Riga Energy Agency

BSR Electric project report

# E-scooters as a potential new tool to increase accessibility of public places and social inclusion

2020

# INDEX

INTRODUCTION ..... 4

1. GREEN MOBILITY FOR GROWTH ..... 6

Current situation of cities in Latvia ..... 8

Overview and dynamics 2007-2017 ..... 11

Challenges and barriers 2020 ..... 13

Old car park ..... 13

Insignificant renewable and electrical energy consumption in transport sector ..... 13

Especially high amount of privately owned vehicles and shrinking use of public transport ..... 15

New vehicle emission legislations ..... 17

2. INITIATIVES AND POLICIES ..... 18

Overview of ongoing national and local long-term strategies ..... 18

The National Energy and Climate Plan ..... 18

Latvia's strategy to reach climate neutrality by 2050 ..... 18

Development plans 2020 and related strategies ..... 19

The National Development Plan ..... 19

The Sustainable Development Strategy of Latvia ..... 19

On Alternative Fuels Development Plan ..... 20

On the Energy Development Guidelines ..... 21

Finished and ongoing projects within Green mobility framework ..... 21

Electromobility Development Plan 2014-2016 ..... 21

Reduction of Greenhouse Gas Emissions in Transport Sector, Aid for EV and Deployment of Their Infrastructure ..... 22

Developing environmentally friendly public transport infrastructure ..... 23

3. COOPERATION ISSUES ON CLIMATE AND ENVIRONMENTALLY FRIENDLY TRANSPORT ..... 24
Stakeholder overview and mapping ..... 24
Stakeholder engagement platforms and initiatives ..... 28
Interaction with academic platforms and initiatives ..... 31
Private sector activities ..... 32
NGO activities ..... 33
4. SUPPORT TOOLS AND BUSINESS MODELS ..... 36
Overview of support tools available ..... 36
Innovative business models toward resource efficient transport ..... 40
Social benefits and urban sustainability aspects ..... 43
5. PILOT ACTIVITIES IN USE OF DIFFERENT E-SCOOTERS. ..... 49
Different type of e-scooters ..... 49
E-scooters for social inclusion ..... 49
Airport e-scooters ..... 51
Outdoor parks e-scooters ..... 52
Heavy duty e-scooters ..... 54
6. USE CASE: "CAN E-SCOOTERS BE AN ECONOMICALLY SUSTAINABLE INSTRUMENT OF SOCIAL INCLUSION?" ..... 56
Pilot use case goal ..... 56
Chosen implementation ..... 56
Result ..... 57
Lessons learned ..... 59
Conclusion ..... 61

# INTRODUCTION

The common challenge of EU countries are the unions ambitious targets for the reduction of transport sector emissions and the aim to phase out conventionally fuelled vehicles in urban transport by 2050. E-vehicles produce significantly less CO2 and noise emissions and are therefore the ideal means of transport in an urban context given the relatively short distances.

While national promotion strategies for e-mobility have primarily focused on individual car use, other potential applications have received less attention. These include:

- Electric delivery vans and trucks that could greatly reduce the CO2 and noise emissions of the urban logistics sector.
- Urban companies and public authorities operating large fleets of cars, e.g. for maintenance workers, that could be replaced by e-vehicles.
- E-bikes (rented/owned) that can be used by commuters travel the last mile to their workplace or for business trips in inner cities.
- E-buses to make public transport even more environmentally friendly if routes, charging infrastructure and operational routines are planned and designed effectively.
- E-scooters to increase the accessibility of public places such as cemeteries and hospitals for people with impaired mobility, thereby strengthening social inclusion.
- Electric ferries and water taxis to complement public transport systems in the many coastal cities of the Baltic Sea Region.

Project BSR Electric aims to enhance the utilization of e-mobility in urban transport systems around the Baltic Sea Region by demonstrating potential applications of various types of urban e- mobility. Transnational pilot activities will outline how different e-mobility applications can be implemented in practice and will guide public authorities, companies, planners and transport providers in the process of integrating these into urban transport strategies.

City of Riga chose to do research project of e-scooters as protentional usage to increase the accessibility of public places such as cemeteries and hospitals for people with impaired mobility, thereby strengthening social inclusion

# 1. GREEN MOBILITY FOR GROWTH

Energy supply (energy industries), industry (manufacturing industries and construction and industrial processes), transport (air, marine, and ground transport), residential and commercial, agriculture, and waste are the main greenhouse gas (GHG) pollutants in the world. European Union (EU) biggest three pollutants are energy supply (29% of GHG emissions), transport (22%), and industry (20%)[1]. Depending on the region the proportions might be different. Latvia's three biggest pollutants are energy supply (34%), transport (29%, from which passenger cars take 70%), and agriculture

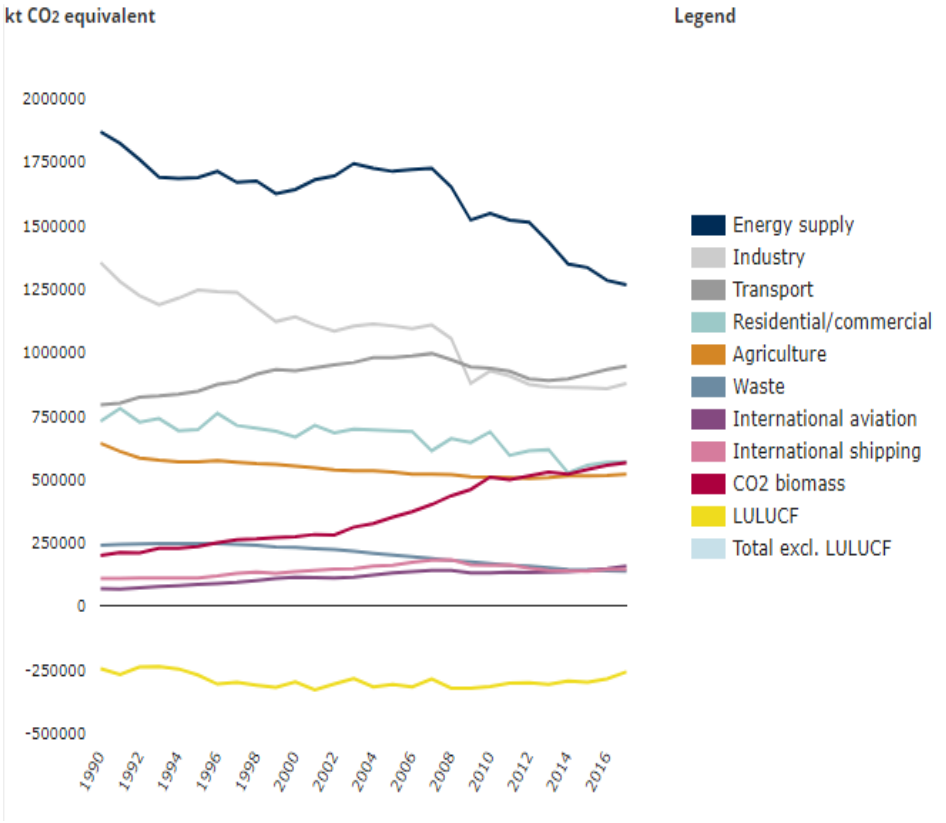


*Figure 1. Greenhouse gas emission by aggregated sector. Available: https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-6/assessment-3. Accessed: 26 12 2019*

(25%).

Seeing that the transport sector is one of the main GHG pollutants, especially in cities, it is only befitting that this sector will embrace many changes in the upcoming

[1] European Environment Agency, "Total greenhouse gas emission trends and projections in Europe," 19 12 2019. [Online]. Available: https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-6/assessment-3. [Accessed 26 12 2019].

years. Emissions regulations are getting tighter, both at the city level and the national level. One of EU 2050 goals is to have transport sector 100% decarbonized, which will be reached with many initiatives and innovations in transport infrastructure and technologies in combination with change of mindset of the society.

Despite the technology not being new or ground-breaking, trolleybuses are seeing a rise across the world. They can carry the same amount of people as buses, but require none or small size batteries to operate with no emissions. For example, Prague is introducing trolleybuses after 47 years the last trolleybus operated there[2]. With trolleybuses it is possible to replace existing, usually diesel powered, buses and investing less than it would be for other types of zero emission vehicles.


*Figure 2. AS Rīgas satiksme, "Trolejbuss." Available: https://www.rigassatiksme.lv/lv/pakalpojumi/transporta-noma/tramvaji-un-trolejbusi/. Accessed: 20 01 2020*

Over two million electric vehicles were sold in 2018, up from just a few thousands in 2010. In 2018 electric vehicle share of global vehicle fleet was around 0.5%, but for buses it was around 17%. Already vast majority of trains are electrified and 50% of new orders for busses are electric. Bloomberg NEF expects that by 2040 in Europe and

[2] S.Alfano, "Trolleybuses return to Pragua 47 years later," 11 11 2019. [Online]. Available: https://www.sustainable-bus.com/trolley-and-tramway/trolleybuses-return-to-prague-47-years-later/. [Accessed 26 12 2019].

China almost 70% of vehicles will be electric (plug-in hybrid, battery electric or hydrogen electric)[3].

By 2050 electric transports are expected to be dominant vehicles because they do not emit GHG emissions and almost do not emit fine particulates at the same time reducing noise in cities. Technological advancement will allow these cars to overcome current challenges they face – expected range and charging infrastructure. Another change in transport sector that will reduce GHG emissions will be shared mobility.

At the moment air and marine transports are in the stage were road transport was a decade ago – first zero emission airplanes and ferries have made their first trips[4][5][6]. In the upcoming two decades it is expected that these vehicles will rapidly shift towards battery electric, hydrogen electric or some hybrid form technologies.

In 2012 there were 77 thousand public charging outlets installed globally. In 2018 there were 190 thousand such charging outlets installed in Europe alone and 632 thousand globally.

## Current situation of cities in Latvia

Riga has trolleybuses since 1947, trams since 1882[7] (electric since 1900), and hydrogen trolleybuses since 2018 (operating since 2020), Liepaja and Daugavpils[8] have

[3] Bloomberg NEF, "Electric vehicle outlook," 2019. [Online]. Available: https://about.bnef.com/electric-vehicle-outlook/. [Accessed 26 12 2019].

[4] B. Cogley, "World's first comercial electric plane takes off near Vancouver," 17 12 2019. [Online]. Available: https://www.dezeen.com/2019/12/17/worlds-first-commercial-electric-plane-canada-seaplane/. [Accessed 26 12 2019].

[5] L. Blain, "Kawasaki launches the world's first liquid hydrogen transport ship," 15 12 2019. [Online]. Available: https://newatlas.com/marine/kawasaki-worlds-first-liquid-hydrogen-transport-ship/. [Accessed 21 12 2019].

[6] F.Lambert, "World's larget all-electric ferry completes its maiden trip," 21 08 2019. [Online]. Available: https://ww.electrek.co/2019/08/21/worlds-largest-electric-ferry/. [Accessed 21 12 2019].

[7] SIA "Rīgas satiskme", "1947. gads – Rīgā uzsākta trolejbusu satiksme," 21. decembris 2019. [Online]. Available: https://www.rigassatiksme.lv/lv/par-mums/vesture/1947-gads-riga-uzsakta-trolejbusu-satiksme. [Accessed 21 12 2019]. SIA "Rīgas Satiksme", "1882. gada 23. augusts – Rīgā atklātas pirmās trīs zirgu tramvaja līnijas," 2019. [Online]. Available: https://www.rigassatiksme.lv/lv/par-mums/vesture/1882-gada-23-augusts-riga-atklatas-pirmas-tris-zirgu-tramvaja-linijas. [Accessed 21 12 2019].

[8] AS "Daugavpils Satiksme", "Tramvaju kustības saraksts," 2019. [Online]. Available: http://satiksme.daugavpils.lv/tramvaju-kustibu-saraksts. [Accessed 21 12 2019].

trams, Rezekne[9] and Jurmala[10] have electric buses, Jekabpils[11] has buses that use CNG (compressed natural gas).

Between cities there is a wide railroad network that operates electric and diesel trains.


*Figure 3. Hydrogen trolleybus at an exhibition in Riga, 2018. Available: https://uzladets.lv/nodota-ekspluatacija-baltija-pirma-udenraza-uzpildes-stacija/. Accessed: 20 01 2020*

livered by 2023. These trains will replace older electric trains and mitigate use of diesel trains for people transportation where infrastructure is appropriate. With the planned first trip of Rail Baltic in 2026, there will be a new railroad system that will allow to travel and transport goods without emissions internationally. It will be possible to travel from Finland, Estonia, Latvia, Lithuania, and Poland to Western Europe using high speed train.

[9] Rēzeknes pilsētas dome, "Elektroautobusi Rēzeknes pilsētā," 2018. [Online]. Available: https://rezekne.lv/istenotie-projekti/elektroautobusi-rezeknes-pilseta/. [Accessed 21 12 2019].

[10] Jūrmalas autobusu satiksme, "Projekta „Videi draudzīga sabiedriskā transporta (autobusu) iegāde" ietvaros ir piegādāti divi "Solaris Urbino 8,9 LE Electric" markas elektroautobusi," 7 8 2019. [Online]. Available: https://www.jurmalassatiksme.lv/lv/2019/08/07/projekta-videi-draudziga-sabiedriska-transporta-autobusu-iegade-ietvaros-ir-piegadati-divi-solaris-urbino-89-le-electric-markas-elektroautobusi/. [Accessed 21 12 2019].

[11] "Jaunie autobusi ir gatavidarbam," 5 3 2019. [Online]. Available: https://www.jekabpilsap.lv/lv/jaunumi/undefined/jaunie-autobusi-ir-gatavi-darbam/. [Accessed 22 12 2019].

Capital city of Latvia, Riga is in awaits of fine from European legislations about air (particularly PM10) pollution. The fine could be tens of millions of euros. The National energy and climate plan for the period from 2021 to 2030 puts emphasis on city of Riga as it is the capital and has the biggest air pollution problems in comparison with other cities of Latvia. For example, in this plan there is a point that states that cities


*Figure 4. 50 kW charging station in Jurmala Available: https://kursors.lv/2019/09/01/elektrum-elektroauto-uzlades-stacijas-izmeginajums/. Accessed: 21 01 2020*

with over 100'000 inhabitants would have to enable zero-emission zones[12]. Currently only one city in Latvia meets the requirement of 100'000 inhabitants – Riga.

By the end of 2019 Riga had 60 km of bicycle lanes built. Out of those 26 km meet the minimum requirements. These 60 km represent 9.3% of the total planned bicycle lanes mentioned in Riga's plans for 2030.[13]In Latvia there are 81 public fast charging (50 kW or more) stations for those vehicles that can use CCS Combo 2, CHAdeMO or Mannekes Type 2. Mainly those are passenger cars and vans. Riga has 8 such charging stations (7 are 50 kW and 1 is 100 kW), Jurmala has 2, and other cities along the main roads have 1 or none.

[12] Ministry of Economics, "NACIONĀLAIS ENERĢĒTIKAS UN KLIMATA PLĀNS," 23 01 2020. [Online]. Available: https://em.gov.lv/lv/nozares_politika/nacionalais_energetikas_un_klimata_plans/. [Accessed 21 12 2019].

[13] Rīgas domes Satiksmes departments, "Rīgas pilsētas velosatiksmes attīstības koncepcija 2015.-2030. gadam," 2015. [Online]. Available: http://www.rdsd.lv/uploads/media/557550c430e1f.pdf. [Accessed 26 12 2019].

Additional support for zero emission vehicles besides the ones from the government of Latvia for e-mobility grants only Riga and Liepaja. Both municipalities have granted free parking within their operated parking spaces.[14]

## Overview and dynamics 2007-2017

In 2007 the world was in the beginning of two crisis. One is known as the global financial crisis while the other as climate crisis.

The financial crisis severely reflected on almost all world's country economics. Especially hard it was for Latvia, which had a GDP decrease of 18% in 2009. The climate crisis is a term now used to describe global warming, climate change, and their consequences. It has replaced both in order to better describe the threat and to urge aggressive governmental policy changes.

Both of these crises reflect on transport sector. Financial crisis once again displayed how fuel prices can rapidly fluctuate influencing almost all businesses and costs. Climate action requires to mitigate greenhouse gas emissions. While the financial crisis dictates the economical aspect, the environmental aspect appeals to ecological side. Having both forces driving the need for an environmentally better and economically cheaper transport has made it a prosperous environment for zero-emission transport. Knowing that electricity is cheaper than fossil fuel and that electric vehicles emit no tailpipe emissions; many vehicle makers began accelerating their electric vehicle programmes. This also allowed for new vehicle makers to enter the market, for example Tesla Inc. and BYD.

According to Latvia's Road Traffic Safety Directorate (Latvian abbreviation - CSDD) in 2007 there were 5 registered electric vehicles on the roads of Latvia. One was part of an exhibition in Motor Museum and two were converted internal combustion cars.

[14] A. Bergs, "ELEKTROMOBIĻIEM BEZMAKSAS STĀVVIETAS RĪGĀ – VAI AR TO PIETIKS?," 20 7 2016. [Online]. Available: http://www.e-transports.org/index.php/jaunumi/152-elektromobiliem-bezmaksas-stavvietas-riga-vai-ar-to-pietiks. [Accessed 21 12 2019].

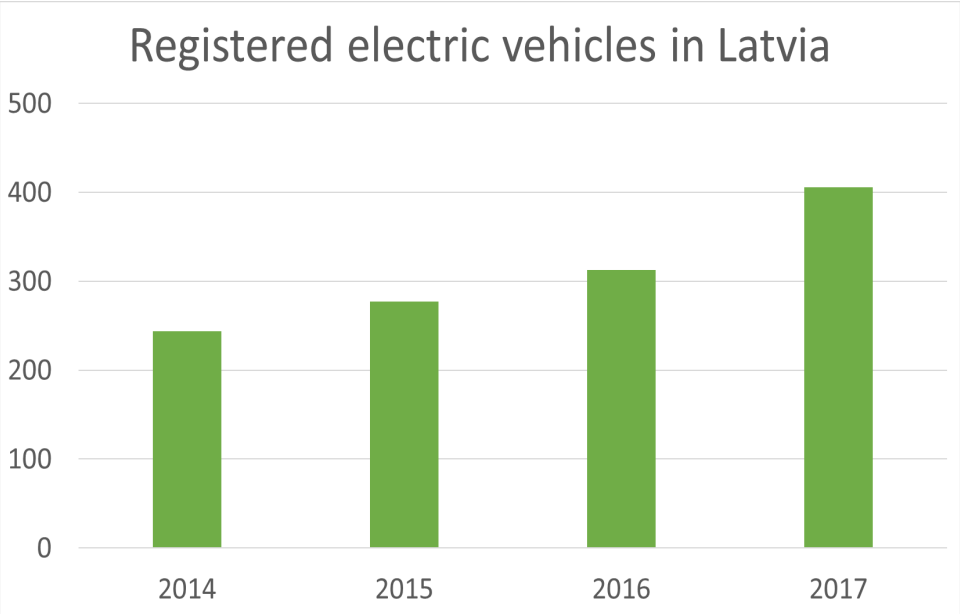


*Figure 5. Registered electric vehicles in Latvia from 2014 till 2017. Data available: http://etransports.lv/index.php/arhivs/elektrotransportlidzekli. Accessed: 21 01 2020*

In 2014 Latvia used some of the resources available through emission trading system in EU to support GHG emission reduction by subsidising electric cars and charging infrastructure. The amount of subsidy could reach 85% for governmental instances and 55% for non-governmental enterprises, but no subsidy was given for private personas. Using this instrument 174 electric cars were bought and 13 charging stations were built. The most popular electric vehicle bought was Volkswagen e-up! Which was the cheapest new electric vehicle at the time. Till the beginning of 2020 this electric vehicle is still the most popular electric car in Latvia with 141 registered units.

In 2014 CSDD was assigned to report on electrical vehicle registrations in Latvia. At the beginning of 2015 there were 244 registered electric vehicles in Latvia. 188 were cars, 25 – mopeds, 25 – quadricycles, 6 – light duty commercial vehicles. The most popular vehicle maker was Volkswagen (135 registrations), followed by Nissan (25), Melex (23) and BMW (12).

In 2017 130 cars from new passenger cars in Latvia were classified as "alternative energy" by their engine fuel (mostly LPG) making 0.7% of that year's total.[15] There were 406 electric vehicles registered in Latvia (+93 registrations (39 new vehicles) comparing to 2016) in total, from which 312 were cars (+71).

[15] Eurostat, "Passenger cars in the EU," European Union, Brussels, 2019.

Ogre and Riga at a certain point in the past years have discussed the idea to have a zone that would require an entrance fee for motorised vehicles. In these zones electric vehicles would not be required to pay entrance fee.

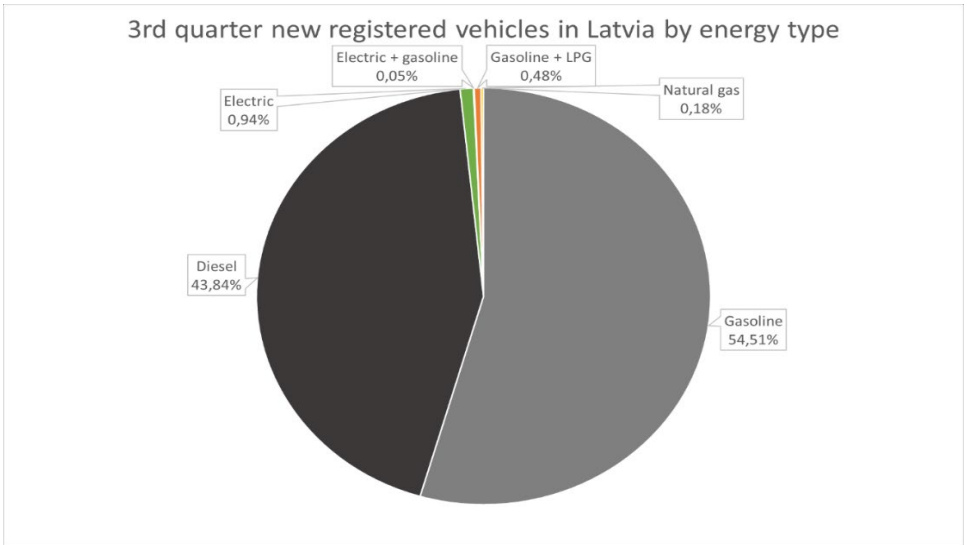


*Figure 2. Registered new vehicles in 3rd quarter of 2019 in Latvia by energy type. Data available: http://etransports.lv/index.php/arhivs/elektrotransportlidzekli. Accessed: 21 01 2020*

## Challenges and barriers 2020

### Old car park

In Latvia transport is responsible for 30.1% of total energy consumption and 78 % from total fossil fuel product consumption. More than 92% of Latvia's transport is powered by fossil fuel (gasoline and diesel) while the rest is mainly LPG.

Latvia's car park is forth oldest and second biggest by engine cubic capacity in Europe. The average vehicle age is 12.6 years and cars that use diesel as their energy source are generally older than gasoline powered ones.

Diesel is the most common energy type (72.2%) while gasoline is the second (17.3%) and LPG is third (5.2%). One of the reasons why diesel is more popular than gasoline is government's tax politics, which favours diesel more than other common energy sources.

### Insignificant renewable and electrical energy consumption in transport sector

In 2018 only 3.06% of all energy consumed in transport sector was from renewable resources. Out of those ¾ were bio-fuel (bio-ethanol and bio-diesel), while

the rest came was electricity. The amount of renewable energy in transport sector is not decreasing, but the proportions relating other energy types has been shrinking over the years.

At the moment there is only first generation bio-fuel being produced in Latvia. Knowing that second generation bio-fuel is significantly more expensive than first generation, it is safe to assume that the local regulations relating mandatory renewable energy mix in fuels is fulfilled by first generation bio-fuel. That will change coming new regulations that would require use of modern bio-fuel types.

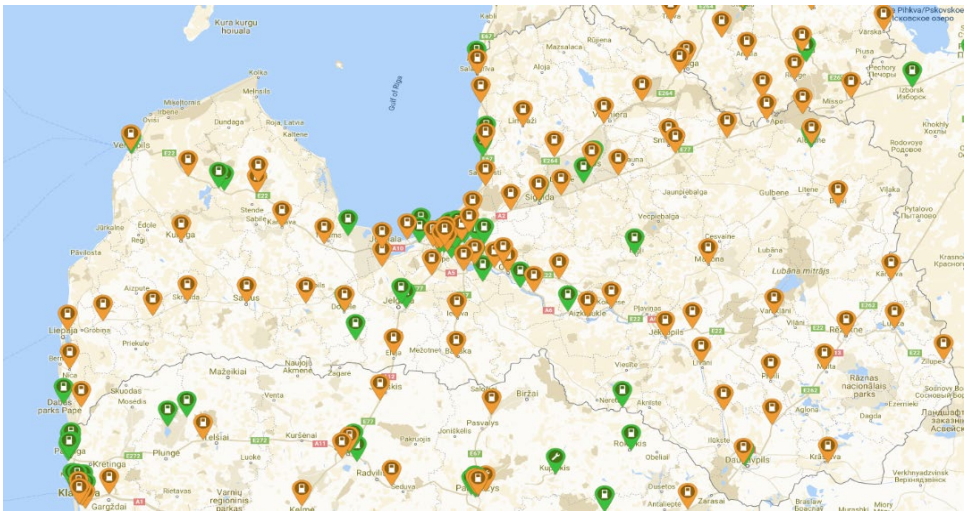

*Figure 7. Public fast charging stations in Latvia. Available: https://www.plugshare.com/ . Accessed: 28 01 2020*

In 2018 CSDD declared that additional 70 fast charging (50 kW) stations were added to the national fast charging network. By the end of 2019 there were 81 fast charging stations (including non-governmental) across Latvia. The main intercity and international roads have at least one such station every 40 km and biggest cities have at least one such station. The government's plan is to open 69 fast charging stations by the end of 2022.

Starting year 2020 there were 948 electric vehicles registered in Latvia. 658 of them were cars, 229 mopeds, 30 quadricycles, 14 commercial vehicles, 9 motorcycles, and 8 buses.

### Especially high amount of privately owned vehicles and shrinking use of public transport

In 2019 there were 820 thousand registered vehicles in Latvia. 78.6% of them were passenger cars. In 2019 there were 860 thousand valid motorised vehicle driving licenses. It can be concluded that almost every person that has a driving license has a motorised vehicle. The car occupancy in Latvia is 1.9 persons.[16] There are 350 cars per 1'000 persons and the number keeps rising especially in Riga and near it. This leads to bigger congestions, which leads to more time needed to make the commute and having a negative impact on local air quality and climate.

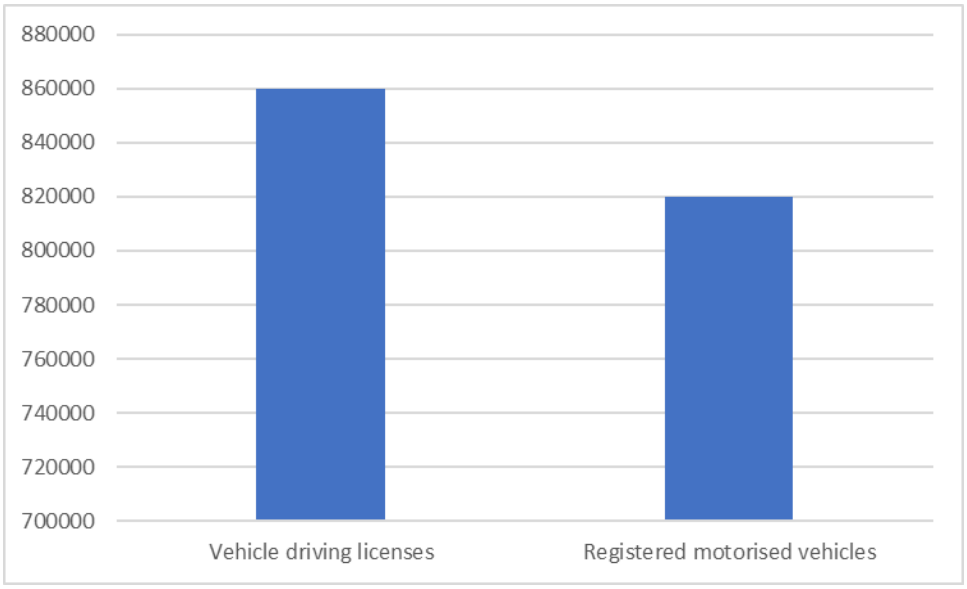


*Figure 8. Vehicle driving license and registered motorised vehicle in Latvia in 2019. Data available: http://etransports.lv/index.php/arhivs/elektrotransportlidzekli. Accessed: 21 01 2020*

During the time period between 2014 and 2018 the number of passengers that use public transport has decreased. Trolleybuses have seen 12.1 % decrease of passengers, trams – 6.2%, busses – 4%, and trains – 5.2%. In 2018 busses and trains saw an increase of passengers in comparison to 2017. Knowing that the number of passengers that use public transport has decreased and that the energy used in private transportation sector

[16] Central Statistical Bureau of Latvia, "Population of Latvia on average walk 2.7 kilometres daily," 14 11 2018. [Online]. Available: https://www.csb.gov.lv/en/statistics/statistics-by-theme/transport-tourism/transport/search-in-theme/2488-latvijas-iedzivotaju-mobilitate-2017. [Accessed 21 12 2019].

has increased, it can be concluded that people choose private transport over public. Another aspect for the change is that more people tend to live near Riga instead of in the city and the public transport system is not integrated to cope with increased demand from nearby regions.

The water public transport system that links Riga's districts or nearby cities is almost non-existing and is focused on tourism instead of convenience and speed.

In last years in Riga there have not been major improvements for bicycle infrastructure for people to use bicycle as a safe and convenient transport. Also, there have been almost no improvements for pedestrian infrastructure, prioritizing motorized vehicles when performing road improvements. Not having an adequate pedestrian and bicycle infrastructure (especially in centre) and lacking public transport has led to people using private motorised vehicles even when the daily commute is relatively small. In comparison, Jelgava's park and ride system next to train stations have seen a


*Figure 9. Bicycle stands in Jelgava train station during winter. Available: https://www.pilsetacilvekiem.lv/vilciens-velo-speks/. Accessed: 28 01 2020*

major liking from public.

Introducing *park and ride* systems that are well integrated with public transport systems, such as trains and trams, can greatly reduce the need of private motorised transports and improve public usage of public transports. In places were such system is in place bicycle stand usage exceeds expectations even in harsh weather conditions.

## New vehicle emission legislations

As of 2020 the carmakers are obliged by new legislation that restricts average tailpipe emissions across all sold cars. From this year onward the average tailpipe emission of sold new passenger cars cannot exceed 95 $CO_2$ g/km and 147 $CO_2$ g/km for vans in states of European Union[17]. More harsh restrictions will be in place in years 2025 and 2030. The newest Volkswagen Golf emits 102-120 $CO_2$ g/km and Nissan Pulsar emits 117-119 $CO_2$ g/km. This means that the dealers will be pressured by carmakers around the continent to sell the least emitting cars the most.

One electric car can allow Volkswagen dealers to sell 4 – 5 non-electric Golf variants and Nissan dealers 5 non-electric Pulsar variants without worrying about the potential backslash effect. When comparing to bigger cars, i.e., Volkswagen Multivan (210-257 $CO_2$ g/km) or Nissan Navara (182-194 $CO_2$ g/km), the difference puts a high pressure on dealers to emphasize electric variants as first choice.

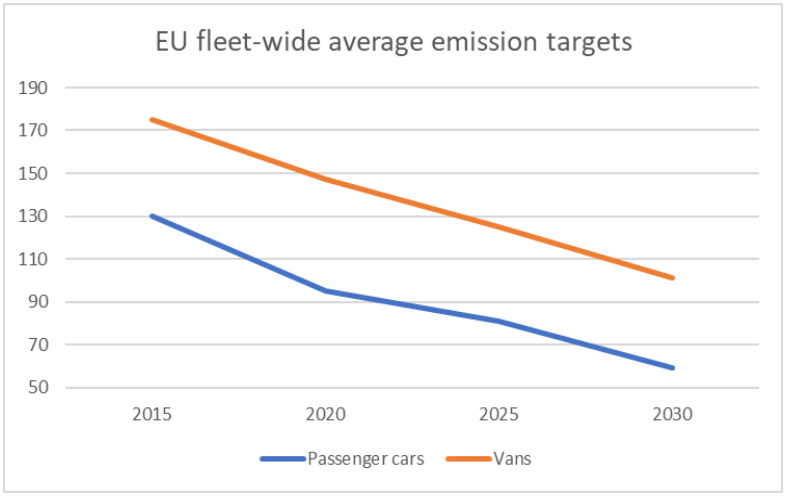


*Figure 10. EU fleet-wide average emission targets 2015-2030. Data available: https://ec.europa.eu/clima/policies/transport/vehicles/cars_en. Accessed 26 12 2019.*

For the award of the Latvia's car of the year 2020 competed 35 cars. The average $CO_2$ emissions for those was 129 g/km. Out of those only 5 complied with the new legislation, one of them being electric and two were mild hybrids.

[17] European Commission, "Reducing CO2 emissions from passenger cars," 2019. [Online]. Available: https://ec.europa.eu/clima/policies/transport/vehicles/cars_en. [Accessed 26 12 2019].

# 2. INITIATIVES AND POLICIES

The spread of electric vehicles is not large in Latvia. That could be explained by the lack of alternative fuels regulations and aid, thus not promoting their wider use. In various times the politicians have said that a support of some sort is in the works, hence delaying the wider publics decision to switch in order to get the most benefits.

## Overview of ongoing national and local long-term strategies

### The National Energy and Climate Plan

The National Energy and Climate Plan for 2021-2030 (NECP 2030) will be a key document for formulating long-term energy and climate policies of Latvia. The plan's main objective is to facilitate the development of a climate-neutral economy in a sustainable, competitive and secure manner.

In section dedicated to transport sector of this Plan it is stated that transport sector is responsible for 28.5% of all greenhouse gas emissions in Latvia. By 2030 it is desired to have an increase in public transport usage and higher alternative fuel (especially non-emission) usage, while increasing renewable energy source usage in this sector. However, Plan states that higher investment will be available for lower emission than non-emission solutions.

### Latvia’s strategy to reach climate neutrality by 2050

Ministry of Environment Protection and Regional Development has submitted a Latvia’s strategy to reach climate neutrality by 2050 to the government of Latvia. This Strategy is Latvia’s first document aimed to reach climate neutrality by 2050. In this strategy NECP 2030 is a stepping stone.

Strategy predicts that by 2050 transport sector is mostly electrified un charging infrastructure is developed to such level that it is comfortable to use for everyone. The private sector is to be without fossil fuels. Electric vehicles being dominant type of vehicles with the help of “polluter pays” principle and other incentives promoting no emission vehicles.

Unlike other plans and strategies, Strategy has an emphasis on air and marine transport next to road transport. Strategy states that air travel will use renewable type

of fuels and electricity as energy sources, while marine transport needs port electrification to succeed.[18]

### Development plans 2020 and related strategies

One of the priorities in Riga planning region development documents "RPR Sustainable Development Strategy for 2014-2030" and "RPR Development Programme for 2014-2020" is the development of internal transport of towns and their connections in relation to the development of electric transport and use of alternative fuel types (biodiesel, hydrogen, ethanol, liquefied natural gas, etc.) in the transport sector. However, no strategic documents have been developed in other local governments for promoting deployment of alternative fuels, except the local government of Limbaži municipality. Development of electric transport in these documents is limited to trains, placing emphasis on Rail Baltica project.

### The National Development Plan

The National Development Plan 2014–2020 (NDP2020) is hierarchically the highest national-level medium-term planning document in Latvia. NDP2020 is closely related to the Sustainable Development Strategy of Latvia until 2030 (Latvia2030) and the National Reform Programme for the Implementation of the EU2020 Strategy (NRP). As such the NDP2020 does not mention any concrete initiatives and policies, but serves as a guideline for the development of the nation.[19]

### The Sustainable Development Strategy of Latvia

In the Sustainable Development Strategy of Latvia until 2030 section Renewable and Safe Energy it is stated that energy consumption in the transport field forms approximately one third of the consumption of primary energy resources of Latvia and is almost completely based on the import of petroleum products because the proportion of electricity and biofuel in the final energy consumption of transport is comparatively

[18] Ministry of Environment Protection and Region Development of the Republic of Latvia, "Latvijas stratēģija klimatneitralitātes sasniegšanai līdz 2050. gadam," 28 01 2020. [Online]. Available: http://www.varam.gov.lv/lat/likumdosana/normativo_aktu_projekti/klimata_parmainu_joma/?doc=26231. [Accessed 30 01 2020].

[19] Saeima of the Republic of Latvia, "Par NAP2020," 20 12 2012. [Online]. Available: https://www.pkc.gov.lv/lv/valsts-attistibas-planosana/nacionalais-attistibas-plans. [Accessed 30 01 2020].

small. A challenge in the transport field is wider use of electric drive both in public transport and in private road transport.

The Strategy states that the use of environmentally friendly vehicles should be promoted, particularly in the centres of large cities and agglomerations. Gradual servicing of public transport vehicles with local RER fuel types should be organised, as well as the use of fuel-saving vehicles should be supported at household level.[20]

### On Alternative Fuels Development Plan

On Alternative Fuels Development Plan 2017-2020[21] has been developed in order to reduce the negative impact of transport on the environment, and also in order to transpose the requirements of Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels, and also to carry out the task specified in Paragraph 7.2 of Cabinet Meeting No. 45 52.§ TA -1907-IP of 13 September (restricted access information).

The plan conforms to the objectives and tasks for the reduction of negative environmental impact and promotion of sustainable development laid down in the NDP2020, the Sustainable Development Strategy of Latvia until 2030, the Environmental Policy Guidelines 2014-2020, the Energy Development Guidelines for 2016-2020, and also in the Transport Development Guidelines for 2014-2020, and also it conforms to the objectives laid down in the White Paper of European Transport Policy - Roadmap to a Single European Transport Area - Towards a Competitive and Resource Efficient Transport System. This plan does not lay comprehensive strategy for the development of compressed natural gas, liquefied natural gas, and hydrogen as types of alternative fuels.

The plan applies to road transport, air and maritime transport with a view to reduce the greenhouse gas (hereinafter - the GHG) emissions in these sectors. The main attention of the Plan is paid to the types of alternative fuels the deployment of which or assessment of necessity for the deployment of which in certain transport sectors is determined as mandatory measures for the Member States in accordance with Directive

[20] Saeima of the Republic of Latvia, "Sustainable Development Strategy of Latvia until 2030," Saeima of the Republic of Latvia, Riga, 2010.

[21] Latvia's Cabinet of Ministers, "On Alternative Fuels Development Plan 2017-2020," Latvia's Cabinet of Ministers, Riga, 2017.

2014/94/EU, namely, electricity for road transport, maritime transport and aviation, compressed natural gas (CNG) for road transport, liquefied natural gas (LNG) for road transport and maritime transport, and also to the measures for promoting the use of such vehicles. Concurrently Directive 2014/94/EU provides for the requirements for promoting the development of hydrogen as fuel in cases when the Member States select to deploy also this type of fuel.

### On the Energy Development Guidelines

Latvia together with other EU countries by Directive 2009/28/EC[22] had a target to meet regarding renewable energy resource usage in 2020 out of total consumption and transport sector had a separate target. The transport sector target for Latvia was set for 10% renewable energy set by On the Energy Development Guidelines for 2016-2020[23]. These Guidelines set another target to reduce the GHG emissions per one unit of fuel or energy supplied until 2020 by 6%.

On 22 October 2014 the EC presented a new Directive 2014/94/EU on the deployment of alternative fuels infrastructure. This Directive establishes a common framework of measures for the deployment of alternative fuels infrastructure in the EU in order to minimise the dependence on oil and to mitigate the environmental impact of transport. This Directive also sets out minimum requirements for the construction of alternative fuels infrastructure, including recharging points for electric vehicles and refuelling points for natural gas (LNG and CNG) and hydrogen, to be implemented by means of Member States' national policy frameworks, as well as common technical specifications for such recharging and refuelling points, and consumer information requirements.

## Finished and ongoing projects within Green mobility framework

### Electromobility Development Plan 2014-2016

Electromobility Development Plan for 2014-2016 has been developed in order to provide an easy-to-use public recharging infrastructure for electric vehicles, it should

[22] The European Parliament and the Council of the European Union, "DIRECTIVE 2009/28/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL," European Union, Brussels, 2009.

[23] Cabinet of Ministers, "On the Energy Development Guidelines for 2016-2020," Cabinet of Ministers, Riga, 2016.

consist of fast and medium fast recharging stations that would be equipped with car identification, smart electricity metering and centralised data accumulation infrastructure for optimal organisation of payments for the charging service. Considering the foreseeable number of electrical vehicles to be registered in the State. In accordance with the Plan approximately 235 such recharging stations should have been established by 2020.[24]

In 2016 Central Finance and Contracting Agency of the Republic of Latvia and European Regional Development Fund came to financing agreement for "Electric Transport Charging Infrastructure Creation". The initial target for 235 various power alternating and/or direct current charging stations by 2020 is changed to have 139 fast direct current charging by 2022 with optional 11 more if all terms are met and both parties agree on them. In July of 2018 Road Traffic Safety Directorate fulfilled the first of three phases opening 70 fast charging (50 kW) stations near main roads (TEN-T) of Latvia and in biggest cities.[25]

### Reduction of Greenhouse Gas Emissions in Transport Sector, Aid for EV and Deployment of Their Infrastructure

In 2014 there was an open tender of project applications "Reduction of Greenhouse Gas Emissions in Transport Sector, Aid for EV and Deployment of Their Infrastructure" of the Climate Change Financial Instrument (CCFI). Using available aid from this tender offer 174 electric cars were bought (mostly Volkswagen e-up!) and 12 charging stations were installed - seven in Riga and one in Sigulda, Ogre, Gulbene, Tērvete, and Talsi Municipality. Establishment of the EV charging infrastructure is one of the most important tasks to be performed in order for the development of electromobility to be possible.[26]

[24] Centrālā finanšu un līgumu aģentūra, "Noslēgta vienošanās par ES fondu projekta "Elektrotransportlīdzekļu uzlādes infrastruktūras izveidošana" īstenošanu," 08 04 2016. [Online]. Available: https://www.cfla.gov.lv/lv/jaunumi/2016/noslegta-vienosanas-par-es-fondu-projekta-elektrotransportlidzeklu-uzlades-infrastrukturas-izveidosana-istenosanu. [Accessed 29 01 2020].

[25] VAS CSDD, "DARBU UZSĀK ELEKTROMOBIĻU ĀTRĀS UZLĀDES STACIJU TĪKLS," 05 07 2018. [Online]. Available: http://www.e-transports.org/index.php/jaunumi/205-darbu-uzsak-elektromobilu-atras-uzlades-staciju-tikls. [Accessed 29 01 2020].

[26] Vides aizsardzības un reģionālās attīstības ministrija, "Klimata pārmaiņu finanšu instrumenta finansēto projektu atklāts konkurss "Siltumnīcefekta gāzu emisijas samazināšana transporta sektorā - atbalsts elektromobiļu un to uzlādes infrastruktūras ieviešanai"," 2014. [Online]. Available: http://www.varam.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=17817. [Accessed 29 01 2020].

### Developing environmentally friendly public transport infrastructure

The aim of the measure is to promote the use of environmentally friendly public transport and to increase the number of passengers in environmentally friendly public transport. Multiple municipalities applied for the available funds.

In 2018 city of Rēzekne public transport fleet was supplemented with four M3 category battery electric buses. Rēzekne became the first city in Baltic states (Estonia, Latvia, Lithuania) to have fully electric buses operating as public transport.[27]

Jelgava's municipality is in midst of a project that would deliver four battery electric busses to their public transport fleet. Together with the vehicles three charging stations will be added. The project is set to be finalized by 31st of March in 2020. The estimated benefits are reduced $CO_2$ emission by 182 tonnes annually, reduced energy needed by 492 MWh annually, and increased number of people that drive with environmentally friendly transport by 20%.[28]

Jūrmala's municipality amongst other buses received two battery electric buses.[29] Ventspils' municipality has prolonged it's procurement process till 2020 and is seeking for small battery electric buses and large hybrid buses.[30]

[27] Rēzeknes pilsētas dome, "Elektroautobusi Rēzeknes pilsētā," 2018. [Online]. Available: https://rezekne.lv/istenotie-projekti/elektroautobusi-rezeknes-pilseta/. [Accessed 29 01 2020].

[28] Jelgavas pilsētas Dome, "Videi draudzīgas sabiedriskā transporta infrastruktūras attīstība Jelgavā," Jelgavas pilsētas Dome, Jelgava, 2018.

[29] Jūrmalas pilsētas dome, "Projekti - Darbības programmas "Izaugsme un nodarbinātība" 4.5.1. specifiskā atbalsta mērķa „Attīstīt videi draudzīgu sabiedriskā transporta infrastruktūru" projekts "Videi draudzīga sabiedriskā transporta (autobusu) iegāde"," 2019. [Online]. Available: https://www.jurmala.lv/lv/attistiba/attistibas_projekti/2019_gads_/1695-darbibas-programmas-izaugsme-un-nodarbinatiba451-specifiska-atbalsta-merka-attistit-videi-draudzigu-sabiedriskatransporta-infrastrukturu-projektsvidei-draudziga-sabiedriska-transporta. [Accessed 29 01 2020].

[30] SIA "Ventspils reiss", "ATTĪSTĪT VIDEI DRAUDZĪGU SABIEDRISKĀ TRANSPORTA INFRASTRUKTŪRU VENTSPILĪ (EBUSS)," 07 2019. [Online]. Available: https://www.ventspilsreiss.lv/lv/uznemums/projekti/attistit-videi-draudzigu-sabiedriska-transporta-infrastrukturu-ventspili-ebuss. [Accessed 29 01 2020].

# 3. COOPERATION ISSUES ON CLIMATE AND ENVIRONMENTALLY FRIENDLY TRANSPORT

## Stakeholder overview and mapping

The climate crisis is an issue that spams over a lot of competencies – transport, education, health, building, farming, energy, etc. Therefore, countries and municipalities face a dilemma – which department should take the lead. The typical choice is to lay it on the local environmental department. In case of Latvia it would be **Vides aizsardzības un reģionālās attīstības ministrija** (**VARAM**, Ministry of Environmental Protection and Regional Development). In case of Riga it would be **Rīgas Domes Mājokļu un Vides departaments** (Riga City Council Housing and Environment Department).

VARAM in 2005 created **Valsts vides dienests** (**VVD**, State environmental service). The objective of the VVD is to ensure that environmental, radiation and nuclear safety and the use of natural resources are complied with, and to promote the sustainable use of natural resources and energy.


*Figure 11. VARAM, "Planning regions of Latvia," VARAM, Riga, 2006. Available: https://www.varam.gov.lv/lv/planosanas-regioni. Accessed: 28 01 2020*

Co-existing to these two major stakeholders are many more that influence both climate and environmentally friendly transport policies. As one of the most influential would be the five **planning regions** of Latvia – Riga's, Vidzeme's, Latgale's, Kurzeme's, and Zemgale's planning regions. Their competence is to ensure regional development planning, co-ordination, co-operation between local governments and other public administration institutions.

Since 2007 there is non-profit Riga's municipality's agency "**Rīgas enerģētikas aģentūra**" (**REA**, "Riga energy agency"), which was created in order to coordinate and manage energy supply and energy efficiency throughout Riga municipality.

Similar agency has been created by Zemgale's region municipalities Jelgava, Jēkabpils, Auce, Ozolnieki, and Bauska. Together they have formulated "**Zemgales reģiona enerģētikas aģentūra**" (**ZREA**, "Zemgale's regional energy agency"). ZREA main goal is to promote energy efficiency and renewable energy use in the public and private sectors, and ensure access to information on these issues for citizens.

The purpose of the **Pasaules Dabas Fonds** (**PDF**, World Wildlife Fund) in Latvia and globally is to protect nature, to preserve genetic, species and ecosystem diversity, to ensure the current and future use of renewable natural resources, to help reduce pollution and wasteful use of natural resources and energy.

**Baltijas Vides Forums** (**BEF**, Baltic Environmental Forum) was created in 1995 as a cooperation between Latvia, Estonia, Lithuania, Germany, and European Comission. Its purpose was to strengthen cooperation and information between the authorities of the Baltic States in the field of environmental protection. In 2004 technical assistance projects were completed by Baltic State accession to the European Union. In 2003, BEF employees established non-governmental organizations (NGOs) in Latvia, Estonia, Lithuania and Germany in order to preserve the various expert networks that have already been established and to implement new projects in the Baltic region.

**Zaļā Brīvība** (Green Liberty) is a non-profit NGO founded in 1993. Green Liberty's mission is to contribute to the development of a society where people live in harmony with each other and the environment. Green Liberty aims at raising awareness about social and environmental implications of current trends in consumerism, trade

and globalization, empowering people to make meaningful decisions connected with their lives directly and indirectly and opposing abuses of power.

Green Liberty participates in several international networks: CEE Bankwatch Network, Climate Action Network Europe (CAN), European ECO Forum, European Environmental Bureau (EEB), Reloop, and national networks: Association 'Social Entrepreneurship Association of Latvia', Environmental Consultative board, and Latvian Platform for Development Cooperation (LAPAS). As such it is one of the most influential NGO's in Latvia.

To promote and support environmentally friendly transport there are many different stakeholders. The highest in the hierarchy would be **Satiksmes Ministrija** (Ministry of Transport) and its subsidiary **CSDD** (Road Traffic Safety Directorate). As is, both do not have their main goal to promote environmentally friendly or friendlier transport, but they both have the jurisdictional power to influence taxes and societies opinion. However, Ministry of Transport, CSDD and VARAM are limited in their actions by **Ekonomikas Ministrija** (Ministry of Economics), which is responsible for all major economical activities, including subsidies and taxes.

Since 2014 **CSDD** has a special department dedicated to promote zero-emission vehicles and manage government's fast charging infrastructure for electric vehicles, which is planned to have 139 fast charging stations by 2022.

As of new regulation across European Union regarding car emissions from 2020, **car dealerships** and **associations** are starting to act as promoters. That is a logical consequence, because their main business depends on cars being sold and repaired, but if their cars sold hurt their supplier, they get a conflict situation. New emission regulations influence logistics companies too.

Influenced by the EU emission regulations and higher taxes are **fuel** (gasoline, diesel, gas) **dealers**. As a mitigation they are promoting compressed natural gas (CNG). Using associations and other means they are influencing governments across the world to slow down the changes, while they adopt. Lately EU and its leaders have made it clear that fossil fuel is going to be phased out by 2050.[31]

[31] European Union, "The European Green Deal," 12 12 2019. [Online]. Available: https://ec.europa.eu/eip/agriculture/en/news/european-green-deal. [Accessed 24 02 2020].

On the other hand, electrical energy suppliers see these changes as an opportunity. Biggest electrical and heat energy supplier of Latvia – **Latvenergo** – is actively promoting environmentally better solutions, such as, washing machines, induction heaters, and electric cars. They organize multiple events and are not afraid to counter fossil fuel representatives.

Company **Zaļā josta** (Green belt) was founded in 2002 when first contracts with managers of used packaging were concluded. Today they are among the market leaders with a many collaboration partners from both waste managers and local governments. The goal of Green belt is to form a society in which entrepreneurs take responsibility and care for collection and recycling of used packaging, environmentally harmful products and electrical appliances used or generated by them as well as to educate and motivate members of this society to sort their waste and to dispose of them in designated places and to have a caring attitude towards natural resources in general.

Association **Pilsēta cilvēkiem** (City for People) was formed in 2016 with the aim of promoting good urban environment in Riga and other Latvian cities. They support safe, fast and easy way to get from point A to point B, no matter with which kind of means of transportation one travels - on foot, bike, public transit, or car. Their main targets are:

- A people-oriented, high-quality public outdoor space where everyone can have a safe and enjoyable stay
- Convenient and secure mobility opportunities within and outside the city for everyone, regardless of age and health
- Protecting the environment, promoting the health of the population. 0 fatalities and serious injuries in road accidents in Riga and abroad

Currently there are three main active zero emission transport promoting NGOs in Latvia – **BIMAB**, **BSR electric**, and **Uzlādēts.lv**. BIMAB (Zero emission mobility support society) main goal is to promote sustainable, zero emission mobility that contributes to society. BSR electric (Baltic Sea Region electric) aims to enhance the utilisation of e-mobility in urban transport systems by exploring un-seized potentials and demonstrating applications of various types of urban e-mobility such as electric city logistics, e-bikes, e-buses, e-scooters and e-ferries. Uzlādēts.lv is a news blog about electric vehicles and renewable technologies in order to promote them in society.

Education is a great resource to promote environmentally friendly and zero emission transport. **Rīgas Tehniskā Universitāte** (**RTU**, Riga Technical University), **Latvijas Universitāte** (**LU**, University of Latvia), **Latvijas Lauksaimniecības Universitāte** (**LLU**, Latvia University of Life Science and Technologies), and **Latvijas Zinātņu Akadēmija** (**LZA**, Latvian Academy of Sciences) are the main educational resources and engagement platforms used to perform projects related to environment.

### Stakeholder engagement platforms and initiatives

As public servant institutions all ministries are open to citizen initiatives and serve as platform to fulfil them. For all of them there is a sub-institution to address the initiative. Private individual initiatives most often have less influential status and less likelihood being accepted. Therefore, there are many associations that have higher influence and can address issues more rapidly.

**Vides konsultatīvā padome** (Environmental advisory council) is a consultative coordinating body whose objective is to promote public participation in the development and implementation of environmental policy. It was created in 2005 and its main function are to promote the preparation of legislation and policy planning documents on issues affecting environmental policy and to promote cooperation and exchange of information in the field of environment between individuals and society as a whole, as well as state institutions and local governments.

Councils main tasks are to, in accordance with the public interest, submit proposals to the VARAM and other ministries regarding draft regulatory enactments and draft policy planning documents, as well as draft international legal acts of the European Union affecting environmental policy and informing the public about environmental issues. integration of sectoral issues.

In 2019 the Council did send and receive 14 different statements. One of them was about salt usage in cities, which was sent to 8 municipalities and Latvian Association of Local and Regional Governments.

**Nacionālā enerģētikas un klimata padome** (National energy and climate council) was created in 2019 in order to encourage coordinated proposals for national long-term energy and climate policy objectives and measures for 2030. Council's members are prime minister, ministers of 8 ministries, and multiple other stakeholders

from all influenced fields. The first official meeting was held in 15th of January in 2020 and the order of business was to discuss the prepared National energy and climate plan for 2030.

Besides its main task Council will:

- Promote the development of a national energy and climate policy and legal framework that promotes the diversification, self-sufficiency and efficient use of resources in Latvia, as well as significantly reducing resource consumption, particularly unsustainable and fossil fuels, and transition to sustainable and renewable energy use
- Promote, in a coordinated way, the development of research and innovation, including the definition of priority research and innovation needs that contribute to the development of a sustainable energy, transport, construction, industry, agriculture, forestry and waste management and climate-neutral economy in a cost-effective and competitive manner
- Promote priorities and directions for the use of funding for energy and climate policy, as well as sources of policy funding, and to leverage private investment to implement the necessary measures

In 2019 **municipality of Cēsis** in collaboration with Green Liberty and The Coca-Cola Foundation announced that it will be the first city in Latvia to be zero-waste in a project called **"Tīri. Labi."** (Clean.Good.). The aim of the project is to promote waste-free lifestyle and educate the citizens and entrepreneurs of Cēsis on its basic principles in order to promote more responsible consumption and reduce the amount of waste generated.

**Zemkopības ministrija** (Ministry of Agriculture) has multiple services that serve in order to defend environment, e.g., State Forest Service, Rural Support Service, and State Plants Service. One of the most recent and most notable achievements from the ministry is Interinstitutional Working Party on Plant Health and Plant Protection Products, which main task is to ensure the evaluation of the current draft European Union documents and the development of the opinion (positions, instructions) and proposals in accordance with the interests of Latvia, to improve the national regulatory framework of Latvia.

In 2018 the **Latvian Council of Science** (subsidiary of Ministry of Economics) announced four open calls for proposals for the national research program "Energy":

- Analytical framework for national long-term energy policy planning
- Energy efficiency
- Sustainable energy infrastructure and market
- Renewable and Indigenous Energy

**CSDD** is assigned to perform the functions of an electromobility management and coordination institution, which includes a number of activities, incl. establishing, monitoring and managing a national network of electric charging stations, informing the public about electromobility news, organizing various events, etc. It's main communication platform on this topic is website e-transports.org, where news about electric vehicles, statistics about registered zero-emission vehicles, and updates regarding national fast charging network are posted on regular basis.

| | 2020 | 2025 | 2030 | 2050 |
|---|---|---|---|---|
| **Bioethanol** | 0 | 0 | 0 | 0 |
| **CNG+Bio** | 8274 | 23649 | 48063 | 170458 |
| **Diesel+Bio** | 408179 | 419578 | 357150 | 50619 |
| **Diesel+Bio+Electric** | 14982 | 43126 | 103380 | 363596 |
| **Electric** | 960 | 2771 | 6535 | 28311 |
| **Gasoline+Bio** | 258375 | 212567 | 143321 | 105481 |
| **Gasoline+Bio+Electric** | 5914 | 7136 | 15302 | 59378 |
| **H2** | 0 | 0 | 0 | 0 |
| **LNG** | 1552 | 793 | 1868 | 3193 |
| **LPG** | 53923 | 73291 | 127264 | 56165 |

*Figure 12. Predicted optimal scenario car amount by energy type. Available: http://www.sam.gov.lv/images/modules/items/PDF/item_7852_PwC_SM_Gala_Zinojums.pdf. Accessed 26 02 2020*

## Interaction with academic platforms and initiatives

In 2018 a research[32] was ordered by the Ministry of Transport. The research is based on Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure scenarios, aimed at identifying the most efficient alternative fuel implementation scenario for Latvian economy. The research reviewed infrastructure implementation scenarios in road transport sector taking into account the fuels – electricity, liquefied natural gas (LNG), compressed natural gas (CNG), hydrogen, and biofuels. It was conducted in a collaboration by various academic structures from **RTU, LLU, Institute of Physical Energy** and other.

**RTU** applied for one of the calls of Latvian Council of Science in 2018 with the purpose to in-depth assess the potential for the production and use of biomethane and the development of policy recommendations to promote it. The physical outcome of the project were improvements to a car that drives on biomethane produced from garbage, which was converted in 2016.

Till 2020 RTU has a major interdisciplinary project called "Development of technologies for biomethane production". Project's main tasks are:

1. Study of commercially available CO2 adsorbents and characterization of required properties
2. Development of the most effective adsorbent structuring methods
3. Investigation of the properties of the most effective structured adsorbents during the biogas enrichment process

In 2019, the Latvian Academy of Sciences has designated the new DC power supply system developed by scientists of RTU Faculty of Power and Electrical Engineering as the most significant scientific achievement in applied science. This system is a solution, which has inspired new electro-mobility research projects to find a way for electric cars to serve not only as vehicles but also as energy storage «stations» for times when it is expensive on the market or inaccessible.

[32] Ministry of Transport, "Pētījums par Eiropas," 2018. [Online]. Available: http://www.sam.gov.lv/images/modules/items/PDF/item_7852_PwC_SM_Gala_Zinojums.pdf. [Accessed 26 02 2020].

On August 8, 2016, scientists of the **LLU** Faculty of Engineering Motorcycle Institute have registered the reconstruction of the Renault Clio internal combustion engine for electric vehicle in Jelgava CSDD department. The electric vehicle is intended for the training of students in various study courses and for scientific research.

## Private sector activities

Multiple private financial institutions, i.e., **banks,** offer lower interest rates to low-emission vehicle loans. For example, Swedbank offers 0.6% lower interest rate and CASCO insurance with 10% premium discount for the first year.

As of 2019 multiple **car dealers** are starting to actively promote electric vehicles. BMW, VW, Renault, and Nissan dealers are using different types of promotion for their electric vehicles. VW already declared that they will aggressively electrify its sold car market to have 42% of all new cars to be electric by 2021.[33]

**Zaļā josta** organizes management of used packaging, disposable dishes and tableware, environmentally harmful products and electrical appliances thus providing an opportunity for their clients to obtain a 100% exemption from Natural Resources

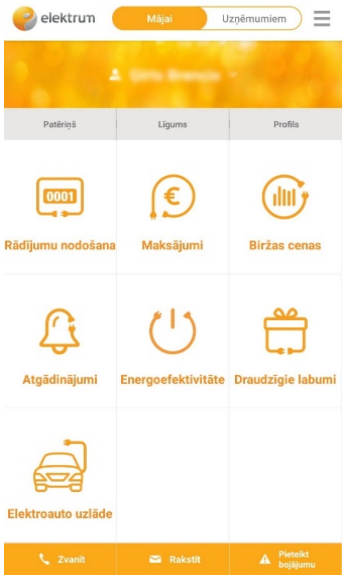


*Figure 13. Elektrum Latvija mobile application: Available: https://www.elektrum.lv/lv/majai/pakalpojumi/elektrum-mobila-lietotne. Accessed 26 02 2020*

Tax as well as to ensure that waste generated by their economic activity is collected,

[33] I. Žaime, "Volkswagen bijis labs gads," Dienas Bizness, 21 01 2020. [Online]. Available: https://www.db.lv/zinas/volkswagen-bijis-labs-gads-494472. [Accessed 26 02 2020].

recycled and goes into repeated circulation. As well, they organize environmentally educational activities to schools and companies.

Since 2013 **Latvenergo** is promoting electric vehicles of all kind by organizing seminars and educating people in their educational **Energy Efficiency Centre**. As of 2019 Latvenergo and its marketing brand **Elektrum** have become electric vehicle charging operator and their mobile application for customers has a dedicated segment for electric vehicle charging. This application is the same as the one for conducting regular interactions with them as electrical energy provider.

### NGO activities

In 1998 **Vides izglītības fonds** (**VIF**, Foundation for environmental education) was established to promote sustainable development through environmental education. The core activities of VIF are related to the implementation of the programs of the world's leading environmental education organization Foundation for Environmental Education (FEE International) in Latvia. As such it serves as platform to implement its international programs and activities in environmental education in Latvia, and imposes strict administrative and quality criteria. Most noticeable actions from VIF have been the implementation of the Blue Flag, Ecoschools, and Young environmental reporters.

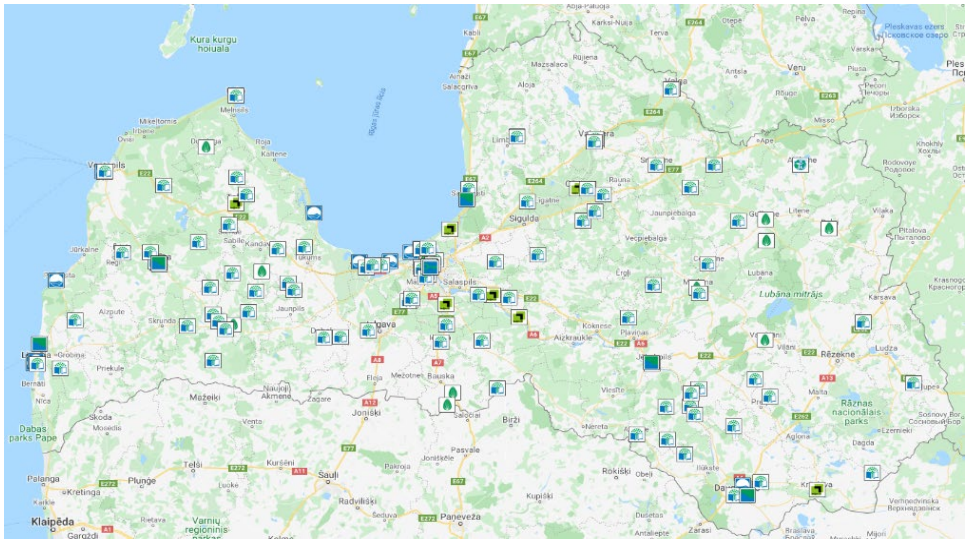


*Figure 14. Foundation for Environmental Education map of activities. Available: http://www.videsfonds.lv/lv/karte. Accessed 26 02 2020*

The Blue Flag is the world's most popular tourism eco-certificate, which is widely recognized by citizens, municipalities and environmental authorities. It is awarded in

three categories - the Blue Flag for swimming, the Blue Flag for marinas, and the Blue Flag for individual yachts. Ecoschools is a widely adopted program that teaches school attendees environmental establishment system. Young environmental reporters is an environmental education program for young people aged 11-25 with the goal of researching, exploring environmental issues, promoting solutions and mastering contemporary media tools for public awareness.

In 2017 in order to facilitate the transition to clean and fair energy in Latvia and to develop long-term cooperation between different energy target groups, **Zaļā Brīvība**, in cooperation with **CEE Bankwatch Network**, hosted the first expert cooperation platform, identifying common problem areas and defining possible solutions and steps.

The platform gathers experts from the energy sector, entrepreneurs, industry NGOs and representatives of the Association of Local and Regional Authorities, which gives an insight into the energy sector from the viewpoint of the public, experts and professionals. The main topics covered in the platform are energy efficiency in the building sector and municipal level, sustainable use of renewable energy sources, sustainable policy making and implementation at EU and Latvia's level, consumer education and efficient planning and implementation of financial mechanisms.

**Pilsēta cilvēkiem** association regularly organizes events in order to promote healthier lifestyle and better environment. One of many of their projects is online air quality monitoring in Riga.[34] Between most recent achievements is multiple noble tree plantings in the centre of Riga. For their active work they have been awarded with a letter of acknowledgment from State Audit Office for successful cooperation in the audit of Riga transport infrastructure.

In 2017 **Baltijas Vides Forums** created a platform called Sustainable Urban Mobility and Everyday Mobility in the Baltic Cities (SUMBA).[35] The aim of the project is to develop an efficient transport modelling system that will improve the mobility of suburban and urban areas in a sustainable way by developing an appropriate transport modelling system in each partner city.

[34] Pilsēta cilvēkiem, "Mūsu gaiss," [Online]. Available: https://gaiss.pilsetacilvekiem.lv. [Accessed 26 02 2020].

[35] "Ilgtspējīga mobilitāte pilsētās un ikdienas pārvietošanās Baltijas jūras reģiona pilsētās (SUMBA)," 2017. [Online]. Available: http://www.bef.lv/index.php?id=164. [Accessed 26 02 2020].

The project will result in the development of common tools for solving mobility problems: through comparative methods, SWOT analysis and other tools, a pilot area-specific mobility plan will be created in each pilot area.

The main target audience of the project is planning specialists and municipalities. It is intended to improve stakeholders' knowledge of sustainable transport solutions.

Society **BIMAB** has organized many electric vehicle events[36] since 2015. Since creation in 2009 they have promoted zero emission (mainly battery electric) mobility in different media, including TV and web news sites. Organized events are of different type – owner gatherings, educational tours, and promotional drives. As well, BIMAB actively participates in legislation process.

**BSR electric** mainly focuses on research regarding e-mobility solutions in urban environment, but serves also as a news site that publishes main news in electric transport area. As of 2017 BSR electric promotes e-mobility in urban transport by exploring untapped potentials, demonstrating different types of urban e-mobility solutions, and status-quo assessment and potential analysis[37].

As a news blog **Uzlādēts.lv** offers news and reviews about e-mobility solutions and technologies regarding electric transportation and renewable technology. In 2019 it organized multiple events for electric vehicle owners and participated in many events as an expert in the field. As such it is one of the few media in Latvian that offers deep information and reviews about environmentally friendly transport and demystifies stereotypes in society.[38]

[36] BIMAB, "Elektromobiļu maratons un salidojums," 9 09 2019. [Online]. Available: http://www.bimab.lv/jaunumi/?id=62-elektromobilu-maratons-un-salidojums. [Accessed 26 02 2020].

[37] BSR E-mobility, "Regional status-quo assessment and potential," 30 11 2018. [Online]. Available: http://emobilitate.lv/wp-content/uploads/2019/01/2018.11.30-BSR-E-mobility-stakeholder-analysis.pdf. [Accessed 26 02 2020].

[38] K. Mendziņš, "Cik netīrs ir mans elektroauto?," 19 11 2019. [Online]. Available: https://uzladets.lv/cik-netirs-ir-mans-elektroauto/. [Accessed 26 02 2020].

# 4. SUPPORT TOOLS AND BUSINESS MODELS

In many areas certain support tools are needed for it to develop to a sustainable level, which is also known as reach of critical mass. E-mobility currently is almost at a sustainable level worldwide. Although electric cars date back to 19th century, it is only now, when climate crisis is near[39], that there is pressure to adapt them as main option.

## Overview of support tools available

In order to reduce local pollution and privately owned car transport, many cities have implemented zero or low-emission zones. Having more zero-emission cars has other benefits besides lower pollution. They are less noisy and emit almost no heat, which would make cities less noisy and cooler.

In these zones it is forbidden to drive unless meeting certain emission criteria. Mostly it means that cars must meet Euro 5 or better emission standard, but there are zones that allow zero-emission vehicles only or such that can drive at least 30 km in zero-emission mode.

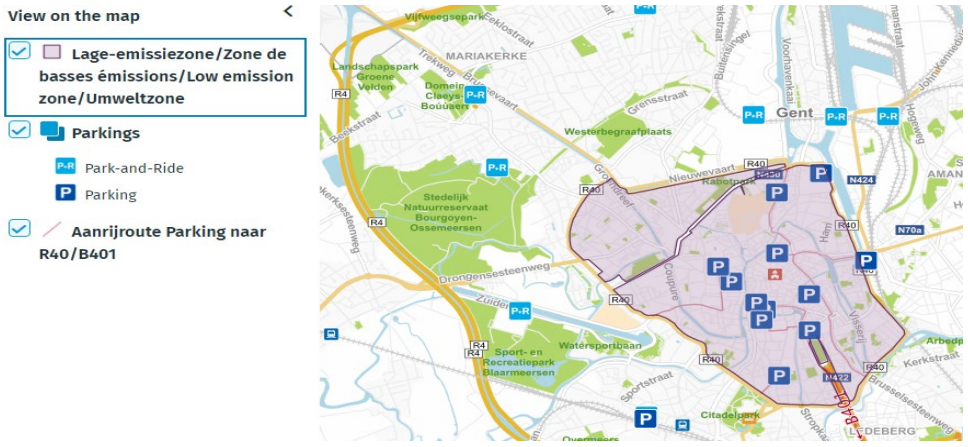


*Figure 15. Ghent's low emission zone. Available: https://stad.gent/en/mobility-ghent/low-emission-zone-ghent-2020. Accessed 28 03 2020*

In Ghent, Belgium, for example, from 2020 in the centre it is forbidden to enter with a car that does not meet Euro 5[40]. There are possibilities to buy one-time pass and

[39] NASA, "Climate Change: How Do We Know?," 25 03 2020. [Online]. Available: https://climate.nasa.gov/evidence/. [Accessed 28 03 2020].

[40] City of Ghent, "Low emission zone Ghent 2020," 2020. [Online]. Available: https://stad.gent/en/mobility-ghent/low-emission-zone-ghent-2020. [Accessed 28 03 2020].

locals have temporary incentives to switch their cars. Park&Ride is preferred solution for those who do drive older than Euro 5 cars.

The example of Ghent in comparison to Oxford, Great Britain, is easy to fulfil as Euro 5 standard was introduced in manufacturing as of 2009. Oxford planned to have two zones in the city – centre would be zero-emission zone, while a wider zone around the centre would be low-emission zone stating from December 2020. However, due to coronavirus outbreak this plan is postponed till summer of 2021.[41]

Due to intense heat waves during the summer of 2019, Paris, France, forbid most polluting vehicles to enter the city[42]. As of April 2019 many German cities forbid entering and parking in certain zones cars that do not meet Euro 5 standard.[43]


*Figure 16. Vehicle restriction road signsin Stutgard. Available: https://www.stuttgart.de/en/diesel-ban.. Accessed 28 03 2020*

[41] Oxford City Council, "Oxford's Zero Emission Zone," 20 03 2020. [Online]. Available: https://www.oxford.gov.uk/info/20299/air_quality_projects/1305/oxford_zero_emission_zone_zez. [Accessed 28 03 2020].

[42] The Local, "Paris bans most polluting cars as heatwave leads to pollution spike," 26 06 2019. [Online]. Available: https://www.thelocal.fr/20190626/paris-bans-most-polluting-cars-as-heatwave-leads-to-pollution-spike/amp?usqp=mq331AQA&_js_v=0.1. [Accessed 28 03 2020].

[43] Landeshauptstadt Stuttgart, "Information on the traffic ban for diesel vehicles," 2018. [Online]. Available: https://www.stuttgart.de/en/diesel-ban. [Accessed 28 03 2020].

In order to prepare for 2028 Olympic games Los Angeles, USA, has set an electric car target, calling it Zero-Emission 2028 Roadmap. The roadmap sets percentage targets for electric vehicles by the time the 2028 Olympics open - 20 to 45 % of private cars, 50 to 100 % of shared cars, 80 to 100 % of buses and all new buses, and 25 to 50 % of delivery trucks. It also calls for 130'000 new public charging stations.[44]

Similar country to Latvia in many aspects is Slovenia, which in 2017 declared its vision on how to reduce greenhouse gas emissions by 2030. After 2025, cars and light duty vehicles with an internal combustion engine running on petrol or diesel with $CO_2$ emissions higher than 100 g/km will no longer be eligible for first-time registration in Slovenia. After 2030, the restriction falls to 50 g/km.[45]

Currently in Latvia only Riga has air pollution problem to a somewhat serious level. City's council has stated that it hopes that people will become richer and buy better cars, which will pollute less. There have been talks to implement a low-emission zone, but there have not been any plans laid for such action. The National Energy and Climate plan does state that cities with more than 100'000 inhabitants by 2030 will have to have such zone. Currently only Riga fits such criteria.

There are plenty of direct support tools available worldwide. Norway, as one of the leading countries for electric vehicle adaption, has VAT exemption among many other incentives for zero-emission vehicles[46], which has allowed to have electric Golf variation to be cheaper than gasoline variation already at the car dealer.

As one of the most polluting countries China has the most to act upon. The NEV mandate in China aims to promote new energy vehicles (NEV) (zero-emission vehicles) and provide additional compliance flexibility to the existing fuel consumption regulation. This policy applies only to passenger cars and states that there must be 12% NEVs from a manufacturer in 2020. At the same time NEVs receive governmental

[44] E. C. Edvarts, "L.A. sets electric-car targets as host of 2028 Olympics," Green Car Reports, 12 09 2018. [Online]. Available: https://www.greencarreports.com/news/1118728_l-a-sets-electric-car-targets-as-host-for-2028-olympics. [Accessed 28 03 2020].

[45] Ertico, "SLOVENIA PRESENTS STRATEGY TO REDUCE GREENHOUSE GAS EMISSIONS BY 2030," 16 10 2017. [Online]. Available: https://erticonetwork.com/slovenia-presents-secure-greenhouse-gas-emissions-reduction-2030/. [Accessed 29 03 2020].

[46] Elbil, "Norwegian EV policy," 2020. [Online]. Available: https://elbil.no/english/norwegian-ev-policy/. [Accessed 28 03 2020].

purchase subsidy that is dependent on the vehicle itself, but, as the NEV proportion of the market grows, China is starting to phase out direct subsidies.[47]

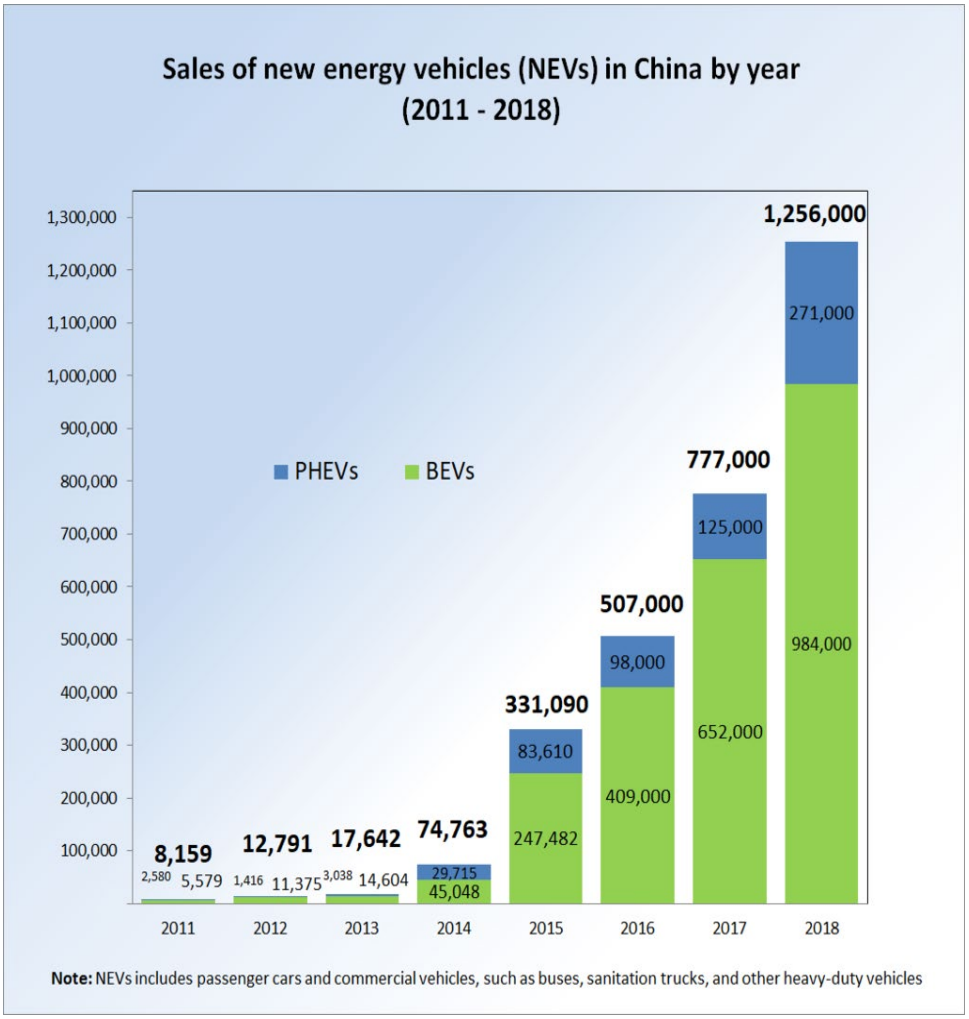


*Figure 17. Annual sales of new energy vehicles in China between January 2011 and December 2018. Data available: https://www.fueleconomy.gov/feg/taxevb.shtml. Accessed 29 03 2020*

USA has chosen not to support on a direct manner, but as a tax rebate, giving all-electric and plug-in hybrid owners up to 7'500 $ after such vehicle is purchased. Several states, such as California, have another tax rebate on top of federal with having up to 7'000 $ available for individual, if criteria are met.[48]

[47] Internation Energy Agency, "New Energy Vehicle (NEV) Mandate Policy," 5 12 2019. [Online]. Available: https://www.iea.org/policies/3335-new-energy-vehicle-nev-mandate-policy. [Accessed 29 03 2020].

[48] United States Environmental Protection Agency, "Federal Tax Credits for New All-Electric and Plug-in Hybrid Vehicles," 2020. [Online]. Available: https://www.fueleconomy.gov/feg/taxevb.shtml. [Accessed 29 03 2020].

Latvia currently has no direct support tools that would result in receiving a discount on buying a zero-emission or low-emission vehicle, but there are multiple non-direct support tools. Among them is exemption from road tax, free first-time registration, and allowance to drive on public transport lanes. As well, Riga's and Liepaja's municipalities have allowed to park for free in municipality parking spaces.

## Innovative business models toward resource efficient transport

As the society understands better the influence that transport has on the environment, many seek to have alternative means of transportation. In many cases it results in a more efficient transport – scooters, bicycles, and electric vehicles.[49]

Along with the understanding comes economical aspect. It is harder to justify owning a car, if you live and work nearby, because the fuel price and parking fees are becoming more expensive. That has resulted in a boom in kick scooters. They are light, zero-emission, cheap to run, and relatively fast means of transportation.


*Figure 18. Bolt electric kick scooters. Available: https://siguldaadventures.com/en/smartbike. Accessed 29 03 2020*

Acknowledging benefits of kick scooters, many companies offer them for short term rent, such as, Bolt, Atom, and City Bee in Latvia, and Uber, Lift, and Lime

[49] K. Mendzins, "Elektroauto mīti – efektivitāte," 04 09 2018. [Online]. Available: https://uzladets.lv/elektroauto-miti-efektivitate/. [Accessed 29 03 2020].

worldwide. They have caused chaos in cities which do not have a suitable bicycle infrastructure, e.g., Riga, Latvia, because they tend to go as fast as bikes, but require better road quality than most pedestrian lanes can offer, while not offering enough safety to drive on the same road as cars do.

Areas with hills have quickly adapted electric bicycles and offer them for rent for tourism. One such example is Sigulda with electric fat bikes for rent. These bikes offer to maintain speed up to 25 km/h and electric range of 60 km. These parameters are well suited for hilly terrains, allowing tourists to spend more time to enjoy the nature and get further.[50]

Electric taxi drivers are currently a niche, but a recent study has found that users are willing to pay extra 15-20 cents per kilometre for a zero-emission ride. This is especially true for younger people. Knowing that electric cars are cheaper to run, have lower insurance and maintenance costs, it could potentially have a huge impact on taxi business.[51]

Having no emissions and almost no noise electric vehicles are very suited for working in public spaces, such as, parks, beaches, and graveyards. Last one in

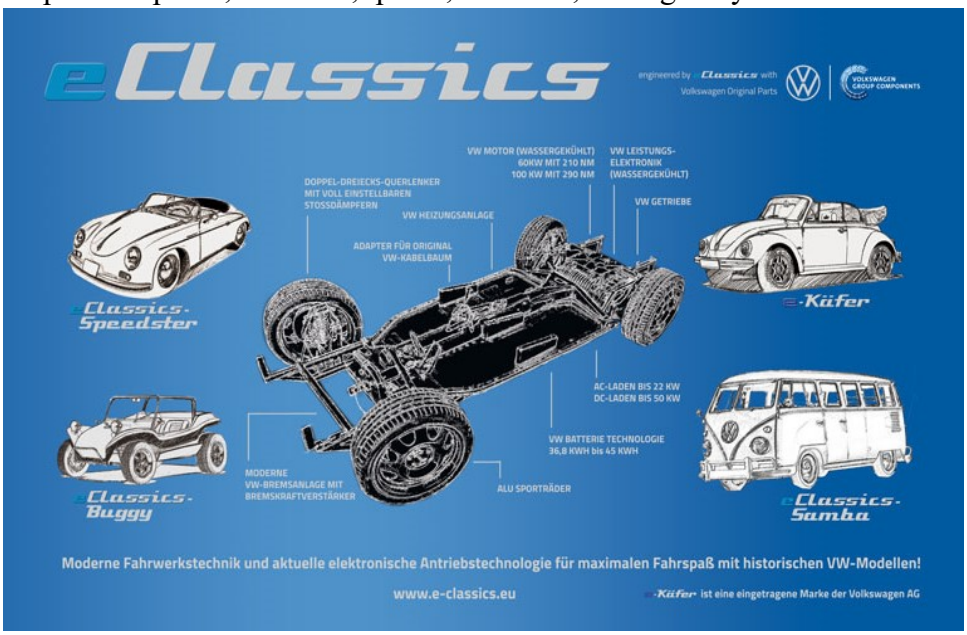


*Figure 19. Volkswagen and eClassics offer to convert cars to electric. Available: https://murschel-electric-cars.de/eclassics-bulli/. Accessed 29 03 2020*

[50] Siguldaadventures, "E-bike tour," 2020. [Online]. Available: https://siguldaadventures.com/en/smartbike. [Accessed 29 03 2020].

[51] Transport and Environment, "The future of Uber in Europe: electric and shared?," 01 220. [Online]. Available: https://www.transportenvironment.org/sites/te/files/The%20future%20of%20Uber%20in%20Europe_electric%20and%20shared%20%281%29.pdf. [Accessed 29 03 2020].

particularly is a sensitive place, where people would like to have as little unnecessary interference as possible. Not only during funeral, but during maintenance works as well.

An emerging business nowadays is car conversion to electric. Nowadays it is mostly done on classic cars or special occasions, but it makes a lot of sense to have a car converted to electric. Having more and more cities forbidding old cars, because of their exhaust emissions, means that those cars have lower value for both the owner and for the market. If the car has sentimental value to it, then there is more reason to convert it to electric. Manufacturers are beginning to offer some model conversions, which can lead to boost in performance and local economy.[52]

Seeing how mainstream car manufacturers are struggling to shift to electric vehicles, has opened the doors for new manufacturers to gain momentum. Tesla, for example, manufactured its first car only in 2008, but now is the second most valued car manufacturer in the world. Others have taken the example and having a positive public acceptance.[53]

*Figure 20. Sono Motors Sion electric car with solar panels. Available: https://notdummy.com/free-ride-up-to-34km-per-day-solar-energy-and-electric-vehicles/. Accessed 29 03 2020*

[52] Murschel Electric Cars GmbH & Co, "Zurück in der Zukunft," 20 03 2020. [Online]. Available: https://murschel-electric-cars.de/eclassics-bulli/. [Accessed 29 03 2020].

[53] P. Ridden, "Sono Motors crowdfunding push raises €53 million," New Atlas, 21 01 2020. [Online]. Available: https://newatlas.com/automotive/sono-motors-sion-crowdfunding-53-million-euros/. [Accessed 29 03 2020].

However electric mobility is still considered as a new field and there is a lot more to discover. Hence, at the moment there is a big potential for researchers to investigate multiple possibilities for the new transportation era. Research is needed in both the potential usage of such transportation, for example, shared electrical transports, and improvement of current technology, for example, energy storage improvements. Ground transport currently is set to have the big shift in nearest 5-10 years, but less certain is aviation and marine vehicles, which can have as big of an impact on the environment as ground transport.

Together with electrical mobility come many other advanced technologies. One such is shared mobility, where a typical consumer would not buy a car, but rent it for a period of time it is needed. Similar as it is nowadays with kick scooters. Another is autonomous driving, where cars do not need a driver or the driver is needed for safety reasons. Combining both previously mentioned is mobility-as-a-service, where a user rents a car that drives on its own for a longer period of time. Mobility-as-a-service for the end user would similar as music streaming services, e.g., Spotify or Deezer. In such way the consumer, becomes a prosumer.

As with almost all transportation means there is a racing edition. Electric vehicles, as there are many types of them, have many different racing series – Formula, Rallycross, Off-road, Kart, and other. World's first national electric kart championship took place in Latvia and the organizers organize first kid's electric kart championship in Latvia.[54]

### Social benefits and urban sustainability aspects

As such, cities are responsible for 70% of greenhouse gas emissions and it is estimated that 70% of Earth's population will live in them by 2050. In the face of climate crisis many cities have started to take action to become climate neutral. One of the biggest pollutants in urban areas is transport. Congestion, pollution and a lack of community spaces have become major drags on people's aspirations and experiences of urban living. In response, cities must manage their resources and priorities to create sustainable places for visitors and residents, and foster innovation and growth. Air

[54] Blue Shock Race Electric karts, "WELCOME TO KID'S ELECTRIC KART CHAMPIONSHIP CUP 2020," 2020. [Online]. Available: https://blueshockrace.com/kids-championship/. [Accessed 29 03 2020].

pollution is considered as 4th deathliest risk factor after high blood pressure, smoking, and high blood sugar.[55]

Ground transportation nowadays is responsible for about 30% of $CO_2$ pollution and up to 50% tiny particle pollution, while increasing noise pollution and contributing to increased heat. This pollution concerns local health and economical aspects. Many people working in cities are actually living in suburbs, increasing traffic, slowing down public transport, which in return increases private transport usage turning into negative feedback into the transportation system.

According to the EPA, fine particle pollution such as that found in internal combustion engine vehicle tailpipe emissions:[56]

- Causes early death (both short-term and long-term exposure)
- Causes cardiovascular harm (e.g. heart attacks, strokes, heart disease, congestive heart failure)
- Is likely to cause respiratory harm (e.g. worsened asthma, worsened Chronic Obstructive Pulmonary Disease (COPD), inflammation)
- May cause cancer
- May cause reproductive and developmental harm

In addition, autism spectrum disorder (ASD) and low birthweight of infants have been linked with fossil fuel emissions. Those most susceptible to health risks from fine particle pollution include infants, children and teens. Children are more vulnerable to health impacts from emissions because of their physiology, because they are growing, and because they have higher breathing rates. These source-based emissions can be reduced entirely by transitioning to an electric vehicle powered by clean renewable energy.

It is hard to evaluate health impact money-wise, but there have been attempts in doing just that in terms of what the impact of climate crisis. Social cost of climate change is estimated to be in between 34 €/$CO_2$ ton and 200 €/$CO_2$ ton[57]. Comparing an

[55] Hannah Ritchie and Max Roser, "Air pollution is one of the leading risk factors for disease burden," 2020. [Online]. Available: https://ourworldindata.org/air-pollution#air-pollution-is-one-of-the-leading-risk-factors-for-disease-burden. [Accessed 29 03 2020].

[56] U.S. EPA, "Integrated Science Assessment (ISA) for Particulate Matter (Final Report, 2019)," 2019. [Online]. Available: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534. [Accessed 29 03 2020].

[57] K. Than, "Estimated social cost of climate change not accurate, Stanford scientists say," Stnaford Enginnering, 12 01 2015. [Online]. Available:

electric vehicle that emits no direct emissions and an average European internal combustion engine car that has 120.4 $CO_2$ g/km[58], means that there is a huge economical potential for switching. As an average car makes about 15'000 km per year, that means that social cost of climate change can be as high as 330 €/year per car.

Though, these calculations are taking into account only direct emissions. Taking into account non-direct emissions (production of electricity and gasoline), means that an electric car is responsible for about 47 $CO_2$ g/km[59], while internal combustion car for about 210 $CO_2$ g/km. The difference is 163 $CO_2$ g/km or 83-487 €/year per car. Such small country as Latvia has 727'164 registered cars, which means that the impact on the society is between 60 million and 354 million €/year.

Internal combustion cars need gasoline or diesel to operate. This possesses national security risk as fossil fuel is mostly imported and price fluctuation is unpredictable. Electricity can be generated by individual households with solar panels, while countries and municipalities can build wind/solar/hydro/gas plants or nuclear reactors depending on the available resources and necessity.

Fossil fuel market is highly dependent on many factors, including war, pirates, and political situation. Electricity price in comparison is more stable and as such electricity is more widely available than fossil fuel. Not having to import fossil fuels would mean that the whole product is local, which means that all economical assets (taxes, wages, transportation) stay local.

https://engineering.stanford.edu/magazine/article/estimated-social-cost-climate-change-not-accurate-stanford-scientists-say. [Accessed 29 03 2020].

[58] European Comission, "Average CO2 emissions from new light-duty vehicles registered in Europe increased in 2018, requiring significant future emission reductions to meet upcoming 2020 and 2021 targets," 19 06 2019. [Online]. Available: https://ec.europa.eu/clima/news/average-co2-emissions-new-light-duty-vehicles-registered-europe-increased-2018-requiring_en. [Accessed 29 03 2020].

[59] European Environment Agency, "CO2 emission intensity," 17 09 2018. [Online]. Available: https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-5#tab-googlechartid_chart_11_filters=%7B"rowFilters"%3A%7B%7D%3B"columnFilters"%3A%7B"pre_config_ugeo"%3A%5B"European%20Union%20(current%20composition)"%5D%7D%7D. [Accessed 29 03 2020].

As with any change, the transition to a transportation sector powered by electricity will have both winners and losers. Widespread adoption of EVs will result in job losses in the oil industry, at gas stations, and possibly in the auto maintenance and mechanic industry (EVs need far less maintenance than conventional gasoline and

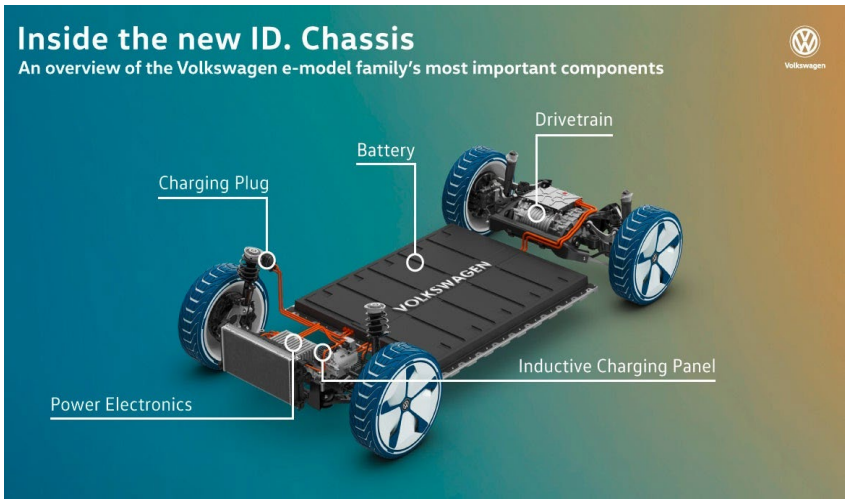


*Figure 21. An overview of the Volkswagen electric car most important components. Available: https://www.carmagazine.co.uk/electric/volkswagen/. Accessed 29 03 2020*

diesel vehicles). However, direct jobs will be created in the auto industry in manufacturing, research and development, and battery manufacturing. Indirect jobs will result from installation and maintenance of electric vehicle supply equipment (EVSE).

In addition to direct and indirect job creation, electric vehicles cost less to maintain and operate. Every euro not spent on gasoline, or oil changes, or transmission fluid has the potential to go back into the local economy. By reducing gasoline expenditures, more money will stay local and boost the local economy.

Electric vehicles serve an important transportation function, but, they, as a typical car, are in use for mobility less than 5% of the time[60]. This limited use, coupled with the storage capability of their batteries means that EV load on the grid can be flexible and also serve as a storage or regulation resource for the grid. The electric grid has extremely limited storage capacity. Thus, every time electricity demand increases, generation must immediately increase to meet this demand. Because of their batteries, electric vehicles can store small amounts of electricity in their batteries and effectively

[60] D. Z. Morris, "Today's Cars Are Parked 95% of the Time," Fortune, 13 03 2016. [Online]. Available: https://finance.yahoo.com/news/today-cars-parked-95-time-210616765.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmx2Lw&guce_referrer_sig=AQAAAAe9bayrW7rlqeNYFIMRWyp0n0fH0uq6Pzvi01b8NgasOShIz_OavsTB1OO6Edyf7C4Hxu7y4UyV6_Vgu3IGwD8PqJ-EnOCQUeKF2WA. [Accessed 29 03 2020].

decouple electricity generation from demand. This could benefit vehicle owners, distribution utilities, and regional transmission operators in a number of ways.

At the most basic level, electric vehicle charging can be managed so that the impact on the grid is minimal. Charging can be managed either through voluntary adoption of utility-offered time-of-use rates that reward off-peak charging (indirect control) or it can be managed through utility-controlled charging signals (direct control). This type of management would result in minimized additional load and grid impact from EVs as well as greater energy cost savings for EV owners and operators. Demand response programs are another area in which EVs can bring value to the electric grid. An aggregated group of EVs can respond to a signal from utilities or regional transmission operators to curtail charging at critical times to avoid high power prices or grid reliability issues. Participants in demand response programs can receive compensation from the regional transmission operator or distribution utilities that offer Demand Response programs.

Electric vehicles can also be used for energy arbitrage. By storing energy purchased during off-peak times and selling it back to the grid or using it to power home energy use (behind-the-meter) during peak load, EV owners and operators can save money, or even make money by storing energy. The storage capabilities of EVs also make them candidates for renewable load following, which means that they can capture and store excess solar or wind power at the time of generation and make it available for use during times of high demand.

The most advanced form of vehicle-to-grid integration involves wholesale market opportunities. EVs equipped with bidirectional chargers could best serve in the ancillary services markets of the regional transmission operator.

While most attention is brought to cars, and for understandable reasons, e-mobility is wider than just light passenger vehicles – they are as big as container ships and as small as kick scooters. When considering urban sustainability, we must take into account the most pleasant way for a pedestrian to travel. More and more city and land

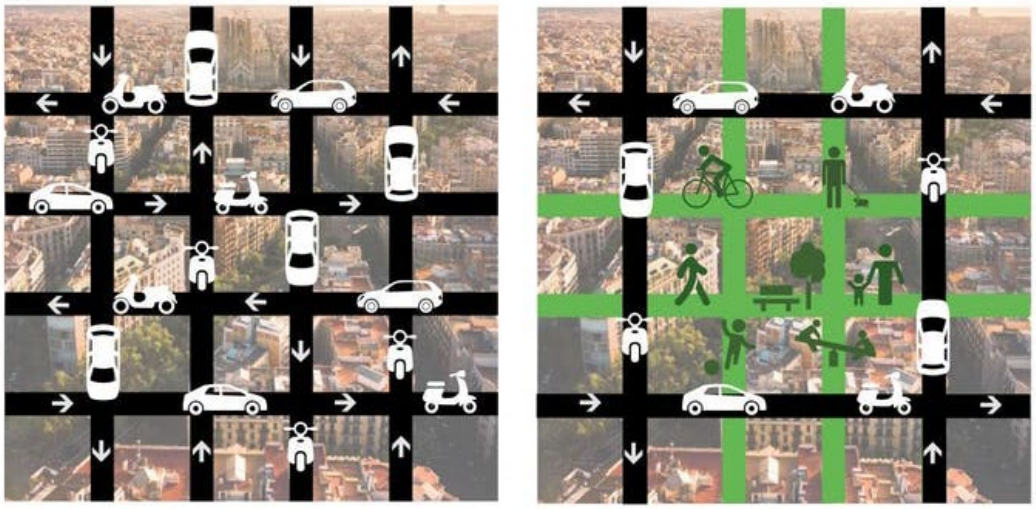


*Figure 22. Superblock model in Barcelona. Available: http://theconversation.com/superblocks-barcelonas-car-free-zones-could-extend-lives-and-boost-mental-health-123295. Accessed 28 03 2020*

scape architects are drawing attention to the importance to first prioritize pedestrians, then cyclists, then public transport, and last priority being privately owned cars. Barcelona, Spain, in 2016 first introduced the idea of superblocks. Superblocks are neighbourhoods of nine blocks, where traffic is restricted to major roads around the outside, opening up entire groups of streets to pedestrians and cyclists. The aim is to reduce pollution from vehicles, and give residents much-needed relief from noise pollution. They are designed to create more open space for citizens to meet, talk and do activities.[61]

[61] A. Nanda, "Superblocks: Barcelona's car-free zones could extend lives and boost mental health," 13 09 2019. [Online]. Available: http://theconversation.com/superblocks-barcelonas-car-free-zones-could-extend-lives-and-boost-mental-health-123295. [Accessed 28 03 2020].

# 5. PILOT ACTIVITIES IN USE OF DIFFERENT E-SCOOTERS.

E-scooter wide usage as low speed vehicles, neighbourhood electric vehicles, electric mobility scooters are the fastest growing category of transportation in the past 5 years. Latvian entrepreneurs experience providing e-scooters to deal with social inclusion and to increase accessibility of public places. The common features, which can be considered as the main benefits of this group:

- Possibility to carry people and goods in internal and outdoor territories and facilities
- Limited and mostly reduced speed up to 10-45 km/h
- Smaller ecological footprint than automotive industry
- Possibility to fulfil certain needs of user by certain specialization of vehicle
- No special charging points needed
- Increase the mobility of human resources
- Facilitate to reach national energy and climate targets for 2030, both in public and private sector

## Different type of e-scooters

As worldwide demand of different type of e-vehicle grow, e scooter vide usage and demand allows manufacturers to introduce new concepts and types and modules. In Latvia several models are in use already.

### E-scooters for social inclusion

Most widely spread e-scooters for elderly or disabled person movement improvement are used privately and in hospitals/ recreation centres. In BSR project Riga's pilot activities two these kinds of e-scooters where tested. On daily bases this type of e-scooters can be seen on streets for private usage. Also, they have proved themselves to be helpful, they still are rarely used in hospitals or nursing houses in Latvia.

*Figure 23 Diffrent type of e-scooters for movment improvment. Available: https://electricscootering.com/best-electric-scooter-elderly/ Accessed 12 05 2020*

If compared to other types of e-scooters most common advantages:

- Small dimensions of device
- Easy to charge and maintenance
- Easy to drive
- Persons with limited mobility possibilities can be safe transported around large territories
- Limited speed

Most common disadvantages

- The size of e-scooter doesn't allow to pick up and carry it.
- In private usages must think of place where to leave and charge it
- The battery is built in, so it must be charges at parking place

Hospitals, clinics and other social centres in Latvia use e-vehicles also in daily operation routines. Specific multifunction cargo space was designed to carry different cargo types for catering service in the Children clinical university hospital and for bed linen/ towels in Riga Psychiatry and Narcology Centre


*Figure 24 E-vehicles. Catering service in the Children clinical university hospital (left), Riga Psychiatry and Narcology Center (right). Available: https://www.bkus.lv/lv and http://rpnc.lv/.Accessed 12 05 2020*

Advantages of these e-scooters for both organizations: Children clinical university hospital and Riga Psychiatry and Narcology Centre.

- In Latvia: mandatory requirements for public bodies to have green public procurement for food and catering services
- Distribution of the food in the closed hospital area
- Raise the mobility of the personal

### Airport e-scooters

Riga international airport uses personal transportation indoors. Mostly used for human transportation inside airport terminals. Also, for luggage transportation from outside to inside.


*Figure 25. Rigas international airport indoor transport. Available: https://www.riga-airport.com/par-lidostu/vide/airport-carbon-accreditation/. Accessed 20 05 2020*

**Advantages:**

- Specially designed with lowered step, with the aim to make passenger easier to use it
- Zero emission during the vehicle using as well during charging. Important aspect as vehicle is used indoor
- Rising the comfort of the passengers

### Outdoor parks e-scooters

Outdoor parks with large territories can gain advantages for using e-vehicles. Most common use for large territories is transportation of visitors. Beside possibility to drive large distances, it is important that e-scooters doesn't make sound or smell during operations.

*Figure 26. 22 hectares of parkland ''Garden of destiny'' in Latvia (right). Available: http://liktendarzs.lv/ and http://liktendarzs.lv/ko-dar%C4%ABt/elektromobi%C4%BCi. Accessed 20 05 2020*

Advantages of outdoor park e-scooter in Garden of destiny:

- Large area: difficult to walk around all of it
- Guided tour around the garden/park territory
- Mainly used by children, old people, disabled people, also by other groups of people
- Vehicle is quite –important aspect as Garden of destiny is a memorial place
- Ensured mobility in the territories where other transport is forbidden.

- Comfortable sit in from wheelchair to e-scooters
- Driving distance 60-80 km per one charge
- Increase the mobility of the visitors

Most common disadvantages:

- Seasonality. The price of e-scooter that is suitable for using in winter is higher
- Seasonality. Tourism season stopping during the winter, e-scooter has no usage during this period
- driver has to have driving skills


*Figure 27. The territory of the Rundales castle ensemble occupies 85 hectares Available: https://rundale.net/parks/pils-ansambla-teritorija/. Accessed 20 05 2020*

tours around city. These scooters are combined together in one long chain with multiple seats allowing small group of tourists to take for guides tour around city.


*Figure 28. An electric train tour "Discover and meet Gulbeni. Available: https://www.visitgulbene.lv/objekts/elektrovilciens/. Accessed 20 05 2020*

Advantages:

- Large area –only low speed vehicles is allowed to drive in the territory of municipal parks
- Electric train as a specific truism offer

Disadvantages:

- Seasonality

### Heavy duty e-scooters

E-car and e-scooter difference sometimes can be measured only by difference in limitation of speed. Some of e-scooters looks like e-cars. Riga ZOO uses several 4 wheal e - scooters for daily routines inside zoo's territory.


*Figure 29. Riga's Zoo e-scooters. Available: https://www.rigazoo.lv/lv. Accessed 20 05 2020*

Advantages of e-scooters in Riga's Zoo:

- Historical territory with limited space for transport
- Can transport both - goods and animals
- Important aspect manoeuvrability together with quietness and zero emissions
- Specific animals are sensitive to the noise
- E –vehicle must not disturb visitors as they both using the same road (for example small children don't like the noise)

- No emissions –important as vehicle is used to carry the food in the animal cages
- E-vehicle is used also in the neighbourhood traffic
- E-vehicle has multifunctional cargo box

Joint Stock Company "Latvia's State Forests" uses e-scooters for work around Tērvates nature park, where they are mostly used for carrying seeds, seedlings.

*Figure 30.. Nursery -seeds and seedlings(left), vehicle in Tērvete nature park (right). Available: http://www.tervetesnovads.lv/marsruti/. Accessed 20 05 2020*

Advantages e-scooters in Tērvates nature park:

- Rising the mobility and the capacity of personal
- Cargo box adapted to the needs of seed and seeding or materials to renovate nature trails and other everyday jobs
- Good in specific weather and nature aspects – wet and dry season; solid and soft grounds (bogs; wetlands)

# 6. USE CASE: "CAN E-SCOOTERS BE AN ECONOMICALLY SUSTAINABLE INSTRUMENT OF SOCIAL INCLUSION?"

## Pilot use case goal

E-scooter for social inclusion could be one of the instruments by municipalities to decrease social exclusion of senior and disabled residents and to allow increased access to various restricted environments.

One of most common challenges, that faces cities in EU to preserve the mobility of elderly people or people with particular mobility requirements. Exist environment, where foot walks are often impossible because of different limited reason such as gas emission and noise pollution limits, long walking areas, different road surface. In all these cases there must be found solution. The provision of e-scooters is one potential solution to address this particular challenge.

During years airports and other private companies has developed similar projects. In these cases, this can be considered as the first project within a municipal setting. Rather simple, but innovative proposal contributes valuable knowledge and experience to other interested municipalities that wish to provide additional services to make all members of its society mobile. This use case addresses pollution free e-mobility in combination with social inclusion, both important issues in cities throughout Europe.

One of main advantages of project is that e-scooter pilots are implemented at the largest municipal hospital and cemetery in the City of Riga. The city enhances existing infrastructure and works to ensure that the project results will contribute to decrease social exclusion throughout the city.

## Chosen implementation

Riga 1st hospital is the oldest hospital in Latvia founded in 1803 under the personal edict of the emperor Alexander I, for two hundred years it has been acknowledged as a top-priority inpatient emergency and immediate care institution. Nowadays the hospital provides a wide range of outpatient and planned inpatient services (including the services of the day-and-night inpatient facility), with the use of the most up-to-date medical equipment and the newest methods and technologies. The territory of the hospital consists of 23 hospital buildings.

In 2018 autumn, two four-wheel slow speed e-scooters was delivered to Riga 1.st hospital. Testing was done between all 23 buildings inside and outside across hospital territory as there are specific procedures/ operation in each of these buildings. Patients have different health conditions, the need to move from one hospital building to another varies, as well as the restrictions of the movement of each individual.

Detailed investigation of the technical requirements was done, as all hospital buildings is historical buildings with specific needs. In consultations with technical experts was chosen specific only suitable e-vehicles. Main aspects that was considered: the size of e – vehicle should fit the sizes of hospital corridors and elevator, the e - vehicle should have speed limit in the territory of hospital (10 km/ h), the e – vehicle has additional sound, when it is use (special requirement for the security reasons). As a result, the best suitable e-scooter was selected: **Model: Shoprider Explorer Speed: 10 km/h. Weight: 300kg. Range: 30 km. Recharging: 8 h. Charger: 220v**

Cemetery area – Matisa graveyard is located in centre area of Riga city and quires 13,2 hectare. Graveyard was founded in year 1871 and is one of the largest in area. In 2019 it was decided to test one four-wheel e-scooter in cemetery area. Investigation of the cemetery was made before selection most suitable e-scooter. Cemetery workers made some specific technical requirements, that include: cemetery roads have different surface – asphalt and dirt road. Both roads are well maintained, however is should be taken in to account that during early spring, late autumn and winter period, dirt road can be transformed in the soft cover, so e -vehicle should be capable to drive in such conditions, cemetery roads have steep slopes, so e -vehicle has to have powerful engine and large studded tires, cemetery roads have different width, e – vehicle should ensure passenger transportation and technical equipment transportation (passenger wheelchairs for example).

Most suitable four wheel e-scooter was selected model: Melex Diamond S Speed: 16 km/h (factory settings max 24km/h). Weight: 850 kg. Range: 60 km. Recharging: 8 h. Charger: 220v

### Result

During conducted testing period results was gathered. Riga 1st hospital around 6 km per e - vehicle per day with max speed 10 km/h; at least 8 patients per day per

scooter; charging once per 3 days per night (guards are responsible for the charging; no technical problems), also positive reviews from the patients are coming in daily: the e – vehicles are used to move patients between 4 departments of Heart Surgery Division. It has been noticed that e – vehicles significantly improve the mobility not only of the patients but also to the sanitaria's. It is important also to stress out that e – vehicle charging is easy to be realized in the territory of the hospital. The charging can be done in any of 23 buildings. This was additional benefit for e – vehicle using in hospital. It increases the mobility of e – vehicles and its users. The night guards are the ones, who are in charge of e – vehicles charging. The trainings of e – vehicle using was organized, for those staff members who showed willingness to use e – vehicles. It was decided that there will be one person, who is in charge to take decision of e – vehicles using. There are 2 permanent sanitary who are using e – vehicles in the hospital.

In cemetery area selected results was gathered: the e – vehicle is used from Tuesday to Sunday, which are the days, when cemetery is open for the visitors. It is charged once per day, during the night. Average distance that e – vehicle drives per day is up to 30km. Only positive feedbacks are received from the visitors of the cemetery, which use the e – vehicle. When the e – vehicle was provided to the cemetery, practical training of e – vehicle using and maintenance was given to the cemetery staff. Due to the fact that e- vehicle is used out door, specific garage was built for its storage. Every evening it is technically cleaned form the dusts and other dirt. The testing of e – vehicle using in the cemetery is still going on.

## Lessons learned

From gathered results some lessons were formed. Riga 1st hospital: it should be taken into account that the staff working in the hospital is mainly older generation, thus it was found out that not all staff members are capable to use e – vehicles. As still many hospitals (or parts of hospital) are located in the buildings which were build century ago, it is important to takin into account that the premises sizes will be different from the recently build hospitals. Thus, should be noted when the type of e – vehicle is selected. the main benefits:

- E – vehicles increase the capacity of employees
- Social inclusion is significantly raised up for the patients
- Technical maintains of the e-vehicles are easy to realize

As the main positive outcomes should be mentioned: easy to use and maintain, no sound (only warning sound), no smell, no gas emissions, can be used indoors and outdoors, for both visitors and staff makes it easy and fast to move in the hospital area, increase stuff productivity, increase social inclusion, easy to recharge the battery. And one negative aspects: older generation staff is not capable to use it.

During testing period it was found out that some additional testing must be done. In Riga 1st hospital, it would be important to test model, when e- vehicle is used both for patient transport and medical equipment transport at the same time and separate. This combined approach could ensure 100% usage of the e – vehicle daily. It also should be more careful tested if hospital need additional e-scooters, so that all departments have their own. As well it is important to understand in which divisions of the hospital, the e – vehicle usage would fit the best. One of the most important issues is trainings for the medical staff to use the e – vehicles. For better results experience exchange between different hospitals or medical organizations.

The main lessons learned from cemetery area: it should be taken into account specific road conditions in particular cemetery (surface; weather impact) selecting e-vehicle. People are visiting cemetery all year along. Taking in account that the weather conditions is seasonal, the e – vehicle has to have possibility to protect from rain and wind in cold season and ensure pleasant drive in the hot season. These aspects are important to ensure positive passengers' attitude for the e – vehicle usage in the cemetery. Due to the fact that e - vehicle has almost no sound, cemetery visitors haven't

had any objectives for this transport usage in the area. It should be stressed out that any kind of transport usage in the cemetery has been forbidden historically in Latvia. E-vehicle also provides transportation of freight and visitors property (wheelchairs). Social inclusion is significantly raised up for the cemetery visitors.

As the main positive outcome should be mentioned: no sound/ tolerant for the specific of the cemetery: significantly improve the visitors' mobility in the area, increase social inclusion and significantly improve the staff mobility in the area.

During testing period, it was found out that additional testing is needed. As the main unsolved issue was need to increase knowledge for all visitors of possibility to use e-vehicle and test the e – vehicle usage in all 4 seasons. Must consider visitor information campaign of e – vehicle usage possibilities in the area.

## Conclusion

Energy supply, production industry, transport, residential and commercial, agriculture, and waste are the main greenhouse gas (GHG) pollutants in the world. European Union's biggest three pollutants are energy supply, transport, and production industry that include Latvia's three biggest pollutants from energy supply, transport, and agriculture. By 2050 electric transports are expected to be dominant vehicles because they do not emit GHG emissions and almost do not emit fine particulates at the same time reducing noise in cities. E-cars are just one of fast-growing e-mobility forms.

The spread of electric vehicles is not large in Latvia. That could be explained by the lack of alternative fuels regulations and aid, thus not promoting their wider use. The National Energy and Climate Plan for 2021-2030 (NECP 2030) will be a key document for formulating long-term energy and climate policies of Latvia. The plan's main objective is to facilitate the development of a climate-neutral economy in a sustainable, competitive and secure manner. In many areas certain support tools are needed for e-mobility to develop to a sustainable level, which is also known as reach of critical mass. Although electric cars date back to 19$^{th}$ century, it is only now, when climate crisis is near, that there is pressure to adapt them as main option.

As the society understands better the influence that transport has on the environment, many seek to have alternative means of transportation. In many cases it results in a more efficient transport. In search for new solutions and better paths for clean energy different transport companies create new, innovate products. E - scooters has been such one product that has gained rapid growth. As market has grown different models are available, that allows to find best suited one for needs.

As most of the EU countries, Latvia aims to reach its goals as the main goal being climate friendly country. E-mobility allows to reach some of these goals and helps to create more non polluted areas where it is used. In research for better environment friendly solutions, it is important to look in direction with existing infrastructure and also creating new sustainable infrastructure.

Worldwide demand of different type of e-vehicle grow, e scooter vide usage and demand allows manufacturers to introduce new concepts and types and modules. In Latvia several models are in use already. E-scooter wide usage as low speed vehicles,

neighbourhood electric vehicles, electric mobility scooters are the fastest growing category of transportation in the past 5 years. Latvian entrepreneurs experience providing e-scooters to deal with social inclusion and to increase accessibility of public places. The common features, which can be considered as the main benefits of this group.

One of most common challenges, that faces cities in EU to preserve the mobility of elderly people or people with particular mobility requirements. Exist environment, where foot walks are often impossible because of different limited reason such as gas emission and noise pollution limits, long walking areas, different road surface. In all these cases there must be found solution. The provision of e-scooters is one potential solution to address this particular challenge. Riga's pilot cases for social inclusion for elderly and people with movements disabilities were conducted keeping in mind that there was no pre-existing infrastructure. In both places e-scooters were addition to employee's workplace. As results showed, that in both places e-scooters gave only positive feedback both from employees as well from visitors that used e-scooters. In conclusion, possibility of e-scooter use for social inclusion shows a lot of potential. Also they have been used in different private companies, there has not been tested their wide usage in municipalities.

E-mobility can be affective way, that helps to achieve climate neutral transport goals. Different pilot research activities have shown good results and should be integrated in wider usage.