

## How EU Member States roll-out electric-mobility: Electric Charging Infrastructure in 2020 and beyond

### Executive summary

Sufficient accessible charging infrastructure is a key enabler for the accelerated uptake of electric cars. This briefing analyses the current and planned future roll-out of EV charging infrastructure in European Member States, based on governments' plans (National Policy Frameworks) submitted to the Commission as part of the implementation of the Alternative Fuels Infrastructure Directive.

The aspirations of the member states to support alternative fuels varies greatly – but 10 Member States (Austria, Denmark, France, Finland, Sweden, Germany, Netherlands, UK, Ireland, and Luxembourg) clearly prioritize electromobility. Only 3 countries (Italy, Hungary and Czech Republic) have ambitious goals for the roll-out of natural gas vehicles. Three countries have proposed unrealistically high estimates for future number of EVs on the road by 2020 (Germany, France, Austria) given there are only 36 months of sales and are unlikely to achieve their goals.

The national plans show that the current level of recharging points available in the EU is sufficient for the number of vehicles on the road – based upon the European Commission recommendation of 10 EVs for each recharging point. National plans for rollout of public charging infrastructures by 2020 EU-wide are also expected to keep pace with the anticipated growth in the number of vehicles. There will also be sufficient fast chargers alongside the principal highway routes with at least one fast recharger every 40km. Accordingly, there is not likely to be any widespread shortage of recharging points if Member States deliver on their plans – although there may be local areas of over and under supply. After 2020 there will need to be a significant further investment, beyond existing plans, to match the number of EVs expected to be on the road. Some further EU funding will be essential particularly in less developed markets.

The national plans indicate that the development of a market for EVs in the EU is likely to occur in three distinct waves. Take-up in Western Europe and Nordics countries will happen first and has already begun; South Mediterranean countries are likely to transition to electricity in a second deployment stage with sales picking up appreciably in the mid-2020's. The Baltics, Central and Eastern European countries are more likely to switch to electric cars in significant numbers until the late 2020's or early 2030's - although there could be an earlier second hand market.

Member States need to ensure that they deliver on their national plan commitments for recharging; and several countries (notably Austria and Germany) will need to strengthen fiscal and other incentives to encourage sales to meet their 2020 EV sales targets. There is no time for complacency if the EU wants to become a world leader in zero-emission technologies.

## 1. Introduction

Sufficient accessible charging infrastructure is essential to enable an accelerated uptake of electric cars. Whilst the early market is likely to be dominated by buyers with off-street parking that can charge at home; electric car drivers want to be reassured they can recharge their car at other times at publicly accessible locations. This includes fast charging alongside highways for trips beyond the range of their car and publicly available charging in other locations largely in urban areas. As the market matures, more electric car users will not have the benefit of off-street parking and for these buyers publicly accessible charging solutions, within close proximity to their homes, will be essential. As the range of EVs increases the recharging challenges are reduced - but do not disappear.

The 2nd Clean Mobility Package, published in November, aims to reduce transport greenhouse gas (GHG) and air pollutant emissions of road transport. Amongst the proposals was an action plan and investment solutions for the trans-European deployment of Alternative Fuels Infrastructure (AFI)<sup>1</sup> to enhance the deployment of alternatively fuelled vehicles. Member States (MS) were required to notify the Commission by 18/11/2016 on their strategy for deployment of AFI in their National Policy Frameworks (NPF). These NPFs provide targets or estimates for the number of alternative fuel vehicles and infrastructure required to refuel/recharge them in addition to other appropriate measure and supporting actions for the development of the market.

This briefing provides a meta-analysis of these plans and evaluates member states ambition for rollout of electric and gas<sup>2</sup> (CNG, LNG, LPG) infrastructure<sup>3</sup>. The work carried out is based on the detailed assessment of the NPFs<sup>4</sup> published by the EU commission and is the Platform for Electromobility's own analysis.

## 2. Member States prioritize electrification of transport

The AFI directive requires member states (MS) to provide an estimate or target for the amount of alternative fuel vehicle and infrastructure to be developed on national territory. The Directive also sets the following (non-binding) recommendations to assess the adequacy of the plans:

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<sup>1</sup> Alternative fuels include electricity, hydrogen, compressed natural gas (CNG), liquefied natural gas (LNG) and liquefied petroleum gas (LPG) and require specific infrastructure solutions

<sup>2</sup> In the brief, gas will be used to refer to CNG, LNG and LPG.

<sup>3</sup> Hydrogen is not included in this study as we consider that the technology is not mature in the short term for passenger cars and it wasn't a mandatory requirement in the AFI Directive

<sup>4</sup> SWD(2017) 365 final

### AFI Directive Requirements

Alternative Fuel	Target year	Indications
Electricity <sup>5</sup>	2020 2025 <sup>6</sup>	<i>Ratio of AFI/AFV: 1:10</i> <i>AFI density on TEN-T Core Network: every 60 km<sup>7</sup></i>
CNG	2020	<i>AFI density on TEN-T Core Network: every 150 km</i>
LNG (heavy-duty only)	2025	<i>AFI density on TEN-T Core Network: every 400 km</i>
LPG (non mandatory)	2025	None

23 NPFs have been submitted to date of the other 5:

- **Malta** and **Romania** are yet to submit their NPF
- **Greece** and **Slovenia** have submitted and translation is on going
- **Sweden** didn't submitted estimates for electricity and gas vehicles or infrastructures.

**Only 8 Member States** submitted their NPF in time and fully meet the requirements that is particularly disappointing.

**Not all countries provide targets for all alternative fuels** as summarised below but most did provide estimates for electric vehicles and recharging<sup>8</sup>.

#### Targets submitted by Member States (out of 23 NPFs)

				
<b>Vehicles</b>	21	11	6	4
<b>Infrastructures</b>	22	21	19	4

<sup>5</sup> Art 4.1 Directive "Member States shall ensure, by means of their national policy frameworks, that an appropriate number of recharging points accessible to the public are put in place by 31 December 2020, in order to ensure that electric vehicles can circulate at least in urban/suburban agglomerations and other densely populated areas, and, where appropriate, within networks determined by the Member States."

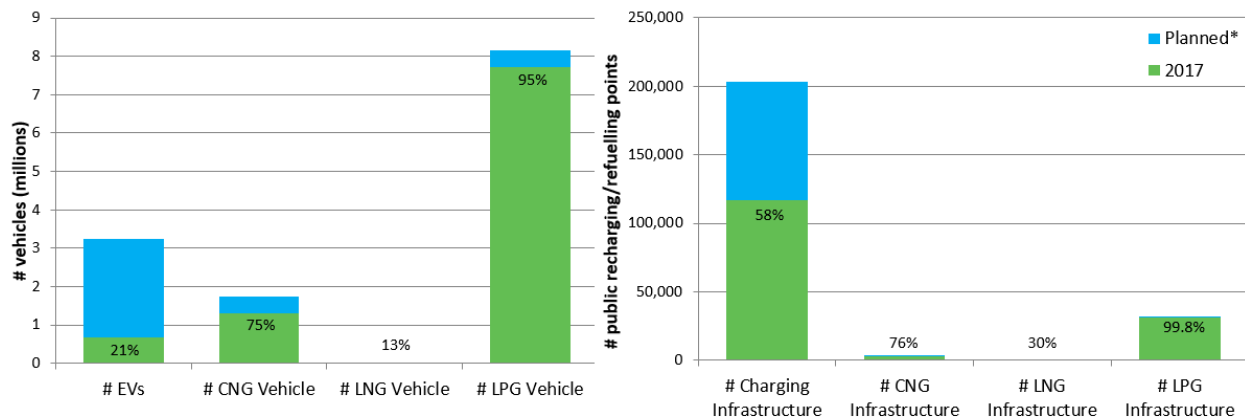
<sup>6</sup> After 2020, the Commission will assess the application of the previous requirements and submit a proposal to amend the Directive. This amendment will aim to ensure that an additional number of recharging points accessible to the public are put in place in each Member State by 2025, at least on the TEN-T Core Network, in urban/suburban agglomerations and other densely populated areas.

<sup>7</sup> This value is derived from field test data from various EU countries and it can be reasonably assumed that it would remove range anxiety concerns according to the Commission. See for more details: JRC (2015) Individual mobility: From conventional to electric cars.

<sup>8</sup> One MS (Spain) did not submit a target for charging infrastructure and two MS did not submit any estimate for the number of EVs (Estonia and Croatia)

**Overall Member States are more ambitious about the shift to electromobility than for gas.** Most forecasts a significant uptake on of the EV fleet and are planning to install considerable additional charging infrastructure in the next 3 years (from 2018 to 2020).<sup>9</sup> The number of vehicles and infrastructure for electricity is projected to increase much more than for CNG (to increase by a third) and LPG (+0.2% of refueling points). The refueling infrastructures and vehicles for LNG might increase by a larger proportion but in absolute numbers LNG is marginal (limited to heavy duty transport) and the timeframe stretches to 2025. As a result **electricity is the alternative fuel of choice in most countries.**

**EU Alternative Fuels targets and estimates (% target achievement)<sup>10</sup>**



\*2020 (Electricity and CNG) or 2025 (LNG and LPG)

**10 out of 28 countries are clearly focusing on electro-mobility<sup>11</sup>:** for achieving clean mobility, albeit different levels of ambition.<sup>12</sup> Member States that have lower ambition for 2020 and those favouring natural gas are likely to experience a delayed uptake of electrification compared to the MS prioritizing electricity for 2020. This delayed uptake is likely to occur as part of a second wave of electric vehicle market uptake of countries that will follow the earlier markets in Western Europe. Ultimately pressure from cross border drivers will require all countries to deploy some level of recharging infrastructure or this will act as a barrier to tourism and trade (see section 4).

<sup>9</sup> For the purpose of this analysis both all-electric battery vehicles (BEV) and plug-in electric vehicles (PHEV) in our count of electric vehicles (EVs); and only recharging/refueling infrastructures accessible to the public are considered. A Public Charging Point (PCP) designates a single outlet or plug.

<sup>10</sup> Methodology: When no future targets/objectives were provided, current figures (vehicles and infrastructure numbers) were used as a (conservative) estimate for future development (2020 or 2025). When a range of target was given, the average of this range was used.

<sup>11</sup> A score was attributed to each MS and for each alternative fuel depending on the number of planned alternative fuels and infrastructure. The scores are adjusted to the size and population of the country.

<sup>12</sup> Spain, Croatia and Estonia did not include a target for electricity and as a result their score was assessed as unambitious.



Czech Republic, Hungary and Italy are the only countries prioritizing natural gas as an alternative fuel. There is a significant risk that this will result in stranded assets and poor residual values for vehicles given the very restricted market.

**3. There will be no shortage of recharging infrastructure in Europe if Member States follow their plans**

The EU Commission recommends 10 EVs per public charging infrastructure other authoritative studies a little more<sup>13</sup>, but this ratio will vary widely between locations and in particular whether fast and regular chargers.

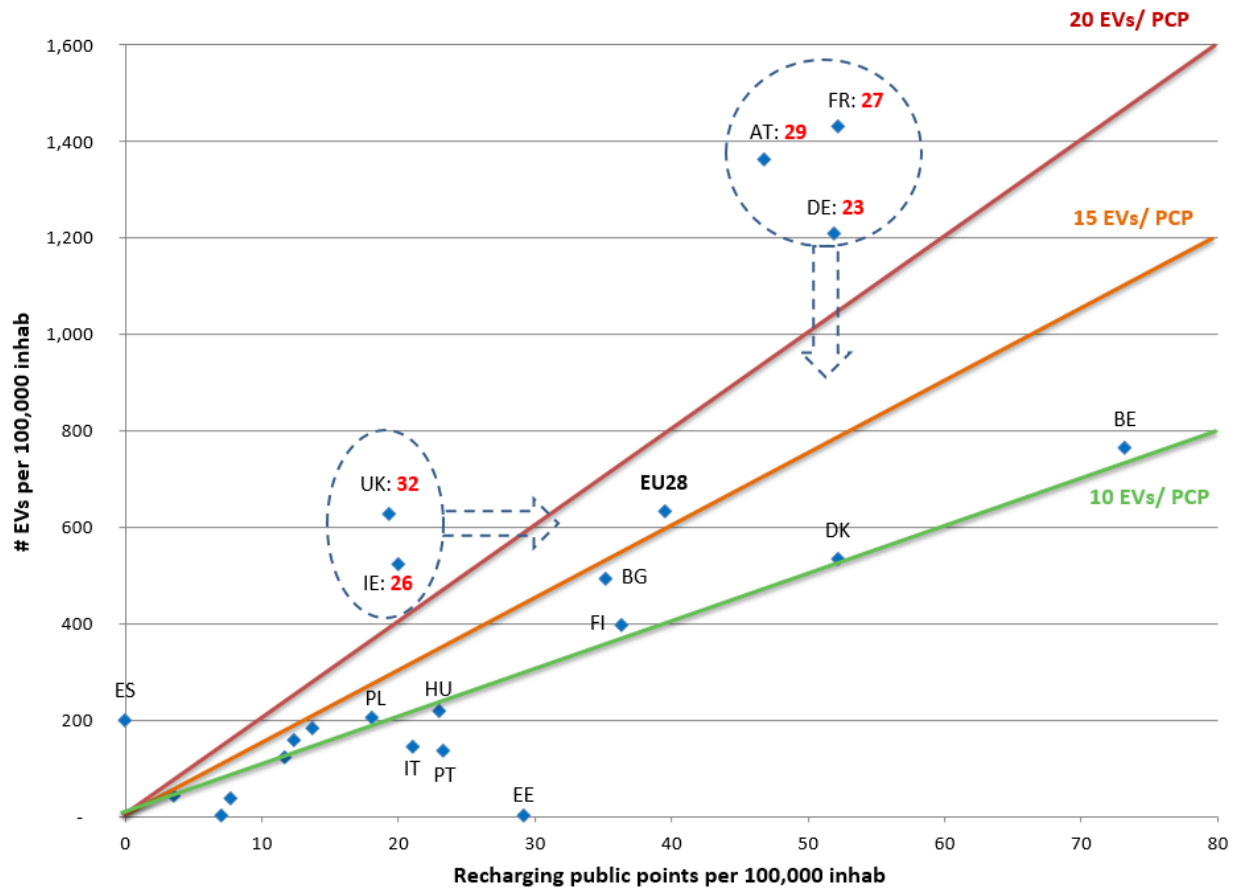
Today, the average infrastructure sufficiency in the EU was around 6 EVs per public charging point and all countries except Belgium (sufficiency ratio of 18) have at most 10 EVs per public charging point (below green line in graphs). This suggests that the current level of rechargers is broadly in line with requirements as at present there are less than 10 EVs/PCP which is considered sufficient. A ratio of between 10 and 15 is practical but not optimal; where the ratio is between 15 and 20 attention is needed; and greater than 20, more rechargers are needed.

<sup>13</sup> Global EV Outlook 2017, OECD/IEA: The study assumes that the market will converge towards 13.4 EVs/PCP (15 EVs per regular PCP and 130 EVs per fast PCP)

In the future technological developments (particularly range) and faster chargers will impact the amount of public recharging infrastructure needed as will the increased number of buyers without off-street parking<sup>14</sup> or using shared vehicles.

The graph illustrates the anticipated provision of charging points per inhabitants (horizontal axis) and the number of EVs per inhabitants (vertical axis) for each MS in 2020 based upon the NPF submissions.

**Supply of public charging points and EVs in 2020**



Off the charts: Luxembourg<sup>15</sup>, 298 PCP/100,000 inhabs, 6772 EVs/100,000 inhabs and 23 EVs/PCP  
 Netherlands, 306 PCP/100,000 inhabs, 820 EVs/100,000 inhabs and 3 EVs/PCP

The plans indicate France, Germany and Austria would experience a shortfall in recharging if the targets for EV sales were met. However these countries have unrealistically high estimates for the future deployment of electric vehicles in 2020 leading to a very high number of EVs per PCP. A more realistic

<sup>14</sup> An exploratory policy analysis of electric vehicle sales competition and sensitivity to infrastructure in Europe, Gillian Harrison and Christian Thiel, 2017.

<sup>15</sup> Luxembourg makes very ambitious estimates for the number of EVs. However because of the country's small size but high density per capita, the provision of public infrastructure is difficult to evaluate.

expectation is that these countries will deliver about half of their vehicle targets, which then would result in a more reasonable ratio of EVs per PCP (at ca. 15) less than optimal but sufficient.

**UK and Ireland have already reached their infrastructure targets**, thus, market figures for 2020 will be higher than what expected in their NPFs which will balance these countries' expected ratio to around 15.

**IF MEMBER STATES ROLL OUT CHARGING INFRASTRUCTURE ACCORDING TO THEIR PLANS THE AVERAGE NUMBER OF EVs PER PUBLIC CHARGE POINT WOULD BE 10.1 IN 2020 – IN LINE WITH THE COMMISSION TARGETS. NO SIGNIFICANT SHORTFALL IN PUBLIC RECHARGING IS EXPECTED IN 2020.**

**The European TEN-T road network will likely be well covered.** The Commission assessed the NPFs with regards to the minimum distance requirement of at least one charging station every 60 km on the TEN-T Core Network for 2025. It was concluded that the coverage “largely seems to be progressing well” and almost all countries will have a coverage that “seems sufficient”. Overall it is estimated that there will be at least one high power charging station every 40 km on the TEN-T Comprehensive network in 2020. This overall picture does however mask some local gaps with no appropriate recharging infrastructure likely to be deployed on highways in Lithuania, Sweden, and Bulgaria in particular.

As part of the review of the Renewable Energy Directive, the European Parliament has suggested that by the end of 2022, 90% of fuelling stations along the TEN-T network have to be equipped with high power charging. In addition, the recent announcements concerning ultra-fast charging (from 150kW to 350kW) networks being deployed in Europe suggest that a sufficiently dense high power network will emerge along Europe's key transport corridors.

#### **4. Beyond 2020: Waves of EV market roll-out in Europe**

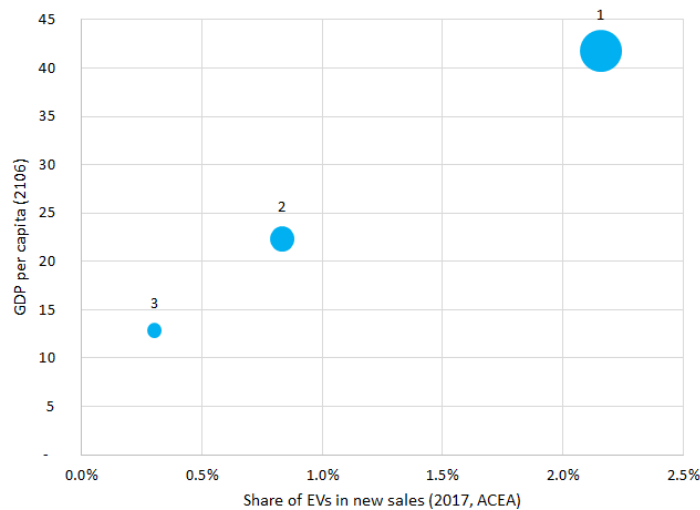
In the next decade, the EV market growth across Europe will be heterogeneous. This does not represent a market barrier as long as in each market, the number of public infrastructures will need to increase in line with the EV market, and cross-border Infrastructure networks are fully covered along the TEN-T network. Our analysis of roll-out plans beyond 2020 based on countries' GDP suggests that EV market uptake is likely to happen in three phases. In Western European and Scandinavian countries EV sales are expected to move beyond a niche (5%) by the early 2020s. In Central and Eastern Europe sales are not likely to be significant until 2030 and beyond<sup>16</sup>. The following figure plots the average GDP per capita and average share of EVs (% of new sales, 2017) and clearly shows this trend<sup>17</sup>.

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<sup>16</sup> The following countries provide estimates for 2025 or 2030 in their NPFs (# EVs or #PCP): Austria, Bulgaria, Czech Republic, Denmark, Spain, Finland, France, Croatia, Hungary, Ireland, Luxembourg, Poland, Portugal and Slovakia

<sup>17</sup> Malta, Croatia, Cyprus and Luxembourg are excluded here since 2017 EV sales are not yet accessible.

**EV uptake is likely to occur earlier in countries with higher GDP (per country category)**



Denmark, Sweden, Finland, Netherlands, Belgium, Luxembourg, Austria, Germany, UK, Ireland, France - constituting the EU's 11 most wealthy countries - are likely to first develop a mature EV market and can be identified as likely market leaders (category 1). These countries will concentrate about 90% of forecasted EV sales and about 75% of upcoming new public charging points (today 93% of EU EVs and 89% of public charging points are in category 1 countries). In these countries, viable business models for charging infrastructures are expected to develop thanks to a significant EV share. These business cases are likely to replace the need for public funding for publicly accessible infrastructure.

The e-mobility uptake in the other countries will likely happen in two separate “waves”. Each wave will bring the corresponding countries to EV market maturity. We expect the second wave to include Spain, Portugal, Italy and Slovenia (category 2) and the third wave to include most Baltic, Central and Eastern European countries (category 3), driven by the emergence of the EV second hand market from the first generation EV in the early markets. Cross-border public charging infrastructure density disparities between regions are not estimated due to an increasingly dense fast charging network along the TEN-T Core Network and other main motorways.

**5. Member States need to seek coherent development of both, vehicles and infrastructure**

Whilst there is inevitable uncertainty regarding future recharging needs this analysis shows that to 2020 the number of recharging points should be in line with the number of electric cars on the road. It will however be essential for member states to deliver on their plans for infrastructure and provide incentives to encourage market growth of EVs so new recharging points are utilized appropriately. All but one Member State has more than one public charging point for 10 EVs today and by 2020 almost all Member States (if plans are delivered) can be expected to keep a level of provision of public charging infrastructure that is sufficient for the market uptake. To ensure successful EV market roll-out, MS should plan public **infrastructure deployment and electric car ramp-up in an ambitious, balanced and realistic way**. To secure the build-up of an adequate and coherent level of public EV infrastructure, the Member States, and the European Commission accompanying the process, should consider the following:



1. Countries that have not submitted their NPF or have only done so partially are urged to do so immediately. This includes Sweden (missing all targets), Spain (missing target for charging infrastructures), Croatia and Estonia (missing estimate for number of EVs) and Malta and Greece (missing NPF).
2. Countries should realistically align their public charging infrastructure and electric vehicle ambitions according to a balanced ratio of about one public charging point for 10 to 15 electric cars. This applies especially to France, Germany, Luxembourg, Austria, UK, Ireland and Bulgaria.
3. It is important to step-up ambition in developing infrastructure (and targets for EVs) in countries that score low within their category. This applies in particular to UK and Ireland infrastructure, Netherlands and Portugal (conservative estimate of EVs), Nordic countries (relatively low ambition), and Italy which is lagging behind on all aspects of e-mobility.
4. It is essential to cooperate to ensure cross-border continuity of TEN-T Core Network fast charger coverage. Cooperation will be essential to preserve integrity of the single market by assuring a well-distributed interoperable fast charging network along important motorways.
5. Countries must deploy adequate national purchase support measures in order to meet EV uptake ambitions. There is a risk that many NPF targets and objectives will not be reached, even where ambition is low without policy support. In particular strong incentives for ZEVs purchase and use; and public sector procurement is needed to drive both supply and demand. Those countries with high ambitions for EV roll-out (France, Germany and Austria) must recognise that targets will be widely missed without more efforts.
6. Countries with no effective network for recharging need to put in place minimal levels of rechargers to enable cross border movements and encourage the very early market. This particularly applies mainly to Bulgaria, Czech Republic, Lithuania, Poland and Estonia.
7. European funding, for example through the European Multiannual Financial Framework (MFF) that is currently being reviewed should be directed to even out potential gaps in the recharging especially at borders transport between early and to support roll-out in emerging markets
8. Countries choosing to prioritize deployment of natural gas should consider whether this can deliver the required level of emissions cuts in the long term and how becoming isolated natural gas islands in a Europe focused on e-mobility will impact upon both mobility and economy. This applies mainly to Czech Republic, Hungary, Italy and Belgium but also Finland, Ireland, Poland and Slovakia for post 2020 ambitions.
9. In cases where market actors are still very hesitant to invest, involvement of Distribution System Operators (DSOs) might be necessary to boost the construction of recharging points in publicly accessible areas until the market reaches sufficient maturity for private initiative. This however should happen under pre-defined rules on phase-out of DSO activity as soon as the market can take over.
10. To ensure seamless and interoperable EU-wide e-mobility and roaming services, market actors need a European framework for a common protocol, open standards and transparent fees.

Market and customers require government's support to seek coherent infrastructure development. A small provision of infrastructure might act as a psychological market barrier whereas a minimum level of infrastructure will pave the way for the private sector to innovate and create new products and services. By respecting the above recommendations, the EU can develop a sustainable alternative to fossil transport, stay a global leader on climate policy and by setting investment security preserve its industrial competitiveness in the global market.