



e-SMART TACTICAL ROADMAP

Objectives, criteria, timelines, milestones and visions to support public and private decision makers for the implementation of e-mobility in local public transport and last mile logistics

Interreg
Alpine Space
e-SMART⁺
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Contact & Disclaimer

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Abbreviations

AF	Application Form
AS	Alpine Space
E-CS	Electric Charging Stations
ENoLL	European Network of Living Labs
ERDF	European Regional Development Fund
EU	European Union
LML	Last-Mile Freight Logistic
LPT	Local Public Transport
OBS	Project Observer
PA	Public administration
PP	Project Partner
RLL	Regional Living Lab
TLLN	Transnational Living Labs Network
WP	Work Package
BEV	Battery Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle

1 Introduction

The Alpine Space Programme is a European transnational cooperation programme for the Alpine region. It provides a framework to facilitate the cooperation between economic, social and environmental key players in seven Alpine countries, as well as between various institutional levels such as: academia, administration, business and innovation sector, and policy making.¹

Decarbonization of transport should involve more than private mobility, in order to make a relevant step forward.

One of the main obstacles to the large-scale introduction of e-vehicles in Local Public Transport (LPT) and Last-Mile Freight Logistic (LML) are the limitations of the local network infrastructure. The current network of electric charging stations in the Alpine region is insufficient to meet the higher energy demand for LPT and LML. In order to avoid load peaks and to not endanger the operation of other electrical systems, an intelligent and electronic load management is necessary. This requires standards and norms for testing and validating the systems, guaranteeing grid stability and dynamic charging, and uniform communication models.

The Interreg Alpine Space project e-SMART aims to achieve this by fostering transnational cooperation among public and private actors for an integrated approach to electric vehicle charging infrastructure planning and e-Mobility services development.

1.1 e-SMART context: The Alpine Space area

The Alpine Space Programme Cooperation Area encompasses the Alps and the surrounding lowlands and links very different regions, such as the Rhone Valley in France with the Adriatic coast of Slovenia and the Greater Milan area with the Bavarian Alpine foothills.

This diverse area at the heart of the European Union is an attractive place to work and live for 70 million inhabitants, covering an area of 390 000 km² and encompassing some of the most important European metropolitan areas. It is also an important contact zone where different European cultures and languages (Germanic, Romance and Slavic) meet. Thus, the Alpine Space has a significant potential for dynamism but is nevertheless confronted with major challenges:

- economic globalization, which requires the territory to be competitive and innovative through the development of the knowledge and information society
- demographic trends, characterized in particular by the interaction of ageing and new migration patterns
- climate change and its foreseeable impact on the environment, biodiversity and the living conditions of inhabitants
- the energy challenge at European and global level of managing and meeting demand in a sustainable, secure and affordable way

¹ <https://interreg.eu/programme/alpine-space/>

- its particular geographical location in Europe, as a transit region, but also as an area with unique geographical and natural features that provide the framework for all future developments²

In this context, the Alpine Space is both a challenging and an opportunity-rich area. In a relatively small area, it includes six countries (including Switzerland), large metropolitan areas, very small municipalities, many tourist attractions and an extremely varied geomorphology. The presence of sensitive areas and protected environments makes this area extremely suitable for the introduction of green and sustainable mobility.

Therefore, the e-SMART partners consider that the development of a transnational strategy for sustainable public transport and last mile logistics is a key factor to jointly address the remaining problems and identify the best solutions to be jointly adopted by all countries and authorities involved. Referring to a common vision and a common strategy will help authorities to take the best decisions for all potential actors in these fields in the Alpine Space (and not only for them). A transnational and commonly agreed strategy would guarantee synergies and consistency between the different actions in the area under consideration.

Thus, e-SMART also follows the macro-regional strategic approach of the EUSALP, especially the action groups AG4 Mobility, AG5 Connectivity and Accessibility and AG9 Energy are to be mentioned in connection with e-SMART, as the same objectives are pursued.

1.2 Main topics of the e-SMART project

e-SMART activates cooperation among public authorities and e-Mobility and energy operators through Smart Living Labs on all levels of governance. It leads, through a Smart Mobility Road Map for Alpine Space decision makers on intermunicipal level, to a common approach in development of e-Mobility services in LPT & LML and in planning of an adequate electric-vehicle charging-system network for the entire Alpine region.

The project designs and tests a set of transnational operational instruments for public and private technicians to plan e-Mobility infrastructure and services in passengers and freight transports in the framework of smart grid and smart territories: Smart Energy Toolkit. The Interreg Alpine Space project e-SMART project involves project partners, stakeholders and observers from Italy, France, Slovenia, Austria and Germany.

The Smart Living Labs create an environment for capacity building, experiential learning based on the active involvement of stakeholders, experts and end-users. For this purpose, a transnational network of five Regional Living Labs has been established and operated, one hub per country, drawing on the experience of other EU initiatives (EnoLL, INTENSSS PA) and activating a four-helix approach by involving partners (PP), observers (OBS) and territorial stakeholders in the fields of energy, mobility, public urban and freight transport and logistics (public administrations, service providers, utilities, research centers, multipliers, sectoral agencies and end-users).

The Transnational Living Lab as well as the individual Hubs, called Regional Living Labs, are intensively engaged in the two thematic fields of SMART Mobility in last mile logistic and local public transport and Smart Energy. Thus e-SMART corresponds with the objectives of EUSALP AG4 and AG9.

The results and discussions of the TNLLs and the RLLs have been summarized in the e-SMART roadmap for decision makers, which will be combined with a tactical e-SMART roadmap developed by the TNLL and the operational roadmaps developed by each RLL. This will also bridge to the e-SMART Toolkit, where appropriate measures and tools for e-Mobility as-

² <https://www.alpine-region.eu/eusalp-eu-strategy-alpine-region>

assessment and planning in public transport and LML will be tested and provided as a platform. The toolkit acts as a platform for existing platforms, receiving data from them, elaborating indicators (DSS) useful for policy makers and returning indicators that can be used within the existing platform, this approach comes from the e-SMART ecosystem approach, where mobility data is the starting point for the digitalization of cities and regions. Thus e-SMART corresponds with the objectives of EUSALP AG5.

As part of the e-SMART project process, the Living Labs are on one side the incubator for the needs, requirements and specifications that will feed into the roadmaps and tools developed, and on the other side the place where to test the developed tools.

1.3 Definition and Objectives of the e-SMART Tactical Roadmap

A roadmap serves as a communication medium and visually represents an overview, the development of a matter over a strategically defined period. The roadmap is defined by its only preparatory character and the rough planning of the steps to be taken over a longer period of time. The roadmap is used to structure long-term projects into individual, more easily manageable steps, taking into account uncertainties and possible scenarios for achieving objectives.

The e-SMART Tactical Roadmap is intended to be a contribution to national and regional energy and mobility planning in the Alpine Space region. The document aims to support decision makers and planning bodies in the field of e-Mobility charging infrastructure planning in public transport and last mile logistics. In doing so, project processes to achieve the goals of e-Mobility projects in the field of public transport and last mile logistics should be facilitated by structuring and considering uncertainties and possible scenarios in the long term. If these processes succeed, the Tactical Roadmap is a significant contribution to upgrading a region through digitalization to a SMART Territory in the fields of public transport and logistics.

In the e-SMART Tactical Roadmap, the entire Alpine Space is considered and examined as a whole, and this structure is transferred to operational roadmaps for the regions/reference areas with their specific features. The Tactical Roadmap results from the transnational exchange and development of know-how in dealing with e-Mobility in the fields of public transport & LML beyond the national borders among the project partners, stakeholders and observers in different formats. The Tactical Roadmap is divided into four main steps. The steps should symbolize how the countries in the alpine space can integrate e-Mobility in LPT and LML. Further information about the steps can be found by the chapters with the same numbers as in the picture.

This tactical roadmap is a document which should support the stakeholders in the LPT and LML market. Due to this, the roadmap is established with a short introduction of the e-SMART project and information about the status quo in LML and LPT. To increase the understanding of the role of the European Union the e-SMART consortium has listed the European mission and vision, including the standards and guidelines for the mobility. Thereafter national initiatives and regulations are discussed in the different alpine space countries including the different positions and tasks of the national stakeholders. Furthermore, the governance models for the diffusion of e-Mobility are described and discussed due to the stakeholder. This includes changes/potentials, actor's role and key elements.

2 e-Mobility

e-Mobility describes the transport of people and goods in a geographical area with the help of electric drives. A wide variety of vehicles can be electrically powered, from railways to miniature scooters, almost everything is possible. The focus of e-SMART is on all vehicles that can be used in LPT and LML. To increase the usage of electricity in LPT and LML, the e-SMART project focuses on the action that can positively affect the transition from internal combustion to electricity. The change needs to include not only the engines, but also a wide group of parameters and actors, such as charging stations, renewable energies, mobility patterns, national regulations and infrastructure.

e-Mobility is seen as a central component of a sustainable and climate-friendly transformation of the transport system based on renewable energies, as envisaged by the climate targets from the Paris Climate Conference and the transport turnaround in passenger and freight transport.³

Charging infrastructure and strategies for e-Mobility in LPT and LML

The most diffused energy supply of electric vehicles: conductive (contact-based) and inductive (contactless).

Plug-based conductive charging as the most important charging technology

In conductive charging, a further distinction is made between plug-based solutions and applications with current collectors (sliding contact). Both inductive charging and conductive charging using current collectors are particularly suitable for special applications. For example, inductive charging stations offer a considerable increase in convenience in private garages, while buses, for example, can be equipped with pantographs or their counterparts (charging rails) in order to simplify charging during a shorter standstill period in the operating process.⁴ Both charging techniques are also possible in principle for moving vehicles. The most widespread charging technology today and probably also in 2030 is conductive charging, which is further differentiated into alternating current (AC) and direct current (DC) charging. Whereas with AC charging the power converter (rectifier) is installed in the vehicle, i.e. the vehicle is supplied with AC power from the infrastructure, with DC charging the rectifier is installed in the charging station.

Demand-oriented design variants of charging infrastructure

To establish a secure connection between the vehicle and the charging station, pantographs or standardized connectors are used with the EU regulation “Directive 2014/94/EU of the European Parliament and of the Council on the deployment of infrastructure for alternative fuels”, the Type 2 plug was adopted as the standard for AC charging points (IEC 62196-1) and the CCS connector system as the standard for DC charging points (IEC 62196-3). Other standardized plugs on the vehicle side that are still occasionally found on the market are the Type 1 plug (AC) and the plug according to the Japanese CHAdeMO standard (DC). For charging with current collectors, there is at least a cross-manufacturer initiative to standardize charging with inverted pantographs called “OppCharge”.

3 Cf. Germany 2020 – energy Policy Review pp. 12 – 13

4 Cf. Seelinger et al. (2016)

For commercial vehicles, there are solutions specially tailored to their needs. In the area of plug-based charging, ceiling- and wall-mounted charging systems as well as flexible, rail-guided solutions (as known from factory buildings) are worth mentioning. Furthermore, charging stations with current collectors are used, especially for buses.

Here, a distinction is made between the classic pantograph approach (mounting of the current collector on the vehicle) and the principle of the inverted pantograph (current collector is mounted on the charging station and descends from above onto the vehicle roof). In a pilot project in Poland, charging capacities of more than 500kW are already being achieved with these technologies.⁵

The above-mentioned status of the currently available charging infrastructure results in different charging strategies that vary depending on the business process, the composition of the vehicle fleet, and the existing infrastructure. The selected charging strategy determines the charging infrastructure and vice versa, both interact with each other. This currently results in three common charging strategies.

1. Opportunity charge:

Charging the vehicle along the predetermined line or tour, either at selected stops/charging or discharging points or at the head/end of the route by means of Inductive or conductive charging. Both technologies enable fast charging through high power. The vehicle can either charge as needed along the route at available charging points or it must charge along the line/tour to charge at predetermined charging points. This strategy requires vehicles to be fully charged overnight, but allows the use of small but conductive batteries.

2. Charging overnight:

The batteries are charged at night in the depot using low voltage sockets or conductive systems. The charging process starts immediately after the vehicle is parked. This system requires large and heavy batteries to store enough energy. No further charging of the battery takes place while the vehicle is in use.

3. Combination of depot charging (overnight charging) and opportunity charging:

The charging process is realized from both low power overnight charging at the depot and opportunity charging with high power at head/end stations or at the depot or other predefined charging points. This allows for smaller battery sizes but a high level of planning.

The charging technologies and charging strategies presented apply to both LML and public transport. Each operator should develop its own charging infrastructure, fleet setup, management and requirements related to its business and operator model. The most crucial phase in the transition from combustion vehicles to an electric fleet is the planning phase, this is where the foundation for the success of the transition is laid but this is also where the most serious mistakes can occur that could jeopardize the smooth operation of the vehicles. In order to build a functioning and economically sound business model, it is therefore also important to recognize the various roles within the business processes of a charging operation.

Business and operator models for e-Mobility

The business models in the ecosystem “charging of electric vehicles” are sometimes very complex; a role model is suitable for illustrating the interaction between the actors involved. It is important to understand that an actor can take on several roles, but in each charging process each role is only filled by one actor. At least the basic distinction between the roles of charging station operator (CPO: Charge Point Operator) and e-Mobility service provider

5 Cf. Electrive (2019a)

(EMSP: e-Mobility Service Provider, sometimes also just EMP or MSP) has also become established in the industry. All roles necessary for a functioning operator model are summarized in the following table.

Table 1 – Role model electro mobility (VDA Studie BEV- vs. H2-Nutzfahrzeuge; Fraunhofer IAO)

Role	Definition/Function
CPO Roles: Charge Point Operator	
Front-End CPO	Takes care of the planning, installation and (electrotechnical) maintenance of the charging infrastructure as well as on-site fault clearance (third level support) in the event of a fault; Usually has little visibility to the end customer.
Back-End CPO	Operates a central or cloud-based software system that serves to manage charging stations (incl. load management) and communication with the EMSP back-end; is responsible for data collection, storage and forwarding in compliance with calibration regulations; manages the list of all authorised user IDs ("whitelist"); takes care of IT-side fault clearance in the event of an error (e.g. through remote-controlled restart of the charging infrastructure); usually has little visibility vis-à-vis the end customer.
EMSP roles: E-Mobility Service Provider	
Front-End EMSP	Represents the interface to the end customer, sets B2C prices and is usually the end customer's contract and billing partner of the end customer; has visibility vis-à-vis the end customer.
Back-End EMSP	Operates a central or cloud-based software system that serves to manage customer master data and communication with the CPO back-end; offers software or hardware solutions (e.g. apps or RFID cards) for activating and paying for charging processes, often also as "white label" offers; is responsible for data transfer in compliance with calibration regulations; provides verification options for billing in compliance with calibration regulations; usually has little visibility to the end customer.
Other roles	
OEM	Usually refers to the manufacturer (Original Equipment Manufacturer) of the vehicle, but can also refer to the manufacturer of the charging pole.
End customer	Customers of a company, employees who charge their private vehicle at their place of work or private individuals who charge their private vehicles at public charging infrastructures, either for a fee or free of charge
Location partners	Provides the land for the installation of charging infrastructure; may offer other services/products at the site (cross-selling). services/products at the location (cross-selling); usually has a say in the business model and business model and B2B prices of the investor; has visibility vis-à-vis the end customer. the end customer.
Investor	Finances the construction and operation of charging infrastructure; defines the business model and with the location partner) the business model and the B2B prices ("CPO prices"). usually has visibility vis-à-vis the end customer, but this is not mandatory.
Distribution grid operator	Operates regional distribution grids (mainly low and medium voltage), so that private and commercial end customers can be supplied with electricity; Establishes the grid connection at the site partner's property.
Energy supplier	Produces and/or purchases electricity and sells it to private and commercial end customers. end customers, e.g. the site partner and/or the investor.
Roaming platform operator	Operates a central or cloud-based software system that serves to bundle communication between a large number of EMSP back-ends on the one hand and a large number of CPO back-ends on the other; sometimes also a more extensive bundling function, e.g. for the commercial agreements (B2B prices) between EMSP and CPO.

2.1 e-Mobility in Local Public Transport

e-Mobility has long since arrived in private transport and the number of e-car registrations will continue to increase. Public transport in Alpine Space will not remain unaffected by this development. Sustainable mobility has developed from a unique selling point to a hard market factor. According to a study by the British market research company Interact Analysis, the market share of new registrations of purely battery electric city buses is expected to reach 40% by 2025. Already in 2019, the share was 12% and tripled compared to the previous year⁶. Transport-related greenhouse gas emissions in Europe today account for 25% of total greenhouse gas emissions in Europe today, of which buses account for 8 % (per passenger and km)⁷.

In order to achieve the decisions made at global and European level to meet the climate targets, a shift from individual mobility to the use of public transport is necessary. In doing so, the public offer should be expanded and made more attractive for all users. At the same time, European public transport is to be made sustainable and emission-free. Several major European cities, including Paris and London, want to have established an emission-free transportation system by 2050. The use of fully electric buses in local public transport is seen as a key component of this.

Advantages of using all-electric buses:

- Reduction of traffic-related CO₂ emissions.
- Reduction of fine dust emissions
- Reduction of traffic noise
- Improvement of the quality of air and life
- Improvement for the image of the city or region

However, converting a conventional bus fleet with internal combustion engines to purely battery-electric models is fraught with challenges. Local public transport must function smoothly, so there must be no serious delays in the operation of the e-buses. A functioning charging strategy with the appropriate infrastructure must therefore be an essential building block for the deployment of corresponding e-vehicles. This strategy must be preceded by thorough monitoring of vehicle and infrastructure requirements. Conversion and operation are therefore very complex, especially in the case of retrofits, and must be prudently prepared and conceptualized. The local context, such as natural conditions and specifics of operation, must be included. This also emerged from the ZeEUS project⁸, which defined planning as the most crucial phase for the success of the retrofit. Therefore, especially the planning phase but eventually also the final operation of the vehicles requires a close cooperation between the city administration and all other stakeholders involved, such as energy providers, bus operators, manufacturers of vehicles and infrastructure, traffic planners, etc.

In principle, any mobility project in this area should be preceded by a feasibility study of a technical and economic nature.

Despite the obvious advantages, fully or partially electric vehicles are not yet very widespread in the e-SMART Alpine Space, this is certainly caused by the quite complex transition and the limited availability of corresponding vehicles and the therefore still very high acquisition costs. To get a better overview of the different situation in the e-SMART partner countries, two graphs follow, one showing the current stock of e-vehicles in public transport and the other the number

6 <https://www.busplaner.de/de/news/elektromobilitaet-e-mobilitaet-e-busse-europa-bis-2025-marktanteil-von-40-18808.html>

7 EU Commission Expert Group on Clean Bus Deployment; D2 Procurement and Operations.

8 www.zeeus.eu

of new registrations in 2021. The data comes from the European Alternative Fuels Observatory⁹.

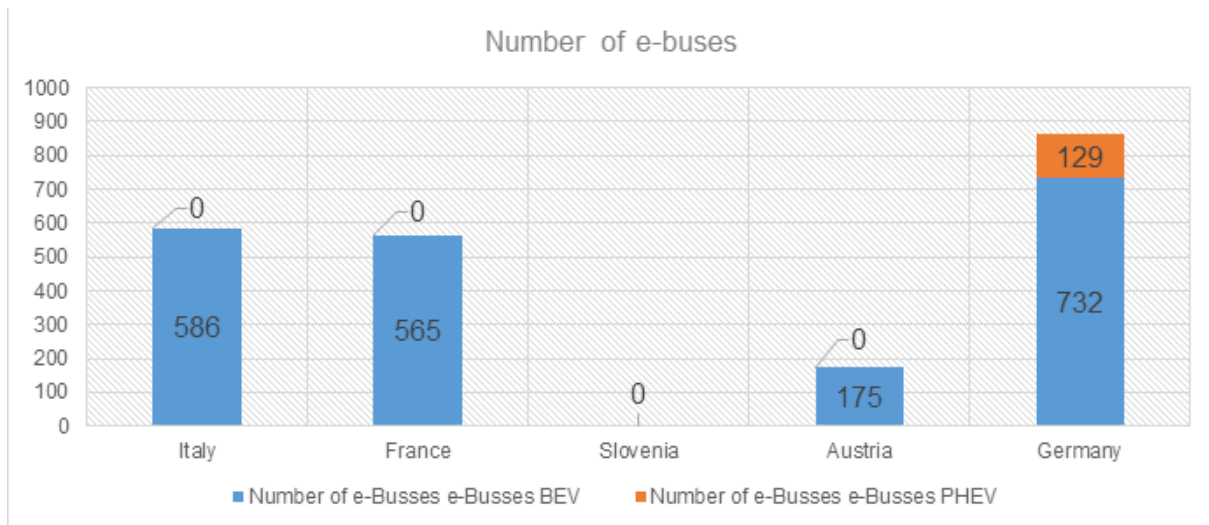


Figure 1 – Number of e-buses in the e-SMART territory in 2021

The data shows that Germany, Italy and France already have some e-buses in operation. However, compared to the number of combustion vehicles in public transport, which in all three countries is over 20,000 vehicles, the e-Mobility development is only slowly gaining momentum. In Austria and especially in Slovenia, the numbers are much lower. The data also shows that battery electric vehicles (BEVs) are significantly more in demand in LPT than plug-in hybrid electric vehicles (PHEVs).

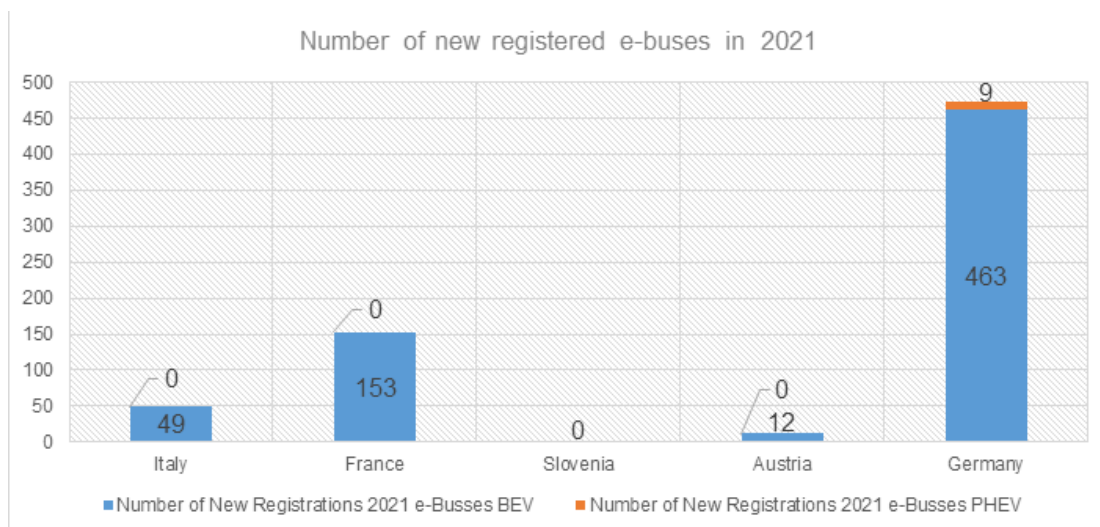


Figure 2 – Number of new registered e-buses in the e-SMART territory 2021

The development of the current fleets is also reflected in the figures for new registrations. In addition, as in the LPT sector, it is clear that BEV technology is much more in demand than PHEV technology.

As can be seen from the preceding graphs, and as already mentioned elsewhere, the restructuring of public transport and the inclusion of e-Mobility offers great potential that is currently only partially or hardly exploited. The following hints should serve as a rough guideline for responsible persons of any kind in the field of public transport.

9 <https://www.eafo.eu/vehicles-and-fleet>

Hints for the integration of e-Mobility into public transport:

- Conduct a feasibility study to understand the operational framework.
- Apply the “systems approach” to identify stakeholders and build collaboration at each stage of the project (planning, installation, and operation)
- Know local regulations and policy framework for efficient planning and installation process, avoiding delays (permits and connection points)
- Consider electric buses as part of a zero-emission mobility strategy, not as the only solution
- Identify the most appropriate solution based on the city’s characteristics and bus operation requirements
- Schedule the additional buses according to the chosen strategy of the chosen strategy and technology and while maintaining the level of service
- Conversion of the fleet to all-electric vehicles based on the needs and strategy of the city and/or its electric mobility strategy (or equivalent) that provides the framework for the of the plan for the deployment of electric buses
- Consider physical impacts in the city: charging pole design, urban space requirements, and space for electric bus depots
- Develop a set of recommendations/guidance on the visual impacts of public transportation infrastructures (bus stops, charging stations, substations and transformers, etc.) on the public realm have
- Consideration of strategic locations of bus depots for efficient operations
- Standardization of charging infrastructure and making it and interoperable for other bus operators and other e-Mobility services
- Sharing of the network between bus operators and other e-Mobility services without compromising service
- Considering the long-term financial impact in terms of health benefits versus the financial cost of the system
- Sharing with experienced cities, knowing that there is no one-size-fits-all solution¹⁰

2.2 e-Mobility in the Last Mile Logistics

As for public transport, logistics must move with the times and adapt to changing environmental factors, market developments and other trends. Increasing traffic congestion with access and delivery restrictions, consumer behavior (e.g. increase in online retail), climate protection and infrastructure are the main drivers.

Difficulty of road logistics when switching to e-Mobility

In e-SMART project, last-mile logistics, as in logistics in general, refers to the final part of the transport of goods. This final part of the transport can be handled by many different vehicles, but only heavy duty vehicles are considered in the project. Here, too, the changeover is fraught with risks, albeit on a much larger scale. In contrast to the operators of bus fleets in local public transport, freight forwarders are completely self-sufficient companies without long-term guaranteed transport contracts and must therefore manage their business much more cautiously and prudently.

¹⁰ Policy Brief of UITP, the International Association of Public Transport. UITP; June 2019

Thus, the current supply and market situation of suitable vehicles make the switch difficult. The market supply is very patchy and the available e-trucks are often converted diesel vehicles (one-offs), which is particularly reflected in the pricing of the vehicles. On average, it can be assumed that the purchase price of an e-truck is about double to triple that of a comparable diesel vehicle. But the lack of an adequate service network of the providers also deters many transporters. In addition, there is a risk that technically unsuitable vehicles will be purchased out of hasty actionism. This can be countered as follows. The market for e-vehicles must be revolutionized and subsidized. E-cars must go into series production in order to sustainably improve conditions, delivery times and the service network. On the energy market too the course could be set in favor of e-vehicles in logistics through appropriate constellations in diesel and electricity prices. In addition, a suitable and sufficient infrastructure must be provided by the energy suppliers. Both of the aforementioned processes can be positively influenced by political influence and the promotion of corresponding business models. In addition, on the political level there also is the possibility to promote more research projects and field trials in the area of e-logistics.

In addition to the minimally invasive method described above (e-truck replaces diesel truck), there is also the possibility to act in a technically innovative way and replace a diesel truck with an e-concept or to restructure the entire business process in terms of sustainability. These methods differ in the naming of the manageable risk (minimally invasive to entrepreneurial) and increase the effort and risk.

In summary, all-electric trucks (BEVs) have significant advantages over electricity-based alternative fuels, including hydrogen, in terms of energy efficiency and limited renewable energy capacity, and can operate without energy imports. However, taking into account the high local electricity demand and the associated grid expansion requirements for charging heavy BEVs or building overhead or induction lines above or below the roadway, it is clear from the current state of knowledge that these measures will place a high burden on the environment ahead of e-vehicles, given the current state of the art.

To make matters worse, the current charging systems and the associated charging strategies do not fit the current business models of logistics on the roads. The vehicles currently on the market are technically unable to meet the requirements of freight forwarders. Due to the large competitive situation in this industry, transports are extremely tightly calculated and the maximum utilization of the vehicles is basically assumed, but this is significantly lower for the current e-vehicles than for comparable combustion vehicles. This affects also the work of the dispatchers who organize the shipments, as with the accesses still limited to the electric refueling areas it requires a more detailed and precise planning of the driver's journey and they have to implement also charging infrastructure with load management systems in their depots. Learning from each other is no longer possible in logistics due to the high level of market competition, and a knowledge advantage is valued and played out as a market advantage.

The current e-vehicle fleets of the e-SMART partner countries were also examined in the logistics sector. It becomes clear that the spread of e-Mobility in the logistics sector, as described above, faces many technical and financial obstacles, as shown by the data from the European Alternative Fuel Observatory.

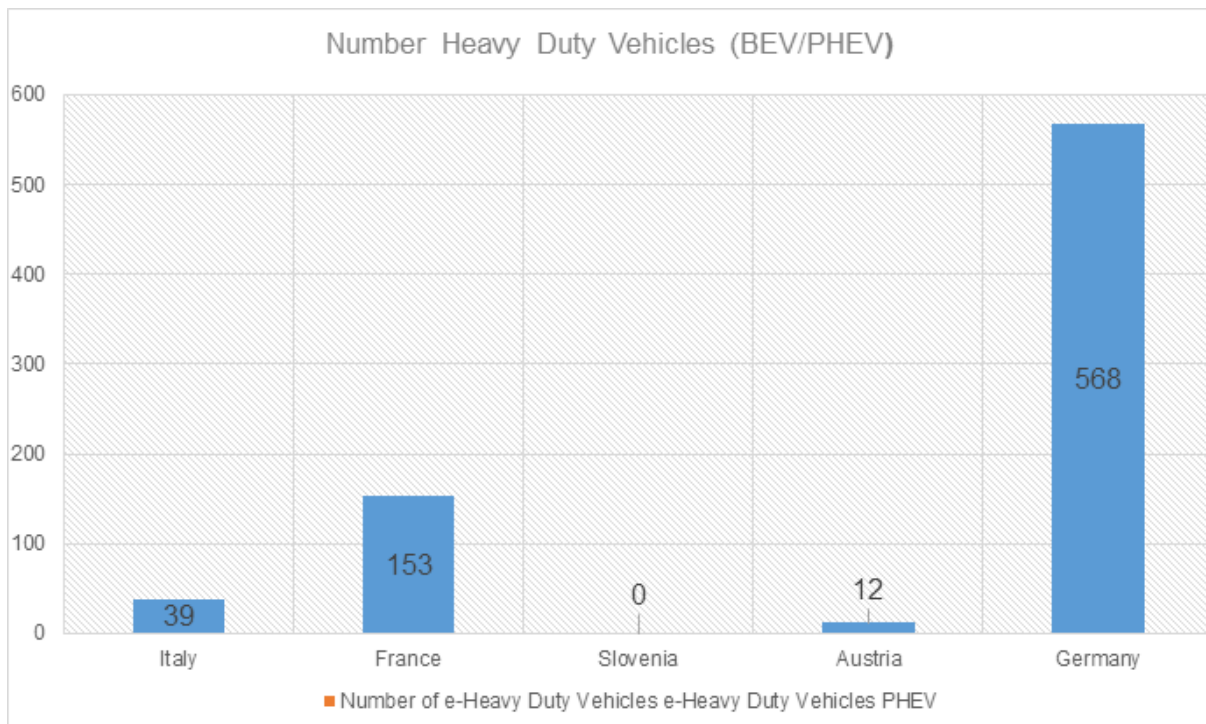


Figure 3 – Number of e-heavy duty vehicles in the e-SMART territory in 2021

Among the e-SMART partner countries, Germany is a pioneer in the field of e-heavy duty vehicles, as it was in the area of public transport, with Slovenia bringing up the rear, as in the case of public transport. In general, only Italy and France exchange second and third places in the comparison of public transport.

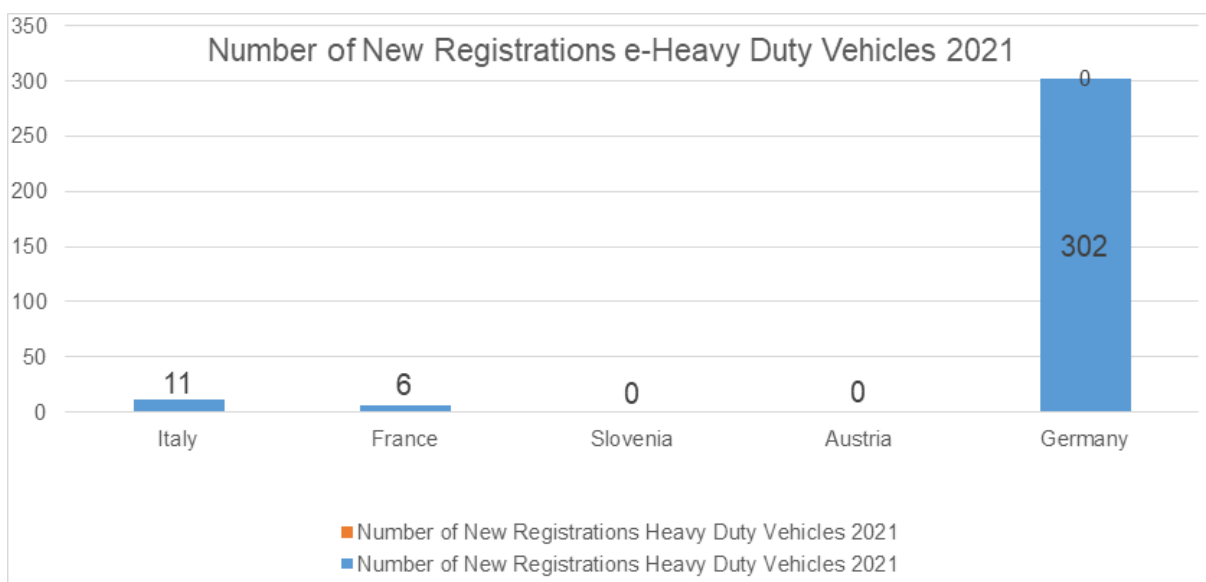


Figure 4 – Number of new registered e-heavy duty vehicles in the e-SMART territory in 2021

The development of the current fleets is also reflected in the figures for new registrations. In addition, as in the LPT sector, it is clear that BEV technology is much more in demand than PHEV technology.

Logistics must also be organized to become emission-free

The figures show the low expansion of e-Mobility in the logistics sector in the Alpine Space. , There is however a great potential for improving the overall CO₂ balance in the Alpine Space, which also means that logistics must be organized with zero emissions as quickly as possible. Against the background of limited resources and above all to protect the climate. However, the external influence on this sector is much smaller than for public transport. In the following, some recommendations for the promotion of e-Mobility in the logistics sector are summarized, but they are rather rudimentary for the reasons already mentioned.

Hints for the integration of e-Mobility into Last Mile Logistics:

- Promote research projects in the field of e-logistics, to improve the technical conditions.
- Increase funding for the expansion of the charging infrastructure for e-logistics.
- Reduce bureaucratic hurdles for the promotion of logistics e-vehicles.
- Apply the “systems approach” to identify stakeholders and build collaboration at each stage of the project (planning, installation, and operation)
- Know local regulations and policy frameworks for an efficient planning and installation process
- Consider e-Heavy Duty Vehicles as part of a zero-emission mobility strategy, not the only solution
- Consider the physical impact on the business site: design of charging systems, space requirements for depots or charging parks
- Develop a set of recommendations/guidance on visual impacts of logistics transportation infrastructure (charging stations, substations and transformers, etc.)
- Standardize charging infrastructure and establish interoperability for other logistics or e-Mobility services
- Sharing of the network between logistics and other e-Mobility services without compromising services

2.3 Mission and vision of the European Union that affect Transport and Mobility evolution

The urgency to act has also reached the European institutions, that’s why in 2020 the European Parliament set a new level of CO₂ reduction, from 40% compared to the 1990 value to 55% of reduction. In addition, climate neutrality by 2050 for the entire EU was decided. In addition to these directives, several new funding lines have been introduced¹¹.

The European Union has launched three major funding programmes that have a strong influence on mobility, infrastructure and the behavior of citizens, but are not primarily related to e-Mobility. Thus, the funding programmes also affect the e-SMART topic complex. In this chapter, the funding programmes are listed and described. These programmes are available and accessible for all Alpine Space countries and stakeholders.

In addition to major funding lines, initiatives and decisions have also been taken to directly address mobility, its decarbonisation and e-Mobility.

¹¹ https://ec.europa.eu/clima/policies/strategies/2030_en

A) Green Deal – Green Europe¹²

Climate change and environmental degradation are existential threats to Europe and the world. That is why Europe needs a new growth strategy if it is to make the transition to a modern, resource-efficient and competitive economy in which:

- no net greenhouse gas emissions are released by 2050
- economic growth is decoupled from resource use
- no one, neither people nor regions, is left behind.

The European Green Deal is our roadmap for a sustainable EU economy. To achieve this goal, climate and environmental challenges must be seen as opportunities in all policy areas and the transition must be fair and inclusive for all. This can ensure a better and healthier life for the current and future generation through:

- clean air, clean water, healthy soil and biodiversity
- renovated and energy efficient buildings
- healthy and affordable food
- more public transportation
- clean energy and the latest clean technologies
- more durable products that can be repaired, recycled and reused
- sustainable jobs and the transfer of skills needed for the transition
- globally competitive and crisis-proof industry

To achieve these goals, Green Deal Europe addresses the following e-SMART themed priority areas with the corresponding actions:

CLIMATE:

Climate change is a global threat and can only be tackled globally. That is why the EU is actively engaged and supports its international partners in climate protection, particularly in the wake of the UN Framework Convention on Climate Change (UNFCCC) and the Paris Climate Agreement. In parallel with its climate action, the EU is taking measures to adapt to climate change. This involves countering the already irreversible consequences of climate change.

Target:

- Climate neutral Europe by 2050
- Reduce greenhouse gas emissions by at least 55% from 1990 levels by 2030.

Measures:

- European climate protection law
- European climate pact
- European adaptation strategy
- Climate diplomacy
- EU at COP26 climate conference

¹² <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0640&from=EN>

TRANSPORTATION:

It is crucial for Europe's businesses and global supply chains. At the same time, transport is not without costs for our society: it causes greenhouse gas and pollutant emissions, noise, accidents and congestion. For example, transport currently accounts for around 25% of the EU's total greenhouse gas emissions. The overarching goal of becoming climate neutral by 2050 requires an ambitious rethink of the transport sector.

Target:

- Reduce transport-related greenhouse emissions by 90% from 1990 levels by 2050.

Measures:

- Sustainable and smart mobility strategy
- Connecting Europe Express

ENERGY:

Energy production and consumption account for more than 75% of European greenhouse gas emissions. Therefore, a decarbonisation of the European energy systems is indispensable to achieve the climate targets for 2030 and 2050. Three aspects are in focus for the transition to clean energy. The first is to ensure a secure and affordable energy supply. The European energy market is to be digitalized, networked and fully integrated. And energy efficiency, especially in buildings, and the development of an energy sector that relies predominantly on renewable energy sources.

Target:

- Interconnection of energy systems and better interlocked grids to promote renewable energy sources.
- Promote innovative technologies and modern infrastructure
- Improve energy efficiency and the eco-design of products
- Decarbonisation of the gas sector and promotion of cross-sector smart integration
- Strengthening the consumer position and mitigating energy poverty of individual member states
- Promoting EU standards and technologies at the global level
- Realizing the full potential of offshore wind energy in Europe.

Measures:

- Energy system integration strategy
- Promotion of renovations
- Hydrogen strategy
- Methane strategy
- Strategy for renewable offshore energy
- Trans-European energy networks

Other starting points of the Green Deal Europe are:

- Environment and oceans
- Agriculture
- Finance and regional development
- Industry
- Research and innovation

B) Digital Europe – Smart Europe¹³

Making Europe greener and more digital is the double challenge for the current generation, and success in meeting these challenges will determine the future. The European Commission has begun to look at a greener Europe through the lens of the European Green Deal. At the same time, it is opening the discussion on the transition to a more digital world: the digital transformation. Digital technology and infrastructure play a crucial role in our personal and business lives. We rely on them to communicate, work, advance science and solve current environmental problems. At the same time, the COVID 19 pandemic has highlighted not only how much we rely on our technology to be available to us, but also how important it is for Europe not to be dependent on systems and solutions from other regions of the world. Should the world of digital technologies be made more accessible to businesses, citizens and public administrations? Digitalization is closely linked to new approaches to mobility, and even makes some of them possible in the first place. The most significant digital key factors for the future of mobility are listed below.¹⁴

C) Europe for Citizens¹⁵

Europe for Citizens pursues two major goals. Firstly, a general understanding of European values, European history and diversity should be created or further developed. Secondly, Europe for Citizens wants to encourage European citizens to actively participate in democracy and politics. They should be given the opportunity to participate concretely in political decision-making processes at the European level, to stimulate debates and to propose practical solutions to problems through cooperation at the European level.

In this context, a network between cities should also be formed to establish long-term cooperation among cities and municipalities. Within the network, resources and/or interests should be shared. In order to jointly face future challenges.

D) Trans-European Transport Network Policy

All transport modes need to become more sustainable, with green alternatives widely available and the right incentives put in place to drive the transition. Concrete milestones will keep the European transport system's journey towards a smart and sustainable future on track:

13 https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en#documents

14 <https://digital-strategy.ec.europa.eu/en/activities/digital-programme>

15 https://ec.europa.eu/info/departments/justice-and-consumers/justice-and-consumers-funding-tenders/funding-programmes/previous-programmes-2014-2020/europe-citizens-efc_en

By 2030:

- Reduce transport-related greenhouse emissions by 90% from 1990 levels by 2050.
- at least 30 million zero-emission cars will be in operation on European roads
- 100 European cities will be climate neutral
- high-speed rail traffic will double across Europe
- scheduled collective travel for journeys under 500 km should be carbon neutral
- automated mobility will be deployed at large scale
- zero-emission marine vessels will be market-ready

By 2035:

- zero-emission large aircraft will be market-ready

By 2050:

- nearly all cars, vans, buses as well as new heavy-duty vehicles will be zero-emission rail freight traffic will double
- a fully operational, multimodal Trans-European Transport Network (TEN-T) for sustainable and smart transport with high speed connectivity
- 10 key areas for action to make the vision a reality

To make our goals a reality, the strategy identifies a total of 82 initiatives in 10 key areas for action (“flagships”), each with concrete measures¹⁶. Through the Trans-European Transport Network policy (TEN-T), the EU aims to build an effective EU-wide transport infrastructure network. EU funding programmes and initiatives make available financial support to projects implementing the TEN-T:

- Connecting Europe Facility (CEF) – financial support for strategic investment in transport, energy and digital infrastructure.
- European Fund for Strategic Investment (EFSI) – supports investment in key sectors through financial guarantees.
- Horizon 2020 - provides funding for research and development projects with the aim of transferring great ideas from the lab to the market.
- European Structural and Investment Funds (ESIFs), including notably:
 - » Cohesion Fund (CF) – supports projects reducing economic and social disparities and promoting sustainable development in 15 cohesion Member States.
 - » European Regional Development Fund (ERDF) – aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions¹⁷.

Intelligent Transport Systems (ITS) can significantly contribute to a cleaner, safer and more efficient transport system. A new legal framework (Directive 2010/40/EU) was adopted on 7 July

¹⁶ https://ec.europa.eu/transport/themes/mobilitystrategy_de

¹⁷ https://ec.europa.eu/transport/themes/infrastructure_en

2010 to accelerate the deployment of these innovative transport technologies across Europe. This Directive is an important instrument for the coordinated implementation of ITS in Europe. It aims to establish interoperable and seamless ITS services while leaving Member States the freedom to decide which systems to invest in. Under this Directive the European Commission has to adopt within the next seven years' specifications (i.e. functional, technical, organizational or services provisions) to address the compatibility, interoperability and continuity of ITS solutions across the EU. The first priorities will be traffic and travel information, the eCall emergency system and intelligent truck parking. The Commission already took a major step towards the deployment and use of ITS in road transport (and interfaces to the other transport modes) on 16 December 2008 by adopting an Action Plan. The Action Plan suggested a number of targeted measures and included the proposal for this Directive. The goal is to create the momentum necessary to speed up market penetration of rather mature ITS applications and services in Europe.

The initiative is supported by five co-operating Directorates-General: DG Mobility and Transport (lead), DG Communications Networks, Content & Technology, DG Research & Innovation, DG Enterprise and Industry and DG Climate Action¹⁸. In addition, measures specifically relating to transport were also implemented, as the transport is responsible for almost 30 per cent of the EU's total CO₂ emissions, of which road transport accounts for 72 per cent. As part of its efforts to reduce CO₂ emissions, the EU has set a target to reduce transport emissions by 60 per cent by 2050 compared to 1990 levels. However, achieving this target is not so easy, as the rate of the emissions reduction has slowed. In other sectors, emissions have been reduced since 1990. However, as our society becomes increasingly mobile, transport-related CO₂ emissions are rising.

Progress in improving the fuel efficiency of new cars is also slowing. After a steady decline, newly registered cars emitted on average 0.4 grams of CO₂ more per kilometer in 2017 than in 2016. To counter this trend, the EU is introducing new CO₂ emission targets aimed at reducing harmful emissions from new cars (cars and vans). MEPs approved the new rules on 27 March. On 18 April, MEPs also adopted a proposal to reduce CO₂ emissions from new trucks by 30 percent by 2030 compared to 2019 emission levels.

The European Commission attaches particular importance to electro mobility. Within the framework of the European Green Cars Initiative of the European Economic Recovery Plan, which was launched in 2008, one billion euros were to be made available for research and development on this topic by 2013 in a public-private partnership (PPP) together with industry; by the end, 420 million euros had been called up. The successor initiative European Green Vehicles Initiative was launched in 2013.

The EEA Europe has mapped the emissions of greenhouse gases from the transport sector with the forecast until 2034 as following:

18 https://ec.europa.eu/transport/themes/its/road/action_plan_en

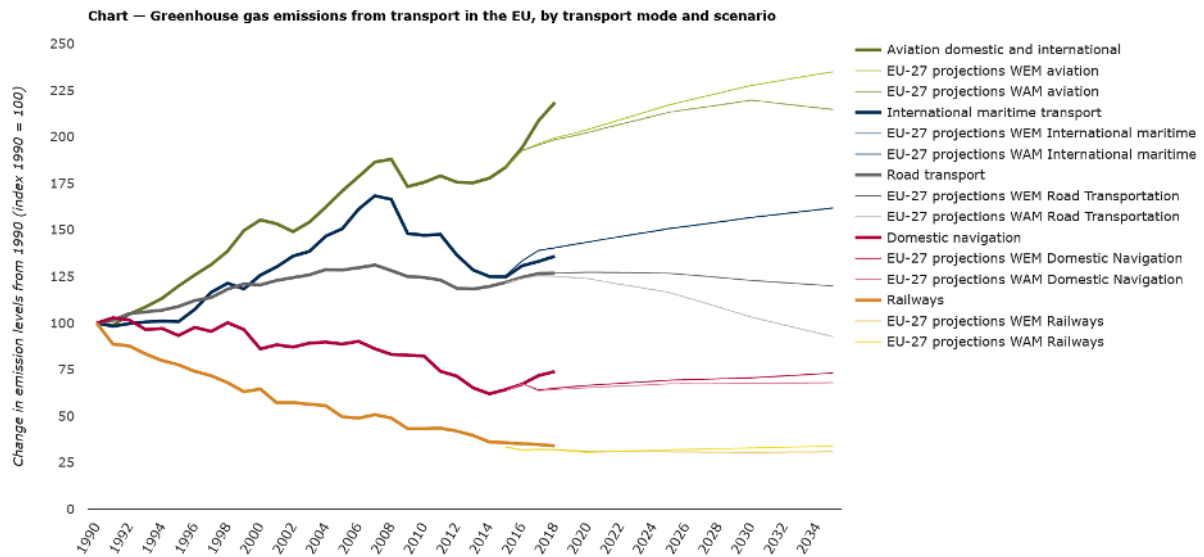


Figure 5 – Greenhouse gas emissions from transport in the EU

As the figure is indicating, the road transports are increasing since 2016 but will be depending on the existing and future-related policies decrease or stagnate. Due to the COVID-19 pandemic the road transport has increased based on the higher demand of internet shopping. Anyhow, road transport is expected to decrease within the next 15 years.

D.1) European Green Cars Initiative¹⁹

An ad hoc advisory body was created, which includes representatives of the involved Directorates General of the European Commission as well as the European technology platforms European Road Transport Research Advisory Council (ERTRAC), European Technology Platform on Smart Systems Integration (EPoSS) and Smart Grids. These and the interest groups of car manufacturers and suppliers (EUCAR) and the European Association of Automotive Suppliers (CLEPA) have made proposals for the design of the Green Cars Initiative, are organizing expert workshops together with the European Commission, e.g. on the topics of batteries or system integration and E/E architecture of the electric vehicle, and have drawn up a road-map for European industry. The aim is to dovetail funding activities in Germany and Europe.

By 2015, about 4.2 million euros had been invested by the European Union in European charging infrastructure and related projects. In addition, an openly accessible network of fast charging stations for electric vehicles has been created. The total cost will be about 8.42 million euros. The expansion was completed at the end of 2015.

D.2) European Green Vehicles Initiative²⁰

The European Green Cars Initiative's follow-on initiative the European Green Vehicles Initiative, launched in 2013, is also organized as a public-private partnership.

It also includes the technology platforms European Road Transport Research Advisory Council (ERTRAC), European Technology Platform on Smart Systems Integration (EPoSS) and Smart Grids, in addition to the representative of the participating Directorates General of the European Commission.

¹⁹ <https://op.europa.eu/de/publication-detail/-/publication/4b896025-3620-4768-9cf6-5e42654d629b>

²⁰ <https://op.europa.eu/de/publication-detail/-/publication/66c86b42-9f62-4f9b-9735-bd0f19adcbcb>

In addition, it participates in monitoring programmes to check the efficiency of activities as well as in programmes to establish communication channels between EU members and their research sites.

It is planned to set up a so-called ERA-NET Cofund Initiative in cooperation with the electro mobility+ Initiative and European countries and regions to promote electro mobility in Europe. The new platform will build on the experience, networks and results of the electro mobility+ Initiative. Its aim is to take transnational research and targeted policy exchange on e-Mobility issues in Europe to a further level of cooperation. With the two-pronged approach of the initiative, research and policy will be more closely networked in order to accelerate the introduction of electro mobility at the European level.

2.4 Targets and measures of the European Union

To decrease the greenhouse effects in Europe a number of initiatives and agreements has been done. The most popular for the e-SMART target group are as following:

- **Paris agreement:** signed by 178 Countries on April 21st 2016, it commits the signatories to maintain the world temperature rise below 2°C and, if possible, below 1.5°C compared to pre-industrial levels.
- **Climate and Energy Package 2030:** it foresees a 40% reduction in greenhouse gas emissions compared to 1990. This target means a 43% reduction in emissions compared to 2005 for the sectors involved in the so-called “Emissions Trading System (ETS)” and a reduction in greenhouse gas emissions of 30% compared to 2005 for “non-ETS” sectors, such as transport.
- **Effort Sharing: COM (2016) 482 final, July 20th 2016:** it delineates the European target on national level by the proposal of the “Effort Sharing” Regulation of the European Commission.
- **European Directive 2009/28/EC:** it forces Member States to promote the use of energy from renewable sources. Specifically, it defines the commitments for each Member State to ensure that its share of renewable energy sources on gross final energy consumption in 2020 is at least equal to its national general target for the share of renewable energy sources for that year. These compulsory national targets are consistent with the objective of at least 20% of energy from renewable sources in the gross final energy consumption of the Community in 2020. With the aim to achieve these objectives more easily, each Member State is required to promote and encourage energy efficiency and energy savings.
- **Regulations 510/2011 and 333/2014 on CO₂ emissions:** they impose progressively more severe limits on CO₂ emissions. In particular, they define respectively the average fleet target for new light commercial vehicles, equal to 175 gCO₂/km by 2017 and 147 gCO₂/km by 2020, and for new passenger cars, equal to 95 gCO₂/km by 2021. The Commission is also committed to finalize a strategy aimed at reducing emissions from trucks, buses and coaches before 2030.
- **World Harmonized Light Vehicle Test Procedure:** The European Commission introduced a stricter procedure for the certification of passenger cars and light commercial vehicles. Starting from September 1, 2017, the WLTP (World Harmonized Light Vehicle Test Procedure) procedure was introduced, which requires stricter and realistic laboratory tests and is completed by roadside testing (RDE - Real Driving Emissions) carried out using PEMS (Portable Emission Measurement System) systems. The aim is to drastically reduce the gap between CO₂ emissions, consumption and emissions of pollutants (NOx in the first place) detected according to the current vehicle type approval

procedures and those actually issued in the roadside guidance. It should be noted that a more severe and more representative evaluation process of actual use will also be used for electric vehicles, with the application of new approval cycles and attention also to the consumption of auxiliary devices such as air conditioning.

- **White Paper 2011 on Transport:** it sets up objectives and measures for an efficient transport system, respecting economic, social and environmental needs. In particular, in the 2011 White Paper, the user is at the center of transport policy and targets include increasing road safety levels, increasing awareness among users of transport costs, the dissemination of practices such as intermodality of passenger transport and rationalization of urban transport.
- **Green Paper on urban mobility, 2007:** it reflects on the main problems of European cities. The report, published by the European Commission, is a collection of reflections aimed at stimulating a public debate on the most critical issues in urban areas: smooth traffic in cities, city cleanliness, smarter, more secure and affordable urban transport.
- **2014/94/UE Directive on Alternative Fuels Infrastructure and Proposal for a Regulation of the European Parliament and of the Council on Alternative Fuels Infrastructure and repealing Directive 2014/94 EU of the European Parliament and of the Council:** It sets out a series of measures for the creation of alternative fuels infrastructure in order to minimize dependence on oil and reduce the environmental impact of transport. At the national level, the long-term strategic objective is to support the rational use of all alternative fuels, with the Directive being “technology neutral” and looking for optimal technical solutions and effective incentive/support schemes. Alternative fuels are considered in the directive to be all fuels or energy sources that can replace fossil fuels in the energy supply for transport (even partially, as in the case of hybrid vehicles): Electricity, hydrogen, biofuels, synthetic and paraffinic fuels, natural gas (including bio methane) in compressed form (CNG) and liquefied (LNG), liquefied petroleum gas (LPG).

The proposal aims to set binding national targets for the development of sufficient alternative fuels infrastructure in the Union for road vehicles, ships and stationary aircraft. Since the transformation on 17 June, the targets for the years 2025 and 2030 are binding.

Objectives are:

- » Ensure a minimum infrastructure to support the necessary introduction of alternative fuel vehicles.
- » Vehicles for all modes of transport,
- » Ensure full interoperability of the infrastructure
- » Ensure comprehensive user information and adequate payment options.

The draft contains common technical specifications and requirements for alternative fuels infrastructure in terms of user information, data provision and payment. It sets out rules for the national strategy frameworks to be adopted by Member States and provides for a reporting mechanism to encourage cooperation and tracking of progress.

On 17 June 2021, it was proposed to amend the Directive specifically for the e-bus sector. Proposals 7 and 8 are particularly relevant to the e-SMART issue:

- » (7) Directive (EU) 2019/1161 of the European Parliament and of the Council (4) provides for national minimum shares for zero-emission buses in public procurement of up to 22.5% for the period 2021-2025 and 32.5% for the period 2026-2030. As more and more transport authorities and operators acquire zero-emission buses to meet these targets, full interoperability between vehicle and charging infrastructure is essential.

- » (8) Interoperability of different types of charging systems for electric buses should be ensured in order to ensure a level playing field for manufacturers and operators and to allow economies of scale, while being open to different technical solutions. In addition, the use of smart charging systems should be promoted, including grid integration of vehicles.
- **Clean Vehicle Directive, 2021:** The revised Clean Vehicles Directive promotes clean mobility solutions in public procurement tenders, providing a solid boost to the demand and further deployment of low- and zero-emission vehicles. The new Directive defines “clean vehicles” and sets national targets for their public procurement. It applies to different means of public procurement, including purchase, lease, rent and relevant services contracts. Adopted by the European Parliament & Council in June 2019, the Directive needs to be transposed into national law by 2 August 2021²¹.
- **“Fit for 55” – The EU Commission’s Proposal Package:**
 - (1) Recast of existing directives/regulations:
 - » EU Emissions Trading Scheme
 - » Land Use and Forestry Regulation (LULUCF)
 - » Regulation on burden sharing
 - » Renewable Energies Directive - RED III
 - » Energy Efficiency Directive
 - » Directive on the development of infrastructure for alternative fuels
 - » Directive on emission standards for passenger cars and light commercial vehicles
 - » Energy Taxation Directive
 - (2) New policy proposals/regulations:
 - » EU Forestry Strategy
 - » CO₂
 - » border adjustment/climate tariff
 - » Climate social compensation/fund
 - » ReFuelEU Aviation (aviation fuels)
 - » FuelEU Maritime (marine fuels)

With these proposals, the EU is implementing its announcement ambitious climate protection policy even when leading industrialized climate protection policy even if leading industrialized do not follow this level of ambition. However, the EU cannot alone achieve its and its share of around 10 % of global greenhouse gas emissions alone can win the battle against climate change. Climate diplomacy (G7/G20) is gaining in importance.
- **Others:** there is a constant development of new rules and reports by the European Commission and related agencies. Some recent examples are the report “Towards clean and smart mobility” EEA Signals 2016, the “European Strategy for Low-Emission Mobility” COM (2016) 501 with its Staff Working Document (SWD 2016) 244 final annex, where the European Commission highlights how reducing emissions in the transport sector is one of the key points for a more environmentally friendly and energy-efficient economy, and the initiative “Europe on the Move”, a wide-ranging set of initiatives that will make traffic safer, encourage fairer road charging, reduce CO₂ emissions, air pollution and congestion, cut red-tape for businesses, fight illicit employment and ensure proper conditions and rest times for workers.²²

21 https://ec.europa.eu/transport/themes/urban/clean-vehicles-directive_en

22 https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/104692.pdf

2.5 Applicable and relevant legislation, standards and guidelines **in Alpine Space**

The e-SMART project aims to provide a transnational approach, coherent with regional policies and plans, in deployment of an interoperable infrastructure for e-LPT and e-LML. This work was done on a solid review of the State of the Art of each PP's country framework. The national legislations are described in the appendix.

Italy

The Italian national context is characterized by a complex scenario, in which the lack of infrastructure and the small number of 50 kW power stations are the main limits to the development of the e-Mobility sector. Currently in Italy almost 4300 public charging stations have been installed, which is a really low number when compared with France, U.K and Germany. The majority of them, almost 48%, are located in north-central Italy. However, the number of charging stations has significantly grown over 2014 thanks to e-Mobility planning developments in the national regulatory framework, especially for e-LML and e-LPT. With reference to the national policies, a very important series of guidance documents related to sustainability in the transport and private sectors have been drawn. The most important ones are the "National Plan for Electric Charging Infrastructures" (PNIRE), the "Roadmap for a Sustainable Mobility", and the "Legislative Decree 257/2016.

Slovenia

Slovenia aims to become carbon neutral in the next future, therefore decreasing harmful effects of transportation to the environment and developing e-LPT and e-LML sectors play a very important role. An active promotion of e-Mobility started in 2015 and Slovenia has proven through diverse projects that it is an e-Mobility friendly country.

One of the biggest projects is the "The Slovenian Green Corridors" that will enable the development of electro mobility in Slovenia within the framework of the European Project Central European Green Corridors (CEGC). The main objective is to establish a dense network of fast charging stations for electric vehicles on the motorway cross of the Republic of Slovenia.

The most important national regulations concerning the development of electric mobility are the following: Energy Act (2014), Decree on renewable energy sources (RES) in transport (2016), The Transport Development Strategy (2015), The Resolution on transport policy, The Action programme for alternative fuels in transport (2019) and The Integrated National Energy and Climate Plan (2020).

Slovenia is still committed to accelerate the process of traffic electrification with funding grants for private persons and enterprise buyers, for purchasing electric vehicles and charging infrastructures. Effects of grants are shown in the growth of the percentage of first registration of BEV vehicles which rose from under 1% of total new registered vehicles in 2019 to around 4,5% in 2021.

France

Thanks to the number of electric cars, investments in infrastructure and electric car sharing programmes, France ambitions to become the European leader in electric mobility.

The French Government is working to give the country the right infrastructure for the diffusion of electric mobility, with a plan for the deployment of public charging stations which provides subsidies both for charging stations in public places and in private areas or workplaces. Moreover, France encourages private companies to cooperate in spreading electric mobility by introducing incentive mechanisms rather than new policies.

From 2010 to April 2019, 179,622 light EVs (passengers and light commercial) and 43,947 plug-in hybrids were registered on a fleet of almost 38 million of vehicles.

With regards to the legislation, the recent national policies regarding e-mobility, e-LML and e-LPT in France are the Law in 2015-992 on energy transition, the Law n° 2019-1428 on mobility orientations, and the Decree 2007-23 on low emission busses and coaches.

Germany

Regarding German Energy and Climate Policy, including the Alpine Space, Europe sets the national implementation framework at the federal level. Certain areas of regulation can be supplemented by laws and policies of regional (state) and local (municipal) governments.

Focal points of the legal acts for e-mobility on a national level:

- Energy industry, in particular the combination of renewable energies and e-mobility
- Charging infrastructure, from construction specifications to installation and commissioning
- Parking Spaces, everything in terms of parking spaces for battery-powered vehicles
- Electric vehicles and their components

National Strategy:

In order to translate the European Directives and the goals from the Paris Agreement into national strategies, the German government has developed the Climate Protection Plan 2050, the National Industrial Strategy 2030, the Master Plan for Charging Infrastructure and the Government Program for E-mobility.

Key goals of these plans are:

- Reducing emissions in the transport sector by 40% to 42% compared to the reference year 1990
- Seven to ten million electric vehicles on German roads
- The implementation of one million charging points

This requires a high electrification level of the market and strong support from policymakers:

- The German Law Map on Electric Mobility is a document that shows all relevant legislations, regulations, laws on European, national, regional and local level.
- The National Centre for Charging Infrastructure – under the umbrella of the federally owned NOW GmbH – coordinating and managing activities in order to expand the charging infrastructure in Germany.

Regional Acts:

Each federal state has different funding programs and initiatives for e-mobility, coming from the respective state budgets or EU funds.

Some examples for LML and LPT initiatives in the Alpine Space:

- Bavaria:
 - » Together with Tank & Rast GmbH and the Bavarian State Ministry of Housing, Construction and Transport, the Federal Ministry of Transport and Digital Infrastructure has set itself the goal of creating fast-charging options at all 68 managed rest areas on Bavarian highways to enable long-distance mobility with electric vehicles.

- » Initiative for Research and Development: The Bavarian Collaborative Research Program (BayVFP) is intending to support research and development of vehicles, innovative drives and necessary subsystems and components in the Mobility funding line and as well as to provide an incentive for the faster dissemination of innovative mobility in the transportation sector.
- Baden-Württemberg:
 - » State Agency for New Mobility Solutions and Automotive, e-mobil BW

Local Engagement:

The municipality cannot directly control all areas and municipal financial resources are limited. In the LML and LPT area, the numerous measures in the sense of e-mobility are leading to steady growth. For example, Germany is the frontrunner in the construction of fast charging stations in Europe. Furthermore most cities and municipalities have ambitious plans to convert their bus fleets to zero emission by 2030.

Austria

The shift towards electric mobility is increasingly gathering pace, and Austria is at the forefront of developments in this field. In 2020 the number of newly registered electric cars rose by 73%. However, Austria not only leads in terms of numbers of registered vehicles or available charging infrastructure, it also plays a pioneering role in research and technological development.

The investment promotion for EVs launched in 2017 has provided numerous benefits such as the abolition of motor-related insurance tax, deductibility for input tax, elimination of non-cash compensation, parking privileges in cities, low maintenance and insurance costs and many other advantages. These measures allowed private users and companies to consider the purchase of an electric car a realistic economical alternative. There are ongoing funding opportunities at national and regional level for companies and private individuals. 2020/2021 companies were granted an additional bonus of 14% for investment measures in the field of e-mobility.

2.6 Coherence of the e-SMART main themes with the European Union's objectives and measures.

The previous chapters 2.4 Targets and measures of the European Union and 2.5 Applicable and relevant legislation, standards and guidelines in Alpine Space show that the European Union already occupies an active field of sustainable mobility by defining targets in the field of mobility, among others in the areas of last-mile logistics and public transport. However, the focus is primarily on environmental aspects and regulates these, for example, through limit values. This is intended to improve the quality of life of Europeans in addition to containing the environmental impact.

The use of electro mobility can be a key technology in this context, as both exhaust gases and the emission of pollutants can be effectively reduced. Against this background, the support of a transnational, consistent and effective network of charging infrastructure in planning and implementation for electric vehicles in LPT and LML is precisely aligned with European objectives and helps to create a favorable environment for the diffusion of electric mobility.

Furthermore, the discussion and adoption of a common strategy in different countries helps to break down barriers and raise awareness that global problems such as climate change can be better solved with a synergetic approach.

3 Governance models for the diffusion of e-Mobility

The governance model describes the political background for mobility decisions and projects in general. Using the e-SMART project itself as an example, the chapter aims to provide information on how political processes for restructuring mobility can be organized and which milestones are useful in this context. Since all countries involved in the e-SMART project have already taken measures for the transition from conventional, fossil fuel-powered mobility to e-mobility, the focus of the countries will vary and will have to be taken into account. Austria and Germany, for example, have so far followed an approach based mainly on the application of measures of a legislative and regulatory nature. The different national structuring in terms of government and expertise can have a strong impact on the type and scope of measures. Federal governments such as the Austrian and German ones are characterized by many local variables, which are also territorially very different.

Actions to inform, monitor, and raise awareness include specific measures that can be defined as potentially flexible bases and supports for further actions. These actions are extremely diverse, e.g. urban mobility monitoring or parking management (temporary parking ban for combustion vehicles), but also information sessions in schools and universities. Awareness campaigns are important to raise awareness and connect Alpine transport policy with users. Thus, these measures are extremely diverse in their focus and intensity; here it is important to find a healthy balance between measures to achieve the best results.

Table 2 – Expanded Governance, the Balance of public and private sector decision-making, control, influence; Cf. Innovative Governance for Urban Green Infrastructure (UGI): A Guide for Practitioners (Ambrose-Oji et al., 2017)

Government actor role	Leading <-----> Enabling					None / regulatory
Form of Non-government actor participation in governance	Information	Consultation	Involvement	Partnership	Empowerment	
Non-government actor role	Provide information and views about UGI (Urban Green Infrastructure) plans and projects as part of decision making process		Some involvement in planning, management, care and maintenance	Shared roles and responsibilities around planning and management	Leasing or purchaing of public land	Management agreement, leasing or purchase of private land
Governance model	Government actor led Consultative Democratic		Co-management	Co-governance /co-production	Non-government actor led governance self governance	

The following graphic shows the policy development process of new measures, policies, and resolutions. This is a cycle process in which the individual stages are mutually dependent and influence each other. In the upper right corner, the European Union is depicted, which guides, conditions and activates national policies in various ways. The yellow boxes show the measures, documents and actions of the e-SMART project that are directly related to the different stages of the policy process, which are visualized in the outer circle of the diagram. The inner pie chart shows the fields of action of the policy, which are additionally assigned to the corresponding stakeholders who are active in this area or have special expertise and influence.

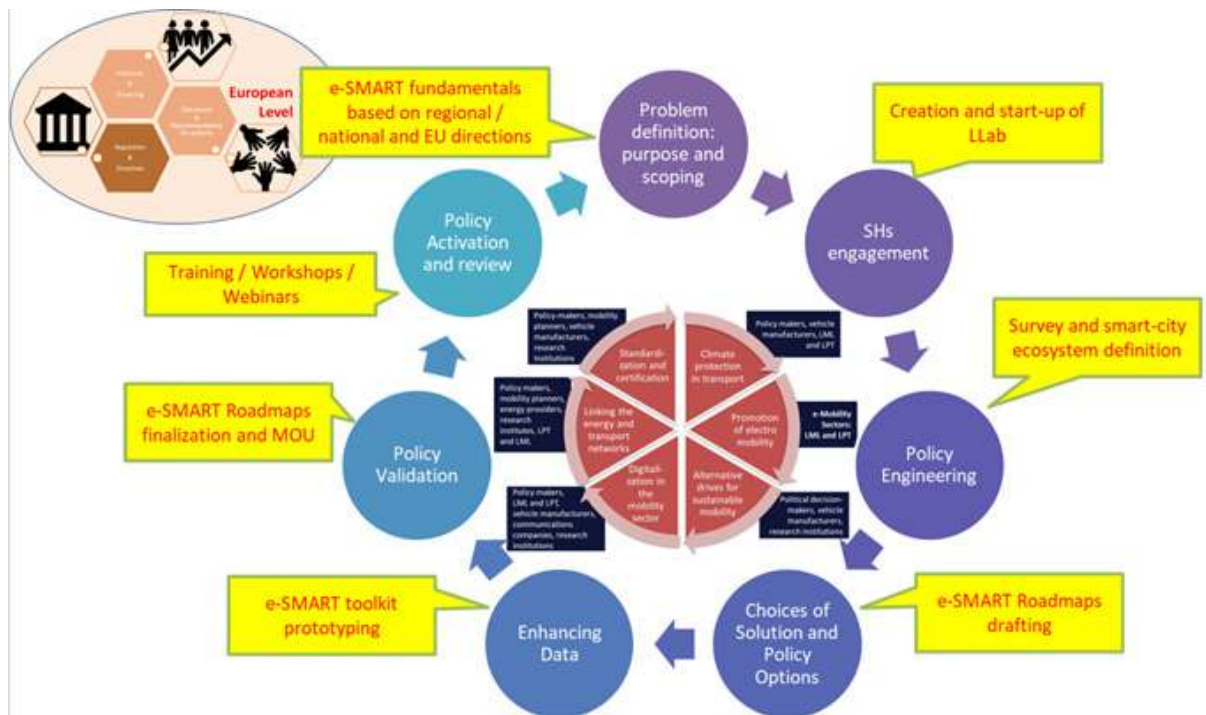


Figure 6 – e-SMART Policy Model (developed and designed by Guido Piccoli)

First, the national policy-making process is influenced at the European level. The EU launches **initiatives** to promote e-mobility in the member states and even creates **financial incentives** for the switch to e-mobility. In addition, the EU makes **recommendations for action** to re-structure mobility with the aim of making it emission-free in the future. As mentioned in several places in the document, all EU member states have committed to zero emissions by 2050. This goal is also supported by **regulations and directives** that have been transposed into national law, such as the Clean Vehicle Directive in conjunction with the Directive on Alternative Fuels (public tenders must take emissions into account when awarding contracts).

Overall, the following process can be seen as a political cycle system, as shown in the diagram, the processes are mutually dependent and influence each other. Political decision-makers, transport planners, vehicle manufacturers, research institutes, logistics companies, public transport operators, electricity providers, communication service providers and other interest organizations were identified as stakeholders involved in the process.

The type and extent of influence on the political process varies from stakeholder to stakeholder and milestone to milestone. The e-SMART project also focused on these milestones and the whole process. For this reason, e-SMART measures, e-SMART outputs or actions of the project are listed in this milestone.

3.1 Political Stages of the Alpine Space on e-Mobility

Problem definition

At the beginning, the problems, the challenges, the benefits and the purpose of political influence must be defined. It is also important to review the measures previously taken in order to gain a better understanding of the task. A collection of possible mobility solutions should be made and evaluated according to the benefits for citizens, operators and other stakeholders involved. In addition, questions about functionality, advantages and disadvantages, conse-

quences and conditions, justifiability and feasibility should be asked and answered for the collected potential solutions. From these steps, initial objectives can be formulated.

Following the objective setting, scoping can be started. In this process, the already collected and pre-sorted solutions will be examined in more detail. Can the solution be scaled and what does it entail? What are the costs and benefits? In addition to these questions, it is also necessary to assess whether and to what extent privatization can take place or whether the responsibility should lie in the public sector. Should an imbalance arise, the question must be asked whether this must be compensated and how this can be done.

e-SMART Reference:

The **e-SMART Fundamentals on regional, national and EU directions** can be used to support this.

Stakeholder Engagement

After goal setting and scoping, the stakeholders must be considered. The involvement of the stakeholders must be considered individually and also the manner of involvement. Disciplines should be assigned, roles distributed and responsibilities clarified in advance. Responsibilities for mobility solutions can be budgeting, regulation, economics, infrastructure, procurement, human resources, spatial planning, energy and data management. In addition, ownership and operator relationships should also be clarified. The timing of involvement depends on the stakeholder's assigned role, discipline or responsibility; if this is managed smartly, time and resources can be saved. In this management, the assignment of key roles can also be an effective instrument. Prioritization can also take place on the basis of these key roles. Basically, the involvement of external partners should always be seen as an opportunity, since additional expertise and the view from different angles can be beneficial.

e-SMART Reference:

In the e-SMART project, stakeholder involvement took the form of Living Labs. More information on the structure, effectiveness and expected output of such Living Labs can be found in the **e-SMART Living Lab Methodology**.

Policy Engineering

Political decisions should be based on an informed discourse on goals and measures. Science can contribute to this by providing evidence on causes and effects, for example through methodologically appropriate, systematic evaluations, but also long-term population studies, as explained in the statement "Scientific and societal importance of population-wide longitudinal studies. But the business community can also contribute its expertise in the relevant areas of mobility issues. Policymaking should address the issues of "Integrated mobility", "Changing awareness towards alternative forms of mobility", "New business and financing models in terms of economic efficiency for providers and users", "Improving connectivity mobility". To open up new ways of mobility without owning a car. Increasing digitization also plays a decisive role here and must be taken into account in equal measure. For example, mobility offerings can be more easily advertised via digital information systems so that they can be more widely used and thus operated more economically. Such information systems are, for example, smartphone apps that can be used on the move and also play a central role in arranging car-

pooling. One means of improving accessibility and securing connections could be the creation of reliable “intermodal travel chains.” This involves combining and coordinating travel options from different modes of transportation. Important for the planning of such trips are information systems that include different means of transport and, if possible, also enable direct booking of the entire trip. The foundation for these and other sustainable mobility concepts is laid in the policy-making process. After the problem analysis, including goal setting and scoping, and the planning of stakeholder involvement, data must also be collected and evaluated for the step of shaping political influence on mobility, and the consequences of the measures must be considered in terms of function, enforceability and possible shifting of existing conditions.

e-SMART Reference:

Information on mobility issues in the field of LPT and LML can be found in the **e-SMART survey** and the **e-SMART smart city ecosystem definition**.

Choices of Solution and Policy Option

At this point in the process, the selection of the collected solutions takes place based on the collected data and the previous steps. The policy options are also included and considered. In addition to the goal setting and scoping, stakeholder involvement and the data collected specifically on the solutions, as explained in the previous steps, current and future circumstances of the political nature of e-mobility should also be considered. What is the mission and vision of the EU in transport and mobility? Which goals and measures does the EU take and which ones will it take in the future and what impact will they have?

e-SMART Reference:

On the one hand, this document is intended to support the **e-SMART Tactical Roadmap** in this step. In addition, the **e-SMART Operational Roadmap** can also be consulted. While this document focuses on a transnational level, the operational roadmap focuses on the national level. It also takes into account the country-specific characteristics and peculiarities. The Operational Roadmap defines macro objectives. It evaluates the urgency of measures against the country-specific background, identifies bottlenecks and presents best practices.

Enhancing Data

Digitalization offers mobility a wealth of opportunities to make tomorrow’s mobility more sustainable. And it can certainly be seen as a driver of sustainable mobility. The raw material of digitization is data, which forms the basis for new applications and processes. In the course of the e-SMART project, public mobility data was identified as a building site for the digitization and development of mobility. This involves the availability of the data - in some cases, the public sector has not yet collected any data at all; the quality of the data - the data was often collected using outdated standards and formats and can today only be processed and evaluated with great effort or not at all; and the exchange of data among public organizations, regions, cities and countries. There is clearly a gap here that must be closed as quickly as possible.

This gap can be provided by public data lakes and platforms that share data, approaches and methods. This can save resources and time and avoid potential errors.

e-SMART Reference:

The e-SMART project provides its own approach to mobility databases and developed a prototype that shares mobility and smart city data on a transnational level, the **e-SMART Toolkit Prototype**. This platform will also serve as a place for the exchange of experiences between experts and interested parties.

Policy Validation

Policy validation is the process of demonstrating that a law, guideline or recommended action is fit for purpose and meets the requirements placed on it. Policy validation is an important tool in quality assurance and is required by authorities within the framework of accreditation and approval procedures. Especially in the area of the desired change in mobility and the energy transition, it is urgently necessary to install a permanent monitoring of the measures and decisions taken. In order to obtain an overview of the effectiveness and the effects on other areas at all times. The findings from the validation can be used to readjust the decisions and measures taken or to redesign them. Furthermore, these findings and experiences are also suitable for exchange between authorities and responsible persons at national and international level.

e-SMART Reference:

The **e-SMART Letter of Commitment** uses this methodology and reflects the measures, findings and actions that have been developed, tested and applied within the e-SMART project. With this document, the signatories commit to recognize and support them.

Policy Activation and review

After the previous steps and stages, it is now a matter of introducing and implementing the political decisions. Due to the great importance of mobility in the everyday life of all citizens, the policy should be transparent and clear. This also increases the acceptance and willingness to implement these measures or to follow the guidelines. This stage can at the same time be the starting signal for a new policy; as already described, description is a political cycle process.

e-SMART Reference:

In the e-SMART project, the knowledge, experience and expertise gained will be published and made available to the general public in the form of **e-SMART trainings, workshops and webinars**.

3.2 Actors Role in the Alpine Space on e-Mobility

This chapter aims to give an overview of the distribution of roles of the actors regarding e-Mobility in the countries participating in e-SMART. The following graphs describe the influence and interests of different actors in the field of e-Mobility. The figures and numbers are based on an e-SMART survey made in 2020. To get an overview of the stakeholders and their importance in the alpine space countries, the stakeholders were divided as following:

- PA: Public Authorities, local and regional public authorities in the Alpine Space regions of the e-SMART partners
- Energy service providers: local, regional and international energy providers
- ICT service providers: these stakeholders are the software developers, the telecommunication operators
- Vehicle manufactures/Sellers: OEM: s as well as vehicle modifications

E-MOB PLANNING

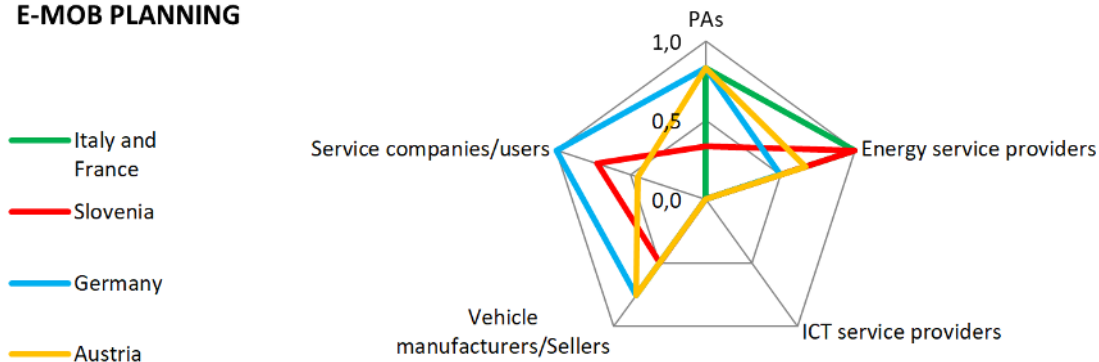
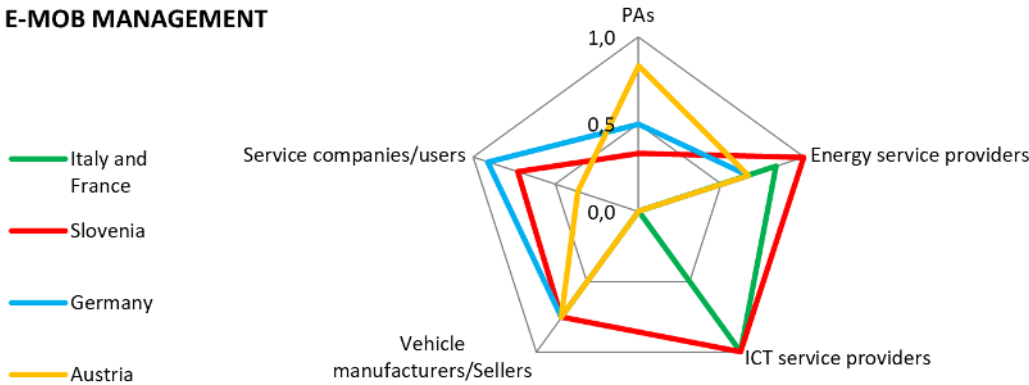


Figure 7 – E-Mob Planning

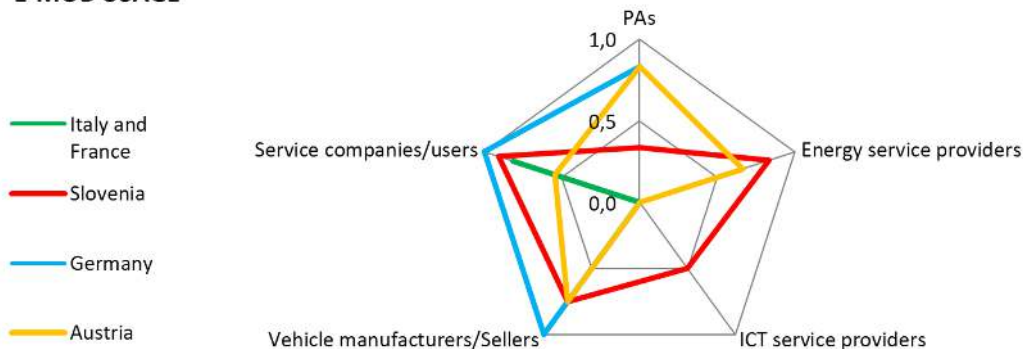
E-Mobility Planning is about finding solutions for effective usage of electric vehicles that not only serves the overall goal of the diffusion of e-Mobility by offering an alternative to conventional internal combustion engines, but also allows economic planning. However, as few business models and solutions for e-Mobility are currently economically or permanently tested, a large part of e-Mobility planning is carried out by service companies in collaboration with the public administrations and the manufactures. In this case, the ICT service providers are considered as service companies, which include digital tools and analytics in their offers. Energy service providers are often included in the collaboration, but it's necessary to pay more attention while planning accordingly to the results of the survey.

Figure 2 shows that e-Mobility planning differs between countries in the Alpine Space, but there are also commonalities between countries. For example, the diagrams for Italy and France are identical in terms of energy service providers, ICT service providers, vehicle manufacturers, service companies and PA. On the other hand, Germany and Austria are very similar and Slovenia is far ahead in energy service providers and service companies. Common to all countries is the high participation of all actors except ICT service providers.

E-MOB MANAGEMENT**Figure 8** – E-Mob Management

In contrast, the energy service providers play a major role in the actual e-Mobility management alongside the service companies. This may be due to the responsibility transferred for power supply and load management. Here, too, there are few or no independent ICT providers; instead, the digital tools that ensure smart energy management, for example, are integrated into the energy service providers or service companies.

As can be seen in the graphic of e-Mobility management above, Italy and France have an identical pattern. However, for the other countries, Slovenia has concentrated on the ICT service providers and Germany has been focusing on service companies and Austria on PA in the topic of e-Mobility management. Common facts for the stakeholders is the high numbers with the difference that the focuses of the countries differ (e.g. the importance of ICT service providers in Slovenia and Austria).

E-MOB USAGE**Figure 9** – E-MOB Usage

The figure 4 shows the e-Mobility usage and the different peaks in the alpine space countries. The service companies/users are taking a big part of importance in the field of e-Mobility usage. Furthermore, is the vehicle manufactures/sellers of importance. As can be seen in the figure 4, the focus in the alpine space countries is different. Slovenia and Austria are focusing on the energy service providers, and in the meantime Germany including Italy/France and Slovenia has a high density of service companies/users. All the participating countries find the vehicle manufactures/sellers of importance. The public authorities are important, and the ICT service providers are not so highly scored in the e-Mobility usage.

LPT PLANNING

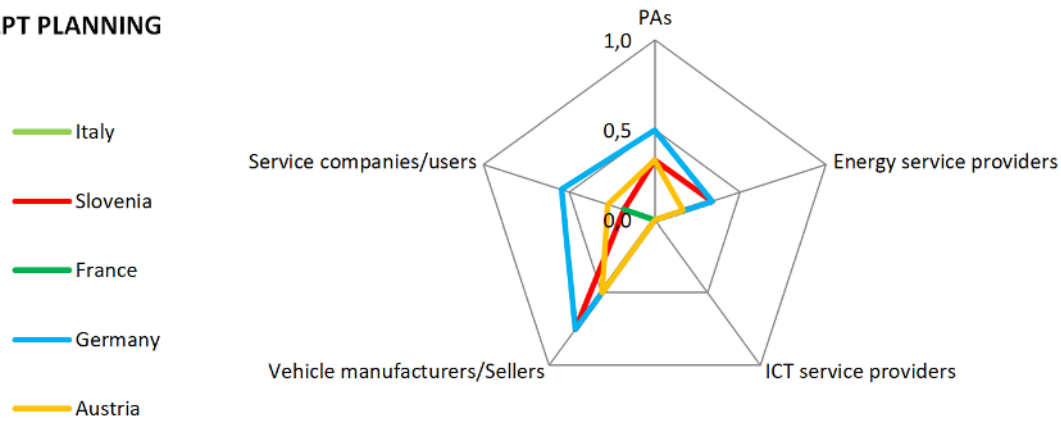


Figure 10 – LPT Planning

The Planning of the Local Public transport is usually the work of the public administrations and transportation operator in consultation with the local energy service provider. Nevertheless, the manufactures and sellers are still over proportionally important for the planning of electric local transport, because supply cannot yet sufficiently meet demand and market saturation has not yet occurred.

For this reason, manufacturers are also directly involved in the planning phase, not least because the corresponding charging infrastructure must be built to match the vehicles.

As figure 4 shows, public transport is not as mature as e-Mobility planning in the Alpine Space countries. In Germany, the graph shows the highest numbers, indicating that planning has already been connected and started to be implemented. In all countries, the topics of public authorities, vehicle manufacturers as well as service providers are of highest importance for the planning of public transport. The differences may be due to the different status quo of the countries.

LPT MANAGEMENT

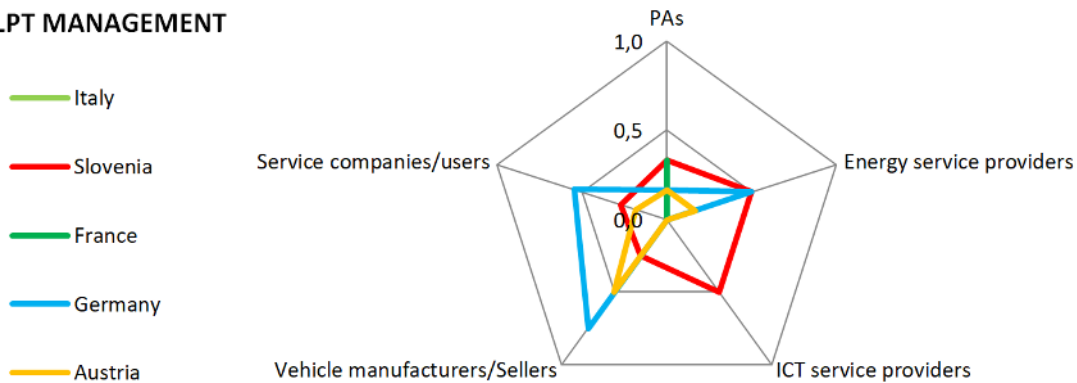


Figure 11 – LPT Management

This phenomenon can also be partially applied to the management of public transport. Public authorities are only involved indirectly. Most of the management of e-LPT, especially in terms of the charging infrastructure, is done by the suppliers in cooperation with the manufacturers and the energy service providers. In order to be able to guarantee an optimal charging management, it needs the strong interest of all three parties.

In the topic of LPT management the focuses differ between Slovenia and Germany/Austria. Slovenia is highly involved with the ICT service providers and Germany/Austria focuses on the vehicle manufactures. Furthermore, can the differences be found in the importance of service

companies? The differences might come from the status quo of the countries due to the LPT management.

LPT USAGE

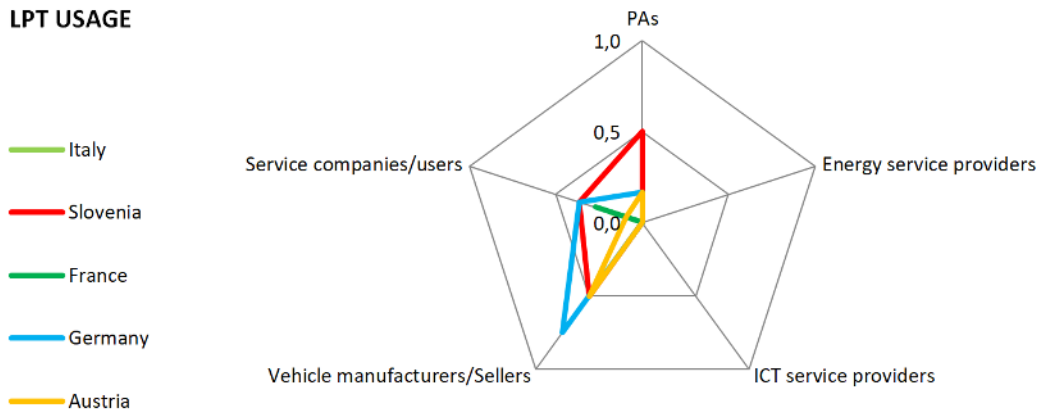


Figure 12 – LPT Usage

The usage of e-LPT depends on the availability of the vehicles. Therefore, concerning the use, the vehicle manufactures and the service providers are responsible for it, pushed by several factors like public awareness, city regulations, CO₂ targets in the sense of a more sustainable transport, while the energy service providers have the most influence on the usage, no energy, no use! This point is missing in the results or not occurred in the first place, which is another sign that the role of the energy service provider has not yet achieved the status it needs. This may change quickly, as the number of e-vehicles grows and energy demand increases.

In this figure, the highest values are reached by the vehicle manufactures for all the countries. In Slovenia a high number is reached by the PA. The importance of ICT service providers and energy suppliers are in this question not of importance.

LML PLANNING

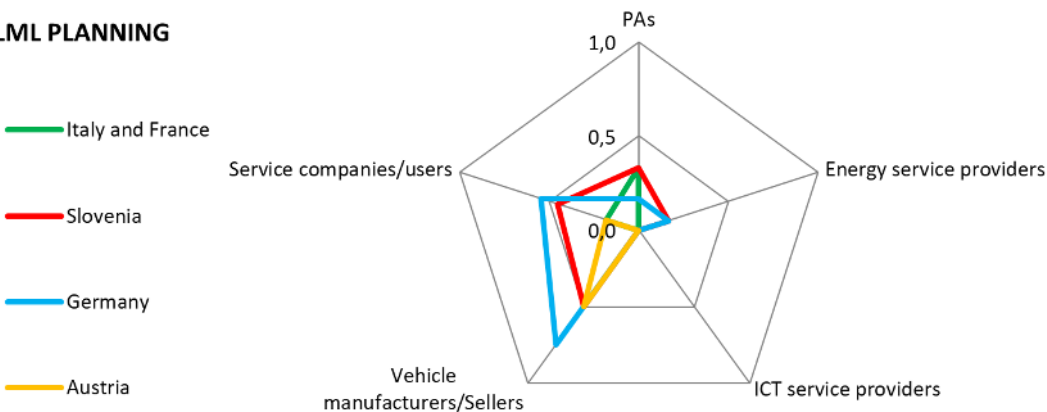


Figure 13 – LML Planning

E-Mobility in the Last Mile Logistic and in Logistics in general is a very young economy that is only just establishing itself. It was found that, depending on the application, no leading technology has yet been able to establish itself. In the heavy-duty segment, hydrogen and battery cells are on an equal footing. In urban applications, e-pedececs and small electric-powered vehicles are dominating the field. The issue is that it is a rapidly growing sector of the economy that is attracting the attention of the entire industry. This is also shown by the results of the survey. The manufacturers play a decisive role in the planning of the LML. In collaboration with service companies, concepts are brought to the road, especially in pilot projects and light-house projects. Common references to PT Figure 4, LML Planning and Figure LML Planning

is the importance of vehicle manufacturers for all countries involved. The difference is that ICT service providers and energy suppliers are not directly involved in LML planning.

LML MANAGEMENT

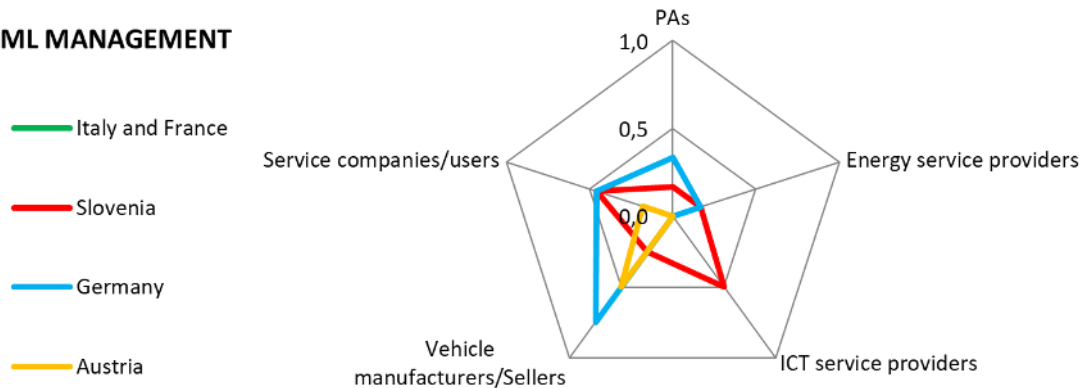


Figure 14 – LML Management

Similar to the results of the LPT Management and Planning, the results show the great influence of manufacturers and sellers in the field of the management of e-LML. Again, this might be due to the dependence to implement the corresponding charging infrastructure, which is far from being a kind of standard solution and often has to be customized individually to the needs of the vehicles and the operators.

LML USAGE

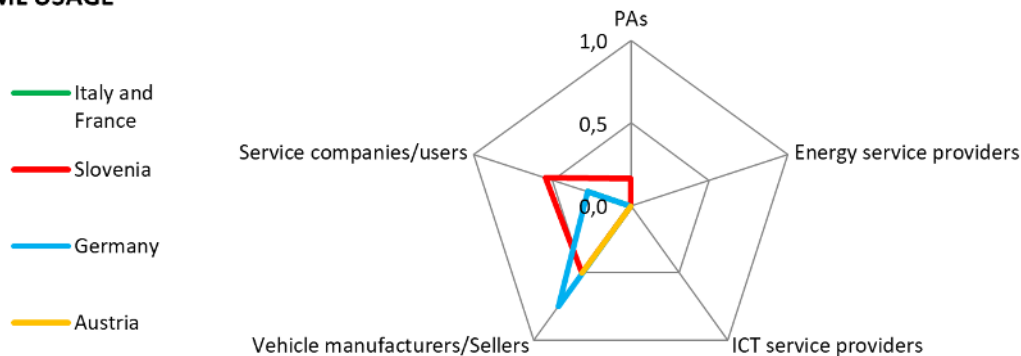


Figure 15 – LML Usage

As mentioned, the choice and type of electrical logistic solution is extremely dependent on the application. It is therefore not surprising that the manufacturers in particular also play a major role in the use. The different roles of the individual actors also become apparent when looking at the key elements.

3.3 Action fields of governance model

The political stages of action from the previous chapter 3.1 Political Stages for the Alpine Space on e-mobility can be summarized for all actors in 6 different fields of action. In order to further promote and enable the diffusion of mobility, all actors involved (see chapter 3.2 Role of actors) have to position themselves and follow the formulated recommendations for action within and beyond their possibilities.

Field of Action 1: Climate protection in transport

Target group: Policy makers, vehicle manufacturers, LML and LPT

As described above, the EU member states have agreed on international climate targets, and some Alpine Space countries also have stricter national targets for reducing greenhouse gas emissions. To achieve these targets, the transport system must be radically changed and transformed. The goal of this transformation must be the design of mobility systems that are as far as possible greenhouse gas neutral and economically and socially sustainable. For this far-reaching change, a process of social and economic change must be initiated, especially within mobility behavior as well as in the automotive industry.

Field of Action 2: Promotion of electro mobility in LPT and LML sector

Target group: e-Mobility-Sector; LML and LPT

Various fields of action can be identified for the promotion of mobility. Within these fields of action, but also across the board, it is indispensable for the promotion of the spread of electro mobility to intensify trade beyond national borders, internationally. In this way, expertise, experience and synergies can be used transnationally. In the following, the fields of action are described and an overview of possible supporting measures is given.

Field of Action 3: Alternative drives for sustainable mobility

Target group: Political decision-makers, vehicle manufacturers, research institutions

In this field of action, all modes of transport must be analyzed with regard to their impact on climate and energy policy goals and, if necessary, alternatives must be examined and, if evaluated accordingly, their use promoted. In addition to the technical and economic aspects, the social impacts should also be examined. Above all, acceptance and user behavior play a decisive role.

Field of Action 4: Digitalization in the mobility sector

Target group: Policy makers, vehicle manufacturers, LML and LPT, Communications companies, research institutions

The ever-advancing digitalization and automation in almost all areas of our lives can be used as an important catalyst for designing climate-friendly, efficient, convenient and affordable mobility. In addition to increasing environmental sustainability, digitalization can also increase the safety of road users. Through barrier-free, fast and networked payment systems, mobility can be customized and highly efficient across different modes of transport. In this field of action, it is also important to work out which prerequisites of digitalization in the areas of infrastructure, networking and legislation are needed for the mobility of tomorrow.

Field of Action 5: Link energy production and transport networks

Target group: Policy makers, mobility planners, energy providers, research institutes, LPT and LML

The energy and transport networks are facing profound change. Infrastructural prerequisites for this change must be determined and their implementation promoted. Charging and refueling infrastructure for electro mobility, hydrogen and LNG play an important role here. But issues in the area of power-to-X and intelligent grid interactions also need to be considered.

Field of Action 6: Standardization and certification

Target group: Policy-makers, mobility planners, vehicle manufacturers, research institutions

As other EU funded project e-MOTICON has already shown, standardization has great influence of on the spread of electro mobility is. After all, the standardization of charging plugs and sockets into uniform, manufacturer-independent systems have rapidly boosted the spread of e-vehicles in the Alpine region. But the list of strategically necessary international consensus processes in the field of mobility is still long, e.g. communication between vehicles or with signalers or other traffic regulators. The focus on e-LPT and e-LML is relevant, also to support the European action for the production of international standards and vehicle production.

3.4 Key elements for the Alpine Space

This chapter describes key elements for the further development of electro mobility. These key elements came from brainstorming sessions at the e-SMART Living Labs and were then divided into three broad areas: A) Green Deal - Green Europe, B) Digital Europe - Smart Europe and C) Europe for Citizens. These three areas are at the same time also large-scale funding programmes with the help of which the corresponding objectives are to be pursued by funding suitable projects from the EU itself. The Key Elements themselves are more deeply described in the appendix.

A) Green Deal – Green Europe

Climate change and environmental degradation are existential threats to Europe and the world. That is why Europe needs a new growth strategy if it is to make the transition to a modern, resource-efficient and competitive economy in which

- no net greenhouse gas emissions are released by 2050
- economic growth is decoupled from resource use
- no one, neither people nor regions, is left behind.

The European Green Deal is our roadmap for a sustainable EU economy. We will achieve this goal by seeing climate and environmental challenges as opportunities in all policy areas and by making the transition fair and inclusive for all.²³

A.1) Energy Management

A major component of the key elements assigned to the Green Deal is energy management. The use of several electric vehicles, especially large ones in the LPT and LML sector, can also have an impact on the local energy or power grid. In order to guarantee both a functioning use of the corresponding vehicles and the stability of the local power grid, appropriate precautions must be taken and the following factors, among others, must also be worked with. The following elements can be assigned to Energy Management; an explanation of the terms can be found in the appendix.

The following statements are recommendations for action for energy suppliers, political funding bodies of the energy industry, political energy planners, as well as for R&D and manufacturers of energy storage and PV systems. These recommendations for action significantly encourage the switch from combustion vehicles to electrically powered vehicles.

²³ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_de

Key elements for energy management	Target/ Measurement	Related Statements
Energy production and Renewable energy systems (RES) rate	Increase of re-nearable energy	<ul style="list-style-type: none"> • Promotion of local and sustainable energy supply by energy supplier • Promote electricity self-production by private household
Vehicle to vehicle (V2V) and vehicle to grid (V2G)	Support and expand technology	<ul style="list-style-type: none"> • Exploiting synergies between electricity self-production and smart grind • Integration of smart grids with the possibilities Vehicle to Grid
Services for flexible electric grid operation	Support and enable flexible services	<ul style="list-style-type: none"> • Promotion of local and sustainable energy supply by energy supplier
Local peaks management	Intelligent peak load management as a contribution to grid stability	<ul style="list-style-type: none"> • Promotion of local and sustainable energy supply by energy supplier • Promote electricity self-production by private household • Consider and integrate local peak load management in the planning of charging networks and charging infrastructure for e-mobility in LML and LPT
Power Grid stability	Grid stability must always be guaranteed	<ul style="list-style-type: none"> • Promotion of local and sustainable energy supply by energy supplier • Promote electricity self-production by private household • Stable power grid coverage without large power fluctuations • Consider and integrate local peak load management in the planning of charging networks and charging infrastructure for e-mobility in LML and LPT
Smart grid network management system	Introduction, expansion and establishment of smart grid management systems	<ul style="list-style-type: none"> • Promotion of local and sustainable energy supply by energy supplier • Integrate DSO strategy and investments into regional energy planning. • Exploiting synergies between electricity self-production and smart grind

A.2) Charging management

Charging electric vehicles requires an infrastructure that is not yet available in many cases. In addition to the electrical infrastructure, the parallel charging of several vehicles also requires a corresponding load or charging management system.

In general, a distinction is made between so-called AC chargers and DC chargers when charging electric vehicles. In AC charging, the direct current required for the vehicle batteries is generated by an on-board charger installed in the vehicle itself. With DC charging, on the other hand, the charging station takes over this power conversion directly and feeds direct current into the vehicle. As a rule, DC chargers can charge electric vehicles with considerably more power and thus much faster.

In addition, the State-of-Charge (SoC) also plays a decisive role in the use of electric vehicles in the areas of LPT and LML. The SoC describes the state of charge of an electric battery in relation to its capacity. The units of the SoC are percentage points (0% = empty; 100% = full). In a battery electric vehicle (BEV), hybrid vehicle (HV) or plug-in hybrid electric vehicle (PHEV), SoC for the battery pack is the equivalent of a fuel gauge.

In logistics as well as in public transport, the processes must function smoothly and reliably. Therefore, the operator must always keep an eye on the SoC and include it in his operational planning and ultimately also in the charging management. The following is a list of the most important key elements in the field of charging management. As in the previous chapter, explanations of the terms can be found in the appendix.

In order to prepare and implement the switch to e-mobility in the areas of LML and public transport, the following targets, measures and statements can be used as effective recommendations for action. The statements are predominantly aimed at mobility planning stakeholders both at the political level and at the private level in the relevant companies, energy suppliers, urban and mobility planners, vehicle manufacturers and research institutions in the field of mobility and energy.

Key elements for charging management	Target/ Measurement	Related Statements
Battery development	Support and promotion of battery development and research projects	<ul style="list-style-type: none"> • Development of technical interfaces and networking possibilities between energy and mobility • Development of more powerful and durable storage media
Standardized charging infrastructure	Creation and establishment of generally applicable standards	<ul style="list-style-type: none"> • Development of technical interfaces and networking possibilities between energy and mobility • Supporting the creation of common charging infrastructures
Smart charging management system	Introduction, development and promotion of intelligent charging systems	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • The inclusion of intelligent charging management systems in the local energy and management strategy.

Key elements for charging management	Target/ Measurement	Related Statements
		<ul style="list-style-type: none"> • Supporting the creation of common charging infrastructures
Charging concept for e-LPT and LML	Planning and expansion of suitable charging infrastructure taking into account local conditions and impacts	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • Promoting the development of tools to analyze the location of charging infrastructure and determine the most suitable charging system • The inclusion of intelligent charging management systems in the local energy and management strategy
Mobility Planning	Promotion and application of sustainable mobility concepts	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • The inclusion of intelligent charging management systems in the local energy and management strategy • Promoting the development of tools to analyze the location of charging infrastructure and determine the most suitable charging system. • Develop charging systems that are specifically targeted to the use of e-mobility in public transport and logistics • Monitoring of freight flows and transporting vehicles in the region
Development of infrastructure (mobility, energy, parking, financial issue)	Support and promote sustainable infrastructural projects and techniques	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • Development of technical interfaces and networking possibilities between energy and mobility. • The inclusion of intelligent charging management systems in the local energy and management strategy. • Promoting the development of tools to analyze the location of charging infrastructure and determine the most suitable charging system.

Key elements for charging management	Target/ Measurement	Related Statements
		<ul style="list-style-type: none"> • Develop charging systems that are specifically targeted to the use of e-mobility in public transport and logistics • Supporting the creation of common charging infrastructures
Improved knowledge of one's territory stakeholders LML flows	Build and expand knowledge about territory freight flows	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • Monitoring of freight flows and transporting vehicles in the region
Sharing charging infrastructure	Development of multi-use charging infrastructure for different mobility concepts	<ul style="list-style-type: none"> • Development of realistic simulations to form scenarios for the use of e-mobility in the fields of energy and mobility • Development of technical interfaces and networking possibilities between energy and mobility • Promoting the development of tools to analyze the location of charging infrastructure and determine the most suitable charging system. • Supporting the creation of common charging infrastructures

A.3) Mobility services

In the course of increasing digitalization and due to social change, services in the mobility sector are becoming more and more popular throughout the Alpine Space. These services in the fields of LML and LPT are often linked to alternative transport solutions and not infrequently also to e-mobility. The following key elements should be considered and the related issues should be taken into account.

Often, the alternative "Mobility as a Service" offers are affected by market barriers and entry barriers, these are not only of a purely economic nature but also political decisions can hinder market entry or large-scale diffusion. Therefore, policy makers are called upon to minimize market barriers of politics for sustainable offers and to facilitate their market entry. But also the providers are called upon to always check their offer for sustainability and marketability. Urban and regional transport planners can use these offers to differentiate the general transport network and offer real alternatives to conventional ones.

Key elements for mobility services	Target/ Measurement	Related Statements
Mobility as a Service (MaaS)	Increasing the supply of sustainable MaaS concepts	<ul style="list-style-type: none"> Promote sustainable offers and reduce political market barriers and barriers to market entry Understand MaaS as complementary to existing municipal mobility services and prevent cannibalization effects
Development of united services for LPT	Implementation of holistic mobility concepts from the combination of different services	<ul style="list-style-type: none"> Understand MaaS as complementary to existing municipal mobility services and prevent cannibalization effects

A.4) Financial aspects and ecological aspects of e-mobility

The use of e-mobility can have a very positive ecological impact on the ecosystem of the area of use. With appropriate planning, the use of these vehicles is profitable in the long term compared to conventional vehicles with combustion engines. The following key factors and issues need to be considered.

Financing from political funding pots or the decision of appropriate subsidies and other financial incentives can decisively advance the spread of e-mobility in all areas, of course also in public transport and logistics. Above all, political decision-makers and funding bodies are called upon to promote and support corresponding projects, processes and plans.

Key elements for financial aspects and ecological aspects of e-mobility	Target/ Measurement	Related Statements
Financing of e-trucks and e-buses	Increase funding and reduce bureaucracy in the funding process	<ul style="list-style-type: none"> Subsidize and finance public transport and LML projects taking into account environmental aspects Facilitate the acquisition of suitable e-vehicles in public transport and LML.
Environmental assessment and cost-benefit analysis	Installation of constant cost-benefit analyses taking into account sustainable aspects	<ul style="list-style-type: none"> Investigation of the various charging systems and mobility solutions in terms of environmental balance, but also in terms of cost-benefit analysis
PPP - Project Financing	Increase in financial resources for PPP project financing	<ul style="list-style-type: none"> Contribution of PPP project financing to the decarbonisation of transport and the energy transition

Key elements for <i>financial aspects and ecological aspects of e-mobility</i>	Target/ Measurement	Related Statements
New business models for mobility	Support and promote new sustainable mobility concepts	<ul style="list-style-type: none"> • Subsidize and finance public transport and LML projects taking into account environmental aspects • Contribution of new mobility-related business models to the decarbonisation of the transport sector
LML and LPT service agreements	Service contract design in favor of sustainable service providers	<ul style="list-style-type: none"> • Subsidize and finance public transport and LML projects taking into account environmental aspects. • Service Agreements as a contribution to the optimal localization of e-LPT and e-LML

B) Digital Europe – Smart Europe

Making Europe greener and more digital is the double challenge for the current generation, and success in meeting these challenges will determine the future. The European Commission has begun to look at a greener Europe through the lens of the European Green Deal. At the same time, it is opening the discussion on the transition to a more digital world: the digital transformation. Digital technology and infrastructure play a crucial role in our personal and business lives. We rely on them to communicate, work, advance science and solve current environmental problems. At the same time, the COVID 19 pandemic has highlighted not only how much we rely on our technology to be available to us, but also how important it is for Europe not to be dependent on systems and solutions from other regions of the world. Should the world of digital technologies be made more accessible to businesses, citizens and public administrations? Of course, the aspiration also has an impact on our mobility. Digitalization is closely linked to new approaches to mobility, and even makes some of them possible in the first place. The most significant digital key factors for the future of mobility are listed below.²⁴

B.1) Handling data

In the course of digitalization, the importance of data continues to increase. Constant technical progress makes it possible to process and process ever larger amounts of data. This also includes the evaluation of mobility data, which greatly facilitates the planning of infrastructure transport networks and general transport and urban planning.

The targets, measures and statements on data handling are addressed to research institutes, mobility planners, mobility service providers, logistics experts and political funding bodies.

²⁴ <https://digital-strategy.ec.europa.eu/en/activities/digital-programme>

Key elements for <i>handling data</i>	Target/ Measurement	Related Statements
Data sharing	Increasing the sharing of data	<ul style="list-style-type: none"> • Open source data platforms are an essential component of Smart Territory approaches • Determine generally applicable standards (formats, collection, etc.) • Promote corresponding projects with the background of data processing for planning, monitoring mobility and energy issues
Big Data	Collection and evaluation of mobility data from the public sector	<ul style="list-style-type: none"> • Open source data platforms are an essential component of Smart Territory approaches
Open-Data platform	Increase in publicly accessible data platforms	<ul style="list-style-type: none"> • Open source data platforms are an essential component of Smart Territory approaches • Determine generally applicable standards (formats, collection, etc.) • Promote corresponding projects with the background of data processing for planning, monitoring mobility and energy issues
Data exchange platforms among Companies and Public Authorities	Increasing the exchange of data between the business community and the public authorities	<ul style="list-style-type: none"> • Open source data platforms are an essential component of Smart Territory approaches • Determine generally applicable standards (formats, collection, etc.) • Promote corresponding projects with the background of data processing for planning, monitoring mobility and energy issues
Data lakes	Increase in publicly available big data collections for analysis of all experts	<ul style="list-style-type: none"> • Open source data platforms are an essential component of Smart Territory approaches
Cloud computing	Provision and simplification for resource sharing in the form of servers, data storage and applications	<ul style="list-style-type: none"> • Determine generally applicable standards (formats, collection, etc.)

B.2) Handling mobility data

In the context of e-SMART, a special interest lies in the handling of furniture data. The extraction, processing and finally the evaluation of these special data sets and the resulting advantages in the planning and operation of transport and energy networks

The targets, measures and statements on the handling of mobility data concern the same target group as the previous statements on the handling of data (research institutes, mobility planners, political funding bodies and decision-makers, mobility service providers and logistics experts). In addition, in the case of mobility data, vehicle manufacturers can also be involved.

Key elements for <i>handling mobility data</i>	Target/ Measurement	Related Statements
Cooperative Intelligent Transport Systems (C-ITS)	Promote the dissemination of C-ITS systems	<ul style="list-style-type: none"> • <i>Using C-IST and CCAM systems to build realistic scenarios for mobility-related issues</i>
Cooperative, connected, and automated mobility (CCAM)	Promote the dissemination of CCAM systems	<ul style="list-style-type: none"> • <i>Using C-IST and CCAM systems to build realistic scenarios for mobility-related issues</i>
Mobility data capturing tools	Expansion of mobility data recording tools	<ul style="list-style-type: none"> • Use data collection tools for mobility data in the field of public transport and LML • Identify common standards for data collection and the formats and nature
Evaluation of instruments (street cameras/sensors/ traffic lights)	Establish self-recorded data as a basic building block of mobility planning	<ul style="list-style-type: none"> • Use data collection tools for mobility data in the field of public transport and LML • Identify common standards for data collection and the formats and nature

C) Europe for Citizens

Europe for Citizens pursues two major goals. Firstly, a general understanding of European values, European history and diversity should be created or further developed. Secondly, Europe for Citizens wants to encourage European citizens to actively participate in democracy and politics. They should be given the opportunity to participate concretely in political decision-making processes at the European level, to stimulate debates and to propose practical solutions to problems through cooperation at the European level.

In this context, a network between cities should also be formed to establish long-term cooperation among cities and municipalities. Within the network, resources and/or interests should be shared. In order to jointly face future challenges.

The following key factors refer to the social and societal developments of Alpine Space that can be linked to mobility.

C.1) Social development

Social developments have a major impact on people's daily lives and thus naturally also on their mobility behavior. But even very general developments can have a lasting impact on our behavior. Climate change, the resulting natural disasters around the globe, the extinction of species and the ever-increasing pollution of the environment have created an awareness for sustainability and environmentally compatible action. Environmental protection is much more important in all areas of our society than it was a few years ago. With society's increasing awareness of the scarcity of the earth's resources, the importance and reputation of sustainable processes and products is growing. Sustainability has long since arrived at the center of society and thus also influences compatibility at the private, political and social levels.

Basically, when formulating targets, measures and statements, it is difficult to identify a target group for recommendations for action to steer social developments. It is much more important to recognize and understand social developments at an early stage and to be able to assess their influence on mobility. Therefore, the statements are addressed to political funding agencies, research institutions and all political bodies.

Key elements for social development	Target/ Measurement	Related Statements
Curricular economy	Increasing the circular economy in the mobility and energy sector to save resources	<ul style="list-style-type: none"> logistics and public transport with the characteristics of the circular economy Sound knowledge of the product life cycle of vehicles in e-LML and e-LPT in connection with the different deployment scenarios
Sharing economy	Increasing sharing offers from the economy to save resources	<ul style="list-style-type: none"> Promote relevant projects to understand the influence of societal developments on mobility behavior and to understand mobility behavior in general
Fair, safe, resilient mobility	Understanding the mobility turnaround as the central point of tackling the climate crisis	<ul style="list-style-type: none"> logistics and public transport with the characteristics of the circular economy Sound knowledge of the product life cycle of vehicles in e-LML and e-LPT in connection with the different deployment scenarios Promote relevant projects to understand the influence of societal developments on mobility behavior and to understand mobility behavior in general
Communication and sensitization	Communication as a tool to reduce reservations and promote sustainable projects	<ul style="list-style-type: none"> Communication of the advantages of sustainable and emission-reduced mobility (air pollution control, noise reduction, climate change, etc.) and raising awareness of these topics to spread e-mobility in logistics and public transport Sound knowledge of the influence of societal developments on mobility

Key elements for social development	Target/ Measurement	Related Statements
Global thinking approach	Understanding globalization as an opportunity to avert the climate crisis	<ul style="list-style-type: none"> • Sound knowledge of the influence of societal developments on mobility

C.2) Political aspects

The question of whether politics can influence the spread of e-mobility in the areas of public transport and logistics does not arise. It is obvious that appropriate political measures can decisively promote sustainable and environmentally conscious mobility, which also includes electric mobility. The aim of this section is to discuss the most effective starting points and recommendations for action.

Key elements for political aspects	Target/ Measurement	Related Statements
Policy cycle management	Design from the point of view of sustainability	<ul style="list-style-type: none"> • Maintain policy cycle management, to continuously improve the efficiency of the entire policy apparatus
Governance model	Design from the point of view of sustainability	<ul style="list-style-type: none"> • Formation of visions and missions, roadmaps for smart city/ smart territory strategies • Increasing these approaches to create acceptance and enthusiasm
Participatory approach	Increasing these approaches to create acceptance and enthusiasm	<ul style="list-style-type: none"> • Formation of visions and missions, roadmaps for smart city/ smart territory strategies • Strategies to engage external stakeholders to conceptualize strategies for sustainable, green and smart mobility
Creative use of policies	Design from the point of view of sustainability	<ul style="list-style-type: none"> • Strategies to engage external stakeholders to conceptualize strategies for sustainable, green and smart mobility
Bureaucratic procedures	Reducing bureaucratic hurdles	<ul style="list-style-type: none"> • Simplification of bureaucratic procedures • Reduction of bureaucratic hurdles to increase efficiency
Municipalities and companies on sustainable logistic solutions	Education and communication of sustainable solutions	<ul style="list-style-type: none"> • Sensitizing municipalities and companies on sustainable logistic solutions

Key elements for political aspects	Target/ Measurement	Related Statements
		<ul style="list-style-type: none"> • Formation of visions and missions, roadmaps for smart city/ smart territory strategies • Strategies to engage external stakeholders to conceptualize strategies for sustainable, green and smart mobility
New scheme of interconnection among PA and private SH	Renewal of the design of the cooperation	<ul style="list-style-type: none"> • Strategies to engage external stakeholders to conceptualize strategies for sustainable, green and smart mobility • Create incentives for private actors to use and purchase sustainable products and services. • Increased cooperation among municipalities and cities on mobility and energy issues. Exchange of experience and knowledge. Descriptions of best practices.
Cooperative scheme for small municipalities (Merge with similar issue)	Renewal of the design of the cooperation	<ul style="list-style-type: none"> • Strategies to engage external stakeholders to conceptualize strategies for sustainable, green and smart mobility • Create incentives for private actors to use and purchase sustainable products and services. • Increased cooperation among municipalities and cities on mobility and energy issues. Exchange of experience and knowledge. Descriptions of best practices.

4 Outlook

As discussed in this Tactical Roadmap, different stakeholders, public or private, play different roles and contribute to the electrification of LML and LPT in different ways and at different stages. One of the most important factors here is collected data and communication among stakeholders. This is also reflected in the growing interest and implementation of smart cities, where different actors and stakeholders also come together to address the issues. In terms of Smart Cities, the role of the public sector is more important due to its influence.

In order to achieve the existing and new goals of Smart Cities, common European rules and initiatives are a pioneering and decisive factor. This should avoid isolated applications in Europe and expand the knowledge base of EV. Thus, projects at European level should also promote and advertise networking among municipalities, cities and regions. However, due to the different focus and phases in the Alpine Space countries, the topics cannot be considered as “lessons learned” in the field of EV. Currently, there are a number of European and national initiatives supporting the development of EVs and smart cities. To date, the focus is more on the car industry than on the transport industry. EV development with LML and LPT is an important step to reduce CO₂ emissions due to mileage, weight, planned routes, charging and technology options. Which can be supported above all at the European, transnational level through appropriate initiations, recommendations for action and decisions.

Based on this tactical roadmap, the e-SMART consortium estimates that the prospects of LPT and LML require European initiatives to support them with regulations and start-ups. The role of the public sector will increase due to smart cities and the interconnectedness of the different actors. This will strongly involve digitalization and the collection/combination of data. The stakeholders active today will remain in the market, and other stakeholders in digitalization will join. In order to be successful in the topic, the e-SMART consortium recommends using the fields of action as a guide, pointing out the importance of communication between stakeholders. Furthermore, communication between countries is important to ensure the success of EV in LML and PT. With different national initiatives and regulations, mobility in the Alpine countries will not have the same result, but cooperation can lead to further success and less CO₂ in Europe. The Alpine Space countries could thus take the lead.

As mentioned in the introduction of this Tactical Roadmap, this document focuses on a holistic view of the Alpine Space, but some chapters’ deal with country-specific information. For a separate look at the countries of the e-SMART consortium, please refer to the e-SMART Operational Roadmaps. These documents explicitly address the specificities of the individual countries and follow the structure of the e-SMART Tactical Roadmap.

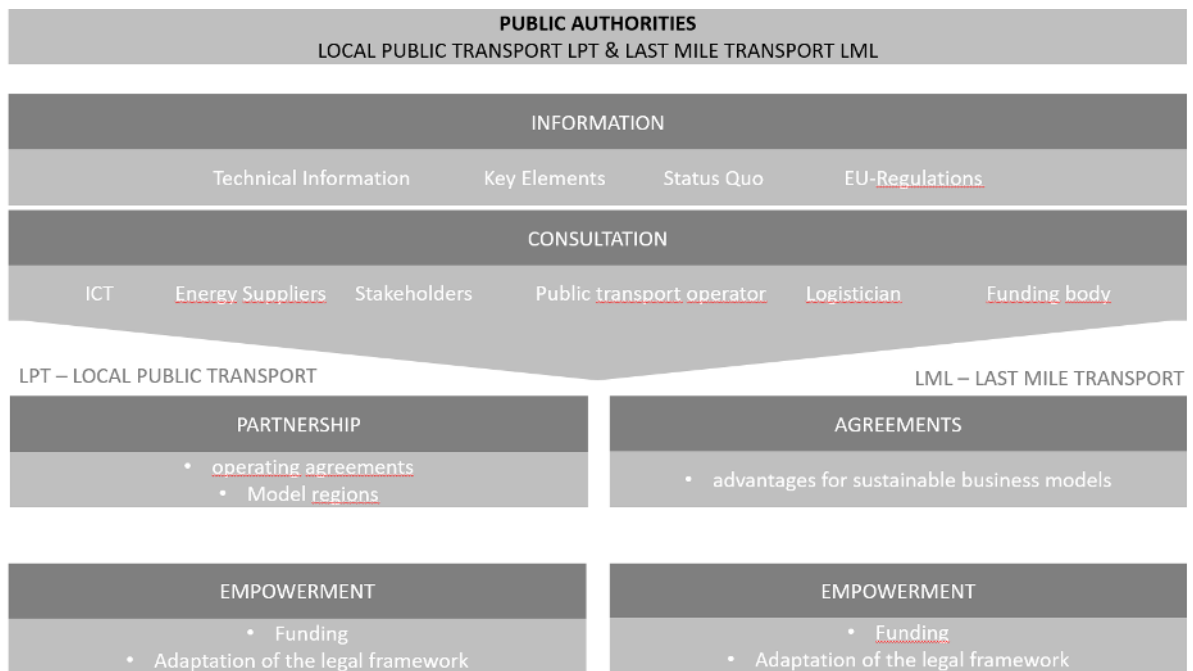


Figure 16 – Information PA

5 Appendix

5.1 General key elements for the Alpine Space

A) Green Deal – Green Europe

A.1) Key Elements for energy management

- **Energy production and Renewable energy systems (RES) rate**

Describes energy production as such but differentiates from fossil energy sources and renewable or regenerative energies. These energy sources include bioenergy, geothermal energy, hydropower, ocean energy, solar energy and wind energy. The RES rate indicates exactly the percentage of electricity in the grid that is generated from renewable energy sources.

- **Vehicle to vehicle (V2V) and vehicle to grid (V2G)**

Both terms are derived from the term Car2x, which describes the communication of a vehicle with its environment. Vehicle to vehicle describes the communication between two neighboring vehicles. Both vehicles act as receivers as well as transmitters. V2V is intended to increase road safety and lead to energy savings and thus strengthen the efficiency of transport. Vehicle to grid (V2G) is a concept for feeding electrical power from the drive batteries of electric and hybrid cars back into the public grid. In contrast to pure e-cars, vehicles with bidirectional charging capability can not only draw electrical energy from the grid, but also feed it back into the grid or the home via special charging stations as part of an intelligent energy system in times of high grid load. Vehicle to grid thus enables intelligent sector coupling, or the supply of a house in the event of a power failure. However, intermediate storage is lossy. V2G technology could help to decarbonize the transport sector, perform load control tasks, improve the integration of renewable energies and provide an additional source of income for energy suppliers and owners of electric cars. V2G technology can thus fulfil a similar function to battery storage power plants and solar batteries. However, a sufficiently high number of vehicles with electric storage and public or private connection points is required for an efficient application. Some manufacturers offer corresponding infrastructure for home connection.

- **Local peaks management**

Peak load management describes the handling of strong power fluctuations in the electricity grid, which can be caused by either an overproduction of electrical energy or a particularly high demand for it. Load management is particularly crucial in the case of energy production from renewable energies.

- **Power Grid stability**

The expansion of renewable energies destabilizes the future electricity grid for two different reasons. Firstly, due to the constantly fluctuating supply of sun, water and wind; modern electricity grids must be able to compensate for these fluctuations. Secondly, due to the shutdown of the large fossil power plants that have stabilized the grid up to now.

- **Smart grid network management system**

Smart grid describes the communicative networking of all actors and components involved in the electricity grid. By connecting electricity generators, electrical consumers, energy storage devices and grid operating equipment within the energy transmission and distribution networks of the electricity supply, the entire grid should be able to be monitored and thus guarantee reliable operation. Due to the increasingly complex interplay of generation; consumption, storage, grid management and the change from centralized to decentralized electricity grids, intelligent electricity grids will be indispensable in the future.

One feature of those grids is the ability to retrieve and process status information and load flow data from the individual grid elements, such as generation plants, consumers (households or industrial plants) or even transformer stations in real time. In addition to production plants, a smart grid also includes larger consumers such as heat pumps, hot water tanks, freezers, car batteries, etc. in the grid management. In addition, by supporting Demand Side Management(DSM), a smart grid offers the advantage of identifying consumption forecasts and savings opportunities on the consumer side. With this information, users can adjust their consumption to the current generation situation by orienting themselves to dynamic tariffs.

A.2) Key Elements for charging management

- **Battery development**

The range problem is considered to be a major obstacle in the switch from combustion engine vehicles to purely electrically powered vehicles of any kind. But the duration of the charging process also plays a significant role in the change of drive technology. Battery research and development is addressing both of these problems. Shorter charging cycles and longer ranges or operating hours enable a broader field of application for purely electrically powered vehicles.

- **Standardized charging infrastructure**

Standardized technical elements and processes are an important prerequisite for the spread of e-Mobility also in the areas of LPT and LML. The predecessor project of e-SMART e-MOTICON already dealt with standardization.

- **Smart charging management system**

Operating an e-vehicle fleet requires good organization and planning. One component of this is an intelligent charging management system, which can be part of the overall energy management of an organization if it is expanded accordingly. The possibility of energy storage opens up a wide range of control and optimization options.

- **Charging concept for LPT and LML**

The smooth and efficient use of e-Mobility in the areas of public transport and LML entails special requirements for the charging infrastructure, depending on the area of application. Appropriate concepts and solutions must be developed for this. The selection of a suitable location is already of elementary importance; the connection to an efficient and stable power grid is a basic prerequisite. General infrastructure

- **Mobility Planning**

For the smooth deployment of electric mobility in the LPT and LML, the specific infrastructure and all other environmental requirements that this propulsion technology entails must be an essential part of mobility planning. Attention must also be paid to the different conditions between urban and rural infrastructure.

- **Sharing charging infrastructure**

The expansion of suitable charging infrastructure is one of the main catalysts for the spread of e-Mobility. In order to further promote this, the sharing or multiple use of private infrastructures is also being discussed. For example, can charging solutions for public transport be combined with solutions for last-mile logistics?

A.3) Key elements for Mobility services

- **Mobility as a Service (MaaS)**

The use of own vehicles is replaced by a mobility offer as a service that is specially tailored to the customer's needs. The possibilities of offering mobility as a service are extremely diverse. The aim of MaaS is to offer the user a means of transport that is optimally tailored to his or her requirements, thus reducing transport efficiency and the need to own vehicles. This should reduce the need for parking spaces and, through ridesharing, reduce the overall volume of traffic. With the expected emergence of autonomous vehicles, new opportunities will arise to complement scheduled and scheduled mass transport with so-called on-demand mobility.

A.4) Financial aspects and ecological aspects of e-Mobility

- **e-LPT and e-LML financing**

The procurement of e-vehicles can be favored by government subsidies or financial relief, for example of a tax nature, and thus accelerate the spread.

- **Environmental assessment and cost/ benefit analysis**

The use of electric mobility is accompanied by a large number of ecological advantages for the corresponding areas of application, and its use can also be financially worthwhile in the long term.

- **PPP - Project Financing**

Financial support programmes to fund e-Mobility projects in the fields of LPT and LML at European, Alpine Space, national and regional level.

- **New business models for mobility**

Digitalization also opens up new business areas for mobility as such. Especially the offers in the sharing sector are becoming more and more popular.

- **LML and LPT service agreements**

Breaking down legal restrictions in public spaces in favor of private mobility service providers. What measures can improve and promote the offer and dissemination of this service:

B) Digital Europe – Smart Europe

B.4) Handling data

- **Data sharing**

Sharing is understood as both provision and use. The pooling of data from different data sources is a key resource that opens up new possibilities for monitoring and insights into energy and traffic control. But also for new digital business models and innovative services. European data protection guidelines form the basis for this.

- **Big Data**
Refers to data volumes that are too large, too weakly structured, too complex and/or too fast-moving, and cannot be effectively dealt with using traditional and manual data processing methods.
- **Data platform**
Open data platforms are considered key to the digital transformation of cities, municipalities and regions. Networked mobility, improvements in air quality, user-centered administrative services, fluctuating use of renewable energies are only a small excerpt of the possible fields of application. The platforms are characterized by the properties neutral, open, secure and interoperable.
- **Data exchange platforms among Companies and Public Authorities**
A key element in promoting the spread of e-Mobility can also be platforms of any kind for data exchange between companies and public authorities. Smart city/region approaches are closely linked to mobility as such.
- **Data lakes**
The data lake is a very large data store that holds data from a wide variety of sources in its raw format. It can contain both unstructured and structured data and can be used for big data analysis. It must be possible to store the most diverse data and data formats, whether structured or unstructured, in the data lake. Distributed data silos are thus avoided. In order to enable the most flexible use of data, the common frameworks and protocols of database systems and database applications from the Big Data environment must be supported. Access to the data must be protected by powerful, role-based access control in order to meet the requirements of data protection and data security. In addition, encryption of data must be used. Mechanisms for backup and recovery of data must also be provided.
- **LML data capturing tools**
Tools for data collection of the simultaneous or sequential measurements and counts, including timestamps for measurable or countable data and groups of related data, as appropriate.
- **Cloud computing**
Is a model that offers computing power and computer resources as a service in a timely manner and with little effort. This can take the form of applications, servers and data storage.

B.2) Handling mobility data

- **Cooperative Intelligent Transport Systems (C-ITS)**
These systems rely on the networking of infrastructure and vehicles. The aim of this networking is to make traffic more efficient and safer.
- **Cooperative, connected, and automated mobility (CCAM)**
- **LML instruments (street cameras/sensors/traffic lights)**
Can measures to favor alternatively fueled vehicles in road transport, comparable to bus-only lanes, contribute to the spread of these vehicles? Are such measures feasible?

C) Europe for Citizens

C.1) Social development

- **Circular economy**
As society becomes increasingly aware of the scarcity of the earth's resources, the importance and reputation of sustainable processes and products increases. Sustainability has long since arrived in the midst of society and therefore also influences compatibility on a private, political and societal level.
- **Sharing economy**
Another result of society's awareness of limited resources and the effective and most efficient use of them is the development of sharing systems. Objects are available for use by several people. This concept has developed into a separate business field, such as car sharing.
- **Fair, safe, resilient mobility**
This point goes hand in hand with the two preceding points: the demand for sustainable, fair but still resilient and reliable mobility is growing due to the social development already described in the points on the circular and sharing economy.
- **Communication and sensitization**
What influence does the communication of all the advantages of sustainable and emission-reduced mobility (clean air, noise reduction, climate change, etc.) and thus raising awareness of these issues have on the spread of e-Mobility?
- **Global thinking approach**
To what extent does the idea of globalization influence mobility in the individual nations?

C.2) Political aspects

- **Policy cycle management**
To what extent and by whom can policy be influenced and supported as effectively and efficiently as possible for all aspects of sustainable mobility. How can fields of action be highlighted and thus awareness of these issues be created at the political level?
- **Governance model**
How can policy be supported in the dissemination of sustainable mobility- What approaches are there? How can the main barriers be brought to the attention of policy makers and eventually be removed?
- **Participatory approach**
The participatory approach allows a city or municipality to develop solutions to problems externally and privately. This means that interest groups and citizens' associations are also involved in the development and decision-making process. To what extent can this influence the diffusion of e-Mobility?
- **Creative use of policies**
- **Simplification of bureaucratic procedures**
Can the reduction of bureaucratic hurdles accelerate and promote the spread of e-Mobility?
- **Sensitizing municipalities and companies on sustainable logistic solutions**

- **New scheme of interconnection among PA and private SH**
How can public and private sector projects be reconciled without sacrificing e-Mobility?
What options are there and how effective are they?
- **Cooperative scheme for small municipalities (Merge with similar issue)**

5.2 Incentives and prohibitions in connection with the spread of e-Mobility in Alpine Space

Bans:

- Drive-through bans (e.g. zone solution for pollutant classes)
- Parking bans
- ...

Incentives:

- State-subsidized purchase premiums for vehicles and infrastructure
- Tax concessions
- discounted/free parking for e-vehicles
- Reward system for the use of public transport

5.3 Legal framework at different levels

EU framework

Year	Ref.	Main topic	Relevant issues
2009	Decision 406/2009/CE	reduce by 2020 CO₂ emissions	<p>2020 objectives in EU GHG emission e-mob.: increasing electricity generation from renewable energy sources to reduce greenhouse gas emissions</p> <p>Public transport and last-mile logistics are not the main focus. Only suggested action on</p> <p>LPT: improving collective transport helps to reduce private car emissions</p> <p>LML: no direct impact</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009D0406&from=EN</p>
2009	Directive 2009/28/CE	promote the use of energy from renewable sources	<p>amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC</p> <p>e-mob: expansion of electricity produced from renewable energy sources</p> <p>LPT & LML: reduce dependence on imported oil in the transport sector</p> <p>https://eur-lex.europa.eu/legal-content/IT/ALL/?uri=celex%3A32009L0028</p>
2009	Directive 2009/33/CE	promotion of clean and energy efficient road transport vehicles	<p>e-mob & LPT: To foster the promotion of clean vehicles on the basis of public procurement</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32009L0033&from=EN</p>
2009	Regulation 443/2009	setting emission performance standards for new passenger cars: 120 g CO ₂ /km by 2012	<p>e-mob: create incentives for the car industry to invest in new technologies for light-duty vehicles</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009R0443&from=EN</p>
2010	COM (2010) 2020	EUROPE 2020 A strategy for smart, sustainable and inclusive growth	<p>e-mob: proposals to modernize and decarbonize the transport sector</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC2020&from=it</p>

Year	Ref.	Main topic	Relevant issues
2010	COM (2010) 186	A European strategy on clean and energy efficient vehicles	<p>e-mob & TPL & LML: encouraging the development and uptake of clean and energy efficient (“green”) heavy- (buses and trucks) and light-duty vehicles (cars and vans) as well as two- and three-wheelers and quadricycles</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52010DC0186&from=IT</p>
2011	COM (2011) 144 - White Paper	Reduce oil dependency in transport sector and to reduce GHG emissions by 2050	<p>e-mob.: Growing Transport and supporting mobility while reaching the 60% emission reduction target.</p> <p>TPL & LML: To build a modern infrastructure. Transport charges and taxes must be restructured in the direction of wider application of the ‘polluter-pays’ and ‘user-pays’ principle. Getting prices right and avoiding distortions</p> <p>https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:en:PDF</p>
2013	COM (2013) 17	Clean Power for Transport: A European alternative fuels strategy - There is no single fuel solution for the future of mobility and all main alternative fuel options must be pursued: LPG, natural gas (LNG, CNG, bio methane, GTL), electricity, liquid biofuels, hydrogen	<p>e-mob & TPL & LML: low CO₂ alternatives to oil are also indispensable for a gradual decarbonization of transport</p> <p>https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0017:FIN:EN:PDF</p>
2014	Regulation 333/2014	severe limits on emissions for reaching the 2020 target to reduce CO ₂ emissions from new passenger cars - no special focus on local LPT and LML, that still contribute to a small share of the emissions originating from the transport sector	<p>amending Regulation (EC) No 443/2009</p> <p>new target: 95 g CO₂/km by 2020</p> <p>e-mob: create incentives for the car industry to invest in new technologies for light-duty vehicles</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0333&from=EN</p>

Year	Ref.	Main topic	Relevant issues
2014	Directive 2014/94/EU	defines a set of measures for the creation of an alternative fuel infrastructure	e-mob & TPL & LML: This Directive defines the minimum requirements for the construction of alternative fuels infrastructure, including charging points for electric vehicles and refueling points for natural gas (LNG and CNG) and hydrogen https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=IT
2016	Directive 2016/2284/EU	Measures to reduce emissions of atmospheric pollutants	amending Directive 2003/35/EC and repealing Directive 2001/81/EC e-mob & TPL & LML: reduce emissions of Sulphur dioxide (SO ₂), nitrogen oxides (NO _x), and non-methane volatile organic compounds (NMVOC) in the all the possible sectors including road transport https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32016L2284&from=EN
2016	Paris agreement (COP21)	United Nations Framework Convention on Climate Change - maintain the world temperature rise below 2°C and, if possible, below 1.5°C compared to preindustrial levels increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development	e-mob & TPL & LML: solutions to decarbonize transport sector https://unfccc.int/sites/default/files/english_paris_agreement.pdf
2018	Regulation 2018/842	Update of the GHG emissions reduction targets - binding annual GHG emission reductions by Member States from 2021 to 2030 meet commitments under the Paris Agreement and amending Regulation (EU) No 525/2013 GHG means emissions in terms of tones of CO ₂ equivalent of carbon dioxide (CO ₂), methane	e-mob & TPL & LML: decarbonize the transport sector https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018R0842&from=EN

Year	Ref.	Main topic	Relevant issues
		<p>(CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF₃) and Sulphur hexafluoride (SF₆)</p> <p>Public transport and last-mile logistics only contribute to a small share of the emissions originating from the transport sector</p>	
2018	Directive 2018/2001/UE	<p>promotion of use of energy from renewable sources</p>	<p>The Directive defines the rules relating to:</p> <p>e-mob: financial support for renewable resources electricity and the self-consumption of this electricity;</p> <p>e-mob & TPL & LML: the use of energy from renewable sources in the heating and cooling sector and in the transport sector;</p> <p>Furthermore, the criteria for sustainability and for the reduction of greenhouse gas emissions for biofuels, bio liquids and biomass fuels are set.</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN</p>
2019	Directive 2019/944/UE	<p>common rules for the internal market for electricity - need to organize electricity markets in a more flexible manner and to fully integrate all market players – including producers of renewable energy, new energy service providers, energy storage and flexible demand</p>	<p>amending Directive 2012/27/EU</p> <p>e-mob & TPL & LML: fundamental step for the electrification of private mobility, public transport, and freight logistics</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L0944&from=EN</p>
2019	Directive 2019/1161/UE	<p>promotion of clean and energy efficient road transport vehicles</p>	<p>amending Directive 2009/33/EC</p> <p>e-mob & LPT & LML: to foster the promotion of clean vehicles on the basis of public procurement for light- and heavy-duty vehicles, including including practices such as lease, rental and hire-purchase of vehicles</p> <p>https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019L1161&from=EN</p>

National frameworks

Italian framework

Year	Ref.	Main topic	Relevant issues
2012	Legge 7 agosto 2012 n. 134	To promote mobility by means of low-emission vehicles - measures to promote infrastructure for the transport sector (electrification, alternative fuels, ...) and reduce GHG emissions	e-mob & TPL & LML: all kinds of vehicles are included https://www.gazzettaufficiale.it/eli/gu/2012/08/11/187/so/171/sg/pdf
2014	PNIRE (Piano Nazionale Infrastrutturale per la Ricarica dei veicoli alimentati a energia Elettrica) del 30 giugno 2016	To guarantee minimum levels of accessibility for the charging service - Furthermore defines some discounts for the purchase of low-emission vehicles.	e-mob & LPT & LML: Defines specific programme agreements, in order to promote the participation of public and private entities, including DSO. http://www.governo.it/sites/governo.it/files/PNire.pdf
2016	Decreto legislativo 16 dicembre 2016 n.257	defines a set of measures to promote diffusion of low-emission vehicles and for the creation of an alternative fuel infrastructure - also simplifying bureaucratic procedures	e-mob & TPL & LML: all kinds of vehicles are included https://www.gazzettaufficiale.it/eli/id/2017/01/13/17G00005/sg
2017	Decreto Ministeriale del 3 agosto 2017	Documentation to build charging infrastructures	e-mob: list of all the documentation (certificates, permissions, ...) needed to build electric infrastructure https://www.gazzettaufficiale.it/eli/id/2017/12/13/17A08289/sg
2018	Decreto del 2 marzo 2018	Documentation to build charging points	TPL & LML: To promote the use of bio methane and other advanced biofuels in the transport sector. https://www.mise.gov.it/images/stories/normativa/DM-biometano-2-marzo_2018_FINALE.pdf
2020	Decreto del Ministro dello sviluppo economico 30 gennaio 2020	Promote smart grid and V2G research	e-mob: promote the diffusion of electric vehicles and the possibility of a bidirectional connection between electric vehicles and power grids (Vehicle-to-Grid) https://www.gazzettaufficiale.it/eli/id/2020/02/14/20A00891/sg

Regional framework for each Region involved (Lombardy, Veneto, Piedmont)

Lombardy framework

Year	Ref.	Main topic	Relevant issues
2013	Programma Regionale di Sviluppo (PRS)	Medium term (2013-2018) strategy for development of LPT and freight mobility infrastructures (regional railways, airport transport, low-emission mobility)	e-mob & TPL & LML: Regional plan to develop LPT, freight mobility infrastructures and low-emission mobility https://www.regione.lombardia.it/wps/portal/istituzionale/HP/istituzione/programma-e-finanze/programma-regionale-di-sviluppo
2015	Programma Energetico Ambientale Regionale (PEAR)	promotion of use of energy from renewable sources (FER)	e-mob & TPL & LML: reducing GHG emissions, improving infrastructures, promoting sustainable mobility http://www.monvisoenergia.it/wp-content/uploads/2015/11/Lombardia_PEAR.pdf
2016	Programma Regionale della Mobilità e dei Trasporti (PRMT)	planning of the transport services and networks offered by the region	e-mob & TPL & LML: Defines the infrastructures development and services for the public mobility, e-Mobility and freights in Lombardy. https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioRedazionale/istituzione/direzioni-generalidi/direzione-generale-infrastrutture-trasporti-e-mobilita-sostenibile/programma-regionale-mobilita-trasporti
2019	Delibera Consiglio Regionale 759 2019	renewal of distribution network for low-emission fuels and electric infrastructures	e-mob & TPL & LML: analysis of infrastructure networks and goals for alternative fuels https://www.regione.lombardia.it/wps/wcm/connect/78d77d9d-6db4-4b20-bea4-b373d04f9048/DCR+759+del+12.11.2019.pdf?MOD=AJPERES&CACHEID=ROOTWORLDKSPACE-78d77d9d-6db4-4b20-bea4-b373d04f9048-mWlyDbR

Veneto framework

Year	Ref.	Main topic	Relevant issues
2019	Piano Regionale Trasporti 2020-2030 (PRT)	Promote road connections (e.g. Veneto-Piedmont), high-speed railway (e.g. Brescia-Padova), public transport	<p>Planning and evaluating strategies, improving road and railway connections, promoting communication between stakeholders and actors</p> <p>LPT: renew of the fleet</p> <p>LML: plan and evaluate the possibility of build a Dolomiti railway</p> <p>https://www.regione.veneto.it/web/mobilita-e-trasporti/piano-regionale-trasporti</p>

Piedmont framework

Year	Ref.	Main topic	Relevant issues
2008	Piano Regionale dell'Infomobilità (PRIM)	promote use of new technologies and information systems	<p>LPT: promoting ICT for the governance and for the citizens (e.g. traffic regulation, mobility of people)</p> <p>http://www.regione.piemonte.it/governo/bollettino/abbonati/2019/17/attach/dda1800000620_1040.pdf</p>
2018	Piano Regionale della Mobilità e dei Trasporti (PRMT)	provide to the PA tools to collect and satisfy citizens' and companies' needs preventing and avoiding emergency situations	<p>e-mob & TPL & LML: Defines the infrastructures development and services for the public mobility, e-Mobility and freights in Piedmont</p> <p>https://www.regione.piemonte.it/web/sites/default/files/media/documenti/2018-10/20180116_dcr_all_a_prmt.pdf</p>
2019	Piano Regionale per la Qualità dell'Aria (PRQA)	Tool to plan, manage, and control atmospheric pollution , improving environmental and health-care conditions	<p>e-mob & TPL & LML: planning how to improve air quality by means of the following sectors: agriculture, energy, transport, and industry</p> <p>http://www.regione.piemonte.it/governo/bollettino/abbonati/2019/16/attach/aa_aa_deliberazione%20del%20consiglio%20regionale_2019-04-17_68036.pdf</p>

Year	Ref.	Main topic	Relevant issues
2020 (<i>Stato: To be approved</i>)	Incentivi per la mobilità sostenibile dei cittadini piemontesi - PRQA	Incentivize usage of urban collective transport, whose fleet must be renewed - The measure aims to support Piedmont's citizens in the use of more agile and adequate transport for urban areas in order to limit the use of private cars and, to replace the more obsolete and polluting regional vehicle fleet.	https://www.regione.piemonte.it/web/temi/ambiente-territorio/ambiente/prqa-contributi-per-sviluppo-della-mobilita-sostenibile-dei-cittadini-piemontesi#:~:text=PRQA%20%2D%20Contributi%20per%20lo%20sviluppo%20della%20mobilit%C3%A0%20sostenibile%20dei%20cittadini%20piemontesi,-Ascolta&text=l%20contributi%2C%20a%20fondo%20perduto,da%202.000%20a%204.000%20euro.

Austrian framework

Year	Ref.	Main topic	Relevant issues
2008	BMF-010220/0304-IV/9/2008	Standard consumption tax – tax exemption	For e-mob: Tax exemption for passenger cars and other motor vehicles primarily designed for passenger transport, including station wagons
2014	BGBL I Nr. 72/2014	Federal Energy Efficiency Law	For e-mob; TPL; LML: promote the transition to a more energy-efficient economy, accelerate technological innovations and improve the competitiveness of Austrian industry by reducing energy consumption https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20008914
2016	LStR 2002 - Wartungserlass 2016 – Rz 175	No benefit in kind for private vehicles	For e-mob: Employees make company vehicles available to their employees. In the case of an electric vehicle, there is no benefit in kind. https://findok.bmf.gv.at/findok?execution=e2s1&segmentId=2e3e01fd-3a1f-4ce4-8963-6b4ce5c431e3
2018	BGBL I Nr. 38/2018 §4 58/02 Energy law	Technical specification for public charging points	For e-mob; LPT; LML: Uniform technical specification for publicly accessible charging points (minimum standard) for private and company cars https://www.ris.bka.gv.at/Dokumente/Bundesnormen/NOR40204860/NOR40204860.pdf

Year	Ref.	Main topic	Relevant issues
2019	Federal Directive 28.11.2019, BMF-010219/0270-IV/4/2019	No input tax	For e-mob: Input tax deduction for cars, station wagons or motorcycles with a CO ₂ emission value of 0 grams per kilometer https://findok.bmf.gv.at/findok?execution=e1s11
2020	BGBL.I Nr. 56/2020 § 2 31/05 KIG 2020	Municipal Investment Law 2020; special purpose fund due to COVID-19;	For e-mob; LPT: Investments on fleet cars and public busses for cities and communes https://www.ris.bka.gv.at/Dokumente/Bundesnormen/NOR40224307/NOR40224307.pdf

5.4 Number of vehicles and registrations

Italy:

Number of e-Busses: 586 (BEV)

Number of New Registrations e-Busses 2021: 49 (BEV)

Number of Heavy Duty Vehicles: 39 (BEV)

Number of New Registrations Heavy Duty Vehicles 2021: 11 (BEV)

France:

Number of e-Busses: 565 (BEV)

Number of New Registrations e-Busses 2021: 153 (BEV)

Number of Heavy Duty Vehicles: 6 (BEV)

Number of New Registrations Heavy Duty Vehicles 2021: 6 (BEV)

Slovenia:

Number of e-Busses: 0

Number of New Registrations e-Busses 2021: 0

Number of e-Heavy Duty Vehicles: 0

Number of New Registrations e-Heavy Duty Vehicles 2021: 0

Austria:

Number of e-Busses: 175 (BEV)

Number of New Registrations e-Busses 2021: 14 (BEV)

Number of e-Heavy Duty Vehicles: 12 (BEV)

Number of New Registrations e-Heavy Duty Vehicles 2021: 6

Germany:

Number of e-Busses: 861 (732 BEV/ PHEV 129)

Number of New Registrations e-Busses 2021: 463 (454 BEV/ PHEV 9)

Number of e-Heavy Duty Vehicles: 568 (BEV)

Number of New Registrations e-Heavy Duty Vehicles 2021: 302 (BEV)

Source: <https://www.eafo.eu/vehicles-and-fleet>

