Executive Summary

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

Final report

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November 2021

EUROPEAN COMMISSION

Directorate-General for Mobility and Transport

Directorate B – Investment, Innovative & Sustainable Transport

Unit B4 – Sustainable & Intelligent Transport

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Luxembourg: Publications Office of the European Union, 2021

ISBN 978-92-76-46335-1
doi: 10.2832/838954

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

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

- 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
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 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

[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.

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.

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MI-03-21-502-EN-N

ISBN : 978-92-76-46335-1

doi: 10.2832/838954