



European Union
European Regional
Development Fund



Publishable Report

- Inner city logistics and autonomous driving-

Author:

Regional Management Northern Hesse GmbH (RMNH)

Contribution:

Centre for Renewable Energy Sources and Saving (CRES) – lead partner

Energy Institute Hrvoje Pozar (EIHP)

Portuguese Energy Agency (ADENE)

Azorean Government – Regional Directorate for Energy (AZORES)

Northwest Regional Development Agency (NWRDA)

Date:

January 2022



European Union
European Regional
Development Fund



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Executive Summary

Inner city logistics and autonomous driving are two different topics that will be increasingly interlinked in the future. Autonomous driving will most likely become a component of inner city logistics applications. However, there are still a number of development steps to be taken before this point is reached. Above all, the regulatory framework must be expanded.

Each city and region have their individual requirements and needs. The concepts of inner city logistics can therefore not be directly transferred from one region to another. However, the goals are the same. The European regions want to reduce their greenhouse gas emissions through a wide variety of measures, increase the quality of life and apply new technologies. All European partner regions face similar challenges with regarding their inner city logistics processes as more and more people are moving to big cities and their surrounding areas. This development not only leads to more passenger traffic within urban areas, but also increases the demand for goods and services, which inevitably entail freight traffic. Against this background, urban freight transport and logistics must also contribute to reducing greenhouse gas emissions. All partner regions have the common goal of developing a more sustainable and carbon-free future for their inner cities. Many different programs and a lot of money are spent in the individual regions. While the same goals are pursued, the focus of the individual programs differs according to local conditions.

Some European countries have already started regulating autonomous vehicles. Some European countries have already started regulating the use of autonomous vehicles. Widespread use of the technology is not yet foreseeable. For this, a comprehensive infrastructure is needed in addition to the regulatory framework. There is still skepticism from the side of the users on the usefulness and safety of autonomous driving all over the regions. In most European regions, the topic is still in the planning phase. Some promising projects can ensure that autonomous driving gains greater social acceptance.

The results of our EMOBICITY project work show the following status quo in our partner regions.

In **Greece**, regarding inner city logistics, there exist some measures to facilitate inner city freight transport, including the “Blue Zone” for heavy vehicles. The Blue Zone has the effect of increasing the average speed of movement both in the demarcated area and throughout the interior ring. Regarding autonomous driving, particularly innovative projects, such as CityMobil2 or the follow-up project AVINT are noticed at a national level. Within the projects the city of Trikala has operated the first autonomous public bus worldwide, running within the boundaries of a city center.

In **Portugal (Mainland/Azores)** the regulation of urban logistics activities is generally taken care of by public notices and regulations, issued by Municipalities. Furthermore, within the scope of urban mobility, the competent regional entities are also municipalities, that implement innovations. Recently, technological Free Zones were legislated through a Council of Ministers Resolution. These zones are physical environments for testing, geographically located in a real or quasi-real environment, intended to carry out tests of innovative technologies, products, services, and processes based on technology, in a safe manner, with the support and monitoring of the respective competent authorities.

In **Germany** various ministries are legislatively involved in the design of a more sustainable inner city logistic. Concepts that include the use of cargo bikes become increasingly attractive. The German parliament has passed a new legislative framework for the traffic of autonomous level four vehicles. Other measures regulate the political framework to increase road safety via innovations and through the introduction of autonomous driving and to promote mobility with improved traffic efficiency and reduced environmental impact.

In **Romania**, companies started to invest in parcels located in various places in the city of Cluj. Carriers deliver the packages to those “Easy Boxes” where they are stored till the client comes and picks them up using a code sent via SMS. The first steps towards creating a framework for autonomous driving have been made at national level. A testing centre for autonomous vehicles is in the planning phase

In **Croatia**, the ambitious greenhouse gas reduction targets regarding logistic processes are implemented by local authorities through various measures. The first step was taken in recognizing autonomous vehicles in the Croatian legal framework in 2021. Autonomous vehicles like the “Robotaxi” by famous innovator Mate Rimac are expected to operate in Zagreb by 2024.

1. Preliminary Observations

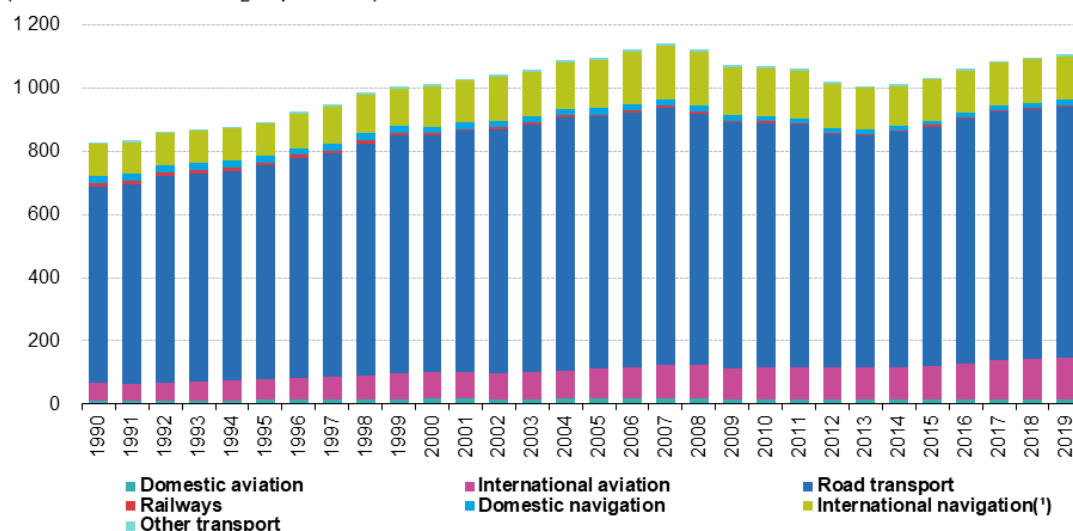
1.1. Inner City Logistics

The question of what is meant by inner city logistics is not clearly defined. The term inner city logistics can refer to many concepts. A common goal for logistical processes within a city is to optimize the supply of goods to city centers. To do this, goods can first be bundled in a freight traffic center. Ideally, these city terminals are in the immediate vicinity of the city. From there, the goods are transported to the city center in small, maneuverable, low-emission vehicles. To achieve good success here, all companies involved in the transport must work closely together. The flow of goods from the consignor to the forwarder to the consignee must therefore be planned. City logistics bundles inner-city freight transports to relieve traffic congestion in cities. This requires a dispatching and communication center that takes over the supply of goods to the city center. It bundles the many different transport companies. [1a]

A look at the CO₂ emissions and the corresponding developments over the past 30 years show that not much has changed [1b].

Greenhouse gas emissions of transport, EU, 1990-2019

(million tonnes of CO₂ equivalent)



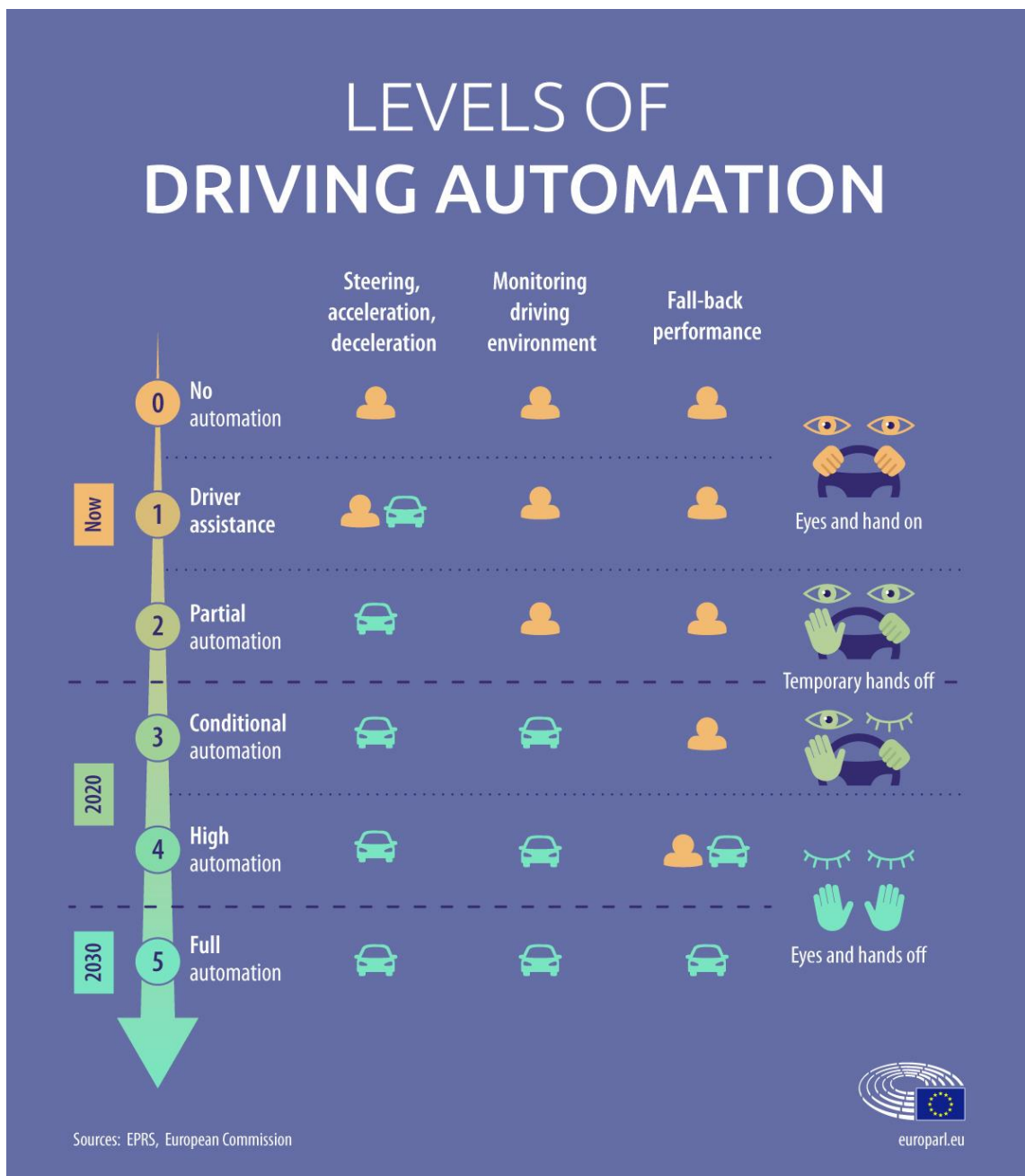
(1) Not included in the EU emissions totals relevant for the energy and climate packages

Source: EEA, republished by Eurostat (online data code: env_air_gge)

In order to achieve the ambitious goals of a climate-neutral European Union, the logistics sector must make a significant contribution to reducing greenhouse gases and reverse the discernible trend. New technologies can be tried out in innovative projects. The exchange through projects like EMOBICITY is essential to transfer the knowledge between the regions.

1.2. Autonomous driving

Automated vehicles use digital technologies to assist the driver. Some or all driving functions could be transferred to a computer system. Self-driving or driverless vehicles that are automated vehicles of level 3, 4 or 5. Connected vehicles are equipped with devices to communicate with other vehicles or infrastructure via the internet. Automated and connected technologies are complementary and all automated vehicles are likely to be also connected soon.



According to the European Parliament there are several challenges of autonomous driving in the EU:

- **“Road safety**: since driverless vehicles must share the road with non-automated vehicles, pedestrians and bicycles, appropriate safety requirements and the harmonisation of traffic rules at EU level are essential.
- **Liability issues**: as self-driving vehicles transfer the driving tasks from humans to autonomous technologies, existing EU liability laws need to evolve and clarify who is accountable in case of accidents: the driver or the manufacturer?
- **Data processing**: EU data protection rules apply also to the automated sector but no specific measures have been taken yet to guarantee cybersecurity and protect self-driving vehicles against cyberattacks.
- **Ethical questions**: self-driving vehicles have to respect human dignity and freedom of choice. EU guidelines for artificial intelligence are being drafted but specific standards might be necessary.
- **Infrastructure**: significant investment in research and innovation is vital to develop technologies and deploy the necessary infrastructure.”

Furthermore, the European institutions are working on common rules, while technologies are progressing rapidly, the EU is working to ensure common rules. The report with several initiatives was adopted by the Parliament in 2019 and stresses that:

- “EU policies and legislation concerning automated and connected transport should cover all transport modes, including short-sea shipping, inland waterway vessels, drones transporting goods and light rail systems.
- Standardisation efforts at international level need to be further coordinated to ensure safety and the interoperability of vehicles across borders.
- Event data recorders should be compulsory in automated vehicles to improve accident investigations and tackle the issue of liability.
- To increase the trust of Europeans in driverless vehicles, rules covering data protection and ethics in the automated transport sector should be developed without delay.
- Special attention should be given to the development of self-driving vehicles that are accessible for people with reduced mobility or disabilities.” [36]

There are several advantages that come with autonomous driving. Human error is involved in about 95% of all road traffic accidents in the EU, and in 2017 alone, 25,300 people died on the Union’s roads. Autonomous vehicles can reduce these figures and improve road safety, while new digital technologies can also reduce traffic congestion and emissions of greenhouse gases and air pollutants.

2. State of the art – Inner city logistics and autonomous driving

2.1. Greece

2.1.1. Regional focus of policy measures

Inner City Logistics

On average the vehicles used in Urban Freight Transport in Greece are trucks of medium size and over 16 years, resulting in increased CO2 emissions.

Also according to the current legal regime (Ministry of Environment, Physical Planning and Public Works), the traffic of heavy vehicles and the supply of shops in the biggest city in Greece (Athens), are governed by a series of restrictions set by Joint Ministerial Decisions (JMC) and Decisions of the Attica Traffic Directorate. These decisions concern the creation of the "Blue Zone", the "Inner Ring" and the "Commercial Triangle" and the imposition of restrictions on the supply hours of the stores and the traffic of vehicles. The "Blue Zone" is a series of measures to facilitate the movement of vehicles related to freight transport in the city center, so the implementation of the Blue Zone has the effect of increasing the average speed of movement both in the demarcated area and throughout the interior ring.

Law 4302/2014 (articles 4 & 5) foresees the use of clean technologies within the urban environment and the minimum requirements in relation to the conditions of loading and unloading of goods. Nevertheless, a Presidential Decree is still pending in order to activate further this provision.

In addition and following L. 4302/2014, a Common Ministerial Decision has been issued (CMD 1023/2018) by the Ministry of Environment & Energy KYA on the voluntary data monitoring by logistics companies of a) greenhouse gas emissions in transport and distribution, as well as energy within storage and distribution centers, b) use of natural resources, including waste / water and water, c) resource management and more specifically material recycling.

Meanwhile, the National Recovery and Resilience Plan (Greece 2.0), foresees investments for green logistics and e-mobility and more specifically in the Component 1.3 (Recharge and refuel) and Component 4.6 (Modernise and improve resilience of key economic sectors). The total budget foreseen for the Components 1.3 & 4.6 are 520 mil. € and 3743 mil. € respectively (although not all of this budget is dedicated to transport, e-mobility and logistics). Moreover it is expected that other components will also indirectly provide further resources for the green transition of inner city logistics. [1]

The running national subsidy scheme for EVs (GO ELECTRIC) also provides subsidies for electric vans (max. 3.5 tons) used in inner city logistics. Especially regarding companies, the subsidy amounts to 15% of an electric cargo vehicle and up to 5,500€ and to 20% of the price of an electric bicycle/tricycle and up to 800€. Currently, each company has a right to use the aforementioned subsidies for up to 3 vehicles (6 for companies located on islands). [2]

Besides the “GO ELECTRIC” subsidy scheme, currently Greece provides various tax incentives for the promotion of e-mobility, mostly addressed to companies rather than individuals. The tax incentives that could be used by inner city logistics companies are:

1. The expenditure discount is increased by 50% for Battery Electric Vehicles (BEV). For example, buying an EV of 30.000€ leads to an accounting cost of 45.000€ and to a reduction of taxable income by 3.300€. For a similar Plug-in Hybrid Electric Vehicle (PHEV), the expenditure discount is 30% and the reduction of taxable income amounts to 1.980€. If the business is based on an island, the discount rates are further increased to 75% and 35% (for BEV and PHEV respectively).
2. Regarding the previous example and if leasing is preferred than buying an EV, the reduction of taxable income amounts to 396€/year for BEVs and 238€/year for PHEVs.
3. The provision of a BEV or a PHEV (50 gCO₂/km) to an employee, of worth up to 40.000€, is not taxed as it's considered to be a benefit in kind.
4. The charging costs of EVs (for work purposes) incurred by employees are considered a company expense, leading to the reduction of the taxable income.
5. Increase in depreciation of asset to 50% when purchasing an EV.
6. Increase in depreciation of asset to 100% for purchasing an EV charging station.
7. Expenditure discount is increased by 50% (70% in islands) when EV charging station is publicly accessible.
8. Expenditure discount increased by 30% when EV charging station serves the company needs.

Another measure that is expected to further promote green inner city logistics is the implementation of the Sustainable Urban Mobility Plans, in each municipality. Most of these plans are currently under public consultation and may foresee actions towards the further inclusion of EVs for inner city logistics and especially last mile deliveries.

Autonomous driving

The most recent legislative initiative regarding autonomous driving has been Law 4784/2021 (art. 42) providing the necessary legal framework for the operation of autonomous vehicles. Among other, the Law foresees:

- Autonomous public buses may be used for urban public transport services. The permit is given after a mobility study is concluded and for a specific route and duration
- An operation centre is required to monitor the operation of up to four autonomous buses.
- It is also allowed to place on the road an autonomous vehicle of category M1 or N1 (private car, van type or small trucks of gross weight up to 3.5 tons), as part of a pilot application only for research purposes

[2.1.2. Summary of relevant projects connected to e-mobility](#)

Inner city logistics

As mentioned above, most of the Sustainable Urban Mobility Action Plans of Greek municipalities are currently under development. Some of them foresee activities regarding inner city logistics.

As an example, the city of Trikala in the Region of Thessaly, foresees inner logistics actions, such as the encouragement of deliveries through bikes and “clean” vehicles. The timeline for the full implementation of this measure extends to 2030. [3]

Furthermore, there are currently a handful of courier/delivery companies that hire employees who own a bike or e-bike for the deliveries. But this is not a generalized practice in Greece today and may apply only in pedestrianized commercial areas and in (few) cities that have developed an extended network of bikeways.

Autonomous driving

The city of Trikala, has been characterized by many as one of the most innovative Greek cities regarding smart transport. To this direction, the city of Trikala has operated the first autonomous public bus worldwide, running within the boundaries of a city center. The pilot action was part of the CityMobil2 project and during its operation (from August 2015 to February 2016) the autonomous bus run 3,580 km transporting 12,138 passengers. [4]

Following CITY Mobil2, the city of Trikala participates in a series of other EU project on autonomous driving including the project AVINT. Within this project, the city of Trikala will purchase two more autonomous e-buses that will operate within the city network. Trikala also participates in a new project called SHOW (SHared automation Operating models for Worldwide adoption). During the project, real-life urban demonstrations taking place in 20 cities across Europe will see the integration of fleets of automated vehicles in public transport, demand-responsive transport (DRT), Mobility as a Service (MaaS) and Logistics as a Service (Laas) schemes. [5]

The Greek island of Astypalea has recently been selected as a model island to apply innovative clean energy transition technologies, including that of autonomous driving. The project is run by the Greek Government in collaboration with the VW group and other national stakeholders. The main pillars of the project are:

- the promotion of e-mobility through the replacement of all conventional vehicles with EVs
- the installation of a hybrid station providing clean energy from renewable energy sources and battery storage system
- the operation of a smart public transport system on-demand, and
- the promotion of autonomous driving on the island

Especially regarding autonomous driving deployment, it is expected to be realized by 2026. [6]

[2.1.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving](#)

Inner city logistics

As already presented above, in Greece there is little development of innovative and green inner city logistics' practices involving EVs. The main reasons may be summarized in the following:

- Lack of cooperation between all stakeholders. A big number of stakeholders is usually involved regarding inner city logistics, including freight transport companies and drivers, shop owners, municipality authorities, citizens etc. To support communication and effective collaboration a clear plan needs to be established covering (as much as possible) the needs of all interested parties.
- Increased cost of electric vehicles for inner city logistics. Despite the subsidies provided for purchasing EVs, the overall cost of EVs' ownership is still high comparing to conventional vehicles. Furthermore, lately there is a big increase in electricity prices,

which further prohibits the uptake of e-mobility and green inner city logistics. As a first step, e-bikes and e-cargo bikes could be promoted, due to their low cost and effectiveness for last mile deliveries (in cities where available infrastructure for the circulation of e-bikes exists).

- Lack of bold incentives to promote “green” inner city logistics. In order to effectively develop and operate innovative and sustainable inner city logistics, there is frequently the need to apply bold measures including pedestrianisation of roads, determination of low-emission zones etc.

- Objections from shop owners, citizens. Often, there are objections to the development of green inner city logistics, by shop owners and consumers in commercial zones and roads. This is due partly to the imposed limits on cars circulation in these areas and the perception that such measures may prohibit consumers from visiting the market. This challenge may be overcome through dedicated and continuous consultation and dialogue, demonstrating good practices and successful previous examples.

Autonomous driving

Despite the fact that autonomous driving has not been deployed widely so far in Greece (as everywhere worldwide), there is an increased activity mainly from specific Greek research institutions and the city of Trikala.

Some of the main barriers and challenges for the uptake of autonomous driving are the following:

- Skepticism from the side of the users (passengers) on the usefulness, safety of autonomous driving. Autonomous driving is a relatively new concept, altering long established habits (i.e. driving your own car, having control over it). Therefore, autonomous driving developers need to communicate effectively the concept and gain the citizens’ cooperation well in advance.
- Autonomous driving is still in a development phase. As such, the legislative framework is (and will be) cumbersome
- In many cases, autonomous driving is a new mobility scheme that needs to be applied in old cities and infrastructure

2.2. Portugal (Mainland)

2.2.1. Regional focus of policy measures

The regulation of urban logistics activities is generally done through public notices and regulations, restricting loading/unloading activities on public roads, framed in the regulation of urban parking, or loading/unloading. These regulations are issued by Municipalities, thus determining the conditions of access to carrying out logistical activities (and restricting the way in which they are performed).[7]

Regarding current regulations, for example, Notice nº 3856/2021, issued by the Municipality of Lisbon, defines the General Regulation for Parking and Stopping on Public Roads (RGEPVP). This regulation contains a set of guidelines that control parking and stopping on public roads, in a manner adapted to Lisbon's reality, as well as the conditions of access to certain areas of the city's territory. This regulation defines, for example, the existence of "loading and unloading pockets", which are «spaces on the public road composed of one or several contiguous alveoli, especially intended, by construction or signaling, for the stopping of vehicles to carry out loading and unloading operations». [8]

By 2030, the World Economic Forum forecasts a 78% increase in urban logistics activities (measured in terms of quantity of deliveries), when compared to 2020. In this sense, trends such as the accelerated increase in e-commerce are expected to evolve, as well as the reduction in delivery times, and the change in the motorization of transport vehicles, to new, more efficient electric or hybrid motorizations (namely, growing use of electric vehicles and bicycles for the last-mile activities). [9]

The Portuguese National Investment Plan (PNI) 2030, that sets the priorities for strategic infrastructure investments in medium-long term, established that (between 2021 and 2030) it will be available around 450 million euros to invest in urban logistics' decarbonization, and around 360 million euros dedicated to the promotion of electric mobility. [10]

About autonomous driving, Technological Free Zones (ZLT) were recently legislated through the Council of Ministers Resolution nº 29/2020, that establishes the general principles for the creation and regulation of Technological Free Zones, and the Decree-Law nº 67/2021, which defines the governance regime and model for the promotion of technology-based innovation through the creation of ZLT. These zones are physical environments for testing, geographically located in a real or quasi-real environment, intended to carry out tests of innovative technologies, products, services, and processes based on technology, in a safe manner, with the support and monitoring of the respective competent authorities. Thus, in these ZLTs it will be possible to test drones

or autonomous cars. Apart from this, it was not established yet a legal framework to regulate autonomous driving, as this technology is still at its early stage.

2.2.2. Summary of projects connected to e-mobility

The FP7 European project FREVUE (March 2013 – September 2017; www.frevue.eu) aimed to prove that electric vans and trucks can offer a viable alternative to diesel vehicles - particularly when combined with state-of-the-art urban logistics applications, innovative logistics management software, and with well-designed local policy. FREVUE established demonstrators in eight of Europe's largest cities, including six capitals – one of these demonstrators was Lisbon. Within this project CTT (the national post company) and EMEL (the municipal agency for mobility and parking) introduced electric vehicles in their fleets for post-delivery services and municipal services respectively. Also, ICT solutions were analyzed to centralise the management of loading and unloading activities and route planning optimisation was tested. [11]

In fact, CTT are pioneer in the incorporation of electric vehicles in its fleet, integrating 9 new electric vehicles in the first half of 2020, which currently has 321 alternative vehicles, granting it the distinction of the largest alternative fleet in the country in the transport and logistics sector. At the same time, CTT is carrying out a wide range of tests with electric vehicles, namely light goods, scooters, and tricycles. The vehicles under test, some of which are unique in Portugal, are transformed according to the postal sector, for the last mile distribution, to provide greater load capacity, safety, and ergonomics in driving. The results obtained are very positive in terms of responding to CTT's operational needs, with benefits regarding the emission of pollutants and the respective carbon footprint. Overall, it is estimated that the use of the vehicles now being tested, may allow a potential carbon saving of 17.5 tons of CO₂ per year, equivalent to an electricity consumption of 10 inhabitants. Moreover, in 2020 a pilot Green Deliveries service was launched together with a large customer, allowing all its customers in the city of Lisbon to receive orders delivered by CTT electric vehicles. [12]

2.2.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving

There are some challenges to autonomous driving that still need to be tackled, namely the lack of legislation and regulation, the creation of an electrified charging network and an adequate urban mobility planning.

Nevertheless, according to “DHL Logistics Trend Radar”, autonomous vehicles have high probability of transforming the way businesses are performed. A paper by Kassai et. Al [13]. investigates if the introduction of autonomous trucks would be feasible for deliveries in urban areas from the experts' point of view. Furthermore, the potential advantages of such autonomous vehicles were highlighted and compared to traditional

delivery methods. Simultaneously, barriers that could slow down such an implementation were also revealed by conducting experts' interviews. The results show that courier, express, and parcel (CEP) companies are interested in innovative logistics solutions such as autonomous vans, especially when it comes to business-to-consumer (B2C) activities. Most of the experts acknowledge the benefits that autonomous vans could bring one day on the market. [14]

Furthermore, recent studies proved that even though the current discussion of autonomous driving mainly focuses on road-based passenger cars, automated micro-vehicles for delivery purposes might be more lucrative and even earlier available on the market. [15] Additionally, advances in autonomous and electric freight vehicles have good potential for improving the efficiency and sustainability of urban freight systems.

2.3. Portugal (Azores)

2.3.1. Regional focus of policy measures

As of now, there is no regional legislative framework both for inner city logistics as for the autonomous driving in the Autonomous Region of the Azores. Within the scope of urban mobility, the competent regional entities are the municipalities, which were supported by the Operational Program Azores 2020 (Programa Operacional Açores 2020) to develop their own Integrated Sustainable Urban Regeneration Plans (Planos Integrados de Regeneração Urbana Sustentável).

At the national level (Portugal mainland), the Transports and Mobility Institute (Instituto da Mobilidade e Transportes, I.P) developed a guide [16] in 2019 for the integration of local urban logistics policies, taking into account good practices based on cooperation between different entities. However, this document is not legally binding, as it is only a guide.

With respect to autonomous driving, Ordinance No. 2930/2019 [17] created a working group with the goal of studying the necessary legislative changes for the introduction of new technologies related to autonomous driving in the automotive sector, also at the national level. As of now, no legislation is foreseen for the Autonomous Region of the Azores on this topic.

2.3.2. Summary of projects connected to e-mobility

Both topics – Inner city logistics and Autonomous driving – are still taking their first steps in mainland Portugal, with several projects and pilots implemented. For instance, on Autonomous driving, the University of Porto, along with Bosch, has recently announced the THEIA project, which aims to develop solutions to improve the sensory capabilities of autonomous vehicles. [18] Furthermore, there is a pilot project in Cascais – MOBI

Cascais [19] – where for the first time in Portugal, an electric vehicle circulates in a public space with no need for a driver.

At the regional scale, there are no developments on Autonomous driving so far. Nevertheless, there is already an ongoing project related to the topic of Inner city logistics, implemented by Delta Cafés, which, in short, draws from its EV fleet to operate in the Azores.

2.3.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving

Specifically, in the Autonomous Region of the Azores, while the municipalities are the competent entities for Inner city logistics and Autonomous driving, the lack of a regional legislative framework is in itself a barrier.

Inner city logistics are responsible for several impacts, such as increased congestion, occupation of public roads and parking spaces, increased atmospheric emissions, noise and reduced road safety. European studies show that vehicles for the transport of goods are responsible for 20% to 30% of emissions in urban areas. [20] With regards to new trends, the World Economic Forum has highlighted three main ones: the accelerated rise of e-commerce; the compression of delivery times; and the technological change in the motorization of transport vehicles. [21] With this in mind, several challenges can be identified: ambiguity and/or absence in the definition of objectives and strategic goals for the urban logistics sector; road network structuring and public spaces, particularly in the historic town centers, present limitations to logistical activities. Therefore, it is essential to invest in planning models based on dynamic and prospective territorial strategies, which allow for current challenges to be tackled, making cities more attractive and reducing the side effects of urban logistics such as pollution, congestion and noise.

On the other hand, regarding autonomous driving, one can say that there are essentially three main points of concern: **lack of information and regulatory framework**, which hinder the proper assessment of this issue; **developing technology**, directly related to the levels based on the degree of involvement of humans in the driving process, with regards to safety and reliability, and also the assurance of systems and software; and, finally, the **ethical issues**, which are still unclear and may require decision-making in the event of emergency situations.

All of these combined reflects that both Inner city logistics and Autonomous driving are still in their very early stage in the Autonomous Region of the Azores.

2.4. Germany

2.4.1. Regional focus of policy measures

Inner City Logistics

More and more people are moving to big cities and their surrounding areas in Germany. This development not only leads to more passenger traffic there, but also increases the demand for goods and services, which inevitably entail freight traffic. Against this background, urban freight transport and logistics must also make a contribution to reducing greenhouse gas emissions. This was also stated, among other things, in the German government's Climate Protection 2020 action program.

As part of the "National Climate Protection Initiative", the Ministry of the Environment therefore decided at the beginning of last year to provide extensive support for so-called micro-depositories. The aim is to relieve inner-city traffic and improve air quality and reduce CO₂ emissions by simultaneously integrating e-vehicles into the last mile.

The core of a climate-neutral transportation system in Germany is a functioning and sustainable infrastructure for the environmental alliance, i.e., for buses, streetcars and subways, as well as bicycle and pedestrian traffic. However, local public transport is not a self-runner - it must be attractive, affordable, fast, safe and convenient for people. Sufficient funds must therefore be made available for attractive public transportation, the range of services must be expanded, and the frequency and quality must be increased. [22]

Autonomous Driving

Automated driving will not be a mass phenomenon in the foreseeable future in Germany and beyond. In the year 2050 a maximum of every fifth vehicle kilometre is expected to be covered automatically according to a study by Prognos AG on behalf of ADAC e.V. The study shows: by 2050, about half of all vehicles will already have an automation function. In most cases, however, this will only be usable on motorways. In addition, it cannot be assumed that drivers will be able to make full use of the functions immediately.

While on motorways a good 40 percent of the driving performance could already be achieved automatically, on country roads the figure is still less than 4 percent. A significant penetration of vehicles that can drive automatically throughout the entire network is not to be expected until after 2050. Since the share of automated driving performance by 2050 is still low, the safety effects will also be rather low by this time. These effects are most likely to occur in the reduction of material damage. Since the serious consequences of accidents occur particularly strongly on country roads, where

automation will hardly have an effect until 2050, the effect of automation on road deaths will still be marginal until this point in time [23].

Nevertheless, Germany aims to take a leading role in autonomous driving. In order to make the most of the great potential of autonomous and connected driving, the German government wants to drive research and development forward and thus make the mobility of the future more versatile, safer, more environmentally friendly and more user-oriented. With the new law on autonomous driving, the government created the legal framework for autonomous motor vehicles (Level 4) to be able to drive in regular operation in defined operating areas on public roads - nationwide. This will make Germany the first country in the world to bring driverless vehicles out of research and into everyday use. The goal is to bring vehicles with autonomous driving functions into regular operation by 2022.

Flexibility is at the forefront of the law: the operation of driverless vehicles is made possible for a maximum number of deployment scenarios. Limited only locally to a defined area of operation, the various use cases are not conclusively regulated in advance. Individual permits, exceptions and requirements such as the presence of a safety driver who is always ready to intervene are therefore unnecessary [24].

The application scenarios include:

- “Shuttle transports from A to B,
- People movers (buses that travel on a fixed route),
- Hub2Hub transports (e.g. between two distribution centers),
- demand-responsive services during off-peak hours,
- first-mile or last-mile transportation of people and/or goods,
- "dual mode vehicles" such as in Automated Valet Parking. “[25]

[2.4.2. Summary of projects connected to e-mobility](#)

Inner City Logistics

The threat of gridlock in many cities poses new challenges for logistics. The last mile must be managed in an economically, ecologically and socially sustainable manner. This is where the concept of cargo bikes comes in, in particular that of the two-lane pedelec cargo bikes, also called "Light Electric Vehicle" (LEV). In combination with the micro depot concept and the integration of trucks/transporters, there are highly interesting application possibilities for the use of LEVs in multimodal concepts for sustainable urban logistics, not only for CEP logistics [26].

Furthermore, the Federal Environment Agency proposes the following measures for the "environmental alliance" component:

- “Regionalization funds must be increased for local public transport, and more money must be made available for the Municipal Transport Financing Act (GVFG). This is an essential basis for expanding the range of services and increasing the quality of local public transport.
- The additional funding required is EUR 11 to 15 billion per year - these funds can be freed up by reducing climate-damaging subsidies, among other things.
- Digital solutions (e.g., Mobility as a Service (MaaS)) and more flexible forms of services are also needed, especially in rural areas (e.g., ridepooling).
- Bicycle and pedestrian traffic are not only healthy, active forms of transport, but above all emission-free. Bicycle and pedestrian traffic must therefore be promoted more strongly and considered from the outset in traffic planning. Therefore, the measures envisaged by the National Cycling Plan should be implemented as quickly as possible. The federal government should also adopt a national pedestrian strategy, for which the Federal Environment Agency has submitted a proposal” [27].

Autonomous Driving

With its "Strategy for Automated and Connected Driving" (AVF Strategy), the German government set out the political framework back in 2015 to increase road safety via innovations and through the introduction of AVF, and to promote mobility with improved traffic efficiency and reduced environmental impact.

The Federal Ministry for Education and Research [BMBF] has been funding research into autonomous driving since 2015 within a "Research Agenda for Autonomous Driving". The subjects include safety technologies for autonomous driving, reliable electronics and sensor technology, new technologies for communication with weaker road users and for IT security. Recently, artificial intelligence applications have become another focus of focus of the funding.

- In the BMBF-funded UNICARagil project, completely driverless electric vehicles of the highest level of automation are being developed under the leadership of scientific institutions, based on the latest results of research into autonomous driving and electric mobility. The technical innovations include a service-oriented electrical/electronic architecture, highly integrated sensor elements and a modular design of energy supply and power electronics. The project brings together seven universities and six companies at ten locations. The BMBF is

funding UNICARagil with around €26.0 million (project duration: 02/2018 - 01/2022).

With its two program pillars "Automated Driving" and "Innovative Vehicles", the BMWi's "New Vehicle and System Technologies" (NFST) funding program addresses two major challenges facing the automotive industry: digitalization and new drive systems and vehicle concepts. The projects are designed as collaborations between automakers, suppliers and research institutions that deliver pre-competitive, application-oriented results. Over the decades, successive lighthouse projects have been funded that have regularly contributed to successful market innovations. The current focus of funding is on methods and processes for safeguarding (security) the newly developed functions. However, higher levels of automation (up to autonomous driving) necessarily require complex systems from the field of artificial intelligence. Therefore, AI will also be the new focus of the program in the coming years.

The Innovative Vehicles program pillar covers the topics of novel vehicle concepts and technologies as well as modern drive technology that help to promote economical, energy-efficient, low-emission and quiet transportation.

- The PEGASUS research project, for example, aims to lay the foundations for the development of test methods for highly automated driving, especially on highways up to speeds of 130 kilometers per hour (duration 01/2016 - 06/2019, 16.3 million euros in funding). The IMAGinE (Intelligent Maneuver Automation - Cooperative Hazard Avoidance in Real Time) large-scale collaborative project aims to develop innovative assistance systems for the "cooperative driving of the future" (10 partners, duration 09/2016 - 08/2020, 17.9 million euros in funding).

In 2016, the BMVI published a research program on automation and connectivity in road transport (AVF). Within the framework of the program, research is conducted into transport and socio-political topics. In 2019, a new funding guideline was published, which is aimed in particular at application-oriented research projects for the further development of mobility and the overall traffic system, also using artificial intelligence methods in urban and rural areas.

- The goal of the PROVIDENTIA project, which is funded by the BMVI as part of the AVF research program, is to provide the driver and, in the case of a highly automated vehicle, the vehicle itself, with the most comprehensive view possible of the route ahead. The forward view is to function reliably, adapted to the situation and also under adverse environmental conditions, while avoiding information overload. It should be possible during day and night and also under adverse environmental conditions. The complex image of the environment on which foresight is based is generated with the aid of sensors on the road (e.g.,

cameras, radar) and with sensors in the networked vehicles (e.g., cameras, lidar) and communicated via the connecting mobile communications network. In the computer systems of the infrastructure (backend), data fusion processes are used to generate a "digital twin" that is as accurate as possible and up-to-date at all times. All information relevant to the vehicle can be derived from this twin. This visualization is manually operated and partially in partially automated vehicles. For control of highly automated vehicles this information will make a significant contribution. The project is being implemented at the Digital freeway. Project duration: 12/2016 - 06/2019; BMVI funding share: €6.09 million. [28]

2.4.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving

The challenges in urban commercial transport in Germany are manifold and cover a wide range of topics. Above all, it is the global trends that have an enormous impact at the local level, but are often difficult to manage there. This is because political and planning cycles do not always match the many fast-moving developments. The emergence of food delivery services with the promise of short-term delivery within only a very narrow window of time is one of those trends. This has posed a huge challenge to traffic as well as public space in German cities for just two years. Another example is climate change, which demands rapid action at the local level as well. However, political decision-making and planning processes are extensive and lengthy. They take time, especially because many actors from administration, planning, civil society, and chambers and associations want to help shape and have a say in them.



Figure 1 Survey on the most important aspects in the optimization of urban transport in 2019.

There is a need for optimization above all in the bundling of goods: According to a survey from 2019, this aspect was important to very important for the majority of respondents for the optimization of urban transport in Germany, with a value of around 4.5 scale points. The avoidance of empty runs and the technical upgrading of existing vehicle fleets were also of high importance in second and third place [29].

Germans are still sceptical about autonomous driving. In a survey commissioned by Autoscout24 in January 2021, a total of around 53 percent of respondents said they were generally rather against allowing autonomous driving vehicles on German roads [30]. In addition to social acceptance, the relevant infrastructure must also be expanded, such as fast Internet. It will still take some time for the technology to become established. Until then, only driver assistance systems will probably be used.

2.5. Romania

2.5.1. Regional focus of policy measures

Inner City Logistics

At the moment, there is no legal framework dedicated to inner city logistics established at the national or regional level. However, several cities started to apply local regulations to limit freight traffic inside the city. This is usually done by a local council decision that defines limited access zones for freight. Most cities have at least one or two zones where the entry of vehicles over 3.5 or 7.5 tonnes is either taxed or forbidden without a special permit.

Autonomous driving

At the moment, there is no legal framework dedicated to autonomous driving in Romania. In accordance with the current law, drivers are not permitted to release the steering wheel while driving, thus being unable to use an automated vehicle on public roads.

The first steps towards creating a framework for the autonomous driving have been, however, made at national level. Cars with autonomous features (e.g., parking features) are approved to be used by drivers on public roads [31]. Furthermore, the Romanian Auto Partnership (PAR – Parteneriatul Auto Român), one of the representative working groups in the automotive industry in Romania, has set out a set of parameters for sustainable development of the auto industry at national level, which include the development of autonomous vehicles as part of the 4-pillars for the future, together with connected, shared and electric vehicles [32].

2.5.2. Summary of projects connected to e-mobility

Inner City Logistics

The potential of regulations for inner city logistics and logistics related curb management is mostly neglected as most cities make use just of basic taxation zoning. Indeed, cities with a pedestrian historical centre like Cluj-Napoca limit the access to the central area for heavy but also light duty vehicles carrying freight. On the other hand, supplying local stores and restaurants is permitted during the night 21:00 – 07:00. In the pedestrian area goods are generally carried by small carts. Cities like Braşov are also using loading zone. For example, between 11:00 and 12:00 AM on lane on the most important street crossing the historical centre can be used for the loading of goods.

As the number of deliveries skyrocketed in the last 5 years, especially in the pandemic period private companies started to invest in parcels located in various places in the city. The main provider is Emag (the largest ecommerce platform in Romania) that already installed hundreds of parcels, named “Easy Box” in all cities and villages. Carriers deliver the packages to those boxes where they are stored till the client comes and picks them up using a cod sent via SMS. One can find an “Easy Box” usually in central areas, neighbourhood centres, close to points of interest and quite frequently at gas stations. Using this system of parcels the whole delivery process is made easier. The same company, Emag, is also one of the first to invest in the electrification of the fleet by starting the “Green Delivery” service (goods delivered by electric vehicles).

The integration of these parcels into public projects is something already integrated in several SUMP in the regions (Cluj-Napoca and Zalău) where using the concept of neighbourhood mobility nodes (stations gathering bike sharing, car sharing, EV-charging and other mobility services) with storage space for small goods, similar to those provided by Emag – Easy Box. The main concern will be in the future on how to operate those boxes. Will they be leased or rented to providers? Sold or will built via PPP.

Autonomous driving

The topic of autonomous driving is in an incipient state at both national and regional levels in Romania, with only a few projects and initiatives being currently planned in this sector. The main such projects are as follows:

- Innovation, Testing and Promotion Centre Cluj (CITPC) is a project planned by the Cluj County authorities aimed at implementing a testing centre for autonomous vehicles in the county, where cooperation with large companies such as Bosch or Porsche, that already have engineering centres in Romania, would lead to testing out various autonomous vehicles. Furthermore, it is expected that the Technical University of Cluj-Napoca would cooperate in this project, by contributing to the overall research [33].
This project is also relevant for the Northwest Development Region, as it will provide one of the first testing hubs at national level and will strengthen the R&D capabilities of the Romanian market in the field of autonomous vehicles. This is expected to further attract investors and specialized work force, thus contributing to the economic development of the region.
- A similar project is also expected to be developed in the city of Timisoara (West Development Region), that will allow the implementation of a testing circuit for autonomous vehicles. The projects are expected to be carried out with companies such as Porsche or Continental, which are already working locally, as well as with the West University of Timisoara.

Furthermore, autonomous driving has been promoted among students as well, in an attempt to spark interest in the field and to ensure the development of specific skills for the future of the workforce. This has been shaped through various competitions such as the Autoliv City Competition or the iDEAS Engineering Competition. The autoliv City Competition was conducted in 2014 in the city of Timisoara and consisted in a competition for students to create an autonomous car [34].

The iDEAS Engineering Competition was held more recently, in 2021, and was organized by Continental in the city of Iasi. The event was dedicated to engineering/technical students and the goal was to design an autonomous car, that could be safely driven on a city road (considering traffic lights) [35].

2.5.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving

Inner City Logistics

Main barriers in this field refer to the lack of experience with UVAR regulations and curb management. The congestions generated by loading and unloading of goods within the city is not yet taken seriously enough. This can also be seen when it comes to enforcement of parking. Usually, cars delivering goods park on the sidewalk or block a traffic lane and don't get punished.

Also, the transition to cargo bikes, especially in historical centres is not yet possible as most cities don't have complete cycling networks or at least corridors that would make such deliveries possible. This might however change in the next 2-3 years as many cities invest in cycling infrastructure.

The electrification of the fleet for city logistics is a process that slowly started but the national subventions for the acquisition of electric vehicles are not well enough adapted to the need of fleet operators. Therefore, logistics operators remain shy when it comes to investing in the electrification of the fleet.

Autonomous driving

As mentioned before, autonomous driving is in an incipient state at national level in Romania. As discussions and advances towards autonomous vehicles are growing worldwide, Romania will need to adapt to the new context and develop the needed conditions to accommodate autonomous driving. However, this will come with its own set of challenges, which can already be seen today:

- At the moment, Romanian cities and regions are still working on improving the existing, more traditional infrastructure, with certain areas still needing extended

work on road, freight and rail infrastructure. This could take away the focus from the new types of transport and could lead in a delayed implementation of modern mobility concepts.

- There are multiple discussions around the safety of autonomous cars, which could lead in a lower social acceptance from local drivers in the beginning, thus making autonomous vehicles less attractive. In this sense, there will need to be very specific information available to the wide public regarding what autonomous driving entails, as well as a well set out strategy for its implementation.
- There is no legislative framework that shapes how autonomous vehicles will be introduced in Romania. This will need to be developed overtime, considering European legislation, as well as best practices and local context and needs.

2.6. Croatia

2.6.1. Regional focus of policy measures

Inner city logistics

The legislative framework in Croatia with regard to inner city logistics can best be observed through the actions of local authorities, which in turn are based on setting ambitious targets for reducing greenhouse gas emissions. Such policies find their drivers in the relevant EU policies, among which the Fit for 55 package currently stands out. In this light, more and more cities are regulating the legislative framework within their jurisdiction to support the city's energy transition.

Such policies are particularly reflected in the transport sector, including inner city logistics. Namely, on the one hand, the authorities implement policies to encourage electric mobility by creating various comparative advantages for EVs compared to conventional vehicles, and on the other hand prescribe restrictive measures such as banning the sale, registration or use of fossil fuel vehicles from a certain year.

Autonomous driving

In 2021, the first step was taken in recognizing autonomous vehicles in the Croatian legal framework. At the end of 2021, the Draft Proposal of the Law on Amendments to the Law on Road Traffic Safety was published in Croatia. This amendment introduces a new term that means a fully automated vehicle, i.e. a vehicle that can move on the road without the presence of a driver - a vehicle that uses hardware and software for continuous full dynamic vehicle control (fully automated vehicle without steering wheel). Sanctions are also prescribed for drivers who use vehicles with built-in driver

assistance systems (partially automated vehicle) in such a way that the driver does not sit in the driver's seat while driving, or that the vehicle is driven independently and unable to react in unforeseen cases.

However, existing legislative framework is not adapted to the appearance and functioning of fully autonomous vehicles. Such vehicles are expected to operate in Zagreb by 2024, as announced as part of the "Robotaxi" project by renowned innovator Mate Rimac.

There is a demanding and responsible task in front of the Croatian Government and Parliament if they want self-driving taxis to travel through Zagreb as announced. Namely, they will have to design and write regulations that should be of sufficient quality even that other European countries can emulate them.

This will not be an easy task as the vehicles to be included in Zagreb's public transport should be at the fifth level of autonomy - as described in the National Recovery and Resilience Plan, which partly funds the project's R&D funding ("Robotaxi"). Therefore, government departments will have to propose a whole range of new rules.

Some European countries have already started regulating autonomous vehicles. It was recently announced that the German parliament has passed a new legislative framework for the traffic of autonomous level four vehicles. The question is whether the Croatian administration will have to go one step further, since level five vehicles are planned in Zagreb and whether it will be able to rely on the expertise and experience of others or will have to pass a regulation that will serve as an example to others.

As agreed with the European Commission, a new regulation on autonomous driving must be adopted by mid-2024. It will include the development of a national autonomous driving test procedure, amendments to road safety laws, amendments to national vehicle type-approval rules, amendments to vehicle, passenger and service insurance regulations, etc. This is also one of the conditions for the payment of the sixth instalment of European money for recovery, which should amount to about 400 million euros.

[2.6.2. Summary of projects connected to e-mobility](#)

Inner city logistics

The City of Zagreb conducted a study (2021) within which the Climate Neutrality Scenario was developed, which assumes the implementation of an active policy to support energy transition in the City of Zagreb. The scenario is modelled using the LEAP tool and is based on a detailed elaboration of the existing energy system in the City of Zagreb. Special emphasis in the study was placed on modelling the consumption of

transport sector and elaborating measures to achieve emission reductions. Therefore, the subsectors of road transport were analysed separately: general road transport, public sector, taxi vehicles and traffic of foreign vehicles realized in the area of the City of Zagreb. Road traffic was modelled by analysing the existing fleet of vehicles by categories and applying the stock turnover method. This reflects future structural changes in the vehicle stock that occur through the implementation of certain measures such as e-mobility incentives or administrative restrictions on sales or use of fossil fuel vehicles. Following the vehicle stock projections, the future needs for different types of infrastructure for EV charging were analysed, as well as related investments arising from the implementation of defined measures.

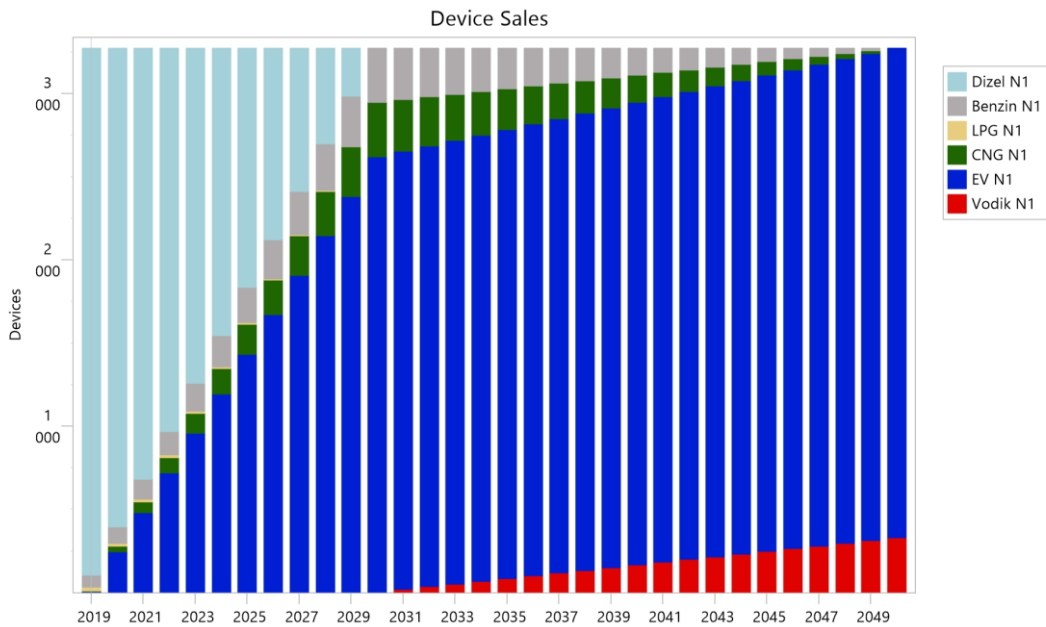


Figure 2 Ban of diesel light duty vehiclec (N1) sales in City of Zagreb by 2030

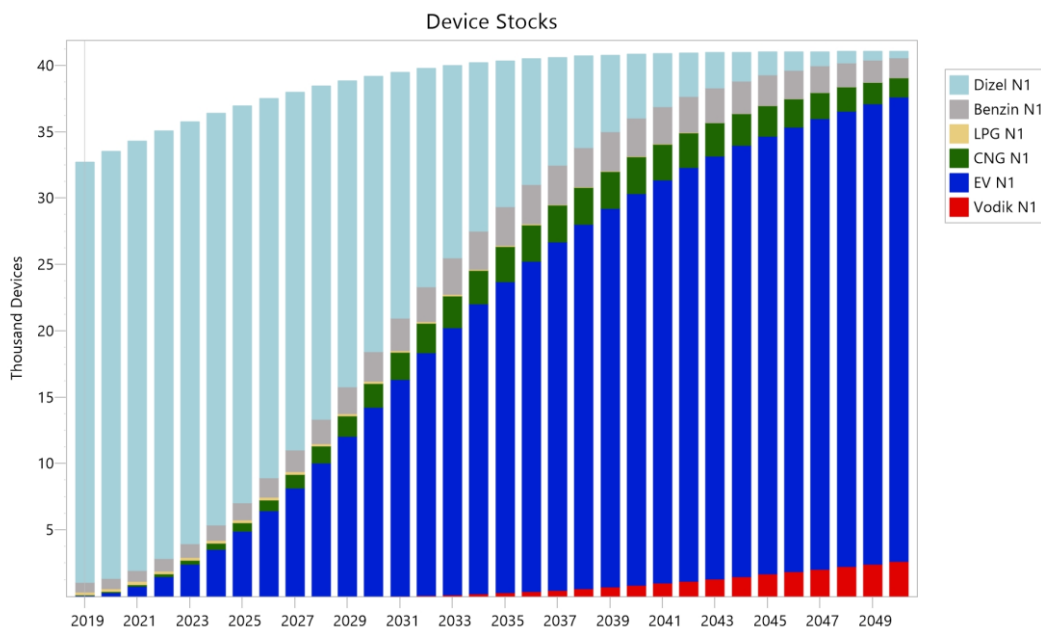


Figure 3 Impact of ban of diesel light duty vehiclec (N1) sales in City of Zagreb by 2030 on vehicle stock (N1 fleet)

Autonomous driving

Several activities related to car industry in Croatia can be pointed out:

- Two years ago, the German company dSPACE opened its R&D center for the automotive industry in Zagreb, and this year Porsche in cooperation with the Croatian Infinum. Porsche is also present in the City of Varaždin with a development center for its company Cetitech.
- In Croatia, the Austrian AVL and the German Atron also have an R&D center.
- Work on autonomous vehicles and robots for industry in Croatia is also done by, among others, DOK-ING, Gideon Brothers and Inetec.
- In the field of cyber security, companies such as Reversing Labs work, navigation is done by Mireo and OptimoRoute, and the hardware for such vehicles is produced by Xylon. Startups such as AIR-RMLD and Hipersfera and the company King ICT work with autonomous drones in Croatia.

The major project regarding autonomous driving is “Robotaxi” project. Mate Rimac, the founder and CEO of Croatian electric hypercar and components developer Rimac Automobili, started a separate company nearly three years ago to work on electric robotaxis. Below are stated few facts publicly available regarding this project:

- Rimac Automobili's sister company, Project 3 Mobility, is one of the proposed projects from the National Recovery and Resilience Plan and as such, it's selected among the projects to be presented to the Commission.
- KIA Motors, a company that is a part of the Hyundai Motor Group, is already directly involved in the project, as an investor and shareholder of the company. The total amount of funds that will be invested in the first, before the commercial phase of the project is 450M EUR
- According to the National Recovery and Resilience Plan, 200M EUR will be co-financed in the pre-commercial phase from EU Funds.
- The project is actively in development for the past several years, its commercial phase, after intensive research and development is expected from the end of 2024.
- Cooperation agreements have been signed with several cities, and company wish is for the first city in the world where the service is available to be Zagreb in 2024.

2.6.3. Challenges, barriers and possible solutions for inner city logistics and autonomous driving

The key challenge both for Inner city logistics and Autonomous driving is a global pandemic that has significantly affected the automotive industry and many related industries. On the one hand, current supply chains have been disrupted, and on the other hand, some investments have been halted or slowed down. This is likely to slow down the approach of the price of electric vehicles to fossil fuel vehicles, which means that the implementation of the planned measures to develop e-mobility will ultimately cost more.

A particular challenge is the existing legislative framework that is not adapted to the traffic and use of fully autonomous vehicles. In the coming period, it will be necessary to design and write regulations that should be of sufficient quality. It will not be an easy task as the vehicles to be developed will be fifth levels of autonomy.

3. Evaluation and comparison of the different policy measures related to inner city logistics

All European partner regions face similar challenges regarding inner city logistics processes as more and more people are moving to big cities and their surrounding areas. This development not only leads to more passenger traffic within urban areas, but also increases the demand for goods and services, which inevitably entail freight traffic. Against this background, urban freight transport and logistics must also contribute to reducing greenhouse gas emissions. All partner regions have the common goal of developing a more sustainable and carbon-free future for the inner cities. Many different programs and a lot of money are spent in the individual regions. While the same goals are pursued, the focus of the individual programs differs according to local conditions. In the following analysis we look at differences and similarities.

Overall, we can state that technological, economic, social, political and individual drivers of change are impacting logistics in European cities:

- the fundamental changes in retailing
- environmental and climate protection
- the increased demand for inner-city logistics space, including the resulting ever-increasing competition for use, and
- the agility and dynamism associated with new technologies and digitization.

In **Greece**, there are many restrictions for inner-city transportation in the so called “Blue Zone” with heavy vehicles. The “Blue Zone” is a series of measures to facilitate the movement of vehicles related to freight transport in the city center, so the implementation of the Blue Zone has the effect of increasing the average speed of movement both in the demarcated area and throughout the interior ring. Furthermore, the Greek National Recovery and Resilience Plan foresees overall more than 4000 mil. € for green logistics and e-mobility. Subsidy schemes are also provided for electric vans used in inner city logistics. Especially tax incentives could be used by inner city logistic companies. As an example, the city of Trikala in the Region of Thessaly, foresees inner logistics actions, such as the encouragement of deliveries through bikes and “clean” vehicles. The timeline for the full implementation of this measure extends to 2030. Furthermore, there are currently a handful of courier/delivery companies that hire employees who own a bike or e-bike for the deliveries.

Challenges identified:

- Lack of cooperation between all stakeholders
- Increased cost of electric vehicles for inner city logistics
- Lack of bold incentives to promote “green” inner city logistics

- Objections from shop owners, citizens

In **Portugal (Mainland)** the regulation of urban logistics activities is generally done through public notices and regulations, restricting loading/unloading activities on public roads, framed in the regulation of urban parking, or loading/unloading. These regulations are issued by Municipalities. Furthermore, these regulations could contain a set of guidelines that control parking and stopping on public roads. The Portuguese National Investment Plan 2030 sets the priorities for strategic infrastructure investments in medium-long term. There will be around 450 million euros to invest in urban logistics to support decarbonization and 360 million euros to promote electric mobility.

One of the relevant projects is the FP7 European project FREVUE, that aimed to prove that electric vans and trucks can offer a viable alternative to diesel vehicles - particularly when combined with state-of-the-art urban logistics applications, innovative logistics management software, and with well-designed local policy. The city of Lisbon participated together with the national post company CTT. The results obtained are very positive in terms of responding to CTT's operational needs, with benefits regarding the emission of pollutants and the respective carbon footprint.

Challenges identified:

- harmonized and/or national legislative framework
- promote electrical vehicles use for last mile distribution operations

In **Portugal (Azores)** there is no regional legislative framework for inner city logistics in the Autonomous Region of the Azores. Within the scope of urban mobility, the competent regional entities are the municipalities, which were supported by the Operational Program Azores 2020 to develop their own Integrated Sustainable Urban Regeneration Plans.

Challenges identified:

- Lack of a regional legislative framework
- Ambiguity and/or absence in the definition of objectives and strategic goals for the urban logistics sector
- Road network structuring and public spaces, particularly in the historic town centers, present limitations to logistical activities

In **Germany** various ministries are legislatively involved in the design of a more sustainable inner city logistic. As part of the "National Climate Protection Initiative", the Ministry of the Environment therefore decided at the beginning of last year, among other things, to provide extensive support for so-called micro-depositories. The aim is

to relieve inner-city traffic and improve air quality and reduce CO2 emissions by simultaneously integrating e-vehicles into the last mile. The Municipal Transport Financing Act is an essential basis for expanding the range of services and increasing the quality of local public transport. The National Cycling Plan promotes bicycle and pedestrian traffic.

The concept of cargo bikes becomes more attractive. In particular, two-lane pedelec cargo bikes, also called "Light Electric Vehicle" (LEV) that come in combination with the micro depot concept and the integration of trucks/transporters are highly interesting application possibilities for the use of LEVs in multimodal concepts for sustainable urban logistics.

Challenges identified:

- political decision-making and planning processes are extensive and lengthy
- Bundling of goods for delivery
- Avoidance of empty runs

In Romania, there is no specific legal framework dedicated to inner city logistics. There are regional regulations established by local council decision that define limited access zones. The potential of regulations for inner city logistics and logistics related curb management is mostly neglected as most cities make use just of basic taxation zoning. Companies started to invest in parcels located in various places in the city of Cluj. Carriers deliver the packages to those "Easy Boxes" where they are stored till the client comes and picks them up using a code sent via SMS.

Challenges identified:

- no legal framework
- further integration of parcels onto public projects

In Croatia, the ambitious greenhouse gas reduction targets are implemented by local authorities through various measures. From promoting electric mobility to banning sales of fossil fuel vehicles, there is a wide range of measures. A study by the City of Zagreb analysed how an active policy to support energy transition in the city could be implemented. Special emphasis in the study was placed on modelling the consumption of transport sector and elaborating measures to achieve emission reductions. It shows the changes in vehicle stock that occur under certain measures.

Challenges identified:

- Overcoming pandemic-related supply chain issues
- Attract further private investments

4. Evaluation and comparison of the different policy measures related to autonomous driving

Some European countries have already started regulating the use of autonomous vehicles. Widespread use of the technology is not yet foreseeable. For this, a comprehensive infrastructure is needed in addition to the regulatory framework. In most European regions, the topic is still in the planning phase. Some promising projects can ensure that autonomous driving gains greater social acceptance.

In **Greece**, the most recent legislative initiative regarding autonomous driving has been Law 4784/2021 (art. 42) providing the necessary legal framework for the operation of autonomous vehicles. The law regulates various applications of autonomous driving.

Particularly innovative projects, such as CityMobil2 or the follow-up project AVINT are noticed worldwide. Within the projects the city of Trikala has operated the first autonomous public bus worldwide, running within the boundaries of a city center. Furthermore, the Greek island of Astypalea will be a model to apply innovative clean energy transition technologies, including that of autonomous driving. The findings are relevant for all European regions, especially for Azorean Islands.

Challenges identified:

- Skepticism from the side of the users (passengers) on the usefulness, safety of autonomous driving
- Autonomous driving is still in a development phase
- In many cases, autonomous driving is a new mobility scheme that needs to be applied in old cities and infrastructure

In **Portugal (Mainland)** regarding autonomous driving, Technological Free Zones were recently legislated through a Council of Ministers Resolution. These zones are physical environments for testing, geographically located in a real or quasi-real environment, intended to carry out tests of innovative technologies, products, services, and processes based on technology, in a safe manner, with the support and monitoring of the respective competent authorities.

Challenges identified:

- lack of legislation and regulation
- creation of an electrified charging network for autonomous vehicles
- adequate urban mobility planning to accommodate autonomous vehicles

In **Portugal (Azores)** there is no regional legislative framework for autonomous driving in the Autonomous Region of the Azores. A working group was created with the goal of studying the necessary legislative changes for the introduction of new technologies

related to autonomous driving in the automotive sector at the national level. As of now, no legislation is foreseen for the Autonomous Region of the Azores on this topic.

Challenges identified:

- Lack of information and regulatory framework
- Developing technology
- Ethical issues

In **Germany**, the "Strategy for Automated and Connected Driving" regulates the political framework to increase road safety via innovations and through the introduction of autonomous driving and to promote mobility with improved traffic efficiency and reduced environmental impact. The Federal Ministry for Education and Research has been funding research into autonomous driving since 2015 within a "Research Agenda for Autonomous Driving". The subjects include safety technologies for autonomous driving. In the BMBF-funded UNICARagil project, completely driverless electric vehicles of the highest level of automation are being developed under the leadership of scientific institutions, based on the latest results of research into autonomous driving and electric mobility.

Challenges identified:

- lack of nationwide infrastructure
- social acceptance must be expanded

In **Romania**, there is no legal framework dedicated to autonomous driving. In accordance with the current law, drivers are not permitted to release the steering wheel while driving, thus being unable to use an automated vehicle on public roads. The first steps towards creating a framework for the autonomous driving have been made at national level. In general, the topic of autonomous driving is in an incipient state at both national and regional levels in Romania, with only a few projects and initiatives being currently planned in this sector. Innovation, Testing and Promotion Centre Cluj (CITPC) is a project planned by the Cluj County authorities aimed at implementing a testing centre for autonomous vehicles in the county, where cooperation with large companies.

Challenges identified:

- no legal framework
- projects are in early stages

In **Croatia**, the first step was taken in recognizing autonomous vehicles in the Croatian legal framework in 2021. The Draft Proposal of the Law on Amendments to the Law on Road Traffic Safety regulates a vehicle that uses hardware and software for continuous full dynamic vehicle control. Existing legislative framework is not adapted to the

appearance and functioning of fully autonomous vehicles. Such vehicles are expected to operate in Zagreb by 2024, as announced as part of the "Robotaxi" project by renowned innovator Mate Rimac. The project is actively in development for the past several years, its commercial phase, after intensive research and development is expected from the end of 2024. Besides that, Croatia has a burgeoning innovative automotive industry with various projects.

Challenges identified:

- adaption of existing legislative framework to the appearance and functioning of fully autonomous vehicles
- Overcoming pandemic-related supply chain issues

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