European Commission

Technical assistance to assess the potential of renewable liquid and gaseous transport fuels of non-biological origin (RFNBOs) as well as recycled carbon fuels (RCFs), to establish a methodology to determine the share of renewable energy from RFNBOs as well as to develop a framework on additionality in the transport sector

Final report | Task 3

Develop a framework on additionality in the EU transport 2020 to 2050 in the EU transport sector

Guidehouse

Fraunhofer ISI

EUROPEAN COMMISSION

Directorate-General for Energy
Directorate C— Green Transition and Energy System Integration
Unit C2—Decarbonisation and Sustainability of Energy Sources

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Abstract

This report analyses the provisions in the Renewable Energy Directive II (RED II) obliging the European Commission to develop a framework to cover additional electricity demand in the EU transport sector with additional renewable energy (RES-E) capacities (Article 27.3 (Art 27.3), subparagraph 3 of RED II). Even though future electricity demand in the EU transport sector is expected to grow significantly and related emissions may increase, the overall risk of electric mobility causing additional emissions in the power sector can be considered small. This is due to the relatively higher efficiency of electric vehicles (EVs) compared to fossil-based vehicles and the fact that EVs are on EU average already less CO2-intense than fossil-fueled vehicles. Hence, we find that there is no urgent need for additionality of renewable energy to cover electricity demand from the transport sector, especially compared with the case of renewable fuels of non-biological origin (RFNBOs). We therefore recommend the design of a voluntary framework on additionality that lets Member States opt to monitor and report additional electricity demand. The framework does not include obligations towards private individuals or economic operators. The report provides detailed guidance on determining the baseline, actual consumption, and projected consumption of electricity to establish such a voluntary framework.

Table of Contents

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1. Summary

The Renewable Energy Directive II (RED II)[1] includes provisions for the European Commission to develop a framework to cover additional electricity demand in the EU transport sector with additional renewable energy (RES-E) capacities. These provisions for additionality are laid out in Article 27.3 (Art 27.3), subparagraph 3 of RED II. The provisions refer only to direct electrification of transport, including electric road and railway transport and excluding indirect use of electricity for renewable fuels of non-biological origin (RFNBO) production.

Future electricity demand in the EU transport sector is expected to grow significantly. According to the EU Roadmap 2050, electricity consumption from road transport alone will amount to 740 TWh in 2050. However, electric mobility is three times as efficient as fossil-based vehicles, so the electrification of road transport will reduce total energy demand in the EU. This makes it easier for Member States to reach their renewable energy.

To evaluate the purpose of the additionality provisions, section 3 of this report summarises the two main technologies that drive electricity consumption in the EU transport sector through direct electrification (electric mobility and electric railway transport). That section also presents the RED II provisions that aim to ensure that additional transport sector electricity demand is covered with additional RES-E capacities.

Electric vehicles (EVs) are on EU average less CO_2-intense than combustion engine vehicles using fossil fuels, assuming electricity from the grid mix. However, EV market uptake may lead to additional greenhouse gas emissions in the power sector, especially if the future load pattern induces marginal electricity production from fossil-based plants due to the merit order principle. Despite this, the overall risk of electric mobility causing additional emissions in the power sector can be considered small as electricity supply in the EU is becoming more renewable due to national RES policies and the EU ETS, which ensures that overall emissions from sectors covered by it (including the power sector) do not exceed a climate target corridor. Therefore, there is no urgent need for additionality of RES-E to cover electricity demand from the transport sector, especially compared with the case of RFNBOs. The provisions from Art 27.3, subparagraph 3 of RED II may still help ensure that the additional electricity demand from the transport sector does not lead to increasing emissions in the power sector.

Section 4 discusses possible interpretations of the provisions regarding their scope, level of obligation, and reference to the baseline. It finds that the provisions do not include obligations towards private individuals, economic operators, or Member States. Instead, they allow for a voluntary framework that Member States may choose to apply to monitor and report additional electricity demand. Member States could also include additional RES-E capacities to cover this demand in Member State planning.

We understand that the current baseline (as stated in the provisions) refers to today's actual electricity consumption in the transport sector (referred to as option 2 in the report). It may also be interpreted as a business-as-usual (BAU) scenario (referred to as option 1). However, the available BAU scenarios that could be referred to for the baseline already include significant uptake of electric mobility. It does not seem reasonable to demand only for additional electricity demand beyond such expected uptake to be covered by additional RES-E capacities.

[1] (DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, 2018)

Section 5 discusses options for determining the baseline (options 1 and 2), actual consumption, and projected consumption. Official EU scenarios and the National energy and climate plans (NECPs) are examined for projections (ex ante), and sources providing the actual electricity consumption of the transport sector are considered for empirical data (ex post). For ex ante determination, it is assumed that a significant effort was made with the NECPs and that the projections are largely based on model results. A drawback is that the models are Member State specific, meaning model assumptions were not aligned, and the models are inconsistent. The EU scenarios are based on common assumptions but may be less accurate than the national models in reflecting the characteristics of the individual Member States. For ex post verification, Eurostat/SHARES is the most comprehensive source of electricity consumption in the transport sector (23 Member States available for road transport). In addition, Member States all must ensure the measurement of electricity consumption in the transport sector within the framework of RED II, which can close existing data gaps in the future and improve the data quality.

Section 6 recommends a voluntary framework on additionality. This framework allows Member States to voluntarily report their expected electricity demand in the transport sector beyond their current baseline. The framework also helps them consider any expected additional electricity demand in the transport sector in their RES-E planning. For the reporting framework, we recommend using Eurostat/SHARES data for the actual consumption and to build on existing projections in the NECPs (Section 5) for projected consumption.

2. Project and report structure

This project is structured into three tasks, each of which is covered by a separate report. This report focuses on task 3, which is concerned with developing an additionality framework for electricity consumed in the EU transport sector. Task 3 also focuses on developing different options with a view to determining the baseline of Member States and measuring additionality according to the provisions of Art. 27.3, subparagraph 3 of Renewable Energy Directive II (RED II).

This report presents the findings in this task from project inception in May 2020 to the report's date. Details on the other tasks can be found in their respective reports. The other reports focus on the following topics:

- Task 1: Assessing the potential of renewable fuels of non-biological origin (RFNBOs) and recycled carbon fuels (RCFs), as defined in RED II, from 2020 to 2050 in the transport sector in the EU. The assessment includes deployment potential, resource competition, and decarbonisation potential.

- Task 2: Developing detailed rules by which RFNBOs producers can provide evidence that they are using fully renewable energy (RES-E) in the production of their fuel to establish the methodology under Art. 27.3, subparagraph 7 of RED II.

This report introduces the characteristics of electric mobility as a technology to decarbonise the transport sector. It analyses RED II requirements for additionality of RES-E capacity to cover future demand from electric mobility in road and railway transport (Section 2). Section 3 discusses general principles of RES-E additionality in the context of electric mobility and electric railway transport and presents possible interpretations of the corresponding provisions in RED II. Section 4 presents options to derive the baseline and projections and actual consumption from existing data sources. These options are assessed based on criteria (see annex 1) in Section 5. Section 6 proposes options to implement the additionality framework according to the provisions of Art. 27.3, subparagraph 3 of RED II, including recommendations for reporting and the consideration of additional capacities in RES-E planning on the Member State level.

3. Policy context

3.1 Characteristics of electric mobility as a technology to decarbonise the transport sector

EVs emit no greenhouse gas emissions during operation, meaning there are zero tank-to-wheel or tailpipe emissions. Compared to carbon-fueled vehicles, EV advantages include that no locally health-threatening tailpipe pollutants like nitrogen oxides (NOx), non-methane hydrocarbons (NMHC), or particular matter (PM) are emitted at the point of use and that noise and vibrations are significantly lower (European Commission, 2020).

While the emissions during operation are zero, the greenhouse gas emissions over the entire lifecycle of an EV depend on the production pathway and the greenhouse gas emission intensity of the electricity that is used to fuel the vehicle. If the electricity input is based on fossil energy sources, the relative greenhouse gas reduction compared to the use of fossil fuels decreases. With an average emission intensity in the European Union of 294 gCO_2/kWh (2017) (European Environment Agency, 2020), the use of EVs is already less CO_2-intense than combustion engine vehicles using fossil fuels (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2019).[2] However, the greenhouse gas reduction potential of EVs is far from fully leveraged.

Compared to other drivetrains and fuel options that contribute to decarbonisation in the transport sectors, electric mobility is the most energy efficient alternative. EV tank-to-wheel energy efficiency is higher than that of internal combustion engine vehicles by a factor of approximately three (European Commission, 2020). In addition to the drivetrain efficiency, direct use of electricity for propulsion is more energy efficient than using electricity based RFNBOs. Due to conversion losses during the production of hydrogen and liquid hydrogen-based fuels, a fuel cell EV travelling 1 km uses twice the electricity input compared to a battery EV (BEV) and a vehicle fueled by liquid hydrogen-based fuels even uses about 4 times the energy as Figure 1 shows. The risk of additional emissions with rising shares of EVs is less pronounced than in the case of hydrogen or RFNBOs.

[2] For example, a compact class electric vehicle charged with the German grid mix (485 g CO_2/kWh; 2017) is about 16% (petrol) or 27% (diesel) less CO_2 intense than an internal combustion engine vehicle over its entire lifetime. This takes into account the whole life-cycle of the vehicle, including production.

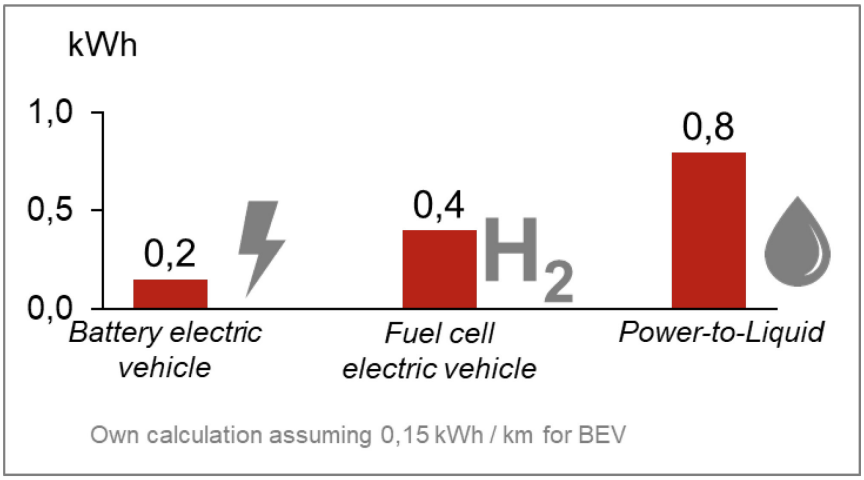


Figure 1: Electricity needed for driving a passenger car 1 km (kWh) (Source: (Agora Verkehrswende, 2018)

[3] scenario, EV stock (battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs)) in EU28 countries could rise from less than 1 million electric cars in 2018 to more than 35 million in 2030 and around 190 million in 2050, assuming the modelled climate targets are achieved (European Commission, 2018). In this scenario, up to 34% of all final energy demand in passenger car transport could be electric by 2050. The related additional electricity demand in 2050 (about 356 TWh) would increase overall EU electricity demand by 10% (compared to 2017). Actual electricity demand from EVs may be even higher than that given the increased ambition of more recent EU climate targets.

The European Climate Foundations' EU Roadmap 2050 would have all passenger cars electrified in 2050 with 80% BEVs and 20% plug-in hybrid electric vehicles (PHEVs). The estimated corresponding electricity consumption from road transport in 2050 is 740 TWh (European Climate Foundation, 2010). Actual future demand will depend on the total number and efficiency of EVs, but it is obvious that additional demand will be quite significant.

It is challenging to measure actual energy consumption from electric mobility accurately on the Member State level. This is due to the different charging points that can be used, including charging at home, at work, and at public or semi-public charge points (shopping malls). The energy demand at public and semi-public charge points is metered, but not aggregated in a systematic manner in many Member States. Charging at public charge points only makes up about 15% of charging processes, the rest takes place at home or at work where no dedicated metering occurs (Transport & Environment, 2020). Member States are relying on proxies to estimate the energy consumption from electric mobility to account for it regarding the RED II transport sector target.

[3] Published in 2016, the EUCO30 scenario is an official scenario developed on behalf of the Commission. It reflects the 2030 targets of at least 40% reduction in greenhouse gas emissions with respect to 1990, 27% share of RES in final energy consumption and 30% reduction in the primary energy consumption and the 2050 decarbonisation objectives, continuing and intensifying the current policy mix. For the scenario, the average specific fuel consumption of a BEV was projected to be one third of that of a conventional internal combustion engine car in 2050. EUCO2030 was built based on the EU Reference Scenario 2016. The technical report of the more recent EUCO3232.5 scenario does not specify vehicle stock; therefore, the older scenario is cited.

3.2 Electricity consumption in railway transport

Electricity in railway made up for 1% of total energy consumption in transport in 2017 (European Environment Agency, 2019). Total energy consumption in railway transport is projected to have no strong changes even though railway activity is projected to increase (76% increase during 2010-2050 for passenger transport and 84% for freight transport) (European Commission, 2016). This is due to expected energy efficiency increases and additional electrification of railway lines. The EU 2016 reference scenario expects efficiency improvements of 14% (freight transport) and 19% (passenger transport) until 2030 compared to 2010 (European Commission, 2017).

Compared to road transport, railway transport is already largely electrified, with 60% of the European rail network electrified and 80% of traffic running on these lines (2017). In cities, rail almost exclusively runs on electricity (European Commission, 2017). The EU 2016 reference scenario projects that substiting the remaining diesel-powered railway lines by electric railway will contribute to electricity consumption in transport, but the main driver for increased electricity consumption will be electric mobility (European Commission, 2016).

3.3 RED II requirements regarding additionality for electric mobility

RED II set a target that RES-E must cover 32% of EU final energy consumption by 2030. Also, RED II first introduced a specific target for the transport sector, requiring Member States to cover 14% of energy consumption from transport with RES-E by 2030. To achieve the target, some RES-E sources may be accounted for with multipliers.

The target accounting rules in RED II strongly encourage Member States to electrify the transport sector. Recital (87) of RED II states:

> *"Electromobility is expected to constitute a substantial part of the renewable energy in the transport sector by the year 2030. Further incentives should be provided considering the swift development of electromobility and the potential of that sector in terms of growth and jobs in the Union."*

Accordingly, the share of RES-E shall be considered 4 times its energy content when supplied to road vehicles and may be considered 1.5 times its energy content when supplied to rail transport according to Art. 27 (2) (b) of the RED II. These relatively high multipliers also aim to reduce electromobilities' comparative disadvantage in energy statistics. Electric mobility requires little final energy per kilometre compared to combustion engines. The multiplier makes up for this calculative disadvantage. The multiplier also accounts for the fact that it is not possible to account for all electricity supplied used for electric road vehicles through dedicated metering, given charging takes place in a decentralised manner at home, at work, and at public charging stations. To calculate the share of RES-E in the electricity supplied to road and rail vehicles, Member States must refer to the 2-year period before the year in which it was supplied as stated in Art. 27.3, subparagraph 1.

Although strong incentives for higher shares of electric mobility are in place, RED II includes provisions to ensure that RES-E is used for electric mobility. According to recital 87, *"options should be explored to ensure that the new demand for electricity in the transport sector is met with additional generation capacity of energy from renewable sources."* Art. 27.3, subparagraph 3 substantiates this recommendation:

> *"In order to ensure that the expected increase in demand for electricity in the transport sector beyond the current baseline is met with additional renewable energy*

generation capacity, the Commission shall develop a framework on additionality in the transport sector and shall develop different options with a view to determining the baseline of Member States and measuring additionality."

The purpose of this report drafted on behalf of the Commission is to provide recommendations how this provision can be interpreted, develop options to determine the electricity consumption in Member States' transport sectors, and develop an additionality framework for the transport sector.

3.4 Purpose of linking electric mobility to additional RES capacities as required by RED II

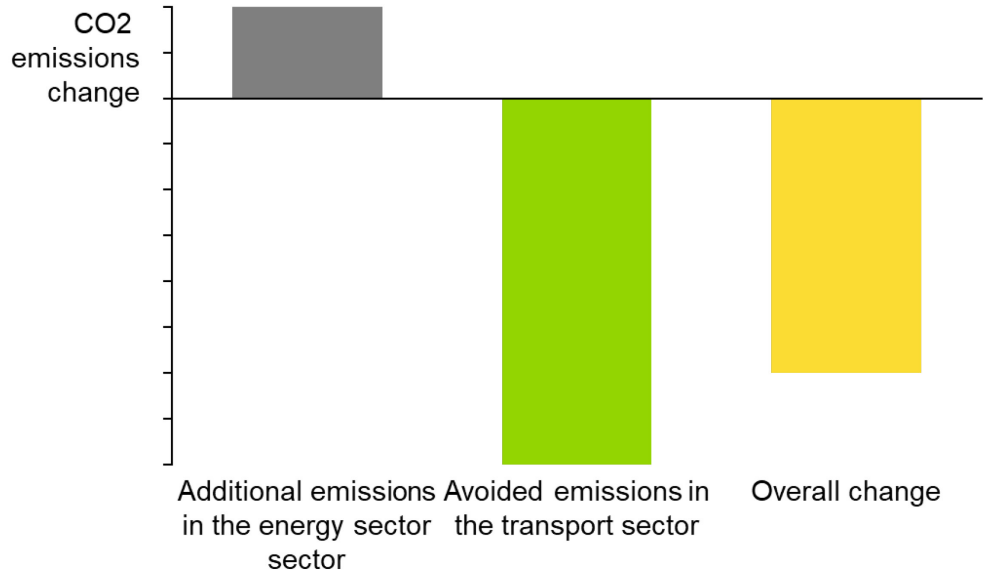
The intent may not be obvious behind the provisions for additional RES-E capacities to cover additional electricity demand in the transport sector given the relatively high energy efficiency of electric mobility. An assessment is required of the possible emission intensity development over time and the marginal electricity production induced by electric mobility. The following section details the purpose of the RED II provisions.

Correlation of transport electrification and electricity mix emission intensity

Well-to-wheel emissions of electric mobility are determined by the share of fossil-free energy in the electricity input. Electric mobility is already less emission intense than fossil-based drivetrains in most Member States today (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2019), but the technology is far from achieving its full emission reduction potential.

In the long term, assuming Member States achieve climate neutrality, the electricity mix will be almost entirely fossil-free and so the EVs' well-to-wheel[4] emissions will be zero. However, the reduction of electric mobility's greenhouse gas intensity will not be linear over time. During the interim period until the achievement of climate neutrality, electric mobility may lead to higher average greenhouse gas emission intensities of the grid mix and higher emissions in the power sector, even if the total greenhouse gas emissions decrease due to the emission reduction in the transport sector. This occurs if additional annual demand exceeded the additional fossil-free energy capacities added to the energy system in a given year. Figure 2 illustrates how avoided emissions in the transport sector are, to a small extent, offset by additional emissions in the power sector.

[4] Well-to-wheel emissions do not include vehicle production.



$_2$ emissions in the EU energy and road transport sectors (Source: Guidehouse)

In extreme circumstances, the electricity used in the transport sector each year could be more carbon intensive than in the previous year, meaning the climate footprint of electric mobility worsens from one year to the next. This may be the case in years with low wind supply and high additional electricity demand in the transport sector, for example, through a sudden surge in EV demand.

The public is aware of the lack of clarity around the development of the electricity input, which presents a credibility issue for electric mobility. This may have negative repercussions on market uptake today if customer decisions are negatively influenced by it. A transparent, reliable additionality framework would help ensure additional EVs do not increase greenhouse gas emissions in the power sector.

Marginal electricity production induced by electric mobility

It can be argued that the average greenhouse gas emission intensity of the grid mix is not the relevant indicator, but rather the emission intensity of the marginal electricity production induced by the “new” demand from electric mobility. If additional demand comes into the system, the merit order of power plants determines which energy source is used to generate additional supply to cover it. RES-E plants (except for biomass) are first in the merit order due to their low marginal cost, so they almost always produce electricity when the weather allows it, meaning that additional demand beyond this supply activates additional fossil-based electricity production plants. This is further aggravated by the typical demand profile of electric mobility with peak demand occurring during evening hours when RES-E supply is lower than average (McKinsey & Company, 2018).

The actual need for additional RES capacities to cover EVs depends strongly on future charging patterns, that may be very different from todays. Charging patterns may change depending on when and how smart charging strategies are introduced. Smart charging strategies could lead to a significantly altered demand profile as charging processes would be temporally shifted. Charging could orient towards RES-E infeed, grid capacity, or electricity cost reduction. Charging patterns that effectively use RES-E infeed could reduce the need for additional capacity for dispatchable plants such as coal by harvesting RES-E

surplus production and by increasing production of existing plants (European Environment Agency, 2016). Significant technical and regulatory barriers remain for the introduction of smart charging strategies; there is also some controversy about what the primary purpose of smart charging strategies should be (European Commission, 2018). The actual demand profile would depend on what the smart charging strategy is optimised for, whether it is cost optimisation or grid-oriented charging patterns.

Given that it is unclear how smart charging strategies will be implemented there is a risk that additional electricity demand from the transport sector will induce carbon intense electricity production due to the merit order principle.

Overlap with European emissions trading

The risk of additional emissions in the power sector from electric mobility is somewhat mitigated as such emissions are already regulated by the European Emissions Trading Scheme (EU ETS). The EU ETS regulates European electricity generation, energy-intensive industry, and intra-European air traffic by setting a cap (annual emissions limit) on greenhouse gas emissions and so facilitates that these are within the target corridor. This raises the question of whether an additionality framework is needed. If the demand for electricity increases due to a growing number of electric vehicles, the EU ETS prevents an increase in emissions above a certain limit within the regulated sectors. Although emissions in the electricity sector could increase, this would have to be compensated by lower emissions from industry or aviation and the total emissions of these sectors would not increase due to more EVs. Against this background, an additionality framework may not appear to be necessary under greenhouse gas savings considerations; however, it could complement the EU ETS in preventing additional emissions in the power sector.

Impact of electric mobility uptake on target achievement

Rising shares of electric mobility facilitate RED II target achievement even with a constant electricity generation mix. The high energy efficiency of EVs compared to fossil-based drivetrains means that the total energy consumption in the transport sector will decrease with increasing shares of electric mobility. Given that the RED II target for the EU is expressed as the share of RES-E in total energy consumption, higher shares of electric mobility will facilitate target achievement even if the total RES-E capacity remains constant over time as high electric mobility shares will decrease the numerator of the target calculation.

The same holds true as the total energy consumption is reduced for the Member State target of 14% RES-E in the transport sector. In addition, the positive impact of other renewable sources such as bioenergy (biogas, liquid biofuels) for target achievement strengthens as the denominator decreases.

4. Possible interpretations of unspecified provisions of Article 27.3, subparagraph 3

Art. 27.3, subparagraph 3 leaves room for interpretation. The following sections include interpretations of the provisions and provide recommendations as to which interpretation is recommendable.

4.1 Scope of the additionality provisions

In the context of Art. 27.3, subparagraph 3, *"demand for electricity in the transport sector"* may be understood either as the demand for electricity for direct use in EVs or railway transport or as the sum of electricity used in direct electrification and electricity used to produce RFNBOs, which are then used in the transport sector.

However, the structure of Article 27 indicates that only electricity used in direct electrification is covered by the provisions. Provisions for RFNBOs are specified from the fourth subparagraph onwards, indicating that the first three subparagraphs refer to direct electrification only.

RED II includes different provisions of additionality for electricity used for direct electrification versus electricity used for RFNBO production because of the large difference in energy efficiency. RED II introduces additionality requirements for RFNBOs because of the high associated risk of additional emissions, which are a lot less pronounced in the case of direct electrification. It is logical that both should be treated separately.

Art. 27.3, subparagraph 3 therefore refers only to electricity used for direct electrification in road and railway transport.

4.2 Additionality concept

RED II does not specify the concept of additionality in Art. 27.3, subparagraph 3. The concept is applied in other climate protection regimes. In the Kyoto Protocol's Clean Development Mechanism (CDM), greenhouse gas savings are considered additional if they would not have occurred in the absence of a Joint Implementation or a CDM project (IPCC, 2020). That means that any greenhouse gas emissions savings that would have been achieved even without CDM projects or projects of joint implementation projects are excluded. Transferring this concept to Art. 27.3, subparagraph 3 of RED II means that only RES-E capacities that were unplanned would be considered additional.

Additional capacities would have to be deployed corresponding to the additional electricity demand from electric mobility and railway in the EU transport sector. If Member States trigger additional RES-E capacities, additionality requirements regarding targets on the Member State level would have to be considered (see chapter 7).

4.3 Addressed parties

The provisions of Art. 27.3, subparagraph 3 are a direct call to action to the Commission, stating that *"the Commission shall develop a framework on additionality in the transport sector."* However, it does not specify whether the obligations that may be derived from this would be addressed to Member States or operators.

For RFNBOs, economic operators are required to ensure that the electricity used in RFNBO production fulfils RED II renewability criteria. In the case of direct electrification, responsibility may shift to economic operators in a similar manner. This shift ensures a degree of fairness of cost allocation, as the stakeholders of the transport sector would have to pay for demand generated in the sector. However, requirements for reporting electricity consumption for EVs and for providing additional RES-E capacities at the level of individual consumers and companies would create an additional barrier for these actors to invest in electric mobility, which might interfere with the political goal of increasing the share and number of EVs. RED II text does not specifically mention economic operators like charging point operators as the parties addressed by the provisions. By contrast, this is explicit for RFNBOs in subparagraph 7 of Article 27, which mentions, *"detailed rules by which economic operators are to comply with the requirements."*

Addressing the provisions to Member States appears more sensible from a viewpoint of practicability. The development of a reliable and uniform methodology for the proof of the amount of additional RES-E that is consumed in the transport sector on an individual consumer level is difficult, as it would have to be applied to a heterogenous group including private consumers, electricity providers, prosumers, and charging station operators.

It is only feasible to measure additionality of RES-E consumed in the transport sector on a system level. This assessment is due to the difficulties related to imposing binding reporting obligations on diverse, numerous stakeholders. The assessment for this task will focus on options to measure energy consumption and ensure additionality of RES-E consumed in the transport sector at Member State level.

4.4 Possible obligations resulting from the additionality framework

This section discusses whether the additionality provisions for electric mobility should result in a legal obligation towards Member States (or economic operators) or not, with three main possible options that may be combined:

- The additionality framework provides one or several options for accurately measuring electricity consumption from electric mobility. Member States should plan for additional RES-E capacities corresponding to additional demand from electric mobility. No reporting or legal obligation for Member States arises.

- Member States have a reporting obligation to show the development of electricity consumption from electric mobility over time. This may include the obligation to follow one specific measurement option. Member States should plan for additional RES-E capacities corresponding to additional demand from electric mobility. No legal obligation for Member States to plan for additional RES-E capacities arises.

- Member States must plan for additional RES-E capacities to cover additional demand from electric mobility.

Given the phrasing of RED II, which excludes an obligation towards Member States but asks that *"the Commission shall develop a framework on additionality in the transport sector and shall develop different options with a view to determining the baseline of Member States and measuring additionality,"* a legally binding obligation to plan for additional RES-E capacities does not seem intended.

A legally binding obligation to plan for additional capacities does not appear aligned to the purpose of EU climate targets against the background of Member States setting specific

targets for themselves (self-obligation) and enjoying a high degree of flexibility in how targets are reached. If the effort-sharing targets[5] are achieved, the need for strict additionality criteria for electricity demand in the transport sector is unclear.

Furthermore, given the higher energy efficiency compared with RFNBOs, the extent to which the additionality criteria pose a burden on Member States with high rates of direct electrification should be critically reflected in future revisions of RED II.We recommend that the provisions on additionality for electric mobility should not be translated into a binding obligation to add additional RES capacities.

The risk of electric mobility causing additional emissions is relatively low as emission savings in the transport sector will likely far outweigh potential additional emissions in the power sector. Additional emissions caused in the power sector also are covered by the EU ETS. Against this background, it can be considered whether a more relaxed interpretation of additionality may be acceptable for electric mobility. In this case, additional RES-E generation capacity could refer either to additional generation compared to the status quo in any given year rather than additionally deployed RES-E capacities. If additionality referred only to additional capacities compared to the previous year, this would be a soft requirement to prevent the worst-case scenario, meaning that the well-to-wheel emissions become more emission intense over time. The disadvantage of this interpretation is that additional electricity demand from transport might take up all the additional RES-E production in a given year, meaning that the average emission intensity of the rest of the electricity demand remains constant.

Figure 3 summarises the obligations from the provisions of Art. 27.3, subparagraph 3 of RED II. While the provisions explicitly demand the Commission to develop a framework on additionality and provide options for Member States to determine the baseline and measure additionality, an obligation for Member States to report on additionality and even ensure additionality of RES-E capacities for electricity demand in transport cannot be derived.

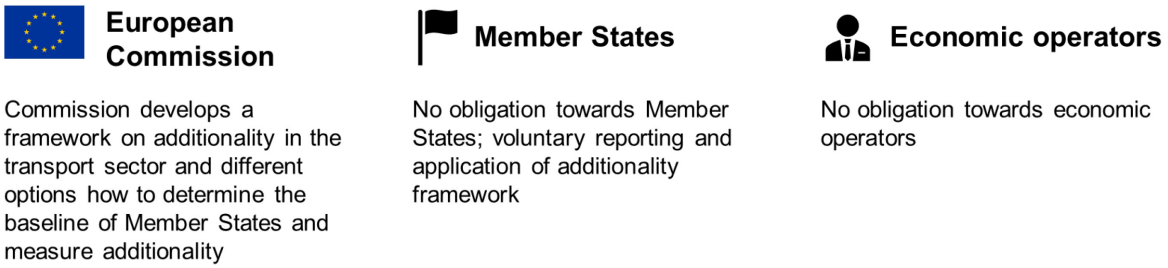


Figure 3: Possible obligations arising from Art. 27.3 subparagraph 3 of RED II (Source: Guidehouse)

Creating a binding reporting obligation or requiring Member States to consider additionality in their RES-E planning would require an adjustment of RED, likely during the upcoming revision. The current provisions allow for a voluntary framework or guidance for Member States, the following sections assess what this framework may look like.

4.5 Interpretation of the current baseline

Art. 27.3, subparagraph 3 states that the Commission shall *"ensure that the expected increase in demand for electricity in the transport sector beyond the current baseline is met*

[5] (Regulation (EU) 2018/842, 2018)

with additional renewable energy generation capacity." There is ambiguity with regard to what the current baseline refers to. Its interpretation is crucial to the definition of an additionality framework for electricity consumed in the EU transport sector.

In the EU, baseline usually refers to a business-as-usual (BAU) projection. For electricity demand in the transport sector, the EU reference scenarios or chapter 4 in the NECPs could be used as data sources.

There is an alternative possible interpretation, which is that baseline refers to today's actual consumption. At first sight, it seems that using a BAU scenario would be more accurate as it considers changes in other parameters that may influence electricity consumption in the transport sector, such as economic growth. However, available BAU scenarios that could be used as the basis for calculating additional demand *"beyond the current baseline"* (such as the EU reference scenarios or chapter 4 of the NECPs) already include significant future EV market uptake as some support measures are already in place. It appears illogical to treat only demand that goes beyond future EV uptake according to BAU scenarios as "additional demand" to be covered by additional RES capacities. Furthermore, using BAU scenarios as the baseline would result in different requirement levels for Member States, depending on weather a Member State had already introduced ambitious EV support policies at the time of modelling the respective BAU scenario.

We therefore recommend that actual consumption in a fixed baseline year should be the "current baseline" for electricity consumption in the transport sector. Choosing today's electricity consumption establishes that all additional demand that was created after a fixed baseline year has to be covered by additional RES-E capacities under the additionality framework.

Figure 4 illustrates the two interpretations. Option 1 indicates that electricity demand covered by additional RES-E capacities is the difference between a target scenario and a BAU scenario. Option 2 indicates that electricity demand covered by additional RES-E capacities refers to the difference between a target scenario and actual consumption defined by a fixed year.

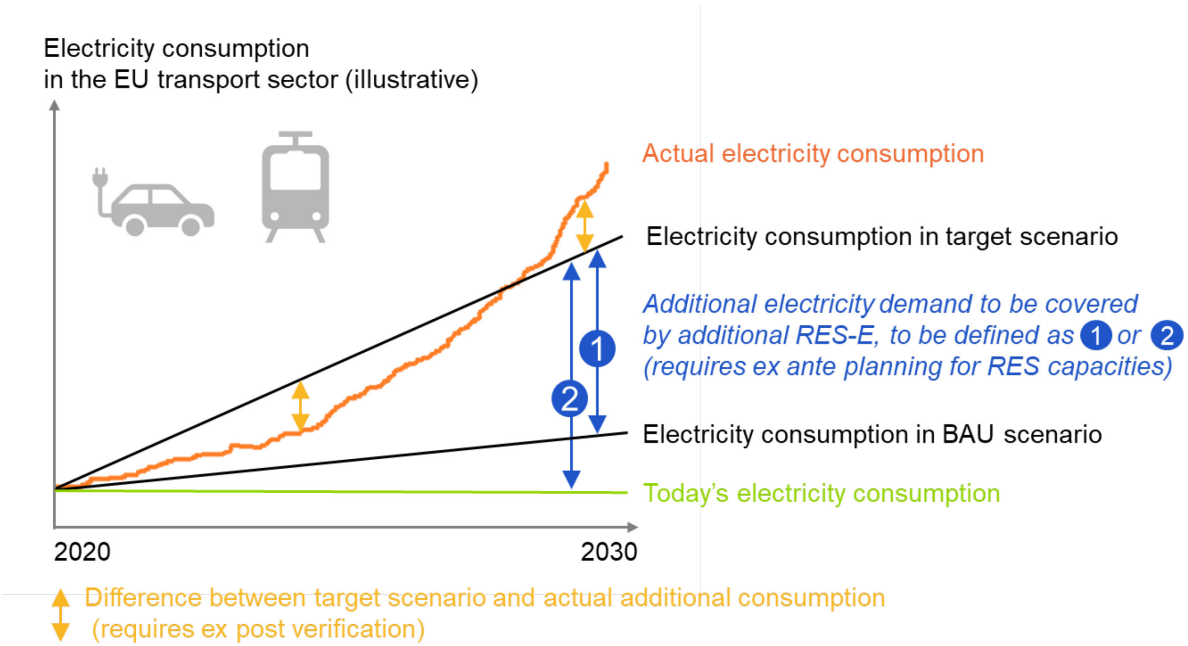


Figure 4: Additionality requirements according to RED II Art. 27.3, subparagraph 3 (Source: Guidehouse)

Actual consumption will divert from the target scenario, going below or beyond the foreseen additional demand in any given year. To account for this difference, an ex post verification could be introduced. Based on such a verification, the target scenario could be updated in regular intervals so that actual consumption diverts as little as possible from the target scenario. This would increase the possibility that all additional demand is covered by the additionality provisions.

5. Options for determining the additional electricity consumption of transport in EU Member States

This section includes our assessment of different options for determining the baseline consumption in the transport sector, building on the conceptual considerations developed in section 4.5. Electricity consumption in other sectors will be defined as the difference of the overall electricity consumption (as taken from official national statistical sources) and the electricity consumption in the transport sector.

The baseline to be determined depends heavily on baseline's definition in Art. 27.3, subparagraph 3. Section 4.5 discusses two possible definitions of the baseline (see Figure 4). Option 1 defines additionality as the difference between a target achievement scenario and a BAU scenario, while Option 2 defines it as the difference between a target achievement scenario and actual consumption. If the definition of additionality is based on Option 1, the baseline represents a BAU projection of electricity consumption in the transport sector for the future. If additionality is defined as Option 2, the baseline represents actual consumption of electricity in the transport sector and this would define the baseline on the basis of existing data. To establish comparability between the baselines of the Member States while also gaining acceptance from the Member States, the determination of the baseline should be based on existing EU-wide or national sources.

The following sections present existing projections (ex ante; option 1 and target scenario) and existing statistics (ex post = option 2), which represent possible sources.

5.1 Determining the additional electricity consumption in the transport sector ex ante based on BAU projections

If the assessment of additional electricity consumption by electric mobility is meant to be an ex ante planning process, an approach based on projections is required. To make such an ex ante assessment of electricity consumption in the transport sector, NECPs or an official EU scenario are appropriate data sources. The EU Reference Scenario (only the 2016 scenario is published, another reference scenario was planned for 2020 but is not yet published)[6] or national current policy scenarios (chapter 4 of NECPs) underlying the NECPs could serve as the BAU scenario and so as the baseline scenario, as they continue current policies but do not consider additional ones. The EUCO3232.5 scenario or national planned policy scenarios (chapter 5 of NECPs) underlying the NECPs could serve as the 2030 target scenario.

For the baseline definition, a scenario is used that continues current policies and so is unlikely to lead to achieving any transport sector targets. Possible sources for determining the baseline include the EU Reference Scenarios or Chapter 4 of the NECPs, which deals with current situation and projections with existing policies and measures. There is also a possibility of using a new scenario (at EU level or by each Member State) that is developed specifically for the baseline definition. This would have the advantage of being more up-to-date and so more reflective of the current political framework conditions of the transport sector.

[6] It is currently unclear when exactly the updated reference scenario will be published.

5.1.1 EU Scenarios

The latest official EU Reference Scenario from 2016 (European Commission, 2016) provides detailed information on electricity generation (see Figure 5). It also details energy consumption by sectors and for every Member State. To determine the baseline, the electricity consumed in the transport sector is needed. This cannot be taken directly from the scenario results, but can be calculated from the information provided, at least for road transport (but not for railway), which would be a weakness of the data. The energy consumption of the transport sector is shown in kilotonne of oil equivalent (ktoe). It is divided into public road transport, private cars and motorcycles, and heavy goods and light commercial vehicles, all of which form road transport. Besides this, rail, aviation, and inland navigation are shown (see Figure 6). For road transport, the amount of electricity used is also given as a percentage of the energy used. In the scenario, this rises from 0% in 2015 to 2.3% in 2050 at EU level. By multiplying the given percentage with the energy consumption from road transport, it is possible to calculate the electricity used in road transport.

ELECTRICITY	2015	2020	2025	2030	2035	2040	2045	2050
Gross Electricity generation by source [1] (GWh_e)	**3251309**	**3357685**	**3430637**	**3527528**	**3632768**	**3759812**	**3900096**	**4063737**
Nuclear energy	867402	772986	717746	777743	789909	734053	732443	736532
Solids	846834	767262	655378	562741	441534	329407	231324	251549
Oil (including refinery gas)	34609	21835	21271	19341	14189	13974	12188	4844
Gas (including derived gases)	566075	580999	682078	654930	796541	925361	945456	835542
Biomass-w aste	188813	213112	249701	283469	317350	363515	381476	391380
Hydro (pumping excluded)	362415	375589	375481	378979	386753	395409	408337	421101
Wind	274278	462720	527399	608460	619197	691880	821486	979998
Solar	103798	154722	192666	232129	256261	293251	353448	428535
Geothermal and other renew ables	7086	8461	8916	9736	11032	12962	13937	14254
Other fuels (hydrogen, methanol)	0	0	0	0	0	0	0	0

Figure 5: Electricity generation shown in the EU Reference Scenario (example EU-28) (Source: EU Commission)

TRANSPORT	2015	2020	2025	2030	2035	2040	2045	2050
Energy demand in transport (ktoe) [4]	**358062**	**350945**	**344898**	**341463**	**343372**	**347354**	**351233**	**355025**
Public road transport	9040	9281	9298	9281	9361	9431	9542	9649
Private cars and motorcycles	204765	190035	179668	174380	172933	172584	172413	172419
Heavy goods and light commercial vehicles	78507	81943	83785	85822	87786	89517	90948	92230
Rail	7395	7863	8317	8637	8864	9044	9042	9018
Aviation	53303	56489	58294	57606	58516	60692	63134	65483
Inland navigation	5051	5334	5536	5737	5912	6086	6155	6225
By transport activity								
Passenger transport	271237	260066	251683	245768	245422	247427	249871	252399
Freight transport	86825	90878	93215	95695	97950	99926	101361	102626
Other indicators								
Electricity in road transport (%)	0,0	0,2	0,4	0,9	1,2	1,5	1,9	2,3
Biofuels in total fuels (excl.hydrogen and electricity) (	4,6	6,1	6,2	6,2	6,3	6,3	6,5	6,6

Figure 6: Energy demand of the transport sector in the EU Reference Scenario (example EU-28) (Source: EU Commission)

In the Reference Scenario for inland navigation and aviation, it seems a justifiable assumption that the demand for electricity from these two sectors will not increase significantly between now and 2050, as electric transport options are only available at very high costs, if at all (International Energy Agency, 2019). For rail, the Reference Scenario data do not show how much electricity is consumed. However, the data is likely available in the models and could be provided by the modellers. The direct automatic reporting of the electricity consumption of all sub-sectors of the transport sector in the scenarios could simplify data collection. Today, data for the baseline are only directly available for road transport, which, however, will most likely show the strongest changes compared to today and represents the most important electricity-consuming end use of the four sectors relevant here.

Thus, the reference scenario is an option for determining the baseline, but it also has disadvantages due to the unavailability of data for rail and the fact that it is an EU scenario that does not come from the Member States themselves and may not take national characteristics sufficiently into account. The problem that it is from 2016 and thus outdated would be solved by the new Reference Scenario planned for 2020 (but in December 2020 not yet published).

Figure 5 and Figure 6 show screenshots from the EU Reference Scenario for electricity generation and energy demand in the transport sector for the EU-28. Data is also available on Member State level. For the EUCO scenarios, the data is available in a similar format and the EUCO scenarios could serve as a basis for the projected consumption. However, these scenarios would be outdated in the case of targets tightening under the New Green Deal.

5.1.2 National energy and climate plans (NECPs)

In addition to the EU Scenarios, NECPs also represent a potential source of the baseline and projected electricity consumption in the transport sector (European Commission, 2020). Chapter 4 of the NECPs (current situation and projections with existing policies and measures) could be used for baseline determination because it could be regarded as a kind of baseline scenario. Chapter 5 (planned policy scenarios) of the NECPs could be used as a basis for determining projected consumption under target achievement.

The electricity consumption of the transport sector is needed to determine the baseline and the projected consumption. However, most NECPs do not provide sufficient detail to derive the electricity consumption of the transport sector, which was not a specific requirement for the NECP. Some Member States do not show any figures for electricity consumption in the transport sector, such as Austria. Although the energy consumption of the transport sector and the sector's share of RES-E are shown in most NECPs, no electricity demand for the transport sector can be derived from this, as, in addition to electricity, sustainable biofuels and imported RFNBOs also count as RES-E. Some Member States (such as Lithuania) report the electricity consumption of the transport sector in chapter 4.2.2 (Dimension Decarbonisation – RES-E) of their NECP. Other countries, such as Bulgaria or Portugal, show the share or consumption of electricity in RES-E used in the transport sector. However, in these cases it is unclear whether this is the total electricity demand by the transport sector or only RES-E.

In some NECPs, such as the Finnish or German one, there is a clear figure for electricity consumption in the transport sector and it refers to electricity from RES-E sources. This is not necessarily equal to the total electricity consumption of the transport sector, since not all electricity is renewable. Assuming the figures in the NECP are in line with Art. 27.3, subparagraph 3 of RED II regarding the calculation factors (multiplication factors) for RES-E use in the transport sector, calculating the total electricity consumption on the basis of RES-E consumption is a major challenge that could not be solved using the NECP documents alone. Not all NECP documents provide information on how much electricity the transport sector will consume in 2030 with existing policies, or what forms of transport (rail, road, etc.) will consume this electricity.

However, the figures in each of the NECPs are based on model projections that likely could also provide the data required for determining the baseline and projected electricity consumption.

5.1.3 Conclusion

A significant effort was made with the NECPs and the projections are largely based on model results. It may be possible for the Member States to extract the electricity consumption of EVs and rail from the respective underlying model results. Even if the data can be extracted from the underlying models, a drawback is that the models are Member State specific and may be based on different assumptions, making it difficult to compare the results. The EU scenarios are based on common assumptions but may be less accurate than the national models in reflecting the characteristics of the individual Member States. Section 5 includes criteria-based assessments regarding the feasibility of these options as the basis for a voluntary reporting framework.

5.2 Determining electricity consumption in the transport sector ex post

In addition to determining the baseline based on projections, it could also be based on statistical data on electricity consumption in the transport sector in a base year (for example, entry into force of RED II) as a fixed reference point. This would require the availability of reliable data sources. Since such a determination is based on statistics and not on projections looking into the future, this is an ex post determination. The advantage of an ex post determination is that it is based on empirical data and is constant over time. Any future increase of the electricity consumption in the transport sector would then be additional. In principle, a uniform data source for the Member States' national statistics is preferable, as this means that different scopes mostly can be avoided. The following subsections present potential data sources. They reference the reference year and actual electricity consumption in the coming years. The data could also provide a source for ex post verification. However, for ex post verification, it is recommended that Member States under RED II submit official data as the preferred sources. Today, SHARES data is used for this.

5.2.1 Eurostat/SHARES

Under Eurostat’s annual energy statistics in the section "Supply, transformation and consumption of electricity," (Eurostat database code: nrg_cb_e) one can find the electricity consumption of the transport sector (“Final consumption - transport sector - energy use”) (eurostat, 2020). This electricity consumption is the sum of the subcategories for rail, road transport, pipeline transport, and one unspecified category. Data for total transport electricity consumption and rail electricity consumption are available for all Member States except Cyprus and Malta. Data on road transport are also missing for Denmark and Sweden.

Although some data gaps persist, these have become smaller in recent years. For example, in 2012, in addition to Cyprus, Malta, Sweden, and Denmark, no data was available for Belgium, Greece, Spain, Croatia, Hungary, Portugal, Slovakia, and Finland. Due to the increasing importance of electricity consumption in road transport, it is possible that these data gaps may be filled in the future. The latest available year is currently 2018. To get more detailed information about the data, a request was made to Eurostat within the framework of this project. According to Eurostat, reported figures tend to underestimate the real consumption of electricity in some Member States, as the countries may not be able to track all electricity consumed in the transport sector due to consumption in private buildings and generic public charging places in commercial buildings. The exact collection of data on electricity consumption in the transport sector is not available to Eurostat but is carried out in the Member States on the basis of the regulation on energy statistics. According to Eurostat, this collection does not prescribe a uniform procedure but rather general principles that must

be followed (Regulation No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics, 2008).

The Eurostat Energy Statistics Quantities metadata website (European Commission, 2019) provides information at Member State level on who collected the data at national level (eurostat, 2020). However, the websites do not present the methodologies, nor are these methodologies usually directly available on the websites of these institutions. To understand more about the methodologies used, these institutions should be consulted. Table 5-1 shows the data available in Eurostat on electricity consumption in road transport.

Eurostat data generally has the advantage that it is available for almost all Member States, but it also has disadvantages in terms of accuracy and comparability between Member States. National sources tend to be updated more frequently, including backdated updates, and are often available more immediately.

The Eurostat data shown is also used for the SHARES data on renewables (European Commission, 2018). In the detailed results of the SHARES data, the electricity consumption of the transport sector is shown. The data is shown in kilotonne oil equivalent but are identical to the Eurostat data shown here when a conversion factor to gigawatt-hour (11.63) is used. The Eurostat/SHARES data will be referred to in simplified form as Eurostat data, where both sources are always meant when it comes to concrete data.

Table 5-1: Electricity consumption in road transport in EU Member States between 2012 and 2018 in GWh

GEO/TIME	2012	2013	2014	2015	2016	2017	2018
Belgium	:	3.000	7.500	12.600	27.600	45.200	57.900
Bulgaria	40.000	53.000	86.000	54.000	55.000	52.681	35.695
Czechia	69.000	67.000	65.000	66.000	69.000	66.888	67.861
Denmark	:	:	:	:	:	:	:
Germany	29.000	40.000	54.000	79.000	108.000	157.000	227.000
Estonia	22.000	21.000	18.000	17.000	17.000	16.000	17.000
Ireland	0.495	0.662	1.297	2.668	4.178	7.102	11.779
Greece	:	22.000	24.000	25.000	23.000	24.262	23.400
Spain	:	22.000	24.000	30.000	40.000	58.000	114.000
France	40.505	62.057	87.488	119.180	159.450	208.672	261.791
Croatia	:	:	:	:	:	:	1.000
Italy	59.000	66.000	68.000	71.000	69.000	82.949	99.016
Cyprus	:	:	:	:	:	:	:
Latvia	65.000	65.000	57.000	52.000	54.000	53.908	28.469
Lithuania	41.000	40.000	35.000	35.000	36.000	36.400	36.700
Luxembourg	0.025	0.217	0.335	0.428	0.797	1.072	1.437
Hungary	:	18.000	17.000	19.000	24.000	24.000	26.000
Malta	:	:	:	:	:	:	:
Netherlands	20.000	34.000	70.000	187.066	346.124	432.044	504.515
Austria	14.927	14.798	14.338	14.174	14.037	14.372	14.676
Poland	20.000	18.000	19.000	22.000	25.000	26.503	28.144
Portugal	:	:	:	1.000	1.000	2.132	5.339
Romania	62.000	46.000	46.000	42.000	37.000	38.145	39.186
Slovenia	:	:	:	:	:	0.868	1.056

GEO/TIME	2012	2013	2014	2015	2016	2017	2018
Slovakia	:	28.000	26.000	25.000	25.000	25.000	24.000
Finland	:	1.000	3.000	5.000	10.000	22.000	46.000
Sweden	:	:	:	:	:	:	:

Source: Eurostat

5.2.2 National Statistics

In addition to Eurostat data, data from national statistics could also provide information on electricity consumption in the transport sector. As Eurostat figures were provided by national sources, it is likely that such data will be available at national level as well. However, as the electricity demand by EVs is still limited, data collection is still in its early stages and hardly any sources other than those used by Eurostat are available. However, the institution collecting data for Eurostat at a national level could also make data available on national platforms, as these would be national sources, which could lead to greater acceptance among Member States. One example of this is the AG Energiebilanzen in Germany. One of its members is the Federal Association of the Energy and Water Industry (BDEW) in Germany, which is also the institution responsible for the figures on electricity consumption in the transport sector in Germany, as shown on the Eurostat website.

The AG Energiebilanzen shows the electricity consumed by the transport sector in Germany. Figures are also available for each sub-sector, including road and rail. For road transport, AG Energiebilanzen's figures since 2016 differ only slightly from the Eurostat figures, but they are significantly different. For example, the figures from AG Energiebilanzen between 2013 and 2015 are significantly higher than the Eurostat figures; AG Energiebilanzen reports no electricity consumption before 2013, but Eurostat does. Eurostat and BDEW could not provide exact information on this, but BDEW's assumption is that the figures in Eurostat do not receive any subsequent updates, as the figures of the AG Energiebilanzen do. Given the limited availability of national sources and the fact that they may use the same data as Eurostat, the differences in data quality appear limited.

5.2.3 Other possible data sources

In addition to Eurostat or national sources, other Europe-wide or worldwide sources could be used for the electricity consumption of the transport sector. Such sources may be relevant for EVs, as good national sources are usually available for rail transport. For example, the UNECE website and the EEA website offer databases on road transport, but are based on Eurostat data for the European area and so cannot provide extra information.

In addition, the International Energy Agency (IEA) usually publishes a Global EV Outlook annually. However, the data it contains does not cover all EU Member States and deviates significantly upwards compared to the Eurostat data, with regard to the stock of EVs. Data on driving distance, efficiency or electricity consumption are not provided by IEA.

Status and problems of statistical data of electricity consumption in road transport

In contrast to railways' electricity use, which is easily tracked, it is more difficult to monitor electricity consumption in road transport, especially since no distinction is made between electricity for the EV and other electricity consumed in private or semi-public areas. Only the electricity consumption of public charging points can be metered easily. As long as no meters measuring the electricity consumption of cars are installed, or as long as there are no obligations for private households to measure the electricity consumed by their cars, the statistical collection of data will only be based on estimates and assumptions. This is one of the main reasons why today few sources show the electricity consumption of road transport. A formula is often used to calculate electricity consumption based on the average annual kilometres driven per vehicle, the number of vehicles and the average consumption of the vehicles. The Eurostat figures for Germany are also based on this formula.

While it seems easy to implement such an approach using the formula, data availability is a challenge. Such a calculation may not be precise because deriving the average kilometres travelled by vehicle is challenging. Such distances are difficult to assess as vehicle usage statistics need to be collected. Furthermore, many kilometres are covered in long-distance travel and vehicles may then be charged outside the Member State. To date, these inaccuracies appear to be minor as little progress has been made in the switch to EVs, particularly for holiday trips and heavy goods traffic, but if, for example, overhead catenary trucks become established in the next few years, this poses a further problem. However, if the kilometres driven by EVs differ significantly from other vehicles, the average kilometres driven would be estimated incorrectly, which would in turn lead to an incorrect estimate of electricity consumption. In addition, there are further challenges with regards to the differentiation between PEVs and fully electric vehicles. The share of PEVs is high in many Member States and growth in this segment is substantial. It is unclear which share of energy consumption PEVs draw from their battery and there is no valid method to reliably measure or estimate electricity use from PEV at this point.

5.2.4 Conclusion

Eurostat is currently the most comprehensive source of electricity consumption in the transport sector (23 Member States available, rail and road transport available). National statistics are also useable, but due to the limited data available for road transport, it cannot be assumed that the national sources differ significantly from the Eurostat data. This is especially the case since, even if data was not collected by the same institution, it is likely based on the same calculation methods (see Box). However, national sources may lead to greater acceptance by Member States and may offer an advantage. All Member States must facilitate the measurement of electricity consumption in the transport sector within the framework of RED II, which can be expected to close existing data gaps in the future and improve the data quality. Other data sources are hardly available.

6. Criteria-based assessment of options for determining the additional electricity consumption in the transport sector

This section measures the defined options for determining the baseline, projection, and actual consumption against a set of assessment criteria. These include reliability of the derived baseline, transparency of the data and methodology, the administrative and economic burden for Member States, political acceptance, and privacy concerns. The annex (section 10) includes a detailed definition of the criteria. For every criterion, we describe a scale with the following three levels (green, yellow, red):

- Green: Fully sufficient or no/limited objections
- Yellow: Acceptable or moderate objections and
- Red: Insufficient or strong objections

When reviewing the RES targets within the framework of RED II, data on electricity consumption in transport will have to be collected by all Member States in the future (it is a RED II requirement to collect this data). Therefore, this data should be used in case of an ex post measurement of current electricity consumption in transport. The RED target achievement is verified via SHARES data, which is currently the same as the Eurostat data. In the following sections we assume that the Eurostat and SHARES data will remain identical in the future.

6.1 Ex ante data

In the case of Option 1 from Figure 4 (when the calculation of additionality is based on a BAU and a target scenario), we recommend the same source is used for both the BAU and target scenarios. This means that either the EU scenarios (reference scenario for the baseline and EUCO scenario for target achievement) or the NECPs (Chapter 4 as baseline and Chapter 5 as target achievement) are used. A mix of sources (such as the EU reference scenario as baseline and the NECPs Chapter 5 as target achievement) is unreasonable due to the different underlying models and assumptions, especially since assumptions on certain technologies and policies can differ significantly. This subsection makes an assessment of the EU scenarios and the NECPs. The assessment always refers to the baseline scenario and the target achievement scenario and only distinguishes between the two scenarios if necessary.

6.1.1 EU scenarios

- **Reliability:** The EU scenarios (reference and EUCO) are project the development of the Member States with a focus on energy use, which means that there is always uncertainty about the developments and the data are less robust than empirical data. However, these are official scenarios that were calculated with great care and high standards of reliability—but they may have weaknesses regarding the reflection of individual country characteristics. They are available for all Member States and are based on the same models, which simplifies comparability.

- **Transparency:** The scenarios (EUCO and reference) and information about the underlying assumptions and methodology are publicly available but the complexity of

the scenarios is high and hardly comprehensible for nonexperts. Basic assumptions and the exact calculation paths are difficult to access and not comprehensible for everyone, which often makes the results a black box for nonexperts.

- **Administrative and economic burden:** As section 5.1 shows, the electricity consumption of road transport can be determined from the EU scenarios without much effort, so Member States would not have any additional burden to collect these data. For rail and the other transport subsectors, modelers might need to be consulted.

- **Political acceptance:** The scenarios are calculated using PRIMES models, which means that there are no inconsistencies between the individual Member State scenarios in terms of modelling. However, in the past, there has been criticism about the model's inaccuracies regarding individual characteristics of Member States as well as the lack of Member State responsibility for the scenarios, which could lower acceptance among policymakers. As of today (December 2020), no up-to-date scenarios are available. The last reference scenario is from 2016 (update was planned for 2020) and the EUCO scenarios are based on the EU's current energy and climate targets, which are likely to tighten up by the end of the year, so timely availability of updated scenario data could be a problem.

- **Privacy concerns:** The scenarios do not include any data from private individuals or households, so there are no concerns regarding privacy.

6.1.2 NECPs

- **Reliability:** NECPs are comparable with the EU scenarios in terms of data reliability. They are official documents and were prepared and reviewed with great care. Compared to the EU scenarios, they are more likely to better reflect the characteristics of the Member States. They are also available for all Member States, although at different levels of detail.

- **Transparency:** The NECPs are publicly available. Although NECP reports are complex, they are also comprehensible to nonexperts. However, the underlying model calculations and assumptions are not fully available to the public and would probably be difficult for nonexperts to understand. Furthermore, the electricity consumption of the transport sector and its subsectors are not necessarily shown in the NECPs, which means that more electricity consumption data for EVs, rail, and other transportation sectors will need to be provided from the models, further reducing transparency. Overall, the transparency of the NECPs appears lower than that of the EU scenarios.

- **Administrative and economic burden:** The NECPs do not always provide the necessary data on electricity consumption in the transport sector, but the underlying modelling should provide the data so Member States do not have a high burden to collect the necessary data. Since the NECPs are official EU documents evaluated by the EU, there would be few additional costs for reporting and verification of the data. If EU climate targets are tightened, Member States would have to revise their NECPs to reflect their updated targets. In such an interim period, the NECPs would not serve as an up-to-date useful source for the projection of electricity demand in the transport sector.

- **Political acceptance:** The NECPs are individual country documents, which means that the scenario assumptions may not be consistent between the individual NECPs. The individual NECPs drawn up by the countries themselves usually reflect the characteristics of the country (leading to high acceptance their) and probably lead to a greater overall acceptance than the EU scenarios.

- **Privacy concerns:** The NECPs do not include any data from private individuals or households, so there are no concerns regarding privacy.

6.2 Ex post data

This subsection assesses available data that can be used for the case of Option 2 from Figure 4, i.e. when additionality is defined as the difference between actual consumption and a target scenario.

6.2.1 Eurostat

- **Reliability:** For most Member States, Eurostat data is based on empirical data (public charging stations in case of road transport) and must partly be calculated with proxies (to determine the electricity demand from charging at home or at the work place) whose difficulties and uncertainties (driving performance of all vehicles is not equal to driving performance of EVs) are mostly known. The data is collected based on Eurostat's quality requirements and is available for most Member States. Only data for Denmark, Cyprus, Malta, and Sweden is missing for electricity consumption in the road transport sector. However, these data gaps will likely be closed once RED II is implemented as it requires the measurement of electricity consumption in transport.

- **Transparency:** Eurostat data is publicly available. The Eurostat websites do not provide any information on how the data was collected, only on the responsible organisation in each Member State. A brief consultation with the responsible organisation in one Member State informed on data collection, but this information was only available by request and only in a rough level of detail. As no official data collection documents are available for these Eurostat data, transparency is not fully ensured in this case.

- **Administrative and economic burden:** The data is directly available in Eurostat and requires little adaptation. If no additional data quality requirements are set for the additionality framework, limited administrative effort is required.

- **Political acceptance:** The Eurostat data is currently the same as the SHARES data, which is already used for the RED target achievement verification. This likely relates to the high acceptance of Eurostat data (also due to lack of alternatives).

- **Privacy concerns:** Eurostat data does not include any data from private individuals or households, so there are no concerns regarding privacy.

6.2.2 National statistics

- **Reliability:** Analysis shows that where national statistics are available, they likely are identical to Eurostat data (probably only one organisation in the Member State collects the data and makes it available nationally and to Eurostat), which means

proxies have to calculate this data. Official national statistics about electricity consumption in road transport (rail is usually available) are available for fewer Member States than Eurostat. However, due to the increasing importance of this data, it is expected that more national sources will be available in the future, especially since the verification of the RES targets will require the collection of this data.

- **Transparency:** Data is usually publicly available but the methodologies behind the data is mostly available on demand only. For some Member States, there is no publicly available documentation on data collection. Due to the complex collection of data and the limited sources available, transparency has not been very high so far.

- **Administrative and economic burden:** Due to Eurostat data currently having much in common national statistics, the same evaluation applies to them. The administrative burden is low for available data, whereas in Member States without an existing national source, data would have to be collected, requiring administrative effort.

- **Political acceptance:** Political acceptance of the data could be slightly higher for the national data (compared to Eurostat) as the data collection can be more controlled by the Member States. The transparency problems and administrative burdens (in case national statistics are not available) further limit acceptance.

- **Privacy concerns:** National sources are usually publicly available and therefore checked and unproblematic regarding privacy concerns.

6.2.3 Other data sources (IEA)

- **Reliability:** Other data sources are usually based on European or national statistics or are collected by organisations such as the IEA. Self-collected data are likely to be based on proxies due to less access to empirical data. Apart from sources based on Eurostat, there are no other known sources for which data on electricity consumption in road transport has been collected that covers several Member States. Due to the lack of direct data from private sources on electricity consumption in road transport, this data would have to be estimated based on the available data, which would involve great uncertainty.

- **Transparency:** The transparency of private organisations' data is usually poor, since the collection of such data is often the business model of the data provider and it is typically not made publicly available.

- **Administrative and economic burden:** Data from the IEA or other private organisations must be purchased for a fee, so additional burden is incurred by the Member State. The data available in these sources would have to be processed further, as they usually do not show the electricity consumption of road transport. The administrative burden seems therefore to be rather high.

- **Political acceptance:** Due to the generally low transparency of data from private organisations, the fact that they usually must be purchased and that they are not easily verifiable, data from private sources will likely be less accepted than official and transparent data.

- **Privacy concerns:** We are not aware of any source that uses collection methods critical to data protection law. If data sources relying on personal data are available in the future, such as the individual driving behaviour of EV users, , this could potentially lead to data protection problems.

6.3 Conclusion

Table 6-1 summarises the assessment from the previous sections. In an ex ante definition of the baseline, the EU scenarios or the NECPs are possible sources and both are comparable in terms of reliability. Both sources were prepared with the great care and high reliability standards and were checked several times. However, these are projections that always contain uncertainties regarding future developments. The administrative burden also seems to be limited for both sources, as the necessary data should be available directly or at least in the respective modelling. However, timely updates of the documents might not be available, which could limit their usability. Transparency seems to be somewhat higher in the EU scenarios, as thorough, uniform information is available whereas the modelling behind the NECPs is not transparently communicated by all Member States. In terms of political acceptance, the NECPs could meet broader acceptance than the EU scenarios, as they were developed by the Member States themselves so that they can better cover the individual characteristics of the Member States. Due to the better reflection of the country characteristics and the resulting higher political acceptance, we recommend the NECPs as a basis for the projected electricity consumption of the transport sector, although not all necessary data is directly available (but likely from the underlying models).

For the ex post data, it is recommended that the additionality calculation be based on the data collected under the RED II (SHARES data). Today these are identical to the Eurostat data, but there are no precise guidelines for this yet so future changes in the collection methodologies seem likely. It can be assumed that the data will be reliable, that it will require little administrative effort (since it has to be collected anyway), and that it will meet with the greatest political acceptance of all ex post data sources. Since we assume that the SHARES data will not differ from the Eurostat data in the future, even if the collection methodology is changed, both sources are equal.

Table 6-1: Evaluation scheme for options to define the baseline for additionality

Options for baseline definition		Reliability	Trans-parency	Administra-tive burden	Political acceptance	Privacy concerns
Ex ante options	EU Scenarios					
	NECPs					
Ex post options	Eurostat					
	National statistics					
	Other data sources					

fully sufficient
acceptable
insufficient

Recommendations

Baseline consumption: Use Eurostat/SHARES data of a specific base year for the baseline, as these are almost completely available for all Member States and the problem of different stages of implementation of policies for electrification of the transport sector between Member States (see section 4.5) is less present here than for a projected baseline. If a projected baseline is used, we recommend selecting it analogous to the projected consumption at target achievement.

Projected consumption at target achievement: Use the NECPs for data on projected consumption in case of target achievement. Since the NECPs are national documents, we believe it is more likely that the policies and measures of the Member States will be strongly oriented towards them, which makes them more appropriate. To ensure consistency, projected baseline consumption and projected consumption when targets are met should be based on the same database. Either the NECPs or the EU scenarios should be used and not one source for one value and the other source for the other value.

Actual consumption: Use Eurostat/SHARES data for actual consumption, as these are also used for the RED II verification.

7. Recommendations for the voluntary framework for additionality

7.1 *Reporting on additionality of RES-E capacities*

The precondition to cover additional electricity demand from the transport sector in the EU with additional RES-E capacities is a standardised approach to reporting the actual consumption, the baseline, and projection of transport sector electricity demand across the Member States.

The inclusion of current and expected electricity demand from the transport sector in regular reporting raises awareness for the large additional demand and makes this development transparent across Member States. As a mandatory reporting obligation for Member States cannot be derived from Art. 27.3, subparagraph 3, this section makes concrete recommendations on a reporting framework for Member States voluntarily choosing to include these indicators in their reporting.

To determine the additional future demand, data on the baseline consumption, the projected consumption and the actual consumption should be uniformly collected and reported to the Commission as part of the NECP progress reports.

In addition to reporting the data above, Member States could show how final energy consumption was impacted. The impact would equal the reduction in final energy consumption in the transport consumption plus the additional energy demand in the power sector. They could also describe (qualitatively) how the additional demand was considered in RES-E planning.

7.1.1 Determining and reporting actual consumption

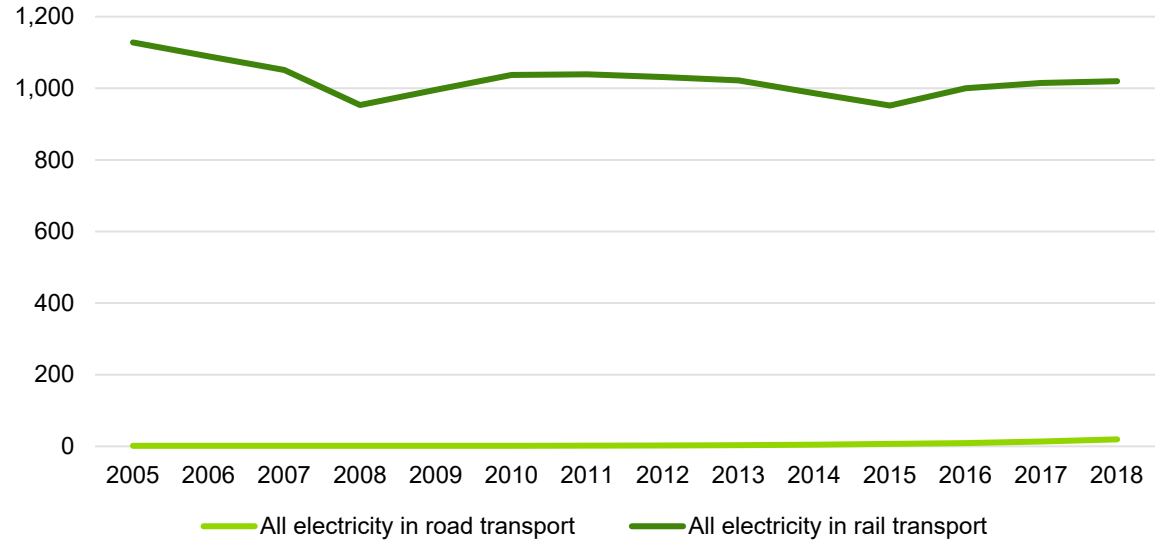
We recommend that Member States report their current electricity consumption, which is necessary for the ex post verification and the baseline, on the basis of Eurostat/SHARES data. Historical data should also be reported, at least the baseline year should always be shown and highlighted. The data can be best extracted from the SHARES tool. In the Transport databook, the electricity consumption of the transport sector is shown in lines 74 to 86. Listed are rail, road and all other transport modes, in each case split into RE and non-RE electricity, where it can be chosen which RES-E share should be used (national, EU, higher value). For reporting we recommend to show rail, road and other transport separately. Table 7-1 lists the figures for Germany as an example. Figure 7 illustrates the electricity consumption.

Table 7-1: Historical electricity consumption in transport sector in Germany in ktoe

	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018
Transport	1,129	1,039	1,041	1,034	1,025	991	959	1,009	1,028	1,039
rail transport	1,128	1,037	1,039	1,031	1,022	986	952	1,000	1,015	1,020
road transport	2	2	2	2	3	5	7	9	13	20
other transport										

Source: SHARES data for Germany

Figure 7: Historical data on electricity consumption in transport sector in Germany in ktoe



Source: Fraunhofer based on SHARES Data

7.1.2 Determining and reporting projected consumption

To report projected electricity consumption in the transport sector, Member States should use data from their NECPs. For the example reporting template (Table 7-2) we assume that NECP data is used for the projection data. The data from Chapter 5 "Impact assessment of planned policies and measures" of the NECPs can be used for the projected consumption in case of target achievement. Again, the electricity consumption of the transport sector should be divided into rail, road, and other transport. If the data is not available in the NECP documents, the contractors responsible for the modelling should be contacted as can provide the data. Units of measurement should be the same as those used for reporting historical data. Table 7-2 could serve as a template. To be thorough, we also recommend using report Chapter 4 of the NECPs, as these figures are necessary in case of a baseline calculation using a reference scenario (which we do not recommend given the reasons mentioned in previous sections).

Table 7-2 Projected electricity consumption in transport sector for Germany in ktoe

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Transport - chapter 4										
rail transport										
road transport										
other transport										
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Transport - chapter 5										
rail transport										
road transport										
other transport										

7.1.3 Determining additional capacities

To determine additional RES-E capacity needs, the baseline must be subtracted from the projected electricity consumption (target scenario):

> Additional RES-E capacities = Projected RES-E consumption - RES-E consumption baseline

To calculate the required additional RES-E, the row "Transport - chapter 4" of Table 7-2 must be subtracted from the row "Transport - chapter 5." In a fixed baseline based on empirical data, the fixed value would always be deducted from the rows "Transport - chapter 5". This fixed value must be taken from one of the columns in the row "Transport" of Table 7-1, dependent on the chosen fixed baseline year.

In the case of ex post verification, the baseline must be subtracted from actual consumption in the target year.

> Necessary additional RES-E = actual consumption in target year - RES-E consumption Baseline

The consumption of the target year can be taken from Table 7-1, the baseline as in the ex ante calculation either from Table 7-1 or from Table 7-2.

7.2 *Consideration of additional electricity demand in transport sector in RES-E planning*

Section 4.4 finds that a Member State obligation to build additional RES-E capacities cannot be derived from the provisions of Art. 27.3 subparagraph 3. A binding obligation would also contradict the fact that RED II does not make any explicit requirements for target additionality and any option that would aim to ensure target additionality[7] effectively will likely require an adjustment of RED II.

This section discusses how Member States could consider additional renewable energy capacities in their planning to cover additional demand from the transport sector, should they voluntarily decide to do so.

7.2.1 Ex ante target adjustment

To ensure the required additional RES capacities are built, Member States need to adjust the volumes of their national RES-E tendering schemes accordingly (either add the additional electricity volumes or equivalent capacities to their auction schedules).

To adjust their RES targets ex ante (which is not mandatory under the current RED), Member States' national contributions to the EU RES target would have to be increased ex ante by the projected additional electricity consumption in the transport sector. The RES target share in the NECP is modified by adding the projected additional electricity consumption in the numerator and denominator. The ex post verification of RES target achievement would then done as described in RED II in Art. 7.

[7] The principle of target additionality is also addressed in great detail in the second interim report of Task 2 of this project, focusing on criteria for RFNBOs. Refer to the Task 2 report for further details.

A challenge of the ex ante target adjustment is the uncertainty in actual additional electricity consumption in the transport sector, which will likely deviate from the projection. This means that additionality would be over or underachieved in practice. This is no immediate problem in a voluntary additionality framework. Member States could regularly perform an ex post verification of target achievement and adjust their future planning accordingly.

If the additionality requirement becomes mandatory, ex post corrections might have to be applied.

7.2.2 Ex post discounting from RES target achievement

In an ex post approach, Member States review their RES targets retrospectively based on empirical data on actual consumption. Member States would deduct all additional electricity consumed in the transport sector from the numerator and denominator of the RES share calculation. They would then show if they had achieved their target with providing additional RES-E capacities for electricity consumption in transport.

If the provisions are obligatory during the RED III revision, implementing the ex post options would require adapting Art. 7 of RED II.

We recommend that a voluntary additionality framework be based on ex ante target achievement, so additional RES-E capacities are included in the planning phase.

8. Conclusions

Assuming the EU's greenhouse gas emission reduction strategies for transport are achieved, electricity demand in the EU transport sector will increase significantly in the coming years. Against this background, the provisions of Art. 27.3, subparagraph 3 of RED II oblige the Commission to develop a framework on additionality to ensure that the expected demand increase is met with additional RES-E capacities:

> *"In order to ensure that the expected increase in demand for electricity in the transport sector beyond the current baseline is met with additional renewable energy generation capacity, the Commission shall develop a framework on additionality in the transport sector and shall develop different options with a view to determining the baseline of Member States and measuring additionality."*

The framework refers only to direct electrification and will help keep electricity demand in the transport sector from leading to additional greenhouse gas emissions in the power sector. These would increase if the additional demand was covered by fossil-based power generation.

EVs, which will make up the largest part of additional demand, are on EU average less CO_2-intense than combustion engine vehicles using fossil fuels, assuming the grid mix as electricity infeed (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2019). However, depending on the load pattern, electric mobility may induce marginal fossil-based electricity production, inducing additional greenhouse gas emissions in the power sector. Aside from this effect, there is small overall risk of electric mobility causing additional emissions in the power sector, as electricity supply in the EU is becoming more renewable due to national RES policies and the EU ETS, ensuring that overall emissions from sectors it covers (including the power sector) do not exceed a climate target corridor. The need for RES-E additionality to cover additional electricity demand from the transport sector is not urgent, in particular compared to the case of RFNBOs. However, by monitoring, reporting, and planning for additional RES-E capacities, Member States could lend increased credibility to electric mobility as a climate technology and refute the ongoing public criticism about the electricity infeed being based on fossil sources. This could increase acceptance of electric mobility.

The provisions of Art. 27.3, subparagraph 3 of RED II do not oblige private households or economic operators. However, they do ask the Commission to develop a voluntary framework for Member States that choose to monitor or report additional electricity demand in the transport sector and to cover this additional demand with additional RES-E capacities. This report provides recommendations on the design of such a voluntary additionality framework.

Additional capacities refer to expected demand that goes beyond the current baseline. The expected demand is defined by a projection. Member State's projections on expected demand could be based on the EU's EUCO scenarios or Chapter 5 of the NECPs. Given that the NECP projections enjoy a larger acceptance among Member States and consider national differences more accurately, we recommend that Chapter 5 of the NECPs should be referred to for the projections.

The baseline in the provisions can be understood as either a BAU scenario to be determined in an ex ante approach or as the actual consumption in a fixed base year that is to be determined. We recommend using the latter as the baseline, as the available BAU scenarios of different Member States include EV support policies and so a certain uptake of electric

mobility already. This also means that Member State's BAU baselines include with different ambition levels. Member States with high ambition levels for EV policy support would have to cover a lower share of overall additional demand with additional RES-E sources than Member States with lower ambition levels if a BAU scenario was used as the baseline. Using a fixed year as a baseline bypasses these complications.

Depending on which interpretation is chosen, the following data sources can be used. The baseline defined as the actual consumption should be based on Eurostat/SHARES data. The baseline defined as a BAU scenario could be based on the EU's reference scenario or Chapter 4 of the NECPs. We recommend the NECP as a database due to higher consideration of Member State specificities.

Member States could report the BAU scenario, actual consumption, and projection in their NECP in greater detail than they currently do to improve transparency, monitor the additional electricity demand, and take it into consideration for national RES-E capacity planning. Section 7 details recommendations on how these indicators should be reported so that Member States can chose to do so in a structured, harmonised way.

In addition to monitoring and reporting additional demand, Member States may support additional RES-E capacities and prove such additionality by adjusting their RES-E targets ex ante or deduct additional electricity demand from the transport sector from their RES-E target ex post. In the given context, an ex ante target adjustment makes more sense. This allows Member States to include additional RES-E capacities in their RES planning.

There is little urgency to provide additional RES-E capacities for electricity demand in the transport sector and the voluntary nature of the additionality framework, so it is unclear if Member States will use the additionality framework. We recommend that the status of the additionality framework is clarified during the revision of RED II. As stated above, the need for an additionality framework for direct electrification is much lower than for RFNBOs from a greenhouse gas savings perspective.

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10. Annex

10.1 Assessment criteria to determine the baseline for electricity consumption of the transport sector

As a preliminary step, we develop a set of assessment criteria for the different baseline options. These include reliability of the derived baseline, transparency, ease of introduction, political acceptance, the administrative and economic burden for Member States and other actors as well as privacy concerns. This list of criteria was presented at the kick-off meeting. With this first interim report, we present a first definition of the criteria and discuss their relative importance. For each of the criteria, we list relevant indicators, provide examples of possible issues in the baseline definition with respect to the criterion, and make a proposal for the valuation of the criterion based on the indicators. For every criterion, we describe a scale of attractiveness with three levels (green, yellow, red), with “green” meaning “fully sufficient” or “no/limited objections”, “yellow” meaning “acceptable” or “moderate objections” and “red” meaning “insufficient” or “strong objections”.

10.1.1 Criterion 1: Reliability of the derived baseline

A very important criterion is the reliability of the baseline in view of data quality, required projections in the future, use of proxy data and related uncertainties. Firstly, the quality of empirical data may be poor due to statistical errors and/or data gaps. The poorer the quality, the lower the reliability of the baseline. Second, if the baseline definition includes future projections of uncertain data, the reliability of the baseline is unclear, but official national or EU sources should be considered very reliable. Thirdly, if the definition of the baseline requires additional assumptions by a Member State, there will be some ambiguity in the definition. Fourthly, the definition of a baseline may involve the use of proxy indicators such as the vehicle stock for energy use. In this case, uncertainty about the correlation between the indicator and the proxy may affect the reliability of the baseline. This criterion gives an indication to what extent an option would be reliable in this respect:

- *Fully sufficient (green):* The option is based fully on empirical data with high-quality data available in all Member States or is based on the best available projections.. There is no or only very limited ambiguity in the definition, and the confidence in used proxies – if any – is high.

- *Acceptable (yellow):* Either the option is based fully on empirical data. In this case, issues with data quality are to be of limited impact only, and issues with respect to ambiguity and confidence in proxies are known to be moderate only. In the case of projections, high-quality projections needs to be available in all Member States, ambiguity in the definition is limited, and the confidence is high.

- *Insufficient (red):* The option is not based on any empirical data. Or there are issues with data quality with substantial or unclear impact. Or there is high ambiguity in the definition. Or there is low or unclear confidence in proxies.

10.1.2 Criterion 2: Transparency

The baseline definition and calculation should be transparent, in order to foster a simple reporting and verification. On the one hand, the baseline definition may require the use of proprietary data. On the other hand, the baseline definition may require complex calculations. In both cases, validity and key factors will not be accessible to a broader

audience. This criterion evaluates these aspects of public data availability and ease of calculation:

- *Fully sufficient (green):* All data required for this option is publicly available. The complexity of calculation is low, i.e. accessible also to non-experts.

- *Acceptable (yellow):* The option contains only some non-publicly available data and only from sources with high credibility. The complexity of calculation is moderate, i.e. easily accessible to experts.

- *Insufficient (red):* The option includes only non-publicly available data or some from sources with low or only moderate credibility. Or the required calculations are highly complex and intransparent, i.e. not easily accessible even to experts.

10.1.3 Criterion 3: Administrative and economic burden for Member States and other actors

Any option to define the baseline will create the need for monitoring, reporting and verification. If data is not yet collected, there may be the need to establish a process for collecting additional primary data or even for generating primary data (e.g. via smart metering). If data is collected only by a private entity, there may be the need to purchase it. Moreover, reporting or verification can be complex if large amounts of data need to be processed and/or stored. In total, this could potentially lead to a disproportionate administrative and/or economic burden mainly for Member States but also other actors. In order for the baseline options to be useful, it will also be important that they can be introduced in a fast and easy manner. However, some data is published with high delay so that the available data may be outdated. If a large number of actors needs to provide data, the effort to introduce the baseline calculation will be high and may take a lot of time. Hence, options will be evaluated towards the need to collect additional data, the need to purchase proprietary data, the availability of timely data and the ease of reporting and verification as follows:

- *Fully sufficient (green):* Compliance under this option can be verified using centrally available and timely data; or the data that need to be submitted are based on existing data and documents. Reporting and verification is simple and requires input by a limited number of actors.

- *Acceptable (yellow):* Member States need to compile most required data to demonstrate compliance and/or some new data types might need to be introduced to the market. Data is published with a delay that is acceptable for reporting purposes. Reporting and verification requirements and the number of actors involved are moderate.

- *Insufficient (red):* Member States would need to compile data with a disproportionate volume and/or additional effort. Some new data types that do not exist at all yet might need to be introduced to the market. Some relevant is published with delay not acceptable for reporting purposes. Reporting and verification requirements and/or the number of actors involved are excessive.

10.1.4 Criterion 4: Political acceptance

The additionality framework is meant to be applied by Member States. Therefore, it is important that the proposed options are consistent and fair across the Member States so that their usage is acceptable to all Member States. An inconsistency across Member States may occur, if national data sources apply differing definitions or data quality is not consistent across Member States. A fairness issue may arise if proxy indicators are used or national circumstances distort outcomes, e.g. in case of “fuel tourism”, that is charging of electric vehicles in neighbouring countries with lower electricity prices. The criterion of political acceptance assesses these aspects in the following way:

- *Fully sufficient (green):* There are no or only minimal inconsistencies across Member States between the data sources relevant for the option. No issues with respect to fairness across Member States are known or to expected for the option.

- *Acceptable (yellow):* The inconsistencies across Member States between the data sources relevant for an option are of limited impact only. Known and/or possible fairness issues across Member States are expected to acceptable for all Member States.

- *Insufficient (red)*: The inconsistencies across Member States between the data sources relevant for an option are high, resulting in non-acceptable difference. Or fairness issues across Member States can be expected to be non-acceptable for some Member States.

10.1.5 Criterion 5: Privacy concerns

An option to define the baseline may include the need to process data from individual private actors (firms, private households), e.g. the use of highly disaggregated metering data. In this case, it is necessary to limit the data to the minimum and to process the data anonymised if possible, for privacy concerns. This criterion assesses such privacy concerns:

- *Fully sufficient (green):* The option does not include the need to process data from individual private actors.

- *Acceptable (yellow):* The option includes the need to process data from individual private actors that is already collected for other purposes and be handled in anonymised way in line with corresponding regulations.

- *Insufficient (red):* The option includes the need to collect additional data from individual private actors. Or the option does not allow an anonymised handling of data already collected for other purposes.

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