminals in maritime Core TEN-T ports and provide 174 MW of OPS. Meanwhile, 139 inland ports are expected to provide OPS by 2030. • While deployment of AFI is expected to accelerate (see above), the evaluation support study concluded that supply still remains an important challenge with the supply of networks and recharging points being implemented too slowly to meet demand in some modes and in some MS. This is partly due to the expectation from AFV market / suppliers that the AFI should be in place before the AFVs enter the market, to ensure there are no barriers to the sales or usage. This was a conclusion of the evaluation support study, where an association of vehicle manufacturers indicated that, from their perspective, there is still a need for a stronger supply side through investment in infrastructure before market forces come into play and that consumers still see (lack of) AFI as a barrier to the uptake of AFV. • This problem is expected to continue into the future and could become more acute as consumer uptake of AFVs increases, which might not be accompanied by the needed growth in AFI, and greater demands are put into the transport sector to decarbonise. • Original ambitions of the AFID were based on policy aims and expected market developments that have since been surpassed. New EU initiatives, like the European Green Deal, will lead to increased urgency in the decarbonisation of transport in order to reach 90% reduction by 2050. This will require faster introduction of AFVs than would have been anticipated under the original AFID and will therefore require a correspondingly faster introduction of AFI, ahead of AFV deployment.
Driver A3: No common framework for all alternative fuels, e.g. for shore-side electricity in ports and at airports	• Some alternative fuels will continue to develop outside of the scope of the AFID, with those developments deriving from market forces and/or interventions at MS level to decarbonise those modes. • This will vary across MS depending on their decarbonisation goals and their ability to support funding of AFI for these modes, as the industry might not be able to support by itself the necessary investments to reach very ambitious goals in terms of AFI. • This fragmented approach could lead to a lack of harmonisation and interoperability across the EU for these modes that are not covered in the AFID.
Driver A4: Scope of the policy framework is not consistent with market and	• New market and technological developments in the field of transport in general (e.g. new mobility patterns and business models), and AFI in particular (e.g. AFI for HDVs, including electric

Driver	Expected evolution under baseline
technological developments	road systems (ERS), where there is no current EU strategy or standards), are likely to keep appearing at a quick pace. • If the AFID, or the overall EU regulatory framework, is not capable of addressing these new developments effectively this could impact the effectiveness and efficiency of further uptake of AFI and AFVs across the EU, particularly for the categories of transport where decarbonisation is more difficult and less advanced. • In the absence of further updates to the AFID, some technologies may develop in a fragmented way and prevent cross-MS interoperability, and thus prevent a more efficient deployment of AFVs and AFIs (e.g. continued lack of standardised approach to electric charging point location, other data provision to users and ad-hoc payment systems, and smart charging capabilities; see also Problem Area B, C and D). • Under the existing AFID framework ambiguity, and potential discrepancy, around what are considered to be alternative fuels could result in less efficient use of investments (e.g. for hydrogen, biofuels and CNG/LNG), resulting in a more fragmented AFI and AFV market. Additionally, the evaluation support study also concluded that there is a need to ensure there is strong coherence between AFID, supporting the deployment of AFI, and other legislation, such as Renewable Energy Directive (REDII, 2018/2001), supporting alternative fuels.

4.2.2 Problem area B: There are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services

Over time, standards have been developed for physical connections and communications, and more interoperable payment services have become available. As such, the problem has been ameliorating. However, several issues still remain, and while it would be expected that improvements would continue to take place, without full interoperability of physical connections, communication standards and payment services the progress towards wider use of alternatively-fuelled vehicles might be slower than it would have been if higher levels of interoperability was achieved, or achieved more rapidly.

Table 4-2 summarises, qualitatively, the expected evolution of the underlying drivers of the problem under the baseline scenario.

Table 4-2: Expected evolution of problem drivers under the baseline scenario for Problem Area B

Driver	Expected evolution under baseline
Driver B1: Technical specifications for refuelling/recharging are still varied and cover only the physical connection of some vehicles and infrastructure; communication protocols for HDVs not specified	• In terms of technical specifications for the physical connections for EV charging, the evaluation support study concluded that technical standards adopted in the context of the AFID's Delegated acts have had a positive role in improving the levels of interoperability of AFI for cars and other light duty vehicles. • Without further clarity on standards for data provision and interoperability, and customer-facing

Driver	Expected evolution under baseline
	data provision, accessing data on charging station location and pricing will likely continue to be variable across the EU and a challenge in some cases. Without further clarity on these aspects, consumers will face a lack of understanding of the options available to them, potentially holding back AFI deployment and AFV adoption. • Standards for high power charging for buses and HDVs have not been defined in the AFID and this could lead to a fragmentation in the market and potentially slower AFI and AFV take up in these segments. Same is true for ERS for HDVs. • For other alternative fuels (LNG, hydrogen), there are still concerns regarding the need to establish standards that can create clarity in the market; without those standards the market for those fuels might take longer to develop.
Driver B2: Framework (provisions/requirements/standards) concerning ad hoc payment options at charging points not in place	• The evaluation support study found the availability of ad-hoc payments was still a problem across the EU, with reports indicating that ad-hoc payments are restricted by the need to use specific web apps or RFID cards in some cases. • This fragmented approach is likely to continue in the future, with market forces and consumer pressure determining which solutions are more widely adopted in each MS. • This approach could create further barriers for cross-border movements of AFVs as the ad-hoc payment options available might continue to diverge across MS.

4.2.3 Problem area C: Consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees

Since alternatively-fuelled vehicles have been gaining traction in the consumer market, issues with availability of adequate consumer information both before buying (performance of different vehicles using different fuels) and while using (available AFI, payment information, etc.) the vehicles have existed. With different industry players using different ways of communicating information to consumers, the problem is likely to continue to exist if there is no action to support transparent methodology to communicate information to consumers.

Table 4-3 summarises, qualitatively, the expected evolution of the underlying drivers of the problem under the baseline scenario.

Table 4-3: Expected evolution of problem drivers under the baseline scenario for Problem Area C

Driver	Expected evolution under baseline
Driver C1: No uniform rules on user information for alternative fuel recharging/refuelling along highways or in other areas	• The evaluation support study found that action by some MS should be expected to continue to contribute towards improving the availability and quality of information, but that this will likely be limited to the MS-level and not ensure consistent access across the EU transport network. Individual companies will decide on the best way to present prices to consumers. Consumer choice and

Driver	Expected evolution under baseline
	preferences will influence companies on the decision of what type of information is shown. • Given this, it is likely that important limitations in terms of the availability of information on the location of AFI infrastructure will remain and present a barrier to the use of AFVs across the EU and limiting the efficient use of deployed AFI. • In terms of price transparency, some MS might decide to implement rules on what kind of information should be presented and how. Thus, a fragmented approach across the EU will continue to exist and transparency to users will not be ensured consistently across the EU.
Driver C2: Recharging/ refuelling stations are not digitally connected	• Market penetration of digitally connected EV charging points will continue to grow, reaching 60% of all charging points by 2024 compared to 45% in 2019 (Berg Insight, 2020), showing a clear trend in growth for the sector. • Without an EU framework, this growth will likely be fragmented with some MS taking steps to ensure all charging points are connected while others may not. This will result in lost efficiency in AFI market developments and limit the ability to harmonise data sharing and information access across the EU.

4.2.4 *Problem area D: Integration of electro-mobility into the electricity system is not efficient*

The evaluation support study concluded that while there has been progress in developing smart charging and V2G capabilities, development is still in its early stages. Without further action, fragmented development is expected, with continuous development of smart charging and V2G capabilities as the market evolves and demands more solutions. This fragment approach could result in further barriers to harmonisation and effectiveness across the EU.

Table 4-4 summarises, qualitatively, the expected evolution of the underlying drivers of the problem under the baseline scenario.

Table 4-4: Expected evolution of problem drivers under the baseline scenario for Problem Area D

Driver	Expected evolution under baseline/assumptions
Driver D1: EV charging points are not required to have smart charging operations functionalities	• Developments in the sector are expected to happen as the EV market continues to grow and creates demand for more solutions for smart charging (and also V2G), which will become more commonplace. • Without an EU framework this progress is likely to be fragmented across MS and may create barriers to a harmonised approach across the EU. Furthermore, without efficient integration with the grid, cost of grid connection and reinforcement will likely remain a barrier to AFI and AFV adoption. • Further intervention at EU level could happen under other EU interventions, e.g. the Electricity Directive (2019/944); the current AFID is expected to play a limited role but could reference other appropriate standards and legislation.

4.3 Model analysis - Projected evolution under the baseline scenario

As explained in section 4.1, the baseline scenario is based on the Reference scenario 2020[8] which reflects the EU level policies adopted by the end of 2019 and the range of foreseen national policies and measures of the final NECPs that Member States submitted in 2019 according to the Governance Regulation. It also takes into account the impacts of the COVID-19 pandemic that have had a significant impact on the transport sector. The REF scenario models the impacts of targets and policies already adopted (such as the CO_2 standards for vehicles) by the end of 2019, but it does not include the revised EU climate ambition for 2030 or the target of net-zero emissions by 2050.

Post-2030, there are no additional policies assumed to drive the decarbonisation. However, several of the measures in place today will continue to deliver emissions reductions in the long term. Thus, by 2050, the CO_2 emissions from transport including intra-EU aviation and intra-EU maritime are projected to be 39% lower relative to 2015 (27% lower when all intra-EU and extra-EU aviation and maritime emissions are considered) under the REF scenario.

In terms of the number of electric vehicles (BEVs and PHEVs), a total of 44 million electric light duty vehicles (30 million BEVs and 14 million PHEVs) is projected to be in circulation by 2030, reaching 151 million by 2050. The table below summarises the expected evolution of various types of AFVs under the baseline (i.e. EU Reference scenario 2020).

Table 4-5: Evolution of the number of alternative fuel vehicles in the baseline

Number of vehicles (in thousands)	Baseline		
	2030	2040	2050
Electric BEV LDV	29,941	67,420	97,033
Electric PHEV LDV	13,987	41,007	54,157
Electric HDV	50	161	231
Fuel Cell Electric LDV	306	3,906	10,301
Fuel Cell Electric HDV	3	63	102
CNG LDV	4,376	6,265	6,580
LNG HDV	621	1,246	1,536

Source: PRIMES-TREMOVE

In terms of the level of AFI, the baseline scenario is based on the level of electric charging infrastructure defined in the NIR targets for 2030 set by 18 MS (AT, DK, FR, FI, DE, LU, NL, SI, BG, CY, CZ, EL, HR, HU, IE, LV, MT, SK) and with relevant projections for the remaining ones. The Member States that set targets for 2030 contributed 82% of the total number of recharging points in 2019, according to the EAFO database. The number of public recharging points in these Member States is projected to increase from 135,134 in 2019 to 1,886,045 in 2030. For the 9 Member States that have not set a target for the future, it has been assumed that their share in terms of total number of recharging points at EU level in 2030 would be similar to that in 2019. This implies that the number of recharging points in these Member States would go up from 29,972 in 2019 to 418,315 in 2030.

[8] EU Reference Scenario 2020 | Energy (europa.eu)

In the case of other type of AFI, including charging for HDVs, HRS, CNG and LNG refuelling stations, and infrastructure for the maritime ports and inland ports, there are only limited targets set by MS in their NIRs.

The table below summarises the approach adopted to develop the baseline for the different types of AFI under consideration.

Table 4-6: Assumptions made to support the development of baseline for road, shipping and aviation AFI

AFI type	Assumptions
Road transport	
Electric charging - LDVs:	Based on Reference scenario 2020 for BEV/PHEVs projections. As regards charging points[9], we have used data from the NIRs of MS (and assumed that these MS will meet the proposed targets) while for MS with no NIR data available, the number of charging points are distributed to MS based on their relative share in 2019 in total EU charging points according to EAFO. In total 2.3 million charging points are projected by 2030.
Electric charging – HDVs	Estimate of charging points[10] based on expected demand for electricity based on the electricity consumption of HDVs per HDV segment derived from PRIMES-TREMOVE. Assumed that depot (i.e. not public) charging will provide 85-90% of the total energy for smaller rigid trucks (<32t) and 50% for larger articulated trucks (>32t). Private charging shares are largely based on previous analysis completed by Ricardo.
HRS – HDVs	It is assumed that the MS with NPF/NIR targets will meet these targets. For the remaining 14 MS we have assumed one station every 300 km (0.4 t/station). In cases where EAFO data indicated more HRS in 2020 than the indicative target or the NPF/NIR, we applied the relevant EAFO 2020 data.
LNG	For 2025, we used the relevant targets in the NIR/NPFs but where NIR/NPFs report lower number for LNG stations than EAFO for 2020, we used the EAFO data. When relevant data was not available we have applied the indicative target of the AFID (every 400 km on TEN-T core, serving both directions). For 2030, we used a demand-driven approach to accommodate the growing demand of LNG. The assumed average capacity of the of LNG stations is 5 t/day.
CNG	We used the relevant targets in the NIR/NPFs but where NIR/NPFs report lower number for CNG stations than EAFO for 2020, we used the EAFO data. In the absence of relevant targets in the NIRs/NPFs we used the indicative targets of AFID (1 fuelling station for 600 vehicles, every 150 km on TEN-T core). The assumed average capacity of CNG stations is 0.5 t/day.
Shipping	

[9] Five different typical charging points ranging from 7 kW to 350 kW have been considered.
[10] Four different chargers from 350 to 1400 kW are considered.

AFI type	Assumptions
Inland – LNG	For the period up to 2030, we assume MS with NIR targets will meet these targets. For the remaining MS, we have used the current number of installations as reported, or zero in cases where AFI was not reported.
Inland – OPS	For the period up to 2030, we assume MS with NIR targets will meet these targets. For the remaining MS, we have used the current number of installations as reported, or zero in cases where AFI was not reported. We have assumed the same MW deployment per installation.
Maritime – LNG	For the period up to 2030, we assume MS with NIR targets will meet these targets. For the remaining MS, we have used the current number of installations as reported, or zero in cases where AFI was not reported.
Maritime OPS	We assume 10MW to be installed across the EU per year starting from 2022.
Aviation	
	We have assumed baseline deployment levels for the year 2025 depending on airport size. For airports with more than 10 million annual passengers, we have assumed all gates and outfield positions will be equipped with FEGP. For airports with 1-10 million annual passengers, we have assumed half the gates and no outfield positions will be equipped with FEGP. For airports with less than 1 million annual passengers, we have assumed no gates or outfield positions will be equipped with FEGP.

A more detailed description of the baseline scenario in terms of projected transport activity, energy demand, CO_2 emissions and air pollution emissions is provided in Annex C.

5 POLICY OBJECTIVES

In parallel with the definition of the problem, the policy objectives were developed, with links to each problem area and its underlying causes. This is to support the level of ambition of the intervention, provide the benchmark against which to assess the effectiveness, and clarify any interactions with other EU legislation.

The policy objectives are summarised in Table 5-1 and have been linked to the problem definition and the respective problem areas. These objectives have been developed based on input from stakeholders (during the exploratory interviews) and the Commission during the inception stages of the project. We have also reviewed the objectives of other relevant EU policies in greater detail to assess whether they were consistent with these objectives. Relevant EU policies included the "Clean Planet for All" Communication, the European Green Deal, 2030 Climate Target Plan (CTP) and EU policies on energy system integration, competitiveness of industry and innovation policy, and functioning of the single market.

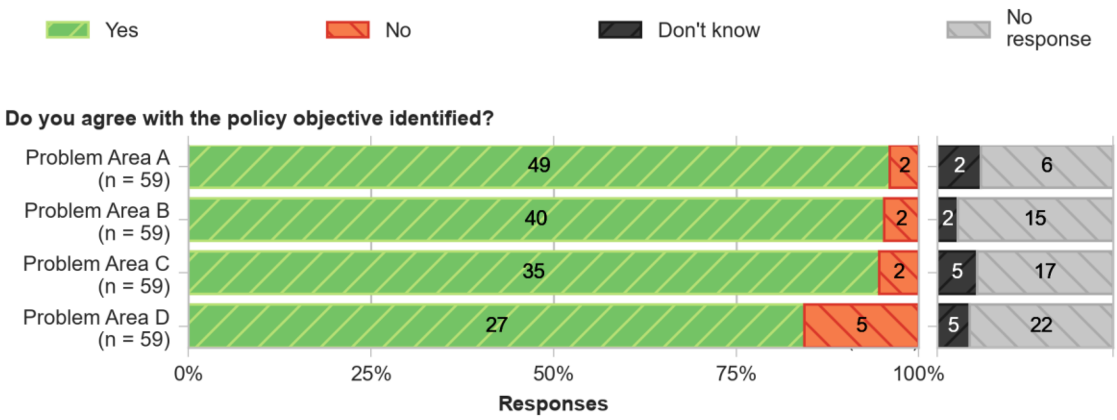
Table 5-1: Definition of policy objectives and link with the problem

Problem definition	Objectives
Overall problem Existing policy framework does not deliver towards the development of a commonly available infrastructure to support the accelerated take up of alternative fuelled vehicles and vessels that would minimise EU	**General objectives** Establish a robust policy framework in the area of alternative fuels and infrastructure that delivers on the following: • Drive the uptake of alternative fuels in all transport modes across Europe in line with

Problem definition	Objectives
import dependence on oil and the environmental impacts of transport and help achieve the ambition of making the EU the first climate-neutral continent by 2050	the overall long-term climate and zero pollution objectives. • Minimise the dependence on oil in the transport sector. • Mitigate the environmental impact of transport by reducing CO_2/GHG and pollutant emissions to air. • Ensures that recharging or refuelling of vehicles/vessels is easy, seamless, safe and transparent for consumers everywhere in the EU. • Ensure availability of sufficient AFI throughout the EU at competitive costs, to remove barriers to the uptake of alternatively fuelled vehicles/vessels/aircraft that ensures that all AFVs can circulate with ease across the EU and that key infrastructure such as motorways, ports and airports enable operation of AFVs.
Problem area A Planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network (at least in terms of TEN-T core and comprehensive networks)	**Specific objective 1** Specify minimum requirements for the roll-out of alternative fuels infrastructure along the TEN-T core and comprehensive network, as well as urban nodes.
Problem area B There are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services	**Specific objective 2** Ensure full interoperability of infrastructure for: • All alternatively fuelled vehicles, vessels and aircraft. • Communication protocols, where needed, that allow competitive markets to develop, including online connectivity. • Easy ad-hoc payment solution on all charging points as well as availability of seamless contract-based payments.
Problem area C Consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees	**Specific objective 3** Ensure adequate information is available for consumers, including: • Information on location/availability of infrastructure through appropriate tools and adequate signposting. • Comprehensive information on prices for recharging/refuelling services as well as on additional services (on online sources and at the point of sale).
Problem area D Integration of electro-mobility into the electricity system is not efficient	**Specific objective 4** Ensure efficient integration of electric vehicles/vessels in the electricity system by expanding the use of smart charging capabilities.

As part of the surveys and interviews conducted for this study, all stakeholder groups were also enquired on whether they agree with the identified policy objectives. In general, a vast majority of respondents agree with the problem definition for each of the problem areas (Figure 5-1). Except for Problem Area A, all stakeholders that disagreed were industry stakeholders – for Problem Area A, one that disagreed was from industry, the other a public authority/public body.

Figure 5-1: Stakeholders' agreement with the objectives associated with each problem area



Among those that did not agree with the objectives set, a few explanations were provided:

- For Problem Area A, AVERE indicated that the objective should go beyond TEN-T and refer to the entire EU transport network. The Hamburg Port Association disagreed because they felt that demand needs to be taken into account, other AFI could become a stranded asset.
- For Problem Area B, CHAdeMO Association Europe disagreed with the objective of aiming for "full interoperability", as for some vehicles already in the market that would not be recommended[11]. Enagas indicated that while standards are required to ensure full interoperability, they should not be mandated.
- For Problem Area C, CharIN eV and IONITY both indicated that information on location and availability of infrastructure is already available, so the objective is not needed. Both did agree that availability of information on ad-hoc pricing is a reasonable objective.
- For Problem Area D, one stakeholder indicated that the objective needs to be much broader (ChargeUp Europe), while another indicated that it is too broad (AVERE). The former indicated that the objectives needed to include aspects on the implementation of the electricity market design, clarification of the role of aggregators and DSO recharging managing charging stations, need for clarity on access to in-vehicles data, while the latter indicated the objective should add a caveat on technical and economic feasibility. CHAdeMO Association Europe disagreed with the need for widespread use of smart charging, as that is not necessary for all chargers and mandating such functionalities for all chargers will harm the competitive market and will not foster the uptake of EVs. The same point was made by IONITY.

[11] As an example, they noted it would not be recommendable to mandade ISO 15118 for DC charging.

6 RETAINED POLICY OPTIONS

6.1 Introduction

In this section we present the process that we followed to first develop a set of policy measures and then screen them using a set of screening criteria (section 6.2). Finally, these measures were further developed and packaged into a set of three policy options.

6.2 Pre-screening the policy measures

This work focused on the identification of the relevant list of policy measures intended to address the identified problems and the development of a relevant set of options. In line with the Better Regulation Tool #17 this includes the following steps:

- **Step 1:** Development of a full list of all possible measures.
- **Step 2:** Screening of the long list of measures.
- **Step 3:** Packaging of selected policy measures into suitable policy options.

Step 1: Development of a long list of measures

As part of Step 1 we developed a long list of potential measures that built upon the initial set of measures described in the terms of reference. These were further elaborated based on input from the Commission and stakeholders (in the exploratory interviews). In developing this long list of policy measures we also considered how these are linked to the problem drivers of each problem area identified that there is more than one alternative addressing each problem driver.

Step 2: Screening of the long list of measures by the project team with input from the Commission.

The next step was the process of screening the detailed list of policy measures. The purpose of the screening process was to narrow down the long list in a sensible manner so that less preferable measures are discarded. The screening was based on the criteria outlined in Table 6-1: below.

Table 6-1: Criteria used in the screening process

Criteria	Description
Legal feasibility	Extent that options respect the principle of conferral and whether they may conflict with other EU legislation.
Effectiveness and efficiency	The contribution of the measure to addressing the specific problem and/or meeting the objectives that it is targeted to and the (qualitative) cost burden or savings that could be achieved with the adoption of the measure. Quantitative assessment will be conducted in the detailed impact assessment.
Technical feasibility	The presence of any technical barriers to the adoption and enforcement of a measure. This is particularly important for measures that require the new types of information for which standardised metrics do not yet exist and would require the development of legislation in other areas.
Political feasibility	Check whether specific options are expected not to garner the necessary support for adoption of legislation and implementation
Subsidiarity and proportionality	To ensure that the principles of subsidiarity and proportionality are respected

The initial screening assessment was qualitative, based on the judgement from the experts in our team, input received from the Commission and from stakeholders as part of the exploratory interviews. A three-scale qualitative ranking for each of the five criteria was used together with an initial recommendation as to whether each measure should be considered further. Policy measures considered, along with the rationale for discarding the ones that were not further analysed, are presented in Annex F.

Discarding of measures related to problem area D

In relation to the measures related to problem area D (grid integration), a more extended screening process was applied concerning the requirement of requiring smart charging functionalities mandatory for all new publicly accessible DC/AC chargers (excl. semi-public). The analysis included a quantitative assessment of the costs and impacts that lead to the conclusion that this set of measures should not be considered further in the context of the main impact assessment and its policy options under AFID.

The analysis found that, at an estimated cost of €225 to €450 per charger to add smart charging capability (18%-36% of slow charger cost) [12] , the total additional investment cost would be in the range of €0.5-€1.0 billion by 2030 and €2.4-€4.7 billion by 2050. It would therefore be expected to represent a sizeable additional cost:

- It would represent a sizeable additional cost of the costs for all normal chargers even for those chargers where smart charging is less relevant. However, also benefits can be expected that can make additional investments worthwhile in particular if the costs of smart recharging points were to decrease substantially in the future.
- While representing a smaller share of the costs for fast chargers[13], it is not relevant for fast chargers due to their high turnover use profiles.

On the basis of the above, the relevant measures were not considered further in our analysis.

Step 3: Packaging of selected policy measures into suitable policy options

The final step of the process was the "packaging" of measures into a set of policy options. Three policy options have been developed in addition to the baseline ("no policy change") scenario. The packages show an ascending level of ambition aiming to meet the policy objectives. The final list of measures included in each policy option is discussed in the next section.

6.3 Definition of policy options

This section presents the final policy measures included in each policy option. The section is structured by over-arching topic, namely targets for road transport, shipping and aviation, and measures to promote interoperability and measures to improve consumer information.

For the measures that include targets for road transport, the final definition of these targets was also based on the analysis as part of Strand A, which in itself the result of detailed desk research and analysis of stakeholder input (see Annex A for more details). The overall approach to defining policy options is as follows:

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[12] Public chargers can start at values as low as €1,250 in 2030 (for a 7kW AC charger).

[13] For fast chargers, which start at more €30,000 in 2030 (50-150kW DC), these additional costs represent a much smaller proportion (<1%)

- **Policy Option 1 (PO1):** This option introduces a number of significant changes to the Directive to fully deliver on the 2030 Climate Target Plan objectives. It sets mandatory quantified targets on the basis of a minimum total recharging power to ensure sufficient supply for the national fleet of electric LDV on the Member State level. In addition, this option introduces mandatory distance-based targets for recharging and refuelling infrastructure on the TEN-T core network for hydrogen refuelling stations and electric recharging points for HDV, with an increase in ambition over time. All targets were derived from the methodology explained in detail in annex A that determines sufficiency levels for the deployment of infrastructure. Member States will be required to update their National Policy Framework with a view to detailing their planning for implementation of infrastructure rollout, including identification of emerging needs in rail and aviation, and corresponding monitoring and reporting..

- **Policy option 2 (PO2):** This policy option thoroughly revises the Directive. It sets the same mandatory national fleet based targets for electric LDV, and adds targets for infrastructure for electric LDV on the TEN-T network and for electric HDVs in urban nodes. It also increases the level of ambition for recharging and refuelling infrastructure for HDV and introduces stricter deployment targets for waterborne transport and for stationary aircrafts. Furthermore, it introduces ambitious measures in terms of interoperability and user information, including a greater level of harmonisation on physical and communication standards and more user friendly ad hoc payment options. It further substantiates provisions on price transparency and other user information, including physical signposting of recharging and refuelling infrastructure.

- **Policy option 3 (PO3):** This policy option includes a change to the legal instrument by replacing the current Directive with a Regulation while also increasing further the level of ambition (in comparison to PO2). It extends the mandatory targets of PO2 infrastructure on TEN-T core and comprehensive network corridors, with additional mandatory deployment targets for electric recharging points on petrol stations and earlier deployment targets for hydrogen stations and increases considerably the ambition of installation of alternative fuels infrastructure in ports. Strict deployment targets are also introduced for waterborne transport and aviation and foresees shortening of the NPF reporting cycle from 3 to 2 years. At the same time, the option reduces flexibility for charge point operators by making terminal payment at fast chargers the standard ad-hoc payment solution.

All policy options, focusing on the design of the policy instrument, are designed in the context of a policy environment achieving the overall 55% emission reduction target by 2030. This policy context is mainly represented by the MIX policy scenario that follows a combined approach of carbon pricing instruments and regulatory-based measures[14].

The following subsections provide details on the measures addressing each problem area for each of the policy options.

6.3.1 Targets for AFI for road transport

Road transport AFI targets have been defined for each of the three policy options in the context of problem area A (planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network). They have been developed for electricity (for cars, LDVs and HDVs), CNG, LNG (HDVs), and hydrogen (HDVs, but also accessible

[14] Policy scenarios for delivering the European Green Deal | Energy (europa.eu)

for LDVs). An overview of the targets included in each policy option is presented in Table 6-2 below.

Policy option 1 includes a national target **for a minimum level of recharging capacity in each Member State of 1.0 kW installed capacity per registered battery electric car/van and 0.66 kW installed capacity per every registered plug in hybrid car/van**. There is also a focus on the development of the AFI across the TEN-T network with specific targets set for minimum level of charging points for **HDVs and for hydrogen**. These become progressively more demanding between 2025, 2030 and 2035 by increasing the scope (in terms of the coverage of both the core and comprehensive TEN-T) and electric charging capacity. More specifically, Member States must ensure at least 700kW installed capacity, with 350kW (or higher) charging points, every 60 km in each direction on TEN-T core network by 2025 and 1400 kW installed capacity with 350kW (or higher) charging points by 2030. In addition, MS must ensure at least 700kW installed capacity, with 350kW (or higher) charging points every 100 km on the TEN-T comprehensive network by 2030 and 1400 kW installed capacity with 350kW (or higher) charging points by 2035. In addition, a mandatory target of at least one charging point of minimum 50kW for HDVs in all safe and secure overnight parking areas is introduced. Member States must ensure every 150 km on the TEN-T core network at least one station serving both directions for heavy-duty vehicles at 700 bar (while 350 bar is optional) by 2030. Light-duty vehicles should be enabled to fuel at all stations. Furthermore, stations have to provide a minimum daily output capacity of 1t by the same year. In addition, at least one hydrogen refuelling station of minimum 1t capacity to be available in all urban nodes across the TEN-T by 2030. There is no change to the current indicative targets for CNG and LNG.

In addition to the national targets, **Policy option 2** sees a focus on the development of the AFI across the TEN-T network with specific targets set for minimum level of charging points for LDVs which become progressively more demanding between 2025, 2030 and 2035 by increasing the scope (in terms of the coverage of both the core and comprehensive TEN-T) and electric charging capacity. More specifically, in the case of LDVs, Member States must ensure at least 300 kw installed capacity, including at least one 150kW recharging point, every 60 km in each direction on the TEN-T core network by 2025 and 600kW installed capacity, including at least two 150kW in each direction on the TEN-T core network by 2030. In addition, Member States must ensure every 60km on the TEN-T comprehensive network 300 kW installed capacity, including at least one 150kW, by 2030 and 600kW installed capacity, including at least two 150kW recharging points, by 2035. For HDVs, in addition to the distance based targets set under PO1, specific targets are set for the availability of publicly accessible charging for urban delivery trucks in all urban nodes of the TEN-T network[15] (600 kW installed by 2025 and 1.2 MW installed by 2030) in every urban node. In the case of hydrogen, the minimum capacity for hydrogen fuelling stations in also increased to 2t per station that is seen as being the level sufficient to meet the demand arising from the MIX scenario in terms of uptake of FCEVs by 2030. In addition, Member States have to ensure that every 450 km on the TEN-T network a hydrogen refuelling station serves liquid hydrogen to trucks. Moreover, the option norms a requirement to also serve liquid hydrogen in at least one third of urban nodes. Finally, in relation to LNG infrastructure, Member States have to ensure that an appropriate number of refuelling points for LNG accessible to the public are put in place by 2025, at least on the TEN-T Core Network, so that LNG heavy-duty vehicles can circulate throughout the EU, where there is demand, unless the cost are disproportionate to the benefits, including environmental benefits[16].

[15] As defined in the TEN-T Regulation (EU) No 1315/2013.

[16] As noted in recital 46 of the AFID, this is understood to result in a necessary average distance between refuelling points for LNG of approximately 400 km

Finally, **Policy option 3** introduces further targets to be met – in addition to those above - including:

- At least one charging point in petrol stations of minimum size of 150kW (set at 12 pumps in 2025 and 8 pumps in 2030).
- Requirements for filling stations with more than one pump for HDVs on TEN-T to be equipped with specific charging points of minimum 350kW.
- Bring forward the target for a hydrogen refuelling stations of minimum 2t to 2025 (from 2030 under PO2)
- The indicative targets for CNG refuelling station every 150 km on TEN-T core to become mandatory.

Table 6-2: Description of policy options and targets for AFI for road transport

Fuel/modes	Baseline (under AFID)	PO1	PO2	PO3
Electricity Cars and LDV	Indicative targets: 1 charger for 10 vehicles, every 60 km on TEN-T core as reflected in the NPFs/NIRs adopted by MS	Minimum level of recharging capacity infrastructure in each Member State of 1.0 kW installed capacity per registered battery electric car/van and 0.66 kW installed capacity per every registered plug in hybrid car/van	As PO1 plus: Mandatory target on TEN-T every 60 km, in each direction of travel 2025 (Core): 300 kw installed capacity, incl. at least one 150kW recharging point 2030 (Core): 600 kw installed capacity, incl. at least two 150kW recharging points 2030 (Comprehensive): 300 kw installed capacity, incl. at least one 150kW 2035 (Comprehensive): 600 kw installed capacity, incl. at least two 150kW recharging points	As PO1 and PO2 plus: 2025: Every petrol station with 12 or more pumps must be equipped with at least one recharging point with a minimum capacity of 150kW 2030: Every petrol station with 8 or more pumps must be equipped with at least one recharging point with a minimum capacity of 150kW
Electricity HDV	No specific provisions, covered under normal electricity charging	Mandatory target on TEN-T core and comprehensive every 60 km in each direction of travel Core: 2025 - : 700kW of charging capacity every 60km <u>per direction</u> (1.4MW total) 2030 : 1.4kW of charging capacity every 60km <u>per direction</u> (2.8.4MW total) Comprehensive 2030 : 700kW of charging capacity every 100km <u>per direction</u> (1.4MW total) 2035: 1.4kW of charging capacity every 100km <u>per direction</u> (2.8.MW total) Safe overnight parking: each safe and secure parking area to have at	As PO1 plus: Urban nodes: every urban node to ensure availability of publicly accessible opportunity charging for urban delivery trucks, with at least 600kW installed power per urban node by 2025, and at least 1.2 MW 2030	As PO2 plus: Every filling station with more than one pump for HDVs on TEN-T core network to be equipped with one 350kW charging point by 2030

Fuel/modes	Baseline (under AFID)	PO1	PO2	PO3
		least one recharger of minimum 50kW by 2030		
CNG	Indicative target: 1 charger for 600 vehicles, every 150 km on TEN-T core) as reflected in the NPFs/NIRs adopted by MS	No change from baseline	No change from baseline	Mandatory target: 1 refuelling station every 150 km on TEN-T core.
LNG HDV	Indicative target: every 400 km on TEN-T core as reflected in the NPFs/NIRs adopted by MS	No change from baseline	Mandatory target along TEN-T core. 1 refuelling every 400 km.	As PO2
Hydrogen for HDV also accessible to LDV	Member State to decide if included in NPFs. Indicative target of a HRS every 300km on TEN-T core. No distinction made between HDV and LDV	Mandatory target for 2030: One station every 150 km along TEN-T core and comprehensive serving both directions for HDV at 700 bar (and 350 bar optionally). LDV should be able to fuel at all stations. Minimum daily capacity for all stations = 1t. At least one station for HDV in all urban nodes of 1lt capacity by 2030	As PO1 plus: Minimum daily capacity of 2t for all stations along the TEN-T and urban nodes In addition, one station every 450 km on TEN-T core and at least one third of urban nodes to serve liquid hydrogen.	Mandatory targets as in PO2, but target date set for 2025

6.3.2 Measures setting targets for AFI for shipping

Shipping AFI targets have been developed for the policy options in the context of problem area A (planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network). They have been developed for both maritime and inland ports, covering LNG, shore side electricity and other fuels for both inland and maritime ports. An overview of the targets included in each policy option is presented below (and in Table 6-3).

In the case of **Policy option 1,** mandatory Onshore Power Supply (OPS) targets for TEN-T core ports are introduced for shoreside electricity supply for both inland and maritime ports. Inland waterway ports on the TEN-T core network should have by 2025 at least one OPS installation per port. Furthermore, maritime TEN-T core ports shall provide one OPS installation in terminals receiving cruise, container, and Ro-Pax above 5000GT by 2030. However, ports with average annual traffic volume during the past three years less than 25 cruise ship calls, 50 container ship calls and 40 ferry calls are exempted. Existing requirement for provision of LNG infrastructure in TEN-T core ports by 2025 is retained.

Policy option 2 sees the requirement for LNG bunkering provision removed. Mandatory OPS targets for TEN-T core and comprehensive ports at all berths (shoreside electricity supply in inland ports) by 2030 (rather than 2025 in PO2). Mandatory OPS requirements are as a percentage of demand for TEN-T core and comprehensive ports for maritime ports. For inland waterway ports, Member States have to ensure that that at least one OPS is also installed in all TEN-T comprehensive ports by 2030. The requirement under the current Directive for LNG bunkering in TEN-T core ports that foresees that vessels must be able to circulate along the TEN-core network is removed.

For maritime ports, Member States have to ensure that OPS is installed to cover at least 90% of demand for all TEN-T core and comprehensive ports at for terminals receiving cruise, container, Ro-Pax above 5000GT by 2030[17]. However, ports whose average annual traffic volume during the past three years is less than 25 cruise ship calls, 50 container ship calls, 40 ferry calls, are exempted.

Policy option 3 builds upon PO2 through requiring 1 OPS installation for TEN-T core and comprehensive ports at all berths for shoreside electricity supply in inland ports by 2025 rather than 2030. It also mandates electricity supply for battery vessels at each TEN-T inland waterway core port by 2030. It also includes a mandate for LNG bunkering in all TEN-T core maritime ports by 2030, replacing the existing provision that only prescribes that circulation on TEN-T core ports must be possible without specifying which port must deploy LNG bunkering. Requirements for maritime ports are the same as in PO2.

[17] Exact percentage need to be determined. Variation of the percentage can be envisaged for each ship type. For technical reasons use of OPS may not be opportune for ship calls of less than 2hr stay at berth. If such calls are excluded the requirements for OPS for RoPax may reduce significantly.

Table 6-3: Description of policy options and targets for AFI for shipping

Fuel / Port type	Baseline	PO1	PO2	PO3
LNG in inland ports	Member State to enable circulation on core network by 2030	No change from the baseline	Delete provision for LNG bunkering	As PO2
LNG in maritime ports	Member State to enable circulation on core network by 2025	No change from the baseline	No change from the baseline	Mandate for LNG bunkering in all TEN-T core ports in 2030
Shore side electricity supply in inland ports	In 2025 unless not cost efficient	Mandatory OPS for **all TEN-T core** ports. **1 OPS installation** per port by 2025.	Mandatory OPS for **all TEN-T comprehensive** ports. **1 OPS installation** per port by 2030.	Mandatory OPS for **all TEN-T comprehensive** ports. **1 OPS installation** per port by 2025.
Shore side electricity supply in maritime ports	In 2025 unless not cost efficient	Mandatory OPS for **all TEN-T core** ports. **1 OPS installation** per port in terminals receiving cruise, container, and ro-pax above 5000GT by 2030. Min requirement: ports whose average traffic volume during the past 3 years is less than 25 cruise ship calls, 50 container ship calls, 40 ferry calls is exempted from this obligation	Mandatory OPS for at least 90% of demand for **all TEN-T core and comprehensive** ports at for terminals receiving: cruise, container, ro-pax above 5000GT by 2030. Min requirement as option 1	Mandatory OPS for at least 90% of demand for **all TEN-T core and comprehensive** ports at terminals receiving: cruise, container, ro-pax above 5000GT by 2030. Min requirement as option 1
Other fuels for inland ports	Cannot be accurately determined due to uncertainty in market development	No change from the baseline	No change from the baseline	Mandate for electricity supply for battery vessels at each TEN-T core port by 2030
Other fuels for maritime ports	Cannot be accurately determined due to uncertainty in market development	No change from the baseline	No change from the baseline	No change from the baseline

6.3.3 Measures setting targets for AFI for aviation

AFI targets for the electricity supply for stationary aircraft (relating to NPF requirements as set out in Article 3.1) have been set out in the context of problem area A (planning and roll out of AFI to enable mobility across the EU is not coherent across the transport network). **Policy option 1** sees the introduction of mandatory targets for stationary commercial passenger aircraft at all gates at TEN-T core and comprehensive airports. **Policy options 2 and 3** build upon PO1 by also requiring mandatory targets at all outfield positions. An overview of the targets included in each policy option is presented in **Table 6-4**.

Table 6-4: Description of policy options and targets for AFI for aviation

Targets	Baseline	PO1	PO2	PO3
Electricity Supply for stationary aircrafts	Art 3.1, to be considered in NPFs	At TEN-T core and comprehensive airports: Mandatory targets for stationary commercial passenger aircrafts at all gates	At TEN-T core and comprehensive airports: Mandatory targets for stationary commercial passenger aircrafts at all gates and outfield positions	

6.3.4 Measures to promote interoperability[18]

A number of policy measures are under consideration to act on the problem that there are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services (problem area B). An overview of the provisions included in each policy option in Table 6-5.

For policy option 1, all new charge points need to be equipped with the following communication interfaces and protocols: Open Charge Point Protocol (OCPP) to ensure full communication of the charging point with the back-end of the charge-point operator and Open Charge Point Interface (OCPI) to enable full communication with roaming platforms. Moreover, operators have to provide static data to Member States national (or common) access points on location, opening time and specific charging station characteristics as well as clearly display prices following a format to be defined in the directive. Charge point operators must offer bank card payments through either a chip card terminal, an NFC interface or through a QR code leading to a specific payment side for the specific charging event.

Policy option 2 would expand on the standards that are required, in addition to PO1:

- All new fast chargers (>50kW) must provide contactless or chip+PIN bank card payment option. Other chargers can also offer QR codes.
- All EV-users must always be offered the option to choose payment method before initiation of the charge. If automatic authentication under contract-based charging is offered by the charge-point operator, the user must have the right to choose either an ad hoc payment option or pay through another EMSP supported by the CPO.

[18] For this problem area, the measures proposed in the stakeholder questionnaire slightly differ from the measures considered in the policy options presented here. Therefore, the stakeholder input could not be used to directly support to analysis of all measures in this problem area and there are some small differences in language in some of the measures. The measures analysed here are mapped against the measures presented in the stakeholder questionnaire in Annex G.

- New annex introducing technical specifications for various physical standards for waterborne transport (e.g., a single solution for shore-side battery recharging points for maritime and inland waterways vessels; hydrogen, methanol and ammonia refuelling points and bunkering for maritime and inland waterways vessels) and for aviation.
- New annex introducing technical specifications developed through EU standardisation organisations for various areas of communication including communication between vehicle and the charging point, the communication of the charging point with the back-end of the charge point operator, the communication with roaming platforms and the communication with the grid.
- Exemption for mechanical shutters is removed. Member States will no longer be allowed to require shutters or any other specific technical requirements to ensure that recharging points can be sold without modifications throughout the EU.

Finally, on **policy option 3** all the interoperability requirements of the previous policy options would still apply but restricts ad-hoc payment by bank card at new fast chargers (>50kW) to terminal payment . It also sent technical specifications for cables (mandatory fixed cables for AC (helical) and DC charge points).

Table 6-5: Description of policy options and measures to promote interoperability

Measure	Baseline	PO1	PO2	PO3
Ad hoc payments	Ad hoc payment mandatory for all recharging points accessible to the public (art. 4 (9)) but no requirements specified.	Debit and credit card acceptance mandatory on all new publicly accessible EV charge points. Three possible options alternatives: • Chip+PIN. • Contactless/Near-Field Communication (NFC). • QR code of single use[19]. No registration or identification of user required; no need to download any specific application.	As PO1 plus: All new fast chargers (>50kW) must provide contactless or terminal (chip+PIN) bank card payment option. Other chargers can also offer QR codes	Reduces flexibility for charge point operators by making terminal (chip+PIN) payment at fast chargers the standard ad-hoc payment solution
Freedom for consumers to choose payment method	No intervention – issue currently not addressed.	No change from the baseline	At every charge point, the EV-user must have the right to choose the payment method before initiating the charge. If automatic authentication is offered by the CPO (for contract-based charging), the user must have the right to choose either an ad hoc payment option or to pay through another EMSP supported by the CPO.	
Physical standards	No new standards introduced.	New annex to the legislation introducing technical specifications for new mandatory physical standards for CPOs to meet new and emerging needs / use cases in road transport (e.g., super-fast charging (megawatt level) for trucks, supplementary	As PO1 plus: Additional technical specifications for maritime transport and inland navigation (e.g., a single solution for shore-side battery recharging points for maritime and inland waterways vessels; hydrogen, methanol and ammonia refuelling points and bunkering for maritime and inland waterways vessels).	

19 QR code would lead to the bank payment gateway of the CPO for processing the payment. In this process, bank card (both debit and credit) payments shall be executed entering the card details.

Measure	Baseline	PO1	PO2	PO3
		standards for hydrogen, as needed).	Technical specifications for aviation would be considered (to be defined later).	
Communication standards for e-mobility	No intervention – issue currently no addressed.	All new EV charge points to be equipped at least with the following standards: • Communication charging point/CPO back-end: Open Charge Point Protocol (OCPP). • Communication with roaming platform: Open Charge Point Interface (OCPI). Exact version of the OCPP and OCPI standards to be mandated to be defined later.	New annex introducing technical specifications to be developed/completed by official standardisation organisations and subsequently adopted via secondary legislation through delegated acts. Standards to ensure full coverage of the different communication areas of the EV charging ecosystem: • Communication between vehicle and the charging point. • Communication charging point/CPO back-end. • Communication with roaming platform • Communication with the grid using IEC (International Electrotechnical Commission) standards. Once the delegated acts are adopted, CPOs must implement the standard.	
Technical specifications for charge points	No changes, technical specifications for recharging points as set out in Annex II of the AFID.	No change from the baseline	Further technical specifications to be specified: Member States no longer allowed to require shutters or any other specific technical requirements to ensure that recharging points can be sold without modifications throughout the EU	PO2 plus: Mandatory fixed cables for AC (helical) and DC charge points.

6.3.5 Measures to improve consumer information[20]

This section discussed policy measures aiming at tackling the problem that consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees (problem area C). Table 6-6 provides a summary of all provisions included under each measure for this problem area.

Starting with **policy options 1,** requirements are introduced on clear specification of price components and mandatory provision of data. Namely, all AFI operators must provide static data (location, opening hours and EV charge point characteristics) and clearly display prices following a format to be defined in the Directive.

Policy option 2 includes all measures from policy option 2, adding new requirements on the type of user information to be provided.

- All operators of AFI must provide dynamic data (operational status (EV, H2), availability (EV), ad hoc price (EV) and energy source (EV, H2)). Changes in dynamic data must be reflected no later than one minute after change.
- Charge Point Operators must display prices at all recharging points.
- E-Mobility Service Providers (EMSPs) must communicate price components (e.g. roaming fees) to consumers prior to recharging session via an app, except when a fixed subscription fee applies (e.g. weekly or monthly).
- CPOs may not differentiate between prices charged to EMSP or ad hoc customers. Prices charged to different EMSPs may also not be differentiated.
- EV charge points and hydrogen refuelling stations must be signposted within the parking/fuelling area along the TEN-T Core and Comprehensive network.

Policy option 3 includes all measures from policy option 2 and add one more requirement that EV charge points and hydrogen refuelling stations are to be signposted in the road corridor along the TEN-T Core and Comprehensive network, and not only within parking areas

[20] For this problem area, the measures proposed in the stakeholder questionnaire slightly differ from the measures considered in the policy options presented here. Therefore, the stakeholder input could not be used to directly support to analysis of all measures in this problem area and there are some small differences in language in some of the measures. The measures analysed here are mapped against the measures presented in the stakeholder questionnaire in Annex G.

Table 6-6: Description of policy options and measures to improve consumer information

Measure	Baseline	PO1	PO2	PO3
Ad-hoc price transparency	General obligation on price transparency for EV charging (art. 4(10).	Introduce requirement for clear specification of price components to the customer prior to recharging session. Price components to be allowed: fee per period of time and fee per kWh. Clearly display prices following a format to be defined in the Directive	As PO1 plus: Requirement for those price components to be displayed physically at the recharging station.	
Contract based price transparency	General obligation on price transparency for EV charging (art. 4(10).	No change from the baseline	Requirement for EMSPs to clearly communicate all existing price components (including, possibly, roaming fees) to consumers prior to the recharging session via a dedicated smartphone application. If a fixed subscription fee applies (e.g., weekly or monthly fees), EMSPs would be exempt from this requirement.	
B2B: Comparability and non-discrimination of prices / rights of EMSPs	General obligation on comparability and non-discrimination of prices for EV charging (art. 4(10)).	No change from the baseline	Introduce prohibition for CPOs to unduly differentiate (or discriminate) between the prices charged to B2B customers (EMSPs) and the prices charged to B2C customers (i.e. the ad-hoc price charged directly to EV-drivers). Price charged to different EMSPs must be equally non-discriminatory.	
User information - data provision through NAPs	No intervention – issue currently no addressed.	Introduction of mandatory requirement on all operators of AFI to provide static data(include location, opening hours, EV charge point characteristics).	As PO1 plus: All operators of AFI must provide dynamic data (operational status (EV, H2), availability (EV), ad hoc price (EV) and energy source (EV, H2)). Changes in dynamic data must be reflected no later than one minute after change.	
Roadside indicators	No intervention – issue currently no addressed.	No change from the baseline	EV charge points and H2 refuelling stations must be signposted within the parking/fuelling area along the TEN-T Core and Comprehensive network.	As PO2 plus: EV charge points and H2 refuelling stations must be signposted in the road corridor along the TEN-T Core and Comprehensive network.

6.3.6 General measures

In addition to the specific measures described above, as part of the assessment we examined two additional changes, with regards to legal instruments and administrative issues.

For **Policy option 1**, no new measures are proposed, i.e. the legal instrument will remain a Directive and the requirement remains for Member States to report as they currently do through National Implementation Reports (NIRs).

In the case of **Policy option 2,** an increase in the reporting requirements for Member States will be introduced including in relation to:

- Alternative fuels infrastructure for road transport (including HDV and different power recharging points); shipping, OPS (including vessels and power), LNG bunkering and other; stationary aircraft; and rail (electrification, hydrogen, battery electric).
- Possible strategy for alternative fuels for aircraft and shipping.

The frequency of reporting will remain as it currently the case under the existing Directive, every three years.

In the case of Policy Option 3, the main change will be adoption of an EU Alternative Fuels Infrastructure Regulation replacing the Directive. There will also be increased frequency of reporting for Member, States from every three years to every two years. An overview of the provisions included in each policy option is presented in Table 6-7.

Table 6-7: Description of policy options – general measures

Measure	Baseline	PO1	PO2	PO3
Legal instrument	Directive	No change from the baseline	No change from the baseline	Switch to a Regulation
Reporting / Monitoring	Member State reporting through NIRs	No change from the baseline	Further specified guidelines set in EU legislation for MS reporting through NIRs Reporting every 3 years	As PO2 plus: Reporting every 2 years

7 ANALYSIS OF IMPACTS

7.1 Introduction

This section provides an assessment of the economic, social and environmental impacts of the policy options under consideration. It is based on the modelling results, input from stakeholders, previous studies and relevant academic research where possible.

The modelling results are used to quantify the 'direct' and, where relevant, indirect impacts associated with the proposed policy measures under each policy option. The modelling results cover the measures associated with the deployment of AFI for different transport modes and categories of Alternative fuels and focus on key impacts, including the level of uptake of AFI and the resulting costs and the associated uptake of AFVs under each option. It also provides an assessment of environmental and health impacts associated with each of the options adopted.

Other impacts (e.g. related to the costs for businesses and authorities, impacts to consumers and employment impacts) are not supported by the modelling results. They have been assessed on the basis of the analysis of data collected from desk research and input from relevant stakeholders as part of the field research.

The analysis of the impacts for each impact category and policy options (where relevant) is presented separately by group of measures that target different problem areas and/or mode as follows:

- Measures setting targets for AFI for road transport (related to Problem Area A).
- Measures setting targets for AFI for water transport (inland and maritime) (related to Problem Area A).
- Measures setting targets for AFI for aviation (related to Problem Area A).
- Measures concerning interoperability requirements (related to problem area B).
- Measures related to consumer information (related to problem area C).

In each case, we compare the expected impact of the set of measures falling under policy options PO1-PO3 with the baseline scenario.

The analysis presented in this section covers the EU27 scope. Costs and benefits are expressed as present value using a 4% discount rate.

As explained above, the impacts of all policy options, focusing on the design of the policy instrument, are assessed in the context of a policy environment achieving the overall 55% emission reduction objective by 2030. This policy context is mainly represented by the MIX policy scenario that follows a combined approach of carbon pricing instruments and regulatory-based measures[21].

Finally, we examine separately the expected impact of the proposed general measures focusing on two key aspects, their expected impact on the effectiveness of the intervention and the possible costs that may arise.

[21] Policy scenarios for delivering the European Green Deal | Energy (europa.eu)

7.2 Economic impacts

7.2.1 Introduction

The analysis of economic impacts covers the following impact categories arising from the measures identified under each policy option:

- Impact on AFI deployment and uptake of AFVs.
- The total investment costs associated with the expected AFI deployment under each option.
- Costs to authorities.
- Cost and benefits to businesses.

Both quantitative and qualitative assessments of economic impacts have been undertaken for each policy option. In general, quantification of impacts using the PRIMES-TREMOVE model has mainly focused on the measures covering problem area A (in particular road transport), and the measures related to other problem areas (B-C) have mainly relied on input from stakeholders and desk research.

7.2.2 Impact on uptake of AFVs and AFI deployment

The set of policy measures under consideration are expected to have a direct impact on the level of deployment of AFI. The level of uptake of AFVs is the same in all POs.

Measures setting specific targets for AFI deployment under the three policy options (PO1-PO3) that are related to problem area A are expected to have a direct impact. In contrast, measures focusing on interoperability and information provision to consumer – related to problem areas B and C – are only expected to have an indirect/secondary impact on the level of deployment of AFI. However, they have an important role to play in terms of the quality of the AFI deployed that is also critical for the uptake of AFVs.

7.2.2.1 Measures setting targets for AFI for road transport

The policy options considered, described in section 6, include a number of measures that are expected to contribute towards the development of AFI across parts of the road transport network. All POs set mandatory targets for Member States to ensure that the recharging infrastructure is sufficient in relation to the LDV fleet. Beyond that, option PO1 also sets specific targets concerning the deployment of charging infrastructure and HRS along the TEN-T. PO2 and PO3 go beyond the national targets when it comes to electric charging for LDVs by including specific targets for the TEN-T and for petrol stations, respectively. Targets for HDV and HRS also become more demanding in terms of the total level and capacity to be provided. In the case of LNG/CNG the indicative targets in the existing AFID become mandatory for LNG under PO2 and for CNG under PO3.

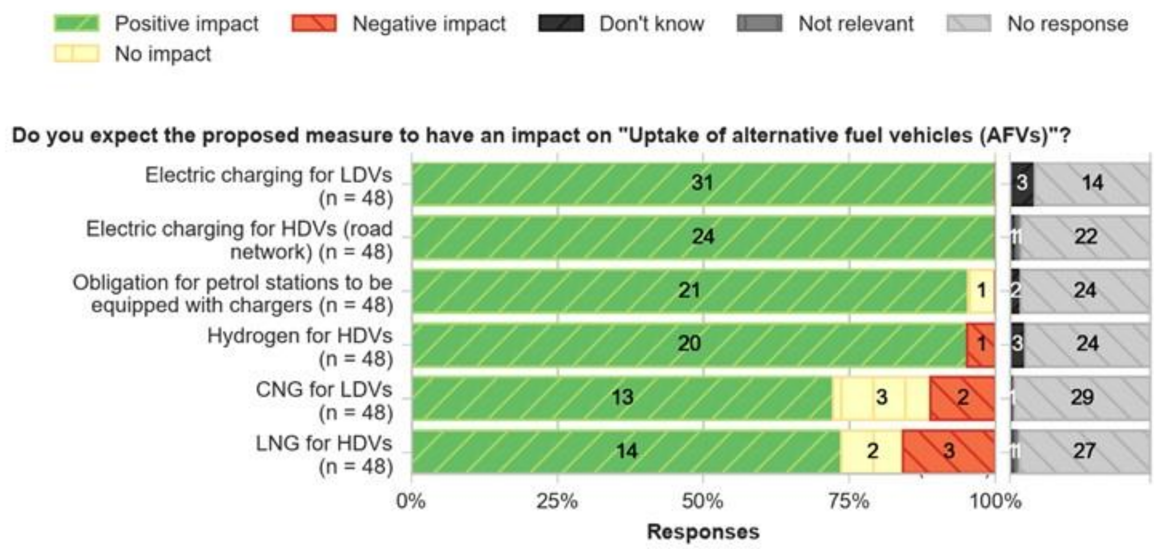
In the following section we present the results of the analysis using the PRIMES-TREMOVE model on the uptake of AFVs by alternative fuel type and by mode and on the expected impact on the deployment of AFI.

7.2.2.1.1 Uptake of AFVs

The deployment of AFI across the three policy options enables the required level of adoption of AFVs. It is well established finding in the relevant literature (e.g. (Stratharas, Moysoglou, Siskos, Zazias, & Capros, 2019; Harrison & Thiel, 2017; Arprad

Funke, Sprei, Gnann, & Plotz, 2019; Smart Transport, 2019; McKinsey & Company, 2018; Grundy, 2020; Geotab, 2021)) that increased availability of infrastructure enables vehicle uptake by addressing perceived barriers (e.g. range anxiety) and reducing the level of disutility associated with the purchase and use of AFVs. This is also a point reflected in the responses of stakeholders to the survey where the great majority indicated that they expect that all of the measures considered to have a positive impact on the uptake of alternative fuel vehicles. Dissenting views provided by specific stakeholders in relation to the measures for LNG (German authorities, anonymous industry, T&E), CNG (one authority, T&E)and Hydrogen (T&E) reflected the views of the specific stakeholders on the appropriateness of setting targets for the specific type of alternative fuel and not on their expected effectiveness of the measures to promote the uptake of the respective type of AFVs.

Figure 7-3: Stakeholder input on the expected impact of the proposed targets for road transport AFI on the uptake of alternative fuel vehicles



Source: Survey of stakeholders

In the case of the measures under consideration, all policy options are expected to ensure the presence of sufficient level of available and interoperable infrastructure. Thus, while the investments in quantity and quality of infrastructure will not directly lead to the uptake of alternatively fuelled vehicles (which are determined by other policies, e.g. the CO2 emission performance standards), availability of such level of public infrastructure will support the uptake of vehicles expected to achieve the EU's Climate Target Plan objectives. In that respect, while the policy options will lead to differences in the distribution of infrastructure, no difference in terms of the level of uptake of AFVs is expected among policy options. Table 7-1 below summarises the expected evolution of AFVs by type for the three policy options.

Light duty vehicles

All policy options project around 7 million additional BEVs and 0.4 million PHEVs by 2030 relative to the baseline, enabled by the availability of AFI. The number of BEVs is projected to increase further by 2050 compared to the baseline (73 million additional BEVs in 2040 and 138 million additional BEVs) but to reduce for PHEVs (57 thousand less PHEVs in 2040 and around 40 million less PHEVs in 2050).

FCEVs are projected to increase significantly from 2040 onwards in all policy options, with a total of 9 thousand additional FCEVs in 2040 and 28 thousand additional FCEVs by 2050 relative to the baseline.

In the case of CNG vehicles, under the policy options (based on the MIX scenario) they would gradually reduce over time, driven by the proposed revision of the Energy Taxation Directive and carbon pricing (i.e. the new ETS proposed for road transport and buildings).

Heavy Duty Vehicles

For all policy options the uptake of electric HDVs is projected to be higher than in the baseline, driven by the assumed CO_2 standards for vehicles. A similar development pattern is projected for fuel cell vehicles. The number of LNG vehicles is projected to go up by 2030 relative to 2020, but to be lower than in the baseline for 2030. They are expected to be gradually replaced by zero emission technologies post 2040 (see Table 7-1).

Table 7-1: Uptake of vehicles in the baseline and in the policy options (in thousands)

Number of vehicles (in thousands)	Baseline			PO1 / PO2 / PO3		
	2030	2040	2050	2030	2040	2050
Electric BEV LDV	29,941	67,420	97,033	36,851	140,261	235,076
Electric PHEV LDV	13,987	41,007	54,157	14,343	40,950	14,897
Electric HDV	50	161	231	110	1,022	2,405
Fuel Cell Electric LDV	306	3,906	10,301	416	12,824	38,727
Fuel Cell Electric HDV	3	63	102	60	549	1,877
CNG LDV	4,376	6,265	6,580	3,954	3,237	431
LNG HDV	621	1,246	1,536	510	1,082	918

Source: PRIMES-TREMOVE

7.2.2.1.2 Impact on AFI deployment

Electric charging for LDVs

Concerning electric charging, Table 7-2 and Table 7-3 below show the expected level of deployment of infrastructure associated with each policy option.

The analysis shows that overall **infrastructure for electric LDV** will develop in all Member States by 2030 and beyond, in line with the evolution of electric vehicle fleet. Each POs is expected to lead to increasingle higher level of total installed capacity at EU level in 2030 (47 GW in PO1, 49 GW in PO2 and 58 GW in PO3) relative to 29 GW in the baseline. This is driven primarily by the mandatory sufficiency index of recharging capacity per vehicle (1kW for BEV and 0.66kW for PHEVs) that applies for all options. Additional capacity is expected for PO2 and PO3 as a result of the additional mandatory targets. Measures concerning CPs in petrol stations and along the TEN-T (PO2-PO3) are expected to make a small overall contribution in terms of total charging points. However, the role of the TEN-T measures is to ensure minimum availability of infrastructure along the whole of the TEN-T which is considered necessary to ensure continuity of the EU network. For PO2 and PO3, 11,363 charging points for LDVs are estimated to be deployed on the TEN-T network (including urban nodes) by 2030 and 12,112 by 2040.

In terms of total number of recharging points, POs are expected to lead to 3.5 to 3.57 million recharging points in the EU in 2030 compared to the baseline of 2.3 million[22]. Assuming that the share of fast recharging points stays constant as in 2020, the POs

[22] For each option we expect an increase in the average capacity of recharging points for the LDV fleet from currently 11 kW to 14-16 kW by 2030 because of the deployment of faster recharging points compared to 2020 (14 kW in PO1/PO2 and 16 kW in PO3 due to the additional high power recharging points in petrol stations under PO3).

would lead to a total number of recharging points of over 4 million (or over 6 million recharging points under the assumption that only normal recharging points of an average of 7.4 kW were deployed).

Table 7-3: Expected AFI deployment in the baseline and in the policy options for 2030-2050 (number of recharging points/facilities)

Infrastructure at EU27 level	Baseline			PO1		
	2030	2040	2050	2030	2040	2050
LDVs recharging points	2,304,552	4,228,772	6,905,744	3,500,690	11,398,548	16,259,467
HDVs charging points	58	526	636	6,173	10,340	12,694
Hydrogen fuelling facilities	1,371	3,004	4,603	1,852	8,222	20,153
CNG fuelling facilities	8,299	9,042	8,760	7,642	4,741	587
LNG fuelling facilities	3,527	4,505	4,850	2,904	3,914	2,896
Infrastructure at EU27 level	**PO2**			**PO3**		
	2030	**2040**	**2050**	**2030**	**2040**	**2050**
LDVs recharging points	3,512,053	11,410,660	16,268,705	3,573,579	11,472,221	16,330,266
HDVs charging points	6,493	10,660	13,014	7,612	11,779	14,134
Hydrogen fuelling facilities	1,993	8,341	20,154	1,990	8,337	20,104
CNG fuelling facilities	7,642	4,741	587	7,645	4,741	587
LNG fuelling facilities	2,904	3,914	2,896	2,904	3,914	2,896

Source: PRIMES-TREMOVE

At the Member State level, the net change in the number of charging points in 2030 in comparison to the baseline varies depending on the level of ambition in the NIRs. This is reflected in the analysis of the number of charging points per MS presented in Table 7-3 below for 2030. As can be seen, the net impact from the baseline is identified as zero under PO1 for a number of MS with NIR targets for 2030 that go beyond the level of infrastructure required under the MIX scenario (AT, DK, EE, DE, LU, NL, SI) or where based on their current share of AFI it is expected that they will have more than the minimum level needed under all policy options (BE, SE). In contrast, a sizeable net increase is expected in MS with low or no targets set in their NIRs for 2030 under all policy options. These include 10 MS with low NIR targets (BG, CY, CZ, EL, HR, HU, IE, LV, MT, SK) and four MS (ES, IT, PL, RO) with no targets that, based on the current level of development of the charging networks, are expected to remain below the minimum infrastructure needed. Thus, when compared to the baseline scenario, certain MS will be required to make a significant additional investment in new AFI under all policy options. Clearly, there is uncertainty around the baseline charging points projections and some MS may consider further incentives for their uptake.

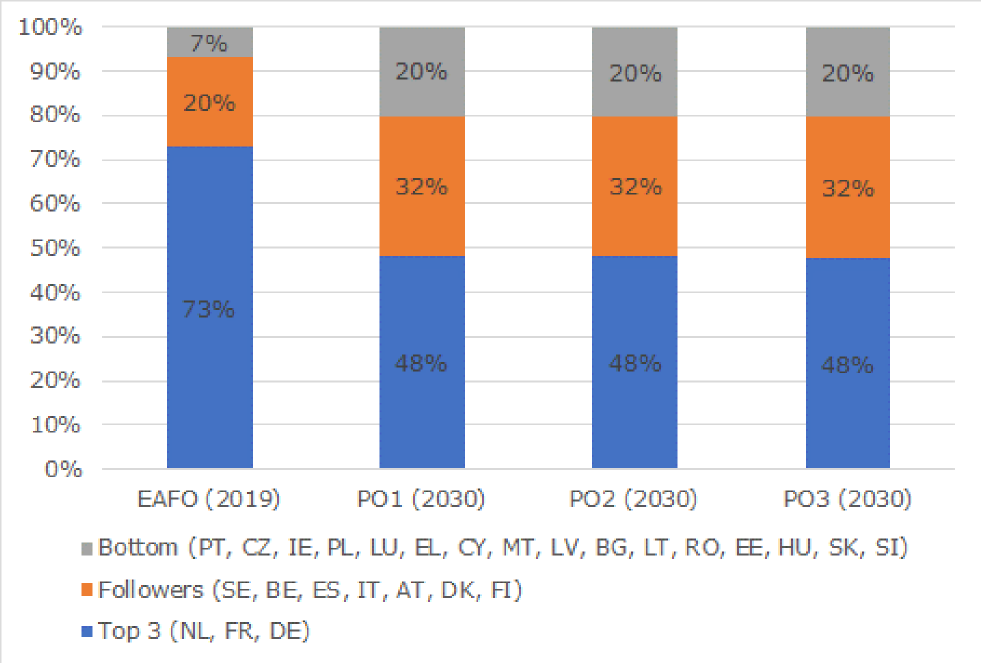
Table 7-4: Projected deployment of recharging points for LDVs in the baseline and in the policy options in 2030 (difference to the Baseline) by Member State

Member State	Number of charging points in the baseline	Difference to the Baseline		
		PO1	PO2	PO3
AT	94,500	0	273	1,776
BE	89,729	0	228	1,928
BG	5,000	23,901	24,200	26,730
CZ	16,900	48,513	48,721	50,925
DK	29,437	0	198	1,325
EE	5,666	0	92	363
FI	25,000	7,365	7,721	8,760
FR	449,981	56,770	58,302	64,458
DE	1,000,000	0	1,363	9,310
EL	10,000	50,261	50,706	54,250
HU	35,000	9,385	9,637	10,736
IE	1,200	37,784	37,932	38,921
IT	62,261	398,103	399,135	411,070
LV	466	3,285	3,511	3,844
LT	4,550	14,280	14,395	14,790
LU	10,320	0	14	144
NL	182,000	0	203	2,483
PL	13,622	234,851	235,640	239,835
PT	43,141	14,512	14,778	16,541
SK	3,000	13,416	13,574	14,108
SI	22,300	0	108	412
ES	123,099	203,953	205,491	211,873
SE	70,705	0	738	2,273
RO	5,541	57,902	58,411	59,649
CY	100	8,664	8,705	8,875
MT	362	3,480	3,485	3,523
HR	671	9,712	9,940	10,127
EU27	**2,304,552**	**1,196,138**	**1,207,501**	**1,269,027**

Source: PRIMES-TREMOVE

At the same time, the adoption of the mandatory targets should not only lead to significant increase in the level of AFI across the MS. It should also reduce the significant existing divergence among MS. Figure 7-1 below provides the distribution of the charging infrastructure among MS in 2019 (based on EAFO data) and in 2030 under the three policy options. As can be seen the share of the three MS that dominated the charging network in 2019 (DE, FR, NL) is expected to decrease from 73% in 2019 to around 48% under the three policy options.

Figure 7-2: Distribution of charging points across the EU by group – Comparison of policy option with EAFO 2019 data



Source: PRIMES-TREMOVE

Concluding, all options are expected to lead to significant increase in MS' charging infrastructure. On the basis of the requirement for the deployment of charging points along the TEN-T, PO2 and PO3 should not only ensure sufficient overall infrastructure but also ensure sufficient infrastructure across the whole of the EU TEN-T network.

Electric charging for HDVs

In the case of charging infrastructure for HDVs, the net impacts of the proposed measures in comparison to the baseline are expected to be greater given the absence of any pre-existing targets (see **Table 7-2**).

In terms of specific measures, the main impact in terms of charging points for HDVs come from the measures concerning charging infrastructure across the TEN-T core and comprehensive. The contribution of the measure on petrol stations is also significant[23] followed by the measure on safe and secure parking[24] and allocation of charging points for urban delivery trucks. We note that the specific measures under the three policy options cover only part of the additional infrastructure to be deployed. Addition charging infrastructure is expected in order to meet the level of demand arising from the increase in the number of AFVs under the MIX scenario.

At the policy option level, Table 7-9 below summarises the expected total infrastructure by Member State in comparison to the baseline. As can be seen, all three policy options are expected to lead to a significant increase of the AFI by 2030, given the expected very limited uptake of such AFI during this period under the baseline scenario and the impact of the measures included in the policy options. After 2030, there are is only limited additional contribution from the proposed measures (along the TEN-T

[23] This is based on an assumption that around 1% of petrol stations have a dedicated pump for HDVs.

[24] Based on an expected number of 500 safe and secure parking spaces.

comprehensive network). The increase in the uptake of HDVs under the MIX scenario is expected to lead to the development of the relevant infrastructure.

Table 7-5: Total number of electric charging points for HDVs on the TEN-T network in 2030 by Member State and by policy option

MS	PO1	PO2	PO3
AT	142	146	173
BE	123	135	166
BG	162	166	212
CZ	112	120	160
DK	106	114	135
EE	52	56	61
FI	214	222	241
FR	843	875	987
DE	739	791	936
EL	242	254	319
HU	132	136	156
IE	83	91	109
IT	556	592	809
LV	121	125	131
LT	69	73	80
LU	7	11	14
NL	114	122	163
PL	418	450	526
PT	147	155	187
SK	88	92	101
SI	55	59	65
ES	820	848	964
SE	401	413	441
RO	280	288	311
CY	23	27	30
MT	3	7	8
HR	121	125	129
Total EU27	**6,173**	**6,493**	**7,612**

Source: PRIMES-TREMOVE

Hydrogen refuelling stations

In relation to **Hydrogen AFI**, the Table 7-11 summarises the expected contribution of the specific measures in terms of the deployment of hydrogen fuelling stations (HRS). In terms of number of charging stations the main impact comes from the requirement for the development of HRS along the TEN-T network under PO1. However, we note that under PO2 there is also increased capacity required (2t per station) in comparison to PO1 (1t per station) that leads to a much higher availability of hydrogen fuel. Furthermore, under PO3 the number of fuelling stations and capacity will increase at a much faster pace.

The contribution of this requirement is illustrated in the comparison of the total impact of the policy options with the baseline scenario, presented in Table 7-11 below. This table also considers in the baseline the HRS that a few MS have committed to develop. This includes the 1000 HRS indicated by Germany in its NIR. Taking this infrastructure into account, under PO3 a total of 1,990 HRS are expected to be deployed by 2030 with a total capacity of 3,715 tonnes across Europe. The total capacity is significantly higher than in PO1 on the basis of the requirement for a capacity of 2 tonnes per fuelling station. This capacity is expected to be sufficient for the level of demand that will arise from the uptake of FCEV under the MIX scenario. This is also a conclusion supported by the relevant association (Hydrogen Europe) which indicated that around 1,500 hydrogen refuelling stations for heavy-duty vehicles will be needed, each with a capacity of 2 tonnes of hydrogen per day.

Table 7-5: Number of hydrogen refuelling points and refuelling capacity per policy option – total and net from the baseline for 2030, 2040 and 2050

Type of AFV	BSL	Net from baseline		
		PO1	PO2	PO3
	2030			
Total HRS	1,371	480	621	618
Total capacity (tonnes)	549	1,168	3,167	3,167
	2040			
Total HRS	3,004	1,205	5,337	5,334
Total capacity (tonnes)	24,07	2,423	9,541	9,541
	2050			
Total HRS	4,603	15,551	15,552	15,501
Total capacity (tonnes)	4,802	26,254	26,254	26,254

Source: PRIMES-TREMOVE

At the Member State level, Germany represents more than 50% of the total HRS under all policy options in 2030. This is driven by the high NIR commitment of 1000 HRS. Only a small number of additional HRS are required under PO2-PO3 (see Table 7-12). However, there is significant additional capacity needed under options PO2 and PO3 (see Table 7-13) reflecting the increase in the capacity per HRS required. Other MS with significant level of HRS include those few that have already indicated relatively ambitious targets (CZ, NL) - where the net impact of the options is small. In other cases the number of HRS required is more sizeable (ES, IT, FR, SE), reflecting mainly the size of their network. In all cases, all MS will need to make additional investment in HRS deployment under PO2 by 2030 while in the case of PO3 this will need to be brought forward.

Table 7-6: Number of HRS in 2030 by Member State and policy option – total and net from the baseline

MS	Baseline	Net from baseline		
		PO1	PO2	PO3
AT	5	12	16	16
BE	20	5	8	8
BG	4	7	11	11
CZ	95	3	6	6
DK	10	11	14	13
EE	2	3	5	5
FI	21	11	14	14
FR	40	72	87	86
DE	1,000	97	115	113
EL	6	18	23	23
HU	26	1	4	4
IE	2	10	12	12
IT	14	46	58	58
LV	3	9	12	12
LT	10	1	3	3
LU	1	1	2	2
NL	50	7	9	9
PL	13	21	33	33
PT	3	15	18	18
SK	3	4	7	7
SI	7	1	3	3
ES	15	73	87	87
SE	10	33	41	40
RO	9	12	19	19
CY	1	3	4	4
MT	0	1	2	2
HR	4	5	8	8
EU27	**1,371**	**480**	**621**	**618**

Source: PRIMES-TREMOVE

Table 7-8: HRS capacity in 2030 by Member State and policy option – total and net from the baseline

MS	Baseline	Net from baseline		
		PO1	PO2	PO3
AT	2	10	30	30
BE	8	15	44	44
BG	2	9	29	29
CZ	38	59	163	163
DK	4	7	23	23
EE	1	4	13	13
FI	8	22	59	59
FR	16	81	207	207
DE	400	613	1,662	1,662
EL	2	22	56	56
HU	10	17	50	50
IE	1	11	26	26
IT	6	51	133	133
LV	1	11	29	29
LT	4	7	23	23
LU	0	2	6	6
NL	20	32	89	89
PL	5	29	86	86
PT	1	17	40	40
SK	1	5	18	18
SI	3	5	17	17
ES	6	77	189	189
SE	4	34	87	87
RO	3	17	51	51
CY	0	3	9	9
MT	0	1	5	5
HR	1	7	22	22
EU27	**549**	**1,168**	**3,167**	**3,167**

Source: PRIMES-TREMOVE

<u>*LNG and CNG*</u>

In the case of **LNG** and **CNG** fuelling infrastructure, the number of vehicles is projected to be lower than in the baseline as explained in the previous section. For this reason the number of refuelling points is also projected to be lower relative to the baseline. Table 7-8 below summarises the impact expected under the two options under consideration.

CNG vehicles are a mature technology and the deployment of CNG refuelling stations largely market driven. Thus, investments into relevant infrastructure along the TEN-T core network have already been triggered through the Directive and Member States planning suggests that sufficient infrastructure will be available in almost all Member States already in the baseline, building on the requirement under the current AFID. The mandatory deployment targets under PO3 would only increase the total numbers minimally in 2030, relative to PO1 and PO2, by filling in remaining gaps in the TEN-T core network. However, the number of refuelling stations in 2030 would be lower in all policy options relative to the baseline, due to the lower uptake of CNG LDVs. Furthermore, because of the expected rapid decline of the number of CNG vehicles post

2035, the required number of refuelling stations will go down to around 600 stations by 2050 which is well below the existing numbers of over 3,000 stations.

The same can be expected for LNG HDV, once a minimum infrastructure along the TEN-T core network is being established and thereby investment security is provided. Thus, the mandatory target included in PO2 and PO3 would only ensure filling the remaining gaps in the TEN-T core network by 2030, relative to PO1 (where such requirement is not included) and provide full certainty about cross-border connectivity for those operators using this transitional technology. However, relative to the baseline all options show lower number of LNG refuelling stations due to the lower uptake of LNG HDVs. The numbers of LNG refuelling stations will go down to around 2,900 by 2050 following the slow replacement of LNG vehicles by zero-emission technologies post 2040.

Table 7-8: Number of CNG and LNG refuelling points per policy option – total and net from the baseline for 2030, 2040 and 2050

Type of AFV	Baseline	Net from baseline (000s)		
		PO1	PO2	PO3
	2030			
CNG	8,299	- 658	- 658	- 654
LNG - HDVs	3,527	- 623	- 623	- 623
	2040			
CNG	9,042	- 4,301	- 4,301	- 4,301
LNG - HDVs	4,505	- 591	- 591	- 591
	2050			
CNG	8,760	-8,173	- 8,173	- 8,173
LNG - HDVs	4,850	- 1,954	- 1,954	- 1,954

Source: PRIMES-TREMOVE

The table below summarises the main findings of our analysis concerning the impact on AFI and AFV of the proposed options.

Table 7-9: Summary of expected impact on the AFV and AFI markets of road transport targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Significant net positive impact on electric charging infrastructure for LDVs (1.2 million additional charging points by 2030; 41 k of which rapid/ultra-rapid) but without ensuring minimum availability across the TEN-T Significant net positive impact on electric charging infrastructure for HDVs (additional 6.1k charging points) ensuring minimum capacity needed and availability along the TEN-T and in all safe and sector parking areas Positive impact on HRS infrastructure along the TEN-T (net of 480 HRS and 1,168 tonnes from baseline) but with limited capacity of 1t per station No contribution in terms of LNG/CNG infrastructure

Measure	Expected impact
Policy option 2	Significant net positive impact on electric charging infrastructure for LDVs (1.2 million additional charging points by 2030; 52 k of which rapid/ultra-rapid) while availability and continuity of charging infrastructure along the TEN-T is ensured Significant net positive impact on electric charging infrastructure for HDVs (additional 6.4k charging points) and ensuring availability along the TEN-T, in safe and secure parking spaces and in all urban nodes Positive impact on HRS infrastructure (net of 621 stations and 3,167 tonnes from baseline) and ensuring minimum capacity (2t/station) needed to meet expected demand and minimum level of HRS with liquid hydrogen No contribution in terms of LNG/CNG infrastructure but provide certainty about cross-border connectivity
Policy option 3	Significant net positive impact on electric charging infrastructure for LDVs (1.3 million additional charging points by 2030; 108 k of which rapid/ultra-rapid) with while ensuring availability across the TEN-T Significant net positive impact on electric charging infrastructure for HDVs (additional 7.5k charging points) going beyond the minimum capacity needed and availability along the TEN-T and in urban nodes Positive impact on HRS infrastructure (net of 618 stations and 3,167 tonnes from baseline) and ensuring minimum capacity (2t/station) needed to meet expected demand and minimum level of HRS with liquid hydrogen No contribution in terms of LNG/CNG infrastructure but provide certainty about cross-border connectivity

7.2.2.2 Measures setting targets for AFI for water transport

With respect to shipping, the policy options under consideration include the following measures which are expected to lead to the deployment of additional AFI:

- A target for **mandatory LNG bunkering in all TEN-T core maritime ports** in 2030 under PO3.
- Targets for **mandatory OPS in inland ports** which vary with the PO:
    - PO1: OPS at one berth in TEN-T core ports by 2025.
    - PO2: In addition to the PO1 target, also OPS at one berth at all TEN-T comprehensive ports by 2030.
    - PO3: In addition to the PO1 target, also OPS at one berth at all TEN-T comprehensive ports by 2025.
- Targets for **mandatory OPS in maritime ports** which vary with the PO:

  - PO1: one OPS installation in TEN-T core ports by 2030. Subject to minimum traffic volume requirements[25].

  - PO2: Mandatory OPS for at least [90]% of demand for all TEN-T core and comprehensive maritime ports at for terminals receiving: cruise, container, ro-pax above 5000GT by 2030. Subject to minimum traffic volume requirements.

  - PO3: Mandatory OPS for at least [90]% of demand for all EU Ports (TEN-T core, comprehensive ports and non-TEN-T ports) for terminals receiving: cruise, container, ro-pax above 5000GT by 2030. Subject to minimum traffic volume requirements.

- Target for **mandatory electricity supply for battery vessels** at each **TEN-T core inland port** by 2030 under PO3.

In addition, the measure that proposes the **removal of the provision for LNG bunkering in inland ports** (under PO2 and PO3) could also affect the deployment of AFI.

In the case of **LNG bunkering facilities in TEN-T core maritime ports,** the new measure is anticipated to contribute to the deployment of new infrastructure although the available evidence also suggests that a significant level of deployment is expected to take place even under the baseline (Table 7-10). Article 6 (1) of the current Directive already required Member States to ensure that an appropriate number of refuelling points for LNG were put in place at maritime ports in the TEN-T Core Network by 2025. According to their NIR and NPF targets, 71 core ports would have such facilities in place by 2025. Assuming no further changes until 2030, the new measure on LNG bunkering for maritime ports is anticipated to lead to the deployment of at least 19 additional facilities such that all 90 TEN-T core ports would be covered by 2030. It is also worth noting that, of the 22 Member States that have core TEN-T maritime ports, half are already planning to deploy LNG bunkering infrastructure in their core ports (i.e. as part of the baseline scenario); the other 11[26] would need to deploy infrastructure in one to three core ports each to meet the new target.

It is however questionable whether there will be no further changes in these 11 Member States until 2030; according to ESPO's input to the consultation for this study, the DNV GL Alternative Fuel Insights Tool already shows that ports all over Europe provide or plan to provide LNG bunkering. In addition, Gas Infrastructure Europe noted in their survey response for this study that the proposed measure could be achieved by 2025 with specific policy interventions but that otherwise "a significant uptake of LNG fuels in maritime sector will take place by 2030". As such, the estimated additional infrastructure of 19 additional LNG bunkering facilities should be considered to represent the maximum that should be associated with this measure, given the possibility that further investments will take place in the baseline.

The provision of additional infrastructure can also lead to the **uptake of LNG vessels.** Currently, there are 125 LNG vessels in operation in Europe according to DNV GL's Alternative Fuels Insight Tool (DNV GL, n.d.). Depending on the type of bunkering infrastructure deployed, anywhere between 50-20,000 m3 of LNG capacity per station could be deployed (EAFO, n.d.a). Per day, this would allow ports to serve between 1 to 400 vessels (depending on the type of ship, ranging from service vessels, tugboats,

[25] Covers terminals receiving cruise, container, and ro-pax above 5000GT. Minimum requirements: Ports whose average traffic volume during the past 3 years is less than [25] cruise ship calls, [50] container ship calls, [40] ferry calls, is exempted from this obligation.

[26] DK, DE, IE, ES, FR, IT, LV, MT, NL, RO, FI

patrol boats and fishing boats which require about 50m3 and very large container ships and oil tankers which require 20,000m3 of LNG) (EAFO, n.d.a). As a result, the additional capacity that could be implemented due to the new measure (i.e., in 19 ports) could enable the refuelling of 19 – 7,600 vessels per day (assuming one station per new port).

Table 7-10: Expected AFI deployment in 2030 by PO and in the Baseline regarding LNG bunkering for maritime ports (number of facilities)

Type of AFI	Baseline	PO1		PO2		PO3	
		Total	Net	Total	Net	Total	Net
Total LNG bunkering facilities in TEN-T core maritime ports	71	-	-	-	-	90	19

Source: Ricardo analysis

The **removal of the provision for LNG bunkering in inland ports** could stop further deployment of this infrastructure for inland ports. Article 6 (2) requires Member States to ensure that an appropriate number of refuelling points for LNG are put in place at inland ports in the TEN-T Core Network by 2030. According to their NPFs, 36 core ports are expected to offer LNG bunkering out of 85 all inland TEN-T core ports in the EU. By removing this provision, it is possible that some of this deployment would not take place although we do not have specific information to assess this. However, the question is also whether there is a need for such infrastructure given the expected use of LNG for inland navigation and the availability of other solutions to achieve the environmental goals.

Stakeholders that participated in the consultation for this study were also asked about a revision of this provision and many argued that there was no need for targets (T&E, European Federation of Inland Ports, Hamburg Port Authority, ministry of transport, information technology and communications (Bulgaria), Central Commission for the Navigation of the Rhine). According to Central Commission for the Navigation of the Rhine, although LNG is a mature alternative fuel, it is not economically viable for inland navigation. Similarly, the Lithuanian authority, although suggesting that targets should be set, also noted that there is an insignificant number of EU countries having connected navigable inland navigation networks and thus there is less need for standardisation in the intra community navigation. In addition, the European Federation of Inland Ports shared that European ports are already hesitant to invest in LNG based on the cases of other ports in the network due to changes in perception of the environmental benefit of LNG which led to the LNG infrastructure being considered in some cases stranded assets. As a result, the deployment of this type of infrastructure might no longer take place in the future.

OPS infrastructure in maritime ports is expected to grow significantly compared to the baseline if the new measures are adopted, especially under PO3 which covers all EU ports that meet the minimum requirements (Table 7-11). Total installed capacity has been increasing since the 2000s and is now more than 90MW across the EU (EAFO, n.d.b). This trend is expected to continue until 2030. However it will fall short from providing the necessary capacity even to cover all TEN-T core ports (see PO1 in Table 7-24 which is expected to lead to additional 682 MW of capacity compared to the baseline). The stakeholder input from the consultation for this study suggests that the lower level of deployment expected in the absence of new policy intervention could be linked to the technical and financial challenges of installing the infrastructure (Eurelectric, ESPO, DE ministry). As such, they also indicate it is not necessarily appropriate to mandate OPS for all ports/berths.

No impacts on the uptake of vessels are expected from this measure. It is only worth noting that, to use this infrastructure, existing vessels might need to be retrofitted. This can include modification of the main switchboard, a new receiving circuit breaker close to the power receiving point, power socket(s) and an upgrade of the ship power management system (EAFO, n.d.c). However, it is likely that newly built ships already have the necessary OPS equipment installed. No other specific impacts on the uptake of vessels are expected.

Table 7-11: Expected AFI deployment in 2030 by PO and in the Baseline regarding OPS in maritime ports

Type of AFI	Baseline	PO1		PO2		PO3	
	Total	Total	Net	Total	Net	Total	Net
Total OPS installed capacity in maritime ports (MW)	174	856	682	3,676	3,502	4,239	4,065

Source: Ricardo analysis

OPS infrastructure in inland ports is anticipated to also increase significantly compared to the baseline due to the new measure (Table 7-12). It is estimated that by 2025 139 ports have OPS installed in at least one berth based on current installations, targets set in national documents and online sources (EAFO, n.d.b). In their NPFs and NIRs, Hungary, Belgium, Croatia, France, Netherlands, Romania provided targets for OPS installation by 2025/2030. It is unclear whether other ports would deploy this infrastructure in the absence of further incentives, but the views of stakeholders suggest that this is likely to be minimal. According to the Central Commission for the Navigation of the Rhine's response to our consultation, key inland ports (in NL, BE, DE, FR) are working towards the deployment of this infrastructure, but other parts of the network would need additional support. Furthermore, they also explained that there is no harmonised system for OPS in inland ports which face technical issues. In addition, in the JRC's state of the art study (JRC, 2020), EFIP explained that there is a high cost of installation and a possible underutilisation by the inland waterway users by 2030. These views suggest that no significant further deployment of this infrastructure in inland ports can be expected in the absence of new policy intervention. On the basis of this assumption, the new measures could contribute to 18-106 additional ports in the EU having OPS depending on the policy option (values represent the upper bound of each option).

As above, no specific impacts on the uptake of vessels are expected, apart from the need to retrofit existing vessels to enable the use of OPS.

Table 7-12: Expected AFI deployment in 2030 by PO and in the Baseline regarding OPS in inland ports

Type of AFI	Baseline	PO1		PO2		PO3	
	Total	Total	Net	Total	Net	Total	Net
Number of ports equipped with OPS	139	85	18	245	106	245	106
TEN-T core	67	85	18	85	18	85	18

Type of AFI	Baseline	PO1		PO2		PO3	
	Total	Total	Net	Total	Net	Total	Net
TEN-T comprehensive	72	-	-	160	88	160	88

Source: Ricardo analysis

With respect to **electricity supply for battery vessels at inland ports** (PO3), there are only limited examples of deployment to date and the technology is still at the early stages. The first applications for battery electric propulsion were realised on small vessels like ferries or excursion ships, where the travel path and time is short and there is a possibility for loading the batteries during breaks. Such batteries were relatively small. Furthermore, in 2017 two battery electric driven freight vessels, able to transport 280 containers, started to operate in the port of Rotterdam and Antwerp. More recently two types of electric battery barges have been designed that use flow batteries with the associated port side infrastructure as part of a project initially funded by CEF (INEA, 2021). The first vessels with this battery type are due to be deployed this year (2021) (Port Liner, 2021), with plans to operate between 5 inland ports in Europe[27].

Overall, with the viability of the technology somewhat unproven and commercial deployment largely yet to take place, it is difficult to make any projections on the status of infrastructure deployment in the year 2030. MS did not include any relevant targets in their recently adopted NIR. Additionally, it is uncertain the extent of the role that battery electric vessels will play in the future. Available evidence suggests that batteries are only suitable for short distance journeys (GRENDEL, 2020). As such, it is likely that electricity will not be the only fuel in the future transport mix and that other fuels, such as hydrogen, are viewed as promising for the inland navigation sector, as underlined by the European Federation of Inland Ports in the survey.

All in all, it is not possible to develop a detailed estimate of the level of deployment of the relevant infrastructure for the year 2030 under the baseline. However, on the basis of above evidence, it is likely that the deployment of specific infrastructure for electric vessels will be limited to a few regional navigation routes on the busiest inland corridors (where there is greatest financial security).

A key point is that existing shore power infrastructure is expected to be too weak for loading large batteries in electric vessels. Operators of the electrical power grids at the quay edge would have to provide connected loads in the megawatt range to support charging of battery electric vessels as the existing low-voltage grid with 400 V three-phase current seems unsuitable. Hence, port authorities will be faced with the question over whether they upgrade existing infrastructure or deploy new recharging units in order to meet the requirement under PO3.

On that basis, the adoption of the measure requiring all Core TEN-T inland ports (total of 85) to upgrade existing on shore power supply or to deploy new electric supply suitable for battery electric vessels will probably lead to a significant increase in the number of ports deploying the relevant infrastructure. In principle, the wider availability of recharging infrastructure should also facilitate the uptake of battery electric vessels among relevant operators. However, this will also be determined by the cost of vessels, development of battery capacity, return on investment and availability of EU and national subsidies (CCNR, 2020).

[27] Dubel, Rotterdam, Amsterdam, Antwerp, and Duisberg

Table 7-13: Overview of expected impacts on AFV and AFI markets of shipping targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Small net positive impact on number of inland ports equipped with OPS (18 additional by 2030). OPS to be deployed in maritime ports by 2030. No impacts on the uptake of vessels are expected. Small net positive impact on the power capacity installed at maritime ports (Additional 682 MW).
Policy option 2	Significant net positive impact on number of inland ports equipped with OPS (106 ports to be covered by 2030). Significant net positive impact on the power capacity installed at maritime ports. (3,502 MW to be deployed by 2030) No impacts on the uptake of vessels are expected. The further deployment of LNG infrastructure in inland ports will likely be halted.
Policy option 3	Significant net positive impact on number of inland ports equipped with OPS (additional 106 ports to be covered by 2025). Significant net positive impact on the power capacity installed at maritime ports. (Additional 4,065 MW to be deployed by 2030) No impacts on the uptake of vessels are expected. The further deployment of LNG infrastructure in inland ports will likely be halted (as in PO2). Small net positive impact on the number of LNG bunkering facilities in maritime ports (at least 19 additional facilities). Undetermined net increase in electricity supply for battery electric vessels. (A total of 85 inland ports to have electricity supply for battery electric vessels by 2030)

7.2.2.3 Measures setting targets for AFI for aviation

With respect to aviation, the policy options under consideration include one measure setting targets for the electricity supply for stationary aircrafts which is expected to lead to the deployment of additional AFI. These targets vary with the policy option:

- PO1: Mandatory targets for stationary commercial passenger aircrafts at **all gates at TEN-T core and comprehensive airports** by 2025.
- PO2: Mandatory targets for stationary commercial passenger aircrafts at **all gates and outfield positions at TEN-T core and comprehensive airports** by 2025.
- PO3: Same as PO2.

Overall, this is measure is expected to have a limited effect on the availability of infrastructure for electricity supply for stationary aircraft above what is expected under the baseline (Table 7-26). As required by the 8th indent of Article 3(1) of the Directive, a number of Member States have considered the need to install an electricity supply for use by stationary airplanes - among those 23 Member States[28][29], AT, DK, EE and LT stated that electricity supply is already in place in a sufficient number of airports. Other Member States have indicated deployment of electricity supply in major airports, although in most cases it is difficult to identify whether this is sufficient to support all aircraft.

Moreover, three Member States have set targets in their NPFs to install this infrastructure: SI stated an objective to install electricity supply for this purpose in two airports by 2025; SK did not mention a specific number of airports to be equipped but noted that they expect to install a supply in the future; NL have already equipped 73 aircraft stands in Schiphol airport; ES have equipped almost all of the airports on the Core and Comprehensive TEN-T network and continue to install and upgrade units until 2030.

In addition, according to ACI Europe, a large number of airports already provide this infrastructure: 82% of respondents to an ACI EUROPE members survey already provide FEGP (fixed electrical ground power). Furthermore, 46% of them have 81-100% of their stands equipped with FEGP. As a result, ACI Europe explained that the measure will not lead to significant changes in major airports, but it might be more relevant for medium-sized airports, although there are technical and financial constrains that should be taken into account.

On the basis of above, we have grouped the 307 airports on the TEN-T network dependent on the annual number of passengers per year and assumed a level of FEGP deployment by 2025 for the baseline. This is summarised in Table 7-14.

Table 7-14: Assumed provision of electricity supply to aircraft by 2025

Type of airport	Size (annual number of passengers)	Number of airports	Assumed % of gates equipped	Assumed % of outfield positions equipped
Large	>10 million	39	100%	100%
Medium	1-10 million	111	50%	0%
Small	< 1 million	157	0%	0%

For each airport, we have extracted the annual number of passengers per year and passenger gates from Eurostat where available. In the absence of Eurostat data, the number of gates were estimated on the basis of the average number of passengers per gate for airports where data was available. Research targeted to individual airports indicated that the average number of outfield positions is approximately twice the number of passenger gates. The final figures for passenger gates and outfield positions for the baseline and policy options are summarised in Table 7-15. However, we note that the number of outfield positions differs widely between each airport and we stress that this calculation is not necessarily representative of the actual situation, and should be treated as indicative only. We do not think it is possible to be more accurate given the limited data available.

[28] Covering 51 airports - including about half of the busiest EU28+EFTA airports with over 5 million passengers per year and approximately 60% of annual EU28+EFTA airport passengers

[29] AT, BE, BG, CZ, DE, DK, EE, EL, ES, FR, HU, HR, IE, LT, LU, LV, MT, NL, PL, RO, SE, SI, SK

The impact under PO2 and PO3 is expected to be significantly greater than under PO1 as these measures support all gates and outfield positions in the EU with FEGP. At the same time, given the high baseline deployment, the total number of FEGP units is expected to grow by around 48%. No impacts on the uptake of aircraft are expected from this measure. It is only worth noting that, to use this infrastructure, existing aircraft might need to be retrofitted.

Table 7-15: Expected AFI deployment in 2030 by PO and in the Baseline regarding electricity supply in airports

FEGP deployment	Baseline	PO1		PO2/PO3	
		Total	Net	Total	Net
Passenger Gates	3,832	4,910	1,078	4,910	1,078
Outfield positions	6,141	6,141	0	9,819	3,678
Total	9,973	11,051	1,078	14,729	4,756

Table 7-16: Overview of expected impacts on AFV and AFI markets of aviation targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Additional 1,078 FEGP units expected to be deployed. No impact on aircraft expected.
Policy options 2 and 3	Additional 4,756 FEGP units expected to be deployed. No impact on aircraft expected.

7.2.2.4 Measures to promote interoperability

Measures focusing on the promoting interoperability of AFI include requirements for ad-hoc payments, the freedom for consumers to choose payment methods, technical specifications for rechargers, and physical and communication standards.

From the perspective of the uptake of AFVs, all above measures are expected to positively impact customer experience through improved convenience and reliability of recharging services. While the impact of each of the measures separately may be relatively small, combined, they could be expected to have a higher positive impact, making the entire experience of using an AFV and AFI easier and contributing to a higher level of uptake of AFVs.

In terms of impacts on the AFI market, the impacts are less clear. These measures do bring additional costs (see section 7.2.2.4 for the impacts on investment costs), and in some cases these could be significant. This could have a negative impact on the deployment of AFI. However, demand for AFI could increase because of the positive impacts in terms of uptake of AFVs. This could mitigate the negative impacts resulting from those additional costs. Additionally, measures on standards and technical specifications could have a positive impact in terms of creating a level playing field in the AFI market, supporting its development. Given this, the overall impact on the AFI market is not clear.

On the requirements for ad-hoc payments, the three different measures in PO1 and then PO2 and PO3 differ in the requirements they impose in terms of availability of ad-hoc payment options. While all policy options require the possibility of paying with a bank card, PO1 allows the possibility of that payment being made via smartphone (using a QR code) for all chargers, while PO2 and PO3 require that for fast chargers contactless or chip+PIN terminals are supported. PO2 and PO3 are thus likely to be more effective in promoting the uptake of AFV, as these options are easier to use and do not rely on the availability of an external device (a smart phone in this case, for QR code option). In any case, all of the different measures should be effective in supporting the AFV market. This is because easiness of payment (or lack of it) has been seen has an important barrier for the uptake of AFVs, as the need for one or more subscriptions services using proprietary technology (e.g. RFID cards) makes the process difficult to consumers – for more discussion on this topic, see section 7.3.2 on the impacts on consumers.

Stakeholders supported this assessment and underlined the importance of access to ad-hoc payment options as a way of improving accessibility for consumers. However, Eurocities and T&E remarked that availability of ad-hoc payments does not need to apply to all EV charging points to avoid imposing unnecessary costs. For example, slow chargers being used overnight by the same user are less likely to require such payment options compared to chargers at supermarkets, since these have higher turnovers.

Still, some stakeholders added some caveats related to the impact on AFI markets that such requirements might have. Namely, IONITY remarked that the requirements may reduce the budget for new innovative digital payment methods that do not require bank cards. Eurelectric also noted that, although ad hoc charging is important to guarantee interoperability, mandating hardware such as payment terminals would hamper investment in the sector, with questionable increases in consumer friendliness.

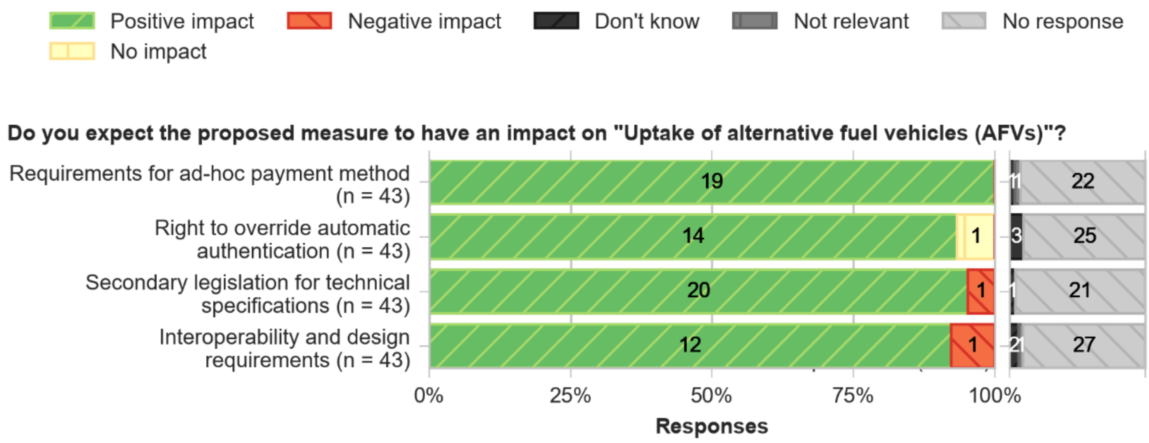
Regarding the freedom for consumers to choose payment methods, the measure under consideration mandates that all EV users must always be offered the option to choose payment method. While this is expected the use of charging points more user-friendly, the overall impacts on the AFV market might be limited. For example, consumers with a contract being able to pay ad-hoc could be useful in certain circumstances (e.g. to separate business from personal expenses), but not likely to be a deciding factor in AFV uptake. From the stakeholders' perspective, ANEC raise the concern that such requirements could lead to increased complexity, and users should be able to, e.g., decide to always choose automated payments with their provider. For AFI markets in general, the impact is expected to be negligible.

On the issue of standards (physical and communications) and technical specifications, all the different measures impose different requirements for EV charging – as well as the possibility of introducing physical standards for waterborne and air transport. Like with other measures in this problem area, these measures are likely to improve the ease of using an EV, thus improving uptake of AFVs (albeit at a small scale). For other modes (waterborne transport, aviation), where standards are less developed (see section 3), the positive impact on the uptake of AFVs could be greater: the experience with road transport, shows that the availability of standards for EV charging had a positive role in improving the levels of interoperability of AFI and the AFID has ensured a common reference framework in the development of the market for light-duty vehicles (Ricardo, 2021a). While the issues at hand are different here (as the market for LDVs is aimed to a great extent at individual consumers, while for waterborne transport and aviation the customers are solely transport businesses), it is also expected that for these modes the standardisation of AFI could help resolve the "chicken and egg" problem were the lack of (standardise) AFI stops businesses from investing in technologies using alternative fuels[30].

Such requirements are also likely to have a positive impact on the AFI market, as they will support the creation of a level playing field across all market players and reduce the costs on interoperability as it will diminish the need for bespoke solutions. This assessment was confirmed by several stakeholders[31], who noted the critical role that they expected to have in supporting the deployment of AFI and increase the ease of use for consumers. IONITY added the caveat that any standards should not be mandated directly on legislation, but rather should be developed through standardisation bodies (as these measures propose).

The above overall positive assessment of these measures in terms of the impacts in the AFV market is supported by almost all stakeholders that contributed to study (see Figure 7-4) that provided a positive assessment of the expected impact of each individual measure under consideration. Only one industry stakeholder considered that measures on technical specifications and interoperability requirements may have a negative impact (no explanation was provided).

Figure 7-4 : Stakeholder responses on if they expect the proposed measures to promote interoperability of AFI to have an impact on the uptake of AFVs (n=43)



An overview of the expected impacts on AFV and AFI markets of the measures to promote interoperability is presented in Table 7-17.

[30] In the case of waterborne transport and aviation, this is not necessarily a vessel or aircraft using solely alternative fuels but could be, for example, the use of electricity while at port/airport suplied to the vessel/aircraft instead of relying on engine (thus fossil fuel) power.

[31] Including the Greek Ministry of Infrastructure and Transport, the Bulgarian Petroleum and Gas Association, the Bulgarian Ministry of Transport, Information Technology and Communications and the European Association of Automotive Suppliers (CLEPA).

Table 7-17: Overview of expected impacts on AFV and AFI markets of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	**Impact**
Policy option 1	Increased ease of use and consumer experience resulting from the availability of ad-hoc payment expected to have a positive impact on AFV uptake. Additional costs could have a negative impact on the availability of AFI, but that could be mitigated by additional demand[32]. Communication standards will mostly impact the AFI market, by reducing interoperability costs and facilitating the existence of a level playing field. For this market, some positive impacts could be expected. For users, there might be some benefits in terms of the availability of data, but that effect in terms on the impact on the level of AFV uptake is likely negligible. For electromobility for LDVs, already exist, the impact on AFV uptake is likely to be negligible. The same is true for the impact on AFI markets.
Policy option 2	As PO1, but mandatory chip+PIN or NFC payment terminals on some chargers could further increase easiness of use for consumers, compared to payment via smartphone/QR code. Increased ease of use has a negligible impact on AFV uptake: e.g. consumers with a contract being able to pay ad-hoc could be useful in certain circumstances, but not likely to be a deciding factor in AFV uptake. Standards could have a positive impact on the level playing field in the AFI market, as long as they are not burdensome or do not negatively impact competition and innovation. For areas where standards are less developed (e.g. HDVs in road transport, waterborne transport, aviation), the positive impact on the uptake of AFVs (or vessels/aircraft) is likely to be greater. Certainty brought by common standards could also have a positive impact on the availability of AFI. Further communication standards could be seen as burdensome for the industry, but this would depend on the standards set. Technical standards could have a positive impact on the level playing field in the AFI market; no significant costs are expected from the measure.
Policy option 3	As PO1/PO2, but mandatory chip+PIN on some chargers could further increase ease of use for consumers, compared to payment via smartphone/QR code. Additional technical standards may have cost implication with potential negative impact on the AFI market.

[32] Invesment costs are discussed in more detail in section 7.2.3.

7.2.2.5 Measures to improve consumer information

Measures to improve consumer information include requirements on price transparency (both for ad-hoc and contract-based payments), measures on comparability and non-discrimination of prices, requirements for data provision through NAPs (on static and dynamic data), and requirements to install roadside indicators on the parking/fuelling area and the road corridor.

Measures strengthening consumer access to information are also expected to have a positive impact on customer experience, which should positively impact on the uptake of AFVs (or, more particularly, EVs). Like with the measures to promote interoperability discussed above, the expected impact of each measure is expected to be relatively small but all combined, they could make the entire experience of using an AFV easier, thus contributing to a higher level of uptake of AFVs.

On the AFI markets, depending on the burden that the measures might represent on businesses, these measures could have a negative impact. Additionally, while they could support the creation of a level playing on the AFI market, there is the potential that some of the measure might directly affect the business model of some CPOs. Still, like with the measures to promote interoperability, if those measures increase the uptake of AFVs, that could increase demand for AFI and have positive impacts on that market. Overall, the impact is thus unclear.

On price transparency, these are likely to support the uptake of AFVs, especially for ad-hoc payments. The requirement to display the ad-hoc price physically at a station (for PO2/PO3) could be of particular importance to help non-EV users become more aware of the existence of these stations and the prices of electric charging, contributing to a positive impact on the uptake of AFVs. For measures on ad-hoc and contract-based pricing that only require that prices are clearly displayed before charging, while they could be important in terms of ensuring transparency, the impacts in terms of AFV uptake is likely more limited – these users are already in the EV ecosystem.

In terms of stakeholder input, FIA agreed that these measures would help to address EV user concerns about a lack of transparency and unfair pricing models. Similarly, AVERE commented that the clarity around the cost of charging is one of the key issues inhibiting the market and that if one wants customers to understand the market better, pricing must be made easier to understand. While agreeing that the measures should regulate what price components should be shown, ChargeUp Europe added that legislation should not regulate how this information is displayed, that should be left to the market.

On the comparability and non-discrimination of prices, impact on AFV uptake is likely to be limited. This is unless the requirement to provide the same prices on B2C as on B2B leads to an overall decrease in B2C prices. But overall, the impact is unclear. Where more impacts could be seen is on the AFI markets, as this requirement might force some CPOs to change their business model. This was a point made by AVERE, who noted that several CPOs' business models rely on having a closed infrastructure charging system. Therefore, according to this stakeholder, requiring non-discriminatory pricing could have an adverse impact on this business model and thereby a negative impact on the development of the market. On the other hand, requirements on non-discrimination could help create a level playing field in terms of competition, reducing the barriers for new market entrants.

On requirements for data provision through NAPs to promote user information, these are likely to have a positive impact on the uptake of AFVs. From the two measures on consideration (provision of static data only in PO1 and provision of dynamic data on PO2/PO3), the measures on PO2/PO3 are likely to have the greatest positive impact, as more relevant data (e.g. on operational status of charging points/refuelling stations and ad-hoc) would be provided. This assessment was confirmed by stakeholders, with AVERE and a national authority noting that EV user access to static and dynamic data could drastically help address concerns around transparency, ensuring customer satisfaction and making recharging as easy as refuelling with fossil fuels. Still, some stakeholders[33] noted that some CPOs might be wary of providing dynamic real time information, as that data could be commercially sensitive and valuable. Other stakeholders (CharIN and IONITY) also noted that static data is already available in NAPs of most Member States, and IONITY added that Google Maps offered availability data – although this is only available for some charging points, nor it is available consistently across the EU.

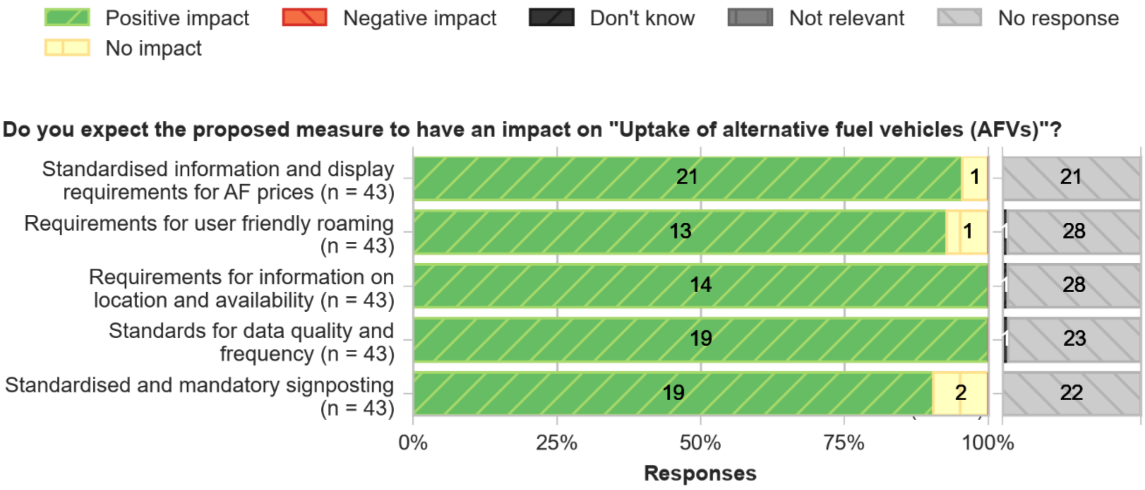
On requirements to install roadside indicators, this would also have positive impacts for the uptake of AFVs. The impact would likely be greater for PO3, as it requires such signs on the road corridor, not only on the parking/refuelling areas (as in PO2) – it is also expected that for most parking/refuelling areas with publicly available chargers there is already some sort of signage available (in order for users to be able to find those chargers/fuelling stations), so the impact beyond the baseline would be limited. On this subject, IONITY and the Irish Rural Link remarked that common signage would render AFI more visible to non-AFV drivers and provide them with more confidence to switch to AFVs; this was also a point made in the OPC. However, some stakeholders, such as AVERE and ANEC, expressed doubt about how effective signposting would be in increasing clarity and transparency of EV charging, particularly taking into account already available digital information.

For the AFI market, the requirement for road signs in PO3 could lead to some costs that could negatively impact the market (as noted, for PO2, most parking/refuelling areas would already have some signage, so additional costs are expected to be limited). Still, as with other measures that effect could be counter-balanced by a greater uptake of AFVs and more demand for AFI.

A summary of the stakeholder views on how measures to promote interoperability would affect the uptake of AFVs is presented in Figure 7-5). As can be seen in the figure, most stakeholders agreed that there would be a positive impact – of the four that said “no impact”, three were industry stakeholders, and one was a public authority/public body (for the measure on standardised and mandatory signposting); these stakeholders did not provide any explanations for their views.

[33] Bulgarian Petroleum and Gas Association, AVERE and Eurelectric.

Figure 7-5: Stakeholder responses on the expected impact on the uptake of AFVs of measures to improve consumer information (n=43)



An overview of the expected impacts of the measures on consumer information on the AFV and AFI markets is presented in Table 7-18.

Table 7-18: Overview of expected impacts of measures to improve consumer information on AFV and AFI markets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Some positive impacts could be seen in conjunction with other measures, and they all increase easiness of use and could, all together, increase the confidence for more consumers to switch to an EV.
Policy option 2	Positive impacts (greater than PO1 due to the additional dynamic data provision and roadside indicated) could be seen in conjunction with other measures, and they all increase easiness of use and awareness and could increase the confidence for more consumers to switch to an EV. Additional costs for the installation of signage could have a negative impact on the availability of AFI. However, many such parking/fuelling areas are likely to already have such signs, so impacts are likely negligible.
Policy option 3	Positive impacts (greater than PO2 due to the additional measure for roadside indicators) could be seen in conjunction with other measures, and they all increase easiness of use and could, all together, increase the confidence for more consumers to switch to an EV. Additional costs could have a negative impact on the availability of AFI, but the overall costs are not expected to be significant (see section 7.2.3.5) and those costs could be mitigated by additional demand.

7.2.3 Total infrastructure costs

7.2.3.1 Measures setting targets for AFI for road transport

On the basis of the analysis of the expected level of AFI deployment, we have also developed estimates of the required investment costs for each type of AFI required.

Table 7-19 below summarises the average annual investments for private operators and public authorities for 2021-2030 and 2031-2050 in the baseline and in the policy options. The most significant costs are associated with the requirement of the minimum sufficient capacity per vehicle for BEV and PHEVs followed by the requirement for the installation of rapid charging points for LDVs in petrol stations. Net annual costs are close to €0.5 billion for PO1 for the period 2021-2030, in comparison to €0.6billion for PO2 and €1.01 billion for PO3. For the period 2031-2050, net costs for PO1 are €1.83 billion, compared to €1.87 billion for PO2 and €2.02 billion for PO3.

In the case of electric charging for HDVs, the net annual investment costs are very similar for all three options (€0.13 billion to €0.15 billion for 2021-2030 and €0.17 billion for all three option for 2031-2050). In the case of hydrogen infrastructure, the net annual costs associated with PO2 and PO3 are greater than PO1 during the period up to 2030 (€0.43 billion and €0.47 billion respectively), driven by the higher capacity per station required and the requirement for the deployment of HRS along the TEN-T. However, the costs are slightly higher for PO1 after 2030. The measure requiring the installation of liquid fuel stations also to contributed to the total investment costs for PO2 and PO3 due to the significant additional costs per HRS expected (estimated €2 million per fuelling station).

Finally, in the case of LNG and CNG, the POs project a decrease in comparison to the baseline as a result of the lower number of LNG and CNG vehicles relative to the baseline. In the case of CNG this is mainly after 2030 (total of €0.07 billion reduction on an annual basis), while in the case of LNG this is mainly in the period up to 2030 (total of €0.06 billion reduction on an annual basis). In both cases the net difference is very small in comparison to the costs for other categories of infrastructure.

Table 7-19: Average annual investments for private operators and public authorities for 2021-2030 and 2031-2050 in the baseline and in the policy options (expressed as difference to the baseline) (€ billion)

AFI Type	Baseline costs		Net from baseline					
			PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
LDVs recharging points	0.69	1.38	0.53	1.83	0.60	1.87	1.01	2.02
HDVs charging points	0.00	0.02	0.13	0.17	0.14	0.17	0.15	0.17
Hydrogen fuelling facilities	0.27	0.53	0.23	2.55	0.43	2.46	0.47	2.48
CNG fuelling facilities	0.21	0.11	-0.03	-0.07	-0.03	-0.07	-0.03	-0.07
LNG fuelling facilities	0.31	0.10	-0.06	-0.02	-0.06	-0.02	-0.06	-0.02
Total	**1.49**	**2.15**	**0.80**	**4.45**	**1.07**	**4.41**	**1.55**	**4.58**

Source: Own elaboration based on PRIMES-TREMOVE model

Average annual maintenance costs for private operators have been estimated at €0.05 billion to €0.16 billion in addition to the baseline for the period up to 2030 and €1.12 billion to €1.21 billion compared to the baseline for 2031-2050. Maintenance costs are attributed only to the private sector.

Table 7-20: Average annual operation costs for private operators for 2021-2030 and 2031-2050 in the baseline and in the policy options (expressed as difference to the baseline) (€ billion)

AFI type	Baseline		PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
LDVs recharging points	0.05	0.24	0.02	0.30	0.03	0.31	0.05	0.35
HDVs charging points	0.00	0.00	0.01	0.03	0.01	0.03	0.01	0.03

AFI type	Baseline		PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
Hydrogen fuelling facilities	0.04	0.32	0.03	0.91	0.05	0.95	0.12	0.95
CNG fuelling facilities	0.12	0.17	-0.01	-0.09	-0.01	-0.09	-0.01	-0.09
LNG fuelling facilities	0.05	0.18	-0.01	-0.04	-0.01	-0.04	-0.01	-0.04
Total	**0.26**	**0.91**	**0.05**	**1.12**	**0.07**	**1.17**	**0.16**	**1.21**

Source: Own elaboration based on PRIMES-TREMOVE model

Total costs increase from PO1 to PO3 (see Table 7-21 that includes the present values for CAPEX and OPEX for the period 2021-2050) mainly driven by the higher costs for electric charging infrastructure for LDV and for HRS. The difference in the net impact for infrastructure for electric HDVs is more limited.

Table 7-21: Total capital and operation costs in the baseline and in the policy options (difference to the baseline), expressed as present values over 2021-2050 (€ billion)

AFI type	Baseline			PO1 (net from baseline)		
	CAPEX	OPEX	Total	CAPEX	OPEX	Total
LDVs recharging points	16.2	2.4	18.6	21.7	2.7	24.4
HDVs charging points	0.2	0.0	0.2	2.5	0.3	2.9
Hydrogen fuelling facilities	7.9	2.6	10.6	19.4	5.8	25.2
CNG fuelling facilities	4.5	2.5	7.0	-0.8	-0.7	-1.6
LNG fuelling facilities	4.1	2.0	6.1	-0.6	-0.4	-1.0
Total	**33.0**	**9.5**	**42.5**	**42.2**	**7.7**	**49.9**
AFI type	**PO2 (net from baseline)**			**PO3 (net from baseline)**		
	CAPEX	**OPEX**	**Total**	**CAPEX**	**OPEX**	**Total**
LDVs recharging points	22.5	2.8	25.3	27.0	3.3	30.3
HDVs charging points	2.5	0.3	2.9	2.7	0.3	3.1
Hydrogen fuelling facilities	21.3	6.3	27.7	21.2	6.9	28.0
CNG fuelling facilities	-0.8	-0.7	-1.6	-0.8	-0.7	-1.6
LNG fuelling facilities	-0.6	-0.4	-1.0	-0.6	-0.4	-1.0
Total	**44.9**	**8.3**	**53.3**	**49.4**	**9.4**	**58.9**

Table 7-22: Summary of expected impact on the total investment costs of policy options

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Estimated total net costs from baseline of €49.9 billion (NPV with 4% discount rate)

Measure	Impact
	- Electricity for LDVs: €24.4 billion - Electricity for HDVs: 2.9 billion - HRS: €25.2 billion - LNG:- €1.6 billion - CNG: - €1.0 billion
Policy option 2	Estimated total net costs from baseline of €53.3 billion (NPV with 4% discount rate) - Electricity for LDVs: €25.3 billion - Electricity for HDVs: 2.9 billion - HRS: €27.7 billion - LNG: -€1.6 billion - CNG: - €1.0 billion
Policy option 3	Estimated total net costs from baseline of €58.9 billion (NPV with 4% discount rate) - Electricity for LDVs: €30.3 billion - Electricity for HDVs: 3.1 billion - HRS: €28.0 billion - LNG: -€1.6 billion - CNG: - €1.0 billion

7.2.3.2 Measures setting targets for AFI for water transport

Based on the expected infrastructure deployment described above, the following investment costs were estimated for the different shipping targets.

For **LNG bunkering in maritime ports,** investments costs include:

- Capital costs linked to costs of installing LNG bunkering and storage tanks, acquisition of land, connection to natural gas pipeline, construction of quay for bunkering, other engineering works and licence costs.
- Operational costs linked to costs of pipeline, LNG terminal take-out fee, personnel / safety training and transhipment costs from import hub.

The nature and extent of these investment costs can vary significantly from port to port, given the differences in capacity requirements, existing infrastructure in ports, and type of bunkering implemented (i.e. Ship-to-Ship (STS), Pipeline-to-Ship (PTS), and Truck-to-Ship (TTS)). The key factors influencing the overall cost differences is the cost of truck, vessel and terminal, and the capacity. Furthermore, not all costs apply to each of these bunkering options. For example, construction of a quay and connection to the pipeline is only relevant for Pipeline-to-Ship. Even within each bunkering option, the costs are highly variable depending on the nature of each installation. The capital costs of each bunkering method are estimated to be €0.2-100 million per port for TTS, compared to €23-73 million per port for STS and €33-237 million per port for PTS (CE Delft, 2015). Similarly, the ongoing costs vary between each port and bunkering method, although to a lesser degree. The main ongoing costs are operational costs of bunker, LNG terminal take out fee, transhipment costs from the import hub and the salaries of safety and technical personnel. The OPEX for each type of bunkering method has been assumed on the basis of the values provided in the LNG study (CE Delft, 2015).

Table 7-23 summarises the costs expected at EU level. The first row represents the total capital expenditure required to build the necessary infrastructure, while the second row indicates the annual cost for operating all of the AFI. For the NPV, we have assumed that the capital cost is distributed between 2025 and 2030. For the purposes of the impact assessment, we have assumed scenarios in which all ports are equipped with the same type of bunkering method, thus representing a lower bound and an upper bound. In reality, the bunkering solution chosen depends on several factors such as distance, traffic intensity, volume, frequency, safety, vicinity to other LNG bunkering ports and land-based demand. It is expected that port authorities will implement the most cost-effective solution that is still sufficient to meet their needs. In the case of the TTS (representing the solution with lowest total investment costs), a tank truck can carry about 50m^3 of LNG, which can be transferred in approximately one hour and may only be suitable for smaller vessels. Whereas Ship-to-Ship and Pipeline-to-Ship can transfer much larger volume at faster rates and are therefore are suitable for most maritime vessels. It is likely necessary that port authorities have to carry out a feasibility study to determine the most suitable bunkering method, which incurs an additional cost. As an example, feasibility studies were carried out in Cyprus and Northern Europe to understand how best to implement LNG in maritime transport[34]. Given the uncertainties described here, it is difficult to identify the exact total investment costs at EU level. Based on the individual specificities of each port, the solution to fulfil the obligations under PO3 at EU level will likely include a combination of the bunkering methods and the total investment cost will be somewhere in between the costs summarised below.

Table 7-23: Summary of infrastructure costs of policy option 3 in comparison to the baseline regarding LNG installations for maritime ports, by bunkering method (EU total)

Infrastructure costs	STS	TTS	PTS
Costs required to install 19 LNG bunkers under PO3 (net to baseline)			
CAPEX (€ billion)	0.912	0.952	2.565
OPEX per year (€ billion)	0.048	0.001	0.001
NPV 2021-2050 compared to the baseline (€ billion)	1.7	1.1	3

Notes: For calculating the present value, a discount rate of 4% is assumed.

Investment costs of **OPS installations for maritime ports** are also specific to each port and ship type. They are associated to the different elements in an OPS installation, including a building/shelter and technical equipment (e.g. switchgear, transformers and frequency converters) (EAFO, n.d.c). Furthermore, cost increases with the power demand requirements such that installations in cruise berths, which require more power, will be more expensive than in ferry berths.

Overall, CAPEX can vary between €1 and €25 million depending on the size and complexity of the installation[35]. Based on a number of sources (Port of Rotterdam, n.d.), (DNV GL, 2018), (Malta National Electromobility Platform, n.d.), (Putz & Partner, 2012), the average capital cost per MW of OPS capacity installed was estimated at €1.5 million, €1 million and €1.2 million for cruise, container and RoPax vessels. In addition, a ratio

[34] See CYnergy and North European LNG Infrastructure Project

[35] Based on the analysis of project submitted for funding through INEA and referenced with literature, source: (DNV GL, 2018)

of operating and maintenance costs per installed MW per year has been used to estimate OPEX (estimated to be around €4,300 per year and per MW installed) (DNV GL, 2018).

Overall, total infrastructure costs were estimated to range between €1.2 billion and €6.5 billion for the period between 2025 and 2050 (Table 7-24). The first row in the table represents the total capital expenditure required to build the necessary infrastructure, while the second row indicates the annual cost for operating all of the AFI.

Table 7-24: Summary of infrastructure costs of policy options in comparison to the baseline regarding OPS installations for maritime ports

Infrastructure costs	PO1	PO2	PO3
OPS capacity installed in MW (net from baseline)	652	3,502	4,065
CAPEX (€ billion)	0.975	4.6	5.3
OPEX per year (€ billion)	0.002	0.015	0.017
NPV 2021-2050 compared to the baseline (€ billion)	1.2	5.5	6.5

Notes: For calculating the present value, a discount rate of 4% is assumed.

In principle, the deployment requirements for installations of **OPS at inland ports** are the same as those for maritime ports. That is, OPS installations in inland ports still require the same building/shelter and technical equipment. However, inland vessels are typically much smaller than seagoing ships and therefore the power needs for each OPS installation is much less. Thus, the costs will be lower than for maritime ports.

For the purposes of the impact assessment support study it has been assumed that power deployed in each installation is the same for all ports. Specifically, each installation comprises 12 CEE 400V sockets and 4 Powerlock 400V sockets, which are suitable for cargo vessels and river cruise vessels, respectively. Thus, the CAPEX and OPEX is the same for each OPS installation across all inland ports in the EU.

The CAPEX for each installation was taken from the investment costs of OPS deployment in Basel and is equal to €2.5 million (JRC, 2020), while the OPEX costs has been derived using the same method as for maritime ports based on the ongoing costs reported by five EU ports[36]. Infrastructure is assumed to be deployed between 2022 and 2025 in the case of PO1, and between 2022 and 2030 in the case of PO2 and PO3. Overall, total infrastructure costs were estimated to range between €65 million and €412 million, expressed as present value over 2021-2050.

Table 7-25: Summary of infrastructure costs of policy options in comparison to the baseline regarding OPS installations for inland ports

Infrastructure costs	PO1	PO2	PO3
Number of inland ports equipped (net from baseline)	18	106	106
CAPEX (€ million)	45	265	265
OPEX per year (€ million)	0.09	0.532	0.532

[36] Bergen, Hamburg, Rostock, Tallinn, Helsinki

Infrastructure costs	PO1	PO2	PO3
NPV 2021-2050 compared to the baseline (€ million)	65	357	412

Notes: For calculating the present value, a discount rate of 4% is assumed.

As we have not been able to quantify the AFI development for electricity supply for battery electric vessels, we can only provide a qualitative assessment of the investment costs associated with this type of infrastructure.

As described in 7.2.2.2, there will be investments needed to upgrade any current OPS systems or install new systems to support battery electric vessels in order to meet the requirements under PO3. These will include the costs a transformer station, frequency converter and cable management system. To transport large currents through a cable the connection cables must have a large cross section. Given that the majority of Core TEN-T ports already have or will have OPS installed by 2025, it is possible that most ports will only need to direct investment towards upgrading existing installations. Nonetheless, while it is not possible to quantify, the introduction of the measure should be expected to introduce some sizeable additional costs.

Overview of expected impacts of shipping targets on infrastructure costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Estimated total costs of €1.28 billion between 2021-2050 (NPV with 4% discount rate) for OPS related measures. 65 million for inland ports and €1.2 billion for maritime ports
Policy option 2	Estimated total costs of €5.86 billion between 2021-2050 (NPV with 4% discount rate). €357 million for inland parts and €5.5 billion for maritime ports
Policy option 3	Estimated total costs of at least €8-11 billion between 2021-2050 (NPV with 4% discount rate) for OPS and LNG measures. €412 million for OPS for inland and €6.5 billion for OPS for maritime €1.1-3 billion for LNG for maritime Additional investment costs for electricity supply for battery vessels at each TEN-T core (not possible to estimate)

7.2.3.3 Measures setting targets for aviation

The main capital costs associated with FEGP installation are evenly split between hardware costs and adapting the power supply network in airports to ensure it extends to all stands. We note that the size of the aircraft determines the system required and in turn the cost. Specifically, wide-body aircraft need a system double in power capacity to that of narrow-body aircraft, while an A380 would require the systems four times the power capacity of a standard FEGP. It can be assumed that capital costs scale linearly with the power capacity of the system.

In the survey carried out as part of this study, ACI Europe provided an approximation of capital costs of €100,000 per stand if electricity provision to the stand is already established for other purposes as well. In the case where airports do not already have electricity provision, the capital costs per stand is around €200,000. These costs are comparable to the costs reported in Zurich airports, which ranged from €102,000-300,000 (Zurich Airport, 2018). In Table 7-26 we have summarised the costs per stand for each type of aircraft.

Table 7-26: Capital costs for FEGP in thousand Euros, by type of aircraft

Aircraft	With existing electricity provision	Without existing electricity provision
Narrow-body	100	200
Wide-body	200	400

It is challenging to identify the exact capital costs associated with this measure given the specificities of each airport and the differences in the number and size of aircraft. On the basis of the airport grouping described in section 7.2.2.3 we have assumed the following costs for passenger gates and stand that do not already have existing infrastructure:

- **Large airports** – 50% narrow-body aircraft and 50% wide-body aircraft, with existing electricity provision
- **Medium-Large Airports –** 75% narrow-body aircraft and 25% wide-body aircraft, with existing electricity provision
- **Small airports** – 100% narrow-body aircraft, without existing electricity provision

The ongoing costs associated with FEGP are general operating maintenance costs. In general, these are expected to be small. However, there is no data readily available on the operating costs of FEGP and therefore it has not been included in our assessment.

On the basis of above, total investment costs are estimated to range between €227 million for PO1 and €949 million for PO2 and PO3. The costs are summarised in Table 7-27. Infrastructure is assumed to be deployed between 2022 and 2025..

Table 7-27: Summary of investment costs of policy options in comparison to the baseline regarding electricity supply to aircraft

Investment costs	PO1	PO2	PO3
CAPEX (€ million)	160.5	671.8	671.8
NPV 2021-2050 compared to the baseline (€ million)	227	949	949

Table 7-28: Overview of expected impacts total investment costs of aviation targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy Option 1	Investment cost of €227 million distributed across many airports. Minimal ongoing costs are expected after this year.
Policy options 2 and 3	Investment cost of €949 million. Distributed across many airports. Minimal ongoing costs are expected after this year

7.2.3.4 Measures to promote interoperability

Introducing interoperability requirements will lead to varying investment requirements but will also unlock some cost reductions through standardisation of AFI. The support study for the evaluation of the AFID showed that the provision of relevant standards on an EU level has provided some cost savings through economies of scale and avoidance of effort and resource duplication (Ricardo, 2021a).

Mandatory ad hoc payment functionality will likely be the biggest source of costs for this problem area and will lead to added costs for installing a payment system for each charging point. We used cost data based on confidential information provided by AFI providers and on estimates by the California Air Resources Board (CARB, 2018) to develop an assessment of the total costs. The unit costs and the calculations are presented in Table 7-29- below.

No data could be identified with regards to the share of new EV charge points already expected to be equipped with ad hoc payment options. As a baseline, we estimated that 25% of new slow chargers are installed with ad hoc payment options (one of Chip + Pin, NFC or QR code) and 50% of new fast chargers are installed with ad hoc payment options. As a sensitivity, we tested also the investment required in case those values increase to 50% and 75% for fast and slow chargers, respectively.

All policy options allow CPOs to install one of three payment options for ad hoc charging on slow chargers. For the estimates we assumed an equal split between the three payment methods. The same split was used for fast chargers under PO1. Under PO2, we assumed an equal split between Chip + PIN and NFC terminals installations for fast chargers. PO3 requires that all fast chargers include Chip + PIN terminals.

Single-use QR code displays are expected to be significantly cheaper than the card terminals since they only require a display and software integration. No estimate for the cost of including a QR code system could be found. We estimated €100 in investment cost and €10 annual operating cost for the analysis.

Investment estimates for the two assumptions studied are in Table 7-29- and Table 7-30 below. It is also possible to compare these cost assumptions[37] with the costs considered in the model for the different types of chargers. For public chargers, prices start at values as low as €1250 in 2030 (for a 7kW AC charger). Inclusion of NFC or chip+PIN terminals in those chargers would thus increase costs considerably – given that there will be an option to use QR codes instead, this could lead to wider adoption of that option, when possible. For fast chargers, which start at more €30,000 in 2030

[37] It should be noted that some of the measures might lead to requirements whose costs can be combined with those, leading to potential efficiencies. For example, measures on digital connectivity (Problem Area C) will require a network connection that these payment terminals can also make use of. However, it is not possible to disentagle these costs between the different measures.

(50-150kW DC), these additional costs represent a much smaller proportion, and as such the negative impact in terms of costs is not as great.

Table 7-29-: Investment cost associated with ad hoc payment options (assuming 25% of slow chargers and 50% of fast chargers comply with the measure in the baseline)

	PO1	PO2	PO3
Chip + PIN terminals			
One-off costs (per unit)	€833	€833	€833
Ongoing costs (per unit/year)	€178	€178	€178
Number of units by 2030	546,312	744,264	825,130
Number of units by 2050	3,346,377	3,510,290	3,979,142
NFC payment terminals			
One-off costs	€667	€667	€667
Ongoing costs	€143	€143	€143
Number of units by 2030	546,312	926,846	837,206
Number of units by 2050	3,346,377	3,424,701	2,970,419
QR code displays			
One-off costs (per unit)	€100	€100	€100
Ongoing costs (per unit/year)	€10	€10	€10
Number of units by 2030	546,312	683,450	679,440
Number of units by 2050	3,346,377	3,042,371	3,042,185
NPV 2021-2050 compared to the baseline	€10.15 billion	€10.39 billion	€10.62 billion

Sources: Confidential information provided by AFI providers and estimates by the California Air Resources Board (CARB, 2018).
Note: Current EV charge point data distinguishes between normal (<=22kW) and fast (>22kW). The proposed measures distinguish between normal (<=50kW) and fast (>50kW). The difference between current and expected number of EV charge points was used to determine the number of new EV charge points by 2030 and 2050. Since the data is not fully compatible, the number of new slow chargers is slightly overestimated and number of fast chargers is slightly underestimated. A discount rate of 4% was considered.

Table 7-30: Investment cost associated with ad hoc payment options (assuming 50% of slow chargers and 75% of fast chargers comply with the measure in the baseline)

	PO1	PO2	PO3
Chip + PIN terminals			
One-off costs (per unit)	€833	€833	€833
Ongoing costs (per unit/year)	€178	€178	€178
Number of units by 2030	361,271	499,555	578,415

	PO1	PO2	PO3
Number of units by 2050	2,204,991	2,366,189	2,834,948
NFC payment terminals			
One-off costs	€667	€667	€667
Ongoing costs	€143	€143	€143
Number of units by 2030	361,271	926,846	837,206
Number of units by 2050	2,204,991	3,424,701	2,970,419
QR code displays			
One-off costs (per unit)	€100	€100	€100
Ongoing costs (per unit/year)	€10	€10	€10
Number of units by 2030	361,271	438,741	432,725
Number of units by 2050	2,204,991	1,898,270	1,897,990
NPV 2021-2050 compared to the baseline	€6.72 billion	€6.96 billion	€7.16 billion

Sources: Confidential information provided by AFI providers and estimates by the California Air Resources Board (CARB, 2018).
Note: Current EV charge point data distinguishes between normal (<=22kW) and fast (>22kW). The proposed measures distinguish between normal (<=50kW) and fast (>50kW). The difference between current and expected number of EV charge points was used to determine the number of new EV charge points by 2030 and 2050. Since the data is not fully compatible, the number of new slow chargers is slightly overestimated and number of fast chargers is slightly underestimated. A discount rate of 4% was considered.

A further aspect to consider is credit card security requirements, which may require compliance certification and testing procedures, as well as other security testing (CARB, 2018). These requirements may lead to additional costs beyond the hardware costs for card payment terminals. However, these costs were not estimated in this impact assessment.

The stakeholder questionnaire shows that five out of nine respondents from public authorities and public bodies expected additional cost as a result of an ad hoc payment option requirement. Surprisingly, only one out of five industry respondents expected additional costs. As will be further discussed in section 7.2.6.4, most of these costs are expected to be the responsibility of industry stakeholders. Several stakeholders[38] noted that a prescription of hardware or technology would trigger CAPEX and OPEX for the CPOs and that such requirement should either not be applied or only be applied to some EV charge points.

As noted, for the other requirements in this problem area, the investment costs are expected to be of a smaller scale:

[38] Eurocities, Transport & Environment, IONITY, Eurelectric, ChargeUp Europe, AVERE and the German Ministry for Transport and Digital Infrastructure.

- The freedom for consumer to choose payment method is likely to be represent a small cost derived from necessary back-office/software changes.

- Introduction of physical standards may lead to retrofit costs to adjust existing infrastructure to fit the new technical specifications. The new standards will also require investment into AFI production to fit the new requirements. However, single-standard infrastructure is cheaper to produce than multi-standard infrastructure and will unlock economies of scale and ultimately the additional costs could be almost negligible (as noted by CHAdeMO Association Europe during the field research).

- The same is true for new technical specifications for charge points. The requirement for CPOs to inform NAPs about the availability of fixed cables (PO2) will have negligible associated costs; removal of the exemption for shutters will lead to costs of adaptation for the manufacturers that still include them in their chargers. PO3 mandates fixed cables for chargers, which will lead to retrofit costs for existing chargers and additional costs for new chargers. These cables can cost up to €90 to be included in a new charger, more if retrofits are required (Schneider Electric, 2021). Assuming that retrofits are required and that all fast chargers will already include a cable in any case, this can lead to costs of up to €0.20 billion by 2050 (in NPV terms).

- Back-office/software changes will also be required with the introduction of communication standards for e-mobility. The required adoption of the OCPP standards in PO1 is likely to require less investment since it is already widely adopted (European Parliament, 2018). Several responses to the AFID OPC also noted that the use of open standards and protocols such as OCPP will lower costs. Investment in compliance with the OCPI standard (also for PO1) consists of a one-time cost of engineering staff time, but concrete costs are not available (CARB, 2018). PO3 will cover a larger number of communication areas of the EV charging system and may therefore lead to additional costs for CPOs to implement all standards. However, standardisation will also allow AFV and AFI producers to streamline the development and production of the product parts and software involved in communication.

- Most of the measures above also include some work from official standardisation organisations to develop the technical specifications and standards. Therefore, the specifications are not determined as of yet and no associated cost can be estimated for their development (by both the standardisation bodies and the industry and government players participating in those efforts) and implementation (mostly for industry stakeholders).

An overview of the expected costs is presented in Table 7-31 below.

Table 7-31: Overview of expected impacts of measures to promote interoperability on the total investment cost

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Total investment cost by 2050: €6.7-€10.2 billion (NPV with 4% discount rate) linked to ad-hoc payment plus costs for development and implementation of standards (not quantified). Some additional costs for communication and physical standards but not possible to estimate at this point.

Measure	Impact
Policy option 2	Total investment cost by 2050: €7.0-€10.4 billion (NPV with 4% discount rate) related to ad-hoc payments plus costs for development and implementation of standards (not quantified). Additional limited costs for measures related to freedom to choose payment system and technical specification (exemptions for shutters removed; CPOs must inform NAPs about availability of cables) plus costs for communication and physical standards that have not been possible to estimate.
Policy option 3	Total investment cost by 2050: €7.2-€10.6 billion (NPV with 4% discount rate) from ad-hoc payments plus mandatory fixed cables for some chargers.

7.2.3.5 Measures to improve consumer information

Introducing requirements that ensure transparency and information availability will lead to some investment requirements for CPOs and EMSPs.

Ensuring ad hoc price transparency as required under PO1 will not require significant investments and will be limited to IT, app and website adjustments – the same is true for contract-based price transparency in PO2/PO3. Installation of physical display at the recharging stations, as proposed under PO2/3, will lead to additional costs for installing such displays at each recharging station. While it was not possible to determine the costs of such displays, it is expected that many charge points already include such a display, and as such for those this would be a matter of software changes to display the price as per the measure.

The requirement for non-discrimination on prices charged to consumers is unlikely to require any additional investments, although it may lead to changes in business models, thus impacting revenues of AFI operators. This is discussed in more detail in section 7.2.6.

A requirement for the provision of static data by CPOs to Member State NAPs on location, opening time and charging station characteristics is unlikely to result in significant costs beyond those associated with software changes. In most cases, the data is likely to already be available and therefore would not result in additional costs. In addition to the requirements for static data under PO1, PO2/3 will require dynamic data to be provided to Member States NAPs. Since this data is likely to already be recorded, making it freely available should not require significant additional expense. Where dynamic data is not readily available, investments in software development are likely be required.

The most significant expenditure with regards to requirements for consumer information is related to roadside indicators on refuelling stations/charging areas along the TEN-T Core and Comprehensive networks. We have used cost data based on two roadside indicator suppliers' product catalogues to estimate costs for the signs, posts and foundation, and assumed an installation cost of €200 per sign (Schilderwerk Beutha GmbH, 2019) (Bremicker Verkehrstechnik GmbH, 2018). We assumed that 50% of recharging and refuelling stations are already marked by indicators within the parking or recharging/refuelling area and will not require additional investment; for the remaining ones, we assumed that one signpost would be needed. We assumed that 25% of stations are already marked by roadside indicators; for the remaining ones, we assumed two signposts would be needed (one of each direction in the road). The unit costs and the calculations for 2030 are presented in Table 7-32.

Table 7-32: Investment cost associated with roadside indicators along TEN-T Core and Comprehensive (2030 and present value)

	PO1	PO2	PO3
Recharging/refuelling area signposts			
One-off costs (per unit)	€537	€537	€537
Number of units for EV recharging hubs	0	1,777	1,777
Number of units for hydrogen refuelling stations	0	355	355
Total costs	-	€1,144,938	€ 1,144,938
Roadside signposts			
One-off costs (per unit)	€1,372	€1,372	€1,372
Number of units for EV recharging hubs	0	0	5,330
Number of units for hydrogen refuelling stations	0	0	1,066
Total costs	-	-	€8,775,724
NPV 2021-2050 compared to the baseline	**-**	€0.001 billion	€0.004 billion

Sources: Cost estimates based on price catalogue of two road sign suppliers (Schilderwerk Beutha GmbH, 2019) (Bremicker Verkehrstechnik GmbH, 2018). Number of units are based on the number of recharging/refuelling sites expected based on the road transport targets. For PO1 no new requirements are introduced. A discount rate of 4% was considered

As shown, PO3 increases the costs more than eight-fold compared to PO2 in 2030. An overview of the expected costs is presented in Table 7-33 below.

Table 7-33: Overview of expected impacts of measures to improve consumer information on the total investment cost

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Limited investment costs expected on back-office/software changes.
Policy option 2	Total investment cost by 2050: €0.001 billion (NPV with 4% discount rate) for roadside indicators plus limited investment costs expected on back-office/software changes and costs to install displays.
Policy option 3	Total investment cost by 2050: €0.004 billion (NPV with 4% discount rate) for road indicators (including signs in the road corridors).

7.2.4 Costs to authorities - Compliance/investment costs

7.2.4.1 Measures setting targets for AFI for road transport

Meeting the AFI targets set in the policy options will require a significant level of public support. This is expected to be needed for as long as the level of demand remains at low levels and will not be commercially viable.

Currently, a number of MS have adopted relevant support instruments as part of their NPFs (see EAFO and NIRs) (European Parliament, 2018). These are also supplemented by the EU funding – mainly via CEF - that was identified by most stakeholders in the Evaluation study for the Directive as being particularly important for supporting the deployment of AFI.

The financial instruments used may vary, including subsidies or tax credits for the capital, but also often covering operating costs. The level of support provided for charging infrastructure is typically in the range of 30%-50% of the initial investment costs. Table 7-34 summarises the information on the support available at national level. Information for hydrogen infrastructure has not been identified.

Table 7-34: Summary of public support for investment in public charging infrastructure by Member State

Member State	AFI supported	Type of support	Level of support (co-funding rate)
Germany	Electric charging	Grant	50% (national programme) Regional: 50% (Nordrhein-Westfalen) Up to 60% in Bavaria and Saxony-Anhalt
France	Electric charging	Grant	40% up to €1,860/charger
Spain	Electric charging	Grant	30%-40% (up to 60% for public entities)
Finland	Electric charging	Grant	30% for >11kW 35% for >22 kW
Denmark	Electric charging	Tax credit	€0.13 per kWh
Austria	Electric charging	Grant	300-15,000 EUR
Austria	Electric charging for HDVs	Grant	Up to 30,000 EUR
Netherlands	Electric charging	Tax credit	75% of costs
Romania	Electric charging	Grant	Up to 2,500 EUR for <22kW Up to 30,000 EUR for >22kW
Sweden	Electric charging	Grant	50%

Sources: EAFO , EVBOX. (Scheuer, 2020; Noyens, 2020)

At EU level, funding via the CEF Blending Facility typically covers 10%-20% of the capital costs (depending on the type of AFI). CEF funding tends to focus on TEN-T network infrastructure and the development of rapid charging and less so on slower chargers. Most often it has a cross-border nature, namely covering the development of the network across multiple MS.

Table 7-35: Co-funding rates under the CEF Transport Blending Facility (period 2014-2020)

Type of alternative fuel infrastructure	Level of support (co-funding rate)
Electric charging	15%
Hydrogen	20%
LNG	10%
CNG	10%

Source: CEF

Another relevant point to consider is how long this level of public support should be expected to be available. According to a recent study by T&E (T&E, 2018) (that also makes reference to similar conclusions from a study by Cambridge Econometrics (Cambridge Econometrics, 2018a)) investment in fast electric charging along motorways should be expected to be entirely private (i.e. without public funding needed) by 2021 in the countries with a higher level of BEV adoption (so-called 'front-runners')[39]. According to the T&E report, this level of demand will be reached when BEVs represent around 2% of the total fleet. In the case of the less advanced countries (so called 'followers'[40] and 'slow-starters'[41]), public funding of motorways will not be needed after 2028 and 2030 respectively. As argued, after that point, there will no longer be a need for public support to ensure the viability of the specific type of infrastructure.

We consider that this is possibly an optimistic assessment of the level of support that will be needed and that it cannot be applied across the whole TEN-T network. Furthermore, given the role of AFI as being available in sufficient levels across the different parts of the network, a certain level of public funding may always be necessary, even when the level of demand is high. Furthermore, for other parts of the network (e.g. urban slow public chargers), ensuring viability of public charging will most probably require a higher share of BEVs in the fleet.

On the basis of the above, we have developed a scenario describing the level of public support that we expect to be available to cover the infrastructure investment presented in section 7.2.3. This is based on the following set of assumptions:

- All MS will provide public funding for investment in public charging infrastructure within the range of the level of funding already provided in the more advanced MS (in the range of 30%-50%). We have used an assumption of 40% for all MS.
- We assume that the level of support will be the same for slow/normal and rapid/ultra-rapid charging points. While the cost of the former is higher (and thus it may represent a greater barrier), rapid chargers will be installed along the TEN-T where there is a clearer business model for their use. In comparison, slow chargers have a lower cost per charging point but also a less clear business model to ensure viability (i.e. they require greater density in urban areas but less certain/predictable utilisation) at this point.
- In the case of **charging infrastructure of HDVs we do not have information on relevant funding available.** We expect that the level of support will be higher for electric charging for HDVs given the low uptake of electric HDVs. We have assumed a funding of 50% of costs until 2030 across all MS.
- Similarly, in the case of **hydrogen refuelling infrastructure**, public funding needed is expected to remain relatively high given the smaller number of FCEVs and the lower level of demand. We have assumed support of 50% over the period up to 2030.
- Public funding for **LNG and CNG infrastructure** is assumed to be more limited. The analysis in the Evaluation of the AFID already suggested that the level of public support is no more than 10% of the total investment (in line also with the level of funding provided under CEF). We expect that this will not continue after 2030 given that the respective network is relatively well established. Having said that, given that the same infrastructure can be used for bio-fuels, some MS and the relevant associations call for continuing support for the specific type of infrastructure. In our estimates, we have assumed a level of public support of 10% of the total infrastructure costs.

[39] Front-runners are most Western and Nordic countries: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Sweden

[40] Followers: Italy, Portugal and Spain

[41] Slow starters composed of EU13 and Greece: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia

- For all types of AFI we have assumed that the level of support will reduce once the relevant targets set by 2030 have been met to a lower level of 10%. In practice, MS may still decide for a more gradual reduction of support but in the absence of more information he have considered this as a reasonable assumption. We have also assumed that three will be no support for LNG and CNG infrastructure after 2030.
- Finally, while MS follow different practices we have assumed that public subsidies will only cover the initial capital costs and not operating and maintenance.

Table 7-36 below summarises the assumptions made for the average level of public support (in terms of percentage share of the total capital investment) expected to be provided over time for the different types of AFI. We note that there is high level of uncertainty, especially when considering the approach that MS will take after 2030.

Table 7-36 – Scenario of level of public (EU and national) support for the deployment of AFI (% of total capital costs)

Type of AFI	Up to 2030	After 2030
Slow/normal charging points for LDVs	40%	10%
Fast/Ultra-fast charging points for LDVs at TEN-T	40%	10%
Charging points for HDVs	50%	10%
Hydrogen fuelling stations	50%	10%
LNG fuelling stations	10%	No funding
CNG fuelling stations	10%	No funding

Source: Own elaboration and assumptions on the basis of various sources

On the basis of the above scenario and the analysis of the total costs associated with each option, we have estimated the annual average investments by public authorities for each policy option. Public support in comparison to the baseline is estimated at €0.39 to 0.71 billion on average per year up to 2030 and €0.45 to 0.47 billion on average per year for 2031-2050.

Table 7-37: Average annual investments by public authorities for 2021-2030 and 2031-2050 in the baseline and in the policy options (expressed as difference to the baseline)

	Baseline		PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
LDVs recharging points	0.28	0.14	0.21	0.18	0.24	0.19	0.40	0.20
HDVs charging points	0.00	0.00	0.07	0.02	0.07	0.02	0.08	0.02
Hydrogen fuelling facilities	0.13	0.05	0.11	0.25	0.22	0.25	0.24	0.25
CNG fuelling facilities	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LNG fuelling facilities	0.03	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00
Total	**0.46**	**0.19**	**0.39**	**0.45**	**0.51**	**0.45**	**0.71**	**0.47**

Source: Own elaboration based on PRIMES-TREMOVE

At the level of individual MS, the costs for the public sector vary significantly. Table 7-38 below presents the total annual costs for authorities in comparison with the GDP for all policy options. As can be seen, while higher average annual investments are expected in Germany, France, Italy, Spain and Poland, when expressed as a share of GDP they would be less than 0.02% in all Member States in PO1 and PO2 and less than 0.03% in PO3. The highest share of public investments would be required for recharging points for LDVs and hydrogen fuelling facilities.

Table 7-38: Average annual investments by public authorities by Member State for 2021-2030 in the policy options (expressed as difference to the baseline, in €million) and share of GDP

MS	Average annual public investments up to 2030 - difference to the Baseline (€ milion)			GDP at market prices 2020 (€ million)	% share of additional AFI investments in GDP		
	PO1	PO2	PO3		PO1	PO2	PO3
AT	5	7	12	375,562	0.001%	0.002%	0.003%
BE	4	7	12	449,571	0.001%	0.001%	0.003%
BG	7	9	16	60,643	0.011%	0.015%	0.027%
CZ	13	18	24	213,589	0.006%	0.008%	0.011%
DK	3	5	9	309,145	0.001%	0.002%	0.003%
EE	1	2	3	27,167	0.004%	0.008%	0.011%
FI	6	9	13	237,467	0.003%	0.004%	0.006%
FR	35	47	67	2,278,947	0.002%	0.002%	0.003%
DE	68	113	138	3,332,230	0.002%	0.003%	0.004%
EL	13	16	27	165,830	0.008%	0.010%	0.016%
HU	4	7	10	135,529	0.003%	0.005%	0.008%
IE	8	10	13	366,506	0.002%	0.003%	0.003%
IT	65	73	109	1,651,595	0.004%	0.004%	0.007%
LV	3	5	6	29,334	0.011%	0.017%	0.022%
LT	4	5	6	48,794	0.007%	0.010%	0.013%
LU	1	1	2	64,143	0.001%	0.002%	0.002%
NL	6	10	17	796,914	0.001%	0.001%	0.002%
PL	43	49	62	521,515	0.008%	0.009%	0.012%
PT	8	10	15	202,709	0.004%	0.005%	0.008%
SK	4	5	7	91,105	0.004%	0.006%	0.007%
SI	1	2	3	46,297	0.003%	0.005%	0.008%
ES	50	61	82	1,119,976	0.004%	0.005%	0.007%
SE	12	17	23	472,260	0.002%	0.004%	0.005%
RO	14	18	22	217,821	0.007%	0.008%	0.010%
CY	2	3	3	21000.3	0.009%	0.012%	0.015%
MT	1	1	1	12823.8	0.006%	0.009%	0.010%
HR	3	5	6	49,104	0.007%	0.010%	0.012%
EU27	385	514	709	13,297,247	0.003%	0.004%	0.005%

Source: Own elaboration based on PRIMES-TREMOVE and Eurostat

Table 7-39: Overview of expected impacts of measures setting targets for road transport on authorities compliance costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Estimated total annual net costs for all EU MS authorities of €0.39 billion over 2021-2030 and 0.45 billion over 2031-2050 (non-discounted) distributed in the twp periods as follows: • electricity for LDVs: €0.21 billion/€0.18 billion • electricity for HDVs: €0.07 billion/€0.02 billion

	• HRS: €0.11 billion/€0.25 billion • LNG: -€0.01 billion/€0 billion • CNG: €0 billion/€0 billion
Policy option 2	Estimated total annual net costs for all EU MS authorities of €0.51 billion over 2021-2030 and 0.45 billion over 2031-2050 (non-discounted) distributed in the twp periods as follows: • electricity for LDVs: €0.24 billion/€0.19 billion • electricity for HDVs: €0.07 billion/€0.02 billion • HRS: €0.22 billion/€0.25 billion • LNG: -€0.01 billion/€0 billion • CNG: €0 billion/€0 billion
Policy option 3	Estimated total annual net costs for all EU MS authorities of €0.71 billion over 2021-2030 and 0.47 billion over 2031-2050 (non-discounted) distributed in the twp periods as follows: • electricity for LDVs: €0.40 billion/€0.24 billion • electricity for HDVs: €0.08 billion/€0.02 billion • HRS: €0.24 billion/€0.25 billion • LNG: -€0.01 billion/€0 billion • CNG: €0 billion/€0 billion

7.2.4.2 Measures setting targets for AFI for water transport

In light of the total investment costs described above to achieve the targets, it is expected that a portion of these costs will be covered through public support. This is particularly relevant to help port authorities overcome the high capital costs associated with the implementation of waterborne AFI. This will be needed until the market is mature enough such that the demand for these fuels ensures that the business model for deployment is viable.

The public funding will comprise a combination of national policy instruments and EU level funding (mainly through CEF).

There are a few examples of Member States adopting **national support instruments**, albeit to a lesser extent than in road transport. From the evaluation of the Directive, the number of Member States introducing policy measures to support LNG for maritime and inland waterway was ten[42] and four[43] respectively. The same data is not readily available for OPS. However, the evaluation did not present the number of national measures concerning OPS. Typically support instruments include financial support to cover a proportion of CAPEX investments and in a small number of cases include incentives to reduce the OPEX such as reductions to tax and berthing fees to support electricity and LNG use in ports. There is limited information in the NPFs and NIRs that detail the quantitative extent of national funding. Data from Spanish NIR suggest an average level of support on a series of LNG deployment projects at 5%, although in some ports the national funding was as high as 40%.

[42] BE, CY, DE, EL, ES, FI, FR, HU, SE, SK
[43] BE, DE, FI, LT

In addition, **EU level funding** is available via CEF Blending Facility, typically covering around 20% of capital costs, and through the priority call 'Motorways of the Sea' where EU support covers between 20-40% of the costs. CEF funding typically focuses on TEN-T network and, given that all measures affect Core and Comprehensive TEN-T ports, it is likely that all ports would be eligible for some funding. CEF funding to date has tended to favour LNG bunkering over OPS both in terms of number of projects supported and the proportion of total costs covered. Moreover, the CEF funding for OPS tends to be directed towards studies developing the technical specifications rather than deployment per se, indicating that the technical development of OPS is lagging behind LNG to some degree. Nevertheless, if this measure is introduced as part of the AFID, it expected that CEF will support the deployment of OPS deployment to a level comparable to LNG funding in recent years.

In the case of LNG bunkering in maritime ports, given that around three quarters of Core ports already are or plan to be equipped with LNG bunkering, we expect that the level of EU and national public funding may not be as high as previously as the business case for ports will become more sustainable as the market becomes more mature. This has already been observed where CEF projects offered more funding in 2014 than in 2019. After 2030, it is unlikely that the national policy incentives will continue to cover operational expenses as well and, in the limited cases they do exist, they are likely to be negligible when scaled up to an EU level.

Concerning electricity supply to battery electric vessels at inland ports, public funding at the initial stages should be expected to quite high on account that it is a zero-emission technology. As outlined in a study by CCNR (CCNR, 2020), incentives in regional operational programmes for such type of investment may reach a funding rate of up to 85%. However, this is limited to a few MS only where financial support is more widely available, such as the Netherlands, and in most cases the funding will be more in line with the other fuels for shipping. It is difficult to make any prediction in the absence of past experience[44] but we expect this to be higher than the level of support available for LNG and, most probably, for OPS. As such, the respective share of the cost for authorities will also be higher.

On the basis of above, we have developed assumed levels of public funding for each measure for the period up to and after 2030 to apply to all MS, summarised in Table 7-40. We note that there is a level of uncertainty, especially considering the differences in AFI development among MS.

Table 7-40: Estimated level of public funding to support AFI deployment for maritime and inland shipping

Type of AFI	Up to 2030	After 2030
LNG for maritime	20%	No funding
OPS for maritime	25%	No funding
OPS for inland shipping	25%	No funding
Electricity supply for battery electric vessels	25-85%	No funding

On the basis of the above scenario, we have estimated the total public sector costs expected for the periods 2021-2030. These costs only relate to the capital expenditure, which is relevant only for the period up to 2030. We estimate that the total cost to

[44] The only European project focusing on battery electric vessels for inland navigation to date is the ACCEL BARGE project, which was terminated (INEA, 2021).

authorities will be € 255-1,904 million. We note that these are net costs in comparison to the baseline scenario where a number of Member States are already expected to invest in AFI under the current plans.

Table 7-41: Estimated costs to authorities for shipping targets, by policy option

Type of AFI	PO1 (€ billion)	PO2 (€ billion)	PO3 (€ billion)
LNG for maritime	-	-	0.1824-0.513
OPS for maritime	0.244	1.150	1.325
OPS for inland shipping	0.01125	0.06625	0.06625
Cumulative for 2021-2030	0.25525	1.21652	1.57365-1.90425
Average annual per year for 2021-2030	**0.0255**	**0.1217**	**0.1574-0.1904**

Table 7-42: Overview of expected impacts of measures setting targets for waterborne transport on authorities compliance costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Estimated total net costs for all EU MS authorities of €0.0255 billion over 2021-2050 (non-discounted) Costs are expected as part of financial support to support deployment of OPS. This is only relevant to 9 MS. Costs are expected to all MS as part of financial support to support deployment of OPS.
Policy option 2	Estimated total net costs for all EU MS authorities of €0.1217 billion over 2021-2050 (non-discounted) Costs are expected as part of financial support to support deployment of OPS. This is only relevant to 11 MS. Costs are expected to all MS as part of financial support to support deployment of OPS.
Policy option 3	Estimated total net costs for all EU MS authorities of €0.1574-1.904 billion over 2021-2050 (non-discounted) Costs are expected as part of financial support to support deployment of OPS. This is only relevant to 11 MS. Costs are expected to all MS as part of financial support to support deployment of OPS. This is only applicable to 10 MS

7.2.4.3 Measures setting targets for AFI for aviation

The environmental and economic benefits to businesses (described below) has encouraged market driven deployment, particularly in larger airports, and financial support from public bodies to date has been limited. On this basis and considering the high level of deployment to date, it is expected that authorities will only have to provide limited financial support, if at all.

In the NPFs and NIRs, there are few policy measures that support the implementation of electricity supply to aircraft. Furthermore, the policy measures that have been introduced largely concern developing action plans or conducting studies including IE undertaking a life-cycle costs assessment of FEGP; RO assessing the need to deploy FEGP; MT developing a ground supply action plan for TEN-T Core airports. Thus, while there is no evidence of direct national support given to airports to cover the capital costs, some national support may be provided in developing action plans. However, this input will be limited to small number of airports. Similarly, at EU level, there have not been any CEF projects that have covered the investment costs of electricity supply to aircraft.

At the same time, by introducing the measure in the revision of the AFID, the number of airports and the number of stands needed at each airport will increase. Given that large airports are already well equipped, the majority of investment costs will be directed at smaller airports. In the survey, ACI Europe underlined that smaller airports would benefit the most from additional support, especially as it is not easily implemented in many small airports because they frequently 'reconfigure' to accommodate seasonal/annual schedule/aircraft type changes. As such, public support will likely be needed to cover the investment costs of small airports, most likely from national funding. However, it is difficult to determine the proportion of costs covered in such cases, as there is no information available on this. At the same time, it can be expected that the level of public support will increase as a proportion of total costs terms from PO1 to PO2 and PO3 as the number of infrastructure needed increases, particularly for small airports where support is needed.

In the survey, ACI Europe also underlined the impact that COVID-19 has had on the financial status of many airports, which may influence the level of support provided by authorities. Furthermore, the funding could come as part of a wider package supporting the ‘greening’ of airports including other measures such as electrification of ground support vehicles / ground movements and electrical heating for terminal buildings.

Table 7-43: Overview of expected impacts of measures setting targets for aviation on authorities compliance costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Public support to cover compliance costs is only expected in a limited number of smaller airports and in these cases it is expected that the majority of investment costs will be covered by businesses.
Policy options 2 and 3	Public support is expected in a limited number of smaller airports. Compared to PO2, however, the number of infrastructure to be deployed increases. Thus, it can be expected that these policy options will require a greater amount of public funding.

7.2.4.4 Measures to promote interoperability

As noted in section 7.2.2.1, deployment of AFI throughout the EU will likely require a certain level of public support, at least until the level of demand does not make AFI commercially viable. In the cases of the measures to promote interoperability, public support will be more relevant for the ad-hoc payments, as these relate directly to deployment of physical infrastructure. For the other measures (communication and physical standards, technical specifications), financial public support will likely be less relevant, unless any of the standards directly increase the cost of AFI whose deployment is being supported by public funds – that said, some level of public expenditure can be expected in the development of said standards.

For ad-hoc payments, the share of public support is expected to assume the same share as it was considered in section 7.2.2.1. That is, for EV chargers (both slow/normal and fast/ultra-fast), public support is expected to remain at 40% until 2030, decreasing to 2030 after then. This support is expected to cover only CAPEX, and not OPEX.

That said, results from field research indicate that public authorities expect compliance costs for all measures proposed under this problem areas. No details were provided on each types of costs are expected.

An overview of the expected compliance costs to authorities of the measures to promote interoperability is presented in Table 7-44.

Table 7-44: Overview of expected compliance costs for authorities of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Costs expected as part of the financial support to support deployment of AFI. Costs expected to support the development of standards. Not quantified.
Policy option 2	Costs expected as part of the financial support to support deployment of AFI. Costs expected to support the development of standards. Not quantified.
Policy option 3	Costs expected as part of the financial support to support deployment of AFI. Costs expected to support the development of standards. Not quantified.

7.2.4.5 Measures to improve consumer information

As with the measures to promote interoperability, compliance costs for authorities are only expected in the form of subsidies to deploy physical infrastructure. For this group of measures, this is thus more relevant for the measure to install roadside indicators and to install physical displays with prices at the recharging stations. For the other measures on price transparency and user information, no compliance costs are expected for authorities.

Still, as with measures to promote interoperability, authorities indicated that they would incur compliance costs for all measures under this problem area. No details were provided on each types of costs are expected.

An overview of the expected compliance costs to authorities of the measures to promote improve consumer information is presented in Table 7-45.

Table 7-45: Overview of expected compliance costs for authorities of measures to improve consumer information

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	None expected.
Policy option 2	Costs expected as part of the financial support to support deployment of AFI.
Policy option 3	Costs expected as part of the financial support to support deployment of AFI. Higher costs expected as level of total investment is greater than PO3.

7.2.5 Costs to authorities - Enforcement/monitoring costs

7.2.5.1 Measures setting targets for AFI for road transport

In the case of the road transport targets, MS will need to monitor the deployment of different type of AFIs across the different parts of the network and ensure that the relevant targets are being met. The exact level of effort required and the associated costs will depend on the specific provisions adopted and the reporting requirements that are not currently defined. As such, we can only make a general qualitative assessment of the expected impacts at this point.

While there is already a process of data collection as part of the MS reporting under the AFID, this is expected to become more demanding since there will be a broader range of AFI to be monitored and the mandatory nature of the targets. National authorities (directly or via the local/regional authorities) will have in place appropriate mechanisms to ensure that the infrastructure developed meets the minimum requirements set and that it is operational. Authorities will need to have in place plans to ensure that charging points available meet the revised requirement. It is thus reasonable to expect that there will be some additional effort required to the current approach that is limited to collecting and reporting available data on AFI every three years for the NIRs.

Unfortunately, national authorities that contributed to the survey were unable to provide estimates of the expected additional monitoring and enforcement costs, even though the majority of them indicated that they expect these costs to increase. As can be seen in Table 7-46 below, in most cases (with the exception of LNG/CNG), the authorities that responded to the survey indicated that they expect additional costs. Of those that indicated that additional costs are expected, they identified that these include monitoring and reporting costs.

Table 7-46: Responses of authorities concerning the type of costs expected from road transport targets

Mandatory target for	Additional cost expected?		Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
Electric charging for LDVs (n= 15)	Yes	9	8	8
	No	2		
	Don’t know/No answer	4		

Mandatory target for	Additional cost expected?		Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
Electric charging in petrol stations (n= 16)	Yes	7	6	6
	No	5		
	Don't know/No answer	4		
Electric chargers for HDVs (n= 16)	Yes	6	5	5
	No	2		
	Don't know/No answer	8		
CNG fuelling stations LDVs (n= 15)	Yes	4	4	4
	No	2		
	Don't know/No answer	9		
LNG fuelling stations for HDVs (n= 16)	Yes	3	3	3
	No	2		
	Don't know/No answer	11		
Hydrogen fuelling for LDVs (n= 15)	Yes	7	6	5
	No	2		
	Don't know/No answer	6		
Hydrogen fuelling for HDVs (n= 16)	Yes	6	6	6
	No	2		
	Don't know/No answer	8		

Source: Survey of stakeholders

At the same time, most of the relevant data on AFI deployed should be available through electronic means with available online datasets allowing for a desk-based assessment of compliance with the targets set. Similarly, inspections in petrol stations and safe parking areas should not add significant burden as they can take place as part of existing inspection/licencing procedures (or may rely on self-reporting). A comprehensive reporting infrastructure - such as the one developed by the German authorities that includes online reporting tools (OBELIS[45] and SnandortTool[46]) - can be used to facilitate the monitoring and reporting required for the different measures. However, such a level of investment most probably goes well beyond what could be the minimum required for the enforcement and monitoring of the proposed measures.

All in all, while additional resources will most probably be needed, we would not expect these to represent significant additional burden for authorities. In relative terms, the level of effort and associated costs will be higher in the case of the more demanding options PO2 with additional targets and even more so in the case of PO3. However, we would still expect that these costs differences will be relatively small.

[45] Online Platform for reporting on all charging stations funded by the Federal charging infrastructure program. All beneficiaries are required to report on a semi-annual basis information concerning the status of the infrastructure funded with information on the location, costs, access and billing, charging capacity, equipment, network connection https://www.bav.bund.de/DE/4_Foerderprogramme/6_Foerderung_Ladeinfrastruktur/3_1_Berichtswesen/Berichtswesen_node.html;jsessionid=0624B3DFAD9E28F4E23CAF38C6AD95DD.live21321

[46] The StandortTool provides a comprehensive map of available charging infrastructure and the projected charging needs up to 2030. It is intended to serve as a planning support tools for the Federal as well as the regional land local authorities https://www.bmvi.de/SharedDocs/EN/Articles/G/scheuer-charging-stations.html

Based on the information provided in the context of the evaluation study, data collection and reporting costs as part of the development of the NIRs were estimated to be in the range of €0-€55,000 with a median value €5,500 per Member State. Thus, while we would expect the level of effort required to increase, even a ten-fold increase of the costs would only represent a relatively limited reporting cost per Member State.

Table 7-47: Overview of expected impacts of measures setting targets for road transport on authorities monitoring and enforcement costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	No significant additional costs expected – existing monitoring/enforcement procedures to be used – approach may vary among MS
Policy option 2	Limited additional costs expected - higher than PO1
Policy option 3	Limited additional costs expected - higher than PO1 and PO2

7.2.5.2 Measures setting targets for AFI for water transport

As with road transport, MS will need to monitor the deployment of different type of waterborne AFI across the different parts of the network. The exact level of effort required, and associated costs will depend on the specific provisions adopted and the reporting requirements that are not currently defined. As such, we can only make a general assessment of the expected costs.

The data collection process already in place for reporting under the AFID is expected to become more demanding due to the increased scope of AFI and AFV reported and the change in mandatory nature of reporting. This is particularly relevant for the measures addressing OPS for both maritime and inland navigation, which are reported on together, and electricity supply for BEVs, which is not reported on currently. National authorities (directly or via the local/regional authorities) will have to have a place a mechanism to ensure that the infrastructure reported is operational and to check that it ensures compliance with the minimum requirements set. Given that there are no power or capacity requirements for the shipping measures, it is not expected that there will be any significant increase to the level of effort required in the reporting. At the same time, analysis of the NPFs and NIRs shows that in some cases port data is difficult to retrieve or not available at all (such as SE). Thus, in the case that the reporting on associated measures is made mandatory, some additional effort for MS may be expected.

The table below (Table 7-48) summarises the number of national authorities that expect monitoring and enforcement costs from the survey conducted as part of the study. In many cases, there is a significant number of stakeholders that did not know. However, for those that did respond, it can be seen that generally stakeholders expect some additional cost. Despite this, no authorities indicate the extent of the cost expected.

Table 7-48: Responses of authorities concerning the type of costs expected from shipping targets

Mandatory target for	Additional cost expected?	No	Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
LNG for maritime ports (n= 10)	Yes	4	4	4
	No	0		
	Don't know/No answer	6		
OPS for maritime ports (n= 10)	Yes	5	5	5
	No	1		
	Don't know/No answer	4		
OPS for inland ports (n= 10)	Yes	3	3	3
	No	1		
	Don't know/No answer	6		

Source: Survey of stakeholders

On the basis of above, while some additional resources may be required, it is expected that the increased level of effort and additional costs will be limited. PO2 and PO3 represent more demanding options and therefore there will be an additional burden relative to PO1. Nevertheless, the cost differences between each policy option will be small.

Quantifying the additional costs for reporting and enforcement is challenging due to the limited input from stakeholders in the survey. However, the evaluation study indicated that the data collection and reporting as part of the NIRs comprise a small proportion of costs for authorities. As such, even accounting for an increased administrative burden in policy option, the reporting and enforcement costs will not represent a significant cost for authorities. Nevertheless, we note that there may be some differences between Member States depending on their process for data collection and reporting.

Table 7-49: Overview of expected impacts of measures setting targets for waterborne transport on authorities monitoring and enforcement costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Limited additional costs expected to collect information – existing monitoring procedures to be used.
Policy option 2	Limited additional costs expected - higher than PO1.
Policy option 3	Limited additional costs expected - higher than PO1 and PO2.

7.2.5.3 Measures setting targets for AFI for aviation

MS will need to monitor the deployment of electric supply to aircraft across the different parts of the network. The exact level of effort required, and associated costs will depend on the specific provisions adopted and the reporting requirements that are not currently defined. As such, we can only make a general assessment of the expected impacts.

The data collection process already in place for reporting under the AFID is expected to become more demanding due to the increased scope of AFI reported and the change in mandatory nature of reporting. National authorities (directly or via the local/regional authorities) will have to have in place a mechanism to ensure that the infrastructure reported is operational and to check that it achieves compliance with the minimum requirements set. For aviation, the reporting on AFI to date has been lacking compared to other modes of transport and the new measure will require MS to differentiate the number electricity stands between passenger gates and outfield positions. However, there are no power or capacity requirements for each electricity stand, which simplifies the reporting requirements. At the same time, analysis of the NPFs and NIRs shows that in many cases the information on airport infrastructure is not readily available. Thus, in the case that the reporting on associated measures is made mandatory, some additional effort for MS may be expected to ensure AFI within all airports is accounted for.

The table below (Table 7-48) summarises the number of national authorities that expect monitoring and enforcement costs from the survey conducted as part of the study. The responses indicate that authorities expect monitoring/reporting costs. Unfortunately, no authorities indicated the extent of the cost expected and as a result it cannot be quantified.

Table 7-50: Responses of authorities concerning the type of costs expected from aviation targets

Mandatory target for	Additional cost expected?	No	Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
Electricity supply to aircraft (n= 6)	Yes	3	2	1
	No	0		
	Don't know/No answer	3		

On the basis of above, while some additional resources may be required, it is expected that the increased level of effort and additional costs will be limited. PO2 and PO3 represent more demanding options and therefore there will be an additional burden relative to PO1. In particular, the added requirement of reporting on outfield positions may introduce challenges. Nevertheless, the cost differences between each policy option will be small.

Table 7-51: Overview of expected impacts of measures setting targets for aviation on authorities monitoring and enforcement costs

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	MS can expect additional costs for the reporting of AFI across the network. However, given that reporting processes are already in place, these costs are expected to be limited.

Measure	Impact
Policy option 2 and 3	MS can expect additional costs for the reporting of AFI across the network. However, given that reporting processes are already in place, these costs are expected to be limited. The cost difference between PO2/PO3 and PO1 are expected to be small.

7.2.5.4 Measures to promote interoperability

As discussed in section 7.2.5.1, MS will need to monitor the AFI market to ensure that the infrastructure reported is operational and to check that it ensures compliance with the minimum requirements set. As noted in that section, while the increased levels of deployment of infrastructure will lead to additional resources needed, the extra burden is not expected to be significant.

Monitoring and enforcement procedures of the specific measures to promote interoperability will simply form part of those overall monitoring and enforcement efforts related to the deployment of AFI. The additional standards set out in PO3 could increase the burden for national authorities, but there is no indication that any particular measures would represent any significant increase in that burden.

Authorities replying to the field research questionnaire agreed that these measures would bring monitoring and enforcement costs for them, but not details or quantifications were provided (Table 7-52).

Table 7-52: Monitoring/enforcement costs expected for authorities for measures to promote interoperability (field research results)

Measure	Additional costs expected		Number of authorities indicating that they expect	
			Monitoring/ reporting	Enforcement costs
Ad hoc payments (n=14)	Yes	5	3	2
	No	4		
	Don't know/ No answer	5		
Freedom for consumers to choose payment method (n=16)	Yes	4	2	2
	No	4		
	Don't know/ No answer	8		
Physical standards (n=14)	Yes	4	3	3
	No	3		
Communication standards (n=14)*	Don't know/ No answer	7		
	Yes	3	2	2

Measure	Additional costs expected		Number of authorities indicating that they expect	
			Monitoring/ reporting	Enforcement costs
Technical specifications (n=14)	No	5		
	Don't know/ No answer	6		

An overview of the expected monitoring and enforcement costs to authorities of the measures to promote interoperability is presented in Table 7-53.

Table 7-53: Overview of expected monitoring/enforcement costs for authorities of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	No significant costs expected.
Policy option 2	No significant costs expected. More standards could lead to additional burden to monitor compliance.
Policy option 3	No significant costs expected.

7.2.5.5 Measures to improve consumer information

Like with the measures to promote interoperability, monitoring and enforcement procedures of the specific measures to improve consumer information will simply form part of the overall monitoring and enforcement efforts related to the deployment of AFI. No additional significant burden is expected as a result of these specific measures.

Authorities replying to the field research questionnaire agreed that these measures would bring monitoring and enforcement costs for them, but not details or quantifications were provided (Table 7-54).

Table 7-54: Monitoring/enforcement costs expected for authorities for measures to improve consumer information (field research results)

Measure	Additional costs expected		Number of authorities indicating that they expect	
			Monitoring/ reporting	Enforcement costs
Ad hoc price transparency (n=16) Contract based price transparency (n=16)*	Yes	5	3	3
	No	5		
	Don't know/ No answer	6		
Comparability and non-discrimination of prices (n=14)	Yes	4	3	3
	No	3		
	Don't know/ No answer	7		
User information (n=16)	Yes	5	3	4
	No	4		
	Don't know/ No answer	7		
Roadside indicators (n=16)	Yes	6	4	5
	No	5		
	Don't know/ No answer	5		

*Questions on both ad-hoc and contract-based price transparency were asked on the same question on the field research questionnaire.

An overview of the expected monitoring and enforcement costs to authorities of the measures to improve consumer information is presented in Table 7-55.

Table 7-55: Overview of expected monitoring/enforcement costs for authorities of measures to improve consumer information

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	No significant costs expected.
Policy option 2	No significant costs expected.
Policy option 3	No significant costs expected.

7.2.6 Costs on business - Compliance/investment costs

7.2.6.1 Measures setting targets for AFI for road transport

As already indicated, there are significant investments required in order to meet the AFI targets under problem area A concerning road transport and various categories of businesses may be affected, either directly or indirectly. Operators of petrol stations (those with at least 8 pumps), and operators of safe secure parking areas for HDVs will be expected to ensure the presence of relevant infrastructure as set by the policy measures.

Road transport network operators should also be expected to ensure the availability of relevant AFI along the parts of the TEN-T network they manage (if these are not managed directly by the public sector). Measures related to minimum number of infrastructure along the TEN-T or the ratio of AFI to AFVs are expected to be the responsibility of the MS. Through licencing or public procurement contracts with network operators they will aim to meet the relevant targets.

In section 7.2.3 we provided an estimate of the total investment costs associated with the implementation of the specific measures and in section 7.2.4 we presented the expected total costs for the public support. On the basis of the assumed public sector support for capital costs, Table 7-56 and Table 7-57 presents the average annual investment costs and the annual operating costs for each policy option. Slightly higher total and net costs are expected for both PO2 and PO3 in relation to PO1 in the period 2021-2030 with the costs for PO3 being the most significant, mainly driven mainly by the higher costs for charging points for LDVs and HRS. The costs after 2030 are largely similar for all three options.

Table 7-56: Average annual investment costs for private operators for 2021-2030 and 2031-2050 in the baseline and in the policy options (expressed as difference to the baseline)

	Baseline		Net from baseline					
			PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
LDVs recharging points	0.41	1.24	0.32	1.65	0.36	1.68	0.61	1.82
HDVs charging points	0	0.02	0.06	0.15	0.07	0.15	0.07	0.15
Hydrogen fuelling facilities	0.14	0.48	0.12	2.3	0.21	2.21	0.23	2.23
CNG fuelling facilities	0.19	0.11	-0.03	-0.07	-0.03	-0.07	-0.03	-0.07
LNG fuelling facilities	0.28	0.1	-0.05	-0.02	-0.05	-0.02	-0.05	-0.02
Total	**1.03**	**1.96**	**0.41**	**4**	**0.56**	**3.96**	**0.84**	**4.11**

Source: Own elaboration based on PRIMES-TREMOVE model

Table 7-57: Average annual operation costs for private operators for 2021-2030 and 2031-2050 in the baseline and in the policy options (expressed as difference to the baseline)

	Baseline		PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
LDVs recharging points	0.05	0.24	0.02	0.30	0.03	0.31	0.05	0.35
HDVs charging points	0.00	0.00	0.01	0.03	0.01	0.03	0.01	0.03
Hydrogen fuelling facilities	0.04	0.32	0.03	0.91	0.05	0.95	0.12	0.95
CNG fuelling facilities	0.12	0.17	-0.01	-0.09	-0.01	-0.09	-0.01	-0.09
LNG fuelling facilities	0.05	0.18	-0.01	-0.04	-0.01	-0.04	-0.01	-0.04

	Baseline		PO1		PO2		PO3	
	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50	'21-'30	'31-'50
Total	**0.26**	**0.91**	**0.05**	**1.12**	**0.07**	**1.17**	**0.16**	**1.21**

Source: Own elaboration based on PRIMES-TREMOVE model

The above figures provide a high-level estimate of the total investment cost expected for the relevant periods. However, in all of the cases above, businesses should expect to recuperate the costs incurred over time and, to the extent possible, make a profit by charging users for the recharging/refuelling services.

The key issue to consider is the possible risk of underutilisation of the AFI infrastructure, determined by the level of AFV uptake and the resulting energy/fuel demand. In that respect, national targets for charging infrastructure and the definition of the targets for infrastructure along the TEN-T have been set on the basis of the understanding of the level of demand from the MIX scenario. As such, the risk of underutilisation is limited. However, other measures under consideration have not been defined on the same basis.

Stakeholders input and some analysis in the literature (Morris J. , 2020) identify possible risks of underutilisation from the provisions concerning the mandatory deployment of rapid charging points in petrol stations (PO3). ChargeUp Europe (representing the electric vehicle (EV) charging infrastructure industry) pointed out that are differences between charging behaviour and the petrol filling of ICE cars casting doubt to the appropriateness of the specific measures. As argued, drivers prefer charging when the car is parked (work, home, retail shopping, hotel facilities) and this may mean an increased need for parking space within the filling stations. In its absence it is expected that charging points will be underutilised. The Bulgarian Petroleum and Gas Association also considered that there is a risk that such infrastructure will be underutilised, posing a financial burden for decades especially in Eastern Europe. Ionity (charging network operator) also questioned the effectiveness of the measure in ensuring availability of charging infrastructure but did not elaborate further on their comments. At the same time, Ionity and two more stakeholders (CharIN eV and the Latvian authorities) argued that in relative terms the compliance costs for petrol station operators may be substantial, especially for those operated by SMEs. It was claimed that such a requirement could even lead to bankruptcy for many of the smaller operators of petrol stations given the sizeable costs of installation of rapid chargers of over €150 kW (estimated to be around €90k per charger) according to the proposed measure.

Other stakeholders were more positive on the impacts of such a measure. BEUC (representing consumers) considered that petrol stations could benefit from the longer charging time as they could become rest areas and will provide petrol station operators alternative revenue streams. However, we note that this argument is applicable to the larger petrol stations with sufficient space, mainly those along the TEN-T network and located adjustment to services areas. It is probably less relevant for petrol stations in urban areas that often have limited space available and will find it more difficult to accommodate vehicles being parked for longer period. Nonetheless, T&E considered that petrol stations in urban areas usually benefit from the best available locations for vehicle accessibility and that they can serve as charging hubs for electric taxis and shared vehicles (T&E, 2020a). Given the absence of specific experience to this point[47] it is not possible to tell whether the expected positive or negative outcomes will prevail. However, we consider that there is indeed a risks that some petrol station operator will not be able recover the investment costs as a result of the underutilisation of the developed infrastructure are probably greater.

[47] A relevant requirement was introduced in Germany in 2020.

Some concerns were also raised in the case of hydrogen infrastructure. Inputs from a number of stakeholders (including Polis and Eurocities representing local authorities, NGOS like T&E and BEUC, industry associations (EVIC), and authorities (EL, BG)) suggested that setting mandatory targets for hydrogen infrastructure could lead to underutilised assets resulting in significant costs for business (and authorities). Most of the comments provided focused on a possible requirement for the provision of hydrogen infrastructure for light duty vehicles that is considered not viable in view of the very limited actual and expected uptake of fuel cell LDVs. There were no similar objections raised concerning the need for deployment of hydrogen infrastructure for HDVs although there were still questions as to the expected level of demand given the slow uptake of hydrogen HDVs. T&E made a broader point of the relative limited efficiency of the hydrogen HDVs in comparison to electric HDVs (as argued up to 2.3 times lower). As a result they expect the risk of underutilisation of the respective infrastructure is greater. Having said that, given that the proposed measure focuses only on the TEN-T network, the scope for the use of the respective infrastructure may be higher and the respective risk of underutilisation is probably less pronounced than suggested. Nonetheless, introducing the more demanding targets as early as 2025 (under PO3) should be expected to lead to overprovision of hydrogen fuelling capacity – at least in the short term- since the number of FCEVs is expected to remain limited under the MIX scenario assumptions (38k LDV and no HDVs in 2025; less than 0.01% of the total stock). This conclusion is also supported in the analysis provided in Annex B where such a high level of investment should be expected to lead to stranded assets.

There were no similar concerns raised by stakeholders in terms of charging infrastructure for HDVs in safe parking areas and in urban nodes. We note that the level of investment and number of charging and fuelling points needed in both cases are very limited. In the case of liquid hydrogen infrastructure (under PO2 and PO3), the analysis in Annex B points to the fact that such technology is still at an uncertain trajectory. As such, the risk that such infrastructure will remain underutilised is greater, particularly in the case of PO3 where a target for 2025 is under consideration.

Based on the above, at the policy option level, PO1 should be expected to introduce the lowest relative risk of underutilisation of the deployed AFI since it includes measures that are assessed to be closer in line with the expected level of demand. In comparison, PO2, and even more so PO3, introduce a greater relative risk of over-deployment of AFI and thus of reduced returns for businesses.

7.2.6.2 Measures setting targets for AFI for water transport

Section 7.2.4.2 indicates that significant investments are expected to achieve the AFI targets under problem area A concerning maritime and inland waterway transport. As highlighted above, a proportion of these costs will be covered by public authorities. However, approximately three quarters of the investment costs will still be the responsibility of port authorities to ensure that the port is equipped with the correct AFI. The expected costs for port authorities for each measure is summarised below (Table 7-57). Nevertheless, we note that port authorities should be able to recuperate the costs incurred. As highlighted in section 7.2.4.2, the specificities of each port can influence the capital costs of each installation and therefore it is not expected that each port authority will be required to invest the same amount. The key factors influencing cost here are existing grid connections for OPS and the availability of space for LNG.

Overcoming the initial cost may be an issue for some ports and stakeholder input in the survey highlighted concern that, without a significant increase in demand, the costs will need not be recouped. As such, ESPO underlined the importance of creating bottom-up coalitions and framework agreements between all relevant stakeholders in the maritime sector to ensure that the demand for alternative fuels infrastructure matches the supply. It was further stated that risk-sharing by infrastructure users is necessary for effective port-side investments to ensure viable business models. At the same time, T&E noted that one of the principal reasons for lack of demand in vessels is that the AFID leaves the installation of AFI to the discretion of Member States and as a result only a limited number of ports offer such infrastructure. Thus, it is likely that the introduction of this measure will increase the demand, as highlighted in section 7.2.2.2, and help address these concerns.

In the survey, European Federation of Inland Ports (EFIP) underlined that there is not much scope for competition in inland navigation. Most actors are small and do not have the financial resources to compete and thus all actors have to work together in order to deploy any type of AFI. CCNR recently investigated the possibility for joint procurement in greening techniques for the inland navigation sector (CCNR, 2020). In such case, investment costs may be shared across actors including port authorities, transport service operators and river commissions.

As discussed in section 7.2.2.2, converting a ship into an LNG-fuelled ship requires a substantial investment and the technical scope, feasibility, and applicability depends on the ship type/size. For new ships, LNG engines are still more expensive than diesel/distillate-fuelled engines. Similarly, retrofitting ships to ensure compatibility with OPS represents a significant cost (although manufacturing new vessels with this capability does not). Thus, it can be expected that some transport service providers may still be resistant to transition to cleaner vessels, which may introduce delays or difficulties for port operators looking to recuperate their investment.

Table 7-57: Estimations on costs to businesses for the period 2021- 2050 for measures relating to shipping targets – NPV in comparison to the baseline (€ billion)

Fuel/mode	PO1	PO2	PO3
OPS for inland waterways	0.05	0.27	0.31
OPS for maritime	0.9	4.13	4.88
LNG for maritime[48]	-	-	1.23

7.2.6.3 Measures setting targets for AFI for aviation

As highlighted in section 7.2.4.2, the majority of investment costs are expected to be covered by businesses. In particular, the capital costs will be the responsibility of airport operators while the ongoing costs will fall to air transport service providers. Despite this, we expect that businesses will be able to recuperate the costs incurred over time, as the cost of using FEGP would be reflected in airport tariffs for using ground equipment and airlines will benefit from fuel savings. However, public funding would still be necessary to overcome the initial costs, particularly for smaller airports with financial constraints.

As described in section 7.2.2.3, many airports already have a high level of infrastructure. As such, the financial burden on each airport is not expected to be high. Smaller airports will be disproportionately affected as they have the least developed existing infrastructure. In these cases, overcoming the initial cost may be an issue. Furthermore, as a result of COVID-19, many airports are not in a secure financial

[48] For the purposes of estimating the costs to businesses, we have assumed that each port has been equipped with STS.

situation and their capacity to invest is significantly compromised until the normal level of air traffic resumes in around 2024-25.

The specificities of each airport will also play a role in the costs incurred. Airport size plays a role, but it also depends on the types of operations, how much the airport uses outfield positions and whether low cost airlines are predominant at the airport[49]. An additional consideration for airports is the electric power supply capacity required to support aircraft. FEGP is very power intensive, whereas airports have finite available electrical power supply capacity, and there may be limits and cost barriers to how much it can be expanded to accommodate FEGP. This means that to enhance electrification, airports might have to prioritise it over different uses of electricity such as provision to ground vehicles. Furthermore, the ability to use FEGP also depends on the electricity network in the area where the airport is located, not simply the airport itself. In some cases, where fixed systems are not able to supply power to satisfy aircraft's requirements, it could have significant implications on the investment required to improve the grid.

7.2.6.4 Measures to promote interoperability

As discussed in section 7.2.6.1, most costs for business will be derived from the need to deploy AFI. Some of the measures included in this problem area will add to that burden, namely the requirement for the availability of ad-hoc payments and on technical specifications. Depending on the standards that are ultimately imposed, measures on physical and communication standards are also to expect to add additional costs. For all measures, the extra requirements in PO2/3 will add to the cost burden – more details on the costs expected for each of the measures have been discussed in section 7.2.3;; most of these costs are expected to be incurred by businesses.

Still, as discussed in section 7.2.4.1 some of those investments are likely to be supported by public funding: in this study, it is assumed that the share of private investment will stay at 60% until 2030 and then increase to 90% for EV charging.

Results from field research, indicate that stakeholder agree that industry will be expected to have compliance costs derived from all measures in this problem areas (Table 7-58). No quantification was provided for any of the measures.

Table 7-58: Compliance costs expected for businesses for measures to promote interoperability (field research results)

Measure	Additional costs expected		Indication of type of additional costs:		Nature of costs expected
			One-off compliance costs	Ongoing compliance costs	
Ad hoc payments (n=15)	Yes	1	1	1	Implement the requirement
	No	4			
	Don't know/ No answer	10			
Freedom for consumers to choose payment	Yes	1	1	1	Implement the requirement
	No	4			
	Don't know/ No answer	14			

[49] Low cost airlines have short turnaround times and are therefore not able to take advantage of FEGP

method (n=19)					
Physical standards (n=15)	Yes	3	3	2	Implement the requirement
	No	4			
	Don't know/ No answer	8			
Communication standards (n=15)*	No	2			
	Don't know/ No answer	13			
Technical specifications (n=15)	Yes	3	3	1	Implement the requirement
	No	2			
	Don't know/ No answer	10			

**Questions on both physical and communication standards were asked on the same question on the field research questionnaire.*

An overview of the costs per measure and policy is provided in section 7.2.7.4.

7.2.6.5 Measures to improve consumer information

As with the measures to promote interoperability, compliance costs for businesses, related to the requirements imposed by the different measures. For this group of measures, the more relevant costs relate to the measure to install roadside indicators and to install physical displays with prices at the recharging stations. More details on the costs expected for each of the measures have been discussed in section 7.2.3; most of these costs are expected to be incurred by businesses.

For those costs that will have the support of public funding, as noted above, it is assumed that the share of private investment will stay at 60% until 2030 and then increase to 90% for EV charging. For hydrogen refuelling (relevant for the measure on roadside indicators), the share of private investment is assumed to stay at 50% until 2030, and to also reach 90% after that.

Results from the field research seem to indicate that industry stakeholders do not expect many compliance costs related to these measures, as at most only two stakeholders indicated expectations for compliance costs (Table 7-59).

Table 7-59: Compliance costs expected for businesses for measures to improve consumer information (field research results)

Measure	Additional costs expected		Indication of type of additional costs:		Nature of costs expected
			One-off compliance costs	Ongoing compliance costs	
Ad hoc price transparency (n=19)	Yes	2	1	2	Implement the requirement
Contract based price transparency (n=19)	No	4			
	Don't know/ No answer	13			

Measure	Additional costs expected		Indication of type of additional costs:		Nature of costs expected
			One-off compliance costs	Ongoing compliance costs	
Comparability and non-discrimination of prices (n=15)	Yes	0	0	0	Implement the requirement
	No	5			
	Don't know/ No answer	13			
User information (n=19)	Yes	1	1	1	Implement the requirement
	No	3			
	Don't know/ No answer	15			
Roadside indicators (n=19)	Yes	1	1	1	Implement the requirement
	No	4			
	Don't know/ No answer	14			

An overview of the costs per measure and policy is provided in section 7.2.7.5.

7.2.7 Costs on business - Enforcement/monitoring costs

7.2.7.1 Measures setting targets for AFI for road transport

We should note that, as in the case of the costs to authorities, it is very difficult to make an assessment of the enforcement and monitoring costs in the absence of specific information on the relevant provisions.

In general terms, we expect that operators of the relevant infrastructure along the TEN-T, and operators of petrol stations and of safe and secure parking will be required to prove that the relevant AFI is in place and operational. This should not be expected to require significant resources. Any reporting of infrastructure deployed and operating linked to funding provision (as in the example on the case of the German OBELIS platform), should not be considered a cost associated with the implementation of the targets under AFID.

This conclusion seems to be supported by relevant business representatives that contributed to the survey conducted for the study. Only a very small number identified relevant monitoring/reporting and enforcement costs (see Table 7-61). Among those that indicated that enforcement costs may arise, the focus was on the possible penalties in the case of non-compliance or the relevant legal dispute costs. In the absence of specific information on the penalties applicable it is not possible to assess the significance of any such costs, if any.

Table 7-61: Responses of business and business representatives concerning the type of costs expected from road transport targets

Mandatory target for	Additional cost expected?	No	Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
	Yes	5	2	1

Mandatory target for	Additional cost expected?	No	Number of authorities indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
Electric charging for LDVs (n= 25)	No	8		
	Don't know/No answer	12		
Electric charging in petrol stations (n= 18)	Yes	3	1	2
	No	4		
	Don't know/No answer	11		
Electric chargers for HDVs (n= 27)	Yes	4	2	1
	No	8		
	Don't know/No answer	15		
CNG fuelling stations LDVs (n= 25)	Yes	2	0	0
	No	4		
	Don't know/No answer	19		
LNG fuelling stations for HDVs (n= 27)	Yes	1	0	0
	No	6		
	Don't know/No answer	20		
Hydrogen fuelling for LDVs (n= 25)	Yes	3	1	1
	No	6		
	Don't know/No answer	16		
Hydrogen fuelling for HDVs (n= 27)	Yes	3	1	1
	No	5		
	Don't know/No answer	19		

Source: Survey of stakeholders

All in all, we do not expect any significant enforcement/monitoring and administrative costs for business arising as a direct result of the road transport targets.

The table below summarises the total costs (compliance and enforcement) on business from the road transport measures on the basis of the analysis presented in this section and in section 7.2.6

Table 7-62: Overview of expected costs (compliance and enforcement) on businesses from measures on road transport (net costs in comparison to the baseline)

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Sizeable total costs for AFI providers - depending also on the level of public support: net total annual investment costs of €0.41 billion and operation costs of €0.05 billion for the period 2021-2030; net total of €4 billion investment and €1.12 billion operating costs for 2031-2050 respectively. Expected to be recovered over time from the usage charges/fees – low risk of underutilisation. No/limited enforcement/monitoring costs expected from the specific measures.

Measure	Expected impact
Policy option 2	Sizeable total costs for AFI providers - depending also on the level of public support – slightly higher than PO1 : net total annual investment costs of €0.56 billion and operation costs of €0.07 billion for the period 2021-2030; net total of €3.96 billion investment and €1.17 billion operating costs for 2031-2050 respectively. Expected to be recovered over time from the usage charges/fees – low risk of underutilisation. No/limited enforcement/monitoring costs expected from the specific measures.
Policy option 3	Sizeable total costs for AFI providers - depending also on the level of public support – higher than PO2 : net total annual investment costs of €0.84 billion and operation costs of €0.16 billion for the period 2021-2030; net total of €4.11 billion investment and €1.21 billion operating costs for 2031-2050 respectively. Expected to be recovered over time from the usage charges/fees – low risk of underutilisation. No/limited enforcement/monitoring costs expected from the specific measures.

7.2.7.2 Measures setting targets for AFI for water transport

For waterborne targets under problem area A, it is not expected that significant enforcement and monitoring costs will be incurred as a result of the measures introduced. While port authorities will have to report to a public body on the number of AFI installations and prove that it meets the required operational standards, we do not anticipate that this will require significant resources. Furthermore, a reporting process will already be in place in the majority of ports and therefore it is unlikely to be any significant change to the administrative burden as a result of these measures. The measure supporting LNG for maritime ports represents the only case where an additional cost may arise regarding the enforcement of safety standards in ports when handling LNG. To ensure safety standards are met, additional safety courses may be required for port operators and crew members of vessels. However, this cost has been incorporated into the estimated total investment costs.

Table 7-63 summarises the stakeholder input from the survey regarding the enforcement and monitoring costs expected by industry. In line with our thinking, it shows that while businesses expect some additional (compliance) costs, these are not relevant to the enforcement/monitoring costs described for waterborne modes under problem area A. Hence, it can be concluded that all enforcement/monitoring and administrative costs for waterborne targets can be considered to be negligible.

Table 7-63: Responses of business and business representatives concerning the type of costs expected from waterborne transport targets

Mandatory target for	Additional cost expected?	No	Number of industry indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
LNG for maritime ports (n= 6)	Yes	3	0	0
	No	3		
	Don't know/No answer	12		
	Yes	2	0	0

Mandatory target for	Additional cost expected?	No	Number of industry indicating that they expect	
			Monitoring/ reporting costs	Enforcement costs
OPS for maritime ports (n= 6)	No	4		
	Don't know/No answer	12		
OPS for inland ports (n= 6)	Yes	2	0	0
	No	4		
	Don't know/No answer	12		

Source: Survey of stakeholders

The table below summarises the total costs (compliance and enforcement) on business from the water transport measures on the basis of the analysis presented in this section and in section 7.2.6

Table 7-64: Overview of expected costs (compliance and enforcement) on businesses from measures on waterborne transport

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy Option 1	Expected total net costs in comparison to the baseline (period 2021-2050) of €0.95 billion across the EU, with larger ports experiencing greater costs for installation of greater capacity. It is expected that business will be able to recuperate the initial expenditure over time.
Policy option 2	Expect total net costs in comparison to the baseline (period 2021-2050) of €4.4 billion across the EU related mainly for OPS for maritime, with larger ports experiencing greater costs for installation of greater capacity. Moderate risk that smaller ports on the comprehensive network will not be able recuperate costs due to low traffic volume.
Policy option 3	Expect total net costs in comparison to the baseline (period 2021-2050) of €6.4 billion across the EU related to OPS and LNG for maritime and , with larger ports experiencing greater costs for installation of greater capacity. it is expected that business will be able to recuperate the initial expenditure over time. High risk that smaller ports on the outside the TEN-T network will not be able recuperate costs due to low traffic volume.

7.2.7.3 Measures setting targets for AFI for aviation

For aviation targets, it is not expected that significant enforcement and monitoring costs will be incurred as a result of the measures introduced. While port authorities will have to report to a public body on the number of AFI installations and prove that it meets the required operational standards, we do not anticipate that this will require significant resources. Furthermore, a reporting process will already be in place in the majority of larger airports and therefore it is unlikely to be any significant change to the administrative burden as a result of these measures. Smaller airports could expect to incur an additional cost for monitoring if they do not already report to public bodies.

In the survey, only one industry member indicated they would expect monitoring/reporting costs, while no industry stakeholders expect enforcement costs. This is expected given that these costs are more relevant to authorities than industry. Although the total number of responses were limited, we conclude that enforcement/monitoring and administrative costs for waterborne targets can be considered to be negligible.

The table below summarises the total costs (compliance and enforcement) on business from the aviation measures on the basis of the analysis presented in this section and in section 7.2.6

Table 7-65: Overview of expected costs (compliance and enforcement) on businesses from measures on aviation

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Airports will be expected to cover most of the investment costs, which may disproportionately affect smaller airports on the basis that they have the least developed infrastructure currently. Limited enforcement/monitoring costs expected for businesses.
Policy options 2 and 3	Airports will be expected to cover most of the investment costs, which may disproportionately affect smaller airports on the basis that they have the least developed infrastructure currently. Compliance costs for PO2/PO3 are expected to be around four times the costs of PO1 for businesses. Limited enforcement/monitoring costs expected for businesses.

7.2.7.4 Measures to promote interoperability

Businesses can be expected to incur some monitoring and administrative costs related to the measures. This could be, for example, to prove that relevant AFI is in place and in compliance with all the requirements. Still, this is not expected to require significant resources. As noted in section 7.2.7.1, there is the possibility that businesses might also incur financial penalties if not in compliance with some of the measures; however, it is not possible to estimate the extent of those penalties, if they are indeed implemented.

Results from the field research indicate that industry stakeholders agree with this assessment, with most stakeholders not expecting enforcement/monitoring costs related to these measures (Table 7-66).

Table 7-66: Monitoring/enforcement costs expected for businesses for measures to promote interoperability (field research results)

Measure	Additional costs expected		Number of industry indicating that they expect	
			Monitoring/ reporting	Enforcement costs
Ad hoc payments (n=15)	Yes	1	0	0
	No	4		
	Don't know/ No answer	10		
Freedom for consumers to choose payment method (n=19)	Yes	1	1	1
	No	4		
	Don't know/ No answer	14		
Physical standards (n=15)	Yes	3	1	1
	No	4		
	Don't know/ No answer	8		
Communication standards (n=15)*	No	2		
	Don't know/ No answer	13		
Technical specifications (n=15)	Yes	3	0	0
	No	2		
	Don't know/ No answer	10		

**Questions on both physical and communication standards were asked on the same question on the field research questionnaire.*

The table below summarises the total costs (compliance and enforcement) on business from the interoperability measures on the basis of the analysis presented in this section and in section 7.2.6

Table 7-67: Overview of expected monitoring/enforcement costs for businesses of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Limited costs expected as part of the deployment of AFI and implementation of standards. Limited enforcement/monitoring costs expected.
Policy option 2	Limited costs expected as part of the deployment of AFI and implementation of standards – although higher than PO1Small costs expected to comply with measure, including back-office/software changes. Limited enforcement/monitoring costs expected.
Policy option 3	Costs expected as part of the deployment of AFI. PO3 expected to have larger costs than PO1 or PO2. Limited enforcement/monitoring costs expected.

7.2.7.5 Measures to improve consumer information

As with the measures to promote interoperability, no significant costs are expected for businesses related to the monitoring and enforcement of the measures to improve consumer information. These results were also confirmed by the field research (Table 7-68).

Table 7-68: Monitoring/enforcement costs expected for businesses for measures to improve consumer information (field research results)

Measure	Additional costs expected		Number of industry indicating that they expect	
			Monitoring/ reporting	Enforcement costs
Ad hoc price transparency (n=19) Contract based price transparency (n=19)	Yes	2	1	1
	No	4		
	Don't know/ No answer	13		
Comparability and non-discrimination of prices (n=15)	Yes	0	0	0
	No	5		
	Don't know/ No answer	13		
User information (n=19)	Yes	1	1	1
	No	3		
	Don't know/ No answer	15		
Roadside indicators (n=19)	Yes	1	1	1
	No	4		
	Don't know/ No answer	14		

The table below summarises the total costs (compliance and enforcement) on business from the measures to improve consumer information on the basis of the analysis presented in this section and in section 7.2.6

Table 7-69: Overview of expected monitoring/enforcement costs for businesses of measures to improve consumer information

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Limited investment/enforcement/monitoring costs expected.
Policy option 2	Costs expected as part of the deployment of AFI and implementation of standards. Limited enforcement/monitoring costs expected.
Policy option 3	Increased costs compared to PO2 from the requirement to install signs in the road corridor as well.

Measure	Impact
	Limited enforcement/monitoring costs expected.

7.2.8 Benefits for businesses

7.2.8.1 Measures setting targets for AFI for road transport

The adoption of the proposed measures for the deployment of AFI should bring certain important benefits for businesses in a number of sectors, including for business in the AFI equipment and services sectors, providers of transport services and manufacturers of AFVs and relevant equipment.

There will be significant direct benefits for the manufacturers of AFI equipment and other businesses along the broader AFI ecosystem (i.e. suppliers of parts/components, software developers, EMSPs and relevant platforms, other support services providers). The new targets will lead to a significant increase in the demand for the relevant AFI and supporting services while also providing high level of predictability in terms of the future demand prospects and relevant opportunities. A total net annual investment and operation on AFI for road transport at the level of €58.9 billion is expected to be required for the period 2021-2050 under PO3 with additional €8-11 billion between 2021-2050 for OPS and LNG measures for waterborne transport, providing substantial business opportunities. All policy options should bring relevant benefits, with PO2 and PO3 expected to have a higher impact due to the slightly higher level of AFI deployed. Furthermore, the increase in the level of investment expected should also help reach the relevant economies of scale for the manufacturers of AFI as well as the service providers, allowing for efficiencies and cost reductions for the relevant businesses.

For the **providers of transport services** (passenger and freight transport) the increased availability of public AFI could facilitate the switch to AFVs with the resulting benefits in terms of the reduction in the total cost of ownership. We note though that most of the providers of such services, especially those operating within urban areas, should not be expected to rely on the availability of public AFI for recharging/refuelling of their AFVs. Private infrastructure in service/parking depots used overnight is most relevant in this case. As such, the development of public infrastructure should only have a limited positive impact for this type of transport services. There is greater possible contribution from the measures focusing on the development of AFI (for both LDVs and HDVs) across the TEN-T (relevant for all policy options) that is relevant for inter-urban, long-haul transport where there will be a need for access to public infrastructure. In that respect, by ensuring a minimum infrastructure across the whole TEN-T network, transport services providers (passenger or freight) will have greater level of certainty and will be able to use AFVs across the whole EU transport network.

For **vehicle manufacturers and suppliers** along the supply chain, the road transport targets for AFI are expected to lead to an increase in the share of sales of clean vehicles under all policy options as a result of the provision of infrastructure (as presented in section 7.2.2.1.2). An increase in the level of sales of for AFVs – instead of ICE vehicles – should have a positive impact on their revenues since prices of AFVs are higher than those of ICE vehicles (European Parliamentary Research Service, 2019), although this may change over time (T&E, 2020b). The same impact may not apply for the profit margins of OEMs that, at least during the initial stages of the adoption of AFVs, are smaller than those for ICEV. However, it will largely depend on the specific pricing strategies of vehicle manufacturers and may not apply across the whole sector. Furthermore, the net impacts of the adopted policy option will apply only to a few MS. As such, the overall impact for the sector, while still positive, may be limited.

Table 7-70: Overview of expected benefits on businesses of measures on road transport

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact for AFI manufacturers in terms of the demand for AFI equipment but also for AFI operators and relevant services provided by the expected development of the market across the EU. Net impact will be more significant in MS with limited current capacity.
Policy option 1	Positive impact for AFI manufacturers (higher than PO1) in terms of the demand for AFI equipment but also for AFI operators and relevant services provided by the expected development of the market across the EU. Net impact will be more significant in MS with limited current capacity. Expected benefit from increased availability of HRS. Ensure availability of minimum relevant infrastructure across the TEN-T network for transport services providers
Policy option 3	Positive impact for AFI manufacturers (similar to PO2) in terms of the demand for AFI equipment but also for AFI operators and relevant services provided by the expected development of the market across the EU. Net impact will be more significant in MS with limited current capacity. Potential benefit from increased availability of HRS but questionable in the absence of sufficient demand.

7.2.8.2 Measures setting targets for AFI for water transport

As described in section 7.2.2.2, the measures concerning shipping targets will increase the deployment of port side infrastructure. As a result, these measures will bring benefits to port authorities and other players in the maritime and inland navigation sectors.

As with the measures for road transport under problem area A, the new targets will increase the demand for AFI and supporting services and thus will bring benefits for the manufacturers of AFI equipment and other businesses along the AFI value chain (i.e. suppliers of parts/components, software developers, and other support services providers). The measures will provide certainty to the AFI market and, as the measures become more demanding through the policy options, the business opportunities for AFI manufacturers will increase. Furthermore, the increase in the level of investment expected should also help reach the relevant economies of scale for the manufacturers of AFI as well as the service providers, allowing for efficiencies and cost reductions for the relevant businesses.

For vessel manufacturers, the shipping targets could lead to an increase in the share of LNG vessels or vessels that are compatible with alternative fuels, as described in section 7.2.2.2. This will have a positive impact on the revenues for sales of new vessels and business opportunities for retrofitting vessels. The investment costs for both manufacturing and retrofitting AFVs remains higher than conventional fuel technologies. Nevertheless, the increase in demand for these services will improve the efficiency of manufacturing processes as it scales up and the ultimately reduce the costs.

Given that transport service providers (passenger and freight transport) are solely reliant on public infrastructure within ports, the increased availability of port side AFI will help transport service providers to switch to AFVs and benefit from associated cost reductions. The price of LNG is often lower than that of other marine fuels (depending on the bunkering method) and the total cost of ownership of LNG ships is generally lower (CE Delft, 2015) (UMAS, 2018). Meanwhile, using OPS can result in a reduction of energy costs by 71% at berth (JUAN GUTIÉRREZ SÁENZ, 2019). Thus, the greater availability of AFI through the policy options will also result in greater cost savings for operators of AFVs. As the port operations using these fuels are scaled up, it is likely that these costs will decrease even further.

Table 7-71: Overview of expected impacts of shipping targets on benefits to businesses

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Benefits will be brought to manufacturers of AFI and supporting services, vessel manufacturers and retrofitters and transport service providers as a result of OPS measures for inland and maritime ports with increasing impact as the market grows.
Policy option 2	Benefits will be brought to manufacturers of AFI and supporting services, vessel manufacturers and retrofitters and transport service providers, with increasing impact as the market grows as a result of the measures for OPS and LNG for inland ports – more than PO1.
Policy option 3	Benefits will be brought to manufacturers of AFI and supporting services, vessel manufacturers and retrofitters and transport service providers as a result of the measures for OPS and, LNG with increasing impact as the market grows – more than PO1 and PO2.

7.2.8.3 Measures setting targets for AFI for aviation

The adoption of the proposed measures for the deployment of AFI should bring certain important benefits for businesses. In particular, AFI equipment and service sectors and air transport service providers are expected to have the greatest benefits from the adoption of these measures.

There will be direct benefits **for the manufacturers of AFI equipment and other businesses along the broader AFI ecosystem** (i.e. suppliers of parts/components and electricity service providers). The new targets will lead to an increase in the demand for the relevant AFI and supporting services while also providing high level of predictability in terms of the future demand prospects and relevant opportunities. All policy options should bring relevant benefits but PO2 and PO3 are expected to have higher impact on the basis that more aircraft stands will be equipped with electricity. However, given the level of existing infrastructure, the additional benefits brought by this measure may be limited. In the survey, ACI Europe went as far as to say there would be no impact on economic activity, innovation or competitiveness.

Air transport service providers can expect to benefit from the fuel savings as a result of switching to use of FEGP over APU, which has high kerosene consumption and maintenance costs. It is estimated that the use of ground equipment to replace the APU could generate fuel savings of €150,000 to €600,000 per year, per aircraft (JRC, 2020), depending on the type of aircraft (Guinault, 2001). As the availability of FEGP is increased from PO1 to PO2 and PO3, so are the opportunities for fuel savings. While many of the international airlines are using FEGP larger airports when available, the measure will present greater opportunity for air transport service providers operating domestically to use FEGP at smaller airports. Theoretically, PO2 and PO3 presents a situation where airlines will be able to use FEGP for all turnarounds. With this, there is also a corresponding increase in electricity demand, which will benefit electricity retailers and generation companies.

Table 7-72: Overview of expected impacts on benefits for businesses of aviation targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	FEGP presents benefits to AFI manufacturers and air transport service providers. Air transport service providers can expect to save significant amounts of money by using FEGP.
Policy options 2 and 3	FEGP presents benefits to AFI manufacturers and air transport service providers. Air transport service providers can expect to save significant amounts of money by using FEGP and PO2/PO3 will make AFI available throughout the EU such that all service providers can benefit.

7.2.8.4 Measures to promote interoperability, measures to improve consumer information and measures to support grid integration

As discussed in section 7.2.8.1, measures that lead to greater deployment of AFI can have positive impacts for some businesses. Namely, that is the case AFI equipment manufacturers and associated enterprises. AFV manufacturers can also be positively benefited if the measures lead to an increase uptake of these vehicles – as it is expected, see section 7.2.2.1. For AFI operators, the balance would depend on the level of demand: if demand is lower than expected, the extra costs associated with the deployment of these measures could result in overall negative benefits; but if the increased uptake of AFV is enough to balance the extra investment needed, these operators can also have experience positive benefits.

In the specific case of measures under discussion in these problem areas, any measures that promote standardisation (e.g. physical or communication standards, as well as technical specifications) could help support the existence of a level playing across the market – albeit sometimes that could happen at the expense of the business models of some market players being negatively affected. As noted in section 7.2.3, some of these measures (notably on ad-hoc payments[50]) can lead to significant costs, which can negatively impact some businesses, especially if the uptake of AFVs is not enough to compensate those costs. Overall, it is not possible to definitely conclude about the level of or quantify the expected benefits.

[50] As noted, there is also some overlap in the capabilities (e.g. connectivity) needed to implement such measures, so there might be some (non measurable) efficiency gains from implement the combined measures.

7.3 Social impacts

7.3.1 Introduction

The analysis of social impacts covers the following impact categories arising from measures identified under each policy option:

- Impact on costs of mobility and on mobility services.
- Impact on consumers and households.
- Impact on prices of goods.
- Impact on public health.
- Impacts on employment and job skills.

The assessment of social impacts has mainly relied on input from stakeholders and desk research, but drawing on the outputs of the PRIMES-TREMOVE model where considering the impacts on the prices of AFVs and to fuel costs that will result from the faster uptake of AFVs and the deployment of alternative fuels infrastructure (in problem area A).

7.3.2 Impact on consumers and households

7.3.2.1 Measures setting targets for AFI for road transport

The impact on consumers and households is related to the following parameters:

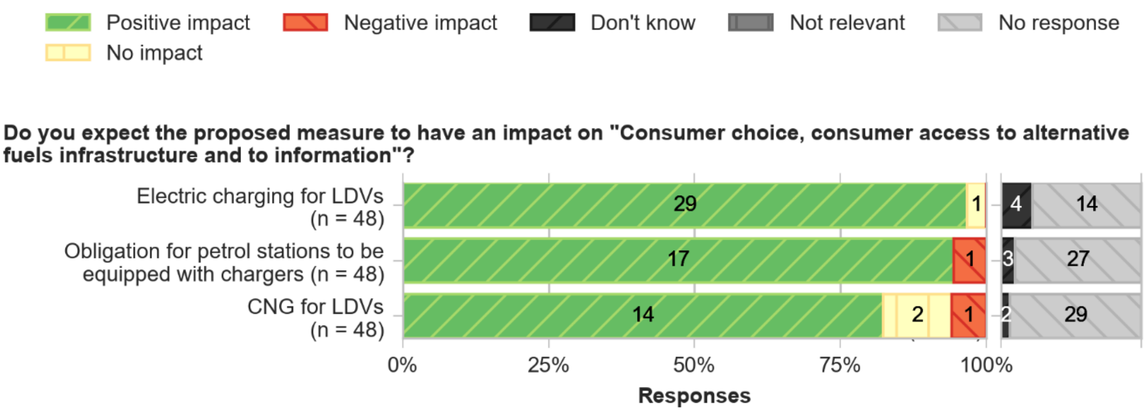
- The availability of AFI, and thus the options available to switch to AFVs.
- To relative impact on the costs of use of AFI.
- The relative impact on costs for the use of mobility and transport services.

In relation to the former, the proposed measures will, at different levels, contribute to an increased availability of AFI across the TEN-T and, depending on the specific policy options, the urban/residential areas at sufficient level. In relative terms, PO2 and PO3 will be more effective since they will ensure a more comprehensive coverage of the TEN-T across MS. All options will help reduce the actual and psychological barrier associated with switching to AFVs from ICE, primarily in relation to electric vehicles and, less so, in relation to fuel cell vehicles. Furthermore, it will not only ensure that a minimum level of AFI is available but also that this will apply across all MS and the EU transport network.

The large majority of stakeholders supported this positive assessment for all the measures relevant for LDVs in terms of consumer choice, access to AFI and relevant information[51].

Figure 7-11: Stakeholder input on the expected impact of the proposed targets for road transport AFI on consumer choice, consumer access to AFI and information

[51] Only one industry stakeholders (ChargeUP Europe) considered the measures related to electric charging in petrol stations as having a negative impact. T&E expressed the same view for the CNG measure.



The increased availability of AFI from the proposed measures should benefit consumers directly by leading to reduced overall prices for the use of recharging/refuelling services. This should come from a combination of reduced AFI deployment costs over time (as a result of economies of scale), and the higher level of competition across the whole of the EU – and not only in the more advanced markets. All options should have similar impact although Policy Options 2 and 3 may lead to even greater benefits to consumers since they ensure a more complete coverage of the network. However, this process may take time and in the initial stages the high level of investment involved - including the more expensive rapid charging infrastructure - may lead to higher premiums. Nonetheless, this premium should still be lower than that arising from the overall reduction in the cost of transport.

Furthermore, by reducing the barriers associated with the purchase and use of AFVs, consumers and households will also benefit from the overall reduced cost of ownership of AFVs (mainly referring to electric vehicles) when compared to ICE vehicles. BEVs have higher upfront costs in comparison to ICE vehicles (even after the provision of significant purchase subsidies in place across most MS) but these are counterbalanced by the reduced running costs of AFVs leading to a lower overall total cost of ownership (TCO). As shown in (Hill, et al., 2018) scenarios with increased share of zero emission vehicles are expected to lead to reduced average TCO, with higher net benefits for higher share of ZEV in the fleet. As a result, while they may face higher initial capital costs, overall consumers and households will benefit from a reduction in the relative share of transport costs to the total household expenditures[52]. Consumers and households with lower incomes may find it more challenging to purchase new AFVs, but through the second hand market they should also have access to the same benefits as first time users.

When considering specific measures, a number of stakeholders indicated that they expect negative impacts from the targets on electric charging and even more so in relation to the mandatory deployment of charging infrastructure in petrol stations. The main reason is the risk of increased costs to cover the limited use of the deployed infrastructure (especially in the MS will low level of demand) and the indirect costs from the increased use of parking space within petrol stations that will also lead to higher rates charged. Having said that, most stakeholders did not consider that the overall impact on costs will be negative.

[52] Transport costs represented 13.1% of total household consumption in 2019 with the operation of personal transport equipment being the largest part (7.1% of total), followed by vehicle purchase costs (3.4%) and transport services (2.3%); Final consumption expenditure of households by consumption purpose (COICOP 3 digit) [NAMA_10_CO3_P3__custom_663473]

Figure 7-12: Stakeholder input on the expected impact of the proposed targets for road transport AFI on costs to consumers

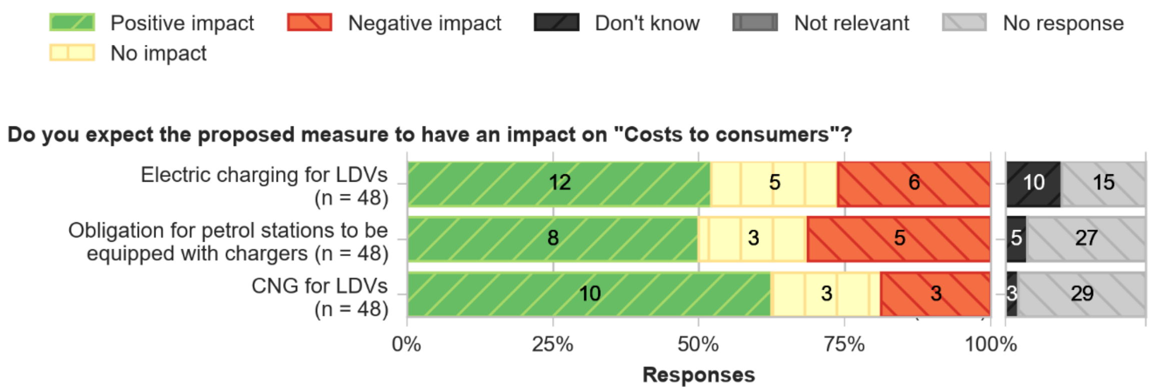


Table 7-79: Overview of expected impacts of road transport targets on consumers and households

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Positive overall impact mainly through increased access to charging infrastructure and, indirectly, to reduced costs of mobility.
Policy option 2	Positive overall impact mainly through increased access to charging infrastructure and, indirectly, to reduced costs of mobility.
Policy option 3	Positive overall impact mainly through increased access to charging infrastructure and, indirectly, to reduced costs of mobility.

7.3.2.2 Measures setting targets for AFI for water and air transport

For both shipping and aviation targets, the impact on consumers and households is likely to be indirect and linked to transport costs as a result of uptake in AFVs. These impacts on costs are likely to include the price of mobility services (see section 7.3.2.2), price of goods (see section 7.3.4.2) and access to AFI directly (which is not considered to be relevant in this case as consumers/households are unlikely to have direct access). However, it is anticipated that the long term impacts on transport costs for consumers/households of shipping and aviation targets will be limited, due to costs from AFI likely to form a small portion of price of goods (estimated at 10% of total cost of product) and subsequent limited impact on the price of mobility services or goods. Therefore, the impact of these targets on consumers and households is anticipated to be negligible across the EU (Table 7-80).

Table 7-80: Overview of expected impacts of shipping and aviation targets on consumers and households

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Little or no impact on consumers and households, resulting from minimal AFV energy and transport costs/price of goods.
Policy option 2	Little or no impact on consumers and households, resulting from minimal AFV energy and transport costs/price of goods.
Policy option 3	Little or no impact on consumers and households, resulting from minimal AFV energy and transport costs/price of goods.

7.3.2.3 Measures to promote interoperability[53]

All measures considered in policy options PO1 through PO3 aim to improve the experience for consumers through improved convenience and choice when using AFVs. These measures include:

- Mandatory ad-hoc payments for EV charging.
- Freedom for consumers to choose payment methods
- Physical standards for EVs and other modes.
- Communications standards for EVs.
- Technical specifications for EV rechargers.

The AFID evaluation support study found that the AFID and the technical standards adopted in the context of delegated acts have had a positive contribution on promoting interoperability of AFI (Ricardo, 2021a). Given this, the new requirements proposed in these measures would be expected to have the same sort of positive impact on the consumer experience.

That issue of consumer experience is connected to the identified problem that there are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services. The measures under consideration in this section aim to address that problem and achieve the objective of ensuring full interoperability of infrastructure for all vehicles, communication protocols and ad-hoc

[53] For this problem area, the measures proposed in the stakeholder questionnaire slightly differ from the measures considered in the policy options presented here. Therefore, the stakeholder input could not be used to directly support to analysis of all measures in this problem area and there are some small differences in language in some of the measures. The measures analysed here are mapped against the measures presented in the stakeholder questionnaire in Annex G.

payment solutions. Given this connection, this section also explores whether the measures are effective in addressing that problem and the related objective.

Finally, given the strong correlation with the impacts on consumers and households, this section will also discuss the impact on the costs of mobility and mobility services for these measures.

Impact on the consumer experience

Starting with the **measures mandating ad-hoc payment options**, these will provide consumers with added convenience and an insurance that a payment option using a bank card will be available at each charging point. Under all policy options, the proposed measure would address concerns about the difficulty of ad hoc payments through app or RFID-based payment or the complete lack of ad hoc payment options by introducing requirements for payment options compatible with bank cards. The added requirements under PO2 and PO3 should also ensure that new fast chargers, which tend to have a higher turnover, and therefore higher number of users, are equipped with NFC or terminal payment options. As these are the most popular ad hoc payment options, this requirement should provide added benefits to the consumer. In comparison, the option for a QR-based payment (which is an alternative in all policy options for some chargers), although cheaper to implement that an NFC or terminal payment, has the disadvantage of requiring a working smartphone with enough battery available and a sufficiently good mobile network signal. On its own, this could make it less attractive and less user friendly for some consumers, thus possibly having a less positive impact on consumers and households.

The availability of ad-hoc payments in all public chargers as required in all policy options will improve the current situation as it has been found that there are concerns about the availability of ad hoc payment options. These were often restricted by the need to use specific web apps or RFID cards, and EV users often have to carry various access cards and download multiple mobile apps to pay on an ad hoc basis (Ricardo, 2021a). The need to have multiple cards/apps often lead to situations where the lack of uniform payment mechanisms at EV charge points means that EV users cannot always conveniently charge their vehicle (European Parliament, 2018). These conclusions were confirmed by the OPC, where 65% (74 out of 113) stakeholders found that they had difficulties sometimes or on a regular basis when trying to pay on an ad hoc basis.

Further, 47% (69 out of 147) stakeholders indicated that card payment should be the common payment method available at all publicly accessible recharging points, followed by smartphone or non-specific banking app (24% of respondents), CPO-specific app (5%). The remaining (24%) respondents specified other methods. The most common 'Other' response was that card *and* smartphone-based payment should be possible. Card-based payment method was preferred by the majority in all stakeholder categories (57% by civic society, 59% by citizens and 58% by authorities) except for industry (24%). A debate on the use of RFID cards also took place in Norway, as EV users called for payment methods based on normal bank cards and cash (Lorentzen, Haugneland, Bu, & Hauge, 2017); these measures would improve on that situation.

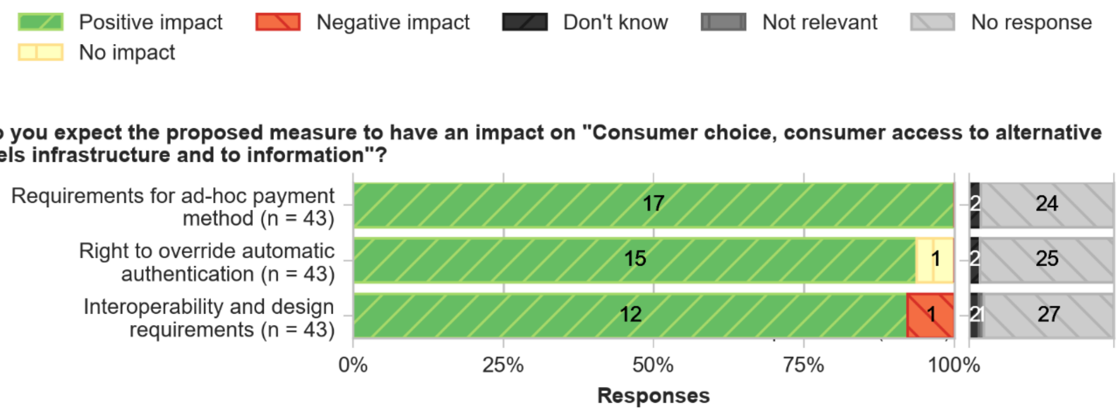
All respondents to the survey indicated that they expect a positive impact on 'consumer choice and access to AFI and information' as a result of mandatory ad hoc payment options. Eurocities noted that requiring ad hoc payment options would reduce barriers and increase fairness of access. Majority of respondents (17 out of 27) agreed that a requirement should apply to all publicly accessible charging points rather than just some. Several stakeholders raised concerns about the use of app or RFID-based payment systems and noted that bank terminals (as required for some chargers on PO2 and PO3) would serve the largest number of consumers. Two industry stakeholders questioned the prescription of a specific technology for ad hoc charging and argued that the market in each Member State would be best equipped to provide the best ad hoc payment option.

Ensuring that EV users have the **right to choose their payment method** before initiating the charge, as proposed under PO2 and PO3, should also positively impact consumer choice. The consumer may choose to change their payment option that is the default under their automatic authentication for various reasons, for example for data privacy reasons. It would also prevent the user from being locked into one provider and payment option. However, some users may find that having to confirm their payment options when they would prefer to proceed with automatic authentication, is an unnecessary added step. This added complexity was a point also stressed on the stakeholder consultation by IONITY and ANEC. In general, 7 out of 13 stakeholders said the measure would have positive impacts to consumers, but five stakeholders said there would be no impact and one said there would be negative impact.

Technical standards for physical aspects and communications, as well as technical specifications, should also have a positive impact on consumers. As noted in section 7.2.2.4, standardisation has the potential to make the use of EV charging easier and more convenient, promoting the uptake of AFVs and bringing positive benefits to consumers. Results from the OPC confirm this assessment, with responses underlining that open standards and protocols prevented vendor lock-in, increased choice, lowered costs, boosted interoperability and improved cybersecurity. OCPP and OCPI were mentioned specifically as minimum requirements, which aligns with PO1[54]. Further points raised calling for open standards noted that it would improve the functioning of the single market and increase competition. Conversely, some respondents noted that mandating standards could risk technological lock-in that could distort competition, which could have negative impacts on consumers. Respondents to the stakeholder questionnaire for this study agreed (12 out of 13) that these measures would have positive impacts for consumer choice and consumer access to AFI (Figure 7-13).

An overview of the stakeholder views on how measures to promote interoperability would affect consumer choice and consumer access to AFI is presented in Figure 7-13. The vast majority of stakeholders indicated an expected positive impact.

Figure 7-13: Stakeholder responses on if they expect the proposed measures to have an impact on consumer choice and consumer access to AFI and information (n=43)



[54] It should be noted, however, that OCPP and OCPI have different versions, so if these policy options are to be implemented there would be a need to choose the version of these standards to implement, as well as any procedures for their eventual update.

Effectiveness in addressing the problem and achieving the objective

Measures on **ad-hoc charging** should also be seen in terms of their capacity to address the current interoperability issues in deployed AFI in achieving the specific objective of ensuring full interoperability of infrastructure for AFVs, communication protocols and easy ad-hoc charging. Given that these measures specifically target a key component of the problem (on payment services) and the objective (easy ad-hoc charging), they could be expected to be effective. As PO2 and PO3 mandate NFC/chip+PIN terminals for some chargers, which makes the user experience easier, these two policy options can be expected to be more effective than PO1. Stakeholders agreed with this assessment, with all 21 that provided input stating that the measure would be effective in addressing the problem at least to some extent, and 22 saying the same about it expected role in achieving the objective of full interoperability of infrastructure for AFVs, communication protocols and easy ad-hoc charging.

For the **right to choose their payment method**, given the limited scope of the measures, it is expected that these measures will have quite limited effectiveness in addressing the problem and achieving the objective. Still, 17 out of 20 stakeholders said that the measure (as asked in the stakeholder questionnaire as the right to override automatic authentication) would help address the problem at least to some extent, and 16 out 19 said the same for the effectiveness in achieving the objectives.

Finally, **technical standards and specifications** are expected to contribute positively towards addressing the problem and achieve the objectives. This is because these measures aim to specifically address the objective of ensuring full interoperability for all aspects of AFI, thus also addressing the problem that there are still issues with interoperability. As PO2/PO3 introduce interoperability requirements that go beyond PO1, those policy options are expected to be the most effective. Majority of stakeholders (21 out of 25 in both cases) agreed that technical specifications would support addressing the problem and achieving the objective, at least by a limited extent. Commenting on their responses, CHAdeMO Association Europe indicated their support for a market-based approach in terms of standards, instead of being directed by legislation. For this organisation, these standards will limit innovation and the "EU will [thus] be left behind the global developments to combat the climate challenges". IONITY indicated that the problem is being addressed by the market already, but they see a role for the EU to speed up market development.

An overview of the stakeholder views on the effectiveness in addressing the problem and achieving the objective is shown in Figure 7-14 and Figure 7-15, respectively. In all cases, a majority of stakeholders indicated at least some level of effectiveness in addressing the problem and achieving the objective.

Figure 7-14 Stakeholder views on the effectiveness of the measures on to promote interoperability contribution to addressing the problem that there are still issues of interoperability in deployed AFI in terms of physical connections, communication standards and payment services

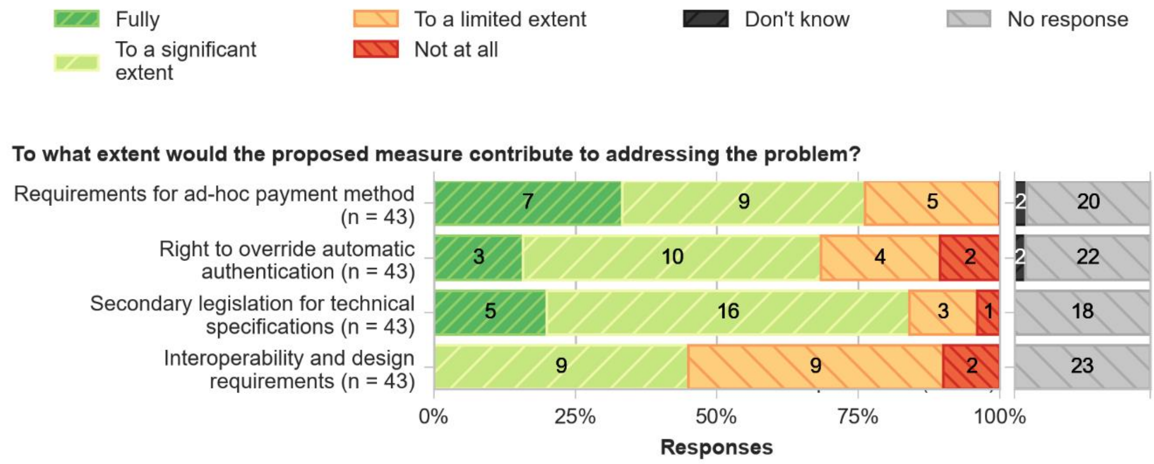
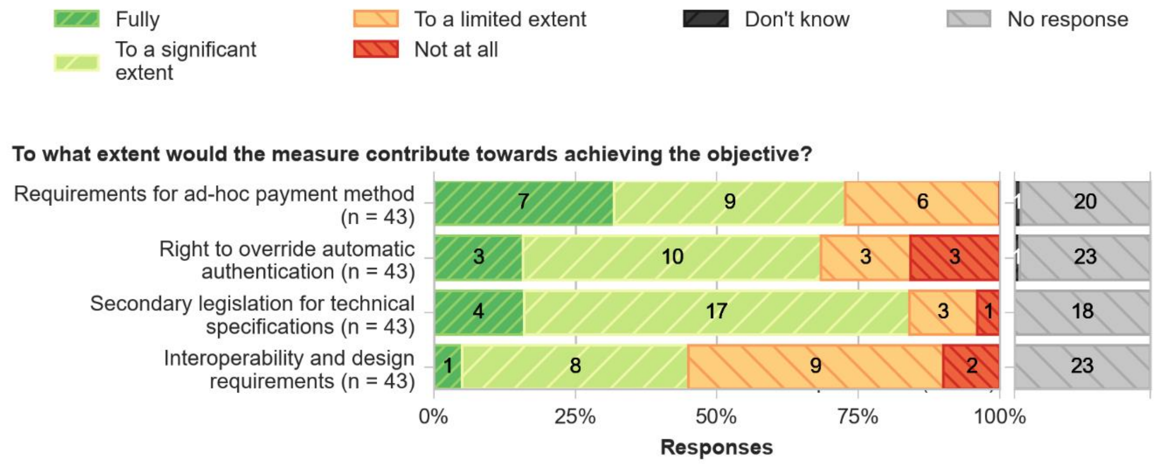


Figure 7-15: Stakeholder views on the effectiveness of the measures on to promote interoperability contribution to achieving the objective of ensuring full interoperability of infrastructure



Impacts on costs

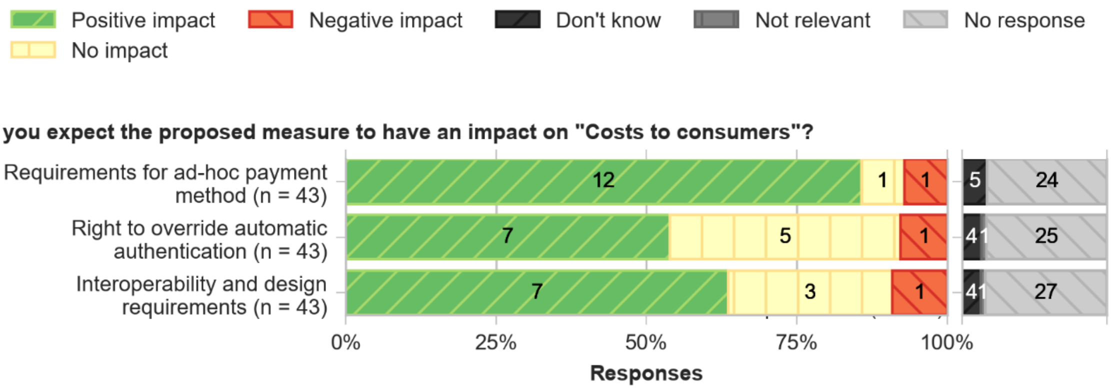
In terms of the impact on the costs of mobility, introducing **requirements for ad hoc payment options** will likely increase the investment cost of some charge points, in some case considerably (up to around €800 per charger for a chip+PIN terminal, which compares to a starting cost for a slow charger of €1250; for fast charger the share on overall costs is smaller; see section7.2.3 for more details). This could negatively impact the costs of mobility and mobility services for consumers, as some of these costs could be passed to consumers. However, most stakeholders disagreed, with 12 out of 14 saying that the measures would bring positive impacts on costs to consumers. This assessment is based on the fact that the easiness of using EVs would increase with these measures, have positive impacts on the level of demand and on competition on the AFI market thus counterbalancing any possible additional costs.

For the **right to choose their payment method** 7 out 13 stakeholders also said that the measure would have positive impacts on costs to consumers, but no explanations were provided. Given the limited scope of the measure, it is not expected for the measure to have any significant positive or negative impacts on the costs to consumers.

In terms of the impacts on costs of the **technical standards for physical aspects and communications, as well as technical specifications**, as noted in section 7.2.3 , these measures on standards and interoperability will require some investment costs. This could lead to costs for industry that are ultimately passed down to consumers. On the other hand, the promotion of interoperability could have positive impacts on competition in the AFI market, which could lead to positive impacts in terms of costs for consumers. As such, overall it can be expected a positive impacts on costs as possible increase in costs and pass-through to consumer is expected to be counterbalanced by increased competition resulting from the implementation of the measures. In that respect, the majority of stakeholders (7 out 11) agreed that there would ultimately be a positive impact on the costs to consumers resulting from these measures.

An overview of the stakeholder views on how measures to promote interoperability would affect costs to consumers is presented in Figure 7-16. Although most stakeholders indicated a positive impact, there were a number of stakeholders that indicated no impact would be expected.

Figure 7-16: Stakeholder responses on if they expect the measures to promote interoperability to have an impact on costs to consumers (n=43)



Summarising, all the measures considered under this problem areas here are expected to have positive impacts on consumers and householders. In some cases, that could come with negative impacts in terms of costs of mobility (particularly for the more expensive measures), but that impact is not expected to be very large and could be compensate by stronger competition in the AFI market. These measures are also all expected to be effective in addressing the problem and achieving the objective. The wider scope of the measures in PO2 and PO3 makes these measures more effective, as they promote higher levels of interoperability.

An overview of the expected impacts on consumers and households (including costs) of the measures to promote interoperability is presented in Table 7-81.

Table 7-81: Overview of expected impacts on consumers (including costs) of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Increased ease of use and consumer experience leads to positive impacts for consumers. Potentially negative impact on costs from ad-hoc payments and communication standards that could be compensated by greater competition resulting from more demand for AFI.
Policy option 2	As PO1, but mandatory chip + PIN or NFC payment terminals on some chargers could further increase ease of use for consumers, compared to payment via smartphone/QR code. Increased ease of use and consumer experience from freedom to choose payment method and communication and technical standard to lead to positive impacts for consumers. Positive impact on costs as any possible increase in costs and pass-through to consumer related to provisions on technical specifications and ad-hoc payment is expected to be counterbalanced by increased competition resulting from the implementation of the measure.
Policy option 3	Increased ease of use and consumer experience from measures (as in PO2 and from mandatory fixed cables) leads to positive impacts for consumers. Some potentially negative impact on costs from technical specifications that could be passed to consumers.

7.3.2.4 Measures to improve consumer information[55]

As with the measures to promote interoperability, measures to improve consumer information (namely by introducing requirements on price transparency, non-discrimination of prices and provision of user information) aim to improve the experience for consumers through improved convenience and choice when using AFVs. Thus, these measures are expected to positively impact consumers and households. As with the measures to promote interoperability, this section will also discuss the impacts on costs of mobility and mobility services. The section will also assess the effectiveness of these measures in addressing the problem that consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees and achieving the objective of ensuring adequate information is available for consumers (including information on location/availability of AFI and information on prices for recharging/refuelling services)..

Impact on the consumer experience

For the measures on **price transparency**, it is clear that improvements in price transparency will have a positive impact on consumers. In the stakeholder questionnaire, several stakeholders[56] underlined that having accurate and comparable prices for each EV charge point are important and a matter of fairness (overall, 22 out of 22 stakeholders indicated positive impacts for consumers).

These stakeholders also noted that ad hoc prices needed to be physically displayed at the EV charge point as the user would otherwise not have the relevant information on

[55] For this problem area, the measures proposed in the stakeholder questionnaire slightly differ from the measures considered in the policy options presented here. Therefore, the stakeholder input could not be used to directly support to analysis of all measures in this problem area and there are some small differences in language in some of the measures. The measures analysed here are mapped against the measures presented in the stakeholder questionnaire in Annex G.

[56] Eurocities, T&E, BEUC, ANEC, AVERE

pricing and payments (as required in PO3). The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) noted that although pricing should be transparent for both ad hoc and contract-based charging, ad hoc is more important.

The majority of stakeholders responding to the OPC also agreed that display of recharging fees should be harmonised at EU level. The most popular options were a requirement for recharging prices to be displayed in every app that provides information on charging infrastructure and a requirement for price display at the recharging station. Several respondents specified that ad hoc prices should be displayed at the stations, while contract-based charging would be provided by the respective EMSP.

Regarding **non-discrimination of prices**, the impacts to consumers would only be relevant if they led to a decrease in B2C prices. Otherwise the measure mostly affects B2B with only indirect impacts on consumers (including the costs they incur). On the OPC, several OPC respondents highlighted discriminatory pricing and access conditions, which would have adverse impacts on households and consumers. The majority of respondents believed that all e-mobility service providers should be allowed to offer their services at any charge-point at a non-discriminatory price set by the CPO.

On the **provision of user information to NAPs**, this is also expected to have a positive impact for consumers. All respondents to this study's stakeholder questionnaire agreed that requirements for information on location and availability (these types of data would be provided to NAPs under this measure) would have a positive impact on consumers. Some stakeholders[57] pointed out commented that static and dynamic data are both important and should be available to EV users for free. One of these stakeholders further noted that such a requirement would be one of the most important measures to ensure customer satisfaction. CLEPA added that if such a requirement were introduced, it should apply to all fuels. CharIN and IONITY commented that no such obligation for information was needed since CPOs that aim to optimise their revenue already make this information available on a few mediums. AVERE also noted that this data will have a drastic positive effect on addressing transparency concerns.

Out of 292 respondents to the relevant OPC question, 244 (84%) agreed that information on AFI should be made available by digital means in order to positively impact consumers. Specifically, the location, opening hours, types and real time availability of recharging/re-fuelling points were expected to be provided by the majority of respondents. A number of responses suggested that the quality of information currently shared by CPOs was often poor and out of date. Conversely, several respondents noted that most apps already provided this type of information. Some respondents also noted that, although they understand the importance of real time data on prices and availability, the supply of this information can be burdensome and complex due to different pricings, which may adversely affect customer confidence when information is not accurate.

Finally, **clear indications on the availability of AFI provided by roadside indicators** on the parking/fuelling area and the road corridor could increase awareness of AFI, providing positive impacts for consumers and households. The majority of respondents to the stakeholder questionnaire (20 out of 21) agreed that there was a positive impact on consumers with regards to standardised and mandatory signposting The majority of OPC respondents also agreed that EU legislation should ensure that information was displayed by physical means, with the largest group selecting road signs on highways as the most important option. Some responses suggested that road signage would be important to support adoption of electromobility. Several noted that

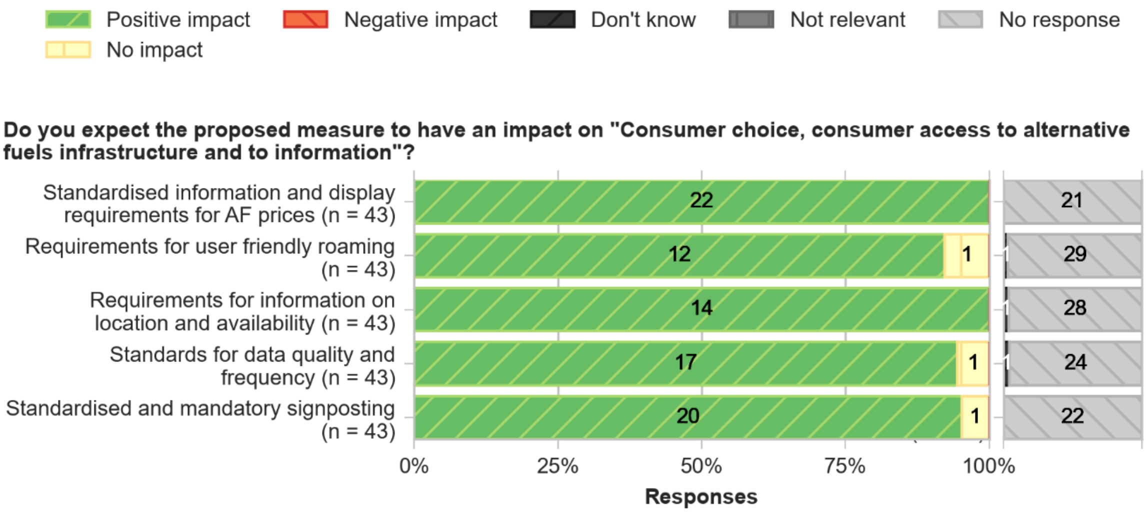
[57] The Greek Ministry of Infrastructure and Transport, BEUC, FIA, ANEC, AVERE.

physical signs explaining the working, pricing and power capacity of charging points should be required next to each charging point.

When respondents to the questionnaire were asked to provide more details, BEUC and BGH2A suggested that apps alone would not be sufficient and welcomed a requirement for signposting. Eurocities remarked that signposting of charge points in the urban area would be unnecessary – the measures under consideration address this concern and only impose requirements on TEN-T Core and Comprehensive. AVERE expressed doubt that signposting would increase clarity and transparency on EV charging, and further noted that the effectiveness of signposting would depend on how much information the signs would display. ANEC noted that although signposting had benefits, the AFI landscape was more complex than traditional fuel stations and that the best way to convey information was digitally through vehicles rather than through signposting. ANEC further commented that the information that needed to be conveyed to the AFI user is too complex to display via signposting. IONITY indicated that while this would indeed make AFI more visible to non-EV drivers, providing more confidence to switch to EV, the requirement may duplicate existing web-based (and up-to-date) data.

An overview of the stakeholder views on how measures to improve consumer information would affect consumer choice and consumer access to AFI is presented in Figure 7-17. The vast majority of stakeholders indicated an expected positive impact.

Figure 7-17: Stakeholder responses on if they expect the proposed measures to have an impact on consumer choice and consumer access to AFI and information (n=43)



Effectiveness in addressing the problem and achieving the objective

These **measures on price transparency** are also expected to support addressing the problem that consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees. The measures should also support achieving the related objective of ensuring adequate information is available for consumers (including information on location/availability of AFI and information on prices for recharging/refuelling services). The measures on price transparency are expected to be effective in both addressing the problem and achieving the objective, as they directly address the problem identified of insufficient transparency. Stakeholders agreed with assessment, with 23 out 23 saying that the measures would be effective in addressing the problem at least to some extent, and 25 out 25 saying the same for achieving the objective. As PO2/PO3 include further requirements compared to PO1, the effectiveness would be higher.

The level of effectiveness of the measures on **non-discrimination of prices** to address the problem and achieve the objective is expected to be somewhat limited, as the measure only marginally addresses the issues identified. Stakeholders had a more positive assessment of the impacts and effectiveness with almost all of them indicating positive impacts or effectiveness in addressing the problem/achieving the objectives[58].

In terms of effectiveness, **provision of user information to NAPs** would help address the problem of availability/compatibility of AFI (PO1 through PO3) and, in the case of PO2 and PO3, on prices/fees (PO2 and PO3). That is, under PO2 and PO3, by imposing further requirements in terms of availability of dynamic data would be more effective in addressing the problem that PO1would. Furthermore, the measures would also support achieving the objective of ensuring adequate information is available for consumers. Again, PO2 and PO3 would be more effective, as more data is required to be made available.

In general, stakeholders agreed with this assessment on effectiveness, with 17 out of 19 indicating that the measures would be effective in addressing the problem, and 16 out of 18 that the measures would be effective in achieving the objective. Commenting on these aspects, AVERE showed its agreement that the measures on data provision would be effective in addressing the problem, and indicated that these measures in combination with other (unnamed) initiatives would be extremely helpful in obtaining market clarity. IONITY did not agree the measure would be effective, and noted information is already shared by major CPOs, so the market is already addressing this topic and special care should thus be taken before any legislation is proposed, and mandates might create more issues than solutions.

Finally, the measures on **roadside indicators** are expected to be effective in addressing the problem and achieving the objective, as they would support more and more transparent information to consumers. Given the wider scope of PO3 (as compared to PO2), it is expected that the level of effectiveness would also increase from PO2 to PO3. All stakeholders responding to the relevant questionnaire question agreed that the measures would be effective at least to a limited extent.

An overview of the stakeholder views on the effectiveness in addressing the problem and achieving the objective is shown in Figure 7-18 and Figure 7-19, respectively. In all cases, a majority of stakeholders indicated at least some level of effectiveness in addressing the problem and achieving the objective.

[58] The measure asked about in the survey relates to requirements for user friendly roaming, which is just a potential component of the measure on non-discrimination of prices.

Figure 7-18: Stakeholder views on the effectiveness of the measures on to improve consumer information contribution to addressing the problem that consumers do not have adequate information on AFI and there is insufficient transparency and certainty, and no standardisation, of availability/compatibility and prices/fees

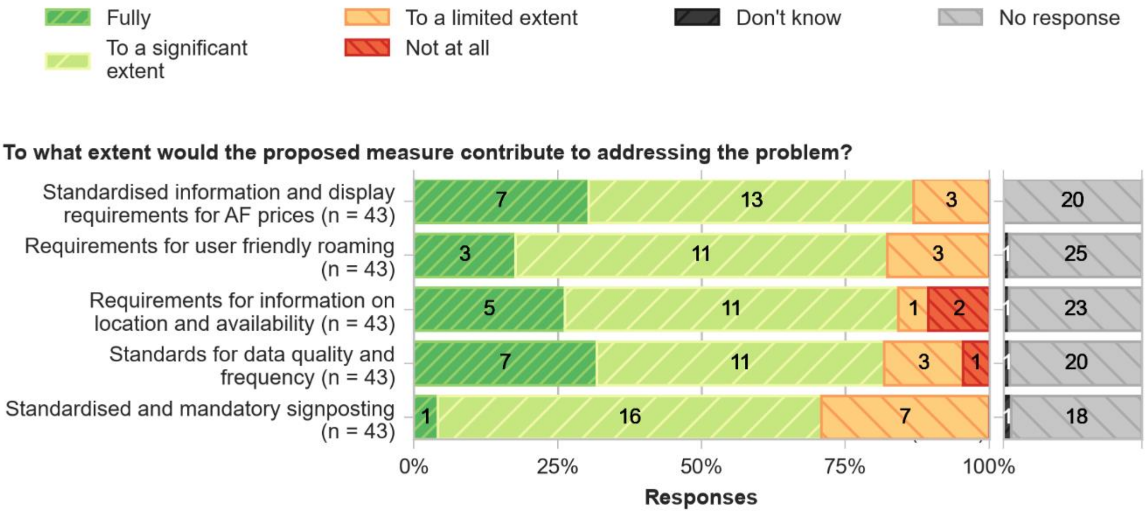
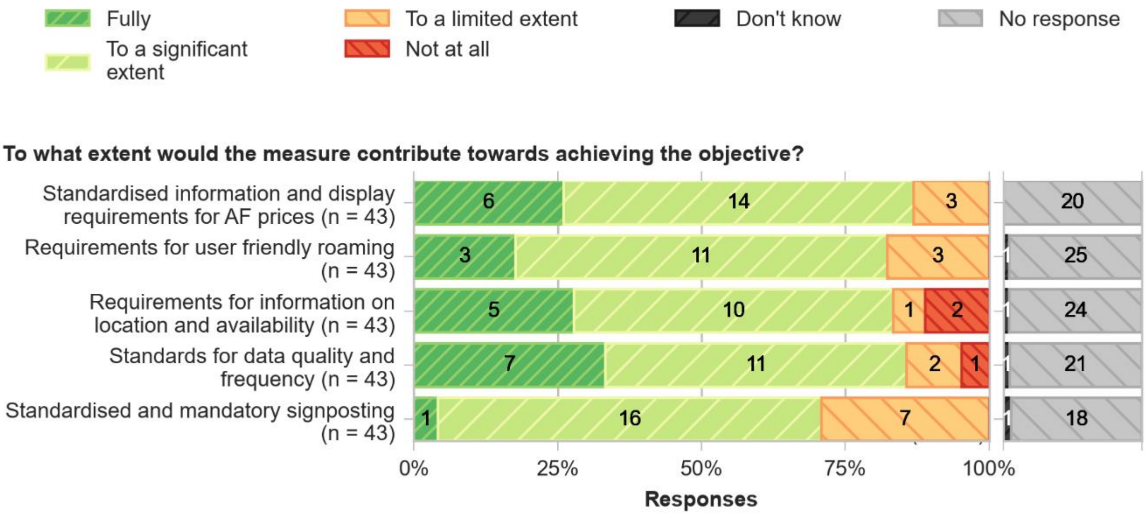


Figure 7-19: Stakeholder views on the effectiveness of the measures on to improve consumer information contribution to achieving the objective of ensuring adequate information is available for consumers



Impacts on costs

In terms of possible costs to consumers, the **measures on price transparency** are expected to have positive impacts. This is derived from the fact that increasing price transparency can be expected to increase competition between AFI providers. A majority of stakeholders (14 out of 21) agreed that we could expect positive impacts on costs on consumers. The same rationale applies in terms of **provision of user information to NAPs**, and positive impacts on the costs to consumers are expected. Stakeholders agreed, with 9 out of 11 noting a positive impact on costs.

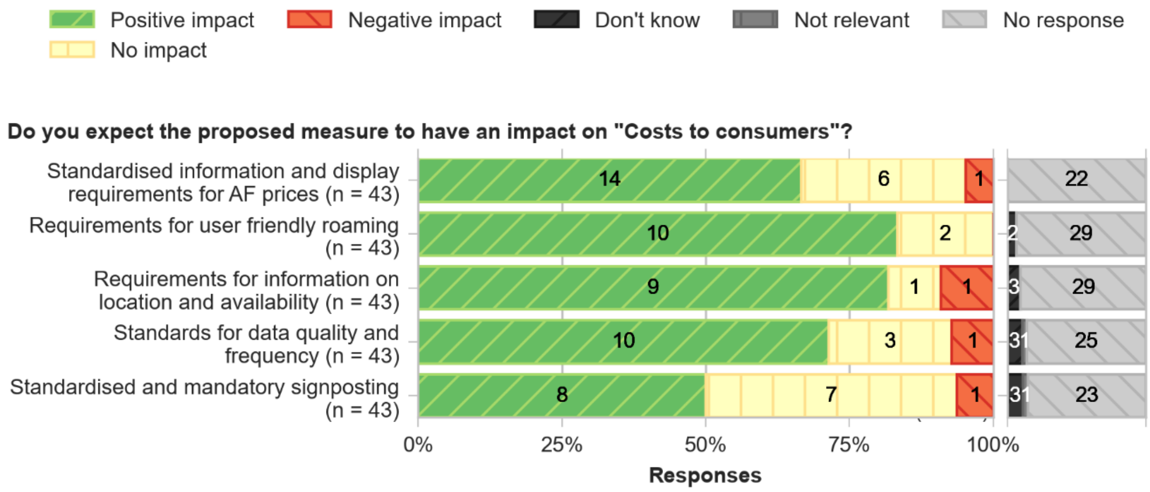
For the measures on **non-discrimination of prices** the impacts on costs are unclear, but could be positive if they resulted on lower B2C prices, positive impact could exist.

Furthermore, non-discrimination of prices and roaming could foment market competition, which would lead to positive impacts for the costs for consumers.

Finally, positive impacts on costs could result if the visibility provided by more **roadside indicators** increases competition. This would be more relevant for PO3, as it requires signposting in the road corridor, not only on the fuelling/parking area.

An overview of the stakeholder views on how measures to improve consumer information would affect costs to consumers in shown in Figure 7-20. In all cases but one (signposting), a majority of stakeholders indicated positive impacts.

Figure 7-20: Stakeholder responses on if they expect the measures to improve consumer information to have an impact on costs to consumers (n=43)



In summary, all the measures considered here are expected to have positive impacts on consumers and householders. Positive impacts could be expected in terms of costs to consumers as well, derived from the fact that more and more transparent user information can increase competition and thus reduce costs. These measures are also all expected to be effective in addressing the problem and achieving the objective. The wider scope of the measures in PO2 and PO3 makes these measures more effective, as they increase the requirements in terms of what information needs to be provided to consumers.

An overview of the expected impacts of the measures on consumer information on consumers and households is presented in Table 7-82.

Table 7-82: Overview of expected impacts of measures to improve consumer information on consumers and households

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Increased ease of use and consumer experience leads to positive impacts for consumers. Positive impact on costs resulting from more competition as the result of the implementation of the measure.

Measure	Impact
Policy option 2	Increased ease of use and consumer experience (slightly greater than PO1) related to ad-hoc price transparency, contract based price transparency, user information and roadside indicator leads to positive impacts for consumers. Positive impact on costs resulting from more competition as the result of the implementation of the measures on ad-hoc and contract based price transparency and user information.
Policy option 3	Increased ease of use and consumer experience leads to positive impacts for consumers (slightly better than PO2) linked to the additional road side indicators.

7.3.3 Impact on public health (external costs of air pollutants)

7.3.3.1 Measures setting targets for AFI for road transport

The impact on public health from the road transport targets has been assessed on the basis of the estimated external costs from the resulting reduction in air pollutants (see also section 7.4.3 below). On the basis of the modelling analysis and using the relevant values from the Handbook of External costs of transport (European Commission, 2019), we can see that the external costs associated are expected to be reduced under all policy options.

The level of impact at EU level will be similar under all policy options (i.e. higher reduction) reflecting the gradual increase in the level of uptake of AFVs under the MIX scenario (see Table 7-83). The policy options would result in €1.8 billion savings in the external costs of air pollution relative to the baseline in 2030, €9.6 billion in 2040 and €10.3 billion in 2050. Expressed as present value over the 2021-2050 period, the total savings amount to €75 billion relative to the baseline.

Table 7-83: External costs savings on air pollution from road transport

External costs of air pollution compared to the Baseline	2015	Baseline			PO1 / PO2 / PO3		
		2030	2040	2050	2030	2040	2050
External costs of air pollution	60.9	22.0	15.0	10.8	20.2	5.4	0.5
% change to Baseline					-8.4%	-64.0%	-95.3%

Table 7-84: Overview of expected impacts of road transport targets on public health

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Expected small net positive impact on emissions reduction mainly from the national targets for charging points for LDVs.
Policy option 2	Expected small net positive impact on emissions reduction (largely similar to PO1) due to very small impact of additional measures.

Measure	Expected impact
Policy option 3	Expected small net positive impact on emissions reduction (largely similar to PO1 and PO2) due to very small impact of the additional measures.

7.3.3.2 Measures setting targets for AFI for shipping and aviation targets

Impacts on public health are directly correlated with the impacts on air pollutants and noise, which in turn are directly correlated with the impacts of AFVs. For both shipping and aviation, the assessment of impact on deployment of AFI and associated uptake of AFV revealed that whilst deployment of AFI would increase under PO1, 2 and 3, it is not anticipated that there would be a substantial impact on the uptake of vessels or aircraft (see 7.2.2.2).

However, enabling changes in the use of fuels are likely to result in reduced air pollutant emission and subsequent positive impacts on public health. The introduction of electricity as a power source at ports (inland and maritime via OPS) and airports will ensure that air pollutant emissions from stationary vessels and aircraft will be minimal. Positive impacts are therefore not limited to additional uptake of vessels/aircraft, as the existing fleet will be able to access the OPS. Additionally, the provision of LNG bunkering facilities at maritime ports will enable the increased refuelling and subsequent uptake of LNG vessels, which have positive air pollutant reduction benefits compared to their diesel and heavy fuel oil counterparts. Positive impacts for public health will be increased in PO3 as increased/more widespread provision is required (Table 7-85).

Table 7-85: Overview of expected impacts of shipping and aviation targets on public health

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Reduction of air pollutant emissions through provision of OPS for vessels at inland and maritime ports from stationary aircraft through switch to electricity supply, resulting in a positive impact on public health. (not quantified).
Policy option 2	Reduction of air pollutant emissions (higher than PO2) through provision of OPS for vessels at inland and maritime ports and from stationary aircraft through switch to electricity supply, resulting in a positive impact on public health. (not quantified).
Policy option 3	Reduction of air pollutant emissions (higher than PO2), resulting in a positive impact on public health linked to PO2 measures and measures related to LNG for maritime ports, electricity supply for battery vessels and more demanding measures for electricity supply for stationary aircraft.

7.3.3.3 Measures to promote interoperability

Any impact on public health from the specific measures to promote interoperability will be indirect, linked to the any resulting impacts on the uptake of AFVs (see section 7.2.2.4) and the impact of that uptake on the impacts on air pollutants (see section 7.4.3).

Given this, as noted in section 7.2.2.4, all of the measures to promote interoperability are expected to positively impact customer experience through improved convenience and reliability of recharging services. To the extent that this has a positive impact on the uptake of AFVs it should also result on a positive impact on public health. While the impact of each of the measures separately may be small, combined they could have a higher positive impact, making the entire experience of using an AFV easier, contributing to a higher level of uptake of AFVs and resulting to a positive impact on public health. More details on the expected impact on the uptake of AFVs are given in section 7.2.2.4.

An overview of the expected impacts on public health of the measures to promote interoperability is presented in Table 7-86.

Table 7-86: Overview of expected impacts on public health of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact on public health, resulting from the positive, but likely small, impact on AFV uptake mainly driven from ad-hoc payments.
Policy option 2	Positive impact on public health (higher than PO1), resulting from the positive, but likely small, impact on AFV uptake from the measures on ad-hoc payments and physical standards.
Policy option 3	Positive impact on public health (largely similar to PO2), resulting from the positive, but likely small, impact on AFV uptake.

7.3.3.4 Measures to improve consumer information

The same rationale used in the measures to promote interoperability applies on the measures to improve consumer information: impacts on public health are directly correlated with the impacts on air pollutants (see section 7.4.3), which in turn are directly correlated with the impacts on the uptake of AFVs (see section 7.2.2.5). As such, measures that have a positive impact on the uptake of AFVs would also have a positive impact on public health. For other measures the impact is likely to be negligible. More details on the expected impact on the uptake of AFVs are given in section 7.2.2.5.

An overview of the expected impacts of the measures to improve consumer information on public health is presented in Table 7-87.

Table 7-87: Overview of expected impacts of measures to improve consumer information on public health

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact on public health, resulting from the positive, but likely small, impact on AFV uptake related to user information measures.

Measure	Impact
Policy option 2	Positive impact on public health, resulting from the positive, but likely small, impact on AFV uptake from the combination of measures on ad-hoc price transparency, user information and signs in parking/fuelling area.
Policy option 3	Positive impact on public health (higher than PO2), resulting from the positive, but likely small, impact on AFV uptake.

7.3.4 Impacts on employment and job skills

The positive development of the AFI markets, and the parallel development of the AFV market, has a positive impact on employment creation across all Member States as (Ricardo, 2021a). Therefore, positive impacts discussed in section 7.2.2 will generally translate into positive impacts on employment and job skills, as discussed in the following sections.

7.3.4.1 Measures setting targets for AFI in road transport

Impact on employment levels

The increasing level of investment in AFI infrastructure over the period up to 2050 should have a positive impact on employment in the relevant sectors. These include new jobs in the construction and manufacturing of AFI as well as those related to the operation of AFI and the broader market developed from the provision of services by AFI operators. Indirectly, any impact on the uptake of AFVs should also be expected to have an impact on employment.

An earlier study on behalf of the European Association of Electrical Contractors (AIE) concluded that, where all types of electric infrastructure are considered (including both public and private), up to 200k new jobs would be created in Europe in the period 2016-2030 in the case that the share of electric vehicles reaches 10% of the fleet by 2030 (AIE, 2018). A study by Cambridge Econometrics (Cambridge Econometrics, 2018b) also indicated that positive impacts in terms of employment in a number of sectors including electrical equipment, services and construction should be expected.

Such positive impacts on employment are expected to counterbalance any negative impacts that may arise for the vehicle manufacturing sector as a result of the increase uptake of AFVs. An analysis of the impact of moderate electrification (23% of vehicle sales by 2035) for the German automotive sector concluded that it would lead to a net job loss of around 83,000 by 2035 (Mönnig , Schneemann, Weber, & Gerd, 2019). However, we note that this analysis assumes there will be high level of imports of electric vehicles (i.e. assumes high level of dependence of imports replacing domestic production of vehicles and batteries) (Osawa & Nakano, 2016). The study by Cambridge Econometrics mentioned earlier found that, under a scenario where BEV and PHEV represented 23% of vehicle sales by 2030 and 50% in 2035, there should be no impact on employment up to 2035 (Cambridge Econometrics, 2018b). However, they expect negative impacts after this period as the share of BEVs - that are less labour intensive than ICE vehicles - increases. According to the IEA, plug-in hybrid electric cars create an additional 6,000 jobs for every 1 million cars sold compared to a gasoline (ICE), whereas battery electric cars create 20,000 fewer jobs (Wietschel et al., 2017).

Another sector possibly affected includes the refining industry since the policy options will further facilitate existing trends related to reduction of oil consumption by improving the energy efficiency of vehicles and the move towards the electrification. This will also depend on the extent that measures related to the promotion or removal for LNG/CNG will be adopted. At the same time, we note that the fuelling industry is already diversifying towards alternatives, with a number of fuel producers/distributors investing in electric charging infrastructure as well as in other AFI forms (e.g. hydrogen) as this can be seen in their publications and the information on AFI funding from CEF (Morris C. , 2021; Coren, 2019; Total, 2020; BP, 2020).

For the purposes of our study, we have used available input from the IEA (IEA, 2020a) that suggested that installation and manufacturing of electric charging points supports around 12 jobs per million USD of investment (circa 9.8 jobs per million EUR). Thus, on the basis of the estimated level of investment for charging infrastructure for LDVs and HDVs presented in section 7.2.3, we can estimate a net job creation from the measures associated with the deployment of charging infrastructure for LDVs and HDVs in the range of 67.2k under PO1 to 119.6k under PO3 for the period 2021-2030 and 0.52 million to 0.62 million for the period 2021-2050.

Table 7-73: Estimated number of jobs created under each policy option associated with investment in charging infrastructure for LDVs and HDVs (2021-2030 and 2021-2050)

	Baseline	PO1	PO2	PO3
2021-2030				
Total investment (CAPEX and OPEX) in charging infrastructure (million EUR)	7,400	14,300	15,200	19,600
Jobs per million EUR	9.8	9.8	9.8	9.8
Total jobs	72,520	140,140	148,960	192,080
Net from Baseline		67,620	76,440	119,560
2021-2050				
Total investment in charging infrastructure (million EUR)	40,200	93,700	95,600	103,800
Jobs per million EUR	9.8	9.8	9.8	9.8
Total jobs	393,960	918,260	936,880	1,017,240
Net from Baseline		524,300	542,920	623,280

Source: Own elaboration based on data from PRIMES-TREMOVE and IEA (2020a)

The estimated net impact from the policy options only captures the direct impact from the investment in electric charging infrastructure. We do not have similar data available for other type of AFI. It does not include any indirect impacts from such investment and, more importantly, the impact on employment from the increase in the turnover of the market of electromobility services and the broader business eco-system that should be expected to benefit from the adoption of measures[59]. Furthermore, we note that the positive net impact identified should be expected to be concentrated in those MS where there is limited AFI and where NIR targets are low or do not exist.

Impact on skills

The above analysis also points to the expected impact on relevant skills needed to serve the increase in the deployment of AFI and the emergence of a new market around electric and hydrogen charging and, indirectly, the increasing uptake of AFVs.

[59] It has not been possible to make an assessment of the expected impact on the GDP of the overall economy and implications on the value added of specific sectors that would allow to assess the overall employment impact.

Concerning **AFI deployment**, a wide range of job qualifications will be needed across a range of sectors including construction, manufacturing, electricity, information and communication technology, advanced materials, computer applications. The study by AIE mentioned earlier pointed out that the wide level of uptake of AFI will lead to new job creation related to charging maintenance jobs, installation and operation of charging points (includes metering, billing and smart charging), battery cell manufacturing, electricity generation and grid connection (AIE, 2018). However, we are not aware of a more detailed analysis of the expected impact on job skills arising from a wider deployment of AFI.

Most stakeholders that contributed to the study (including industry representatives, national authorities and NGOs) also provided a positive assessment of the expected impact of the relevant measures on employment and skills and only one stakeholder (different in each case[60]) considered that negative impacts can be expected (see Figure 7-6). However, none of them elaborated further on the underlying issues.

Figure 7-6: Stakeholder input on the expected impact of the proposed targets for road transport AFI on employment and job skills

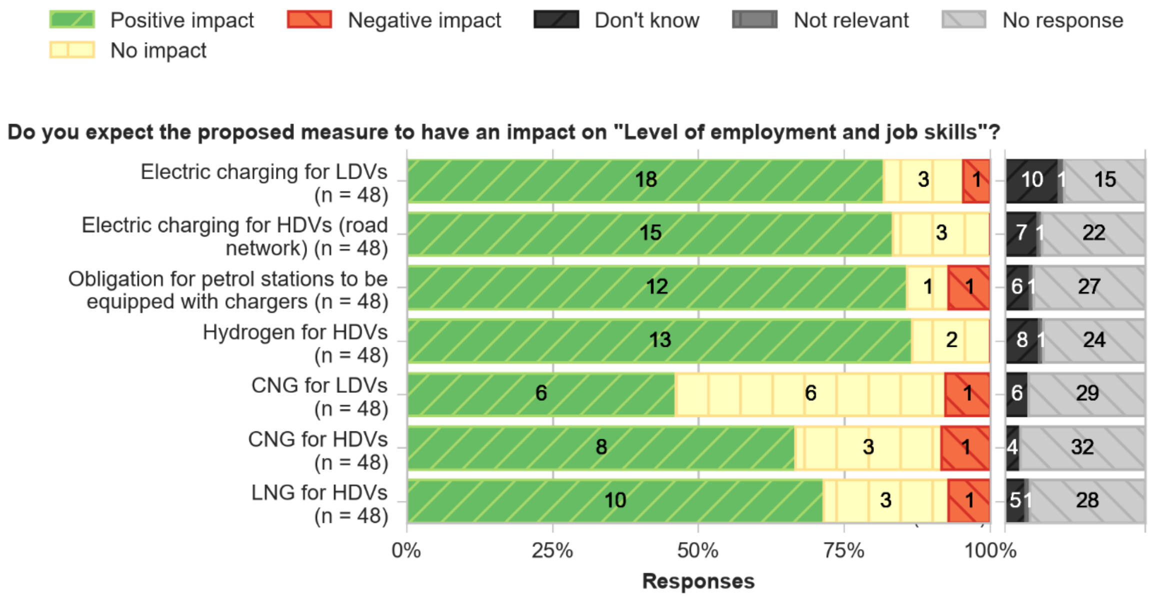


Table 7-74: Overview of expected impacts of road transport targets on employment and job skills

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Expected positive impact associated with the initial investment in AFI : 67k new jobs for 2021-2030 and 0.52 million for 2021-2050 associated only with the investment in charging infrastructure with a much smaller additional number for HRS and additional related to the development of the AFI operation services market.

60 An anonymous industry representative for electricity for LDVs, ChargeUP Europe for electric chargers in petrol stations, T&E for measures related to hydrogen, CNG and LNG infrastructure

Measure	Expected impact
	Impacts expected to counterbalance any negative impacts from increase in the share of AFVs.
Policy option 2	Expected positive impact associated with the initial investment in AFI : 76k new jobs for 2021-2030 and 0.54 million for 2021-2050 associated only with the investment in charging infrastructure with a much smaller additional number for HRS and additional related to the development of the AFI operation services market. Impacts expected to counterbalance any negative impacts from increase in the share of AFVs.
Policy option 3	Expected positive impact associated with the initial investment in AFI: 119k new jobs for 2021-2030 and 0.62 million for 2021-2050 associated only with the investment in charging infrastructure with a much smaller additional number for HRS and additional related to the development of the AFI operation services market. Impacts expected to counterbalance any negative impacts from increase in the share of AFVs.

7.3.4.2 Measures setting targets for AFI in water transport

The impact of the shipping targets on employment is expected to be positive, although it has not been possible to quantify these. By increasing the demand for new infrastructure and supporting services, the new measures can lead to the creation of new jobs in construction, manufacturing, electricity, among other sectors. The impact is expected to increase with the level of ambition of the targets through the policy options.

The available literature on the impacts from the deployment of LNG bunkering suggests that the effect will be positive, but they also do not quantify the extent of the impact:

- A study of the Congressional Research Service in the US (Congressional Research Service, 2019) identified the potential for LNG bunkering projects to create jobs in engineering, construction, and operation.

- A Study on the Completion of an EU Framework on LNG-fuelled Ships and its Relevant Fuel Provision Infrastructure (CE Delft, TNO, 2017) suggested that investment in LNG, as a relatively new technology, could support the export of new technologies and thereby increase employment in the EU.

- A study focusing on the use of LNG in Malta (Cassar, 2017) highlighted that new bunkering infrastructure could create job opportunities, including in training and certification.

No similar studies were identified for OPS or electricity supply to battery electric vessels but similar impacts on employment are expected associated to the need to deploy and run the new infrastructure.

As described in section 7.2.8.2, in addition to the direct impacts associated to the construction and operation of new infrastructure, the measures are expected to bring benefits to a range of businesses such as vessel manufacturers, suppliers of parts/components, software developers, and other support services providers. It can be expected that this increase in business will translate into new job opportunities in these sectors.

Moreover, it is anticipated that new skills will be required for staff at ports for the operation of the new infrastructure. In particular, staff will need to be upskilled on the management of LNG facilities associated with the increased safety requirements of LNG.

In line with the assessment above, the majority of the stakeholders that participated in the consultation for this study also indicated that they expect the proposed measures to have a positive impact on employment and job skills (Figure 7-8). No further comments on this impact were received.

Figure 7-8: Stakeholder responses on if they expect the proposed measures to have an impact on employment and job skills (n=29)

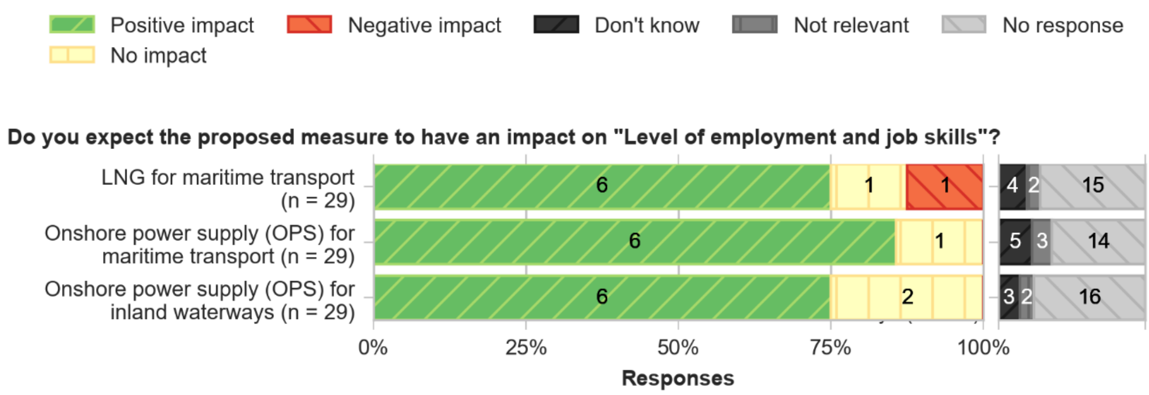


Table 7-75: Overview of expected impacts of shipping targets on employment and job skills

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Expected positive impact on employment and job skills arising from the demand for new infrastructure and supporting services related to OPS for inland and maritime ports.
Policy option 2	Expected positive impact on employment and job skills (slightly higher than PO1) arising from the demand for new infrastructure and supporting services related to OPS for inland and maritime ports.
Policy option 3	Expected positive impact on employment and job skills (higher than PO2) arising from the demand for new infrastructure and supporting services related to OPS for inland and maritime ports, LNG for maritime ports and mandate for electricity supply for battery vessels.

7.3.4.3 Measures for setting targets for AFI for air transport

The impact of aviation targets on employment is expected to be limited. As discussed in section 7.2.2.3 the deployment of FEGP is already well established in large airports and the measures do not represent a significant increase the AFI deployed. For smaller airports, the measures are more impactful, however it is not expected that this will create a significant number of jobs in AFI manufacturing companies, as these are already well established. Furthermore, it will have no impact on the employment of jobs at airports, as ground handling services are already provided for. However, it is anticipated that new skills will be required for staff at airports for the operation of the new infrastructure.

Table 7-76: Overview of expected impacts on employment and job skills of aviation targets

Measure	Impact
Policy option 1	No impacts are expected as the market is well developed and existing airport employees will operate the infrastructure.
Policy options 2 and 3	No impacts are expected as the market is well developed and existing airport employees will operate the infrastructure.

7.3.4.4 Measures to promote interoperability

As discussed in sections 7.2.2.4 and 7.2.3.4, the measures introduced to promote interoperability will benefit the AFV and AFI markets and will require additional investments. This will have a small positive impact on employment in the industry. The introduction of standards may adversely impact some producers that do not currently comply with such standards; however, this is likely to be negligible. An overview of the expected impacts of measures to promote interoperability on employment and job skills is presented in Table 7-77.

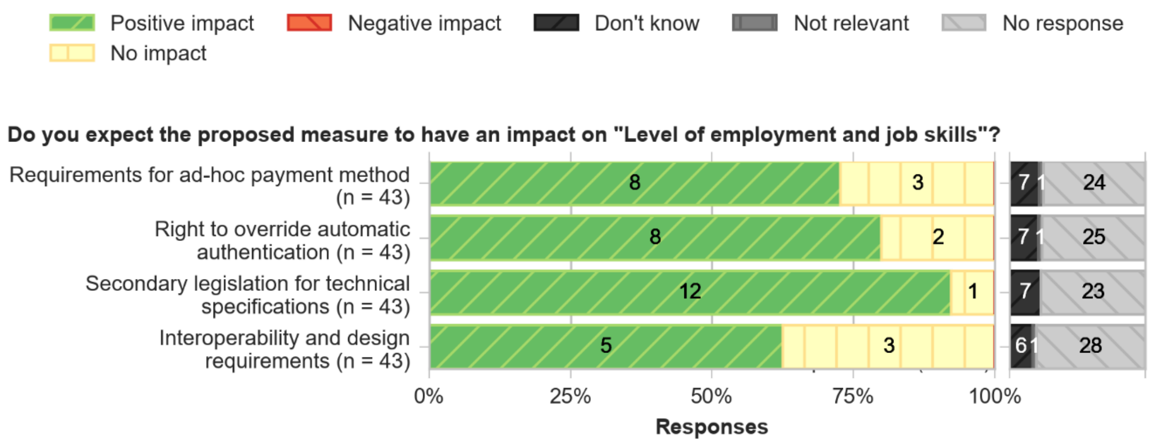
As discussed in section 7.2.9.1, analyses by the Internal Energy Agency estimated that installation and manufacturing of EV charge points support 12 jobs per million USD of investment, or around 10 jobs per million EUR (IEA, 2020b). An estimate of the net job creation due to investment, e.g., in ad hoc payment options could be made on this basis. By 2030, the number of jobs vary from around 8,500 in PO1 to 12,000 for PO3; by 2050 these increase greatly from 53,500 in PO1 and 56,500 in PO3. For the provision of cables in PO3 job created can be up to 700 in 2030 and 3,000 by 2050. For the other measures that require investment in physical infrastructure (namely the measures on physical standards and technical specifications), no estimates on the level of employment are possible, given the lack of information on investment costs.

As presented in section 7.2.9.1, some studies also note that a negative impact on employment in the vehicle manufacturing and refining sectors can be expected. Increased uptake of AFVs as a result of measures to promote interoperability may contribute to such an impact. Although the scale of this impact could not be quantified, it is not expected to be of a great extent.

For the measures on communication standards, the provision of IT hardware and software, as well as data management, is expected to develop new business activities in the transport sector, as found out in the evaluation support study (Ricardo, 2021b). Standards for communication between EVs and EV charge points can thus be expected to require new employees along the value chain to implement and maintain these systems.

An overview of the stakeholder views on how measures to promote interoperability would affect the uptake of AFVs is presented in Figure 7-9. As indicated in the figure, the majority of stakeholder believed the measures would have a positive impact on the level of employment and job skills, with the remaining respondents believing they would have no impact. Across the different measures, seven out of nine responses expecting no impact came from four Member State ministries responsible for transport. CHAdeMO Association Europe noted that introduction of standards may reduce investment in innovation and research, which may adversely impact job skills due to less diversification of AFI offerings.

Figure 7-9: Stakeholder responses on if they expect the proposed measures to have an impact on employment and job skills (n=43)



An overview of the expected impacts on employment and job skills of the measures to promote interoperability is presented in Table 7-77.

Table 7-77: Overview of expected impacts of measures to promote interoperability on employment and job skills

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact due to additional investment in AFI market and positive impact on AFV and AFI markets. Small positive impact (not quantified) due to additional investment in AFI market.
Policy option 2	Positive impact (slightly higher than PO1) due to additional investment in AFI market and positive impact on AFV and AFI markets related to ad-hoc payment and physical and communication standards.
Policy option 3	Positive impact (slightly greater than PO2) due to additional investment in AFI market and positive impact on AFV and AFI markets related to additional ad-hoc payment measures.

7.3.4.5 Measures to improve consumer information

As discussed in sections 7.2.2.5 and 7.2.3.5, the measures introduced to promote consumer information will benefit the AFV and AFI markets and will require additional investments. This will have a small positive impact on employment in the industry. An impact on job skills is not expected.

The multiplier used in previous sections refers to the installation and manufacturing of EV charge points and is therefore unlikely to accurately reflect the impact on employment as a result of mandating signposting – these jobs would be mostly in less-skilled manufacturing and construction. Given the investment estimates presented in section 7.2.3 (less than €10 million for PO3), the measures for roadside indicators are unlikely to result significant impacts on employment.

As discussed in 7.2.9, evolving requirements for data and information are likely to develop new business activities around the AFV and AFI supply chain that require new employment for implementing and maintaining these IT systems (Ricardo, 2021b). Still, this impact is expected to be limited, given the limited investment required.

The majority of stakeholders responding to the question if these measures would have an impact on employment and job skills believed that measures to promote consumer information would have a positive impact (Figure 7-10).

Figure 7-10: Stakeholder responses on if they expect the proposed measures to have an impact on employment and job skills (n=43)

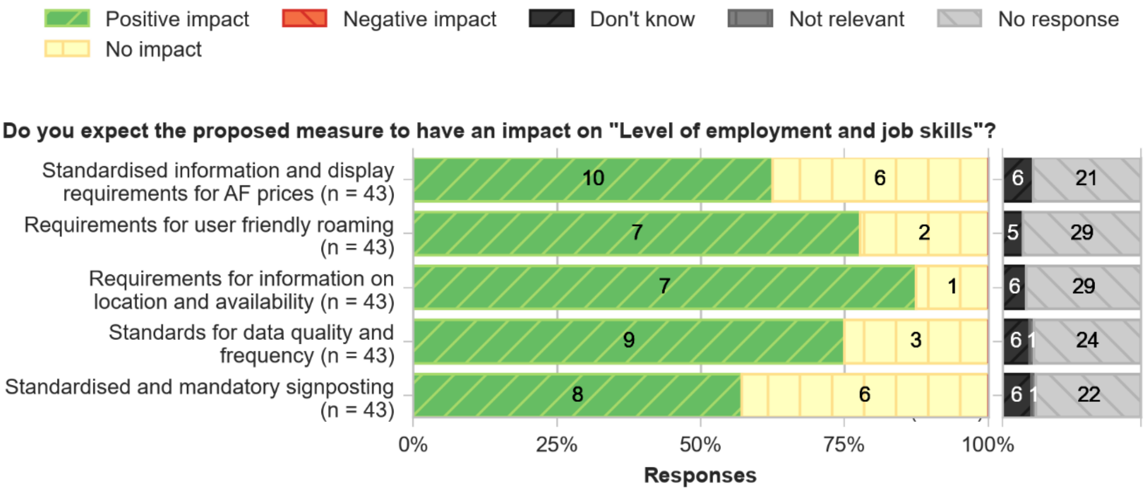


Table 7-78 below provides an overview of the expected impacts on employment and job skills as a result of measures to improve customer information.

Table 7-78: Overview of expected impacts of measures to improve consumer information on employment and job skills

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Little or no impact expected due to limited additional investment.
Policy option 2	Positive impact on employment for sign manufacturing and construction due to increased number of signs required.
Policy option 3	Positive impact on employment for sign manufacturing and construction due to increased number of signs required (slightly higher than PO2).

7.4 Environmental impacts

7.4.1 Introduction

The analysis of environmental impacts covers the following impact categories arising from measures identified under each policy option:

- Greenhouse gas emissions.
- Air pollutant emissions.
- Noise.

Environmental benefits represent the key rationale for taking action towards the faster and broader deployment of alternative fuels infrastructure. The PRIMES-TREMOVE model has been used to quantify the impacts of selected measures/options on GHG, energy use and air quality, in particular those relating to problem area A (road transport). Other impacts have been assessed relying on input from stakeholders and desk research.

7.4.2 Greenhouse gas emissions

7.4.2.1 Measures setting targets for AFI for road transport

On the basis of the modelling analysis, a positive impact (i.e. reduction) is expected from all policy options up to 2050 with the level of reduction increasing over time (see Table 7-88). In 2030 the level of reduction under all options is expected to be around 5.3%[61] in comparison to the baseline scenario, reaching over 90% reduction by 2050. However, we note that the impacts are a result of the gradually increasing uptake of AFVs over time under the MIX scenario, which is the same under all policy options. It should be recalled that all policy options include all other policy initiatives part of the "Fit for 55" package and other initiatives (e.g. CO_2 emissions standards for vehicles, carbon pricing, improvements in the efficiency of the transport system, etc.) and these contribute to the CO_2 emissions reductions from road transport.

Table 7-88: Tank to wheel CO_2 emissions from road transport in the policy options and the baseline

Tank to wheel CO_2 emissions from road transport	2015	Baseline			PO1 / PO2 / PO3		
		2030	2040	2050	2030	2040	2050
Road transport emissions in Mt of CO_2	722	574	453	389	543	158	4
% change to 2015		-20.5%	-37.2%	-46.1%	-24.7%	-78.1%	-99.5%
% change to Baseline					-5.3%	-65.1%	-99.0%

Source: Own elaboration based on PRIMES-TREMOVE

On a well to wheel basis[62], CO_2 emissions from road transport would go down by 19.3% in the baseline scenario by 2030, by 35.6% in 2040 and by 44.3% by 2050 relative to 2015. In all policy options, higher emissions reductions are projected (23.9% decrease in 2030, 75.5% in 2040 and 98% by 2050 relative to 2015) due to the higher uptake of

[61] Excluding powered two-wheelers.

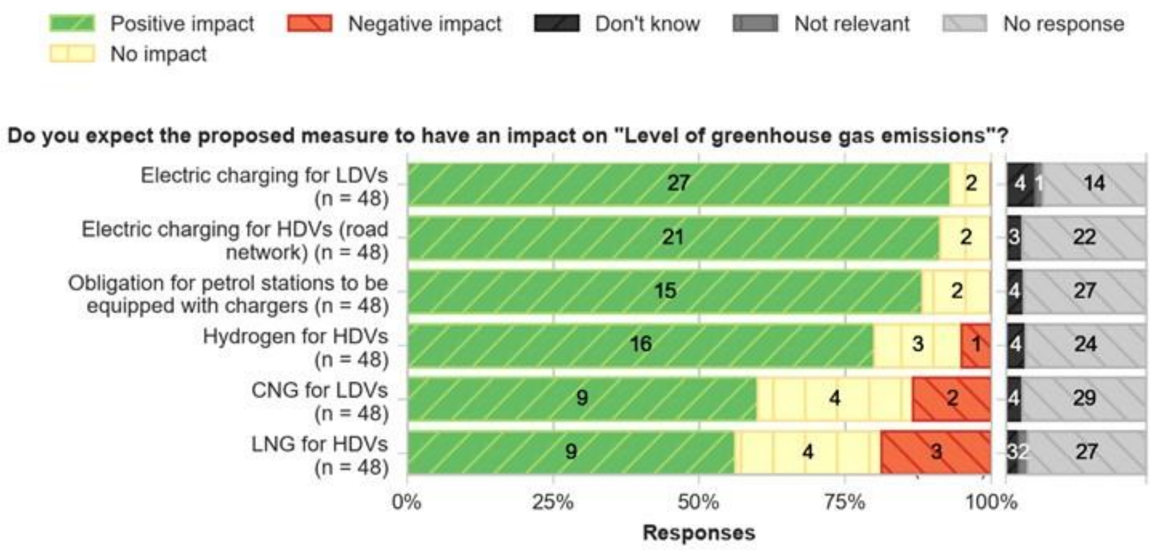
[62] Only EU emissions for the domestic production are covered by the quantified well to wheel emissions. Worldwide upstream emissions related to the sourcing of fossil fuels are not reflected in this modelling exercise. For biofuels, well to wheel CO_2 emission factors reflect the energy use in the production process. Indirect land-use change (ILUC) emissions are not included.

zero-emission vehicles, but also due to the power generation sector that is set to achieve decarbonisation by 2050. The power generation mix plays an important role in this time perspective considering the large scale electrification of road transport.

The reduction in external costs of CO_2 emissions is projected at €445 billion relative to the baseline over the 2021-2050 period, expressed as present value. These have been monetised using the Handbook on the external costs of transport.

This is also reflected in the responses of stakeholders to the survey, with the large majority of respondents indicating positive impacts for electric charging and hydrogen (except T&E which focused its criticism on the idea that promoting the less efficient hydrogen solution is going to delay the adoption of electric vehicles) (see Figure 7-23). While the majority indicated a positive impact, there was a greater share which considered that there are possible negative impacts from LNG/CNG measures (including the German authorities, T&E and one industry representative) and few more (including three authorities[63] and one anonymous industry representative) than considered that there were no impacts.

Figure 7-23: Stakeholder input on the expected impact of the proposed targets for road transport AFI on greenhouse gas emissions



Source: Targeted stakeholder consultation

Table 7-89: Overview of expected impacts of road transport targets on CO_2 emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Small indirect positive impact by ensuring sufficient public charging infrastructure to support the uptake and use of electric vehicles that will contribute to CO_2

[63] BG, LV and one anonymous

Measure	Expected impact
	emissions reduction and reduction of oil consumption. Very small impact of other measures.
Policy option 2	Expected small net positive impact on emissions reduction (higher than PO1) from the combination of additional measures.
Policy option 3	Expected small net positive impact on emissions reduction (higher than PO2) from the combination of measures.

7.4.2.2 Measures setting targets for AFI for water transport

Based on the increased AFI deployment and the associated uptake of AFV described in section 7.2.2.2, each measure is expected to have positive environmental impacts with increasing effect as the policy options become more demanding. We note that the exception to this is the measure concerning LNG for inland waterways, which removes the requirement for provision of LNG bunkering. We do not expect any direct environmental impacts as a consequence of this measure.

For OPS (both maritime and inland waterway), the CO_2 emissions reduction only applies when the vessel is at berth. While OPS reduces onboard emissions at berth, consideration needs to be given to the emissions associated with power generation as such, as the source of this power will have a major influence on the overall emissions reduction achieved. In particular, if renewable energy is used, near-zero emissions of CO_2 and other air pollutants (described below) can be achieved. Thus, the CO_2 emissions reduction achieved as a result of the OPS measures introduced are dependent on the energy mix and will vary between each MS. We note that in some Member States[64], the CO_2 emissions associated with power generation are indeed higher than those emitted when using MGO as a fuel (EEA, 2020a). As a result, OPS does not yet provide a reduction in CO_2 emissions in these select countries. Rather, a switch to OPS would represent an increase in CO_2 emissions. However, in each of these countries (and the EU in general) the CO_2 emissions associated with power generation are decreasing year on year and in turn improving the environmental benefits of OPS. Therefore, it can be expected that in the future OPS will represent an improvement in CO_2 emissions for all Member States by 2025 (the earliest year for which an OPS target is set for).

It is challenging to estimate the impact of this measure for the period up to 2050 as there is limited data available. However, we have made some key assumptions to estimate the impact of **OPS for maritime** on CO_2 emissions in the absence of real data:

- The EU's monitoring, reporting and verification of carbon dioxide emissions from maritime transport (MRV) data for 2019 reported 138 million tonnes of CO_2 for EU shipping (including while the vessel is at sea and at berth).
- Of the 138 million tonnes, 6% (8.28 million tonnes) were generated when ships were at berth (European Commission, 2020a).
- At berth emissions are derived from auxiliary engines and auxiliary boilers. It is assumed that 80% of all berth emissions are derived from auxiliary engines, based on a study in the Port of Gavle (GUTIÉRREZ SÁENZ, 2019). Hence, auxiliary engines comprise 6.624 million tonnes of CO_2 every year for EU maritime.

[64] CY, EE, PL

- The CO_2 emissions reduction of using electricity as an alternative to MGO has been estimated by the % difference in carbon intensities of each fuel (gCO_2/kWh). We have taken into account how the emissions factors for EU power generation will evolve to 2050 using inputs form PRIMES-TREMOVE.
- We have used the percentage of total calls covered with OPS under each policy option to determine how many berthing occasions this CO_2 emissions reduction applies to.

Table 7-90 summarises the expected CO_2 emissions reduction under each policy option net to the baseline. The emissions reductions are driven by the replacement of MGO with electricity supply for auxiliary engines in all cases and therefore is directly correlated with the number of vessels that are capable of using OPS. Hence, PO3 represents the greatest reduction as this measure serves all maritime ports with OPS such that all ships can use electricity when at berth. Although impacting all types of ships, the greatest reduction is expected to be derived from container ships, which emit the greatest volume of CO_2 at berth currently. For the period up to 2050, the total reduction of CO_2 emissions is between 48.38 – 82.97 million tonnes of CO_2 which corresponds to around 1.45-2.48% of total maritime emissions produced in that period. We note, however, that in the context of total EU maritime CO_2 emissions the impact of OPS is limited, even for the most ambitious policy option covering all EU maritime ports.

Table 7-90: CO_2 emissions impact of policy options concerning OPS for maritime in million tonnes

Type of AFI	Baseline	PO1		PO2		PO3	
		Total	Net	Total	Net	Total	Net
Up to 2030	0.33	5.29	4.97	8.16	7.84	8.72	8.39
2031-2050	3.26	46.67	43.41	72.84	69.54	77.83	74.57

Given the nature of OPS, the environmental impacts for inland waterway can be considered to be of the same nature as maritime. Specifically, CO_2 emissions reduction occurring at berth, with the extent of the reduction deepening on the energy mix in electricity production. Although it is worth noting the total EU CO_2 emissions generated by inland navigation are significantly less than in maritime as result of smaller vessels and far fewer vessels. Given the limited information available on the current environmental performance of inland navigation, in particular when vessels are at berth, it has not been possible to calculate an estimated CO_2 reduction. Nevertheless, it is expected that PO2 and PO3 have the greatest impact as each of the policy options have the greatest AFI deployment (covering all TEN-T Core and Comprehensive ports) and, in turn, the greatest uptake in vessels.

Unlike OPS, the provisions for LNG bunkering will impact the CO_2 emissions in ports when vessels are at berth and when vessels are in operation. Furthermore, use of LNG has possible impacts on CO_2 emission from both a well-to-tank and tank-to-wake perspective, though the exact extent is subject to discussion following continued assessments of fossil LNG emissions. However, the impact assessment accompanying the FuelEU maritime initiative has shown that fossil LNG will be gradually replaced with liquified biomethane (or bio-LNG) from 2030 onwards and renewable low-carbon synthetic e-gas from 2035 onwards. By 2050, renewable and low carbon fuels are projected to represent the large majority of gaseous fuels used in maritime. Such decarbonised gases (bio-LNG and e-gas) use the same infrastructure as the LNG and are projected to represent 21% of the fuel used in international shipping by 2050, according to the impact assessment accompanying the FuelEU maritime initiative.

Concerning the impact of electricity supply to battery electric vessels, the impact on the environment is dependent upon the uptake of vessels, which is facilitated by the deployment of AFI. Environmental benefits are expected while the vessel is at berth **and** in operation. Thus, deployment of such type of infrastructure can bring significant additional CO_2 reductions when compared to OPS that only cover a small part of the total operations – and associated emissions – of fossil fuel-based vessels. A further advantage is that the efficiency of converting electrical power into movement is about 85% compared to diesel engines with an efficiency of about 40% (CCNR, 2020). Clearly, the total level of the impact from the measure will depend on the level of uptake of electric vessels that may result from the deployment of relevant infrastructure along the TEN-T core inland ports. This has not been possible to estimate but we can reasonably conclude that the measure should lead to a reduction of CO_2 emissions from inland waterway. In the context European transport, however, inland navigation represents only 0.5% of total GHG emissions from transport in Europe (EEA, 2020b). This represents the maximum CO_2 reductions this measure could achieve, in the scenario where all vessels are battery operated and no CO_2 emissions are associated with power generation. Hence, the impact of this measure on CO_2 emissions is limited in the context of the European transport sector.

Table 7-91: Overview of expected impacts of shipping targets on CO_2 emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	CO_2 emissions reductions limited to while the vessel is at berth, which only comprise a small volume of total waterborne emissions. Limited impact on maritime CO_2 emissions estimated at 48.38 million CO_2 tonnes net from baseline for the period up to 2050 (1.45% reduction the total maritime CO_2 emissions) Expected impact of OPS for inland ports very limited affecting 19 ports.
Policy option 2	For OPS, CO_2 emissions reductions limited to while the vessel is at berth, which only comprise a small volume of total waterborne emissions. Emissions reduction of 77.38 million tonnes net from baseline for the period up to 2050 (2.31% reduction of total maritime CO_2 emissions). OPs for inland ports measures to affect a higher number of ports (106) but impact to remain limited. For LNG, emissions are likely to decrease but cannot quantify.
Policy option 3	For OPS, CO_2 emissions reductions limited to while the vessel is at berth, which only comprise a small volume of total waterborne emissions. Estimated CO_2 emissions reduction of 82.97 million tonnes net from baseline for the period up to 2050. (2.48% reduction of total maritime CO_2 emissions). Same impact as in the case of PO2 from OPS for inland ports. For LNG, emissions are likely to decrease (similar to PO2). Concerning impact of the mandate for electricity supply for battery vessels at each TEN-T core port by 2030 a positive impact on the CO_2 emissions from inland navigation is expected but the reduction will be very small (less than 0.5% of total emissions from European transport).

7.4.2.3 Measures setting targets for AFI for aviation

The use of FEGP in airports allows the aircrafts engines and auxiliary power unit (APU) located in the tail to be switched off once the aircraft is on stand. FEGP provides an alternative to the traditional jet fuel used to run APUs, as it runs on grid electricity and thus has a much lower carbon intensity. The exact fuel burn and environmental impact of running APUs are dependent on various factors such as aircraft type, weight and turnaround times. Furthermore, unlike aircraft main engines, APUs are not certificated for emissions, and the manufacturers generally consider information on APU emissions rates as proprietary (ICAO, 2011). As a result, little data are publicly available to serve as a basis for calculating APU emissions and the extent of environmental benefits that FEGP brings is difficult to quantify and we can only provide a general assessment.

We note that in the context of total aviation emissions, the environmental impact of FEGP is limited on the basis that APUs account for a small proportion of CO_2 emissions in aviation (approximately 1%) (DfT, 2017). As with shipping, consideration needs to be given to the emissions associated with power generation and as such, the source of this power will have a major influence on the overall emissions reduction achieved. In particular, if renewable energy is used, near-zero emissions of CO_2 and other air pollutants (described below) can be achieved when the aircraft is on stand, representing a 1% reduction in total aviation CO_2 emissions. In reality, the GHG reduction will not be as high as 1% due to the emissions factors associated with power generation and it will vary widely between each MS.

A further limitation of FEGP is that it cannot substitute for pneumatic power requirements (for some aircraft) or be used to heat and cool the aircraft, which are both traditionally powered by the APU (Sustainable Aviation , 2018). Thus, to completely remove the use of APUs when the aircraft is on stand to maximise the full environmental benefits, FEGP would have to be deployed alongside preconditioned air (PCA) derived from a central energy plant or through decentralised, gate mounted chiller/heater units on or near each airbridge. As an example of the potential impact, in Zurich Airport, it was found that if all stands are equipped with FEGP and PCA, the APU CO_2 emissions would reduce by 96% (Zurich Airport, 2018). The implication of solely FEGP deployment is that only a proportion of the APU emissions are reduced. However, there are not studies that identify the reductions of FEGP as it is commonplace to deploy PCA alongside FEGP. Thus, we can't determine the level of reduction.

Table 7-92: Overview of expected impacts of CO_2 of aviation targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	APU emissions only represent 1% of total aviation CO_2 emissions and FEGP only offers a reduction a proportion of these emissions. As such, this measure has significantly limited impact in the context of total CO_2 emissions int he aviation sector.
Policy options 2 and 3	APU emissions only represent 1% of total aviation CO_2 emissions and FEGP only offers a reduction a proportion of these emissions. As such, this measure has significantly limited impact in the context of total CO_2 emissions int he aviation sector.

7.4.2.4 Measures to promote interoperability

For the measures to promote interoperability, impacts on GHG emissions are directly correlated with the impacts on the uptake of AFVs (see section 7.2.2.4). All of the measures to promote interoperability are expected to positively impact customer experience through improved convenience and reliability of recharging services, which would have a positive impact on the uptake of AFVs and a resulting positive impact on GHG emissions. While the impact of each of the measures separately may be relatively small, combined, they could have a higher positive impact, making the entire experience of using an AFV easier, contributing to a higher level of uptake of AFVs[65] and a resulting positive impact on GHG emissions. More details on the expected impact on the uptake of AFVs are given in section 7.2.2.4.

An overview of the expected impacts on GHG emissions of the measures to promote interoperability is presented in Table 7-93.

Table 7-93: Overview of expected impacts on GHG emissions of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	**Impact**
Policy option 1	Positive impact on GHG emissions, resulting from the positive, but likely small, impact on AFV uptake as a result of the ad-hoc payment measures.
Policy option 2	Positive impact on GHG emissions (higher than PO1), resulting from the positive, but likely small, impact on AFV uptake linked to ad-hoc payment standards and the physical standards for HDVs.
Policy option 3	Positive impact on GHG emissions (higher than PO2), resulting from the positive, but likely small, impact on AFV uptake from ad-hoc payment measures linked to the ad-hoc payment measures.

7.4.2.5 Measures to improve consumer information

The same rationale used in the measures to promote interoperability applies on the measures to improve consumer information. Impacts on GHG emissions are directly correlated with the impacts on the uptake of AFVs (see section 7.2.2.1.2). As such, measures that have a positive impact on the uptake of AFVs would also have a positive impact on GHG emissions. For other measures, the impact is likely to be negligible.

An overview of the expected impacts of the measures on consumer information on GHG emissions is presented in Table 7-94.

Table 7-94: Overview of expected impacts of measures to improve consumer information on GHG emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

[65] Besides the uptake of AFV per se, another contributin factor is the use of those AFVs: better availability of AFI and more user friendliness of that AFV would allow longer journeys using those AFVs, replacing journeys using fossil fuel-powered vehicles.

Measure	Impact
Policy option 1	Positive impact on GHG emissions, resulting from the positive, but likely small, impact on AFV uptake driven mainly from the improved user information.
Policy option 2	Positive impact on GHG emissions (higher than PO1), resulting from the positive, but likely small, impact on AFV uptake driven by ad-hoc price transparency measures, user information and additional signs in parking areas.
Policy option 3	Positive impact on GHG emissions, resulting from the positive, but likely small, impact on AFV uptake (higher than PO2 due to increased expected impact of the roadside indicators).

7.4.3 Air pollutant emission reduction

7.4.3.1 Measures setting targets for AFI for road transport

As in the case of CO_2 a positive impact is expected in terms of the reduction in the level of air pollutants (NOx and PM) from all policy options. However, again the impact is associated with the evolution of the fleet composition as projected under the MIX scenario. As such, the impact of the policy measures related to AFI is only indirect to the extent that it ensures the minimum level of AFI needed.

By 2030, NOx and PM emissions from road transport[66] are projected to decrease by 6.6% and 7.6%, respectively, relative to the baseline, driven by the uptake of zero-emission vehicles enabled by the deployment of infrastructure. The reductions in air pollution emissions relative to the baseline are expected to be higher post-2030, due to the larger penetration of the zero emission vehicles for both LDVs and HDVs.

Table 7-95: Air pollutant emissions from road transport in the policy options and the baseline

Air pollution emissions from road transport	2015	Baseline			PO1 / PO2 / PO3		
		2030	2040	2050	2030	2040	2050
NOx emissions (ktons)	2,850	1,000	733	547	934	290	32
% change to 2015		-64.9%	-74.3%	-80.8%	-67.2%	-89.8%	-98.9%
% change to Baseline					-6.6%	-60.5%	-94.1%
PM2.5 emissions (ktons)	131	58	38	27	54	14	1
% change to 2015		-55.7%	-70.8%	-79.7%	-59.1%	-89.0%	-99.1%
% change to Baseline					-7.6%	-62.3%	-95.4%

At the level of individual measures, the responses from stakeholders suggest that the impacts on air pollution should be largely the same as those indicated in the case of greenhouse gas emissions. Namely, there are positive assessments made on the expected impacts of all measures related to electrification. There are more negative views in the case of CNG and LNG infrastructure that are again based on the logic that such measures extend the use of internal combustion engine vehicles that emit air pollutants (see Figure 7-27).

[66] Excluding powered two-wheelers.

Figure 7-27: Stakeholder input on the expected impact of the proposed targets for road transport AFI on air pollution

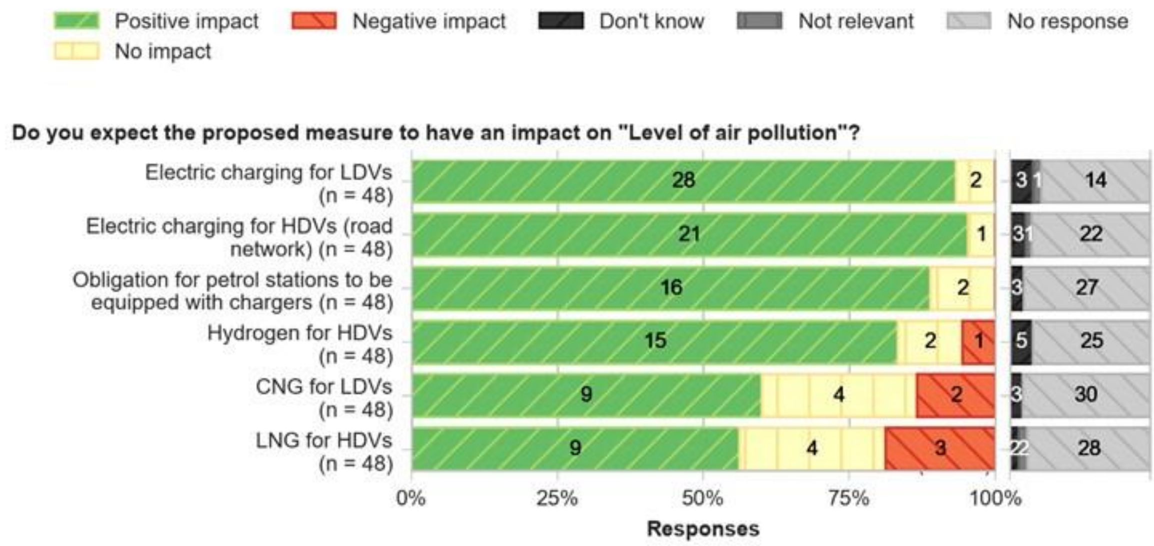


Table 7-96: Overview of expected impacts of road transport targets on air pollutant emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Expected indirect small net positive impact on emissions reduction from the national targets leading to higher uptake of EVs (mainly) and other AFVs.
Policy option 2	Expected small net positive impact (higher than PO1) on emissions reduction from the combination of measures leading to the higher uptake of AFVs.
Policy option 3	Expected small net positive impact (higher than PO3) on emissions reduction from the combination of measures leading to the higher uptake of AFVs.

7.4.3.2 Measures setting targets for AFI for water transport

Whilst it has not been possible to quantify the exact impacts on air pollutants of shipping due to the lack of data, we are able to make a general assessment.

The reduction of air pollutants and improvement on local air quality is arguably the main environmental benefit for both OPS and LNG as they both offer substantial reductions in air pollutants. Given that air quality is considered the top priority for ports (ESPO, 2019), this environmental impact represents a significant benefit to those in the maritime and inland waterway sectors. The uptake of LNG will impact both local air quality and air pollutants produced when the vessel is in operation, while OPS has a much more localised impact.

Electricity generation is typically located some distance from densely populated areas, whereas dockside shipping emissions will often occur close to city centres as a consequence of a port's typical location. As with CO_2 emissions, consideration needs to be given to the emissions associated with power generation. While coal-fired power plants emit more CO_2, they have lower emissions of nitrogen oxides, particulate matter and sulphur oxides, compared with those associated with burning marine diesel fuel with a 0.1 sulphur content. Hence, all policy options supporting OPS are expected to have a positive impact on air pollutants, with the effect increasing as the policy options become more ambitious and the frequency of use of OPS from vessels more widespread. For battery electric vessels, no air pollutants are generated while the vessel is in operation and thus presents a far greater environmental benefit than OPS. However, the air pollutants from inland navigation only form a small proportion of the total air pollutants from European transport, although there are no specific figures available.

The uptake of LNG in maritime is also expected to have a reduction on air pollutants under PO3 as a result of the uptake of LNG vessels. LNG contains little sulphur and LNG engines are tuned to emit low NOx emissions, which makes LNG an attractive fuel for ships that operate in Emission Control Areas (ECAs), where ships must comply with more stringent air quality standards.

Table 7-97: Overview of expected impacts of shipping targets on air pollutant emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	For OPS, impacts are limited to while the vessel is at berth, which will have positive impacts on local air quality.
Policy option 2	Sizeable reduction on air pollutants – higher than PO1- emitted at berth expected from OPS measures (maritime/inland). This will have a positive impact on local air quality while the vessel is at berth but will not be significant in the context of total maritime air pollutants.
Policy option 3	Sizeable reduction -higher than PO2- on air pollutants emitted at berth expected from OPS measures (maritime/inland). This will have a positive impact on local air quality while the vessel is at berth but will not be significant in the context of total maritime air pollutants. In relation to LNG vessels, reductions on air pollutants and local air quality will be significant. Additional positive impact from mandate for electricity supply that are expected to have a significant reduction on air pollutants emitted at berth and while the vessel is in operation.

7.4.3.3 Measures setting targets for AFI for aviation

An additional benefit of using FEGP in replacement of jet fuel powering APUs is the reduction of air pollutants at ground level. The main air pollutants considered here are NOx, HC, CO and PM_{10}. As noted previously, consideration needs to be given to the emissions associated with power generation, although this is a minor issue as power generation occurs at some distance from airports. Nevertheless, it is expected that lower emissions of air pollutants compared to the burning of jet fuel in APUs. As such, the measure will offer benefits across all air pollutants and the effects will increase the policy options become more ambitious.

As highlighted in section 7.4.2.3, the extent of the reduction of air pollutants is difficult to assess on the basis that the exact fuel burn and environmental impact of running APUs are not well documented and dependent on various factors such as aircraft type, weight and turnaround times. Nevertheless, at Zurich Airport, it was estimated that FEGP and PCA provision at all stands would offer a reduction of NOx pollutants while stationary by 96% of APU emissions (Zurich Airport, 2018).

We note, however, that APU emissions only comprise a small proportion of total aviation air pollutant emissions. While there may be some impact at a local level, the pollutants associated with taxiing, take-off and landing are expected to result in this impact being negligible.

Table 7-987-997-100: Overview of expected impacts of air pollutants of aviation targets

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	APU emissions only comprise a small proportion of total aviation air pollutant emissions. As such, this measure has significantly limited impact in the context of total CO_2 emissions in the aviation sector.
Policy options 2 and 3	APU emissions only comprise a small proportion of total aviation air pollutant emissions. As such, this measure has significantly limited impact in the context of total CO_2 emissions in the aviation sector.

7.4.3.4 Measures to promote interoperability

For the measures to promote interoperability, impacts on the emissions of air pollutants are directly correlated with the impacts on the uptake of AFVs. Given this, as noted in section 7.2.2.1.2, all of the measures to promote interoperability are expected to positively impact customer experience through improved convenience and reliability of recharging services, which would have a positive impact on the uptake of AFVs and a resulting positive impact on air pollutant emissions. While the impact of each of the measures separately may be relatively small, combined, they could be expected to have a higher positive impact. They will make the entire experience of using an AFV easier and contributing to a higher level of uptake of AFVs and a resulting positive impact on air pollutant emissions. More details on the expected impact on the uptake of AFVs are given in section 7.2.2.1.2.

An overview of the expected impacts on air pollutant emissions of the measures to promote interoperability is presented in Table 7-101.

Table 7-101: Overview of expected impacts on air pollutant emissions of measures to promote interoperability

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact on air pollutant emissions, resulting from the positive, but likely small, impact on AFV uptake.

Measure	Impact
Policy option 2	Positive impact on air pollutant emissions, resulting from the positive, but likely small, impact on AFV uptake of ad-hoc payment measures and physical standards.
Policy option 3	Positive impact on air pollutant emissions related to ad-hoc payment measures, resulting from the positive, but likely small, impact on AFV uptake.

7.4.3.5 Measures to improve consumer information

The same rationale used in the measures to promote interoperability applies on the measures to improve consumer information: impacts on air pollutant emissions are directly correlated with the impacts on the uptake of AFVs (see section 7.2.2.1.2). As such, measures that have a positive impact on the uptake of AFVs would also have a positive impact on air pollutant emissions. For other measures the impact is likely to be negligible. More details on the expected impact on the uptake of AFVs are given in section 7.2.2.1.2.

An overview of the expected impacts of the measures on consumer information air pollutant emissions is presented in Table 7-102.

Table 7-102: Overview of expected impacts of measures to improve consumer information on air pollutant emissions

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Positive impact on air pollutant emissions, resulting from the positive, but likely small, impact on AFV uptake.
Policy option 2	Positive impact on air pollutant emissions, resulting from the positive, but likely small, impact on AFV uptake.
Policy option 3	As PO2, but measure has the potential to lead to higher levels of AFV uptake, which would also have a higher positive impact on air pollutant emissions.

7.4.4 Impact on noise

7.4.4.1 Measures setting targets for AFI for road transport

A move from conventional vehicles to electric and fuel cell vehicles is expected to have a positive impact on the overall levels of noise. Noise levels from electric vehicles are significant lower than ICE vehicles at low speeds (typically below 20 km/h) (Campello-Vicente, Peral-Orts, Campillo-Davo, & Velasco-Sanchez, 2017; Verheijen & Jabben, 2010). Any benefits even out at higher speeds as tyre/road noise becomes more dominant. As such, there are potential indirect impacts from the deployment of AFI, primarily in urban areas as a result of a faster replacement of conventional vehicles by electric vehicles.

At the level of individual measures, while impacts are expected to be limited, measures related to electric charging infrastructure are expected to be more relevant in comparison to those focusing on the LNG/CNG AFI. The latter are not expected to have an impact on the levels of noise in comparison to other ICE vehicles. This is also reflected in the responses of stakeholders that are clearly supportive of the expected role of electric charging infrastructure in comparison to measure focusing on CNG and LNG fuelling infrastructure (see Figure 7-28).

Figure 7-28: Stakeholder input on the expected impact of the proposed targets for road transport AFI on noise

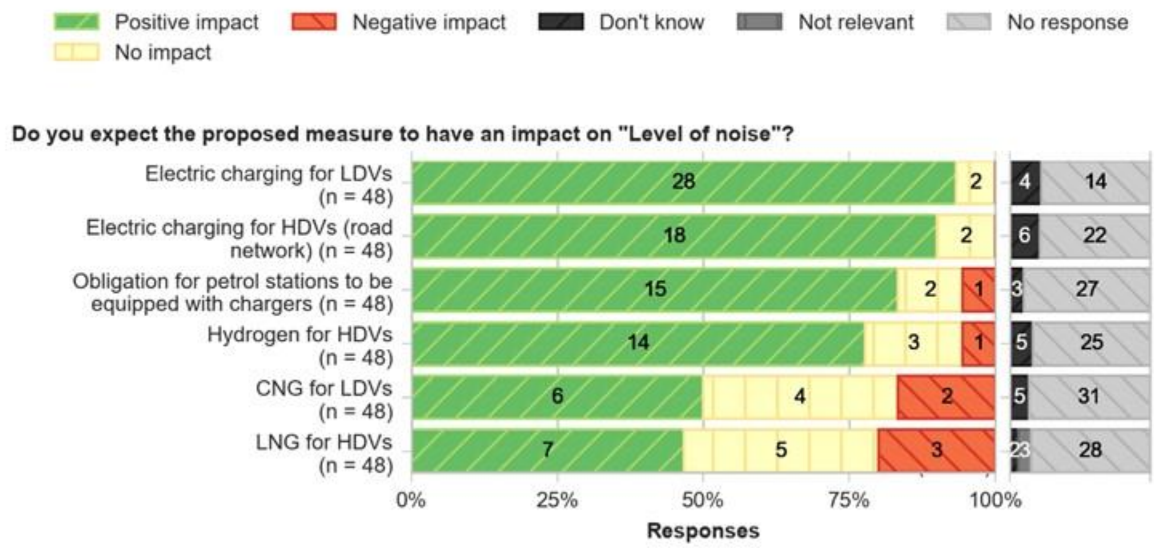


Table 7-103: Overview of expected impacts of road transport targets on noise

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Expected impact
Policy option 1	Very small indirect positive impact by ensuring sufficient public charging infrastructure to support the uptake and use of electric vehicles that have a limited contribution to noise (primarily in urban areas).
Policy option 2	Expected very small net positive and indirect impact on noise reduction from the combination of measures (same as PO1).
Policy option 3	Expected very small net positive impact on noise reduction from the combination of measures (same as PO1 and PO2).

7.4.4.2 Measures setting targets for AFI for water transport

An additional benefit from using OPS instead of onboard power generation is the elimination of noise and vibration from the auxiliary engines whilst at berth. This improves the working conditions for both the people on board as well as those working on the quayside. In contrast, LNG is not expected to have any significant impacts on noise pollution and the measure is not considered in this impact category. There has been a limited number of studies investigating the impact of noise reduction as a result of OPS and therefore we can only provide a general assessment of the impact.

Considering that noise is generated through auxiliary engines, it is expected that OPS will have varying impact depending on the type of ship using it at berth. It is estimated that the noise reductions achieved through OPS range from 0dB (Tankers/RoRo) to 16dB (Bulk). At the same time, auxiliary engines are only partly responsible for noise generation, with the majority of the noise originating from handling of cargo or air conditioning (Ranrio, 2015). Hence, the use of OPS is only expected to have a limited impact on noise pollution in ports.

In inland navigation, noise pollution is already considered to be negligible (Hofbauer & Putz, 2020). It is significantly quieter than other modes, both in terms of loading and route routing, and assumed that transport takes place mainly in sparsely populated areas. Thus, inland navigation has so far been able to comply with noise emission limits without the need for noise protection measures. Therefore, OPS or electricity supply to battery electric vessels are not expected to have any significant impact on noise.

Table 7-104: Overview of expected impacts of shipping targets on noise

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Negligible impacts overall. Small improvements in noise pollution in maritime ports possible. However, any impact of OPS on noise pollution is expected to be limited considering that the main sources of noise are handling of cargo and air conditioning.
Policy option 2	Negligible impacts overall (as in PO1).
Policy option 3	Negligible impacts overall (as in PO1 and PO2). Provisions related to LNG are not expected to provide an additional advantage.

7.4.4.3 Measures setting targets for AFI for aviation

The use of FEGP in airports allows the aircrafts engines and auxiliary power unit (APU) located in the tail to be switched off once the aircraft is on stand and thus reduces the noise in between landing and take-off.

Although there is no quantification of the impacts of FEGP on noise, Nice Côte d'Azur Airport (d'Azur, n.d.) reported a reduction of noise on the apron as a result of installing FEGP. Furthermore, several airports are incorporating the use of FEGP into their noise reduction plan, such as Stansted Airport and Aberdeen airport (London Stansted Airport, Noise Action Plan 2019-2023, 2019; Aberdeen International Airport, 2018).

However, noise in airports is primarily generated by aircraft as they arrive, depart and move around the airport. Additional sources of noise at the airport come from activities involved in getting the passengers and cargo to and from the aircraft, from aircraft maintenance and engine tests, from construction activities at the airport and from vehicles coming to and from the airport. Therefore, while FEGP may offer some noise reductions, these are expected to be negligible when considering other sources of noise in airports (London Stansted Airport).

Table 7-105: Overview of expected impacts of aviation targets on noise

××	×	O	✓	✓✓	
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive	Unclear

Measure	Impact
Policy option 1	Negligible impact as APUs do not represent a significant noise source in airports and therefore FEGP has limited noise reductions in perspective of the whole airport.
Policy options 2 and 3	Negligible impact as APUs do not represent a significant noise source in airports and therefore FEGP has limited noise reductions in perspective of the whole airport.

7.5 Analysis of impact of general measures

The general measures under consideration include the change the regulatory instrument used - from a Directive to a Regulation – and changes to reporting provisions. Both of these 'general measures' have a supporting role, which may increase the effectiveness of the other proposed targets and measures across the range of policy options. They may also have some cost implications for authorities.

The following sections analyse the possible impacts of the two general measures in relation to these two aspects.

7.5.1 Impact on effectiveness of the legislation

In considering **changes to the legal instrument used**, it is only in policy option 3 that an actual change is realised, which involves switching to a Regulation. In this case there will not be a need for the transposition of the provisions of the Directive by Member States. The specific changes to the provisions will apply uniformly and enter into force on a set date in all of the Member States in the form of an EC Regulation.

Moving to an EC Regulation could have the following important advantages:

- In can ensure greater consistency in the implementation of the adopted measures across the EU since there will not be scope for variation among Member States as part of the transposition process.
- There will not be scope for delays in the adoption of the relevant measures with the adopted targets becoming binding from the time of its entry into force. This is contrary to the process of transposition of the Directive by 27 EU Member States.

Both of the above were issues identified as part of the evaluation of the AFID and the use of a Regulatory instrument can help address them and they represent an important additional advantage when it comes to ensuring a fast deployment of AFI across the EU and supporting the accelerated uptake of electric vehicles across the EU.

Having said that, we should note that the main reason for the very limited consistency is the fact that the Directive only referred to indicative targets (and only for charging infrastructure), asking Member States to develop their own national plans (NPFs) and without setting any more specific requirements. Thus, in the context of the specific measures/targets under consideration under all policy options it can be expected that the level of variation will be reduced.

In terms of the possible delays to the adoption of the specific measures, it may still be the case that binding targets in the form a Regulation that will allow for limited flexibility will attract greater scrutiny among Member States and thus longer negotiating time before being eventually adopted. Nonetheless, to the extent that there are not changes to the targets and dates set in the proposal, this should not have a negative impact on effectiveness.

We should also note that there is significant level of support among stakeholders for the use of a Regulatory instrument, although they still do not represent a clear majority. A switch to a Regulation was supported by a range of stakeholders, largely representing industry stakeholders. In the context of the surveys and interviews undertaken for this study, 14 (out of 63) respondents considered that the entire Directive should be replaced with a Regulation and a further 16 considered that parts of the legislation should become a Regulation (just two public authorities supported the entire Directive being replaced with a Regulation and 5 supported parts of the Directive).

The main reasons put forward for switching to a Regulation was the importance of a more standardised and consistent approach to the deployment of the necessary infrastructure between Member States and the need for faster deployment. As argued, both objectives would be better achieved through the use of a Regulation that would ensure that action is taken in the necessary timescales and in a consistent format creating also greater certainty for companies operating across borders (and thus facilitating further the deployment of AFI). A large share of respondents to the OPC (157 out of 324) also agreed that the objectives of the AFID could be achieved better if policy measures discussed for the revision of the Directive were implemented through a Regulation, that would replace the current Directive[67].

A smaller but still sizeable majority disagreed with the need for a regulation. The main argument put forward by those who wanted the AFID to remain a Directive (21 out of 63 respondents to the survey) was that using a Directive will provide the necessary flexibility to Member States (even within the context of the specific targets and measures under consideration). As argued, a Regulation could be too prescriptive in imposing a 'one-size-fits-all' approach on all Member State markets that may not be appropriate. Similarly, among the OPC respondents, 76 out of 324 stated that they either rather or completely disagreed with the switch to a Regulation. This included 12 industry respondents (including 4 national service providers) and 9 national authorities. Still, as discussed above, at least in terms of the specific targets set, the use of a Regulation does also allow Member States to set the approach to meet the targets.

All in all, there are some evident advantages from a move to a Regulation, even if the use of a Directive can also be sufficient to achieve the objectives.

Existing requirements of the AFID regarding **reporting** require Member States to prepare a National Implementation Report (NIR) on the implementation of the NPFs, firstly in 2019, and then every three years after. The content of the report is defined in Annex 1 of the Directive, which includes legal measures; policy measures supporting the implementation of the national policy frameworks (NPFs); deployment and manufacturing support; research, technological development and demonstration (RTD & D); targets and objectives; and alternative fuels infrastructure developments.

Measures relating to reporting and monitoring are not anticipated to change from the current situation in policy option 1. However, policy options 2 and 3 see further specified guidelines set out in EU legislation, and an increase in frequency of reporting to every 2 years in PO3 (from the current 3-year reporting cycle). Whilst there are reporting requirements already in place, the revised specified guidelines in EU legislation are intended to result in a strengthening of the existing reporting requirements. Therefore, there may be higher compliance with the requirements, which could potentially lead to

[67] See Question E31 in OPC

increased effectiveness of identifying and subsequently implementing measures as required by the legal instrument. In the survey and interviews undertaken for this study stakeholders were asked whether they agree with the measure to require Member States to report on a set of binding data in their National Implementation Reports (NIRs) every three years[68]. The majority of respondents (40 out of 63) agreed with the measure, with just 4 disagreeing. Stakeholders who agreed with the measure explained the following:

- There is a need to provide detailed requirements, agreed following extensive consultation with Member States.
- The strengthened reporting requirements are likely to:
  - Reveal the degree of implementation in EU Member States;
  - Reveal information on regional/territorial disparities;
  - Identify areas for further improvement; and
  - Force Member States to provide data and potentially improve investment in the deployment of infrastructure.
- Data quality is likely to improve, especially if a requirement for a European database in addition to the National Access Points is included.
- Although the reporting frequency is suggested to be every three years, increased frequency may be required to ensure accelerated deployment of AFI.

Where stakeholders disagreed with the measure, the main comment again related to the frequency of reporting, with several calling for it to be increased (including annually, every 1.5 years) with the view that increased frequency in reporting would have a positive impact on the deployment of alternative fuels infrastructure.

7.5.2 Impact on costs

Considering the possible **change of legal instrument to a Regulation**, it is anticipated that minimal costs would be incurred by authorities. Any costs incurred are expected to be related to the personnel and administrative costs of making this change for Member States. Additionally, savings could be expected if a Regulation was implemented, as Directive would not have to be transposed into national legislation.

Limited cost information was collected from national authorities for the Evaluation study (via the national authority survey) relating to the development of the NIRs and associated reporting. Member states were asked about the total costs for their organisation of the development of the NIRs (split by activity). A number of activities could be considered relevant for the transposition of the Directive, including organising consultation with stakeholders prior to the development of the NIRs; external support studies; and collection of required data/information. It was estimated that the cost of these activities was **€92,000** per Member State (weighted average). Whilst specific transposition costs are not known, it could be conceived that such activities could be included in the transposition of any future Directive, particularly in Member States decide to undertake consultation activities/support studies. However, it is anticipated

[68] Compared to the current situation, the legislation would further define detailed requirements on the data to be reported (with a target date of 2025).

that this would be the maximum expected cost, but in practice it is likely to be a much simpler process, possibly involving administrative/legal processes.

As part of the surveys undertaken, national authorities were asked whether they expect any additional direct costs (compared to the current situation) as a result of implementing the measures. Of the 20 authorities responding to this question, five indicated that they did expect additional direct costs if there were to be a change of legal instrument (from Directive to a Regulation) (see Table 7-106). All five indicated that additional direct costs are likely to be related to monitoring and reporting and enforcement costs. A further 7 authorities indicated that they did not expect additional direct costs, and 8 did not know/did not answer. No further information on costs to authorities associated with the measure was provided by stakeholders. However, it could reasonably be expected that any costs incurred by authorities relating to the one-off administrative costs and personnel costs involved in changing the legal instrument would be minor.

Table 7-106: Responses of authorities concerning the type of costs expected from a change of legal instrument

Measure	Additional costs expected		Number of authorities indicating that they expect		
			Monitoring/ reporting	Enforcement costs	Other
Change of legal instrument (n= 20)	Yes	5	5	5	0
	No	7			
	Don't know/No answer	8			

Source: Ricardo analysis – National authority surveys

Regarding the **reporting and monitoring** measure, it is anticipated that costs to authorities would be incurred primarily due to the increased reporting frequency requirements in policy option 3 (every two years, rather than the current every three years). Both policy options 2 and 3 also stipulate further specified guidelines for Member State reporting set in EU legislation. However, as authorities already report using similar existing guidelines, it is unlikely that costs will be incurred.

To determine potential costs to authorities of reporting and monitoring activities, the previous costs incurred by authorities can be used as a reasonable comparison. As part of the Evaluation for the Directive, weighted average costs for the development of the NIRs reported by Member States were identified to develop an overall estimate at EU27 level for the total costs incurred by national authorities (derived from surveys and interviews with national authorities). This total cost was estimated to be **€3,400,000** (€126,000[69] per Member State). There was some evidence that the overall average costs vary depending on the size of the country (e.g. Spain and Germany in particular returning high costs for the development of the NIR). Feedback from national authorities indicated that the main costs associated with the NIR development are personnel costs for drafting and publication of the document.

In surveys for this study, 9 authorities (out of 20) indicated that they expected additional direct costs if MSs were required to report on a set of binding data in their NIRs every three years (see Table 7-107). Eight indicated that additional direct costs are likely to be related to monitoring and reporting, and 5 indicated that additional costs were likely to be related to enforcement costs. A further 3 authorities indicated that they did not expect additional direct costs, and 8 did not know/did not answer. No

[69] Maximum cost of €671,000 reported by Spain and a minimum cost of €0 reported by five[69] national authorities: BE (FLE), BG, LU, RO, SK

further information on costs to authorities associated with the measure was provided by stakeholders.

Table 7-107: Responses of authorities concerning the type of additional costs that Member States expect to incur to report on a set of binding data in their NIRs every three years – Costs to authorities (authority responses)

Measure	Additional costs expected		Number of authorities indicating that they expect additional		
			Monitoring/ reporting	Enforcement costs	Other
MS report on set of binding data in NIRs (n= 20)	**Yes**	9	8	5	0
	No	3			
	Don't know/ No answer	8			

Source: Ricardo analysis – National authority surveys

Based on the identification of reported costs of NIR preparation by authorities, it can be assumed that similar costs would be incurred for each reporting requirement as part of a revised Directive (PO3). As these activities are currently performed, and at the same frequency under the existing Directive, it is anticipated that negligible recurring costs would be incurred. Although it is acknowledged that costs may increase depending on the exact specifications and associated data requirements.

However, PO3 requires an increase in reporting frequency, from the current requirement to report every three years, to every two years. Therefore it is anticipated that Member States could see an increase in reporting costs of 50% under this policy option (see Table 7-108).

Table 7-108: Overview of expected impacts of general measures on costs to authorities

Measure	Impact
Policy option 1	No changes.
Policy option 2	Negligible increases in costs to authorities, depending on whether reporting requirements are increased significantly.
Policy option 3	Negative impact on costs for authorities due to increased frequency of reporting requirements from every 3 to every 2 years. Minor additional costs (if any) for the change of legal instrument

8 COMPARISON OF OPTIONS

8.1 Effectiveness

The effectiveness of the options is examined against the policy objectives identified in section 5. The criteria presented in Table 8-1 below are used to help assess effectiveness.

Table 8-1: Objectives and assessment criteria related to the effectiveness of policy options

Objectives	Assessment criteria
General objective	
Establish a robust policy framework in the area of alternative fuels and infrastructure that delivers on the following: • Drive the uptake of alternative fuels in all transport modes across Europe in line with the overall long-term climate and zero pollution objectives. • Minimise the dependence on oil in the transport sector. • Mitigate the environmental impact of transport by reducing CO_2/GHG and pollutant emissions to air. • Ensures that recharging or refuelling of vehicles/vessels is easy, seamless, safe and transparent for consumers everywhere in the EU. • Ensure availability of sufficient AFI throughout the EU at competitive costs, to remove barriers to the uptake of alternatively fuelled vehicles/vessels/aircraft that ensures that all AFVs can circulate with ease across the EU and that key infrastructure such as motorways, ports and airports enable operation of AFVs.	• Impact on the level of deployment of AFI at EU level. • Impact on distribution of AFI across the EU network and level of variation among Member States. • Impact on uptake of AFV (by type) in line with MIX scenario for 2030 and the 2050 targets • Environmental impacts (emission and external costs) including CO_2, pollutant emissions, noise (coming from the model including impacts on oil consumption). • Impact on consumers.
Specific objectives	
Specify minimum requirements for the roll-out of alternative fuels infrastructure along the TEN-T core and comprehensive network, as well as urban nodes.	• Ensure presence of minimum target on AFI along the TEN-T and urban nodes.
Ensure full interoperability of infrastructure for: • All alternatively fuelled vehicles, vessels and aircraft. • Communication protocols, where needed, that allow competitive markets to develop, including online connectivity. • Easy ad-hoc payment solution on all charging points as well as availability of seamless contract-based payments.	• Impact on level of interoperability of AFI. • Impact on ease of access/use of AFI.
Ensure adequate information is available for consumers, including: • Information on location/availability of infrastructure through appropriate tools and adequate signposting. • Comprehensive information on prices for recharging/ refuelling services as well as on additional services (on online sources and at the point of sale).	• Impact on availability, access and quality of information related to AFI location and availability and prices for consumers.

The results of the analysis of impacts are summarised in Table 8-2.

Table 8-2: Comparison of impacts of policy packages in terms of objectives (in comparison to baseline)

Strongly negative	Weakly negative	No or limited impact	Weakly positive	Strongly positive	Unclear

	PO1	PO2	PO3
Specific policy objective 1: Ensuring sufficient infrastructure to support the required uptake of alternatively fuelled vehicles across all modes and in all MS			
Increase of number of public accessible recharging	Positive effect on road transport recharging infrastructure: increase to 3.501 million public accessible chargers by 2030, 11.4 million by 2040 and 16.3 million by 2050, fully addressing overall needs of the LDV fleet. Some shortcomings in cross-border connectivity for 2030 as some parts may not be fully equipped due to lack of provision. PO leads to a steady increase in public accessible recharging points for HDV, including 6,173 chargers in 2030, 10,340 by 2040 and 12,694 in 2050 along the TEN-T.	Positive effect on road transport recharging infrastructure: increase to 3.512 million public accessible chargers by 2030, 11.4 million by 2040 and 16.3 million by 2050, fully addressing overall needs of the LDV fleet and ensuring full cross-border connectivity in the TEN-T. PO leads to a steady increase in public accessible recharging points for HDV, including 6,493 chargers in 2030, 10,660 by 2040 and 13,014 in 2050 along the TEN-T.	Positive effect on road transport recharging infrastructure: increase to 3.574 million public accessible chargers by 2030, 11.5 million by 2040 and 16.3 million by 2050, fully addressing overall needs of the LDV fleet and ensuring full cross-border connectivity in the TEN-T. PO leads to a steady increase in public accessible recharging points for HDV, including 7,612 chargers in 2030, 11,779 by 2040 and 14,134 in 2050 along the TEN-T.
Increase of number of refuelling points on roads	Positive effect also for road transport refuelling infrastructure: hydrogen refuelling points to increase to 1,852 by 2030, 8,222 by 2040 and 20,153 by 2050; the number of LNG refuelling points would be 2,904 in 2030 ensuring minimum connectivity, while in 2050 slight decrease to 2,896.	Positive effect also for road transport refuelling infrastructure: hydrogen refuelling points to increase to 1,993 by 2030, 8,341 by 2040 and 20,154 by 2050 but with almost double the capacity than in PO1. The number of LNG refuelling points would be 2,904 in 2030 ensuring minimum connectivity, while in 2050 slightly decrease to 2,896.	Positive effect also for road transport refuelling infrastructure: hydrogen refuelling points to increase to 1,990 by 2030, 8,337 by 2040 and 20,104 by 2050 with the same capacity as in PO2. The number of LNG refuelling points would be 2,904 in 2030 ensuring minimum connectivity, while in 2050 slightly decrease to 2,896.

Increase of number of OPS and other alternative fuels infrastructure in ports	PO also has a moderate positive effect on OPS provisioning in ports, leading to a total installed capacity of 856 MW in maritime ports and equipping 85 TEN-T core inland ports with OPS (net of 18). No impact on LNG provisioning	PO has a strongly positive effect on OPS provisioning in ports, leading to a total installed capacity of 3,676 MW in maritime ports and equipping 85 TEN-T core inland ports (net of 18) and additional 160 TEN-T comprehensive inland ports with OPS (net of 88). No impact on LNG provisioning.	PO has a strongly positive effect on OPS provisioning in ports, leading to a total installed capacity of 3,676 MW in maritime ports and equipping 85 TEN-T core inland ports (net of 18) and additional 160 TEN-T comprehensive inland ports with OPS (net of 88). All 91 TEN-T ports will be equipped with LNG bunkering.
Increase of number of electricity supply to stationary aircraft	Positive impact also on electricity supply to stationary aircraft, equipping 11,051 passenger gates and outfield position (net of 1,078).	Strong positive impact on electricity supply to stationary aircraft, equipping 14,729 passenger gates and outfield position (net of 4,756).	Strong positive impact on electricity supply to stationary aircraft, equipping 14,729 passenger gates and outfield position (net of 4,756).
Specific policy objective 2 Ensuring full interoperability of the infrastructure			
Increase in the directional alignment of the EV charging backend	The option has a positive effect on the directional alignment on the EV charging backend through requiring a set of open communication interfaces and protocols that will prevent technological lock in of proprietary solutions.	The option has a positive impact on the alignment of the EV charging backend, as it prescribes transfer of relevant standards (when finalised) for communication protocols and interfaces into EU law by means of delegated action, securing common technical specifications in the internal market. It will ensure common communication standards between the recharging infrastructure and the grid and thereby facilitate smart recharging.	The option has a positive impact on the alignment of the EV charging backend, as it prescribes transfer of relevant standards (when finalised) for communication protocols and interfaces into EU law by means of delegated action, securing common technical specifications in the internal market. It will ensure common communication standards between the recharging infrastructure and the grid and thereby facilitate smart recharging.

Extent to which outstanding technology developments are standardised	The option also has a positive impact on standardisation of technology developments by addressing additional charging standards for trucks, supplementary standards for hydrogen	The option has a strongly positive impact on outstanding technology standardisation needs, as it addresses requirements for maritime transport and inland navigation in addition to the road transport standards in PO1.	The option has a strongly positive impact on outstanding technology standardisation needs, as it addresses requirements for maritime transport and inland navigation in addition to the road transport standards in PO1.
Specific policy objective 3: Ensure full user information and adequate payment options.			
Increase in the extent of customer information available	The option has a positive impact as it increases consumer information on location, opening time and certain charging stations characteristics, hence increasing certainty of consumers.	The option has a strong positive impact on consumer information available as it extends to the relevant information on operational status, availability, price ad-hoc, which will strongly improve user experience. Physical signposting will complement the extent of consumer information	The option has a strong positive impact on consumer information available as it extends to the relevant information on operational status, availability, price ad-hoc, which will strongly improve user experience. It has the most comprehensive requirement for physical signposting for customers.
Increase in the provision of data to national access points	It also positively impacts the provisions of data reporting to national access points of Member States. The requirement to share static data will enable better user services development.	Through this requirement for static and dynamic data, PO2 will also have a strong positive impact on the increase in provision of data to national access points.	PO3 will also have a strong positive impact on the increase in provision of data to national access points.

8.2 Efficiency

Efficiency concerns "the extent to which objectives can be achieved for a given level of resource/at least cost". The combined measures under the three POs have economic, social and environmental impacts. The major costs of the policy options come in the form of capital and operation costs for the installation and maintenance of public accessible recharging and refuelling infrastructure and measures related to interoperability and user information. A summary of these costs is provided in Table 8-3 below.

Table 8-3: Summary of capital and operation costs related to infrastructure – present value for 2021-2050 compared to the baseline (in €billion)

Costs summary - present value for 2021-2050 compared to the baseline (bil. €'2015)	PO1	PO2	PO3
Capital and oparation costs related to infrastructure			
Road transport			
LDVs recharging points	24.4	25.3	30.3
HDVs charging points	2.9	2.9	3.1
Hydrogen fuelling facilities	25.2	27.7	28.0
CNG fuelling facilities	-1.6	-1.6	-1.6
LNG fuelling facilities	-1.0	-1.0	-1.0
Waterborne transport			
LNG installations for maritime ports			1.1 - 3
OPS installations for maritime ports	1.2	5.5	6.5
OPS installations for inland ports	0.1	0.4	0.4
Aviation			
Electricity supply to aircraft	0.2	0.9	0.9
Interoperability			
Ad-hoc payments	6.7-10.2	7.0-10.4	7.2-10.6
Mandatory fixed cables	-	-	0.2
User information			
Roadside indicators	-	0.001	0.004
Total capital and operation costs	58.1 - 61.6	67.1 - 70.5	75.2 - 80.5

8.3 Coherence

In terms of the coherence with EU policy, the following aspects have been examined:

- Internal coherence of the policy options under consideration.
- Coherence with the main EU policy objectives of relevance.
- Coherence with other relevant EU legislation, specifically the CO_2 emissions performance standards and the Sustainable Finance Regulation.

This drew on the conclusions of the analysis of coherence undertaken for the evaluation of the AFID.

PO1 improves the **internal coherence** of the AFID, as a result of the increased priority given to hydrogen refuelling infrastructure, resulting in similar provisions for this energy source as there are in the current Directive for electricity and gas. PO2 and PO3 then subsequently develop the provisions for different fuels and energy sources in a similar manner, so there is no improved coherence as a result of these POs. However, PO2 does further improve coherence within road transport, as it extends the mandates for the provision of electric vehicle recharging infrastructure on the TEN-T to LDVs (in addition to HDVs as under PO1).

PO1 improves the coherence of the AFID with all of the **main EU policy objectives** of relevance, while subsequent POs further increase the coherence in some cases. The mandates for the provision of relevant recharging and refuelling infrastructure under PO1 improve the coherence of the AFID with the ***Green Deal, the 2030 Climate Target Plan and the Smart and Sustainable Mobility Strategy***, while the more extensive mandates under PO2 and PO2 further improve this. The more extensive nature of the mandate under PO3 leads to a more strongly positive assessment. PO1 also improves the coherence between the AFID and EU objectives on ***consumer rights***, as a result of improved provisions relating to consumers, and the ***functioning of the internal market***, due to improved interoperability and the increased availability of infrastructure. PO2 provides further benefits in both respects, while under PO3, although there are only minor improvements in relation to consumer rights, there are again significant improvements relating to the availability of infrastructure and on the functioning of the internal market as a result of the mandates requiring deployment on more of the transport network.

An increased focused on energy sources that have zero tailpipe emissions under PO1 contributes to improving the coherence of the AFID with **other relevant legislation**, specifically the ***LDV and HDV CO_2 emissions performance standards Regulations*** and the ***Sustainable Finance Regulation***. The increased mandates under PO2 and PO3 further improve this coherence, although the inclusion of mandatory targets for some gas vehicles under PO2 and PO3 undermines this improved coherence with the Sustainable Financial Regulation. This is because the Technical Expert Group on Sustainable Finance (that is supporting the Commission in the implementation of the Regulation) did not propose that such vehicles be considered to be sustainable.

Table 8-3 below summarises the analysis of coherence.

Table 8-4: Comparison of impacts of policy packages in terms of coherence

Strongly negative	Weakly negative	No or limited impact	Weakly positive	Strongly positive

Impacts	PO1	PO2	PO3
Internal coherence			
Internal coherence	Increase in internal coherence as it includes similar provisions for hydrogen (for relevant vehicle types) as for electricity and gas.	Compared to PO1 improves internal coherence, as it extends the mandate for the provision of electric vehicle recharging infrastructure on the TEN-T to LDVs (in addition to HDVs as under PO1).	Nothing additional compared to PO2.
Coherence with the main relevant EU policy objectives			
Green Deal, the 2030 Climate Target Plan and Smart and Sustainable Mobility Strategy (SSMS)	Mandates for the provision of relevant recharging and refuelling infrastructure will help to ensure that low and zero emission vehicles can be recharged/refuelled and so support the aspirations of the *Green Deal, the 2030 Climate*	More extensive mandates will further contribute to the aspirations of the *Green Deal, the 2030 Climate Target Plan* and the *SSMS.*	More extensive mandates will further contribute to the aspirations of the *Green Deal, the 2030 Climate Target Plan* and the *SSMS.*

Impacts	PO1	PO2	PO3
	Target Plan and the *SSMS.*		
Impact on consumer rights	Increases in payment options, price transparency and available information support consumers.	Further improvements of benefit to consumers.	Minor advances compared to PO2.
Impact on the functioning of the internal market and competition	Improved interoperability supports the functioning of the internal market and enables improved competition. Mandates on the provision of infrastructure support the functioning of the internal market, by ensuring that the necessary infrastructure is available (where mandated).	Further standardisation leads to an improved functioning of the single market and support for competition. Further supports the functioning of the internal market, as mandates require the deployment on more of the transport network.	Minor advances compared to PO2 with respect to interoperability and standardisation. Further supports the functioning of the internal market, as mandates require deployment on even more of the transport network.
Coherence with other relevant EU legislation			
LDV and HDV CO_2 emissions performance standards Regulations	Increased focus on electricity for LDVs and electricity, and hydrogen for HDVs, increases coherence between AFID and these Regulations as a result of an increased focus on zero tailpipe emission vehicles.	Increased focus on electricity and hydrogen infrastructure reinforces coherence between the AFID and the CO_2 emissions standards Regulations.	Increased focus on electricity and hydrogen infrastructure reinforces coherence between the AFID and the CO_2 emissions standards Regulations.
Sustainable Finance Regulation	Increased focus on electricity and hydrogen for road and inland waterways is consistent with the recommendations of the Technical Expert Group on Sustainable Finance, which is supporting the Commission in the implementation of the Regulation.	Increased focus on electricity and hydrogen infrastructure reinforces coherence. However, the inclusion of mandatory targets for LNG for HDVs has a negative impact on coherence (as the Technical Expert Group did not propose that LNG trucks be considered to be sustainable).	Increased focus on electricity and hydrogen infrastructure reinforces coherence. However, the inclusion of mandatory targets for CNG for road transport has a negative impact on coherence (as the Technical Expert Group did not propose that CNG vehicles be considered to be sustainable).

9 EU ADDED VALUE

As discussed in section 3 on the problem definition, EU right to act on this market derives from Article 114 of the Treaty on the Functioning of the EU (TFEU), which establishes the EU's prerogative to act on setting standards related to environmental performance and the protection of health. Furthermore, Title VI (Articles 90-91) makes provisions for the Common Transport Policy and Title XVI (Articles 170-171) for the trans-European networks.

Compared to action at the Member State level, EU action allows better coordination for even and widespread deployment of AFI. This facilitates travel across the EU for consumers and transport operators and supports the correct functioning of the internal market. EU intervention also supports the creation of a level playing field where vehicle and equipment manufacturers are able to produce at scale, using pan-EU standards, interoperability requirements and technical specifications, for the EU internal market. This gives more certainty to industry players, encouraging investments on manufacturing capability to support the uptake of AFVs and AFI.

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11 ANNEXES

11.1 Annex A – Detailed methodology – (Strand A)

11.1.1 Overview

Strand A is focused on developing a methodology for the assessment of availability of AFI. There is no unified consensus with respect to which methodology or criteria can most accurately represent sufficient AFI provision. Partly, this is due to there being very limited historic data and relatively small current market size that would help to establish what "sufficient" infrastructure looks like, especially in light of technology developments and changes in user behaviour, and business cases.

As the impact assessment is being undertaken for AFID, there was an opportunity to explore the development of metrics and criteria to establish sufficient AFI targets – Strand A investigates these optimum metrics and criteria that can lead to a refinement of targets for AFI provision, and analyses possible numerical values for these targets.

Strand A is divided into three different sub-tasks, each of which assesses the criteria and metrics used to measure AFI provision for a specific subject topic area:

- Task 1.1 is focused on assessing the suitability of metrics and criteria for the assessment of sufficiency of AFI provision, focusing on road transport.
- Task 1.2 assesses whether specific criteria need to be developed for HDV AFI coverage that differ from the criteria for LDVs.
- Task 1.3 explores different types of electric charging points and a possible need for a differential assessment for targets for charging infrastructure provision.

The methodology for Strand A primarily comprised of a combination of desk-based research (including literature review specific to each of the sub-tasks and for each category of AFI that was identified) and stakeholder engagement which informed the identification of the metrics and criteria most well-suited to measure sufficient AFI provision.

The methodology for Strand A follows a similar step-by-step process for each of the sub-tasks. A high-level overview of this step-by-step process is as follows (**noting that the stepped approach was updated as the project progressed**):

- Step 1: Establish context by assessing approaches adopted by Member States to set targets and monitor deployment of infrastructure for each sub-task.
- Step 2: Desk-based review of research relevant to each of the sub-tasks.
- Step 3: Engagement with targeted stakeholders, consisting of academics, R&I institutions, and representatives of HDVs and ERS to contribute to the overall understanding of strengths and weaknesses of different metrics and criteria for each sub-task.
- Step 4: Initial assessment of metrics and criteria for each sub-task, undertaken via an internal workshop with Ricardo experts and the European Commission, informed by the desk research and targeted stakeholder interviews.

- Step 5: Survey of national authorities, local / regional authorities and select industry stakeholders ('Alternative Fuels Infrastructure Survey Strand A') on the optimum metrics and criteria to be used to assess sufficient AFI provision and their relative strengths and weaknesses, informed by the outputs of the desk research, stakeholder engagement and internal workshop.

- Step 6: Synthesis of desk research, stakeholder engagement, workshop outputs and survey results to undertake a full assessment of different metrics and criteria to be used to measure sufficient AFI provision, and develop numerical targets for different categories of AFI.

For each sub-task, there are three overarching metrics that were explored in greater detail. The methodology for Strand A kept the definitions of these metrics as simple as possible for stakeholders in order to obtain the most comprehensive and useful feedback from stakeholder interviews. The three metrics are as follows:

- Distance-based: maximum distance between recharging or refuelling stations (km).

- Fleet-based: number of vehicles per recharging or refuelling station.

- Traffic volume-based: vehicle kilometres per recharging or refuelling station.

The results of Strand A informed the most suitable metrics to be used for assessing infrastructure provision in given geographic areas and for different types of AFI, in the consideration of whether to include a provision for targets for AFI in an updated AFID. Additionally, the results were used to inform optimum numerical targets to be used for different categories of AFI, and were combined with the policy options as developed under the Impact Assessment in Strand B. An overview of the method for each of the steps of Strand A is provided below.

11.1.2 Stepped approach to Strand A

Step 1: Establish current approaches used by Member States

An assessment of the NIRs and NPFs was undertaken to establish the current approaches used by Member States to assess sufficient AFI provision. An analysis was undertaken to assess whether Member States used a specific methodology to determine the targets (if any) they have implemented to measure AFI for different fuel types. The analysis outlines that different metrics and criteria and associated methodologies have been utilised by Member States when determining targets for AFI provision, both in terms of between Member States and differing metrics and criteria depending on the fuel. As expected, in many cases Member States made use of fleet-based and distance-based targets for AFI provision; however, the use of a supporting methodology for these targets varies between Member States.

An overview of the outcomes of this step is provided for each of the sub-tasks below.

Task 1.1 – Assess suitability of metrics and criteria for the assessment of sufficiency of alternative fuels infrastructure

The NPFs and NIRs are the principle documents for assessing criteria related to LDVs, which have been reviewed as part of the evaluation. In the NPFs, the targets for infrastructure were established pursuant to Article 3(1). In some cases, the supporting methodology for determining an appropriate amount of infrastructure has been presented in the NPF, whilst in other cases it was carried out as part of a separate study or it is sometimes unclear how targets have been established. The targets are given as absolute numbers regardless of fuel type or mode of transport.

Although the targets in the NPFs have been presented in absolute terms, in many cases fleet-based and distance-based metrics have been considered in some manner, often following the guidance provided by the AFID specific to fuel types:

- For electricity for road transport, recital (23) states that the appropriate average number of recharging points should be equivalent to at least one recharging point per 10 cars.
- For CNG for road transport for the TEN-T core network, recital (41) states that the necessary average distance between refuelling points should be approximately 150km.
- For LNG for HDVs for the TEN-T core network, recital (46) states that the necessary average distance between refuelling points should be approximately 400km.

It is often difficult to assess the degree to which these metrics have contributed to the absolute target presented in the NPF. In some cases, MSs simply acknowledged that their targets adhere to the indicative metrics, rather than using it to determine the absolute number.

With regard to establishing a target for electric infrastructure for 2020, 4 MSs included a fleet-based metric of some sort. All MSs that have included a fleet-based metric have continued with the ratio of at least one recharging point per 10 vehicles with the exception of Denmark, where a separate study was used, that indicated a ratio of 60 vehicles per recharging point would be sufficient for 2030. No corresponding figure for 2020 was provided. Furthermore, Denmark noted that Norway, a country with a relatively mature EV market, has a ratio of 20 vehicles per recharging point.

Given the focus of the AFID recommended targets for 2020 are concentrated on urban/suburban agglomerations, some MSs considered only geographic areas that meet specific population criteria. Croatia identified areas with a population greater than 20,000 inhabitants as needing infrastructure, whilst Latvia used a figure of 5,000. France developed this further by assessing population densities to ensure that the amount of infrastructure was in line with 3,000 inhabitants per recharging point.

The MSs that have achieved their targets established in the NPF for electricity are Austria, Croatia, France, Latvia, Lithuania and the Netherlands. Croatia, France, Latvia and the Netherlands all used some form of distance-based metric when developing their targets:

- Croatia aimed for a recharging point every 50km on motorways
- France aimed for a distance of 1.5km-3km between recharging points in urban agglomerations, depending on the population density
- Latvia established the target of a recharging point every 30km (+/- 10km) on TEN-T roads and 50 km (+/- 10km) on regional roads connecting TEN-T roads
- Local authorities in Netherlands view a maximum distance of 300m to the nearest charging point to be acceptable in urban agglomerations.

Distance-based metrics were used more widely in setting CNG targets with 8 MSs using one refuelling per 150km for the TEN-T core network in line with the guidance presented in the AFID. In addition to this, Spain decided a distance of 400km between refuelling points was necessary to provide a sufficient number of refuelling points. Whilst the distance-based metric was used to determine the absolute number of refuelling points in some cases, other MSs used it to identify locations of infrastructure after having already identified an appropriate number of refuelling points through other means, such that the distance between refuelling points does not exceed a maximum. In a similar manner to electricity, the AFID requires a target for an appropriate number of CNG refuelling points in urban / suburban agglomerations. The number of inhabitants of urban agglomerations for which coverage was deemed necessary by each MS ranged from agglomerations with a population of 10,000-100,000. The MSs that have achieved their 2020 targets for CNG infrastructure are Czech Republic, France, Luxembourg and the Netherlands. Czech Republic and Luxembourg both included a distance-based metric in their supporting methodology, whilst France's approach was based on population and population density. It should be noted that CNG is used for both LDVs and HDVs, although CNG use in cars is minimal in Europe. However, the NPFs do not distinguish between the types of vehicles the infrastructure intended to serve.

Although the AFID discusses LNG only in the context of HDVs, the methodology used in setting the target for the TEN-T network should still be discussed briefly. In a similar manner to CNG, the distance-based metric of one refuelling point per 400km was acknowledged by several MSs in determining their targets. Beyond this, there were no other methods of determining the infrastructure number. Germany and Spain have both exceeded their targets initially set in the NPF for 2025 already, both of which used a target of at least one refuelling point per 400km.

In the case of hydrogen, the supporting methodology for setting targets for Hydrogen was limited, if present at all. It was largely based on the predicted market development (thereby most closely resembling a fleet-based metric). As such, this has led numerous MSs to reconsider the target in the NIR because the market did not develop as much as much was expected. There are some exceptions to the market-based approach, notably in Bulgaria and Finland where a distance-based metric was considered.

Task 1.2 – Develop specific criteria for heavy-duty road vehicles alternative fuels infrastructure coverage

For Task 1.2, HDVs are defined as including freight vehicles (HGVs) and buses / coaches.

The vehicle projections in the NPFs and NIRs are typically broken down by type of vehicle (e.g. passenger cars, HGVs, buses, etc.), but separate infrastructure targets are not provided for each. However, often the particular needs for certain vehicles are discussed, including the suitability of different fuels. In general, the suitability of fuels for HDVs are:

- Electricity is suitable for shorter distances (up to 150km)
- CNG is suitable for short to medium distances (up to 300km)
- LNG is suitable for long distances (over 300km)
- Hydrogen is suitable for short to medium distances (up to 300km)
- Both electricity and hydrogen technologies for HDVs are actively being developed and are expected to be used for longer distances in future, particularly for hydrogen.

As such, infrastructure targets for LNG are set primarily for the TEN-T network, whilst the remaining fuels generally have targets for both urban agglomerations and the TEN-T network. Whilst separate infrastructure targets have not been set for LDVs and HDVs, it has been noted in France that only a certain portion of infrastructure is accessible to HDVs.

Table 11-111-211-3 shows the number of MSs that have at least one AF vehicle registered for HGVs, buses/coaches and HDVs total for different alternative fuels with the total number of vehicles presented in brackets. This provides context to Task 1.2 by indicating the coherence of uptake of alternative fuels in HDV sector across the EU and identifying which alternative fuels are well established. CNG is the most developed market in the context of the HDV sector, based on the greatest number of vehicles in total. Sweden, Italy, France and the Netherlands are the MSs with the greatest uptake of CNG in the HDV sector. France and the Netherlands both initially focused efforts on CNG uptake in public transport but in recent years have started to promote the fuel in the freight sector. According to the EAFO, Italy and the Netherlands are the only countries to have registered LNG vehicles and publicly accessible LNG infrastructure, which are exclusively for the freight sector.

Table 11-111-211-3 Number of MS with at least one vehicle registered

	HGV (freight)	Buses / coaches	HDV
Electricity (BEV)	13 (270)	23 (2545)	23 (2815)
CNG	16 (20235)	18 (15767)	18 (36002)
LNG	2 (2447)	0 (0)	2 (2447)
Hydrogen	0 (0)	4 (35)	4 (35)

Source: (EAFO, 2020)

Measures were extracted from the NPFs and NIRs. For both HGVs and buses / coaches, there are examples of measures that are solely focused on each mode, as well as part of wider scope measures that incorporate LDVs or other modes of transport such as rail or waterborne. These have been summarised below, highlighting any trends in type of measure and fuel type between MSs.

For HGVs, grants for RTD&D are the most popular way of promoting AF, largely taking the form of pilot projects deploying infrastructure and research projects to better understand the effectiveness of different decarbonisation solutions. Several of these deployment projects have been co-financed with the Connecting Europe Facility (CEF), such as CYnergy, Connect2LNG and PAN-LNG, whilst other research has used national funding; the FESH field trial (electric road system) in Germany, for example. This field trial is one of several RTD&D projects deploying electric road systems, whereby overhead lines are used to charge HGVs. Other notable projects include eWayBW and ELISA in Germany and the ehighway in Gävle, Sweden. In-motion charging has applications for shuttle transport (e.g. industrial areas, ports), electrified mine transport and electrified long-haul traffic.

While RTD&D represents a significant proportion of activity in the HGV sector, other policy measures have been introduced to incentivise the uptake of AF. In general, financial incentives (e.g. direct incentives for purchase vehicles, tax incentives) that address the HGV sector tend to be measures that include LDVs as well. Tax systems specific to AF HGVs include the exemption of HGV tolls in Germany and the heavy-vehicle tax in Sweden. The greatest number of measures to support uptake of AF in HDVs promote electricity and LNG, although most measures address more than one fuel. Overall, there are fewer measures relating to hydrogen and CNG in comparison to the other fuels, with hydrogen having the least support, likely due to the immature market. Austria, France, Ireland and Germany are among the Member States that have developed and implemented the most measures to support the uptake of AF in the HGV sector.

The number of MSs that have introduced policies directed at buses is greater than those for HGVs, with a large number of measures consisting of public procurement of AF vehicles for public transport services. However, there are several measures that apply to both sectors. Compared to HGVs, there are a lower number of grants for RTD&D and direct incentives for purchasing vehicles, although there are still several schemes in place for municipalities to have subsidies for vehicle purchase. Infrastructure-focused measures typically involve some form of subsidy for the deployment of recharging infrastructure. Luxembourg and Hungary have introduced the most measures, of which the majority are different public procurement projects. In a similar manner to HGVs, most measures address more than one type of fuel. However, the greatest number of measures to support uptake of AF for buses / coaches concern electricity followed by CNG. In contrast to the HGV sector, the number of measures supporting LNG are relatively low.

The number of measures introduced to promote fuels for LDVs is far greater than that of the HDV sector. In the LDV sector, there are far more opportunities for subsidies for purchasing vehicles and building infrastructure, as well as different types of tax incentives. The number of research projects determining effectiveness of different solutions reflects the slower development of AF in the HDV sector than in the LDV sector.

The assessment of the HDV policies in the NPFs and NIRs shows that there is still lots of ongoing research into the most effective decarbonisation solutions and that the strategy chosen by MSs is not certain.

Task 1.3 – Types of electric charging and possible need for differentiated assessment

The definitions of charging infrastructure used in this report are as follows:

- Private slow charging – charge points located in private locations (at home or at the workplace);
- Public slow charging – charge points situated in 'destination / top-up' locations, where individuals park for a few hours;
- Public fast charging – charge points situated in public short-stay locations, such as motorway service areas;
- Public ultra-fast charging – as above or at charging hubs.

The approach to categorising electric vehicle charging infrastructure varies among Member States and has also changed within some Member States when comparing their NPFs and NIRs. The most common definitions adopted by MSs in the NPFs were those in the AFID and the European Alternative Fuels Observatory (EAFO) which use 'normal' (≤22kW) and 'fast' (>22kW). Although the power ratings used by MSs were the same, there was some inconsistency in the terminology used by MSs i.e. the use of 'slow', 'semi-fast' or 'medium' in replacement of 'normal'. However, the larger inconsistency between MSs was the categorisation of recharging points with higher power ratings, which were not defined in the AFID. The terms 'rapid' or 'ultra-fast' have been used to denote both 43kW AC or 50kW DC charging points without any clear preference. In the cases of Denmark, Czech Republic and Latvia, the specific name of the recharging point or the connector standard was used (e.g. CHAdeMO or Tesla Supercharger). In the NIRs however, the Excel reporting template provided by the European Commission presented further classifications of high-power recharging points disaggregated by type, as indicated in the previous section. As such, most MSs have used this template to indicate separate targets for infrastructure depending on power rating.

Further emphasis was placed on high-power recharging infrastructure in the NIRs as a reporting requirement ensured that MSs provided 'information on the methodology applied to take account of the charging efficiency of high-power recharging points', which MSs have interpreted as referring to utilisations rather than actual energy efficiency. In general, MSs stated that a specific methodology was not in place to account for the charging efficiency but that there has been an increase in deployment of high-power infrastructure in recent years. Austria provided the most detail in their NIR for the methodology by carrying out a study on the current usage of high-power infrastructure. It was determined that the current national utilisation rate of high-power infrastructure is still low but that a foundation has already been laid for the anticipated uptake of the electric vehicle market.

As highlighted in Task 1.1, the location of deployment is generally dependent on population size in urban areas, with MSs often setting a threshold population in their NPFs to decide which areas require recharging infrastructure. Within urban agglomerations, Slovakia has focused deployment in areas where the public are most likely to congregate (e.g. shopping centres, universities, hospitals, etc.) whilst Luxembourg has targeted at least one recharging point in each car park and park & ride area. Outside of this, there was limited information in the NPFs on specific locations within urban areas, with the exception of France and the Netherlands who used a distance-based metric as described in Task 1.1. For the TEN-T network, MSs were more inclined to consider other criteria such as the battery capacity of vehicles and the range of EVs per charge to ensure the infrastructure network is strategically located, as well as acknowledging the importance of high-power chargers for the purpose a long-distance travel. This is in contrast to urban areas, where it is accepted the EV users will primarily use private recharging stations, with a smaller reliance on high-powered chargers; though noting that with limited access to off-street parking in heavily built up areas there may be a greater reliance on "on-street residential charge points", which are considered publicly accessible normal powered charge points situated on-street in residential areas, sometimes located in lamp posts. However, it should be noted that high-power chargers are ideal for specific applications in urban areas, such as car clubs or taxis.

We note the inherent difficulty in accurately determining how much privately accessible charging infrastructure is installed in a Member State (e.g. charging infrastructure located in home locations or at workplaces). It is important to note the difference in privately-owned and privately accessible infrastructure. For example, in the case of Slovenia, 40% of recharging infrastructure is privately-owned but the majority of that infrastructure is publicly accessible in locations such as shopping centres or car parks. In the case of the Netherlands, MS have noted that infrastructure is semi-public, whereby it is only available at certain times throughout the day. Table 11-4 presents the assumptions that MSs have made in their NPFs for the share of recharging points that are privately accessible. For those MSs that have made assumptions, the share is consistently around 90%. In general, publicly accessible recharging points are viewed as a 'back-up solution', due to greater accessibility and relative low cost of home or workplace charging. Although separate targets have not been set for private-recharging points, Finland states that the aim is for every electric vehicle to have a home recharging point. Several measures have been implemented to promote use of private electromobility infrastructure across the EU. These typically take the form of improved electricity contracts for home charging and subsidies for businesses to purchase vehicles or build infrastructure.

Table 11-4 MS assumptions on the share of private recharging infrastructure

Member State	Assumption
Austria	One recharging point per passenger car
Czech Republic	80% for BEV (90%-95% for PHEV)
France	90%

Member State	Assumption
Luxembourg	95%
Spain	Greater than 90%

Source: NPFs and own analysis

Step 2: Desk-based review of research

A full literature review was undertaken for Strand A, and the AFID Impact Assessment in its entirety that contributed to the understanding of the optimum metrics and criteria to be used to assess sufficient AFI provision. The desk-based review of research was used to inform the following steps in Strand A, in particular the questions that should be asked during the targeted stakeholder interviews and the background information to the internal workshop.

The sub-sections below summarise some relevant information from literature that contributed to each of the following steps within Strand A

Task 1.1 – Assess suitability of metrics and criteria for the assessment of sufficiency of alternative fuels infrastructure

Methodologies / best practice for measuring sufficient AFI provision

There are numerous different methods and criteria used to determine AFI provision. Distance-based and fleet-based are well-covered in the NPFs, NIRs and within literature. Traffic volume-based is less frequently used as a metric at a macro level – this may be due to the required level of granularity of the analysis, where a more comprehensive dataset is required to accurately utilise a traffic volume-based metric. As an insight, traffic volume-based analyses may be more suited to analysis of AFI provision in a smaller, defined area, and can be considered to be a mixture of distance-based and fleet-based criteria. Population and population density have been used as a proxy for traffic volume-based criteria in some studies.

Initial findings from the review of NPFs and NIRs and the initial review of literature show that different fuels may be more suited to different criteria to measure their provision. Both distance-based and fleet-based criteria have been widely used thus far to measure AFI provision. Distance-based metrics may be more suitable to measure infrastructure for alternative fuel vehicles that are already commonly deployed (e.g. EV charging and CNG / LNG), to ensure a minimum provision of infrastructure to support the vehicle fleet; whilst fleet-based metrics may be more suitable to assess infrastructure provision for less commonly deployed vehicle (e.g. hydrogen transport), to develop the infrastructure as the demand increases whilst also enabling a base level of infrastructure to be deployed. Other methodologies have utilised a fleet energy-based approach, where the energy requirements of a future alternative fuel vehicle fleet have been estimated to establish the infrastructure requirements for this fleet.

Varying methodologies for measuring AFI provision in different geographic areas

The review of literature and of the metrics and criteria used in NPFs and NIRs show that different methodologies and criteria have been used to assess AFI provision based on differing geographic areas. At a high level, this can be considered to be related to the class of vehicle for which infrastructure is being deployed. As an example, metrics to measure AFI provision for infrastructure related to fuels well-suited to HDVs (e.g. for LNG and / or CNG) tend to be focused on highways such as the TEN-T networks and strategic roads rather than in urban or rural areas. This is due to the travel profiles and user behaviours of HDVs, where the infrastructure is far more optimally situated in an area with high HDV traffic than areas where the infrastructure wouldn't be as well-utilised. Distance-based metrics are common for these assessments.

As infrastructure becomes more focused in an area, such as urban cities or urban nodes, more granular analyses and different metrics can be used to assess AFI provision. Some cities have defined infrastructure targets based on the projected number of vehicles that will make use of the infrastructure, thereby incorporating a fleet-based metric specific to that geographic area. In the context of the current work, this indicates that differing geographic areas may be more well-suited to different metrics to measure AFI provision.

Statistical links between sufficient AFI provision and uptake of vehicles

Several studies have sought to assess whether there are statistical links between sufficient AFI provision and uptake of vehicles. One such study assessed a number of regions and the fleet-based metric of charging infrastructure provision by a number of organisations. The findings from the study show that there are varying ratios of chargers to vehicles dependent on the region and the definition of the charge points being counted (e.g. whether a charge point is considered to be publicly accessible or private), and estimates vary per region also. As an example, the ideal ratio of chargers to vehicles in China is between 1:8 and 1:15, whilst ideal ratio estimates for the United States vary from 1:7 to 1:27. The study does not succeed in concluding that there is a causal link between AFI provision and vehicle take-up, and is subject to further investigation, noting that the market is evolving rapidly and the conclusions of this may have changed. A consensus on the ideal ratio of chargers to vehicles has not yet been formed and is subject to further investigation. This also supports assessing AFI provision on a more granular basis, taking into account regional and vehicle differences.

User preferences and behaviours for different AFI

User preferences and behaviours will also have an influence on the metrics and criteria to use for AFI. As the market for a particular alternative fuel begins to mature, user preferences and behaviours will play a greater role in defining where infrastructure should be situated and, relatedly, how deployment of this infrastructure should be measured. For more well-developed alternative fuel options such as CNG, LNG and electromobility, users have shown a preference for refuelling / recharging in public places in a manner that is most similar to the model of liquid fuel refuelling (though noting that EV users will mostly charge in home or workplace locations, as described further in Task 1.3). For CNG and LNG commercial vehicles and vans, it is likely that quick refuelling in strategic locations will be required in order to ensure they can continue with their duty cycles. For electric commercial vehicles and vans, depot-based recharging is likely to be the primary method of recharging, with limited reliance on public chargers. Electric taxis and car sharing vehicles and electric buses may have a greater reliance on public recharging.

Task 1.2 – Develop specific criteria for heavy-duty road vehicles alternative fuels infrastructure coverage

Overview of HDV technologies

The alternative fuel vehicle market for zero emission powertrain HDVs (electricity and hydrogen) is relatively immature when compared with LDVs. The HDV sector is more difficult to decarbonise due to aspects such as the weights of the vehicles, the long journey distances they tend to be used for and the technological development of the vehicles and their associated costs. In terms of zero emission options, there several options that are currently being developed:

- Battery electric HDVs, deriving propulsion from a large on-board battery.

- Hydrogen fuel cell HDVs, making use of a hydrogen fuel cell for propulsion.
- Electric road system (ERS) / in-motion charging HDVs; where HDVs are charged dynamically via overhead catenaries or in-road conductive or inductive power transfer.
- Hybrid solutions of the above, such as hydrogen ERS or hydrogen range extender vehicles.

Due to the immaturity of the zero emission HDV market (electricity and hydrogen), metrics and criteria to assess infrastructure provision specifically for HDVs can be considered to be underdeveloped when compared with the zero emission LDV market. Additionally, the supporting infrastructure requirements are less well-understood compared to the LDV market.

With respect to fuels such as CNG and LNG, the supporting infrastructure can be considered to be more understood, with infrastructure already deployed for CNG and LNG HDVs; however, as outlined in the overview of NPFs and NIRs above, the deployment of these vehicles is still relatively low. Metrics and criteria for CNG and LNG have tended to be distance-based or in some cases focused on population densities in some countries. The metrics for more established HDV fuels may be different to those utilised for newer HDV technologies, as outlined above.

The difficulty of switching to zero emissions in the HDV sector is well-stated, due to the relative immaturity of the zero emission HDV market and the necessity for technological development. Many stakeholders have cited the next five years as being crucial to determine the optimum pathway towards HDV decarbonisation, allowing sufficient time for the technologies to develop.

HDV categorisation and user profiles

Different types of HDV have very different user profiles dependent on their size and how they operate. From prior work, HDVs can broadly be divided into four categories:

- Small rigid freight HDVs (up to 3.5t).
- Large rigid freight HDVs (between 3.5t and 16t).
- Articulated freight HDVs (greater than 16t).
- Coaches & buses, though noting these may have differing duty profiles and refuelling needs.

With respect to zero emission powertrains, each of these HDV categories would have differing on-board energy requirements, with the larger vehicle categories necessitating larger energy storage. This is due to the different weights of the vehicles and also differences in how far they travel – past Ricardo work has shown that articulated freight HDVs tend to travel far greater distances compared with other vehicle categories. In contrast, the refuelling behaviours of CNG and LNG HDVs can be considered to be relatively similar to the current petrol and diesel HDV market; as such, metrics and criteria to assess provision of these types of infrastructure may be different to those assessing zero emission powertrains. Coaches and buses also have very different operational profiles, dependent on whether they are focused on urban or intercity transport.

The differences in requirements based on the HDV categorisation impacts demand for alternative fuels and AFI based on AFI type and the location of the infrastructure.

Methodologies for assessing AFI provision for HDVs

Similar to the LDV market, there are numerous possible methodologies to assess AFI provision for HDVs. The targets and methodologies in NIRs and NPFs have typically focused on a distance-based approach to determining targets for HDVs for LNG infrastructure. Given the relative uncertainty of the trajectory of decarbonisation of HDVs, a fleet energy-based approach has been used in Ricardo's prior work to determine AFI provision for HDVs – this estimates the energy requirement from a future HDV fleet based on differing powertrains and estimates the infrastructure requirement based on energy throughout, to support this future fleet of HDVs.

As specified in Step 2 of Task 1.1, it is desirable to ensure a minimum provision of infrastructure to support newer vehicle technologies across the TEN-T networks; following this, due to the relative immaturity of the zero emission HDV market, it may be more appropriate to determine AFI provision for HDVs on a fleet-based approach, where the amount of infrastructure develops as demand increases. Location is an important consideration for this approach also, i.e. to target locations that are in high demand for HDVs. The metrics and criteria used to assess AFI provision for HDVs are expected to differ based on geographic area, with a far more prominent focus on ensuring infrastructure provision on the core and comprehensive TEN-T networks compared with infrastructure provision in urban or rural areas specifically dedicated to HDVs.

Locations for AFI for HDVs

The optimum locations for AFI for HDVs, and thus locations where targets for AFI could be applicable, can also be considered to vary for different categories of HDV and their duty cycles. AFI to serve HDVs needs to be situated in areas that are already well-utilised by HDVs, such as existing refuelling stations and areas where HDV drivers take breaks. Additionally, under EU drivers' hours rules, an HDV driver must take a break of 45 minutes every 4.5 hours, thereby providing an indication of the time necessary for a full recharge / refuel to take place for heavy duty cycle HDVs. This also needs to consider the segmentation of HDVs, where different categories of HDVs would have optimum locations for infrastructure that differ from other categories of HDV. We will aim to form a more comprehensive understanding of optimum locations for HDV recharging and refuelling during the engagement phase of the project, thereby informing metrics and criteria to use to assess HDV AFI provision.

Depot-based charging can be particularly important for BEV HDVs, where the vehicles can recharge overnight and reduce their reliance on publicly available infrastructure. Current deployment of depot-based charging tends to prioritise a one charger to one vehicle ratio, to ensure access to the infrastructure. It can be assumed that the market will respond to this need as more vehicles are deployed, where supporting infrastructure will become essential. The reliance on the depot-based charging model may result in less of a requirement for public charging, depending on the category of HDV – small rigid HDVs may rely on depot-based charging whilst the infrastructure may be essential for articulated HDVs.

Electric roads systems for HDVs

Electric road systems (ERS) (also referred to as in-motion charging, or e-roads) technology for HDVs is actively being developed and trialled in numerous European countries and around the world. In-motion charging has been highlighted as being potentially suitable for larger vehicle categories, due to a number of factors. Larger vehicle categories typically undertake longer daily distances and are far heavier than LDVs. As such, these vehicles require larger batteries to operate them – ERS represents an opportunity to power and charge the vehicles whilst in motion, thereby allowing the vehicles to make use of smaller batteries, reducing their costs and lessening the effect of the weight of the batteries on reducing the payload of the vehicles.

When considering ERS, there are broadly three systems to consider:

- Overhead conductive dynamic charging (e.g. catenaries).
- On-road conductive dynamic charging (or conductive power transfer, CPT) (e.g. contact rail in a road's surface).
- Inductive dynamic charging (or inductive power transfer, IPT) (e.g. wireless power transfer from in-road coils).

Each of these three types of systems have advantages and disadvantages considering aspects such as vehicle compatibility, disruption to existing infrastructure, costs of deployment, efficiencies of the system, and aesthetics. Current evidence suggests that catenary systems is the most well-developed system to-date, though none of the technologies can be discounted. Concerning metrics and criteria to assess deployment of this infrastructure, it can be assumed that the metrics and criteria are the same for each of the three types of system, considering they would all likely be deployed along a highway such as the TEN-T Core and Comprehensive networks.

Task 1.3 – Types of electric charging and possible need for differentiated assessment

Developments in the charging infrastructure market

The electric vehicle and charging infrastructure markets have greatly developed since the introduction of the AFID. The range of available EV models has significantly expanded, and the vehicles have gotten comparatively less expensive. Correspondingly, battery sizes in vehicles have increased, and the penetration of the vehicles in fleets, whilst still low, is steadily increasing. Due to the increase in battery sizes, amongst other factors, there has been a growing preference for increasing powers of charge points in public spaces; however, larger batteries can also correspondingly reduce reliance on public charging infrastructure, as an EV user may be able to return to their home to charge without needing to charge publicly. Home and workplace charging still tends to be lower-powered charging, as the vehicles can charge whilst parked for long periods of time.

Higher-powered charging is becoming more commonplace in public locations. AC charging up to 43kW and DC charging for 50kW and above is being deployed in public areas such as motorway service areas and along core highway routes such as the TEN-T Core and Comprehensive networks. Charging infrastructure exceeding 100kW is increasing in prominence, with installations happening across Europe on highly utilised networks. It must be stated that a vehicle's capability to accept a charging power exceeding 100kW depends on the on-board capabilities of the vehicle's system to accept that level of charge. Charging up to 150kW is becoming more common; but a vehicle needs to move up to a 400V electrical system to accept levels of charge above 150kW, which is expensive to implement and is likely to solely be applicable to some premium vehicles.

Smart charging is also being actively deployed in a number of countries across Europe, and vehicle-to-grid technologies are beginning to be developed. Smart charging is being considered for all charging options, with a focus on longer-term parking. Vehicle-to-grid technologies solely focuses on longer-term parking.

These developments in the charging infrastructure market, such as an increasing range of charger powers and the fact they support different vehicle categories, highlight the potential need for different criteria to be used when assessing charging infrastructure provision under different categories.

Targets for charging infrastructure provision

Targets for charging infrastructure provision can be very high-level, such as country level, or far more granular, focusing on one particular area. As our analysis of the NPFs and NIRs shows, many Member States have set targets for charging infrastructure at a country level, using distance-based or fleet-based metrics. These methods can ensure a base level of infrastructure to serve a vehicle fleet, and particularly for distance-based metrics, establish a core network of charging infrastructure on strategic roads. As stated above, it is becoming commonplace for metrics and criteria to be implemented to determine provision of higher-powered chargers at strategic locations such as motorway service areas and areas that would be highly used by long-distance commuters.

As the area becomes more focused, infrastructure targets can tend to go into more granular detail, with criteria and metrics depending on the type of charger, their location, and the intended fleet to use the infrastructure. One example is the provision of DC charging for taxi fleets, where dedicated infrastructure may be provided in a city for taxis and a metric attached to this infrastructure based on the taxi fleet, which would differ from other targets in a given area. Metrics and criteria may also differ when considering charging provision in destination areas, such as where individuals stop for a longer period of time and as such lower powers of charging infrastructure are required. The differences in the metrics used for targets for charging infrastructure provision to-date suggest a possible need to differentiate targets, metrics and criteria based on the type of infrastructure.

User behaviours and preferences for charging infrastructure

In comparison to other alternative fuels, electromobility can be considered to be a far more developed market, with a much larger number of vehicles compared to other vehicle types. Correspondingly, the market for charging infrastructure can be considered to be more developed than some other alternative fuels, with more experience and research focusing on user behaviours at different types of charging infrastructure. Numerous studies and other sources have noted that a vast majority of charging for passenger vehicles is likely to take place at home and at workplace locations with lower-powered charging, with statistics of up to 90% of charging taking place in these locations.

Fast (between 22kW and 100kW) and ultra-fast (over 100kW) charging is preferred in strategic locations where stopping times are short, to ensure convenience for the consumer. Ultra-fast chargers can give confidence to consumers when travelling long distances and cater for different commuting patterns; but they tend to be deployed in lower numbers than other types of chargers. EV users tend to prefer a model that closely resembles the petrol station model when charging on highly utilised networks. As such, the research on user behaviours to-date indicates that metrics and criteria may need to differ depending on user behaviours and travel profiles, as the market for charging infrastructure continues to diversify.

Geographic differences in charging infrastructure provision

In addition to locational differences depending on the type of chargers, geographic differences are also common. Highways such as TEN-T networks and strategic roads are often said to be well-suited to higher-powered charging. Urban areas can have more of a charging "ecosystem" approach, where the charging needs of different types of EV users are considered, thereby providing a greater range of charging (e.g. home charging, workplace charging, destination charging, fleet charging, etc.). Charging provision in remote areas has been highlighted as being particularly problematic, as the private sector may not want to invest in infrastructure in areas that will be particularly underutilised – as such these areas have been identified by some stakeholders as potentially needing further public support, to ensure a consistent network of charging infrastructure in all areas. The advantages of having a traffic volume-based metric to assess charging infrastructure provision is clear here, where less well-utilised areas can be equipped with a level of infrastructure suited to local circumstances. The geographic differences in charging infrastructure provision point to a potential necessity for differential criteria and metrics to assess charging infrastructure provision in these different geographic areas.

Step 3: Targeted interviews with Strand A stakeholders

As an initial task, exploratory interviews were also held with stakeholders to explore the direction of Strand A, as part of the overall exploratory interview phase of the AFID Impact Assessment. Targeted interviews were then held with stakeholders considered particularly relevant to the aims of Strand A. The targeted interviews were undertaken using structured interview documentation with questions focused on each of the focus areas within Strand A (i.e. LDV metrics and targets; HDV metrics and targets; and differential metrics and targets for EV charging), with the questions informed by the desk-based research.

The sub-sections below present the outcomes of the exploratory interviews and the methodology for the targeted stakeholder interviews.

Exploratory interviews

Feedback was obtained via a series exploratory interviews undertaken as part of the overall AFID Impact Assessment project on the metrics and criteria to be considered within Strand A. In summary:

- Stakeholders were unanimous in their agreement that more granular metrics and criteria are required to assess AFI provision.
- Most stakeholders agreed that more granular metrics and criteria can assist in monitoring availability of AFI. The only disagreement here was for CNG and LNG infrastructure metrics.
- Differences in the granularity of metrics and criteria by fuel type, with respect to geographic areas, are recommended by stakeholders.

In terms of feedback on specific metrics and criteria:

- Distance-based metrics are supported by all stakeholders, but only for the Core and Comprehensive TEN-T networks and other highways.
- Fleet-based metrics received tentative support from most stakeholders, with fleet-based metrics seen as viable in a national context but with varying effectiveness by the type of fleet.
- Traffic volume-based metrics received mostly mixed to negative views from stakeholders to implement on a Member State level, with the metrics considered more challenging to implement.

With respect to feedback on the different sub-tasks and focus areas within Strand A:

- Stakeholders were unanimous that the effectiveness of the metrics varies based on geographic locations.

- Stakeholders were unanimous that specific criteria should be developed to assess AFI provision for HDVs; one stakeholder recommended differentiating targets based on location of HDV refuelling.

- Stakeholders mostly supported the inclusion of electric road systems in the AFID, though highlighted the immaturity of the market, noting that the inclusion of ERS in definitions should be sufficient, prior to deciding on the ideal technology for ERS or whether it is viable as a technology option at the EU-level.

- Stakeholders were unanimous that criteria for charging infrastructure need to be differentiated by both charger power and geographic area; though stakeholders were divided on whether it is necessary to differentiate charging infrastructure criteria by travel profile, with the previous two metrics seen as sufficient.

Targeted interviews for Strand A

Interviews focusing on Strand A were carried out in late June and early July 2020 with targeted stakeholders. The interviews provided the opportunity to obtain more in-depth feedback on the overall task and criteria to be used. Relevant stakeholder groups were identified for each of the sub-tasks, with input from the Commission. Table 11-5 presents the status of each interview for Strand A. Alternative contacts were not identified for those stakeholders that did not have capacity to participate in an interview. Therefore, the number of stakeholders involved in Strand A interviews was fewer than initially anticipated; however, sufficient feedback was received to contribute to the aims of Strand A for each focus area. Some of the stakeholders below overlap with stakeholders identified as priority stakeholders for Strand B; these stakeholders were contacted twice during the project to provide feedback on the different tasks.

Table 11-5 Status of stakeholder interviews for Strand A

Stakeholder category	Priority stakeholders for Task 1 targeted interviews	Status
Academics	Transportøkonomisk institutt – TØI (Eric Figenbaum)	Complete
	Sussex University (Benjamin Sovacool)	No capacity
	UC Davis (Scott John Hardman)	Complete
HDV representatives (Task 1.2 only)	UETR	No capacity – C-19
	ENEL	Complete
R&I institutions / NGOs	Transport & Environment	Complete
	ICCT	Complete
ERS representatives	Oeko Institut	No capacity – C-19
	Trafikverket	Post-workshop

With respect to the above, three stakeholders indicated that they had no capacity to carry out an interview for Task 1, with the reason for UETR and Oeko Institut being the

COVID-19 pandemic and a lack of capacity to take on additional work. Trafikverket initially had no capacity to engage with the project but since contributed some qualitative information to the project. Whilst neither of the ERS representatives could be contacted, the project team used in-house ERS experts to develop the metrics and criteria to be used to assess ERS provision. Additionally, other stakeholders had very relevant comments on ERS.

The primary intention of the targeted interviews was to contribute information to the internal project workshop. The results from the interviews were used, along with the desk-based research, for the workshop focused on the initial assessment of metrics and criteria described in the following section.

Step 4: Internal workshop: initial assessment of metrics and criteria

The initial assessment of metrics and criteria to measure sufficient AFI provision for each sub-task was undertaken via an internal workshop on 15 July 2020. A pool of internal experts was identified to attend the workshop, with internal expertise sourced for each alternative fuel in scope and specific experts for HDVs. In addition, members of the European Commission joined the workshop to share their views on each of the sub-tasks. The aim of the workshop was to seek consensus on the most suitable metrics and criteria to be used to assess sufficient AFI provision. A comprehensive presentation was prepared in advance of the workshop to guide the discussions and scoring of the different approaches, with the scoring simply based on low, medium or high suitability of each of the metrics to assess sufficient AFI provision.

For each sub-task, a concise summary of the desk-based research and stakeholder engagement activities and outputs were presented to participants of the workshop. Following the presentation of the background information, the participants were asked to discuss the relative strengths and weaknesses for each of the metrics, for each fuel type, based on the information presented and their own expert knowledge. To determine the scoring, the following specific criteria were considered for each sub-task:

- **Task 1.1**:
  - **Effectiveness**: to what extent the criteria can be used to indicate sufficient AFI to support the AF fleet, and can be turned into a meaningful metric across the combination of criteria and geographies.
  - **Implementation**: whether AFI defined under a metric or criterion, if a metric or criterion is utilised, could be implemented with relative ease by cities, regions or MSs, i.e. the ability to track progress against these criteria.
- **Task 1.2**:
  - **Appropriateness**: to what extent the criteria are appropriate to describe the provision of sufficient AF infrastructure to support the AF HDV fleet, and can be turned into a meaningful metric across the combination of criteria and geographies, taking into account the differences in the HDV market.
  - **Implementation**: whether AF infrastructure defined under a metric or criterion, if a metric or criterion is utilised, could be implemented with relative ease by cities, regions or MSs, i.e. the ability to track progress against these criteria.
- **Task 1.3**:

- **Relevance**: to what extent the criteria are relevant to describe charging infrastructure provision to support the electric vehicle fleet and can be turned into a meaningful metric across the combination of criteria and geographies.

It was initially intended that scoring (of low, medium and high applied to the metrics and criteria using a series of tables) would be carried out during the workshop. However, due to the level of discussion stimulated by the workshop activity and time constraints, this was not possible. As a result, the scoring was undertaken after the workshop by the project team, using detailed notes taken throughout the workshop.

Once the scoring had been established, participants of the workshop and targeted stakeholders were presented with the outcomes of the internal workshop and asked for feedback on the analysis using tables of metrics and criteria. The project team received feedback from TOI, ICCT, Trafikverket and T&E. The feedback was incorporated into the final output from the workshop.

Summary of workshop outputs

The workshop participants noted there are few differences between TEN-T urban nodes and other urban areas in terms of allocation of metrics and targets to assess AFI provision, and the coverages of Core and Comprehensive networks negate any consideration of other highways. As such, the geographical areas considered in each of the sub-tasks were narrowed down to Urban areas / nodes, Core TEN-T network, Comprehensive TEN-T network and Areas outside the TEN-T network (e.g. secondary networks or rural areas). In general, the consensus from the workshop indicated:

- Distance-based metrics were generally more appropriate for Core and Comprehensive networks;

- Fleet-based metrics were generally more appropriate for urban areas, where vehicle density is more important;

- Traffic volume-based metrics can be useful for when demand for AFI increases in certain areas. It was suggested that the EC could potentially provide a standard set of tools / a common methodology for regional and local authorities to implement these metrics where considered necessary, such as in Member States with particularly high demand for EV charging infrastructure fluctuating due to seasonal demand.

In addition to these key metrics considered in Strand A, population statistics can be important metrics to consider when establishing targets. For each of the fuels considered in Task 1.1 (for LDVs), the key recommendations are:

- **Electricity**: Distance-based metrics should be used for the Core and Comprehensive network, whilst fleet-based metrics are more suitable for urban areas as they are more capable of dealing with variability and differences between cities, such as types of charging stations and vehicle penetration rates.

- **Hydrogen**: Infrastructure is primarily focused on HDVs, with very few hydrogen passenger vehicles currently deployed. Distance-based metrics should be used for the Core network to deploy a skeleton network. Similarly, this metric should be used for the Comprehensive network when there is a need to extend the network. As demand increases, fleet-based metrics could become more relevant if the private sector does not take over once demand develops to a sufficient level that generates demand beyond this skeleton network and install refuelling stations in areas where demand is perceived to exist. It is desirable to combine locations for hydrogen recharging for LDVs and HDVs.

- **CNG**: Distance-based metrics are suitable to be used on the Core network. Depending on the continued focus of CNG in the AFID in terms of specifying targets (i.e. political decisions), a distance-based metric is also suitable to be used for the Comprehensive network in the future. There is no need for metrics in urban areas as CNG should be moving away from cities.

- **LNG**: Infrastructure is only relevant for HDVs. Distance-based metrics are suitable to be used on the Core network. As with CNG, this could be extended to the Comprehensive network dependent on the broader political decision on its continued consideration for targets within the AFID, and if demand for the infrastructure were to greatly increase.

For Task 1.2, the conclusions and recommendations from the workshop were:

- Specific targets should be set for HDVs that differ from LDVs, and segmentation by HDV category is strongly recommended.
  - Different HDV categories will have different mobility patterns that will impact infrastructure provision. However, it is important to keep metrics as simple as possible and it is recommended that HDVs should be segmented into small rigid HDVs (up to 3.5t), large rigid HDVs (greater than 3.5t), and long haul HDVs / coaches.

- It may be beneficial for the European Commission to provide tools / methodologies to assess high-demand areas for HDV refuelling / recharging, based on traffic volume-based metrics or mobility patterns of HDVs. This would be a common methodology published as part of the AFID that Member States can apply to accommodate their own unique needs.

More specifically, for each of the fuels considered in Task 1.2:

- **Electricity**: Distance-based metrics should be used along Core and Comprehensive networks. For urban deliveries / depot charging, monitoring depot-charging may be of great value, but initial feedback indicates that this would be particularly burdensome for Member States. Furthermore, it is not possible to know how many trucks are privately used in any given city. As such, no metric / target may be necessary for urban areas.

- **Hydrogen**: For the initial coverage on the Core network, distance-based metrics are recommended to be used. As demand increases, there will be a need to review the targets, but this is not expected until at least the late 2020s (same comments as for Task 1.1).

- **CNG & LNG**: There are some differences in the metrics used between the LDVs and HDVs for these fuels, as highlighted in the Task 1.1 summary above.

- **ERS**: Whilst it should be included in definitions of AFI, it is too early for the metrics and criteria to be set. Nonetheless, it will be unique to each Member State and targeted on specific road sections – an assessment will be needed using metrics of ERS length, location and assumed energy demand.

For Task 1.3 focusing on electromobility, the key recommendations from the workshop are:

- The threshold for ultra-fast charging should be increased from 100kW to 150kW.
- Although private infrastructure was initially covered within the scope of Task 1.3, the European Commission believes that the additional effort involved in measuring private charging (including workplace charging) is disproportionate to the benefits achieved at the Member State level, considering the large difficulty associated with monitoring such data.
  - TØI, UC Davis, T&E and ICCT were all strong in their opinion that (a) private charging (home and workplace) and (b) depot-based charging should be monitored at some level, despite the difficulty in measuring such infrastructure provision.
- Segmentation of metrics and criteria by charger type is strongly recommended by all stakeholders.
  - Higher-powered chargers are required on the Core and Comprehensive network due to travel patterns.
  - Normal powered charging in public locations is important for urban areas for charging in residential areas where no off-street parking is available and for destination charging.
  - A weighted system to charging infrastructure provision, either applying numerical weights to different powered chargers or specifying a required power at a given charging site, could be implemented to monitor charging provision, subject to further consideration in the survey.
- Differentiation of metrics and criteria by travel profile should be discounted for LDVs and should only be considered for HDVs for captive fleets. Specifically, fast and ultra-fast charging is relevant to medium and long-distance highway travel for HDVs.

Step 5: Survey of national authorities and industry stakeholders ('Alternative Fuels Infrastructure Survey Strand A')

Following the internal project workshop, the next step of Strand A involved the development of a survey for national authorities, local / regional authorities and select industry stakeholders. This survey was separate to the survey developed for Strand B / the AFID Impact Assessment, and solely focused on the aims of Strand A.

The main aims of the survey were as follows:

- Sense check the conclusions / recommendations resulting from the Strand A analysis undertaken thus far, based on levels of agreement with a number of statements;
- Receive feedback on the optimum metrics and criteria to be used to assess sufficient AFI provision for each alternative fuel category for different geographic areas;
- Obtain inputs for numerical values to be used for potential targets to implement in terms of minimum infrastructure provision, using metrics and criteria chosen by the survey respondent;

- Receive feedback on specific numerical targets for different categories of AFI and for different geographic areas – the numerical targets were provided based on the combined analysis of Strand A up to that point, including the desk-based research, targeted interviews and internal workshop outputs, and were used to stimulate discussion rather than to specify the actual targets that may be considered in an updated AFID.

The Strand A survey was released at the same time as the Strand B survey, but was only sent to national authorities, local / regional authorities and select industry stakeholders.

Step 6: Synthesis of information to produce numerical AFI targets

The final step of Strand A comprised a synthesis of all of the analysis undertaken, with the primary objective of informing the optimum metrics and criteria to be used to assess sufficient infrastructure provision for each category of AFI and for each geographic area, and to suggest numerical values for targets for this AFI provision. The determination of targets can be broken down into two categories: AFI-specific targets a geographic area-level granularity; and national targets (specifically for EV charging).

With respect to the AFI-specific targets, a combination of desk-based research, targeted stakeholder feedback, internal workshop outputs and survey results were used to determine targets for AFI that can be considered sufficient in terms of a minimum level of infrastructure provision for a specified year.

Focusing on hydrogen, the targets were derived from a calculation of the capacity for hydrogen refuelling stations required to support the fleet. Specifically:

- Vehicle efficiencies and average distances travelled were used to determine the required capacity to support the entire EU fleet.
- This was divided by the distance between HRS on the Core TEN-T network recommended by stakeholders and literature to form a target.

With respect to a potential national-level target for EV charging provision, an energy-based approach was used to calculate the amount of EV charging infrastructure required to serve the anticipate EV fleet:

- As with hydrogen, the vehicle efficiencies, average distances travelled and the expected proportion of energy to be delivered via public recharging were utilised to determine the energy required for slow and fast public charging for BEVs and PHEVs.
- An assumption was made on the level of utilisation of recharging points based on literature review and expert knowledge to determine the number of recharging points required to support the delivery of energy
- The expected number of vehicles was simply divided by the number of recharging points to determine a fleet-based national-level ratio.

The numerical targets for each type of AFI, and the rationale for the target and the utilisation of the specified metric, are presented in Annex B.

11.1 Annex B – RATIONALE FOR AFI TARGETS (Strand A)

This annex presents the rationale for proposing specific numerical targets for the various types of **road transport** AFI, using the metrics and criteria identified as being optimum for each category of AFI through the Strand A work. The recommended targets should be interpreted as a **minimum level of infrastructure** rather than the optimum level of infrastructure, and Member States would be free and encouraged to go beyond the figures that have been proposed, should demand exist in a Member State.

The numerical targets outlined below are to be used **should a target for a category of AFI be implemented in a specific measure / policy option**. The specific numerical targets have been incorporated into the policy options within the overall AFID Impact Assessment (Strand B), representing different ambition levels for the targets, as outlined and analysed in Section 6.

The recommendations are based on a combination of desk-based and field research (i.e. the overall methodology for Strand A). The minimum targets have been developed to accommodate the varying needs and characteristics of Member States whilst also ensuring an EU-wide minimum coverage of infrastructure. Where appropriate, national targets and more granular geographic-location specific targets are provided.

11.1.1 Electricity

LDV targets for TEN-T networks

The recommendation is for the **Core TEN-T network** to have a target of 300kW installed charging capacity every 60km in each direction by 2025 (600kW total), including at least one 150kW charging point per direction.

The recommendation is for the **Core TEN-T network** to have a target of 600kW installed charging capacity every 60km in each direction by 2030 (1200 kW total), including at least two 150kW charging points per direction.

The recommendation is for the **Comprehensive TEN-T network** to have a target of 300kW installed charging capacity every 60km in each direction by 2030 (600kW total), including at least one 150kW charging point per direction.

The recommendation is for the **Comprehensive TEN-T network** to have a target of 600kW installed charging capacity every 60km in each direction by 2035 (1200 kW total), including at least two 150kW charging points per direction.

The justification for these figures is based on a synthesis of the desk-based and field research. In particular, some points can be drawn out:

Fast and ultra-fast charging is seen as the preferred charging solution on the Core and Comprehensive TEN-T networks, with a minimum provision defined using a distance-based metric

For the **Core TEN-T Network**, an original target of one ultra-fast (150kW+) charge point every 60km was developed based on desk-based research[70] and initial feedback from stakeholders during the targeted interviews. In summary, this initial "indicative" target was chosen in response to commuting patterns on the Core network and distances achievable by EVs. In response to this element of the Strand A survey, stakeholders supported an increased target to the one proposed. Stakeholders in the Strand A survey also strongly supported prioritising fast and ultra-fast charging on the Core and Comprehensive networks (19 of 21 respondents); and also strongly supported the usage of a distance-based metric on these networks (20 out of 22 respondents).

Responses to the questionnaire showed that the preferred distance between charging points on the Core TEN-T was 30-70km. The consensus from literature and from expert opinion is that sufficient level of base infrastructure is 150kW per 50-60km up to 2025 (Platform for electromobility, 2020; T&E, 2020a; Greenway, 2019; ACEA, 2020; Eurelectric, 2019), adding that this should be in two directions or that each site should have two recharging points (ACEA, 2020). The increased ambition is reflected in the suggested target of 300kW charging capacity (per direction) by 2025. A further increased ambition is recommended for 2030 as the deployment of electric LDVs increases.

For the **Comprehensive TEN-T network**, an original target of one ultra-fast (150kW+) charge point every 100km was developed based on desk-based research (Sustainable Transport Forum, 2019) and initial feedback from stakeholders during the targeted interviews. Stakeholders supported either for the target to stay the same as proposed or an increased target to the one proposed. As noted in the section above, stakeholders were strongly supportive of a distance-based metric for both the Core and Comprehensive TEN-T networks. In terms of the distance between recharging points suggested by stakeholders, the preferred range amongst stakeholders was 50-100km. In addition, the consensus from literature is that sufficient level of infrastructure is 150kW per 60-100km, adding that this should be in two directions or that each site should have two recharging points. In consideration of the expected distances achievable by EV batteries, and the necessity for frequent public recharging, it was concluded that keeping the 60km distance the same as for the Core network is the most logical target to implement, but that the targets set for the Comprehensive network should be delayed by 5 years (2030 and 2035) due to the lower volumes of traffic on the Comprehensive network.

A sense-check of the recommended targets for the Core and Comprehensive TEN-T networks is provided below, with supporting commentary on the choice of target provided in this section.

Stakeholders were strongly supportive of having flexibility to achieving targets

From the survey analysis and based on stakeholder feedback during targeted interviews, there was an overall desire to have flexibility within targets to avoid being too prescriptive on the types of charging. At the same time, there is clear consensus in literature and amongst stakeholders that ultra-fast should be prioritised for the Core network, and fast or ultra-fast for the Comprehensive network, to serve the travel patterns of users on these more heavily utilised and crucially located networks (i.e. users require a shorter time to recharge in order to continue their journey).

As such, the recommended approach is based on specifying a required charging power per charging site, using a distance-based metric, which allows for a certain degree of flexibility to achieving the target. In addition to this, chargers need to be deployed in

[70] (ACEA, 2020) (T&E, 2020a), (Greenway, 2019), (Energies, 2019), (Eurelectric, 2019) (Platform for electromobility, 2020)

both directions to ensure travel in either direction is supported with accessible charging infrastructure to the road network; as such the recommended target is on a per-direction basis.

Respondents to the Strand A survey were generally supportive of having a weighted approach (i.e. allocating specific weightings to different types of charging infrastructure, where high-powered chargers would have a higher weighting) to provision of charging infrastructure (13 of 18 respondents agreeing with this approach); however, the approach of having an allocation of stated power requirement at a given charging site received more mixed feedback (6 of 15 respondents agreeing and 3 of 15 respondents disagreeing).

One the basis of the above he approach of having an allocation of stated power requirement at a site along the TEN-T networks, along with a specification of a minimum power requirement of 150kW for at least one charger, is recommended. It satisfies the strong support for fast and ultra-fast charging along the TEN-T networks whilst also allowing a degree of flexibility for Member States in achieving targets.

What do these targets mean in practice?

In practice, the power requirement per site can be fulfilled by different combinations of recharging points of different power ratings, thereby influencing the total number of recharging points deployed on the network. For example, for the 2025 target on the Core TEN-T network, Member States can adopt two possible combinations to fulfil the minimum requirement, ensuring that at least one recharging point has a power rating of 150kW:

- 2 x 150kW recharging points; or
- 1 x 150kW and 3 x 50kW recharging points.

The table below presents the total number of recharging points along the Core and Comprehensive networks for each of the years 2025 and 2030 for an example low and high scenario, where low refers to fewer recharging points deployed and high refers to a greater number of recharging points deployed.

Table 11-4 Number of chargers deployed for recommended LDV targets on TEN-T networks

Scenario	Combination of recharging points	Distance between RP (per direction)	Total number of RP along Core network (both directions)
2025			
Core TEN-T Network			
Low	2 x 150kW recharging points	60km	3,124
High	1 x 150kW and 3 x 50kW recharging points	60km	6,250
2030			
Core TEN-T Network			
Low	4 x 150kW recharging points	60km	6,250
High	2 x 150kW and 6 x 50kW recharging points	60km	12,500
Comprehensive TEN-T Network			

Scenario	Combination of recharging points	Distance between RP (per direction)	Total number of RP along Core network (both directions)
Low	2 x 150kW recharging points	60km	3,982
High	1 x 150kW and 3 x 50kW recharging points	60km	7,964

Assuming a national fleet-based vehicle to charger ratio of 20:1 (see Section 0 below), the total number of recharging points on the Core and Comprehensive TEN-T network will constitute a relatively small proportion of the expected EU fast / ultra-fast recharging network (estimated at 9% in 2025 and 28% in 2030 for the high scenario); for the **total** recharging network (i.e. not just the fast / ultra-fast charging networks), the targets will account for approximately 0.5-2% depending on the year in question (i.e. 2025 or 2030) and the combination of infrastructure for a Member State.

The specification of 300kW per 60km in each direction is treated as minimum infrastructure provision. Where the charging demand is shown to exceed this capacity, it is expected that the market will deploy additional chargers due to a positive business cases, as a result of proven high demand..

LDV national-level targets

The recommendation is to have a **national target** of 1kW per BEV and 0.66 kW per PHEV to charge points, applicable to all Member States, for both 2025 and 2030. Assuming an average power output of 11 kW per recharging point, this would correspond to a an infrastructure – electric vehicle ratio of 1-12.

The desk-based research (Eurostat, 2019) (T&E, 2020a) (BEUC, 2019; Lucas et al., 2018) and field research has strongly indicated that the previous 10:1 ratio of EVs to charge points in the AFID is no longer fit-for-purpose, and that an updated national level target would be necessary to assess the minimum infrastructure needed to cater for a growing EU electric LDV fleet. This is due to aspects such as changing utilisation rates of chargers, higher-powered chargers being deployed, and battery sizes within vehicles getting larger, with accompanying longer ranges.

In order to determine an updated minimum national-level target for electric LDVs, an energy-based approach was utilised, whereby the minimum sufficient level of charging infrastructure was determined by assessing the energy requirements of EVs, the proportion of energy delivered by public chargers, and the utilisation of charging infrastructure. All values used as data inputs are based on a combination of a comprehensive literature review, the assumptions made in preferred policy scenario in the Climate Target Plan Impact Assessment (MIX scenario (European Commission, 2020b)) where relevant and Ricardo's expert opinion. The resulting output is the total number of normal recharging points (separately for BEVs and PHEVs) on which basis further assumptions on the ratio between infrastructure and vehicles and between normal and fast recharging points can be made.

To determine the energy requirements of EVs for the year 2030 for both BEVs and PHEVs, the total number of vehicles in the EU was multiplied by the average distance driven in a year and the efficiency factor (electric energy per distance in kWh/km). For PHEVs, an additional utility factor was applied in the PHEV calculation to account for the proportion of distance travelled using electricity (as opposed to conventional fuel). The number of EVs and distance driven per year were both derived from the MIX scenario. The efficiency factor and utility factor are also in line with those used in the MIX scenario.

Table 11-5: Calculation of total energy consumed per year for EVs for 2030

Field (Green text = input data; red text = calculation)	Value
Number of BEVs	34,322,000
Number of PHEVs	13,716,000
Average km / year (assume same for BEV / PHEV)	13,141
Electric energy per km BEV (kWh/km)	0.127
Electric energy per km PHEV (kWh/km)	0.165
Uplift for more recent data on efficiencies from Ricardo	16.5%
2030 electric energy per km BEV (kWh/km)	0.148
2030 electric energy per km PHEV (kWh/km)	0.192
UF for PHEVS (% of km in EV)	52%
Total energy consumed per year BEV (kWh)	68,138,505,584
Total energy consumed per year PHEV (kWh)	18,369,204,572

It is necessary to determine the proportion of energy delivered by public recharging infrastructure (as opposed to private home or workplace recharging infrastructure). Although a significant majority of recharging occurs in private locations currently and will continue to do so in the future, the proportion of energy delivered by public recharging infrastructure is expected to increase by 2030 as the number of EV users living in urban areas that do not have access to off-street parking (e.g. living in apartment blocks) is expected to increase and more longer journeys will be made, that will require access to public charging. Thus, it is also expected that the usage of high-powered recharging points will increase. It is therefore assumed that around 40% of all recharging events for battery electric vehicles will take place at publicly accessible recharging points towards 2030.

For PHEVs, the proportion of energy delivered via public normal charging is greater than that for BEVs due to the smaller battery size and hence more normal top-up charging (this is in-line with latest research and understanding of how larger battery PHEVs are used (ICCT, 2020)). The total energy to be delivered by each type of public recharging point for each year was calculated and is presented in the table below. The respective proportions of public charging were estimated based on latest available research (ICCT, 2020) (T&E, 2020a; Nationale Platform Sukunft Der Mobilitat, 2020; Element Energy, 2019; Neaimeh et al. , 2017; Eurelectric, 2018) and expert opinion on how this is likely to evolve in the future, taking into account anticipated greater EV ownership by people with no off-street parking. The literature indicates a broad range of the expected proportion of energy to be delivered by public charging from 15-40%.

Table 11-6: Calculation of total energy to be delivered by each type of recharging point per year for 2030

Field	Value
Total energy consumed per year BEV (kWh)	68,138,505,584
Total energy consumed per year PHEV (kWh)	18,369,204,572

Field	Value
Proportion of energy delivered via public normal BEV	20%
Proportion of energy delivered via public normal PHEV	33%
Proportion of energy via public fast BEV	20%
Total energy delivered via public normal chargers per year BEV (kWh)	13,627,701,117
Total energy delivered via public normal chargers per year PHEV (kWh)	6,061,837,509
Total energy delivered via public fast chargers per year BEV (kWh)	13,627,701,117
Power Output required per BEV in kW	1
Power Output required per PHEV in kW	0.66

To translate this to the total number of each type of recharging point, it is first necessary to determine the energy delivered per year for an individual recharging point. This requires an assessment of the average power output and utilisation of recharging points. As an example, it is unrealistic for an 11kW recharging point to be used 24 hours per day and supply 11kW of power for the whole duration. Furthermore, the distribution of 'normal chargers' needed to be accounted for which includes a range of types from 2.4kW to 22kW chargers (noting that the use of on-board chargers that accept a 3-phase AC supply will likely remain limited, especially at the 22kW AC power rating). The same logic applies for 'fast' chargers. As such, the average power of normal recharging was determined to be 7.7kW, as calculated in the energy-based model. Similarly, on the basis of the existing and expected range of fast chargers, an average rate of 130kW was assumed for fast chargers, that can deliver an average epower of 104 kW. From this the energy that could be delivered by each charger per year was calculated.

Based on assumptions based on expert knowledge of the industry, a realistic daily utilisation of each charging point type was derived, based on a combination of practical average usage time and availability. For normal chargers this was determined to be around 2 hours per day on average, and for fast chargers it was determined to be 3 hours per day on average. From this, the energy that could be delivered by each charger per year was calculated and the power required per electric vechles established.

By dividing the total amount of energy that needs to be delivered by each public charger type per year for the fleet by the respective energy delivered by individual recharging points per year, the number of normal recharging points and fast charging points needed to support the EV fleet was derived. The values are presented in the table below.

Table 11-7:Total number of normal and fast chargers derived from the energy-based calculation

Field	Value
Number of normal chargers BEV	2,693,000
Number of normal chargers PHEV	120,000
Number of fast chargers BEV	1,108,316

These values have been compared with the number of AFVs under the baseline to determine a ratio of vehicles to each type of recharging point and ultimately a combined fleet-based ratio. A fleet-based ratio of **12:1** was calculated with the average power per recharging point to be approx. 11 kW.

However, the chosen energy-based approach to estimating required minimum infrastructure is very sensitive to the assumptions used (e.g. a change in utilisation rate and share of private recharging has a notable impact on the ratio of charging infrastructure to EVs). Furthermore, the ratio also assumes an ideal geographical distribution of the recharging points.

The energy-based calculation shows the assumed split between normal and fast chargers, but a fleet-based should not suggest a relative split between these types of chargers as this depnds on local conditions and user preferences that can vary greatly between Member States and even within regions. The fleet based sufficiency index includes all publicly accessible recharging points. Therefore, the recharging points on the Core and Comprehensive TEN-T networks contribute to this fleet based target.

LDV targets at petrol stations

The recommendation is for every petrol station with **12 or more pumps** to have a target of at least one recharging point with a minimum charging power of 150kW by 2025.

The recommendation is for every petrol station with **8 or more pumps** to have a target of at least one recharging point with a minimum charging power of 150kW by 2030.

The recommended targets for this measure that is part of PO3 are focused on the analysis from the AFID Impact Assessment survey (i.e. Strand B). Please refer to Section 7 for the full analysis of this measure.

Stakeholders were supportive of the measure in terms of offering greater consumer choice and accessibility of charging infrastructure. Overall, 21 of 22 respondents indicated that the measure would have a positive impact on the uptake of AFVs, and 17 of 18 stakeholders opined that it would have a positive impact on consumer choice and access to AFI and information.

In terms of the specific threshold. the desk and field research (Greenway, 2019) undertaken during the overall Impact Assessment has found that large petrol stations, especially those in motorway service areas, are considered a high priority area for fast charging. The Strand B survey contained a question on the optimum quantity of pumps within a petrol station for which a target should be applied (with options being 6 or 10 pumps), along with the year of implementation. In consideration of the feedback from stakeholders and the concerns raised above, the recommended targets were for petrol stations with 12 or more pumps to have a target by 2025, and for petrol stations of 8 or more pumps to have target by 2030, allowing larger petrol stations to be prioritised.

Both of the targets specified above are based on provision of at least one recharging point with a minimum power of 150kW – this is to ensure commuters can charge quickly in these locations, similar to existing refuelling patterns at petrol station locations. Of note, a target for a petrol station may assumed to be superseded by a national-level target, as a national-level target would include petrol stations within the scope of the target.

Having said that, there are important reservations concerning the adoption of such a measure. Mandatory targets for specific locations risk that not the optimal location of recharging points is chosen and that potentially this infrastructure is not being used or that investments in more suited locations will not materialise as sufficient recharging capacity has already been installed under a mandate. Furthermore, given that this measures is part of PO3, the interplay of fleet and distance based targets with additional location based targets (petrol stations) for electric LDV can be expected to affect open and competitive market deployment. As such, despite the general support there are also important limitations to its implementation. ***HDV targets for TEN-T networks***

The recommendation is for the **Core TEN-T network** to have a target of 700kW installed charging capacity every 60km in each direction by 2025 (1.4MW total), consisting of 350kW (or higher) charge points.

The recommendation is for the **Core TEN-T network** to have a target of 1.4MW installed charging capacity every 60km in each direction by 2030 (2.8MW total), consisting of 350kW (or higher) charge points. The recommendation is for the **Comprehensive TEN-T network** to have a target of 700kW installed charging capacity every 100km (maximum) in each direction by 2030 (1.4MW total), consisting of 350kW (or higher) charge points.

The recommendation is for the **Comprehensive TEN-T network** to have a target of 1.4MW installed charging capacity every 100km (maximum) in each direction by 2035 (2.8MW total), consisting of 350kW (or higher) charge points.

The justification for these figures is based on a synthesis of the desk-based and field research. In particular, some points can be drawn out:

HDVs have different recharging patterns than LDVs

It is essential that the infrastructure supporting electric HDVs fits in with the duty cycles of HDVs. In general, HDVs are used more frequently than LDVs and have busier duty cycles than LDVs, requiring higher-powered charging due to their larger batteries. In general, smaller HDVs and vans may be able to utilise infrastructure for LDVs, but the larger categories of HDVs will require dedicated charging infrastructure.

15 out of 23 respondents to the Strand A survey agreed that HDV and LDV recharging targets should be differentiated (with 2 out of 23 disagreeing). Additionally, the Strand A survey investigated whether charging targets should be segmented by category of HDV (with the recommended categories being small rigid HDVs (up to 3.5t); large rigid HDVs (greater than 3.5t); and long haul HDVs / coaches). 13 out of 23 respondents supported this segmentation, with 4 out of 23 disagreeing with this segmentation – resistance to this suggested segmentation was either based on the segmentation not being detailed enough, or the segmentation being too detailed, with different stakeholders voicing different opinions.

In consideration of the above, it was considered necessary to distinguish targets for LDV and HDV recharging. Whilst the targets above are not segmented into specific HDV categories, HDV segmentation is implicitly considered within the specification of targets (as outlined below).

Market readiness of electric HDVs

With respect to technological readiness of electric HDVs, desk (CCC, 2019) and field research has noted that long haul (i.e. articulated) HDVs are at a lower technology readiness level than small rigid and large rigid HDVs. Long haul HDVs will require infrastructure in the future, but not within the current timescales being considered within the AFID as volumes of long haul electric HDVs are expected to be very low up until 2030. As such, the infrastructure should be prioritised for small rigid and large rigid HDVs (though infrastructure for long haul trucks will become important in future).

Suitability of charging infrastructure for electric HDVs

Prior Ricardo work (CCC, 2019) has determined that 350kW charge points would be required for small rigid HDVs in public locations; and that at least 700kW charge points would be needed for large rigid HDVs in public locations. This analysis was based on a combination of expected market development of electric HDVs (in particular battery sizes in electric HDVs) along with the specification of EU regulations that state that drivers have to take breaks every 4 hours for 45 minutes – as such, drivers can utilise these rest breaks to charge their vehicles in the allocated time using suitably high-powered charge points.

This analysis contributed to the specification of the stated power to be available at charging sites along the TEN-T networks and the associated years for implementation, where the dedicated infrastructure would need to be at least 350kW in order to serve the duty cycles of electric HDVs coming to the market. In consideration of the distances between chargers for the targets, the distance for the Comprehensive network target was increased from 60km to 100km – this is due to the fact that HDVs more heavily utilise the Core network in comparison to the Comprehensive network, and as such a greater amount of infrastructure would be required on the Core network – stakeholder feedback within the Strand A survey agreed with this, where a majority of respondents recommended a distance between 100-150km for the Comprehensive network target.

What do these targets mean in practice?

Similar to the LDV targets, the power requirement per site can be fulfilled by different combinations of different recharging point powers, thereby influencing the total number of recharging points deployed on the network for HDVs. For example, for the 2025 target on the Core network, Member States can adopt two possible combinations to fulfil the obligation:

- 1 x 700kW recharging point; or
- 2 x 350kW recharging points.

The table below presents the total number of recharging points along the Core and Comprehensive TEN-T networks for each of the years 2025 and 2030 for example low and high scenarios, where low refers to fewer recharging points deployed and high refers to a greater number of recharging points deployed.

Table 11-9 Number of chargers deployed for recommended HDV targets on TEN-T networks

Scenario	Combination of recharging points	Distance between RP (per direction)	Total number of RP along Core network (both directions)
2025			
Core TEN-T Network			
Low	1 x 700kW	60km	1,562
High	2 x 350kW recharging points	60km	3,124

Scenario	Combination of recharging points	Distance between RP (per direction)	Total number of RP along Core network (both directions)
2030			
Core TEN-T Network			
Low	2 x 700kW	60km	3,124
High	4 x 350kW recharging points	60km	6,248
Comprehensive TEN-T Network			
Low	1 x 700kW	100km	1,194
High	2 x 350kW recharging points	100km	2,388

HDV national-level targets

No national targets are necessary for electric charging infrastructure for HDVs due to the early stage of the market. At this stage, it is not possible to determine what the evolution of demand for different HDV technologies will be, beyond providing for a minimum level of infrastructure to allow the markets to develop. As such, the Core and Comprehensive TEN-T networks should be the primary focus of targets (rather than a national target) until the market develops further to assess whether another target is required.

HDV targets at safe overnight parking areas

The recommendation is for each of the **500 safe and secure parking areas for HDVs** expected to be certified to have a power output of at least 50 kW by 2030.

There were no suggestions or questions within the Strand A or Strand B surveys related to provision of targets for recharging infrastructure for HDVs in safe and secure parking areas. However, subsequent discussions with stakeholders held by the European Commission have indicated that these should be priority areas to locate charging infrastructure for HDV drivers, considering safe and secure parking areas are already used by HDV drivers as rest areas. As such, a target was developed for this AFI location in consideration of the characteristics of charging behaviours in this location.

In consideration of the power of charging infrastructure that should be considered in safe and secure areas, prior Ricardo analysis (CCC, 2019) has indicated that 50kW charge points are suitable to charge small and large rigid HDVs overnight, based on the expected evolution of battery capacities of electric HDVs and based on the fact that HDVs expected to use these sites will be there for at least a number of hours or overnight. As such, the recommendation is for at least one charger of a power of 50kW to be installed in each of the 500 safe and secure parking areas for HDVs expected to be certified. The target year is recommended to be 2030 – electric HDVs deployed in advance of this year are largely expected to be charged in depots, with overnight charging in public locations expected to increase in prominence towards 2030.

HDV targets for urban nodes

The recommendation is for every **TEN-T Urban Node** to ensure availability of publicly accessible opportunity charging for urban delivery trucks, with at least 600kW installed charging power per urban node, and at least 150kW per charging point, by 2025.

The recommendation is for every **TEN-T Urban Node** to ensure availability of publicly accessible opportunity charging for urban delivery trucks, with at least 1.2MW installed charging power per urban node, and at least 150kW per charging point, by 2030.

The provision of targets for AFI in urban areas generally received mixed opinions from stakeholders in both the targeted interviews and the Strand A survey – the characteristics of urban areas vary considerably depending on a large number of characteristics (e.g. population, vehicle characteristics, parking characteristics), and as such a single target for urban areas is seen to be not fit-for-purpose. However, the role and importance of TEN-T Urban Nodes in connecting the TEN-T Core and Comprehensive networks has been highlighted in separate stakeholder discussions with the European Commission, in particular to serve urban delivery trucks which are expected to transition to electric before other categories of HDV, with stakeholders noting to the European Commission that the importance of TEN-T Urban Nodes needed to be recognised. The importance of deployment of charging infrastructure in urban areas to serve urban delivery trucks has also been highlighted in previous literature (T&E, 2020a).

In order to cater for the charging needs of these vehicles, it is recommended that a target for each of the TEN-T Urban Nodes should consist of at least 600kW installed charging power per urban node, with at least 150kW of charging power per charging point, by 2025, with the target increasing in 2030. This will cater for commuting patterns of electric urban delivery trucks, but with a vast majority of their charging needs expected to be satisfied by depot-based charging.

HDV targets at filling stations

The recommendation is for **every filling station on the TEN-T Core network with more than one pump for HDVs** to be equipped with at least one 350kW charging point by 2030.

There were no questions within the Strand A or Strand B surveys that focused on provision of HDV recharging infrastructure at filling stations. However, subsequent discussions with stakeholders held by the European Commission have indicated that locating charging infrastructure at filling stations on the TEN-T Core network is desirable for HDV drivers, as the infrastructure would be situated in an area already used by HDV drivers. As such, a target was developed for this AFI location in consideration of the characteristics of charging behaviours in this location. Of note, should a target be implemented for HDV charge points at filling stations, it is highly likely that there will be strong interaction with the previously recommended target for HDV infrastructure along the Core and Comprehensive TEN-T networks, as outlined above.

The recommended target is for every filling station on the TEN-T Core network with more than one pump for HDVs to be equipped with at least one 350kW charging point by 2030. The numerical value for the target is based on the same logic as for the recommended targets for HDV recharging along the TEN-T Core and Comprehensive networks, where the recommended power of the public chargers to be deployed would cater for the initial tranche of electric HDVs being deployed, i.e. small rigid and large rigid HDVs.

11.1.2 Hydrogen

LDV and HDV targets for TEN-T networks

The recommendation is for the **Core and Comprehensive TEN-T networks** to have one hydrogen refuelling station serving both directions every 150km for HDVs at 700 bar (and 350 bar optionally) by 2030; LDVs should also be able to refuel at all hydrogen refuelling stations.

In terms of the minimum daily capacity for all stations, 1 tonne is considered as the minimum to be provided, although higher capacity levels could also be considered to be more in line with the expected demand under the MIX scenario .

The justification for these figures is based on a synthesis of the desk-based and field research. In particular, some points can be drawn out:

Ranges of hydrogen LDVs and HDVs coming to the market

The results of the Strand A survey showed that stakeholders were supportive of a distance-based target on the Core and Comprehensive TEN-T networks for hydrogen refuelling infrastructure for both LDVs and HDVs. For LDVs, 20 out of 22 respondents recommended a distance-based metric for LDVs for both networks; and for HDVs, 14 out of 17 and 13 out of 16 respondents recommended distance-based metrics for the Core and Comprehensive networks, respectively.

Within the Strand A survey, stakeholders were asked to provide feedback on an indicative target of one hydrogen refuelling station every 300km, with this indicative target based on the expected ranges of hydrogen LDVs and HDVs coming to the market, along with findings from a survey conducted by the STF (Sustainable Transport Forum, 2019). Feedback from stakeholders indicated that this distance is too large and is approaching the distances achievable for both LDVs and HDVs, and as such a shorter distance would be required to give confidence to the ability to refuel hydrogen powered vehicles. Based on stakeholder feedback and expected ranges of hydrogen vehicles, the recommended distance is one HRS every 150km along the Core and Comprehensive TEN-T networks.

The same distance is recommended for both the Core and Comprehensive networks to allow for a minimum level of infrastructure for hydrogen powered vehicles to move around the EU. The recommended target year is 2030, as hydrogen vehicles are unlikely to start entering the market in reasonable volumes until the late 2020s at the earliest.

Combined location for LDV and HDV refuelling

As outlined in the analysis of Strand A survey responses, and from engagement with stakeholders during targeted interviews, along with general industry knowledge, hydrogen LDVs are unlikely to be deployed in large quantities due to the growing prominence of electromobility, and as such HRS infrastructure is more likely to be deployed to serve hydrogen HDVs. Numerous stakeholders commented on the efficiency of supplying and storing hydrogen in one facility / location for both LDVs and HDVs; as such, whilst the vehicle types will require different types of infrastructure, the recommendation is to combine the locations for both LDV and HDV hydrogen refuelling. Such an approach should also minimise the risk of stranded assets in case hydrogen vehicles will only be deployed in one of the two market segments.

Of note, additional stakeholders commented on the possibility of combining refuelling locations for hydrogen, CNG and LNG, pending the continued inclusion of CNG and LNG refuelling in the AFID.

Characteristics of hydrogen refuelling stations

A sufficient level of hydrogen infrastructure is dependent on the number of HRS, the distance between each HRS, the capacity of each station and the technology used (e.g.

pressure). The latter characteristic can be treated independently, whereas the number of HRS, distance between each station and the capacity of each station are all dependent on one another when determining targets for the TEN-T networks at an EU level. Whilst the number of HRS does not play a significant role, the distance between HRS must not exceed a maximum value to ensure that there are no issues with vehicle range and ability to refuel, and the capacity of each HRS must not fall below a minimum to ensure that it can support the expected demand for hydrogen. This is particularly important for HDVs, which require a significant mass of hydrogen at each refuelling session.

In order to determine a suitable target for hydrogen vehicles, a capacity-based approach was utilised, whereby the minimum sufficient level of refuelling infrastructure was determined by assessing the capacity requirements of hydrogen vehicles, the proportion of energy delivered by public refuelling station and the distribution of HRS along the Core and Comprehensive TEN-T networks. Similar to the electricity calculations, all values used as data inputs are based on a combination of a comprehensive literature review, the MIX scenario (where relevant) and Ricardo's expert opinion. The resulting output is the total number of refuelling stations, the distance between each station and the required capacity of each station.

To determine the energy requirements of hydrogen vehicles for the year 2030 for both LDVs and HDVs, the total number of vehicles in the EU was multiplied by the average distance driven in a year and an efficiency factor (hydrogen consumption per distance in kg/km). The number of vehicles and distance driven per year were both derived from the MIX scenario.

Table 11-10: Calculation of hydrogen fuel requirements for expected fleet evolution (2030)

Field (Green text = input data; red text = calculation)	Value
Number of passenger cars	251,598
Number of LCVs	22,496
Number of Small Rigid	272
Number of Large Rigid	4,991
Number of Articulated	36,701
Passenger Car average km/year	13,344
LCV average km/year	20,332
LDV average km/day	37
LCV average km/day	56
Small rigid average km/day	96
Large Rigid average km/day	265
Articulated average km/day	597
LDV efficiency (kg/km)	0.0087
LCV efficiency (kg/km)	0.0137
Small rigid efficiency (kg/km)	0.0367
Large Rigid efficiency (kg/km)	0.0593
Articulated efficiency (kg/km)	0.0881
Fuel consumed per day passenger car	80,117
Fuel consumed per day LCV	17,193
Fuel consumed per day small rigid	958

Field (Green text = input data; red text = calculation)	Value
Fuel consumed per day large rigid	78,375
Fuel consumed per day articulated	1,930,641

Similar to the calculations for charging infrastructure, it is necessary to determine the proportion of energy delivered by public refuelling infrastructure (as opposed to private (e.g. depot) refuelling infrastructure). The current level of private infrastructure is negligible and given the high CAPEX of hydrogen refuelling stations and challenges in terms of fuel distribution, it is expected that the proportion of energy to be delivered via private refuelling infrastructure in 2030 will continue to be small. The respective proportions of public charging were estimated based on Ricardo expert opinion on how this is likely to evolve in the future, considering greater uptake of hydrogen within the freight industry. By multiplying the required capacity to support hydrogen vehicles by the proportion to be delivered via public refuelling infrastructure, a final (public) capacity is calculated.

Table 11-11: Calculation of required public hydrogen refuelling capacity

Field (Green text = input data; red text = calculation)	Value
Proportion of fuel delivered by public HRS passenger cars	100%
Proportion of fuel delivered by public HRS LCV	80%
Proportion of fuel delivered by public HRS small rigid	80%
Proportion of fuel delivered by public HRS large rigid	80%
Proportion of fuel delivered by public HRS articulated	80%
Total fuel delivered via public HRS per day passenger car	80,117
Total fuel delivered via public HRS per day LCV	13,754
Total fuel delivered via public HRS per day small rigid	766
Total fuel delivered via public HRS per day large rigid	62,700
Total fuel delivered via public HRS per day articulated	1,544,513
Total fuel delivered via public HRS per day (kg)	1,701,850
Total fuel delivered via public HRS per day (t)	1,702

To develop the daily capacity into a target for Member States, the length of the TEN-T network was divided by the distance between HRS (recommended by stakeholder input and literature) to determine the number of HRS that will be distributed on the TEN-T network. Given that the traffic flow on the TEN-T network will be much greater than that for urban areas for hydrogen vehicles (due to the uptake in freight vehicles), it was assumed that 90% of the total capacity would be delivered on the TEN-T network. Thus, the capacity of each HRS could be calculated. The calculation is presented in Table 11-14.

The calculation results in a required capacity of approximately 2t for each HRS on the TEN-T network – this was determined to be the required capacity to satisfy the refuelling for the expected number of hydrogen vehicles for the MIX scenario. As outlined previously, and supported by the desk and field research, the trajectory of the hydrogen market is very unclear, with uncertainty around the numbers of vehicles and the technology that will be used. Furthermore, from stakeholder input, the priority at this stage is to ensure a minimum network of infrastructure and that in areas where there is greater demand, the market will increase the capacity of the infrastructure.

Due to the fact that the fuel cell vehicle market has a much more uncertain trajectory than the BEV market, there is a higher likelihood that the MIX scenario may not be achieved. As such, taking a more conservative approach, the recommendation for a **minimum level** of infrastructure is to have a capacity of 1t per HRS – whilst this will not satisfy the infrastructure requirements for the MIX scenario, it is nevertheless deemed sufficient as a minimum level to allow the hydrogen market to develop. The 1t capacity is also close to the minimum suitable capacity solely for HDV refuelling. This would result in approximately 711 HRS along the Core and Comprehensive networks, and 88 in Urban Nodes (as described below).

Table 11-12 Calculation of required targets along TEN-T networks and TEN-T Urban Nodes

Field (Green text = input data; red text = calculation)	Value
TEN-T Network	
TEN-T network length	106,605.4
Distance between HRS	150
Number of refuelling stations	710.7029
Percentage of energy from comprehensive	0.9
Total capacity delivered (t)	1,531.665
Required capacity of each HRS (t)	2.155142
TEN-T Urban Nodes	
Number of nodes	88
HRS per node	1
Number of HRS in nodes	88
Percentage of energy from nodes	0.1
Total capacity delivered (t)	170.185
Required capacity of each HRS (t)	1.93

LDV and HDV national-level targets

No national targets are considered necessary for hydrogen refuelling infrastructure for LDVs or HDVs due to the early stage of the market. At this stage, it is not possible to determine what exctly the evolution of demand in particular for different HDV technologies will be and how exactly this will affect the demand for publicly accessible recharging, that would go beyond providing for a minimum level of infrastructure to allow the markets to develop. As such, the Core and Comprehensive TEN-T networks should be the focus of targets until the market develops further.

HDV targets for urban nodes

The recommendation is for **TEN-T Urban Nodes** to have at least one hydrogen refuelling station for HDVs by 2030, at 700 bar (and 350 bar optionally). The minimum daily capacity for all stations should be a minimum of 1 tonne.

Similar to the specification of targets for electric infrastructure in urban areas for HDVs, the provision of targets in urban areas for HDVs received mixed opinions, with many considering targets for urban areas as being unnecessary as hydrogen infrastructure is mainly intended to serve HDVs. However, the role of TEN-T Urban Nodes in connecting the Core and Comprehensive TEN-T Networks has been highlighted several times in stakeholder discussions with the European Commission, and as such it is desirable to the hydrogen industry to have HRS infrastructure at TEN-T Urban Nodes.

The recommendation is for each of the 88 TEN-T Urban Nodes to have at least one HRS installed by 2030, to coincide with the targets for the Core and Comprehensive TEN-T networks, which will assist in ensuring a minimum network of HRS is deployed across the EU to allow the market to develop. Stakeholder feedback has indicated that the market is expected to respond with further locations once the infrastructure requirements are more understood. It is not considered necessary to provide infrastructure for hydrogen powered LDVs in urban areas, but this can be deployed as an optional consideration should the market respond.

The rationale for the HRS capacity per station is provided above in Section 0. Additionally, focusing on the existing 88 Urban Nodes allows for the prioritisation of larger nodes with are likelier to have large multimodal hubs.

Higher ambitions for hydrogen refuelling station targets

The desk based and field research has highlighted that the direction the hydrogen AFV industry will take is very unclear (ICCT, 2017; Ricardo, 2021a; IEA, 2019). There are uncertainties leading up to 2030 regarding exactly how much HRS infrastructure will be required; and some Member States / regions may require more infrastructure than others to cater for an increased demand for hydrogen refuelling infrastructure, which could be achieved by increasing capacity of stations or by deploying more stations (or deploying stations at a quicker pace).

The targets for HRS specified thus far can be considered as minimum targets to allow the market to develop, i.e. the provision of a skeleton network. Dependent on the direction of the market, there may be higher ambitions with respect to deployment of hydrogen refuelling infrastructure, as outlined in the policy options in Section 6. This section considers three alternative / additional targets that could be deployed for hydrogen refuelling stations, focusing on increasing the capacity of hydrogen refuelling stations; specifying targets for liquid hydrogen infrastructure; and increasing the ambition for the deployment of a network of hydrogen refuelling stations.

Increased capacity

The recommendation is for the **Core and Comprehensive TEN-T networks** to have one hydrogen refuelling station serving both directions every 150km for HDVs at 700 bar (and 350 bar optionally) by 2030; LDVs should also be able to refuel at all hydrogen refuelling stations. The minimum daily capacity for all stations should be 2 tonnes.

The recommendation is for **TEN-T Urban Nodes** to have at least one hydrogen refuelling station for HDVs by 2030, at 700 bar (and 350 bar optionally). The minimum daily capacity for all stations should be 2 tonnes.

The first higher ambition scenario for the provision of HRS involves increasing the required capacities of HRS to 2t. As noted, the previously outlined target is recommended to be the minimum level of infrastructure necessary to allow for the market to develop. The "increased capacity" target should be viewed as the target catering for the expected numbers of hydrogen vehicles in the MIX scenario to be deployed. The increased capacity for HRS is applicable to targets for HRS on the Core and Comprehensive networks and in TEN-T Urban Nodes.

Liquid hydrogen

The recommendation is for **liquid hydrogen infrastructure** to be deployed in one hydrogen refuelling station every 450km on the **Core Ten-T network**; and for one station out of three located in **TEN-T Urban Nodes** to serve liquid hydrogen, focusing on the largest urban nodes or in large multimodal hubs, by 2030.

There were no suggestions or questions within the Strand A or Strand B surveys related to provision of targets for liquid hydrogen refuelling stations (rather than gaseous hydrogen). However, subsequent discussions with stakeholders held by the European Commission, particularly with HDV manufacturers, have indicated that some truck manufacturers are exploring the technological development of liquid hydrogen refuelling. As such, despite the uncertain technology trajectory for this fuel type, and further energy efficiency loses it leads to, a target was developed for liquid hydrogen refuelling.

The recommendation is for deployment of liquid hydrogen infrastructure every 450km along the Core TEN-T network, and for one station out of every three located in TEN-T Urban Nodes to dispense liquid hydrogen, with the Urban Nodes focusing on the largest urban nodes or in large multimodal hubs (the exact determination of which nodes need to be equipped is not relevant for the Impact Assessment). This is expected to be a suitable level of infrastructure provision to allow for the potential liquid hydrogen market to develop, rather than recommending similar to deployment to other HRS.

Increased ambition

The recommendation is for the **Core and Comprehensive TEN-T networks** to have one hydrogen refuelling station serving both directions every 150km for HDVs at 700 bar (and 350 bar optionally) by 2025; LDVs should also be able to charge at all hydrogen refuelling stations. The minimum daily capacity for all stations should be 2 tonnes.

The recommendation is for **TEN-T Urban Nodes** to have at least one hydrogen refuelling station for HDVs by 2025, at 700 bar (and 350 bar optionally). The minimum daily capacity for all stations should be 2 tonnes.

Whilst considered unrealistic by desk and field research and from expert opinion on the industry (see above), it is possible that the development of the hydrogen industry could greatly accelerate in the coming years (Fuel Cells and Hydrogen 2 Joint undertaking, 2019). As such, the final "higher ambition" scenario is focused on deploying suggested targets for HRS at a quicker pace, specifying the targets for 2025 rather than 2030. Some minor support for this accelerated target was voiced by stakeholders in the Strand B survey, where it was stated that AFI needs to be in place in advance of the expected uptake of hydrogen vehicles, particularly in the context of Member States continuing to bring forward the ban of petrol and diesel vehicles. However, a large negative impact of this was noted in terms of the greatly increased cost of HRS provision and the possibility of stranded assets, particularly since HRS tends to break down when it is underutilised.

11.1.3 CNG

LDV and HDV targets for TEN-T networks

The recommendation is for the **Core TEN-T network** to have a target of one CNG refuelling station every 150km by 2025, serving both LDVs and HDVs.

The recommendation for the target for CNG infrastructure along the Core TEN-T network is based on the targeted interviews with stakeholders and the responses to the Strand A survey, which largely indicated that the proposed (and existing) target was appropriate. Several stakeholders indicated that CNG refuelling sites should serve both HDVs and LDVs, noting that the criteria for CNG HDVs can follow the same as for LDVs, ensuring stations are designed for heavy duty requirements (e.g. considering flow rate and nozzle design). Alignment with CNG LDV infrastructure criteria with HDV infrastructure criteria would simplify the implementation of stations.

According to EAFO, there are more CNG LDVs (1,240,540) than HDVs (41,667), but the LDVs are mainly located in Italy (around 80%). The expected vehicle uptake for both vehicle categories is not expected to be that high, and as such it is not considered necessary to have separate infrastructure for LDVs and HDVs. As such, to avoid having too much infrastructure and to save on implementation costs, the same refuelling points should be used for both LDVs and HDVs. Alignment with CNG LDV infrastructure criteria with HDV infrastructure criteria would simplify the implementation of stations.

There was very little support from stakeholders for extending targets for CNG provision beyond the Core TEN-T network (i.e. to the Comprehensive TEN-T network, TEN-T Urban Nodes, or areas outside the TEN-T network), as outlined in Annex A. Additionally, in reference to these two annexes, it is worth noting that many stakeholders question the continued consideration of CNG in the AFID, with numerous stakeholders supporting the removal of CNG from the AFID[71].

The suggested year for the target is 2025, based on expected fleet evolution and input from Strand B survey in which 13 of 16 stakeholders supported a target for this year. It is not considered necessary to provide a different target for 2030 for CNG infrastructure, again due to the expected fleet evolution – the market is expected to respond should additional infrastructure become necessary.

LDV and HDV national-level targets

No national-level target for CNG LDVs or HDVs is proposed – it is not considered necessary to provide a fleet-based national target for CNG vehicles due to the expected fleet evolution.

11.1.4 LNG

HDV targets for TEN-T networks

The recommendation is for the **Core TEN-T network** to have a target of one LNG refuelling station every 400km by 2025, to serve HDVs.

[71] Eurelectric, T&E, AT BMK, Direction générale de l'énergie et du climat and another public authority all argued against the inclusion of LNG in the survey.

The recommendation for the target for LNG infrastructure for HDVs along the Core TEN-T network is based on the targeted interviews with stakeholders and the responses to the Strand A survey. There is limited information in literature in terms of specifying a target for LNG infrastructure, or why it should change from what is currently specified in the AFID. In general, stakeholders were in support of using the same target that is currently within the AFID. There was very little support from stakeholders to expand the scope of targets for LNG infrastructure beyond the Core TEN-T network.

Similar to CNG infrastructure, many stakeholders also question the continued inclusion of LNG in the AFID for road transport[72], with numerous stakeholders supporting its removal, as shown in Annex A. However, some stakeholders noted the potential benefits LNG can provide for modes of transport separate to road transport. Furthermore, a survey of stakeholders carried out by the Sustainable Transport Forum indicated broad support (81%) for an LNG station every 400km (Sustainable Transport Forum, 2019). Given the stakeholder support for keeping the target the same and the question surrounding the continued inclusion of LNG in the AIFD, it is recommended that the target be kept the same.

The suggested year for the target is 2025, based on the expected fleet evolution and to ensure full connectivity on the TEN-T network. It is not considered necessary to provide a different target for 2030 for LNG infrastructure, again due to the expected fleet evolution.

HDV national-level targets

No national-level target for LNG HDVs is proposed – it is not considered necessary to provide a fleet-based national target for LNG vehicles due to the expected fleet evolution.

[72] Eurelectric, T&E, AT BMK, Direction générale de l'énergie et du climat and another public authority all argued against the inclusion of LNG in the survey.

11.2 Annex C – Detailed description of the baseline

The Baseline scenario for this impact assessment support study is the EU Reference scenario 2020. The EU Reference scenario 2020 (REF2020) reflects the EU level policies adopted by the end of 2019 and the range of foreseen national policies and measures of the final NECPs that Member States submitted in 2019 according to the Governance Regulation[73]. The EU Reference scenario 2020 also takes into account the impacts of the COVID-19 pandemic that had a significant impact on the transport sector.

Main assumptions of the Baseline scenario

The main assumptions related to economic development, international energy prices and policies are described below.

Economic assumptions: The modelling work is based on socio-economic assumptions describing the expected evolution of the European society. Long-term projections on population dynamics and economic activity form part of the input to the transport and energy models and are used to estimate transport activity and energy demand.

Population projections from Eurostat[74] are used to estimate the evolution of the European population, which is expected to change little in total number in the coming decades. The GDP growth projections are from the Ageing Report 2021[75] by the Directorate General for Economic and Financial Affairs, which are based on the same population growth assumptions.

Table 11-14 : Projected population and GDP growth per Member State

	Population			GDP growth	
	2020	2025	2030	2020-'25	2026-'30
EU27	447.7	449.3	449.1	0.9%	1.1%
Austria	8.90	9.03	9.15	0.9%	1.2%
Belgium	11.51	11.66	11.76	0.8%	0.8%
Bulgaria	6.95	6.69	6.45	0.7%	1.3%
Croatia	4.06	3.94	3.83	0.2%	0.6%
Cyprus	0.89	0.93	0.96	0.7%	1.7%
Czechia	10.69	10.79	10.76	1.6%	2.0%
Denmark	5.81	5.88	5.96	2.0%	1.7%
Estonia	1.33	1.32	1.31	2.2%	2.6%
Finland	5.53	5.54	5.52	0.6%	1.2%
France	67.20	68.04	68.75	0.7%	1.0%
Germany	83.14	83.48	83.45	0.8%	0.7%
Greece	10.70	10.51	10.30	0.7%	0.6%
Hungary	9.77	9.70	9.62	1.8%	2.6%
Ireland	4.97	5.27	5.50	2.0%	1.7%
Italy	60.29	60.09	59.94	0.3%	0.3%
Latvia	1.91	1.82	1.71	1.4%	1.9%

[73] Regulation (EU) 2018/1999

[74] EUROPOP2019 population projections https://ec.europa.eu/eurostat/web/population-demography-migration-projections/population-projections-data

[75] The 2021 Ageing Report : Underlying assumptions and projection methodologies https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en

	Population			GDP growth	
	2020	2025	2030	2020-'25	2026-'30
Lithuania	2.79	2.71	2.58	1.7%	1.5%
Luxembourg	0.63	0.66	0.69	1.7%	2.0%
Malta	0.51	0.56	0.59	2.7%	4.1%
Netherlands	17.40	17.75	17.97	0.7%	0.7%
Poland	37.94	37.57	37.02	2.1%	2.4%
Portugal	10.29	10.22	10.09	0.8%	0.8%
Romania	19.28	18.51	17.81	2.7%	3.0%
Slovakia	5.46	5.47	5.44	1.1%	1.7%
Slovenia	2.10	2.11	2.11	2.1%	2.4%
Spain	47.32	48.31	48.75	0.9%	1.6%
Sweden	10.32	10.75	11.10	1.4%	2.2%

These projections take into account the potential medium- to long-term impacts of the COVID-19 crisis on the structure of the economy. Overall, conservative assumptions were made regarding the medium-term impacts of the pandemic on the re-localisation of global value chains, teleworking and teleconferencing and global tourism.

Energy prices assumptions: The projections of the POLES-JRC model – elaborated by the Joint Research Centre and derived from the Global Energy and Climate Outlook (GECO[76]) – are used to obtain long-term estimates of the international fuel prices.

The COVID crisis has had a major impact on international fuel prices[77]. The lost demand cause an oversupply leading to decreasing prices. The effect on prices compared to pre-COVID estimates is expected to be still felt up to 2030. Actual development will depend on the recovery of global oil demand as well as supply side policies[78].

Table 11-15 shows the international fuel prices assumptions of the Baseline, including the policy options of this impact assessment support study.

Table 11-15: International fuel prices assumptions

in $'15 per boe	**2000**	**'05**	**'10**	**'15**	**'20**	**'25**	**'30**	**'35**	**'40**	**'45**	**'50**
Oil	38.4	65.4	86.7	52.3	39.8	59.9	80.1	90.4	97.4	105.6	117.9
Gas (NCV)	26.5	35.8	45.8	43.7	20.1	30.5	40.9	44.9	52.6	57.0	57.8
Coal	11.2	16.9	23.2	13.1	9.5	13.6	17.6	19.1	20.3	21.3	22.3
in €'15 per boe	**2000**	**2005**	**'10**	**'15**	**'20**	**'25**	**'30**	**'35**	**'40**	**'45**	**'50**
Oil	34.6	58.9	78.2	47.2	35.8	54.0	72.2	81.5	87.8	95.2	106.3
Gas (NCV)	23.4	31.7	40.6	38.7	17.8	27.0	36.2	39.7	46.6	50.5	51.2
Coal	9.9	15.0	20.6	11.6	8.4	12.0	15.6	16.9	18.0	18.9	19.7

Source: Estimates, derived from JRC, POLES-JRC model, Global Energy and Climate Outlook (GECO)

Technology assumptions : Modelling scenarios on the evolution of the energy system is highly dependent on the assumptions on the development of technologies - both in terms of performance and costs. These assumptions have been updated based on a

[76] https://ec.europa.eu/jrc/en/geco

[77] IEA, Global Energy Review 2020, June 2020

[78] IEA, Oil Market Report, June 2020 and US EIA, July 2020.

rigorous literature review and consulted with stakeholders. The updated technology assumptions are published together with the EU Reference Scenario 2020.

Policies included in the Baseline scenario

The Baseline scenario is based on policies adopted at EU level by the end of 2019. In particular, at EU level, the Baseline scenario takes into account the legislation adopted in the 2017-2018 Mobility Packages[79]. At national level, the scenario takes into account the policies and specific targets, in particular in relation with renewable energy and energy efficiency, described in the final National Energy and Climate Plans (NECPs) submitted by Member States at the end of 2019/beginning of 2020.

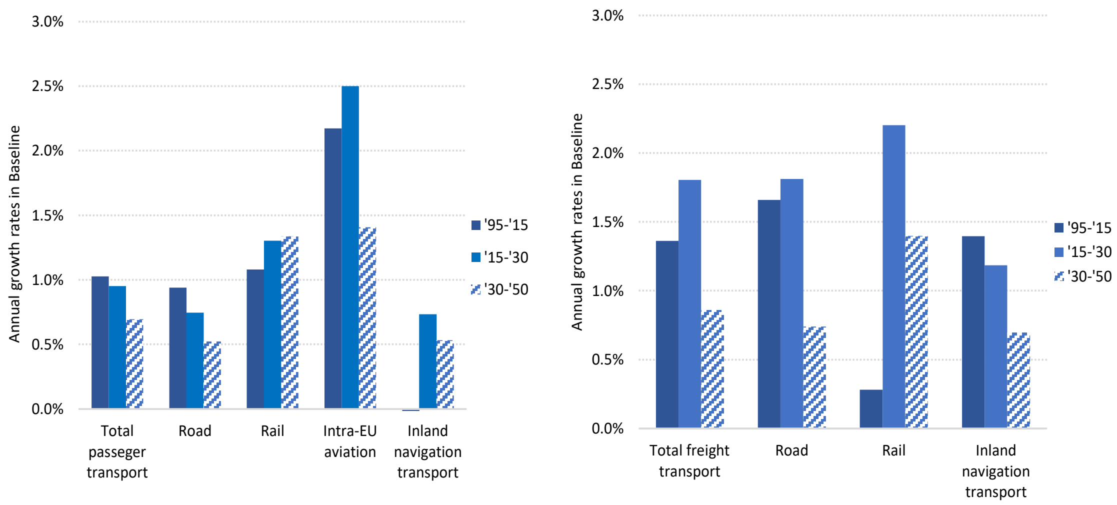
The Baseline scenario models the policies already adopted, but not the target of net-zero emissions by 2050. As a result, there are no additional policies introduced driving decarbonisation after 2030. However, climate and energy policies are not rolled back after 2030 and several of the measures in place today continue to deliver emissions reduction in the long term.

More details on the policies included in the Baseline scenario are available in the EU Reference scenario 2020 publication[80].

Main results of the Baseline scenario

EU transport activity would continue to grow in the Baseline scenario, albeit at a slower pace than in the past. Freight transport activity for inland modes (expressed in tonne-kilometres) would increase by 31% between 2015 and 2030 (1.8% per year) and 55% for 2015-2050 (1.3% per year). Passenger traffic (expressed in passenger-kilometres) growth would be lower than for freight with a 16% increase by 2030 (1% per year) and 33% by 2050 (0.8% per year). The annual growth rates by mode, for passenger and freight transport, are provided in Figure 2.

Figure 2: Passenger and freight transport activity in the Baseline scenario (average growth rate per year)



Source: Baseline scenario, PRIMES-TREMOVE transport model (E3Modelling)
Note: For aviation, domestic and international intra-EU activity is reported, to maintain the comparability with reported statistics. For freight, inland navigation transport covers inland waterways and national maritime.

Road transport would maintain its dominant role within the EU. The share of road transport in inland freight would remain relatively stable by 2030 at 71% and slightly

[79] Source : https://ec.europa.eu/transport/modes/road/road-initiatives_en
[80] EU Reference Scenario 2020 | Energy (europa.eu)

decrease to 69% by 2050. For passenger transport, road modal share is projected to decrease by 2 percentage points between 2015 and 2030 and by additional 3 percentage points by 2050. Passenger cars would still contribute 71% of passenger traffic by 2030 and more than two thirds by 2050, despite growing at lower pace relative to other modes. Rail transport activity is projected to grow significantly faster than for road, driven in particular by the assumed completion of the TEN-T core network by 2030 and of the comprehensive network by 2050, supported by the CEF, Cohesion Fund and ERDF funding. Domestic and international intra-EU air transport would grow significantly (by 46% during 2015-2030 and 91% by 2050) following the recovery from the COVID-19 pandemics, although at slower pace than projected in the past. Transport activity of freight inland navigation[81] also benefits from the completion of the TEN-T core and comprehensive network and the promotion of inland waterway transport and would grow by 19% during 2015-2030 and by 37% by 2050. The significant growth in freight inland navigation and rail freight activity is also supported by the implementation of electronic documentation for freight transport and the European Maritime Single Window environment. International maritime transport activity would grow strongly in the Baseline (by 20% between 2015 and 2030 and 50% by 2050), due to rising demand for primary resources and container shipping.

Total energy use in transport, including international aviation and international maritime, is projected to decrease by 6% between 2015 and 2030 and by 15% by 2050, which in the context of growing activity shows the projected progress in terms of energy efficiency. These developments are mainly driven by the implementation of the CO_2 emission performance standards for new light duty and heavy-duty vehicles post-2020, supported by the roll-out of recharging and refuelling infrastructure and also by the shift towards more energy efficient modes such as rail and waterborne transport. Road transport is responsible for more than 70% of total energy use in transport but this share is projected to significantly decline over time, to 68% by 2030 and 60% by 2050 thanks to the progressive electrification of the sector and greater use of more sustainable transport modes.

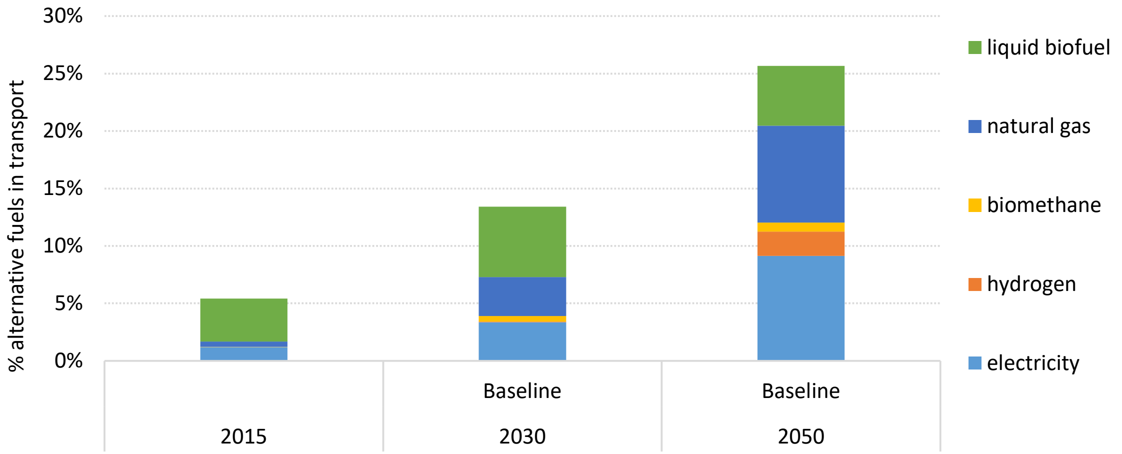
Alternative fuels[82], including renewable and low carbon fuels, are projected to represent 13.3% of transport energy demand (including international aviation and maritime transport) in the Baseline scenario by 2030 and 24.8% by 2050. Around 6.6% of all transport fuels in 2030 would be of biological origin, as shown in Figure 3, driven by policy measures and notably the Renewable Energy Directive.

Electricity use in transport would steadily increase over time as a result of uptake of zero and low-emission powertrains in road transport and further electrification of rail. Its share in the total energy use in transport would go up from around 1.2% in 2015 to 3.3% in 2030 and 9% in 2050 (see Figure 3). The uptake of hydrogen would be facilitated by the increased availability of refuelling infrastructure and is projected to represent 1.6% of energy use in transport by 2050.

[81] Inland navigation covers inland waterways and national maritime.

[82] According to the Directive 2014/94/EU, 'alternative fuels' refer to fuels or power sources which serve, at least partly, as a substitute for fossil oil sources in the energy supply to transport and which have the potential to contribute to its decarbonisation and enhance the environmental performance of the transport sector. They include, inter alia: electricity, hydrogen, biofuels, synthetic and paraffinic fuels, natural gas, including biomethane, in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG)), and liquefied petroleum gas (LPG).

Figure 3: Share of alternative fuels used in transport (including international aviation and maritime) in the Baseline scenario



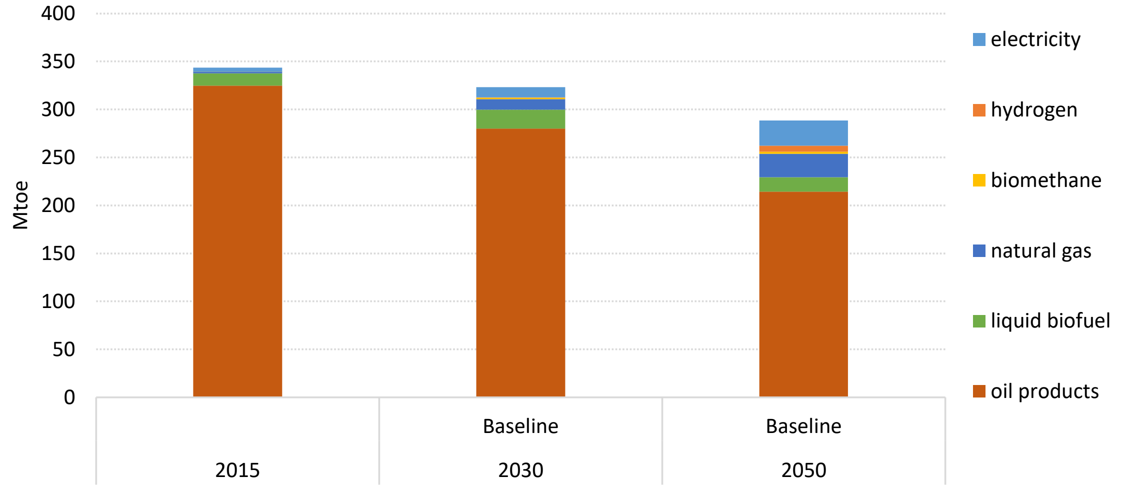
Source: Baseline scenario, PRIMES-TREMOVE transport model (E3Modelling)

Battery electric vehicles would see faster growth beyond 2020, in particular in the segment of light duty vehicles, driven by the CO_2 emission performance standards, supported by the rolling-out of recharging infrastructure. The share of battery electric vehicles in the total stock of passenger cars would reach around 11% by 2030 and 33% by 2050. The share of low and zero-emissions cars (including battery electric, fuel cells and plug-in hybrids) is projected to go up to 17% by 2030 and 54% by 2050. For the light commercial vehicles segment, the share of battery electric powertrains is projected at 4% by 2030 and 25% by 2050. Electric buses are projected to represent around 11% of the vehicle stock by 2030, driven by the implementation of the Clean Vehicles Directive and air quality concerns in many cities banning combustion engine buses, while the uptake of electric and fuel cell heavy goods vehicles is projected to be more limited in the Baseline scenario (3.1% of vehicle stock by 2050).

Liquefied Natural Gas (LNG) is projected to represent around 3.3% of the energy use in transport by 2030 and 8.2% by 2050 in the Baseline scenario, driven by the implementation of the Directive on the deployment of alternative fuels infrastructure and of the Regulation on non-road mobile machinery, the TEN-T Regulation and also by the MARPOL Annex VI rules as regards the reduction of nitrogen and sulphur oxides emissions in the maritime transport. In the Baseline scenario, the share of LNG use in heavy goods vehicles energy demand is projected to go up to 9.0% by 2030 (16% by 2050) and for inland navigation to 4% by 2030 (9% by 2050). LNG would provide about 5% of maritime bunker fuels by 2030 and 19% by 2050 – especially in the segment of short sea shipping.

Oil products would still represent about 87% of the EU transport sector needs in 2030 and 75% in 2050, despite the current renewables policies, CO_2 emission performance standards for new light duty and heavy goods vehicles, and the deployment of alternative fuels infrastructure which support some substitution effects towards alternative fuels such as biofuels and biomethane, electricity, hydrogen and natural gas.

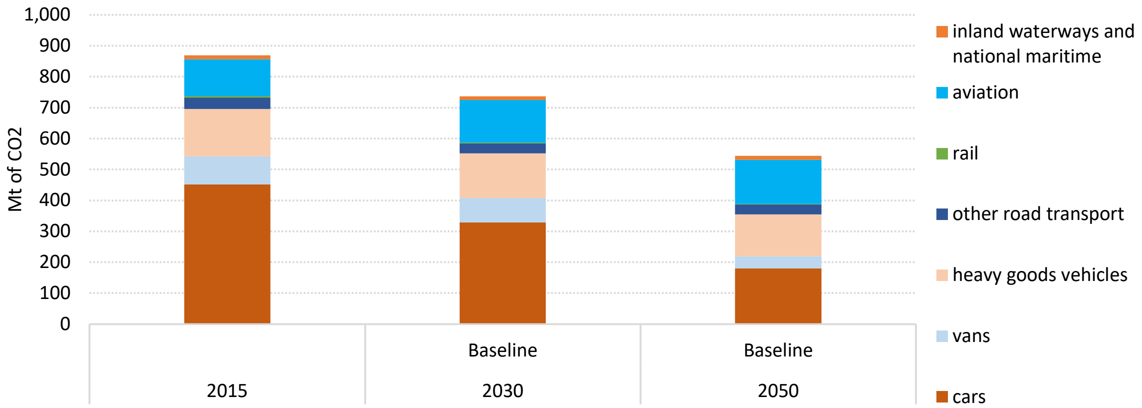
Figure 4: Fuels use in transport (including international aviation and maritime) in the Baseline scenario



Source: Baseline scenario, PRIMES-TREMOVE transport model (E3Modelling)

CO2 emissions from transport including international aviation but excluding international maritime, in line with the 2030 climate and energy policy framework, are projected to be 15% lower by 2030 compared to 2015, and 36% lower by 2050. Compared to 1990 however, this translates into 4% higher emissions by 2030 and only 23% lower emissions by 2050, due to high increases in transport emissions during the 1990s. When accounting the intra-EU aviation and intra-EU maritime in the transport emissions, the Baseline projections show reductions of 17% by 2030 and 39% by 2050 relative to 2015. When all intra-EU and extra-EU aviation and maritime emissions are accounted in the transport emissions, the Baseline scenario results in 11% decrease in transport emissions by 2030 and 29% decrease by 2050 compared to 2015 levels. This illustrates the significant emissions reduction gap to be closed by 2030 and 2050, to contribute to the 2030 Climate Target Plan and the European Green Deal objectives.

Figure 5: CO_2 emissions from transport (including international aviation but excluding international maritime) in the Baseline scenario



Source: Baseline scenario, PRIMES-TREMOVE transport model (E3Modelling)

The largest contribution to the projected decline in transport emissions between 2005 and 2050 is due to increased fuel efficiency of passenger cars and light commercial vehicles. Conversely, aviation has been one of the fastest growing sectors in terms of CO_2 emissions over the past decades.

NOx emissions are projected to go down by 54% between 2015 and 2030 (69% by 2050), mainly driven by the electrification of the road transport and in particular of the light duty vehicles segment. The decline in **particulate matter** (PM2.5) would be slightly lower by 2030 at 49% relative to 2015 (73% by 2050). Air quality issues represent a particular concern in urban areas. In the Baseline scenario NOx and PM2.5 emissions are projected to decrease at higher pace in urban relative to inter-urban areas (69% reduction in NOx emissions by 2030 and 60% for PM2.5 emissions), thanks to the use of more sustainable alternative modes, including active modes, and cleaner vehicles. Overall, external costs related to air pollutants would decrease by about 60% by 2030 (78% by 2050)[83].

Costs assumptions for road transport refuelling/recharging infrastructure

This section presents the assumptions related to the unit costs of the refuelling/recharging infrastructure used in this impact assessment, drawing on the study supporting the evaluation of the Directive on alternative fuels infrastructure (Ricardo, 2021a) and the Reference scenario 2020. The unit costs are assumed to be the same in the baseline and the policy options.

Electricity recharging infrastructure

The assumed costs for the electricity chargers cover capital expenditures (CAPEX) and installation costs (Table 47). Network upgrade costs are not included. Three different categories of charging points based on recharging power are considered. The slow charging points, which are appropriate for use when the electric vehicle is parked for prolonged time, include public AC chargers with 7 KW power and public semi-fast AC chargers with 22 KW power. The second category of charging points considers rapid DC chargers of power output 50 KW and 150 KW. The third category of charging points includes ultra-rapid DC chargers, with typical power 350KW. These public chargers are placed in key nodes of the road network and are associated with the need for a quick recharge during a trip. Their use is likely to be restricted to premium and commercial vehicles, due to the larger battery sizes and ability to charge at these power levels.

Table 11-16: Electricity recharging infrastructure costs

Investment costs (EUR/point)	2020	2025	2030	2040	2050
Slow charging points					
public HH (7KW AC)	1,500	1,340	1,253	1,171	1,139
public spaces (22KW AC)	6,280	5,423	4,974	4,561	4,403
Rapid charging points					
public spaces (50KW DC)	45,000	37,728	34,019	30,687	29,422
public spaces (150KW DC)	90,000	72,510	63,757	56,016	53,114
Ultra-rapid charging points					
public spaces (350 KW DC)	230,000	186,614	164,836	145,532	138,282

[83] Covering NOx and PM; excluding international maritime.

Source: Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure

The breakdown of the charging point capital costs for 2020 into CAPEX and installation costs is provided in Table 48. The installation costs do not include costs related to grid 159 Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure. 160 For electric chargers of 350 kW or higher a unit cost is used that ranges from 470 EUR/kW in 2030 to 395 EUR/kW in 2050. 130 reinforcement. The latter costs are accounted and reflected in the electricity prices and are provided by the PRIMES energy systems model.

Table 11-17: CAPEX and installation costs of chargers in 2020

Charging point type	Capex	Installation	Total
Slow charging points			
public HH (7KW AC)	667	833	1,500
public spaces (22KW AC)	3,280	3,000	6,280
Rapid charging points			
public spaces (50KW DC)	28,125	16,875	45,000
public spaces (150KW DC)	70,000	20,000	90,000
Ultra-Rapid fast charging points			
public spaces (350 KW DC)	170,000	60,000	230,000

Source: Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure

The learning rates that were used to estimate the CAPEX reduction over time are around -9% for rapid and ultra-rapid charging points, -8% for public semi-fast charging points (22 KW AC) and -7% for slow on-street public charging points (7 KW AC). For the installation costs, the learning rate is assumed to be -2%. The operation and maintenance costs (O&M) are estimated as a fraction of the capital costs per charging point per year, over the lifetime of the infrastructure (see Table 49). Additional lifetime extension costs of 25% are assumed, in order to extend the operation of charging points that have been installed for more than 15 years (e.g. replacement of aged components such as power electronics).

Table 11-18: Assumed O&M costs per annum for electric vehicle recharging infrastructure (as a percentage of investment costs)

O&M costs (% investment costs/point, p.a.)	2020-2050
Slow charging points	
private HH off-street charging (7KW AC)	1%
public HH on-street charging (7KW AC)	1.6%
public spaces (22KW AC)	1.2%
Rapid charging points	
public spaces (50KW DC)	1.2%
public spaces (150KW DC)	1.2%
Ultra-rapid charging points	
public spaces (350 KW DC)	1.2%
Lifetime extension for charging points with > 15 years lifetime (% investment cost)	25%

Source: Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure

Hydrogen

The assumed costs for hydrogen refuelling stations (HRS) consider the total cost of the installation (Table 50). The components of an HRS that are covered by the assumed costs include the cost of the H2 storage tank, the cost of the compressor and the cost of the dispensers. The cost for hydrogen generation, which can be either centralized or decentralized, is not included in the abovementioned total cost. The PRIMES model 131 considers that the hydrogen production cost is included in the hydrogen fuel prices as a means for investors to recuperate their costs. Three categories of HRS are considered based on the daily refuelling capacity in tons H2 per day: a small station of 0.4 tons H2/day capacity, a medium station of 1 ton H2/day capacity, and a large station of 2.5 tons H2/day capacity. Table 50 presents the assumed evolution of the HRS capital costs over time. In the case of HRS of 2 tons H2/day capacity, a linear interpolation was used.

Table 11-19: Hydrogen refuelling station costs

Investment costs (Eur/Station)	2020	2025	2030	2040	2050
Small (0.4 tons H_2/day)	2,500,000	2,324,083	2,148,167	2,069,252	1,990,337
Medium (1 tons H_2/day)	3,800,000	3,344,280	2,888,561	2,801,448	2,714,336
Large (2.5 tons H_2/day)	5,700,000	5,016,000	4,332,000	4,024,200	3,716,400

Source: Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure

O&M costs of hydrogen refuelling infrastructure are assumed to be 4% of the investment costs per year (over the lifetime of the infrastructure) of a refuelling station. Additional costs (e.g. refurbishment, lifetime extension) of 40% are assumed in order to extend the operation of vintage charging points with a lifetime higher than 20 years. Furthermore, in the case of liquid hydrogen stations (capacity of 2 tons/day), a cost of 2 million EUR is added in addition to the cost of gas H2 stations.

CNG/LNG

The capital costs for CNG and LNG stations for road transport (Table 51) cover the total costs for the installation of the station. These costs are assumed to remain unchanged over time and they include the cost of the compressor, the storage tank and the metered dispenser. For road CNG/LNG stations three different representative station sizes are considered, namely a small 500 kg/day station, a medium 2,000 kg/day station and a large 5,000 kg/day station. O&M costs of CNG and LNG refuelling stations are assumed to be 4% of the capital costs per year (over the lifetime of the infrastructure) of a refuelling station. Additional O&M costs (e.g. refurbishment, lifetime extension) of 40% are also estimated separately, applied only to those stations installed for more than 20 years.

Table 11-20 Road CNG/LNG refuelling station costs

Investment costs (EUR)	2015-2050
Small station (500 kg/day)	450,000
Medium station (200 0kg/day)	720,000
Large station (5000 kg/day)	1,330,000

Source: Ricardo et al. (2021), Evaluation of the Directive on the Deployment of Alternative Fuels Infrastructure

11.3 Annex D – List of stakeholders interviewed

<table>
<tr><th colspan="2">Type of stakeholder</th><th>Name of stakeholder / organisation</th></tr>
<tr><td colspan="2">Public authorities and other public bodies</td><td>DG ENER
Eurocities
Polis</td></tr>
<tr><td rowspan="5">Industry and associations</td><td>Transport service providors / operators</td><td>ACI Europe
Community of European Railway and Infrastructure Companies (CER)
European Federation of Inland Ports (EFIP)
European Sea Ports Organisation (ESPO)
Federation Internationale de L'Automobile (FIA)
International Road Union Organisation (IRU)
International Association of Public Transport (UITP)
1 x anonymous</td></tr>
<tr><td>Energy service provider</td><td>Eurelectic</td></tr>
<tr><td>Fuel and battery producers and retailers</td><td>ePURE
1 x anonymous</td></tr>
<tr><td>Manufacturers of transport equipment</td><td>European Association of Automotive Suppliers (CLEPA)
NGVA Europe</td></tr>
<tr><td>Refuelling station and charge point operators</td><td>The European Association of Electromobility (AVERE)
FuelsEurope
1 x anonymous</td></tr>
<tr><td colspan="2">Civic society</td><td>European Consumer Voice in Standardisation (ANEC)
European Consumer Organisation (BEUC)
European Disability Forum (EDF)
Transport & Environment (T&E)
Irish Rural Link / European Economic Social Council</td></tr>
<tr><td>TOTAL</td><td></td><td>24</td></tr>
</table>

11.4 Annex E – List of stakeholders responding to the survey

Type of stakeholder		Name of stakeholder / organisation
Public authorities and other public bodies		Ministry of Infrastructure and Transport (Greece) Ministry of Transport (Latvia) Bundesministerium fur Verkehr und digitale Infrastruktur (Germany) TIMISORA International Airport-Traisan Vuia Hamburg Port Authority Ministry of Climate and Environment (Poland) Ministry of Transport, Information and Communications (Bulgaria) Environment, Energy, Mobility, Innovation and Technology (BKMK) (Austria) Central Commission for the Navigation of the Rhine (Secretariat) AustriaTech DG MOVE Ministry of Transport Baden-Warttemberg (Germany) 5 x anonymous public authorities and other public bodies
Industry and associations	E-mobilty service provider	BGH2A National Sector Organisation of Electric Mobility in Bulgaria (EVIC) 1 x anonymous
	Energy service provider	Engas Eurelectric Gas Infrastructure Europe Latvian Hydrogen Association EHA Energy and Hydrogen Alliance
	Fuel and battery producers and retailers	SNPAA Liquid Gas Europe 1 x anonymous
	Manufacturers of transport equipment	CHAdeMO Association Europe CharINeV 2 x anonymous
	Refuelling station and charge point operators	Bulgarian Petroleum and Gas Association Ionity GmbH ChargeUp Europe
	Transport service providors / operators	Business Region Gatebourg AB Deutsche Post DHL Group SEA-LNG Limited 4 x anonymous
Civic society		N/A
TOTAL		**42**

11.5 Annex F – List of policy measures and final screening

Table 11-16 below presents the initial long list of measures by problem areas together with a summary of last round of screening that was performed together with the Commission.

Table 11-16: Policy measures and final screening

ID	Measure	Screening
General measures		
G1	Change of legal instrument: Replace the Directive with Regulation (for all OR parts of the legislation)	Assessed
G2	MS reporting through NIRs following further specified guidelines set in EU legislation	Discarded - addressed in other measures
G2-2	MS reporting through NIRs. Detailed binding requirements set in the legislation on the data to be reported. Target year: 2025, then every three years	Assessed
G3	Central EU monitoring of deployment of infrastructure. Market actors to report directly to the Commission. A central monitoring platform would be created. Target year: 2025, then every three years	Discarded - no clear benefit
G4	Revise the scope of the AFID by including new re-fuelling / re-charging infrastructure	Assessed
G5	Introduce common provisions to accelerate the approval of new infrastructure and to harmonise concession practises. Target year: 2025	Discarded. Interfering in Member States planning procedures is outside the scope of the AFID
Problem area A – General		
A1	Revise the current definition of AFs and their further distinction into alternative and low- and zero-emission or sustainable alternative fuels based in line with the European Green Deal	Discarded - addressed in other measures
A1-2	Revise the current definition of AFs for a clearer distinction into alternative and low and zero-emission or sustainable alternative fuels following a life-cycle perspective and other environmental damages	Discarded - addressed in other measures
A2	Differentiate the level of ambition for roll out of distinct AFI based on the tail-pipe emission performance of fuels and projected vehicle fleet demand in road transport	Discarded - addressed in other measures
A2-2	Differentiation of the level of ambition for roll out of distinct AFI based on the emission performance of fuels and projected vehicle fleet demand in road transport including an exclusion of fossil alternative fuels in road transport.	Discarded - addressed in other measures
A3	Require that MS set binding national targets for infrastructure that need to be approved by the Commission.	Discarded - addressed in other measures
A3-2	MS set target according to common EU methodology	Discarded - addressed in other measures

ID	Measure	Screening
A3-3	Commission sets targets	Discarded - addressed in other measures
A4	Require mandatory inclusion of hydrogen (road and waterborne) and other renewable fuels that require distinct infrastructure in NPFs; including an exclusion of fossil alternative fuels in road transport.	Discarded - too prescriptive/demanding
A5	Revise the scope of the AFID by including new re-fuelling / re-charging infrastructure (e.g. in motion re-charging systems).	Discarded - addressed in other measures
A6	Replace NPFs and set mandatory targets for some AFI infrastructure on specific networks only (e.g. Core TEN-T) (according to a suited methodology).	Discarded - addressed in other measures
A6-2	Replace NPFs and set mandatory targets for all AFI applicable to the TEN-T core and comprehensive network (according to a suited methodology)	Discarded - addressed in other measures
A6-3	Replace NPFs and set mandatory targets for all AFI covering the whole transport network according to a suited methodology	Discarded - addressed in other measures
A7	Introduce common provisions to accelerate the approval of new infrastructure and to harmonise concession practises. Target year: 2025	Discarded – not in the scope of the AFID
Problem area A – Road		
A8	Revise the current definitions of regular and high power charging under the AFID to better reflect technological developments of recharging infrastructure for passenger cars, light and heavy-duty vehicles, including the development of in-use road charging (reflecting on the outcomes of Task 1).	Discarded - too prescriptive/demanding
A9	Introduce obligations to MS to ensure that publicly accessible recharging points are being installed within a specific distance from every citizen's home	Discarded - other (subsidiarity, etc.)
A9-2	Introduce obligations to MS to ensure that consumers have the right to request that a publicly accessible recharging point is installed within a specific distance from their home	Discarded - other (subsidiarity, etc.)
A10	Electricity, Cars / LCV in private buildings: Inclusion in NPFs . MS to encourage owners of office and apartment building to install re-chargers in buildings and facilitate investments	Discarded - too prescriptive/demanding
A10-2	Electricity, Cars / LCV in private buildings: Grant owners of parking places in condominiums / apartment blocks the right to install rechargers in their parking without agreement of co-owners ("right to plug"). Target year: 2025	Discarded – not in the scope of the AFID
A10-3	Electricity, Cars / LCV in private buildings: Detailed requirements going beyond EPBD for owners of private parking to equip parking with rechargers. Target year: 2025	Discarded – not in the scope of the AFID
A11	Set minimum target for the share of public chargers in urban areas in disadvantaged neighbourhoods.	Discarded - other (subsidiarity, etc.)
A12	Set minimum target for the minimum number of chargers in relation to number of vehicles of Transport Network Companies (i.e. ride sharing/taxis/ride hailing) in urban areas (criterion to be defined). Target year: 2030	Discarded - no clear benefit
A13	Revise the current definition of "publicly accessible" infrastructure to include an additional category of "Semi-	Discarded - addressed in other measures

ID	Measure	Screening
	public" infrastructure (located on private premises that are accessible during specific hours, e.g. supermarket car-parks)	
A14	Electricity for Cars/LCVs publicly accessible on private properties: MS to ensure owners of parking on private properties to install re-chargers	Discarded - too prescriptive/demanding
A14-2	Electricity for Cars / LCV publicly accessible on private properties: Inclusion in NPFs. Minimal mandatory requirements to pre-cable (for new) and/or install recharging points for entities that provide parking (supermarkets, car park operators, shopping malls, etc.). One rechargers for each 20 parking spaces. Target year: 2030	Discarded - too prescriptive/demanding
A14-3	Electricity for Cars / LCV publicly accessible on private properties: Inclusion in NPFs. Minimal mandatory requirements to pre-cable (for new) and/or install recharging points for entities that provide parking (supermarkets, car park operators, shopping malls, etc.). One rechargers for each 10 parking spaces. Target year: 2030	Discarded - too prescriptive/demanding
A15	Introduce obligation for petrol station operators to equip some petrol stations (those, e.g., with more than 6 or 10 pumps) with publicly accessible re-charging infrastructure. Target year: 2025	Assessed
A15-2	Introduce obligation for petrol station operators to equip all petrol stations with publicly accessible re-charging infrastructure. Target year: 2030	Discarded - too prescriptive/demanding
A16	Mandatory targets for recharging infrastructure for electric cars on TEN-T core including its urban nodes (distance based or other to be determined, possibly under consideration of expected EV traffic volume). Power of mandatory minimal infrastructure could be 150 kW or a more granular approach covering different chargers can be chosen.	Assessed
A16-2	Mandatory targets for recharging infrastructure for electric cars on TEN-T core, comprehensive and urban nodes	Assessed
A16-3	Mandatory targets for recharging infrastructure for electric cars throughout the transport network including regional targets Regional targets would cover urban areas and all areas not covered by TEN-T. (Regulation could cover different chargers in terms of power. E.g.: publicly accessible charger per 10 vehicles and at least 10% of all chargers have to be 150kW, etc.)	Assessed
A17	Electricity for LCVs(vans): MS to define targets for electric chargers through NPFs	Discarded - no clear benefit
A17-2	Electricity for LCVs(vans): Mandatory targets for electric chargers on TEN-T core including its urban nodes	Discarded - no clear benefit
A17-3	Electricity for LCVs(vans): Mandatory targets for electric chargers on TEN-T core, comprehensive and urban nodes	Discarded - no clear benefit
A17-4	Electricity for LCVs(vans): Mandatory targets for electric chargers on TEN-T core, comprehensive and urban nodes BUT more ambitious target setting in terms of timing and density	Discarded - no clear benefit
A18	Identify possible measures to support the roll-out of infrastructure for heavy-duty vehicles, including on long-distance networks and in urban/sub-urban areas	Discarded - addressed in other measures

ID	Measure	Screening
A18-2	Require MS to adopt measures to support the roll-out of infrastructure for heavy-duty vehicles, including on long-distance networks and in urban/sub-urban areas (with particular emphasis on regional distribution trucks)	Discarded - addressed in other measures
A19	Electricity for HDVs: MS to define targets through NPF	Assessed
A19-2	Electricity for HDVs: Mandatory targets on TEN-T core and its urban nodes, with differentiated power requirements	Assessed
A19-3	Electricity for HDVs: Mandatory targets on TEN-T core, comprehensive and urban nodes, with differentiated power requirements	Assessed
A20	Electricity for HDVs in not publicly accessible areas: Inclusion of requirements/targets in NPFs concerning minimum infrastructure in logistic hubs	Discarded - too prescriptive/demanding
A20-2	Electricity for HDVs in not publicly accessible areas: Mandatory targets for logistic hubs	Discarded - too prescriptive/demanding
A20-3	Electricity for HDVs in not publicly accessible areas: Mandatory targets for logistic hubs and private logistic centres	Discarded - too prescriptive/demanding
A21	Electricity for two wheelers: MS to define targets through NPF (mandatory inclusion)	Discarded - addressed in other measures
A21-2	Electricity for two wheelers: Mandatory targets on TEN-T core	Discarded - no clear benefit
A21-3	Electricity for two wheelers: Mandatory targets on TEN-T core, comprehensive and urban nodes	Discarded - addressed in other measures
A21-4	Electricity for two wheelers: Mandatory (fleet based?) targets throughout the transport network incl. regional targets	Discarded - too prescriptive/demanding
A22	Electric Road Systems for HDVs: Recognition as an alternative fuel infrastructure (incl. in definitions)	Discarded - no clear benefit
A22-2	Electric Road Systems for HDVs: MS to define targets through NPFs (optional)	Discarded - no clear benefit
A22-3	Electric Road Systems for HDVs: MS to define targets through NPFs (target setting only if economically feasible)	Discarded - too prescriptive
A22-4	Electric Road Systems for HDVs: Mandatory targets on TEN-T core	Discarded - too prescriptive/demanding
A23	CNG: Mandatory quantitative targets on TEN-T core	Assessed
A23-2	CNG: Optional for MS to define targets for CNG in their NPFs	Assessed
A23-3	CNG: Exclusion of CNG for road transport	Assessed
A24	LNG for HDVs: Mandatory targets on TEN-T core	Assessed
A24-2	LNG for HDVs: Optional for MS to define targets for LNG in their NPFs	Assessed
A24-3	LNG for HDVs: Exclusion of LNG for road transport	Assessed
A25	Hydrogen for cars and LCVs: MS to define targets in NPF	Assessed
A25-2	Hydrogen for cars and LCVs: Mandatory targets on TEN-T core (just setting targets for the absolute minimum)	Assessed

ID	Measure	Screening
A25-3	Hydrogen for cars and LCVs: Mandatory targets on TEN-T core, comprehensive and urban nodes (just setting targets for the absolute minimum)	Assessed
A25-4	Hydrogen for cars and LCVs: Mandatory targets on TEN-T core, comprehensive and urban BUT more ambitious targets in terms of density and timing	Discarded - too prescriptive/demanding
A26	Hydrogen for trucks: MS to define targets in NPF	Assessed
A26-2	Hydrogen for trucks: Mandatory targets on TEN-T core (to ensure minimum geographical coverage)	Assessed
A26-3	Hydrogen for trucks: Mandatory targets on TEN-T core, comprehensive and urban nodes (to ensure minimum geographical coverage)	Discarded - too prescriptive/demanding
A26-4	Hydrogen for trucks: Mandatory targets on TEN-T core, comprehensive and urban nodes (to ensure minimum geographical coverage) BUT more ambitious targets in terms of density and timing	Discarded - too prescriptive/demanding
A27	Biofuels, synthetic and paraffinic fuels, e-fuels (other than hydrogen): Inclusion / better specification of synthetic fuels without other changes	Discarded - no clear benefit
A27-2	Biofuels, synthetic and paraffinic fuels, e-fuels (other than hydrogen): Inclusion of infrastructure targets in NPFs for the fuels in this category IF dedicated infrastructure was required, e.g. for E85 , ED Diesel	Discarded - no clear benefit
A27-3	Biofuels, synthetic and paraffinic fuels, e-fuels (other than hydrogen): Possible mandatory infrastructure targets on TEN-T core for the fuels in this category IF dedicated infrastructure was required.	Discarded - no clear benefit
A27-4	Biofuels, synthetic and paraffinic fuels, e-fuels (other than hydrogen): Mandatory targets on the TEN-T core, comprehensive, urban nodes IF dedicated infrastructure was required.	Discarded - no clear benefit
Problem area A – Waterborne		
A28	Complement NPFs and Art 4-6 AIFD by mandatory quantitative targets for some AFI in European ports and by type of trade (e.g. short sea shipping / deep sea shipping / inland waterways) and/or traffic (cargo, passenger, cruise, etc.).	Discarded - addressed in other measures
A29	Shore side electricity supply in maritime ports: Set mandatory targets for provision of shore side electricity for all TEN-T core sea ports and some berths (berths for cruise ships and/or container ships). Target year: 2030	Assessed
A29-2	Shore side electricity supply in maritime ports: Set mandatory targets for provision of shore side electricity for all TEN-T core/comprehensive sea ports and some berths (berths for cruise ships and/or container ships). Target year: 2030	Assessed
A29-3	Shore side electricity supply in maritime ports: Set mandatory targets for provision of shore side electricity for all sea ports and some berths (berths for cruise ships and/or container ships). Target year: 2030	Assessed
A30	Shore side electricity supply for inland ports: Set mandatory targets for provision of shore side electricity for all TEN-T core inland ports and some berths (1 berth per port; potentially more for larger ports). Target year: 2030	Assessed

ID	Measure	Screening
A30-2	Shore side electricity supply for inland ports: Set mandatory for provision of shore side electricity for all TEN-T core/comprehensive inland ports and some berths (1 berth per port; potentially more for larger ports). Target year: 2030	Assessed
A30-3	Shore side electricity supply for inland ports: Set mandatory provision of shore side electricity for all inland ports and some berths (1 berth per port; potentially more for larger ports). Target year: 2030	Assessed
A31	Mandatory upgrading of existing infrastructure for the use of biofuels, biogas/methane and power-to-gas fuels (e-gas) if specific infrastructure was required in specific or all ports.	Discarded - no clear benefit
A32	Introduce common standard for battery swapping in inland waterway transport and requirements for specific or all ports to provide for such possibilities.	Discarded - impact not measurable
A33	LNG in inland ports: Further specification in legislation how to determine "enable circulation" in practical terms	Discarded - other (subsidiarity, etc.)
A33-2	LNG in inland ports: Mandatory refuelling points in some TEN-T core ports (1 per port). Target year: 2030	Discarded - no clear benefit
A33-3	LNG in inland ports: deletion of exiting provision to ensure circulation along TEN-T core network	Assessed
A33-3	LNG in inland ports: Mandatory refuelling points at all TEN-T core (and some comprehensive) ports (1 per port). Target year: 2030	Discarded - no clear benefit
A34	LNG in maritime ports: Further specification in legislation how to determine "enable circulation" in practical terms	Discarded - other (subsidiarity, etc.)
A34-2	LNG in maritime ports: Mandatory refuelling points in some TEN-T core ports (1 per port). Target year: 2030	Discarded - no clear benefit
A34-3	LNG in maritime ports: Mandatory refuelling points at all TEN-T core (and some comprehensive) ports (1 per port). Target year: 2030	Assessed
A35	LNG in NPF (target for LNG in sea and inland ports): Still part of NPF for planning and reporting	Discarded - other (subsidiarity, etc.)
A35-2	LNG in NPF (target for LNG in sea and inland ports): no more NPFs	Discarded - addressed in other measures
A36	OPS in NPF (targets for maritime and inland ports): Targets set at EU level but still part of NPF for planning and reporting	Discarded - addressed in other measures
A36-2	Onshore power supply systems targets for maritime and inland ports: No more NPFs	Discarded - addressed in other measures
A37	Hydrogen infrastructure targets for maritime and inland TEN-T core ports (1 per port). Target year: 2030/post-2030	Discarded - too prescriptive/demanding
A37-2	Hydrogen infrastructure targets for maritime and inland TEN-T core ports - to enable hydrogen-powered trains operating in ports. Target year: 2030	Discarded - too prescriptive/demanding
Problem area A – Aviation		
A38	MS to define infrastructure targets for AF ground support vehicles at airports over a minimum size	Discarded - too prescriptive/demanding

ID	Measure	Screening
A38-2	Mandatory for MS to define AFI targets for airport ground movement infrastructure through NPF	Discarded - too prescriptive/demanding
A38-3	Mandatory targets for airports to install infrastructure for ground movement in airports	Discarded - too prescriptive/demanding
A39	Mandatory targets for the use of alternative fuels in airport ground operations	Discarded - too prescriptive/demanding
A40	Mandatory upgrading of refuelling infrastructure for aircrafts for the use of biofuels or renewable e-fuels IF specific infrastructure was required at TEN-T core airports.	Discarded - no clear benefit
A40-2	Mandatory upgrading of refuelling infrastructure for aircrafts for the use of biofuels or renewable e-fuels if specific infrastructure was required at all TEN-T core and comprehensive airports.	Discarded - no clear benefit
A41-1	Mandatory targets for electricity supply for stationary commercial passenger aircraft at all gates: Target year: 2025	Assessed
A41-2	Mandatory targets for electricity supply for stationary commercial passenger aircraft at all gates and outfield positions. Target year: 2030	Assessed
A42	Targets for AFI for supply of aircrafts	Discarded - No clear demand yet for such alternative fuels
Problem area A - Rail		
A42	No change on hydrogen infrastructure targets, but development of standard for infrastructure for hydrogen fuelled trains	Discarded - too prescriptive/demanding
A42-2	No change on hydrogen infrastructure targets, with optional inclusion of AFI in NPFs	Discarded - too prescriptive/demanding
A42-3	MS to define hydrogen infrastructure electrification targets through NPF	Discarded - too prescriptive/demanding
A42-4	Mandatory hydrogen infrastructure targets based on rail traffic needs. Target year: 2030/post 2030	Discarded - too prescriptive/demanding
A43	Mandatory requirements and technical specifications for infrastructure for hydrogen fuelled trains	Discarded - too prescriptive/demanding
A44	No change on infrastructure electrification targets, with optional inclusion in NPFs	Discarded - too prescriptive/demanding
A44-2	MS to define infrastructure electrification targets through NPF	Discarded - too prescriptive/demanding
A44-3	Mandatory infrastructure electrification targets based on rail traffic. Target year: 2030/post 2030	Discarded - too prescriptive/demanding

ID	Measure	Screening
A45	Reference to technical specification for infrastructure for electrification of railway lines and non-mandatory requirements for inclusion directly in the Directive.	Discarded - impact not measurable
A46	No change on targets for increase in zero emission fuel use for rail, with optional inclusion in NPFs	Discarded - impact not measurable
A46-2	MS to define targets for increase in zero emission fuel use for rail through NPF	Discarded - impact not measurable
A46-3	Mandatory targets for increase in zero emission fuel use for rail based on rail traffic	Discarded - impact not measurable
A46-4	Mandatory targets for increase in zero emission fuel use for all rail lines	Discarded - impact not measurable
Problem area B		
B1	Introduce minimum uptime requirements for publicly accessible infrastructure by fuel type.	Discarded - no clear benefit
B2	Mandatory design requirements for certain (e.g. at least one 'accessible' charger in recharging stations of a certain size) or for all new recharging/refuelling infrastructure. Target year: 2025	Discarded - too prescriptive/demanding
B3	Prescribe mandatory communication protocols currently in the market (i.e., OCPP, OCPI); Partial coverage: Focus on areas with issues widely identified (i.e., charging station-network management system; roaming)	Assessed
B3-2	Prescribe mandatory communication standards developed by official standardization organizations through delegated acts); Focus on areas with issues widely identified (i.e., charging station-network management system; roaming) (Partial coverage)	Assessed
B3-3	Prescribe mandatory communication standards developed by official standardization organizations through delegated acts; Complete harmonization of the different areas of the EV charging ecosystem (from the EV to the grid (Full coverage)	Assessed
B4	Make third party bank card payment (with no registration requirements) mandatory on all new publicly accessible DC charging points (excluding semi-public)	Assessed
B4-2	Make third party bank card payment (with no registration requirements) mandatory on all new DC publicly accessible charging points PLUS semi-public DC chargers	Assessed
B4-3	Make third party bank card/ payment (with no registration requirements) mandatory on all new (AC and DC) publicly accessible recharging points (excl. semi-public)	Assessed
B4-4	Make third party bank card payment (with no registration requirements) mandatory on all new AC/DC publicly accessible charging points (incl. semi-public)	Assessed
B5	Introduce minimum requirements for roaming platforms, e.g.: non-discriminatory access for all EMSPs, transparency of prices (for EMSPs and consumers), linking of roaming platforms to ensure full EU coverage, etc.	Assessed
B5-2	Introduce minimum requirements for roaming platforms, e.g.: non-discriminatory access for all EMSPs, transparency of prices (for EMSPs and consumers), linking of roaming platforms to ensure full EU coverage, etc. PLUS Require CPOs to connect to a minimum amount of EMSPs, either via roaming platforms	Discarded - addressed in other measures

ID	Measure	Screening
	or B2B connections; In addition prescription of communication protocols to be implemented by charge point operators	
B5-3	Introduce minimum requirements for roaming platforms, e.g.: non-discriminatory access for all EMSPs, transparency of prices (for EMSPs and consumers), linking of roaming platforms to ensure full EU coverage, etc. PLUS Require CPOs to connect to a minimum amount of EMSPs, either via roaming platforms or B2B connections; In addition prescription of communication protocols to be implemented by charge point operators PLUS All re-charging points that offer contract based charging must also offer roaming; In addition, regulate roaming platforms and communication protocols in order to ensure that every EMSP connected to any roaming platform can be used at any charge point	Discarded - addressed in other measures
B6	Require CPOs to connect to a minimum amount of EMSPs, either via roaming platforms or B2B connections; In addition prescription of communication protocols to be implemented by charge point operators	Discarded - too prescriptive/demanding
B6-2	As B6 plus: All re-charging points that offer contract based charging must also offer roaming.	Discarded - too prescriptive/demanding
B6-3	Make roaming mandatory on all publicly accessible recharging points (all CPOs must connect to at least one roaming platform).	Discarded - too prescriptive/demanding
B7	Oblige all CPOs operating publicly accessible rechargers (excluding semi-public) to allow all EMSPs to operate on their network for free	Discarded - too prescriptive/demanding
B7-2	Oblige all CPOs operating publicly accessible rechargers (excluding semi-public) who offer contract based charging to allow all EMSPs to operate on their network against a non-discriminatory/ transparent fee	Discarded - addressed in other measures
B7-3	Include definition of EMSPs as market actors in the EV market and introduce provisions that allows EMSPs to operate in the market. Target year: 2025	Discarded - too prescriptive/demanding
B8	Allow automatic authentication. EV-user can choose at every charge point if he wants to charge with the EMSP automatically authenticated or pay ad hoc (right to opt out from authentication)	Assessed
B8-2	Allow automatic authentication. EV-user to be able to choose at every charge point if he wants to charge with the EMSP automatically authenticated or pay ad hoc (right to opt out from authentication) PLUS Requirement that EV-user can choose and change the EMSP to be automatically authenticated on a regular basis (e.g. monthly)	Discarded - too prescriptive/demanding
B8-3	Allow automatic authentication. EV-user to be able to choose at every charge point if he wants to charge with the EMSP automatically authenticated or pay ad hoc (right to opt out from authentication) PLUS Requirement that EV-user can choose and change the EMSP to be automatically authenticated on a regular basis (e.g. monthly) PLUS requirement that EV-user can choose and change the EMSP to be automatically authenticated at every charging event	Discarded - addressed in other measures
B9	Partial/full harmonisation of technical requirements for rechargers (to be specified; e.g. provision of cables, no requirement for shutters). Target year: 2025	Assessed

ID	Measure	Screening
B10	Set minimum requirements for the installation of wireless power recharging infrastructure for specific user groups (e.g. taxi fleets in public space) following the proposed standard for wireless recharging of vehicles.	Discarded - other (subsidiarity, etc.)
B11	Set technical specifications for TEN-T core charging for trucks - static infrastructure/pantograph chargers. Target year: 2030	Discarded - too prescriptive/demanding
B11-2	Set technical specifications for electric road systems on TEN-T core for trucks - dynamic infrastructure. Target year: 2030	Discarded - too prescriptive/demanding
B12	Make Combo2/CCS and Chademo mandatory on all new publicly accessible rechargers	Discarded - too prescriptive/demanding
B12-2	Make Combo2/CCS and Chademo mandatory on all publicly accessible rechargers	Discarded - too prescriptive/demanding
B13	Expand mandate to introduce mandatory standards (applicable to infrastructure) to new and emerging vehicles / use cases (incl. for trucks)	Discarded - addressed in other measures
B14	Introduction of an EV charging subgroup within the STF	Discarded - other (subsidiarity, etc.)
B14-2	Set up of an EV charging group/forum with a balanced representation. Creation of an interoperability/V2G roadmap and execution (i.e., definition of PKI governance, market rules, etc.). COM plays a moderator role to reach consensus and accelerate the developments.	Discarded - other (subsidiarity, etc.)
B14-3	Set up an EV charging group/forum with a balanced representation as part of a new European Agency for land transport. The Commission is sole responsible to decide about future communication protocols developments.	Discarded - other (subsidiarity, etc.)
B15	ISO 15118: PKI Governance structure: Multiple Root Certification Authorities (RootCAs); The interoperability management is based on sharing 'trust lists' with a process ensuring a secure update.	Discarded - other (subsidiarity, etc.)
B15-2	ISO 15118: PKI Governance structure: One or more (according to ISO15118 max 5) regulated Root Certification Authorities (RootCAs) under the control of an independent Governing Authority, which determines the PKI rules, mutual recognition (interoperability/trust list) etc.; Establish minimum principles for RootCA(s) in terms of market independence.	Discarded - other (subsidiarity, etc.)
B15-3	ISO 15118: PKI Governance structure: Unique Root Certification Authority (CA); The CA may be public or regulated private party, e.g. consortium of market actors	Discarded - other (subsidiarity, etc.)
B16	Detailed mandatory accuracy requirements for measurement equipment in new chargers. Target year: 2025	Discarded - too prescriptive/demanding
Problem area C		
C1	Standardise roadside indicators for alternative fuel infrastructure	Discarded - other (subsidiarity, etc.)
C1-2	Standardise and mandatory signposting on TEN-T core	Discarded - addressed in other measures

ID	Measure	Screening
C1-3	Standardise and mandatory signposting on TEN-T core and comprehensive and urban nodes and within rest areas along the TEN-T network	Assessed
C1-4	Require standardised and mandatory signposting on all roads and other relevant sites (e.g. Large parking lots)	Discarded - too prescriptive/demanding
C2	Mandate where price and compatibility information has to be displayed (re-charging/re-fuelling station, car display/mobile applications);	Discarded - addressed in other measures
C3	For ad-hoc recharging: clear specification/harmonisation of price components (allowing only time fee + kWh fee) to the customer, clearly displayed at station. Target year: 2025	Assessed
C3-2	For ad-hoc recharging: clear specification/harmonisation of price components (allowing only time fee + kWh fee) to the customer, clearly displayed at station PLUS mandatory information through electronic means (e.g. app) of all price components and expected recharging price. Target year: 2025	Assessed
C4	Mandate digital connectivity of re-charging and re-fuelling stations (new chargers only). Target: 2025	Discarded - addressed in other measures
C5	Oblige operators of recharging/refuelling infrastructure to provide (e.g. to NAPs) real-time data on availability and accessibility, so it can be used by third party market actors and consumers at reasonable cost	Discarded - too prescriptive/demanding
C5-2	Oblige operators of recharging/refuelling infrastructure to provide (e.g. to NAPs) real-time data on availability and accessibility, so it can be used by third party market actors and consumers for free	Discarded - too prescriptive/demanding
C5bis	Oblige operators of recharging/refuelling infrastructure to provide (e.g. to NAPs) real-time data on ad hoc prices, so it can be used by third party market actors and consumers at reasonable cost	Discarded - too prescriptive/demanding
C5bis-2	Oblige operators of recharging/refuelling infrastructure to provide (e.g. to NAPs) real-time data on ad hoc prices, so it can be used by third party market actors and consumers for free	Assessed
C6	Oblige Member States to ensure that (electronic) booking of re-charging points is enabled for heavy duty transport. Target year: 2030	Discarded - too prescriptive/demanding
C7	Introduce provisions for common categories and formats of data on availability and accessibility and their provision through the national and/or common access points (through development of delegated regulations under ITS Directive 2010/40/EC)	Discarded - addressed in other measures
C8	Provide for the development of one common AFI data infrastructure across the EU (developed at EU level)	Discarded - too prescriptive/demanding
C9	Strengthening of fuel labelling requirements, including overall price comparison and fuel compatibility	Discarded – not in the scope of the AFID
C10	Mandate that Member States ensure that consumer information in accessible for persons with disabilities.	Discarded - too prescriptive/demanding

ID	Measure	Screening
C11	For contract-based recharging: require that, unless if fixed monthly fee applies, EMSP must specify price components for every charging session to consumer prior to recharge	Assessed
C11-2	For contract-based recharging: require that, unless if fixed monthly fee applies, EMSP must specify price components to consumer prior to recharge PLUS detailed transparency requirements for billing from EMSP	Discarded - too prescriptive/demanding
C11-3	For contract-based recharging: require that, unless if fixed monthly fee applies, contract-based price must be based on ad-hoc price (e.g. ad hoc price – % discount), clearly specifying the applied price change (e.g. % change) in comparison to the ad hoc price ahead of charging session	Discarded - too prescriptive/demanding
C12	Data provision through National Access Points: Mandatory requirement on operators of alternative fuel infrastructure to make static data (e.g. location) available	Assessed
C12-2	Data provision through National Access Points: Mandatory requirement on operators of alternative fuel infrastructure to make static data (e.g. location) available PLUS mandatory requirement to make dynamic data (e.g. availability) available	Assessed
C12-3	Data provision through National Access Points: Mandatory requirement on operators of alternative fuel infrastructure to make static data (e.g. location) available PLUS mandatory requirement to make dynamic data (e.g. availability) available PLUS mandatory requirement to make charging/fuelling prices available and all static data (e.g. location, prices) should be provided for free	Discarded - too prescriptive/demanding
C13	Data quality for data provided through National Access Points : Define data quality requirements for static data (according to measure C12)	Discarded - addressed in other measures
C13-2	Data quality for data provided through National Access Points : Define data quality requirements for static and dynamic data (according to measures C12-2 and C12-3)	Discarded - addressed in other measures
C13-3	Data quality for data provided through National Access Points : Define data quality requirements for static and dynamic data (according to measures C12-2 and C12-3) PLUS Introduce a minimum update frequency for static and dynamic data (i.e., every 10 min)	Discarded - addressed in other measures
Problem area D		
D1	Make smart charging functionalities mandatory for all new publicly accessible DC/AC chargers (excl. semi-public)	Discarded - too prescriptive/demanding
D1-2	Make smart charging functionalities mandatory for all new publicly accessible and semi-public chargers	Discarded - too prescriptive/demanding
D1-3	Make smart charging functionalities mandatory for all new publicly accessible, semi-public and private chargers	Discarded - too prescriptive/demanding
D2	Provide for guaranteed access to battery data to any service provider following EV-user consent and respecting GDPR.	Discarded – not in the scope of the AFID
D2-2	Provide for guaranteed access to battery data to any service provider following EV-user consent and respecting GDPR PLUS developing standards/ procedures for access to battery data (possible through delegated act)	Discarded – not in the scope of the AFID

ID	Measure	Screening
D3	Add specific cyber-security requirements (to be defined) to the AFID. Target year: 2025	Discarded – not in the scope of the AFID
D3-1	Introduce provisions to the NIS Directive identifying electric vehicle charging infrastructure as critical infrastructure. Target year: 2025	Discarded – not in the scope of the AFID
D4	Smart meters to be installed at all new publicly accessible AC and DC rechargers (excluding semi-public)	Discarded - too prescriptive/demanding
D4-2	Smart meters to be installed at all new publicly accessible AC and DC rechargers (including semi-public)	Discarded - too prescriptive/demanding
D4-3	Smart meters to be installed at all rechargers (public, semi-public and private)	Discarded - too prescriptive/demanding

11.6 Annex G – Comparison of measures proposed in the policy options for problem areas B, C and D and measures proposed in the stakeholder questionnaire/checklist

	Final measure proposed	Associated measure proposed in field research questionnaire
Problem Area B – Measures to promote interoperability		
Ad hoc payments	**PO1**: All new EV charge points to be equipped with a bank card payment option (one of chip+PIN, contactless/NFC or single-use QR code). **PO2**: PO1 + All new fast chargers (>50kW) must provide contactless or chip+PIN payment option. **PO3**: PO2 + All new fast chargers (>50kW) must provide chip+PIN payment option.	**Measure B3**: The proposed measure would introduce additional requirements for every charging point to provide EV-users with a common ad-hoc payment method (i.e. without subscription). Sub-measures: • Requirement to apply in every publicly accessible recharging point to provide EV-users with a common ad hoc payment option. • Requirement to apply on only some publicly accessible recharging points to provide EV-users with a common ad hoc payment option (e.g. exemption for charges below 7 kW or chargers located on private properties such as supermarket parking).
Freedom for consumers to choose payment method	**PO2+PO3**: All EV-users must always be offered the option to choose payment method.	**Measure C7:** The proposed measure would introduce specific rights to EV-users, such as always having the option to overwrite automatic authentication. Sub-measures: • At every charging point the EV-user can overwrite the automatic authentication and can either pay ad hoc or – if the charge point is equipped accordingly – with a contract. • At every charging point the EV-user can choose to pay with a contract. • Every charging point to provide contract based recharging and co-operate with other EMSPs on a non-discriminatory basis to allow roaming.
Physical standards	**PO2+PO3:** New annex introducing technical specifications for various physical standards for road transport, waterborne transport and aviation.	**Measure B2:** The proposed measure would allow the Commission to adopt secondary legislation with regards to technical specifications for infrastructure. Scope could include technical specifications for recharging infrastructure for heavy duty vehicles, electric road system, communication protocols between the recharging point and the vehicle, and liquid hydrogen refuelling. Sub-measures: • Set technical specifications for recharging infrastructure for heavy duty vehicles.
Communication standards for e-mobility	**PO1:** All new EV charge points to be equipped with the OCPP and OCPI open communication standards. **PO2+PO3:** PO1 + New annex introducing technical specifications developed through	

	Final measure proposed	Associated measure proposed in field research questionnaire
	standardisation organisations for various areas of communication.	• Set technical specifications for electric road system. • Set technical specifications for communication protocols between the recharging point and the vehicle. • Set technical specifications for liquid hydrogen refuelling. **Measure B4**: The proposed measure would introduce interoperability and design requirements for all rechargers (e.g. in terms of the connector standards or the measurement equipment to be used). Scope could include connectors, accuracy requirements for measurement equipment, requirements on shutters, and provision of cables. Sub-measures: • In addition to Combo2/CCS connectors, make Chademo connectors mandatory on all new publicly accessible rechargers. • Detailed mandatory accuracy requirements for measurement equipment in new chargers. • Common requirements on shutters for all new chargers. • Common requirements on the provision of cables for all new chargers of 100kW or more.
Technical specifications for charge points	**PO2:** Exemption for mechanical shutters is removed. CPOs must inform NAPs if fixed cables are available at the EV charge points. **PO3:** PO2 + Mandatory fixed cables for AC (helical) and DC charge points.	
Problem Area C – Measures to improve customer information		
Ad-hoc price transparency	**PO1**: Requirement for clear price component specification (fee per period of time and fee per kWh) prior to each recharging session. All price components to be provided online for ad hoc recharging. **PO2+PO3**: PO1 + Price information must be displayed on a digital screen at the recharging station.	**Measure C2**: This proposed measure would introduce one or multiple requirements related to the pricing of alternative fuels, e.g. standardisation information and display requirements for price components for ad-hoc or contract based recharging. Sub-measures: • Introduce standardised information and display requirements for price components for ad-hoc recharging at stations. • Introduce standardised information and display requirements for price components for contract-based recharging through electronic means (e.g. app).
Contract based price transparency	**PO2+PO3**: EMSPs must communicate price components (e.g. roaming fees) to consumers prior to recharging session via an app, except when a fixed subscription fee applies (e.g. weekly or monthly).	

	Final measure proposed	Associated measure proposed in field research questionnaire
Comparability and non-discrimination of prices	**PO2+PO3**: CPOs may not differentiate between prices charged to EMSP or ad hoc customers. Prices charged to different EMSPs may also not be differentiated.	**Measure B6:** This proposed measure would introduce specific requirements to ensure user friendly roaming. They will apply to charge point operators and/or roaming platforms and cover the terms of access of EMSPs, mandatory roaming and transparency of prices. Sub-measures: • Introduce minimum requirements for roaming platforms, e.g.: non-discriminatory access for all EMSPs (E-mobility Service Provider). • Introduce minimum requirements for roaming platforms to link to other roaming platforms in order to ensure full EU coverage. • Introduce requirement for CPOs (charge point operators) to connect to a minimum amount of EMSPs, either via roaming platforms or B2B connections (business-to-business). • Prescription of standard communication protocols to be implemented by charge point operators to connect to EMSPs and roaming platforms. • Introduce requirements for CPOs that all re-charging points offering contract-based charging must also offer roaming. • Introduce requirement for CPOs to make roaming mandatory on all publicly accessible recharging points (all CPOs must connect to at least one roaming platform). • Introduce requirement to oblige all CPOs operating publicly accessible rechargers to allow all EMSPs to operate on their network on a non-discriminatory basis. • Oblige all EMSPs to provide information on the costs for a recharge at every recharging point, e.g. through an app.
Data provision through NAPs	**PO1**: All AFI operators must provide static data (location, opening hours and EV charge point characteristics) to NAPs in DATEX II format. Changes in static data must be reflected no later than one day after change. **PO2+PO3:** PO2 + CPOs and HRSs must provide dynamic data (operational status (EV, H2), availability (EV), ad hoc price (EV) and energy source (EV, H2)) to NAPs	**Measure B5**: This proposed measure would introduce specific requirements to ensure full connectivity of rechargers to ensure that information on location and availability can be provided to the EV-user. Sub-measures: • Oblige CPOs to make location information available for free, e.g. through National Access Points. • Oblige CPOs to make information on technical availability of the recharger available for free in near real time.

	Final measure proposed	Associated measure proposed in field research questionnaire
	in DATEX II format. Changes in dynamic data must be reflected no later than one minute after change.	• Oblige CPOs to make information on occupancy of the recharger available for free in near real time. • Oblige CPOs to make information on ad hoc prices available in real time for free in near real time. **Measure C5:** This proposed measure would introduce standards for data quality and frequency requirements for that data. Sub-measures: • Standardise static (e.g. location) data in terms of quality and frequency. • Standardise static (e.g. location) and dynamic (e.g. availability) data in terms of quality and frequency.
Roadside indicators	**PO2:** EV charge points and H2 refuelling stations must be signposted within the parking/fuelling area along the TEN-T Core and Comprehensive network. **PO3:** PO3 + EV charge points and H2 refuelling stations must be signposted in the road corridor along the TEN-T Core and Comprehensive network.	**Measure C1:** This proposed measure would introduce standardised and mandatory signposting in certain parts of the TEN-T network. Sub-measures: • Standardised and mandatory signposting on TEN-T core. • Standardised and mandatory signposting on TEN-T core, comprehensive and urban nodes network. • No dedicated signposting required, but full information should be available electronically, e.g. through apps.

11.7 Annex H: Open Public Consultation

This annex provides a detailed analysis of the Open Public Consultation (OPC) undertaken in relation to Evaluation and Impact Assessment of the Directive on the Deployment of Alternative Fuels Infrastructure (2014/EC) ('AFID'). The annex outlines the range of stakeholder groups that engaged in the consultation and an analysis of responses.

11.7.1Respondents to the OPC

The Commission launched the 12-week OPC on 6 April and it closed on 29 June 2020. The OPC invited all citizens and organisations to provide input on both the Evaluation and the Impact Assessment of the AFID[84]. In total, **324 responses** were received. The breakdown by stakeholder type is shown in Table 2-1.

Table 2-1: Classification of stakeholders responding to the OPC

Stakeholder group	Number of responses	% of responses
Company/business organisation	107	33%
Business association	80	24.7%
Public authority (national, regional and local authorities)	28	8.6%
Non-governmental organisation (including relevant industry associations)	22	6.8%
Consumer organisation	7	2.2%
Environmental organisation	1	0.3%
Academic/research institute	1	0.3%
EU citizen	70	21.6%
Non-EU citizen	1	0.3%
Other	7	2.2%

In terms of geographical/Member State distribution, the majority of respondents indicated that their country of origin was one of the EU Member States (315 respondents). Nine respondents were based outside of the EU. The number and percentage of respondents by country of origin is shown in Table 2-2.

Table 2-2: Geographical distribution of responses received

[84] The evaluation input was analysed in the stakeholder consultation report supporting the Evaluation Final Report.

Country of origin	Number of responses	% of responses	Country of origin	Number of responses	% of responses
Belgium	60	18.5	Slovakia	2	0.6
France	53	16.4	Denmark	1	0.3
Italy	50	15.4	Estonia	1	0.3
Germany	49	15.1	Greece	1	0.3
Sweden	19	5.9	Luxembourg	1	0.3
Netherlands	17	5.2	Malta	1	0.3
Spain	11	3.4	Romania	1	0.3
Austria	10	3.1	Canada	1	0.3
Czech Republic	8	2.5	Grenada	1	0.3
Poland	8	2.5	Israel	1	0.3
Finland	6	1.9	Japan	1	0.3
Hungary	6	1.9	Norway	1	0.3
Ireland	5	1.5	Switzerland	1	0.3
Slovenia	3	0.9	United Kingdom	2	0.6
Latvia	2	0.6	United States	1	0.3

11.7.2Identified campaigns and ad-hoc contributions

There was evidence of ***coordinated responses***, particularly from industry representatives, as there were often similar responses from representatives of business associations and those of companies / business organisations, although there were also some coordinated responses from other types of respondents. However, identifying the extent of the coordinated responses, and the number of these, was challenging. This is clear from the analysis of the responses to Question 5 in the main problems section (Section C). Here, the analysis began by grouping sixteen responses together, which clearly had common elements, although few of them were similar (let alone identical) in all aspects. The analysis of these sixteen was followed by a discussion of a further two responses, which had a lot of similar elements to the previous 16, and so which may also have been coordinated. However, evidence of such a high level of coordination is not evident in response to all questions.

Reviewing the remainder of the analysis of the responses to Question 5 reveals around 12 other references to "similar responses" from industry stakeholders, most of which come from between two and four respondents, which could be indicative of coordinated responses. One of these was clearly a coordinated response, i.e. that in relation to L-category vehicles, were there were 10 similar responses to Question 5, while a similar level of coordination was seen in response to several other questions.

In relation to other types of respondents, there was also evidence of at least one coordinated response each from representatives of consumer organisations and NGOs, and of a coordinated response between some NGOs and 'Other' respondents.

11.7.3 Contribution of consultation activities to the Evaluation and the Impact Assessment

Following the closure of the OPC, the analysis of responses to the questions (as presented in the following sections) was incorporated into both the evaluation question responses (Evaluation Report) and the assessment of impacts (Impact Assessment support study), to ensure that the views of key stakeholder groups have been accounted for in the context of both studies. The consultation analysis built on the findings from the modelling activities, desk research and use of indicator data; and the survey and interview programme analysis conducted in the course of both studies.

11.7.4Analysis of OPC responses - Evaluation

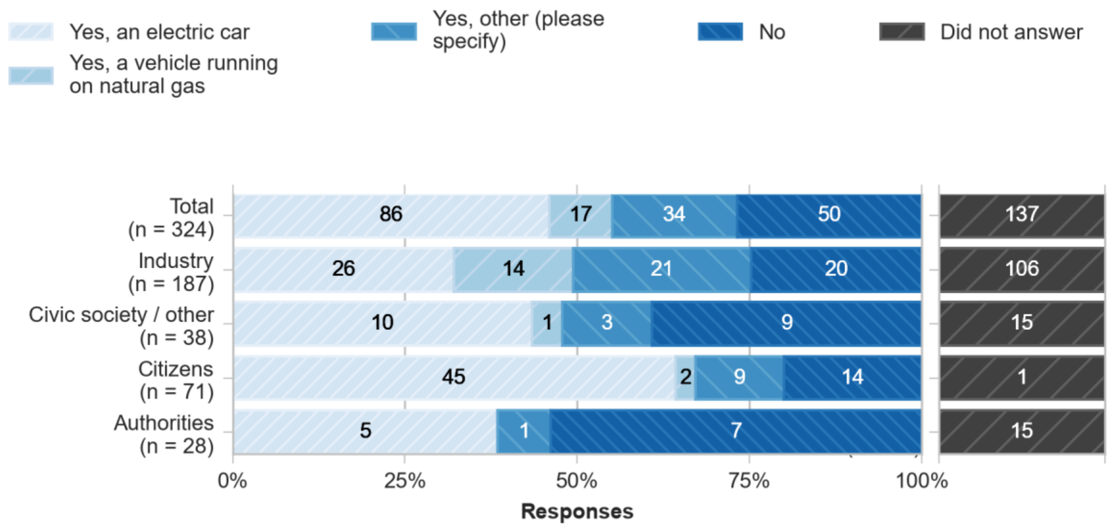
Sections A and B of the OPC relate to the Evaluation support study. The analysis relating to these sections is presented here. Questions are numbered A1 to A9 and B1 to B6.

11.7.4.1 SECTION A: Citizens experience with Alternative Fuels Infrastructure

11.7.4.1.1 A1. Do you own or regularly drive an alternatively fuelled vehicle?

In answer to the question 'do you own or regularly drive an alternatively fuelled vehicle', 86 out of 324 responded that they own/regularly drive an electric car, 17 stated that they own/regularly drive a vehicle running on natural gas, 34 stated that they own/regularly drive an 'other' type of alternatively fuelled vehicle (see Figure 5-1). 50 stated that they did not and 137 did not answer the question.

Figure 5-1: A1. Do you own or regularly drive an alternatively fuelled vehicle?



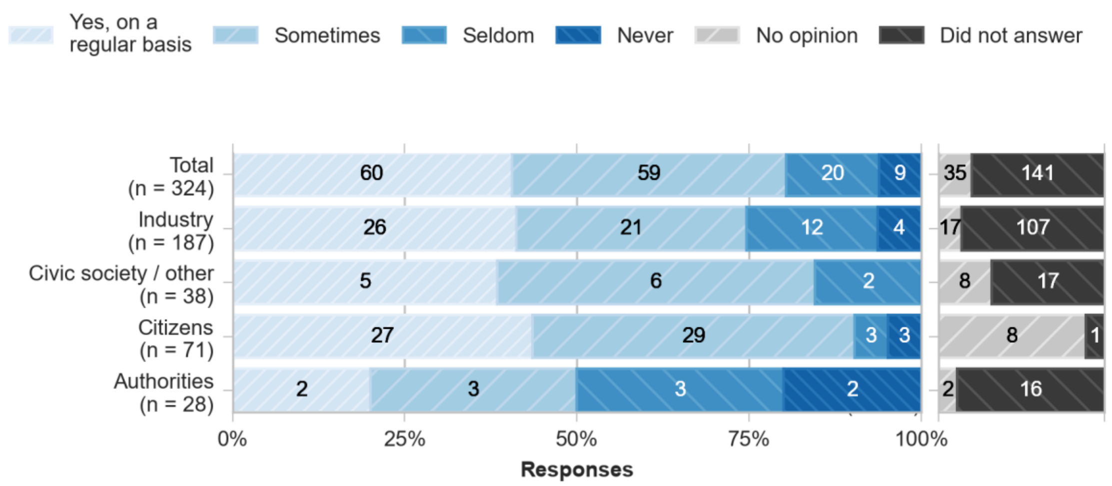
In order to further ***clarify their 'Yes, other' response***, 34 respondents provided additional information on the vehicles that they used. The most common alternatively-fuelled vehicle that was mentioned (other than electric and natural gas vehicles) was a fuel cell electric / hydrogen vehicle, which was mentioned by six respondents (three business associations, one company / business organisation and two EU citizens). Three respondents noted that they owned, or regularly drove, an LPG vehicle (a business associations, one company / business organisation and an EU citizens), while two EU citizens mentioned a plug-in electric vehicle and another noted that they drive both a hybrid and a range extended electric vehicle. Two respondents (one representing a company / business association and another from an NGO) noted that they used vehicles that used HVO as a fuel, while another representative of a company / business association noted they used both HVO and RME in their vehicles.

In addition, a number of other types of electric vehicles were mentioned including one company that had electric bikes and electric three-wheeled vehicles in its fleet, another company that owned electric rail vehicles and a further company that mentioned e-scooters, while an EU citizen mentioned an electric L-category vehicle. Four respondents (three representing companies / business organisations and one an NGO) noted that their members operated vehicles using various alternative fuels, without further specifying these, whilst a representative of a company / business organisation and a public authority noted that they had both electric and natural gas vehicles in their fleets.

11.7.4.1.2 A2. Do you have difficulties finding alternative fuels infrastructure to recharge/refuel your vehicle?

In answer to the question 'do you have difficulty finding alternative fuels infrastructure to recharge/refuel your vehicle?', 60 responded that they have difficulty on a regular basis, 59 responded that they sometimes have difficulties, 20 responded that they seldom have difficulties and 9 responded that they never have difficulties (see Figure 5-2). 35 did not have an opinion and 141 did not respond to the question.

Figure 5-2: A2. Do you have difficulties finding alternative fuels infrastructure to recharge/refuel your vehicle?



11.7.4.1.3 A3. In case you have difficulties finding recharging/refuelling infrastructure, what are the main underlying problems?

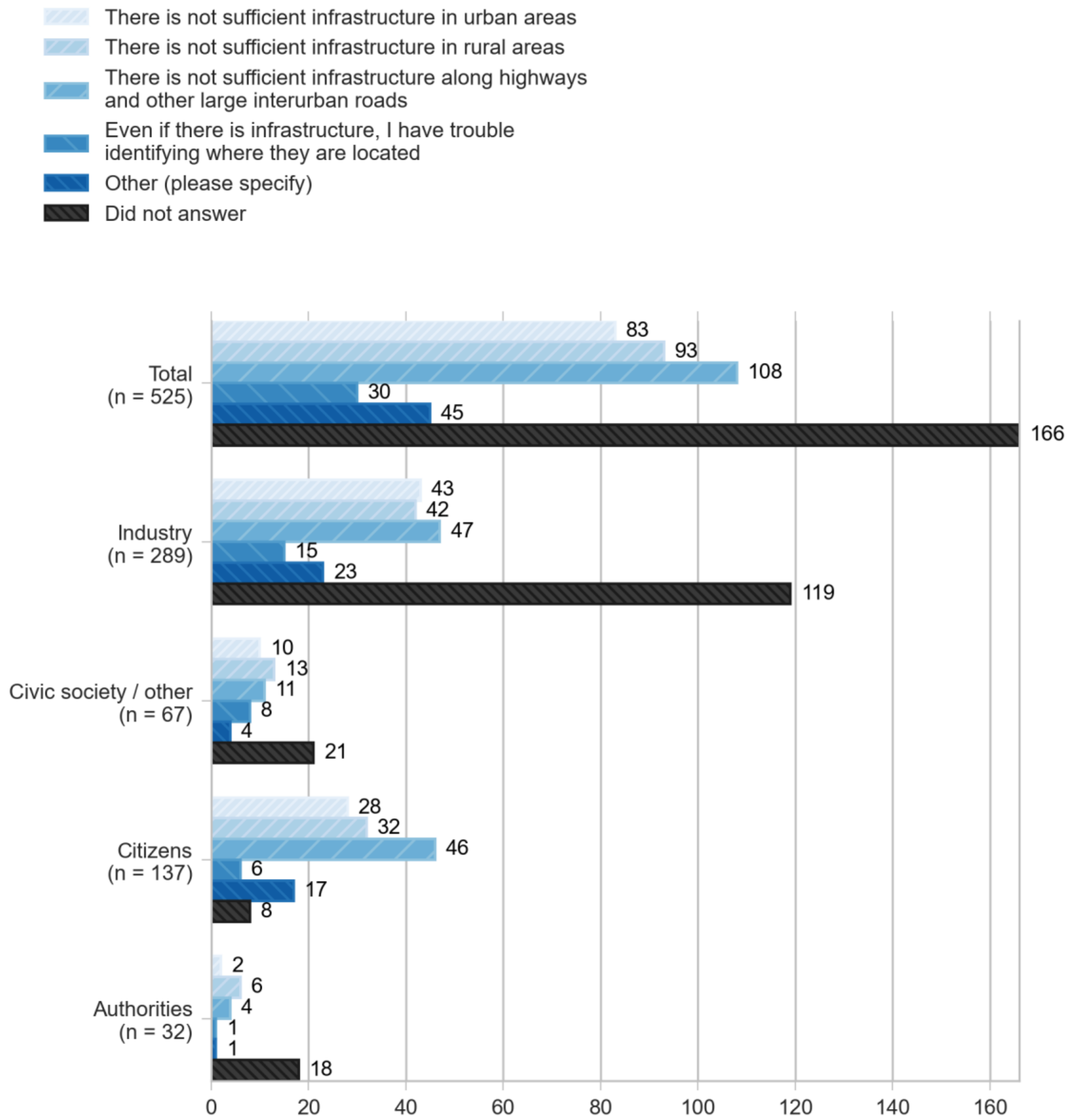
Respondents were asked 'in case you have difficulties finding recharging/refuelling infrastructure, what are the main underlying problems?' (see Figure 5-3). Of those that responded (158[85]) the following underlying problems were identified:

- There is not sufficient infrastructure in urban areas – 86 respondents
- There is not sufficient infrastructure in rural areas – 93 respondents
- There is not sufficient infrastructure along highways and other large interurban roads – 108 respondents
- Even if there is infrastructure, I have trouble identifying where they are located – 30 respondents
- Other (please specify) – 45 respondents.

166 did not respond to the question.

[85] Respondents could select more than one answer

Figure 5-3: A3. In case you have difficulties finding recharging/refuelling infrastructure, what are the main underlying problems?



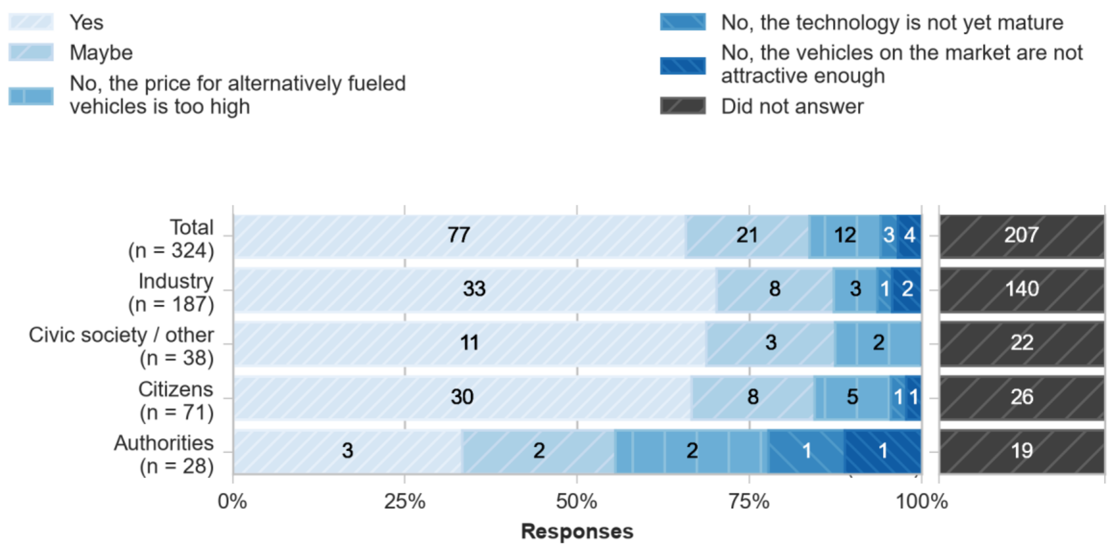
In total, 24 stakeholders provided additional responses that did not relate to either the sufficiency of the infrastructure or to problems in locating it, while others further clarified their concerns with respect to the sufficiency of the infrastructure. The most common ***additional issue*** that was raised was that either terminals did not work, or did not work properly, which was raised by seven EU citizens, two representatives of company / business organisations and one representative each of a business association and a public authority. One of the next most common issues was that charging points were often already occupied, either by charged electric vehicles or vehicles with internal combustion engines, which was identified by two EU citizens and a representative of a consumer organisation. The lack of availability of electric vehicles rechargers of sufficient power was mentioned by two EU citizens and one representative each of a business association and a company / business organisation, while general problems with accessing the recharging points, e.g. as access was limited, was also noted by two EU citizens and two representatives of a company / business organisation. The interoperability of charging stations was identified as an issue by an EU citizen and a representative of a company / business organisation. Other issues raised by individual EU citizens, included that information on the infrastructure was often not reliable, that there was often insufficient parking at charging sites and that the provisions for recharging L-category vehicles were not sufficient.

Other stakeholders qualified their response ***relating to the sufficiency of recharging or refuelling infrastructure***. Two representatives of a company / business organisation and one each representing a business association, public authority and an NGO underlined that there was a lack of recharging infrastructure for electric vehicles in all areas. Three respondents (two representing a company / business organisation and the other an NGO) noted that there was not sufficient recharging or refuelling infrastructure for buses to enable them to use alternative fuels. In addition, two respondents (an EU citizen and a representative of a business association) suggested that there were not enough hydrogen refuelling stations, while another business association respondent was concerned about the lack of natural gas stations, generally, while a representative of a company / business organisation was concerned about the lack of LNG infrastructure and another about the lack of LPG infrastructure. A representative of a company / business organisation noted that there was a lack of refuelling stations with HVO100, while another called for more to be done to encourage the use of alternative fuels on the railways. Finally, a car rental company noted that they had problems installing electric vehicle charging points at airports and, to a lesser extent, at train stations, as a result of a reluctance on the part of the owner/operator of the associated parking infrastructure and difficulties in obtaining the necessary authorisations.

11.7.4.1.4 A4. In case you do not own an alternatively fuelled vehicle, would you buy one, if you were certain that there was sufficient recharging or refuelling infrastructure?

In answer to the question 'in case you do not on an alternatively fuelled vehicle, would you buy one, if you were certain that there was sufficient recharging or refuelling infrastructure?', 77 agreed that they would buy one and 31 stated that they would maybe buy one (see Figure 5-4). Of those that responded they would not buy one, 12 stated that the price for alternatively fuelled vehicles is too high, 3 stated that the technology is not yet mature and 4 stated that the vehicles on the market are not attractive enough. 207 did not answer.

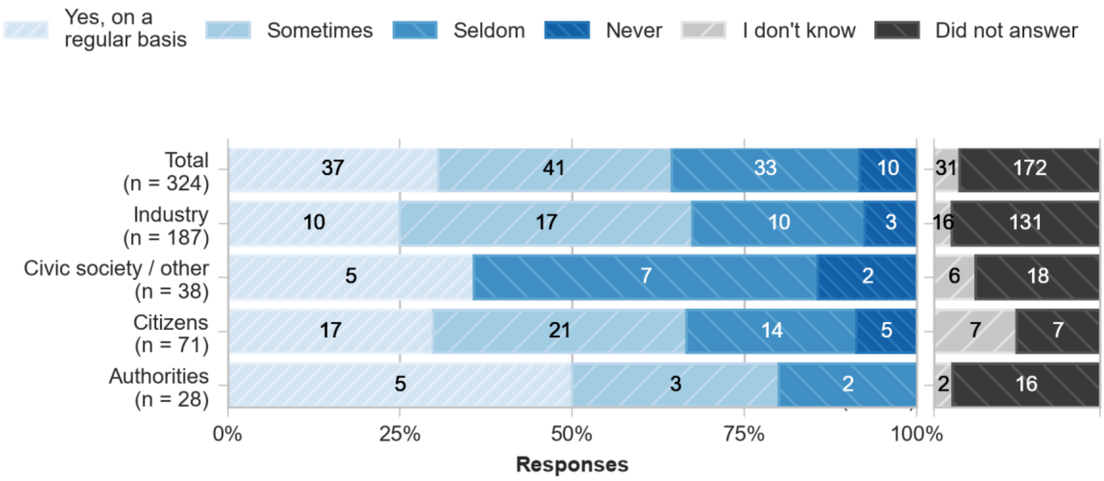
Figure 5-4: A4. In case you do not on an alternatively fuelled vehicle, would you buy one, if you were certain that there was sufficient recharging or refuelling infrastructure?



11.7.4.1.5 A5. When you recharge your electric-vehicle, do you feel well informed in advance on the price you will have to pay for the charging service?

In answer to the question 'when you recharge your electric-vehicle, do you feel well informed in advance on the price you will have to pay for the charging service?', 37 agreed that they did feel well informed on a regular basis, 41 stated that they feel well informed sometimes, 33 responded that they seldom feel well informed and 10 feel that they never feel well informed (see Figure 5-5). 31 responded that they did not know and 172 did not answer.

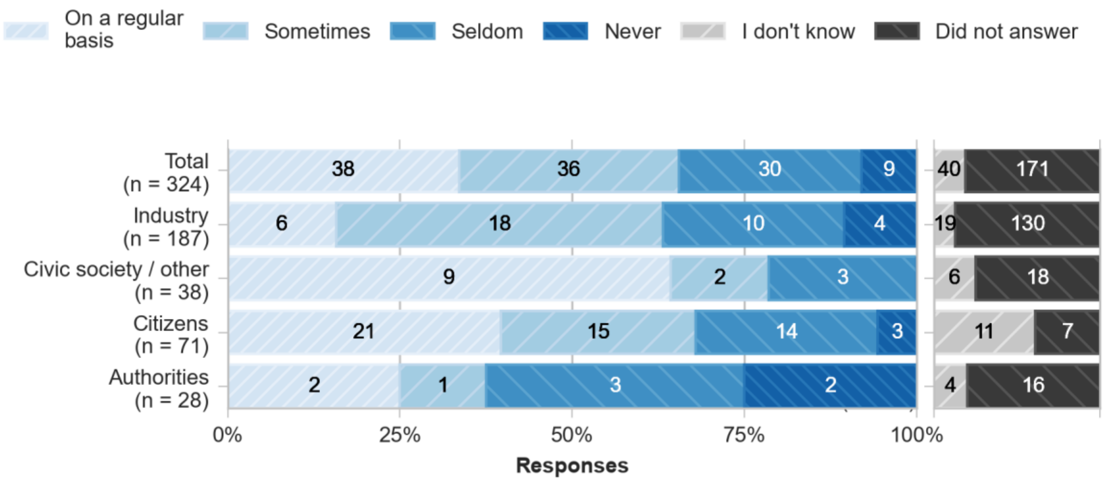
Figure 5-5: A5. When you recharge your electric-vehicle, do you feel well informed in advance on the price you will have to pay for the charging service?



11.7.4.1.6 A6. The Directive already requires that users can pay ad hoc at the recharging point. However, in practice many different payment options have developed throughout Europe. How often do you face difficulties when trying to pay?

In answer to the question 'how often do you face difficulties when trying to pay?', 38 stated that they face difficulties when trying to pay on a regular basis, 36 stated they sometimes face difficulties, 30 stated that they seldom face difficulties and 9 stated that they never face difficulties (see Figure 5-6). 40 respondents did not know and 171 did not answer.

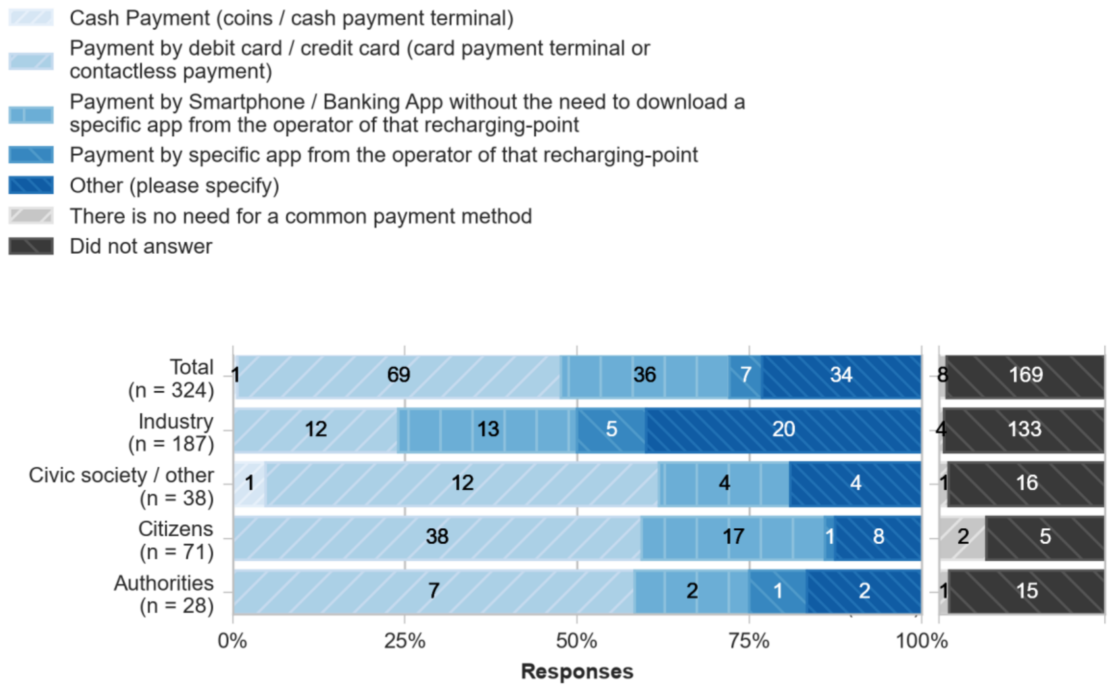
Figure 5-6: A6. The Directive already requires that users can pay ad hoc at the recharging point. However, in practice many different payment options have developed throughout Europe. How often do you face difficulties when trying to pay?



11.7.4.1.7 A7. If you believe that a common payment method should be available at all publicly accessible recharging points, please indicate which payment option should be available?

Respondents were asked 'If you believe that a common payment method should be available at all publicly accessible recharging points, please indicate which payment option should be available?'. The majority of respondents (69) stated that payment by debit card/credit card (card payment terminal or contactless payment) should be available (see Figure 5-7). 36 stated payment by Smartphone / banking app without the need to download a specific app from the operator of that recharging point, 7 stated payment by specific app of the operator of that recharging point, 1 stated cash payment, and 34 stated 'other'. 8 stated that there is no need for a common payment method and 169 did not answer.

Figure 5-7: A7. If you believe that a common payment method should be available at all publicly accessible recharging points, please indicate which payment option should be available?



In total, 33 respondents provided additional comments to clarify their '***Other' response***. The most common response in this respect was to highlight that payments by both bank card ***and*** smartphone should be possible, which was mentioned by eight respondents, including four representatives of a company / business organisation and an EU citizen, as well as one representative each from a business association, public authority and an NGO. A business association proposed that there should be three different payment options, i.e. bank cards, smartphone / banking app and the operator's own app, while one public authority representative thought that the three options should be bank cards, smartphone / banking app and cash and another that the three options should be smartphone / app, bank card and different options for online-based payment methods. One representative of a company / business association thought that all four options about which views were asked in the question should be possible, while another supported the use of bank cards, smartphones / banking apps, operators' apps and via a company framework contract.

Nine respondents called for there to be e-roaming, including two business associations, two representatives of a company / business organisation and five EU citizens, with two explicitly referring to the application of ISO 15118. Two additional EU citizens called for terminals to communicate with vehicles, to which an account is linked as is the case with Tesla.

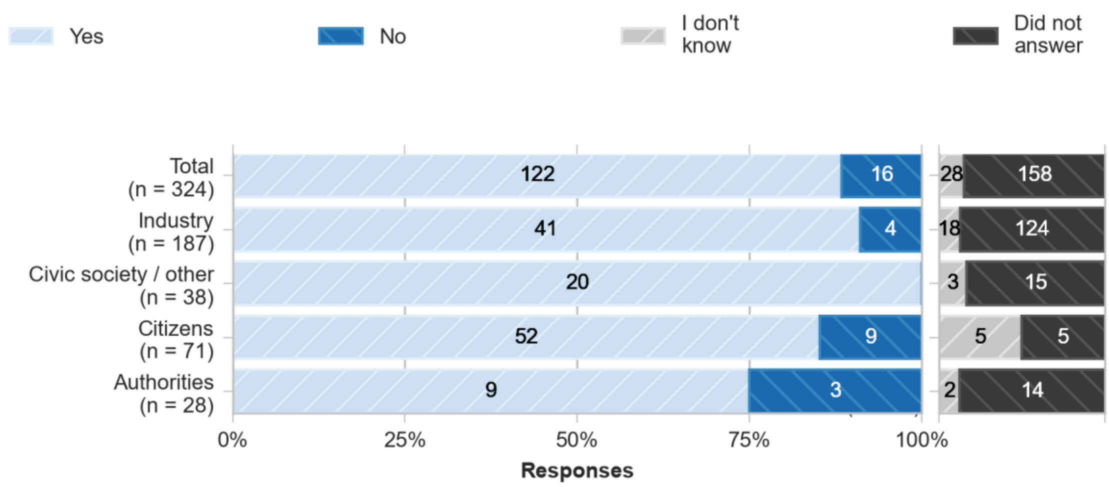
Two ***business associations*** said that there was no need for a common payment method, although one of these noted that users should not have to pay only through the app of the charging point operator. Other responses from representatives of a ***company / business organisation*** were that payments should be via: a brand-neutral fuel card app; the app of their chosen e-mobility service provider; the app of the recharging point operator, as other alternatives create complications; and an app of either the charge point operator or a mobility service provider, which aggregated across the charging networks. A business association explicitly noted that road haulage operators would like to have the option of using traditional fuel cards at all refuelling stations, as well as an option to pay by an electronic bank transfer on a monthly basis.

Consumer organisations provided different responses. One believed that payment by debit card should be the default option, with cash being a secondary option where possible, in order to reduce the range of apps and cards that consumers currently needed. Another thought that contactless payment was the best option, as many apps were not user-friendly. A third called for Directive to require that multiple payment options were available, including debit and credit cards, and that it should include provisions that enabled consumers to charge their car without entering a contract and without the need for signing up on websites or mobile applications. Specifically, they believed that the Directive left too much space for the interpretation of what is meant by *ad hoc* payments, which needed to be clarified to ensure that such payments were easy and that access to these was harmonised. They also argued that one of objectives of Directive, i.e. to have 'reasonable, easily and clearly comparable, transparent and non-discriminatory' prices for charging was not being realised in practice, as some charging stations had time-based tariffs, and so called for stronger EU-wide requirements in this respect.

11.7.4.1.8 A8. Do you believe that roaming (payment through the user's electro-mobility service provider) should be available at every publicly accessible recharging point?

In answer to the question 'Do you believe that roaming (payment through the user's electro-mobility service provider) should be available at every publicly accessible recharging point?', 122 respondents agreed compared with 16 that did not (see Figure 5-8). 28 stated that they did not know and 158 did not answer.

Figure 5-8: A8. Do you believe that roaming (payment through the user's electro-mobility service provider) should be available at every publicly accessible recharging point?



Eight stakeholders took the opportunity to elaborate on their response to question 8, which did not have a box for an open response, in the open response box for question 9.

A respondent from an ***academic/research institution*** noted that roaming was more than just payments, which was what was implied by the question. A respondent from a ***business association*** who had answered 'Yes' to question 8 underlined that 'roaming' should be understood as the roaming of a charging service, as was the case in France, and not as roaming to do with the supply of energy, as it was in some other Member States. Another business association that answered 'Yes' to question 8 underlined that proprietary solutions should not be completely banned, while a third highlighted the importance of fast internet connections in all Member States to ensure comprehensive roaming.

A representative of a ***company / business organisation*** noted that while roaming should be available, the point should not be 'exaggerated', while another noted that roaming could help to improve access to charging points, but that it added to the cost, so underlined that this extra cost should not be prohibitive. A third company / business organisation representative noted that roaming was a second-best option, behind the ability to pay using widely available methods, as was the case with petrol cars. A ***public authority*** representative suggested that online, real-time information about the state of the charging infrastructure was more important than ensuring roaming.

11.7.4.1.9 A9. Do you have any general comment on using alternative fuels infrastructure that you would like to share?

Ninety-eight stakeholders provided further comments on their ***use of alternative fuels infrastructure***. In response to question 9, some ***business association*** representatives underlined their views on the (role of) different fuels. One noted that EU policy was contradictory, as the CO2 emissions standards for vehicles were pushing manufacturers towards electric vehicles, while ignoring the potential of other clean fuel solutions, such as biogas, which was in turn undermining investments in the development of a dense CNG refuelling network. Another noted that in Italy, there was already a widespread network of NG stations and that it was easy to find information in advance on fuel prices and to make payments, while a third noted that LPG already had a fairly good distribution network for road transport, although this was lacking for maritime transport. Another business association representative underlined the importance of the AFID only promoting fuels that were in line with the 2050 carbon neutrality objective. With respect to hydrogen, one respondent from a business association noted that neither price information nor the availability of payment options were a barrier to the uptake of these vehicles in Germany, while another respondent called for the further development of hydrogen refuelling infrastructure.

Three business associations called for the focus to be on the consumer, with one noted that legislation should focus on optimising and improving the consumer experience, and the market and technology development would follow. Another noted that the user experience was often not good and that cars often stayed too long at recharging points. On the other hand, a business association representative cautioned that measures to protect the consumer and to make their experience more comfortable risked increasing costs, so could be counterproductive. Instead, the market should be left to find the most efficient way. Another noted that it was important for users to also be aware of the availability of private charging points, as 40% of charging occurred at such recharging points, while a third called for there to be more pragmatic building permit procedures to speed up the construction of infrastructure, supported by incentives to build public, semi-public and private recharging points.

From the perspective of the 26 representatives of a ***company / business organisation***, the most common issue (from seven respondents) that was raised was a need for more infrastructure, including for: recharging electric cars at commercial offices or in certain Member States; for recharging electric vehicles on motorways; for the public recharging and refuelling of buses and coaches; for in-depot refuelling and recharging; and for refuelling natural gas vehicles in general.

As with business associations, there were some comments on the fuels covered from representatives of a company / business organisation. A couple noted that the benefits of electric vehicles were undermined, as many were charged using largely non-renewable electricity, one of whom also underlined that the location of recharging infrastructure for electric vehicles should not try to follow the same approach that is currently taken for petrol and diesel refuelling stations. Another noted the potential of biomethane as a fuel in Ireland, while it was also suggested the electric buses could be more challenging to use than buses using hydrogen or biogas.

As with business association respondents, a number of representatives of a company / business organisation noted concerns with respect to the users' experience. One noted that hydrogen refuelling stations tended to be too complicated calling for the user to be able to operate these with the same effort as petrol refuelling stations, while another noted that easy access and payment must be guaranteed for electric vehicle recharging points and a third noted that it was often not clear what power the recharging point was. In the same vein, it was also noted that the main ambition of the Directive should be to ensure that all Member States install a sufficient number of refuelling points and that they were all easy to use and accessible for all, in accordance with the European Standard EN 17161:2019 'Design for All'. Another respondent noted that there were often problems of compatibility between different recharging systems, so there was a need for harmonisation or a standard recharging or refuelling system for each alternative fuel.

There were a number of comments about the price for recharging electric vehicles. One company / business association respondent questioned why some electric vehicles could be recharged for free and why electric cars benefited from tax subsidies, whereas another felt that the price of recharging an electric vehicle was too high. It was also noted that information on *ad hoc* charging was generally not as relevant for fleet or company vehicles. Another noted that pricing and price information were major problems for electric vehicle recharging, which needed EU regulation to ensure healthy competition. It was also suggested that the AFID should adopt the principles of the Electricity Market Directive (2019/944/EU) and ensure discriminatory access of electricity suppliers to the public charging station infrastructure, so as to establish price competition at the charging station and guarantee the free choice of supplier for consumers. Another respondent commented that there was often a strong link between the charging point operator and the mobility service provider (MSPs), which should be brought to an end to ensure that all MSPs received the same treatment.

More generally, a respondent called for the EU to ensure transparent and non-discriminatory pricing, to enhance market openness of electric vehicle roaming services and to unify the basic definition of a public charging service, while another called for the EU to ensure timely and interoperable technical standards and non-discriminatory tender specifications for AFI. Another respondent called for a platform-based model of interoperability to be implemented, rather than a bilateral model, although whichever model was chosen, they underlined that it was important that this was freely available.

In relation to public transport, one respondent was concerned that, without a more strategic approach, the way in which electromobility – including fuel cell buses – was developing risked simply being the sum of many pilot projects. Another noted that, often for both operational and tax reasons, recharging and refuelling stations for buses were set up by an operator for their own operations. It was also noted that there were large differences between Member States in terms of the level of electrification of the rail network and the speed of its expansion. Finally, one company / business organisation argued that, as the electric vehicle market was relatively underdeveloped in their country, there was no need for EU intervention at this time.

Of the seven representatives of ***consumer organisations*** that provided a further comment, four mentioned the importance of the availability of an adequate amount of infrastructure (in one case explicitly high speed recharging infrastructure), while another explicitly mentioned the importance of charging infrastructure at train stations and other modal interfaces to ensure that the last mile could be travelled without the need to use fossil fuels. Three noted the importance of transparent information on price, two underlined the need for information on the real-time availability of recharging infrastructure and the importance of information on their location, while a single respondent noted that recharging infrastructure should be properly maintained. As one noted, such measures should increase consumer confidence and ensure that motorists have the same level of comfort and convenience as they do with refuelling petrol and diesel vehicles today. A similar point was made by an ***environmental organisation***, which noted that across Europe, similar charging solutions should be deployed, while charging and access to infrastructure should be offered in a non-discriminatory way, as it was for petrol/diesel refuelling stations today.

The most common issue raised by the 36 ***EU citizens*** were the need for more high power charging stations (either of more than 50 kWh, 100 kWh or even 150 kWh), particularly on motorways, which was raised by 14 respondents. Other issues raised by several EU citizens included the challenges of paying given the number of different cards and contracts (eight respondents) and the price of recharging an electric vehicle, particularly in France, which was a concern of four EU citizens. A couple of EU citizens raised concerns over cars that were not recharging, including ICEVs, parking at recharging points, the lack of awnings over recharging points to protect drivers from the weather and the poor maintenance of some recharging points. Two citizens also raised the issue of the different sockets and plugs that were in use. Other points that were raised by EU citizens, included that the location and status of all recharging stations should be visible on an app, that information on recharging and billing should be transparent (and that this should be based on energy consumed not the charging time taken) and that all charging points in Europe should have multilingual menus.

A general lack of recharging infrastructure was raised by citizens in different contexts, including one that mentioned that there was often an insufficient number of recharging terminals at charging stations and another who called for recharging infrastructure to be prioritised for car sharing and other services that encouraged multimodal transport. One citizen called for more recharging points to be located where people needed these depending on people's potential need for different levels of power, e.g. slow chargers for those charging overnight and fast chargers for those in transit, while, along similar lines, another respondent called for more charging in urban locations where people parked, e.g. at shopping centres and in car parks. One citizen suggested that the location of recharging points should be regulated by a national authority to ensure that these did not go to waste.

In relation to hydrogen, one citizen noted that the hydrogen refuelling network was better developed in some Member States than in others, while another considered that the development of a hydrogen refuelling network across Europe would be too costly.

Some citizens raised some broader policy points. One called for action on mobility patterns more generally, while another called for an end to parking spaces being converted into electric vehicle recharging points and a third called for more incentives to buy electric cars to overcome the comparatively high cost. Another criticised the instability of EU policy, which initially focused on biofuels, then natural gas and now electromobility, for which we were also likely to identify reasons not to support it at some point. Finally, one EU citizen expressed their surprise at the absence of Direct VLT (120V DC) ERS (Electrified Road System) infrastructure from the scope of the Directive. A ***non-EU citizen*** called for speed reductions on motorways to reduce CO_2 emissions and deliver other environmental benefits.

The availability of infrastructure was also a concern of the 11 ***NGOs***. Comments from their representatives included that there was insufficient infrastructure in general, and along highways and other major inter-urban roads in particular, that there were too few recharging points and biogas (including liquid biogas) refuelling points and that there was an insufficient number of recharging and refuelling for buses. Two NGO respondents called for there to be common and easy way to make ***ad hoc*** payments without the need for a contract, in order that charging and paying for electricity was as easy as paying for petrol, while another called for all charging infrastructure to be able to support smart charging and a fourth for a common charging solution to be applied across Europe with mandatory roaming.

More specifically, one NGO respondent noted that existing charging points did not generally meet the needs of motorcyclists and three noted that charging stations, and the space that they occupied, were often not designed with the needs of people with disabilities. A respondent from an organisation that they classified as belonging to the ***'Other'*** category noted that charging points were often blocked by either ICEVs or charged EVs.

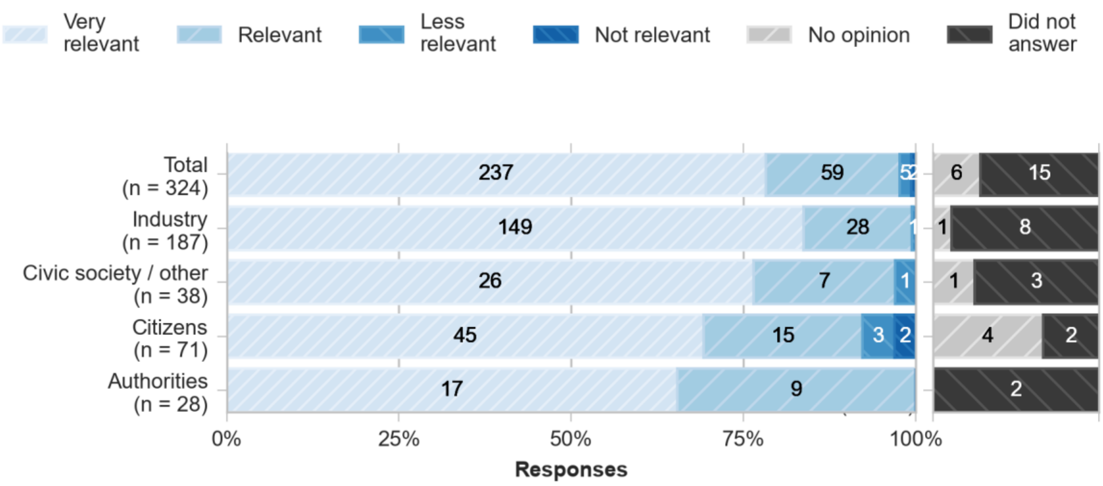
From the perspective of ***public authority*** representatives, one noted that LPG, LNG and CNG should not be considered to be an alternative fuel, while two others noted that greater importance should be given to expanding the network of hydrogen refuelling infrastructure, with the source of both hydrogen and electricity being taken into account. Another public authority representative called for there to be a wider selection of possible payment methods and for the price between selective and contract-based charging not to differ too much. Finally, more generally, one respondent called for there to be more communication locally about the qualitative and quantitative benefits of different fuels.

11.7.4.2 SECTION B: General assessment of the Directive's relevance and scope (questions related to the evaluation)

11.7.4.2.1 B1. In your view, how relevant is a policy on alternative fuels infrastructure at EU level as established by the Alternative Fuel Infrastructure Directive to support the uptake of alternative fuels

Respondents were asked 'In your view, how relevant is a policy on alternative fuels infrastructure at EU level as established by the Alternative Fuel Infrastructure Directive to support the uptake of alternative fuels?'. The majority of respondents (237) stated that it is very relevant, whereas 59 stated it was relevant, 5 stated it was less relevant and 2 stated it was not relevant (see Figure 5-9). 6 respondents did not have an opinion and 15 did not answer.

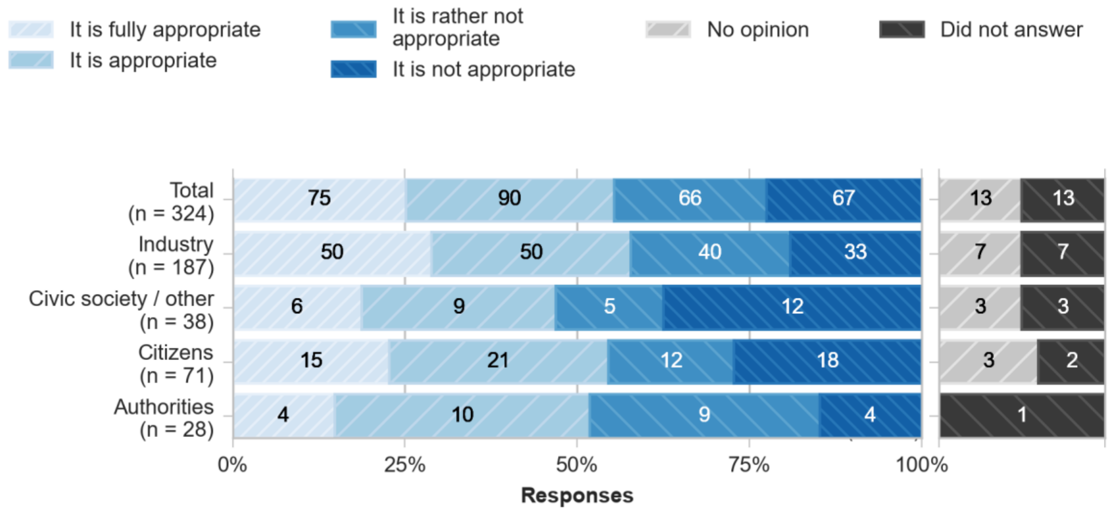
Figure 5-9: B1. In your view, how relevant is a policy on alternative fuels infrastructure at EU level as established by the Alternative Fuel Infrastructure Directive to support the uptake of alternative fuels?



11.7.4.2.2 B2. In your view, is this scope still appropriate in the context of the long-term objective of the European Green Deal to reduce transport emissions by 90% by 2050?

Currently, the Directive covers electricity, hydrogen, biofuels, synthetic and paraffinic fuels, compressed natural gas (CNG), liquefied natural gas (LNG) and liquefied petroleum gas (LPG) as main alternative transport fuels. Respondents were asked ‘In your view, is this scope still appropriate in the context of the long-term objective of the European Green Deal to reduce transport emissions by 90% by 2050?’ (see Figure 5-10). Slightly more respondents (165) stated that it is fully appropriate or appropriate, compared with 133 who stated it was rather not appropriate or not appropriate. 13 respondents did not have an opinion and 13 did not answer.

Figure 5-10: B2. In your view, is this scope still appropriate in the context of the long-term objective of the European Green Deal to reduce transport emissions by 90% by 2050?



Twenty respondents clarified their response that ***'Some fuels are missing'***. Of the eight representatives of ***business associations***, two suggested that the latest generation of fossil fuels, with one explicitly mentioning high octane petrol potentially blended with biofuels, should also be covered due to their potential to reduce emissions. Two others explicitly mentioned ammonia and methane as missing from the scope of the Directive. Three respondents implicitly supported the existing coverage of fuels in the Directive, although highlighted the importance of ensuring that the AFID was open, and able, to include new fuels, particularly in relation to shipping, that could help to decarbonise transport. Another noted that battery powered trains were not covered by the Directive. Finally, one respondent from a business association noted that the revised AFID should be aligned with the revised RED).

Two of the six representatives of a ***company / business organisation*** that thought that fuels were missing from the scope of the AFID called for the inclusion of biogas (even though biomethane is explicitly mentioned in the Directive), whereas three called for the inclusion of 'e-fuels' produced from renewable energy, with one of these noting that they were not clear whether or not such fuels were covered by the definition of 'synthetic and paraffinic fuels'. The final company / business organisation respondent underlined the importance of keeping the Directive open to new fuels that were not yet mentioned, including dimethyl ether, ammonia and synthetic e-fuels.

Of the two ***EU citizens*** who thought that fuels were missing from the scope of the Directive, one mentioned ammonia and synthetic kerosene for aircraft, while the other proposed ammonia-based fuels and also noted that the scope of the Directive should be kept open for new fuels.

Four representatives of ***public authorities*** identified fuels that they felt were missing from the scope of the Directive. One of these mentioned ethanol and another HVO100. The two others both mentioned the lack of coverage of sustainable fuels for aviation and maritime transport, with one noting that it should be explicit in the AFID that 'synthetic fuels' included 'renewable liquid and gaseous transport fuels of non-biological origin', as defined in the revised RED.

Eighty-eight respondents clarified their response that ***'Some fuels are not relevant anymore'***. Of the 12 ***business associations*** that thought that some fuels were no longer relevant, seven explicitly suggested that the fossil fuels that were currently covered by the Directive (i.e. CNG, LNG and LPG) were not compatible with the Green Deal, with one other noting that, while they were not compatible in the longer-term, they were needed for long-haul road transport in the short-term. In addition, two respondents stated that the focus of the Directive should be on the electrification of vehicles, with one also including hydrogen in this.

Six set out more detail on what they would like to see, based largely on the electrification of transport. Three of these called for more coherence between the AFID and other pieces of EU legislation, including the CVD, the CO_2 vehicle Regulations, the green finance taxonomy and recent Commission decisions on state aid. One of these called for the AFID to include an amended list of sustainable fuels for light duty vehicles by taking into consideration the approach taken by the revised CVD, while also calling for there to be more focus on the needs of buses and trucks for recharging infrastructure. Another called for separate lists of sustainable fuels for light- and heavy-duty road transport vehicles, as well as for maritime transport. For light duty vehicles, they also explicitly called for the approach in the AFID to be aligned with that in the revised CVD, which they noted was also in line with the EU's green finance taxonomy, while also highlighting that more attention needed to be paid to recharging infrastructure for buses and trucks. The third called for the AFID to establish a CO_2 emissions threshold for light duty vehicles to support only zero emission fuels and that this threshold should be consistent with the emissions thresholds set out in the light duty vehicle CO_2 emissions Regulation. In relation to heavy-duty vehicles, they called for the maintenance of an exhaustive list of technologies, to include electricity, low-carbon hydrogen, biogas, e-fuels and biofuels.

Another business association highlighted the importance of supporting zero-emissions mobility for road transport by focusing on electric vehicles and on electricity for maritime transport, both for on-shore power supply and also for short-sea shipping, as exemplified by the Horizon 2020 e-ferry project. They also called for green hydrogen to be reserved for the sectors for which electrification was not an option, such as 'deep-sea' shipping and aviation. The inclusion of compressed and liquid biogas and electric road systems for heavy duty road transport was considered important by another respondent, while a third proposed that 'synthetic fuels' in the AFID be defined in the same way as in the revised RED.

The additional comments from representatives of a ***company / business organisation*** reflected those of the business associations in relation to the fuels that they considered to be no longer relevant for the AFID. Of the 24 respondents, 12 explicitly called for the exclusion of all fossil fuels, while two called for the exclusion only of LPG, one for the exclusion of both LPG and LNG and another for LPG and biofuels to be excluded. One respondent also called for there to be no use of synthetic or paraffinic fuels in cars.

Eleven respondents called for the focus to be on electrification or on fuels that have the potential to be zero emission. Of these, some expanded further on their views with one proposing that separate lists of 'fossil-free' fuels should be developed for light- and heavy-duty road transport vehicles, as well as for maritime and aviation. In relation to hydrogen, one respondent noted that this should be reserved for trains and long-distance buses, while two respondents considered that it should be reserved for non-transport purposes.

From the perspective of the three ***consumer organisations*** that believed that some of the fuels were no longer relevant, one called for the focus of the AFID to be only on truly zero emission vehicles, so electricity and hydrogen, another for synthetic and paraffinic fuels and LPG to be excluded and the third for the exclusion of CNG, LNG, LPG and biofuels that were made from food or from feedstocks, the cultivation of which competed with food. The one representative of an ***environmental organisation*** also called for the exclusion of fossil fuels from the scope of the AFID and for the focus to be on electrification and the establishment of an end date for the production and distribution of fossil fuels. The one representative of an ***academic / research institution*** who responded stated that the Directive should focus on electromobility.

Many of the 26 ***EU citizens*** who believed that some of the fuels were no longer relevant listed one or more of the fuels covered by the Directive. Of these, 19 wanted to see LPG excluded and the same number wanted to exclude CNG/LNG from the scope of the Directive, while eight did not want synthetic and paraffinic fuels covered, seven were against the inclusion of biofuels and three did not support the inclusion of hydrogen. A couple of EU citizens, who wanted to see CNG/LNG excluded did support the inclusion of biogas, so noted that infrastructure for this would still be needed. Rather than stating the fuels that they wanted to be excluded, three respondents called for the focus to be electricity, with one of these noting that the electricity should only be from renewable sources. Finally, another EU citizen called for a more focused approach with only electric vehicle recharging points being supported for light duty vehicles, whereas hydrogen and LNG refuelling infrastructure should be supported for heavy duty vehicles, rail and shipping. A ***non-EU citizen*** called for the focus to be electricity.

Five of the seven ***NGO*** respondents called for the exclusion of fossil fuels from the scope of the AFID, while four explicitly called for the focus to be on electricity, with one noting that the electricity should be generated from renewable sources. In an extensive response one NGO respondent underlined that the EU needed to aim towards zero emission mobility from 2025 onwards. They called for the current lack of coherence between the AFID and the Green Deal to be identified as an explicit problem that the revised Directive needed to address and that the Directive be turned into a Zero Emission Infrastructure Regulation. In relation to hydrogen, they argued that, as it was anticipated that the market for fuel cell electric cars would not be significant, the deployment of hydrogen infrastructure should be prioritised at ports, where it could be used for drayage operations, by ships and by associated industrial clusters. They also underlined the importance of securing a sufficient supply of renewable energy for transport, which was an issue in many sectors. Finally, another NGO respondent did not consider that either biofuels or synthetic fuels should be covered by the Directive.

The only response from a representative of an organisation that they classified as ***'Other'*** noted that the inclusion of fossil fuels in the AFID was not compatible with the Green Deal, and called for the approach to alternative fuels to be different for different transport modes, taking into account the specificities of each sector. For light-duty vehicles, they suggested that the approach taken in the revised CVD should be considered, while they noted that it was also important to support the needs of buses and trucks in relation to recharging infrastructure.

Many of the 12 representatives of ***public authorities*** had a more nuanced perspective on the fuels that should be excluded, with some noting that while fossil fuels were not compatible with the Green Deal, they were often needed in the transition to sustainable fuels. For example, one respondent noted that where fossil fuels were needed for the transition, they should gradually be replaced by an increasing proportion of non-fossil fuels, with a focus on electrification. Another noted that the use of LPG was expected to decline quickly, while CNG and LNG would be needed in the transition to hydrogen and electricity for heavy-duty road transport, so questioned whether there was a need for an EU framework, particularly targets, for these fuels.

While supporting the phasing out of fossil fuels by 2050, another public authority respondent noted that LNG and LPG would need to be replaced in the long-term by biogas and synthetic gas, while both LNG and LPG would continue to be relevant for shipping. They also called for full consistency between the AFID and the revised RED and CVD, and noted that as the latter was currently being transposed (and referred directly to the definition of AFs in the AFID), there should be no change in the scope of alternative fuels covered by the AFID at this point. Another public authority respondent noted that the focus of the AFID should be on zero emission technologies, especially for road transport, although they also noted that fossil fuels would be needed in the transition phase while zero emission technologies were not sufficiently mature. In addition, they noted that the impact of fuels on air pollution needed to be taken into account, which meant that biofuels were not a solution. Similarly, another respondent noted that LNG and biofuels could be considered to be transition fuels, particularly for trucks and shipping, whereas electricity (and to a lesser extent hydrogen) should be the focus for cars and vans.

Another public authority representative called for the removal of fossil fuels from the scope of the Directive, where this was feasible, with the AFID focusing on fuels with a renewable potential or feedstock, such as electricity, hydrogen, biomethane and sustainable advanced biofuels in road transport, whilst ensuring coherence with the revised CVD. In line with other respondents, they also called for a consideration of the need for alternative fuels by mode to account for the specificities of the maritime and aviation sectors. The complementarity of fossil fuels with more sustainable alternatives (e.g. biogas, electricity and hydrogen) was noted by another public sector representative, who believed that fossil fuels were no longer suitable. They argued that the economic interests of those that supply the fossil versions of fuels often clashed with the provision of greener fuels, so proposed that, in Annex II of the Directive, there should be a mention of the importance of the traceability of the origin of electricity, hydrogen and biogas, as was currently proposed in France.

Other public authority responses were more clear-cut. One noted that CNG, LNG and LPG were not compatible with delivering climate neutrality and that, as biofuels would only ever be a niche application, the focus for cars and trains should be electricity, while for ships, planes and buses it should be hydrogen. Two others explicitly noted that CNG, LNG and LPG should not be included, while calling for more emphasis on renewable fuels for transport that were not alternative fossil fuels. Another public authority representative simply noted that the focus should be on fuels that were based on renewable energies. Finally, another respondent noted that LPG was not relevant in Sweden.

Thirty-five respondents clarified their ***'Other'*** response. Many of the 13 responses from ***business associations*** and the 14 from representatives of a ***company or business organisation*** either underlined fuels that should be added to, or excluded from, the scope of the Directive, with only a minority making other comments. In addition, there were several responses that were very similar that were made by at least one representative of both of these groups.

In terms of missing fuels, a representative of a business association and one from a company or business organisation noted that electric road systems for heavy duty road transport vehicles were missing, while also underlining that fossil fuels, such as GNG, LNG and LPG were needed as transition fuels for long-haul heavy road transport. The lack of coverage of heavy duty vehicles in the Directive was also mentioned in three of four similar responses submitted by two representatives of a business association and two from a company or business organisation, all of which also underlined the lack of targets for Member States. Three of these responses also underlined that some of the fuels covered by the Directive were not able to contribute to the long-term pathway of delivering climate neutrality, although in many cases, if the fossil fuel was phased out, there were renewable fuels that could use the same infrastructure. They also underlined that, in the longer-term, only renewable electricity and hydrogen should be promoted by the AFID. In addition, one of these respondents proposed that blending obligations, as have been introduced in Sweden, could be used for LNG to ensure that environmental benefits were delivered. The lack of coverage in the Directive of overhead catenary lines that enable dynamic charging was also mentioned by another company / business organisation representative. Another representative of a company / business organisation noted that the expansion of electrical railway infrastructure had been left out of the Directive.

Three respondents, two from a business association and one from a company / business organisation (whose response was very similar to that of one of the business associations), underlined the importance of the Directive covering e-fuels. One of these business associations called for these fuels to be supported by an appropriate taxation framework, while the three similar responses were not clear whether e-fuels were already covered by 'synthetic and paraffinic fuels' and called for their explicit inclusion. The business association also called for the inclusion of ammonia within the scope of the Directive, particularly for maritime shipping. The importance of having a stronger focus on CO_2-neutral fuels was also highlighted by another representative of a company / business organisation, which suggested that the Directive leave room for new fuels to be added and proposed that the Commission regularly review the list of fuels covered by the Directive.

In terms of fuels that should be taken out of the scope of the Directive, three of the respondents from business associations and companies / business organisations thought that the fossil fuels covered by the AFID should be removed and one suggested that only LPG and LNG should be excluded, whereas three others called for the focus to be on electrification and one called for the focus to be on electricity and hydrogen. Three respondents – one from a business association and two from a company / business organisation – noted the importance of using CNG, LNG or LPG as transitional fuels, which should be phased out in favour bio-based gases, while making sure that the scope of the AFID was consistent with the revised RED.

A number of more general comments were also made. One representative of a business association argued that no fuel that was currently within the scope of the AFID should be removed for the sake of regulatory certainty and investor confidence. Another business association argued that, from the perspective of the maritime sector, the Directive should not favour any particular technology and so target setting by technology was not appropriate. They also underlined that it was important for LNG to be considered as an alternative fuel, at least during a transition phase. A representative of a company / business organisation suggested that charging infrastructure for electric vehicles should be the subject of a separate piece of legislation, as trying to cover all alternative fuels in one piece of legislation would be difficult.

There were fewer additional comments from other types of stakeholder. The one response from a ***consumer organisation*** noted that there was currently no labelling requirement for hydrogen to show whether or not this had been produced from renewable sources. One of the two ***EU citizens*** who had an additional comment questioned why fossil fuels were still being considered, while the other one noted that electrified road systems were missing from the scope of the Directive. An ***NGO respondent*** noted that the focus of the Directive – or the Regulation that they would prefer – should be on electric and hydrogen vehicles, as well as renewable, synthetic fuels for which the focus should be on their availability and access to filling stations. A representative of an organisation that they classified as ***'Other'*** thought that ammonia was currently missing from the scope of the Directive, while a ***public authority*** representative underlined that the Directive should cover only 'green' or renewable fuels and energy sources.

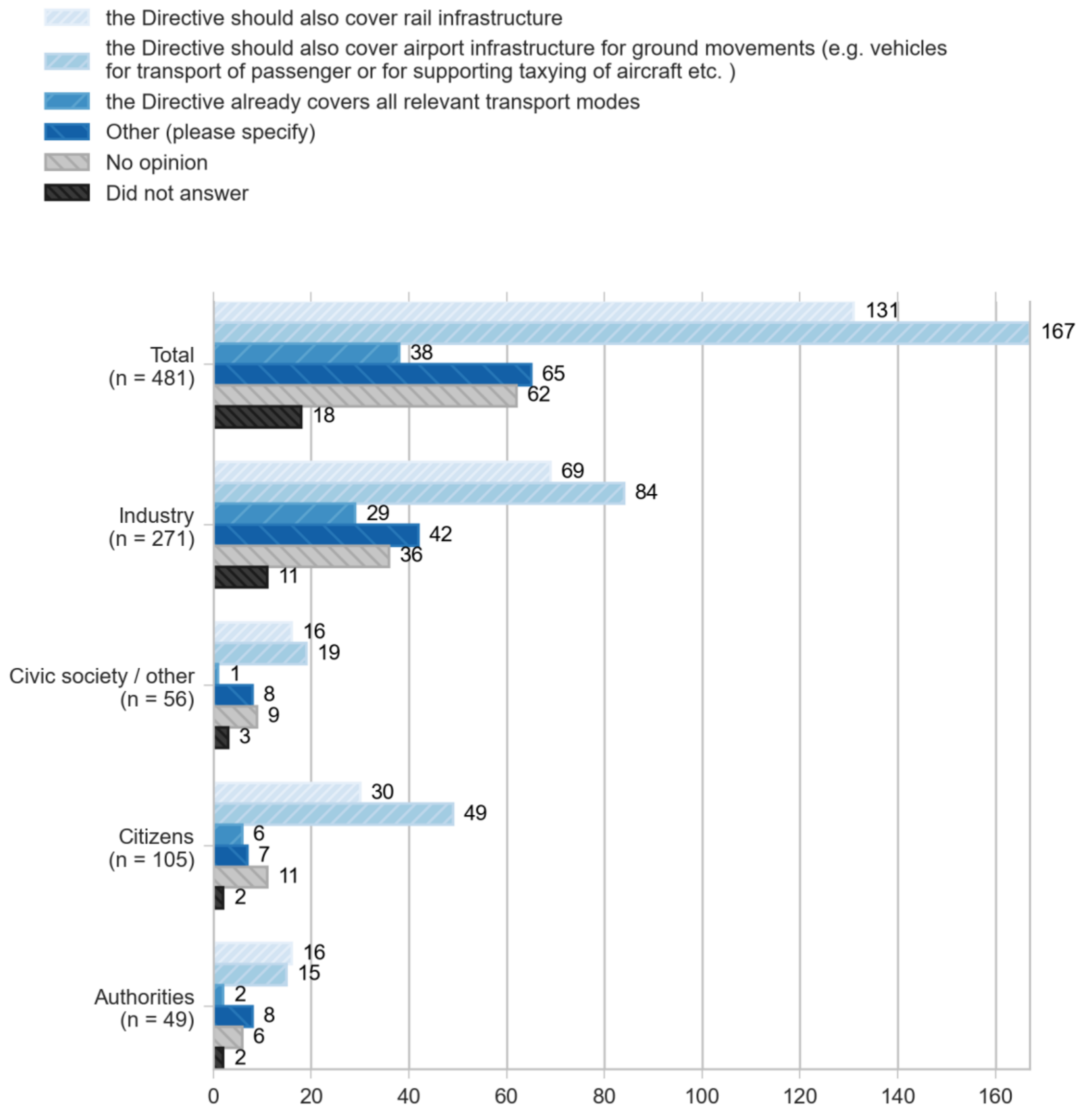
11.7.4.2.3 B3. Currently the Alternative Fuel Infrastructure Directive covers alternative fuels infrastructure for road and shipping. In your view, is this appropriate?

Respondents were asked whether the scope of the directive in terms of modes (currently road and shipping) was appropriate[86]. 38 respondents stated that the Directive already covered all relevant modes (see Figure 5-11). 131 respondents stated that the Directive

[86] Respondents were able to select more than one answer

should also cover rail infrastructure, 167 stated that it should cover airport infrastructure for ground movements, and 65 stated 'other'. 62 respondents did not have an opinion, and 18 did not answer.

Figure 5-11: B3. Currently the Alternative Fuel Infrastructure Directive covers alternative fuels infrastructure for road and shipping. In your view, is this appropriate?



Sixty-three respondents provided a further response to clarify their 'Other' response. The one representative of an ***academic / research institution*** underlined that the Directive should cover all modes, although with different strategies for each mode, as did six representatives of ***business associations***. One of the latter underlined the importance of hydrogen as an option for cars, forklifts, commercial vehicles, trucks, buses, ships and trains, while noting the potential role of ports, and airports, for providing a hub around which synergies could be created for the uptake of hydrogen. The potential role of hydrogen for trains and for airports, again in order to create a hub, was also underlined by another business association. Another respondent that supported the Directive covering all modes noted that it was important for the Directive to include the construction of tank infrastructure for hydrogen and infrastructure for overhead lines for hybrid trucks. Two similar responses (one from a representative of a company / business organisation) noted that any inclusion of rail in the AFID would need to be compatible with Directive 2012/34/EU ('A single railway network for Europe'). They also both underlined the potential synergies in developing the supply of alternative fuels for different modes, and so argued that the AFID should cover the technical, organisational and economic interfaces for the whole of the transport sector, which could include focusing on rail/road intermodal intersections for the development of a hydrogen refuelling network, for example. Another respondent underlined that many parts of the transport sector could be electrified.

Business association respondents identified some road transport modes that they felt were not sufficiently covered by the Directive (even though its focus was on road transport), with four respondents mentioning electric infrastructure for recharging trucks and one mentioning infrastructure for public transport. One respondent from a business association felt that the use of electricity for onshore power supply for ships in ports should be mandatory in order to help improve the air quality of the nearby cities, while another called for the revised AFID to cover provisions for LPG infrastructure in inland and maritime ports. Six business associations explicitly supported the expansion of the Directive to airports/aviation, with four wanting the scope to be expanded to more than only ground movements, with one suggesting that it should also apply to the power supplied to planes when these were stationary and three proposing that it should also apply to sustainable aviation fuel.

Other business associations suggested that the Directive should be expanded to various types of non-road mobile machinery, including the electrification of machinery used in agriculture (which was suggested by three respondents), construction (twice), off-road leisure vehicles and fishing fleets (once each). Other suggestions included expanding the scope of the Directive to logistics platforms and non-public areas in order to promote alternative fuels and reduce emissions.

Representatives of the 18 ***companies / business organisations*** who provided an additional response also supported the expansion of the coverage of the Directive to other modes. Two respondents gave their support to the coverage of all modes, with one noting that this would create and support synergies between the different fuels. In addition to airport ground movements, another respondent proposed that the Directive also be applied to the vessels, vehicles and machinery that operate in ports, while two others explicitly supported the expansion of the scope to railways and airport ground movements.

Other themes raised by representatives of companies / business associations were similar to those raised by business associations, with three respondents suggesting that the Directive needed to put more focus on infrastructure for trucks, two calling for more attention to be paid to infrastructure for public transport vehicles and one each suggesting that the Directive be expanded to cover machinery used in agriculture, the electrification of aircraft and sustainable aviation fuels. In addition, two respondents argued that there should be a greater focus on hydrogen, with one noting that using hydrogen in the rail industry and for airport ground operations could support its use in road transport, while the other supported the use of hydrogen-based fuels (including ammonia and e-fuels), particularly for ports. Two similar responses called for micro-liquefaction plants for LNG to be covered, as well as multi-purpose refuelling stations.

On the other hand, one respondent argued that rail and airports were very specific sectors that did not need EU intervention.

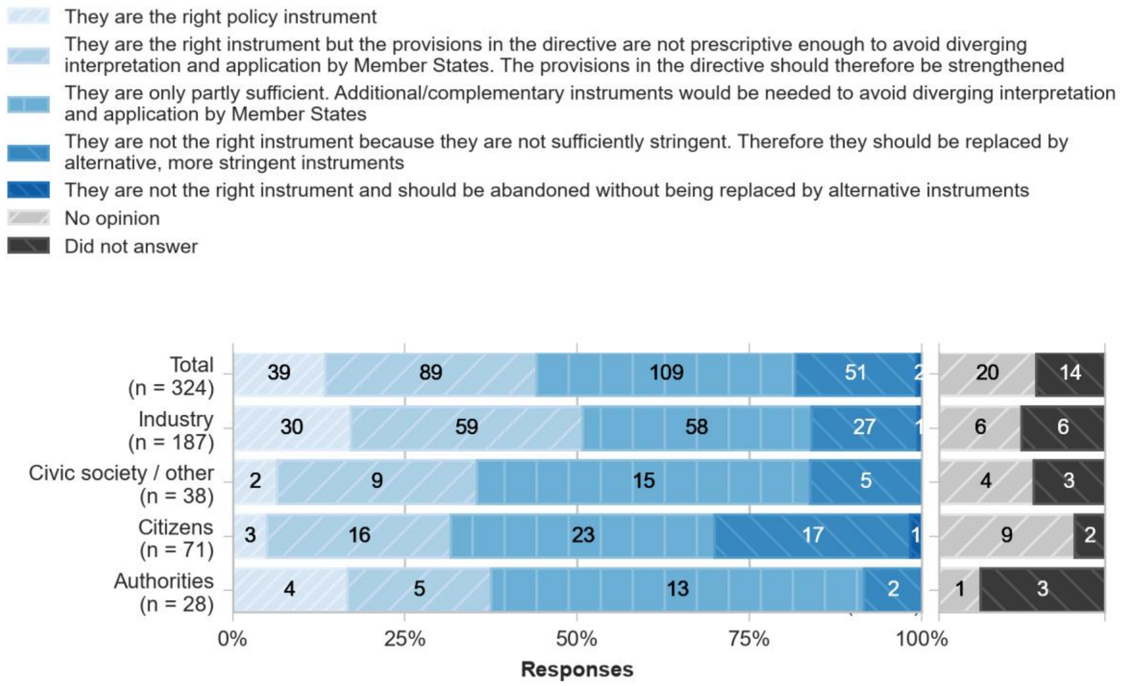
There were fewer additional responses from other stakeholders. The one response from a representative of a ***consumer organisation*** called for there to be binding requirements for port infrastructure, both inland and maritime (particularly for onshore shore power supply for ships), power connections in truck parking spaces and for non-road mobile engines. Applications that were mentioned by the six ***citizens*** that provided an additional response were aircraft (three times), garden equipment and ERS for trucks, while additional responses from ***NGO*** respondents suggested infrastructure for electric aircraft flying within the EU and for public transport vehicles. Two of the three respondents from organisations that they classified as ***'Other'***, called for the Directive to cover all modes of transport, with one noting that the AFID could be used to support battery-powered trains where the provision of overhead lines was not cost-efficient. In addition, they called for the Directive to also cover the onshore power supply for ferries and other passenger and cargo ships and ground support vehicles at airports, as well as infrastructure for public transport, electric bikes and cargo-bikes. Another respondent underlined that there was a need for coherence between the AFID, the LDV CO_2 Regulation and the CVD.

The eight representatives of ***public authorities*** that provided additional comments also proposed a range of additional vehicles that might be covered, including aircraft (mentioned by three respondents, including in one case electricity for these) with one each mentioning construction machinery, off road vehicles in ports, public transport and electric bicycles (including cargo bikes). Another respondent emphasised the potential for battery and hydrogen trains, which were being tested in France, and for the use of hydrogen from renewable sources for port activities, including for refuelling the ships themselves.

11.7.4.2.4 B4. In your view, are the NPFs the right instrument to ensure the development of a coherent infrastructure network throughout the EU?

The Alternative Fuels Infrastructure Directive currently requires from Member States to establish "National Policy Frameworks" (NPFs). Within this framework, Member States have to develop targets and objectives for the deployment of alternative fuels infrastructure, based on an assessment by the Member States of national, regional or EU-wide demand. Respondents were asked 'In your view, are the NPFs the right instrument to ensure the development of a coherent infrastructure network throughout the EU?' (see Figure 5-12). The majority of respondents (109) stated that they are only partly sufficient, and additional/complementary instruments would be needed to avoid diverging interpretation and application by Member States. 39 stated that they are the right instrument, 89 stated that they are the right instrument but the provisions in the directive are not prescriptive enough to avoid diverging interpretation by Member States (and the provisions should be strengthened), 51 stated that they are not the right instrument because they are not sufficiently stringent (they should be replaced by alternative, more stringent instruments) and 2 stated they are not the right instrument and should be abandoned without being replaced by an alternative. 20 respondents did not have an op[inion and 14 did not answer.

Figure 5-12: B4. In your view, are the NPFs the right instrument to ensure the development of a coherent infrastructure network throughout the EU?



Seventeen respondents who felt that the NPFs were the ***right policy instrument*** provided additional comments to support their response. From the perspective of the seven ***business associations*** that made an additional comment, a common theme was that the NPFs were the appropriate instrument as a result of the different conditions in Member States and so they allowed Member States to follow the route to decarbonise transport that was more appropriate for them. Having said that, there was a recognition from a couple of these respondents that the NPFs needed to be in line with either the Green Deal or with other, relevant EU legislation. Another respondent underlined that it was appropriate that the NPFs also covered the development of the market on alternative fuels, including relevant national measures to encourage their uptake, while another noted that Member States' reporting could be tightened to ensure more consistent implementation. It was also suggested that regional activities covering different Member States should be encouraged, while local and regional authorities should be consulted in the development and implementation of the NPFs. One business association respondent suggested that the Directive should also cover the provision of high octane petrol.

Eight of the nine respondents that represented either a ***company or a business organisation*** that felt that the NPFs were the right instrument as they let Member States take the actions that were right for them, as conditions, markets and consumer needs varied between the countries. Five of these respondents were concerned that setting EU-level targets risked leading to an insufficient coverage and would not be cost-effective. The other respondent argued that the tools were sufficient, but that the Directive should be converted into a Regulation. The only respondent from a ***public authority*** also mentioned the importance of letting Member States have a choice, as the socio-economic conditions differed between countries.

Fifty-one respondents clarified their belief that the NPFs were ***the right instrument but the provisions in the Directive are not prescriptive enough to avoid diverging interpretation and application by Member States and so the provisions needed to be strengthened***. The common themes mentioned by the 22 representatives of ***business associations*** in this respect were the need for better monitoring/reporting, the importance of mandatory targets, the need for more action to ensure interoperability/consistent implementation and that NPFs should be consistent with other national policies.

Improved monitoring or more frequent reporting of the deployment of infrastructure for alternative fuels was raised by eight of these respondents, while six called for mandatory targets. On the other hand, two respondents argued against mandatory targets as a result of the specific peculiarities of the Member States, while, in very similar responses, two business association respondents (as well as four company / business organisation representatives) called for the NPFs to be binding on Member States with all but one of these suggesting that there should be proportionate sanctions if the targets in an NPF were not met. Seven respondents raised the importance of a common implementation in Member States, including with respect to interoperability. Four respondents noted that the NPFs should be consistent with other relevant national policies, including the NECPs, while one suggested that the NPFs should include a concrete action plan for the deployment of infrastructure. Four similar responses (two of which were from company / business organisation representatives) proposed that the AFID should be explicit that the infrastructure for electricity, hydrogen and gas can be used for both fossil and renewable versions of certain fuels/energy sources, although gradually the infrastructure would only be used for the renewable versions of these. Another respondent noted that support for fuels by the Directive should take account of the maturity of the technologies, the availability of feedstocks and their respective decarbonisation potential. Finally, one argued that the focus should be less on electricity recharging infrastructure, the deployment of which was being addressed by the market, and more on hydrogen.

Similar themes were raised by the 22 representatives of a ***company / business organisation*** who provided an additional comment. Another respondent (in addition to those mentioned in the previous paragraph) also called for the NPFs to become binding and that they should guarantee the necessary financial support for the deployment of the infrastructure, as this required a long-term time horizon. In common with the business associations, two other representatives of companies / business organisations also noted the importance of better coordination between the NPF and other relevant national polices and two the importance of more standardisation. In addition, two called for better, or more frequent, monitoring or reporting and three called for the consideration of mandatory targets, with one of the latter calling for a series of milestones supported by better EU-level coordination of the implementation of the NPFs.

In common with some business associations, two company / business organisation respondents called for there to be more coordination between the NPFs, while one called for the AFID, including the NPFs, to be revised to bring them in line with the Green Deal and another noted that the Directive should include instruments for encouraging the use of renewable gas and renewable electricity. One respondent suggested that the NPFs lacked a concrete perspective, so could contain more goals and communication with the public, while another suggested that the NPFs should not cover the TEN-T, which should be an EU level responsibility, while a third respondent wanted to see the AFID give more indication of the minimum level of infrastructure that was needed for land and sea transport.

There were far fewer responses from other stakeholders. An ***EU citizen*** argued that there needed to be more harmonisation and stricter reporting, while a ***non-EU citizen*** called for clear European standards, the implementation of which should be subject to a national action plan (rather than a higher level policy framework). From the perspective of the two ***NGO*** respondents, one argued that natural gas should be excluded from the scope of the Directive, while the other called for more binding requirements, in particular in relation to LNG. A respondent from an organisation that they classified as ***'Other'*** called for different licence plates for electric cars in order to help to reduce emissions. The two ***public authority*** respondents both called for more cooperation between Member States, the first in order to better support the development of infrastructure for long-distance transport and to provide a more united front towards the car industry, while the second called for more involvement of the regions.

Eighty-two respondents provided an additional comment to support their belief that the NPFs were ***only partly sufficient***. The themes raised by the 18 respondents representing ***business associations*** who felt that the NPFs were only partly sufficient were similar to those raised by those who felt that the NPFs needed to be strengthened (see above). These included: the need for better monitoring/reporting; mandatory targets; action to ensure interoperability/consistent implementation; and for consistency with other national policies. The need for better monitoring and/or reporting was mentioned by four respondents, while binding Member State targets were also proposed by four respondents. On the other hand, three respondents argued that there was a need for Member States to assess and identify their own targets, although it was proposed that guidance could be useful (e.g. by the Commission) to support the Member States' respective assessments or that a dynamic method be developed to support Member States in determining their infrastructure needs. The importance of the Directive in delivering a harmonised or a common approach was identified by four stakeholders, with one suggesting that a Regulation was needed, while the need for better coordination with other policies was highlighted by four respondents, in which context the NCEPs and Energy Performance of Buildings Directive (EPBD) were mentioned. In addition, one respondent suggested that there needed to be more coordination between the Member States in relation to the NPFs.

Some more specific issues were also raised. One respondent noted that minimum binding targets for the deployment of AFI at the national level should be set, which should be aligned with the targets set in the Clean Vehicles Directive (CVD), the application of which should then be set out in more detail at the national level. Another noted that the AFID should be turned into a Regulation, to include common targets and be harmonised with the EU's railway Directives in order to clearly define the responsibilities of the infrastructure managers and railway undertakings. Other respondents called for there to be more focus on e-fuels, for there to be financial incentives for connecting private recharging infrastructure to the grid and for the EU to promote the exchange of best practice in relation to the deployment of AFI.

From the perspective of the 29 representatives of a ***company / business organisation***, common themes were the need for binding targets and the importance of a harmonised approach and more consistency, with a number calling for the Directive to become a Regulation. More stringent objectives overall were called for by three respondents, while binding national targets were sought by seven respondents, with two of these also calling for intermediate targets, e.g. for 2025 and 2030. On the other hand, four respondents called for more guidelines or the development of a methodology to support Member States in setting their national targets, one of which also supported more regular progress reviews. Three respondents underlined the importance of a harmonised approach and two called for more consistency, while five called for the Directive to be turned into a Regulation.

In addition, more specific issues were mentioned. Two respondents argued that the NPFs should also cover the deployment of AFI for public transport (with one mentioning the importance of making the AFID consistent with the CVD), while another called for electrified railway lines and hydrogen filling stations for trains to be covered by the Directive, as well as binding timetables to electrify cross-border tracks. Three respondents called for additional complementary measures, including funding support and fiscal incentives, while another called for the private installation of recharging points to be encouraged. Others called for the inclusion of specific technologies in the Directive and the NPFs, e.g. general infrastructure for HDVs, ERS for HDVs (coupled with financial support for its implementation), recharging infrastructure for L-category vehicles, ultrafast charging, hydrogen and e-fuels. One respondent proposed that enabling transport refrigeration units and coach air conditioning systems to use electric power while in safe and secure parking would reduce emissions and make it quieter, thus allowing drivers to rest more peacefully.

Other respondents called for a narrower focus of the Directive, e.g. only focusing on the TEN-T corridors, technical aspects or on the modes where fuels are more expensive, such as for HDVs, aviation and maritime transport.

From the perspective of the three representatives of ***consumer organisations***, there was a need for more obligations on Member States. Two specifically noted that there should be more binding requirements in relation to the deployment of AFI, with one also noting that the rules around *ad hoc* payments needed to be based on the electricity received, rather than the time taken for recharging. The other respondent explicitly noted that there should be obligations for Member States in relation to the installation of recharging points in the largest shopping centres, the larger service stations and along motorways, while they also believed that municipalities should be obliged to install recharging points.

The main issues raised by ***EU citizens*** were in relation to payments, the importance of EU level action and the need for a minimum supply of infrastructure. Two citizens called for a standardised payment method, while another called for the payment options to at least include a contactless bank card (and also called for pricing to be per kWh consumed and for the pricing display to be clear). Two respondents called for there to be a standardised way of connecting to refuelling/recharging infrastructure, while two others underlined the importance of having sufficient AFI in place and another noted that it was important that the recharging network in any particular area was not a monopoly. Two EU citizens underlined the importance of an EU level approach, while one commented that it was important that the national strategies were implemented. Finally, one called for Member States to be given carbon budgets, while another called for the Directive to cover ERS for HDVs and a third underlined that there were different approaches currently taken in different countries.

The most common theme mentioned by ***NGO respondents*** was the need for binding Member State targets, which was mentioned by five of the 10 respondents, while two also called for the Directive to become a Regulation. In support of binding targets, one noted that each Member State should be required to define an 'essential charging network', which should include locations is less densely populated areas where it was unlikely that charging points would be installed by commercial operators, on the basis of which a competitive charging network would be able to develop. Other NGO respondents called for more precisely defined requirements, for clearer objectives in the NPFs and for more homogeneity between the NPFs. More specifically, another respondent called for the AFID to ensure adequate infrastructure for trucks and another for there to be mandatory requirements on Member States to deploy recharging and refuelling infrastructure for public transport to ensure consistency with other (unspecified) EU legislation.

The only response from an organisation that was classified as ***'Other'*** argued that Member States' reporting requirements should be tightened, with local authorities being consulted on the content of the NPFs, which should be aligned with the EU Green Deal. They also called for minimum binding targets on Member States and for the Directive to be turned into a Regulation.

The issues raised by the nine ***public authority*** respondents were more diverse. One noted that the implementation of the Directive varied a lot between Member States and called for there to clearer requirements to ensure that sufficient infrastructure was deployed, supported by continuous monitoring. Another called for more harmonisation to the extent that was necessary to ensure compatibility and ease of use, while another underlined that it was important for differences between Member States to be taken into account. One respondent noted that it was not possible for the Directive to be the driving force for all Member States, which were at different levels of implementation, and so other instruments were needed, while another explicitly called for there to be more financing instruments available. More specifically, one public authority called for the Directive to cover battery trains, while another felt that home recharging for electric vehicles also needed to be addressed and a third called from more user-friendly charging (in terms of billing, roaming, etc). Another called for the NPFs to be strengthened by focusing on fewer fuels.

Forty-five respondents expanded on the reasons why they felt that the NPFs were ***not the right instrument as they were not sufficiently stringent***. Of the 11 ***business associations*** that expanded on their reasons for believing that there was a need for the NPFs to be more stringent, four respondents made general comments, two of which supported mandatory targets and one of which called for the Directive to become a Regulation. Another noted that it was necessary to ensure that the national measures were actually implemented, while another implicitly called for greater consistency between Member States.

In addition, there were more specific responses from seven respondents. There was a repeated response from four respondents (as well as a similar response from a fifth association) that called for the Directive to become a Regulation and contain clear implementation targets, particularly for L-category vehicles (based on the technical specifications set out in Commission Delegated Regulation (EU) 2018/674). A separate respondent felt that the NPFs had not successfully addressed the cross-border challenges faced by inland ports and called for there to be roadmaps and targets per axis, while another also called for a Regulation that contained targets for recharging infrastructure on the TEN-T core network and for off-street parking spaces.

Ten of the 16 representatives of ***companies and business organisations*** who provided additional text supported mandatory targets and/or the Directive being turned into a Regulation in order to speed up and improve the consistency of implementation. Of those that supported mandatory targets, three similar responses again noted that this was important for L-category vehicles in particular, while one called for targets for infrastructure for recharging and refuelling HDVs. Another respondent noted that with respect to rail, there was a need for EU level guidance to ensure that international railway traffic used rolling stock with alternative propulsion systems, while underlining that the AFID should be harmonised with the railway Directives. Three respondents implicitly called for more harmonisation between the NPFs, while another suggested that the NPFs had been developed with insufficient analysis and supporting measures.

Eight of the 13 ***EU citizens*** that provided additional comments called for there to be some kind of stricter implementation, with four suggesting that the rules should be mandatory or binding and two others called for a Regulation rather than a Directive (and one of these also called for adequate financial instruments). Others provided more specific comments, with one noting that L-category vehicles were currently ignored, while another called for a common European standard for vehicle recharging infrastructure. Two respondents noted that national approaches did not fit well with cross-border travel, with one noting that Schengen should also be relevant for sustainable mobility and another called for infrastructure to be implemented to meet user needs.

There were only five responses from other types of respondent. The one representative of a ***consumer organisation*** called for there to be binding targets and for the Directive to be turned into a Regulation to ensure better harmonisation. The one response from an ***environmental organisation*** also called for binding targets, which the Member States could be encouraged to go beyond; similar issues were raised by the single response from an ***NGO***. One of the two ***public authority*** representatives underlined that the Directive should not leave room to be reinterpreted at the national level and so called for the objectives for each Member State to be set at the European level taking account of the same indicators, while the other called for the Directive to become a Regulation.

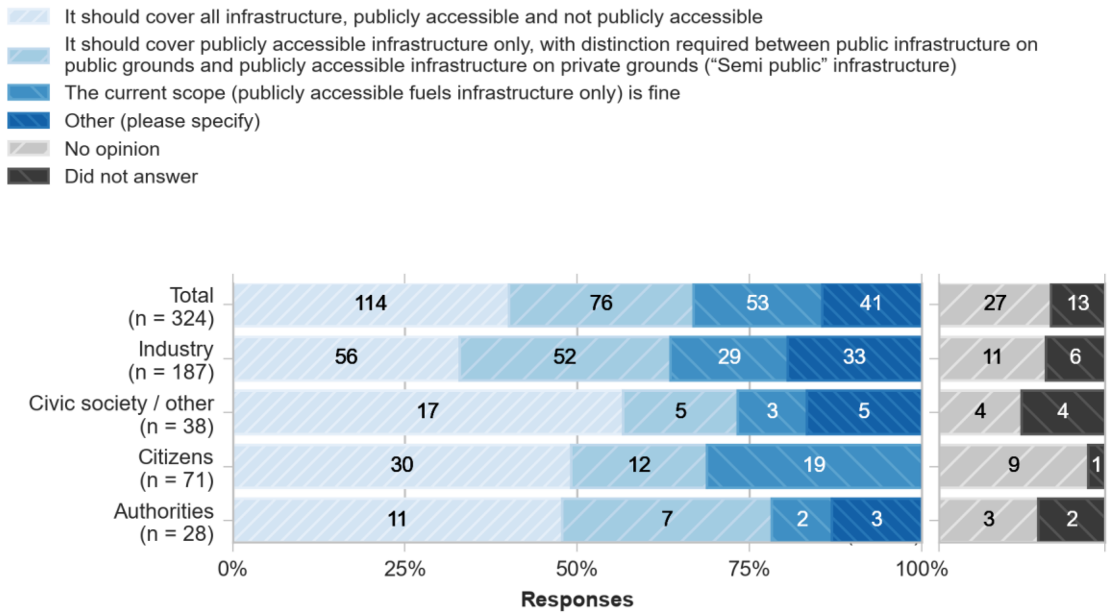
Two stakeholders elaborated on why they believed that the NPFs ***should be abandoned without being replaced by alternative instruments***. A representative of a ***company / business organisation*** argued that the NPFs had been ineffective and poorly implemented, so the Directive should be replaced by a Regulation in order to deliver a faster, more effective and harmonised approach across the EU that should introduce binding, weighted deployment targets, unified terminology and unified measurement and reporting requirements for Member States. An ***EU citizen*** called for there to be mandatory bilateral agreements between Member States along the TEN-T corridors to help them obtain funds from the EU for the development of AFI in these corridors, a mandatory agreement between European banks and the European Central Bank to give loans at a low interest rate to support the deployment of infrastructure and also to involve car makers and fuel producers.

Five stakeholders made a comment, even though they ***did not express an opinion*** on the initial question. A ***business association*** underlined that it was important that the NPFs went beyond the development of infrastructure to also require Member States to report on the development of the market for alternative fuels, including national measures that had been put in place to support the uptake of alternative fuels. A representative of a ***company / business association*** called for the Directive to be turned into a Regulation and to be expanded to include recharging infrastructure for L-category vehicles, while another called for the focus of the Directive to be only on electric cars, rather than on other fuels for these vehicles. An ***NGO*** respondent called for the introduction of standards relating to the accessibility of recharging stations for electric cars, while a ***public authority*** called for there to be more advice and funding to support the deployment of infrastructure.

11.7.4.2.5 B5. Currently the Alternative Fuel Infrastructure Directive addresses publicly accessible fuels infrastructure only. Should it also address infrastructure not accessible to the public?

In response to the question 'Currently the Alternative Fuel Infrastructure Directive addresses publicly accessible fuels infrastructure only. Should it also address infrastructure not accessible to the public?', the majority of respondents (114) stated that it should cover all infrastructure, publicly accessible and not publicly accessible (see Figure 5-13). 76 stated that it should cover publicly accessible infrastructure only (with distinction required between public infrastructure on public grounds and publicly accessible infrastructure on private ground), 53 stated that the current scope is fine, and 41 stated 'other'. 27 did not have an opinion and 13 did not answer.

Figure 5-13: B5. Currently the Alternative Fuel Infrastructure Directive addresses publicly accessible fuels infrastructure only. Should it also address infrastructure not accessible to the public?



Fifty respondents provided a further explanation, not all of which expanded on their reasons for responding ***'Other'*** to the original question. For example, of the 15 ***business association*** respondents that expanded on their response, a repeated response from two associations noted that the current scope of the Directive was fine as long as the distinction between 'publicly accessible infrastructure' and 'not publicly accessible infrastructure' was clarified. Another business association respondent expanded on their reason for answering that the Directive should cover all recharging infrastructure, as this would help to promote the deployment of alternative fuels infrastructure for private and semi-private use. Three similar responses highlighted that private charging infrastructure should not be neglected, arguing that, although the Directive should not be expanded to cover these recharging points, the obstacles to implementing these should be overcome by ensuring consistency with the EPBD, including by bolstering the 'right to plug-in' and by strengthening the transposition of the latter into national legislation. A separate response also highlighted the importance of not overlooking non-public charging points, perhaps also in the EPBD.

In addition, four responses from associations (two of which were very similar) called for a clearer definition of what was meant by a 'publicly accessible infrastructure'. The two very similar responses noted that private infrastructure that allowed access to other private users should also be included in the scope of the Directive, so these could be included in the definition of 'publicly accessible' infrastructure. In addition, they both underlined that the technical specifications in Annex II should only apply to publicly accessible infrastructure. One of the other responses underlined the importance of installing charging for apartments.

Other responses referred to specific categories of vehicles. One noted that there were opportunities for installing charging points for L-category vehicles on private grounds that were accessible by the public, for example in car parks and at supermarkets, which should be covered by any amended legislation. Another respondent called for the revised AFID to include infrastructure for public transport, even though this was not publicly accessible, as this would support the deployment of these fuels in public transport. They called for careful planning in this respect, as the relevant supply infrastructure that was added for public transport could also be used to put publicly accessible infrastructure in place nearby. Finally, two business association respondents noted that, by its nature, charging infrastructure for heavy duty commercial vehicles will be semi-public or private, which needs to be recognised in the Directive.

Many of the responses from the 18 representatives of a ***company / business organisation*** also explained a response other than 'Other'. Two respondents explained why they felt that the current scope was appropriate. Both felt that there should be no distinction between infrastructure depending on whether it was on public or private grounds, as it was the accessibility of the infrastructure, not its ownership, that mattered. One also argued that rather than simply the recharging activity being a supply of energy, it should be considered to be a comprehensive service that supplied additional information. Five respondents clarified why they supported the Directive applying only to publicly accessible infrastructure with a distinction made depending on whether the infrastructure was on public or private grounds. Three of these felt that where infrastructure on private land had no access restrictions, it should be considered to be publicly accessible infrastructure and be subject to the same regulations. In cases where access was limited, if use was above a certain threshold, the infrastructure should be considered to be publicly accessible and be subject to the same regulations as public chargers. The other two respondents highlighted that charging infrastructure in private buildings should be addressed, with one calling for the remaining obstacles for installing non-public points to be removed in order to ensure a needs-based right-to-plug, while the other called for (unspecified) additional requirements for private buildings and for the terms 'public', 'semi-public' and 'private' in this context to be clearly defined.

Three respondents expanded on why they supported the Directive applying to all infrastructure. One implied that this was important, as it was difficult to find infrastructure that was able to handle large vehicles. The other two, while supporting the Directive applying to public, semi-public and private infrastructure, noted that different approaches and obligations would be important for different use cases. One suggested that only minimum interoperability requirements should be put on semi-public infrastructure, so as not to deter private investment, while the other highlighted the importance of business-to-business aspects, as the car rental market did not own the parking spaces that they used, so relied on other companies for the presence of recharging points, the requirements of which may vary by location.

Another company respondent noted that they could accept the Directive applying to all infrastructure, as long as infrastructure that allowed access to private users with an authorisation was still defined as being publicly accessible, and that road hauliers were considered to be 'private users', otherwise the notion of 'users' needed to be extended to include business-to-business use, e.g. by simply referring to 'users', as opposed to 'private users'[87]. Another company respondent was not able to support distinguishing between the grounds on which the infrastructure was located, as they were concerned that this would hinder the inclusion of private infrastructure with no public access, which was important, particularly for commercial HDVs.

Other comments from company / business organisation respondents included that the definition of what was meant by 'accessible' should be tightened, and that there was a need to address non-public infrastructure, particularly with respect to charging points for apartments. Comments were also made in relation to specific modes. With respect to rail infrastructure, one respondent noted that if these were included within the scope of the Directive, they would never be publicly accessible. For bus infrastructure, it was noted that infrastructure in both the depot and in public spaces were important. Another respondent noted that if privately-financed ERS for buses were deployed on a public road, this should be opened up for public use if a suitable business model could be found. It was noted in another response that the critical recharging points for commercial vehicles will be in semi-public or private hubs, a fact which needed to be reflected in the Directive. Finally, one respondent commented that 'excessive interference' in the technical specifications for non-publicly available infrastructure

[87] Note: There is only one reference in the Directive to 'private users', e.g. in recital 26.

should be avoided, although they noted that attention should be given to in-depot charging, particularly in terms of financing the upgrade of this infrastructure.

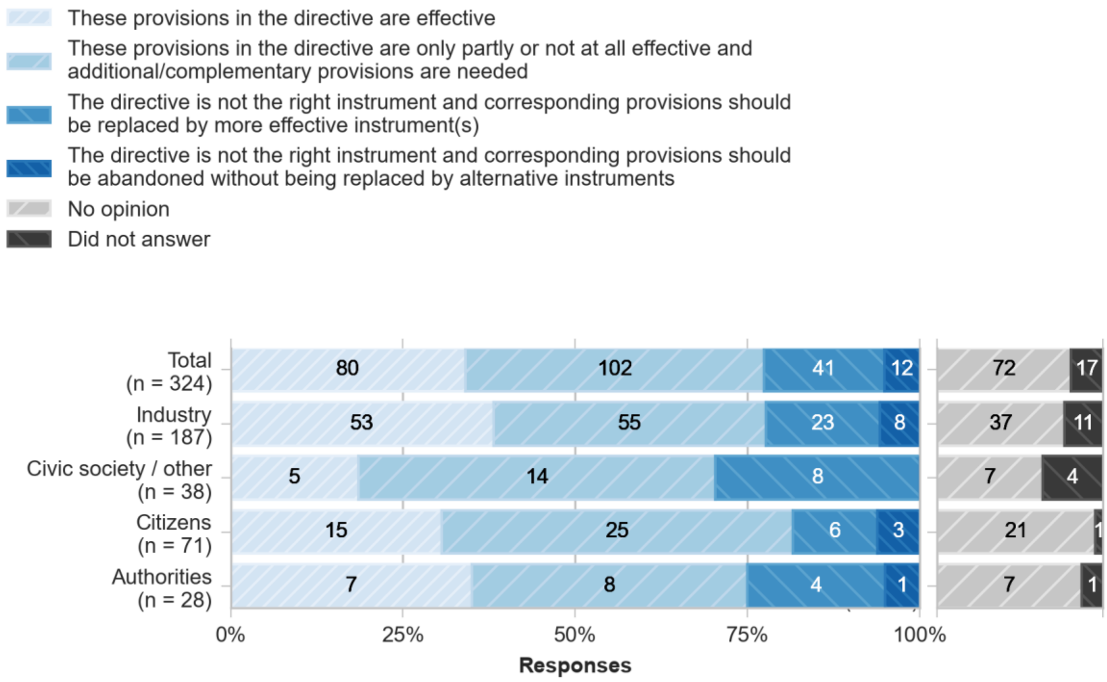
There were fewer additional comments from other types of stakeholder. Both of the two representatives of a ***consumer organisation*** that made an additional remark commented that the definition of what was meant by 'publicly accessible' or 'semi-public' infrastructure needed to be clarified. One of these called for the Directive to cover semi-public and private charging points, as an extended 'right to plug' and charging stations within buildings and on commercial properties should be covered by the Directive. The other called for infrastructure in commercial locations to be covered by the definition of semi-public, whereas infrastructure in residential locations should be excluded, as decisions on this should be left to the Member States. From the perspective of an ***NGO respondent***, the Directive should cover publicly available infrastructure on public or private land.

One of the three ***public authority*** respondents underlined that the Directive should cover public and private infrastructure as both were needed, even though they fulfilled different purposes. Another noted that it was important for companies to have certainty as to what fuel infrastructure was available to them, and if this required the Directive to apply to infrastructure at private locations, these should be included. Otherwise, it would be appropriate to limit the Directive to public and semi-public infrastructure, although a different regime could be applied to semi-public (and private), e.g. to only include some basic interoperability requirements. The final public authority respondent noted that there needed to be a clear definition of what was meant by semi-public infrastructure and that minimum requirements for such infrastructure needed to be set, paying particular attention to infrastructure for buses and at logistics hubs.

11.7.4.2.6 B6. In your view, are the current provisions in AFID effective in ensuring that consumers/users receive relevant, consistent and clear information on the compatibility of their vehicle engine/model with the alternative fuels/recharging options available at each refuelling/recharging point?

The Alternative Fuels Infrastructure Directive currently requires from Member States to ensure that relevant, consistent and clear information is made available to consumers/users as regards those motor vehicles which are fuelled with alternative fuels. Such information has to be made available in motor vehicle manuals, at refuelling and recharging points, on motor vehicles and in motor vehicle dealerships in their territory (Article 7). Respondents were asked 'In your view, are the current provisions in AFID effective in ensuring that consumers/users receive relevant, consistent and clear information on the compatibility of their vehicle engine/model with the alternative fuels/recharging options available at each refuelling/recharging point?' (see Figure 5-14). 80 respondents stated that these provisions are effective, 102 stated that they are only partly or not at all effective and additional complementary provisions are needed, 41 stated that the Directive is not the right instrument and corresponding provisions should be replaced by more effective instrument(s), and 8 stated that the Directive is not the right instrument and corresponding provisions should be abandoned without being replaced by more effective instrument(s), 72 did not have an opinion and 17 did not answer.

Figure 5-14: B6. In your view, are the current provisions in AFID effective in ensuring that consumers/users receive relevant, consistent and clear information on the compatibility of their vehicle engine/model with the alternative fuels/recharging options available at each refuelling/recharging point?



Thirty-five respondents expanded on their reasons for believing that ***the provisions in the Directive were effective***. Of the 12 responses from representatives of ***business associations***, there were four very similar repeated responses that underlined that consumer information was not needed for L-category users, as they were 'experienced consumers' (and a similar response was also received from three company respondents). Seven of the other respondents felt that the provisions were sufficient or effective, although some of these made additional suggestions. One respondent suggested that the Directive should prescribe that the information should also be made available electronically, while another noted that more information would be needed in relation to the 'next generation of charging stations', e.g. in relation to the state of the charge and the capacity of the battery, in order to enable smart charging. A third respondent proposed that, in relation to the information on hydrogen vehicles, the labelling requirements of the vehicle type-approval regulations (EU Regulations 79/2009/EC and 406/2010) could be aligned with those of EN 16964, in order to remove duplicate requirements.

From the perspective of the 18 representatives of a ***company / business organisation***, six commented that the consumer information provisions were effective or sufficient and four highlighted that the market and commercial interests should ensure that sufficient information was provided to consumers, while three noted that relevant standards had already been developed in various areas. Other responses noted that the problem was elsewhere, rather than with the provisions of the Directive, e.g. in relation to Member State implementation, the maturity of the market or the lack of recharging infrastructure. More specific comments came from two respondents, with one noting that it would be more appropriate for the fuel price comparison information to be put online, while another suggested that there was confusion around the presentation of the total cost of ownership, the use of which needed to be required by legislation.

From the perspective of other stakeholders, the only ***EU citizen*** and both representatives of ***public authorities*** that provided an additional comment suggested that the provisions were sufficient, although one of the latter commented that they had not yet been implemented. The one ***non-EU citizen*** suggested that there should be a mechanism, such as a bar code, that enabled users to access the information in all European languages, while the one ***NGO*** representative commented that the information on fuel price comparisons was probably more appropriate for the websites of car dealers, rather than providing this information at the recharging / refuelling point.

Seventy respondents who felt that the ***provisions were only partly or not at all effective and needed additional or complementary measures*** provided additional information to support their view.

Six respondents from ***business associations*** made reference to specific standards. Three made reference to EN 16942 on the provision of information on certain liquid and gaseous fuels (as did two company / business organisation representatives). One of these business association respondents noted that, of the fuels covered by the AFID, this standard did not cover electricity, while the four others (including the company / business organisation representatives) provided a very similar response that argued for the inclusion of a well-to-wheel approach to measure CO_2 emissions, after having referred to EN 16942. Two of three similar responses made reference to EN 17186 on harmonised labels for electrified car power supply, while two of these (and a very similar response from a company / business organisation) also referred to ISO 15118 on vehicle-to-grid communication interfaces. In relation to the former, the comment was that its voltage classes needed to be revised, while in relation to the latter it was underlined that the interoperability of new functions between the vehicle and the service provider should be assured in accordance with this standard.

Suggestions for additional means of communication included general awareness raising measures, such as media and educational campaigns (two responses), a website or app with the location of all recharging points around Europe (two responses from business associations, along with one company / business organisation representative), and providing information on fuel prices on a label attached to each newly sold vehicle.

Three respondents made comments in relation to the provision of information on fuel prices. One criticised the methodology as not being relevant, which made the end result confusing and useless, while another suggested that there were issues with respect to the way in which electricity prices were considered, implying that this needed to be differentiated by the way in which the vehicle had been charged. A third suggested that the information should be expressed in €/100 kilometre and be provided with and without taxes.

Additionally, two respondents suggested that there was a need for information on the capability of an electric vehicle to communicate with and provide services to the grid. Two other business association respondents (as well as three company / business organisation representatives) suggested that it was up to the manufacturers to provide more information to consumers, with two providing a similar response (one business association and one company) suggesting that only manufacturers were able to provide the consumer with information on the suitability of a vehicle for different fuels and/or chargers. The other three provided a similar response proposing that the information be provided to users by manufacturers via software updates. Another respondent suggested that the problem was not with the supply of information, but with the lack of maturity in the market.

Of the 25 representatives of a ***company / business organisation*** that provided further information to clarify their response, a number provided similar responses to a business association representative (see above).

Six other respondents made comments in relation to the type of information that needed to be provided. One suggested that the speed of charging was rarely clear and that important information on charging, such as the means of access to vehicle data or warranty clauses that limit charging patterns or bi-directional charging, were often hidden. Another called for the provision of a basic set of information relating to electromobility, including the connector/plug type compatibility, the maximum power recharging capacity of the vehicle and bidirectional charging functionality. Another representative of a company / business organisation called for information on the technical details, location and accessibility of infrastructure to be made more widely available (as did a very similar response from an organisation that was classified as 'Other'), along with the price, while another suggested that there was often a lack of clarity between the vehicle specifications and the refuelling options available at stations. Another respondent noted that there needed to be more consistent signage to indicate the options available at recharging points. Finally, a respondent called for more information to be made available in relation to the capacity to communicate between the vehicle and the grid.

In similar responses, two respondents made reference to Directive 2014/32/EU[88]. They noted that this Directive required that measurement device with a display showing the charged kWh should be installed at every charging station, whereas many charging stations did not have such a display. They argued that this provision made it illegal for providers to charge kWh prices at most EU charging stations, which needed to addressed in the AFID, e.g. by allowing for this information to be displayed on a mobile device or digital display.

Three respondents made comments in relation to the provision of price information to consumers. One argued that price transparency needed to be addressed urgently and called for there to be an agreement on a pricing unit for charging points, as there was for conventional fuels. Another called for more information about the price and origin of the electricity provided, while a third called for this information to be provided on the internet for each country.

Five respondents made comments specifically in relation to heavy-duty vehicles. Two of these called for more of a focus on HDVs more generally, while one called for more information on which vehicles could be converted to use the different ERS solutions. Another noted that the Directive did not cover buses, while another noted that it was sometimes difficult to obtain the approval of bus manufacturers to use alternative fuels, such as synthetic diesel, in their vehicles.

A number of different issues were raised by the 11 ***EU citizens*** who provided more information to support their response. Three called for there to be more information provided by dealers, with two suggesting that more training for dealers was important and one suggesting that manufacturers should also have to supply the correct information. In relation to electromobility, one EU citizen called for more information on what a consumer could expect in terms of charging time, charging power and cost, along with whether charging stations were actually in operation, while another noted that better information on charging speed would be important. Another EU citizen noted that it was often very complicated at charging stations, as the means of activation, price and charging power were often not clear.

More generally, two EU citizens called for better information as either the current information was too fragmented, or the information provided in existing manuals was insufficient. Another respondent called for a promised national platform in their country to be implemented, while another suggested that fuels that were a danger for either then environment or human health should carry a warning in the same way that cigarettes did.

There were fewer responses from other types of stakeholder. The one respondent from an ***academic / research institution*** called for the focus to be on electromobility, particularly around the use of charging infrastructure. Two of the four representatives

[88] Directive 2014/32/EU on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments

of ***consumer organisations*** noted that more information needed to be provided in relation to the characteristics of electric vehicles and how to charge these. One provided more detail, calling for labelling to be used to indicate the maximum power that an electric vehicle could accept, the Car Labelling Directive to be amended to ensure that information on electric cars (including real world driving range, maximum charging capacity and average charging time at maximum power) be communicated to consumers and that the Regulation on fuel price comparisons be properly enforced. Another welcomed a harmonised approach to the labelling of fuels and chargers across Europe, although called for Member States to ensure that these standards were applied, while another called for all labelling to use pictograms and keep any language simple.

One of the four ***NGO respondents*** considered that transparent and easy-to-compare pricing for charging was important, and that this information should be made available to consumers in a simple and coherent way. Another called for information to be made available on the content and origin of the fuels, and also proposed that, where possible, information on CO_2 emissions per kWh be provided for all fuels. The other two NGO respondents called for the requirements to be extended to cover other vehicles, with both mentioning buses and one also mentioning HDVs, taxis and coaches. Of the three representatives of organisations that they classified as ***'Other'***, one called for more education and another for strengthened provisions to avoid the potential for divergence between Member States. The one ***public authority*** respondent called for better access to reliable information, along with more training from dealers and a stronger ambition with respect to roaming that should be accessed through a single entry point, e.g. a website.

Twenty-seven respondents provided further information to support their view that the ***provisions relating to consumer awareness should be replaced by more effective instruments***. The most common issue raised by the nine representatives of ***business associations*** was the need for a life cycle approach to the presentation of the environmental performance of different fuels in order that consumers have a more accurate reflection of the environmental benefits of different fuels, with three of these highlighting gas and/or biogas in particular. In addition, two respondents called for more general measures to raise awareness of alternative fuels, while another underlined the important role of the dealer in providing relevant information to consumers. Finally, one respondent stated that they did not believe that providing price information for gas in the metric of '€/100 km' was the best way of communicating the price of gas to consumers.

As with business associations that believed that the provisions on consumer information should be replaced be more effective instruments, the most common issue that was raised by the eight representatives of a ***company / business organisation*** was the importance of a life cycle or well-to-wheel approach. Indeed, this point was raised by all eight respondents, in two sets of very similar responses, with six respondents highlighting the benefits of gas and/or biogas and one mentioning biofuels more generally.

The issue of the dealer was raised by the one representative of a ***consumer organisation***, who noted that in their country dealers generally were not interested in selling alternatively-fuelled vehicles. From the perspective of the three ***EU citizens***, one noted that rather than providing information to consumers, the focus should simply be on supplying only carbon-neutral fuels, another underlined the importance of a lifecycle approach (providing a very similar response to some of the company / business organisation representatives) and a third noted the inconsistencies in different countries with respect to whether dealers stated that biofuels could be used in a particular model of car and the challenges of providing information on fuel prices as taxes were continuously changing.

One of the two ***NGO*** representatives commented that there was a need to make information on recharging points more available, particularly in relation to their technical details, location and accessibility, as well as on their prices. The other welcomed the EN 17186:2019 standard on harmonised labels for electric car power supply, although called for more coherent labelling to be ensured across the EU, e.g. by means of a Regulation. Two of the three public authority respondents suggested that rather than providing information on compatibility, this should be enforced through standards. The other public authority respondent suggested that making price comparison information available in dealerships was probably more appropriate than providing this at refuelling stations.

Seven respondents provided more explanation as to why they felt the ***relevant provisions of the Directive should be abandoned***. One of the additional comments from the two ***business associations*** was that providing information on the compatibility of vehicle models with each recharging point was too large an administrative burden, given the range of charging protocols and vehicle models that were available. while the other called for the price comparison information to be made available as a tool on the internet in each Member State. A very similar response from one of the two representatives of a ***company / business organisation*** echoed this last point and also noted that it would be important that this information was easy to update in a cost-effective manner. The other respondent suggested that it was only the vehicle manufacturer that was able to provide the user with information about the suitability of charging capacities, connections and fuels for a particular vehicle, as a result of the range of vehicles that were available. From the perspective of ***EU citizens***, one noted that there was often a lack of appropriate knowledge in local registration vehicle offices, while another called for a simplification of the approach to recharging electric cars, as there was currently too much variation in terms of sockets, recharging speeds and payment options. Finally, a public authority respondent noted that there was no need to indicate the type of fuel to be used for vehicles that were not intended for public use.

Finally, nine respondents that had not ***expressed an opinion*** on the question provided additional comments. The one ***business association*** respondent underlined that it was important that information regarding vehicles and alternative fuels was clear, simple and easy to understand, as well as being easy to find. From the perspective of the four representatives of a ***company / business organisation***, one noted that L-category vehicle users were sufficiently aware of technology, so providing the relevant information in the operating instructions would be sufficient. Other responses underlined that it was necessary for AFI to rely on existing standards, argued that the scope of the Directive should be expanded with strengthened provisions for the deployment of AFI for public passenger transport and that it was important not to over-regulate. The only additional response from an ***EU citizen*** was that it was important to simplify the process so that fair roaming charges were applied. One of the three ***public authority*** respondents underlined that interoperability and the provision of price information were important, while for electric vehicles open and non-discriminatory access to publicly available infrastructure was of fundamental importance. Of the other two respondents, one noted that it was important to expand the scope of the Directive to railways, while the other noted that more attention should be paid to recharging points at apartments and at work locations.

11.7.5Analysis of OPC responses – Impact Assessment

Sections C, D, E and F of the OPC relate to the Impact Assessment support study. The analysis relating to these sections is presented here. Questions are numbered C1 to C6, D1 to D30, E31 and F32

11.7.5.1 SECTION C: Main problems

11.7.5.1.1 C1. Are the National Policy Frameworks the adequate instrument to ensure that a sufficient number of publicly accessible infrastructure will be deployed over the next decade?

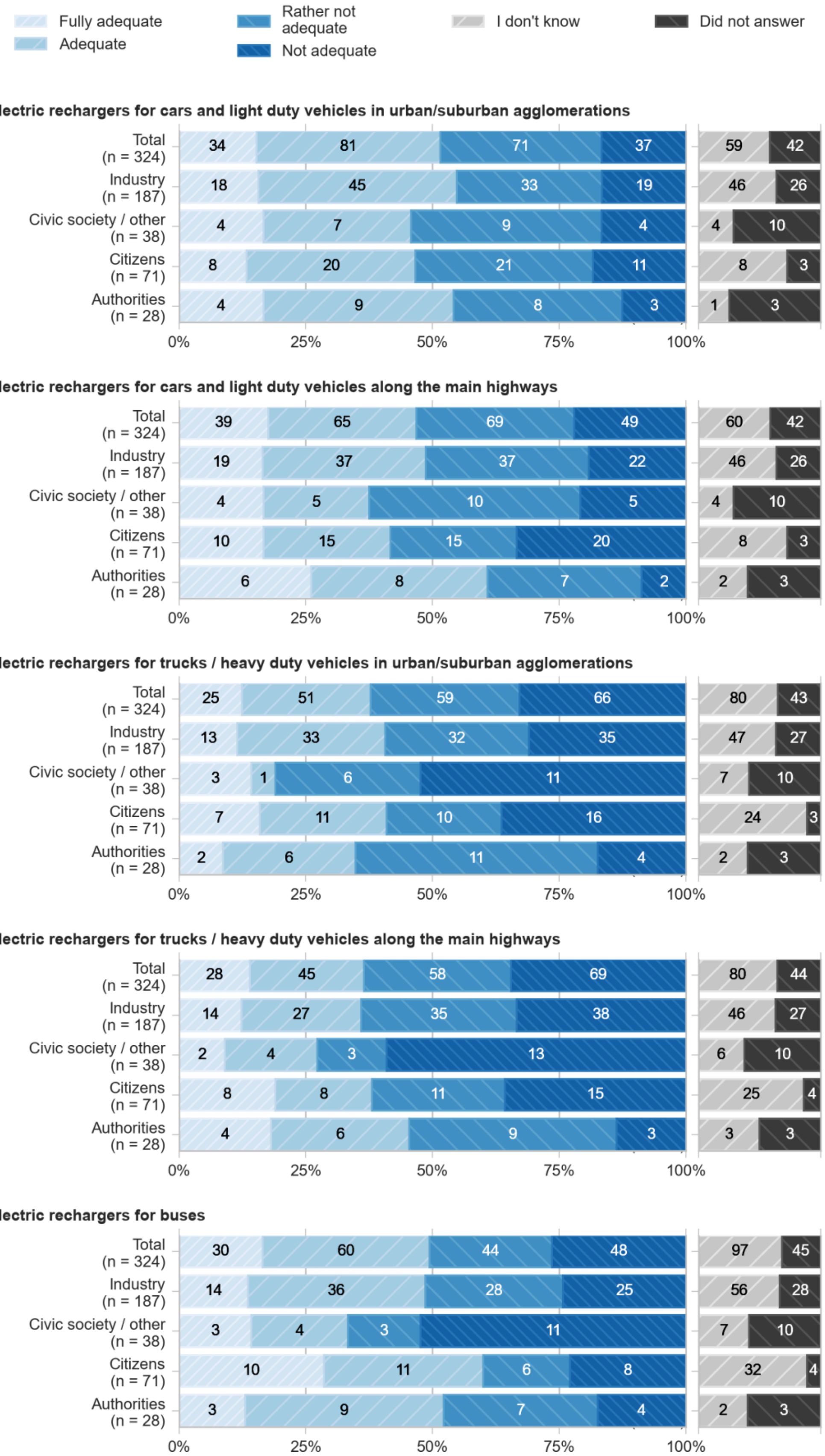
A rapid uptake of alternatively fuelled vehicles and vessels is expected in the next decade. For example, the European Green Deal considers it likely that by 2025 around 13 million zero and low emission vehicles will circulate on roads. Respondents were asked, in their view, are the National Policy Frameworks (NPFs) the adequate instrument to ensure that a sufficient number of publicly accessible infrastructure will be deployed over the next decade (see Figure 6-1).

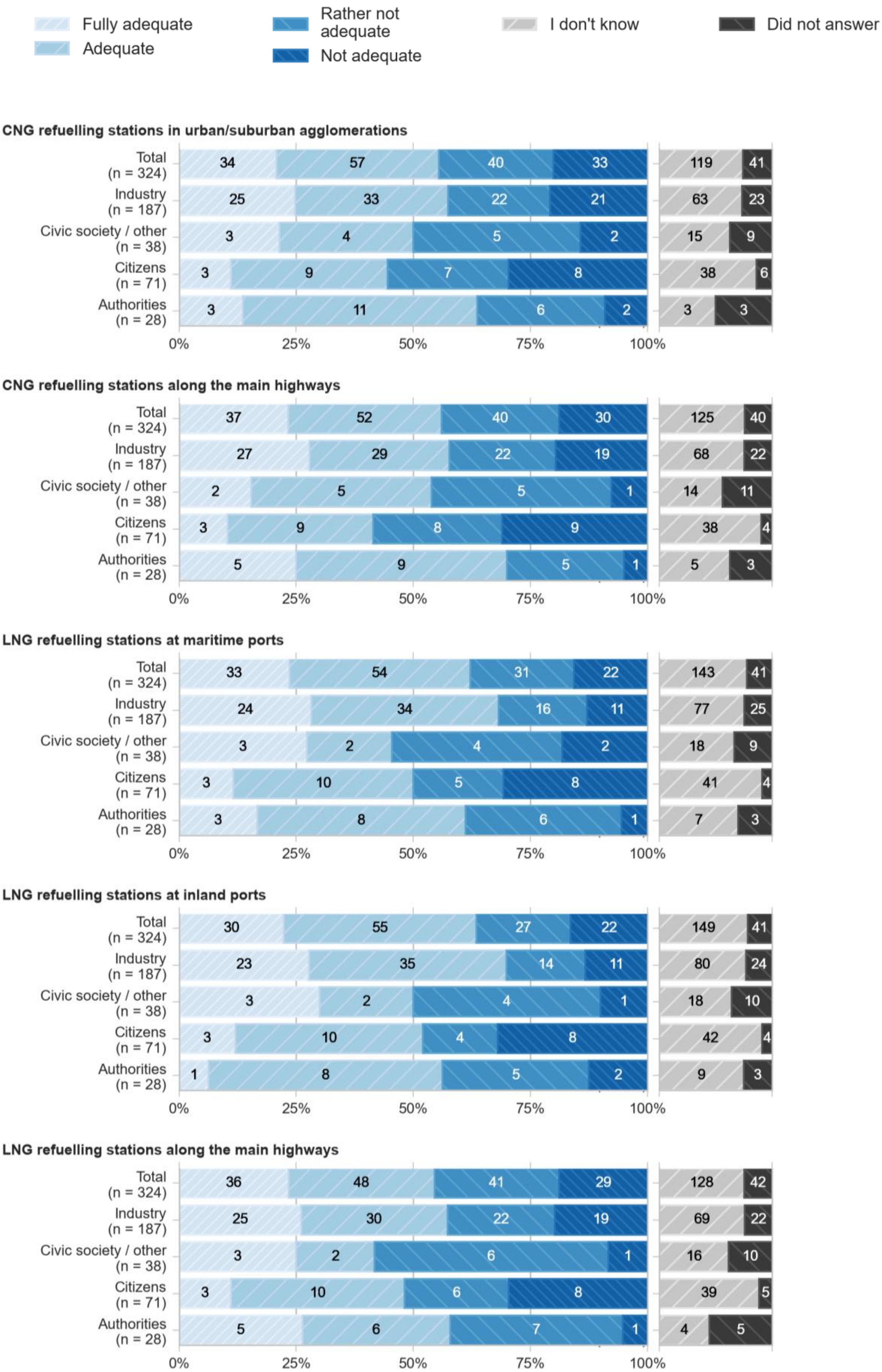
In most cases there are a wide variety of views (both agreeing and disagreeing) regarding whether NPFs are an adequate instrument for the sufficient deployment of public AFI. NPFs are considered to be most adequate ('fully' or 'adequate') for electric rechargers for cars and light duty vehicles (LDVs) in urban/suburban agglomerations (115 out if 282 respondents, with 59 stating 'don't know'). However, the majority of stakeholders responded that NPFs were not adequate ('rather not adequate' or not adequate') for the sufficient deployment of electric rechargers for cars and LDVs along the main highway (118 out of 282); trucks/heavy duty vehicles (HDVs) in urban/suburban agglomerations (125 out of 281), trucks/HDVs along the main highways (127 out of 280) and for buses (92 out if 279).

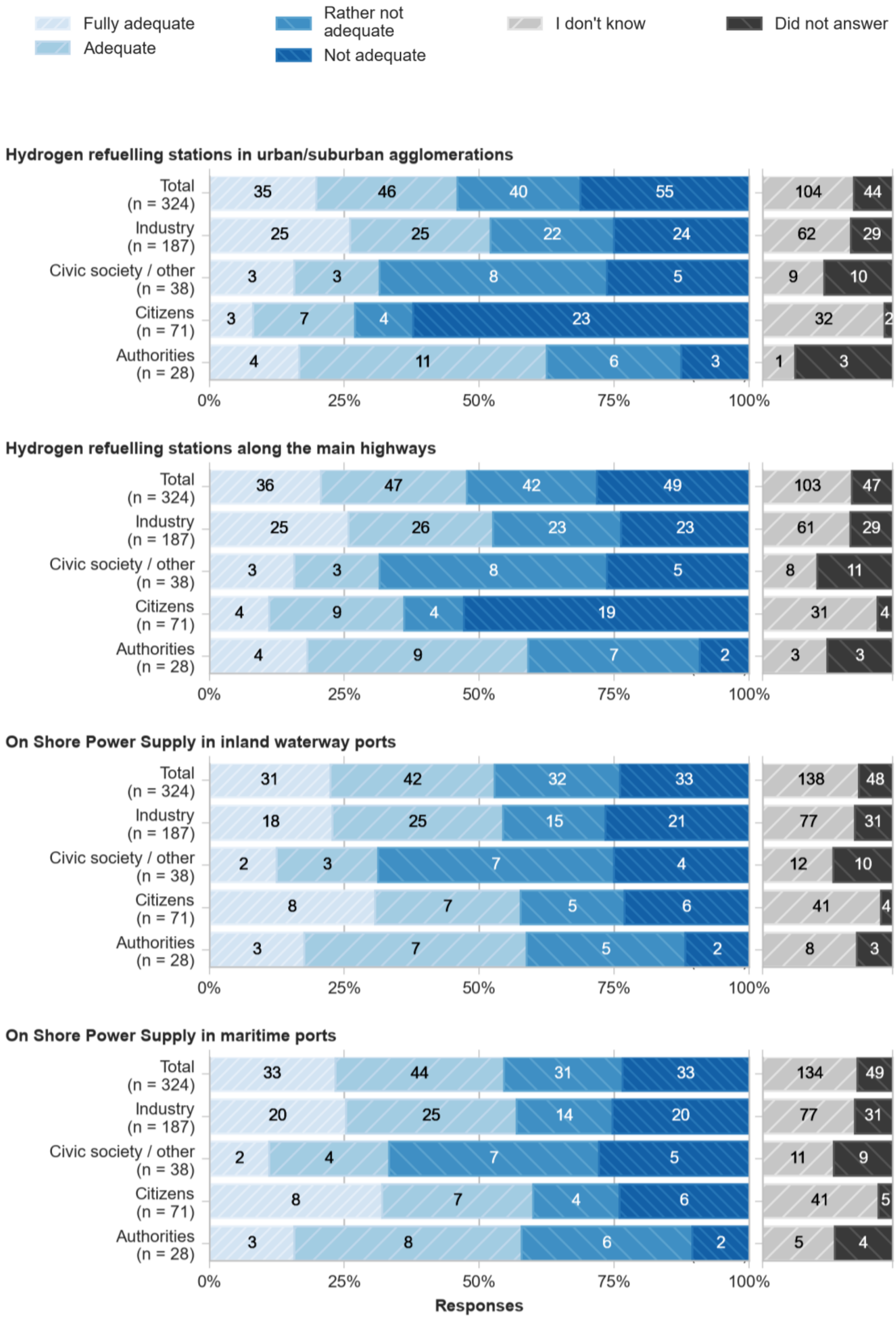
There was a high level of uncertainty about the adequacy of NPFs for delivering CNG and LNG infrastructure (between 119 and 149 respondents out of 280+ responded that they did not know), but of those that stated an opinion, the majority agreed that they were adequate.

The level of uncertainty for hydrogen and onshore power supply was also in the majority for respondents. Of those that stated an opinion, slightly more respondents stated that NPFs were not adequate for the sufficient deployment of hydrogen refueling stations in urban/suburban agglomeration (95 out of 208 respondents), and along the main highway (91 out of 272 respondents). Slightly more respondents stated that NPFs were adequate for the sufficient deployment of on shore power supply in inland maritime ports (73 out of 276) and maritime ports (77 out if 275).

Figure 6-1: C1. In your view, are the National Policy Frameworks the adequate instrument to ensure that a sufficient number of publicly accessible infrastructure will be deployed over the next decade?



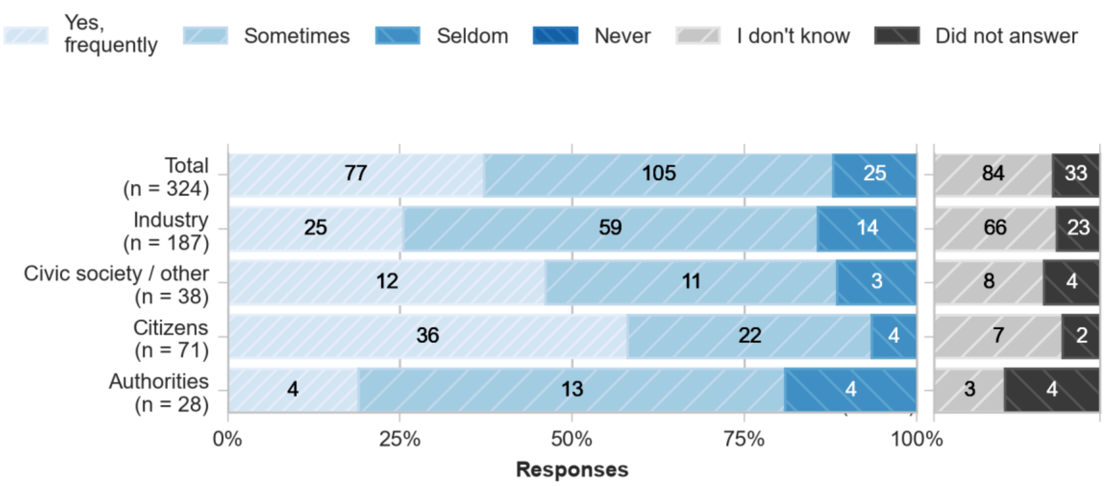

Fully adequate
Adequate
Rather not adequate
Not adequate
I don't know
Did not answer
CNG refuelling stations in urban/suburban agglomerations
Total (n = 324) 34 57 40 33 119 41
Industry (n = 187) 25 33 22 21 63 23
Civic society / other (n = 38) 3 4 5 2 15 9
Citizens (n = 71) 3 9 7 8 38 6
Authorities (n = 28) 3 11 6 2 3 3
0% 25% 50% 75% 100%
CNG refuelling stations along the main highways
Total (n = 324) 37 52 40 30 125 40
Industry (n = 187) 27 29 22 19 68 22
Civic society / other (n = 38) 2 5 5 1 14 11
Citizens (n = 71) 3 9 8 9 38 4
Authorities (n = 28) 5 9 5 1 5 3
0% 25% 50% 75% 100%
LNG refuelling stations at maritime ports
Total (n = 324) 33 54 31 22 143 41
Industry (n = 187) 24 34 16 11 77 25
Civic society / other (n = 38) 3 2 4 2 18 9
Citizens (n = 71) 3 10 5 8 41 4
Authorities (n = 28) 3 8 6 1 7 3
0% 25% 50% 75% 100%
LNG refuelling stations at inland ports
Total (n = 324) 30 55 27 22 149 41
Industry (n = 187) 23 35 14 11 80 24
Civic society / other (n = 38) 3 2 4 1 18 10
Citizens (n = 71) 3 10 4 8 42 4
Authorities (n = 28) 1 8 5 2 9 3
0% 25% 50% 75% 100%
LNG refuelling stations along the main highways
Total (n = 324) 36 48 41 29 128 42
Industry (n = 187) 25 30 22 19 69 22
Civic society / other (n = 38) 3 2 6 1 16 10
Citizens (n = 71) 3 10 6 8 39 5
Authorities (n = 28) 5 6 7 1 4 5
0% 25% 50% 75% 100%


Fully adequate
Adequate
Rather not adequate
Not adequate
I don't know
Did not answer
Hydrogen refuelling stations in urban/suburban agglomerations
Total (n = 324)
35 46 40 55 104 44
Industry (n = 187)
25 25 22 24 62 29
Civic society / other (n = 38)
3 3 8 5 9 10
Citizens (n = 71)
3 7 4 23 32 2
Authorities (n = 28)
4 11 6 3 1 3
Hydrogen refuelling stations along the main highways
Total (n = 324)
36 47 42 49 103 47
Industry (n = 187)
25 26 23 23 61 29
Civic society / other (n = 38)
3 3 8 5 8 11
Citizens (n = 71)
4 9 4 19 31 4
Authorities (n = 28)
4 9 7 2 3 3
On Shore Power Supply in inland waterway ports
Total (n = 324)
31 42 32 33 138 48
Industry (n = 187)
18 25 15 21 77 31
Civic society / other (n = 38)
2 3 7 4 12 10
Citizens (n = 71)
8 7 5 6 41 4
Authorities (n = 28)
3 7 5 2 8 3
On Shore Power Supply in maritime ports
Total (n = 324)
33 44 31 33 134 49
Industry (n = 187)
20 25 14 20 77 31
Civic society / other (n = 38)
2 4 7 5 11 9
Citizens (n = 71)
8 7 4 6 41 5
Authorities (n = 28)
3 8 6 2 5 4
0% 25% 50% 75% 100%
Responses

11.7.5.1.2 C2. Do users of electric vehicles face problems when it comes to payments when charging their vehicles at re-charging points operated by an entity with which the user does not have a contract?

Respondents were asked whether users of electric vehicles face problems when it comes to payments when charging their vehicles at re-charging points operated by an entity with which the user does not have a contract (see Figure 6-2). The majority of respondents that answered were in consensus that there are always at least some problems with these payments for electric vehicle drivers and that problems were more frequent than seldom, but with differing degrees of incidence. 105 out of 291 responded 'sometimes', with 77 responding 'frequently'. The smallest proportion of responses indicated that were seldom problems and this was consistent across all stakeholder groupings. The groupings were then split between the remaining two answers 'yes, frequently' and 'sometimes'. Civil society indicated a slight *preference* to 'yes, frequently' with 12 out of 34 responses in comparison with 11 responses for 'sometimes' whilst citizens leaned much more heavily to 'yes, frequently' with 36 responses out of 69 with only 22 selecting 'sometimes'. Both industry and authorities, however, indicated more towards the problem only being sometimes rather than frequently.

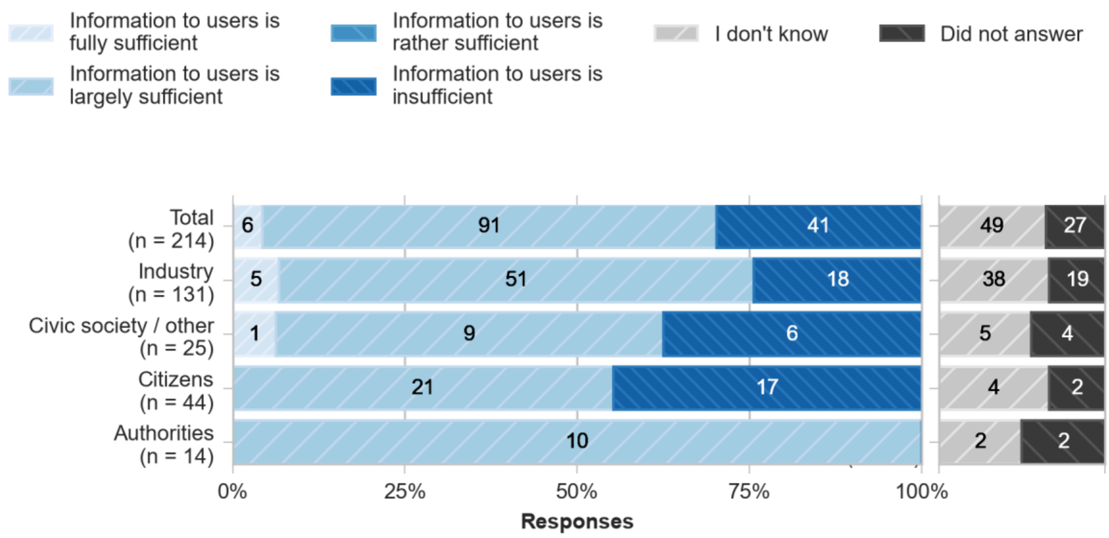
Figure 6-2: C2. In your opinion, do users of electric vehicles face problems when it comes to payments when charging their vehicles at re-charging points operated by an entity with which the user does not have a contract?



11.7.5.1.3 C3. Is the information that is currently provided on location, availability, etc. of re-charging and re-fuelling points sufficient to cover the needs of the user?

Respondents were asked whether the information that is currently provided on location, availability, etc. of re-charging and re-fuelling points is sufficient to cover the needs of the user (see Figure 6-3). Overall, responses tended towards the current information on re-charging and re-fuelling points being sufficient for the needs of the user with 97 out of 187 stating that information is either fully or largely sufficient. However, nearly one quarter of respondents stated that the information to users is insufficient (41 out of 187). 49 stated that they did not know. Response from across the stakeholder groups were largely consistent, with the majority of responses in each group being 'largely sufficient'. There was slightly less agreement from citizens and civic society, with 17 out of 42 and 6 out of 20 responding respectively that 'information to users was insufficient'.

Figure 6-3: C3. In your view and experience, is the information that is currently provided on location, availability, etc. of re-charging and re-fuelling points sufficient to cover the needs of the user?



11.7.5.1.4 C4. The Commission assessment of the national policy frameworks developed under the Directive shows a variety of approaches to setting targets, objectives and supportive actions. Please indicate to what extent do you agree with the following observations?

Stakeholders were asked to what extent they agreed with the three statements in relation to the variety of approaches to setting targets, objectives and supportive actions shown in the Commission assessment of the National Policy Frameworks (NPFs) developed under the Directive. Stakeholders largely agreed on each of the three listed statements (see Figure 6-4).

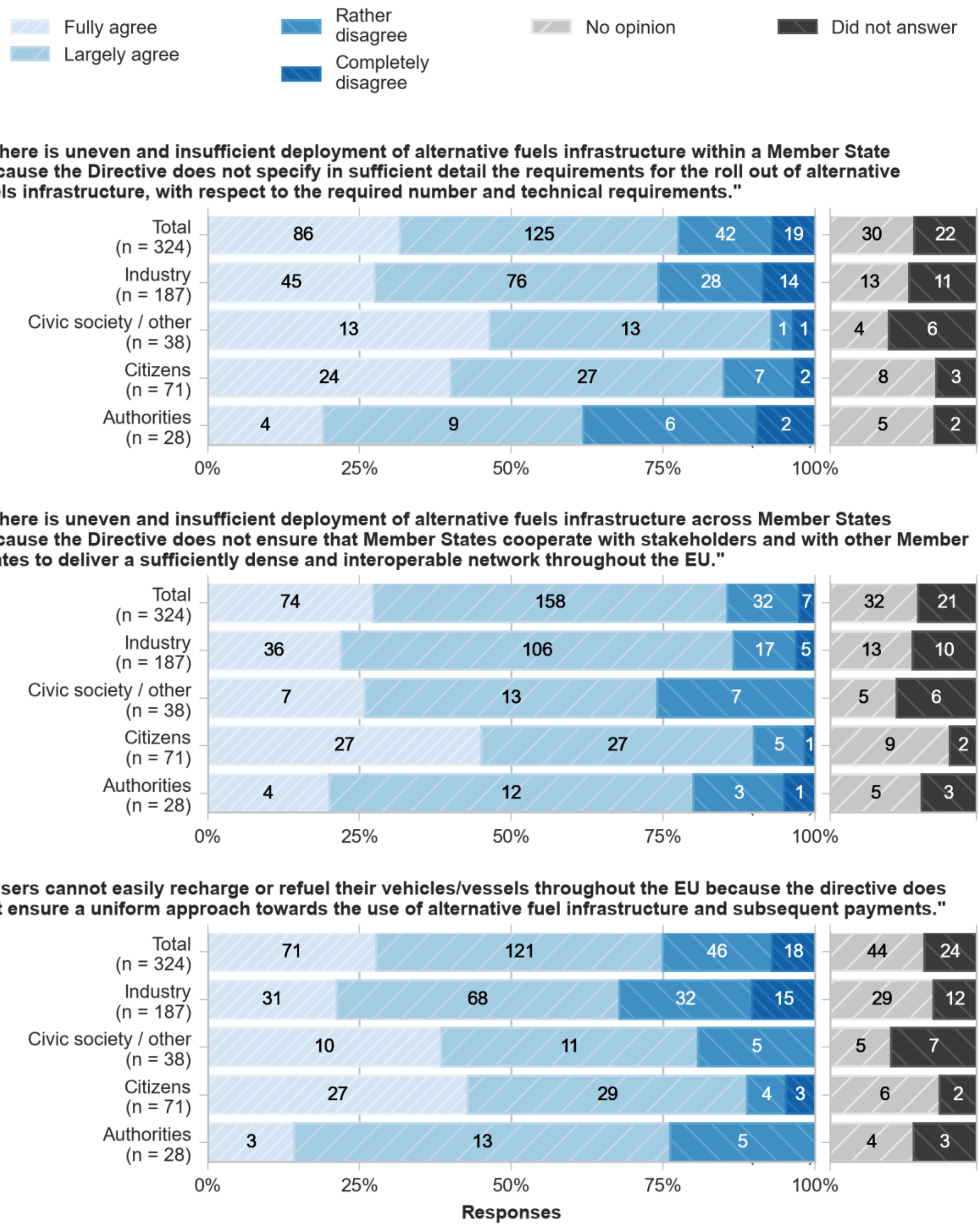
The majority of respondents (211 out of 302) agreed with the statement '*there is uneven and insufficient deployment of alternative fuels infrastructure within a Member State because the Directive does not specify in sufficient detail the requirements for the roll out of alternative fuels infrastructure, with respect to the required number and technical requirements*'. 61 disagreed and 30 did not express an opinion. Civic society stakeholders displayed the highest level of agreement (26 out of 32).

With respect to '*there is uneven and insufficient deployment of alternative fuels infrastructure across Member States because the Directive does not ensure that Member States cooperate with stakeholders and with other Member States to deliver a sufficiently dense and interoperable network throughout the EU'*, the majority of respondents (232(out of 303) agreed with the statement. Citizens displayed the highest level of agreement within their group, with 54 out of 69 agreeing.

The majority of respondents (192 out of 300 respondents) agreed that '*users cannot easily recharge or refuel their vehicles/vessels throughout the EU because the directive does not ensure a uniform approach towards the use of alternative fuel infrastructure and subsequent payments'*. Again, citizens displayed the highest level of agreement (56 out of 69 respondents).

Figure 6-4: C4. The Commission assessment of the national policy frameworks developed under the Directive shows a variety of approaches to setting

targets, objectives and supportive actions. Please indicate to what extent do you agree with the following observations?



11.7.5.1.5 C5: In your view, are there any other causes of the limited impact of the Directive?

In total, 196 respondents provided their views on why the Directive had had a limited impact. Of these, 62 were representatives of a business association and 79 were from either a company or a business organisation. These covered similar issues, and also contained some coordinated responses, so are analysed together.

One of the most common reasons provided was inconsistency between EU polices. In particular, there were sixteen responses (five from business associations and eleven representatives of companies / business organisations) that commented that ***the CO_2 Regulations for road transport vehicles pushed manufacturers away from fuels that were covered in the AFID,*** with many explicitly mentioning LNG, CNG or biomethane in this content. Five of these responses underlined the need for technology neutrality and called for a WTW approach for assessing emissions from the relevant EU policies. Ten of these respondents noted that, while investment in LNG refuelling infrastructure was still high, it still needed support through dedicated funding as the market was not yet sufficiently mature to supply LNG to transport, while eight mentioned infrastructure specifically for inland navigation in this context.

In addition, some of these responses made additional points. Three noted that the recommendations of the report of the Technical Expert Group (TEG) that is supporting the development of the Sustainable Finance Regulation were not consistent with the fuels covered in the AFID, as LNG and CNG refuelling stations were only considered to be sustainable in the TEG's report if they supplied certain biofuels. Other comments that were made included a single respondent in each case mentioning that: the standard (2%) for the proportion of hydrogen to be blended with natural gas was too high; the importance of financial support for hydrogen refuelling stations; and for more ambitious targets and implementation measures for hydrogen in the AFID. Others said that it was important to recognise that the gas that was transported in natural gas pipelines already included a share of biomethane and proposed that the lack of cars on the market that were able to use biomethane undermined the effectiveness of the AFID. In addition, two called for there to be targets for the deployment of infrastructure beyond the TEN-T and another that the Directive should include guidance for providing financial support to the deployment of infrastructure in the context of the national policy frameworks (NPFs).

Two other responses were similar to those mentioned above as they both raised the same issues with respect to LNG infrastructure (and one highlighting infrastructure for inland navigation in particular), although did not criticise EU policies for their inconsistency. The first of these also underlined that LNG helped to reduce air pollutant emissions and that LNG infrastructure would also support the supply of bioLNG and synthetic LNG. Furthermore, they criticised the complex governance procedures in Member States and called for the harmonisation of these at the European level and for the infrastructure to benefit from a 'fast-track procedure'. The second called for a more proactive approach to monitoring Member States' implementation of their NPFs, as well as fiscal support for consumers, incentives for manufacturers, support for projects close to centres of demand (such as for bioLNG liquefaction) and better alignment with other policies, including the Renewable Energy Directive (RED), the Energy Performance of Buildings Directive (EPBD) and the Emissions Trading Directive.

Other responses also referred to the CO_2 standards as an issue. A response from a business association noted that, while the Directive had led to Member States developing targets for the deployment of alternative fuel infrastructure, the CO_2 standards for vehicles encouraged manufacturers to develop certain technologies, rather than all of those that had the potential to provide clean solutions for road transport. The last point was reiterated in a similar response from two respondents (a business association and a representative of a company / business organisation). A similar point was also raised by another respondent, i.e. that the tailpipe-based standards in the vehicle CO_2 standards Regulations forced manufacturers to focus on battery electric and plug-in hybrid vehicles, thus leaving limited scope for gas vehicles in their respective business models.

In similar responses, two representatives of a company / business organisation made reference to Directive 2014/32/EU[89], particularly that that Directive required that

[89] Directive 2014/32/EU on the harmonisation of the laws of the Member States relating to the making available on the market of measuring instruments

measurement devices with a display showing the charged kWh should be installed at every charging station, whereas many charging stations did not have such a display. They argued that this provision made it illegal for providers to use prices relating to kWh at most EU charging stations, which needed to be addressed in the AFID, e.g. by allowing for this information to be displayed on a mobile device or digital display. Both respondents also commented that, while under the AFID 'electric vehicle charging' is seen as a service, under EU tax law it is seen as 'electricity supply'. This means that e-mobility providers have to have a registered business in every Member State, otherwise their customers would not be allowed to charge at charging stations outside of the country in which they have their contract. Again, this was something that they called on the AFID to address. One of these responses also noted that the Electricity Market Design Directive made it difficult for Distribution System Operators (DSOs) to build and operate neutral charging infrastructures, which meant that there was no guaranteed geographical coverage within their distribution area and that insufficient investments were being made. Another representative of a company / business organisation association noted that the different taxation rates on electric vehicles, infrastructure, business travel and fuels between Member States influenced the different levels of take up of alternative fuels, as can be seen in the Netherlands and Norway.

Sixteen responses – nine from business associations and seven representatives of a company / business organisation – that differed in most other elements mentioned the ***absence of binding or mandatory targets as one of the main problems***. Within these 15 responses, three similar responses also noted that the different fuels were not subject to the same taxes, which negatively affected electricity (in relation to the use of electricity for shore-to-ship electricity connections), while two of these also raised a lack of coordination between the NPFs. One of these three highlighted that it was important for Member States to take the same approach to the provision of alternative fuels infrastructure in cross-border road transport corridors, while another noted that it was still not yet clear which alternative fuel was best suited for ships and even doubted whether the maritime sector on its own would be able to create a sufficient market without the respective fuels being used in other sectors.

A common theme amongst other respondents that supported binding targets was the need for criteria to be developed as the basis for deploying infrastructure across the road transport network, which was mentioned by three of these respondents. In addition, more effective monitoring of Member States' implementation of the Directive was proposed by four, the importance of sanctions/enforcement relating to the implementation of the NPFs was mentioned twice, while the need for more cooperation, either between national or regional authorities, was mentioned three times. The absence of requirements for heavy duty vehicles in the Directive and the need for more consideration of the consumer's perspective (dynamic pricing, harmonisation of ad hoc payments, etc) was explicitly noted by two of these respondents. Two of these respondents also called for more differentiation between the different types of charging infrastructure by their power and two also called for more attention to non-public charging infrastructure, as most charging was either done at home or at work, with one of these calling for either the AFID or the EPBD to address this. Another of these respondents argued that a robust framework for electromobility was needed, which included mandatory infrastructure deployment targets to cover the TEN-T comprehensive network and for charging on private grounds and in buildings to be covered in AFID to make up for the weak requirements of the EPBD. They also called for the time period for the approval and permitting procedures to be shortened and for incentives for grid connections and electrical system reinforcements.

Other issues raised by these respondents included the importance of incentives, or targets, to stimulate the demand for zero emission vehicles, that smart charging should be made mandatory and that EU and Member State funding and tax policies should be aligned with the aim of delivering climate neutrality by 2050. In addition, it was suggested that requirements for hydrogen should be mandatory rather than voluntary within the Directive and that a mandatory standard for authentication and payments be introduced.

Seven respondents – two representing business associations and five companies / business organisations – called for the AFID to be transformed into a Regulation, so that it would be more binding overall at the national level.

While not explicitly mentioning a lack of binding or mandatory targets, other respondents raised issues about ***enforcement and sanctions***. A respondent from a business association commented that without penalties or incentives for Member States, the Directive was not considered to be a priority by some national authorities, while another called for the Directive to be complemented by clear requirements for Member States, including who was responsible for providing the specified infrastructure, how and by when, as well as mechanisms to ensure the sustainability of investment. Other business associations blamed the lack of impact of the Directive on a lack of accountability, a lack of monitoring and enforcement of the provisions of the Directive, or on a lack of enforcement and sanctions. A similar response from a business association and a representative of a company / business organisation also noted the limited enforcement under the Directive as a reason for its lack of impact, while another company / business organisation called for there to be stricter requirements. Other representatives of a company / business organisation made more general remarks, with one calling for a "more structured governance structure at all levels (EU, within Member States and also involving local administrations) and another saying that the directive was too vague and provides too much leeway.

Some respondents provided ***comprehensive responses*** as to what they saw as the problem with the Directive, or with the role of the directive more generally. A business association felt that the reasons for the Directive's limited impact were the lack of demand-side measures, market barriers resulting from the adoption of incoherent national and local measures and a lack of a level playing field, as the costs and risks involved in deploying infrastructure put off smaller operators from entering the market (incentives were needed to overcome this). The lack of demand-side measures was also mentioned by a representative of a company / business organisation, who called for fiscal support for consumers and incentives for manufacturers to build more affordable and better alternatively-fuelled vehicles, along with a better alignment of EU legislation, such as the CO_2 standards for vehicles, the EPBD, RED, Electricity Market Design Directive and the Energy Taxation Directive (ETD). A representative of a company / business organisation felt that the limited impact could be explained by the low numbers of electric vehicles in use, the fragmented charging landscape, an immature market and there being different rules to enter and operate in different Member States, along with different levels of engagement from Member States themselves.

A business association underlined that the AFID was only one component in the policy framework, which needed to provide a coherent approach, supported by incentives and grants. In order to develop the market for hydrogen and synthetic fuels they called for renewable energy to be treated differently from the perspective of taxation, for the role of renewable fuels to be recognised in the respective CO_2 emissions performance standards Regulations and for relevant practical provisions to be developed under the RED. For electromobility, they called for the development of standards to ensure interoperability, particularly e-roaming, and for criteria to ensure the quality of infrastructure. A representative of a company / business organisation believed that the AFID had so far failed to ensure an adequate number of fast charging stations where these were needed, and so called for Member States to be required to develop suitable 'site-allocation' strategies to ensure that this was addressed. They also called for the procedures for allocating permits to operate new fast charging stations to be made more transparent and open to new market players. A business association noted that there were still barriers to connecting stations to power infrastructure, as well as various legal and fiscal barriers.

Four respondents – covering two sets of similar responses, both of which were provided by a business association and a representative of a company / business organisation – felt that the Directive ***focused too much on the TEN-T corridors*** at the expense of other areas. One of this set of responses singled out urban areas as somewhere where more action was needed to deploy recharging points, and they called for a set of minimum requirements (for access, operation and interoperability) for publicly accessible charging stations.

Other respondents – one business association and seven representatives of a company / business organisation – felt that the ***lack of consistency of implementation in the Member States*** was a reason for the lack of impact of the Directive. Half of these respondents also felt that the various national targets were not sufficiently ambitious. Three similar responses also highlighted that enforcement of the Directive was insufficient and that there was insufficient coordination between Member States across borders. One of these also noted that public tendering often effectively disqualified those with more innovative charging solutions, which should be addressed in the AFID. Another response underlined that Member States' deployment plans often did not reflect market developments, and so the revised Directive should set minimum and mandatory objectives for the provision of basic charging infrastructure. Another representative of a company / business organisation noted that the methodologies used in Member States to set their targets were different and that Member States also relied to a large extent on the EPBD for providing publicly accessible charging points and charging points in buildings.

Some respondents, either explicitly or implicitly, criticised a ***lack of national action***. One business association said that there was an urgent need to expand the number of recharging points on the roads in Spain, while another noted that the impact of the Directive depended on the ambition of the respective NPFs. One representative of a company / business organisation implied that Member States had generally taken a passive approach and that the conflicting interests of private companies and public entities had hindered the delivery of common goals, while another blamed the lack of investment from industry and a lack of consumer acceptance.

Two respondents called for there to be ***more coordination*** <u>**within**</u> ***Member States*** when implementing the necessary infrastructure. A business association noted that infrastructure is costly, so the solutions needed to be affordable for all stakeholders and be supported by the necessary policies that affect vehicles, fuels, infrastructure and consumer choices. Otherwise, the impact of the Directive will be limited. A representative of a company / business organisation noted that local and regional authorities had an important strategic role to play in planning for the deployment of public recharging stations, but that this role was not sufficiently taken into account in the Directive. Hence, Member States should be encouraged to work closely with local authorities when setting the targets for the deployment of public recharging stations.

Other respondents highlighted that an issue was the ***lack of an adequate methodology for understanding the level of deployment that was appropriate***. Two similar responses, from a business association and a representative of a company / business organisation, noted that there had been extremely limited engagement with local stakeholders to date, and called for more differentiation in the Directive between the requirements of different vehicle segments and for the Directive to harmonise what is communicated to consumers and how.

In relation to the ***inclusion of standards*** in the Directive, a couple of similar responses (one from a business association and the other from a representative of a company / business organisation) suggested that some of the technology requirements in the Directive had been mandated prematurely, which disadvantages incumbent technologies, such as CHAdeMO. Two similar responses from business associations called for the EU to ensure interoperable technical standards for electric vehicles and electric vehicle supply equipment. One of these also called for the application of ISO15118 for vehicle to grid connections, enhanced standards for combined charging systems and for harmonised, non-discriminatory, EU-wide access to charging networks. Another business association called for all of the remaining (missing) technical standards to be put in place as soon as possible, including those for high-power electric charging (above 150 kW for cars and commercial vehicles), minimum standards for DC chargers (to support a voltage range of at least 200-920 volts), electric buses and high-power charging for commercial vehicles (of between 1-3 MW). In addition, they called for guidance on the application of ISO15118 to ensure its coherent application and the definition of criteria to ensure the interoperability and quality of payment services. Another representative of a company / business organisation called for more clarity in general at the European level on standards and labels.

In their individual responses, five representatives of a company / business organisation made comments relating to the ***cost of infrastructure***. One of these noted that who pays remained a challenge, as infrastructure was costly, another noted that as investment was high, funding was needed to support deployment and a third that more financial support would speed up the deployment of infrastructure. Another respondent noted that it was important that the provision of alternative fuel infrastructure remained eligible for support from EU funding, while another suggested that Member States had not allocated sufficient financial resources to the initiatives that they had set out in their NPFs, particularly in the eastern Member States. Another respondent called for the Connecting Europe Facility (CEF) to be extended to support the deployment of infrastructure on the comprehensive TEN-T network, as this was not sufficiently addressed in Member States' NPFs.

For some respondents, the reason for the lack of impact of the Directive related to the ***consumer experience***. In particular, the fact that users have to be prepared for many different payment options was identified as an issue by one respondent from a business association and four representatives of a company / business organisation. One of these respondents underlined that there should be "as low a threshold as possible" to enable consumers to pay for charging their vehicles, while another also suggested that obtaining real-time information about the location and status of charging points was difficult. Four respondents made more general points about the importance of improving interoperability, calling for requirements or standards on access, operation and interoperability. Another noted that the Directive made no distinction between the differing needs of consumers in rural and urban areas, while also suggesting that the definition of, and the technical standards relating to, publicly accessible charging points needed to be tightened.

A similar response from a business association and two representatives of a company / business organisation suggested that ***the lack of attractive mass market alternatively-fuelled vehicles*** was hampering their uptake, which in turn was adversely affecting the deployment of the necessary fuel infrastructure. These responses noted that the main policy drivers for clean vehicles were the CO_2 emissions standards and the Clean Vehicle Directive (CVD), neither of which sufficiently recognised the potential benefits of gas-powered vehicles in reducing transport's emissions (as noted by other respondents – see above). In addition, two of these respondents noted that the benefits of plug-in hybrids were overestimated as they were usually used in their electric mode to a limited extent and that hydrogen was not yet widely available as a transport fuel. In addition, one also noted that the development of the charging network for electromobility was not paying sufficient attention to user behaviour or the way in which battery technology was developing. Another company / business organisation thought that the main issue was the lack of availability of electric vehicles on the market, which meant that the deployment of recharging infrastructure was slow. Additionally, fiscal incentives could be put in place to ensure that AFI was put in place when the use of electric vehicles did increase.

A number of respondents focused their comments on one or more ***fuels or energy sources***. Four of these responses focused on electromobility. A representative of a company / business organisation noted that the biggest problem was in providing charging points to multi-occupancy buildings (either residential or commercial), while noting that there was also a need for more kerbside charging. They also suggested that Member States often add extra requirements for these, which reduces the effectiveness of the Directive. Other respondents called for the diversity of recharging infrastructure to be reflected in the Directive and for the promotion of a market for electromobility services, while one argued that there had been a market failure in Germany as a result of the emergence of regional monopolies of charging station providers. A company / business organisation representative called for the Directive to coordinate the roll-out of electric road systems (ERSs) for heavy duty vehicles, while another called for the development of hydrogen refuelling infrastructure for these vehicles.

One company / business organisation noted that, in relation to electromobility, the AFID did not sufficiently take into account that 90% of electric vehicle recharging took place at home, that the Directive made the provision of infrastructure for hydrogen optional and that the roll-out of gas infrastructure had been limited to a few Member States. A business association called for there to be more focus on electric and hydrogen infrastructure, while at the same time improving the quality of the information that was provided to consumers. A business association, which focused its response on LNG, called for the focus not to be on the refuelling stations for LNG, but on the overall supply system. Two respondents focused on biofuels. A business association commented that the only reference to biofuels in the Directive was in relation to the labelling of fuels, whereas the blends that needed a dedicated infrastructure, such as E85 and ED95, had been ignored. A representative of a company / business organisation also called for the Directive to support high blend biofuels, such as ED95 and biodiesel for trucks and buses.

Other respondents focused their comments on a specific mode of transport. There were ten similar responses relating to ***L-category vehicles***, five from business associations and five from representatives of a company or business organisation. All bar one of these started by calling for the Directive to contain more stringent requirements on Member States regarding the number of charging points for L-category vehicles, while all bar two went into more detail as to what they would like to see. These made reference to the technical standards that were introduced for recharging L-category vehicles in Commission Delegated Regulation (EU) 2018/674, which was introduced to supplement the AFID[90]. These all called for Member States' targets for L-category vehicles to be set for the socket-outlets and vehicle connectors that were specified in the Delegated Regulation, i.e.: for an electric L-category vehicle of less than 3.7 kVA, either those of Type 3a (as described in standard EN 62196-2 for charging Mode 3), or those complying with IEC 60884 (for Mode 1 or Mode 2 charge); and for electric L-category vehicles over 3.7 kVA, socket-outlets and vehicle connectors of Type 2, as described in standard EN 62196-2.

One respondent from a business association highlighted that the lack of recharging and refuelling infrastructure for ***public transport***, both within and outside of depots, was a barrier to introducing alternative fuels for public transport. Hence, they called for a strengthening of the provisions in the Directive to facilitate the deployment of this infrastructure, while noting that any national, regional or local targets had to take into account the variability in the cost of supplying this infrastructure, as it depended on the location of the infrastructure, the length of any connections and the complexity of the

[90] Commission Delegated Regulation (EU) 2018/674 supplementing Directive 2014/94/EU of the European Parliament and of the Council as regards recharging points for L-category motor vehicles, shore-side electricity supply for inland waterway vessels and refuelling points for LNG for waterborne transport, and amending that Directive as regards connectors for motor vehicles for the refuelling of gaseous hydrogen

installation. A similar response from a representative of a company / business organisation and an NGO highlighted that, whereas the inclusion of public transport in the AFID was voluntary, the CVD included demanding targets for clean vehicles for public transport. As a result, the AFID needed to better support the deployment of alternative fuels infrastructure for transport to better complement the CVD. Another company / business organisation respondent noted the lack of standards for recharging infrastructure for buses and the lack of funding for the construction of bus charging points.

From the perspective of ***maritime transport***, a business association suggested that the uptake of electric onshore power supply (OPS) could be stimulated by relevant tax exemptions in the ETD, while they also noted that it was important to pay attention to the demand for alternative fuels to ensure that there was no investment in unnecessary infrastructure. A representative of a company / business organisation suggested that the governance process was too complex and called for procedures to be harmonised at the European level and benefit from a 'fast-track procedure'. In addition, they noted that only two ports in the EU had sufficient power capacity to provide OPS to their vessels and noted that there were cost barriers relating to both the initial investment and to operational costs, as OPS was more expensive than conventional maritime fuels. Hence, they also called for a tax exemption for OPS, while also calling for more LNG infrastructure, as this could also be used for bioLNG in the future. A repeated response from a representative of a company / business organisation and an NGO called for more incentives to encourage ship owners to switch to LNG, for fiscal incentives to encourage the use of alternative fuels in the maritime sector and an improved EU funding programme, as well as stronger provisions in the Member States' national plans. The latter should be supported by defining and adopting technical and safety standards for the use of LNG, including ship-to-ship, shore-to-ship, truck-to-ship and bunkering operational standards and implementing standard European port regulations for LNG operations.

A business association underlined that no single approach suited the diversity of the situations within ports, so suggested that setting goals by technology or solution may not be appropriate for ports. For each port, they suggested that it was important to draw on the latest developments in research and innovation and to engage with local stakeholders to identify which alternative fuels, or whether OPS, was appropriate for the port. Another noted that no OPS project anywhere in the world had been undertaken without public support, and so called for investments in OPS and LNG to be encouraged when there was sufficient demand. In addition, they noted that, in order to supply electricity to ocean-going ships, the frequency of electricity supply had to be increased from 50 Hz, which was typical for the EU's grid, to 60 Hz, which required investment in frequency and high voltage converters. A third association called for the AFID to recognise that investments had been made by industry into LNG-powered cruise ships, and called for its scope to be extended to cover other innovations that may be relevant to cruise ships, including fuel cell technologies and bioLNG.

In relation to ***inland waterways***, a representative of a business association noted that there was no long-term certainty on the return on investment in infrastructure for alternative fuels in inland ports, and that the price for alternative fuels was high and demand was very low. A representative of a company / business organisation felt that there was a lack of financial support to operators of both maritime and inland ports, and to those providing alternative fuels in these ports, which could be addressed through more public-private partnerships that would need to be supported by the public sector. The same respondent also called for owners and operators to be educated about the benefits of upgrading their facilities and called for no new docking or refuelling areas to be built without the provision of onshore charging facilities.

There were a **number of issues** raised by a single respondent. A business associated noted that they considered that the price of alternative fuels (specifically e-fuels) compared to their fossil alternatives was an important reason for the limited impact of the Directive. A representative of a company / business organisation called for frequent reviews of the Directive, so that it was able to respond better to the development of the market and relevant technologies, while another called for the Directive to focus on creating a level playing field, rather than regulating the approach taken to consumers. Another company / business organisation representative called for the Directive to contain targets based on the penetration levels of alternative fuels, rather than on the provision of the relevant infrastructure.

Finally, a small minority of respondents thought that the ***impact of the Directive had been sufficient or that the current approach was appropriate***. A business association said that they did not believe that the Directive had had a limited impact, as infrastructure had been put in place in some countries that would not have been deployed without the national targets required by the legislation, while another felt that there had been a significant amount of infrastructure deployed as a result of the Directive (as evidenced by the information on the European Alternative Fuels Observatory; EAFO). Another respondent felt that the Directive's impact had been in line with the needs of the market, while another suggested that the Directive was only able to have as much impact as the market allowed. A representative of a company / business organisation underlined that the market could be expected to deliver what was needed, so that the Directive should not become a barrier, while another suggested that deployment should be left to the market, rather than there being detailed requirements (other than standardisation) set at the EU level and a third that the market would develop once the business models, standards and legal framework had been put in place.

Two of the three representatives of ***consumer organisations*** who responded to this question called for binding targets to be put on Member States. In addition, one of these also called for requirements relating to availability and interoperability, as well as calling for more transparency for pricing on public chargers, including that the default should indicate pricing in terms of €/kWh. In addition, they called for the provision of information to consumers under Article 7 of the Directive to be properly enforced and for EU legislation to require that clear information be presented on the range and charging capacity of specific electric vehicles. The other respondent that supported binding targets felt these were needed as a result of the lack of implementation of the Directive by Member States. They also called for further clarification in the Directive with respect to the interpretation of what was meant by 'ad hoc payments' and suggested that the Directive should prevent unfair and unclear pricing that was based on the time taken to charge, rather than on the amount of electricity supplied. A third representative of a consumer organisation suggested that the rules around billing were not clear. The one response from an ***environmental organisation*** also identified the lack of ambitious targets for Member States as a reason for the Directive's lack of impact, along with insufficient monitoring of its implementation and an inadequate supply of infrastructure.

Three similar responses from the 13 that came from representatives of ***NGOs*** suggested a number of reasons for the limited impact of the Directive, which covered similar issues to a response from a respondent classified as 'Other'. Common issues raised by these four responses were a lack of ambitious targets for the deployment of infrastructure per Member State and per vehicle type (i.e. for light duty (LDVs) and heavy duty vehicles (HDVs), while one also mentioned rail) and a lack of monitoring of the implementation of the Directive. Three also mentioned a lack of coverage of commercial properties and a lack of adequate metrics to measure the sufficiency of the supply of public charging infrastructure, while two suggested that the supply of charging points was not in line with anticipated demand and the other two noted that definitions of fast charging points in the Directive were outdated. Finally, one of these suggested that a lack of standards, e.g. relating to smart charging, was an issue.

A number of NGO respondents focused on **electric vehicle recharging infrastructure**. One respondent suggested that a reason for the limited impact of the Directive was the lack of integrated planning for the provision of recharging infrastructure, particularly for lorries and vans, and the lack of the necessary grid capacity. Another suggested that the deployment of the necessary recharging infrastructure was not likely to be sufficiently comprehensive and evenly distributed across Member States as a result of the way in which the Directive was implemented, i.e. via the NPFs. A different respondent also suggested that the EU requirements for the development of the recharging network were not sufficiently precise, while another called for the Directive (and the associated funds from the CEF) to cover the deployment of charging points across the entire TEN-T network. Another response suggested that the Directive was not sufficiently ambitious with respect to the deployment of infrastructure for **LNG and CNG**.

A couple of responses focused on a particular mode. One underlined that the AFID was voluntary for **public transport**, whereas the CVD included strict mandatory requirements for public transport vehicles for Member States. Hence, they called for the revised AFID to focus on increasing efforts to deploy the necessary refuelling and recharging infrastructure for public transport vehicles. Another respondent suggested that the lack of switching to LNG in **maritime transport** was due to the costs involved and the time needed, and uncertainties involved with, the infrastructure authorisation process. Hence, they called for more incentives for ship owners to switch to LNG, more incentives to deploy the infrastructure, the improvement of funding programmes, shorter authorisation periods and the definition and adoption of the necessary technical and safety specifications for LNG used in maritime applications.

Other NGO respondents made more **general comments**. One suggested that the deployment of infrastructure was hindered by monopolies in some places, e.g. refuelling stations along motorways, and the uncertainty of future developments and their pace, while another noted that there was a lack of financial support to deploy an adequate level of infrastructure. On the other hand, one respondent underlined that the deployment of infrastructure should not be regulated in too much detail at the EU level, as it was important to enable regions to take account of their own needs.

Common themes in the 19 responses from ***EU citizens*** and the single response from a ***non-EU citizen*** were the lack of sufficient obligations, a lack of collaboration/competition and the strength of the economic interests involved. Three responses suggested that the lack of binding requirements on Member States was the reason for the lack of deployment of infrastructure in their respective countries, with one of these suggesting that there was no economic penalty for Member States that did not implement the Directive and another suggesting that economic interests in their country were hampering deployment. A different respondent suggested that the issue was too technical for the national level and also that the economic interests against deployment in their country were too strong. Another suggested that national policies were not sufficiently flexible to support deployment and a third suggested that the Directive should provide a clearer framework for Member States. In addition, two other citizens simply blamed strong economic interests for the limited impact of the Directive.

A number of citizens identified **more practical issues**. One suggested that a lack of cooperation between providers of publicly available infrastructure and a lack of focus on home charging limited the impact of the Directive, while another suggested that relevant national funding programmes contained too specific technical requirements and a third that there was too much fragmentation and too little interoperability between infrastructure. Another respondent suggested that the responsibility for the deployment of the infrastructure in their country was not clear, while two responses suggested that a lack of infrastructure that functioned effectively was an issue. Other reasons put forward for the limited impact of the Directive included a lack of competition leading to high prices and that there were different approaches in different countries. Others called for more focus on smart charging, the inclusion of L-category vehicles and the mandatory deployment of ERS infrastructure.

An ***academic / representative of a research institution*** noted there was still an issue in terms of the definition of publicly available infrastructure, as opposed to semi-public and non-public infrastructure. There were three responses from organisations that classified themselves as ***'Other'***. In addition to the response already covered above, one of these suggested that there was insufficient awareness of alternative fuels among consumers and that national authorities should be taking more of a lead, while the other called for more prescriptive requirements to better support Member State implementation via the NPFs.

The 14 responses from representatives of ***public authorities*** covered a wide range of issues. Some responses focused on a specific mode or mentioned a particular fuel. One response underlined that **home charging** for electric vehicles was important, so should be covered in the AFID, while also calling for more flexibility at the European level to allow some Member States to use **biofuels** produced sustainably from feedstocks grown on domestic farmland and in forests. A different response suggested that the lack of consideration of **rail** in the Directive was an issue, particularly in relation to recharging stations for battery trains. Another called for the expansion of the Directive to **rail** and **aviation**, for all fuels to be accounted for on a life cycle basis and for incentives to support their deployment.

One respondent called for a **transition** to zero emission mobility via CNG and hybrids before considering zero emission vehicles. On the other hand, a different respondent called for the focus to be on fuels that were here to stay beyond 2050, and so called for there to be **no focus on transition fuels**. However, they noted that the deployment of zero emission fuels should be undertaken in a steady way to meet the needs of the market and that regions should be able to move at the pace that was appropriate for them. The importance of allowing different speeds of transition in different Member States was also highlighted by another respondent.

Other responses made more **general points** as to why the Directive had had a limited impact. One implied that as the level of investment that was needed was high, there was a need for more flexibility in terms of the provision of state aid, while another suggested that the absence of clear deployment targets was the reason for the limited impact. More **specific points** were also raised by other respondents, including that the lack of qualitative information on charging infrastructure was a barrier and that the focus on the TEN-T, rather than on wider deployment, was a barrier to the uptake of the fuels. Another respondent suggested that the limited impact of the Directive was due to a lack of multilevel governance frameworks to coordinate deployment and limited provisions on the information and availability of recharging points, as well as a lack of coherence between the AFID and other EU legislation.

11.7.5.1.6 C6: Are there other aspects you would like to underline regarding the functioning and/or impact of the Directive 2014/94/EU? Are there issues that could be simplified?

There were 141 responses to this question, of which 48 came from representatives of ***business associations*** and 53 from representatives of ***companies and business organisations***; these cover similar issues and contain some similar responses, so are covered together. There were a number of generic responses that did not explicitly mention a mode or a specific fuel.

At a **general level**, a business association proposed that the detail of the deployment of infrastructure should be left to the NPFs, although common criteria should be set for the Member States. Another called for there to be better monitoring of the actions in the Member States, including to ensure that Member States did not put complex and costly initiatives in place, while a third called for business models, standards and a clear regulatory framework. Two representatives of a company / business organisation called for the Directive to become a Regulation. Another company / business organisation representative suggested that a small permanent group of experts from relevant industries be created to advise Member States on practical issues related to the transposition of the Directive, in order to improve harmonisation and implementation. Another suggested that an increase in the use of alternative fuels would be supported by a stronger and more detailed Directive. A different respondent noted that permitting procedures were often lengthy and complex, which acted as a barrier to investment, and so called for streamlining in this area to allow the development of competitive and market-driven businesses.

A comprehensive general response from a representative of a company / business organisation underlined that refuelling connections for all of the fuels and energy sources should be standardised, that all public electric vehicle recharging infrastructure should be interoperable, that all charging points at residential and commercial locations should support smart charging and that technical and safety standards for LNG and hydrogen refuelling stations should be consistent across Europe. In addition, they noted that uncertainty about the business models that were allowed was hindering investment, suggested that the AFID should follow the lead of the revised RED in easing permitting and approval procedures and proposed that there was a need for more clarity of the roles and responsibilities of the various actors that were involved in providing electric vehicle recharging infrastructure.

A number of responses mentioned some aspect of the **quality** of infrastructure. A similar response from two business associations, and a representative of a company / business organisation, suggested that the Directive should contain guidelines on ensuring the quality of infrastructure, both from the perspective of safety and the service level offered. In addition, the company / business organisation response also called for the deployment of infrastructure beyond the TEN-T and for there to be targets for the minimum level of renewable energy that made up the electricity and gas supplied. A company / business organisation respondent called for digital maps to be made available to consumers that showed the status and payment options for different infrastructure, and which enabled these to be booked.

There were a number of responses that focus on **pricing**. A business association suggested that the price comparisons between different fuels could be improved, while another called for uniform and comparable pricing information between different fuels. A company underlined their belief that price discrimination was an important topic. For example, they argued that when a charging point infrastructure company received subsidies or public support and/or occupied land provided by the public sector, they should not be allowed to offer exclusive services, as this led to unfair competition and market distortions. They also believed that the provision of fast charging infrastructure should not receive a subsidy where charging facilities were already available for similar reasons. Three other company / business organisation representatives suggested that the approach to the presentation of fuel price comparisons in the Directive would be more effective as an internet-based tool.

Some **issues of inconsistency** between the AFID and other pieces of EU legislation were identified. A business association noted that the EU's CO_2 standards for vehicles only supported some of the clean technologies supported by the AFID. A representative of a company / business organisation argued that the scope of the AFID needed to be extended to ensure that publicly accessible and private charging infrastructure, as required by the Energy Performance of Building Directive (EPBD), were on an equal footing.

A number of responses also underlined the importance of **technology neutrality**. A business association underlined the importance of maintaining technology neutrality to ensure that the widest possible range of fuels was covered, while another underlined that such an approach would maximise the potential of different fuels to reduce transport's GHG emissions over time depending on their degree of maturity, including their use in the current fleet. A representative of a company / business organisation noted that a technology neutral approach was important to assess the potential impacts of different fuels.

A couple of responses highlighted the risks of the AFID **prescribing technical standards**. A business association noted that, in relation to hydrogen, ISO TS 20100 was subsequently withdrawn due to safety concerns and that, while ISO 17268 was appropriate for nozzles, there were no nozzles in Europe that met this standard. The response suggested that, if the AFID did include technical standards, there needed to be a better approach to gaining and acting upon expert advice where the text introduced compliance issues. Another business association suggested that mandating technical requirements could impede fair competition and distort the market. In order to illustrate this, they gave the example of the current Combo-2 mandate (EN62196-3, configuration FF), which was not on the market when the AFID was proposed, and, even though their numbers have subsequently increased, there were still as many CHAdeMO (EN62196-3, configuration AA) charge points available as investors continued to install these. A representative of a company / business organisation mentioned the importance of technology neutrality in the context of not imposing premature standards that risked impeding fair competition and innovation. On the other hand, a representative of a company / business organisation argued that a consensus had begun to emerge between European producers of electric vehicle charging points, so that setting a standard in Europe should be considered, while also calling for more comprehensive information to be provided to consumers.

A number of responses focused on a specific mode or modes. Two similar responses from business associations mentioned that most of the existing electric vehicle recharging infrastructure was not suitable in terms of size and capacity for **HDVs** and noted that there was, more generally, a lack of refuelling infrastructure for HDVs, including in relation to hydrogen and bioCNG/LNG. Both also noted that there was also a lack of infrastructure for alternative fuels for air, sea and rail transport.

A company representative also noted that there was a lack of infrastructure for HDVs, while another felt that the omission of HDVs limited the impact of the Directive and also noted that the AFID could also be used to stimulate greener fuels at ports and terminals, supported by changes to taxation and measures to ensure that consumers use the infrastructure. A business association respondent noted that infrastructure for HDVs should be future-proofed as infrastructure for (bio)LNG could be used for hydrogen at a later date and also called for the Directive to cover infrastructure on private property, as HDVs often recharged at loading/unloading locations. As a result of their importance for long-haul road transport, a company / business organisation representative called for a common approach to the provision of the necessary infrastructure across Europe. Another representative of a company called for there to be more focus on zero emission HDVs, including on grid reinforcement and charging point installation in resting areas, depots, distribution and delivery centres. Another company / business organisation representative called for the inclusion of ERS in the Directive, including a strategy and timeline for ERS, followed by an evaluation of different technologies and eventually the regulation of standards and the securing of interoperability. The importance of expanding the scope of the Directive to include HDVs, particularly ERS, was also mentioned by a representative of a business association. Another response from a representative of a company / business organisation called for the expansion of the AFID to **rail transport** in order to support the sector's further electrification.

A business association representative argued that the focus of the Directive on publicly accessible infrastructure and private vehicles was a missed opportunity, as more emissions reductions could have been delivered through a greater focus on **public**

transport, and the provision of the necessary refuelling/recharging infrastructure, supported by its increased use, as well as mandatory targets. Similar responses from three representatives of a company / business organisation (as well as an NGO representative) referenced the CVD in support of their response. These noted that, while the CVD was mandatory for public transport, the inclusion of public transport in the AFID was only voluntary, and so called for the revised AFID to address this. Two of these also noted that the CVD referred to the AFID to define what it meant by clean fuels for buses. In this context, they noted that as the public transport sector was currently implementing the requirements of the CVD, the definition of alternative fuels for buses in the AFID should not be changed in the forthcoming revision of the AFID.

In relation to **shipping**, a similar response from three business associations noted that few NPFs mentioned the **electrification** of ports, whereas it was now clear that the electrification of ports was an opportunity to reduce emissions from the sector. A separate response from another business association proposed that the AFID should create further incentives for the electrification of maritime ports. Three similar responses from business associations underlined the importance of taking a flexible, technology-neutral approach to the provision of alternative fuels infrastructure for shipping, with two calling for a goal-based approach and one for port roadmaps. One of these also called for a different approach for inland ports compared to maritime ports and another underlined the importance of there being sufficient funding.

Two similar responses (the first from a representative of a business association, the second from a company/business organisation) highlighted that there were no reported **LNG refuelling points** for the **maritime sector** in a number of Member States and also called on the JRC to map existing and potential bio and synthetic LNG supply to increase the use of existing LNG infrastructure and identify needs for capacity increase. The second of these also called for more clarity on how to determine whether there was insufficient demand, or disproportionate costs, for the provision of OPS. A business association noted that there was a need for a real push if the Directive's ambition for LNG infrastructure in ports and for OPS were to be met by 2025. Specifically, in relation to cruise ships, another business association respondent noted that these were being fitted with the capability to use OPS, although the ports that these ships used were often not on the TEN-T, so that there was a mismatch between the Directive and reality. In addition, the response called for guidance on the methodology to be used to assess the demand for, and cost-benefit of, the provision of OPC.

Other responses focused on a **specific fuel or energy source**, including a number that focused on different aspects of **electric vehicle recharging**. One company / business organisation respondent called for more high-performance charging points to be available on motorways and in cities, while another called for different rules on public and non-public charging points and for more action to improve interoperability between Member States. The latter also suggested that the Directive's reference to 'non-contractual' charging was not legally correct, and so should be amended to either 'non-permanent' or 'occasional' charging. Another representative of a company / business organisation called for the Directive to regulate roaming charges, ensure clear price information, allow for credit card payments and ensure that status information was provided at the charging station. The challenges of generating a positive business case for the deployment of recharging infrastructure, even with public funding, was mentioned by a company / business organisation representative, which called for Member States not to put more hurdles in place that made it even more difficult.

A similar comprehensive response from a representative of a business association and three respondents from companies / business organisations underlined that it was important that further market fragmentation was prevented as a result of different technical requirements for hardware, metering requirements, public data transmission requirements and fire safety requirements for car parks. They also called for the market to be allowed to operate, so while there should be no retail price regulation, they supported standardised rules to establish a level playfield field, as well as for mobility service providers (MSPs) to be allowed access to the networks of charging point operators (CPOs). Two of these also called for there to be a regular review of the Directive to ensure that it was kept up-to-date with the development of the market. In addition, one of these called for more binding targets on the deployment of infrastructure, another for more sanctions on Member States for non-compliance and a third for the definition of infrastructure to be revised to also include distributed infrastructure and for more information to be provided to consumers on the availability, location and payment methods of recharging points. Another respondent from a company / business organisation called for the roles of the MSP and CPO to be kept independent, as this would create better price transparency, and for infrastructure to allow for real-time authorisation and processing.

Another similar response from three respondents (one from a business association, the others from a company / business organisation) noted that faster certification and approval procedures were important for expanding intelligent recharging infrastructure. In addition, one of these called for market barriers not to be created, for a flexible and dynamic approach to the expansion of recharging infrastructure and for targets to increase the uptake of electric vehicles, while the other called for better integration between energy and transport supported by intelligent control. Another business association called for the administrative processes needed to deploy a charging point to be simplified, particularly in cities.

Four similar responses (two from business associations, one from a company / business organisation and one from an organisation that classified itself as 'Other') underlined that the Directive should not leave any risk of a lack of harmonisation across Member States, with all providing the example of the possibility of Member States imposing a mechanical shutter on alternating current (AC) stations (as allowed in Annex II of the Directive), which has led to one Member State taking a different approach to others. In addition, one of these criticised the lack of sanctions on Member States when they did not apply the Directive (the lack of the possibility of making ad hoc payments at public charging points in one country was mentioned), while two called for the AFID's scope to be expanded to commercial and residential properties, for the widespread adoption of smart charging services and for the Directive to support open, public and transparent tendering policies for fast charging points.

Another business association called for the AFID to promote the **widespread deployment of smart charging devices**, supported by open and non-discriminatory access to battery-related data to support third party smart charging service providers (this last point was made in a very similar way by a company / business organisation). Similar points were made by other business associations, with one underlining the importance of a sound framework for smart charging and other technologies, such as vehicle-to-grid, supported by open data and standards and dynamic pricing, and another called for better integration with the electricity system, supported by intelligent charging and access to data, along with contract-based fees. A similar response from two business associations called for a data server to be created to facilitate the exchange and use of dynamic data, and also gave their support to the harmonisation of ad hoc payments. A similar point was made in another two similar responses – one from a business association, the other from a company / business organisation – that the minimum requirement should be to send occupancy data, and proposed that the EU should establish a means of exchanging data on charging points that would help with the transparency of charging costs. One of these also called for clear definitions on what was meant by a public, semi-public and private recharging point and also called for better data to be communicated to the public more generally. The latter point was made by another business association, which called on the EU to focus on delivering a level playing field and to ensuring that the missing recharging standards, including for buses, were put in place. A company / business organisation respondent noted that a definition of 'charging station' would be useful in the Directive, and also called for connections to the grid to be simplified and for the deployment of charging points on highways, particularly those operated under concession, to be simplified, and allowed in rest areas (even where there was no petrol station).

In relation to **payment options for recharging points**, a business association respondent supported selective charging (rather than contract-based charging) and for the technical requirements for publicly accessible charging points not to be overcomplicated, e.g. by providing the possibility of layering these depending on the location and operating model. In addition, they did not support a general roaming obligation. The importance of leaving the decision of whether to implement a platform-based or a bilateral model to market players was underlined by a company / business association representative, who called for there to be no mandatory introduction of a single roaming protocol as only a global standardisation approach would bring different markets together. In addition, they underlined that it was important to ensure that there was no discrimination, e.g. with respect to price, by local monopolies. Another respondent suggested that focusing on ad hoc payments, as the AFID does, was not sufficient, as it was important to open the market to roaming services to support the development of a market in innovative charging services.

Two company / business organisation representatives provided similar responses that highlighted the importance of making charging stations **accessible for people with disabilities**. This meant that access to the charging station had to be barrier-free to all those with mobility disabilities, including wheelchair users, and that all of the operational elements of the charging point had to be between 80 cm and 110 cm off the ground.

Two similar responses (one from a business association, the other from a company / business organisation) called for the AFID to invite Member States to take action to support the faster uptake of **liquid, low carbon drop-in fuels** in order to help with the decarbonisation of the existing vehicle fleet. Another business association made a similar point and also called for more synergies between the AFID and other pieces of EU legislation, notably the ETD, the CO_2 emission Regulations and the RED.

In a similar response, two business associations called for stricter requirements in the AFID to prevent Member States from preventing the use of e-fuels for certain applications and also for unified standards for hydrogen and **LNG refuelling infrastructure**. Nine similar responses (two from a representative of a business association, one from an NGO, the others from company / business organisation respondents) noted that the standards for LNG refuelling stations varied between Member States (and even sometimes within countries), particularly those relating to safety and permitting provisions (which can be lengthy). In addition, one of the company / business organisation respondents and the NGO called for the implementation of technical regulations to avoid inconsistencies in the construction of infrastructure, for favourable taxation for infrastructure operations and for incentives to develop the infrastructure and associated fuels. A representative of a company / business organisation suggested that requiring infrastructure for alternative fuels, particularly for LNG, only to be deployed along the TEN-T was not sufficient to support its use. A company / business organisation representative suggested that CNG cylinder inspections should be simplified in some Member States in line with international standards, while another noted that, in the short-term LNG and CNG were the only realistic alternatives to diesel (and also that is was important to take account of fuels' well-to-wheel emissions). Two similar responses from representatives of companies / business organisations noted that it was important not only to stimulate the deployment of the LNG refuelling stations, but also the deployment of LNG supply infrastructure, including micro-liquefaction plants.

A representative of a business association called for the provisions relating to **hydrogen** to become mandatory, rather than voluntary. This should involve binding targets on the deployment of refuelling infrastructure, financial support from Member States, cooperation between public and private stakeholders to support investment, the development of hubs, e.g. at airports and ports, to allow synergies between different modes and the expansion of the scope to railways. A company / business organisation called for the scope of fuels in the Directive to be limited to hydrogen and electricity.

Two responses also called for more support from the Directive for **biofuels**, with the one from a business association noting that this was particularly important for infrastructure for high biofuel blends, while a company / business organisation representative noted that more support for biogas, biodiesel and bioethanol could support European industry and make lorries and buses less vulnerable when international crises affect oil supplies. Another business association respondent underlined that a technology-neutral approach should be taken, so as to not overlook the decarbonisation potential of fuels such as high-octane petrol.

The single response from a representative of a ***consumer organisation*** called for the Directive to focus only on electric and hydrogen-powered mobility and the type of chargers needed by consumers. They also called for the Directive to become a Regulation to set targets at the EU level and to put in place binding measures in relation to different aspects. These included the type of chargers, information to consumers, the availability of chargers, fair and transparent pricing, coverage in all areas and data access, which they believed would be implemented more quickly in a Regulation than a Directive.

In the nine responses from representatives of ***NGOs***, there were three similar and called for the scope of the Directive to be extended to commercial properties (two also mentioned logistics hubs), for an assessment of the potential of smart charging at public recharging points and the removal of the regulatory obstacles that remain in this respect (e.g. access to battery-related and other data, a lack of operational standards for smart charging and vehicle-to-grid (V2G) connections). Two of these also called for the Directive to address social equity and take account of the need for a just and fair transition by requiring that a certain proportion of charging points be deployed in areas of low income or high air pollution. Another respondent called for the revision of the Directive to be closely aligned with Member States' implementation of the Electricity Directive to help facilitate the widespread uptake of smart charging and support the cost-efficient and beneficial integration of electric vehicles with the grid.

Another NGO respondent called for the mandatory involvement of organisations representing those with disabilities in the deployment of refuelling and recharging infrastructure to ensure that the accessibility needs of those who they represent were taken into account. The importance of providing investment and operational support for the deployment of recharging and refuelling infrastructure in sparsely populated areas was mentioned by another respondent, as otherwise there was a risk that such deployment would not happen. Finally, another NGO respondent underlined the lack of consideration of powered two-wheelers in the Directive, which was an oversight as the most challenging issue that the sector was facing was a lack of charging points.

Two of the relevant comments in the 11 responses from ***EU citizens*** and the single response from a ***non-EU citizen*** called for quick action to ensure that the necessary infrastructure was put in place, with one suggesting that there was no longer time to take a technology neutral approach. A separate response suggested that too much in the way of public funds was being spent on infrastructure for fuels with no long-term role (e.g. CNG), whereas a fuel with existing infrastructure and proven benefits (LPG) was being overlooked, while another called for the use of hydrogen for LDVs not to be encouraged. Another citizen called for real interoperability to be imposed on infrastructure. Other relevant responses focused on **electric vehicle recharging infrastructure**. In relation to charging, one response underlined the importance of dynamically controlled and bidirectional charging to allow electric vehicles to be used to support the grid, while another called for the retrofitting of charging points, particularly in residential complexes, to support smart charging. Another response called for better pricing and other information on charging stations, along with the facilitation of roaming without allowing price discrimination or putting up other access barriers. Other responses called for the amount of electricity used to be clearer on recharging points and for a better geographical deployment of recharging points in their country.

The ten responses from representatives of ***public authorities*** covered a diverse range of issues. One highlighted that there was an issue with the national implementation of the Directive, which suffered from uncertainty with respect to state aid, a lack of free advice, lengthy development processes and a lack of funding, while another suggested that local jurisdiction and administrative issues were more of a challenge than technical issues. A couple of respondents made comments relating to the **fuels covered**, with one noting that it was important to take account of the way in which electricity and hydrogen were produced as, in some countries, bio CNG had lower emissions, while another called for more support for biofuels. A separate response commented on the modes covered, calling for the decarbonisation of road freight and maritime transport to be facilitated by the Directive through the use of all alternative fuels, while another called for the expansion of the Directive to cover HDVs, as well as for roaming and interoperability to be improved, while also suggesting that the Committee formed under Article 9 of the Directive did not function well. Other responses called for different payment options to be made available in a non-discriminatory way for all users and for the labelling requirements to be made simpler, with only the minimum amount of information being provided.

There were three responses from organisations that classified themselves as ***'Other'***. In addition to the response covered already, the only relevant issue that was mentioned was the importance of consistency between the AFID, CVD and the car and van CO_2 standards.

11.7.5.2 SECTION D: Policies

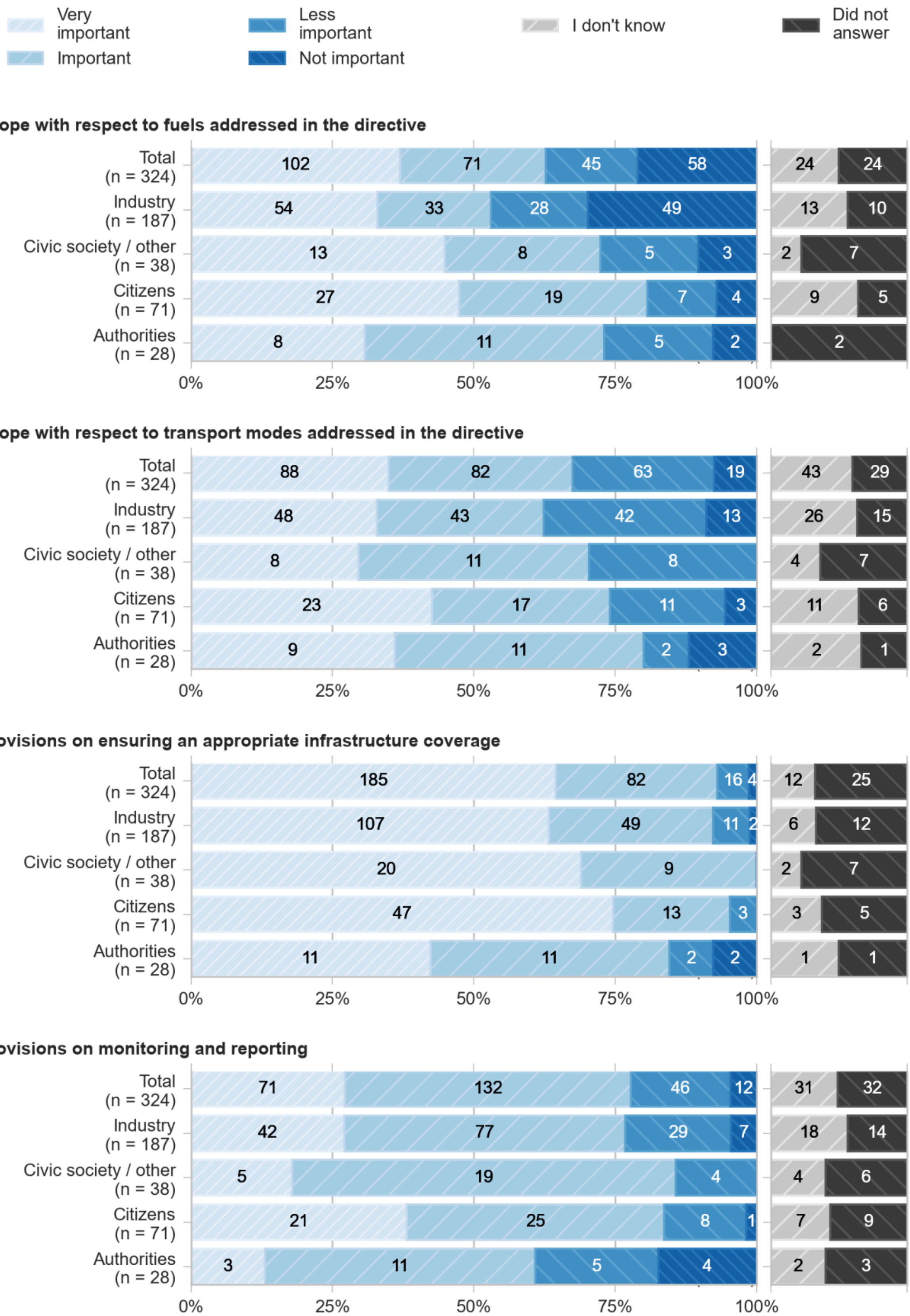
11.7.5.2.1 D1: Importance of revising aspects of the AFID

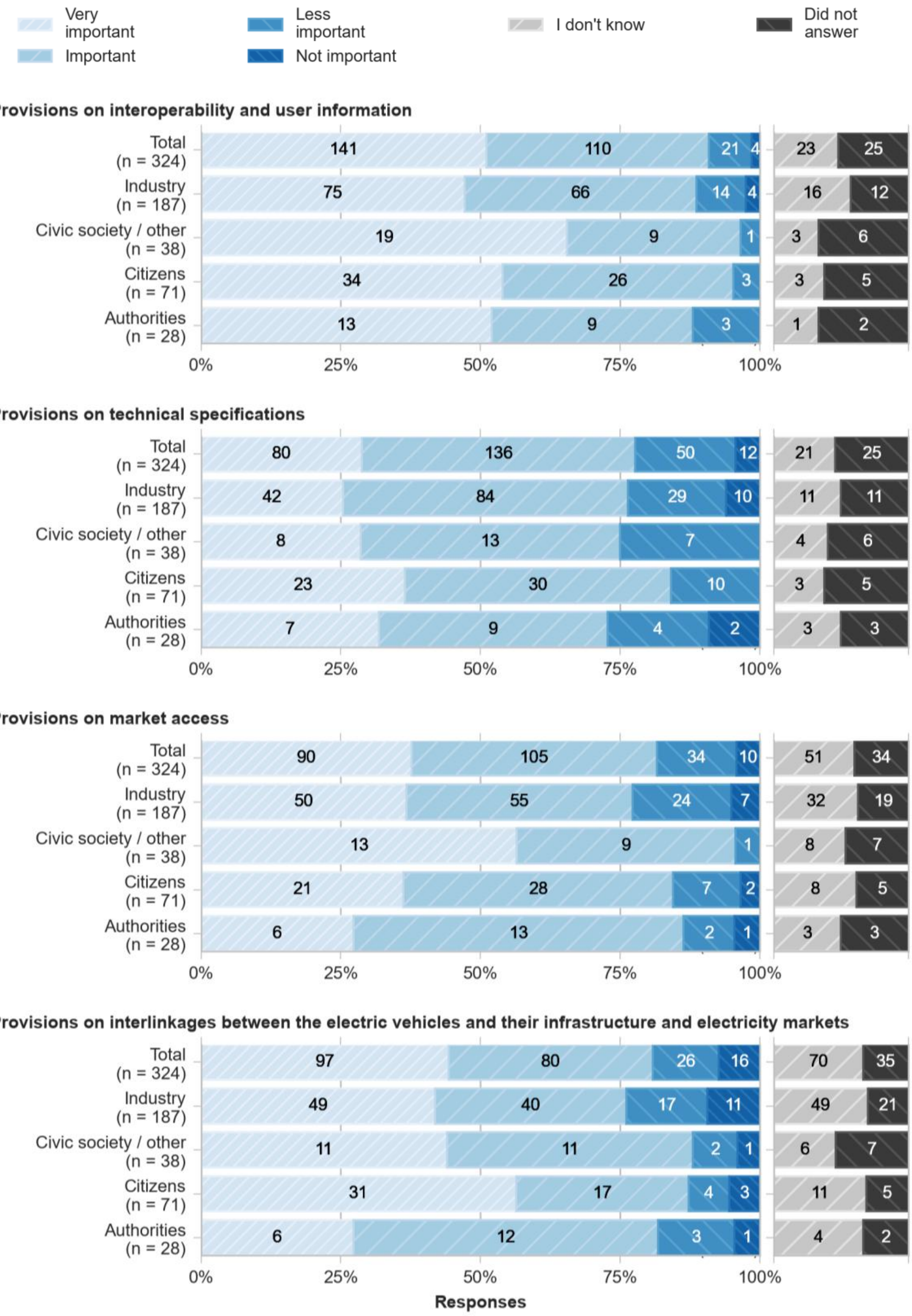
Respondents were asked how important it was, in their opinion, to revised parts of the Alternative Fuels Infrastructure Directive, including the following:

- Scope, with respect to fuels addressed in the Directive;
- Scope, with respect to transport modes addressed in the Directive;
- Provisions on ensuring an appropriate infrastructure coverage;
- Provisions on interoperability and user information;
- Provisions on technical specifications;
- Provisions on market access; and
- Provisions on interlinkages between electric vehicles and their infrastructure and electricity markets (see Figure 6-5).

The aspect identified as being most important to revise was '*provisions on ensuring an appropriate infrastructure coverage'*, with 267 (out of 299 respondents) indicating it was either very important or important. This was followed by '*provisions on interoperability and user information*' (251 out of 299 respondents) and '*provisions on monitoring and reporting'* (203 out of 292). The aspect considered to be least important in terms of revision was '*scope with respect to fuels addressed in the Directive'*, with 58 out of 324 stating it was not important, and a further 45 stating is was less important.

Figure 6-5: D1. In your opinion, how important is it to revise the following parts of the Alternative Fuels Infrastructure Directive?



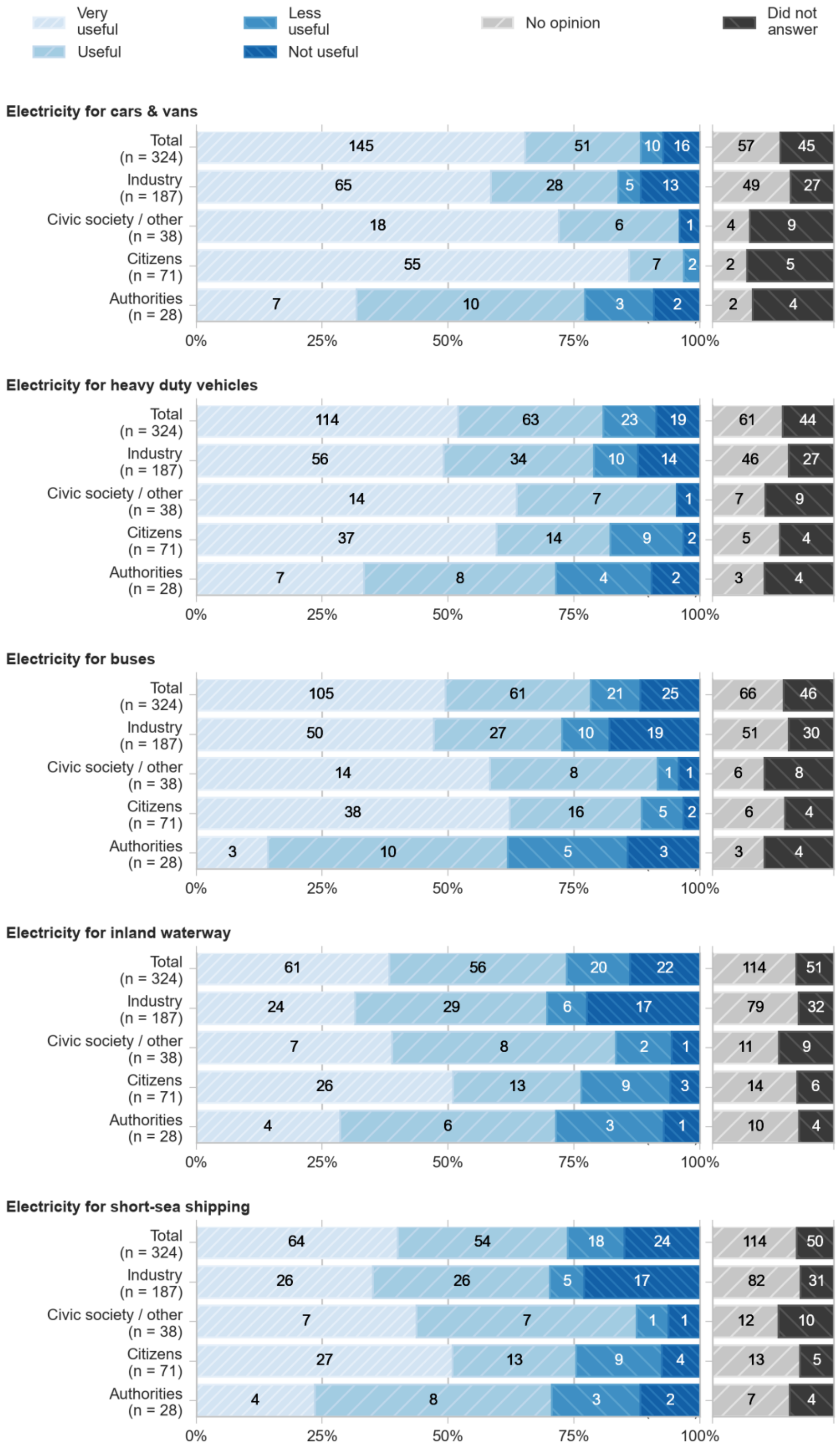


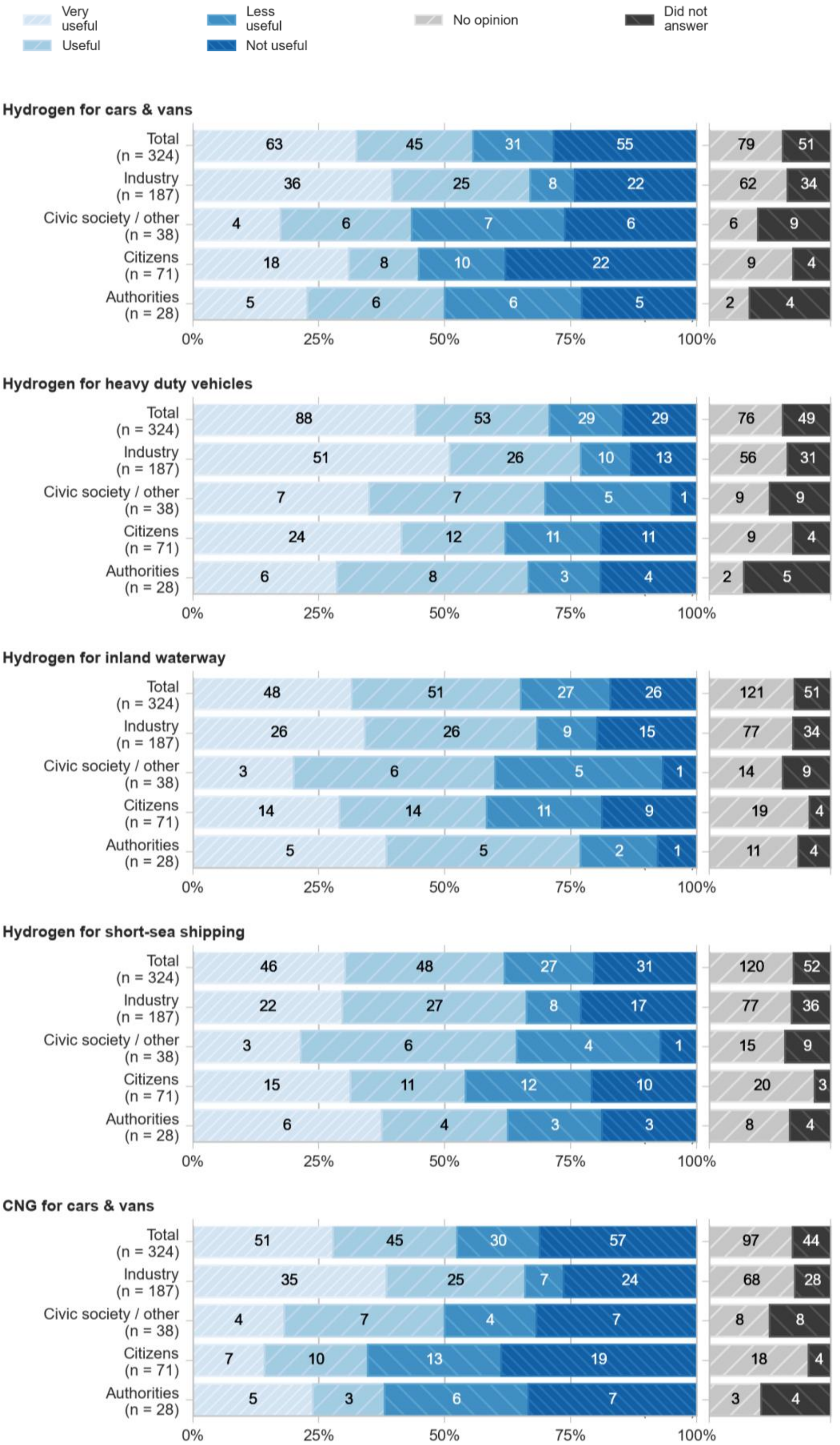
11.7.5.2.2 D2. In your view, how useful are mandatory deployment targets for Member States that are derived by using a common methodology

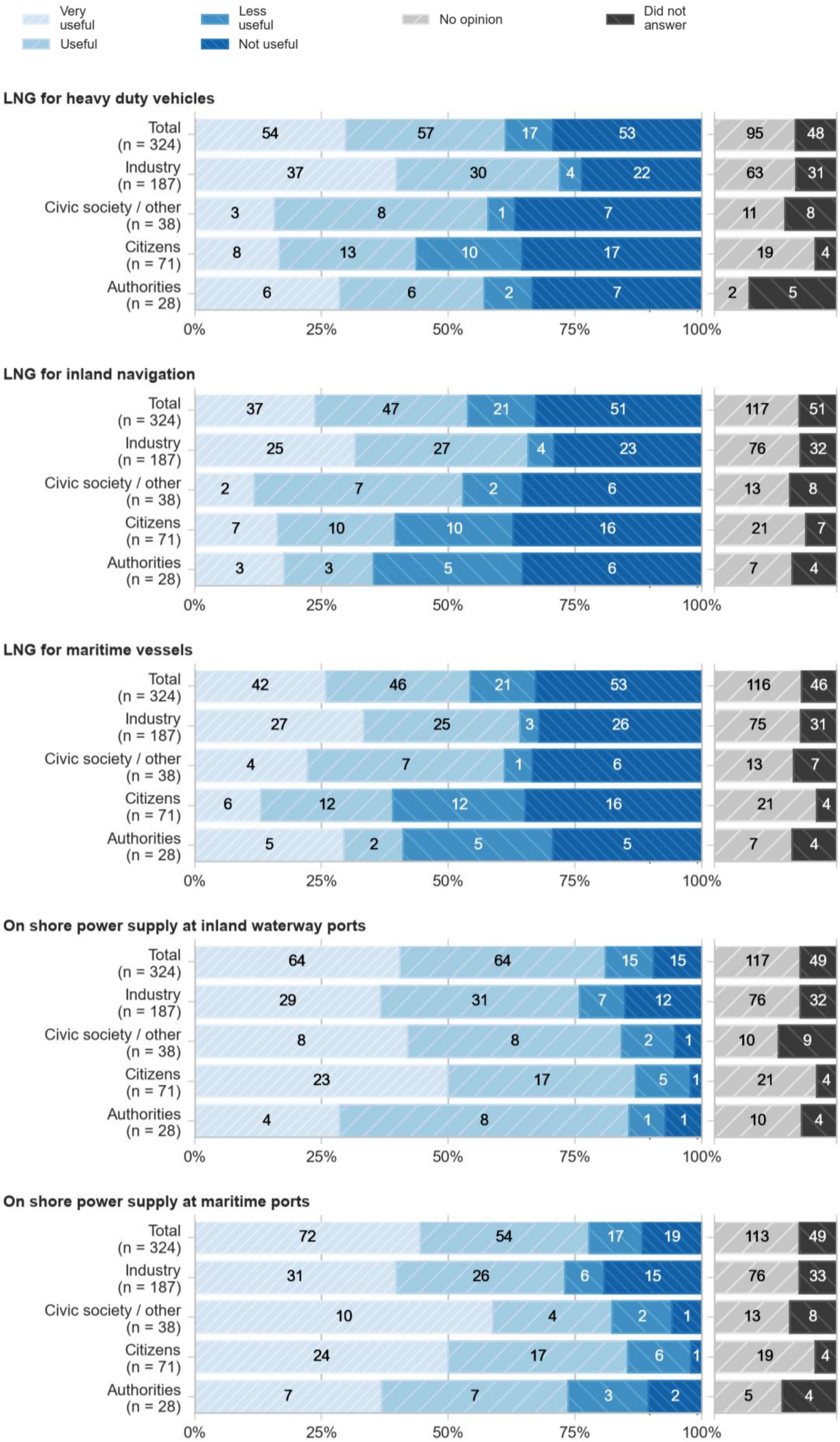
to ensure a coherent minimum alternative fuels infrastructure roll out in the following areas?

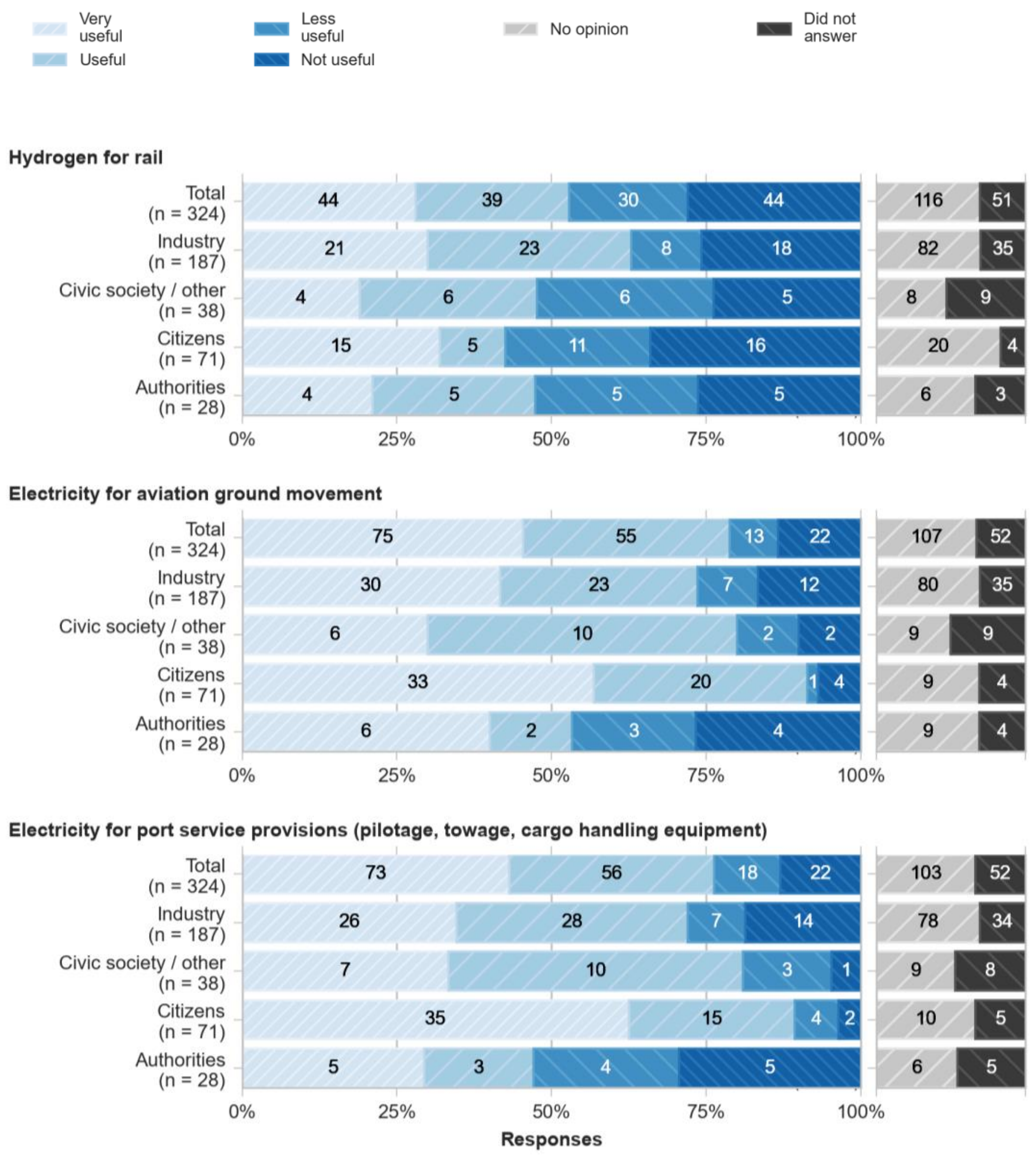
Right now, Member States are obliged to establish targets for the roll out of alternative fuels infrastructure through their NPFs. However, those national targets are being set without using a common methodology. Stakeholders were asked, in their view, how useful are mandator deployment targets for Member States that are derived by using a common methodology to ensure a coherent minimum alternative fuel infrastructure roll out in a range of areas (see Figure 6-6). The areas where mandatory deployment targets were considered to be the most useful (very useful or useful) included electricity for cars and vans (196 out of 279 respondents), electricity for heavy duty vehicles (177 out of 280), electricity for buses (166 out of 278) and hydrogen for heavy duty vehicles (141 out of 275). Those areas with a high number of responses stating that they were not useful included CNG for cars and vans (57 out of 280 respondents), hydrogen for cars and vans (55 out of 273), LNG for inland navigation (53 out of 278) and LNG for heavy duty vehicles (51 out of 273).

Figure 6-6: D2. In your view, how useful are mandatory deployment targets for Member States that are derived by using a common methodology to ensure a coherent minimum alternative fuels infrastructure roll out in the following areas:


Very useful
Useful
Less useful
Not useful
No opinion
Did not answer
Electricity for cars & vans
Electricity for heavy duty vehicles
Electricity for buses
Electricity for inland waterway
Electricity for short-sea shipping
Total (n = 324)
Industry (n = 187)
Civic society / other (n = 38)
Citizens (n = 71)
Authorities (n = 28)
0%
25%
50%
75%
100%


Very useful
Useful
Less useful
Not useful
No opinion
Did not answer
Hydrogen for cars & vans
Total (n = 324) 63 45 31 55 79 51
Industry (n = 187) 36 25 8 22 62 34
Civic society / other (n = 38) 4 6 7 6 6 9
Citizens (n = 71) 18 8 10 22 9 4
Authorities (n = 28) 5 6 6 5 2 4
0% 25% 50% 75% 100%
Hydrogen for heavy duty vehicles
Total (n = 324) 88 53 29 29 76 49
Industry (n = 187) 51 26 10 13 56 31
Civic society / other (n = 38) 7 7 5 1 9 9
Citizens (n = 71) 24 12 11 11 9 4
Authorities (n = 28) 6 8 3 4 2 5
0% 25% 50% 75% 100%
Hydrogen for inland waterway
Total (n = 324) 48 51 27 26 121 51
Industry (n = 187) 26 26 9 15 77 34
Civic society / other (n = 38) 3 6 5 1 14 9
Citizens (n = 71) 14 14 11 9 19 4
Authorities (n = 28) 5 5 2 1 11 4
0% 25% 50% 75% 100%
Hydrogen for short-sea shipping
Total (n = 324) 46 48 27 31 120 52
Industry (n = 187) 22 27 8 17 77 36
Civic society / other (n = 38) 3 6 4 1 15 9
Citizens (n = 71) 15 11 12 10 20 3
Authorities (n = 28) 6 4 3 3 8 4
0% 25% 50% 75% 100%
CNG for cars & vans
Total (n = 324) 51 45 30 57 97 44
Industry (n = 187) 35 25 7 24 68 28
Civic society / other (n = 38) 4 7 4 7 8 8
Citizens (n = 71) 7 10 13 19 18 4
Authorities (n = 28) 5 3 6 7 3 4
0% 25% 50% 75% 100%


Very useful
Useful
Less useful
Not useful
No opinion
Did not answer
LNG for heavy duty vehicles
Total (n = 324) 54 57 17 53 95 48
Industry (n = 187) 37 30 4 22 63 31
Civic society / other (n = 38) 3 8 1 7 11 8
Citizens (n = 71) 8 13 10 17 19 4
Authorities (n = 28) 6 6 2 7 2 5
0% 25% 50% 75% 100%
LNG for inland navigation
Total (n = 324) 37 47 21 51 117 51
Industry (n = 187) 25 27 4 23 76 32
Civic society / other (n = 38) 2 7 2 6 13 8
Citizens (n = 71) 7 10 10 16 21 7
Authorities (n = 28) 3 3 5 6 7 4
0% 25% 50% 75% 100%
LNG for maritime vessels
Total (n = 324) 42 46 21 53 116 46
Industry (n = 187) 27 25 3 26 75 31
Civic society / other (n = 38) 4 7 1 6 13 7
Citizens (n = 71) 6 12 12 16 21 4
Authorities (n = 28) 5 2 5 5 7 4
0% 25% 50% 75% 100%
On shore power supply at inland waterway ports
Total (n = 324) 64 64 15 15 117 49
Industry (n = 187) 29 31 7 12 76 32
Civic society / other (n = 38) 8 8 2 1 10 9
Citizens (n = 71) 23 17 5 1 21 4
Authorities (n = 28) 4 8 1 1 10 4
0% 25% 50% 75% 100%
On shore power supply at maritime ports
Total (n = 324) 72 54 17 19 113 49
Industry (n = 187) 31 26 6 15 76 33
Civic society / other (n = 38) 10 4 2 1 13 8
Citizens (n = 71) 24 17 6 1 19 4
Authorities (n = 28) 7 7 3 2 5 4
0% 25% 50% 75% 100%



There were 197 additional responses to this question, of which 60 came from representatives of ***business associations*** and 83 from representatives of ***companies and business organisations***; these included many similar responses, and so are discussed together.

In relation to **public transport**, a business association respondent, whilst supporting mandatory Member State targets, called for the priority to be on alternative fuels infrastructure for public transport. Two representatives of companies / business organisations made similar calls (as did an NGO representative), with a specific reference to ensuring that the provisions of the AFID in relation to public transport were strengthened to complement the targets in the CVD, while another called for the consideration of not only electricity for buses (as implied by the question), but also of hydrogen and CNG.

A long-distance bus provider underlined the importance of the development of a common European market for the provision of alternative fuels, including in support of the fuel cell powered buses that they were planning to test. On the other hand, while supporting a common methodology more generally, a business association respondent suggested that a common methodology would not be useful for buses as the best option for these vehicles was recharging for battery electric buses at depots, which were a private facility outside of the scope of the AFID. This was echoed by another business association that suggested that there was unlikely to be much need for public infrastructure to recharge electric buses.

From the perspective of **road freight transport**, a business association underlined that it was important to have common objectives for Member States in order for there to be legal certainty about their investments, while three company / business organisation representatives underlined the importance of mandatory targets to ensure a coordinated roll-out of infrastructure in order to avoid challenges for cross-border road freight. A similar response from two business associations called for mandatory targets for the deployment of infrastructure for **different freight modes**, so that those transporting freight have an appropriate level of coverage across borders, while another similar response made the same point in relation to international transport more generally and a further similar response underlined the importance of all Member States deploying ERS.

Eleven similar responses (five from business associations, five from representatives of companies / business organisations and an NGO representative) noted that **L-category vehicles** had not been mentioned, which risked missing the importance of providing alternative fuel infrastructure for these vehicles.

In relation to **railways**, a business association respondent underlined the importance of catenary infrastructure for supplying electricity to recharge battery-powered trains, supported by a common approach to measuring emissions across the modes and guaranteeing interoperability. A company / business organisation called for targets for the electrification of national railway systems through overhead lines, for the construction of hydrogen refuelling stations for trains and for the construction of 'electrification islands' for battery trains, along with binding timetables for the electrification of cross-border tracks. Another respondent called for the AFID to support the replacement of diesel trains on non-electrified lines through the deployment of infrastructure for battery-powered trains and hydrogen trains.

There were a number of responses relating to **maritime transport**. A similar response from three business associations underlined that the deployment of alternative fuels infrastructure should not lead to ports being able to compete on the basis of being able to supply cheaper fossil-fuel based alternatives, e.g. if one port was required to provide OPS whereas a nearby port was not. In relation to cruise ships, a business association underlined that operators' use of alternative fuels depended on the shore-side availability of these and suggested that it did not make sense from a users' perspective that different ports in the EU, and even within a Member State, had a different methodology for providing such fuels. In addition, they called for a technology neutral approach that went beyond LNG and electricity, as they noted that some cruise ships were testing fuel cells on-board vessels.

On the other hand, another business association argued that a common methodology would not have any effect on ports, as they did not want one technology favoured over another, and instead called for the Directive to support ports, while taking account of their diversity. They noted that ports should be able to develop alternative fuels infrastructure and OPS in line with their own economic model, and in collaboration with all of its stakeholders. This point was echoed in another response that stated that mandatory targets for alternative fuels in ports would only be appropriate if they took account of the likely demand for fuels and the potential impact of their installation on the operation of the port. Another business association argued that the Directive's current approach to the provision of OPS was appropriate and, if there were any changes regarding OPS, that solutions with equivalent environmental benefits should also be allowed and that ports should be able to supply OPS power that meets demand. In addition, they suggested that any mandatory requirements should be goal-based, technology neutral and have emission reduction standards accompanied by port roadmaps.

A similar response from a business association and a representative of a company, while supporting the setting of comprehensive targets covering as many modes of transport as possible to support the development of business cases, noted that the scope of action on shipping should not be limited to short-sea shipping. With respect to **inland ports**, another business association argued that there should be a technology-neutral, goals-based approach (such as requiring zero emissions at berth) to the provision of alternative fuels infrastructure, rather than setting targets for some fuels and not others. One representative of a company / business organisation commented that there was no option relating to **aviation** in the question.

A representative of a company / business organisation argued that **ports and airports** should be subject to the same requirements as they competed against each other, and so called for a common methodology for each type of infrastructure to help with benchmarking and the tracking of deployment. They also called for mandatory targets to ensure the deployment of sufficient recharging infrastructure and for these to be line with the need to reduce GHG emissions.

Some responses covered a **range of fuels and energy sources** for which targets could be set according to a common methodology. A business association called for the focus to be on non-fossil alternative fuels, with fossil fuels being discouraged or only used as part of a transition to renewable energy. Another noted that the approach taken should ensure that refuelling infrastructure for all gaseous and liquid fuels, as well as recharging infrastructure for electromobility, was treated equally in the context of the national plans taking account of the technology and market maturity of the technologies and their environmental performance based on a life cycle assessment. One respondent simply underlined that a technology-neutral approach was key, while another noted that the installation of recharging and refuelling infrastructure was important to support the achievement of the CO_2 standards for road transport vehicles. Another business association respondent underlined the importance of rolling out infrastructure for different fuels. They called for ambitious targets for hydrogen and for the targets for electromobility to differentiate between types of charging and the charging capacities of vehicles, as well as for the deployment of charging points for electric commercial vehicles. Another respondent also expressed their support for the deployment of different fuels.

A representative of a company / business organisation called for the focus of the Directive to be on electricity, while another called for the approach to focus on zero carbon fuels rather than transitional fossil fuels and a third for the exclusion of fossil fuels. Another suggested that the priority of the targets should be infrastructure for electricity, renewable or low carbon hydrogen and synthetic fuels, although they also noted that LNG was a potentially beneficial technology that should be enabled by changes to the vehicle CO_2 standards. Another respondent called for the inclusion of ammonia, hydrogen and e-fuels in the NPFs. A different response called for a technology neutral approach, including binding targets for hydrogen refuelling stations, for recharging stations to be differentiated between LDVs and HDVs to reflect their different needs and for the further development of infrastructure for CNG and LNG, as it supported the uptake of sustainable renewable fuels. A separate response called for the use of high-blend biofuels in lorries and buses, while another called for sustainable liquid alternative fuels, such as paraffinic diesel and E85, to be used as much as possible, as the costs of infrastructure for other fuels was high.

In relation to **electromobility**, a similar response from one business association and three representatives of a company / business organisation called for ambitious binding targets to ensure a consistent development of the electric vehicle market across the EU based on a common methodology that reflected that charging needs differ between

Member States. They called for the targets to be based on a weighted approach that took account of a range of factors, such as the power classification of a charging point, its socket type and accessibility, grid capacity, local demographics and characteristics and existing national needs. They also called for the revised Directive to look at the different use cases for HDVs and to consider introducing targets for recharging infrastructure at depots, logistics hubs and delivery centres. A separate similar response – from one business association and representatives of three companies / business organisations – called for binding, minimum targets per Member State for the deployment of publicly-accessible infrastructure (including in rural areas and along highways), along with ambitious requirements for private charging. These included requirements for the provision of infrastructure on medium and large commercial properties, to upgrade cables in residential buildings and for charging infrastructure for electric commercial vehicles in urban areas, distribution centres and truck depots.

Other business associations made less extensive comments on **electric vehicle recharging**. A business association suggested that a common methodology could be very simple, e.g. to set a date by which tenders to install charging points in a certain proportion of parking spaces near residential buildings had to be awarded or a date by which a certain number of fast charging points had to be deployed within certain distances on the TEN-T core network. Another business association, while noting that a common methodology was important to avoid the fragmentation of the market in the EU, suggested that this should involve binding targets for charging infrastructure (taking account of the power level of chargers and the need for an appropriate geographical coverage) and be in line with the Green Deal and market developments. Another business association (and a similar response from a representative of a company / business organisation) suggested a common methodology was needed to ensure that an EU-wide coherent and harmonised deployment of charging infrastructure took place that gave consumers easy access and use. In addition, they underlined that the approach needed to reflect the needs (taking account of geography and demography) and accommodate the high-power charging needs of the HDV segment. Two similar responses from business associations called for there to be a strong focus on the provision of recharging infrastructure at the EU level, supported by comparable national measures. Another respondent called for deployment targets, and associated monitoring, to be based on a precise definition of what was to be counted (so the parking spaces available at recharging points that included a type 2 socket or CCS, not the number of sockets) and for the organisation responsible for the planning of the deployment of publicly accessible recharging points to be clearly specified to ensure an appropriate coverage. With respect to trucks, a business association called for consideration to be given to both high voltage conductive charging standards, as well as pantographs, but called on the EU to not yet set a mandate, and instead wait for these to be agreed at IEC/CENELEC.

Similarly, representatives of a ***company / business organisation*** made more **general remarks about charging infrastructure for electric vehicles.** One noted that standardisation, e.g. of plugs, and the uniform provision of infrastructure had to be undertaken at the EU level, while another called for the methodology to deploy public charging stations, and for private charging, to be included in the scope of the legislation. A separate respondent noted that the current approach in the Directive, including the lack of binding minimum targets for Member States, did not address the current disparities in the deployment of recharging infrastructure, either from a geographical perspective or in relation to ensuring a sufficient range of charging options. Another suggested that the current approach had been insufficient, so called for mandatory targets for recharging infrastructure linked to the deployment of electric vehicles. The importance of there being mandatory targets based on a common methodology ensuring, not only the right density of recharging points, but also that these were of sufficient quality (in terms of access and maintenance), was underlined in another response.

Another respondent gave an example of why there was a need for a common methodology for electric charging points noting that sometimes the number of plugs, rather than the number of charging points, were counted. A respondent noted the importance of mandatory targets for publicly accessible recharging stations in order to close the gap in deployment between Member States, while another underlined the importance of improved and harmonised technical specifications, supported by a common methodology for the deployment of infrastructure based on expected market demand. Another respondent called for electromobility to be recognised as the most advanced option and for the Directive to set out mandatory milestones for the provision of recharging infrastructure for 2022, 2025 and 2030 based on the anticipated demand that was expected three years after these dates. Another respondent underlined for there to be a widespread adoption of electric vehicles, charging had to be as easy as using a petrol station, and roaming needed to be as straightforward as it is for mobile phone networks, while also calling for charging provisions for rental vehicles (and for ground handling equipment) at airports.

A business association called for a coherent approach across Member States that incentivised electromobility over other fuels and which provided a standardised approach to the deployment of the necessary recharging infrastructure in both the **road transport and maritime sectors** (with respect to OPS). A representative of a company / business organisation also called for targets for electric vehicle recharging infrastructure for road transport and for targets for alternative fuel refuelling and recharging infrastructure for maritime transport to be set at the EU level. This should reflect different use cases for road transport (including recharging at home, offices and public locations) and cover all relevant fuels for maritime transport, including electricity, hydrogen and LNG. A representative of a company / business organisation argued that the provision of OPS was important at ports and inland water terminals in order to support temperature-controlled transport, while electrical supply onboard freight trains and at rail freight terminals was needed for similar reasons.

On the other hand, while noting that any common methodology for calculating targets should not create disparities between Member States, a business association argued that a **common methodology was not needed** for electric vehicle recharging infrastructure as this was already developing as a result of the market.

A number of responses focused on **gas infrastructure**. A similar response from seven business associations and nine representatives of a company / business organisation, a couple of which underlined that their focus was on biomethane, called for a common methodology for the development of gas refuelling infrastructure. Many of these also proposed criteria for urban areas based on spatial density and for the TEN-T core, although called for some flexibility in terms of providing the relevant infrastructure on the latter. In addition, seven of these regretted that the survey had not considered the potential for CNG for local freight, buses, inland navigation, regional rail and short sea shipping, while five underlined the importance of relevant concessions lasting long enough to pay back on investment and deliver some profit. A national business association noted that the provision of CNG infrastructure was important in their country, as was the provision of LNG infrastructure for international HDV transport. A representative of a company / business organisation, while supporting a common methodology for the deployment of infrastructure, called for targets for the provision of CNG infrastructure for HGVs, in addition to those for cars and vans, while two representatives of a company / business organisation suggested that LNG for rail was missing. Two other representatives of a company / business organisation called for a more strategic approach to the development of LNG infrastructure, e.g. close to large distribution centres, as well as near highways and close to airports.

Four respondents focused on the role of **hydrogen,** including two business associations and two from representatives of a company / business organisation. The latter called for mandatory deployment targets for hydrogen infrastructure for road, rail, ports and airports, before setting out the benefits of a range uses of hydrogen in transport. A separate response from a business association called for binding targets for hydrogen refuelling infrastructure, as this would speed up investment and cooperation between public and private stakeholders. They suggested that this should be focused initially on the TEN-T corridors followed by a wider diffusion. Other responses recognised the potential importance of hydrogen as a fuel for HDVs. One company respondent noted that few hydrogen refuelling stations were suitable for HDVs in relation to the way in which the fuel was dispensed or the space needed for the vehicle, while another suggested that hydrogen would play a key role for HDVs. Another respondent noted that, while the development of hydrogen HDVs was still at an early stage, the development of technical specifications for compressed hydrogen could be set to ensure the smooth introduction of the fuel. On the other hand, one respondent felt that it was too early to set targets for hydrogen. A representative of a company / business organisation underlined the versatility of hydrogen, and so called for Member States to be subject to binding targets for the deployment of hydrogen refuelling stations along the main transport corridors.

Other respondents made more **general comments**. A business association underlined that defining certain framework conditions across the EU should be beneficial in terms of the consumer acceptance of alternative fuels, while another underlined the importance of having data on all technologies before setting mandatory targets based on a common methodology. A third business association called for uniform methods as this made it easier for Member States, although they underlined the importance of this method being able to take account of the different conditions in Member States in terms of traffic volumes, population density and the structure of settlements. Another business association criticised the lack of "specific objectives" and penalties or incentives for Member States in the Directive, which they considered meant that national governments did not consider it a political priority and so the infrastructure was not deployed, thus undermining consumer acceptance.

Similarly, representatives of a ***company / business organisation*** made some more **general comments**. One noted that emissions needed to be calculated using a common methodology across the modes and energy sources, whilst noting that interoperability should be guaranteed for all fuels, while another two similar responses felt that only a common methodology allowed for comparisons and accountability. A separate response called for the mandatory targets to be uniform across the different fuel types in order to create a level playing field, and for deployment to be supported by more public-private investment and tax incentives to benefit public and private investment. Another response called for the uniform deployment of infrastructure to be ensured at the EU level, while Member States should ensure that the necessary publicly accessible infrastructure was deployed taking account of national peculiarities and conditions. A separate response suggested that mandatory targets should be set for the level of penetration of alternative fuels, rather than on the number of recharging/refuelling points, and that innovation and the market should be left to define the mix of fuels. A similar response from two representatives of a company / business organisation suggested that mandatory targets based on a common methodology could be considered for the TEN-T, although if Member States chose to do this, they would need to demonstrate that the deployment was aligned with other measures to ensure the uptake of vehicles. A separate response called for homogenous roll-out plans that delivered the minimum requirements in order to avoid distortions. Two similar responses called for a technology neutral approach to be taken if mandatory targets were applied, while noting that these could be useful for immature fuels, such as hydrogen, although these needed to be set at the national level taking account of the national context, the existing level of infrastructure and the vehicles that were in use.

A business association noted that a **common, non-binding methodology** could be beneficial if it reflected specific conditions in each Member State and was based on demand. A representative of a company / business organisation underlined that the common methodology needed to be sufficiently flexible to take account of geographical differences and needs. Another respondent proposed that Member States should be left to decide whether or not to set targets for road transport fuels whose use was increasing slowly, such as hydrogen, CNG and LNG, and for fuels for non-transport modes, whereas for other fuels it was important to ensure that national targets ensured the sufficient, but not excessive, deployment of infrastructure.

On the other hand, three similar responses (one from a business association, the other two from a company / business organisation) ***underlined their opposition*** to fixed targets for expanding electromobility. Instead, they called for these to be linked, in a uniform, dynamic and flexible way, to the uptake of electric vehicles, which should be monitored by an independent national body, which would then inform the national infrastructure strategy. For other fuels, such as hydrogen, CNG and LNG, they believed that more stringent requirements relating to the distance from infrastructure were more appropriate, as private refuelling was not an option for these fuels. Another business association made a similar point, while calling for mandatory targets (rather than a common methodology), they noted that fixed targets did not generally meet consumers' requirements and so called for a dynamic, flexible approach that was linked to expected vehicle sales for electric vehicles and took account of charging capacities, the power classes of charging points and their locations. In addition, they noted that it would be useful to complement national infrastructure deployment plans with dedicated funding.

A number of business associations argued that **mandatory targets were not useful** at the EU level. Instead one called for a technology neutral approach, while noting that mandatory targets could be relevant for less mature alternative fuels, such as hydrogen, although these should be defined by Member States and supported by national incentives that took account of the national context and availability of vehicles. Another respondent argued that the deployment of alternative fuel infrastructure should be a Member State decision and addressed at the most appropriate level in each country. Another business association also cautioned against mandatory national deployment targets, as deployment needed to reflect the bigger picture, including the need for any adjustments to distribution networks. Another respondent, who believed that mandatory targets were not an appropriate means of stimulating the market, called instead for incentives to support profitable operators and for regulatory mechanisms, such as a 'right to plug'. Similarly, another response, which also did not support mandatory targets, called for an approach to ensure a minimum coverage of infrastructure across Europe, taking account of population density and pollution levels. A further response from a business association argued that setting mandatory targets was not in line with the principle of technological neutrality and that setting mandatory minimum targets would be an obstacle for some alternative fuels that already had appropriate distribution networks. A response called for targets to be the responsibility of Member States, as infrastructure needed to be built to meet demand, while another felt that a common methodology and targets were unnecessary as the market would deliver the necessary infrastructure. A different respondent called for targets to be left to Member States, as each country has its own specificities and knew best the needs of its market, while another suggested that Member States should be allowed to make their own decisions on targets.

One of the six responses from representatives of ***consumer organisations*** underlined their belief that a new Regulation should focus on electricity and hydrogen (including for HDVs and rail), as gas vehicles did not deliver CO_2 emissions reductions to the same extent as these energy sources and also emitted other pollutants when burnt (and also pointed out that 16 Member States had not yet provided any estimates for the development of CNG vehicles). Another respondent highlighted the importance of expanding infrastructure for alternative fuels in the context of a holistic transport strategy, along with a coherent strategy for the deployment of hydrogen as a fuel, particularly on the railways. More emphasis in the AFID on synthetic fuels was called for by another respondent, particularly for their potential to be used as drop-in fuels and so reduce carbon emissions and avoid having to prematurely scrap internal combustion-engined vehicles. Other representatives of consumer organisations called for a technology-neutral approach, for the use of electricity rather than hydrogen and for any common methodology to differentiate between uses and also between peripheral and transit countries, as a denser charging network was needed in the latter. The one response from an ***environmental organisation*** called for all CNG and LNG targets to be removed from the Directive and for the focus to be on the electrification of road transport and smaller water vessels, with hydrogen and ammonia (as a hydrogen carrier) used to decarbonise other shipping.

Two similar responses from the 13 representatives of ***NGOs*** who answered the question called for all gas targets to be removed from the scope of the Directive. Instead, they called for infrastructure for maritime transport to consist of electricity supply for battery electric ships and hydrogen/ammonia refuelling for other ships, for the concentration of hydrogen at Europe' largest ports (both for trucks and other applications) and for the focus of electric truck targets to be on providing charging at the EU's main urban areas to support the electrification of urban and regional deliveries. The removal of natural gas from the Directive was also called for by another NGO respondent.

An NGO respondent suggested that, while progress had been made in deploying infrastructure for recharging LDVs, this was still lacking in sparsely populated areas. They called for the provision of charging points, along with the development of compressed and liquefied biogas (for heavy duty road and maritime transport) to continue to be led by EU policy. Another response suggested that renewable/low carbon electricity, hydrogen and synthetic fuels were the fuels that could contribute to the decarbonisation of transport and so called for targets and infrastructure to support their uptake. In relation to electromobility, one respondent suggested that a common methodology was needed to inform the development of an essential recharging network in the Member States, so as to provide the minimum charging infrastructure that was needed to encourage the uptake of more electric vehicles and which supported Member States in developing realistic targets.

Some NGO respondents made more **general comments**, including that a common methodology was the only way to have a homogeneous development of alternative fuels in Europe, that a common methodology should be the basis of a European internal market for such fuels and that mandatory targets should be set to ensure that the roll-out of infrastructure was harmonised across Member States, including for powered two-wheelers. On the other hand, one respondent called for Member States to continue to be able to set relevant targets, and another that there was a need for clear and specific criteria to ensure that Member States set targets more systematically.

Three of the 17 responses from ***EU citizens*** and the single response from a ***non-EU citizen*** called for a focus on **electrification**, while two others called for electricity to be the main focus complemented by hydrogen for HDVs (and perhaps rail). A separate response called for a common approach and methodology for electromobility to enable cross-border roaming, while another response suggested that mandatory development targets should be developed for the deployment of electric vehicle charging points to address the current uneven distribution of these. This respondent also called for hydrogen, CNG and LNG to be ignored.

Three other citizens suggested that **hydrogen** should not be considered as a transport fuel, while another acknowledged that it could be appropriate for heavier vehicles (not cars). On the other hand, one called for the creation of homogenous refuelling infrastructure for hydrogen to support its uptake. Two other citizens considered that **CNG** should not be included in the Directive, whereas another citizen called for the development of infrastructure for gas refuelling, another for the development of LPG infrastructure and a third that LNG could be a transition fuel for heavy duty road and maritime transport.

Other citizens made more general points, including underlining the importance of ensuring a reliable recharging and refuelling network throughout Europe, the importance of standardisation at the European level, the need for a rapid transition for all modes and the importance of the consideration of the potential of L-category vehicles. There was a single response from an ***academic or research institutions***, which called for explicit choices to be made regarding fuels, arguing that electromobility was the most likely candidate, while the science and market developments suggested that targets for other fuels were less credible.

There were 12 additional responses from representatives of ***public authorities***, some of which identified additional fuels for which targets could be set according to a common methodology. These included hydrogen for aviation, electricity and batteries for rail and biofuels, while another respondent called for natural gas to be excluded and underlined that hydrogen should come from green sources, not fossil fuels. One respondent suggested that the responsibility for the development of infrastructure for HDVs was not clear.

Another response suggested that mandatory targets were particularly useful for zero emission technologies, although noted that objectives for transition technologies could be useful where there was not yet sufficient zero emission technologies, such as LNG for shipping. In addition, the response noted that mandatory objectives had to be smart, developed using a methodology that took account of the characteristics of each Member State and were sufficiently flexible to be able to be adjusted in response to the evolution of the market. Another response noted that a common methodology with minimum quantified targets could be useful to avoid imbalances between Member States and to ensure a coherent network. It also called for the inclusion of a target for the provision of CNG infrastructure for HGVs.

Other responses called for **harmonised approaches for specific applications**. One noted that a harmonised approach for shipping would be preferable, noting that this was best taken forward at the international level. Another response called for a common basis to the rolling out of infrastructure for cross-border modes of transport, although called for clear basic conditions rather than the application of fixed ratios. Another response made a similar point: that the application of a common methodology should be restricted to transport modes that crossed borders, as local transport did not need such an approach.

Other public authority respondents were **less convinced about the usefulness of EU level targets**. One noted that charging solutions were situation-specific and so mandatory EU-level targets risked leading to a sub-optimal solution, so the Directive should ensure that NPFs included targets to provide a basic level of infrastructure and a method for reacting to developing needs. Another response called for the Directive to encourage the use and development of fuels such as hydrogen and synthetic fuels, although again called for national targets for these to be set in respective NPFs. Finally, a response called for a proportional approach, reflecting the needs of individual Member States, while also underlining that there should be no mandatory target for the use of hydrogen on the railways, as its electrification should be the main priority, complemented by gas and hydrogen where necessary.

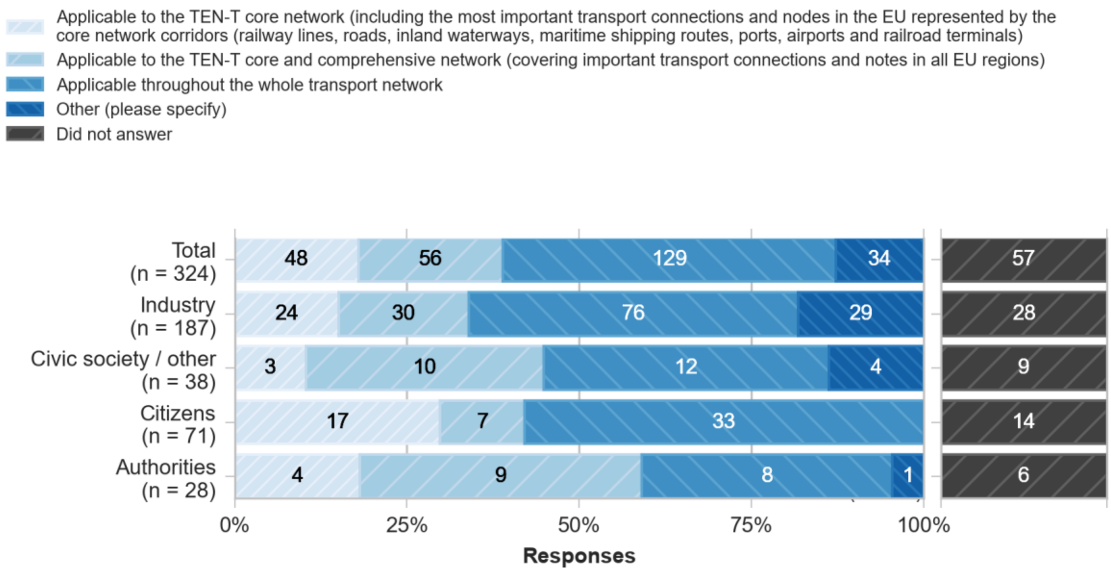
One of the two responses from organisations that classified themselves as ***'Other'*** called for a common methodology, including binding targets per Member States (that were in line with the Green Deal and market developments, and which took account of national needs and the power levels of chargers) to avoid the fragmentation of the EU market. The other called for financial support for the deployment of infrastructure more generally.

11.7.5.2.3 D3. Should such mandatory targets be applicable throughout the whole transport network or only for specific parts of it?

Only those stakeholders who indicated that mandatory deployment targets are useful for at least some of the areas mentioned in Question D2 were asked to respond to questions D3 to D10.

Respondents were asked whether such mandatory targets should be applicable throughout the whole transport network or only for specific parts of it (see Figure 6-7). Overall, the majority of stakeholders agreed that it should (129 out of 267 responses), with 56 stating that they should be applicable to the TEN-T core and comprehensive network, and 48 stating that they should be applicable to the TEN-T core network, including the most important transport connections and nodes in EU represented by the core network corridors.

Figure 6-7: D3. In your view, should such mandatory targets be applicable throughout the whole transport network or only for specific parts of it?



There were 34 additional responses to this question, of which 13 came from representatives of ***business associations*** and 15 from representatives of ***companies and business organisations***. These included a number of similar responses, while other responses covered similar issues, so these are analysed together.

Two similar responses (one from a business association) called for targets for the **whole TEN-T network**, which should include publicly accessible commercial sites and truck depots, as well as upgraded cabling and charging requirements for residential and non-residential buildings, while also taking account of the status and flexibility of the local electricity system and the availability of renewable energy resources. Another business association respondent called for the deployment of charging infrastructure to cover the whole TEN-T network, as well as important urban nodes, while also ensuring a clear link with the revised TEN-T Guidelines, which should focus on zero-emission mobility.

Two similar responses (one of which was from a business association) called for deployment targets to go **beyond the TEN-T** to focus on locations where most charging took place, i.e. at work and at home, and so called for legislation to ensure an ambitious increase of public charging (including fast charging), of private charging that was accessible to the public and of private charging that was not accessible to the public. Another business association respondent noted that, while the TEN-T network was a good starting point, the ultimate goal should be to cover the whole network. A response from a representative of a company / business organisation called for the whole network to be covered in a coherent manner throughout the EU, although they underlined that for rental electric cars used across borders, it was essential to ensure that there was sufficient recharging infrastructure along the TEN-T, as well as at airports and train stations, as these are major travel hubs.

Other responses explicitly called for the **entire transport to be covered**. One business association respondent underlined that, only if the entire network was included would it be possible to have an adequate supply of recharging and refuelling infrastructure in all areas, including rural areas, so called for private charging points (at home and at work locations) to be included in the Directive. They did not believe that there should be specific targets for electric vehicle recharging infrastructure, only a flexible and dynamic framework for their expansion. However, they did think that more stringent requirements were more relevant for hydrogen, CNG and LNG, as there were no home-refuelling options for these. Another business association called for there to be uniformity across Europe.

In supporting the coverage of the entire transport network, a number of representatives of companies and business organisations underlined the importance of **urban areas**. One argued for mandatory targets in urban areas, as the provision of recharging infrastructure at apartment buildings and workplaces was a crucial factor in the uptake of electric mobility, while another underlined the importance of infrastructure in urban areas and in residential areas. It was also suggested that it was important for urban areas to be covered, as 90% of the charging would take place here, although it was underlined that any targets needed to consider the local status of the grid, fleet and traffic volumes and population density. Another respondent argued that, while there should be mandatory targets across the whole network, those on the core TEN-T network and in urban areas should be set in line with the benchmarks for zero and low emission vehicles in the EU's CO_2 standards for vehicles, with the power classes of the charging points taking into account the charging capacities of vehicles.

The importance of differentiation depending on the mode of transport and fuel was highlighted by one business association. For roads and rail, the electrification of the whole network was important, whereas the TEN-T core network should be the focus for shipping and airports. A business association respondent underlined that it was not simply the number of charging points that was installed that was important, but their location, while another noted that the infrastructure should be installed on all routes provided that the relevant vehicles were available. A representative of a company / business association highlighted that the comprehensive TEN-T network should be seen as a priority for deployment to ensure that the uptake of zero emission vehicles was fostered in regions not covered by the core TEN-T network, while another suggested that synergies between the TEN-T and TEN-E should be exploited when developing the distribution networks and deciding on the location of the necessary infrastructure.

One business association respondent underlined that targets for the provision of refuelling and recharging infrastructure should apply to **public transport** in order to support the implementation of the CVD, and that these targets should be further defined in national deployment plans in line with the respective country's CVD targets. A representative of a company / business organisation also called for the Directive to cover infrastructure for public (as well as private) vehicles, while another noted that infrastructure for buses needed to be in cities and in rural areas.

Two similar responses (one of which was from a business association) highlighted that the **electrification of rail** should continue, although they also noted that alternative fuels were an option on parts of the network that were difficult to electrify. In addition, one of these suggested that targets for the electrification and deployment of alternative fuels, particularly hydrogen refuelling stations, should apply to the whole transport network, while noting that the electrification of rail should not be prevented by the introduction of "arbitrary" targets for the deployment of other alternative fuels.

A business association suggested that mandatory targets needed to go beyond **TEN-T ports** to include ports used by cruise ships. A representative of a company / business organisation also mentioned the potential of including ports used by cruise ships, as well as of coastal areas and islands that had the potential to generate renewable energy.

In relation specifically to **hydrogen**, a business association and a representative of a company provided a similar response that argued that hydrogen refuelling stations could be installed throughout the transport network, as these could be located next to a renewable hydrogen production sources, while the distribution networks could be developed along the TEN-T networks.

On the other hand, a company / business association representative suggested that **targets might be too prescriptive**, as a result of Member States' specificities.

One of the two responses from representatives of ***consumer organisations*** called for the TEN-T core and comprehensive networks to be covered by a new Regulation, which should include Member State targets for urban and suburban areas, supported by EU funding to invest in less attractive locations, such as private and commercial buildings and car parks, in order to ensure that no-one was left behind. The other respondent called for consumer protection, interoperability and standardisation to apply to the whole network, although suggested that the deployment of infrastructure should be dependent on the mode and the interaction with the internal market.

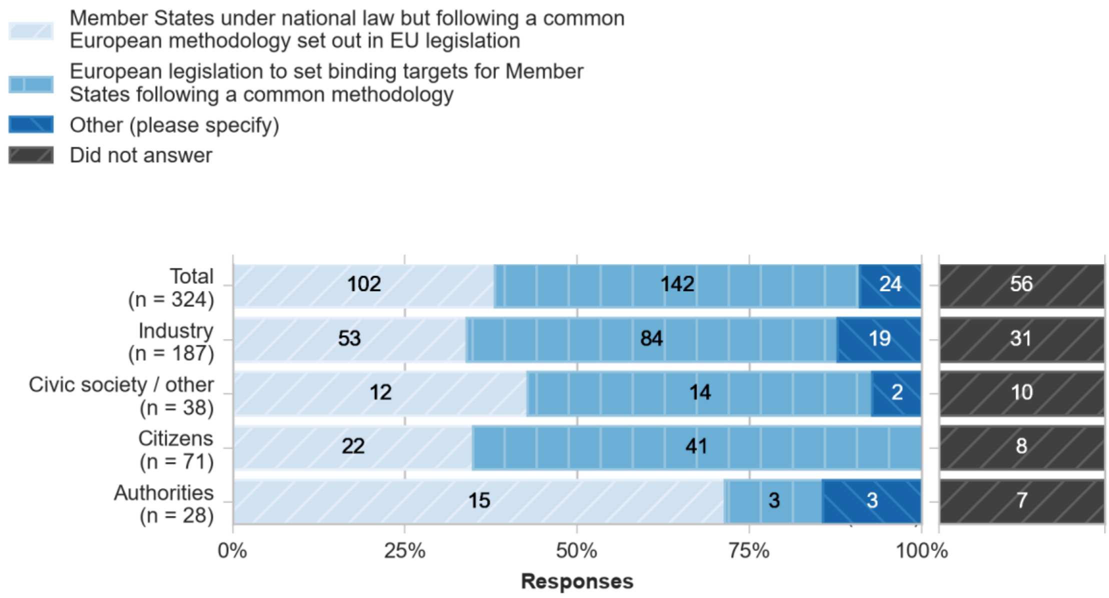
One of the two responses from representatives of ***NGOs*** was similar to one from a representative of a company / business organisation and supported the coverage of the whole transport network. However, this noted that the comprehensive TEN-T network should be seen as a priority for deployment to ensure that the uptake of zero emission vehicles was fostered in regions not covered by the core TEN-T network. The other respondent called for Member State targets to apply to infrastructure for both private and public vehicles.

The single response from a representative of a ***public authority*** underlined that it was important to deploy infrastructure where there was a need for it, although noted that this would probably be beyond the TEN-T network and its urban nodes and include other urban areas.

11.7.5.2.4 D4. Who should set mandatory deployment targets?

Respondents were asked, in their view, who should set mandatory deployment targets (see Figure 6-8). Stakeholders predominantly opted for European legislation to set binding targets for Member States following a common methodology (142 out of 268 respondents). Industry, civic society and citizen respondents all agreed, with just authorities being in favour of Member States setting mandatory deployment targets under national law, but following a common European methodology set out in EU legislation.

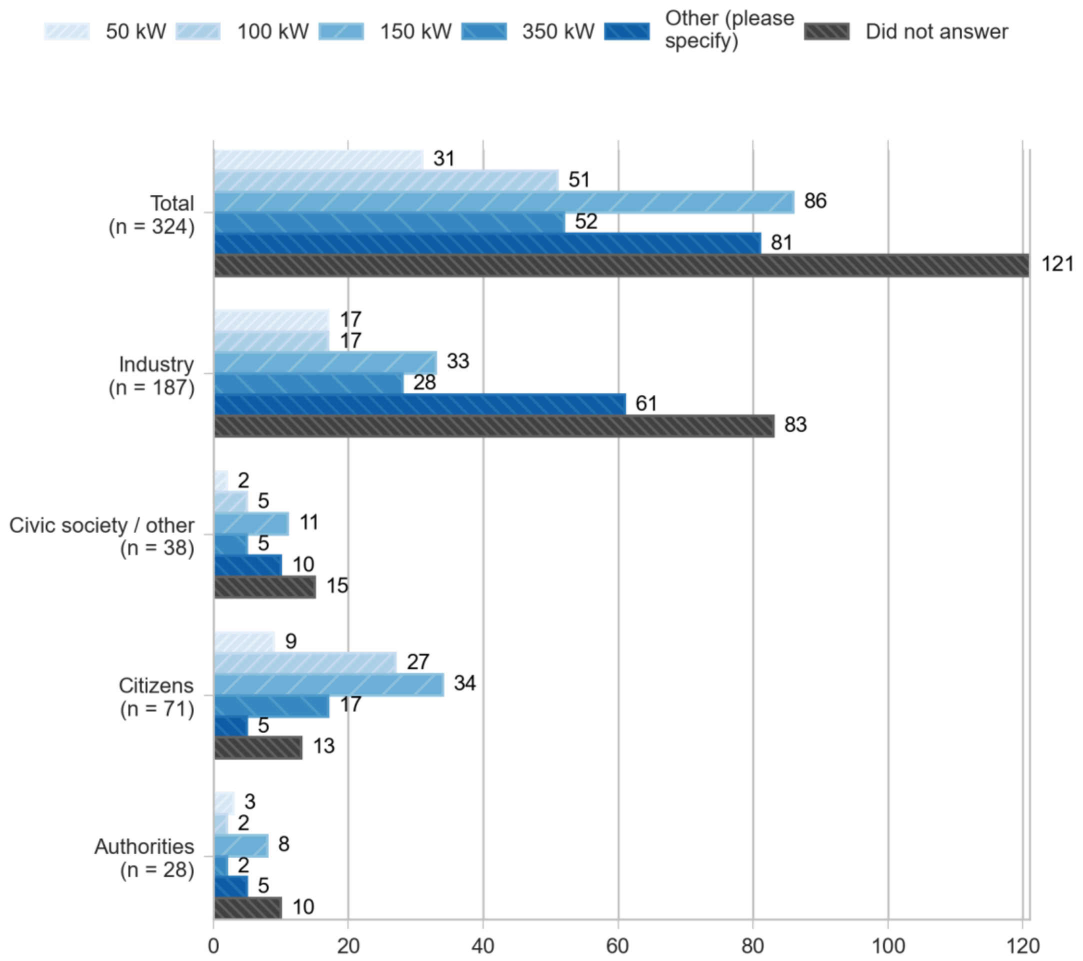
Figure 6-8: D4. In your view, who should set mandatory deployment targets?



11.7.5.2.5 D5. Which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for passenger cars and light duty vehicles along the TEN-T network?

Respondents were asked, in their view, which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for passenger cars and light duty vehicles along the TEN-T network, with multiple answers possible per stakeholder (see Figure 6-9). The most selected power wattage was 150kW with 86 responses and was the most selected specifically stated wattage for all stakeholder groups. this was closely followed by 350kW (81). 50kW was the least chosen (31).

Figure 6-9: D5. In your view, which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for passenger cars and light duty vehicles along the TEN-T network (multiple answers possible):



There were 78 additional responses to this question, of which 26 came from representatives of ***business associations*** and 33 from representatives of ***companies and business organisations***; these addressed similar points and included some similar responses, so are covered together.

A number of responses highlighted **that a range of powers were appropriate**. One noted that the normal power charging (7kW-22kW) was still appropriate in some cases (e.g. overnight charging or charging during working hours), although a rapid charging network would be necessary along the TEN-T, while another underlined that the power requirement was dependent on the vehicle, its use, the distance travelled and the charging mode and so, for example, a car used for commuting and a shared vehicle would have different requirements. A similar response from a business association and a representative of a company / business organisation noted the challenges of fast charging for the grid, and so underlined the importance of having a range of powers available and of using pricing incentives to influence user behaviour. Two similar responses from representatives of a company / business organisation made a similar point that the lower possible charging power should be selected as the mandatory level in order to keep the impact on the grid as low as possible.

The importance of putting in place a **balance of AC and DC charging points** to support both short- and long-distance travel was underlined by one respondent, while another noted that the type of power charging point that was appropriate was dependent on its location. Another response noted that the optimal power for charging could be anywhere between 50 kW and 1,000 kW by 2030, although as a range of electric vehicles would be in use by then, they noted that it would still be important for chargers on the TEN-T to cater for a range of powers.

Responses from a number of ***company / business organisations*** also noted that a **range of power levels should be available**. In underlining the importance of the Directive covering a range of types of charging, one response called for the prioritisation of 'slow charging', as this would be the most widely adopted use case, i.e. charging at home and at work. A similar response from one representative of a company / business organisation and a representative of an NGO suggested that 50 kW should be the minimum requirement in urban areas, 150 kW in peri-urban environments and on secondary roads while 350 kW should be the minimum on the primary road network and on highways. Another response noted that a range of powers was needed to meet different needs, and that these should cater for longer stops and top-ups, as well as for the needs of two-wheeled vehicles. A separate response suggested that 22 kW AC would probably be sufficient in urban areas, whereas on highways and in areas, where street charging was not possible, 150 kW would be more appropriate.

In relation to the proposed **minimum power of 150 kW,** nine responses (five from business associations, the others from companies / business organisations) called for this to be the minimum, with two noting that ideally the minimum would be 350 kW. A representative of a company / business organisation suggested that while 150 kW was appropriate in the short-term, 350 kW would be more appropriate in the medium to long term, although they noted that what would be most appropriate would depend on the location of the charging point. Another respondent that identified 150 kW as the minimum suggested that ideally the minimum should be 200 kW, although they noted that consideration needed to be given to the location of the charging point. Another respondent noted that the appropriate level depended on the number of cars and that any level greater than 200 kW depended on the type of battery in the cars. On the other hand, a business association noted that such a power level could not be achieved across the board and so it must be possible to achieve the minimum power with existing infrastructure.

With respect to the proposed **minimum power of 350 kW**, a business association noted that this power was not currently supported by some national networks, while a representative of a company / business organisation suggested that while 350 kW would be desirable in the future, the current network in some countries would not be able to support this now. A representative of a company / business organisation suggested that using 350 kW as a minimum would future-proof solutions, although noted that this would be costly and risked a lock-in in favour of a few manufacturers, so proposed that a lower minimum standard might be more sensible. A company / business organisation representative called for a power level of **600 kW** to facilitate charging within 15 minutes that would enable a significant range to be covered, while another argued that high power levels were more favourable as they reduced charging times.

A number of respondents made more **general comments**. Five similar responses (from two business associations, a representative of a company / business organisation and two NGOs) called for the Directive to set (unspecified) minimum standards, which should reflect the number of charging points, the charging power and the ratio of the number of charging points to vehicles, and then let the market decide which power was most useful. A separate business association called for the decision on the charging point power level to be left to Member States, while another suggested that the needs would vary by Member State, although called for a common (unspecified) minimum standard. A response from a company / business organisation responded with respect to ERS technology and noted that the appropriate power was dependent on the number of receivers on the vehicle. Two business association responses and one from a company made reference to the ACEA position paper for their response to this question (see Section 1.4).

A similar response from four business associations mentioned the importance of considering the needs of **L-category vehicles** when setting minimum voltages. Four responses from representatives of a company / business organisation also mentioned the need to address charging infrastructure for L-category vehicles, with one proposing that DC chargers of less than 12 kW conforming to IEC 61851 -25 should be deployed for such vehicles.

A number of respondents suggested **that there was no need for minimum power requirements.** A similar response from one business association and two representatives of a company / business organisation suggested that this should be left to the market, with one noting that each power level had different use cases and that high power was not necessarily always better. In its response, a business association underlined its opposition to rigid target values for recharging infrastructure, as it noted that the most appropriate solution was based on the charging needs and vehicles, the local situation, the network connection and the possibility of price differentiation; hence the decision should be left to the market. A similar response from two company / business organisation representatives also underlined that there was no need to set a minimum capacity requirement, as different power levels (including those as low as 7kW-22kW) were more appropriate for different use cases. Two other separate responses also stated that they did not support binding targets, with one noting that they saw no developments that would require one or other minimum charging capacity. A similar point was made in two similar responses (one from a business association) that such technical decisions should not be set in legislation, but left to the market, with one noting that if legislation was too prescriptive it could have a negative impact on technology development. Two other responses from representatives of a company / business organisation also noted that a range of power levels were relevant for passenger cars, with one calling for the development of the power level of recharging infrastructure to be left to the market.

One of the two responses from representatives of ***consumer organisations*** suggested that 50 kW was the minimum, while the other underlined the importance of ensuring the safety of charging stations along the TEN-T. The one response from a representative of an ***environmental organisation*** noted that there were already cars on the market that could be charged using power levels of more than 200 kW, so underlined the importance of future-proofing infrastructure to overcome concerns around charging anxiety.

One of the five responses from representatives of ***NGOs*** (three of which were similar to other responses – see above) suggested that the Directive should require Member States to develop their own 'essential networks', with reference to a common European methodology, and so the power requirements should be determined by Member States in this context with a view to setting up a competitive recharging market and ensuring a minimum coverage. Another response underlined that it was important that minimum requirements varied according to the location of the charging points, e.g. in urban environments compared to peri-urban locations and secondary roads, and on primary roads and highways.

A range of issues were mentioned in the four responses from ***EU citizens*** and the single response from a ***non-EU citizen***. One suggested that 50 kW would be a sufficient minimum for stationary charging points, while 30 kW would be appropriate for ERS, while another suggested that the charging of L-category vehicles would also need to be addressed. More generally, one respondent called for similar minimum capacities for infrastructure for hydrogen and other alternative fuels, while another underlined the importance of addressing the capacity of the grid.

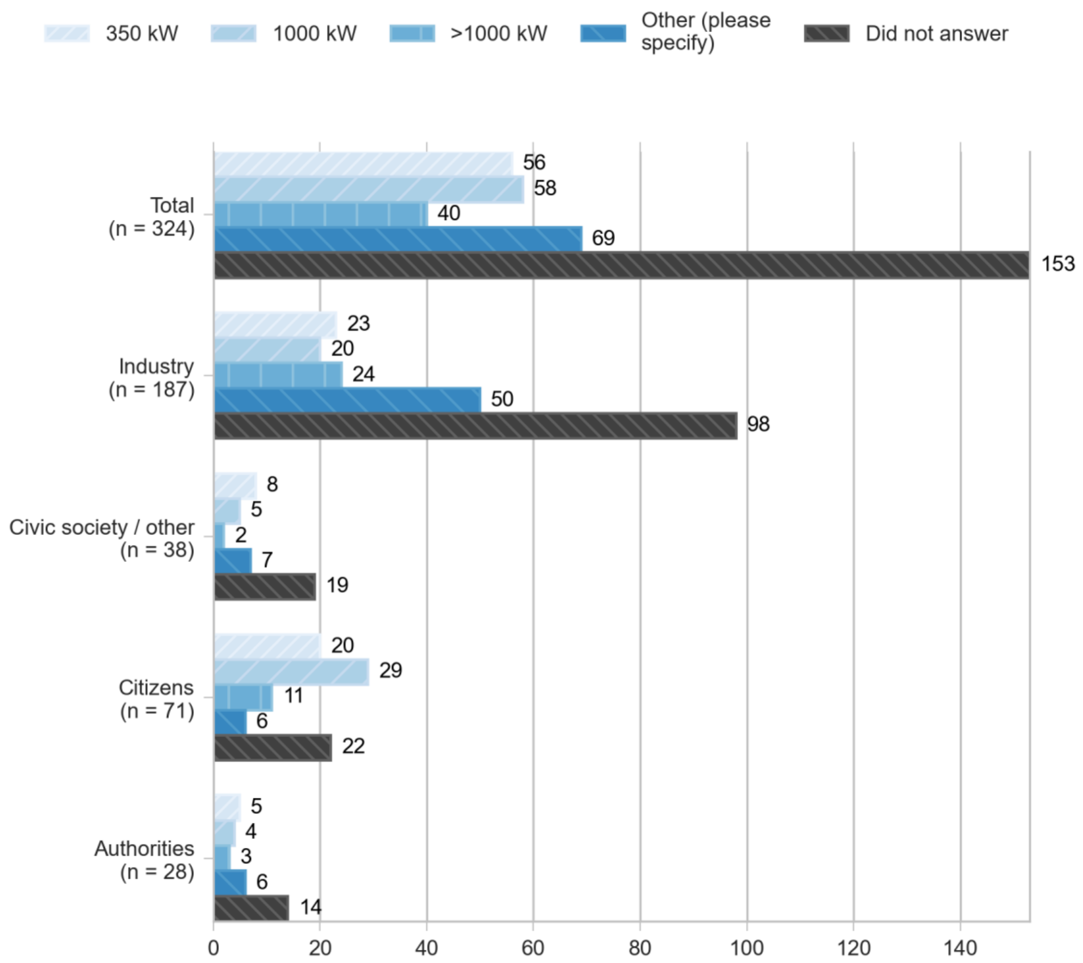
One of the five responses from representatives of ***public authorities*** called for the minimum to be 300 kW, while another called for a range of power levels between 50 kW and 350 kW to be supplied, while underlining the need to future-proof the network. Two separate responses underlined that the minimum charging power depended on the location or function of the charging point, while taking account of the total charging capacity. The final response called for the market to be left to determine the optimum power.

There were two responses from organisations that classified themselves as ***'Other'***, one of which called for the minimum to be in the range of 100 kW to 250 kW, as 350 kW would require too much electricity capacity. The other called for mandatory minimum requirements, with the market being left to decide the most useful power levels above these.

11.7.5.2.6 D6. Which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for heavy duty vehicles along the TEN-T network?

Stakeholders were asked, in their view, which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for heavy duty vehicles along the TEN-T network, with multiple answers possible (see Figure 6-10). Overall, 'Other' represented the highest number of responses (69). This was followed by 1000 kW (58) and 350 kW (56).

Figure 6-10: D6. In your view, which power should be required in case of mandatory targets for publicly accessible recharging infrastructure for heavy duty vehicles along the TEN-T network (multiple answers possible):



There were additional 66 responses to this question, of which 18 were from representatives of ***business associations*** and 30 from representatives of ***companies and business organisations***; these covered similar themes, so are covered together.

A number of responses made a general point about **potential targets**. A business association called for mandatory targets to include only minimal requirements, such as in relation to the number of charging points, the charging power and the ratio of charging points to vehicles, and leave the market to decide the most appropriate power charging level. A company / business organisation representative made a similar point, i.e. that minimal requirements should cover the number of charging points, power levels and the ratio of charging points to vehicles, while a decision on the power level should be left to the market. Another business association suggested that 150 kW would be sufficient as a minimum requirement and that anything above this should be left to the market, as the business case for higher power charging needed further validation. A representative of a company / business organisation suggested that while deployment targets might support the deployment of HDV recharging infrastructure along the TEN-T, the power requirement should respond to the needs of the respective HDV technology.

Some responses suggested that the **charging needs of HDVs were not yet clear**. One business association noted that on the basis of current technology, a 3-phase 380V-32A charging station would be suitable to charge some HDVs overnight, whereas rapid charging would need at least 1000 kW, while heavier and/or longer-range vehicles would need more than this. A representative of a company / business organisation argued that there was no need to set minimum capacity requirements, as the power level that was needed depended on the use case, while another called for consideration to also be given to dynamic charging to complement static charging. A business association suggested that adopting one power over another at this point was premature, as there were not yet sufficient numbers of vehicles in circulation. A similar comment was made by two representatives of a company / business organisation, i.e. that it was not yet possible, or necessary, to identify the power level, as there were not yet sufficient numbers of electric HDVs on the road.

Others made more **general points**. One business association suggested that even outputs of 150 kW were currently not able to be achieved everywhere, with the implication that mandating higher minimum levels would be problematic. A different business association suggested that the most appropriate power level should be based on the current needs in the Member States, which could vary between country, while another suggested that the power level should be set following the definition of the Megawatt Charging System (MCS/high-power charging for commercial vehicles (HPCCV)). A representative of a company / business organisation also noted that the power level that was needed depended on the use case and called for the power levels to be defined in cooperation with HDV manufacturers, while another noted that there was a range of different needs, including the potential for lower power stops for trucks overnight or during their driver's rest period. A different respondent noted that a mix of power levels would be needed, although noted that slower charging should be incentivised, as faster charging was more challenging for the grid. Two similar responses made a similar point: that the lowest possible charging power should be required in order to keep the impact on the grid as low as possible. Another respondent stated their preference for cars and HDVs to use the same recharging infrastructure.

In relation to the power levels mentioned in the question, one business association argued that the power level should be at least **350 kW** in combination with chargers with powers of over 500 kW, while another suggested that 350 kW should be sufficient for a truck with three or four 250 kWh batteries. A representative of a company / business organisation suggested that 350 kW was sufficient for now, although higher powers needed to be considered in the future, while another suggested that 350 kW would be sufficient for overnight charging, whereas 1000 kW would be needed to recharge a vehicle during a driver's rest period. A different respondent suggested that 350 kW should be sufficient for charging on a driver's scheduled breaks, while another suggested that 350 kW was sufficient at the moment although power levels of at least

1000 kW would be needed in the future to recharge the buses and trucks that were being developed.

A business association suggested that the level should be at least 500 kW for long-haul trucks, although noted that the needs depended on the HDV segment. Another business association stated that minimum should be **1000 kW**. A representative of a company / business organisation suggested that power levels of up to 2000 kW would be suitable for vehicles with the MCS/HPCCV specification.

Two business association responses and three from a company made reference to the ACEA position paper for their response to this question (see Section 1.4). One of these also noted that, while it was useful to have high power chargers, not all needed to be 1000 kW and expressed concern that mandating these along the TEN-T network risked impeding deployment, while another suggested a power of between 500 kW and 1000 kW.

A number of respondents argued that there was **no need for targets to be set**. A business association called for the market to be left to determine the necessary requirements, another called for the market to be left to decide which power level was most useful, while a third called for the market to be left to naturally build up in the necessary infrastructure in response to wider developments. Similar points were made by representatives of a company / business organisation. Two similar responses suggested that there was no need to set targets for power, as this would develop from the market taking account of different use cases, while another argued that legislation should never support a specific power capacity, as this risked having a negative impact on technological development.

A business association stated their **opposition to setting rigid targets** in general, and specifically with respect to infrastructure for HGVs, as the technical development was at a very dynamic stage. Two similar responses from representatives of a company / business organisation made a similar point, both underlining their opposition to binding targets and calling for the expansion of infrastructure to be based on need and the number of vehicles.

In addition, two respondents – one representing a business association, the other a company/business organisation – underlined that **L-category vehicles** should not be forgotten in deciding the lower voltage rating. A representative of a company / business organisation responded in relation to ERS, noting that the power requirement depended on the number of receivers on the vehicle. A number of other representatives of a company / business organisation expressed their **support for the use of other types of truck**. One made it clear that they did not support electric trucks, another mentioned their preference for CNG/biomethane and perhaps hydrogen to be used in trucks, rather than electricity, while a third suggested that there was no need to set targets for HDV recharging points along the TEN-T at this point, as gas was the most credible decarbonisation option for trucks while hydrogen should also be supported.

One of the two responses from representatives of ***consumer organisations*** suggested that 350 kW should be selected as a minimum, while the other response called for battery sharing systems to be tested for trucks in the TEN-T. The single response from a representative of an ***environmental organisation*** noted that there was a difference between chargers at distribution hubs, which could have a lower power, and those on the roadside, which should be at least 1000 kW to speed up charging and to avoid queues for charging. Two of the three responses from representatives of ***NGOs*** were similar and called for mandatory targets to set minimal requirements (covering the number of charging points, power levels and the ratio of charging points to vehicles) and then let the market decide the most useful power level, and then noted that different charging powers would be needed for different vehicles depending on the circumstance. The other response called for the power level to be determined by Member States' essential networks and noted that the higher power levels needed for HDVs underlined the importance of their optimal integration with the grid.

The four responses from ***EU citizens*** and the single response from a ***non-EU citizen*** mentioned a number of issues. One suggested that it was too early to consider charging infrastructure for trucks, while another suggested that it was important not to require electricity infrastructure to be rebuilt and so called for charging points to be accompanied by renewable energy plants and battery storage facilities to avoid the need to have to take high amounts of power from the grid. Other responses were not as directly relevant to the question, with one noting the potential benefits of ERS for lighter trucks, while another proposed a minimum value for hydrogen refuelling infrastructure.

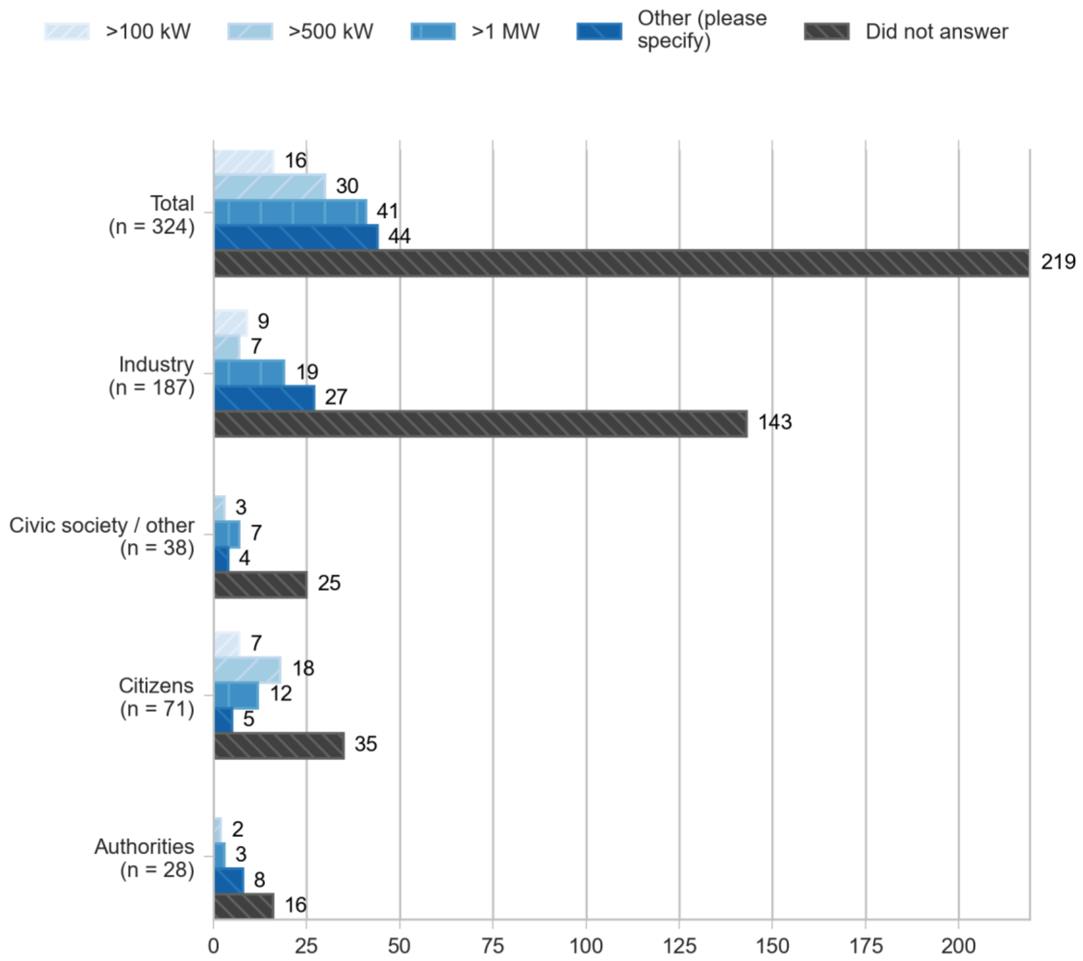
One of the five responses from representatives of ***public authorities*** suggested that the appropriate power level at the moment was 350 kW and that the recharging network should be designed in such a way that the upgrading to the higher powers that would be needed in the future could be undertaken with low additional costs. A different response suggested that the capacity needed was dependent on the location, and so different capacities could be deployed, while taking account of the charging needs in different Member States, while another called for the determination of the appropriate power level to be left to the market. The other two responses expressed doubts of the relevance of supporting the deployment of electric trucks, with one underlining that the impacts of recharging such vehicles on the electricity network had to be taken into account.

There was a single response from an organisation that classified itself as ***'Other'***, which made a similar point to previous responses that minimal requirements should cover the number of charging points, power levels and the ratio of charging points to vehicles, while a decision on the power level should be left to the market.

11.7.5.2.7 D7. Which power should in case of mandatory requirements shall apply for onshore power supply in maritime ports of the TEN-T network?

Stakeholders were asked, in their view, which power should, in case of mandatory requirements, apply for onshore power supply in maritime ports of the TEN-T network, with multiple answers possible (see Figure 6-11). A large number of respondents did not answer this question with 219 out of 324 stakeholders choosing not to answer. The popularity of the different wattages was distinct per stakeholder group. Overall, 44 stakeholders chose to specify an 'other' option, 27 out of 44 votes in industry and 8 out of 12 for authorities. For specific wattages, industry favoured the higher >1 MW with 19 votes, although 27 of the industry stakeholders voted to specify 'other' power arrangements. Due to the higher number of industry stakeholders, this weighted heavily on the overall rankings. Civil society most for wattages greater than 1 MW whereas citizens votes most for greater than 500 kW. Power supplies of greater than 100 kW had the least votes in total and was voted similarly lowly across all stakeholder groupings.

Figure 6-11: D7. In your view, which power should in case of mandatory requirements shall apply for onshore power supply in maritime ports of the TEN-T network (multiple answers possible):



Ten respondents provided responses that expanded on the ***vessels that should*** be covered if the mandatory requirement was that the OPS in maritime ports on the TEN-T network should be ***more than 100 kW***. Three of the four responses from representatives of business associations mentioned fishing boats, two mentioned yachts, and two smaller vessels, such as those used for cargo and supply. Two of the four company / business organisation respondents mentioned tugboats, two mentioned tourist boats, and one each mentioned fishing boats and motorboats. The two responses from citizens mentioned tugboats, pleasure boats and ferries.

There were 15 responses that expanded on the ***vessels that should*** be covered if the mandatory requirement for OPS in ports was ***more than 500 kW***. All of the four responses from business associations mentioned cargo boats, while two mentioned ferries and one 'larger' fishing boats. Two of the three representatives of companies / business associations mentioned ferries, while tourist boats and 'large workboats' were also mentioned. In the five responses from citizens, there were two mentions each of larger ferries, cruise ships and short haul cargo vessels, and one of tugboats. The one response from a stakeholder that classified themselves as 'Other' suggested containers and 'luxury liners', while the single response from a public authority mentioned passenger ferries, 'work' and freight vessels. More generally, a representative of a consumer organisation suggested that this power should be for all medium-range vessels.

There were 27 responses that expanded on the ***vessels that should*** be covered if the mandatory requirement for OPS in ports was ***more than 1 MW***. All of the four responses from business associations mentioned (larger) ferries and container ships, while three also mentioned cruise ships. The most common vessels mentioned in the 12 responses from representatives of companies / business organisations were cruise ships (mentioned five times) and ferries (four), while four mentioned various types of cargo or container vessel, with one specifically mentioning refrigerated container vessels. 'Feeder vessels' and 'operational equipment' were also mentioned in this context. More generally, it was suggested that the same charging standard that was applied to trucks and buses should also be applied to vessels in maritime ports. A response from a consumer organisation mentioned cruise ships and cargo vessels, whereas an environmental organisation (and two NGOs) suggested that a power supply greater than 1 MW would be needed for all vessels, whereas large ships, such as cruise ships, would need a power of at least 10 MW. Both of the other two NGO respondents mentioned ferries and cruise ships, while one also mentioned container ships. The three responses from citizens mentioned ferries, 'heavy duty' and long-distance merchant vessels, while both of the responses from public authorities mentioned ferries, while also mentioning container traffic and cruise ships.

Twenty seven respondents chose to ***specify an alternative response***, of which 10 were representatives of ***business associations***. Two provided a detailed response on the OPS needs of different types of vessels. One mentioned that less than 50 kW was needed for small leisure boats, that a range of 50 kW to 100 kW was needed for smaller fishing boats (typically those less than 15 metres in length), while an OPS of more than 10 MW was needed for large cruise ships and tankers. The other suggested that cruise ships needed an OPS of between 10 MW and 20 MW, container vessels needed a power supply ranging from 3 MW to 7.5 MW depending on their capacity and roll-on/roll-off ferries needed an OPS of between 1 MW and 3 MW, while also noting that power to most of these vessels would need to be supplied in AC at 60 Hz. More generally, two respondents suggested that there was no need to set minimum capacity requirements, as the development of these should be left to the market. Another two similar responses noted that the power demand of vessels was variable, and so the provision of OPS should be specific to the circumstances and maritime traffic of specific ports. Similarly, another response suggested that the provision of the OPC should be based on the technical needs of the shipping concerned.

There were eleven responses from representatives of ***companies / business organisations***. One response suggested that, as the power demand for vessels was variable, the OPS should be at least 11 MW, while also noting that the international standard for cruise vessels was for a power supply of at least 16 MW, otherwise there were potential issues with the vessels' safety systems. Other responses suggested that cruise ships needed a minimum of 10 MW and that electric sailing would need an OPS of at least 1 MW. Another response called for fuel cells powered by renewable gases in ports to generate power for ships and for these to be mandatory in TEN-T ports. More generally, two similar responses suggested that there was no need to set minimum capacity requirements, as the development of these should be left to the market, while another two similar responses suggested that there was no need for minimum capacity requirements, as ships were able to charge for longer times at lower powers. Another response noted that each port had a unique vessel profile, and so the demand for power should be assessed on a case-by-case basis, while another made a similar point that the OPS that was needed depended on a range of factors.

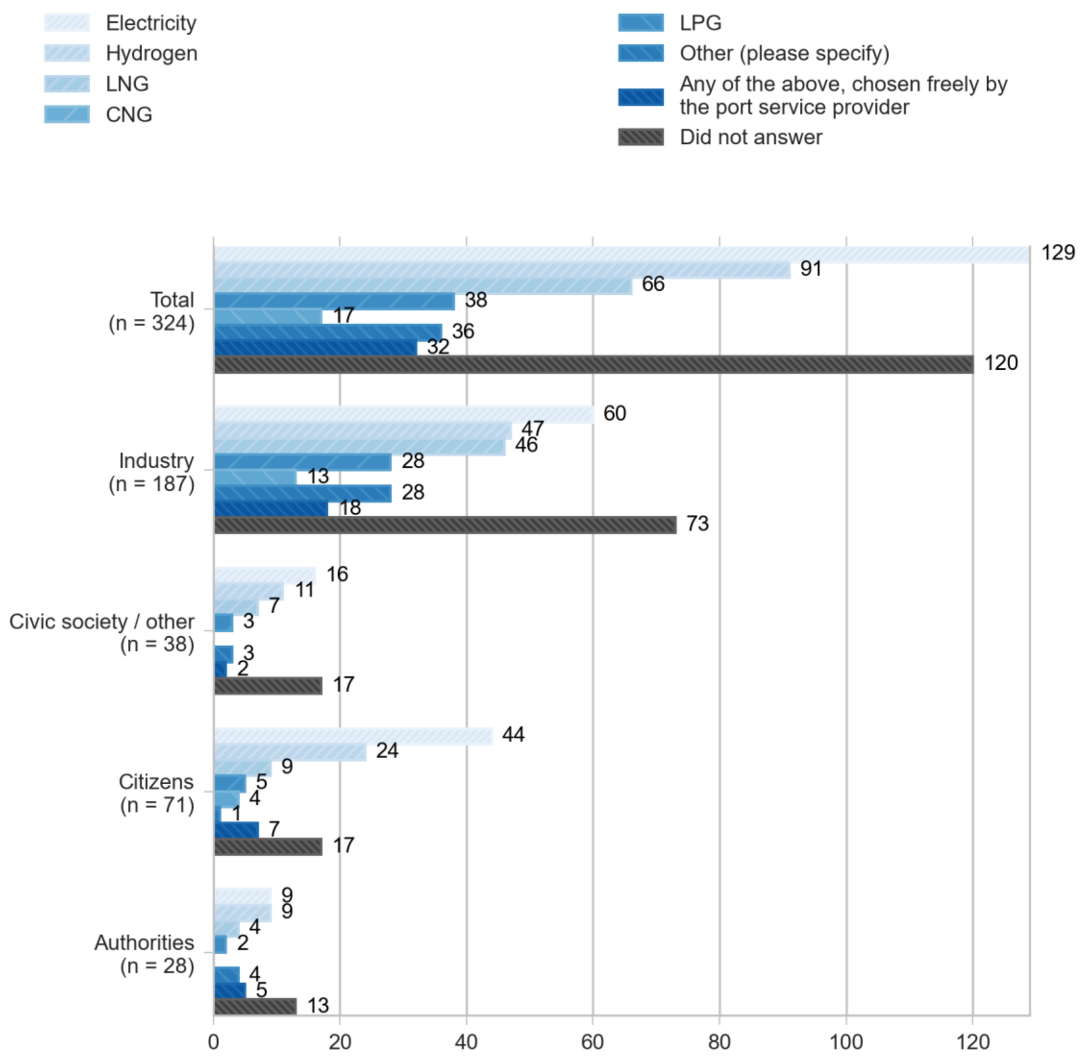
A representative of an ***environmental organisation*** suggested that a minimum requirement should be set to ensure that there was sufficient capacity, and that it should be mandatory for cruise ships to use OPS. A response from an organisation that was classified as ***'Other'*** suggested that the proposed minimum requirements in the question were less than studies had suggested would be economic (which had been estimated to be 5.5 MW for cruise ships and 1.8 MW for ferries) or which reflected peak power demand (which ranged from 1 MW for small container ships to 20 MW for large cruise ships). As the power demand varied from one type of ship to another, they called for the minimum standards to focus on the minimum number of onshore power connection points and the use of internationally recognised standards for these.

Two of the four responses from ***public authorities*** noted that the power requirements of ships varied, with one noting that sea going ships required, on average, at least 1 MW, while the demand could rise to as much as 15 MW per ship. Another response noted that the capacity was dependent on the location of the power supply and the total power demand, and so different capacities could be rolled out, as long as the different needs were met. The final response argued that the important point was that the connection between the vessels and the OPS was compatible between different ports.

11.7.5.2.8 D8. Which alternative fuel should - in case of mandatory targets - port service providers (pilotage, towage, cargo handling equipment) have to offer in ports of the TEN-T network?

Stakeholders were asked which alternative fuel should, in case of mandatory targets, port service providers have to offer in ports of the TEN-T network, with multiple answers possible (see Figure 6-12). Electricity was selected the highest throughout all stakeholder groups totalling 129 responses. This was followed by hydrogen (91) and LNG (66). Electricity was tied highest with hydrogen for authorities which was the second most popular choice throughout all of the other stakeholder groups at 91 votes. LNG was the third highest selected option with 66 votes overall and this was representative throughout all stakeholder groups. LPG was the least picked overall with only 17 votes and the least popular specifically for industry, civil society and authorities.

Figure 6-12: D8. In your view, which alternative fuel should - in case of mandatory targets - port service providers (pilotage, towage, cargo handling equipment) have to offer in ports of the TEN-T network (multiple answers possible):



There were 32 additional responses to this question, of which 11 were from representatives of ***business associations***. In terms of specific additional fuels that were mentioned, two respondents mentioned ammonia, one mentioned methanol, one biofuels (including biogas and biodiesel) and one bioLNG in addition to all of the other fuels mentioned in the question (while noting that these should be chosen freely by the port service provider). Another respondent supported the use of all gaseous fuels, as well as ammonia, methanol and biodiesel. In relation to electricity, one respondent underlined that electricity was the most energy efficient and cheapest (in terms of the total cost of ownership) of all the fuels mentioned, while another called for support to provide recharging infrastructure for long haul trucks. Another called for hydrogen refuelling stations in ports that enabled hydrogen to be used as a shipping fuel, to support the decarbonisation of industrial areas and by the providers of services in ports. A more general response called for legislation to promote ports as “green gateways” for zero emission mobility to encourage (rather than limit) the use of a range of clean technologies. Another response cautioned against mandatory targets and called for the scope of the Directive to be expanded to include LPG infrastructure for shipping and the necessary alternative fuel infrastructure for port handling equipment and port fleets. Finally, a response called for the Directive to retain an open and comprehensive approach, so, rather than allocating a particular fuel for a particular use, it should ensure that all options were available to decarbonise transport taking a lifecycle perspective.

Most of the 14 responses from representatives of ***companies / business organisations*** made general remarks, although biofuels (biogas and biodiesel) were mentioned as an additional fuel by three respondents, one of which also mentioned synthetic paraffinic fuels (as in the scope of the Directive as it stands) while underlining that the provision of the fuels was the responsibility of the service provider. A response also suggested that compressed biomethane produced from local rural supply chains should be considered, while two responses mentioned that the fuels should not be limited to those in the question, as it was important to incorporate future fuels when they became available. Another response suggested that the fuels should be determined in the respective NPFs, although noted the potential of LNG in reducing maritime emissions. The potential of LNG was also mentioned in another response, which also called for hydrogen refuelling stations in ports to enable hydrogen to be used as a shipping fuel, to support the decarbonisation of industrial areas and by the providers of services in ports.

Another response underlined their belief that electricity, hydrogen and LNG would all play a role in decarbonising ports and so should be offered by port service providers. In relation to electricity, it was also suggested that ERS were suitable for ports, e.g. for cargo handling, drayage trucks and in- and outbound transport. Another response called for shore connection to electricity be made mandatory before 2025 and that propulsion in ports should be electric (either battery or hydrogen) by 2030, with hydrogen becoming the default fuel after 2030. This view was reflected in another response that suggested that the electrification of ports should be the short-term solution, supported by green hydrogen in the longer-term. On the other hand, one response noted that CNG, LPG and hydrogen were not available in all countries and that the investment costs were not justified by the low demand, particularly in sparsely populated countries.

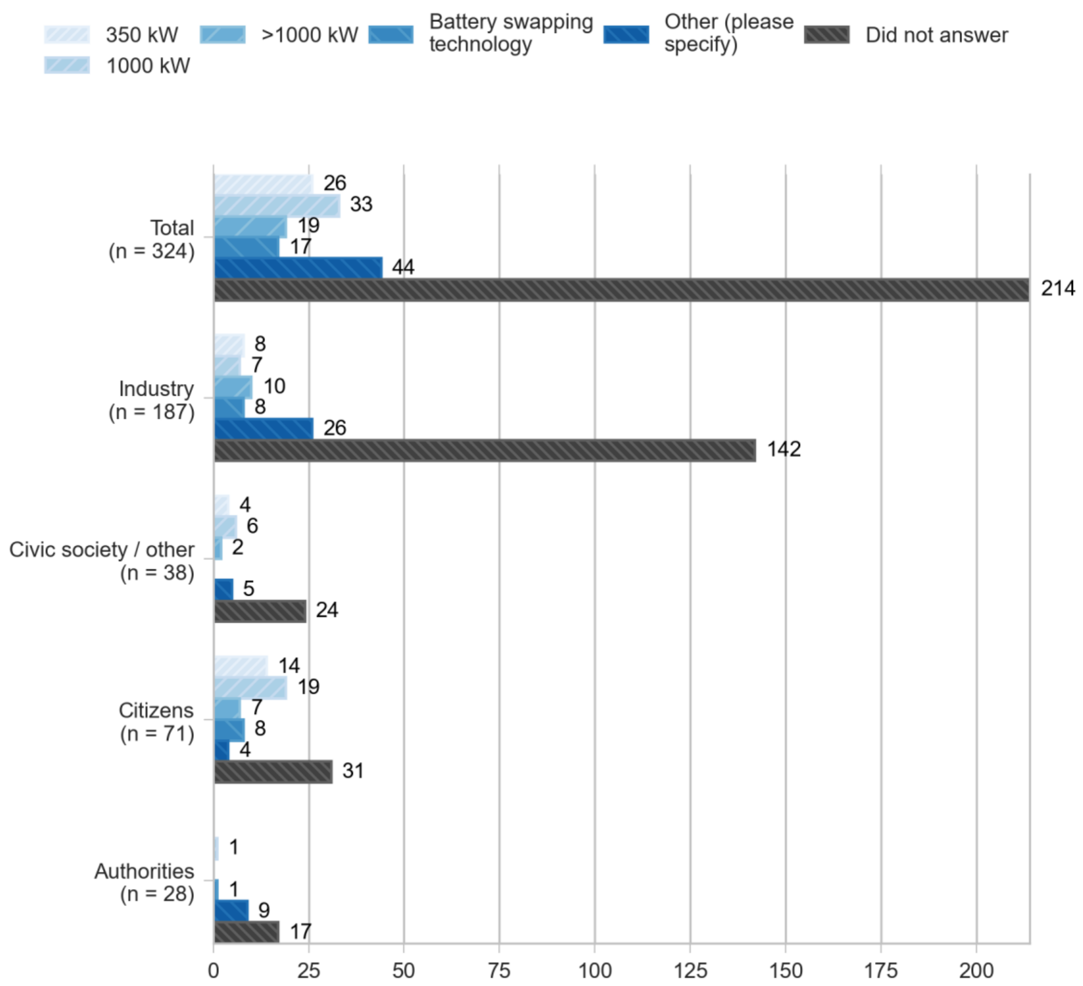
A similar response from an ***environmental organisation*** and an ***NGO*** called for shore-side electricity infrastructure to be mandatory in all ferry and cruise passenger terminals by 2023 and in all appropriate cargo ship terminals by 2025 at the latest. In addition, they called on the AFID to recognise the importance of ammonia and hydrogen in decarbonising those ships that could not be electrified using a battery and for there to be no targets for LNG. A response from another NGO called for the AFID to focus on new fuels and energy sources, so battery electric, fuel cells, and synthetic fuels (such as LNG, CNG and methanol in line with the revised RED), while noting that some of the infrastructure for the latter might already exist (although the availability of filling stations could still be an issue). A response from a ***citizen*** called for renewable liquid fuels to be included, so that the internal combustion engine could continue to be used.

The first of the three responses from ***representatives of public authorities*** noted that they believed that fuels should be chosen freely based on customer demand. Another response noted that alternative fuel infrastructure should also enable the use of different renewable fuels in port services, taking account of the specific technology and market development. It also suggested that mandatory targets for specific fuels might not be the best approach given regional differences, including in the way in which different fuels might be used. The final response underlined the importance of alternative fuels in reducing the GHG footprint of maritime transport and underlined the potential of green hydrogen in this respect, both as a fuel for ships and also for port services.

11.7.5.2.9 D9. Which power should - in case of mandatory targets - be required for recharging infrastructure for inland waterways vessels along the TEN-T network?

Stakeholders were asked which power they thought should be required for recharging infrastructure for inland waterways vessels along the TEN-T network, with multiple answers possible (see Figure 6-13). A large number of stakeholders did not answer with (214 out of 324 respondents). 'Other' was selected most frequently overall (44 responses), followed by 1000 kW (33) and 350kW (26). Industry and authorities voted highest for 'other' rather than specific wattages. 1000kW was the most popular wattage overall with 33 out of 110 answers, followed by 350kW at 26 and >1000kW with 19 votes. Civil society and citizens opted for 1000kW most frequently with 6 out of 17 answers and 19 out of 40 answers respectively. Battery swapping technology was not picked at all by civil society. Authorities only chose 1000W and battery technology once out of 11 answers with zero votes for 350kW and greater than 1000kW.

Figure 6-13: D9. In your view, which power should - in case of mandatory targets - be required for recharging infrastructure for inland waterways vessels along the TEN-T network (multiple answers possible):



There were 30 additional responses to this question, of which nine came from representatives of ***business associations*** and a further 10 from representatives of ***companies and business organisations***; these covered similar issues and so are covered together.

A number of responses referred to the **minimum power requirements needed**. A business association noted that power requirements depended on the desired use of the power, proposing that 500 kW was sufficient for powering onboard electrical appliances while docked and that 1000 kW was needed for charging onboard batteries that were used for traction. In addition, they noted that separate battery swapping locations would be needed for long-range vessels, for which the minimum power requirements would depend on the number of batteries being charged simultaneously and any ancillary services that were being offered. Another business association underlined that the right infrastructure for recharging batteries was needed and again noted that the power requirement at battery swapping locations was dependent on the number of batteries being charged simultaneously.

The importance of **intermodal interactions** was mentioned by a couple of representatives of a company / business organisation. One suggested that recharging infrastructure should be aligned across modes, which would help to bring down costs, so called for the power requirements for inland waterway transport to be aligned with those of HDV charging (e.g. the MCS). Another respondent underlined the importance of there being a connection in ports, as both water vessels and road vehicles could need different types of rapid charging station depending on their size. They noted that the power needed would depend on various factors, including the availability of charging stations, the topology of the port and the number of vessels in use, as well as being a function of driving distance, length of charging session and the size of each vessel, all of which needed to be taken into consideration in determining the appropriate power levels.

Three representatives of a company / business organisation underlined that the power level needed depended **on the use case**. One of these noted that for short-distance vessels charging would be possible, although the level needed depended on the vessel, while for long-distance applications battery swapping would be important. Another suggested that the use case and minimum charging level that was needed depended on the location of the recharging infrastructure, the distance between recharging locations and the respective grid capacities.

Some respondents did not **support setting requirements**, either at this stage, or in general. A business association and a representative of a company / business organisation implied that there was currently insufficient information about the vessels for targets to be set at the current time. Three business associations did not support power levels for recharging infrastructure being set in legislation, with two calling for this to be left to the market, while the other argued that the minimum capacity requirement should not be set in legislation as it depended on the use case. Similarly, a representative of a company / business organisation did not support minimum capacity requirements, as this was something that would develop when left to the market, while another respondent was against such requirements as companies needed financially viable solutions.

Other respondents expressed their support for **other fuels to be used for inland waterway** vessels, rather than electricity, with one business association implying that the focus should be on hydrogen, LNG or ammonia, while a representative of a company / business organisation underlined their belief that CNG, LNG (including the bio and synthetic versions) and hydrogen were options for inland waterways, in addition to electricity. A similar response from a business association and a representative of a company / business organisation underlined that LNG and CNG were well adapted to use on inland waterways and that this would also help maritime vessels that travel upriver.

The one response from a representative of a ***consumer organisation*** noted that battery sharing systems were relevant, particularly for cargo handling equipment, whereas the one response from a representative of an ***environmental organisation*** suggested that the EU should seek input from industry to determine the most appropriate option. The one response from a representative of an ***NGO*** argued that LNG was the most suitable alternative fuel for inland navigation, as it was economic, efficient and its environmental impacts could be reduced.

The single response from an ***EU citizen*** and the only response from a ***non-EU citizen***, respectively, suggested that the power levels should be defined with relevant experts and noted that it was possible to recharge at each lock, depending on the size of the barge and the presence of a sufficient number of solar panels.

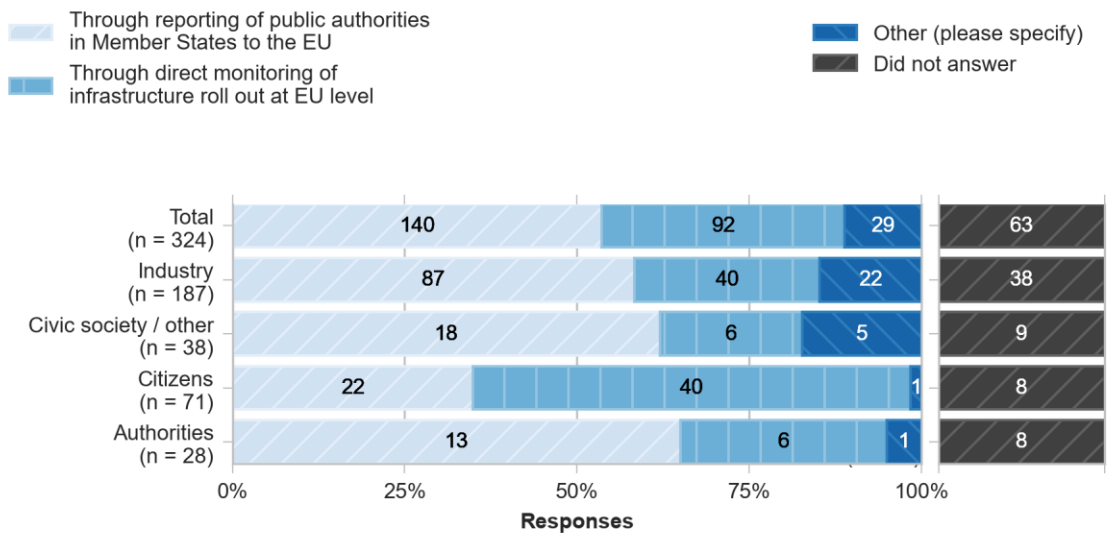
Two of the three relevant responses from representatives of ***public authorities*** noted that electricity for inland waterway transport was still in its early stages, with one noting that the appropriate power would be dependent on how the technology develops, while the other suggested that battery swapping should be included in the AFID to build on the experience of an initiative that has been launched in the Netherlands. Another respondent suggested that the targets should be set on the basis of the compatibility of the technical equipment, not on its power level.

There was a single response from an organisation that classified itself as ***'Other'***, which suggested that mandatory targets should set minimum requirements, whereas the determination of the most useful power should be left to the market.

11.7.5.2.10 D10. How could the compliance with mandatory targets be best monitored?

Stakeholders were asked how the compliance with mandatory targets could best be monitored (see Figure 6-14). 140 out of 261 stakeholders stated that compliance could best monitored through the reporting of public authorities in Member States to the EU. This was common throughout all stakeholder groups except citizens where it gathered only 22 out of 63 responses compared to 40 responses for compliance through direct monitoring of infrastructure roll out at EU level. This option was picked second highest across the rest of the stakeholder groups. Only 29 stakeholders overall chose to specify a different answer, gathering only 1 response out of 63 citizens and 20 authorities. 63 stakeholders in total chose not to answer at all.

Figure 6-14: D10. In your view, how could the compliance with mandatory targets be best monitored:



There were 28 additional responses to this question, of which 11 came from representatives of ***business associations*** and 10 from representatives of ***companies and business organisations***; these covered similar issues, so are discussed together.

A number of respondents mentioned the potential of using the **EAFO** for the purpose of monitoring compliance with mandatory targets. One business association suggested that the EAFO should be regularly updated to monitor the deployment of alternative fuel infrastructure, supported by annual reporting from Member States on the implementation of the Directive. A different business association called for an enhanced EAFO to improve monitoring capacity, as well as for the development of national institutions in the Member States to monitor the deployment of infrastructure (as some countries had already done) and for the same methodology and standardised reporting format to be used throughout the EU. A representative of a company / business organisation called for National Access Points (NAPs) to monitor deployment at the national level with the information being aggregated at the EU level, e.g. by the EAFO. On the other hand, another company / business organisation representative noted that this was a fast moving and fractured market, which the EAFO was not able to keep up with.

Other respondents underlined their belief in the importance of an **EU role in monitoring**. One business association called for the EU to specify the monitoring and reporting rules to be followed by Member States, while another preferred an EU level monitoring, although underlined that this should not cause too much administrative burden for different stakeholders.

A similar response from a business association and three representatives of a company / business organisation called for compliance to be monitored through **NAPs** using standardised reporting formats across the Member States. Three of these responses then noted that it was important that the data shared through these access points was limited to respect data privacy and business confidentiality and could be automated using the Open Charge Point Interface (OCPI) protocol; two suggested that a supervisory body be created to monitor and ensure compliance.

Other respondents expressed a preference for **Member State level monitoring**. One business association respondent suggested that Member State authorities should report to the EU, while noting that it was important that parallel institutions to those that were already monitoring deployment in some Member States should not be created. A representative of a company / business organisation argued that monitoring should be managed at the Member State level, and then reported to the EU level, as there was no value in EU monitoring as a result of differing local characteristics and the need for flexibility.

Other suggestions from representatives of business associations were that a combination of the two approaches in the question was needed, or that the approach to monitoring should be differentiated by transport mode (e.g. direct EU monitoring of the deployment of charging points on roads, whereas Member State monitoring and reporting to the EU was sufficient in other cases). Another business association suggested that even more important than monitoring compliance was what happens when non-compliance had been established. Another perspective from a representative of a company / business organisation (a similar response was also provided by an NGO) was that cities should establish coordination bodies to facilitate the installation of the necessary infrastructure, particularly for public transport, and that these bodies should also provide advice and guidance, as well as managing data on the availability of the infrastructure. Another respondent suggested that reporting should include a measure of efficiency, e.g. the load service factor of the infrastructure. Two business association responses and one from a company made reference to the ACEA position paper for their response to this question (see Section 1.4).

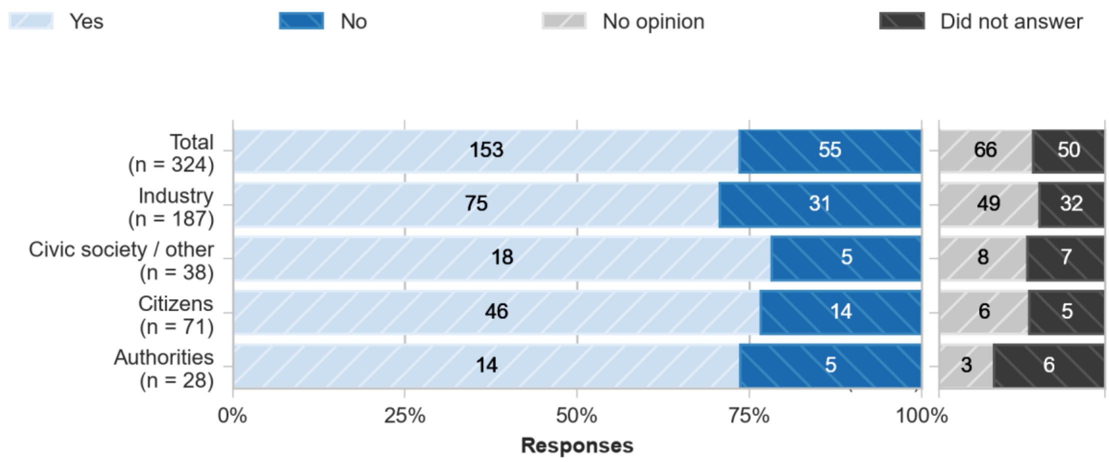
The one response from a representative of an ***environmental organisation*** suggested that the Impact Assessment should assess the costs and benefits of the two options proposed in the question, which was also mentioned by two of the four responses from representatives of ***NGOs***. Both of the latter also suggested that direct reporting by charge point operators via an EU-level harmonised monitoring framework could be effective, and that dedicated national authorities be appointed in the Member States to monitor and report on progress to reaching the quantitative targets. The other NGO respondent called for the reporting to the EU to be undertaken by public bodies that were independent from the national body responsible for compliance with the target.

The single response from a ***non-EU citizen*** suggested that the Commission should set up a common platform for monitoring and provide Member States with the tools to provide this information, as this would make it possible to have real-time status reports, which could be used to generate annual reports. The single response from a representative of a ***public authority*** called for there to be national reports in combination with a common EU monitoring system supported by regular checks to determine whether the objectives were sufficiently in line with the development of the market.

11.7.5.2.11 D11. Do you believe that owners of an electric vehicle should be entitled to have a re-charging point installed in their neighborhood?

Stakeholders were asked whether they believed that owners of an electric vehicle should be entitled to have a recharging point installed in their neighbourhood (see Figure 6-15). The stakeholder groups predominantly agreed, with 153 out of 188 respondents, compared to only 55 out of 188 who believed that they shouldn't.

Figure 6-15: D11. Do you believe that owners of an electric vehicle should be entitled to have a re-charging point installed in their neighborhood?

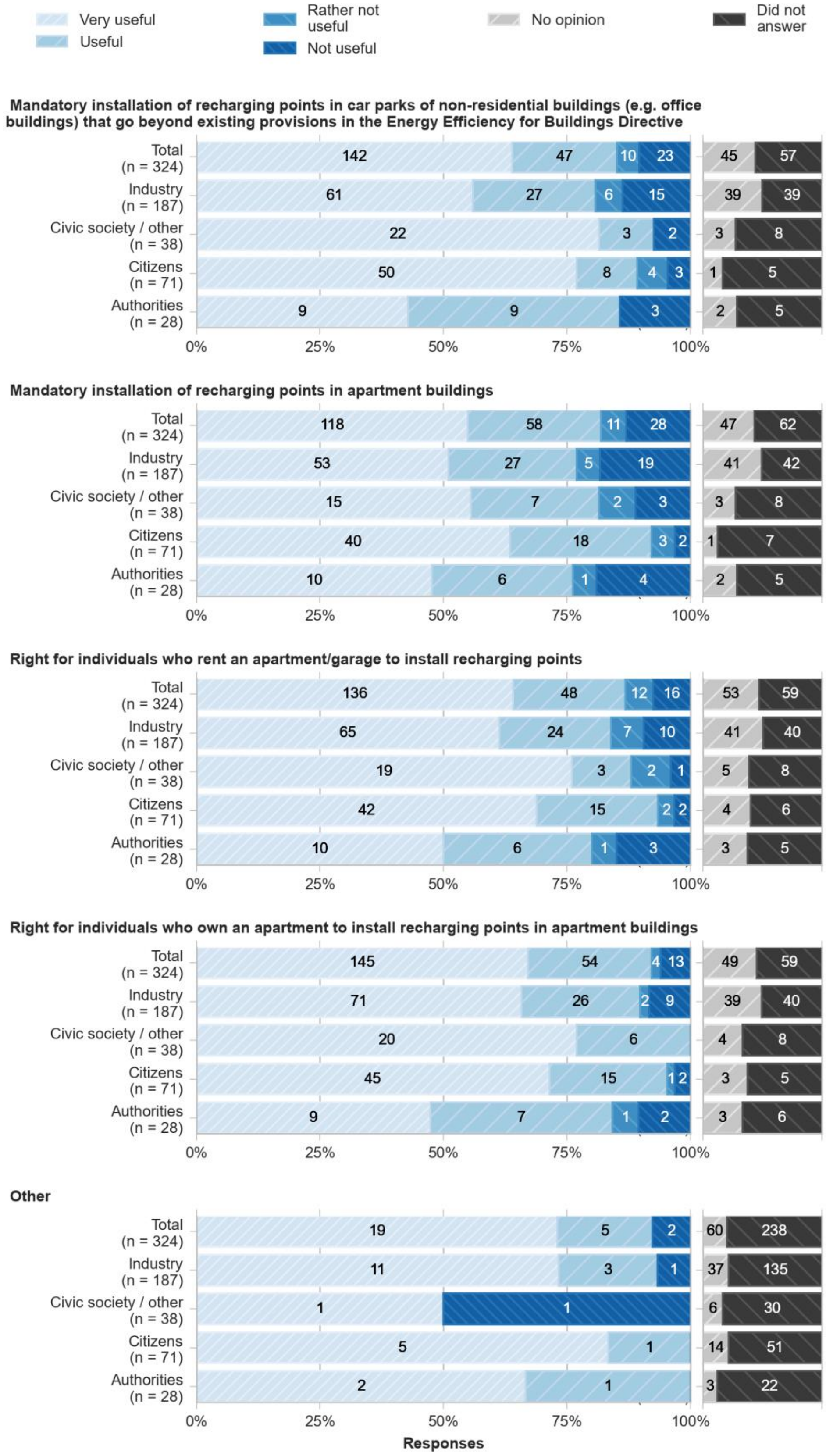


11.7.5.2.12 D12. How useful would you consider the following measures to facilitate and accelerate the development of recharging points not accessible to the public (such as private re-charging points in apartment buildings, offices, etc.)?

Stakeholders were asked how useful they considered a range of measures to be in facilitating and accelerating the development of recharging points not accessible to the public (such as private recharging points in apartment buildings, offices etc.) (see Figure 6-16). All four measures were considered to be predominantly very useful or useful, with very little difference between them. The most useful was considered to be 'right for individuals who own an apartment to install recharging points in apartment buildings (199 out of 265). This was followed by:

- 'Mandatory installation of recharging points in car parks of non-residential buildings (e.g. office buildings) that go beyond existing provisions in the Energy Efficiency for buildings Directive (189 out of 267);
- 'Mandatory installation of recharging points in apartment buildings (176 out of 262); and
- 'Right for individuals who rent an apartment/garage to install recharging points' (114 out of 265).

Figure 6-16: D12. How useful would you consider the following measures to facilitate and accelerate the development of recharging points not accessible to the public (such as private re-charging points in apartment buildings, offices, etc.)?



There were 121 additional responses to this question, of which 34 came from representatives of ***business associations*** and 50 from representatives of ***companies and business organisations***; these are analysed together, as they cover many similar issues and involve a number of similar responses.

Some respondents made **general comments**. A business association suggested that the ideal was to have a large number of 7 kW charging points, with intelligent charging for residential and non-residential buildings. General comments from representatives of a company / business organisation called for a right to install recharging points for businesses that rent offices to be considered, while another called for enterprises to have the right to plug at sites that they rented or co-owned along with the right to self-generate energy for electric vehicles. A different respondent suggested that whether the options in the question could be useful depended on how they were applied, including the hardware that was used, while they called for private infrastructure to be thought of as a service and so called for the 'right to a charging service' to be assured. Another response suggested that it was important to improve access to private recharging infrastructure, as this was currently under-utilised. A different respondent suggested that work locations would not be the appropriate place to deploy faster charging points, while another called for an updated ISO 15118 standard for bi-directional charging. A different respondent noted their support for any measures that pushed the electrification of transport, while two different responses called for the installation of charging points to be easier.

A number of respondents **were not in favour of a mandatory approach**. One business association, while noting that a mandatory approach would result in a better charging network, suggested that the owner of a property should be able to decide how it was used, while another made a similar point, although suggested that charging points should be allowed if requested and that the application of the rights proposed should only be allowed if the owner of the property gave their permission. A different business association also expressed a preference for rights, rather than mandates, to allow for specific needs and business cases to be assessed, while another (again while acknowledging that the measures proposed could be effective) expressed their support for incentivising rather than mandating the installation of charging points to ensure that the most appropriate charging point for the building could be installed. A separate response, while also noting the potential benefits of mandatory obligations, was concerned that this would be challenging for existing apartments, both from the perspective of the owners and the distribution network operators, so preferred that the obligation was subject to negotiation between owners and operators, including in relation to the sharing of costs.

Similar points were made by representatives of a company / business organisation. One noted that while installing charging points in apartment buildings should be encouraged, mandating these could lead to excessive costs, so the decision should be left to the owner of the building, while another noted that, while it was important that cabling and charging points were in place for buildings, mandatory requirements could lead to unnecessary costs if charging points were installed that were not then used. A different respondent suggested that mandatory targets might lead to resistance, so preferred rights to be given to users for the installation of charging points, although they did support mandatory requirements on all new buildings to include provisions for electric vehicle recharging (cabling ducts, power outlets in parting areas, etc.). Another respondent suggested that the mandatory installation of charging points in apartment buildings, without taking account of their potential use, risked increasing costs unnecessarily, whereas giving individuals a right to have a charging point installed made mandatory requirements unnecessary. Three similar responses from representatives of a company / business organisation and an NGO implied that any mandatory requirements should only be implemented if supported by a cost benefit analysis.

Other respondents called for **more incentives, rather than mandates**. A business association suggested that all three elements (the cabling, the connections to the house and the charging point itself) of private charging points lacked a sustainable, long-term funding concept, so called for an incentive programme to support the installation of the minimum requirements and further appropriate investments. A different business association response called for financial support to citizens who wanted to install a charging point. A representative of a company / business organisation supported programmes to incentivise the acceleration of the installation of charging points, as they felt that mandates risked leaving businesses with investments that were not used, whereas incentives would enable investments to fit with individual needs, which could encourage more private sector funding and so reduce the need for public money.

Fifteen responses made reference to the **EPBD**, ranging from commenting solely on the EPBD, suggesting that the AFID needed to address insufficiencies in the EPBD or proposing that the issues mentioned in the question should be addressed in a revised EPBD, not in a revised AFID. A business association called for the EPBD to be made more stringent in relation to the deployment of recharging infrastructure and noted that deployment was often subject to lengthy approval procedures, either relating to the building itself for multi-occupancy buildings or to the grid connection. A similar response from a business association and a representative of a company / business organisation called for legislation (they referred both to the EPBD and the Energy Efficiency Directive) to give Europeans the 'right to plug', which ensured installation within a fixed time period and involved streamlined procedures, and for public authorities to be encouraged to respond to the requests of citizens that do not have a suitable location for the installation of recharging infrastructure by installing recharging infrastructure nearby. A different business association also called for the 'right to plug' to be introduced to complement the requirements of the EPBD, while they also noted that the market should be sufficient to deploy recharging infrastructure for rented apartments, while another couple of similar responses called for minimum requirements for residential and non-residential areas to be set in the EPBD.

A representative of a company / business organisation also called for the (pre-)cabling and charging infrastructure requirements of the EPBD to be strengthened, as well as for the 'right to plug' to be introduced (as installation procedures were often lengthy and costly), for regulatory barriers in national housing legislation to be addressed, for all new charging infrastructure to be smart, for the electricity tariff structure to be organised to incentivise off-peak use and for there to be guidelines for energy storage (V2X). A different respondent called for the EPBD to have minimum requirements for residential and non-residential buildings, in terms of both the number of spaces that have the cabling for charging points and for the minimum number of charging points themselves. A separate respondent also called or the 'right to plug' to be explicitly required by legislation, e.g. in the EPBD, without the need for the consent of owners' associations or landlords, while another noted their support for the installation of the right pre-cabling and capability for charging points in residential areas. Finally, another respondent called for the revision of the AFID to address the gaps relating to private recharging infrastructure that are present in the EPBD, including addressing the obstacles to accessing non-public charging points to ensure the 'right to plug'.

Two business associations **criticised various different elements of the EPBD** as it stands. The first commented that it did not appear that customer and visitor parking spaces or 'open-structure' garages were covered by the EPBD, that the minimum requirements for non-residential buildings were too low and called for the replacement of the potential waiver of the application of the requirements of the Directive when the 7% threshold (for the recharging infrastructure costs as a proportion of the total costs of renovation) was exceeded by tiered requirements. The other response called for the installation of only smart charging infrastructure in new and renovated residential and commercial buildings, for this infrastructure to be able to communicate with energy management systems in a secure way and for building occupants to be able to use vehicle recharging to optimise their own energy use.

On the other hand, while acknowledging that private recharging infrastructure was important, a business association suggested that the AFID should retain its focus on publicly-accessible infrastructure, while private infrastructure should be addressed elsewhere, e.g. in the EPBD. A representative of a company / business organisation noted that it was important not to create overlaps between the AFID and the EPBD and suggested that giving electric vehicle owners the 'right to plug' in their neighbourhoods could be problematic, so proposed that these requests be recorded by the relevant authorities so that sufficient infrastructure could be deployed.

Other responses referred to the **role of the building sector in deploying charging points**, without explicitly referring to the EPBD. Four similar responses – two from business associations and two from a representative of a company / business organisation – underlined the importance of buildings as the majority of charging will be undertaken at home or at work, while noting that owners and tenants of buildings often faced a lot of hurdles to installing charging points on properties. In addition, one of these underlined the importance of pre-cabling, rather than mandating charging points, although supported there being a right to request the installation of a charging point, which should be smart in all cases.

Other responses focused on the requirements regarding **residential buildings** in particular. A business association suggested that legislation should create the conditions to make the deployment of charging points easy whenever these were needed by owners or tenants, while another proposed that new buildings and major renovations should ensure that the basic infrastructure to allow the future installation of charging points was put in place. A representative of a company / business organisation suggested that there should be mandatory requirements for the installation of recharging infrastructure in residential buildings. Another called for more action to improve residential charging infrastructure, including improving EU provisions relating to cabling and infrastructure in residential buildings, to strengthen the 'right to plug', to improve access to charging infrastructure for houses without sufficient space and for new buildings and renovations to benefit from intelligent energy management systems. Two similar responses suggested that the installation procedures for installing charging points in multi-unit residential buildings were too long, with one calling for a 'right to plug'.

Four representatives of a company / business organisation underlined the **importance of home or work charging**, as being important in covering most recharging needs. One of these underlined that it was important to simplify the installation of recharging infrastructure in residential buildings and noted that, while owners should be able to request a charging point, it should be up to the installer to identify the best place for this in collaboration with the relevant public authority. Another suggested that there should be a time-limit (from request) for the installation of charging points in multi-unit dwellings, and that these should be progressively pre-equipped for recharging infrastructure, while calling for incentives for the installation of charging points at work locations, supported by a better tax environment to support recharging at work. On the other hand, one response suggested that if the focus of the development of the network was on work locations and a publicly available network, there would not need to be as much focus on home charging infrastructure.

Other responses mentioned considerations with respect to **publicly accessible recharging infrastructure**. One suggested that it would be important to have a booking system for publicly accessible fast chargers, while another response noted that low power charging points were most suitable at home and work locations, while smart charging would be more relevant for private and commercial car parks. Another respondent underlined the importance of future-proofing public locations with infrastructure that would be relevant in the longer-term.

Some respondents suggested **other types of location** where charging points should be installed. Two business associations (in responses that were not similar) suggested that the main problem relating to electric vehicle charging was the availability of charging points that allowed overnight parking near homes, whether this was public or private, while another suggested that there was a need for common guidelines and a safe common standard on the safe charging of vehicles in underground car parks. A representative of a company / business organisation suggested that charging points should be installed at tourist locations, large event locations and large car parks. A different representative of a company / business organisation underlined the importance of a technology neutral approach when supporting the development of charging points that were not accessible to the public.

In relation to **other types of vehicle**, a similar response from a business association and a representative of a company / business organisation suggested that mandatory installation requirements in car parks, office buildings and apartment blocks would not help the uptake of HDV battery electric vehicles, whereas financial incentives for the deployment of publicly-accessible and non-publicly accessible recharging infrastructure and for the purchase of HDVs would be beneficial. A representative of a company / business organisation suggested that when assessing the need for charging points for HDVs, the deployment of ERS should be taken into account, as the more there was of the latter, the fewer charging points would be needed. Two business association respondents implied that it was difficult to answer this question, as the answer varied by vehicle type, e.g. for HDVs and light commercial vehicles compared to cars, with one referring to ACEA's position on this issue (see Section 1.4). Another business association noted that the installation of charging and refuelling points in depots and workshops would be important to support the public transport sector in deploying clean vehicles.

Four responses mentioned the importance of **railway stations**. Two of these – one from a business association, the other a representative of a company / business organisation – that were similar, noted that installing electric vehicle charging points at railway stations would be useful. The other two similar responses, both from a representative of a company / business organisation, noted than rail stations and public transport stops were becoming multimodal hubs (involving trains, buses, parking and shared vehicle rental) and so should be a priority for deploying infrastructure for alternative fuels.

There were 10 similar responses from five business associations and five representatives of a company / business organisations, which called for a **fair and consistent of all alternative fuels**, rather than a focus on electromobility. In addition, one of these suggested that there was already an abundance of charging points compared to the number of vehicles on the road, while nine called for the electric vehicle recharging infrastructure to reflect the development of the market and five believed that there was no justification for a private electric vehicle user requiring access to a publicly accessible charging point. Four of these also mentioned that the principle of technology neutrality should be observed, and three noted that the maturity and development stage of the respective alternative fuel should be taken into account. A separate response from a business association suggested that if there was no encouragement to build refuelling stations for other alternative fuels, it would be difficult for these to compete with electricity, while another also suggested that a focus on a single technology (such as electromobility) would be an obstacle to the development of other alternative fuels.

The three responses from representatives of ***consumer organisations*** mentioned different issues. One called for the legislation to define more precisely what recharging infrastructure (in terms of power capacity) was needed where, while noting that consumers should benefit from an extended 'right to plug', more deployment of charging points and easier procedures for installing these. In addition, they called for rules to access semi-public chargers to be included within the scope of the legislation, and noted that these should allow for ad hoc charging without the need to enter into a contract. A different respondent noted that it was difficult in some Member States to install wall-boxes in garages as a result of the need for all owners to agree, while another response suggested that the measures in the question relating to residential property were a matter of subsidiarity. The one response from a representative of an ***environmental organisation*** suggested that those who own an apartment should be allowed to install a charger, unless there were significant technical challenges.

Three of the nine responses from representatives of ***NGOs*** were similar. These underlined that, as private charging would meet most recharging needs, the scope of the AFID should be expanded to address the need for recharging infrastructure in buildings, for which the provisions of the EPBD were too weak. In addition, they called for the e-mobility deadlines in the EPBD to be brought forward, with clear targets for Member States for the cabling of shared buildings and for there to be particular provisions regarding the cabling of social housing in disadvantaged neighbourhoods. Another response also referred to the EPBD, suggesting that the AFID should cover the deployment of recharging infrastructure at home and at work, accompanied by a more ambitious approach in the EPBD. Other responses called for rules to ensure that new properties had charging points and for the right to plug (and other requirements on charging points) to be included in a Regulation, while another underlined that there were safety issues regarding installing charging points in buildings that needed to be addressed. On the other hand, one response suggested that having mandatory targets for one type of fuel was not in line with the principle of technology neutrality and called for Member States to be able to choose the right mix of fuels, without a focus on one fuel being imposed.

Many of the 11 responses from ***EU citizens*** and the single response from a ***non-EU citizen*** mentioned residential charging with some making more general comments. One suggested that the focus should not be on residential locations, but on facilitating or obliging the deployment of at least a slow charging point at all places of residence and car parks, while another suggested that the mandatory deployment of a minimum number of charging points at offices and residential buildings would be efficient. A respondent suggested that providing charging at home, or near to home, would reduce the need for publicly-accessible recharging infrastructure, while another noted that charging in underground garages could be useful as long as safety issues were addressed and a third suggested that all parking places should have a charging point. Another response suggested that a barrier was the difficulty in installing private recharging infrastructure. Other responses called for the mandatory installation of charging points at parking and service areas along motorways and other major roads, for payments to be via apps rather than cards and for a greater focus on bi-directional charging points, particularly at commercial locations and at residential properties where owners wanted these. On the other hand, one respondent suggested that the installation of private infrastructure should not be imposed, while another underlined that it was important to avoid over-regulation.

The single responses from an ***academic / research institution*** suggested that, even though the business case for non-public charging was not optimal, investments should begin as soon as possible, as a result of the benefits of such infrastructure.

The 10 responses from representatives of ***public authorities*** covered a range of issues. One suggested that the AFID should focus more on charging points that were not publicly-accessible (and also called for mandatory reporting on the deployment of infrastructure), while another called for more extensive obligations for buildings (as a result of the insufficiency of the EPBD) and a third for the 'right of access to a company charging socket' for those employees who were not able to recharge their cars at home. Another respondent called for the deployment of fast charging points for long-distance travel to be set out at the EU level, supported by binding requirements to provide planning security, although suggested that the approach within urban areas should not be set at a general level. Other responses underlined the importance of home charging and called for low speed charging points to be installed at offices for staff to use.

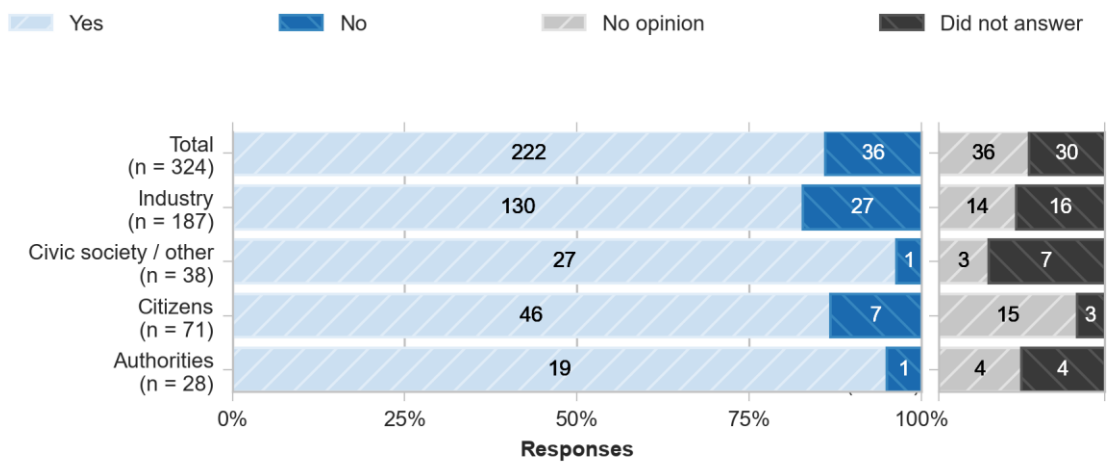
On the other hand, one response was concerned that mandatory installation requirements would create costly, unbalanced networks, whereas the provision of rights to individuals would allow for a more effective, user-centric deployment. A different response suggested that the AFID should focus on public recharging and on alternative fuels more generally, while leaving the deployment of semi-public and private recharging infrastructure to the EPBD, while another called for the AFID to focus on providing infrastructure for public transport, rather than for privately-owned cars. A different response suggested that the areas covered by the question should be included in national legislation, stimulated by the EU where necessary.

There were two responses from organisations that classified themselves as ***'Other'***. One of these underlined the importance of private recharging infrastructure for recharging electric vehicles and so called for the AFID to be extended to cover private recharging infrastructure in buildings (even though its current scope was publicly accessible infrastructure) as the equivalent provisions in the EPBD were too weak, while calling for increased ambition with respect to the deployment of recharging infrastructure more generally. The other response underlined the importance of bidirectional charging to enable a car's battery to be part of a house's energy storage system.

11.7.5.2.13 D13. Do you believe that further mandatory technical requirements/standards are required to ensure full interoperability of infrastructure and services across Europe?

Stakeholders were asked whether they believed that further mandatory technical requirements/standards are required to ensure full interoperability of infrastructure and services across Europe. 222 out of 294 stakeholders across all groupings indicated that they did. Only 36 stakeholders did not agree.

Figure 6-17: D13. Do you believe that further mandatory technical requirements/standards are required to ensure full interoperability of infrastructure and services across Europe?



11.7.5.2.14 D14. In which areas would technical requirements/standards be needed?

Those stakeholders who responded 'yes' to the previous question were asked to expand on which areas would technical requirements/standards be needed. There were 122 additional responses to this question, of which 35 from representatives of *business associations* and 49 from representatives of *companies and business organisations*. Most responses related to electric vehicle recharging, although there were a few mentions of other fuels and some mode-specific responses.

In relation to the **physical interfaces between vehicles/vessels and infrastructure**, three responses highlighted that the Combined Charging System (CCS) for passenger cars was the standard that should apply, with two similar responses underlining that interoperability was key for all publicly accessible chargers, as was the static and dynamic data associated with these. The other response called for CCS, as the European standard, to be the basis for all further technical developments, including 'plug and charge', V2G and high-power charging. A different response underlined that standards for communication and interfaces were required to support the uptake of electric vehicles.

Some responses were more comprehensive covering a **range of different aspects of electric vehicle recharging**. One of these called for equal conditions relating to competition between all market participants and called for users to have a free choice of e-mobility service provider (EMSP), for switching loading certificate / EMSP to be simple and immediate and for there to be a free choice of aggregator for bi-directional charging. In addition, they called for measures to ensure the quality of charging and for there to be a stronger focus on the non-discriminatory interconnection of European roaming solutions. A different respondent called for data to be shared, including on the state of charge of an electric vehicle, and for a quality assurance for charging services to be set up, while another called for high-level communication requirements to improve interoperability, supported by open data sharing. A separate response called for the implementation of e-roaming protocols to be mandatory, and for the standardisation of pricing, invoicing and payment to be considered, while another argued that the Directive's provisions on ad hoc payments were not sufficiently prescriptive or enforced. One response called for standards relating to cybersecurity for the exchange of information between the CPO and EMSP and for the data exchange from electric vehicles, e.g. relating to the state of the charge of the battery, while another did not support full interoperability for physical interfaces, as users were different, and also noted that there was no established standard for vehicle authentication and identification.

Other responses underlined the need for **open standards and protocols**. A similar response from five respondents called for open standards and protocols to prevent vendor lock-in, to increase choice, to lower costs and to boost interoperability and cybersecurity. Specifically, four of these called for the Open Charge Point Protocol (OCPP) to be applied to hardware and software solutions and for the OCPI to be embedded as a minimum requirement for publicly accessible charging stations to support roaming. In addition, two called for minimum standards for plugging in HDVs in order to support their deployment, with one noting that there was a particular issue relating to the cables to be used for HDVs. One of these also called for the market fragmentation relating to technical hardware, in relation to shutters and metering, to be addressed.

A different response noted that it was important that open-source protocols, such as OCPP and OCPI, were used for electric vehicle recharging infrastructure to facilitate interconnections between different actors, while another proposed that for charging points that had a communication connection, a minimum requirement should be the implementation of a communication protocol, such as OCPP. Another response called for common open standards for electric vehicles and their recharging infrastructure, including in relation to e-roaming, as well for the identification of vehicles to be optional and for the option to pay anonymously to be made compulsory. They also called for certification programmes to assess compliance with the protocol. A different response called for there to be a single identification protocol, such as OCPI. The importance of there being open standards for communications security and cybersecurity was underlined in another response, which also called for a common, open approach to the ultra-rapid charging protocols that were being developed.

Some responses focused **on e-roaming.** One suggested that there needed to be a stronger focus on interconnecting the various e-roaming solutions, supported by improved access to data and the implementation of ISO 15118 for vehicles and infrastructure. A similar response called for increased interoperability between the different e-roaming services, facilitated by OCPI, the application of ISO 15118 (to which manufacturers should keep the thresholds low for EMSPs) and data sharing. On the other hand, another respondent suggested that that e-roaming should be left to the market to determine the most efficient technical solution.

A number of responses focused specifically on the connection between **electric vehicles and the grid or buildings**. One of these noted that common standards for V2G technology would be useful to support the deployment of this technology, while another called for the establishment of a common protocol and standards to enable the exchange of energy (and information) between vehicles and the grid and for harmonised standards to be set for manufacturers and grid operators. A different response suggested that, even when charging points were supposed to be compatible with OCPP, it was difficult to link chargers from different manufacturers in a smart charging grid, and so called for the compatibility of the charging devices from different manufacturers to be addressed to support smart charging through the use of adaptable communications protocols and standards. Another response called for the enforcement of ISO 15118-2 on 'plug-and-charge' and ISO 15118-20 on bi-directional charging, supported by access to vehicle data and a common smart meter protocol (as in France), as well as for interoperability between vehicles and other distributed energy resources to be ensured by a European protocol. Two similar response underlined the importance of DSOs in electromobility and called for them to have the possibility to influence charging processes to minimise the potential impact on the grid and suggested that an interface to the electricity network could enable smoother grid integration. A different response called for ISO 15118 on bi-directional charging to be urgently updated, as it only covered DC technologies, while also calling for improved arrangements for smart metering certification. Another respondent noted that the harmonisation of standards and protocols to support V2G use cases was needed, while noting that the upcoming IEC 63110 standard and ISO 15118 would be important in this respect, while also calling for a coordinated EU approach to this.

Other responses suggested other areas for which standards were needed. Three responses mentioned **billing**, with one underlining that uniform and automated billing should be possible without a membership card. Two similar responses suggested that it was important to have European standards to cover **safety aspects**, while another called for the mandating of the installation of cables attached to recharging infrastructure to improve safety. A different response called for an **EU standardised meter** for both AC and DC stations to avoid different national specifications and for the imposition of more stringent standards on existing stations, while another called for common standards for high-power charging for both LDVs and HDVs.

In relation to **trucks**, two similar responses called for action on the relevant specifications and for flexibility regarding biofuels. One of these also called for ERS standards to be set no later than 2023, and set out a timeline for this to happen, involving specific Member State plans to speed up deployment, followed by an evaluation of the technologies before standards were introduced to ensure interoperability. In addition, the respondent called for more flexibility for Member States with respect to the use of biofuels taking account of local production capacities and feedstocks. Two other similar responses called for the missing standards for commercial vehicles to be addressed, while suggesting that the critical standards for cars were in place. Three responses, two of which were similar, called for MCS/HPCCV to be put in place for trucks. A different response called for an extensive network of plug-in facilities to power the refrigeration equipment in trucks and trailers, while another called for a CCS-based communication protocol to be recognised as the standard for the high-power charging of HDVs.

A respondent suggested that the Directive should prioritise infrastructure for HDVs, particular for **passenger transport vehicles**, and underlined that the possibility of sharing recharging infrastructure between buses, coaches and trucks should be considered and so underlined that the relevant infrastructure needed to be interoperable. A different response highlighted the importance of considering interoperability and standards to support the deployment of low emission vehicles, while another mentioned standards relating to electric buses, including ISO 15118, IEC 62196, IEC 60309 and the V2ICP specification.

Ten responses, of which eight were very similar, highlighted the importance of standards for **L-category vehicles**. The similar responses proposed that the relevant DC charging system should comply with IEC 61851-25 and that the DC connector and vehicle inlet should adhere to standard IEC 62196-6.

In relation to **hydrogen**, two similar responses suggested that there were no interoperability issues for gaseous hydrogen vehicles with a compressed hydrogen storage system (CHSS) of less than 250 litres. On the other hand, these respondents suggested that, for vehicles with larger CHSS, there was no standardised solution for H50 and H70 nozzles/receptacles in EN ISO 17268, that meeting the requirements of EN 17127 would be challenging until a standardised refuelling protocol was available, that there are no roaming protocols available for hydrogen and that there were no technical requirements or standards for the physical interfaces between vehicles (or vessels) and infrastructure. In addition, they noted that there were no technical specifications in the AFID for liquid hydrogen or cryo-compressed hydrogen vehicles covering these issues. Three similar responses noted that both compressed and liquefied hydrogen were being considered as options to power heavy duty trucks, and so called for the technical specifications for one or the other to be decided, when appropriate, in order to ensure a smooth introduction. It was also suggested by another respondent that technical standards for interoperability were needed for the construction and permitting of hydrogen infrastructure.

On the other hand, some responses argued that there was **no need for any more standards**. Three similar responses were concerned that mandating additional standards in a market that was already competitive risked technological lock-in and distorting competition, and instead called on the Commission to support the capabilities of existing standards and ensure that their application did not adversely affect the market and to focus on developing minimum sets of criteria rather than binding standards. Another response suggested that, while further mandatory standards might be needed at some point, these should come from industry, and not be imposed. Another response called for standards to be set through competition, rather than binding standards being imposed.

In addition, two responses underlined the need for a **consistent approach between different pieces of EU legislation** to ensure the interoperability of infrastructure and services. Both of these mentioned that the AFID listed more fuels that the Fuel Quality Directive (FQD), while one also noted that the AFID was not consistent with the regulations on emission standards or vehicle type approval legislation. The other called for all fuels listed in the AFID to be accepted for vehicle certification, e.g. paraffinic diesel in accordance with EN15940.

One of the three responses from representatives of ***consumer organisations*** set out key elements for interoperability, including price transparency, the availability of ad hoc charging, cost-reflective roaming charges, minimum standards for chargers and plugs, different payment options and fair access to battery data. Another called for electric vehicle recharging stations to be accessible and 'barrier-free' for people with disabilities, and the third simply called for the charging process to be as simple as possible. The single response from a representative of an ***environmental organisation*** called for protocols to allow users to register their payment details, either in their car or with a third-party solution provider, to enable cars to start charging as soon as they were plugged in.

There were 10 responses from representatives of ***NGOs*** covering a range of different issues. Three similar responses suggested that interoperability could be improved through high-level communication requirements in the infrastructure value chain, the use of interoperable technologies, information availability and open data sharing, which both also called for the Commission to request the development of a new standard on smart charging. A different response called for the revised legislation to support interoperability and to accelerate the development of optimal standards, supported by open access to data, while another called for standards to improve the safety of recharging electric vehicles, particularly to reduce fire risks. Another response noted that technical requirements relating to the communication of the management systems of charging stations with the systems that aim to optimise the service would be useful. It was suggested by one respondent that electric cars should only be charged when there was either excess or sufficient electricity, and that bi-directional charging (regulated at the EU level) would contribute to grid stabilisation. In addition, one response highlighted that interoperability and charging standards were important to support the deployment of low emission buses, while another underlined the international nature of both maritime transport and heavy duty road transport, with the implication that standards implemented widely would help these modes.

Some of the 12 responses from ***EU citizens*** and the single response from a ***non-EU citizen*** focused on issues directly raised in the question, while others were of a more general nature. One suggested that CCS should be the only standard for cars and underlined the importance of roaming protocols, while another called for a single standard for plugs and a third called for the identification of electric vehicles to be as transparent as possible to the end user. Another response suggested that there were too many communication protocols in use. In relation to V2G, one called for this to be possible in a uniform way across the EU, while another called for V2G to be standardised so as to facilitate this across Europe. Two responses noted that Tesla's system should be taken as an example of how electric vehicle charging should take place more generally. One respondent called for the automatic connection of cars to DC charging at parking spaces, as well as for all electric cars to have photovoltaic cells on their rooves, so as to continuously recharge the car. A separate response focused on water-bound vessels and called for a uniform global standard for these, while another response called for the approval process for hydrogen refuelling stations to be defined in the same way throughout the EU.

There was a single response from an ***academic and those from research institutions***, which argued that the basic requirement relating to recharging electric vehicles should not be left to proprietary solutions, as this would limit the development of business cases and services based on providing information to users, as well as generating security risks.

The eight responses from representatives of ***public authorities*** covered a number of issues. Three of these respondents underlined the importance of standardised roaming protocols, two of which called for the setting of the OCPI protocol for roaming. In addition, one of these responses noted that some standards, such as those relating to V2G and communication security, would be useful and that it would be important to strive for a standard for the identification and authentication of electric vehicles in the near future. A different response noted the importance of easily accessible and clear online roaming protocols, as well as for the standardisation of physical interfaces, while another underlined that to optimise charging, it was important for vehicles to communicate with charging points.

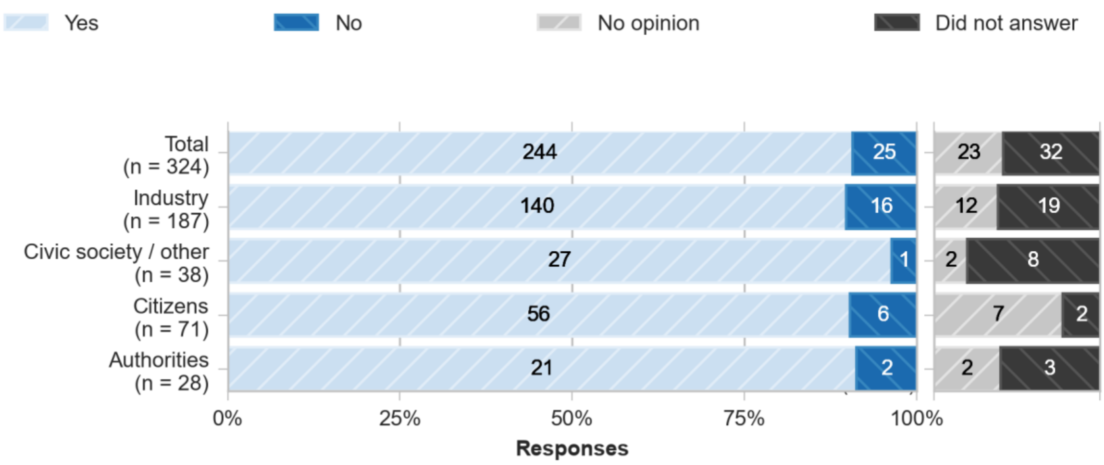
In relation to the **railway sector** one response noted that technical specifications would be useful in relation to recharging voltages, the interfaces between trains and electrical recharging infrastructure and admissible currents, while noting that these would support the development of battery electric trains. It was noted by another respondent that the interoperability of shore connections for maritime transport was clearly set out in international standards and so there was no need for additional standards on this.

There were two responses from organisations that classified themselves as ***'Other'***, one of which mentioned apps for shared services, while the other called for uniform payment systems.

11.7.5.2.15 D15: In your view, should EU legislation ensure that certain information on alternative fuels infrastructure is made available to the user by digital means (e.g., through an app)?

Stakeholders were asked, in their view, should EU legislation ensure that certain information on alternative fuels infrastructure is made available to the user by digital means (e.g., through an app) (see Figure 6-19). 244 out of 292 stakeholders across all groupings indicated that they did. Only 25 stakeholders did not agree.

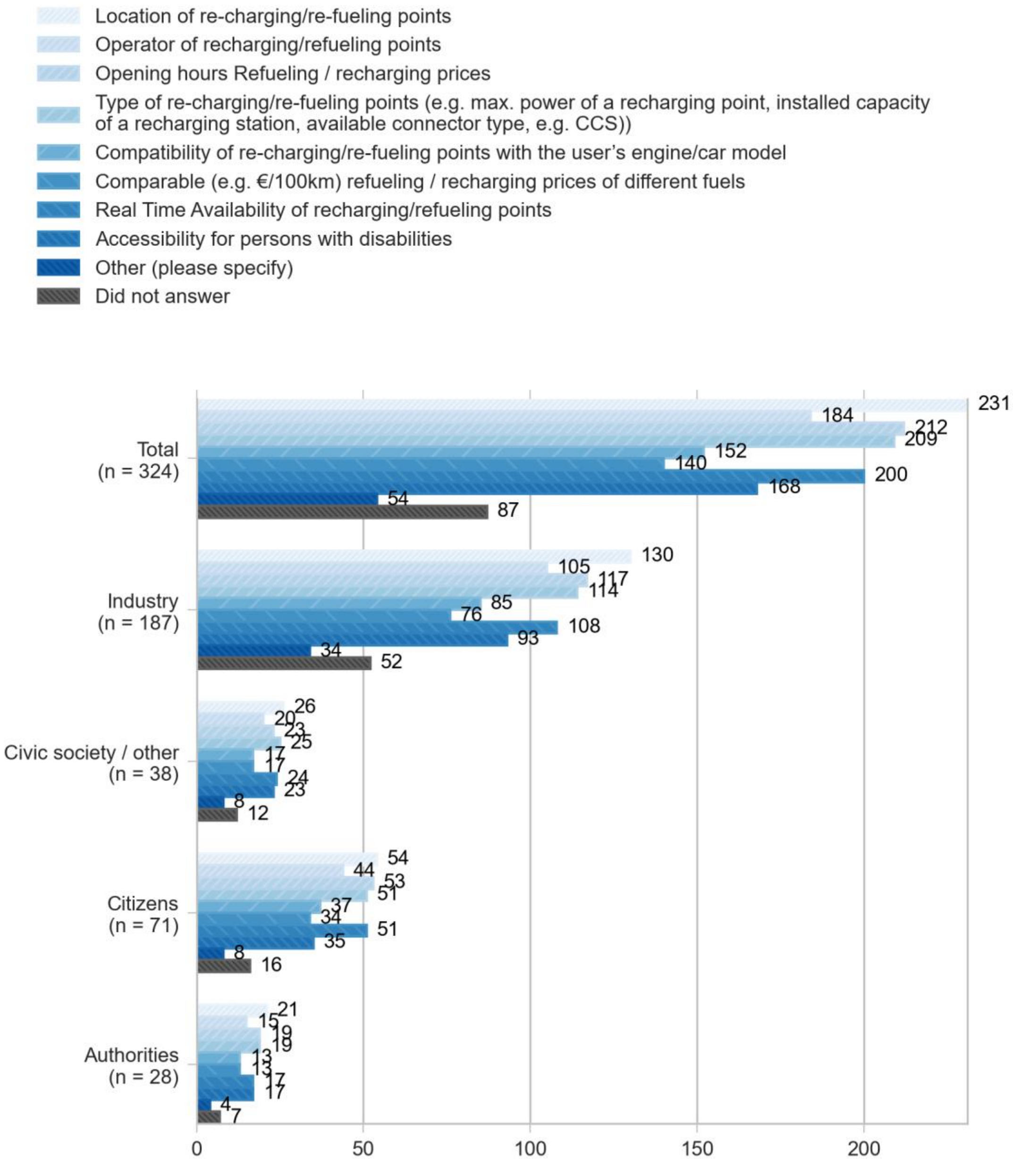
Figure 6-19: D15. In your view, should EU legislation ensure that certain information on alternative fuels infrastructure is made available to the user by digital means (e.g., through an app)?



11.7.5.2.16 D16. Which information should be provided?

Stakeholders who replied 'yes' in question D15 were asked to specify which information they believed should be provided with multiple answers possible (see Figure 6-20). Of these stakeholders, the different groupings were generally aligned in their answers. The location of re-charging/re-fuelling points was the most popular information stakeholders wanted to be provided with 231 out of 237 answers. Similarly, opening hours for refuelling/recharging prices, types of re-charging/refuelling points and real time availability of recharging/refuelling points attained a large number of votes each with 212, 209 and 200 respectively. These were voted second, third and fourth highest in each of the stakeholder groupings, although ordered slightly differently per grouping. Compatibility of re-charging/refuelling points with the user's engine/ car model and comparable refuelling/recharging prices of different fuels tended to be the least chosen with 152 and 140 votes overall respectively. Only citizens voted for accessibility for persons with disabilities a bit less than compatibility with user's engine / car model. Fewer stakeholders across all groups chose to specify an 'other' option with 54 in total.

Figure 6-20: D16. If you replied yes to Q15, which information should be provided? (multiple answers possible)



There were 50 additional responses to this question, of which 10 came from representatives of ***business associations***, which covered a range of issues. **Additional information** that EU legislation should ensure is made available by digital means that was mentioned by these respondents included: contact persons for potential error codes (while also underlining that charging points should enable remote access services); the potential to find and pre-book charging slots; information on how to access the charging station; the means of authentication or authorisation; the means of making ad hoc payments; and the charging tariff. Another respondent referred to Californian legislation to identify other information that could be included, i.e. the station name and id, its geographic location, address and phone number, its access type (public, private, etc), payment methods and pricing information. They also called for a NAP in every Member State to have this information, which was made available for free to information providers. A similar response from two respondents (one of which was a representative of a business association) suggested that all the information be made available on a central website that can be used by potential users.

There were a number of more **general responses** from business associations. One suggested that it was not necessary to set minimum obligations, as this should be left to the commercial decisions of operators, although they noted that most apps provided the information listed in the question anyway. A different respondent noted that different information requirements should apply to, say, a charging point at a holiday apartment and a charging point at a charging station, while another noted that having all of the information listed in the question available for the infrastructure to be used by the shipping sector would also be useful. Three similar responses (from two business associations and a representative of a company / business organisation) mentioned that all public chargers should have fixed cables and that there should be a more uniform human-machine interface for remote services, with one of these also suggesting that prices should be presented in €/kWh, not €/100 km.

The most common additional pieces of information mentioned in the 20 responses from representatives of ***companies and business organisations*** were information on **pricing** and **availability**. One response noted that, while all the information listed in the question were relevant, the most important piece of information was transparent and comparable pricing information, along with information on when the charging point could be accessed (e.g. if it is on private land) and on average occupancy rates at different times of the day (as this might be easier to supply than real-time information on availability). Two other responses mentioned pricing (one the general pricing structure, the other real-time pricing information), and another mentioned payment options, and a fourth the availability. A representative of a company / business organisation suggested that information on whether the charging point was bi-directional or not should also be included, as should information on the source of the electricity used (e.g. renewable or not, local, etc.), while another suggested that information on nearby services should also be provided. Another respondent suggested that a standardised definition of error codes was important, along with direct access to whomever could deal with these, as well as information about the entity that was responsible for the charging point.

On the other hand, a number of respondents expressed **concerns about requiring certain information to be required to be presented**, including pricing. One, while acknowledging that information on pricing was very relevant to consumers and so believed that this should be provided in apps where possible, did not want the provision of this information to be mandatory (as services could be supplied with different prices, which would risk making the requirement to display all prices on the app too burdensome). A different respondent suggested that information on prices and real-time availability was difficult to keep accurate, so there was a risk of a loss of confidence if the provision of such information was required. Another representative of a company / business organisation noted that, depending on who was operating the app, some information was easier to provide than others, as, for example, a charging point operator does not know the customer-specific pricing of an EMSP. They also noted that the provision of some information via apps was difficult as a result of technical limitations, so called for the details of this to be worked out with industry to ensure that technology was able to comply with any legislative requirements.

Some respondents commented on aspects of **real-time information**. A representative of a company / business organisation noted that providing the time at which the 'real-time' information was provided was important, while another suggested that it would be important to provide real-time information on available power, as this varied over time depending on usage. On the other hand, another respondent, whilst acknowledging that providing the information listed in the question digitally would be useful to consumers, noted that dynamic real-time information, such as availability, was commercially-sensitive and valuable data that should be owned by the service provider for them to share as they wished.

Three responses made **modal-specific comments**. One noted that information should be provided on whether the infrastructure was suitable for HDVs, both in relation to space and the availability of safe parking, in a version of the app that was adapted for commercial vehicle use, while another called for information to be provided on the road segments that were electrified and the type of ERS that was in place. Another suggested that information should be provided on whether there were plug-in facilities for refrigeration units at secure truck parking locations and for bus air conditioning systems when these were parked. Two respondents commented that the question only focused on electric vehicles.

One of the two responses from representatives of ***consumer organisations*** underlined the importance of the AFID mandating, at a minimum, that tariffs were displayed to users on charging points based on the amount of electricity charged (in €/kWh) and that these were transparent to users before charging and included on their bill after charging. The other respondent called for the 'optimisation' of the quality and intelligibility of the information provided to consumers, which could be presented both visually (pictograms) and in simple language for operational information. The one response from a representative of an ***environmental organisation*** criticised the use of €/100 km as a means of providing price information, arguing that this value varies a lot between different cars and is also dependent on a range of factors, including driving conditions.

Two of the five responses from representatives of ***NGOs*** explicitly mentioned pricing information, whereas one mentioned the payment method. In relation to pricing, both responses argued that this information should be presented in terms of €/kWh, with the first underlining that €/100 km depends on too many factors to be a useful means of comparison, while the second made a similar point and also noted that their proposed approach reflected energy efficiency. In addition the latter noted that all of the information in the question should be made available to consumers, but through a menu so that users could choose which information to access, as it was important not to overburden consumers with information. A different NGO respondent suggested that while it was important that users were able to easily access information, it was important to ensure that legislation did not put an excessive burden on operators of recharging/refuelling points, as this may lead to disproportionate costs. Finally, another NGO suggested that information should include information on the accessibility and suitability of charging points for motorcycles and other L-category vehicles.

Two of the seven responses from ***EU citizens*** and the single response from a ***non-EU citizen*** called for it to be possible to reserve charging points in advance, with one of these also suggesting that there should be a means of reporting whether a petrol or diesel car was parked in the space reserved for electric vehicle recharging. A separate response called for information to be made available as to whether smart charging was possible, while another called for information on the compatibility with bi-directional charging to be communicated. Other information that respondents believed should be provided included: whether or not the charging point was functional or out-of-order; the source of the electricity; the different types of authorisation and other features of the charging station (toilets, etc); and the charge level of the vehicle being charged (if there was one). This response also underlined that pricing information should be provided in 'cost per kWh'.

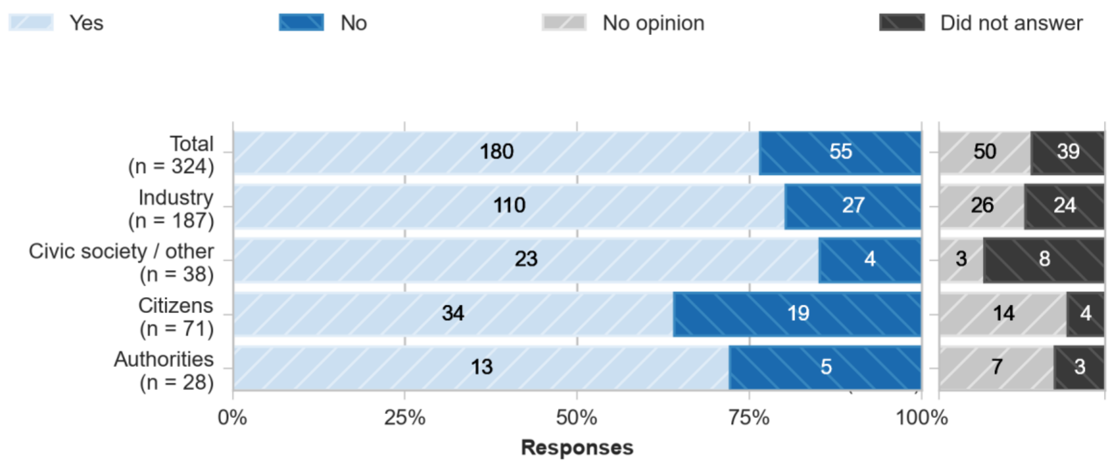
The four responses from representatives of ***public authorities*** covered different elements. One underlined that transparent dynamic information on the availability of a charging point was important, as was the user being able to clearly see (all elements of) the price before starting to recharge. They also noted that the lack of qualitative information on charging infrastructure was a barrier to its use, so suggested that there should be a mandatory exchange of disclosure of a homogenous, aggregated dataset.

A similar theme was mentioned by a different respondent, which called for all information to be made available via open data in a standardised format so that anyone could use the data. Another response suggested that legislation should make it possible to allow exceptions for real-time information.

11.7.5.2.17 D17. Should the EU legislation ensure that certain information is made available to the user by physical means?

Stakeholders were asked whether they thought that EU legislation should ensure that certain information is made available to user by physical means (see Figure 6-21). 180 out of 285 stakeholders agreed that it should. This was the trend throughout all stakeholder groups. On the contrary, 55 stakeholders overall responded 'no'. The citizens stakeholder group disagreed the most with 19 out of 67 votes compared to 34 votes for yes. 50 stakeholders indicated that they had no opinion and 39 did not answer at all.

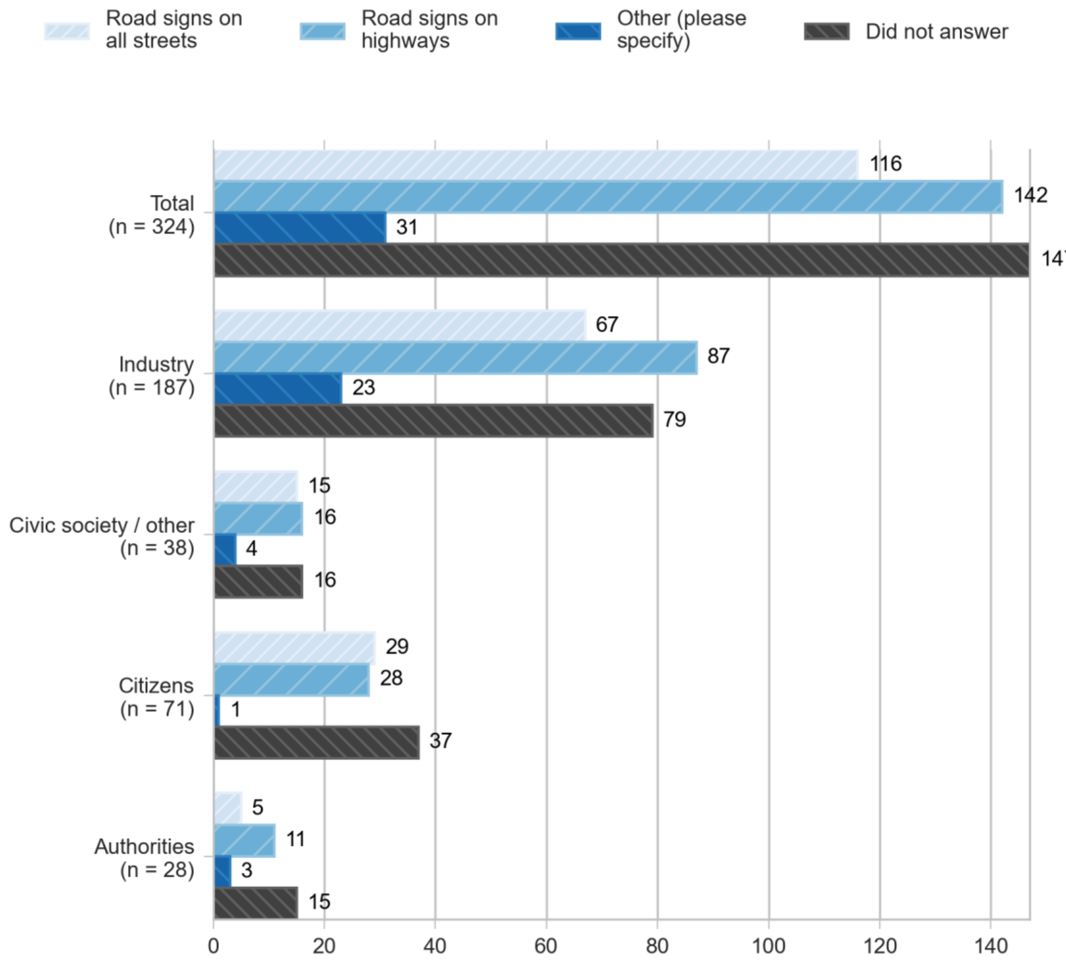
Figure 6-21: D17. In your view, should the EU legislation ensure that certain information is made available to the user by physical means?



11.7.5.2.18 D18. To which physical means are you referring to?

Stakeholders who replied yes to question D17 were asked to specify which physical means they were referring to so that information is made available to the user with multiple answers possible (see Figure 6-22). Road signs on highways was the highest selected option overall with 142 out of 177 stakeholders. This was the trend throughout all stakeholder groups except for citizens where it was outvoted by road signs on all streets by 28 votes to 29. Road signs on all streets was voted the second highest overall with 116 votes and throughout the rest of the stakeholder groups. Only 31 stakeholders specified a different option through selecting 'other'. There was a high number of stakeholders who did not answer with 147 out of 324 stakeholders not providing an answer.

Figure 6-22: D18. If you replied yes to Q17, to which physical means are you referring to (multiple answers possible)?



There were 31 additional responses to this question, of which 12 came from representatives of ***business associations*** and 11 from representatives of ***companies and business organisations***. Several of these mentioned that there was no need for the provision of physical information as the information should be provided online, or eventually through cars' internal systems. However, a number of responses did propose additional physical means, including information at the recharging/refuelling point, signs and user guides.

A number of responses focused on the **provision of information at the recharging / refuelling point** itself. One suggested that it was important to have a sign next to the point to explain how it worked and which prohibited parking when the vehicle was not recharging / refuelling, while another suggested that crucial information, such as pricing and power capacity for recharging infrastructure should be physically present at the charging point. Another suggested that there should be clear signs at charging points that these should not be used for parking, which would then support the removal of illegally parked vehicles. Two other responses underlined the importance of physical information on pricing to be available at charging stations.

Other responses focused on the **provision of road signage**. One suggested that, at least in the transition stage, physical signage on the location of recharging infrastructure would be important to support the widespread adoption of electromobility, while another suggested that physical signs would be important until all of the information was available digitally. A different respondent suggested that the same approach to other alternatives fuels should be taken as is currently the case with signposting for LPG, CNG and LNG. On the other hand, a response suggested that mandating signage for electric vehicle recharging infrastructure could be excessive as the amount of infrastructure increases, so suggested leaving it to local authorities to identify the best solution locally.

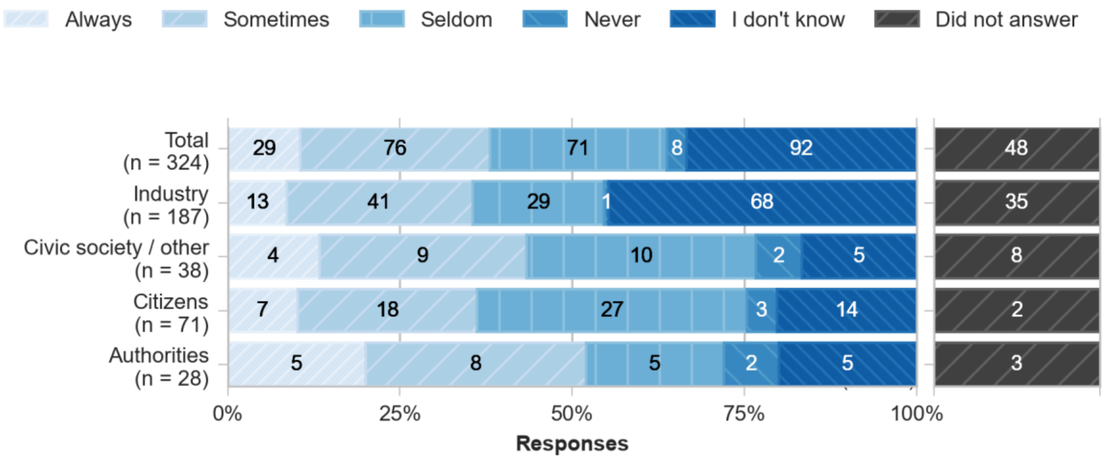
In addition, two respondents suggested that the necessary refuelling / recharging information should be provided in the **manufacturer's instruction manual**. Four responses simply called for a harmonised approach within the EU (with two specifically mentioning a logo), without specifying further to what this should apply.

The one response from a representative of an ***environmental organisation*** called for more physical signs to indicate the location of charging points and hubs to increase the visibility of these and so help to reduce people's concerns about the availability of the infrastructure. This point was echoed by two of the three responses from representatives of ***NGOs***. Another called for minimal signposting on roads, as most users would rely on online navigation tools. The one response from an ***EU citizen*** underlined that physical information was still important as some charging stations were in areas without sufficient mobile phone coverage. One of the three responses from representatives of ***public authorities*** suggested that signposts should be on all roads, while another suggested that signposts should only indicate fast recharging points and a third suggested that the information should only be online.

11.7.5.2.19 D19. How often are the prices charged at publicly accessible re-charging points clearly identifiable?

Stakeholders were asked how often the prices charged at publicly accessible re-charging points are clearly identifiable (see Figure 6-23). The majority of stakeholders stated that they did not know (92 out of 276). Of those that had a view, this varied significantly, with 76 stating sometimes, 71 stating seldom, 29 stating always and just 8 stating never.

Figure 6-23: D19. In your view, how often are the prices charged at publicly accessible re-charging points clearly identifiable?

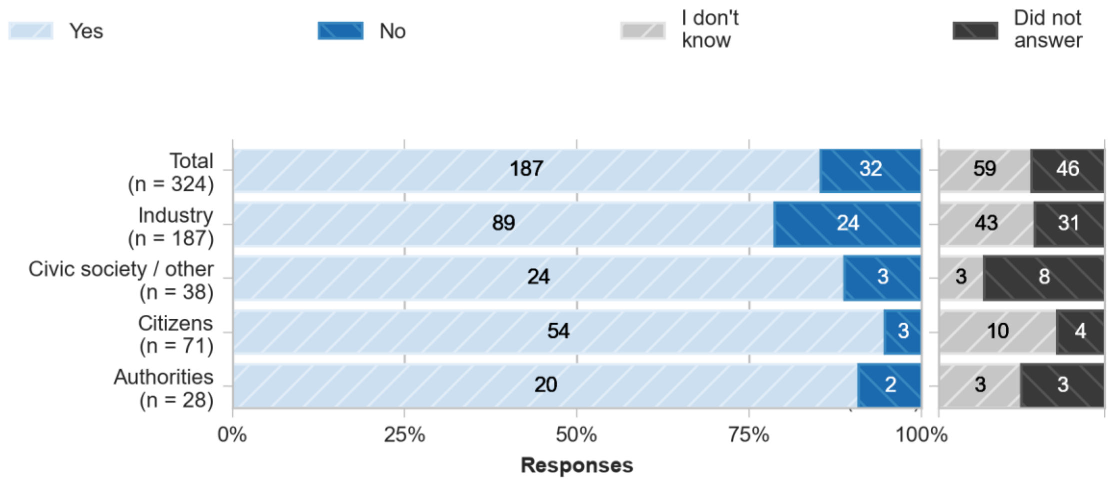


11.7.5.2.20 D20. Should there be a harmonization of the display of recharging fees required at EU level?

Currently many different concepts and price components exist to price electric recharging services, e.g., initial fee, time fee, kWh fee, possibly roaming fee. Stakeholders were asked whether there should be a harmonization of the display of recharging fees required at EU level, offering initial fee, time fee, kWh fee and possibly roaming fee as examples (see Figure 6-24). The majority of stakeholders (187 out of 278 respondents) agreed that there should. Only 32 stakeholders responded 'no'.

Figure 6-24: D20. Currently many different concepts and price components exist to price electric recharging services, e.g., initial fee, time fee, kWh fee,

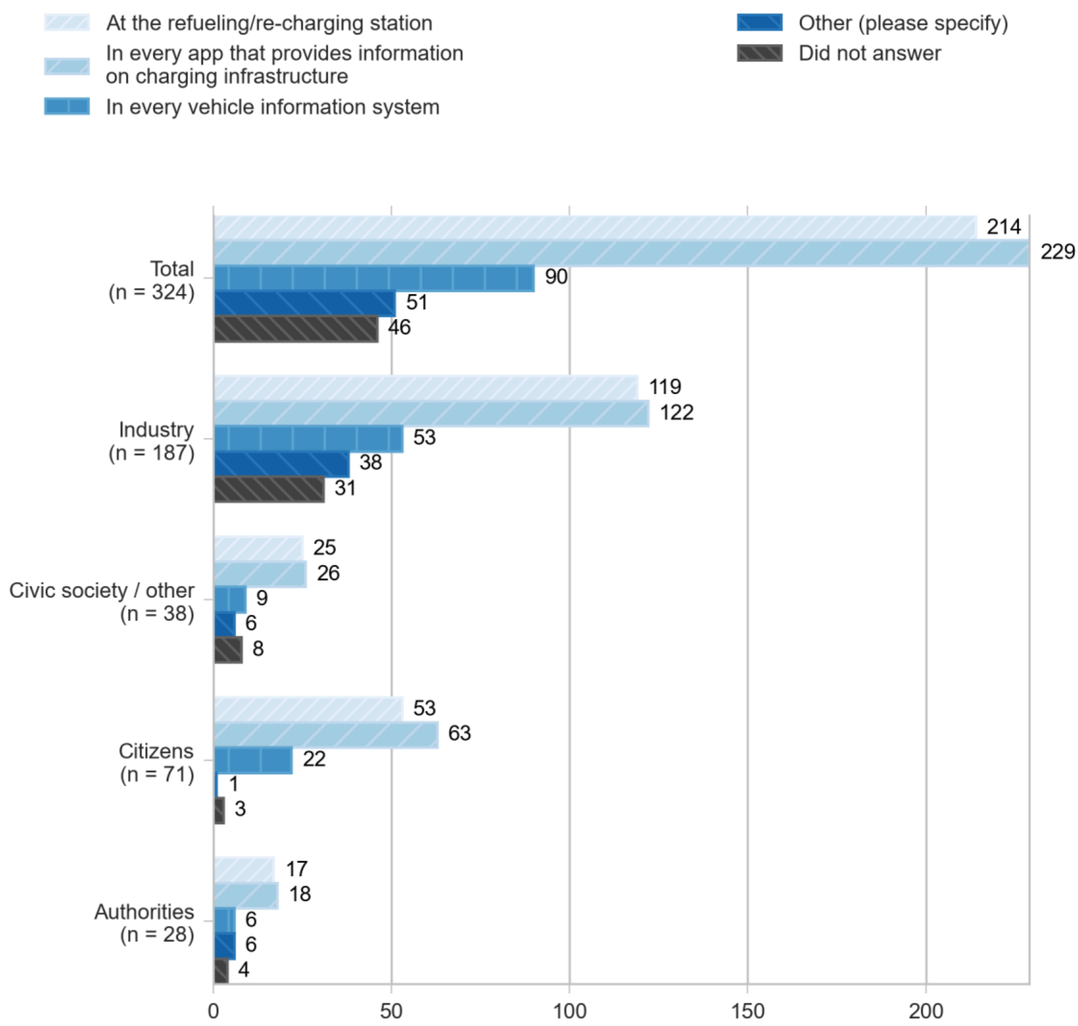
possibly roaming fee. Should there be a harmonization of the display of recharging fees required at EU level?



11.7.5.2.21 D21. Where should information on the refueling/re-charging price be displayed?

Stakeholders were asked where they thought information on refuelling/re-charging price should be displayed with multiple answers possible (see Figure 6-25). The highest selected option was that refuelling/recharging prices should be displayed in every app that provides information on charging infrastructure. This option was selected 229 times out of 277. The second highest was for the prices to be displayed at the refuelling/recharging station with 214 votes. The third highest selected answer was prices to be displayed in every vehicle information system with much fewer votes at 90 overall. These trends were consistent throughout all stakeholder groups. Other answers were specified 51 times overall although only 1 citizen selected this option. 46 stakeholders did not answer at all.

Figure 6-25: D21. In your view, where should information on the refueling/re-charging price be displayed (multiple answers possible):



There were 49 additional responses to this question, of which 16 came from representatives of ***business associations*** and 20 from representatives of ***companies and business organisations***. A common response – from six respondents – was that information should only be displayed at the refuelling / recharging station for ad hoc payments, as charges via contracts would be provided by the respective EMSP, with one of these noting that integration into in-vehicle systems would further improve the convenience for users. Another two similar responses underlined the importance of the real-time display of pricing information at the recharging / refuelling point. A couple of respondents suggested that the first two options in the question – providing pricing information at the refuelling / recharging station and in apps – were most important, as it was important to inform consumers of the prices in advance and while they were recharging.

The importance of **digital information** was highlighted by a number of respondents. One underlined that pricing information should be available online and through apps, as it was important that users had access to this information before arriving at the refuelling / recharging station. A different response also underlined the importance of the information being in every app and in-vehicle navigation system to ensure that information was provided before reaching the charging station, while another called for the information to be made available in an online portal. Another three responses called for the provision of pricing information in apps, with one noting that this was where users received their information so information at recharging stations was unnecessary and another suggesting that the app should be provided by a relevant public body. Two additional responses also called for information to be provided in apps – and possibly in in-vehicle navigation systems – as it was important for consumers to be informed of prices prior to visiting the charging point. A different respondent noted that, as there could be different 'ad hoc' charging rates, it was not practical to display pricing information – even dynamic pricing – at charging points, while another suggested that Article 7 of the AFID (i.e. that on consumer information) should change to apply to internet-based information. Two other (different) responses suggested that including the information in in-vehicle navigation systems would be the way forward in the medium-term.

Two similar responses suggested that a distinction had to be made for **gas mobility and electromobility**. For the former, they argued that a price display at the refuelling station was sufficient, whereas for the latter it was important that customers received the information on pricing beforehand, although this information should also be available in real-time at the charging point.

Other responses answered more generally about how the **information should be made available**. One suggested that pricing information should be available at the NAPs, while another two similar responses that charging point operators should ensure that pricing information was made available so that it could be used in a wide range of digital applications. A different response suggested that the information should be made available as public information in the same way as it was for petrol and diesel prices, while another noted that pricing information should be publicly-available via application programming interfaces (APIs). From the perspective of the maritime sector, it was noted that vessels and shipping companies receive pricing information from local agents and brokers.

Two similar responses suggested that there were diverging requirements for private car drivers and business operators of commercial vehicles, so that it was not possible to answer this question. One of these referred to the ACEA position paper for their response to this question (see Section 1.4).

More **generally**, one respondent suggested that it should be sufficient for the AFID to require that the customer have information on the price, and the components of this, before starting the transaction, in order to give leeway to operators. Another respondent called for such decisions to be left to market forces.

One of the two responses from representatives of ***consumer organisations*** suggested that information to consumers about prices should be communicated through as many means as possible, including via the options listed in the question, as well as on digital roadside displays, as is the case with fuel prices. The other response highlighted the importance of providing pricing information on bills. One of the four responses from representatives of ***NGOs*** suggested that pricing information should be available using digital tools, whereas another suggested that the information should be available at the charging point for those users who did not have a contract. A different respondent called for there to be a mandatory communication standard for public and semi-public charging points that enabled the communication of pricing information to any device that a consumer might wish to use to access it. The one response from an ***EU citizen*** suggested that pricing information should be displayed wherever a user could easily see it.

The six responses from representatives of ***public authorities*** stressed the importance of digital information. One noted that the information should be available online, while another call for the information to be made available via open data using a standardised format that could be used in different applications and a third that the information should be in the app of the consumer's chosen mobility operator. A different respondent underlined that having information on prices physically present at the charging point would not be practical as a result of the number of EMSPs operating, while another suggested that pricing information could be made available via a QR code available at the charging point. Finally, one respondent suggested that relevant information should be made available to rail operators.

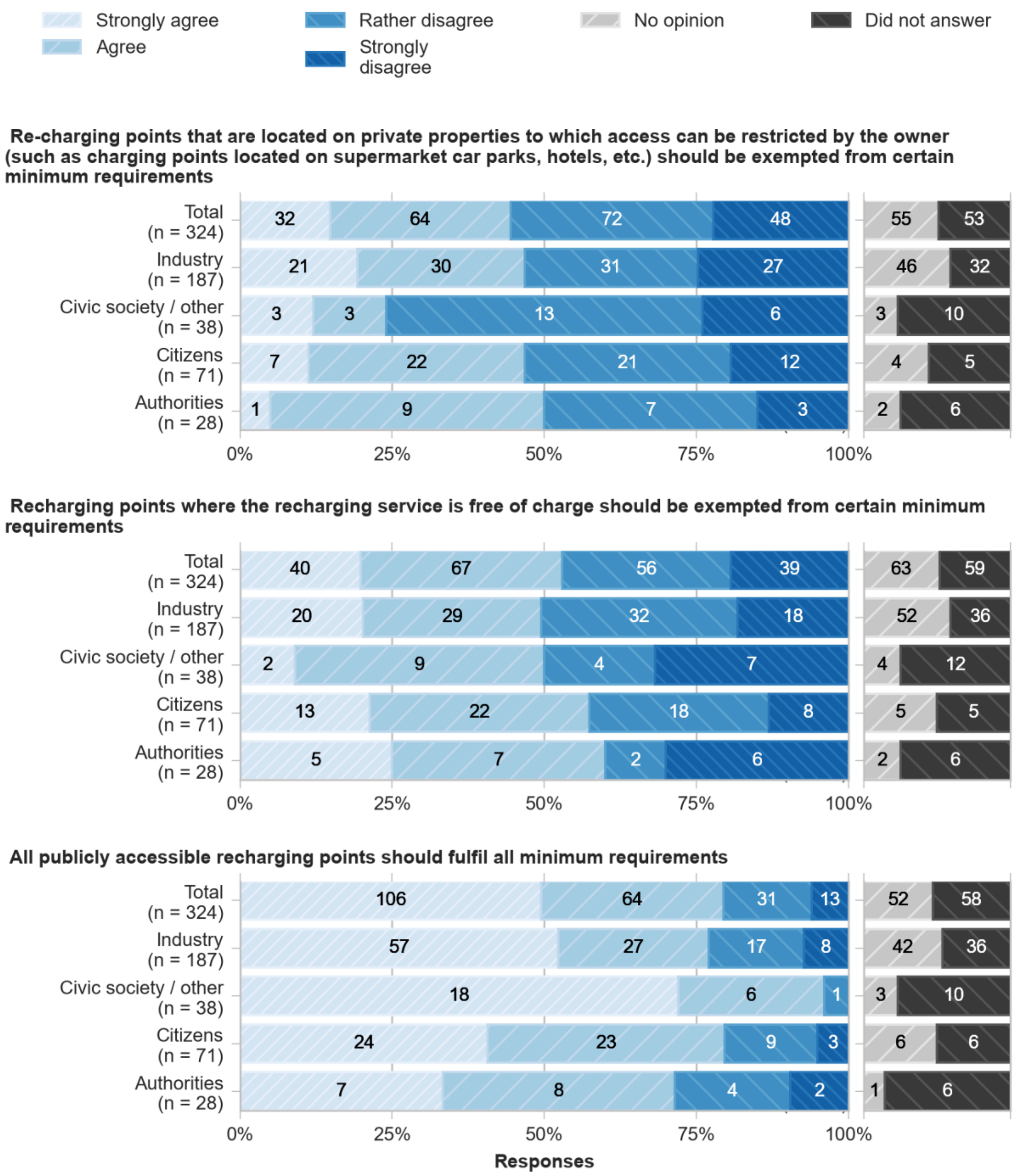
11.7.5.2.22 D22. On the possible exemption of recharging points from certain minimum requirements, to what extent, do you agree with the following statements?

On the possible exemption of recharging points from certain minimum requirements, stakeholders were asked to what extent did they agree with the statements outlined in Figure 6-26. For the first statement, stakeholders tended to disagree a bit more than they agreed that re-charging points which are located on private properties to which access can be restricted by the owner should be exempted from certain minimum requirements, with 120 negative votes compared to 96 positive. This was reflected in each of the stakeholder groupings except authorities where the positive-negative split was tied at 10 votes each. Civic society disagreed the most frequently with 19 compared to only 6 votes agreeing with the statement.

The second statement was similarly close. 107 stakeholders agreed that recharging points where the recharging service is free of charge should be exempted from certain minimum requirements with 95 stakeholders disagreeing. Industry and civic society were split with only 1 vote more for disagreement by industry and 11 votes each for civic society. Civic society did however have 7 stakeholders strongly disagreeing compared to only 2 strongly agreeing. Citizens and authorities both voted slightly more so in agreement with the statement with 35 out of 61 votes and 12 out of 20 votes respectively.

The third statement was much more clear-cut with 170 stakeholders agreeing, compared to 44 disagreeing, that all publicly accessible recharging points should fulfil all minimum requirements. 106 out of these 170 votes were strongly in agreement. Civic society were especially in agreement with 18 strongly agreeing and only 1 'rather disagree' with nobody strongly disagreeing.

Figure 6-26: D22. On the possible exemption of recharging points from certain minimum requirements, to what extent, do you agree with the following statements?



There were 97 additional responses to this question, of which 28 came from representatives of ***business associations*** and 43 from representatives of ***companies and business organisations***. Some respondents did not support any exemptions, while others called for exemptions for semi-public or private recharging points, while others responded in relation to other modes or fuels.

Some respondents replied at a **general level**, rather than for a particular type of infrastructure. One of these argued that, as long as infrastructure complied with safety standards, there was no need for any other minimum requirement, which was also implied by another respondent. A different response underlined the importance of a differentiated approach to requirements in order not to undermine the potential for some operating and business models. A similar point was made by another respondent who called for the same requirements for all public charging points, while supporting less stringent requirements for semi-public and even less stringent requirements for private infrastructure. Two similar responses called for there to be less stringent requirements on semi-public recharging infrastructure compared to public recharging infrastructure depending on the use case, although this should always be interoperable. Another respondent called for all recharging infrastructure that was accessible to the public to be subject to the same standards, including private recharging infrastructure, if it had sufficiently high use, while another respondent suggested that minimum requirements might need to be phased in for existing infrastructure. Another called for minimum technical standards to be applied to all recharging infrastructure, although suggested that payment and roaming requirements should not apply to all infrastructure.

Some of those who believed that there should be **no exemptions qualified their response**. Five similar responses argued that all publicly available infrastructure should respect certain minimum requirements, including interoperability, roaming, safety and cybersecurity standards. A different response also set out the requirements that publicly accessible infrastructure should meet, including basic quality, safety and security requirements. Another response underlined the importance of ensuring interoperability, that there was an ad hoc payment option and that information on pricing was available at all charging points.

Others did not **qualify their support for no exemptions**. One argued that requiring the same rules for all charging points ensured that there was a level playing field, although they did suggest that exemptions could be given on a case-by-case basis, where this was appropriate. Three similar responses called for there to be no exemptions to ensure that the customer experience was the same in all charging scenarios, while a different response called for the same requirements to apply to all public and semi-public infrastructure. Four similar responses made the same point, with three arguing that otherwise there would be a risk of a distortion in competition between public and semi-public charging points. Another respondent believed that there was no need for any exemptions for publicly accessible charging points, although believed that there was a need to clarify what infrastructure was publicly accessible and what not, and for the specification of the requirements that should apply in each case.

In relation to exemptions for **semi-public charging infrastructure**, two similar responses believed that charging points offering free charging on semi-public premises should be exempt from certain minimum (unspecified) requirements, although these charging points should always be subject to cybersecurity and interoperability requirements. Another response argued that recharging that is supplied to customers as a courtesy should be exempt from certain minimum (unspecified) requirements, although adherence to these should be encouraged. Another response suggested that there was a case for having lighter requirements on semi-public infrastructure to encourage their installation. On the other hand, one response argued that semi-public charging points should not be regulated.

Of those who argued that there should be **exemptions for private recharging infrastructure**, two similar responses believed that these should be exempt from certain minimum (unspecified) requirements to avoid excessive investment costs. A different response argued that on private property, the requirements should be left to the owner of the property, while another noted that any requirements on non-publicly accessible infrastructure in the AFID should be aligned with the requirements of the EPBD.

Some responses **criticised the criteria used in the question**. One suggested that the criteria should not be whether the charging point was located on private property that determined the requirements applied, but its accessibility. Another suggested that the appropriate criterion was who provided the service: if it was a charging point operator, then the requirements should be the same as other public charging points; if it was the owner of the charging point on private property, then it should be up to them to decide on the requirements.

Other **suggestions for exemptions** included public charging points at petrol stations and car dealerships. It was also suggested that the safety requirements for the installation of charging points in lower levels of underground car parks in some Member States were over-cautious.

A number of responses focused on other road transport modes or other fuels. Four responses made a similar point in relation to **buses**, i.e. that their recharging (and refuelling) infrastructure should be exempted from certain requirements as access to these had to be limited for security reasons and/or to ensure that buses were able to use the infrastructure when they needed to. It was suggested that the definition of 'private charging' be extended to include charging infrastructure used only by buses. It was also noted that a booking system should be in place for fast chargers and that coaches and lorries were not necessarily able to use the same charging infrastructure as there was not yet a standard that set the location of the recharging inlet on the vehicle. Another response underlined that dynamic charging on roads had to be open. In relation to the provision of **hydrogen** refuelling points, three similar responses called for the technical requirements set out in the Directive to be only applicable for publicly accessible refuelling points. Another respondent also called for exemptions for **CNG refuelling** at private locations.

Finally, eight respondents noted or implied that it was not possible to answer the question without knowing what "minimum requirements" were meant by the question.

The one response from a representative of a ***consumer organisation*** called for a better definition in the Directive of what was meant by a public charging point and suggested that one to which access was restricted in some way, including not being available 24 hours a day, should be considered as being 'semi-public'.

Three of the six responses from representatives of ***NGOs*** were similar and called for the same minimum requirements to apply to public and semi-public charging points. They also called for charging points that did not meet these requirements to be counted as less than one charging point so as not to incentivise the deployment of charging points that did not meet minimum requirements. A different response called for the minimum requirements to include a connection to a public database, roaming and non-discriminatory access, although it noted that private charging points could be exempted from these requirements. A respondent noted that public fast charging points along major transport routes should not be overlooked, while another called for charging points for public transport vehicles to be exempt from certain minimum requirements, as access to these would be restricted.

Many of the nine responses from ***EU citizens*** suggested possible exemptions. These included charging points at public offices, hospitals, car parks, private individual property and proprietary charging points such as Tesla's. One response suggested that charging points at supermarkets should have the same requirements as public charging points, although suggested that charging points at hotels and restaurants should be allowed to have different requirements. Another response made a similar point, suggesting that only free charging points, such as those at hotels, should be allowed to apply different requirements. A different response suggested that as requirements had been set for specific reasons, they should apply to all charging points, while another noted the importance of security, maintenance and the provision of information. On the other hand, one response underlined that any minimum requirements should not be restrictive to implement, while another underlined the importance of keeping the installation of semi-public charging points simple, so as not to deter their deployment. The one response from an ***academic and those from research institutions*** argued that there should be a different approach for public and semi-public recharging infrastructure.

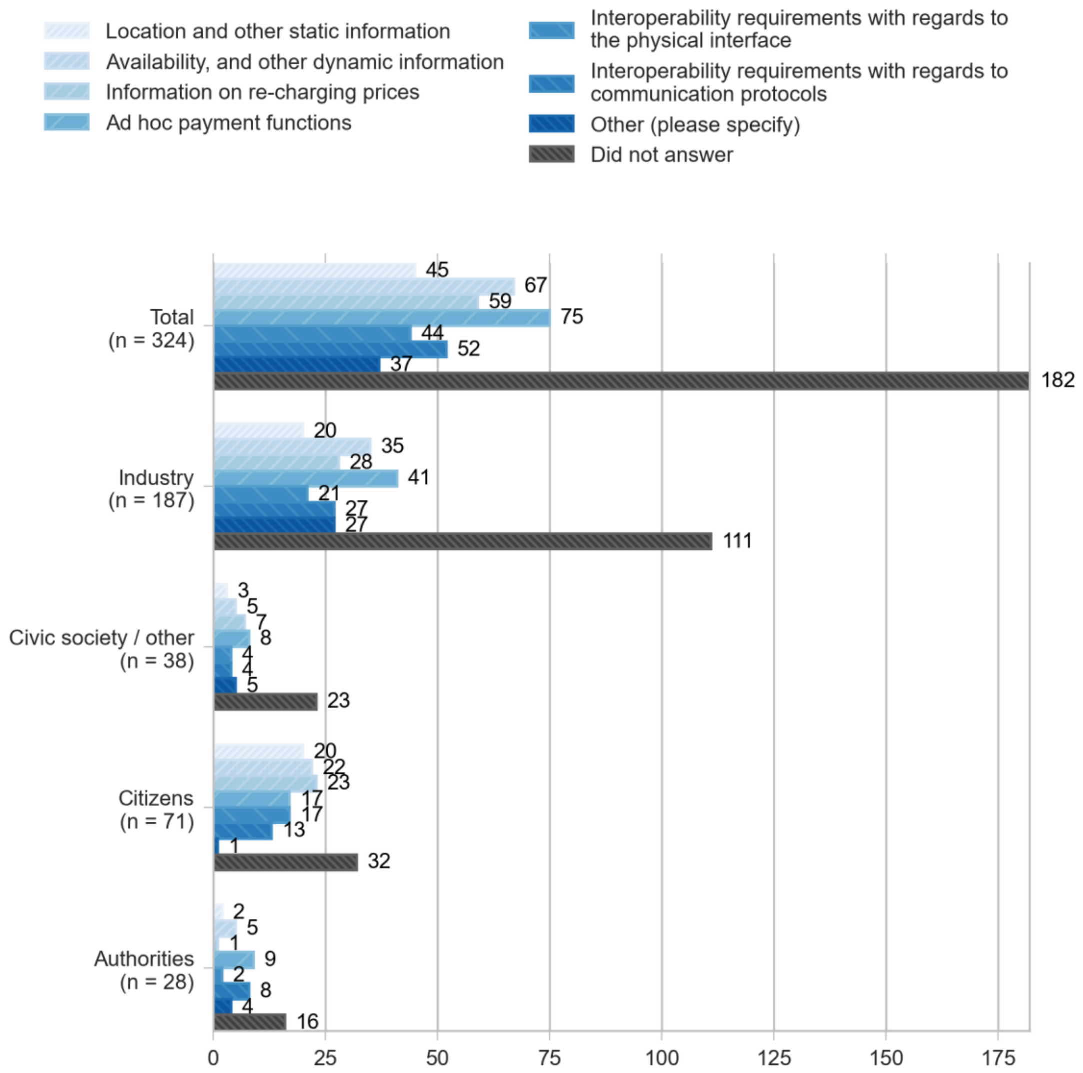
There were six responses from representatives of ***public authorities***. One noted that deviations from the minimum requirements depended on what these requirements were, although did note that exemptions should be allowed if it was made clear to the user the extent of these, e.g. that limited payment options were available. Another respondent called for minimum criteria for smart charging points, although noted that these should be sufficiently flexible with respect to charging point design. Other responses suggested potential exemptions, e.g. non-public charging infrastructure, charging points for buses and charging points for railways.

There were three responses from organisations that were classified as ***'Other'***. One of these called for minimum requirements to apply to all recharging infrastructure that was accessible to the public, while another noted that the length of time that a car might need to charge – depending on what the driver had stopped for – should be taken into account when setting minimum requirements. On the other hand, the other response suggested that the minimum requirements for charging points, other than those on the TEN-T, should be left to Member States.

11.7.5.2.23 D23. In case you believe that some recharging points should be exempted from fulfilling some minimum requirements, which requirements should those be?

Stakeholders were asked which minimum requirements should recharging points be potentially exempted from, with multiple answers possible (see Figure 6-27). Answers were relatively varied throughout all stakeholder groups. Overall, ad hoc payment functions was selected the most (75 responses) which was mimicked in industry, civil society and authorities but not citizens. Citizens instead voted for information on re-charging prices the most with 23 votes out of 39. This option was selected second highest in civic society. Availability, and other dynamic information was selected second highest overall and by industry and citizens with 67 votes across all groups. The two least selected options were location and other static information and interoperability requirements with regards to the physical interface with 45 and 44 votes respectively. 182 out of 324 stakeholders did not answer.

Figure 6-27: D23. In case you believe that some recharging points should be exempted from fulfilling some minimum requirements, which requirements should those be (multiple answers possible):



There were 36 additional responses to this question, of which nine were from representatives of ***business associations*** and 17 from representatives of ***companies and business organisations***. Many of the responses suggested requirements that need not apply to some types of charging station, while some made more general comments.

At a **general level**, one response suggested that communication between the charger and the vehicle should never be exempt, although other requirements could be. A different respondent suggested that there was no need for any exemptions, as excluding information would not necessarily ease administrative burden, while another suggested that all charging points should have to fulfil a minimum level of requirements and a third felt that there was no need to mandate a certified electricity meter. Two similar responses suggested that, if a charger was **publicly accessible**, it should have to comply with all standards.

In relation to **semi-publicly available infrastructure**, one respondent suggested that some minimum requirements should not be mandatory as these would not be relevant, although the availability of ad hoc charging and connectivity should be required. A different response suggested that for semi-public charging points, interoperability should be ensured, while another suggested that such infrastructure need not always be smart and a third suggested that such infrastructure should not be regulated.

On the other hand, with respect to **private infrastructure** a respondent suggested that any binding requirements would increase costs and so could discourage the deployment of these points, so suggested that the decision should be left to the owners of the infrastructure. A different response suggested that investors in charging points on private property should have the freedom to choose which socket or plug to use, while another underlined that exemptions should only be allowed for infrastructure that was not open to the public and a third that minimum requirements for charging points on private property should not be mandatory. Another respondent suggested exempting charging points at workplaces and private apartment blocks from all requirements, while another suggested reducing the requirements for charging points in these locations. Another respondent suggested that private infrastructure need not always be smart. Taking a slightly different perspective, another response suggested that if a charging point was installed with private funds, the owner should be able to decide whether to make these points available to other charging service providers.

Four responses noted that, where **chargers were free to use**, they should not need ad hoc payment functionality, while three underlined that the presentation of the charging price was not needed on such chargers and two respondents suggested that these did not need to be interoperable either. Another suggested that such chargers could have lower power requirements.

Two responses suggested that, as there was diverging needs for passenger cars and for business operators, it was not possible to answer this question; one of these responses referred to the ACEA position paper in this respect (see Section 1.4). A different respondent also noted that there were so many different potential combinations (public/private, free/paid) that it was not possible to give a single answer to the question, while another suggested that any exemptions for any charging point had to be based on the specific use case.

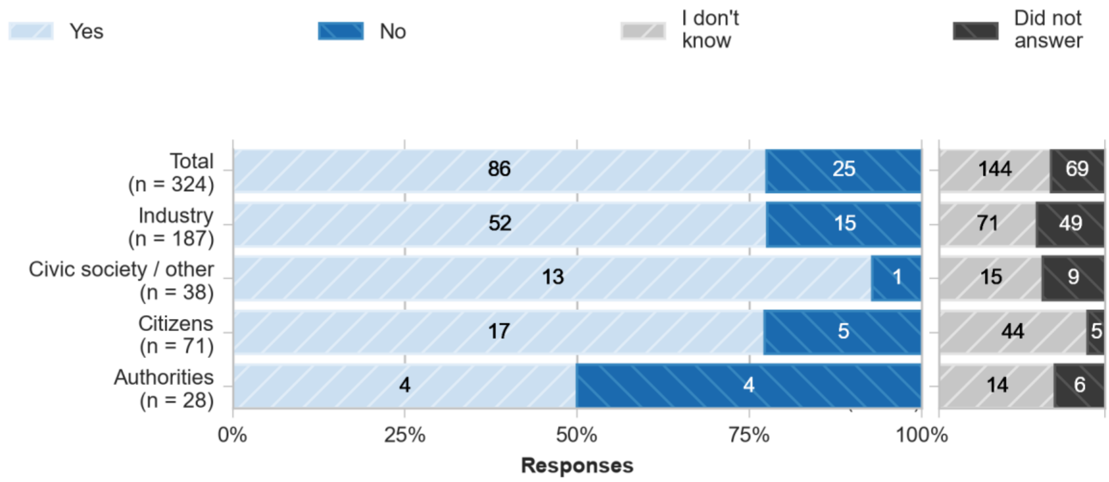
The one response from a representative of an ***environmental organisations*** and three of the four ***NGO respondents*** suggested that minimum requirements should apply to all infrastructure that was accessible to the public, although they suggested that it should be evaluated whether it was relevant to exempt semi-public chargers from some requirements. The other NGO respondent suggested that interoperability requirements should be ensured for all semi-public charging points. The single response from an ***EU citizen*** suggested that hotels and businesses should be able to offer recharging to visitors without the relevant charging points having to meet minimum requirements.

One of the four responses from representatives of ***public authorities*** suggested that criteria for charge point design be established that contained an effective minimum baseline of requirements, based on the utility of the respective requirements, in order to allow for flexibility in charging point design. A different response suggested that exemptions could be given with respect to roaming connections where charging points were free and for the availability of a card terminal, while another response called for there to be exemptions only where these were made clear to potential users. Finally, it was suggested that even privately-owned infrastructure should have some minimum requirements to ensure reliability and consumer protection.

11.7.5.2.24 D24. In your view, are there currently problems that e-mobility service providers face when they want to offer their services on charging points that are operated by a third party?

Stakeholders were asked whether they believed there are currently problems that e-mobility service providers face when they want to offer their services on charging points that are operated by a third party (see Figure 6-28). 86 out of 255 stakeholders agreed that there were. This was the trend through most stakeholder groups, especially civic society with 13 votes for yes and only 1 vote for no. Authorities were split between yes and no with 4 votes for each. The largest proportion of stakeholders, 144 out of 255, selected that they did not know.

Figure 6-28: D24. In your view, are there currently problems that e-mobility service providers face when they want to offer their services on charging points that are operated by a third party?



There were 70 additional responses to this question, of which 14 came from representatives of ***business associations*** and 31 from representatives of ***companies and business organisations***. Common themes that were raised included a lack of interoperability, discriminatory pricing and that some CPOs did not let certain EMSPs access their infrastructure.

In relation to **interoperability**, three similar responses noted that there needed to be a general set of standards to ensure quality and interoperability. A different respondent suggested that individual contracts between CPOs and EMSPs were often complex and contained no obligation to ensure interoperability (even when roaming was available), while another highlighted interoperability issues in relation to the use of remote comments and status notifications that were not based on real-time information. A different response noted that there should be a level playing field in relation to interoperability and roaming, and that customers should be able to choose their EMSP and to easily change their EMSP, a point which was echoed by a separate response. Another respondent suggested that interoperability was not guaranteed and that some market operators retained some form of exclusivity over the use of their recharging points, while another respondent suggested that the use of open protocols, such as OCPI, would help interoperability.

Other respondents highlighted **cross-border interoperability** issues. Two similar responses suggested that cross-border interoperability and data exchange was limited. Another response argued that the classification of electricity for VAT purposes in different countries caused barriers to the development of cross-border e-mobility businesses.

It was suggested by various respondents that **pricing could be discriminatory**. Two similar responses noted that pricing mechanisms were often complex, and that different pricing applied to EMSPs compared to the CPOs' own customers, with these subsequently calling for non-discriminatory pricing. Two other similar responses suggested that pricing could be high or discriminatory. A different respondent noted that network charges and connection fees could be high and suggested that DSOs could be in an advantageous position when they provided e-mobility services, which risked distorting competition. Another respondent suggested that discriminatory access conditions sometimes went beyond pricing (without further specifying these), while high roaming charges were raised by a separate respondent that also underlined that sometimes operators were not prepared to open up their infrastructure to the market. Another response suggested that, in addition to different pricing, there were also often different authentication protocols.

Four respondents also suggested that some **CPOs would not give access to their infrastructure to all EMSPs**, while another called for all EMSPs to be able to access all CPO networks. Five other similar responses called for fair and adequate access to CPO networks for EMSPs based on commercial criteria that enabled the market to operate, and three of these called for this to be supported by open standards, open communication protocols and the enabling of roaming. Furthermore, one of these suggested that the way in which the market worked in some Member States did not allow competition.

Other respondents suggested that the **quality of the information shared was often poor**. Four suggested that information often suggested that a charging point was available, even when it was out of service. One respondent also suggested that there were issues relating to **working and contractual relationships**, including that there was often a lack of support, e.g. for booking services, or that technical support was supplied by a competitor, while there could also be issues with billing. A different response suggested that there were often connectivity issues, while another noted that contractual discussions could be lengthy and that IT infrastructure was not standardised and a third that it was difficult for EMSPs to operate over different networks, as they had to have multiple accounts that made it difficult to offer good services to customers. Another respondent noted that the communication software used by many charging points also limited EMSPs from offering services at some third-party charging points, while it was also noted that there were different technical ways to connect a CPO and an EMSP, which often took time to implement.

Others identified **broader issues that were at play**. One respondent called for an appropriate balance to be found between CPOs and EMSPs, arguing that when the tariff charged by the CPO to the EMSP was higher than the former's ad hoc charging, it hampered the development of the EMSP, while CPOs often objected to the EMSP's tariff policy. Two similar responses argued that the market was too shallow and so did not work properly, as most charging points operated at a loss, whereas EMSPs did not want to share this loss. It was also suggested by another respondent that in certain countries, charging service operators that were in a dominant position were blocking the development of roaming within their respective countries. Two similar responses suggested that different policies and practices in different Member States prevented roaming having an EU coverage, and that operators that acted as both a CPO and an EMSP often provided access to other EMSPs with a poorer level of service compared to that which they offered their own customers. Another response suggested that there was often no non-discriminatory access for third party electricity providers to public charging stations, while roaming protocols often served to reinforce local and regional monopolies. It was suggested by another respondent that the situation could vary depending on the development stage of the CPO and that in some countries the separation between the CPO and the EMSP was not clear, while another suggested that local operators often erected unfair market entry rules.

The three responses from representatives of ***consumer organisations*** called for provisions to ensure access to data to enable service providers to offer new services to consumers, suggested that if a service was offered to the public it should be interoperable and noted that in their region, third parties did not offer services via other operators' charging points. The one response from a representative of an ***environmental organisation*** mentioned the discriminatory high fees that EMSPs faced to access CPO networks.

Four of the six responses from representatives of ***NGOs*** mentioned the issue of pricing. Two similar responses mentioned that EMSPs faced discriminatory access or high fees to access CPO networks, while another response noted that fees were often different for different providers for accessing the same network, while a different response highlighted high roaming charges, communication and protocols as problems. Another response suggested that the lack of an information standard was a problem, while a further response suggested that the interpretation of existing requirements varied between Member States.

There were 11 responses from ***EU citizens***, some of which also mentioned pricing and interoperability. One response noted that CPOs charged access fees to connect to their networks, which hindered interoperability, that relevant data was often not passed or was not of sufficient quality and that the requirement to pass prices on prevented them from providing offers related to pricing. A different response suggested that there were difficulties in communication between services, different tariffs and difficulties in accessing the necessary identification information. Another suggested that a problem was that some operators were not required to allow roaming access and, where they did, prices were often prohibitive. Two additional responses called for mandatory interoperability standards.

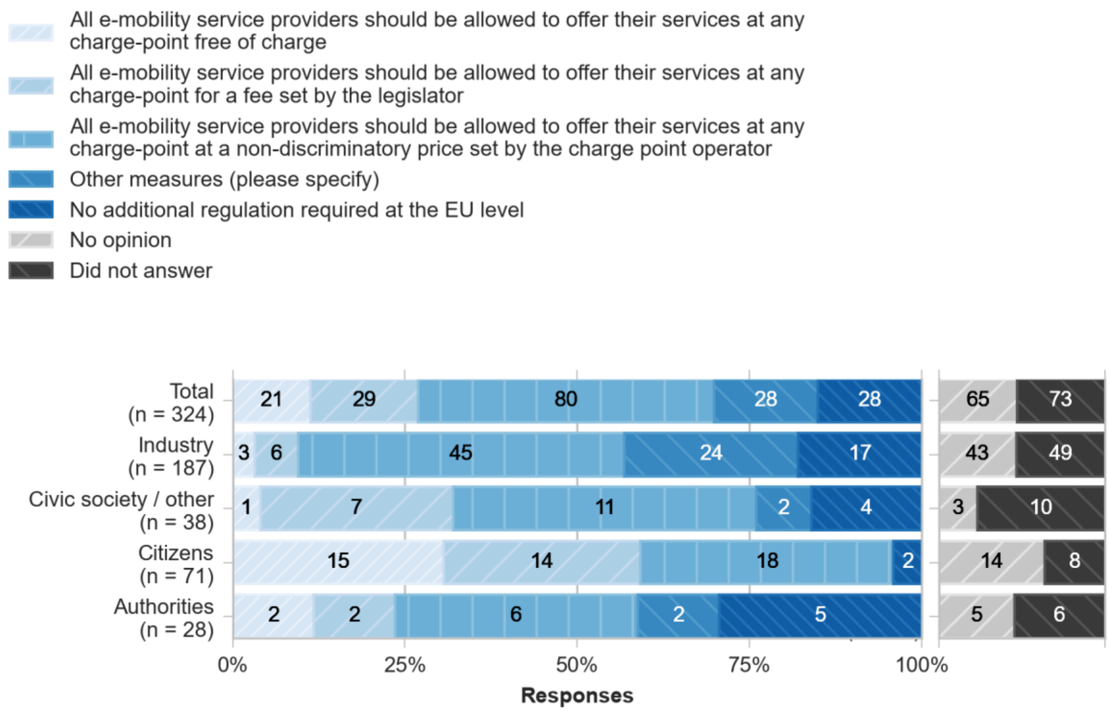
A couple of responses were more from the consumer perspective, with one noting that a lot of different apps and cards were required, another that some networks prevented the use of apps to use services, while a third that too many apps or cards were needed. A different respondent suggested that information regarding the functioning of charging points was often incorrect, while another suggested that information about whether or not a charging point was in service was often incorrect and a third that the necessary information was often not provided, e.g. about real-time availability.

There was a single response from an ***academic and those from research institutions***, who suggested that the provision of information was often poor, that contracts were not uniform leading to different requirements and that quality requirements relating to the third parties were often different. The two responses from representatives of ***public authorities*** suggested that problems included pricing models and the transmission of information that was legally compliant. The single response from an organisation that was classified as ***'Other'***, suggested that some CPOs did not allow EMSPs to use their network, or only provided access at high prices, while the information supplied, e.g. on the availability of a charging point, was often not correct.

11.7.5.2.25 D25. Should policy measures be introduced at the EU level to provide for the following as regards to market access for service providers?

Stakeholders were asked whether policy measures should be introduced at the EU level to allow all e-mobility service providers to offer their services at either any charge-point free of charge, at any charge-point for a fee set by the legislator, at any charge-point at a non-discriminatory price set by the charge-point operator or that no additional regulation is required at the EU level (see Figure 6-29). The highest picked option was that all e-mobility service providers should be allowed to offer their services at any charge-point at a non-discriminatory price set by the charge-point provider. This option was selected 80 times overall and was the highest selected throughout all stakeholder groups. The other options gathered similar amounts of votes and the order changed between the different stakeholder groups. The second most selected option was that there should be a fee set by the legislator, gathering 29 votes overall. This was due to its selection frequency by civic society and citizen stakeholders, with 7 and 14 votes respectively. This was not reflected in industry where it was vastly outvoted for a specified 'other' option with 24 votes compared to 6 votes for fee set by the legislator. Industry also voted highly for no additional regulation required at the EU level with 17 votes out of 95 opinionated answers. Authorities also voted highly for no additional regulation with 5 votes out of 17 answers. The lowest selected overall was services to be allowed free of charge with only 21 votes out of 186 answers. Contrarily, this was the second most picked option by citizens who voted for it 15 times out of 49 answers. There were 65 stakeholders that indicated that they had no opinion and 73 stakeholders that did not provide an answer.

Figure 6-29: D25. In your view, should policy measures be introduced at the EU level to provide for the following as regards to market access for service providers:



There were 28 additional responses to this question, of which six were from representatives of ***business associations*** and 18 from representatives of ***companies and business organisations***.

The most common alternative suggestion that was made was that there should be separate **contracts, or negotiations**, between the CPO and EMSP in which the prices are set. Three similar responses called for all EMSPs to be allowed to offer services on the basis of a contract with the CPO and felt that non-discriminatory prices would be solved by market forces. Two similar responses noted that negotiating a price between the CPO and EMSP was an alternative to the CPO setting a non-discriminatory price, while a separate response called for EMSPs to be able to offer services on the basis of a contract with the CPO. Two similar responses underlined that they were committed to market solutions and so the respective parties should be able to negotiate a price that takes account of their respective cost structures. Four similar responses suggested that an oversight, or arbitrage system, could be created in which a CPO and EMSP could be brought together to resolve disputes and address any concerns about anti-competitive behaviour. A different response highlighted that commercial terms for using a particular charging point could differ significantly, e.g. for car club operators that enter into contracts with a city to use a particular charging point, compared to other users.

Other respondents **offered alternative responses with minor changes to the options provided in the question**. One suggested that EMSPs should be allowed to offer their services at any charging point under *non-discriminatory conditions*, not just with non-discriminatory pricing, while another suggested that EMSPs should only be able to provide services at charging points installed *with public resources* at a non-discriminatory price set by the CPO. A different response suggested that the non-discriminatory fee should be set by the CPO *and approved by a regulatory authority,* while another underlined that, while the price charged by the CPO should be non-discriminatory, the price to the customer should be determined by the EMSP.

Other respondents expanded on the **reason for their chosen response**. One, which supported EMSPs being allowed to offer their services at a non-discriminatory price set by the CPO noted that interoperability between EMSPs and CPOs was important and that this could be delivered either by peer-to-peer connections where the respective actors concluded bilateral deals, or through the creation of an e-roaming platform that enabled a technical connection between different CPOs.

In relation to **free charging**, one respondent suggested that it should be possible to offer this under certain circumstances. On the other hand, a different respondent called for free charging to be banned as it was against basic economics. Two similar responses called for EMSPs to be subject to the same regime as other alternative fuels providers.

Finally, three responses challenged the **premise of the question**. One called for CPOs to be able to decide which EMSPs should be able to use their networks, as the market was still evolving and EMSPs were still unregulated, although the response did note that anti-monopoly measures and oversight authorities could play a useful role with respect to the behaviour of CPOs towards EMSPs. Another response suggested that if obligations were placed on CPOs to provide access to EMSPs, then some minimum requirements should also be placed on EMSPs. Finally, another response argued that this should not be regulated at the EU level, but at the Member State level, where the decision should be between a DSO-based model, where a service provider sells the electricity, or a liberalised model where the service provider should not sell the electricity.

The one response from a representative of a ***consumer organisation*** suggested that all EMSPs should be allowed to offer their services at any charging point *for a maximum fee set by the legislator*, while the single response from a representative of an ***NGO*** suggested that market access for new e-mobility services should be required to support and build on the public transport networks in cities. One of the two responses from representatives of ***public authorities*** suggested that all EMSPs should be allowed to offer their services at any charging point for a fee set by the owner of the infrastructure, while underlining that the scope of the services that could be offered would have to be specified. The other response underlined that EU intervention should enable interoperability and ensure transparent information.

11.7.5.2.26 D26. In your view, which policy measures listed below are essential to ensure that the efficient integration of electro mobility into the electricity system is possible and fully aligned with the electricity markets rules? (multiple answers possible)

Stakeholders were asked which of the listed policy measures are essential to ensure that the efficient integration on electro mobility into the electricity system is possible and fully assigned with the electricity markets rules. The policy measures are listed in the key of Figure 6-30 and multiple answered were possible. The highest selected option was that there should be '*mandatory interoperability requirements for the communication between the electric vehicle and the recharging point to enable smart charging'*. This option was selected by 117 out of the 217 stakeholders who provided an answer. It was also the highest selected option by all stakeholder groups. The following options had a similarly low level of votes:

- Mandatory requirements for all publicly accessible recharging points (existing and new to be equipped with smart metering systems (63);

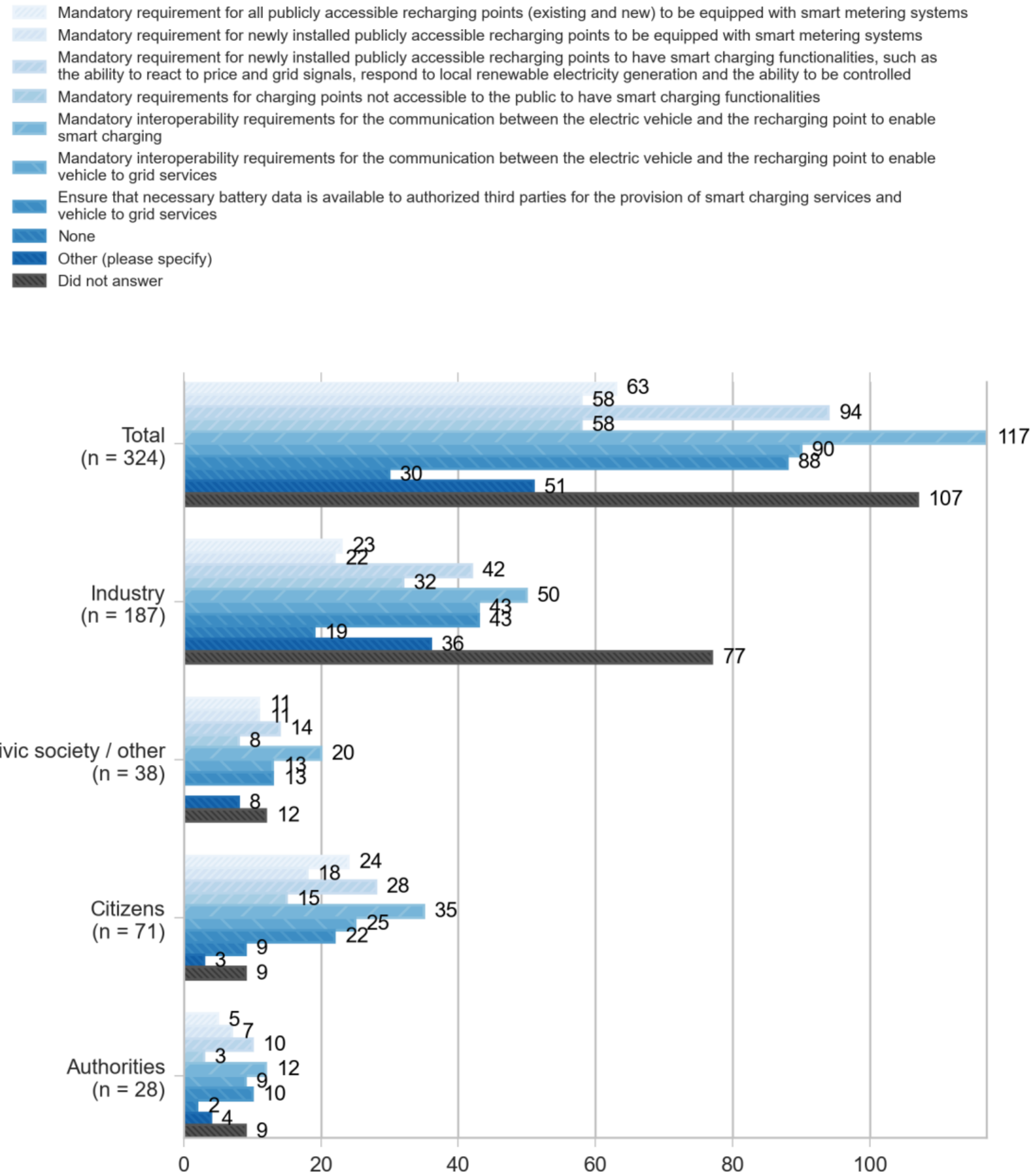
- Mandatory requirements for newly installed publicly accessible recharging points to be equipped with smart metering systems (58); and
- Mandatory requirements for charging points not accessible to the public to have smart charging functionalities (58).

However, the following options had similarly high number of votes:

- Mandatory requirement for newly installed publicly accessible recharging points to have smart charging functionalities, such as the ability to react to price and grid signals, respond to local renewable electricity generation and the ability to be controlled (94);
- Mandatory interoperability requirements for the communication between electric vehicle and the recharging point to enable vehicle to grid services (90); and
- Ensure that necessary battery data is available to authorised third parties for the provision of smart charging services and vehicle to grid services (88).

The least selected option was that there should be no policy measures with only 30 votes overall and gathering 0 votes in civic society. Industry specified other options the most with 36 out of the 51 selections for other. 107 out of 324 stakeholders did not provide an answer.

Figure 6-30: D26. In your view, which policy measures listed below are essential to ensure that the efficient integration of electro mobility into the electricity system is possible and fully aligned with the electricity markets rules? (multiple answers possible)



There were 46 additional responses to this question, of which 14 responses came from representatives of ***business associations*** and 19 from representatives of ***companies and business organisations***.

A similar response from four business associations and two representatives of a company / business organisation suggested that **meters compliant with the Measuring Instrument Directive should be the reference across the EU** to avoid different national technical requirements. Two of these respondents underlined that their members were working to ensure that their charging stations were capable of smart charging, although four suggested that, rather than mandate smart charging, it would be important to let the market decide what was needed. In addition, two underlined that it was therefore important to ensure that the market conditions were right, although one underlined that operators needed fair access to battery data. Two of these also underlined that ensuring the best integration of electromobility required intensive cooperation between all stakeholders (manufacturers, operators of charging stations and distribution network operators) accompanied by a corresponding exchange of data, while one suggested that charging should be seen as providing a 'behind-the-meter' service. One also suggested that ISO 15118 was an option for a communication standard, although noted that its implementation needed to be undertaken with preconditions to ensure that there was non-discriminatory and fair cooperation between all relevant actors. Two suggested that the processes of DSOs needed to be changed to speed up the deployment of charging points and proposed that a maximum waiting period be defined and mandated between requesting a permit and connection to the grid. Finally, one underlined that link between the AFID and the Electricity Market Design Directive in this respect. A separate response that covered similar issues also suggested the smart meters were not necessary, as meters compliant with the Measuring Instrument Directive would be sufficient. While arguing that none of the requirements listed in the question should be applicable at the level of the individual charging point, this response did propose that it should be mandatory to accept bidirectional flows of electricity and that mandating charging only with renewable electricity might be considered.

Other respondents were also **cautious about mandating smart charging**. One suggested that the best way to encourage investment in charging infrastructure was to lower the cost of installation and operation, whereas legislation requiring smart charging would increase costs, while another noted that, while smart charging could be useful, it was important not to overregulate. A different response suggested that, as smart meters were required for energy sales, they did not need to be mandated through the AFID, while another called for smart meters to be made available at supply points (as already required by EU legislation), not at recharging points. Another response noted that, rather than mandating smart charging, protections should be in place to enable consumers and businesses to manage the integration of electromobility into the electricity system.

More **generally**, a response underlined that a lot of standardisation work still needed to be undertaken, while also noting that the regulatory framework did not currently encourage the integration of renewable energy and local energy storage. Another response called for local grid operators and electricity market regulators to develop rules for the non-discriminatory access to network infrastructure, including minimum technical requirements, for smart charging services, while also calling for the resale of locally produced or stored energy via a charging point to be enabled by the regulatory framework. A different response underlined that it was important to unlock the potential of smart charging by making energy and grid costs more variable.

Other responses mentioned **access to data**. One noted that once the 'necessary battery data' had been defined and agreed upon, these could be made available to third parties to offer smart charging services. They also argued that mandating a technical solution other than CHAdeMO for V2G charging, which was the only protocol with any market experience or products, would disadvantage the existing technology and so called on the EU not to do this, while they also disagreed with imposing a specific protocol that mandated a particular means of communication. Another response noted that access to vehicle data was critical to making smart charging and V2G charging a reality, and so called for an open data system, without proprietary vehicle data. They also noted that an assessment of the electricity system and grid connection should be made before deciding whether or not to install smart charging, while also calling for all charging points to have adaptable communication protocols and standards. A different response also underlined that access to in-vehicle and battery data was crucial, along with dynamic pricing, to support smart charging and V2G services, which were fundamental to the integration of electromobility into the electricity system. Hence, they called for smart metering functionality to be ensured in new recharging points where service flexibility would be beneficial.

Some responses noted where **smart charging functionalities would be particularly important**. One suggested that smart charging functionalities would be important in buildings, but not for publicly accessible charging points, other than those that might be used for charging overnight near homes. Another response called on the Commission to mandate smart charging requirements in publicly accessible slow charging points in residential locations and in the outskirts of cities, and also suggested that all private infrastructure should also enable smart charging. A different response noted that by smart charging functionalities they meant a charger that operated in Mode 3 (according to IEC 61851-1) and which could be remotely controlled, and suggested that these should be mandatory on low power chargers in urban areas at least. The fact that 90% of charging takes place at home or at the office was underlined in another response, which called for a minimum level of smart charging functionality in private recharging infrastructure.

Some responses proposed specific **additional policy measures**, other than those listed in the question. One respondent suggested that a measure should be to 'define a European open standard to send emergency signals and grid conditions', in order to allow for emergency conditions to be addressed and for action to be taken to ensure grid stability. Another response suggested that there should be an obligation to make infrastructure information accessible to all users via a public database.

A couple of similar responses noted that the **integration of electromobility into the electricity system was a complex issue**, while noting that smart functions, and the link with energy systems, was crucial, although it required further analysis to ensure that legislation would not require the installation of technical equipment that would later prove not to be sufficiently effective. Two other similar responses noted that market access was a complex issue that could not be covered by a single piece of legislation, and then made reference to the ACEA position paper for their response to this question (see Section 1.4). More generally, two similar responses underlined that a transition period was needed for equipping existing charging points with smart metering functionality, with one of these also noting that the potential duration of parking and the charging process were better criteria than accessibility in determining whether smart charging functionality should be included. Another response noted that a key aspect of the integration of electromobility into the electricity system was that the latter needed to be able to cope with the additional demand with acceptable investment costs, while still being able to cope with specific events, e.g. particularly cold periods where demand increases. For this to happen, they called for there to be full transparency given to the market on forecastable constraints, investment and on developments in connection tariffs, while electricity grid tariffs should be reviewed to best reflect the costs incurred by the additional, marginal use of the electricity grid.

From the perspective of **car rental companies**, it was suggested that smart charging was not essential at this stage, although it was acknowledged that it could offer some benefits. Another response underlined that electromobility should be evaluated using a life cycle approach, including taking into account the costs of increased investment in distribution and storage, which were higher than for other alternative fuels.

One of the two responses from representatives of ***consumer organisations*** called for battery-related data to be accessible to third party service providers to allow smart charging systems. The other response called for it to be mandatory for publicly accessible charging points subsidised by public money to be equipped with smart meters, although noted that exceptions could be made for charging points not supported by public money. In addition, they called for there to be no mandatory requirement for consumers to install smart meters and for consumers to have a free choice as to whether they wanted their vehicle to communicate with charging points or for third parties to have access to their battery data. The one response from a representative of an ***environmental organisation*** called for the priority to be that public chargers enabled cars to recharge as quickly as possible, so smart charging was only relevant for private chargers. The three responses from representatives of ***NGOs*** called for the enabling of V2G solutions to be a priority, for information on infrastructure to be made available to users via public databases and for smart metering to be mandatory in all charging stations.

The three responses from ***EU citizens*** noted that there should be a distinction between the requirements on fast charging points and slower, every day charging points, and that the focus should be on the provision of incentives for V2G and vehicle-to-house solutions.

One of the three responses from representatives of ***public authorities*** noted that it should be possible for owners, or for those responsible for balancing the grid, to be able to intervene in charging in some situations, while another called for national legislation to be changed to allow for V2G services. The third response, while noting that the options in the question all had their merits, cautioned that adding too many requirements risked adversely affecting the affordability, and thus the scalability, of applying these, particularly in relation to smart meters, which, while nice to have, should not yet be regulated.

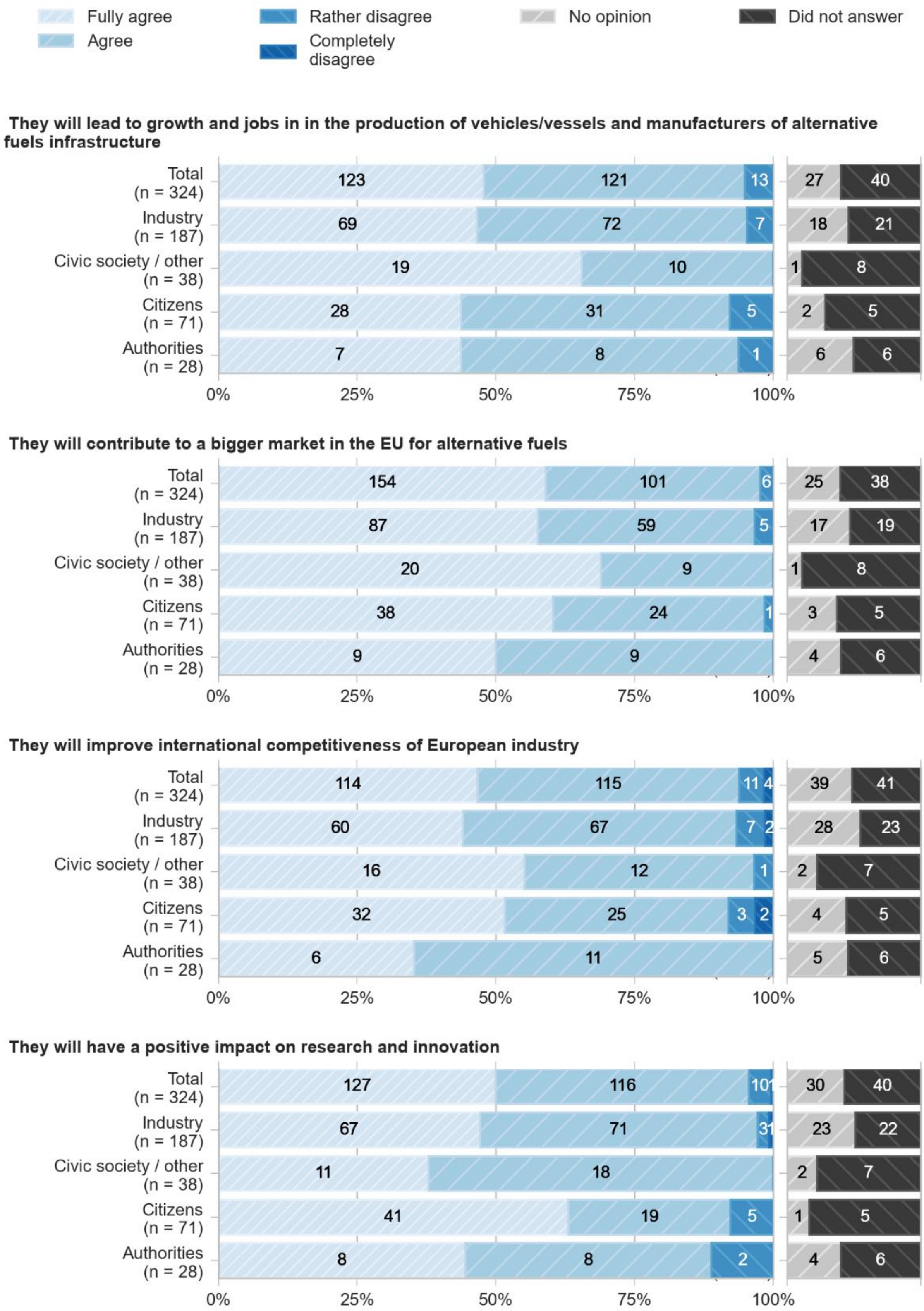
The one response from an organisation that was classified as ***'Other'***, while noting that it was important to investigate the potential of developing smart charging functionalities, suggested that smart charging requirements should not be mandated. Instead, they argued that it was important to create the right electricity market conditions and to incentivise smart charging as soon as interoperable smart charging standards were finalised.

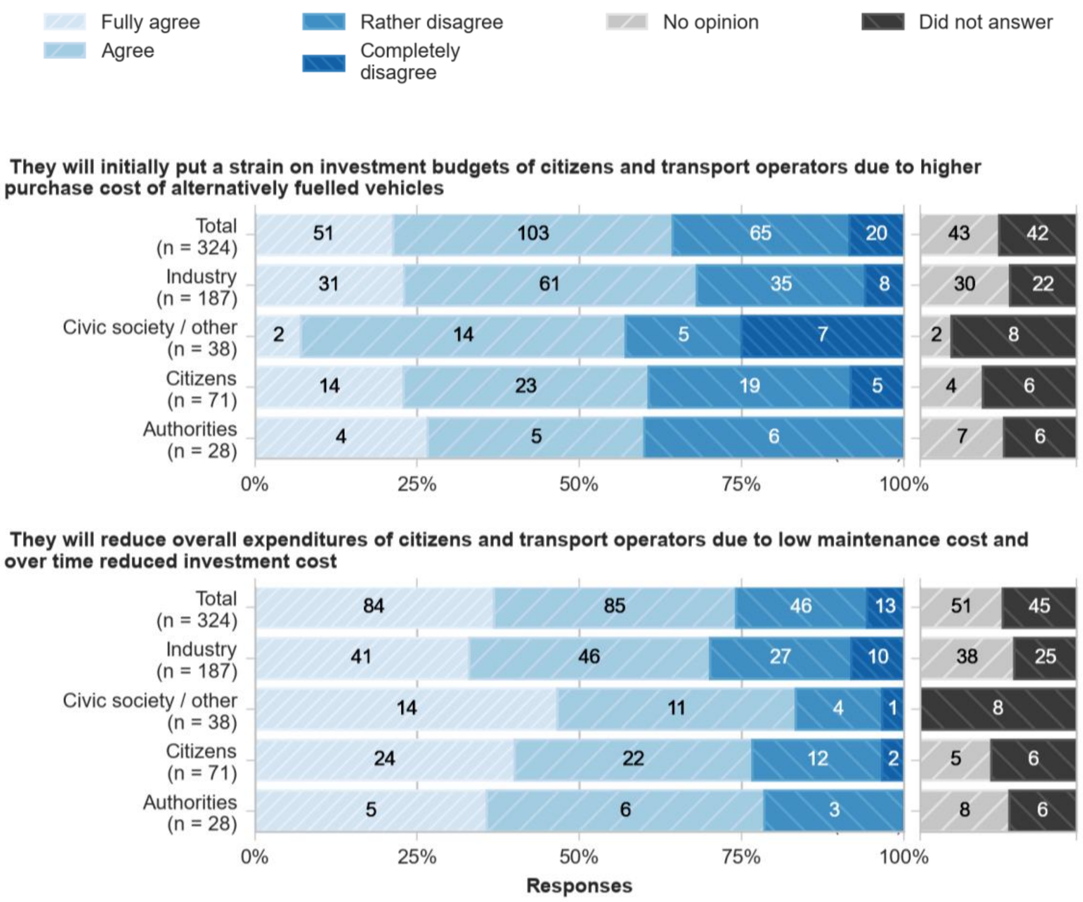
11.7.5.2.27 D27. To what extent do you agree with the following statements on the likely economic impacts of measures outlined in the Inception Impact Assessment?

Stakeholders were asked to what extent they agree with a range of statements on the likely economic impacts of measures outlined in the Inception Impact Assessment (see Figure 6-31). In all cases, the majority of respondents either fully agreed or agreed. Those measures with the highest level of agreement were as follows:

- They will contribute to a bigger market in the EU for alternative fuels (255 out of 286);
- They will lead to growth and jobs in the production of vehicles/vessels and manufacturers of alternative fuels infrastructure (244 out of 284);
- They will have a positive impact on research and innovation (243 out of 284); and
- They will improve international competitiveness of European industry (229 out of 283).

Figure 6-31: D27. To what extent do you agree with the following statements on the likely economic impacts of measures outlined in the Inception Impact Assessment?

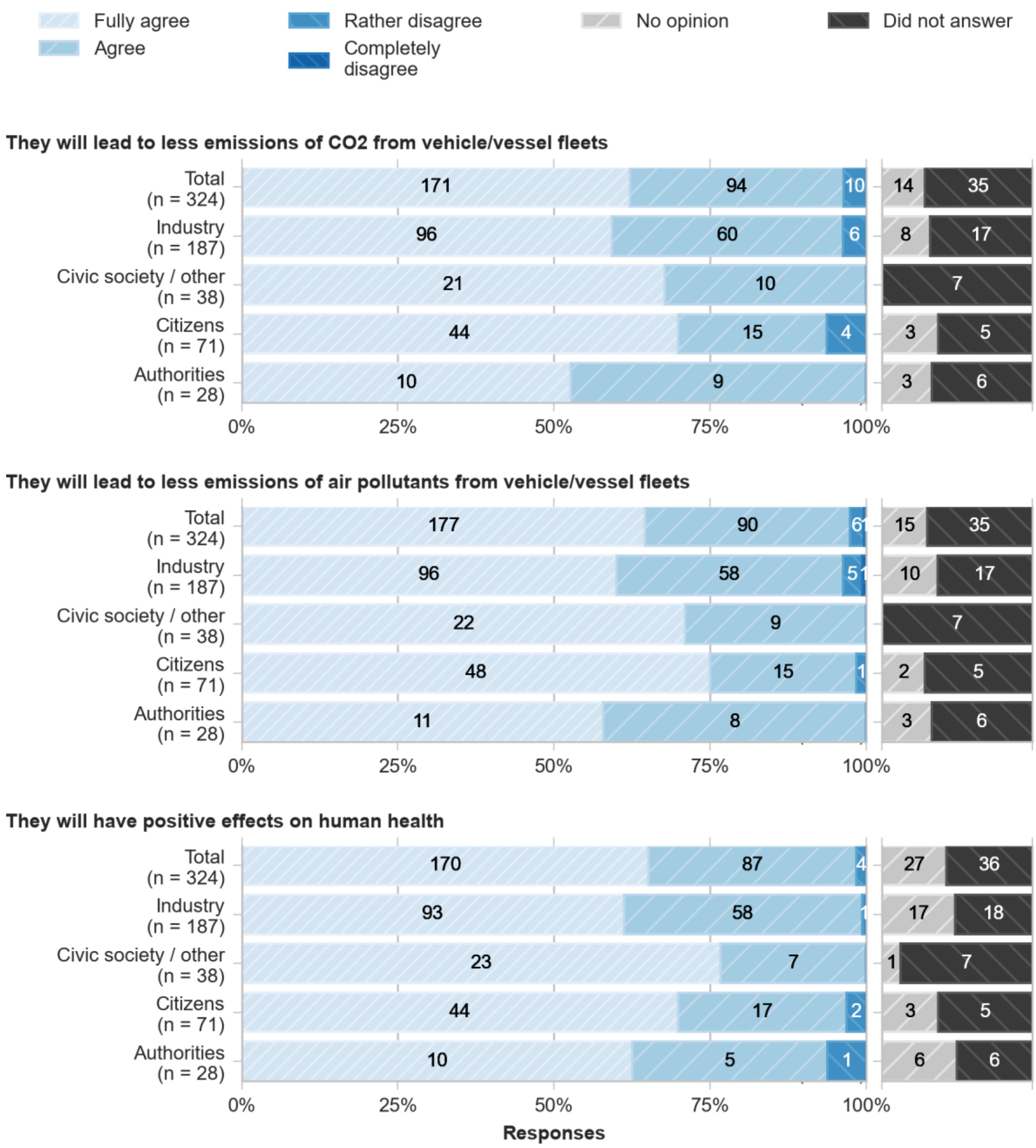




11.7.5.2.28 D28. To what extent do you agree to the following statements on environmental impacts of measures outlined in the Inception Impact Assessment?

Stakeholders were asked to what extent they agreed with the statements listed in Figure 6-32 on environmental impacts of measures outlined in the Inception Impact Assessment. All stakeholder groupings voted overwhelmingly in agreement on the impact of the Inception Impact Assessment measures on each of the three environmental impacts shown in the graphs. 265 out 275 stakeholders agreed that the measures would lead to less emissions of CO_2 from vehicle/vessel fleets. Only 6 stakeholders from industry and 4 from citizens voted 'rather disagree'. 267 out of 274 stakeholders agreed that the measures would lead to less emissions of air pollutants from vehicle/vessel fleets. Only 7 votes disagreed, 1 from citizens and 6 from industry which also contained 1 'completely disagree'. 257 out of 261 stakeholders agreed that the measures would have positive effects on human health with the 4 negative votes spread between industry, citizens and authorities.

Figure 6-32: D28. To what extent do you agree to the following statements on environmental impacts of measures outlined in the Inception Impact Assessment?

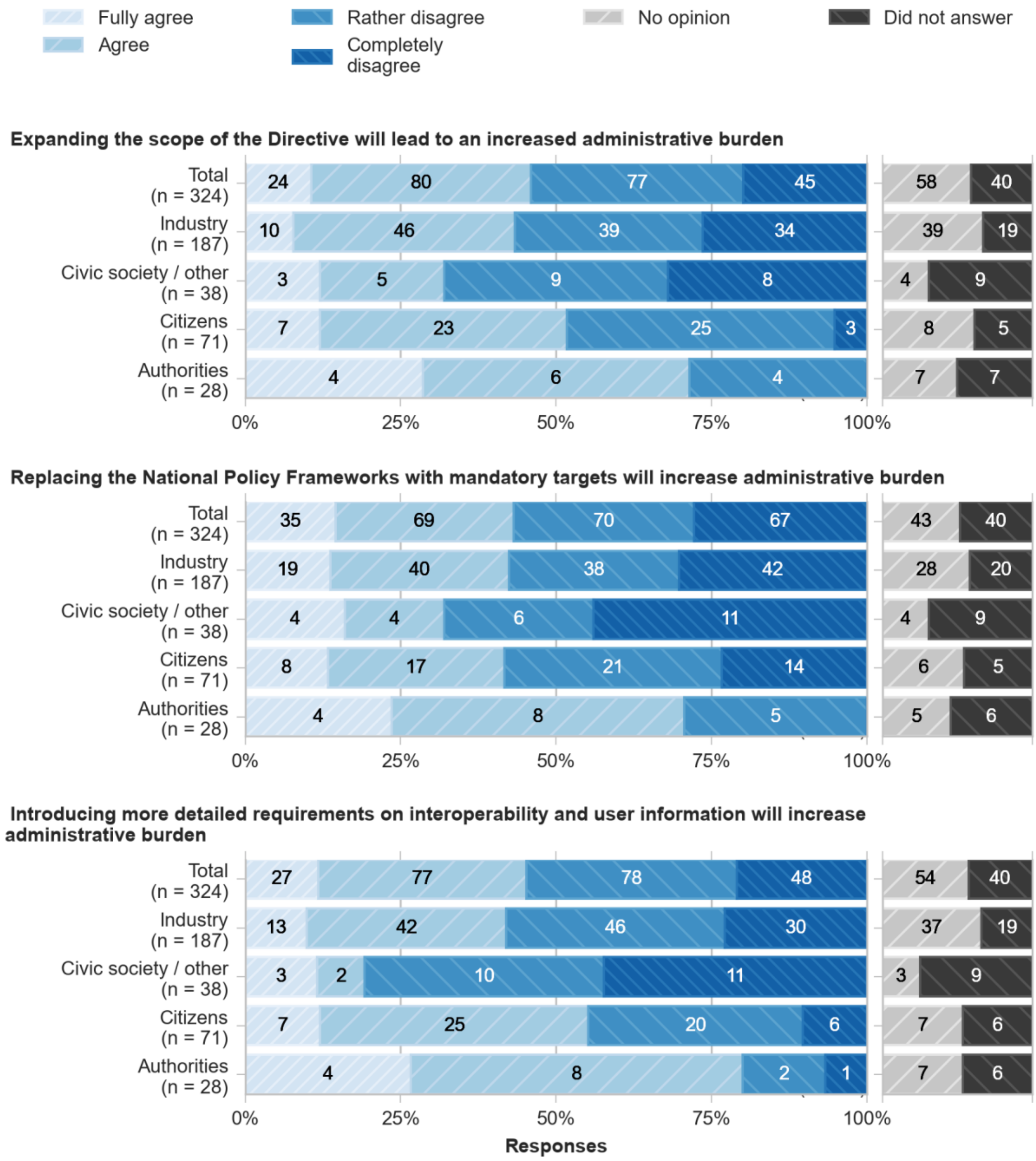


11.7.5.2.29 D29. To what extent do you agree to the following statements on administrative burden and simplification?

Stakeholders were asked to what extent they agreed with the statements listed in Figure 6-33 on administrative burden and simplification. Votes were relatively evenly split positively and negatively for expanding the scope of the Directive will lead to an increased administrative burden, where 104 stakeholders agreed and 122 disagreed. Industry and civic society had more votes indicating disagreement with 73 disagreements compared to 56 agreements for industry and 17 disagreements compared to 8 agreements for civic society. Citizens only slightly favoured agreement with 30 votes compared to 28 whilst 10 authorities agreed compared to only 4 disagreeing.

This stakeholder orientation was the same throughout the next two statements except citizens also disagreed more than they agreed that replacing the National Policy Frameworks with mandatory targets will increase administrative burden. Civic society and authorities were more polarised for the last statement that introducing more detailed requirements on interoperability and user information will increase administrative burden. Civic society voted 22 out of 25 times in disagreement whilst authorities contrarily voted 12 out of 15 times in agreement.

Figure 6-33: D29. To what extent do you agree to the following statements on administrative burden and simplification?



11.7.5.2.30 D30: Do you have any comment on other potential impacts (not mentioned above) of the possible policy measures?

There were 93 responses to this question, of which 31 were from representatives of ***business associations*** and 47 from representatives of ***companies and business organisations***. These responses covered similar issues, and also included many similar responses, so they are analysed together.

By far the most common issue that was raised was the importance of **using all alternative fuels that had the potential to reduce GHG emissions** to increase the environmental impact of the Directive. A number of similar responses underlined the importance of **biomethane** in supporting the decarbonisation of transport. Seventeen similar responses underlined that the uptake of renewable fuels such as biomethane would support the integration of gas and electricity, which would support power-to-gas facilities and exploit the storage capacity of the gas grid. In addition, eight of these underlined the benefits for agriculture of using agricultural wastes as a transport fuel, two highlighted the potential importance of biomethane for different modes of transport, three noted that this would help to improve the EU's energy self-sufficiency, while two also called for the use of life cycle assessment in EU policies. A different response called for the Directive to make the most of the opportunities offered by LNG, CNG and biomethane to reduce transport's CO_2 emissions, while also calling for the scope of the Directive not to be expanded and for there to be no additional requirements on Member States, in order to limit the administrative burden. A similar point was made in another response, which called for all options that could contribute to the decarbonisation of transport, including bioLNG and bioCNG, to be treated equally in all relevant EU policies, while another also highlighted the potential benefits of using the storage capacity of the gas grid.

Other responses made **more general points** about the importance of considering all alternative fuels to decarbonise transport. One underlined that an increased focus on alternatively-fuelled vehicles and green energy would help to improve the EU's security of energy supply, as demand could be met by local production, including wind, solar and biomethane, while two similar responses called on the Directive to promote all alternative fuels that could contribute to decarbonising transport irrespective of their infrastructure needs. A separate response underlined that there was a need for technology neutral incentives to support the market development of alternative fuels and for fuels to be supported if they had a positive impact after having considered their life cycle emissions, while another called for all alternative fuels to be taken account of, including synthetic fuels, that could be used in current refuelling infrastructure. The importance of taking account of the technological maturity of different fuels was underlined in another response, noting that the development of gas technologies would enhance the lead of European industry in this area, while another called for the incentivisation of all alternative drives and fuels for all modes of transport, supported by funding and an appropriate taxation and policy framework.

In relation to **buses**, it was highlighted that all the alternative fuels currently covered by the Directive should continue to be promoted, including gas-to-liquid, as it would not be possible to completely switch to electric buses in the next decade, while another noted that the impacts would only be delivered if public transport was included in the scope of the Directive and if emissions were evaluated from the lifecycle perspective. A different response noted that the current flexibility in relation to the roll out of fuels in the **maritime sector** should be retained, while another suggested that standards for alternative fuels for maritime transport, including OPS, should be set at the international level.

A number of responses focused on **electromobility**. Two similar responses suggested that investments in the electrification of transport needed to be aligned with the expansion and digitalisation of the grid, while also suggesting that the electrification of ships, especially ferries, should be addressed in the AFID. Three other responses believed that the Directive would have a greater impact if it applied to charging that took place at home or at work, and if the current fragmentation caused by the NPFs was addressed, while another called for plug-in facilities to be installed to supply power to parked trucks and their trailers for their refrigeration units. A different response expressed a concern that if "ensuring interoperability" meant mandating a specific communication protocol within electromobility that this would negatively affect the half a million vehicles already on the road and existing fast-charging points, which could undermine the trust of consumers and investors. Another response noted that the impacts of electromobility would be enhanced if it was widely integrated into the energy system, which was smartly managed, while the importance of reinforcing electricity distribution grids was highlighted by another response.

One response underlined that the benefits of electric vehicles would be optimised, if they were integrated with the development of 'mobility as a service' solutions that involved **public transport**, while another underlined that the move to electromobility should be part of a wider rethinking of transport to include a greater consideration of other modes of transport, while also noting that the recycling of vehicles needed to be considered. In relation to jobs, one response noted that while the transition would lead to a reduction in manufacturing jobs, this would be made up for by an increase in other jobs in the electromobility sector. On the other hand, one response underlined that electromobility was not CO_2-emission free, while another suggested that using renewable electricity for recharging should be mandated.

A few responses focused on **hydrogen**. Three similar responses underlined that fostering the uptake of hydrogen in the EU would help the EU take a global lead in the development of hydrogen as a fuel. Another response noted that there would also be a positive impact on the EU's energy independence by maintaining a leading position on hydrogen, which also noted that electromobility should be evaluated on a lifecycle basis.

A number of responses focused on **infrastructure for a particular mode**. One response underlined that the **deployment of ERS** in the EU would help to reduce costs for hauliers and logistics operators. Another response called for more focus on alternative fuels for **buses and coaches**, including support for pilot projects for market-ready technologies, such as a hydrogen-powered long-distance buses, and for incentives to encourage investment to support the uptake of clean technologies.

A number of responses mentioned that there might be an initial increase in **administrative burden**, although most of these considered that this would be outweighed by subsequent benefits. Two similar responses suggested that, while the proposed changes may increase administrative burden, this would be compensated for by economies of scale and digitalisation. A different response implied that the increase in administrative burden would be acceptable given the increased effectiveness and impact of a revised Directive, while another also suggested that the benefits would outweigh any potential increase in administrative burden. Two similar responses considered that, while the initial burden might be higher, this would decrease once the targets were in place, while another felt that although removing fuels that were "no longer relevant" would increase administrative burden in the short-term, it would have long-term benefits. One response suggested that more requirements relating to interoperability and user information had the potential to decrease the administrative burden from having to deal with diverging national systems.

Other responses made more **general points**. One implied that the impact of the Directive would be improved if there was a functioning single market for electromobility, more accurate information on the available infrastructure and if taxation frameworks facilitated and incentivised the uptake of carbon-free alternative fuels. Another noted that common criteria would support investment, as they would provide certainty, which would increase the impact of the Directive. A different response noted that the proposed changes would lead to a more cohesive and functioning single market for electromobility, while another underlined the importance of maximising the potential benefits of digitalisation. The potential of the proposed actions to improve the public's acceptance and perception of alternative fuels was mentioned in another response.

Three similar responses called for the analysis of the necessary infrastructure and the scale of this that was needed **on the TEN-T network**, including by when it should be deployed.

On the other hand, some responses **cautioned against too many measures**. Two similar responses noted that, while some measures brought potential benefits for consumers, these incurred costs and so risked slowing down deployment, while another suggested that EU level binding targets would disrupt national markets. A different response noted that, while unified targets and regulations were beneficial, it was important not to discourage investors, while another underlined that it was important to have the right level of regulation.

One of the two responses from representatives of ***consumer organisations*** noted that additional environmental benefits would be delivered by introducing sharing systems for truck batteries on highways and also by replacing the diesel units of refrigerated trucks with electric units that could be operated by plugging the vehicle in to roadside units when parked. The other response noted that the impacts stated would only be achieved if electric charging and hydrogen for HDVs were covered; if the AFID covered a broader range of fuels, such as gas and oil-based fuels that the respondent considered not to be sustainable, the stated impacts would not be delivered.

Two of the four responses from representatives of ***NGOs*** suggested that the impacts would be delivered if all fuels were considered in a consistent way using life cycle assessment. A different response suggested that the impacts would only be delivered if the revised AFID included public transport in its mandatory scope, while another suggested that optimal grid planning, smart metering and variable pricing by time would substantially reduce the costs of integrating electric vehicles into the electricity system.

The four responses from ***EU citizens*** and the single response from a ***non-EU citizen*** suggested that other renewable fuels should be considered alongside electrification, called for incentives rather than regulation, suggested that the digitalisation of transport would reduce costs and warned against relying on 'grey' hydrogen in the transport sector.

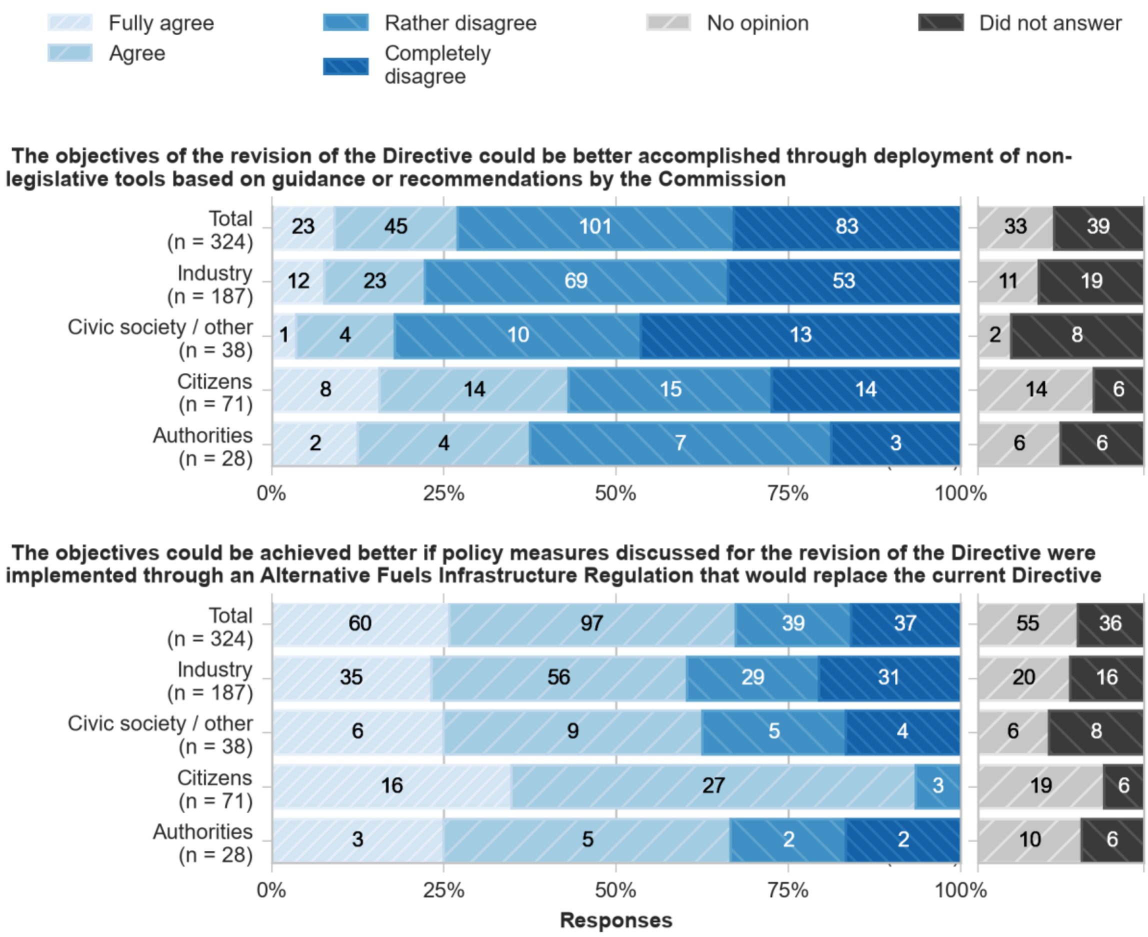
One of the two responses from representatives of ***public authorities*** suggested that the benefit of the Directive exceeded its administrative burden, while the other suggested that the impact of the Directive would increase if there was sufficient coordination with other EU policies that focused on alternative transport fuels.

11.7.5.3 SECTION E: Relevance of other action at European level

11.7.5.3.1 E31. To what extent do you agree with following statements?

Stakeholders were asked to what extent they agreed with the two statements outlined in Figure 6-34. 184 out of 252 stakeholders, throughout all groupings, disagreed with the first statement that the objectives of the revision of the Directive could be better accomplished through deployment of non-legislative tools based on guidance or recommendations by the Commission. This was particularly compounded in the industry and civic society stakeholder groups with 122 out of 157 and 23 out of 28 stakeholders voting in disagreement respectively. Stakeholders were much more in favour of the second statement gathering a majority of agreements with 157 out of 233 stakeholders voting positively. Citizens were particularly in favour with only 3 stakeholders disagreeing. There was also a higher amount of 'no opinions' for the second statement, 55, in comparison to the first statement, 33.

Figure 6-34: E31. To what extent do you agree with following statements?



There were 121 additional responses to this question, of which 43 came from representatives of ***business associations*** and 51 responses from representatives of ***companies and business organisations***. These are covered together, as they addressed similar issues and contained a number of similar responses. Responses included further justification for the selection of either response – i.e. that there should be more non-legislative tools or that the Directive should become a Regulation – as well as further explanation as to why the AFID should remain a Directive.

Those respondents that provided an additional explanation for the **support of non-legislative tools** generally saw these as complementary to a legislative approach. Five similar responses, all of which supported the Directive becoming a Regulation, noted that non-legislative tools were the best option in relation to setting standards, as did two other responses. On the other hand, one respondent called for more non-legislative tools, as these were better able to support Member States at different levels of infrastructure deployment, while another noted that non-legislative instruments were better able to react to market developments. A different respondent noted that non-legislative tools provided more room for interpretation, while another called for more guidance for the NPFs on the development of common policies.

The main reasons for respondents wanting the **AFID to become a Regulation** were the importance of a more standardised and consistent approach to the deployment of the necessary infrastructure between Member States and the need for faster deployment. Eight similar responses – five from business associations and three from a representative of a company / business organisation – suggested that, as the Directive had failed to deliver adequate recharging infrastructure for electric vehicles, a Regulation was required; a similar argument was put forward by a different respondent. Three other similar responses called for a Regulation to deliver an accelerated rollout of harmonised infrastructure to ensure that the necessary electric vehicle recharging infrastructure was deployed for all types of vehicle. Two other similar responses called for Regulation that should also ensure that recharging infrastructure for HDVs should be deployed.

A respondent suggested that a Regulation would ensure a less inconsistent implementation across the Member States and so contribute to creating a harmonised electromobility market, while another made a similar point that a Regulation would be a more effective and easier way of delivering a single market for electric vehicle recharging. A different response noted that a Regulation was needed to ensure that the varying Member State approaches were more in line with the deployment of electric vehicles, while another that a Regulation could lead to a more consistent deployment of infrastructure. Two similar responses suggested that a Regulation would provide more planning and operational security for international companies that use low and zero emission vehicles, while another noted that a Regulation could promote a more consistent and unified approach and be quicker to implement, which would be more consistent with the urgency of the situation.

Other responses called for a Regulation in order to guarantee deployment, to ensure better compliance by Member States and to ensure that infrastructure, particularly ERS, was not deployed in a fragmented manner. A different response called for an ambitious AFID to focus on the installation of publicly accessible recharging infrastructure by setting obligatory targets for Member States, supported by a "European control centre" to plan, implement and review milestones, which could be facilitated by the Directive becoming a Regulation. Other responses suggested that a Regulation: would ensure that action was taken in the necessary timescales; could better ensure the delivery of the desired objectives; would provide more certainty for companies operating across borders; could bring benefits if designed appropriately; would ensure the binding specifications that were needed; and would deliver the stronger policy framework that was needed. In addition, support for turning the AFID into a Regulation was provided so as to ensure: a common EU regulatory framework; a more consistent implementation of electric vehicle recharging infrastructure across the Member States; and as a result of the binding and enforceable nature of the legislation.

The most common rationale that was put forward by those who wanted the **AFID to remain a Directive** was that a Directive provided more flexibility to Member States, while a Regulation could be too prescriptive in imposing a 'one-size-fits-all' approach on all Member State markets. Three similar response called for flexibility at the national level to enable each Member State to develop the best alternative fuel options for their specific national context, while also underling that a Directive was the best way of ensuring the coordination needed between Member States to provide the necessary infrastructure for long-distance transport. A similar response from three business associations and three representatives of a company / business organisation noted that targets at the EU level were often powerful, whereas under the current Directive not all Member States had installed CNG and LNG filling stations. Hence, these respondents called for a revised Directive with binding targets to be implemented in national legislation. Two other responses felt that the Directive as it stood was sufficiently balanced in relation to targets and methodology, so that it should not be replaced by a Regulation as it was important for Member States to be able to take account of their national context. Three other similar responses underlined the importance of the revised Directive being made consistent with other EU policies in order to promote the development of fuels that are already available and cost-effective, such as LPG and bioLPG.

A different response called for the AFID to remain a Directive to provide Member States with the flexibility to deploy alternative fuels in an optimal manner, taking account of local specificities, while another called for the detailed legislation to be undertaken at the national level so that this was able to reflect the respective national market conditions and a third noted that the NPFs were the appropriate instrument, as these enabled Member States to set their own targets. Two similar responses suggested that a Regulation could be too prescriptive, while another cautioned against a detailed and centralised organisation of the market and a third called for legislation not to limit the scope of action for Member States. The importance of Member States having flexibility to implement solutions that were relevant to local circumstances was suggested by another respondent as a reason for retaining a Directive, while another suggested that the Directive worked as it was and suggested that the imposition of minimum requirements would deprive Member States of the necessary flexibility. A different response noted that a Regulation would introduce more prescriptive requirements on certain alternative fuels, which should be avoided, while another two responses noted that the current approach was the most appropriate as it enabled Member States to develop approaches that were more relevant to them.

Other responses suggested that imposing mandatory requirements may adversely affect the existing economic inequalities between Member States, that a Directive allows Member States more flexibility to legislate in accordance with the characteristics of their own market and that mandated solutions imposed a 'one-size-fits-all' approach that was not necessarily appropriate. Another respondent noted that the Directive enabled Member States to set their own dynamic goals, which was sufficient. Three responses suggested that covering all **modes of transport** within a Regulation would be difficult, so called for the AFID to remain a Directive that provided a framework that enabled a relevant approach to be taken in each Member State with respect to each transport mode.

Other responses called for **additional actions in the context of the Directive**. A similar response from three business associations and a representative of a company / business organisation noted that the shipping industry, and specifically the cruise sector, needed alternative fuels as quickly as possible and so called for more monitoring of the NPFs and underlined the importance of the interoperability of infrastructure for new fuels. Another response relating to maritime transport underlined that for European ports, a goal-based approach, with emission reduction standards and a technology neutral approach, accompanied by a port roadmap, was the best way of delivering the necessary reductions in emissions. Two other similar responses called for mandatory targets for Member States, supported by an EU master plan to support the deployment of recharging infrastructure. On the other hand, one respondent noted that the impact of the Directive had been significant, so underlined that this should continue, whereas another underlined that what was needed for buses was a greater involvement of bus operators in the development of national strategies and standards, supported by the corresponding financing.

Some respondents simply noted their **requirements for any revision**. One noted that any amendment to the AFID should not create unnecessary administrative burden, should help the market to grow, should ensure technology neutrality and be consistent with other relevant EU legislation. A different response suggested that the AFID was convoluted and lacked clarity, so called for more action to ensure the concept of an open market design and actions to ensure service quality for electric vehicle users, while another called for the EU and Member States to agree on goals, the delivery of which should be left to each Member State's market. A different respondent underlined that the revised Directive had to be clear and ambitious and ensure the harmonised and coherent deployment of infrastructure across the EU in order to support the deployment of electric vehicles, while another noted that the AFID should address the needs of HDVs and ensure consistency with other relevant EU legislation. Alternatively, one respondent called for a **separate Directive** to focus only on the deployment of recharging infrastructure for electric cars.

Other responses outlined the **potential benefits of different approaches**. One noted that while a Directive could deliver a minimum level of harmonisation and deployment (if implemented with more coordination and enthusiasm), a Regulation might be better suited to dealing with issues, such as pricing, pricing transparency and payments. Another response suggested that, while a Regulation could lead to less market fragmentation, a Directive would allow implementation to be undertaken in line with national circumstances. In relation to HDVs, a response suggested that while a Directive could deliver a minimum level of harmonisation and targets, the potential of a Regulation should be explored in order to ensure a faster deployment of infrastructure. Another response suggested that changing the Directive to a Regulation would only be relevant for long-distance transport, whereas for other transport, e.g. local and urban transport, the flexibility provided by the Directive was appropriate. While recognising that non-legislative tools would have limited direct effect, one respondent suggested that they could still be considered in some circumstances, while a Regulation might also be considered.

The one response from a representative of a ***consumer organisation*** noted that the Commission's own analysis of the NPFs suggested that the current non-binding approach had not worked, so called for a Regulation that provided a framework for each alternative fuel. The single response from a representative of an ***environmental organisation*** also called for the AFID to be turned into a Regulation to widen the regulatory framework and involve more actors to ensure a more harmonised approach to electric vehicle recharging.

Two of the 10 responses from representatives of ***NGOs*** were similar and called for the AFID to become a Zero Emission Infrastructure Regulation (ZEIR) to widen the regulatory framework and involve more actors, to create a single electric vehicle recharging market and to ensure a swift deployment of the necessary infrastructure. Another response called for a Regulation, as it would be more effective in ensuring seamless and reliable recharging in different counties, would better ensure that smart charging services were widely available and would more easily enable requirements and targets to be set on different market players. Other responses supported a Regulation as it would: be directly applicable in Member States; ensure better coordination and implementation; and enable binding targets to be set in every Member State. Another response noted that experience with other legislation had shown that regulation can be a good stimulus for market competition.

On the other hand, one respondent felt that whether AFID was a Directive or Regulation did not matter, as long as mandatory targets were set for Member States, which were monitored and adjusted when necessary to reflect market developments. From the perspective of bus infrastructure, it was suggested that, rather than more stringent regulation, what was needed was a stronger focus in the Directive and NPFs on public transport, accompanied by relevant standards and bringing together of stakeholders to share experience with best practice, business cases and deployment strategies. Another respondent supported the AFID remaining a Directive, as this provided Member States with an appropriate degree of freedom for the development of alternative fuels in each country.

Four of the six responses from ***EU citizens*** and the single ***non-EU citizen*** called for stronger requirements, with one suggesting that the Directive was too bland, another that mandatory regulation was needed to enforce implementation, a third that Member States would only advance at the required speed if there were relevant requirements to do so and a fourth for clearer rules and control mechanisms. Other respondents suggested that the AFID should ensure that sufficient recharging infrastructure was deployed, and that the Directive should cover ERS. The one response from an ***academic and those from research institutions*** underlined that stronger legislation was needed to ensure that the electromobility market developed in the most efficient manner in a short period of time.

While one of the five responses from representatives of ***public authorities*** called for a Regulation to ensure an adequate supply of infrastructure and to avoid the fragmentation of deployment, another response suggested that a separate Regulation could be developed alongside the AFID to complement it. Other responses: implied that the NPFs were sufficient, although underlined that negative images about electric vehicles needed to be addressed; suggested that the objectives of the revision of the Directive could be achieved by setting a framework that would standardise the approach to be taken, but which would allow Member States to take account of national circumstances; and noted that existing recharging infrastructure should be protected.

One of the two responses from organisations that were classified as ***'Other'*** suggested that only EU legislation was able to ensure that the deployment of alternative fuels was aligned with the EU's climate objectives, which should be achieved through the revision of the AFID, while suggesting that more specific measures, such as a specific Regulation, might be needed to ensure the rapid deployment of the necessary infrastructure for road transport. The other response called for action to support intelligent networking.

11.7.5.4 SECTION F: Final Remarks

11.7.5.4.1 F32: Other reports, sources of information supporting responses.

There were 105 responses to this question, of which 31 came from representatives of ***business associations*** and 45 from representatives of ***companies and business organisations***. Where these provided additional reports, or links to further information, these are covered in Section 1.4. On the other hand, a number of respondents provided additional comments, rather than additional information. These responses are covered in this section.

A number of additional comments focused on a **specific fuel**. One underlined the environmental benefits of **LPG** in different transport sectors and called for LPG to stay within the scope of the AFID as support for it, and other alternative fuels, was still needed, while also noting the potential of bioLPG using existing LPG infrastructure. Another response underlined the benefits of **high-octane** fuels in improving the performance of the existing vehicle fleet and noted that the revision of the AFID could be used to increase consumers' awareness of the existence and benefits of these fuels, while also highlighting the benefits of fuel ethers, including bio-ethers, in improving the performance of existing fuels. Another response called for **bioCNG** vehicles to be treated in the same way in the Directive as electric vehicles, as both were climate-compatible vehicles, noting that producing biomethane was the best way of recycling biowaste, including from agriculture.

Other responses made points in relation to the AFID and **biofuels**. One response suggested that the Directive, the consultation and the Sustainable Transport Forum continuing to overlook biofuels delayed the uptake of renewables in transport and slowed the sector's GHG reduction, while a similar point was made by another respondent who underlined the potential of ED95 for reducing emissions from heavy duty road transport. A third respondent highlighted the potential, and importance of continuing to consider, the potential of current and new biofuels in reducing transport's emissions.

Three similar responses pointed out that the operators of electricity distribution networks were working to integrate **electric vehicles** into their grids, while another called for the Directive to focus on electromobility rather than covering other fuels, such as hydrogen and CNG. Another respondent noted that the maturity of the electric vehicle market differed widely in different countries and so that in some countries it was more appropriate to let the market develop, rather than regulate deployment at the EU level. A comprehensive response called for the exclusion of fossil fuels from the Directive and for the focus to be on electrifying transport. They also called for: the enforcement of an open data protocol on vendors of electric vehicle supply equipment (EVSE); the enforcement of interoperability for CPOs by implementing an open data protocol; the enforcement of data sharing of EVSE on public domains; the clear mention of tariffs on charging point infrastructure; for EVSE infrastructure to be able to identify and authenticate users; for EVSE in the public domain to have a clear protocol on how to book EVSE; in cities, for EVSE to provide priority for shared electric vehicles; and for EVSE in the public domain to have V2G functionality. On the other hand, another respondent argued that electromobility should not be considered for HDVs, as a result of the battery size, weight and capacity that would be needed, and called for a life cycle evaluation of electromobility more generally.

In relation to **hydrogen**, one response noted that its production and use in transport was still in the early stages, and so called for an investigation of the different factors, such as how hydrogen will be produced and distributed, as this would have an impact on the tank systems to be used in vehicles.

Five similar responses – two from business associations and three from representatives of companies / business organisations – called for a **more equal representation of different alternative fuels in the AFID**. These noted that there were 19 out of 50 questions in the consultation that focused on electromobility, whereas none focused specifically on CNG or bioCNG, in spite of the fact that the JRC's research has shown that bioCNG has an equal or better environmental footprint than green electricity. As a result, they called for the AFID to take account of the decarbonisation potential of different fuels and ensure that the right infrastructure was put in place for different modes. Another response called for the Directive to follow the technology neutrality principle so that customers were able to choose the best technology available in the most cost-efficient manner.

Other responses focused on a particular **type of vehicle**. Eight similar response (four from business associations and four from representatives of a company / business organisation) expressed their disappointment that **powered two wheeled vehicles** had been left out of the scope of the consultation, even though they were covered in the Directive, and called on the Commission to consider the needs of these vehicles in the revision of the AFID. In addition, an apparently separate response also called on the Commission to give more consideration to the needs of L-category vehicles. Another respondent commented that, while the questionnaire claimed it would cover **all modes**, its focus was on road transport, so the questionnaire was not suitable to provide a full picture of the aspects that were relevant to make decisions on the use of alternative fuels in all modes of transport. Another response underlined that as **railway stations** were increasingly becoming multimodal hubs, they should receive priority attention for the deployment of alternative fuels infrastructure for road transport vehicles. Another respondent underlined that, with other legislation pushing bus operators to adopt alternative fuel vehicles, such as the HDV CO_2 standards and the CVD, it was important that there was sufficient recharging infrastructure for **buses** in place, and so called for more commitment from Member States to put the necessary recharging infrastructure in place, as well as more measures to promote the use of public transport as a means of decarbonising transport.

On the other hand, one respondent was more **cautious**, suggesting that any additional mandatory measures risked making the system more burdensome and putting in place bureaucratic barriers to the deployment of fuels.

Responses from ***EU citizens*** suggested that the survey was one-sided, as it focused on electric vehicles, while it did not meaningfully cover hydrogen, complained that L-category vehicles had been ignored and suggested that electric vehicles were a temporary solution before the wider adoption of hydrogen and renewable fuels.

11.7.6Analysis of ad hoc contributions

The documents that were submitted as part of the consultation, and the links that were provided in response to the previous question, are analysed in this section. The documents varied from contributions that were directly and fully relevant, such as direct responses to the consultation and position papers on the AFID or alternative fuels for transport, through more general policy papers (e.g. on the Green Deal or decarbonising transport, more generally) to more detailed papers that were of less relevance or which focused on a particular aspect of the subject, e.g. the carbon performance of a particular fuel. The focus of the analysis in this section is to cover in more detail the responses that are fully relevant, focus on the alternative fuels aspects of the more general policy papers, and provide a brief summary and link to the more detailed papers.

The order in which the documents are analysed follows a similar approach to that taken in response to other questions. Responses from industry are summarised first. These made up the majority of additional submissions – 42 of the 63 that were provided. These are grouped together by respondent type, e.g. starting with vehicle manufacturers, and then subject area, so responses focusing on a particular fuel or mode, although some of the responses from 'NGOs' and 'Others' were also covered in this section, as some of these were also effectively from industry associations. Responses from civic society (consumer organisations, environmental organisations and NGOs) public authorities and from citizens are covered at the end.

There were five submissions from vehicle manufacturers and their associations. ACEA, the **European Automobile Manufacturers' Association**, referred to their position paper on the AFID[91], which had already been directly referred to by different respondents when answering specific questions (see, for example, Questions 5 and 10 in Section 1.3.2). In addition, Dutch organisation RAI Vereniging also directly referenced ACEA's position paper in response to the previous question. The paper provided ACEA's perspective on the implementation of the Directive to date, followed by 10 recommendations for its review, in order to support the implementation of the Green Deal. Their first recommendation was the importance of the Commission **speeding up the adoption of the proposal to revise the AFID**, as the infrastructure needed to be in place as soon as possible so that manufacturers were able to meet their own regulatory targets for reducing CO_2 emissions from new vehicles. In this context, they called for infrastructure targets to be set at least from, for example, 2023, 2025 and 2028, in order that the infrastructure was in place before the relevant vehicles came on to the road. Such **targets should be mandatory for Member States** and set within a Regulation that also ensured that deployment was monitored and that the implementation in the Member States was properly enforced. The AFID should specify the maximum allowable distance between recharging stations – with relevant exceptions – while the NPFs should also cover soft measures, such as pragmatic approval procedures and incentives for vehicles and private infrastructure. In addition, it underlined that infrastructure for **all alternative fuels should be covered** in investment plans, respecting technology neutrality, so not neglecting lower carbon liquid fuels. They also called for the revised **Directive to cover all road transport vehicle segments**, in order to ensure that dense truck- and bus-specific (gas and hydrogen) refuelling and electric recharging networks were developed, in addition to those for passenger cars.

The paper's fifth recommendation was to **guarantee the 'right to plug'**. It noted that the EPBD had been a missed opportunity in this respect, as there needed to be more action from Member States and local authorities to improve and speed up the planning processes for installing recharging infrastructure, particularly for residential buildings, as well as to ensure that public infrastructure was reliable and properly maintained. Under a recommendation to **increase the number of charging points and refuelling**

[91] https://www.acea.be/uploads/publications/ACEA_Position_Paper-Review_of_Alternative_Fuels_Infrastructure_Directive.pdf

stations, the paper set out ACEA's estimates for infrastructure needs for passenger cars (electric charging points and hydrogen refuelling stations) and trucks (battery electric, hydrogen fuel cell and gas). In relation to charging points for cars, it noted the importance of there being a balanced share of AC and DC charging points, for all public parking spaces to be equipped with charging spots (where possible) and for a maximum distance between high power charging stations to be set. They also called for all public charging points to be linked to an EU-wide information portal to enable customers to access up-to-date information, for public charging points to facilitate charging for those not able to charge at home or at work and for clear definitions of 'public', 'semi-public' and 'private' charging points. For trucks, they called for semi-public chargers to be located in areas not accessible to the general public, but which could be used by different transport operators.

The importance of quick EU action, supported by national investment, was underlined by ACEA as being important in **creating an EU-wide infrastructure network** along the TEN-T and other primary and main roads. It was underlined that this network needed to allow for ad hoc payments and be mandatorily connected to a roaming platform, which ensured non-discriminatory access for all users. The paper also called for **improved data quality and monitoring at the EU level**, e.g. through the EAFO, with more relevant data collated and reported, along with clear guidelines to Member States. In addition, ACEA called for the **promotion of smart charging and flexible pricing**, as smart charging was important to allow for the successful integration of electromobility into the energy system, as it would enable the optimal management of charging and electric flows. Flexible pricing was considered to be a useful support measure that should also be covered by the revised Directive. Finally, they underlined the importance of **completing standardisation** for the remaining missing technical standards, including for high power electric recharging and electric bus recharging, as well as proposing new definitions for the classification of different charging points according to their power.

In its submission on the revision of the AFID, FEBIAC, **Belgian & Luxembourg Federation of Automobile & Two-wheeler Industry**, underlined that the development of the AFID was essential to deliver the Green Deal and that the Directive should be technology neutral and support all fuels, including electricity, gas, hydrogen and liquid fuels. FEBIAC called for **binding targets for Member States** for publicly accessible infrastructure, including the number and type of charging (including when these were slow, fast, or ultrafast) and fuel stations. Specifically, in relation to electric vehicle recharging, they called for a **right to plug**, the roll-out of high-speed charging infrastructure and the promotion of digital solutions and dynamic charging to support smart electricity grids and markets. They underlined the importance of other measures to support the use of alternative fuels in fleets and in long-distance transport, including in safe parking facilities and rest areas. Finally, they called for European standardisation for all fuels to ensure **interoperability, price transparency and the widespread availability** of relevant information and the monitoring of technological developments to inform additional actions.

ACEM, representing the **motorcycle industry in Europe**, submitted its position paper on electric mobility and powered two wheelers. The paper underlined the importance of appropriate and **adequate recharging infrastructure** and called on the Commission to promote investments for the development of large-scale recharging infrastructure for electric powered two wheelers in all Member States. In addition, the paper called on the Commission to support the development, and then reference in legislation, the **adopted standard on DC charging** for small and medium electric powered two wheelers, specifically for the DC charging system as described in IEC 61851-25 and the DC connector and vehicle inlet as described in IEC 62196-6.

In its submission, **Mazda Motor Europe** set out its position on alternative fuels and their infrastructure. They called for the focus to be on the deployment and use of fuels and energy sources that were **CO_2-neutral and ensured a real-life CO_2 reduction** and for further support for renewable liquid fuels in EU innovation and funding programmes. In addition, they called for the revision of the AFID (and RED) to incentivise such fuels, while seeking opportunities for synergies between different mobility sectors. In relation to the electricity used for electromobility, they underlined that this needed to increasingly come from **renewable sources** and so called for an increase in Member States' targets for the incorporation of renewable energy into their energy mix and for the CO_2 reduction in the transport (and energy) sector to be approached from a well-to-wheel perspective. In relation to infrastructure, they called for an **increase in Member State targets** for the deployment of refuelling and charging points and for local authorities to be encouraged and supported to install infrastructure in urban areas through targets and access to EU structural funds, as well as for the further incentivisation of the deployment of home charging solutions.

Volvo Trucks' submission was a figure representing their view on the potential developments in fuel use for 2030 and 2050. This foresaw the use of the internal combustion engine (using diesel, LNG/CNG, biogas or HVO) being replaced almost completely by electric batteries and fuel cells by 2050.

There were a number of other additional submissions that made general points in relation to the AFID. In its position paper, BDEW, the **German Federal Association of Energy and Water Management** e.V. underlined that the current approach, where the Directive set EU-level framework conditions, which enabled the **detailed regulation to be undertaken at the Member State level**, should be maintained. However, it noted that the methodology for identifying targets and the monitoring of the national strategic frameworks should be uniform. The paper also underlined that the Directive should **focus on all fuels** that could help to reduce transport's GHG and air pollutant emissions (including renewable gaseous fuels and synthetic liquid fuels for aviation) and that other EU legislation should ensure that a sufficient number of vehicles, including gas vehicles, were put on the market. BDEW called for **national strategic frameworks to be more dynamic** to take account of the way in which vehicles were coming onto the market, and the plans for these, which could be monitored by an independent national body, and for the deployment of gas infrastructure to be sufficient for commercial vehicles. They also called for the **guarantee of competition** along the entire value chain and for relevant standards to be used, including for the communication relating to electric vehicles to be undertaken in accordance with ISO 15118, which should be made mandatory, while AC charging points should all be equipped with type 2 sockets. Furthermore, they called for data provision requirements to be regulated holistically and for prices to be displayed in terms of the energy content of the fuel in kWh. Finally, they underlined the importance of **faster certification and more technical approval procedures** and for central contact points to support the expansion of recharging infrastructure. The paper also included detailed proposals for the revision of different articles of the Directive.

Transport and Logistics Netherlands (TLN), the Dutch employers' federation that focuses on representing the interests of freight transport operators, made five points. They called for the revised AFID to take the charging and refuelling **needs of HDVs** into account, which included extending the scope of the Directive to infrastructure on semi-private and private property, as this was where many trucking companies refuelled/recharged their vehicles during loading and unloading. They called for the focus to be on **green electricity and green hydrogen**, and so alternative fossil fuels, such as LNG and CNG, should be phased out. In addition, they called for **more uniformity** between the recharging and refuelling networks of different Member States, as truck operators often crossed borders, and for charging requirements to be linked to CEF funding for safe and secure truck parking areas.

The submission of the European Energy Retailers (EER), a network of **independent energy and solution providers**, covered the decarbonisation of transport and alternative fuels infrastructure. This underlined that all modes of transport needed to be decarbonised and called for mandatory targets for the level of penetration of alternative fuels, rather than for the provision of the respective recharging / refuelling infrastructure. It called for the definition and mix of the penetration of alternative fuels to be left to innovation and the market. However, the submission underlined that the decarbonisation of transport had to be based on the use of "**alternative fuels of renewable origin**", so electricity produced from renewable sources, advanced biofuels (particularly biomethane) and renewable hydrogen, while noting that LNG and CNG should be considered as transitional fuels, while they did not consider biofuels as a sustainable option. They called for fuel labelling to indicate which fuels were of renewable origin, and for taxation to support the use of these fuels. They called for the use of **existing infrastructure to be maximised**, and for the provision of new infrastructure to be left to the market, except for in unprofitable locations. Finally, they called for infrastructure and information to be interoperable and homogeneous and for consumers to have open and neutral access to all information about their consumption, in order to support a competitive market.

In its submission, **French company, La Poste**, underlined that an insufficient network of recharging points was acting as a brake on the uptake of electric vehicles. Hence, they were in favour of the development of scalable and interoperable recharging infrastructure as a means of encouraging the uptake of electric vehicles. In addition to the development of a **larger, more accessible public network of recharging points**, they called for better use to be made of the network of private recharging stations that already existed. They also called for a reduction in regulatory constraints that governed the installation of charging points for electric vehicles in basements, which would make it possible to install recharging points in both public and private car parks. In addition, they called for the development of **refuelling infrastructure for CNG and bioCNG vehicles**, as gas engines were of economic interest for moving higher payloads.

Austrian company Fronius provided comments on the Directive. In the context of the need to decarbonise transport and the need to reduce dependence on oil-based fuels, they called for the development and implementation of a European framework to **certify or guarantee the origin of different fuels** (including electricity, hydrogen and biofuels), supported by lifecycle analysis and labelling. They also called for a harmonised European framework on standards regarding alternative fuels, particularly for electricity and hydrogen. With respect to **hydrogen**, they noted that the AFID's provisions were not as well developed as for other fuels, which should be addressed. This should include a distinction between green (i.e. renewably produced) hydrogen and blue hydrogen, which was based on steam methane reformation or coal gasification with carbon capture and storage, with the former being promoted. In this context, it suggested that there could be **more support for the development of hydrogen refuelling systems** that were equipped with renewable energy systems, such as solar power, as these would produce and use the hydrogen locally, thus supporting jobs. Furthermore, they called for connections between hydrogen and the TEN-T to be established, as should a **European framework** for the technical requirements or compatibility of hydrogen systems, while they noted that a roadmap and numerical goals would support the deployment of the relevant infrastructure. Finally, they noted that one of the standards in the Annex of the Directive relating to hydrogen needed to be updated (ISO/TS 20100) and called for more consideration of externalities.

The **Eaton Cooperation**, based in Ireland, provided additional information in the context of the consultation on the AFID. While supporting the electrification of transport to help deliver clean mobility, they noted that both consumer demand and regulation were important in increasing the uptake of clean vehicles and fuels and that more could be done within the regulatory framework. They made recommendations to the Commission, including that there should be a **common regulatory framework across the EU** that applied to both public and private alternative fuels infrastructure, and that a methodology should be developed that enabled the identification of gaps where infrastructure was lacking. This should be accompanied by **"sufficiently high targets"** for the availability of charging infrastructure for electric vehicles, regardless of their location. They also called for regulation to match consumer demand and to ensure that **slow chargers were incentivised**, so as to allow home and office charging, and noted that safety aspects should be addressed in the technical requirements for charging infrastructure. Finally, they called for **smart charging** to be used to reduce the total cost of ownership of electric vehicles, to support the grid in alleviating load peaks and to allow for the integration of more renewable energy and synergies between vehicles and the power system.

German **energy supply company**, EnBW, submitted its position on the revision of the AFID covering seven areas. They emphasised that customers should have a **free choice regarding authorisation and payment methods** at recharging stations to enable seamless charging throughout Europe. While believing that there was no need for any retail price regulation relating to charging tariffs, they underlined that **pricing information had to be transparent** before charging to support a competitive market for electromobility. They noted that standardisation had to be accompanied by rules that ensured a level playing field and fair competition, which guaranteed a fair choice for consumers and which prevented anti-competitive behaviour. While noting that ISO 15118 was an important enabler of electromobility, they underlined that consumers should not be restricted to using this or to their choice of EMSP. In relation to **access to data**, they underlined that CPOs should continue to grant EMSPs fair and adequate access to their recharging infrastructure, and that the static and dynamic data relating to charging stations and vehicle batteries should be made easily available to customers, and that drivers should be able to freely decide on the use and transmission of their vehicle data. Rather than mandatory deployment targets for recharging infrastructure, they called for **deployment targets for public infrastructure to be linked to the deployment targets** for plug-in vehicles and the deployment of non-public charging infrastructure in order to ensure a more efficient use of resources. Finally, they underlined that regulatory requirements regarding technical standards were necessary.

Energy company, E.ON SE, submitted two documents: one was its position on the implementation of the ISO 15118 standard; the other its position on green gases. They called for the **further development and implementation of ISO 15118**, although noted that there needed to be **certain pre-conditions** to guarantee non-discriminatory and fair cooperation between all of the relevant actors. They called for the binding standard to be used and implemented by all vehicle manufacturers, and for its deployment in vehicles and recharging infrastructure to be monitored in a transparent manner to inform any potential infrastructure funding needs. They also underlined that consumers should have a free choice of EMSP when they purchase an electric vehicle and be able to simply and freely change EMSP in a non-discriminatory manner. In the second paper, they noted that **green gases**, including hydrogen, synthetic methane and biomethane, should be considered in the context of the decarbonisation of transport as this would require less infrastructure than focusing only on electric vehicles. They called for action to reduce the costs of producing green gases and to untap their potential. This included a 'green gas quota', investment in gas networks, research and funding programmes, as well as a market launch programme and action to reduce electricity prices to support power-to-gas applications using green electricity.

A Czech business association underlined the importance of taking a comprehensive approach to reducing GHG emissions and focusing on all relevant sectors.

The fuel on which most comments were provided was **electricity**, with twelve additional contributions coming from relevant trade associations, companies involved in the provision of electromobility or from respondents that focused their response on electromobility.

In its comments, Germany-based association, **Charging Interface Initiative** (CharIN) e.V., made comments in relation to the political framework, the technical framework and the grid and power supply. They called for a clear and harmonised **political framework** that clearly defined the roles and responsibilities of different actors to increase interoperability and increase investment. In addition, they called for charging infrastructure for electric vehicles to be regulated separately from other alternative fuels, for increased funding for the installation of recharging infrastructure and for the removal of administrative barriers to the deployment of infrastructure. In relation to the **technical framework**, CharIN underlined the importance of: ensuring compatibility between the CCS standard and previous versions; coming to an understanding of how to implement roaming; developing an independent and secure Public Key Infrastructure (PKI) process; the development of adequate charging solutions for HDVs; and regulation and incentives to support the deployment of automated charging solutions. Finally, in relation to the **grid and power supply**, they called for appropriate rules to enable the access of electric vehicles to grid services and energy markets; for new charging infrastructure to be future-proof and smart; and for the regulatory framework to incentivise the use of renewable energy as the source of power for electric vehicle recharging.

Smart Energy Europe (SmartEn), the European business association for digital and decentralised energy solutions, submitted two documents: its White Paper on making electric vehicles an integral part of the power system; and a summary of the discussions at a SmartEn workshop on this subject. The former set out five key priorities, along with relevant recommendations. In order to make **it easy for electric vehicles to interact with the electricity system**, the paper called for there to be no asset class for electric vehicles, for there to be access to in-vehicle data for CPOs and EMSPs, for there to be a simpler interconnection process with the grid and for there to be no "double network charges". The second priority was to **eliminate the barriers to the aggregation of electric vehicles** through changes to the Electricity Directive. In relation to **reducing the costs of equipment and installation, and increasing the availability of smart charging infrastructure**, they called for: only smart charging infrastructure to be deployed in buildings; incentives for installing smart charging in shared buildings; the AFID to include a binding target for the deployment of public recharging infrastructure; and the application of open technical standards to prevent vendor lock-in for publicly-funded infrastructure. In order to **harmonise and simplify the user experience**, SmartEn supported non-discrimination between payment methods, price transparency for publicly-accessible stations, CPOs being considered as service providers, minimum requirements for smart meters and common processes for electric vehicle to register as service providers. Finally, SmartEn called for **revision of the taxation system** to ensure that unconsumed electricity was not taxed and for the taxation of vehicles to be based on their efficiency, flexibility (e.g. ability to provide services) or CO_2 footprint.

In its position of the revision of the Directive, the **CHAdeMO Association**, representing providers of CHAdeMO, the DC fast recharging protocol, highlighted four points. First, it underlined the importance of **building on Europe's competence** in electric vehicles and their recharging infrastructure in an inclusive and technology neutral manner, while preserving and support existing infrastructure, specifically the 14,000 high power DC CHAdeMO recharging points and associated standards. Second, it underlined that any **further standardisation of electric vehicle recharging technologies** was premature, as international harmonisation efforts were ongoing. Third, it underlined the importance of the Commission **collaborating closely with industry experts** in the revision of the Directive, and of taking into consideration the development of international and European standards, including those for smartphone application using 4G/5G and Wi-Fi technology. Finally, they underlined the importance of **fostering a competitive environment** to deliver a better experience for electric vehicle users.

EuropeOn, the **European Association of Electrical Contractors**, submitted its recommendation for the shift to electromobility, which covered four areas. First, they underlined the **job creation potential of the electrification of transport**, which needed a strong regulatory framework for electromobility to provide the certainty to businesses to realise this job potential, as well as a holistic approach to the deployment of infrastructure. Second, they called for a **"sound policy framework" for home charging**, as this was where the majority of charging will be undertaken. In order to support this, they called for more streamlined approval procedures for the installation of home charging infrastructure and for the "Renovation Wave" to include requirements for smart charging in renovated buildings and adequate funding schemes for "unaffordable" grid connections or upgrades to electrical systems in single buildings. In relation to **data and standards**, EuropeOn recommended that it should be ensured that competitive energy service models were not hampered by proprietary vehicle data, a regulatory framework be set up to enable consumers to decide how their vehicle data were used and that open communication protocols and standards for charging infrastructure be mandated. Finally, in relation to the **role of regulated entities**, they called for grid operators and utilities to be kept away from dominant positions, for there to be a framework to enable better and faster communication with grid operators and for network tariffs to be reformed to accommodate and incentivise energy services and e-mobility.

The position paper of the **French Electricity Industry** (UFE) covered five areas. First, they called for the **extension of the scope of the Directive** to include all infrastructure that was accessible to the public, i.e. to public infrastructure and to infrastructure on parking spaces for private non-residential buildings accessible to the public, while differentiating the respective minimum requirements. The revision of the Directive should also assess the obstacles to the use of non-public charging points with the aim of guaranteeing an effective 'right-to-plug' and recognise and address the charging power levels that were not sufficiently covered in the current Directive. They also called for an assessment of the prospects of the use of decarbonised hydrogen for long-haul road and maritime transport. In the context of a **new approach to addressing the electric vehicle market evolution**, they called for the EU's LDV CO_2 emissions legislation to only support zero emission fuels, while calling for the list of alternative fuels of relevance to HDVs in the AFID to be maintained. They also called for minimum binding targets for Member States in relation to infrastructure for LDVs and HDVs, and for local and regional authorities to be involved in the drafting of development plans for the roll out of the necessary infrastructure. While they believed that NPFs remained a useful tool, they called for the monitoring of deployment to be tightened. Third, they called for the scope of the Directive to be extended to identify the prospects for **smart charging** and for the Directive to introduce a definition of "smart charging". In addition, they underlined the importance of **improving the consumer experience** by guaranteeing different payment solutions and providing improved information on pricing, location and access of recharging infrastructure, supported by open standards and protocols and the standardisation of recharging infrastructure. Finally, they underlined that the revision of the AFID **should go alongside the assessment of the TEN-T** core and comprehensive networks to identify targets for the deployment of an adequate number of recharging points on this network, although leaving the market to decide on the most useful power level for the minimum requirements.

The position paper from ChargeUp Europe, the voice of the **European electric vehicle charging infrastructure industry**, set out twelve key recommendations. They called for the Directive to be made into a Regulation and for it to only **focus on zero emission fuels** and to prioritise only those options with the greatest potential to decarbonise the transport sector. They called for the scope of the legislation to be expanded to include **privately-owned infrastructure** that was both accessible and not accessible to the public, supported by ambitious, binding and weighted targets to deliver a minimum level of coverage across the EU and improved transparency and market governance. Member States were urged to **develop "site-allocation strategies"** for the deployment of fast charging stations along highways and other major traffic corridors, and to ensure that tendering procedures were open and transparent. They underlined the importance of

interoperable and open networks to facilitate the adoption of open, non-discriminatory and uniform communication protocols and the related standards, while ensuring the necessary conditions for roaming, taking a consumer-centric approach and introducing a “right to plug”. The importance of **increasing the focus on electric HDVs** was also mentioned, as was the need to future-proof recharging infrastructure, supported by a clear definition of “smart charging”.

The **German Association of TÜV e.V**. submitted its position paper on electromobility. This set out a number of measures that the association felt were important to deliver the set emission reduction targets. The first called for a **clear commitment to electric drivetrains in road transport**, either in battery electric vehicles or using hydrogen in a fuel cell, while at the same time expanding the use of renewable energies to ensure the sustainable electrification of transport. This should be supported by **ambitious regulation**, incentives and the education of the population and the further deployment of electric vehicle recharging infrastructure. They also called for the further development of **hydrogen and fuel cell technologies**, although argued that e-fuels were not competitive as a source of energy for transport. They concluded by underlining that addressing any remaining safety concerns was important for the acceptance of electromobility.

The submission from German company Hubject, **an e-roaming Service provider**, set out the case for e-roaming and provided an overview of its platform. The submission underlined that by linking the various players in the market, including CPOs and EMSPs, e-roaming enabled electric vehicle drivers to have a contract and access medium to all publicly available charging stations. It emphasised that, to facilitate e-roaming, there needed to be a **technical and contractual interface between CPOs and EMSPs** and suggested that, as its own approach was popular, that there was a preference for a platform-based model. The submission concluded that, whether a platform-based or bilateral model was chosen, this **choice should be left to market players:** a single roaming protocol should not be mandatory. In addition, they noted that it had to be ensured that there was no discrimination by local monopolies and that open protocols were mandated, based on IEC WG 63119.

German company IONITY, which is installing a **high-power charging network in Europe**, submitted its position on the review of the AFID. It underlined that electric vehicle users preferred easy access to charging networks with their charging services, so called for the regulatory framework to be harmonised across Europe to give CPOs and EMSPs the opportunity to establish a sustainable business case. While underlining the **importance of roaming** in providing accessibility to a wider range of charging points for users, they called for the further development of technical roaming solutions to be left to market players. They underlined that **CCS, supported by the ISO 15118, should be the future standard** for Europe, while they noted that they supported the development of standardised PKI. They also called for a harmonised approach that **aligned the technical developments on DC metering with the regulatory requirements for pricing information** and structure to improve price transparency across the EU. Whilst recognising that electric vehicle drivers preferred seamless and secure payment and billing, they were concerned that further regulation on payment options might make it more difficult for operators to satisfy consumer preferences, arguing that it would be in the interest of operators to make the charging experience as easy as possible for the user. They called for **electric vehicle recharging to be regulated separately** from other alternative fuels, as a result of its decentralised nature, and for the regulatory framework to be harmonised across the EU to support the deployment of a pan-European charging network. They noted that recharging infrastructure needed to be located where it was easy to use, so underlined that public space needed to be made available for charging infrastructure, and on motorways for high power charging in particular. They noted that processes for connecting charging points to the grid were often complex, and varied by region, which slowed down installation, and so called for a **more harmonised and “fast lane” approach for the**

installation of public recharging infrastructure. Finally, they called for regulation to incentivise technologies that enabled the use of renewable electricity for charging electric vehicles.

In its submission, **Enterprise Holdings** underlined that the revision of the AFID should ensure a coherent Europe-wide approach to the deployment of infrastructure for alternative fuels, while effectively accommodating the needs of vehicle rental and the other mobility services that were developing in Member States, particularly in urban areas. The submission underlined that electric vehicles and their recharging infrastructure needed to meet customer expectations for the adoption of electric vehicles to be sustainable. In order to help ensure this, they called for **regulatory protection to prevent service disruptions** due to inadequate infrastructure, price distortions linked to supply limitations and market distortions through the "self-supply of vehicle manufacturers" to support their own mobility services. In addition, they underlined that the rental business model required **access to rapid and ultra-rapid DC charging points** and confidence in battery warranties that these would support intensive rapid charging regimes. They also called for the provision of rapid and ultra-rapid recharging points at airports and railway stations and gave their support to roaming based on ISO 15118 standards.

German company LichtBlick SE submitted two documents: a memorandum produced for them on '**Legal questions regarding the framework for charging infrastructure for electric vehicles**'; and a paper entitled 'Antitrust law and access to charging posts: Towards the liberalisation of the charging power market'. The former set out a number of challenges faced by electric vehicle recharging in the context of German law, including in relation to the charging models and the **rights of third-party electricity suppliers to co-use charging infrastructure**. In response to these challenges, and to promote the deployment of recharging infrastructure, they called for a specific regulatory framework for charging infrastructure. These should ensure that a **return on investment** must be possible for the CPO, specify the right to access and use of charging infrastructure by third party electricity suppliers and enable quick changes of supplier.

A German company set out seven areas that it considered to be important for the revision of the AFID. First, they called for the **recognition of the unique role of EMSPs in the electric vehicle recharging industry** and called for support for their development, by being considered as a separate category of recipient in the context of EU funding. In relation to **transparent and non-discriminatory pricing**, they called for the regulatory framework to ensure that EMSPs were able to access charging point stations with fair business-to-business prices and that discriminatory access fees for electric vehicle drivers were avoided, as well as for the harmonisation of charging units (in kWh) and a consistent, EU-wide framework to facilitate the development of new technologies and trends in the electric vehicle recharging industry. They also called for the **openness of the market for electric vehicle roaming services** to be enhanced by enabling access and ensuring fair prices and for the **unification of data exchange protocols, with CPOs being required to provide accurate billing data**. In relation to payments, they called for the **promotion of contract-based payment services in combination with ad hoc payment mechanisms**. More generally, they underlined the importance of unifying the definition of "public charging service", as in their experience this differed between Member States, while calling for the encouragement of green electricity in public charging infrastructure to underline the "greenness" of electromobility.

In addition, the following links and / or documents relating to electromobility were provided by respondents:

- Number of recharging points installed from the EAFO: https://www.eafo.eu/alternative-fuels/electricity/charging-infra-stats#

- Plug-in vehicles by inlet type: https://www.chademo.com/almost-1-million-chademo-vehicles-in-the-world/

- V2G projects in the world: http://everoze.com/app/uploads/2018/10/UKPN001-S-01-H-V2G-global-review-compressed.pdf

- French Association for Roaming of Electric Vehicle Charging (AFIRÉV) provided a link to their thoughts on a quality commitment charter for relevant stakeholders: https://www.afirev.fr/en/quality-of-services/

- AFIRÉV's thoughts on service quality more generally: https://www.afirev.fr/en/6073-2/

- AFIRÉV's recommendations regarding ISO 15118: https://www.afirev.fr/en/recommendation-by-afirev-following-an-analysis-of-the-utilities-and-costs-of-iso-15118-communication-protocol-between-electric-vehicle-and-charging-point

- Eurelectric (the Union of the Electricity industry) provided a link to a paper on policies for ensuring sufficient EV charging infrastructure: https://cdn.eurelectric.org/media/3972/policies_for_sufficient_ev_charging_infrastructure-2019-030-0482-01-e-h-35B30B2D.pdf

- Eurelectric also provided a link to a paper that set out its five key priorities for installing charging infrastructure in Europe that was fit for the next decade: https://cdn.eurelectric.org/media/4396/afid_review_-_eurelectric_priorities-2020-030-0229-01-e-h-7BB0CFF7.pdf

- Eurelectric submitted a policy brief on the TEN-T, including priorities for sustainable transport and financing electricity infrastructure: https://cdn.eurelectric.org/media/4502/eurelectric_ten-t_policybrief_final-2020-030-0416-01-e-h-3AA36CE2.pdf

- Eurelectric submitted a paper on electric vehicle interoperability, which contained use cases and recommendations for further developments: https://cdn.eurelectric.org/media/4562/20200709_eurelectric_ev_charging_interoperability-2020-030-0465-01-e-h-4C8220FC.pdf

- Enedis (2019), Report on the integration of electric mobility in the public electricity distribution network: https://www.enedis.fr/sites/default/files/Report_on_the_integration_of_electric_mobility.pdf

- RTE and ADEME report on the integration of electric vehicles into the power system: https://www.rte-france.com/sites/default/files/integration_of_electric_vehicles_into_the_power_system_report.pdf

- T&E's Policy roadmap for the revision of the AFID to ensure the adequate uptake of electric truck charging infrastructure: https://www.transportenvironment.org/publications/roadmap-electric-truck-charging

- T&E's report that modelled how many EV public chargers would be needed in each country in 2025 and 2030 to be in line with the EU Green Deal climate ambition:

https://www.transportenvironment.org/publications/recharge-eu-how-many-charge-points-will-eu-countries-need-2030

- T&E's position paper on AFID and shipping: https://www.transportenvironment.org/sites/te/files/publications/2020_02_RechargeEU_trucks_paper_Annex-AFID-and-shipping.pdf
- EuropeOn's report on the potential and feasibility of shore-side electricity: http://europe-on.org/wp-content/uploads/2020/06/A-feasibility-study-Shore-power-in-Norwegian-ports.pdf
- EuropeOn's report on the potential and feasibility of the electrification of fishing fleets: http://europe-on.org/wp-content/uploads/2020/06/Electrification-of-the-coastal-fishing-fleet_V1-1pdf.pdf
- The Irish government's consultation on the EPBD: https://www.housing.gov.ie/sites/default/files/public-consultation/files/public_consultation_draft_tgd_l_2020_buildings_other_than_dwellings.pdf
- T&D Europe's Brochure 'Electro-mobility: Towards Clean, Zero-Emission Transport': https://www.tdeurope.eu/component/attachments/attachments.html?id=1184
- "Fuels and engine technologies with focus on GHG and Energy utilization", Elizabeth Lindstad, SFI Smart Maritime Report, April 2020: http://www.smartmaritime.no/documentation/publications/research-reports/fuels-and-engine-technologies-with-focus-on-ghg-and-energy-utilization/554/
- Refuelling points per fuel and per province in Spain: https://geoportalgasolineras.es/#/Inicio
- Consumer information on availability, accessibility and usability of recharging infrastructure and smart recharging infrastructure in Spain: https://www.ree.es/es/red21/vehiculo_electrico/puntas-publicos-recarga-inteligente#
- ECOS's report 'Electric vehicle smart charging. The key to a renewable and stable grid': https://ecostandard.org/wp-content/uploads/2020/04/ECOS-BRIEFING-SMART-CHARGING-HR.pdf
- Regulatory Assistance Project (2020), 'Building a market for EV charging infrastructure: A clear path for policymakers and planners': https://www.raponline.org/knowledge-center/building-market-for-ev-charging-infrastructure/
- E-Mobility White Paper: Making Electric Vehicles integral parts of the power system, Smart Energy Europe: https://smarten.eu/e-mobility-white-paper-making-electric-vehicles-integral-parts-of-the-power-system/
- Emerging Best Practices for Electric Vehicle Charging Infrastructure, International Council on Clean Transportation. https://theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf
- EASE, the European Association for Storage of Energy, paper, "Energy Storage and the Alternative Fuels Infrastructure Directive": https://ease-storage.eu/es-alternative-fuels-infrastructure/

- EASE, "Energy Storage: A Key Enabler for the Decarbonisation of the Transport Sector": https://ease-storage.eu/energy-storage-transport-sector/

- Chamber of Labour Austria (Bundesarbeitskammer) provided links to the following document comparing the price of electromobility to those of petrol and diesel: https://www.arbeiterkammer.at/interessenvertretung/wirtschaft/energiepolitik/E-Tanken.html

Four additional submissions focused on gas. **GASNAM**, the Iberian association that promotes the use of natural and renewable gas in land and maritime transport, submitted three papers, one focussing specifically on Portugal, the other two on land transport and maritime transport in Spain. The first paper noted that the inclusion of gas in the AFID had been **essential for the development of the gas market** in Portugal, although the installation of infrastructure was still not sufficient to support the use of renewable gas in the future. Hence, they called for **the development of the necessary infrastructure** based on an indicator of around 2,000 vehicles per station. They underlined that there was a need for **better consistency between relevant EU laws**, including the revised RED, and for the harmonisation of the taxation of fuels and for incentives for green fuel infrastructure. In addition, they underlined the importance of using **well-to-wheel and lifecycle analysis** when considering which fuels to support, and for infrastructure to be considered neutral as it is was a facilitator of decarbonisation. Furthermore, they called for **more interoperability** through common standards and harmonised standards between Member States, the development of hydrogen refuelling infrastructure at multifuel stations and for more ambitious decarbonisation targets.

The second paper from GASNAM made very similar points for land transport in Spain. In addition, they noted that **Member States should be able to set their own objectives**, following a common European methodology, with a mechanism to be applied to prevent non-compliance, as well as a long-term stable regulatory framework for each fuel and for the intelligent deployment of the necessary infrastructure. The third paper again made similar high-level points about the use of gas in maritime transport in Spain. It also noted the **importance of LNG, and bioLNG, for maritime transport**, and noted that the revision of the Directive was an opportunity to minimise the investment risk currently associated with the provision of the necessary infrastructure, while also emphasising the importance of taking a well-to-wheel approach when considering different fuels.

Federmetano, the Italian national federation representing distributors and transporters of methane, made similar points in relation to the development of gas infrastructure in Italy. They underlined that Member States were working to implement their renewable energy targets and deploying alternative fuels infrastructure in the context of their NPFs in **accordance with national priorities and solutions.** They similarly called for Member States to be able to set their own objectives, following a common European methodology, with a mechanism to be applied to prevent non-compliance, for the AFID to be technology neutral and for infrastructure to be considered neutral as it is was a facilitator of decarbonisation. Furthermore, they called for infrastructure for LNG HDVs to be deployed at logistics depots and at ports. Finally, they called for the AFID to focus on the short- to medium-term, whilst ensuring that it was able to respond to the market and local conditions.

An Italian trade association noted that the **mix of fuels covered by the AFID was still relevant**, as it was important to take a technology neutral approach. They underlined the importance of an **appropriate level of taxation** to support the development of LNG in Italy and to guarantee the competitiveness of LPG, which was already established in the country. They called for the disbursement of grants to take into account the **maturity of technologies**, particularly in support of the development of LNG, which would also benefit from European standards, including in relation to maritime bunkering. While noting that the NPFs provided Member States with flexibility, they called for a strengthening of the provisions at the European level to ensure the adequate implementation of the NPFs, supported by a clear timeline and milestones.

The **Swedish Gas Association** (Energigas Sverige) submitted a document that contained its proposed amendment to UNECE R110, which defines the working pressure of an LNG tank to be the primary relief valve setting, without stating a minimum setting of this relief valve. The association believe that this is a safety risk, and so has proposed a relevant amendment.

The following links and reports relating to gas were also provided:

- IFPEN study comparing CNG, bioCNG and hybrid vehicles to diesel and electric vehicles: https://www.ifpenergiesnouvelles.com/sites/ifpen.fr/files/inlineimages/Innovation%20et%20industrie/Analyse%20du%20cycle%20de%20vie%20(ACV)/Rapport_AFG_version-EN.pdf

- The response from the European Biogas Association (EBA) and NGVA to the European Green Deal focusing on the use of biomethane in transport: https://www.ngva.eu/wp-content/uploads/2020/06/EBA_NGVA-Europe_TheEuropeanGreenDeal_FastLaneTransport_20200615_spread.pdf

- An EBA and NGVA report on the role of biomethane in the circular economy: https://www.ngva.eu/wp-content/uploads/2019/07/circular-economy-leaflet_190718.pdf

- A life cycle assessment of the use of LNG as a marine fuel: https://www.thinkstep.com/content/addendum-life-cycle-ghg-emission-study-use-lng-marine-fuel

- Natural gas vehicle Italy provided a link to its position on the AFID: https://www.ngvitaly.com/wp-content/uploads/2020/06/RevisioneDAFI-sintesi.pdf

- Ecological institute report ‘ Trucks: liquid natural gas is not an option for climate protection’: https://www.oeko.de/presse/archiv-pressemteilungen/presse-detailseite/2020/lkw-fluessiges-erdgas-ist-keine-option-fuer-klimaschutz

- Federal Environment Agency report that showed that liquefied natural gas trucks hardly had any climate advantage: https://www.umweltbundesamt.de/themen/fluessigerdgas-lkw-haben-kaum-einen-klimavorteil

- Decarbonisation of on-road freight transport and the role of LNG from a German perspective. Mottschall, M.; Kasten, P.; Dr. Rodriguez, F. / Öko Institut E.V: https://www.oeko.de/fileadmin/oekodoc/LNG-in-trucks.pdf

- EASE, "Power-to-Gas Business Cases: Revenue Streams, Economic and Regulatory Barriers, Business Opportunities":https://ease-storage.eu/power-to-gas-business-cases-revenue-streams-economic-and-regulatory-barriers-business-opportunities/

- EASE, "EASE Recommendations on Sectoral Integration Through Power-to-Gas/Power-to-Liquid": https://ease-storage.eu/wp-content/uploads/2017/05/2017.05.15_EASE-Recommendations-PtG-PtL_final.pdf

One additional response related to hydrogen, which was from H2IT, the **Italian Hydrogen and Fuel Cell Association**, which set out a series of key elements for the revision of the Directive. First, they called for the **consideration of hydrogen by Member States to be mandatory**, not optional as is currently the case. The deployment of hydrogen refuelling infrastructure should be supported by clear target and measures, as well as economic support from governments, while also noting that binding targets would speed up the deployment process. They also called for the harmonisation and simplification of the regulatory framework in different European countries to facilitate the movement of passengers and goods. While noting that a **minimum coverage on the TEN-T should be the first priority**, they suggested that the AFID should encourage the wider diffusion of hydrogen refuelling infrastructure, where this was economically and environmentally appropriate, including the provision of infrastructure at strategic hubs, such as airports and ports. They also called for the evaluation of projects to include the **well-to-tank perspective**, for there to be stricter reporting requirements on Member States and for cooperation between public and private stakeholders to be encouraged.

In addition, in relation to hydrogen, the following documents / links were provided:

- Report from Hydrogen Europe calling for the deployment of hydrogen fuel cell trucks: https://hydrogeneurope.eu/sites/default/files/2020.02.12%20Joint%20call%20for%20deployment%20of%20FC%20trucks_final%20version%20with%20logos.pdf

- Fuel Cell and Hydrogen Joint Undertaking's, Hydrogen roadmap Europe 2019: https://www.fch.europa.eu/sites/default/files/Hydrogen%20Roadmap%20Europe_Report.pdf

- National Hydrogen Mobility Development Plan for Italy (Piano Nazionale di Sviluppo Mobilità Idrogeno Italia) 2019: https://www.h2it.it/wp-content/uploads/2019/12/Piano-Nazionale_Mobilita-Idrogeno_integrale_2019_FINALE.pdf

- Joint Shift2Rail/FCH JU study "Use of fuel cells and hydrogen in the railway environment, 2019"

- Joint CleanSky/FCH JU study "Hydrogen powered aviation", 2020

- Hydrogen Council "Path to hydrogen competitiveness A cost perspective", 2020

- Hydrogen Europe "Green Hydrogen for a European Green Deal - A 2x40 GW Initiative", 2020

Other submissions related to the other fuels covered by the AFID. A joint declaration calling for legal consistency of the EU alternative fuels definition was submitted by **ePure**, the association representing the interests of European renewable ethanol producers. Other associations mentioned on the declaration were **Liquid Gas Europe**, representing national LPG associations, the **European Biodiesel Board**, **UPEI** (representing importers and wholesalers/retail distributors of energy for the transport and heating sectors, independent of the major petroleum producers) and **ACEA**. The declaration called for a technology-neutral approach and for the maintenance of the AFID's current list of alternative fuels. It underlined that consumers and transport operators would only adopt low and zero emission options, if they were affordable, convenient and commercially-viable, and that **LPG and sustainable, renewable fuels and gases**, which were already competitive in the EU market, delivered environmental benefits and could be deployed quickly.

In its response, company **Neste**, based in Finland, underlined that the revision of the Directive should be coherent and aligned with the EU's decarbonisation policies. It noted that the Directive should not be limited in scope to those furls that require major fleet renewals or the deployment of new infrastructure and instead recognise the value that **alternative and renewable liquid drop-in fuels** could play in decarbonising transport, including in the existing vehicle fleet. In this context, they underlined the potential for renewable paraffinic diesel (HVO), as well as the potential for renewable hydrogen and power-to-liquid fuels, to be used in internal combustion engines to decarbonise transport. As a result, they **proposed an amendment to recital 6 of the AFID**, which covered synthetic fuels. In terms of the revision of the Directive, they called for Member States to be free to set deployment targets at the national level that reflected national circumstances. In addition, they underlined the importance of the new AFID being consistent with other legislation, such as the CVD, revised RED, ETD and the FQD, while also calling for the vehicle CO_2 emissions Regulations to be brought in line with these pieces of legislation.

Reports and links that were provided that related to these other fuels included:

- "LPG Bunkering – Guide for LPG Marine Fuel Supply", WLPGA 2019: https://www.wlpga.org/wp-content/uploads/2019/10/LPG-Bunkering-2019.pdf
- "LPG for Marine Engines – The Marine Alternative Fuel", WLPGA 2017: https://www.wlpga.org/wp-content/uploads/2018/02/LPG-for-Marine-Engines-2017-.pdf
- "BioLPG – the Renewable Future", Atlantic Consulting 2018: https://www.wlpga.org/wp-content/uploads/2018/10/BioLPG-The-Renewable-Future-2018.pdf
- Johnson, E (2017), "A carbon footprint of HVO biopropane", *Biofuels, bioproducts and biorefining*, 11:887-896. The paper concluded that HVO biopropane, which is produced in the course of producing renewable diesel from oils and fats, had a variable carbon footprint, depending on the feedstock, although this could be as low as 5 gCO_2e/MJ.

Other respondents provided links to reports on fuels, more generally:

- Frontier Economics, "The overall CO_2 balance for drive technologies in private transport today and in the future. Life cycle analysis as the basis for goal-oriented climate policy and regulations": https://www.uniti.de/images/PDF/publikationen/Aktuelle%20Studien/RPT-Frontier-Uniti-LCA-26-11-2019.pdf

- Global Alliance Powerfuels, "Powerfuels. A missing link to a successful global energy transition": https://www.uniti.de/images/PDF/publikationen/Aktuelle%20Studien/Powerfuels-A_missing_link_to_a_successful_global_energy_transition.pdf

- World Energy Council Germany / Frontier Economics (2018), "International Aspects Of A Power-To-X Roadmap": https://www.uniti.de/images/PDF/publikationen/Aktuelle%20Studien/20181018_WEC_Germany_PTXroadmap_Full-study-englisch.pdf

- Prognos et al, "Status And Perspectives Of Liquid Energy Sources In The Energy Transition": https://www.uniti.de/images/PDF/publikationen/Aktuelle%20Studien/1805xx_Status-Liquid-Energy-Sources_final.pdf

- Dena report on the "integrated energy transition": https://www.uniti.de/images/PDF/publikationen/Aktuelle%20Studien/9261_dena-Leitstudie_Integrierte_Energiewende_lang.pdf

Three additional contributions related to **public transport**. The **UITP's submission** was a joint statement with **ACEA** calling for the scaling up of alternative fuel infrastructure for public transport that was needed to deliver the targets of the CVD. The statement regretted the slow progress in deploying alternative fuel infrastructure for public transport that had been made to date. Moreover, it underlined the connection between the deployment of alternatively-fuelled vehicles and the deployment of the associated recharging and refuelling infrastructure and that increased deployment of the latter would help to reduce the total cost of ownership of the vehicles. It stressed that the deployment of the refuelling and recharging infrastructure was important as otherwise the CVD's targets for clean buses could not be met, and so called for Member States to work with public transport authorities and operators to **scale up the necessary measures to deploy alternative fuel infrastructure for public transport**. Finally, they urged the Commission to **increase funding** to support both the deployment and operation of infrastructure in the market uptake phase, while focusing on the needs of public transport authorities and operators.

In its additional contribution, **CEEP, the European Centre of Employers and Enterprises providing Public Services and Services of General Interest**, set out the **main challenges** that it had identified with respect to infrastructure for public electric and alternatively-fuelled buses. These were: financing, including ensuring that this was diverse; a lack of infrastructure; the availability of vehicles at acceptable prices; grid capacity; no "one-size-fits-all" solution for hydrogen refuelling infrastructure; and a lack of a roaming system for charging electric vehicles. Hence, CEEP made a **number of recommendations**, including calling for the AFID to focus on bus charging and refuelling infrastructure, including standards for electric bus charging interfaces and reporting on public transport infrastructure, **taking into account the relevant CVD targets**. They also called for there to be **no change in the list of fuels** covered by the AFID, as the CVD targets for buses were linked to the AFID's list of fuels. In addition, they called for data on charging point location and utilisation to be **made available for private vehicles**, along with the establishment of national bodies to facilitate the installation of charging and refuelling points. Furthermore, they underlined the importance of involving distribution system operators in the planning process for the installation of electric vehicle charging points at an early stage to ensure sufficient grid capacity. Finally, they called for **consumption-based charging to be enforced**, e.g. by stipulating that a display on a mobile device was sufficient to meet this requirement, and called for an issue in EU tax law to be addressed, i.e. that charging electric cars was seen as supplying a good (i.e. supply of electricity) and so e-mobility providers had to be registered in all Member States as otherwise their customers were not allowed to charge their cars outside of the country in which they had a contract.

In a brief additional remark, **French rail operator SNCF** highlighted that railway stations needed to receive priority attention for the deployment of alternative fuels, as they were increasingly becoming multimodal hubs where passengers were able to access a range of different mobility solutions.

Other reports and links that were provided that related to public transport:

- KCW et al, "Comprehensive analysis of the existing cross-border rail transport connections and missing links on the internal EU borders": https://ec.europa.eu/regional_policy/en/information/publications/reports/2018/comprehensive-analysis-of-the-existing-cross-border-rail-transport-connections-and-missing-links-on-the-internal-eu-borders

- Allianz pro Schiene, "Electrified routes in the state railway networks in European countries": https://www.allianz-pro-schiene.de/wp-content/uploads/2019/10/191021_pm_elektrikation_grafik.pdf

- Allianz pro Schiene, "Electrified and non-electrified border crossings in the German rail network": https://www.allianz-pro-schiene.de/wp-content/uploads/2019/10/elektrierter-Grenz%C3%BCberg%C3%A4nge.pdf

- The fleet of urban services vehicles in France on January 1, 2018, published in November 2018: https://www.utp.fr/note-publication/publication-de-la-brochure-le-parc-des-vehicules-des-urban-services-on-1st

- "The Urban Transport Services continue their energy transformation in France", published in February 2020: https://www.utp.fr/note-publication/les-services-urbains-poursuivent-leur-mue-energetique

- "Broschüre VDV und sphera | Emissionsfreie Energie- und Antriebskonzepte für Stadtbusse zur Umsetzung der europäischen Clean Vehicles Directive", 2020: https://www.vdv.de/umsetzung-cvd.aspx

- The following project is of interest in understanding the various constraints and possibilities relating to infrastructure dedicated to public passenger transport: https://assured-project.eu/use-cases/pillar-i-electric-buses

There were four additional submissions that focused on maritime transport. The **European Sea Ports Organisation** (ESPO) submitted its roadmap to implement the objectives of the European Green Deal in ports. In relation to the AFID and alternative fuels, they called for a **goal-based, technology-neutral approach**. They proposed a gradual emission reduction standard for ships at berth, e.g. that by 2030 CO_2 emissions from ships at berth in ports should be reduced by 50% on average across all segments of shipping, and underlined that OPS should be encouraged as part of the solution, although noted that this should be assessed on a case-by-case basis. The paper also called for **LNG's role as a transition fuel to be recognised**. Finally, they called for the revision of the ETD to provide a permanent, EU-wide tax exemption for all clean fuels and clean sources of energy.

The **European Community Shipowners' Associations** (ECSA) expanded on its response to questions 5 and 6 of the 'Main Problems' section of the survey. While noting that the objective of the Directive remained relevant, for maritime applications its impact was limited as the Directive was limited to OPS and LNG. In **relation to OPS**, they noted that there was still often a lack of a sufficient business case, which would be facilitated by a tax exemption for the provision of energy to ships, which would help to close the cost gap with conventional marine fuels. In addition, OPS still faced a 'chicken and the egg' problem with ports not willing to invest until there was sufficient demand and shipowners not willing to invest until there was sufficient capacity. They called for action to **support the provision of green electricity to ships** and to support cooperation to reduce or share costs. Furthermore, they noted that it was not clear how the demand and benefit of the provision of OPS was to be determined, which did not help solve the 'chicken and the egg' problem, as ship owners were not able to know in which ports relevant investment would occur. In **relation to LNG**, the ESCA called for the development of LNG bunker infrastructure to support the use of LNG as a transition fuel, while also underlining that provisions should be made for the **potential use of other fuels** in the maritime sector.

In its submission, FEPORT, the **Federation of European Private Port Companies and Terminals**, set out five areas that it felt were important to take into consideration. First, they underlined that **technology neutrality** was important to foster innovation and to avoid stranded assets, and to allow for different solutions aside from LNG and OPS. Second, they underlined the importance of **recognising LNG as a transitional fuel**, supported by the retention of existing tax exemptions for LNG in the ETD. Third, they underlined that it was important to ensure that the **uptake of OPS** was based on a viable return on investment for port stakeholders, so argued that the current provision around deploying OPS should be maintained, i.e. that OPS should not be deployed where there was no demand or where the costs were disproportionate to the benefits. They called for a focus on **increasing demand for OPS through the ReFuel EU Maritime initiative**. Finally, they called for **tax exemptions** for OPS and other clean energy sources to be allowed, e.g. in the ETD.

In its response, the **World Shipping Council** (WSC) underlined that the Directive should ensure that the **potential use of other fuels** in the maritime sector, such as green and blue ammonia, green and blue hydrogen and e-methanol, **was left open** and that the Directive should not require investment in particular fuels, in case these turned out to be inferior. It also suggested that the scope of the Directive should be **expanded to cover non-publicly accessible infrastructure**, as the infrastructure needed by the shipping industry fell into this category. In relation to **short-sea shipping**, they called for a clarification of what was meant in the consultation and suggested that requiring all large ships to connect to OPS may not be cost-effective, while the electrification of ports should be focused – at a minimum – on smaller, specialised vessels. They also noted the importance of the **AFID being consistent with international rules** adopted by the IMO. In addition, in relation to at-berth requirements, the WSC suggested that emissions at berth be addressed through an **emissions reduction goal**, rather than prescribing that all or most ships achieve this through the use of OPS.

In addition, links to two documents that set out the environmental technologies and practices, including in relation to alternative fuels, that were relevant to the cruise ship industry were supplied:

- https://res.cloudinary.com/dix5tzpvs/image/upload/v1543611360/CLIA/404%20Image%20backups/2018-environmental-technologies-and-practices-document.pdf

- https://cruising.org/about-the-industry/policy-priorities/environmental-stewardship/industry-environmental-technologies-and-practices

The one additional contribution that focused on **inland waterways** was a position on the revision of the Directive from the **European Federation of Inland Ports (EFIP).** This called for a goal-based solution, supported by deployment based on focusing on different axes and national and EU funding. In relation to the **goal-based solution**, EFIP underlined its support for technology-neutrality, which they felt was not adhered to by the current Directive. They called for a target for vessels to be **zero emission at berth by 2030**, supported by relevant legislative action on technical and safety regulations, particularly the revision of the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways Treaty to facilitate the development of hydrogen as a fuel for inland waterway vessels. They called for an **axis-based approach** instead of a focus on the TEN-T network, as inland ports were not evenly distributed. The axis-based based approach would involve relevant stakeholders entering into a dialogue to create infrastructure roadmaps for each axis. Such a bottom-up process would ensure progress, although it would need to be **coordinated by existing European platforms**. In addition, EFIP underlined the importance of CEF funding to support the deployment of alternative fuels infrastructure for inland waterways, stressed that state aid rules should not hinder the deployment of this infrastructure and called for inland waterways to be considered separately from maritime transport, as a result of the differences in the two sectors.

There were four additional contributions from consumer organisations. The **Fédération Internationale de l'Automobile** (FIA) Region I submitted a paper on alternative fuels and vehicles. It noted its support for the deployment of cars using alternative fuels, although noted that more action was needed to ensure that motorists were able to use these fuels with the same degree of comfort and convenience as they were able to use petrol and diesel. They called on Member States to **increase the deployment** of recharging and refuelling infrastructure and for KPIs to be set to measure their performance, although they noted that only alternative fuels that were truly sustainable and offered significant emissions reductions should be supported by legislation. From the **perspective of consumers**, they underlined that motorists should have easy access to information about the location, condition, operation and availability of recharging points, whilst pricing information relating to recharging and refuelling should be transparent and multiple payment options should be offered. Finally, they proposed that information on vehicle costs and emissions should be provided at the point of sale.

BEUC, the **European Consumer Organisation**, submitted a paper, which included recommendations, entitled 'Making electric cars convenient'. This underlined that, while consumers had a lot to gain from the transition to electric vehicles, their needs and expectations had to be addressed, particularly in relation to range anxiety, the ease of recharging and battery durability. They called **for the roll-out of normal and fast recharging stations to be accelerated** along highways, in urban areas and in private buildings, and for publicly available charging infrastructure to be maintained and swiftly repaired, where necessary. In **relation to the consumer experience**, they underlined that charging tariffs should be easily understandable and comparable, that users should pay only for the charge that they use, that payments by debit card (and cash when possible) should be enabled at all publicly available charging stations and that consumers should be provided with **reliable information** on the location and real-time availability of charging stations. They also called for consumers to be made aware of the technical characteristics of their vehicles, including its electric driving range and charging capacity, and for new eco-design requirements to be developed to ensure that electric car batteries were durable, repairable and recyclable.

The **German Federal Association of Consumers** (vzbv) submitted two documents: the first of which was a response to the Commission's intention to revise the AFID; the second appears to be a similar contribution to a national debate, from the vzbv, the Federal Association of CarSharing (bcs), the Federal Association of Solar Mobility (BSM) and the Berlin-Brandenburg Electric Mobility Association. The former started by calling for the development of a comprehensive electric vehicle recharging network in Europe, followed by a call for an **adequate level of consumer information**, including information about the location of charging points, whether these were working, available and enabled ad hoc charging. They also called for **uniform and transparent pricing information**, based on kWh, while additional price components should be shown transparently. The paper also underlined that a high level of **data protection and security** had to be guaranteed for all authentication, billing and payment processes. Finally, they underlined that recharging points had to be **easy to use**, so authentication should be possible using a single access medium, ad hoc charging without a subscription should be possible at all new stations, charging stations should be easy to find and those installed using public money should have to be repaired promptly, when necessary. The second paper made similar points, as well as others, relating to the German context.

In its response, the **Austrian Electromobility Club** (EMC) proposed an additional problem, in addition to the four listed in the consultation, and also expanded on its priorities for addressing the third and fourth problems listed in the inception impact assessment. Its additional proposed problem related to the **pricing of high-power recharger points**, as it noted that the prices that were charged for the use of these charging points were excessive. Whilst they recognised that in the longer-term the market would ensure that prices reached appropriate levels, they argued that there was a need for action in the short-term to keep the prices for using high power charging points to acceptable levels. In relation to the third problem (**'Users of an alternative fuels road vehicle often face problematic conditions for using that infrastructure'**), they called for ad hoc charging to be possible without a contract or registration, for price transparency and comparability and for the activation of charging for electric cars to be possible via a hotline that was available 24 hours a day, seven days a week. In addition, they called for clearly visible markings and signposts and for a Europe-wide register of charging points with sufficient, up-to-date information. In relation to the fourth problem area (**'Current networks are not well equipped to ensure the adequate integration of a rapidly increasing fleet of electric vehicles into the electricity grids'**), they underlined the importance of rapidly increasing the number of high-power charging points on motorways and other transit routes. Furthermore, they called for the output of these high-power charging points to be at least 150 kW and that there should be energy storage facilities at large charging stations to reduce peak loads, to keep the grid stable and to support the use of renewable energy sources. Finally, in relation to the **pricing of high-power recharger points**, they underlined that there should be fair prices (e.g. no more than double the local household electricity price), that the price for roaming should be regulated and that billing should generally be based on the amount of energy used.

Environmental organisation **Bellona Europa** submitted its position paper on the implementation of the EPBD. This underlined that the EPBD complements the AFID. **ECOS**, an **environmental organisation specialising in standardisation**, submitted a paper on smart charging, calling it the key to a renewable and stable grid. In the context of the revision of the AFID, they called for the swift development and implementation of standards that support EU regulatory requirements for smart charging. Moreover, they called for **incentives to encourage and enable** the operators of public or semi-public car parks to install smart charging in their car parks and for policies to ensure that power inverters involved in electric vehicle recharging did not destabilise the grid. Finally, they called for independent access to electric vehicle data (i.e. not via the manufacturers) to enable smart charging.

A submission from an Italian-based organisation that classified itself as 'Other' underlined the potential of carbon neutral energy carriers, such as those **produced from waste and biomass**, in decarbonising transport. As a result, they called for a wide range of alternative fuels to be considered and for investments in X-to-Power flexible systems that were able to use such technologies, supported by the necessary research and development.

There were 10 additional contributions from **public authorities** or their representative associations. The response from the **German Federal Government** provided its support for an ambitious amendment to the Directive, which left individual Member States responsible for the means and instruments for the development of the necessary infrastructure. The importance of respecting the principle of subsidiarity when building infrastructure was underlined. In relation to electric road vehicles, it underlined the importance of ensuring the **development of a powerful fast-charging network** throughout Europe (of at least 150 kW), which may lead to a need to redefine what is meant by fast charging. This network should also take account of the recharging needs of heavy commercial vehicles, the specifications and standards for which, including in relation to stationary and dynamic charging, should be covered by the Directive. In addition, they called for **the removal of fuels from the AFID**, if they did not require alternative infrastructure and underlined that the fuels covered should be limited to those that were demonstrably suitable for achieving the goals of the Paris Agreement, while ensuring that the Directive focused on the deployment of the infrastructure, not on the quality of the fuels. **Binding standards and technical specifications**, such as those already issued by the respective standardisation organisations, were necessary to guarantee interoperability, unless this could be achieved through other means, in which case preference should be given to non-discriminatory regulations that did not prohibit existing solutions. In order to improve **customer friendliness and reliability**, the aim should be to establish uniform payment systems using common means of payment and ensure that roaming was enabled for electric vehicle drivers. Specifications for the maintenance and availability of infrastructure (to minimise downtime) and for the availability of operators (e.g. in a call centre) could also be considered. Finally, consumers should also be able to be aware of the location and availability of recharging and refuelling infrastructure without any obstacles and be aware of the price (in €/kW) before beginning to charge their vehicles. Mobile devices could be used to help improve the clarity of prices. The submission underlined that any provisions relating to data should respect data protection, data security and the data sovereignty of consumers.

In its response, the **Swedish Association of Local Authorities and Regions** (Sveriges Kommuner och Regioner; SKR) welcomed the evaluation of the Directive. It called on national authorities to **increase investments** that supported the transition in the transport sector and underlined that the role of municipalities and regions in this transition needed to be recognised. They called for the EU to work to achieve coordinated systems for sustainable transport, including in relation to a **common EU standard for recharging infrastructure** and their payment systems. Fossil fuels should be phased out in the long-term, while renewable fuels produced sustainably from forest and agricultural raw materials should be promoted, taking account of the special conditions of the Nordic region to a greater extent. Finally, they suggested that the Directive should reflect the public's greater consideration of green issues and its willingness to change it transport patterns.

The submission from the **Europaforum Norra Sverige** (EFNS), a network for politicians at local and regional level in northern Sweden, underlined its support for the Directive, although called on the Commission to **consider whether fossil fuels, such as natural gas, should still be included**. EFNS called for a clearer wording relating to incentives, such as those for installing fast chargers, in order to encourage the deployment of infrastructure in sparsely populated areas, while they also underlined that **regional conditions should be taken into account** when considering the technical harmonisation of infrastructure and fuels. Finally, they underlined the importance of Sweden continuing to be able to provide state aid for the production of liquid biofuels.

The submission from the **Bothnian Corridor**, which brings together seven Swedish counties, largely in the north of the country, underlined the importance of the electrification of transport and use **of climate-neutral biofuels** to achieve the EU's climate goals, while calling for the AFID to be expanded to cover other modes, such as rail and aviation. They also suggested that the AFID, as well as other EU legislation, should take a life cycle approach to determine the climate impact of different fuels. They underlined the importance of **incentives to support the development of infrastructure** for alternative fuels, particularly in sparsely populated areas, while also calling for incentives and regulation to enable support for the expansion of the production of biofuels.

The **Conference of Peripheral Maritime Regions** (CPMR) provided its additional contribution to the consultation, emphasising three points. In relation to **ensuring territorial accessibility**, it underlined that the AFID needed to foster the deployment of infrastructure for alternative fuels in all European regions and so avoid isolating disconnected regions, such as sparsely populated areas, rural areas, islands and the outermost regions. To support this, the AFID should incentivise Member States to deploy infrastructure beyond the TEN-T and ensure better interoperability between modes of transport and across borders. Second, they called for a **stronger mention in the Directive of the need to involve regions** in the deployment of infrastructure, so that regional authorities were fully involved in the development of the NPFs. Third, they called for the AFID to foster clean transport that took into account of, and built on, the strengths and specificities of each territory to **ensure a fair transition to clean transport**. In this context, they underlined the importance of technology neutrality to support innovation and context-based solutions.

Action Group 4 of the **EU Strategy for the Alpine Region** (EUSALP) submitted two documents: the first was an additional contribution to the consultation; the second, a presentation outlining the results of a survey on the development of alternative fuels in the Alpine Region. The first covered two issues. The first of these was the **importance of addressing the accessibility challenge** by ensuring that an alternative fuels network was developed in alpine corridors, and also on secondary networks and in remote valleys. In addition, they noted that it was important to improve interoperability and connections across borders and between modes, while it was also important to provide funding for the deployment of alternative fuels infrastructure beyond the core network corridors. Second, they called for **more engagement of the regions**, particularly in the development of the NPFs. They also noted that the macro-regional strategies, such as EUSALP, were already undertaking relevant work and creating effective platforms in which national and regional authorities work together to coordinate and harmonise their activities.

The French region of **SUD Provence Alpes Côte d'Azur** made a similar point to other regions, that it was important that **regions were fully involved in the development of the NPFs**, as the region was aware of the local renewable energy resources (in their case biomethane) and was, at least in France, responsible for transport. They also called for the **expansion of the territorial coverage** of the development of infrastructure for alternative fuels to beyond the core TEN-T, and particularly to the Alpine region, while also noting that more local production and use of hydrogen in particular would help to reduce costs. They suggested that the minimum level of coverage had now been met, and so the future installation of infrastructure for alternative fuels should be developed to meet demand, i.e. in terms of the way in which different fuels were being used by different vehicles, so called for **more consistency and complementarity between different policy areas**. In addition, they called for the deployment of infrastructure to be supported by appropriate funding mechanisms, particularly in relation to hydrogen and, to a lesser extent, a network of ultra-fast charging stations. Finally, they noted the importance of taking action to reduce emissions, including air pollutant emissions, from port activities and that as a region they had been taking action in this respect. However, they underlined that, as it was an international sector, **action also needed to be taken internationally to reduce pollution from the maritime sector** and so called on the Commission to do this, particularly in the context of the EU's neighbourhood policy in the Mediterranean.

The response from the **Swedish Region Västra Götaland** started by noting that the Directive had not had the impact that had been hoped for, and so called for well-defined targets and appropriate national implementation. They called for the legislation to support the deployment of technological innovations and for the requirements relating to HDVs to be taken into consideration. The submission supported the Directive's provisions that each electric vehicle driver should be able to make **ad hoc payments without the need for a contract**, so called for the enforcement of this provision and the elimination of any barriers to its implementation. They also called for an alignment of the deadlines of the revised AFID with those of the LDV and HDV CO_2 standards, for the CEF to support the wider deployment of alternative fuels infrastructure and for a better alignment between the AFID and the EPBD to ensure that charging points were deployed where they needed to be. Finally, they suggested that, if methane was to continue to be considered as an alternative fuel, it would be important to consider how to increase the proportion of biogas.

In its submission, the **French region of Bretagne** called for the revision of the AFID to contribute to a number of areas. They called for the Directive to systematically be extended to all territories, ports and logistics platforms, as well as to all road and river nodes, while also taking action to support the use of alternative fuels in rural areas. Without going into detail, they also called for there to be a method of **standardising the deployment of infrastructure** across the whole of Europe and for the AFID (and TEN-T) to be made more consistent with other EU polices in order to promote a multi-sectoral approach. In addition, they called for more alternatively-fuelled vehicles to be put on the market and for action to reduce the costs of these vehicles. For electricity, hydrogen and biogas, they called for **increased traceability** of the origins of the fuels. In addition, they called for the AFID to include all alternative fuels that could be used to decarbonise road freight and maritime transport, and for the use of LNG and renewable hydrogen and other green fuels in ships. Finally, they called for **public transport operators** to be encouraged to install the necessary refuelling / recharging stations, while also calling for the deployment of relevant refuelling points for railway applications.

A response from a **German public authority** noted that hydrogen should be considered on a par with electricity as an energy carrier to contribute to meeting climate protection goals. In addition, they noted that the maximum levels of state aid allowed for by the EU's Treaties would not enable municipal companies to convert their fleets to hydrogen in sufficient numbers that would make the construction of a hydrogen filling station economic. Hence, either fleets would be converted over a long period, or not at all.

In addition, **citizens** provided the following reports and links:

- Paper on Tempo Beta's ZE-Drive.
- Links to sites on renewable fuels: https://aireg.de/themen/alternative-flugkraftstoffe-aus-regenerativen-energien/regenerative-kraftstoffe/; and https://www.energieagentur.nrw/mobilitaet/kraftstoffe_und_erneuerbare_energien
- Forecasts of the uptake of electric cars: https://www.bcg.com/fr-fr/publications/2020/drive-electric-cars-to-the-tipping-point.aspx
- Tested ERS are described in: https://www.appsinmedic.com/servers/ers2020/absFiles/pdf_29739.pdf

- Hydrogen-energy sector report to the Ministry of Ecology and the Minister of the Economy: https://www.economie.gouv.fr/files/files/directions_services/cge/filiere-hydrogene-energie.pdf
- Efficiency of the ADEME hydrogen chain: https://www.ademe.fr/rénement-chaine-hydrogene
- Battery Pack Prices Fall: https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/

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