MUSE

Cross-border Cooperation for Energy-Efficient Sustainable University Mobility

Guidelines for Public Administrations related to energy efficient mobility

Interreg
ITALIA-SLOVENIJA
UNIONE EUROPEA
EVROPSKA UNIJA

MUSE

Progetto standard co-finanziato dal Fondo europeo di sviluppo regionale
Standardni projekt sofinancira Evropski sklad za regionalni razvoj

REGIONE AUTONOMA FRIULI VENEZIA GIULIA

Unione Territoriale Intercomunale del Noncello

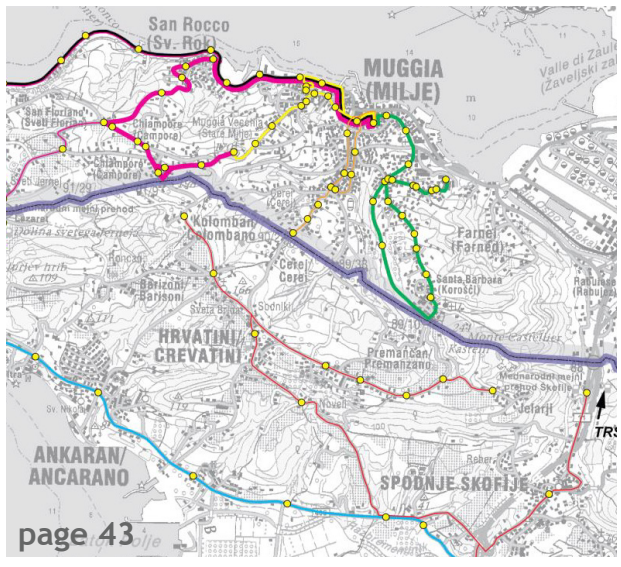
UNIVERSITÀ DEGLI STUDI DI TRIESTE

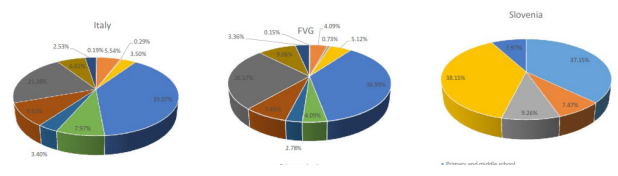
UL 100 Univerza v Ljubljani

RRA LUR
regional development agency of ljubljana urban region

RRA severne Primorske
Regijska razvojna agencija d.o.o. Nova Gorica
Regional development agency of northern primorska L.t.d. Nova Gorica

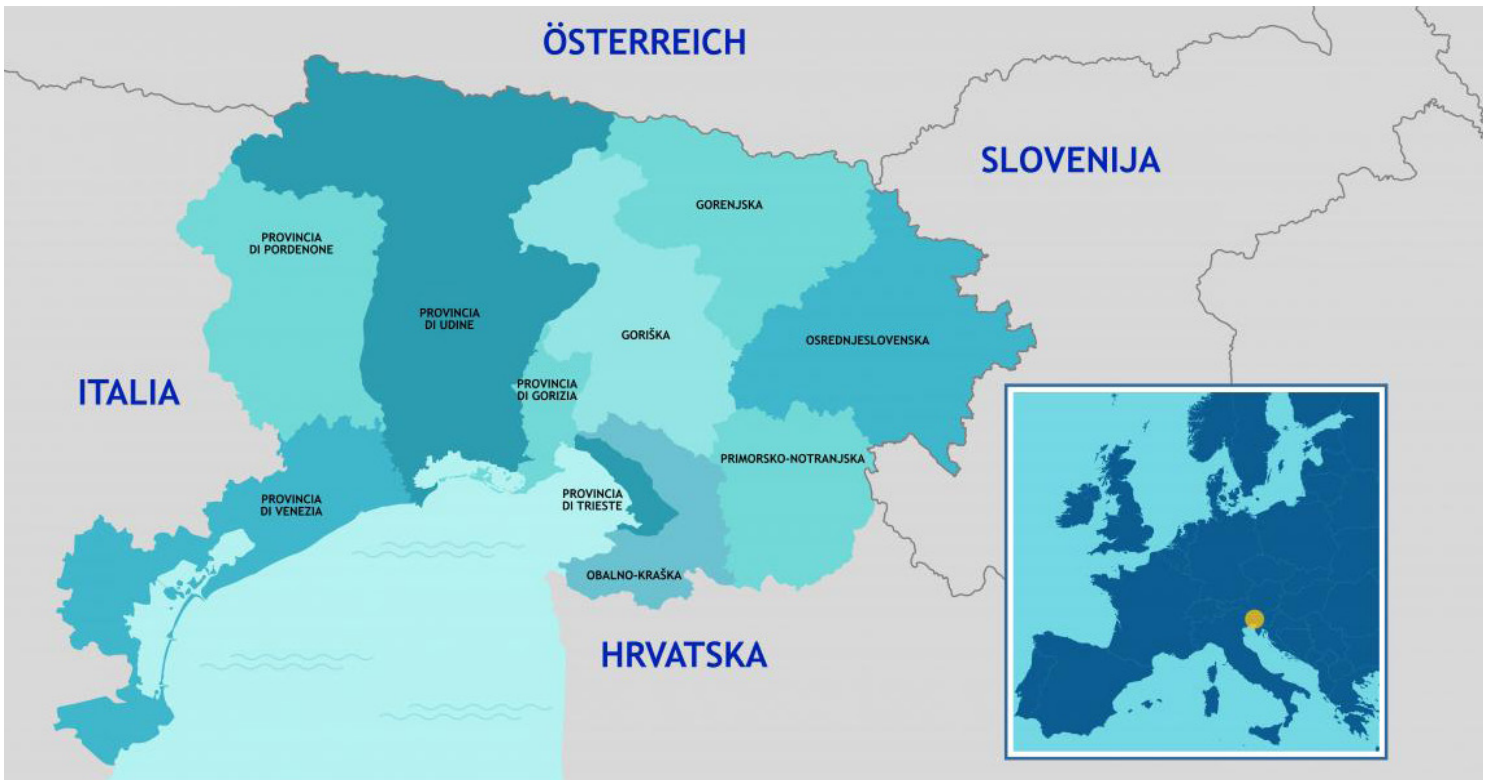
Content





INTERREG V-A ITALY-SLOVENIA - MUSE PROJECT

The INTERREG V-A Italy-Slovenia was approved and officially noticed by the European Commission in 2015. The Programme area extends over a total surface of 19,841 km² and has a total population of approximately 3 million inhabitants. The entire Programme area includes 5 Italian NUTS3 level regions (provinces of Venice, Udine, Pordenone, Gorizia and Trieste) and 5 Slovenian statistical regions (statistical regions of Primorsko-notranjska, Osrednjeslovenska, Gorenjska, Obalno-kraška and Goriška). Overall, on NUTS2 level on the Italian side, the regions involved are those of Veneto and Friuli Venezia Giulia, while for the Slovenian side, Vzhodna Slovenija and Zahodna Slovenija as highlighted in figure.



MUSE (CROSS-BORDER COLLABORATION FOR ENERGETICALLY EFFICIENT SUSTAINABLE UNIVERSITY MOBILITY) is one the projects co-financed by INTERREG V-A Italy-Slovenia programme (2014-2020) under Priority 2 axis (cooperating for implementation of low carbon strategies and action plans). The MUSE project brings together 6 partners (3 Italian and 3 Slovenian), and 5 Associates (3 Italian and 2 Slovenian) in a close partnership The project aims to integrate energy efficiency and a reduction of CO2 emissions within the urban and extra-urban mobility strategies of the cross-border local authorities by testing innovative electric mobility services and by increasing the responsibility of the Public Bodies themselves, with the goal of ensuring the integrated planning of sustainable mobility.

The project's primary objective is to develop guidelines and an action plan for the local Public Bodies regarding the integration of energy efficiency elements within the urban, extra-urban and cross-border mobility context. Thanks to the MUSE project, Public Administrations (PAs) will improve their ability to plan low environmental impact mobility services, while students and university employees will have more sustainable mobility services at their disposal during the implementation of the pilot measures.

In particular, during the course of the pilot measures, the project will implement and test energy efficient mobility solutions involving the use of electric vehicles (EVs) inserted within a micro-grid logic, the production of energy using renewable sources, and the use of smart systems for monitoring and managing the mobility services themselves, with the support of ICT. Universities and research centres will capitalise on the research and studies carried out in the fields of sustainable mobility, energy efficiency in terms of CO2 reduction, and energy balances in the transport sector, while the

PAs will capitalise on the innovative initiatives envisaged by the project territories' SEAPs and SUMPs. This collaboration will lead to increased knowledge and responsibility on the part of the public administrations.

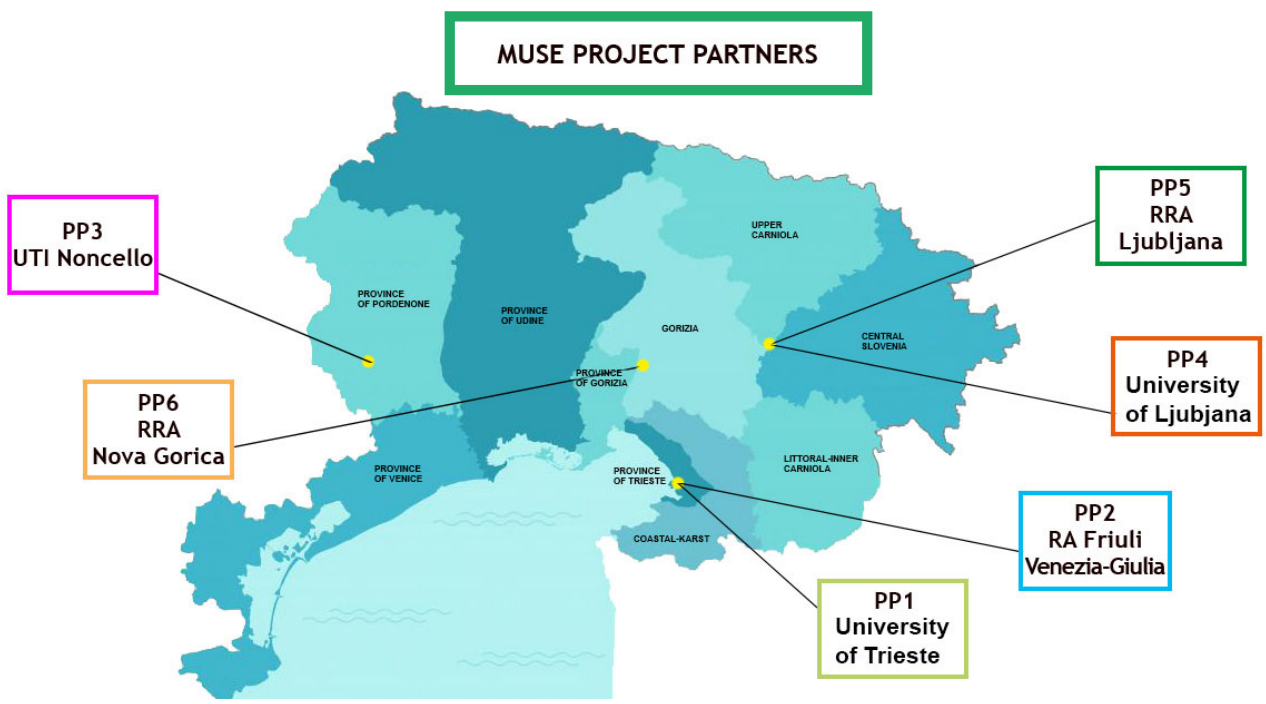
The development of a Cross-Border Community that fosters dialogue and the exchange of experiences and information between PAs, Research Centres/Universities, and operators in the transport sector will ensure the durability of the project's results, and will lead to greater awareness of eco-sustainable behaviour among citizens.

In fact, citizens will have the opportunity to adopt or reinforce their eco-sustainable urban, suburban, and cross-border mobility behaviour thanks to the low carbon mobility services implemented by the partnership and promoted by the Cross-border Community.

The ultimate objective of the INTERREG V-A Italy-Slovenia programme is to promote innovation, sustainability and cross-border governance to create a more competitive, cohesive and liveable area.

As part of WP 3.1, this report numbered 3.1.1 presents a guideline and useful information of sustainable and energy efficient mobility both in country and university level for PAs. It can be used by PA who are involved in introducing and / or improving new policies related to the sustainable and energy efficient mobility.

More detailed information regarding "Territorial and transport information of Italy and Slovenia", "Best Practices related to MUSE", "Accomplished projects by MUSE PPs", "PPs projects related to MUSE AF", and "National Energy Efficiency Action Plan Overview for Slovenia and Italy" can be accessed through Deliverable No. 3.1.1-1, 3.1.1-2, 3.1.1-3, 3.1.1-4, 3.1.1-5 respectively.



ITALIAN PARTNERS

LEAD PARTNER

Università degli Studi di Trieste - Dipartimento di Ingegneria e Architettura

Trieste- ITA

The Department of Engineering and Architecture (DIA) of the University of Trieste, lead partner of the MUSE project, is paying particular attention to the quality of life of students and commuter employees by improving their mobility. The multidisciplinary team of researchers from the fields of transport economics, engineering, social sciences and geography, aims to create a database and a model capable of estimating the habits of use and charging of electric vehicles, useful to support the institutions in sustainable mobility planning. To achieve this goal, the academics involved in the project are also working to create a research center on the topic of Transport-Energy-Environment at the University, catalyst and pivot of a cross-border network.

www.units.it

PROJECT PARTNER 1

Regione Autonoma Friuli Venezia Giulia - Direzione Ambiente ed Energia - Servizio Energia

Trieste - ITA

RAFVG is implementing the measures established by the European Commission to promote the transition to a low-carbon economy, reducing urban pollution caused by internal combustion engines and increasing the production of energy from renewable sources, thus contributing to the achievement of the EU objectives for the protection of the environment and the fight against climate change set for 2020 and beyond. In the MUSE project, RAFVG will support the drafting of guidelines relating to the integration of the Sustainable Energy Action Plan (SEAP) and the actions of the Sustainable Urban Mobility Plans on Energy Efficiency and Sustainable Mobility (SUMP) in the tools mobility planning, as well as the drafting of an action plan on cross-border mobility of university students and employees. RAFVG will also collaborate for the creation of the cross-border community to increase skills and awareness on mobility planning and the integration of energy efficiency thanks to the networking of universities and research centers, public administrations and private operators.

www.regione.fvg.it/rafvg/cms/RAFVG/ambiente-territorio/

PROJECT PARTNER 2

Unione Territoriale Intercomunale del Noncello

Pordenone - ITA

The Noncello Inter-municipal Territorial Union is a local public body of Friuli Venezia Giulia, which brings together the Municipalities of Pordenone, Roveredo in Piano, Porcia, Zoppola, Fontanfredda. In the MUSE project, he is responsible for contributing to the development of a cross-border community between public administrations, organizing the exchange of good practices and personnel and coordinating the networking and development actions of the network of stakeholders through political and technical tables. It is also responsible for the implementation of the pilot project at the Municipality of Roveredo in Piano, which consists of two stations for charging electric vehicles (one for cars and one for bicycles), powered by electricity produced by a photovoltaic system installed at the Municipality itself.

www.Noncello.utifvg.it

SLOVENIAN PARTNERS

PROJECT PARTNER 3

Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo Prometnotehniški inštitut

Osrednjeslovenska - SLO

Univerza *v Ljubljani*

The issue of sustainability is one of the most important global issues and is the greatest challenge for the future development of cities. Ljubljana is achieving very high environmental standards, setting ambitious goals for the further improvement of environmental conditions. With more than 40,000 students, the University of Ljubljana trains high-profile scientists, artists and skilled professionals to lead sustainable development, drawing inspiration from the European cultural heritage of the Enlightenment and Humanism. Thanks to the results of the studies for the MUSE project, the University wants to outline an environmentally friendly approach to daily commuting, contributing to environmental sustainability and reducing emissions, especially by promoting the use of bicycles.

www.uni-lj.si/

PROJECT PARTNER 4

RRA SEVERNE PRIMORSKE Regijska razvojna agencija d.o.o. Nova Gorica

Goriška - SLO

RRA severne Primorske
Regijska razvojna agencija d.o.o. Nova Gorica

The Nova Gorica Regional Development Agency (RRA-SP) offers advice to Municipalities and other Public Administrations in the preparation, management and monitoring of local, regional, cross-border and international development projects thanks to its important role in the integration of interests and local and regional resources and specific skills in the sectors of economic development and mobility at regional level. In the MUSE project, RRA-SP acts as a regional development agency, promoting the improvement of cross-border cooperation in the sustainable development of the territory, in synergy with mobility systems and in particular with cycling. To achieve this goal, RRA-SP will coordinate the partners, divided into working groups, in the development of an educational package for the training of the staff of public bodies and professionals competent on the subject of energy and transport. The didactic material produced will represent the basis for the creation of a new cross-border experimental course of higher education, established thanks to the coordination between the Universities of the Program area.

www.rra-sp.si

PROJECT PARTNER 5

Regionalna razvojna agencija Ljubljanske urbane regije

Osrednjeslovenska - SLO

RRA LUR
regional development agency
of ljubljana urban region

RRA-LUR is a public body competent for the preparation, coordination and implementation of the regional development programs of the 26 municipalities of the urban region of Ljubljana (LUR). As technical support to decision makers and regional advisory bodies, RRALUR is in charge of the balanced and inclusive development of the region through strategic planning, coordination and development of projects in the fields of economy, traffic, infrastructure, environment and rural and territorial development. In the MUSE RRA-LUR project it will share its experiences, studies, knowledge bases and action plans to support the drafting of an integrated strategy for transport, the integration of local energy concepts with sustainable mobility, the increase of skills of the main stakeholders of the region (municipalities, transport operators, policy planners), the implementation of a pilot project and the improvement of cooperation with universities and with Italian partners. RRA-LUR will also develop a document that will define the pilots development and coordination methodology, defining the criteria for monitoring progress and evaluating results to produce a final report.

www.rralur.si

1. Introduction

MOST of the societies are car-dependent for doing daily activities. Car-dependency is a concept in which commuters are willing to travel and access to the desired destination by (private) cars instead of using other transportation options such as bicycles, public transport, and walking. There are two main reasons for car-dependency movements. The first one is related to the opportunistic nature of people, since using a car is more pleasurable, comfortable, and advantageous. The second reason lies in the designs of urban environments that require the use of car – e.g. parking lots are placed next to the buildings, open-air shopping streets are replaced by shopping malls, city centres with a mixture of commercial, retail, and entertainment functions are replaced by single-function business parks and multiplex entertainment complexes, each with generous parking supply.

Using car as a main transport mode influences road capacity directly and cause traffic congestions (especially in urban areas) that results in the demand for construction of new roads and/or increase the number of existing lanes, in consuming more and more land previously used for housing, manufacturing and other social and economic purposes, and in removal of impediments to traffic flow. Public transport becomes less and less viable, eventually becomes a minority form of transportation, and people's choice and freedom to live functional lives without the use of the car is greatly reduced. Car-dependency is not only an issue of environmental sustainability due to the consumption of non-renewable resources and production of greenhouse gas emissions, but is also an issue of social and cultural sustainability. Car-dependency creates a physical separation between people and reduces the opportunities for an unstructured social encounter.

In the period 1990 - 2015 greenhouse gas emission in the EU have been reduced by 22,1% once several regulations by European Commission entered into force. European Commission provides several proposals and goals such as clean energy for all Europeans, improvement in energy efficiency, and promotion of the use of energy from renewable sources to speed up the transition to the clean energy economy. A comprehensive summary of all proposals and EU regulations regarding energy efficiency has been provided by EU-Winter Package (Hancher & Winters, 2017). Despite a significant improvement in energy efficiency, with an increase in renewable electricity share up to 29% and the impressive cost reduction of renewable power technologies, the full potential of energy efficiency in the EU is yet to be unlocked. The EU has set the ambitious goal of getting half of the electricity from renewable sources by 2030; however, today it merely covers a third of the European economic potential.

Since the buildings are responsible for approx. 40 % of energy consumption and 35% of greenhouse gas emissions in the EU, the first steep EU took towards the energy efficiency, was adoption the directives on the energy performance of buildings and on energy efficiency. Transport, at all levels, with approx. 30% of all energy consumption and more than 25% of greenhouse gas emissions (road transport's share of the total greenhouse gas emissions is 70% of the entire sector), is also one of the main polluters. Although transport has become more energy efficient, it still depends on oil for 96% of its energy needs. European Commission released a comprehensive plan for increasing mobility and reduction of emissions entitled "Transport 2050", where key goals for the different type of trips - within cities, between cities, and long distance are set. By 2050 the key goals of Transport 2050 roadmap, are the following:

- reduce Europe's dependence on imported oil and cut carbon emissions in transport by 60%;
- no more conventionally-fuelled cars in the cities;
- 40% use of sustainable low carbon fuels in aviation; at least 40% cut in shipping emissions;
- a 50% shift of medium distance intercity passenger and freight journeys from road to rail and waterborne transport, all of which will contribute to a 60% cut in transport emissions by the middle of the century.

Although there is remarkable progress on legislative and political levels in recent years, EU countries need to implement strategies to change the consumers' and enterprises' energy consumption habits and to promote efficient energy use. EU member states can gain the EU's 2030 climate targets and become more environmentally-sustainable by creating more opportunities for green jobs and green growth, investment in energy efficiency and renewable energy projects.

How can be the car-dependency issue tackled?

By understanding the weaknesses of car-dependency and at the same time increasing awareness of positive effects of sustainable transport modes on the individuals, society, and environment, new concepts of urban planning and transport policies have been introduced. Opposite to car-dependency movement, car-free movement refers to the sustainable urban design and transport policies in which residents

are encouraged to use green transport modes instead of the owned car. The main goal of car-free development is improving the sustainable and energy efficient mobility by greatly reducing or eliminating, or converting road and parking space to other public uses and to rebuild compact urban environments where most destinations are easy-to-reach by walking, cycling, public transport, and low impact vehicles.

Some governments have responded with policies and regulations aimed at reversing car-dependency by increasing urban densities, encouraging mixed-use development and infill, reducing space allocated to private cars, increasing walkability, supporting cycling and other alternative vehicles similar in size and speed, and public transport. The most-successful solutions in the transport sector for decreasing car-dependent journeys and increasing car-free (less-car) intensive lifestyle are **multimodal**, can be referred to also as **mixed-mode or intermodal transport** and **shared mobility** systems. Some of the shared mobility systems, such as bike-sharing and car-sharing systems, can be used as part of the multimodal transport system. However, generally, in shared mobility systems, the commuter uses just a specific shared system for traveling from origin to the destination while in the multimodal transport system commuters are encouraged to use a combination of some transport modes utilizing public transport benefits.

Mobility vs. Accessibility

Mobility is how far you can go in a given amount of time. Accessibility is how much destinations you can get to in that time. In simpler term, mobility refers to the distance you can travel in a given time period,and accessibility refers to the number of destinations and activities you can reach in that time. For instance, the most productive places are the most congested and the most access-rich have low mobility .

Multimodal transport

As a part of sustainable land-based transport, the ultimate goal of multimodal transport is to decrease the number of car-dependency journeys by using shared mobility and public transport systems. Multimodal transport contains two or more transport modes in a journey combining the strengths (and offset the weaknesses) of various transportation options such as walking, cycling, or driving with the benefits of public transport. In multimodal transport for the begging and/or end of the journey, the commuter is encouraged to use public transport systems due to 1) higher passenger capacity, 2) vast network covering urban environments, and 3) being environmentally-friendly transport mode.

The most widely used modal inter-urban transport systems are:

- park-and-ride: the commuter parks the car in the nearest point to the shared mobility systems or the public transport station;
- kiss-and-ride: the commuter is driven to the public transport (e.g. train, bus, ferry) station by a friend or relative (e.g. parent, spouse) when a station is close to home;
- bus (i.e. feeder buses) to public transport nodes;
- bike-and-ride: the commuter use bike to the nearest public transport station, where bike-parking area available close to the public transport station is needed.

Multimodal commuting is used for the inter-regional transport as well. In this regard, commuter often starts the trip employing a rapid transit mode such as a regional train, then uses one or more low-speed transport modes e.g. bus, tram, or bicycle to reach the destination. The effectiveness of a multimodal transport can be evaluated as travel time to the destination, convenience, safety, or environmental impact. Because commutes using multimodal transport rely on a certain degree of coordination, scheduling can often be an issue. For example, if a commuter needs to take a late train occasionally it would be an annoyance, but if a commuter needs to take late train regularly this can make commuting impractical.

The multimodal transport system has been globally considered for travelling to the most trip attractions points such as educational institutes, medical centres, and industrial parts.

Multimodal transport increases environmental benefits (e.g. less pollution) and reduces traffic congestion, enables significant cost savings to the city and local government. Nowadays, well-known navigation companies, like Google Map Transit and Rome2rio, has been proposing and planning a multimodal commuting to the passenger who wants to make an inter-urban or inter-regional journey using existing transport alternatives.

> The weather can be a decisive factor in choosing the (multiple) transport mode. Even when the use of a car is involved in the transition from one mode of transportation to another, commuters are exposed to weather conditions. As a result, multi-mode commuters often travel prepared for inclement weather.

Shared Mobility

Shared mobility is a demand-driven vehicle-sharing arrangement system where travellers share a transport mode either simultaneously (e.g. ride-sharing) or over time (e.g. car-sharing or bike-sharing). Shared transport is one of the well-implemented strategies for reducing greenhouse gasses and other emissions from the transport sector in the face of the global climate emergency by finding ways of getting more less-car intensive lifestyle on theroad Most known shared mobility system is hitchhiking, car-pooling, car-sharing, bike-sharing, demand responsive transport, and the most recent one is E-scooter sharing.

> Intermodal commuting can combine the benefits of walking and cycling with the benefits of rapid transit. The use of a bicycle can, for example, make a 20-mile light-rail or suburban rail journey attractive even if the endpoints of the journey each located 1 mile out from the stations. As another example, the 30 minutes walking time becomes 8 minutes bicycling.

> Research has shown that in the United States, services like Zipcar, have reduced demand by about 500.000 cars. In the developing world, companies like eHi, Carrot, Zazcar, and Zoom have replicated or modified Zipcar's business model to improve urban transportation to provide a broader audience with greater access to the benefits of a car and provide "last-mile" connectivity between public transportation and an individual's destination.

2. Sustainable (green) and energy efficient transport

SUSTAINABILITY is OFTEN defined as a balance of the three E's: the environment, the economy, and social equity, commonly referred to as the "three pillars" of the sustainability.

Sustainable transport refers to the broad subject of transport that is sustainable in the senses of social, environmental and climate impacts and the ability to, in the global scope, supply the source energy indefinitely. All proposals released by European Commission (2017) emphasizes on the role of sustainable mobility and biofuels and aimed at encouraging EU governments' for innovation in low-emission vehicles, alternative fuels, promotion of multimodal transport and alternatives to the use of a car.

> Ride-sharing and renewable energy sources are critical to provide a 40% reduction in urban vehicle transportation costs globally by 2050. And "there can be an 80% cut in CO2 emissions if cities implement sustainable transport aspects in-vehicle technology: automation, electrification, and, most importantly, ride sharing". (ITDP & ITS-Davis, 2017)

Energy efficiency in transport is the travelled distance of passengers or goods divided by the total energy put into the transport propulsion means. There are several kinds of energy used by the transport sector including liquid fuels, and electrical sourced by fossil and renewable energies (solar, wind). The opposite definition of the energy efficiency in transport is the energy (fuel) consumption which is often used confusingly. To avoid the confusion between energy efficiency and fuel consumption, metre per Joule (m/J) has been used for energy efficiency measurements while Joules per meter (J/m) has been used for energy consumption in transport. In simpler term, "the more efficient the vehicle, the more metres it covers with one Joule (more efficiency), or the less Joules it uses to travel over one meter (less consumption)".

Energy efficiency and energy consumption for different types of road transport modes are summarized in Table 1.

It is recommended to take the following consideration into account regarding the energy efficiency of transport modes for making a fair comparison. Someone believes that the energy cost for producing a vehicular system should be considered during the comparison of different kind of transport modes. For instance, walking requires little or no special equipment while cars need a great deal of energy for production and have relatively short lifespans.

Some others believe that the vehicle energy efficiency calculations would be misleading considering energy cost of producing the vehicle itself. This initial energy cost can, of course, be depreciated over the life of the vehicle to calculate an average energy efficiency over its effective lifespan. In other words, vehicles that take a lot of energy to produce and are used for relatively short periods will require a great deal more energy over their effective lifespan than those that do not. These vehicles are therefore much less energy efficient than they may otherwise seem. As an example, hybrid and electric cars use less energy in their operation than comparable liquid-fuelled cars, but more energy (avg. 34.700 kWh) is used to manufacture them compared to liquid-fuelled cars (avg. 20.800 kWh), so the overall difference would be less than immediately apparent.

It is important to note, also, that as these are average numbers for French cars and they are likely to be significantly larger in more auto-centric countries like the United States and Canada, where much larger and heavier cars are more common.

Table 1. Energy efficiency and consumption of land passenger transport means (National Research Council, 2011)

Mode of transport	Energy Efficiency			Energy consumption		
	km/MJ	m/J	(m.pax)/J*	MJ/100 km**	J/m	J/(m.pax)
Human propelled						
Walking	4.55	0.00455	0.00455	22	220	220
Velomobile	55.56	0.05556	0.05556	1.8	18	18
Bicycle	9.09	0.00909	0.00909	11	110	110
Motor assist						
Motorized bicycle	8.33	0.00833	0.00833	12	120	120
Electric kick scooter	24.87	0.02487	0.02487	4	40	40.21
Automobile						
Solar car	14.93	0.01493	0.01493	6.7	67	67
Petrol/Diesel fuelled cars	0.12-0.77	0.00012-0.00077	0.00015-0.00092	96-822	960-8220	800-6850
Electric/Hybrid cars	0.7-2.65	0.0007-0.00265	0.00084-0.00317	37.8-143.5	378-1435	315-1196
Buses						
MCI 102DL3	0.07	0.00007	0.00082	1335	13350	1213.64
Trains						
Urban rail						432
CR400AF (CN)- CP-Lisbon (pt)			0.0015-0.01304			666.67-76.67

* For passenger transport, the energy efficiency is normally measured in terms of passengers times distance per unit of energy, in the SI, passengers metres per Joule (m.pax)/J.
** Volume of fuel (or total energy) consumed per unit distance per vehicle; e.g. L/100 km or MJ/100 km.

2.1 Green Transport Modes

Generally, green transport modes as known as Eco-Mobility refer to the transport modes which are in accordance with the sustainable transport objectives. Eco-mobility stands for environmentally friendly transport options where all groups of people feel valued and integrated. Eco-Mobility consists of walking, cycling, EVs powered by electricity from renewable energy sources, and green public transport. These transport modes have low to no emission compared to the personal cars powered by fossil fuels.

Walking is the most recommended energy efficient transport mode in the context of sustainable mobility because of its zero-emission aspect.

Micro-mobility is referred to transport modes namely bike, Scooter, and Segway. A standard lightweight bicycle both in normal and electric pedal-assisted (E-Bike) is one of the most energy-efficient forms of transport. Compared to the walking (22 MJ), a 64 kg cyclist riding at 16 km/h requires about half the food energy per unit distance (11 MJ)[1]. This is equivalent with 0.321 L/100 km means that a bicycle will use between 10-25 times less energy per distance travelled than a personal car, depending on fuel source and size of the car. In addition, because of the lightweight (usually between 7–15 kg) of bicycles, it requires very low amounts of materials and energy approx. 100-200 times less energy to produce compared to a car weighing 1.500 kg or more.

Exp. Bike sharing system, Ljubljana, Slovenia

	Walking	Bike	E-Bike
Avg. Speed (km/h)	4	16	30
Energy Cons. (MJ)	22	11	3.6

Exp. E-Bike sharing system, Kranj, Slovenia

Electric kick scooters typically have a maximum range of under 30 km and a maximum speed of roughly 25 km/h. Intended to fit into the last mile niche and be ridden on the bike lanes, they require little skill from the rider. Because of their light weight and small motors, they're extremely energy efficient.

The Segway Personal Transporter was developed from the self-balancing iBOTwheelchair which was initially developed at the University of Plymouth in 1994. Recently, battery power and its recharging time, self-balancing ability, safety & security level of Segway is improved by international companies. It is used for different mobility aspects such as tour devices for tourist or policemen, mobility tool for employee inside the huge building like Airport or university campuses.

Exp. Sidewalk corral for shared e-scooter in Santa Monica, USA

Exp. Segway tour in University of Michigan, USA

1 27 kcal/km or 43 kcal/mile ≈ 3.1 kW · h ≈ 11 MJ per 100 km

Green cars - The car powered by fossil fuels is an inefficient mode considering sustainable transport objectives. However, cars have remarkable mode-shareamong all transport options for commuters in the urban and suburban area and it is impossible to shift the whole mode-share of private cars to other transport modes. Recently, transport authorities try to shift some part of the car users to Eco-Mobility. This is the main reason that urban transport authorities in EU, like other parts of the world, encourage commuters to use green cars powered by biofuels such as electricity and hydrogen. Because of being more energy efficient, electric-based cars are used more than hydrogen-based cars.

Electric car sharing system, Ljubljana, Slovenia

Green Public Transport (e.g. E-Bus)

By implementation of eco-mobility in the cities, the need for public transport usage has been increased. Then, transport authorities have to use green powered public transport modes instead of regular public transport vehicles.

According to a European Commission project; Zero Emission Urban Bus System (ZeEUS), it is obvious that the electrification of public transport has high priority for cities, public transport agencies, and operators to help cities save money, improve health and cut greenhouse gas emissions.

The greatest number of electric buses is operating in the UK, with over 18% of the total European fleet, followed by the Netherlands, Switzerland, Poland, and Germany, with around 10% each. In order to accelerate deployment, countries such as France, Germany, Italy, and the UK have set up, or are setting up, national legal frameworks to promote vehicles with reduced environmental impact and energy consumption.

A single zero-emissions bus is able to eliminate 1.690 tons of carbon dioxide over a 12-year lifespan, the equivalent of taking 27 cars off the road (Environmental Protection Agency). In 2016, research showed that a city could save about $150.000 per bus just from the reduction of respiratory and other illnesses by transitioning city transit's 5,700 diesel buses to an all-electric fleet. It also showed that the city could cut carbon dioxide emissions across the fleet by 575.000 metric tons per year, and each bus could save about $39.000 per year in fuel and maintenance costs, in addition to the health savings. (Aber, Columbia University, New York, USA)

E-Bus line at the University of Yaoundé, Cameroon

Solar electric bus service in Adelaide, Australia

The upfront cost for a full fleet of electric buses and their charging infrastructure compared to conventional buses are the main challenges of most European cities. But electric bus sector is growing rapidly and will tackle these challenges, driven by advanced technology, more manufacturers, and local efforts to cut greenhouse gas emissions, improve public health and reduce reliance on diesel and gasoline-powered vehicles.

The average lifespan of a diesel bus is about 12 years or 500.000 miles. Replacing an entire fleet with electric buses is expensive and would cost about $300.000 more than diesel buses — but the research shows it pays off.

Converting from diesel fuel to electric bus would save $237.000 in maintenance costs over its lifetime, in addition to the savings from not buying diesel fuel. For instance, a $1 million investment upfront cost per bus, saves $1,76 million in diesel fuel savings over 16 years. On diesel costs alone, that means saving $110.000 per year. (Proterra Company, USA)

2.2 Green Transport Infrastructure

Green transport infrastructures include roads, stations, and required charging facilities used by green transport modes. Green roads-based infrastructure refers to the specific space of the road allocated for a specific transport mode namely walking path (e.g. greenway), cycling paths (e.g. bikeway), and dedicated public transport lanes (e.g. bus lane). It increases the mobility of those specific transport modes by giving priority for their movement.

Stations are another important element of green transport infrastructure. Charging stations based on their application has been provided in the street-side e.g. E-bike or E-Cars charging stations or in terminals e.g. E-buses or E-trains/trams charging stations. Required area for charging stations' implementation, no. of charging lots, and optimizing the location of charging stations in the urban area has become a frontier research topic. In addition, urban planners are faced with different challenges including 1) the integration of charging stations for shared mobility systems with other urban transport modes, 2) demand-supply analysis for every trips' production and attraction points, namely educational institutes, medical centers, business districts, social/leisure activities area, and 3) connectivity needs to urban infrastructures like urban electricity network.

In 2017, the European Commission proposed the Alternative Fuels Infrastructure Directive. It seeks to address consumer anxieties through an increase of public charging infrastructure and sets harmonized requirements for charging connectors as well as for user information requirements. An action plan was implemented to help develop and manufacture batteries. Cheaper, more durable and reliable batteries will help lower prices and thus enhance the European electric vehicle market. Sales of plug-in vehicles and battery EVs have increased by 35% and 51% respectively in 2017 compared with 2016 (European Environment Agency). However, they only account for 1,1% of all new cars sold in Europe. Consumers are reluctant to buy EVs for varying reasons such as high costs, too few charging points inside and outside the cities, and insufficient battery life expectancy.

Development of sustainable charging facilities and producing

user-friendly charging equipment's, both in stations and in the vehicle, has been mostly considered by private and public companies in recent years.

Urban electricity network and solar energy are the most common power sources used for green stations because of their energy efficiency advantages. Although the implementation cost of an urban electric-based station is less than the solar energy-based station, solar energy-based stations are more environmentally-friendly because of using renewable energy.

SLOVENIA

Rooftop-battery-based electric buses began operating in Graz, Austria in November 2017. The buses can be fully charged within 30 seconds by using 60.000 farads super-capacitor as its battery, reducing fuel consumption out of 6 million liters per year for the city. The new buses are 18 meters long, with a maximum capacity of 135 passengers. The facilities inside, including the seats, buttons, air conditioners, and shelves, are optimized for better experiences.

Did you know?

- *Bicycle sharing systems have been introduced in over 230 cities across Europe, most of them in France, Spain, and Italy.*
- *The largest bicycle sharing system in Europe operates in Paris - it has around 20,000 bicycles and 1,800 bicycle stations.*
- *The largest platform for carpooling is the French platform BlaBlaCar with over 20 million members in 19 countries.*
- *The first car sharing system was set up in Zürich in 1947. Today the leading countries in this area are Switzerland and Germany.*
- *People sharing cars on average travel 40% less after they have joined the car sharing scheme.*
- *In 1999 the French city of La Rochelle introduced the first system of electric car sharing.*

Source: European Secretariat, 21.8.2017

3. Transport and mobility

3.1 Transport and Mobility at state level

SINCE Slovenia is a very dispersed country in terms of population (having more than 6.000 villages, towns or cities), similar characteristics are observed with a dispersion of roads infrastructure. Public roads in Slovenia are divided into state roads, owned by the Republic of Slovenia, and municipal roads owned by municipalities. The total length of the public road network is around 38,900 kilometers. Of those, there are around 32,160 kilometers (83%) of municipal and 6,724 kilometers (17%) of state roads.

Data on daily mobility and travel habits

Following the urbanisation processes in the last decades, Slovenia is becoming a more and more urbanised country. With 49 % of the total population leaving in the urbanised areas and 0.18 % annual rate of increase of urbanisation rate, the main commuting points of Slovenia have centralised to the main urbanised areas e.g. Ljubljana urban region (LUR), Maribor region, Kranj, Novo Mesto, Celje, and others. Ljubljana, as a capital with more than 280.000 inhabitants, also accepts the majority of daily commuters working outside the LUR.

Car dependency in Slovenia: statistical data (2017) indicate that residents of Slovenia (aged from 15 to 84 years) on average performed more than 12 billion kilometres on their daily trips i.e. 7,200 kilometres per adult person. They spend on average 76 minutes per day on the way. Almost 60 % of trips were performed with a car. No matter the transport mode used, the average length of one trip was around 13 kilometres, which is a distance easily accessible with EVs (E-car or E-bike). Similar commuting patterns can be defined also for the population of students in Slovenia which daily migrate to the University of Ljubljana. The graph below shows the distribution of trips on working and non-working days by the hour of their beginning.

Considering data on mobility in the time of working and school days, it can be clearly seen that there are different mobility patterns among non-working and working days in Slovenia. On working days, residents and students of Slovenia performed 3.2 trips on average, and on non-working days 2.7 trips. As we usually travel longer distances to recreation areas, length of average trip on a non-working day was about 17 kilometres which is 5 km longer than on working days.

On working days most trips started between 7 and 8 am and return trips began between 3 and 4 pm. On non-working days most trips started between 10 and 11 am. The afternoon rush hour in Slovenia usually lasts until 5 pm when the majority of return trips from faculties or work are already finished.

Despite all the efforts to improve the situation in the field of sustainable mobility at a national or regional level, the car is still largely predominant mode of transport for all trip purposes such as leisure, work or school-related trips. National statistics indicate that there were 21 billion vehicle-kilometres (vkm) driven on Slovene national territory in the year 2017 by passenger vehicles, which is 2 % more than in the year 2016. 86% of all vkm in Slovenia were done by private passenger cars (18.1 billion vkm) and only a small share was performed by the public transport system. Following the pattern of highways, the latest processes of centralisation and dispersion of settlements, we can see why almost half of vkm made in Slovenia (7.2 billion vkm) were driven on motorways and highways.

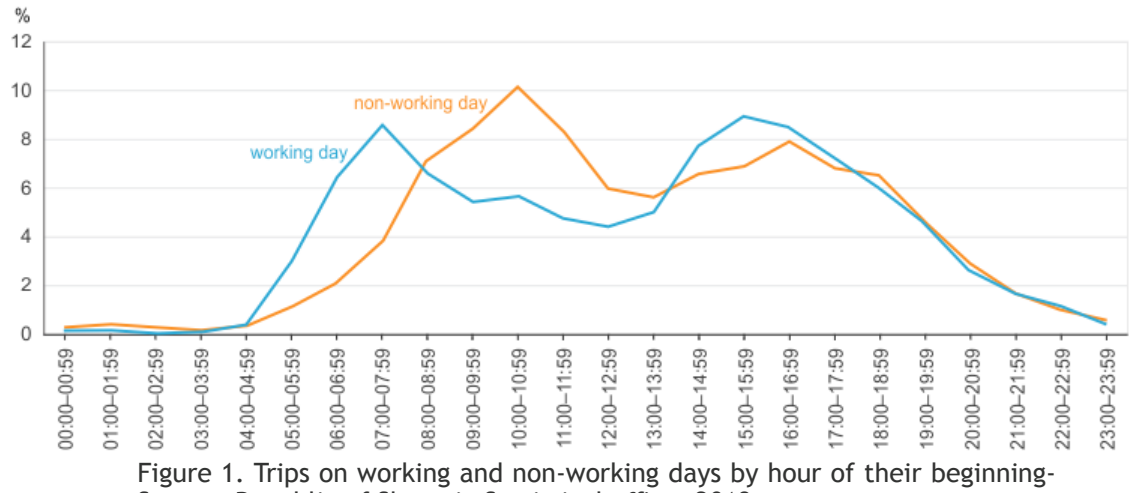


Figure 1. Trips on working and non-working days by hour of their beginning-
Source: Republic of Slovenia Statistical office, 2018

The map below indicates daily commuting patterns in Slovenia for an average working day in the year 2012 which closely follow the patterns of motorways infrastructure of Slovenia.

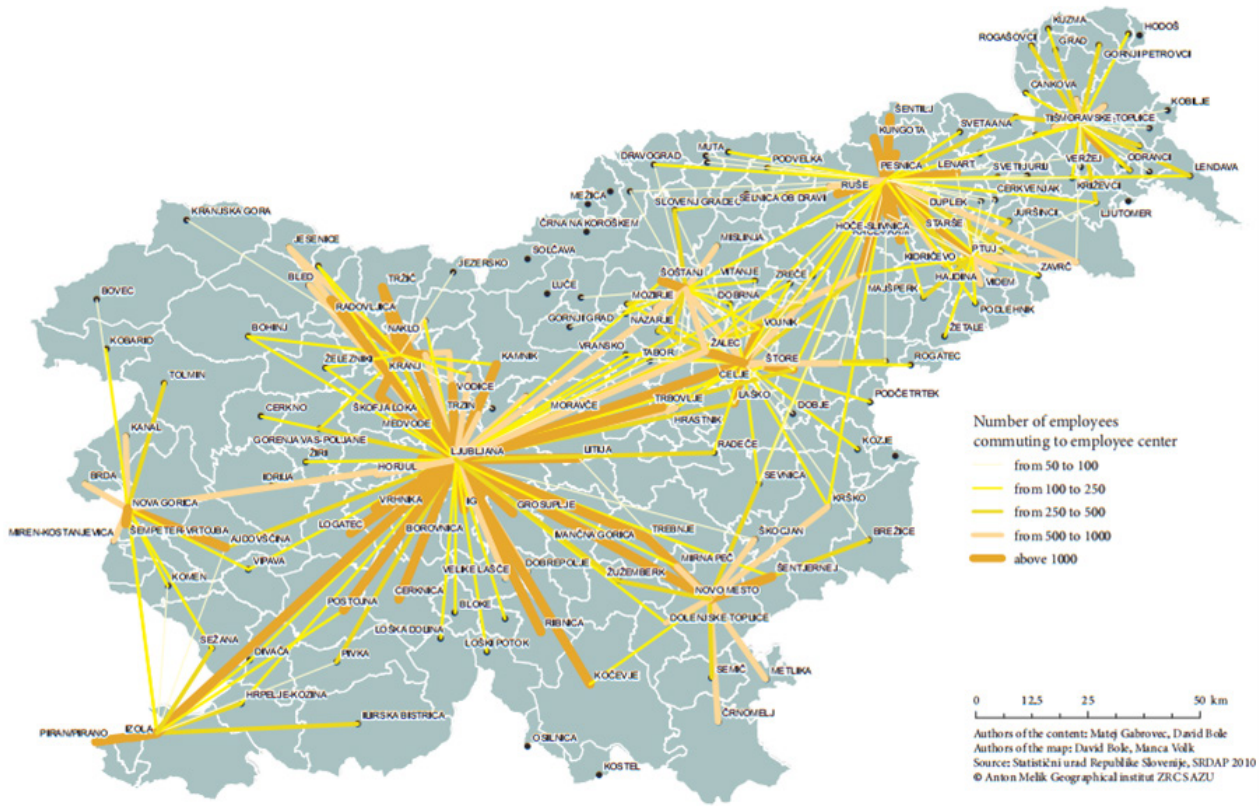


Figure 2: Daily commuters in Slovenia in the year 2012
Sources: http://zgs.zrc-sazu.si/Portals/8/Geografski_vestnik/vestnik-84-1-bole-gabrovec.pdf

Car ownership and modal split

Situation of car ownership in Slovenia is quite dramatic. In recent years the number of passenger cars per 1.000 inhabitants has been increasing after a slight decrease in 2012 and 2013. In 2016 most passenger cars per 1,000 populations were registered in Goriška and Notranjsko-kraška statistical regions (589 and 569, respectively) and the fewest in Zasavska and Podravska statistical regions (491 and 517, respectively).

In the year 2001, there were "only" 442 cars registered per 1.000 inhabitants. The number of registered passenger cars at the end of 2017 was 1.1 million (541 cars per 1,000 populations), which is 3% more than at the end of 2015. In year 2016 car registrations increased by 17% and first registrations of new passenger cars increased by 7% compared to 2015. Preliminary data for the year 2018 show that the first registrations of new cars does not begin to decline. The average age of passenger cars registered in Slovenia was nearly 10 years in 2016, which was the highest value in the last decade.

Observing the data on car ownership, it is quite easy to understand the car-dominant modal split in Slovenia. In two thirds of all trips by car (work- or school-related), there was on average only one person in the car, thus the car occupancy rate was 1.7 (the number is indicative since the real occupancy in cars can vary from 1.3 to 1.7 depending on the urbanisation of the area). Walking was the second most common transport mode on 21.3% of trips; a bicycle was used on 4.5% of trips and public means of transport (bus and train) on 4.3% as a mode of transport in Slovenia.

As indicated in the graph below, the distribution of transport modes is slightly different between working and non-working days. In general, the usage of car increases while usage of public means of transport decreases (decreased quality of service, longer waiting times) during weekends. Data also show that leisure and work were the most frequent purposes of the trips (36.1% and 24.0%, respectively), while the third most frequent trip purpose was shopping (15.1%).

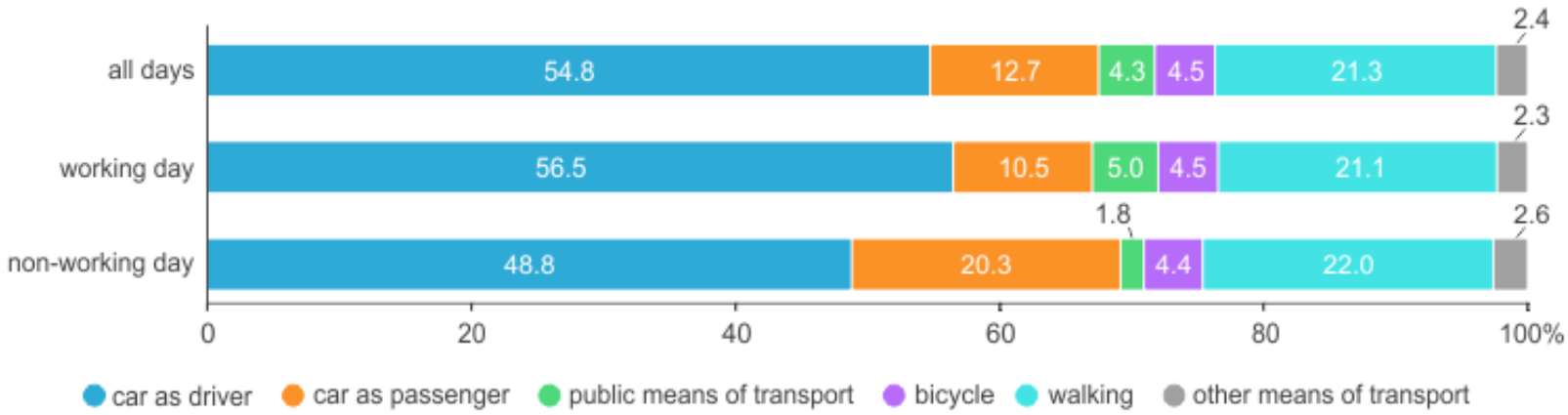


Figura 3. Viaggi per tipologia di mezzo di trasporto e di giorni in Slovenia nel 2017
Fonte: Republic of Slovenia Statistical office, 2018

With the development of e-bikes, the majority of transport in middle range distances could be performed by electric bicycles or public transport instead of cars. Considering the improvement of infrastructure and latest development of e-bikes (e.g. increase of distances, battery capacity, speed), e-mobility could present one of the major improvements in sustainable mobility on the regional level for students. Students who leave in the outskirts of Ljubljana or even in student's homes within the city could commute by e-bikes and thus participate to reduce car dependency within Ljubljana urban region.

SUMP (Sustainable urban mobility plan) & SEAP (Sustainable Energy Action Plan) - Strategy of E-Mobility in Slovenia

According to the Covenant of Mayors' web site, 29 mayors of Slovenian municipalities (out of 212 in total) which represent 30 % of the Slovenian population, has joined the initiative. In the LUR, only the Municipality of Ljubljana (MOL) takes part. In terms of mobility, Sustainable Energy Action plan (SEAP) needs to cover these topics:

- public transport (PT) strategy and measures for its improvement;
- transport study and model;
- sustainable parking policy;
- mobility plans and sustainable mobility promotion;
- bicycle lanes;
- promoting alternative transport means;
- renewing of the municipal transport fleet;

Yes, you can, can!, Source: IPoP

- traffic lights optimisation;
- implementing of the P&R system and limitation of parking in the city centre.

In 2013, the strategy of "Elekromobilnost in MOL" was adopted, with the goal of gradually moving of MOL citizens to environmentally friendly vehicles and adapting the fleet to one of the forms of e-mobility. It should be stressed that not only implementing measures to promote e-mobility should not be in conflict with the basic goal of Municipality of Ljubljana's transport policy i.e. the shift of mobility towards a greater proportion of walking, cycling and the use of public transport. But also, the introduction of e-mobility must, therefore, be integrated into the goal of reducing the use of personal vehicles in Ljubljana's traffic. Participants in transport should

use as much as possible the use of public regular passenger services, cycling and walking; if they do not wish or do not want to do so for any reason, they should use a passenger car that will bring them in an environmentally and healthy innocuous manner to the desired location. Measures have been taken to promote e-mobility, which are divided into I) infrastructure measures e.g. reliefs in the use of EVs, II) investment measures e.g. promotions, information activities, and III) measures at decision-making levels outside the MOL. Among other things, a plan for the development of a charging infrastructure was developed, the construction of charging stations at new and existing parking lots of MOL and introduction of EVs into the Municipality of Ljubljana's fleet has been planned.

Alternative fuels strategy: situation analysis, proposals

The Strategy proposes a sets of measures for each alternative fuel, on the basis of which a detailed action plan for 2018-2020 will be drawn up in the next six months. Priority will be given to measures that establish a charging infrastructure for EVs and for vehicles using compressed and liquefied natural gas; this will enable the government to promote the increased popularity of vehicles that run on alternative fuels. Measures are envisaged for all areas, from financial incentives, co-financing of the construction of alternative fuels infrastructure and amendments to legislation, to the promotion of innovative solutions, the acceleration of economic development, public information and the removal of administrative barriers. Financial incentives for the purchase of electric and plug-in hybrid vehicles, exemption from the payment of various fees for EVs, free parking, etc. will certainly remain part of these measures.

The use of alternative fuels is important in order to achieve the environmental targets in the area of greenhouse gas and pollutant emissions. Slovenia has stringent targets, since despite the fact that traffic density is increasing rapidly, it has to reduce greenhouse gas emissions by 9% in 2030 relative to 2020 levels. This therefore means an increase in emissions of 18% relative to 2005, however, one has to consider the fact that traffic on some sections has doubled since 2005, and that freight transport is projected to grow by between 60 and 80%, and private transport by 30% by 2030. By 2029 and after 2030, the following pollutants will have to be reduced by the following respective amounts relative to 2005: sulphur dioxide by 63 and 92%, nitrogen oxides by 39 and 65%, non-methane volatile organic compounds by 23 and 53%, ammoniac by 1 and 15% and solid particles (PM2.5) by 25 and 60%.

If Slovenia has to achieve its alternative fuels targets by 2030, in addition to measures for improving public transport, we have to ensure that at least 17% of the cars travelling on its roads are electric or plug-in hybrid vehicles (200,000 vehicles), 12% of light commercial vehicles are electric (11,000 vehicles), a third of all buses run on compressed natural gas (1,150 buses) and almost 12% of heavy goods vehicles (just over 4,300 vehicles) run on liquefied natural gas. As the number of vehicles running on alternative fuels will increase, the number of charging and filling stations will have to be increased, on motorways and elsewhere. Slovenia is one of the first countries in Europe to have installed high-powered e-chargers on its motorway network. This network will be significantly expanded over the next five years, enabling Slovenia to provide coverage of the Trans-European Transport Network (TEN-T) with chargers. With the projected growth in traffic, Slovenia will require 1,200 standard-power chargers for domestic transport by 2020, rising to 7,000 by 2025 and 22,300 by 2030. In addition, all ships arriving in the port in Koper will have to be supplied with electricity and liquefied natural gas from land by 2025.

In order to reach the environmental targets, it will also be necessary to significantly increase the consumption of biodiesel, starting in 2018 with a 7% mixture of biodiesel with fossil diesel with an increasing share in the following years, and a gradual increase in the percentage of heavy goods vehicles running on pure biodiesel (B 100) from 0 to 10% from 2020 to 2030.

In order to ensure that traffic causes the least possible amount of environmental pollution, we have to promote a sustainable transport policy: pedestrian and bicycle traffic within settlements and increasing the competitiveness of public transport.

But this will not be enough, since due to the dispersed nature of the settlements in many parts of Slovenia it is difficult to replace car use with public transport. Slovenia will therefore have to be sufficiently ambitious in its introduction of alternative transport fuels to ensure that the mobility that will continue to be provided by private vehicles pollutes the environment as little as possible. This is also one of the objectives of the Strategy.

Another key to a faster transition to green mobility in the area of private vehicles is the car industry's contribution through improvements in the area of e-mobility, the use of hydrogen and fuel cells and innovations and improvements to classical internal combustion engines. Technological advancements will allow faster development and will allow us to reach the targets more quickly.

The Ministry of Infrastructure will draw up an annual review of the results in this area and propose amendments to the Strategy to the government as needed. This grew out of a study of additional measures needed in order to increase the percentage of vehicles running on alternative fuels in Slovenia, which was conducted by a consortium led by the University of Ljubljana, Institute of Chemistry.

The study found that Slovenia currently has 227 public access electrical charging stations with 470 connections, 1 hydrogen filling station, 115 for liquefied petroleum gas and 4 for compressed natural gas, but has no filling stations for liquefied natural gas and 100% biodiesel. The vehicle fleet is slowly catching up to the charging infrastructure. The largest number of alternative-fuel vehicles run on liquefied petroleum gas (at the end of 2016 there were 8,980 registered), 124 on compressed natural gas and 6 on hydrogen (modified vehicles). There are nearly 1,000 EVs and plug-in hybrids, but their numbers lag far behind the charging infrastructure, if we assume that one connection is sufficient to charge 10 vehicles, and we have 470 of them.

Slovenia promotes the purchase of alternative-fuel vehicles through subsidies for EVs, which are also exempt from payment of annual fees for use of vehicles on roads. There are also favourable loans available for purchasing cars, motorcycles and electric or hybrid-drive bikes whose CO2 emissions are less than 110 g/km. Vehicles whose CO2 emissions are less than 110 g/km are charged a lower rate (0.5%) on their motor vehicle tax. Some municipalities and providers offer free parking and charging of EVs.

E-vehicles in Slovenia

"E-mobility in Slovenia is no longer just a vision, a dream of environmentally conscious and technically oriented individuals", E-mobility is growing in Slovenia. On December 31, 2014, there were 133 personal and special electric cars in Slovenia, 2 buses, 18 freight vehicles, on December 31, 2015 there were 288 personal and special cars, 2 buses, 38 freight vehicles, on December 31, 2016, there were 457 personal and special cars, 4 buses, 53 freight vehicles, while on December 31, 2017 there were already 780 personal and special vehicles, 3 buses and 94 freight vehicles. As seen, the number of electric cars is almost doubled every year, the same with freight vehicles, while the situation is slightly worse for buses. Still, the number of EVs is far from adequately, which is, of course, also related to the price of such vehicles and a rather short range.

Among the leading providers of electric vehicle charging services in Slovenia is Elektro Ljubljana. In the field of e-mobility, the system operator ELES is also very active, which helps in the development of e-mobility, primarily by encouraging the use and expansion of smart electric charging stations and OMV. The municipalities themselves are also responsible for the progress in e-mobility. For example, the city of Ljubljana expanded pedestrian area within the city centre and began using an electric vehicle for the transport of people. “Kavalir” service is free of charge and is arranged up-on a call. A network of e-filling sites has already been quite well-developed in Slovenia, which is shown in more detail in the pictures below.

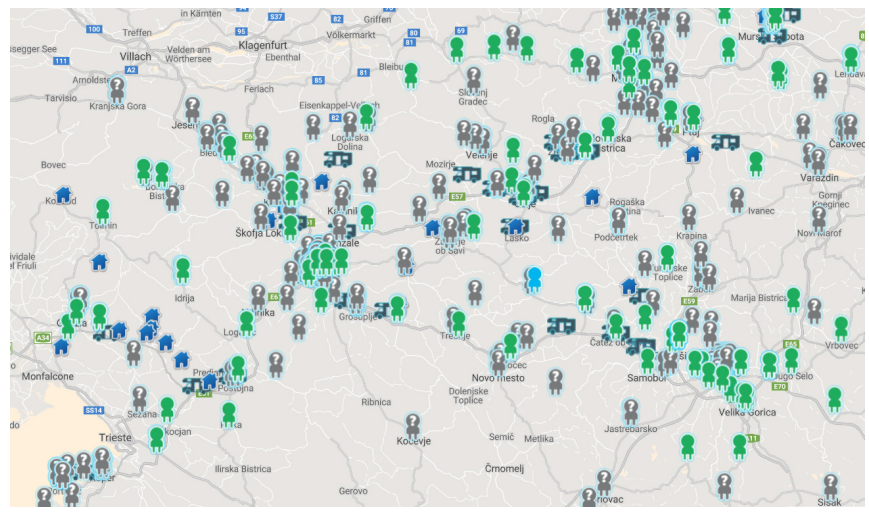


Figure 4. Locations of charging stations in Slovenia
Source: www.polni.si

At the time of the adoption of the Strategy, MOL used two EVs called “Kavalir” mainly intended for the transport of the elderly, mobility-impaired people, and visitors, run around the pedestrianized historical city centre. In Ljubljana, there were five electric goods vehicles and one sweeping machine; JP Žale had seven EVs (of which four electric scooters), Public Holding Ljubljana has seventeen hybrid vehicles and two electric scooters, and Municipality of Ljubljana also has six hybrid passenger cars.

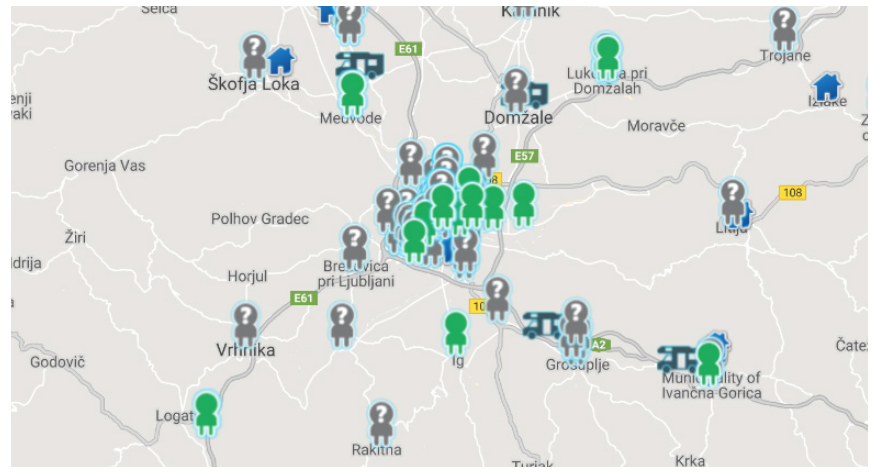


Figure 5. Locations of charging stations in Ljubljana urban region
Source: www.polni.si

Car-sharing

On July 1, 2016, Ljubljana joined the European Capitals which are acting in the so-called car-sharing car rental system. So far, the only provider of car-sharing system in Slovenia is company AvantCar with Avant2Go system. In the Avant2GO fleet, 30 cars were initially included in electric power only, and by the end of 2018, the plans include a network of as many as 500 cars, which would reduce the number of private cars on the streets of Ljubljana by up to 10,000. All Avant2Go cars are electrically powered.

Figure 6. Carsharing Locations in Ljubljana
Source: avant2go.com

Users can choose among electric small cars: Smart Fortwo ED, Renault Zoe and BMW i3. The entire process from booking, unlocking and locking the car, starting up the engine and final payment is made through the Avant2GO mobile application. The Avant2Go system has also expanded to the cities of Maribor, Kranj and Murska Sobota, and is also present at Ljubljana Jože Pučnik Airport. Introduction of Avant2Go service on Ljubljana airport provide users a convenient and more environmentally friendly mode of transportation between the capital and airport. Aerodrom Ljubljana supports the project with the aim of promoting sustainable forms of transportation to the airport.

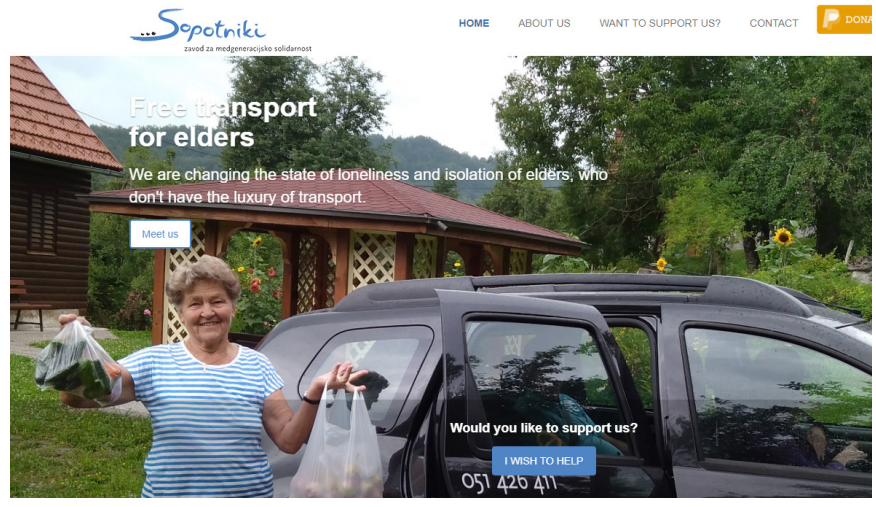
Avant2Go car sharing is also available to the employees of Ljubljana Aeroport for their daily operational and logistics needs, and to other companies that operate within the airport ecosystem and wish to optimise their mobility. There are initially four connections at the station, with the possibility of expansion in accordance with needs. Another positive side of the station is the use of 100 % renewable energy sources for the charging connections, through which the combination of electric mobility and sharing is further justified.

Car pooling

Car pooling services are promoting practices for car journey's sharing by which car is being occupied with more than one person. This action prevents the need for others to drive to school or work by themselves. By having more people using one vehicle, carpooling reduces each person's travel costs such as: fuel costs, tolls, and the stress of driving. No matter if carpooling was arranged through apps or among co-workers which commute in similar directions, carpooling is also a more environmentally friendly and sustainable way to travel. In common practice, sharing journeys reduces air pollution, carbon emissions, traffic congestion on the roads and also reduces the need for parking spaces. In general the services in Slovenia are used from students and young adults.

Although it is not the only service in Slovenia, the market for general carpooling use has increased with introduction of prevoz.org (www.prevoz.org). Prevoz.org is a private initiative which is mostly focusing on national carpooling service for students and daily commuters. Transnational long-distance carpooling service, which occurs mainly between Slovenia and major cities in the neighbouring countries, is dominated by service provider BlaBlaCars who has more than 20 million members across Europe. In Slovenia there are some initiatives for developing carpooling which are focusing on specific users e.g. students, older residents and people with reduced mobility. Among the others the most known are Prevoz.org, Zavod Sopotniki, and Prostofer which are shortly described below.

Sopotniki.org is an organisation for intergenerational solidarity operating as a non-profit private body, registered in Slovenia's register of voluntary organisations.



Organisation follows one simple goal: to offer free transport to rural elderly and thereby help them get involved in an active social life. Sopotniki.org was established to help elders get involved in active social life and is not meant to be used for general public who does not need the service. Since they also have other options, they do not offer service for general public who are below 65 years of age. Service is focused to prevent the state of isolation and loneliness of elderly people who leave in small remote villages, who

almost never leave their homes due to remoteness, lack of transport means or poor traffic connections. Services are arranged through a phone at least one day in advance and are scheduled according to availability of voluntary drivers. In the year 2017 there were around 700 users registered within municipalities all over Slovenia.

Sopotniki.org operates on a basis of volunteer drivers of different ages and occupations, majority of them are active pensioners who are still able and willing to drive. Service covers small villages and towns in the regions of Slovene municipalities Hrpelje - Kozina, Divača, Sežana, Sevnica, Brežice, Postojna, Krško and Kočevje, which all operate as a separate service network. Cars, gasoline and call centre is usually subsidised from municipalities in which the Sopotnik service operates.

Prostofer.si is a sketch from the word's "volunteer" and "chauffeur". This is another passenger forwarding service offered by voluntary active drivers that can use their cars for transporting older people to their errands. The service operates via a communication centre (free number). Potential user of a ride and drivers are connected exclusively on the basis of local relevance as drivers use their own vehicle. Before the ride is permed the driver and the passenger must agree on the pick-up location and on time of pick-up.

Public transport (Bus/Train) infrastructure and services

In Slovenia public passenger transport (PPT) services are in general divided on compulsory or optional public utility services. According to data from year 2015, services are carried out by the total number of 36 passenger transport carriers. Only one carrier operates rail passenger transport (Slovenian railways – Passenger transport) and 35 carriers operate public long-distance regular passenger transport in road transport on the basis of concession contracts.

More than half of the road public transport carriers can be classified as smaller carriers, which, according to the current timetable, carry up to 20,000 registered kilometres of services. 17% of concessionaires can be classified as medium-sized carriers that perform between 40,000 and 70,000 registered kilometres a month and 36% of carriers can be classified as major carriers transporting over 100,000 registered journeys per month. One of the main recent Slovenian project concerning mobility of students was implementation of integrated public passenger transport system which is currently still available only to pupils and students of Slovenian educational system. In addition to various other actions project implements unified info-mobility system, integrated tariff and ticketing system,

Prostofer operates as a free service which receives funding from various sponsors and donators of "Zlata mreža" initiative. Drivers are given different rewards from sponsors of the network and are thus motivated to perform the service. The service has indicated to improve general safety of older drivers and other road users and has I addition increased affordable mobility and social inclusion of the elderly. In majority of cases the drivers are elderly persons who are still able and willing to drive.

unification of user-interfaces. Currently there are some initiatives also to implement and expand demand responsive transport services also in Slovenia (e.g. Ljubljana urban bus provider in Podutik area and some municipalities within Ljubljana urban region) which do not directly target student's population.

Rail public transport: The public railway infrastructure of the Republic of Slovenia comprises a total of 1,207.7 km of main and regional railway lines, out of which 333.5 km are double-track and 874 km are single-track railway lines. As vast majority of railway lines are opened for the mixed traffic of

In order to improve passenger transport rail service Slovenian railways are in a process to put in operation 26 single and double-decker multiple units that will be made from Stadler company. Single-decker trains, intended also for cross-border use, can seat 235 people and also have standing room for additional 227 people. Double-deckers trains will operate only in routes within Slovenia and will seat up to 171 seats with additional standing availability for 167 people. Trains will also have some places available for bikes or e-bikes.

passenger and freight trains, need for integration among both systems in order to perform the PPT service is very important. This is a problem especially in direction to coastal areas of Slovenia where Port of Koper is located. Unfortunately, the number of rail PPT users is in decline. In year 2017 almost 12.6 million passengers were carried in national rail transport which is 4,8 % decrease in comparison to year 2016.

In comparison to national rail usage, number of passengers in international rail transport (including transit) reached 830,000 in 2017, which is an increase of 6.2% from year 2016. It has to be taken in consideration that nationally based railway passenger transport is still prevailing over the international passenger rail transport as it represents 93.8% of total railway passenger transport in Slovenia. Data on average distance travelled with rail passenger transport indicate that average trip in rail is in length of 46 km and lasts around 50 minutes. Considering the current state, it is of great importance to further develop rail infrastructure and improve rail timetables so even more students would use the service for daily commuting to their universities.

Urban and interurban road public transport system: Road public transport in Slovenia is divided into interurban and urban transport services. Only in the case of urban municipalities with more than 100,000 inhabitants (City of Ljubljana and Maribor) urban transport services are provided as compulsory public utility services. In smaller municipalities urban lines operate as optional services. Besides Ljubljana and Maribor, two main university cities, urban bus public transport service has been organised in 13 cities and towns in Slovenia (city of Jesenice, Kamnik, Koper, Kranj, Krško, Ljubljana, Maribor, Murska Sobota, Nova Gorica, Novo mesto, Piran, Velenje, Škofja Loka). In addition to the urban bus transport in Ljubljana the Slovenian Railways offer a city transport card valid for the Ljubljana township as part of the PSC contracted with the Government of Slovenia. In three municipalities (Nova Gorica, Postojna and Velenje) urban transport operates free of charge.

Overview of data indicates that in year 2017, 61.7 million passengers were carried by buses in urban public transport in Slovenia. The number of passengers increased by 18.9% compared to 2016 which is mostly the case of implementation of integrated ticketing system in September 2016. Urban buses operated on 145 urban routes, which is 7 more than in 2016, with total length of 1,627 km in one direction. The graph below interprets relation of passengers in urban public transport and number of routes from year 2007 to 2017.

Observing interurban transport services, we can see that 31.7 million passengers were carried by buses in interurban public scheduled transport in year 2017 (5.6% more than in 2016). Most passengers travelled distances up to 20 kilometres which is a shorter distance than in rail passenger transport. In year 2016, 541.4 million passenger kilometres were made in Slovenia. In 2017, buses operated on 1,768 interurban routes which is a slight increase than in year 2016 (1,711 interurban routes).

Similar situation with operation of public transport can be found also in Ljubljana urban region (LUR) where the University of Ljubljana is located. Urban bus in Ljubljana operates on 39 lines which are also operated outside the City of Ljubljana borders. Data indicate that LUR is well covered with PT since 49 % of LUR inhabitants leave within 30 minutes reach to the city centre with urban and interurban public transport system. Only 10 % of LUR inhabitants do not have connection to regular PT service (considering 1.000 m radium of accessibility around PT stations). Modal share of PT in LUR is around 8 % during working days. Majority of users are commuters, pupils, students, owners of monthly URBANA pass and inhabitants of LUR who do not have regular access to PT in the region.

Data also indicates that capacities of PT in LUR (bus and train together) in the morning peak hours (before 9h) are approximately 18.000 seats which is not sufficient to the number of potential users that are daily commuting to LUR. Analyses performed within sustainable urban development plan (SUMP) of LUR show that greatest potential in the terms of sustainable mobility of passenger transport could be performed within the system of public transport. The main shortcomings of public passenger transport in Slovenia can be described as follows:

- lack of general system management to operate the system comprehensively from the aspect of passengers' needs;
- not well coordinated timetables among PT modes;
- travel time is uncompetitive compared to private vehicles; and
- the frequency of services, especially rail services, is too low and not arranged according to the principle of a clock-face timetable.

Integrated Implementation of integrated public transport in Slovenia has since several years been a project led by Slovenian Ministry of Infrastructure. A goal of the project implemented in the first stage in September 2016 was to create the conditions for implementation of a unified single ticketing system and integration of all bus and railway transport timetables, tariff systems, organisation models and networks. The fare ticketing platform is based on contactless smartcard technology and mobile transaction

system, where passengers could conveniently purchase and validate electronic fare tickets with different transportation operators and providers.

Park and Ride (P+R) development

Due to the dispersed settlement of Slovenia and also some parts of LUR there were, until recently, relatively poor interconnections between public transport and personal transport. The delayed renovation of railway transport network and constant increase in road transport demanded the construction of new infrastructure which would integrate public transport and personal (e.g. cars or bikes) transport systems. As PPT in the joint transport system has a small share and does not enable fast, comfortable and price-efficient mobility at the regional level was needed.

Source: ljubljana.info

Process of P+R development in LUR began in the year 2007. In this year outline of its development vision in 'The Regional Development Programme' was prepared with provision of 22 potential locations for P+R's. It was a fundamental programmatic document at the regional level of the LUR which was adopted by the mayors of the municipalities in LUR. Through the involvement of key stakeholders at national level Regional Development Agency of Ljubljana Urban Region (RDA LUR) managed to bring the project in the national strategies to provide EU funding.

Process of P+R implementation in Ljubljana urban region: Basing on a four-step transport model and other measures to allocate future main origin-destination centres, three basic types of intermodal interchange points in LUR have been specified: main transport centre (Passenger transport Centre located in the centre of Ljubljana), Intermodal hubs outside the regional centre and P+R schemes along arterial roads to urban centres. Depending on priorities, land usage and PT operation specific P+R locations were than allocated.

> Until the end of year 2015 ten P+R sites in Ljubljana urban region have already been constructed (among others Stožice, Barje, Domžale P+R) or re-constructed (Dolgi most P+R). From P+R locations further travel to the Ljubljana city centre is available with efficient Ljubljana urban transport (LPP) services using URBANA smart card (two rides with LPP for P+R users are free of charge on the day of parking payment). In addition to parking services some P+R also offer BicikeLJ bike renting system service, bike parking spaces and parking spaces for recreational vehicles.

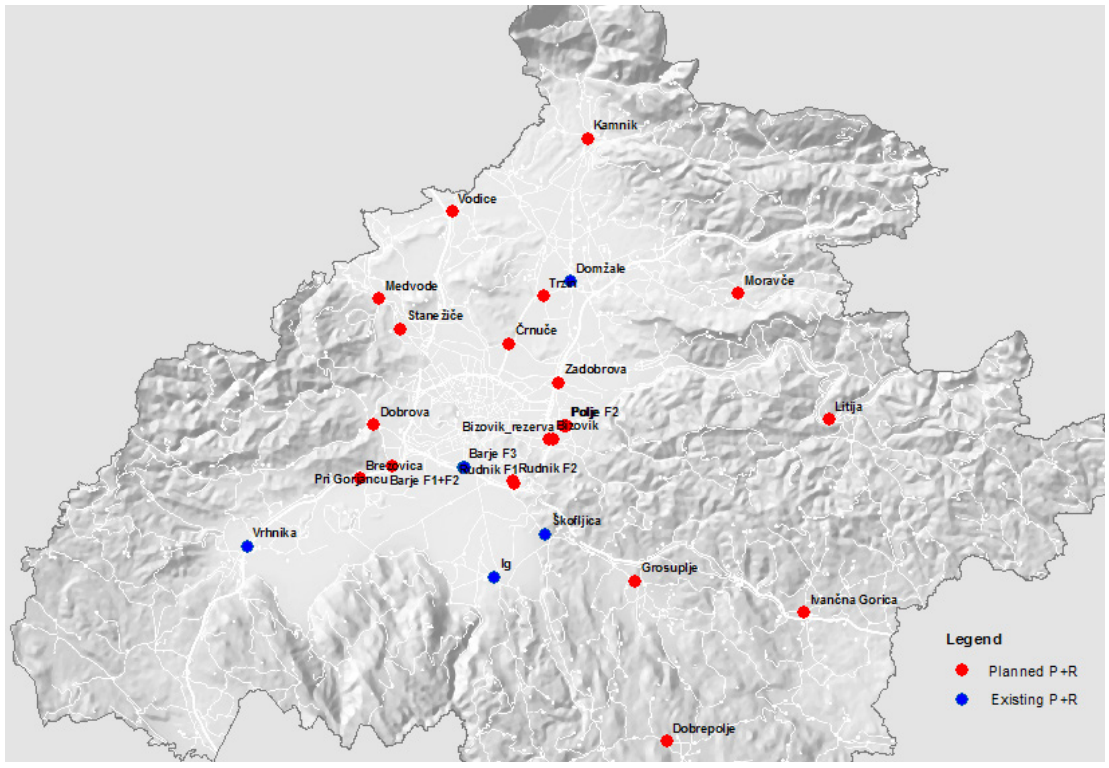


Figure 7. Existing (blue dot) and planned (red dot) P+R in Ljubljana urban region
Source: RRA LUR, LUZ, 2018

P+R Borovnica (at train station of Borovnica). Al P+R will improve sustainable mobility and intermodality for students in the Ljubljana urban region. Also, other Slovenian regions are planning to develop various sorts of P+R. Some P+R are in plan also around city of Maribor to support sustainable commute to the city centre.

Current results indicate that there are still some measures to be done (improvement of PT timetables, accessibility to P + R) in order to increase the number of P+R users in the greater Ljubljana urban region. In majority of time P+R Barje and P+R Dolgi most are full and are also in usage from students of Ljubljana University, yet some incentives to promote P+R usage for students should be performed. Observing the importance of P+R facilities in LUR majority of users are performed on P+R Barje and Dolgi most which are described below:

- P+R Barje is constructed at the motorway entrance on the east side of Barjanska Street and divided into northern and southern parking lots. P+R Barje offers 347 parking spaces for private vehicles, 2 charging stations for 4 electrical cars, covered structure for 156 bicycles and access to rental system BicikeLJ with 20 bikes. Parking tariff is 1,2 EUR per day which also includes 2 tickets for city public bus. Therefore, P+R Barje is an important contribution to the expansion of the P+R centres on the outskirts of Ljubljana and an incentive to switch from private vehicles to public passenger traffic.
- Dolgi most P+R, car park for vehicles arriving in Ljubljana from the direction of the coast. Customers can park their cars and drive to the Ljubljana city centre by using the city public transport. By paying the parking fee at the automated payment machine, you get two rides for the bus no. 6 which are valid on the day of the parking fee payment. After its renovation in years 2016-2017 P+R Dolgi most has 349 parking spaces for private vehicles, 11 parking spaces for tourist buses and 11 for caravans which are currently free of charge. Bicycle stands are available and there are 20 bicycles from the rental system BicikeLJ. From autumn of 2018 P+R Dolgi most is connected with railways as railway station Dolgi most was constructed servicing passengers commuting to and from Ljubljana.

Cycling (Bike, e-Bike)

Currently, cycling as a mode of transport and for recreational purposes has a great impact in all Slovene regions. With many bright examples of planned or already build cycling infrastructure (among others: cycling connections in Savinjska region, cycling network in Southeast Slovenia, Upper Carniola cycling project, Soča cycling connections, cycling paths along river Mura and Drava, development plans of cycling infrastructure in LUR) is slowly improving cycling infrastructure. Improvement can especially be seen in the case of urbanised areas (e.g. Ljubljana, Maribor, Ptuj, Celje, Velenje, Koper, Nova Gorica, Novo Mesto) where cycling infrastructure and cycling usage is steadily increasing. Data from cycling counters in Ljubljana indicate that share of cyclist is increasing and is current at around 11 % on a city level. Data from traffic counters indicate that the share of cyclist during the summer months is four times the ones during the winter months, which can be the case in all the Slovenian cities.

In several cities and towns in Slovenia (Ljubljana, Maribor, Kranj, Velenje, Murska Sobota, Piran, etc.) bicycle sharing systems (or bikeshares) are successfully complementing the use of public passenger transport. The systems in those cities enable to its users to borrow a bicycle at one bicycle station and return it at any other bicycle station in the same city/ town. Most developed and known is the bicycle scheme available in Ljubljana called “BicikeLJ”, which is a public service offered by the city of Ljubljana.

Similar system is planned also to be implemented in University city of Maribor where 120 bikes will be made available on 12 stations around the city. BicikeLJ system in Ljubljana is quite popular also among the students of University of Ljubljana, since many of BicikeLJ stations are located at or near specific faculties. System can be used for 60 minutes free of charge and students have many options to use the system in order to get from faculties to some locations of student homes in Ljubljana.

Road safety for cyclists in Slovenia: One of the important aspects of cycling development in Slovenia is road safety. In order to assure safety, the following requirements should be met mostly in the terms of safe infrastructure: construct infrastructure that avoids conflicts with intersecting and crossing traffic, construction of separate surfaces for bicyclist, reduce travel speeds at conflict points and avoid cyclists being forced off the road.

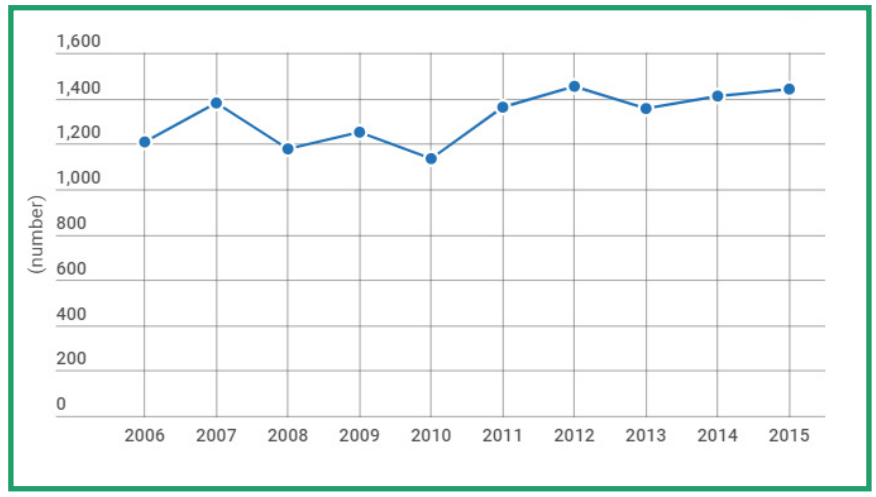
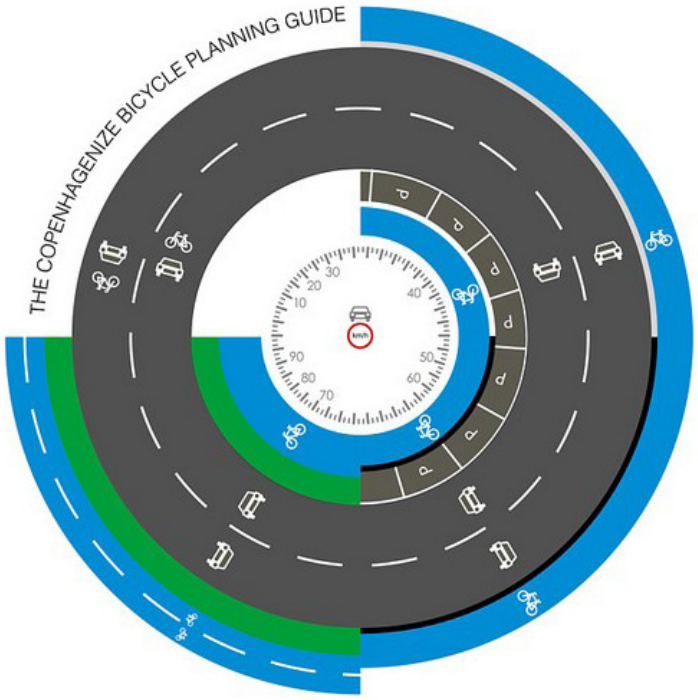


Figure 8. Cyclists involved in accidents in Slovenia 2006-2015
Source: -Republic of Slovenia Statistical office, 2018

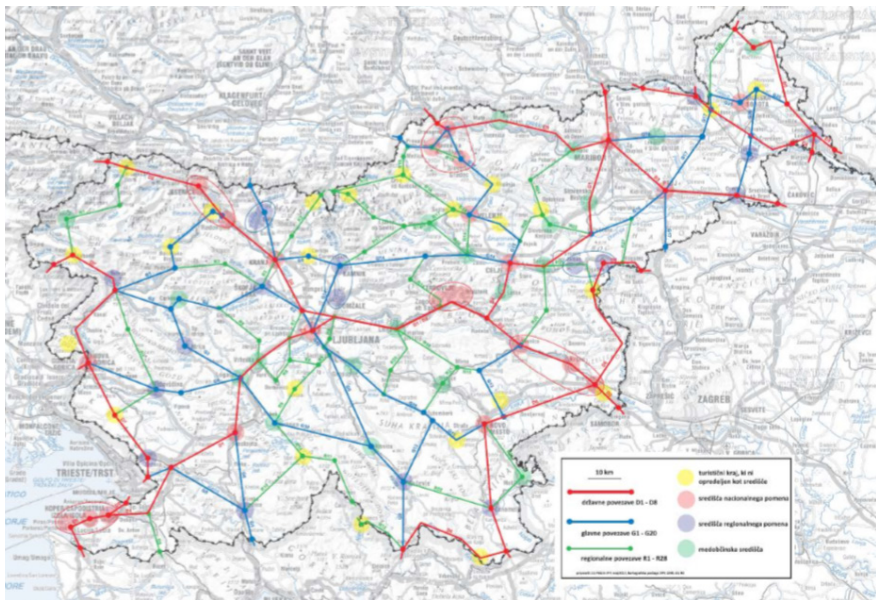


Source: www.copenhagenise.com

Nevertheless, according to data from Ministry of Interior of Slovenia, 22,937 car drivers and 1,439 cyclists were involved in the traffic accidents in 2015.

Despite the increase of the number of cars in the last ten years, the number of car drivers involved in the traffic accidents constantly decreased, while the number of cyclists involved in the traffic accidents increased. This data should be used with caution, since there are some traffic incidents in Slovenia that do not get reported to the authorities and are thus not included in statistic reports on accidents.

For future development and reconstruction of cycling infrastructure on a national level it is of great importance of Slovenian authorities to follow good examples from other countries and also implement cycling infrastructure guidelines and technical specifications.

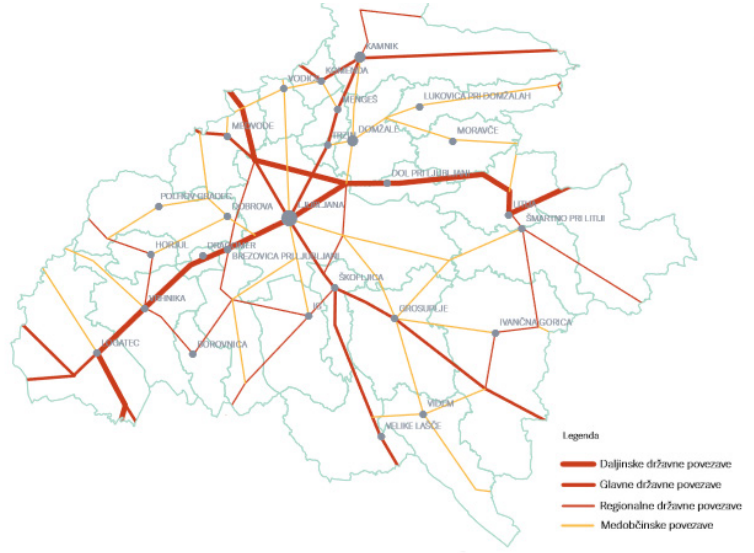


Source: "Izdelava modela povezanosti celotne Slovenije s kolesarskimi potmi", 2017

In order to design and construct quality bike infrastructure in Slovenia, there are several guidelines and technical specifications that should be adopted from countries with best practices on design of cycling infrastructure. One of benchmarks to follow are examples from Denmark where simple planning guide for cycling infrastructure was prepared on the basis of speed of car traffic. 10-30 km/h - no separation is advised among car and bike; 40 km/h painted lanes, 50-60 km/h separated by curb, 70-130 km/h fully separated by a median, bicycle infrastructure should be placed on the right side of parked cars, bi-directional is advised on only off-street. On a long term, Slovenia should follow those recommendations.

Future development of cycling infrastructure

Within the project with the name "Modelling of bicycle connectivity of Slovenia" – unofficial translation (Slo: Izdelava modela povezanosti celotne Slovenije s kolesarskimi potmi: FGG, IPOP, 2017), the proposal on national, main and regional cycling connections is prepared, as seen from the figure.



Source: Ljubljana Urban region SUMP, 2018

Main strategic actions to improve cycling in the regional context, as outlined in SUMP of LUR, are mainly focusing on:
Improvement of transport connections with bicycle infrastructure,
Increase of bike share in modal split of daily commuters in the regional mobility (e-bikes are supporting the reach of bicycles on the regional scale) and
Recognize importance of PT-bike intramodality in the regional scale for improving accessibility to and in urbanised areas.

Following the provision of national bicycle network, a plan to construct regional and local cycling paths was also prepared in LUR. When constructed it will have a positive influence on travels with a bike or e-bike for students to daily commute to faculties from municipalities around Ljubljana.

Walking

In comparison to other transport modes, walking is the most natural, healthy and socially equitable way of moving. It does not cause emissions and does not have any other negative environmental impacts. In the function of daily mobility for students and other residents, walking is mostly suitable for shorter distances (up to 2 km), which corresponds to the characteristic of the structure of most settlements in Slovenia and the length of average trip in them.

Within urban spaces with safe and adequate pedestrian infrastructure majority of journeys could be performed by foot, but that is rarely the case in Slovenia. When addressing walking it has to be taken into consideration that pedestrian infrastructure are mostly used by the very most vulnerable groups of city residents such as elders, pupils, students and physically impaired, so safety is of uttermost importance.

Safe walking infrastructure, be it curbs, pedestrian areas, parks and recreational surfaces are crucial for development of walking as an independent mode of transport. In addition, walking is important part of each trip since as all the routes with the car and public transport start and end with walking. National statistics indicate that walking is the second most common mode of movement in Slovenian settlements, although its share has been declining in the past decades with rise of motorisation.

National surveying performed by Statistical Office of the Republic of Slovenia (conducted for the first time in year 2017) indicates, that walking is used in 21.3% of trips and it also beats bicycle trips (4,5 %) and usage of public transport (4,3 %) in Slovenia. Only on trips at distances with less than 1 kilometre of length, there were more trips made on foot than by car. At all other distances, cars were the dominant mode of transport.

Encouragement to use different means of transport while providing safe infrastructure for doing it is really necessary, as most of our trips are made only by one mode of transport (95% according to 2017 provisional data), which means that walking is a complementary mode of transport on majority of journeys. When two modes of transport were used in one trip in Slovenia, walking was mostly combined by another “vehicle mode of transport” - again most often by cars.

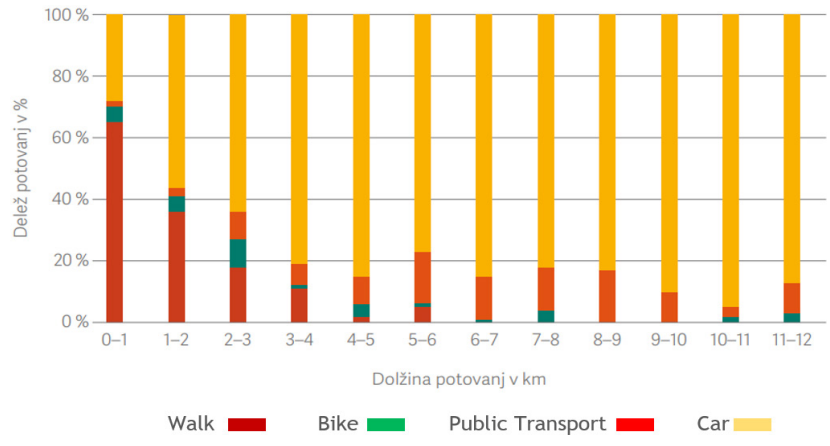


Figure 9. Modal share of different modes of transport by inhabitants of LUR
Source: LUR, 2014

Development and promotion of walking in Ljubljana urban region: Considering the levels of urbanisation and motorisation in LUR, walking is still a dominant mode of transport for the trips of distance below 1 km. For distances over 1 km walking is usually used as a complementary mode to PT or car (as seen from the graph below). Analyses performed within preparation of Sustainable urban mobility plan for LUR indicated that there are two main reasons for car-dependency movements.

The first one is related to the simple “opportunistic nature” of people, since using a car is more pleasurable, comfortable, and advantageous than using non-motorised modes of transport if there is no congestion to hinder it. The second reason lies with the designs of urban environments in some parts of LUR that require the use of car e.g. parking lots are placed next to the buildings, open-air shopping streets were slowly replaced by shopping malls, city centres with a mixture of commercial, retail, and entertainment functions were replaced by single-function business parks and multiplex entertainment complexes (e.g. BTC), each with generous parking supply on the outskirts of Ljubljana along the ring-road. Residents thus have to travel greater distances in order to perform their daily activities. Besides preparation of SUMP for City of Ljubljana and for LUR which both empower the actions for walking infrastructure and promotion, there are also other bright examples in Slovenia that promote and improve walking for future generations.

ITALY

General travel habits and car use

LOCAL rail public transport in Friuli Venezia Giulia is carried out by Trenitalia and by the Società Ferrovie Udine-Cividale (FUC), a company owned by the Region.

Travelers and commuters using the train in Friuli Venezia Giulai Region are an average number of 20,000 per week. According to the survey on the satisfaction of users of Trenitalia, in 2016, 90.5% of users were generally satisfied with the trip (87.0% in 2015) and 80.3% with punctuality (75.9% in 2015). Also ISTAT[2] measured user satisfaction and according to the survey 67.7% of people aged 14 or over who used the train at least once a year were satisfied with the service (+ 1.4% compared to 2015), 59.7% satisfied with punctuality (+ 2.0% compared to 2015), higher than the Italian average (55.4%). The punctuality of trains has improved in recent years, with 97.3% of the regional trains operated by Trenitalia and 98.7% of trains operated by FUC, which in 2016 arrived on time or with a limited delay within 5 minutes.

The satisfaction of citizens for public bus transport is detected by the four transport companies (ATAP, APT, SAF and TT) through interviews conducted on board, at bus stops and by phone, for a total of 5,018 interviews in the 2016-17 winter season. The topics dealt with are the reliability of the service, coverage, punctuality, comfort, and safety of travel, ease of finding travel documents. By reporting the data of the various surveys to a common scale, analyzing the questions with overlapping content between the various surveys and weighing the responses for the population of the respective provinces, 70.2% of respondents were satisfied with the ease of finding the tickets, 75.8% of the punctuality, 72.6% of the reliability and regularity of the service, 73.1% of the courtesy of the drivers, while 80.6% consider the safe journey in terms of risk of accidents and 77.6% considered it safe in terms of the risk of theft or acts of petty crime. The percentage of satisfied users measured by ISTAT through the survey was instead equal to 83.5% for the punctuality of the races, to 77.1% for the frequency of the same and to 68.8% for the ease with which find a seat.

Use of car

The monitoring of the motorway traffic in FVG takes place through the registration of the vehicle entrance and exit toll booths. The average daily transits represent the daily average of the number of vehicles entering the network in the section considered, regardless of the length of the route. In the last three years (data available 2014-2016) there has been a constant increase in traffic, which has exceeded the 2012 level for heavy vehicles (trucks) and, for the A4 highway, also for light vehicles (cars, motorcycles, vans). In 2016 there were increases for all traffic categories: the busiest motorway is confirmed as the A4, with 40,055 average daily transits of light vehicles in each direction, + 4.1% on 2015, and 13,785 heavy vehicles, + 5.1% on 2015.

The car is confirmed as the main mean of transport for daily home to work journeys: according to ISTAT data, in 2016 78.4% of those employed 15 years or more who left their homes to go to work used the car, 72.2% as driver and 6.2% as passenger, up from 77.9% in 2015 (74.9% as drivers and 3.0% as passengers). They follow the bicycle (6.1%), motorcycles and mopeds (5.7% in the complex) and the bus or tram (5.7%), while in 8.3% of the cases we go to the place of work on foot. Within the framework of the TrIM project (Transport Infrastructure Monitoring), traffic monitoring sensors were installed on the regional network in an area straddling the provinces of Gorizia and Udine. The overall traffic index on the monitored network (median of the individual indices) indicates an increase of 2.0% in 2015 for light vehicles and a 3.6% decrease for heavy vehicles, while in the first 4 months of the year 2017 there was an 8.1% increase in light goods traffic and 4.4% in heavy vehicles.

According to the ACI (Italian Automobile Club) as at 31.12.2016, in Friuli Venezia Giulia Region there were registered 781,824 cars, with an increase of 12% of new registrations compared to 2015 and 45.3% compared to 2013. The rise continued in 2017, with an increase of 4.1% in the first 4 months of the year.

Half (50%) of passenger cars registered in 2016 is fuelled by diesel, which is confirmed as the most popular fuel, and 44.9% by petrol. The cars with diesel engines are more popular in the provinces of Udine and Pordenone (respectively with 52.1% and 54.7% of the matriculation), while in Gorizia and Trieste the petrol engine is more popular (53.3% and 56.4%). 866 cars were with a thermal/electric hybrid engine, 862 were gas or bi-fuel petrol-gas cars, whilst 27 were electric cars registered in 2016, for a total of 73 electric vehicles registered as of 31.12.2016, numbers that should rapidly increase to support a shift towards low-carbon cities in the next years.

The aging of the vehicle fleet is a phenomenon that has been going on for several years, to which various factors contribute, from the market crisis between 2010 and 2013 to the end of the state-run scrapping incentive policies in place periodically up to 2009. For a comparison, in the long term, it should be considered that in 2011 the percentage of cars with more than 10 years was 40.6% and 8.0% with more than

2 Italian National Institute of Statistics

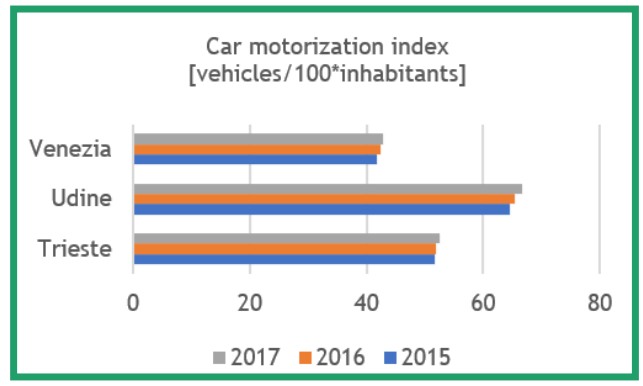
20 years, while in 2006 these percentages were equal to 32.9% and 5.1%. In terms of the European pollutant emission class, Euro 0 cars registered for more than 20 years are 53,076, and those for Euro 1 are 21,816. The most common Euro class is Euro 4 with 263,023 cars, half of which registered in the three-year period 2006-2008, the market's peak years.

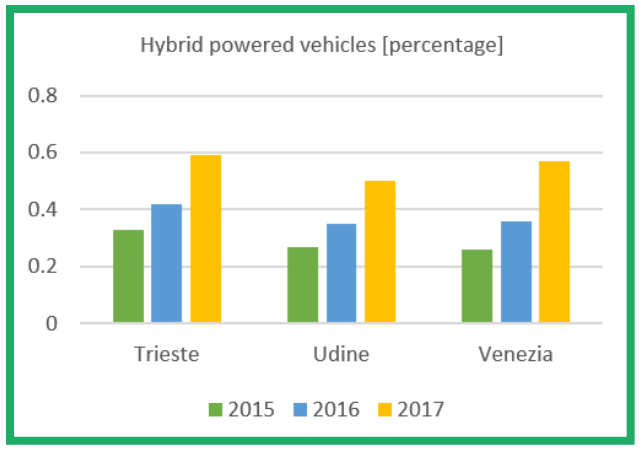
Finally, according to the twelfth report (year 2018) of Euromobility on sustainable mobility in the main 50 Italian cities, Venice is in third place for sustainable mobility, after Parma and Milan and is the most virtuous city, with the lowest number of cars per inhabitant circulates. With regard to the national experimental programme on mobility managers in Venice, the coordination role is present in both an Area Office at the municipal level and an Area Office at the provincial level. Finally, according to the report by Euromobility, the largest offer of local public transport (places * km / inhab) is recorded in Milan and Venice, while the highest number of passengers per inhabitant travels to Venice, Milan, Rome, and Trieste. Below are reported the data[3] for the three-year period 2015-2017 according to Euromobility - Sustainable Mobility Observatory related to the number of vehicles per 100 inhabitants (Car motorization index) for the cities of Trieste, Udine and Venice.

Car motorization index [vehicles/100*inhabitants]

City/Year	2015	2016	2017
Trieste	51,7	51,98	52,49
Udine	64,65	65,39	66,7
Venezia	41,84	42,43	42,75

Figure 1: Car motorisation index
Source: Euromobility – Sustainable Mobility Observatory)





Electric powered cars [percentage]

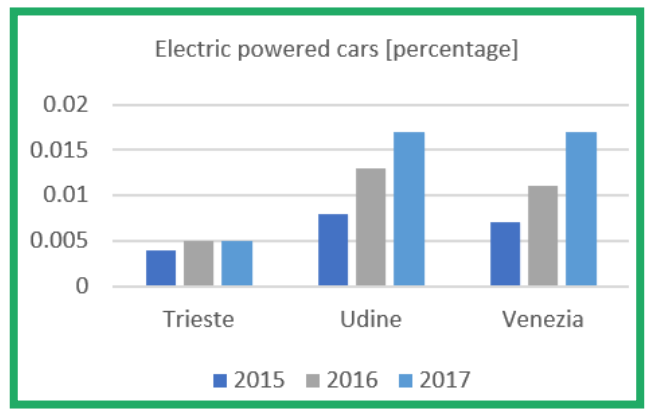
City/Year	2015	2016	2017
Trieste	0,004	0,005	0,005
Udine	0,008	0,013	0,017
Venezia	0,007	0,011	0,017

Figure 2: Hybrid vehicles statistics
Source: Euromobility – Sustainable Mobility Observatory

Hybrid powered vehicles [percentage]

City/Year	2015	2016	2017
Trieste	0,33	0,42	0,59
Udine	0,27	0,35	0,5
Venezia	0,26	0,36	0,57

Figure 3: Electric vehicles statistics
Source: Euromobility – Sustainable Mobility Observatory



As shown by the data, the car motorization index is slightly increasing every year, meaning that the number of cars compared to the number of inhabitants of the main 3 cities of the Italian Area is increasing. Udine has the highest car motorization index, with more than 66 cars every 100 inhabitants in 2017, while Venice has the lowest index (42,75 in 2017). If we look at the percentage of hybrid vehicles on the total number of vehicles in the three main cities of the Area, we can say that, even if the numbers are low, there is a constant increase in all the cities (Figure 2). In all three analyzed cities the percentage is lower than 1% and incentives for the use of hybrid powered vehicles are needed. The same evidence is related to electric powered cars, which would need stronger support to become more wide spread (Figure 3).

3 http://www.xn--osservatorio50citt-wrb.it/

Development of E-vehicles

Friuli Venezia Giulia Region

The Regional Council of Friuli Venezia Giulia has approved the Regional Plan for Electric Mobility of Friuli Venezia Giulia Region at the end of 2017.

The Plan promotes the integrated development of a charging network that supports the circulation of e-vehicles, in accordance with the provisions of international and national legislation. The project that the Region wants to achieve has both planning and operational nature, since all the planned and funded interventions are included in the plan for electric mobility. The initiative is consistent with the national infrastructural plan for the recharging of electric powered vehicles (Pnire), to which Friuli Venezia Giulia has signed up with its own project which is divided into four interventions: the drafting of the electric mobility plan, the preliminary planning activity for the installations of recharging infrastructures, the purchase and installation of recharging infrastructures for vehicles powered by electricity and, finally, communication and publicity actions for the citizens.

The activities will be financed with funds from the Infrastructures and Transport Ministry, which made available approximately € 540,000, and with the Region's own funds for the same amount, thus bringing investments to start the mobility network to over € 1 million. The Region is also involved in the preparation of the regulation for the granting of incentives for demolishing of polluting vehicles and the purchase of hybrid, electric or bi-fuel vehicles, to which is allocated in the last Stability Law resources for € 1,4 million. The primary objective of the plan is to encourage e-mobility, closely linked to the creation of an efficient infrastructure that adequately covers both private access and public access recharging. By 2020, all users should be able to easily recharge vehicles for daily use. Between 2020 and 2030 the objective is to make available, in the face of an effective transition to the electricity of part of the fleet in circulation, a capillary and uniform recharge service throughout the regional territory. The charging network will have to be integrated with urban public transport planning, with the actual needs of the different territorial realities, also based on congestion problems and the issue of atmospheric pollution. Therefore, the four cities of Trieste, Gorizia, Udine, and Pordenone are considered primary nodes of the network, without neglecting smaller towns with significant commuting relevance, both for reasons linked to work, education and health and for tourist attraction.

Moreover, the Municipality of Pordenone set up a plan for the installation of 15 charging stations for e-vehicles ant it is now[4] performing the procedure for the assignment of their management service.

Metropolitan City of Venice

At the end of 2018, a plan was presented for the installation of 18 charging stations for electric cars in Venice Mestre, Marghera, Campalto, Zelarino, Carpenedo, Gazzera, Favaro, and Chirignago.

The project involves the construction of a network consisting of 50 columns through an agreement with the infrastructure supplier, with a duration of 8 years, which provides supply, installation, management, and maintenance of these infrastructures. The charging network will feature both "fast recharge" infrastructures (20 minutes) and "pole station" ones (one to two hours for a full recharge). This agreement, together with the introduction by 2020 of 30 new electric buses to Lido and Pellestrina, follows the recommendations contained in the European protocols that require cities to promote electric vehicles. The city of Venice is at the forefront from the point of view of incentives for sustainable mobility, and the data of the first four-year monitoring provided by the sustainable energy action plan show that the city has reached 4 years in advance (compared to the target 2020) the objective of reducing atmospheric emissions of pollutants by 20%.

Car sharing

Car sharing for PAs of Friuli Venezia Giulia Region

From a first analysis conducted in 2016, it appears that the PAs of Friuli Venezia Giulia (Autonomous Region of Friuli Venezia Giulia, Health Care Companies, Municipalities of the provincial capital, Authorities of the Port System of the Sea Eastern Adriatic, Universities and Research Centers), have mobility needs managed with at least 1500 cars traveling for 50-100km per day, mainly in urban areas.

In particular:

- 70% are underused vehicles (less than 10,000km / year);
- obsolete vehicles: 530 are over 10 years old, of which 320 are over 15 years old;
- lack of data: over 380 vehicles lack data on the year of registration and/or distance;
- type of service: only a small part is so-called "blue-blue" cars, with a driver.

In the Friuli Venezia Giulia Region, the initiatives in favor

4 Beginning of 2019

of electric mobility and specifically for electric car sharing are various. One of these is given by the European project H2020 - NeMo[5] - New Mobility in Friuli Venezia Giulia, which has developed NOEMIX, a car-sharing service for the Public Administration. The service is going to start in 2020 , thanks to a public-private partnership, through which Friuli Venezia Giulia is the candidate for being the first Region in which a large share of the fleets owned by Public Bodies will be replaced by e-vehicles. Aggregating the needs of different Public Administrations, the Region aims to move from the current model based on the purchase of cars to one based on a "centralized electric mobility service" managed by private operators. NOEMIX will introduce in the car park of the regional PAs at least 560 electric cars, 660 charging stations, and renewable energy production plants, which will guarantee 50% of the electricity supply, while the remaining 50% will be given by the purchase of energy certified green. The expected savings amount to 4,261 GWh / year of primary energy, to which are added 0,659 GWh / year of green energy production. The model can be replicated in other regions of Italy and Europe.

Car-sharing in Trieste

From March 2018 in Trieste, a car-sharing has started, organized via the web or mobile phone, usable by several users, through a card. This is an initiative introduced by the Regina garage in via della Raffineria, with the aim of stimulating an increasingly ecological way of moving. Soon the garage will also be equipped with charging columns for private electric cars. It is a car-sharing service that is part of a European circuit, and the direct site to register and request the card is www.biroshare.com. The service makes available a mini car, just under two meters long and equipped with a space for luggage. Furthermore, since June 2018 the information campaign has been launched on the innovative and sustainable mobility activities that the Municipality of Trieste is conducting in the framework of the European project CIVITAS PORTIS[6]. In Trieste, the project aims to integrate the Port area, in particular, Porto Vecchio, with the city, improving urban mobility and experimenting sustainable mobility actions such as bike- and car-sharing. The purpose of CIVITAS PORTIS is to improve the accessibility of the area through various actions: the preparation of an Urban Plan for Sustainable Mobility (PUMS); the enhancement of the traffic data collection and analysis system; the development of apps and IT systems that provide useful and updated information to those moving in the city; the increase in cycle paths and pedestrian areas. To facilitate the achievement of these objectives, an information campaign is launched for citizens and stakeholders that, until the end of August 2020, foresees the organization of public moments to update the progress of the project, with thematic events, seminars, conferences, and round tables, useful also to gather ideas and functional suggestions for a participatory decision-making process.

Car-sharing in Udine

After the success obtained with bike-sharing, the municipal bicycle time-hire system, the City of Udine is developing its car-sharing system. In Udine, the works for the construction of the first parking lots and the related electric charging stations in the city-center parks are ongoing. The project aims to create real hubs of sustainable mobility, which will bring Udine to have a total of 17 columns with two charging accesses each, of which the first 7 were contracted in April 2018. The works are financed by the Region through the Pisus funds and the Ministry of transport, the Municipality of Udine and the Municipality of Tavagnacco. In two parking lots (Moretti and Magrini) two shelters will be built with roofs made by photovoltaic panels in order to use solar energy to produce a part of the electricity used by the cars. Added to this is the creation of a remote vehicle management system through the creation of a smartphone application. The parking lots are distributed evenly in the city center serving almost all the areas of the city with a greater concentration in the west, where there are the most used parking lots. All points identified, moreover, are equipped with a bike-sharing station. The combination of the two offers will favor the shift to sustainable mobility, allowing the use of bicycles to travel in the historic center and the use of electric cars around the center or to the suburbs. Parking stalls for car-sharing will be made recognizable by coloring the surface with green paint with non-slip characteristics.

Metropolitan City of Venice

The car-sharing service promoted by the Metropolitan city of Venice is called Io Guido. It is a service where a fleet of cars are made available to a group of pre-authorized customers (through signing of the relative contract).

With a simple phone call to the call centre, the subscriber can reserve a vehicle, whenever necessary, paying only for the cost of consumption. It’s possible to book on-line too. Besides the advantage of avoiding the costs of owning a car (such as payment for insurance, maintenance, and cleaning), subscribers to car-sharing also get a series of parking and travel concessions that are valid throughout the city. To access the service the user must have previously signed the related registration contract, available in the following versions:

5 http://www.regione.fvg.it/rafvg/cms/RAFVG/ambiente-territorio/energia/FOGLIA118/

6 https://civitasportis.triestetrasporti.it/il-progetto/

- for "Individuals" (natural persons): annual registration fee € 50,00;
- for "Companies" (all subjects holding a VAT number who intend to authorize their employees to use the system): annual registration fee € 100,00.

With the clear objective of further encouraging the use of "car-sharing" as a "system of integration of urban public transport", the Municipal Administration of Venice also allows the vehicles used for the service - within the municipal territory - to:

- transit and stop in the "limited traffic areas" area;
- use the preferential lanes and/or lanes reserved within the municipal territory (see documentation contained inside the vehicle);
- support for free in paid stalls (so-called "blue stripes");
- free circulation in the days with "alternative license plates", of "total block of traffic" and during the c.d. "Ecological days".

Carpooling

Cities are considered the core-place of innovation in mobility practices and long-distance transport is less in the spotlight, and consequently also less studied by academic literature. But also here, significant changes are happening, especially where liberalization of public transport services took place, such as in railways and coach transport.

Long-distance ridesharing, differently from car-sharing or mobile-apps for a taxi, is focused at sharing the costs of car travels among private users and not in making a profit for the driver. Carpooling and ridesharing are partially overlapping concepts because they all refer to the optimization of the use of a vehicle by sharing it with other users. Actually, the main difference lays in what is shared, namely a ride which is done anyway by one driver (ridesharing) or a car which is pooled among a group of users (carpooling) or owned by a provider and short-rented to subscribed users for occasional use (car-sharing).

Concerning car-pooling practices, available data are mainly the ones related to the BlaBlaCar web platform.

In this chapter we want, on the one hand, to better understand the dynamics and the diffusion of the service on a national scale and, on the other, to obtain some information on the segment of mobility less known to statistics, e.g. occasional long-distance mobility. The first results obtained show that the users of the service still represent a marginal share of the journeys that affect our country but give useful indications on current mobility practices. The trips offered, for example, take place on average distances in the order of 300 km and are greater in the north than in the rest of the peninsula. Furthermore, they present different patterns of weekly distribution depending on the place of origin, as well as a different geographical spread. Larger cities, Milan in the first place, generate trips on very large areas, while the provincial capitals present much smaller and more polarized catchment areas.

Trieste, at the end of one of the busiest traffic routes (Figure 4), is the city that attracts more passes in Friuli Venezia Giulia: there are 18 thousand cars a month in shared cars, against the 3 thousand of Gorizia, the 6.500 of Pordenone and 13 thousand of Udine. On a weekly basis, for Trieste we are talking about 2 thousand available seats (there are those who only offer one on their vehicle, two or three). Venice, Padua, Milan, and Bologna are the most popular destinations for those leaving the Region.

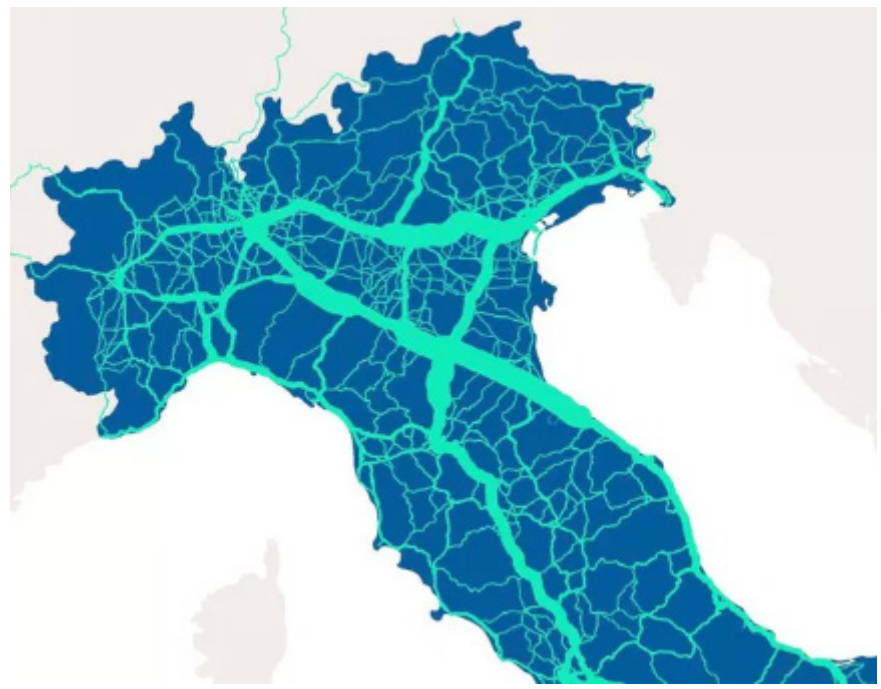


Figure 4: Map of car-pooling rides on the Italian national road infrastructure

Main reasons for the car-pooling practice

The particular position of Trieste, combined with the conditions of rail or road transport means that younger travellers will gladly offer shared transfers to and from Trieste when they decide to embark on a journey. Last summer, according to data disseminated by BlaBlaCar, half of the shared trips had Trieste as their final destination, while the remaining part had the regional capital as an intermediate stage of a long journey, mainly abroad: Ljubljana, Budapest, Zagreb, Rijeka, Maribor, Vienna, and Munich. Two-thirds of the trips involve people who travel by car over 100 kilometers, but the platform is also used for internal mobility in the region. Trieste-Udine is the most frequented route, with 77% of trips within the Friuli Venezia Giulia borders, and an average expense of 5,50 €. The drivers are employed (35%), workers with an intermediate managerial role (20%), but a good portion is made up of military or law enforcement officers who take advantage of the weekend to reach the family and friends.

In the area of Venice, BlaBlaCar seems to be the only efficiently working car-pooling system. Anyway, the Municipality of Venice[7] is trying to promote the car-pooling service provided by the German Flinc Social Mobility Network (https://www.flinc.org/). It is an application for dynamic car-pooling available for iPhone and Android created by the German company flinc - Social Mobility Network that deals with solutions for mobility and manages a carpooling service based on the creation of a network of users. BlaBlaCar is now developing a new service named BlaBlaLines. This is a new app that works with the same system, but that covers short distance journeys. It was designed especially for commuters, who move every day for more or less short sections. The launch is planned in France, where 13,5 million people drive every day to go to work and to go home but where on average each car does not carry more than 1,08 passengers.

To conclude this chapter, we can underline that all the main car-pooling platforms which tried in the past years to promote in Italy a car-pooling service have actually disappeared, changing the main mission of the company (e.g. the company Bring-me, which now offers a service of ride-sharing for workers named Jojob) or being bought by BlaBlaCar, which actually acts as monopolist for the car pooling / ride-sharing service, At least for the moment.

7 https://www.comune.venezia.it/it/content/il-carpooling-ovvero-condividere-lautomobile

Public transport (Bus/Train) infrastructure and services

Rail public transport

In Friuli Venezia Giulia Region, the rail service has a significant role within the Public Transport system, serving more than 20.000 people daily within the region. The Region has regulated the regional rail services through specific contracts with two providers, Trenitalia S.p.A. and Società Ferrovie Udine Cividale srl.

Connections to Austria are active since 2012, and the service is managed by Società Ferrovie Udine Cividale srl in partnership with the Austrian Österreichische Bundesbahnen (ÖBB). Since June 2018 connections are also active with Slovenia, managed by Trenitalia spa in partnership with Slovenske železnice.

The main double railways in the region are:

- (Mestre) - Latisana - Cervignano - Monfalcone – Trieste;
- Monfalcone - Gorizia – Udine;
- Aurisina - Villa Opicina;
- Udine - Pordenone - Sacile – (Mestre);
- Udine – Tarvisio.

The Region is connected to the Province of Venice with two key lines, from Trieste and Udine to Venezia Mestre. In relation to the Province of Venice the key lines continue from Friuli towards the western part of Veneto (Padova and Verona), passing from Venezia Mestre, the key station and mobility hub providing connection to Venezia Santa Lucia, the Venice City Centre Rail Station.

The rail network in both areas is shown in Figure 5.

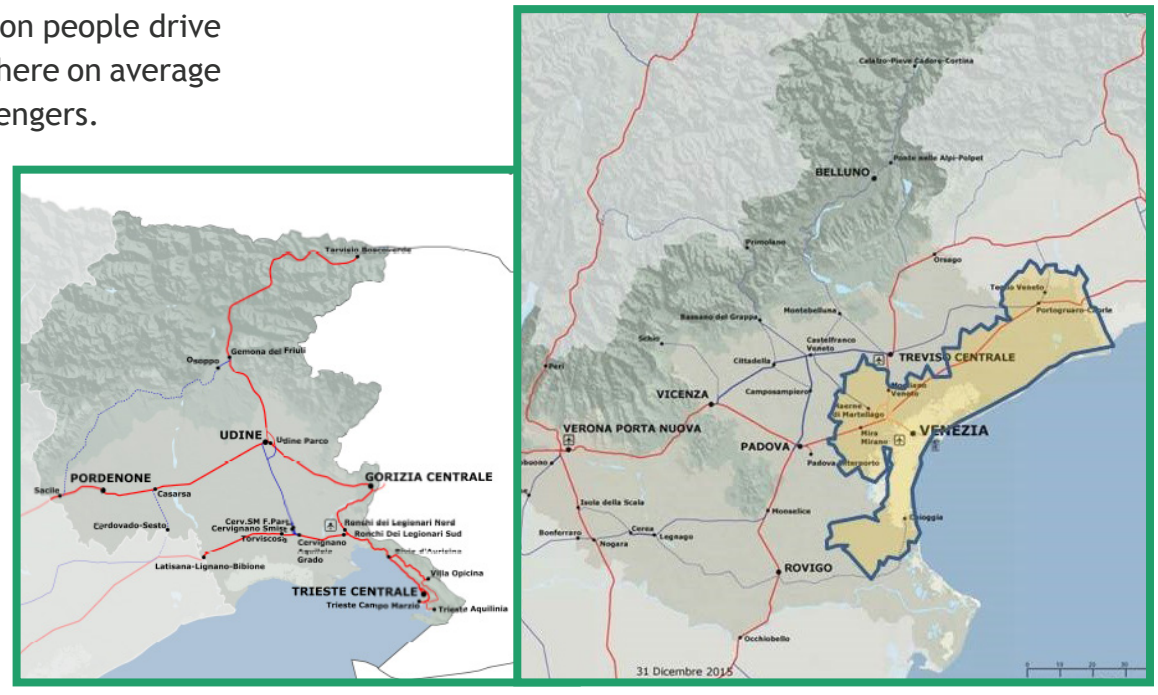


Figure 5: Railway network across Friuli Venezia Giulia Region (on the right) and in the Province of Venice (yellow area in the left-hand side image). Source: www.rfi.it

Friuli Venezia Giulia Region is also committed to support the implementation of new important High Capacity and High-Speed Lines within two key international axes crossing the region: the Pan-European Corridor V (Lisbon - Lione - Torino - Venezia - Trieste/Koper - Ljubljana - Budapest - Lvov) and the Baltic – Adriatic Railway Corridor.

It is currently under design the new high-speed line Mestre - Ronchi sud - Trieste continuing towards Divača and Lubiana, included in the Trans-European Networks planning. A feasibility study has been completed for the new high-speed connection Venice – Trieste, which has been funded by the EU Commission. A pre-feasibility study has been concluded covering the line Venice to Ljubljana. Agreements between Italy and Slovenia exist to work towards the definition of the line[8] .

Urban and extra urban road public transport system

Public Transport in Friuli Venezia Giulia Region includes both urban and extra-urban connections, as provided by the Regional Plan for Public Transport. The services are managed by specific providers, with contracts stipulated between the Management Units (Provinces) and the transport companies, as listed below:

- Province of Gorizia, Azienda Provinciale Trasporti di Gorizia APT S.p.A.;
- Province of Pordenone, Azienda Trasporti Automobilistici Provinciali - ATAP S.p.A.;
- Province of Trieste, Trieste Trasporti S.p.A.;
- Province of Udine, Autoservizi F.V.G. S.p.A. – SAF.

For urban transport in cities, the Municipalities have direct contracts for the provision of public transport. Included in the Public Transport of the region is also the historic cable train which connects the City of Trieste to Opicina, with 13 stops along a 5,175Km trail, which started to work in 1902, with the last renovation in 2006.

The data related to Public Transport in the Region are given in the table below.

8 http://www.regione.fvg.it/rafvg/cms/RAFVG/infrastrutture-lavori-pubblici/infrastrutture-logistica-trasporti/FOGLIA9/

Table 1: Data on Public Transport in Friuli Venezia Giulia Region (source: Regione Friuli)

Year 2015	Kilometres			Vehicles			Passengers			Employees
	EXTRA-URBAN	URBAN	TOTAL	EXTRA-URBAN	URBAN	TOTAL	EXTRA-URBAN	URBAN	TOTAL	TOTAL
GORIZIANA	4,251,116	1,316,523	5,567,639	82	35	117	3,696,808	1,666,393	5,363,201	198
PORDENONESE	6,077,539	1,191,607	7,269,145	139	25	164	7,096,596	3,669,416	10,766,012	248
TRIESTINA		12,646,903	12,646,903		271	271		65,008,791	65,008,791	796
UDINESE	12,257,559	3,213,887	15,471,446	318	79	397	12,675,131	11,454,906	24,130,037	571
TOTAL	22,586,214	18,368,920	40,955,134	539	410	949	23,468,535	81,799,506	105,268,041	1,813

In Veneto Region, the competence framework is very similar, whereby the Provinces are the competent authorities over their territory, while the municipalities are in charge of the urban services circulating only within the municipality boundaries unless they include a connection to a train station or an airport. The Province of Venice is in charge of two traffic basins, namely Venice and the Eastern Veneto. The lines within the Province are currently managed by two Consortia (Consorzio ACTV for Venice basin, Consorzio ATVO for Eastern Veneto) plus some services managed by private companies.

A peculiar case is one of the public services within the City of Venice, which is mainly on water. The Province is in charge of granting the navigation services within the City of Venice and the lagoon, including connections between Venice and Chioggia. This service is managed directly by the Municipality of Venice through the Consortium ACTV. The provision of this service is of primary importance for the City and its surroundings, as the City centre is inaccessible by road vehicles.

The public transport provided by ACTV, founded in 1881, ensures connections across Venice, transporting 95 million passengers only on the water with over 120 dock stations and 30 lines, which includes:

- Two City Centre Lines (1 and 2);
- Lines connecting the external perimeter of the City up to Murano and Venezia Lido;
- Lagunar Lines, connecting the most external parts of the Laguna, up to the Main Land, the Airport, Treporti, Punta Sabbioni, Chioggia, Fusina, S. Giuliano.

- Additional seasonal lines during the summer or specific events, to face the high peak of visitors;
- A ferry boat to Venezia Lido where vehicles can be loaded.
- Alilaguna, five lines connecting the Airport Terminal and the Cruise Terminal to the City centre, Lido, Murano e Punta Sabbioni.

The road public transport connects only Piazzale Roma with the Main Land, Mestre, the Airports of Venice and Treviso.

Integrated public transport and ticketing system

The Friuli Venezia Giulia Region is moving towards regional integrated public mobility services and ticketing integration. The Region has in fact implemented a European Public Tender procedure for the provision of maritime and road public transport across the region, which is the first process of this kind coming to a conclusion in Italy[9]. This new contract is expected to lead to significant savings and better service provision, with increased connections to main hospitals, sanitary structures, schools and between the Cities and their hinterland. Intermodality and bicycle services are going to be favoured, with an additional 184.000 km/year more connecting interchange hubs. The service will include also connections in mountain regions and services to reach key touristic destinations. Provisions for fleet renovation and investments in technologies are also foreseen as well as investment to improve accessibility to passengers with reduced mobility and support cycling. When the new services will be activated it will be possible to travel with a single ticket or pass across the whole Friuli Venezia Giulia Region at reduced fees.

An integrated ticketing system is already available in the Venice Metropolitan area also in connection with the nearby city of Padova. Thanks to an agreement between the railway provider Trenitalia and AVM/ACTV, supported by the Veneto Region, the Metropolitan City of Venice and the Municipality of Venice, three types of monthly integrated passes are available through the AVM Venezia Official App.

This initiative aimed especially to facilitate the thousands of commuters moving daily in this area, using various public or individual transport options, allows a shifts towards a sustainable and integrated public transport service. The App is free and allows to buy tickets and passes of local public transport and train tickets on the Venice-Padova line, paying car parks in Mestre, Marghera, and Lido, plan itineraries through the trip planner using trains, buses, trams, and boats, view the daily news, verify and plan timetables and routes. The Venice integrated ticketing started in February 2018, is the

Figure 6: Public Transport Map of Venice
Source: http://actv.avmspa.it/

first step to experiment ticketing integration and then potentially extending it across the regional area; Veneto Region is in fact committed to invest towards a unique regional ticketing system. The testing area is one of the most important connection hubs of the Region, as the only station of Mestre serves about 85 thousands people daily and 31 million annually, with about 500 trains per day.

It is also worth mentioning the new cross border ticket Italia-Slovenia, an integrated ticket available from March 2019 thanks to the Interreg CE project 'CONNECT2CE'[10], which includes a train connection between Trieste and Ljubljana and the local urban transport in Trieste to reach the train station.

P+R development

Interchange or Park and Ride (P+R) are car parks located in peri-urban areas and city outskirts, where the user can leave the car and reach the city centre with alternative ways, such as Public Transport, electric vehicles, bicycles. This solution is particularly designed for users who need long term parking

9 http://www.regione.fvg.it/rafvg/giunta/dettaglio.act;jsessionid=B30F1F0049777D88E4C06D96F602BB61?dir=/rafvg/cms/RAFVG/Giunta/Santoro/comunicati/&id=104407&ass=C08&WT.ti=Ricerca%20comunicati%20stampa

10 https://www.cei.int/news/8431/connect2ce-project-trieste-trasporti-and-slovenske-zeleznice-agree-to-launch-a-cross-border

and aim to reduce traffic loads in city centres and increase the number of available car parks within the city area for short term parking.

In the Italian Programme Area, the diffusion of Park and Ride solutions is particularly present in and around the City of Venice. "Parcheggia e vai" is the name of the initiative of the Municipality of Venice aiming to promote an integrated and sustainable mobility able to provide interchange parks and alternative solutions to the car to reach the City centre, including Local Public Transport and bike-sharing. At the moment, 3 intermodal P+R parks are available in Mestre, each with a bike-sharing station, 2 e-charging points and Public transport direct stops to reach the centre of Venice.

Other 10 free car parks are available in Mestre, with the possibility to reach public transport or cycling routes nearby. On the City of Venice further 4 parks are available from which the city centre can be easily reached by walking or ferry boat.

The "Parcheggia e vai" Project also intends to activate incentives to support the uptake of these services, such as reduced fees for the annual car park passes or free access to the bike-sharing for the first year. The project is expected to be implemented in several steps[11] .

In the Friuli Venezia Giulia Region, this solution seems less widespread, probably due to the fact that cities have medium to small dimensions, the biggest being Trieste with about 200.000 inhabitants. Some P+R parks are available in the main cities and are also activated during specific events or periods, such as during the Christmas time.

11 http://avm.avmspa.it/it/content/parcheggia-e-vai-2

Cycling Infrastructure

The National Cycling Network (Bicitalia) and Eurovelo

The figure below shows the map of National Bicitalia Network and the EuroVelo Network crossing the Italian Programme Area.

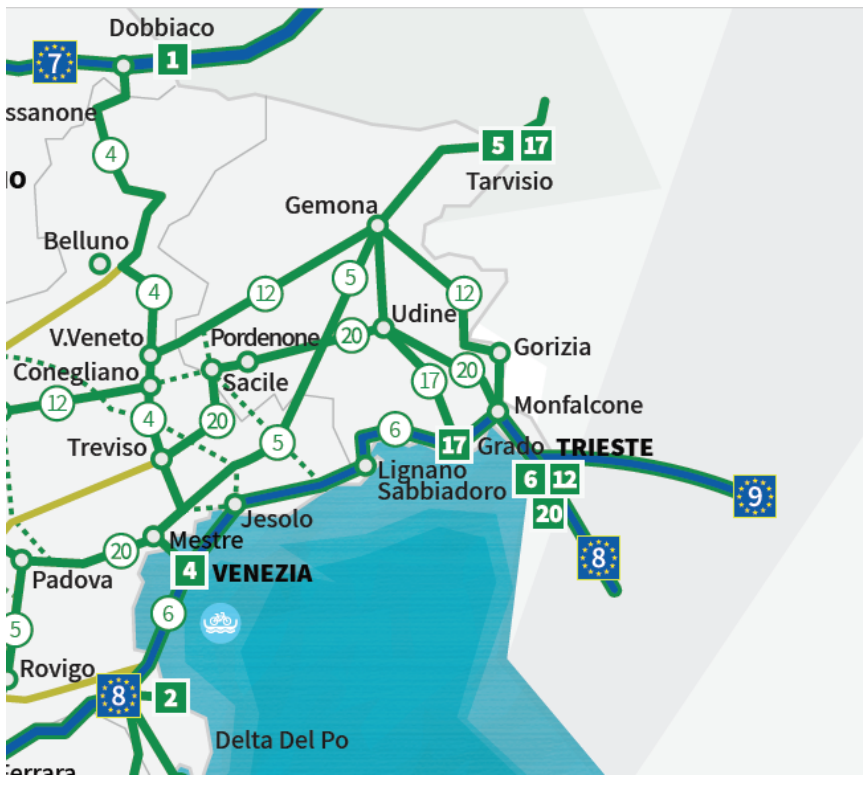


Figure 7: Network of Bicitalia and EuroVelo
Source: http://www.bicitalia.org/it/

Both Friuli Venezia Giulia Region and the Province of Venice are crossed by the Mediterranean Route Eurovelo 8 and by several cycling routes of national importance.

Cycling routes and network in Friuli Venezia Giulia Region [12]

Friuli Venezia Giulia Region is implementing a Network of Cycling routes of Regional Interest (ReCIR), which consists in a large network across the regional area, connected to similar networks in nearby countries and regions. In particular ReCIR is interconnected with the proposed Italian cycling network named Bicitalia and the European network EuroVelo. The final objective of ReCIR is to create a network of trans-regional high quality cycling routes, key infrastructural core for the development of a sustainable tourism and mobility, reaching a wide range of users.

ReCIR has been identified with several regional legislative acts (delibere 2297/2006, 3266/2007 e 2614/2015) in the framework of actions planned by the regional law 14/1993 aiming to support cycling mobility. ReCIR is intended to be the key structure of the so called "Diffused Cycling network", through which the Region aims to ensure that in the medium to long term, a big part of the regional territory is cyclable, within and outside cities and towns. In order to achieve this, the development of "Local Cycling networks" by local administrations will be crucial; for this reason, the Region has provided incentives for local PAs to realise cycling routes, both through regional and national laws and through European Funding, and requires that all Local routes are connected to ReCIR.

Cycling routes belonging to ReCIR are of regional priority interest and connect the key centres of attraction from a touristic, artistic, cultural and naturalistic point of view within the region, and the same centres with other cycling routes of nearby regions and Countries. Cycling routes are long distance cycling ways ensuring cyclists' comfort and safety both on dedicated paths or along secondary roads, where traffic is extremely limited. ReCIR is made of ten cycling routes,

Table 2: The cycling routes constituting the regional cycling network "ReCIR"

Identification code	Route
FVG1	Ciclovia Alpe Adria
FVG2	Ciclovia del mare Adriatico
FVG3	Ciclovia pedemontana e del Collio
FVG4	Ciclovia della pianura e del Natisone
FVG5	Ciclovia dell'Isonzo
FVG6	Ciclovia del Tagliamento
FVG7	Ciclovia del Livenza
FVG8	Ciclovia della montagna carnica
FVG9	Ciclovia della bassa pianura pordenonese
FVG10	Ciclovia Noncello-mare

12 http://www.regione.fvg.it/rafvg/cms/RAFVG/infrastrutture-lavori-pubblici/infrastrutture-logistica-trasporti/ciclovie/#id4

Figure 8: Network of Friuli Venezia Giulia Cycling routes of Regional Interest, ReCIR

spanning over more than 1,000 km in total, of which 450 km are completed (Table 2, Figure 8). All related interventions, implemented or planned, benefit from Regional funding.

The Regional Plan for Landscape, effective since May 2018, identifies the following weaknesses in the regional framework of soft mobility:

- the regional cycling network ReCIR has still to be completed;
- significant fragmentation of the local, municipal and intermunicipal cycling networks;
- fragmentation of the legislative framework;
- low maintenance and limited services available;
- impact of road and energy infrastructures;
- not homogeneous and sometimes absent or not clear signposting.

However, strengths are also highlighted:

- presence of structured routes across the whole region;
- interregional and international connections;
- presence of a rail network and public transport;
- diffused intermodality;
- strong presence of associations linked to soft mobility.

Cycling routes and network in the Province of Venice

Several cycling routes of regional and national interest are partly included in the Province of Venice, in particular connecting the City of Venice with the rest of the Region and other regions and countries.

Veneto Region has approved its Cycling Mobility Master Plan in 2005 and its Cyclo-tourism Plan within the Regional Trails Network, identifying 4 itineraries of regional interest and 7 provincial trails to be promoted within a specific project of touristic valorization with dedicated signposting.

The routes are based on those identified by the Regional Master Plan and also on the Bicitalia national network, with the aim to achieve a coordinated planning process promoting the best routes across the region. The Province of Venice is crossed by all 4 regional itineraries, all of them reaching the City of Venice, and by 1 provincial route which covers the islands of Venice (Table 3, Figure 9).

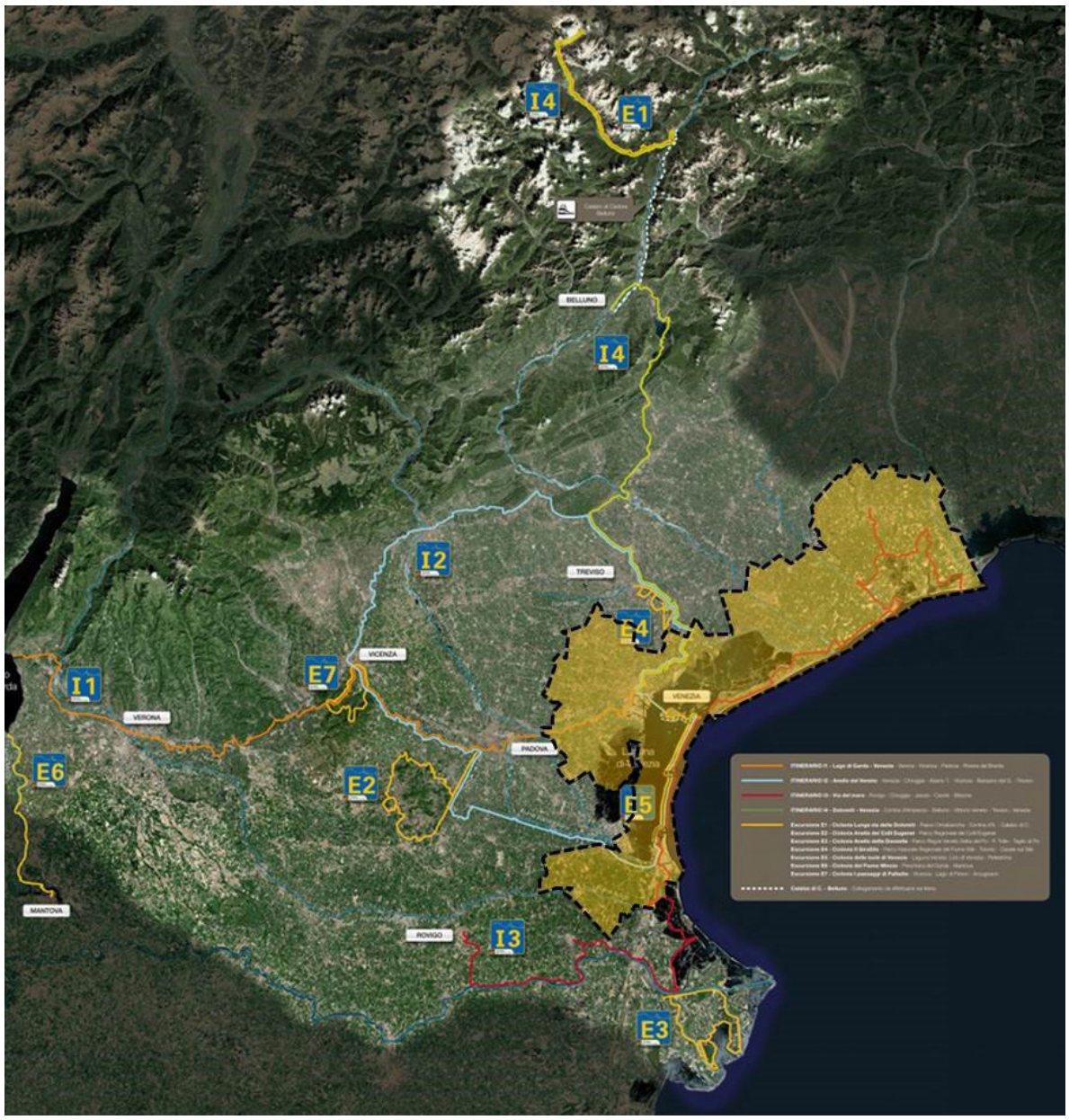


Figure 9: Network of Veneto Region Cycling routes (the yellow area identify the Province of Venice)

Table 3: The cycling itineraries promoted by Veneto Region crossing the Province of Venice

ID	Route	Total lenght
I1	Lago di Garda - Venezia	185 km
I2	Anello del Veneto	305 km
I3	La via del mare	250km
I4	Dolomiti - Venezia	191 km
E5	Ciclovia delle Isole di Venezia	40 km

At the local level, municipalities are promoting the extension and connections of existing local cycling ways, also thanks to available regional and national funding.

Bike-sharing

In all the main cities of the Italian programme area a Bike Sharing system exists, the most recent set up in Trieste. The table below summarises the number of Bike Stations in each city, based on the data available on the official websites of the Municipalities. In Trieste, the system was expected to start in 2018 but

experienced delays and should be operative from 2019. From the analysis of SEAPs in the Italian Programme Area, two municipalities in the Province of Venice, over 20,000 inhabitants (Mira and San Donà di Piave), include within their actions a Bike sharing system set up and the enhancement of the existing one respectively, including education activities in schools to promote safe cycling. In SEAPs of smaller municipalities Bike Sharing is not included, and only in one case an initial study is mentioned for the set-up of an electric bike-sharing (a Municipality in the Province of Venice in association with two from Treviso Province: Terre tra il Meolo e il Musestre: municipalities of Meolo, Roncade, and Monastier).

Table 4: Number of Bike sharing stations in the main cities of the area (municipalities websites)[13]

City	Number of stations
Gorizia	5
Pordenone	8
Udine	24
Trieste	11
Venezia	19

13 Trieste: http://www.retecivica.trieste.it/new/mobilita_sostenibile/default.asp?pagina=bikesharing

Walking infrastructure

At national level, data show a limited use of soft mobility for travelling from home to the work place and schools: 71% of trips to the job place is by private vehicles, while 40% of trips to schools is by private vehicles, followed by public transport (30%) and walking (25%). In 40 years, up to 2011, people using public transport to go to work have decreased, the number of people using private vehicles has tripled, while pedestrian mobility has decreased from 32 to 11% and cycling from 9 to 4%[14].

Even if efforts have been made towards sustainable mobility, the offer of services and safety conditions is still lacking in many cities. Generally, the challenge that Local PAs across Italy face is to invest more in Local Public Transport and provide more services and safety conditions towards soft mobility, including cycling and pedestrian mobility. In Friuli Venezia Giulia Region, the regional Plan for Road Safety has within its priorities road safety in urban areas, with particular reference to users such as pedestrians and cyclists. According to this, funding has been provided to local administrations to guarantee safety conditions in towns and cities, including limited traffic zones and limited speed zones.

14 All data taken from Qualità dell'ambiente urbano, XIII Rapporto ISPRA, 2017

Interesting results emerged from the analyses carried out in the drafting of the Pordenone's SUMP, specifically concerning the commerce sector, where 393 employees were interviewed in 148 commercial activities of various kinds, generally confirming the national data:

- 67% reach the place of work by car, 16% walking and 8.4% cycling;
- 63% park near the activity, while 83% declare to have had difficulty in parking;
- 23% are in favor of new pedestrian zones and 72% are against;
- 32% of retailers are available to provide forms of customer parking facilities;
- 12% believe that the ring car parks must be upgraded.

Furthermore, concerning the results of the same study on pedestrians, where 302 interviews were conducted on a well-stratified sample, it emerges that 89% moves to the city center by car and 9.2% by bicycle, 56% agree with the enlargement of the pedestrian areas while an enlargement of Z.T.L. is welcomed by 51% of respondents. This picture reflects the situation of the biggest cities across the region, whilst the demand for cycling and walking across the city is still not so widespread.

However, good practices exist. For example, the City of Udine joined the "Città 30 e lode" a national initiative aiming to apply European models of sustainable mobility providing road safety and quality of life in residential areas and has benefitted from regional funding for the implementation of limited speed areas and other measures. It has to be noted that initiatives are also starting from citizens and associations: for example a local initiative, started by labor unions and Centro Antartide in collaboration with the Municipality of Udine, is currently trying to study and plan a series of measures to improve the liveability of urban areas, focusing on a pilot neighbourhood; one of the sectors the initiative focuses on is Transport and Mobility, with the general aim to promote a more safe, healthy, accessible, liveable and sustainable neighbourhood (and city) starting from walkability[15].

In Trieste, according to the recent Plan for Urban Traffic, the pedestrian areas are growing, as are the pedestrian paths favored from the center to the outskirts, with the aim to create a continuous network dedicated to pedestrian and cyclists. It is also proceeding to the realization of "zone 30" projects both in the urban center and in some small areas of the city.

15 http://www.retecivica.trieste.it/new/mobilita_sostenibile/default.asp?pagina=bikesharing

In relation to the Province of Venice, it has to be said that the City of Venice is one of the cities with the highest rate of pedestrian trips : data shows that pedestrian trips in Venice are 2%higher than the average rate in European cities with the same dimension and population. This is linked to the geography and architecture of the City, most of which is not accessible by car but only by public transport or soft mobility.

From the analysis of SEAPs across the Italian programme area, it emerges that all Plans include specific actions towards safer and more sustainable mobility, specifically addressing pedestrians: the implementation of restricted traffic areas, limited speed areas and the set-up or enhancement of Pedibus (Walking Bus) for Schools; actions to raise awareness and informing citizens, improve Mobility and transport planning.

3.2 Mobility at University level

For a thorough understanding of the mobility needs at university levels, two analyses were carried out by MUSE PPs containing: I) Territorial coverage of the university and its campuses, locations of student dormitories, and II) Mobility needs for employees and students. The general data regarding universities in Italy and Slovenia is presented in the table below.

	***Italy** (Friuli Venezia Giulia)*				***Slovenia***		
City	***Trieste***	***Gorizia***	***Pordenone***	***Portogruaro***	***Nova Gorica***	***Ljubljana***	***Portorož***
University Name	Uni of Trieste	Department of Political and Social Sciences (Uni of Tri)	Department of Engineering and Architecture (Uni of Tri)	Department of Education (Uni of Tri)	Uni of Nova Gorica	Uni of Ljubljana	Faculty of Maritime Studies and Transport (Uni of LJ)
No. of faculties / University campuses	*10*	*1*	*1*	*1*	*3*	*26*	*1*
No. of employee	*1,306*	*?*	*?*	*?*	*249*	*5,898*	*540*
No. of students	*16,691*	*667*	*62*	*24*	*1,453*	*43,264*	*1000*
No. of Dormitories	*6*	*1*	*1*	*-*	*7*	*29*	*2*

SLOVENIA

It supposed to be useful recalling here some descriptive aspect related to the features of the territory where each campus of the University of Ljubljana, University of Nova Gorica, and University of Primorska are located, both within the boundaries of the city and also outside it.

The University of Ljubljana is made up by 26 faculty and research institutions which 25 of them located inside the 1st ring road of Ljubljana city as shown in the Figure. Main student's accommodation provider in Ljubljana are Študentski domovi v Ljubljani (28 dormitories with 7941 beds) and Dom podiplomcev Ljubljana (140 studios and 30 apartments). Almost all the student dormitories are located inside the 1st road ring of Ljubljana city as well. Data analysis indicate that 58% of all Slovenian students' study in Ljubljana urban region. Less than

Figure 10. Geographical spread of faculties and research institutions of the University of Ljubljana in the city of Ljubljana

half of all students in the region are permanent residents of this region while others migrate daily or weekly from the rest of Slovenia. Majority of students originating from outside LUR commute to the University with a private car.

As all the facilities located within the Ljubljana city and there are no big elevation differences among different points of the city, providing E-bike sharing system and improving service quality of the existing bike sharing system as well as Park & Ride system can be useful solution in improving sustainable and energy efficient mobility of students and university employees.

Among the University of Ljubljana faculties, only Faculty of Maritime Studies and Transport is located in **Portorož city**. At the faculty at the present studies about 1000 students per year. About one third of students are local students. The rest of the students come from other parts of Slovenia, and from the Erasmus student exchange. They are usual located in the vicinity of the faculty. The majority of them are in the Korotan student dormitory, and at the Dijaški dom in Portorož, in the immediate vicinity of the faculty. Other found place in several smaller private providers of student rooms in a radius of 5km from faculty. The possibility of accommodation is also located at the Koper student dormitory, which is 15km away. Most of the employees come from nearby towns. Most of them use their own transport, including cars, moto cycles and few also bicycles. For traveling to the faculty, they spend on average, outside the tourist season, less than 55 minutes. During the lunch break, students and employees can take advantage of the diverse range of local snacks and food suppliers. Students usually choose nearby market and News café bar near the beach, about 300m away. Employees usually go to the Beli Križ, which is about 1km away. The nearest post office is in the centre of Portorož, about 2km away, and in centre of Lucia, about 4km away. The nearest health centre is located in Lucija, about 4km away, and in Piran, about 2km away. In Piran there is also a boat school of Slovenia, which is regularly used during the study. The distance from the school to it is about 2km.

University of Nova Gorica

The University of Nova Gorica is a university institution that deals with higher education at undergraduate and postgraduate level and with scientific research activity. It is located in Rožna Dolina, a settlement in the Municipality Nova Gorica. It's 3 km from Rožna Dolina to the centre of Nova Gorica and 2 km to Šempeter/Gorici. In Nova Gorica, there are three main higher education institution namely School of advanced social science, University of Nova Gorica, and European faculty of law. The number of students for this institution is 328, 409, and 716 respectively while the number of employees are 57, 146, 46 respectively.

The public transport in Nova Gorica and Šempeter/Gorici is free of charge since April 2006. There are 3 intercity bus lines passing Rožna Dolina:

- Route 1: (Vrtojba) - Šempeter Pri Gorici - R. Dolina - Nova Gorica (MAP) - Prvomajska - IX. Korpus – Solkan;
- Route 2: (Vrtojba) - Šempeter Pri Gorici - R. Dolina - Nova Gorica (MAP) - Cankarjeva - Lavričeva - M. Štrukelj – Solkan;
- Route 4: (Vrtojba) - Šempeter Pri Gorici - R. Dolina - Nova Gorica (MAP) - Cankarjeva - Lavričeva - Kromberk - Loke - Ajševica - Stara Gora cemetery.

The first bus on weekdays starts at 5:30 pm in Solkan, the last end at 8:30 pm in Solkan. Intervals are on weekdays until 16:00 on the Nova Gorica - Šempeter pri Gorici route for 30 minutes, at peaks between 6:00 and 7:30, between 13:30 and 16:00 hours, 20 minutes. After 16:00 and on Saturdays, Sundays and holidays the interval is of 60 minutes.

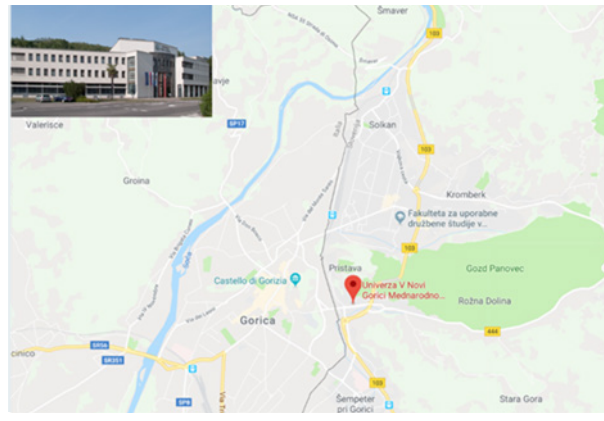


Figure 11 Location of the university of Nova Gorica

> The University of Nova Gorica began operatinng in the academic year 1995/1996 as the Faculty of Environmental Sciences, the firstinternational postgraduate school in Slovenia, founded by the Municipality of Nova Gorica and the Jožef Stefan Institute in Ljubljana.

In the context of urban transport, there is also an international line which connects Nova Gorica railway station Gorizia, but it is subject to another regime (use is payable and intended exclusively for international traffic) and, in addition, it is not part of the basic urban traffic concession:

- International route: Nova Gorica - Vojkova - Lavričeva - Cankarjeva - Erjavčeva - Nova Gorica;
- ŽP - S. Gabrielle - via Carducci - Corso Verdi - Corso Italia - Stara Gorica ŽP.

The current regulation of urban public passenger transport is not entirely satisfactory. In traffic peaks buses are overloaded, the frequency on individual lines is

not adequate, some new settlements are not or are poorly connected with the urban transport. Lines and timetables are proposed by the concessionaire on the basis of currently available financial resources, available fleet, etc. which is not necessarily optimal and in certain segments definitely offers the possibility of improvement.

Accommodations for students in Goriška:

- students home ERJAVČEVA, Erjavčeva 36, 5000 Nova Gorica (56 accommodations)
- students home PRESTA, Bazoviška ulica 1a, 5000 Nova Gorica
- rooms in MAINSON LANTHIERI, Vipava (14 accomodations)
- students dorm Nova Gorica, Streliška pot 7, 5000 Nova Gorica (127 accommodations)
- students dorm Ajdovščina, Cesta 5. maja 12, 5270 Ajdovščina
- students dorm Vipava, Grabrijanova 17, 5271 Vipava
- students dorm, 26 Ulica padlih borcev, Šempeter pri Gorici 5290 (108 accommodations)

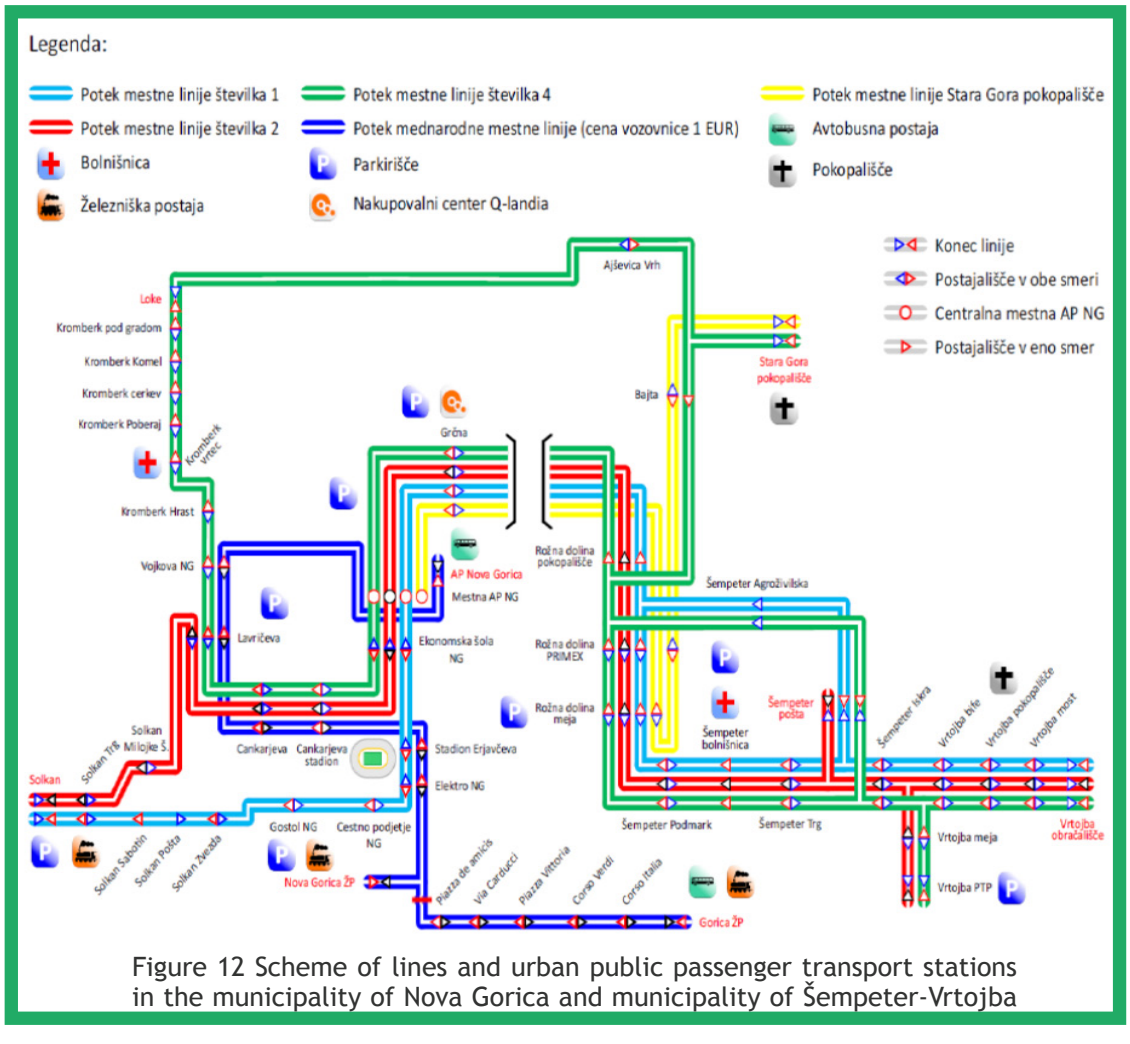


Figure 12 Scheme of lines and urban public passenger transport stations in the municipality of Nova Gorica and municipality of Šempeter-Vrtojba

All faculties in Nova Gorica have direct access to the public transport, dormitories as well. Transport from the city centre to the UNG seat in Rožna Dolina is well organized and frequent enough.

University in Nova Gorica is situated in two locations. Primary location is Vipavska 13 in Nova Gorica (Rožna dolina) and the second is in Lanthieri mansion in Vipava, while student dormitories are placed in several locations:

- Student home Nova Gorica is offering to the students, beds in contemporarily equipped student residence hall on Erjavčeva street in Nova Gorica.
- Student home Presta, Nova Gorica consists of four floors has apartment type rooms and suitable for all students who would like to stay in nice, quiet home at the same time enjoy student life. It is Based in Marušičeva street.
- Dijaški dom Nova Gorica in Streliška pot is offering to the students, beds in contemporarily equipped pupil and student residence hall in Nova Gorica.
- Dijaški dom Ajdovščina is offering 10 beds to the students of University of Nova Gorica. It is located in cesta 5. maja in Ajdovščina.

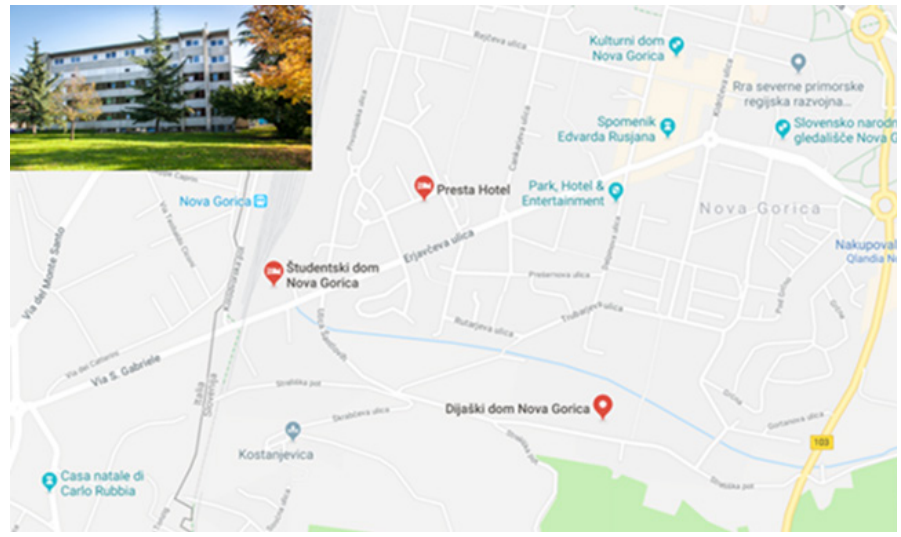


Figure 13 Locations of dormitories in Nova Gorica

- Dijaški dom Vipava is offering 25 beds to the students of University of Nova Gorica. It is placed in Vipava, a few minutes walking to the Lanthieri Mansion.
- Dijaški dom Postojna is offering several beds to the students of University of Nova Gorica from October 1st until June 24. It is placed in Tržaška street in Postojna.
- Rooms at Lanthieri Mansion, Glavni trg 8, Vipava is placed in the University building.

The distances between dormitories and University vary based on the location of a dormitory anfd location of the faculty. The locations that are in Nova Gorica and in Rožna dolina are connected by city bus. But due to the short distance scan be easy accessed by bike (in exceptional cases also by walk). It is necessary to go across the small hill to reach the faculties from the Nova Gorica dormitories. But it is also the possibility to take the old tunnel which goes through the hill and where the bike trail is placed.

The distance between dormitories and faculties in Vipava can be reached by walk or bike. They are placed very close (even in the same building).

For all other arrangements the use of public transport or a car is necessary. Some locations (Nova Gorica to Postojna). Are not so well connected with public transport, therefore a car is needed.

The cities (places) where the faculties and dormitories are placed are not equipped with bike or car sharing infrastructure.

ITALY

It seems worth underlining here some descriptive aspect related to the features of the territory where each site of the University of Trieste is located, both within the boundaries of the city and also outside it, i.e. in the cities of Gorizia, Pordenone and Portogruaro.

The University's main site is in Piazzale Europa 1 overlooking the city, with about 200 m above sea level. It is located 2.2 kilometres from the railway station and 2.8 from the city centre, to which it is very well connected thanks to several bus lines that operate with frequent runs. The average time to reach the University main campus from the railway station by bus is circa 15 minutes, whilst 20 from the city centre (and vice versa). A proposed intervention to foster sustainable mobility for students and staff to reach this site should thus take into account the importance of elevation. Therefore, it is advisable to implement measures to strengthen the already efficient bus services or to develop a system of electric bike sharing that may allow students, administrative and teaching staff to reach the main site in an effortless manner.

A more complex picture is drawn if looking at the Department of Medical, Surgical and Health Sciences, which is spread across a number of sites in the city of Trieste. In such a case no clear-cut indication can be provided. In fact, there are different altitudes levels amongst the sites, ranging from the sea level of the Maggiore Hospital to more than 200 m above sea level of the Cattinara hospital. Sites are connected thanks to an efficient bus system, but the time required to travel from one location to another is quite heterogeneous. In this respect, it might be useful to replicate the same suggestions proposed to foster the sustainable mobility to reach the University main site, i.e. increasing the already satisfactory frequency of bus connections, or consider an electric bike-sharing system.

As far as the Department of Economics, Business, Mathematics and Statistics is concerned, there is an efficient bus connection from the train station to both the sites located in via dell'Università, 1 and Via Tigor, 22. It thus may be advisable to implement a bike and e-bike sharing system to allow students that commute on a daily basis to reach the above mentioned sites, with special reference to the latter, given the presence of a 30 metres altitude difference between the two.

As far the Department of Legal, Language, Interpreting and Translation Studies is concerned its close proximity to the train station implies that no specific action is proposed. Conversely, regarding the Department of Humanities both a bike and e-bike sharing systems might be implemented since its non-negligible distance from the train station, with which it is however very well connected through the bus system.

If looking at the satellite campuses of Gorizia, Pordenone and Portogruaro, there are good connections between the train stations and the site where the classes are held thanks to a well-organized bus system. Given the flat nature of the areas and the relatively modest distance to be covered by students and staff from the train stations, probably a mere bike-sharing system could be implemented.

Given the heterogeneity that features the sites within the city of Trieste, but also other satellite campus with their own peculiarities it is relevant to check whether there are architectural constraints that may prevent or make bureaucratically complex the construction of photovoltaic plans to charge and/or store the energy needed to fuel the electric bikes.

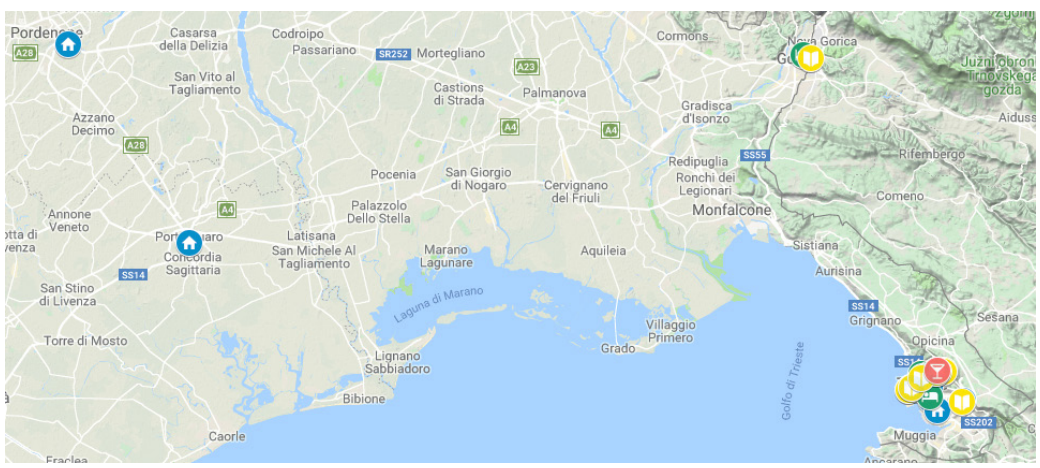


Figure 11. Geographical spread of departments, dormitories, libraries of the University of Trieste in the city of Trieste and in the satellite sites of Gorizia, Pordenone and Portogruaro

3.3 Mobility at cross-border level

The geographical coverage of the area is characterized by an internal diversity with the presence of coastal areas, mountain ranges, rural and urban areas, and lagoon landscapes. The cooperation area includes various models of territorial development.

When planning new cross-border connections, it is necessary to estimate the number of potential passengers. In doing so, we can derive from the current traffic on individual routes and determine the target modal split or the share of passengers that are supposed to use public passenger transport. The existing studies show that employees use public transport to a greater extent only in cases where their workplace is not accessible with a personal vehicle and/or when public transport is faster than personal. In the case of journeys for the purpose of care, leisure activities and similar, the share of users of public transport on routes outside major cities is very low. On cross-border relations, where the share of travel to work and school is low, we can achieve a 5% share of public transport users only with a high-quality service, that is, at least one-hour interval over the whole day.

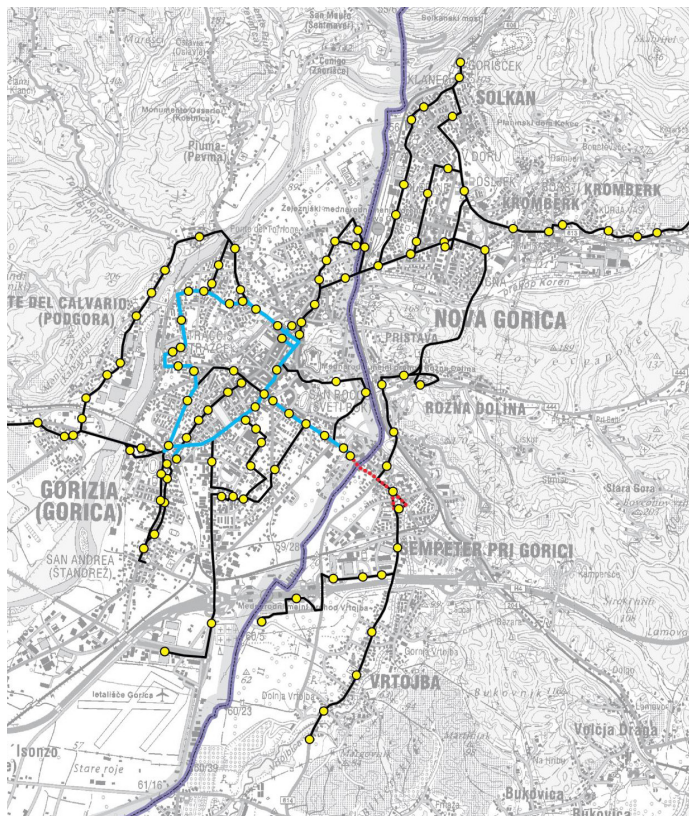
Nova Gorica - Gorizia route

A specific example is the functional urban region of Gorizia, Nova Gorica and Šempeter. Regarding the area of Nova Gorica and Gorizia, the data from the Road Directorate of the Republic of Slovenia show that cross-border personal traffic is relatively large. At the border point Rožna Dolina, the average daily passenger turnover of passenger cars in 2012 was 9343. There are several border crossings in the Gorica area, which means that the total cross-border traffic is roughly twice as high. On the other hand, according to Avrigo (today Nomago), in 2012, 18,453 passengers were transported on the international city line of passengers (both carriers are taken into account). The share of cross-border passengers using public transport therefore does not even reach 1%. With a more attractive service, which means above all a higher frequency, the potential for increasing the number of passengers is therefore very high.

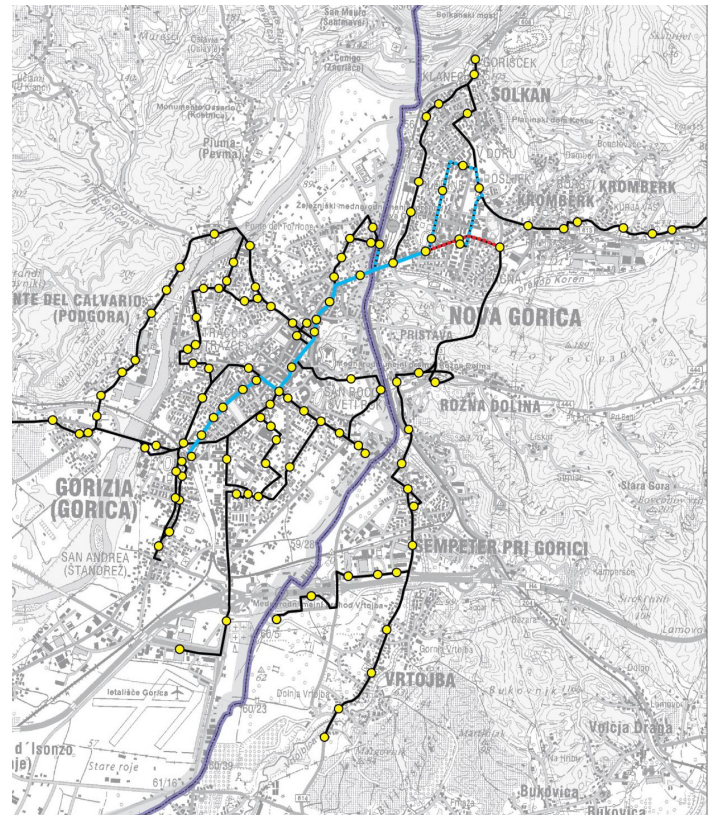
A suggestion was that in the first phase, a significant increase in the frequency of a cross-border city bus neither has sense nor is economically viable, if carriers do not have the right to operate a cabotage. Instead following measures are foreseen: the arrangement of a cross-border switchover point at the New Railway station, the extension of Italian lines 3 and 5 to Šempeter pri Gorici, and the increase of frequency and the change of route on the international city line. The fourth possible measure is the connection between Miren and Nova Gorica past the cemetery in Gorizia.

In the immediate vicinity of the railway station of Nova Gorica, the Piazza della Transalpina is the starting point of the Italian line 1 which drives past the railway station in Štandrež/St.Andrea. This route is an ideal connection between both railway stations. Unfortunately, the connection is only conditionally usable, since it is obligatory to buy tickets in advance, which cannot be done on the Square of Europe for a trip with Gorizia city buses. Therefore, the proposal is the introduction of ticket sales at Nova Gorica railway station and the installation of a self-service card terminal at the Italian stop. It is also reasonable to place appropriate direction signs at the railway station in Nova Gorica.

Both Italian circular lines have a turning point at the hospital at Via Vittorio Veneto. From there it is only 700 m to the



The route of the extended line



Modified route of the international line Gorizia - Nova Gorica

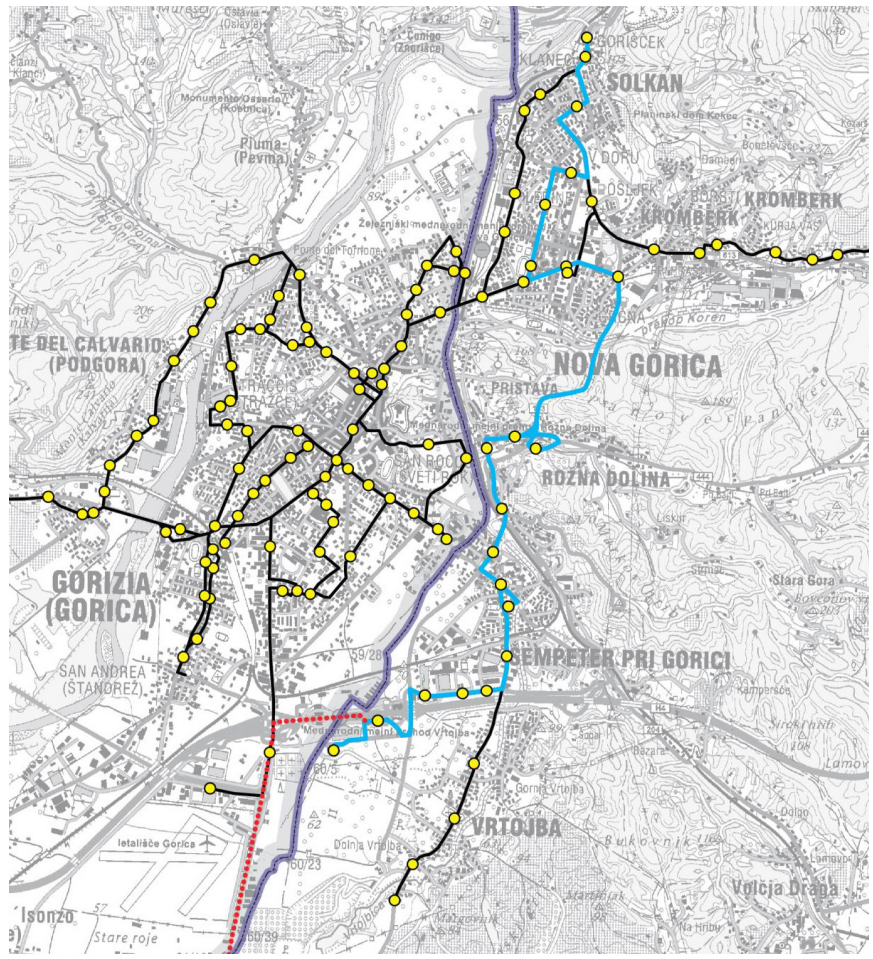
center of Šempeter, and 1 km to the final stop of the Slovenian buses at the post office. The minimum extension of the Italian lines would thus connect Šempeter with Gorica. The two lines together have 15 connections on weekdays, and the extension would mean 30 additional kilometers per day, which would roughly amount to EUR 75 per day of additional costs. On Sundays there are 10 daily trips, which means 20 extra km. The route of the extended line is shown in Figure 3. Since the existing Italian carrier would not transport passengers within Slovenia, there are no legal obstacles to the introduction of such a line. It is necessary, however, to introduce a pre-sale of tickets for Gorizia (Italian) city traffic in Šempeter.

According to the valid timetable, the international city line operates 10 times a day between 8:00 and 20:00 with a break between 13:00 and 15:00. Transportation is subsidized by both municipalities. In addition, Nomago, also has a 2-carriageway with a bus line connecting Idrija with Gorizia, and on Sundays from March to November as well as an international line linking Gorizia to Sveta gora/Montesanto.

Depending on field visit and passenger surveys, the following changes have been proposed. The line should operate in one-hour intervals from seven in the morning to eight in the evening, which means 14 journeys per day. In the itinerary, the deviation to the railway station in Nova Gorica should be canceled, as it is already connected with the Italian line 1, and passengers must not be transported from the railway station to the center of Nova Gorica in accordance with the existing permit anyway. As Italian travelers dominate for the motive of shopping, an extension to Grčna or to the shopping center Qlandia has been proposed, where the bus would turn at the roundabout. The cancelation of the deviation on Cankarjeva Street has also been suggested. For the most part, passengers enter at the main bus station, while traveling time to Gorizia is therefore disproportionately long. Passengers traveling to the northern part of Gorizia should be able to conveniently switch to the city bus at the bus station, which means that the timetables should be adjusted accordingly. Due to the shortening of the route from 7 to 5 km, the buses on the proposed line would, despite 4 additional departures, travel the same kilometers as they do now.

The current price of one-way tickets is EUR 1, which is less than the one-time ticket in Gorizia. This is not a logical rate, therefore an increase of EUR 1.30 has been suggested, which is also the basic price for the shortest distance in Slovenian long distance traffic. The introduction of a return ticket at a price of EUR 2 and the possibility of buying in advance has been proposed, both of which will accelerate the driving of buses.

Miren has, according to the accessibility standards provided for in the Decree on the method of performing public utility services, the public regular transportation of passengers in internal road transport and the concession of this public service, too few daily connections with Nova Gorica. With the extension of city lines from the Vrtojba border crossing to Miren across the Italian territory, as shown in Figure 5, several goals would be achieved. By organizing a leaping point at the Gorizia cemetery and coordinating the timetable, the Italian line no. 6 would connect Miren and the business zone at the border crossing with Gorizia with public transport, and improve the public transport between Miren and Nova Gorica as well.



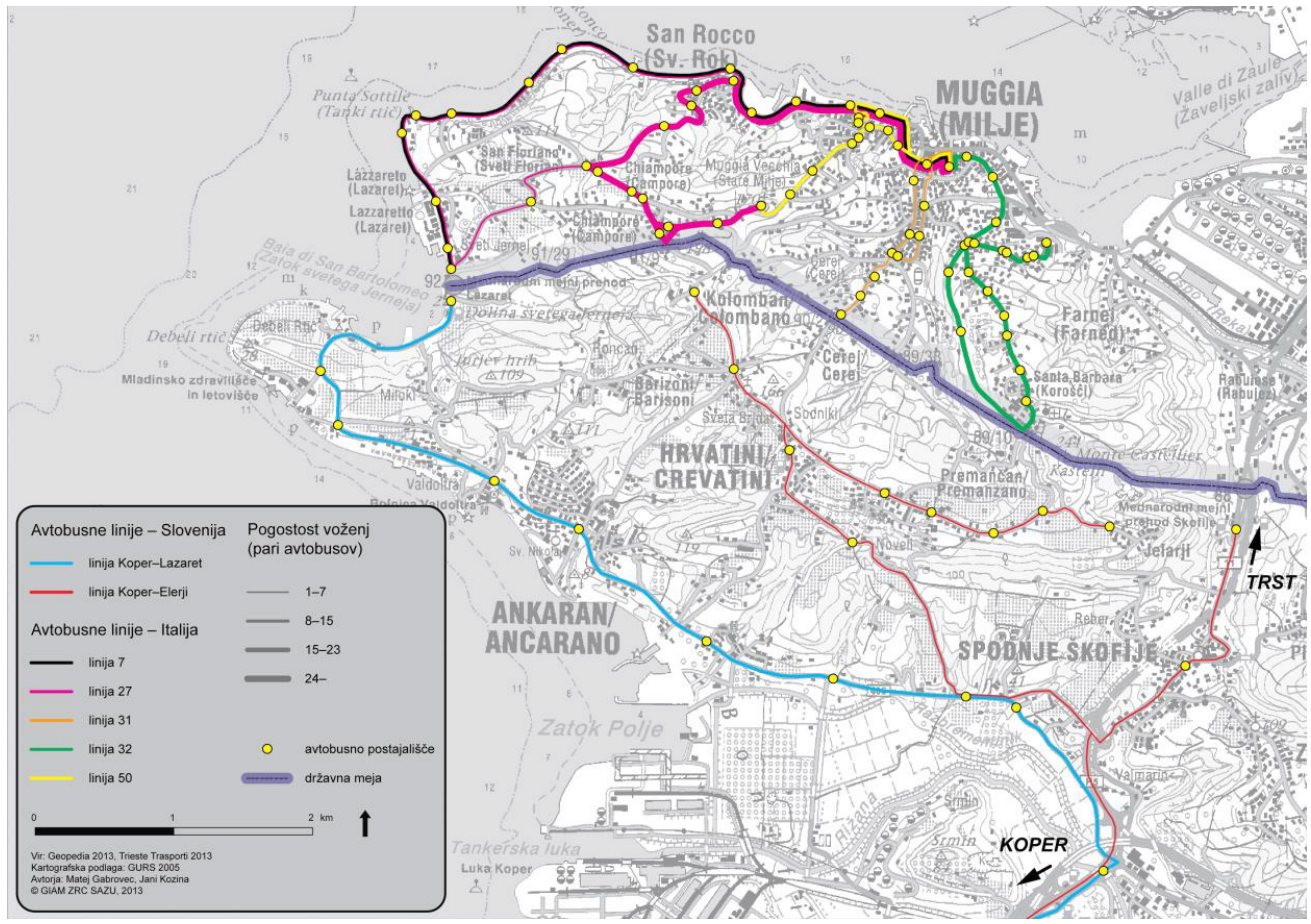
Extension of Slovenian city lines via Italy to Miren

Koper – Trieste route

In the framework of the Adria-A project, a multimodal transport model was developed in the cross-border Slovenian-Italian area. The model dealt with the Goriška and Obalno-kraška regions in Slovenia and the Trieste, Gorizia and Udine regions in Italy. A relatively small share of cross-border traffic is shown in the aforementioned results studies of ADRIA-A project. Therefore, an economically efficient and at the same time high-quality cross-border public passenger transport cannot be organized, if it is not harmonized with internal long-distance and urban passenger traffic. In doing so, some legal obstacles were encountered.

At the border point of Lazaret, the average daily flow of personal vehicles in 2012 was 1444. According to estimations, about a quarter of vehicles are crossing the road only for the purpose of purchasing fuel at a gas station on the Slovenian side. The actual number of cross-border passengers at this border point is therefore only around 1000. This means that the potential number of daily cross-border passengers is 50 or less, which means that it is not possible to introduce economically sustainable international lines in the case of authorization for the carriage of cross-border passengers. However, if the carrier in Italy and in Slovenia has the right to transport local passengers, traveling within Slovenia or Italy, then the line sustainability is not questionable.

The existing public bus network is shown in Figure on the right. There are no cross-border links in the area under consideration. Slovene as well as Italian lines have end stations near border crossings or border points, in some cases (Cerej, Lazaret) are turning points near the border. There is a transfer possibility from Slovenian to Italian side by bus only at Lazaret, where the distance between the Slovenian and Italian stops is 300 m. On the others border crossing points, where it would be possible to cross, the distances are longer, ranging between 700 m and 2 km. Crossing the border is also possible at the border points in Čampor, Cerej and Premancan, but they require an about 15-minutes-walk.



Existing public bus network

Network of public passenger transport lines traffic is denser on the Italian side, where there is also a higher frequency of journeys. In the municipality of Milje, public bus transport operates within the framework of Trieste city traffic, carried out by the company Trieste Trasporti. In the area of municipalities, there are 5 lines connecting Milje with Korošci, Cere, and Stare Milje and Lazaret. Buses are low-floor, suitable for disabled people, number of standing places is higher than the number of seats, the seats are not padded, and therefore buses are relatively uncomfortable for long distance services. Milje is well connected to Trieste with a very frequent urban line (the interval is about 10 minutes). This line also allows to connect with Koper through the transfer to Žravlje on the international line of Trieste - Koper. However, there is no direct international connection between Koper and Milje in the area taken under consideration. There is just the international line between Koper and Trieste, carried out by Arriva Dolenjska and Primorska. This line is a possible crossing point towards the Milje and Žravlje.

Venice/Udine to Trieste and Ljubljana

INTERREG CROSSMOBY has started on September 8th, 2018, and allows to connect not only the regional capital Trieste (together with Udine) with the Slovenian capital Ljubljana, but also other important cities of both the involved territories, which are relevant for their industrial, touristic and intermodal characteristics. The touristic aspect plays a particular role, especially in the promotion of a sustainable use of cycling, since trains are endowed with 30 places ad hoc developed to bikes and trains' route is close to cycling path of European interest.

Being Udine and Trieste two very well connected cities residents in Udine have also the possibility to reach Trieste in the early morning for example with a train leaving at 07:38 from Udine, arriving in Trieste at 08:43 and then there take the train to Ljubljana at 09:02.

There is also the possibility to reach Ljubljana from Udine in a multimodal way. Passengers can take the 09:15 Autobus EC830 offered by the Austrian railways from Udine, reach Villach at 10:50 and then take the 12:53 Sava 211 train to Ljubljana where they arrive at 14:32.

The above options can also be very useful for the traveller who start her journey from Venice. In fact, Venice and Trieste are two very well linked cities with two different train lines, one that stretches along the coast and one that goes up north and passes through Pordenone, Udine and Gorizia before reaching Trieste. For example, travellers may take the train Regionale Veloce 2203 from Venice at 06:41 and arrive in Trieste at 08:48. This will allow passenger to take the already mentioned train 1825 from Trieste to Ljubljana at 09:02.

Residents in the municipalities of the UTI Noncello can benefit from the presence of the train that goes from Venice to Trieste along the inner path that includes the city of Pordenone and passes through Udine and Gorizia remarked above.

The calling stations for existing routes are reported in the Figure below:

Venice to Trieste

Arrival	Departure	City
	06:41	Venezia S. Lucia
06:51	06:53	Venezia Mestre
07:03	07:04	Quarto D'Altino
07:16	07:17	S. Dona' Di Piave-Jesolo
07:26	07:27	S. Stino Di Livenza
07:36	07:37	Portogruaro-Caorle
07:47	07:48	Latisana-Lignano-Bibione
07:59	08:00	S. Giorgio Di Nogaro
08:08	08:09	Cervignano-Aquileia-Grado
08:16	08:17	Trieste Airport
08:22	08:23	Monfalcone
08:48		Trieste Centrale

Pordenone to Trieste and Udine

Arrival	Departure	City
	06:17	Pordenone
06:27	06:28	Casarsa
06:34	06:35	Codroipo
06:53	06:55	Udine
07:09	07:10	Cormons
07:18	07:19	Gorizia Centrale
07:29	07:30	Sagrado
07:39	07:40	Monfalcone
08:03		Trieste Centrale
	16:50	Pordenone
16:57	16:58	Cusano
17:03	17:04	Casarsa
17:10	17:11	Codroipo
17:18	17:19	Basiliano
17:30		Udine

Udine to Ljubljana

Arrival	Departure	City
	17:54	Udine
18:11	18:12	Palmanova
18:22	18:23	Cervignano-Aquileia-Grado
18:29	18:30	Trieste Airport
18:34	18:35	Monfalcone
18:58	19:07	Trieste Centrale
19:37	19:58	Villa Opicina
20:08	20:09	Sezana
20:17	20:18	Divaca
20:37	20:38	Pivka
20:50	20:51	Postojna
21:01	21:02	Rakek
21:12	21:13	Logatec
21:30	21:31	Borovnica
21:48		Ljubljana

The role of tourism is quite important to develop and sustain demand for bus transportation. There is a cheap direct connection between Venice Mestre and Portoroz. Venice Mestre train station and Venice Tronchetto are very well connected to Ljubljana with frequent direct buses. Flixbus company services in the region is another option for crossing the border. Along Trieste-Ljubljana route, there are a number of buses which are probably more satisfactory than those provided by the railway alternative. Flixbus also offers a connection between Trieste and touristic destinations, such as Portoroz and Bled as well as between Gorizia and Ljubljana once per day in the evening, a much shorter time than that required by the train. Flixbus, instead, does not offer a connection between Pordenone and Ljubljana. However, there is a connection between Udine and Ljubljana for those travelers that are going to Zagreb as their final destination. GOOPTI (van pooling transport) is also a private transport services provider from Slovenia. They provide transfers mainly from and to the main airports in the cross border region, namely Ljubljana, Trieste, Venice and Treviso. The service than further extents to Bergamo, Milano, Bologna, Maribor, Vienna, München and many others.

Summing up, it can be argued that there is a number of connections between the INTERREG MUSE areas from the Italian involved territories and the city of Ljubjana, which however require quite a long time when the actual distance is considered. This is a fact deriving from the absence of a dense network of rail infrastructure in Slovenia, as well as between Slovenia and Italy, with the only exception of the recent opening of the Trieste/Udine Ljubljana connection. Particularly problematic is the absence of a direct train connection between Gorizia and Ljubljana which could probably ease the movement of people and goods between the two territories. In fact, Gorizia residents who wish to reach Ljubljana should either go to Trieste or Monfalcone and take the INTERREG CROSSMOBY trains or go to Udine from where they have to rely on the options provided by the Austrian railway system.

4. E-MOBILITY

This chapter provides an overview of EU, Italian and Slovenian legislation on CO2 reduction, communication requirements between EVs and infrastructure (charging stations, electricity distribution network, etc.), and environmental impacts (pros. & cons.) of suing EVs.

4.1 E-Cars demand survey in Italy and Slovenia

In order to support the MUSE objectives, the University of Trieste carried out also an additional survey to understand the prospects for E-Cars' uptake through a stated preference experiment. The survey allowed to compare the environmental awareness across Italy, Slovenia and the bordering Friuli Venezia Giulia Region, taking into account socio-demographic features on a total of 2,717 individuals. This is relevant to understand mobility features across different groups of the population, characterized by the diverse peculiarities that are are presented in the following figures. The survey questionnaire has been divided into two main parts:

Socio-economic characteristics of the respondent:

- such as gender, education, occupation, municipality of residency, municipality of the workplace/study, number of individuals in the household, number of individuals with license in the household, income of the household, number of gasoline/diesel/GPL cars owned by the household, number of hybrid or methane cars owned by the household, number of electric/plug-in cars owned by the household, garage availability, average number of km travelled per day, average number of km travelled per year, and number of trips longer than 400 km per year.

Stated preference experiment: the interviewee is presented with 12 choice scenarios in which the respondent has to choose between an electric and an equivalent conventional car on the basis of the following features:

- price;
- fuel efficiency;
- driving range;
- time required for a complete fast recharge;
- maximum distance between fast charging stations;
- free parking (1 hour, 3 hours, unlimited).

The samples present some socio economic features it is worth looking before focusing on the latent constructs of electric car knowledge and environmental awareness, with the aim to highlight commonalities or differences. Investigation on gender and age composition in the studied areas showed that surveyed population is almost equally composed by females and males. In addition, as **Figure 12** depicts, in the Italian and FVG surveys the two largest groups of respondents are between 35 and 44 years of age, and between 45 and 54.

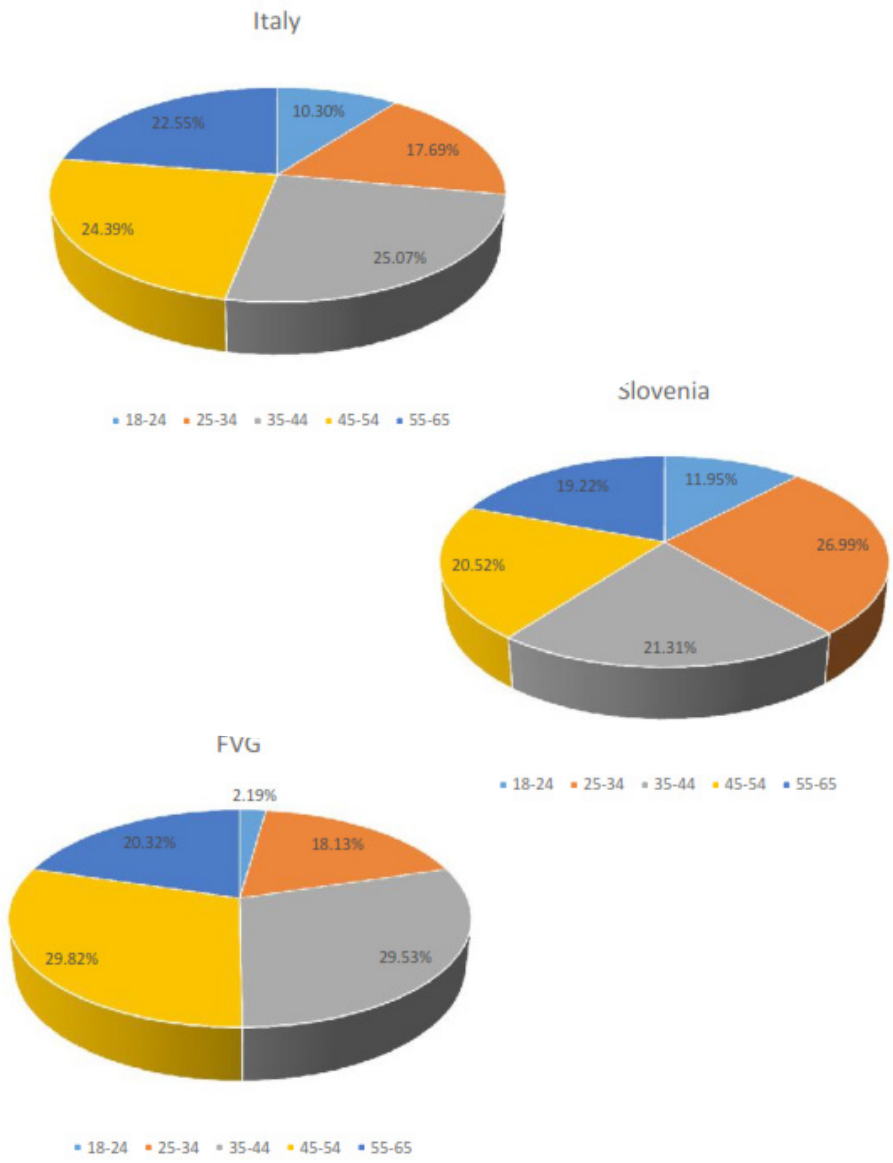


Figure 12. Age class composition of surveyed population

In the Slovenian sample, the largest group is for younger people, i.e. between 25 and 44 years of age.

When education is concerned, Figure 13 shows that most of the interviewees in Italy have either a high school diploma, followed by a master degree. Due to a different classification in the questionnaire, an almost identical share of respondents in Slovenia hold either a primary and middle school diploma, or a university degree (at different levels). The Slovenian sample is made up by a larger share of individuals that hold a University degree than their Italian peers, if we look at undergraduate, master and PhD level. However, this difference is

narrower if the Region Friuli Venezia Giulia is considered. When looking at job composition we observe that most of respondents in the surveys are white collars employees, potentially of heterogeneous level as shown in Figure 14.

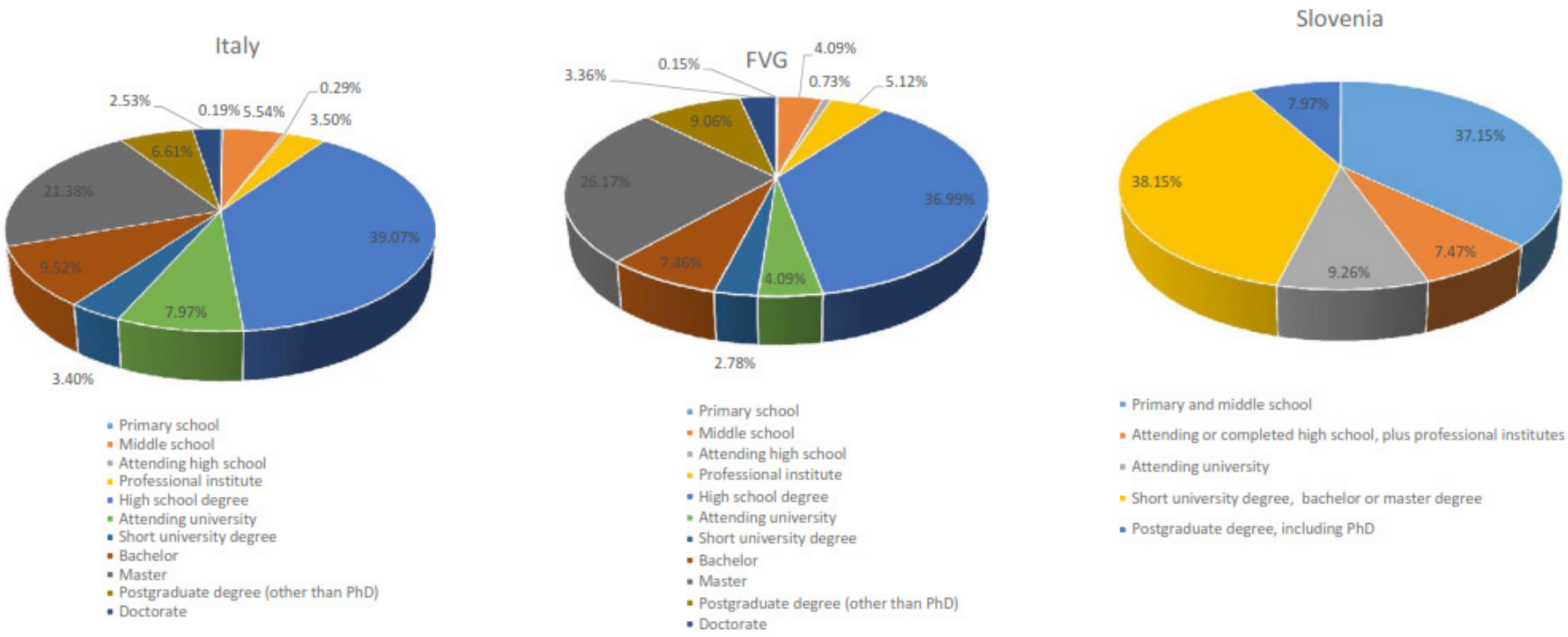


Figure 13. Educational levels of surveyed population

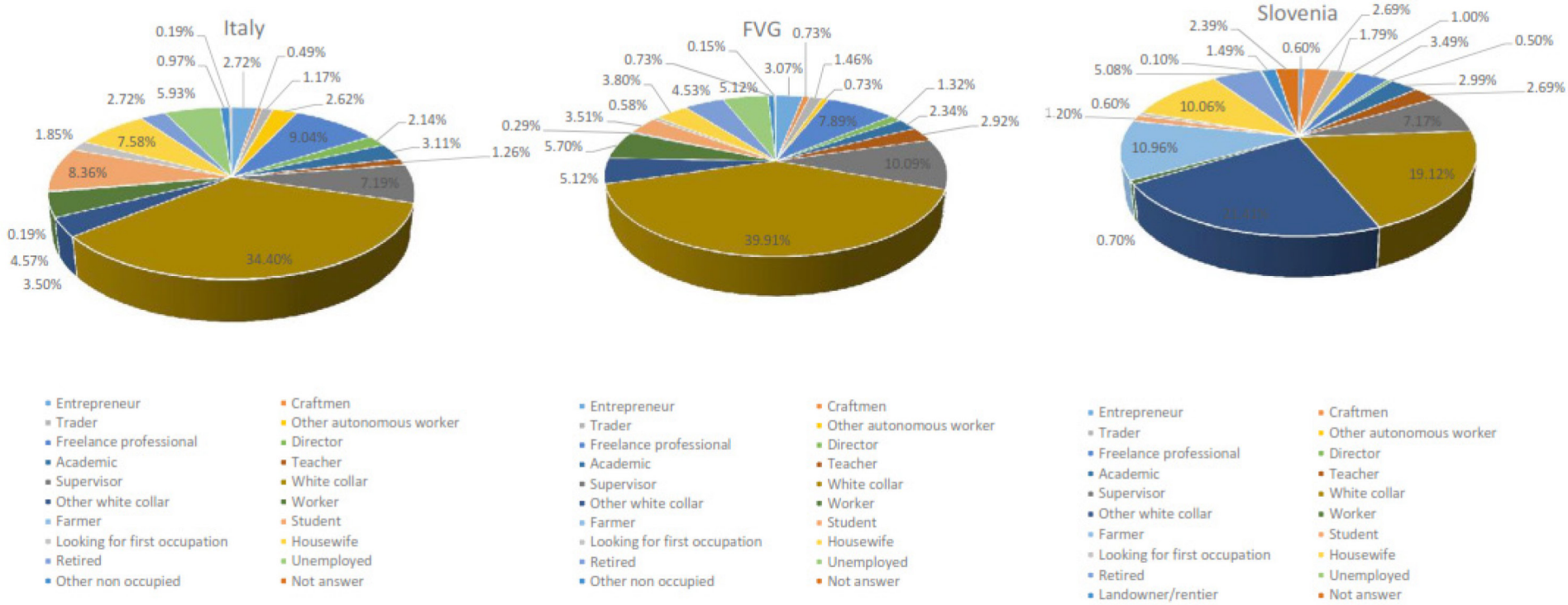


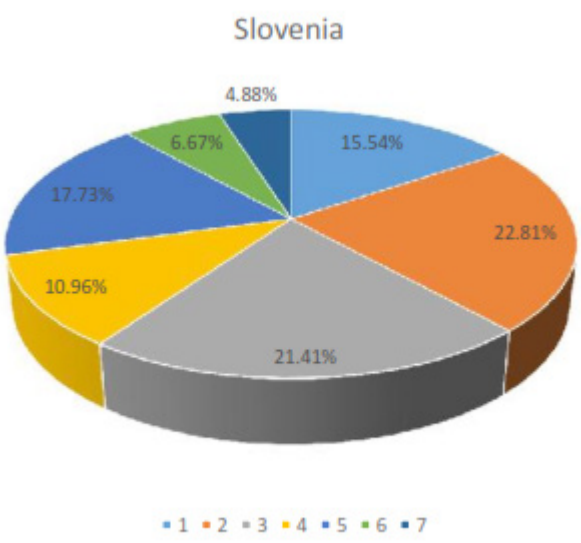
Figure 14. Job composition of surveyed population

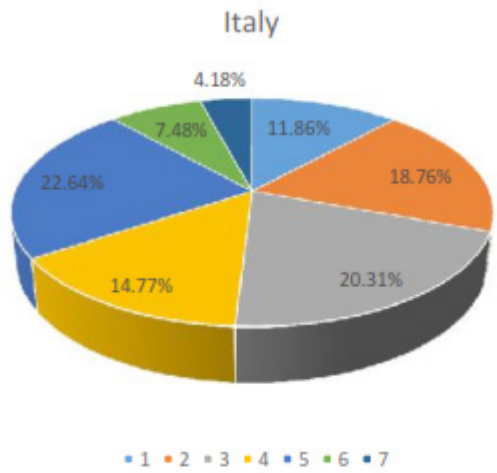
If we consider the number of the people in the household, in Italy and Slovenia most often the household is composed by four members (Italy: 30.8%, Slovenia: 28.7%), whilst in the Friuli Venezia Giulia Region by just two with 31.4%. We also observe that a non-negligible number of households are composed by three individuals. More than 65% of Slovenian interviewees declared a family income less than 30,000 Euros. More than 48% of Italian respondents declared a family income lower than 30,000 Euros. More than 56% of Friulian respondents declared a family income between 30,000 and 70,000 Euros.

Given these premises which indicate that there is overall a certain degree of overlap between the samples for a number of features, we move on to consider the replies to questions related to electric car knowledge and environmental awareness. These are unobservable (latent variables) where the self-assessed level of expertise with cars is measured through a Likert scale from 1 being the lowest and 7 being the highest, whilst the perception of environmental concern is measured through an inverted Likert scale with 1 being the highest and 4 the lowest. The questionnaire also collects information on EV driving experience, availability of EV charging stations nearby the place of study/work/residence.

Less than 20% of the respondents has ever driven an electric car (Italy: 16.13%, FVG: 12.57%, Slovenia: 18.33%) showing a similar picture similar across the three samples. More than 22% of Italian respondents' believe they have a good expertise with cars, whilst 25% of Friulian interviewees state they have a lower knowledge (level 3). This outcome is similar to their Slovenian peers who showed a prevalence of level 2 replies.

Most of the Italian and Friulian respondents' (circa 40%) state there are no charging stations close to the place where they live/work/study. Conversely, more than 70% of the Slovenian interviewee state that these infrastructures are in place. Moreover, more than 50% of the respondents in all three surveys largely agree that the environmental situation of the place where they live is worrisome.





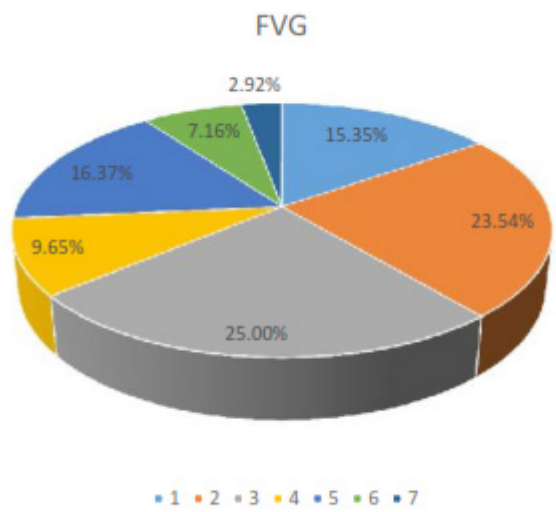


Figure 15. Self-evaluated level of expertise with electric cars of surveyed population

4.2 Key legislation and standards - EU

Electricity as an energy vector for vehicle propulsion offers the possibility to substitute oil with a wide diversity of primary energy sources. This could ensure security of energy supply and a broad use of renewable and carbon-free energy sources in the transport sector, which could help the EU and also INTERREG V-A Italy Slovenia programme targets on CO2 emissions reduction.

One of the initial legislation is the **Directive 2009/28/EC on the promotion of the use of energy from renewable sources** which sets a market share target of 10 % of renewables in transport fuels.

Regulations 4510/2011 and 333/2014 set CO2 emission performance for light-duty vehicles and for new passenger cars, respectively. The target is of 147 g CO2/km from 2020 for new light commercial vehicles, and of 95 g CO2/km for the average emissions of the new car fleet.

The **Directive 2014/94/EU on the deployment of alternative fuels infrastructure** most directly tangents E-mobility, since requires all EU member states to develop national policies frameworks to establish adequate infrastructure for alternative fuel with the goal to decrease oil dependency and transport's impact on the environment.

The **Directive 2018/844/EU on energy performance of buildings** includes measures for electric vehicle charging points. The directive imposes Member States to lay down requirements for the installation of a minimum number of charging points for all non-residential buildings with more than 20 parking spaces by 1 January 2025, and to simplify the deployment of recharging points in buildings, such as in permitting and approval procedures.

There is also a further strategy, entitled **A Clean Planet for All, A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy** (2018).

The purpose of this long-term strategy is not to set targets,

but to create a vision and sense of direction and plan for it. One of the goals is maximising the deployment of renewables and the use of electricity to fully decarbonise EU's energy supply. And since the transport sector is responsible for around a quarter of GHG emissions in the EU, the document proposes a system-based approach (low and zero emission vehicles, decarbonised, decentralised and digitalised power, more efficient and sustainable batteries, highly efficient electric powertrains …) and more efficient organization of the mobility system (based on digitalisation, data sharing and interoperable standards).

On the issue of interoperability of E-mobility, the Joint Research Centre of the European Commission, has established a **European Interoperability Centre for EVs and Smart Grids** which brings together knowledge and tests facilities in the areas of efficiency, hybrid exhaust emissions, electromagnetic compatibility, smart grids and battery testing. Interoperability aims at ensuring the interwork and the data exchanges between the e-mobility and the smart grid systems. Interoperability will thus not only facilitate reliable communication and functionality of any plug-in vehicle with recharging devices – it will rather pave the way for seamless integration of e-mobility into tomorrow's smart grid infrastructure. It will enable automatic billing, EV-roaming and energy management for e-mobility electricity demand in the smart grids' whole architecture, which in turn manages evermore green electricity to be used. This joint effort involves industry and will provide a platform for transatlantic cooperation - focused on harmonising standards, technology validation and testing methods to facilitate e-mobility through interoperability.

4.3 Key legislation and standards - Slovenia

The national regulatory framework

Slovenian legislation in the objectives and strategies mainly summarizes the EU legislation. Below are short descriptions of the national regulations addressing (also) e-mobility.

In Slovenia the key legislation tackling e-mobility is the **Energy Act** (Energetski zakon, Uradni list RS, št. 17/14 in 81/15), that obliges electricity distribution operators to develop basic fast charging stations infrastructure on Slovenian highways. By the end of December 2015, this was already implemented successfully, and all 26 foreseen fast-charging stations were put in public use. The second impulse coming from the Energy Act is the obligation to managers (or owners) of public parking infrastructure to yearly report the number of CS for EV and the amount of energy used for charging EVs. Reporting instructions can be found in R**ules on data submitted by energy service providers and other liable entities** (Pravilnik o vrstah podatkov, ki jih zagotavljajo izvajalci energetskih dejavnosti in drugi zavezanci, Uradni list RS, št. 22/16 in 24/16 – popr.). Additional to the Energy Act, this legislation requires also reporting on the amount of energy from renewable sources used in traffic, and reporting for parking of public sector buildings.

The decree on renewable energy sources in transport (Uredba o obnovljivih virih energije v prometu, Uradni list RS, št. 64/16) sets the measures and obligations of fuel distributors with regards to the placing biofuels and other renewable energy sources on the market. In terms of e-mobility renewable energy sources refers to the biofuels, electricity from renewable energy sources, hydrogen from renewable energy sources, and other renewable energy sources. The target values for the share of energy from renewable sources were set as at least 6.20 % in 2017, at least 7.00 % in 2018, at least 8.40 % in 2019, and at least 10.00 % in 2020. Unfortunately, the intermediate goals are not achieved and it seems very difficult to achieve the final goal, by 10 % in 2020.

The Ministry of Infrastructure, responsible also for the energy sector, is preparing the document entitled **Energy Concept of Slovenia**, with the main goal of decreasing GHG emissions related to energy consumption. The goal (in the version of the document from August 2018) sets at least a 80% reduction of GHG emissions relative to 1990 levels by 2050. The target for the year 2030 will be set in accordance with other EU countries. Among the priorities in the field of transport, the central goal is to increase the share of cars using alternative (low carbon) fuels with an emphasis on e-mobility.

The regional (local) regulatory framework

In accordance with the Energy Concept of Slovenia, all Slovenian municipalities must prepare **Local energy concept** documents following the Rules on the methodology and mandatory content of the local energy concept (Pravilnik o metodologiji in obvezni vsebini lokalnega energetskega koncepta, Uradni list RS, št. 56/16). The main issues that need to be addressed in the Local energy concept are:

- a categorisation of the road network and transit flows in the local community (LC);
- status quo of the bicycle lines in LC;
- description of the bike sharing systems;
- P&R options;
- number of electric, hybrid and fuel cells and gas driven vehicles in LC;
- number and description of the electric charging stations for electric vehicles.

4.4 Key legislation and standards - Italy

The national regulatory framework

National transport policies are based on European planning and they are implemented at regional and local level. The first implementation plan is Italy's National Renewable Energy Action Plan (PAN 2010), as required by Directive 2009/28/EC. The related Law 7 August 2012, n. 134, contains a series of measures aimed at constructing the network infrastructure for recharging EVs and the experimentation and diffusion of public and private fleets of low emission vehicles, with particular emphasis to the urban context. Such a legislation merged into the National Infrastructure Plan for the Recharge of EVs (PNIRE), approved and published by the Prime Ministerial Decree in the Official Gazette no. 280 of 2 December 2014. The Plan defines the guidelines to ensure a unitary and coherent development of the recharging service in the territory, on the basis of indicators that take into account the actual needs present in the various local areas.

Finally, Legislative Decree 16 December 2016, n. 257 establishes the minimum requirements for the construction of alternative fuels infrastructure, including recharging points for EVs and refuelling points for liquefied and compressed natural gas, hydrogen and liquefied petroleum gas, to be implemented through the National Strategic Framework. It also defines the common technical specifications for recharging and refuelling points, and requirements concerning users' information.

The regional regulatory framework

The Regional Law 11 October 2012, n. 19 - called "Rules on energy and fuel distribution" and amended by Article 53, paragraph 1 of the Regional Law of 17 July 2015, n. 19 - requires that every municipality with a population of more than 5,000 inhabitants be equipped with at least one charging point for electric cars available for public use. This obligation was to be implemented within two years.

The fundamental document for the FVG transport planning is the Regional Plan of Transport Infrastructures, the Mobility of Goods and Logistics, as defined in the Regional Law of 20 August 2007, n. 23 and approved by DPReg 300 of 16. 12. 2011. The purpose of the Plan is to set up the punctual and linear infrastructures, as well as the services, in the framework of the promotion of an integrated regional logistics platform that guarantees modal and territorial equilibrium.

As an instrument to ensure compliance with the limit values of pollutants and the lowering of ozone levels, the Regional Council has definitively approved the **Regional Plan to Improve Air Quality** with resolution no. 913 of 12 May 2010. Following Legislative Decree 155/2010 "Implementation of Directive 2008/50 / EC on ambient air quality and cleaner air in Europe" establishing a unified regulatory framework for the assessment and quality management of ambient air, it was necessary to update the regional air quality improvement plan to adapt some contents to the criteria of the new legislation. The update includes the adaptation of the zoning of the regional territory. With resolution n. 288 of 27 February 2013, the Regional Council approved the draft "Update of the Regional Plan for the Improvement of Air Quality", an integral part of the current Regional Plan to improve air quality. On April 15, 2013 the new **Regional Plan of Local Public Transport** was approved (Decree of the President of the Region No.80 / 2013). This plan has extended the competences of the Friuli Venezia Giulia Region in the field of traffic and transport, including the functions concerning to regional and inter-regional rail services and those related to maritime, automotive and rail services of a cross-border nature.

An important step concerns the system for cycling mobility. The Friuli Venezia Giulia Region has implemented the **Network of Cyclo-ways of Regional Interest (ReCIR)** which consists of a wide network of cycle tracks that covers the whole regional territory and connects to similar infrastructures of the neighbouring States and Regions. The ReCIR is meant to be the backbone of the infrastructure for sustainable mobility, which is intended to allow, in the medium to long term, cycling into much of Friuli Venezia Giulia Region, both in suburban and urban areas. In 2014, the Infrastructural Plan for vehicles powered by electricity was approved, pursuant to Article 17-septies of the Decree-Law no. 83 (2012). The National Plan has as its object the construction of infrastructural networks for the recharging of vehicles powered by electricity and interventions for the recovery of the building stock for the development of the same networks. The construction of charging facilities for electric cars must refer to a unified regional standard identified by national and community legislation. In this regard the European Commission has decided to opt for a standardization of the plug in order to give unity within Europe. At the municipal level, a forecast is required in the urban planning instruments of the need to set up electrical connection infrastructures for the recharging of vehicles.

A further relevant document of the regional planning is the **Regional Energy Plan**, approved by the Regional Council n. 2564 of 22 December 2015, made enforceable by the Decree of

the President of the Region nr. 260 of December 23, 2015 and published on the ordinary supplement no. 47 of 30 December 2015 to the BUR n. 52 of 30 December 2015. This plan aims to increase consumption and production from renewable energy sources, energy redevelopment, environmental sustainability, infrastructural interventions with eco-compatibility criteria, to increase technological and IT applications, and the diffusion of knowledge in the energy and environmental fields. A general objective of the Regional Energy Plan is promoting energy efficiency. Measure 27a deals specifically with the adoption of regional and municipal plans concerning electric mobility and the charging infrastructure. In addition, Measure 19 provides indications for subsidizing the charging infrastructure and its standardization. The Regional Energy Plan underlines that the current difficulties could be overcome via:

- incentives for companies and the PA to buy or lease EVs;
- the promotion of car sharing with EVs;
- the development of charging networks, together with their standardization of the sockets, assuring interoperability and accessibility.

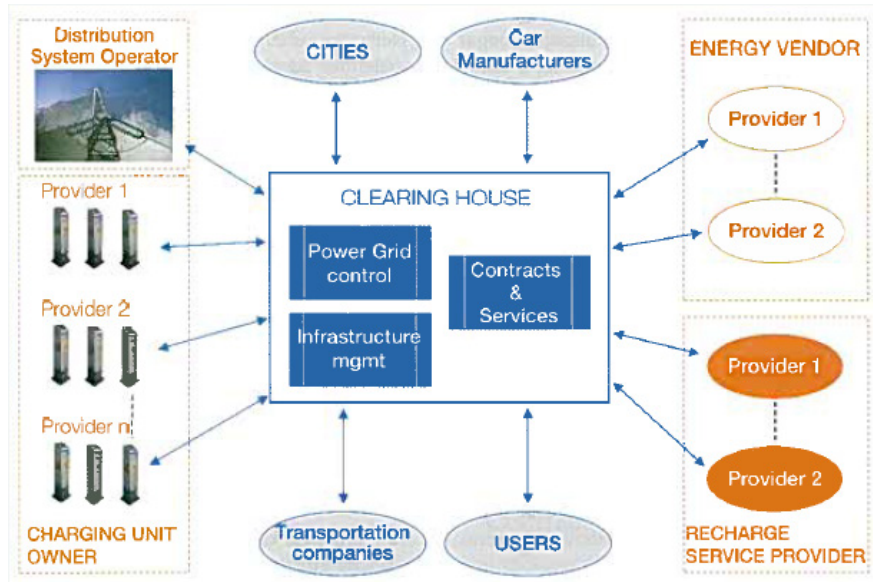
Finally, the Region, on 28 December 2017 adopted the Regional Plan of Electric Mobility for Friuli Venezia Giulia (PREME FVG). The primary objective of the plan is to encourage electric mobility, closely linked to the creation of an efficient infrastructure that adequately covers both private and public access charging stations. On the basis of a charging demand model estimated at municipal level, the Plan forecasts the number of slow and fast charging stations needed in the years 2020, 2025 and 2030. Public funds will soon be made available in order to cover 50% of the implementation costs of the investments in the charging infrastructure.

4.5 Communication between: an electric vehicle and relevant infrastructures

The electric network challenge

As technological barriers related to vehicles driving range seem to be progressively overcome by gradually improving batteries and electric drives, the main technological obstacles for a large scale deployment of EVs remain the lack of an optimized network of electric vehicle supply equipment (EVSE) – i.e. all accessories, devices, power outlets or apparatuses, including the charging stations (CSs), installed for the purpose of delivering energy to the EV and allowing communication, standardized user interfaces and proper charging stations control centers mitigating the effect of simultaneous charging loads on the electricity distribution grid.

The Electric Management System is the central remote control system that allows the control and management of the charging infrastructure. Thanks to the presence of the communication system installed in each column, supervision over the whole territory is possible. Its clearing function also allows to provide both the semi-processed data of the refills and the information related to the services associated with them (authorizations and possible activation of the smart charging service), external systems that manage the network and the systems of customers interested in reporting and issuing invoices.



As shown in the Figure above, the Operation Center is characterized by a WEB-based interface that can be used by both users and operators who manage the charging infrastructure. The entire charging process is dependent on communication with the control center. Thus, in the absence of communication, it is not possible to authorize and therefore start the process. The system consists of three main modules:

- Power Grid Control: this module allows the operation center to communicate with the control system of the distribution network (SCADA or ADMS), centralized system that receives data from the various sensors installed on the network and allows to perform a flow analysis in real time. The curve provided by the ADMS represented the trend that the fleet of cars connected to the network had to respect in order not to violate the constraints. This module will be essential when there is a strong penetration of EVs and vehicles can exchange energy in both directions with the grid.
- Infrastructure Management System: this module allows the complete management of the columns, with the possibility to operate both on existing and installed ones and to configure new ones. Often, to facilitate control, the columns are grouped into aggregates called LOAD AREA.

- Contract Management Module: it is the contract management module and contains all the data related to the commercial aspect. It allows to insert both the new contracts stipulated between the energy vendors and the users and the creation of new RFIDs associated with them. It also offers the possibility to block lost RFID cards, monitor any expiring contracts and eliminate those terminated. The contract form is essential for enabling the recharge, it must be verified that the RFID used is valid and authorized to recharge on that column.

Charging stations

Battery EVs need to be charged at a charging station. Charging stations fall into four basic contexts:

- Residential charging stations: An EV owner plugs in when he or she returns home, and the car recharges overnight. A home charging station usually has no user authentication, no metering, and may require wiring a dedicated circuit. Some portable chargers can also be wall mounted as charging stations.
- Charging while parked (including public charging stations) – a commercial venture for a fee or free, offered in partnership with the owners of the parking lot. This charging may be slow or high speed and encourages EV owners to recharge their cars while they take advantage of nearby facilities. It can include parking stations, parking at malls, small centers, and train stations (or for a business's own employees).
- Fast charging at public charging stations >40 kW, delivering over 100 km of range in 10–30 minutes. These chargers may be at rest stops to allow for longer distance trips. They may also be used regularly by commuters in metropolitan areas, and for charging while parked for shorter or longer periods.
- Battery swaps or charges in under 15 minutes. A specified target for CARB credits for a zero-emission vehicle is adding 200 miles to its range in under 15 minutes. In 2014, this was not possible for charging EVs, but it is achievable with EV battery swaps and hydrogen fuel cell vehicles. It intends to match the refuelling expectations of regular drivers.

The reference standard regarding conductive charging systems for EVs is **IEC 61851**, which makes several classifications of electric vehicle supply equipment. This standard contains the general requirements and defines, for the electric vehicle, four ways of recharge:

- Mode 1: Slow recharge (6-8 h) at 16 A (AC). This is the easiest way to connect vehicles to a power supply and allows slow charging. The electric vehicle is connected to the mains via a standard power outlet, mode 1 allows charging up to 16 A and 250 V AC in single phase and 16 A up to 480 V in three phases.
- Mode 2: Slow recharge (6-8 h) at 16 A (AC) with protection device built into the cable. The electric vehicle is recharged by connecting it to a standard AC outlet. Compared to the previous case on the vehicle network connection cable there is a device called ICCB that allows the presence of a driving circuit and a protection system against electric shocks. Mode 2 allows to recharge the vehicle up to 32 A and 250 V AC in single phase and up to 32 A and 480 V AC three-phase. It also allows the connection of an EV to a dedicated structure (EVSE) permanently connected to the AC network.
- Mode 3: (protection device in the installation, specific charging station) Recharge in alternating current (AC). It consists in supplying power to the battery charger inside the vehicle.
- Mode 4: (AC/DC external to the vehicle). This charging mode consists in supplying direct current power directly to the electric vehicle battery.

Charging stations provide one or a range of heavy duty or special connectors that conform to the variety of competing standards. Common rapid charging standards include the **Combined Charging System (CCS)**, **CHAdeMO**, and the **Tesla Supercharger**.

Charging connectors

To allow the development of electric cars, charging connectors have been standardized. These are the main ones:

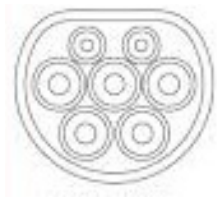
- Type 1: Yazaki (SAE J1772) Connector developed in the USA and Japan, it is present as a solution for vehicle-side connection Vehicle connector-inlet.
- Type 2: Mennekes Connector, introduced by the homonymous German house in 2009, is one of the European standards, developed especially in Germany.
- Type 3a: Scame is installed for both the EVSE side coupling Plug and socket outlet, and as a solution for vehicle vehicle-connector-inlet coupling.
- Type 3b allows single-phase charging, the standard prescribes that the limits of 32 A and 250 V are not exceeded. It has 5 pins: 2 power pins (phase and neutral), 1 pin for the protective conductor and 2 auxiliary pins and circuit piloting.
- Type 3c allows single-phase and three-phase charging, with the standard prescribes that the limits of 63 A and 480 V

are not exceeded. IPXXD degree of protection, since there is a shutter device against accidental contact of live parts. It has 7 pins: 4 power pins (3 phases and neutral), 1 pin for the protection conductor, 2 auxiliary pins and driving circuit. Used in European countries.

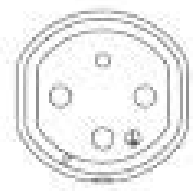
- ChadeMO System: a connector for fast charging, developed in Japan in 2009, was one of the first solutions on the market to allow rapid charging in direct current. Despite the high diffusion throughout the way, it was recognized as the official standard for rapid direct current charging only a few years ago.
- Combo 1: connector for fast charging, also called universal connector, was developed by SAE in 2012, in fact it is very developed in the USA. Mounted as an inlet on vehicles, it allows both charging via the TYPE 1 connector and DC charging. It has 7 pins: 2 pins for DC charging, 2 pins for AC charging, 1 pin for the protective conductor and 2 auxiliary pins and driving circuit.
- Combo 2: connector for fast charging: developed in Germany for powering via mode 4, the chosen configuration is always the case C, where the cable and vehicle connector are mobile. Solution used for vehicle-side coupling Vehicle connector-inlet.

Type 1 Yazaki

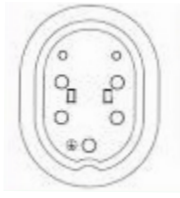
Type 2 Mennekes



Type 3a Scame

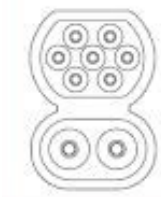


Type 3c Scame



ChadeMO

CCS Combo 2



Charging time

The charging time depends on the battery capacity and the charging power. In simple terms, the time rate of charge depends on the charging level used, and the charging level depends on the voltage handling of the batteries and charger electronics in the car. The **US based SAE** defines:

- Level 1 (household 120 VAC) as the slowest;
- Level 2 (upgraded household 240 VAC) in the middle; and
- Level 3 (super charging, 480 VDC or higher) as the fastest. Level 3 charge time can be as fast as 30 minutes for an 80% charge, although there has been serious industry competition about whose standard should be widely adopted.

Location of charging stations

Charging stations will be needed where there is on-street parking, at taxi stands, in parking lots (at places of employment, schools and universities, hotels, airports, shopping centers, convenience shops, fast food restaurants, coffeehouses, etc.), as well as in the workplaces, in driveways and garages at home. Existing filling stations may also incorporate charging stations. As of 2017, charging stations have been criticized for being inaccessible, hard to find, out of order, and slow; thus reducing EV expansion. At the same time more gas stations add EV charging stations to meet the increasing demand among EV drivers.

Charging station manufacturers and charging network operators

There is a large and growing number of charging station manufacturers and charging network operators. The main charging station manufacturers operating in Europe are: ABB (stations with CHAdeMO and CCS), Bosch Automotive Service Solutions Inc. (stations with SAE, CCS) and Siemens (stations with CHAdeMO and CCS). The main charging network operators in Europe are: Allego, E.ON, Ecotricity, Fastned, Tesla Inc., ENELx (Italy), HERA (Northeast of Italy), Chargepoint (Italy), Repower (Italy), and Petrol (Slovenia).

Paying for charging

There are several possibilities:

- Paying for charging at home. At home the charging station is connected to the household power. Energy consumed through the charging station is simply added to the household electricity bill. If one lives in an apartment complex, the agreed rule at the complex level apply.
- Using a free public charging station. Some public charging station owners do not charge a fee to use their station. A business might want to earn goodwill by giving free charging. In some cases using the station will be free (no cost) but one should still have a membership card.
- Credit cards at public charging stations. Using a credit card is very rare at public charging stations since the typical charging session fee is small enough to be impractical to

bill through a credit card.

- Charging network membership cards. The network operator keeps a prepaid money and bill a card on (say) a monthly basis.
- Charging network membership fees. The typical way to pay for charging is through membership fees. Each network structures their fees to suit both themselves, and local laws.
- Usage fees - by the hour - by the kiloWatt-hour. Depending on local laws, and charging network operator preference, a user may be charged by the hour or by the kW-h or a combination of both. Some governments prohibit sale of electricity, except for electricity utility companies. In such areas, charging networks cannot charge by the kW-h for electricity and instead must charge some other sort of usage fee.
- Fees pay for energy AND the parking space AND charging network fees. In some cases, charging stations are owned not by the charging network operator, but by the host site. It's the host site that sets the policies, fees, etc. for the station. The charging network imposes a fee on the host site, which the host site typically passes on to users of the station.

Finding a charging station and e-mobility roaming (eRoaming)

EV drivers have more options than ever when it comes to finding a charging station. In Europe, charging network (e.g. Chargemap) have developed robust smartphone apps that make finding a station within the network and with their network partners easy. Smartphone apps have allowed charging station and network operators to offer more value to customers, including information about individual EVSE connector availability, EVSE station details, nearby amenities, and similar helpful information. These offerings continue to iterate as customer feedback is merged with internal innovation from solution providers.

There are also a large number of non-networked free charging stations. These are often backed by governments or by retail outlets that want to attract customers to their stores while implementing more green, corporate social responsibility programs.

The public EVSE network as it exists today is diverse and dynamic, with new hardware and solution providers cropping up nearly every week. As plug-in vehicles continue to move into the mainstream, consolidation and a drive towards charging connector standardization is likely to develop.

In order to spur this development, e-mobility roaming (eRoaming) is going to be pursued. For instance, the European project “NeMo Hyper-Network” proposes a distributed environment with open architecture based on standardised interfaces, in which all electro mobility actors, physical or digital, can connect and interact seamlessly, in order to exchange data and to provide more elaborate e-mobility ICT services in a fully integrated and interoperable way for both B2B and B2C.

Interoperability

Interoperability is defined as the ability of various systems to work together. For the e-mobility market, interoperability leads to non-discriminatory e-mobility services, such as charging and navigation, and makes it available through-out a defined territory (e.g. Europe) without limitation and with a coherent service quality level at an optimized price. Although all European and national public authorities refer to interoperability in their regulations or their tenders, there are typically three primary concerns that have to be addressed:

- establishing a fair business case for all stake-holders, taking into consideration investments and operating costs;
- defining clear interoperability rules;
- ensuring a coherent and equivalent service level, nationally.

From a customer’s point of view interoperability could be defined as the ability to use the Electric Vehicle Charging Infrastructure (EVCI) wherever it is located, whichever EV the customer uses and irrespective of who operates the charging point. The current variety of connector types, of methods of payments and of providers make challenging the use an EV. The interoperability for EV users has been compared to the early days of ATM banking when banks issued cards that generally had to be used at the bank issuing the card, rather than any ATM. Today, ATM cards are widely used across all cash-dispensing machines.

4.6 Environmental impact of E-Mobility

Besides overcoming the technical difficulties, the use of vehicles powered by electricity instead of fossil fuels reduces CO2 production, helping to keep the air in cities healthier and cleaner. The environmental advantages are combined with the economic ones: an electric car has reduced operating and maintenance costs compared to a "conventional" car, and it is also possible to obtain tax deductions for the purchase cost and installation of the electric charging columns. The use of smart cars has a positive impact on the reduction of noise pollution: the increase in electric cars will contribute to improving the environmental conditions in the cities,

with positive repercussions on the value of the buildings. As many studies demonstrate (for a recent survey see European Environment Agency (2018), EVs from life cycle and circular economy perspectives, Transport and Environment Reporting Mechanism (TERM) report), one of the crucial determinants is the electricity mix. The main findings are the following:

- Overall, across its life cycle, a typical EV in Europe offers a reduction in greenhouse gas emissions compared with its ICEV equivalent. The extent of the difference can depend on a number of factors, including the size of the vehicle considered, the electricity mix and whether the BEV is compared with a petrol or diesel conventional vehicle. A credible estimate is that life-cycle GHG emissions from BEVs, charged using the average European electricity mix, are 17-21 % and 26-30 % lower than similar diesel and petrol vehicles, respectively).
- EVs can offer local air quality benefits due to zero exhaust emissions, e.g. nitrogen oxides (NOx) and particulate matter (PM). However, EVs still emit PM locally from road, tyre and brake wear, as all motor vehicles do or local PM emissions, there is a great deal of uncertainty and variation in the results, depending on the assumptions made around ICEV emissions and on the different estimation methods for non-exhaust emissions. In addition, electricity generation also produces emissions. Here, the spatial location of emissions is important.
- In relation to noise pollution, the available literature considered in this report relates only to the use stage. The difference in noise emissions between EVs and ICEVs strongly depends on vehicle speed. Reflecting this, modelling studies have shown benefits of passenger car fleet electrification in terms of exposure to, and annoyance from, noise in urban areas where speeds are generally low and traffic is frequently stationary.

5. MEASURES AND INDICATORS OF SUSTAINABLE TRANSPORT AND ENERGY EFFICIENT MOBILITY

The objectives of the MUSE project are similar to SUMP, for example, energy efficient mobility and the reduction of CO2 emissions at the urban and suburban areas. The objectives are also compatible with global perspectives on sustainable and liveable transport planning:

Sustainability Goals:

Economic	Social	Environmenrtal
Economic productivity	Equity / Fairness	Climate change prevention and mitigation
Local economic development	Safety and security	Air, noise and water pollution prevention
Resource efficiency	Community development	Non-Renewable Resource Conservation
Affordability	Cultural heritage preservation	Open space preservation
Operational efficiency	Public fitness and health	Biodiversity protection

Sustainable transport planning recognizes that transport decisions affect people in many ways, with a variety objectives and impacts. Sustainability emphasizes the integrated nature of human activities and therefore the need for coordinated planning among different sectors, groups and jurisdictions. It expands the objectives, impacts and options considered in a planning process, and by this ensure that individual short-term decisions are consistent with long-term (strategic) goals.

Main goals within MUSE projects are:

- Road safety:
  - to reduce road accidents in general, and, in particular, the significant reduction in the overall number of accidents involving deaths and injuries, the significant reduction of social costs resulting from accidents, the significant reduction in the number of accidents with deaths and injuries among weak users.
- Socio-economic sustainability and sustainable mobility for all:
  - to improve social inclusion, an increase of citizenship

satisfaction, an increase in the employment rate, and a reduction of mobility costs (related to the need to use the private vehicle).

- Effectiveness and efficiency of the mobility system:
  - to improve local public transport, modal rebalancing of mobility, congestion reduction, to improve the accessibility of people, to improve the integration between the development of the mobility system and the structure and development of the territory, to improve the quality of road and urban space.
- Energy and environmental sustainability:
  - to reduce the consumption of traditional fuels other than alternative fuels, to improve air quality, to reduce noise pollution.

For instance, the charging infrastructures to be tested through MUSE will be useful to stimulate the use of EVs for university mobility, at regional and cross-border level. The adoption of the Green Belt and the proposal of the construction for a "Bio-Region" lie in the realm of a cross-regional and cross-national partnership that mimic MUSE actions.

Another important issue dealing with trans-border mobility can be a seamless and interoperable e-mobility network providing international services which is essential for the success of the MUSE project. Preliminary studies conducted through NeMo project (Hyper-Network for E-Mobility across EU) showed that an integrated E-car charging network area should include the following information at least:

- network services: finder and optimiser, brokerage, service pricing (static and dynamic);
- planned services: e-mobility actors' monitoring and profiling;
- electric vehicle driver/owner services: smart navigation and journey planning, wireless authentication solution;
- grid related services: navigation to charging point based on user and grid requirements, global customer charging behaviour, grid load management, load forecasting due to charging, local energy management;
- electric vehicle and battery related services: adaptive state-of-charge limit, capacity calculation, and load management.

A Net-based survey for Italian side reveals that only a few municipalities have approved SUMP. In Friuli Venezia Giulia region, only Pordenone has an approved SUMP, while Trieste and Grado are drafted. As the objectives of the MUSE and SUMP project are particularly similar, PAs should be able to harmonize the actions that will derive from the MUSE project to the actions of the SUMP. A good example of proper harmonization of SEAPs/SECAPs and SUMPs based on an in-depth understanding of the features of each plan is SIMPLA project (Sustainable Integrated Multi-sector PLAnning). SIMPLA's solution, a step-by-step methodology, aimed to promote multi-level governance, encouraging the integration of policies at the national, regional and local level for integrated planning of sustainable energy actions.

5.1 Lessons learned form best practices in Slovenia and Italy

SLOVENIA

According to SEAPs and Local energy concept, the actions that should be considered by Slovenian municipalities for improving eco-mobility and sustainable transport are as follows:

- developing bicycle lanes;
- renewing of the municipal transport fleet;
- electrification (or gas use) of public institutions car fleet,
- traffic lights optimisation;
- sustainable parking policy;
- implementing the P&R system at both ends of the corridor, and limitation of parking in the city centre.

There are quite some positive experiences made in Slovenia and good practices available in line with SEAP objectives. Some of them were gathered in the CIPRA booklet "Zbornik dobrih praks: Trajnostna mobilnost v praksi" which are as follows:

- Parking Management, Ljubljana
  - Push & Pull – project, that takes from the bad in order to support the good.
  - It means a long term and stable financing source – revenues from the parking fees.
  - Parking lots that were once free of charge are now charged with a fee. Money generated is used for sustainable mobility support and parking lots maintenance.
- Communication Platform, Ljubljana
  - During the European Mobility Week in 2017 a new communication platform was introduced with a slogan »Pusti se zapeLJati« (play on words: let me drive/ seduce you LJubljana) and aimed at encouraging and raising awareness on sustainable mobility.
- Kavalir, Ljubljana; KRanvaj, Kranj
  - Public transport with small electric vans free of charge to call on.
- Local and city bus free of charge, Velenje, Nova Gorica,

Murska Sobota.

- Extension of the local bus lines into suburban areas, Ljubljana – Grosuplje, - Brezovica.
- Narrowing of the road and widening of the pavement in front of zebra lines, Ljubljana
  - Pedestrian have now shorter way across the street, the situation is more clear, cars' speed is reduced and hence the safety of the pedestrian is increased.
- Joining the bus lines of a school bus and normal bus, Grosuplje
  - The solution that used to be quite common in more remote areas of Slovenia, as there were only few passengers and hence no or very rare bus lines available, brought back to life.
- Carpooling on-line platform "Prevoz.org"
  - Established by students of University of Ljubljana. Information on offered rides and contacts are given. Users make arrangements directly with the driver.
- Traffic limitation in sensitive natural environments, Kranjska Gora, Bohinj
  - In some Alp valleys (e.g. Vrata) and forest roads in national park (Bohinj) car rides are limited and public transport solutions are offered, such as hop-on hop-off buses, also for cyclists.
- Soft mobility in Bohinj
  - Mobility card, cheap trains and buses available from several towns to Bohinj in winter (ski vlak and skibus), park&bike and hop-on hop-off buses in summer.
- Car-pooling, Electric charging stations, also for bicycles, and use of e-bikes for postal services, Moravske Toplice
- Installation of electric charging station for EVs (e-car, e-bike), gas station for LPG, Tolmin
- City municipality of Maribor:
  - Set up of a club with benefits for the PT users
  - promotion of PT and waste sorting (e.g. free bus tickets as reward for collecting plastic bottles),
  - promotion of PT linked with cultural and sport events (e.g. buying a monthly ticket or 20 rides ticket gets you also a ticket for theatre performance or football match at your choice),
  - announce a competition for a promotional campaign for PT image and marketing,
  - interactive bicycle map with info on parking lots, bike sharing system, potential biking black spots (dangerous), biker trip tips, etc.

ITALY

At national level, one of the best strategies in Italy is REP (Regional Energy Plan) which aimed:

- to build more sustainable energy production plants;
- to raise public awareness on sustainable mobility;
- to encourage sustainable behaviour of citizens;
- to subsidies companies and PA for the creation of electric vehicles fleets for business;
- to subsidies the development of car-sharing systems using electric vehicles;
- to develop charging networks, together with the standardization of sockets and plugs, thus making this technology more accessible to users use.

According to PREME_FVG, Regional Energy Plan for the e-mobility in the FVG Region, fast charging stations are required in Lignano Sabbiadoro and Trieste based on current penetration rates of electric cars at the regional level and also tourist recharge demand.

The PREME_FVG proposed a set of actions for limiting the phenomenon of "wild stop", optimizing the use of charging stations, and promoting people to use EVs such as:

- Increasing the availability of data on e-mobility for users (CS location, type of socket, payment mode, grid and battery related data, charging mode, charging complete, charging for a certain time, and equip the charging stations with remote surveillance on the occupation of the stall so that the officials in charge of the control of the improper use of the stalls can take appropriate actions);
- Making comparatively cheaper the purchase of electric vehicles (free parking, access to preferential lanes, free access to limited traffic zones.
- Subsidies for the purchase of electric vehicles.

NOEMIX project also supports the transition towards e-mobility in public fleets (a car sharing mode and acquired through leasing) by building integrated technical, economic and legal expertise for the launch of concrete investments:

- First, the annual kilometre-travelled distance per vehicle should be measured. Once annual distances exceeds 10.000 km, the cost per kilometre of electric vehicles is lower than the current reimbursement for the use of the employees' own vehicle. Vehicles used less than 25 km per day can potentially be abandoned.
- Replacement of endothermic vehicles with new electric ones will allow for saving in the energy used for propulsion from the current 5,64 GWh per year to 1,32 GWh (savings of more than 500.000 Euros per year).

Establishment of an electric car club for the FVG region is another best practice which resulted in:

- car-sharing fleets made up of about 25% of electric cars in large cities, whilst in small and medium-sized cities, the electric car club is still not economically convenient, although it is technically feasible.
- Carpooling has developed very fast and gained acceptance. It is confirmed that it is an important component of a sustainable mobile.
- Based on a survey on the potential demand for car-sharing from students of the University of Trieste, it is found that there is a students' demand for car-sharing services, which is likely to be substantial.

At the university level, a thorough understanding of the existing and preferred mobility pattern (travel behaviour) of students and university employees can help to improve decision-making and policy implications. According to several studies conducted by the University of Trieste regarding students' mobility and commuting behaviour, parking and bus pricing policies, the obtained results are as follows:

- The first task should be to update the dataset to understand if and how the students' and staff's mobility has changed in the last years.
- Potential changes are related to the appearance of electric vehicles (cars and bikes) and the introduction of electric car clubs. Carpooling has made big strides both in Italy and in Slovenia.
- The behaviour of the administrative employees is quite regular and significantly different from the professors and research personnel, while the students show very varying arrival and departure times as well as systematic transfer among multiple locations during the day.
- With reference to the students' population (c. 25,000), they survey shows thatthat about 37% are daily commuters, while 60% live in Trieste. About 47% of the students use public transport. 24% use the private car, 5% the scooter, 5% the train and 21% walk to the university.
  - The most important factor influencing mode choice is the perceived cost (34%), followed by travel time and time variability (27%), image and the environment (15%), comfort (11%), flexibility (9%) and safety and security (4%).
  - From the preferred improvements point of view, parking improvements are deemed the most important (22%), followed by cycling (19%), public transport (19%), carpooling (18%), fare revision (12%), improved walking paths.
- The students' needs depend on the place of residency. There are three main categories: 1) students living permanently in Trieste; 2) Students residing within 65-75 km from Trieste who are likely to daily commute from their home; and 3) students residing more than 65-75 km from the University that are likely to weekly commute.
  - The monetary value of one hour of travel time for Italian students is estimated to be 13 euros.
  - Car-pooling on-line platform like "Prevoz.org" in Slovenia can be used by students and university employees for the same trips origin-destination
- Fully subsidizing bus service would raise the bus share from the current, average 53%, to 61-82% depending on the means of payment.
- Substantially increasing the monetary parking cost would raise the bus share from 53%, on average, up to 71-77%, depending on the means of payment.

- Reducing the number of parking places the size of the parking lots or relocating them further away from the university buildings would increase bus ridership to 56% and the latter to 69%.

This kind of studies also could allow the university mobility manager and the city authorities to take effective decisions e.g. on parking and bus pricing policies, to plan the location of the university sites and to forecast their impact on the city traffic. A mix of the aforementioned policies is probably more acceptable and effective than single policies.

5.2 Organizational and Technical Strategies and Measures

In line with MUSE goals mentioned above, this section presents organizational and technical guidelines to gain the goals providing short- and long-term strategies and measures. The actions/measures can be grouped as follows:

- management (awareness and dissemination via workshops, training courses and social media, fostering-rewards programs including incentives/discounts/subsidiaries, mobility data collection and survey system etc.);
- Infrastructural measures (user-friendly infrastructure for cycling and walking, PT stops, charging stations, parking lots, etc.);
- Vehicles (renting/purchasing systems, inter-modality (bus-bike), safe bike parking places, etc.);
- ICTs (websites/platforms and apps providing useful information of available services/transport modes and their detailed info etc.).

Organizational actions/measures can be applied for all the technical measures, as they are the basis of implementing every policy regarding the improvement of sustainable and EE mobility:

- **Increased competitiveness of the university/municipality:** to increase the university's & municipality's possibilities for applying for (EU) tenders in order to get financial supports;
- **Establishment of systemic, financial and administrative conditions in managing mobility:** acceptance of SUMP or University mobility plan, revision of the document every 2 years, renewals every 5 years, regular provision of funds for the implementation of measures;
- **Balanced investment planning:** achieving a balance of investment shares for individual transport modes;
- **Mobility monitoring and management:** development of sustainable mobility office (mobility manager) for systematic monitoring of the mobility behaviour data (update every 2 years), and planning required actions/measures to reach more sustainable and EE mobility pattern;
- **Education:** raising the driving culture of road users in terms of traffic safety (to reduce the number and the severity of accidents);
- **Promoting sustainable mobility:** raising awareness on the benefits of sustainable and energy efficient mobility (improving quality of life and health);
- **Public involvement:** ensuring decision-making transparency at all stages of transport and mobility planning.

From technical perspective:

Walking

Walking is the most EE mobility mode for decreasing air and noise pollutions as well as increasing healthy lifestyle. It is a simple, useful and a pleasure too . All PAs should try to increase the number of walking people and encourage them to walk instead of using the car. To this end, providing a useful, safe, comfortable, and interesting walk plays a vital role and should consider following aspects of walking:

- **useful walk:** it includes 4 main steps namely:
  1. leave cars at homes (car-less lifestyle),
  2. mix the uses (accessible distance by walk to other EE mobility modes),
  3. get the parking right, and
  4. let transit work (developing an integrated transit network with walkways networks).
- **safe walk:** protect the pedestrian (separation of sidewalks and decrease the interaction between pedestrians and vehicles, increase walkways' width, turning motions, direction of flow, signalization, roadway geometry, etc.);
- **comfortable walk:** shape the spaces, plant trees and use green elements in design;
- **interesting walk:** make friendly and unique faces.

Designing for pedestrians means making facilities and spaces accessible to the most vulnerable users. In other words, designing safe, continuous, and unobstructed walkways includes visual variety, and incorporate protection from extreme weather and vehicle flows to ensure an enjoyable walking experience (NACTO, 2016). Measures that can be used for increasing the number of people use walking for their main transport mode: awareness and empowerment motivation for walking; development of green and comfort

walking lanes within/to/from university departments (faculties); accessibility to/from leisure and green areas; increasing pedestrian's safety at crossings; increasing pedestrian's safety by introducing green lanes separators between sidewalks and traffic lanes; ensuring lightening of walkways for utilizing during evening and nights.

Cycling (bicycle)

Taking several studies on cycling into consideration, it is a well-established fact that use of bicycle has positive impacts on mobility, quality of life and health. For instance, in Netherlands, the health benefits of bicycle use are estimated at 3% of GDP and these benefits alone are many times more than the 0.5 billion euros per year spent on bicycle traffic by the Dutch authorities collectively. That is why most of PAs try to promote people to use personal (E) bike and/or bike-sharing systems instead of cars. Cycling facilities should be safe, direct, intuitive, clearly delineated, and part of a cohesive, connected network to encourage use by people of all ages and confidence level (NACTO, 2016). There are several strategies and measures that can be implemented to achieve higher number of cyclists, namely; increasing awareness via workshops, training courses and social media, fostering-rewards and motivational programs, development of info app and web platform with bike routes and available rental bikes, providing appropriate number of safe bike-parking areas, introduction of (E) bike-sharing systems, implementation of bike E-charging stations, ensuring bike repair & maintenance services, development/improvement of green lanes to/from university departments (faculties), incentives for purchasing e-bikes.

Public Transport

The use of public transport can be considered as a third option for improving sustainable and EE mobility systems of universities after walking and cycling. However, the existence of appropriate number of stops and routs for traveling to/from university departments (faculties) are the most effective factors in choosing this mode of transport. From inter-modality point of view, the location of stops is another effective factor in using public transport and increasing the number of commuters. Being accessible by walk, bike (e.g. bike-sharing) or even car (park and ride system) have an unneglectable role in terms of the first and the last mileage transport. Improvements at stops (accessibility, time schedule), safety and comfortability, improving travel time and delay of buses using temporal (signal priority) and spatial (bus-only lane) prioritization, development of circular and/or direct routes among departments (faculties) at peak hours, development of info app and website about inter-modality and available transport modes inside/around university departments (facilities), providing incentives/discounts and integrated tickets for users can be used as measures in achieving more number of PT commuters.

Private Car

In car-depended societies, it is both timely and costly to change mobility behaviour of people and requires a lot of effort as it is an on-demand, point-to-point transport mode with high level of privacy and comfort. However, it can be possible by using the measures tested successfully around the world such as traffic calming measures (limiting speed within university department (faculties) area), parking management (restrictions) and reducing number of parking places, training and awareness on car-sharing, car-pooling and E-car programs through workshops and social media, rent/purchase of electric (green) fleet, development of app, website for parking and e-charging stations information, as well as car-pooling platforms.

Threats

During implementation of all organizational and technical strategies/measures, potential threats should be considered:

Strategies/ measures	Threats
Organizational	• Governance: coordination and communication between stockholders; • Bureaucracy, legislation, and financing issues; • Technical and human resources needs for ICTs' development, integration and maintenance.
Technical	• High costs in infrastructure measures; • Cycling and pedestrian's facilities must be designed as an entire network and concur in time; • Needs of funds for rent or exchange of bicycles; • The integration of walking, cycling and public transport modes may require the intervention of PAs; • Overvaluation of the private car and resistance to change transport mode; • E-charging infrastructure measures have high costs

Table below summarizes **possible organizational measures** that can be planned and implemented at both university and municipality levels.

Strategical Objective	Operational Objectives	Measures	Implementation guidance
Increased competitiveness of the university/municipality: to increase the university's & municipality's possibilities for applying for (EU) tenders	University/municipality bid at least every 3 years for tenders (EU or national) in relation to sustainable mobility	Ensuring personal/experts in the field of applying for tenders	Education of university/municipality employees in charge of investments via seminars and lectures in the field of transport infrastructure and energy efficient mobility
Establishment of systemic, financial and administrative conditions in managing mobility	Accept SUMP or University mobility plan, revise document every 2 years, renewals every 5 years	Ensuring personal/experts to carry out the SUMP or University mobility plan and regional cooperation in the field of sustainable and energy efficient mobility	
	Regular provision of budget funds for the implementation of measures		
Balanced investment planning: Change in planning priorities and its implementation	Achieving a balance of investment shares for individual transport modes and a ratio of 90:10 between investments in infrastructural and soft measures	Inclusion of an external consultant in the field of estimating the costs of investments in transport infrastructure	Architect or urban planner should be involved in any design of transport infrastructure
Monitoring: Systematic monitoring of the mobility pattern data	Introducing monitoring of travel habits and the effects of investments and measures; data update every 2 years	Determination of permanent measuring points for all types of traffic, which in the long run allows comparison of different types of means of transport (modal split)	To introduce the monitoring of travel habits and the effects of investments and measures, and update data every 2 years
Education: Raising the driving culture of road users in terms of traffic safety	Improve the driving behaviour of road users	workshops and trainings in the field of traffic safety	Collaboration with the police, Automobile Association and other associations
	Reduce the number of accidents.	Traffic calming measures and improvement of road infrastructure safety	Taking into account current technical guidelines for slowing down of motorize traffic in settlements, avoiding excessive number of horns
Promoting sustainable mobility: Raising awareness on the benefits of sustainable and energy efficient mobility	Modal-shift to sustainable transport modes	Increase the number of bus stops, modify the timetables to meet the needs, increase the number of bike (e-bike) sharing stations and car (e-car) sharing station close to universities and residential areas	Harmonization with the PT providers, University and other PA
		Introduction of a circular line within the municipality/ university campuses	Investment in electric bus and/or van or in the "On-Demand Responsive" system Providing last-mail services like shuttle services to the nearest stop/ station
		Introduction of a smart card (integrated ticketing) for all modes of PT and introduction/promotion of a shared mobility modes like car-sharing, bike-sharing, etc.	Proving subside/salary bonus to encourage students/employees for using sustainable modes Easier and more favourable purchase of tickets (more ticket selling points, online purchase, e-ticket, ticket vending machine, mobile applications, ticket subsidies, monthly, annual tickets).
Public involvement: Ensuring decision-making transparency at all stages of transport and mobility planning	Ensure public involvement by consultation with residents and key stakeholders.	Inclusion of the notifications of planned development projects in the municipal/university-wide newsletter and other media	Possibility of public debate on all major measures in the transport network

Tables below summarize possible strategical measures by each transport modes namely private car, public transport, cycling, and walking.

Private Car

Strategical Objective	Operational Objectives	Measures	Implementation guidance
Reducing the number of car trip Reducing traffic congestion and improving person -and network-based delay	By 2030 reduce the number of journeys shorter than 1 km by 20 %, and shorter than 4 km by 10 %.	Establishment of a time-limited parking system	Definition and implementation of a parking policy. Replacement of parking places by other public infrastructure (extension of walking and cycling infrastructure, green spaces, parks, playgrounds). Execution of safe, convex, attractive and comfortable bicycle surfaces in the settlement and between settlements.
		Enhance the existing cycling and walking infrastructure, construction of all missing sections of the cycling network	
	By 2025 increase the average occupancy of a passenger car.	Together with neighbouring municipalities, introduce the carpooling, electric bike & car sharing systems	Purchase of vehicles (personal and electric bicycles) for the implementation of the bike sharing and car sharing measure
		Establishment of Intermodal Interchange Points, e.g. Park and Ride infrastructure	Provide parking spaces at the railway station and at the entry points in to the municipality
Monitoring the number of vehicles	By 2020, establish a database on the number of vehicles and update it every two years.	Traffic counting using automatic counters or manually Evaluating parking lots usage during the working and non-working days	Determination of number and locations of traffic counting points based on the frequency and type of vehicles. Making traffic impact study with a macroscopic traffic model, for analysing variants and predicting traffic in the future.
Increase traffic safety	By 2030, elimination of dangerous segment with a high level of potential accidents especially in residential area	Greater control over traffic in residential areas especially in the area of kindergartens and schools and universities. Activities for raising public awareness about traffic behaviour.	Close cooperation with the Police, Inter-municipal police, Automobile Associations, Universities
	By 2030, reducing number of traffic accidents (both injured and fatalities)	Implementing traffic calming measures (speed limit area, zone 30 signs, narrowing road, raised road paving for intersection and pedestrian crossing, shikans, central traffic islands, etc.)	Expert analysis (before-after study) on implemented traffic calming measures, and the implementation of measures to slow down motor traffic in residential area (avoiding excessive number of humps)
		Improvement of existing roads (rehabilitation of damaged roadways and bridges, increase of load capacity and permissible burdens on roads and transport facilities - bridges, overpasses, ..., regulation of dangerous sections and accident block spots, expansion in order to increase throughput) and installation of appropriate traffic signalization.	Expert analysis (before-after study) of all locations with high level of traffic accidents (black spot analysis) and elimination of causes (preparation of an action plan)
		Reconstruction of intersections (e.g. introduction of roundabouts or raised intersection)	Taking into account current technical guidelines for traffic calming measures, avoiding excessive number of speed humps
Raising the culture of traffic of all participants.	By 2030, improve the travel habits of road users.	Co-financing safe driving courses for motor vehicle drivers.	Collaboration with Automobile Association and other municipal / university associations
Greater attractiveness and quality of the urban environment.(eco mobility)	By 2030, reduce the negative impacts on the environment.	The fleet of public institutions and economic operators shall be replaced by electrically powered vehicles. Providing specific parking spaces and charging stations for EVs.	Purchase of official EVs, installation of additional public filling stations for EVs, cooperation with the local electricity distributor in the preparation of the transmission grid to increase the quantities of electricity transferred
	By 2025, the common transport space in the city center of municipalities should be converted to car-free zones/ pedestrianised streets	Restriction of motorized traffic (one-way connections, bans for freight, permits for local residents, time-limited traffic regime, etc.)	
		Motorized vehicle prohibitions in the central zones of city, where pedestrians and cyclists have priority over the car.	Implementation of an architectural - urban design contest to select the best solution
		Co-financing the purchase of vehicles for environmentally-friendly operation (EVs).	ICE vehicles financed by the municipality/university must be electrically powered, assisted and advised by citizens to obtain Eco-Fund subsidies when purchasing an EV

Public Transport (PT)

Strategical Objective	Operational Objectives	Measures	Implementation guidance
Increase the volume of journeys with PT	By 2030, increase in the number of passengers by 10 %	New stops for PT close to universities and other public institutions.	New bus stops at locations where a professional analysis of supply and demand determines that they are needed.
		Introduction of a “university” bus line connecting universities and student related facilities (libraries, dormitories etc.).	Possible combination with "on-Demand Responsive" systems
			Purchase an electric (or other sustainable fuel) bus/van.
	By 2030, increase the proportion of employees/students who travel by PT by 10%	Promoting the use of PT for travelling to/from work, university by reimbursement of transport in the form of PT tickets, incentives for employees/ students using PT, providing PT information, web applications, PT promotional campaigns).	Increasing the number of stops and arranging/ optimizing existing ones based on demands, implementing administrative measures to encourage employees/students to use public transport.
		Improvement of existing PT stops (shelters, benches, trash bins, bicycle stands, information boards with timetables, layout of bus stops).	The appearance of bus shelters (bus stops in general), in the municipality should be uniform.
		Consistency of timetables and frequencies of PT with actual demands (night, weekend, tourist lines, increased PT capacities at traffic peaks, web applications).	Harmonization with the PT provider, universities and other PAs
		Combining different travel modes (the possibility of transporting bicycles by bus and train, safe bicycle shelters on the PT stops).	Establishment of a single information system (mobile application, websites, social networks, portals, ...) that will include all forms of public transport and travel modes, ...
Monitoring the number of trips made by PT modes and user habits.	By 2020 establish a database of numbers and habits and update it every year.	Collection of official data from the bus operator regarding the bus lines occupation – every year Yearly survey regarding student’s mobility habits and needs.	Passengers data collection from

Bicycle

Strategical Objective	Operational Objectives	Measures	Implementation guidance
Ensuring conditions for comfortable, safe and attractive cycling	By 2025, raise the number of cyclists who ride up to 4 km by 15%.	Construction of safe bicycle infrastructure within municipality / university campuses	Bicycle paths are performed separately from the carriageway
		Build safe cycling routes between settlements.	
	By the year 2030, the share of university students who are cycling to/from university will increase by 10%. By 2030, increasing the share of university employee who are cycling to/from university by 10%	Laying of bicycles at bus stops, near universities, administrative buildings, churches, shops, ...	Safe and covered bike shelters
		University actions for promoting “bike-train” & “bike-bus” trips	Cooperation with PT operators and PAs
		Construction and arrangement of the cycling network connection to city.	Collaboration with municipality and PA decision makers
		Eliminate critical points in terms of safety throughout the entire cycling network	Construction of missing cycling connections, promotion of the use of a bicycle,
	By 2030, the establishment of a bicycle connection between universities envisages national cycling routes.	Construction and arrangement/optimizing of the cycling connection between universities. Construction and settlement of the bicycle connection to nearby municipalities / university campuses	Cooperation with municipalities / university
			Build e-bikes charging station, and bike sharing (rental) systems Cooperation with municipalities / universities in the region

Accessibility of cycling for all	By 2020, at least 4 bikes or e-bikes/university available to rent for students and employees	Introduction of system for renting bikes/e-bikes, with the possibility of extension of the system	Check the market for bikes/e-bikes
	By 2020, two charging stations for e-bikes will be provided		Setting up the rental system
Cooperation between municipalities and universities establishing cycling network	Document on university mobility harmonized with SUMP	Adoption of a document	Relocation of personnel, time and financial resources
Raising awareness of the benefits of cycling	Every year, at least one campaign in the field of awareness and promotion	Active role in 'Mobility Week'	Cooperation with Automobile Association, Universities, Tourist Association, Student Clubs and association
		Road Safety course for students and employees ate university and other PA	
Tracking the number and habits of cyclists	By 2020, establish a database on the number and habits of cyclists and update it every two years	Establishment of a system for monitoring cyclists using surveys or counting (digital or manual), by monitoring the number of cyclists at the different locations (university, other PAs buildings, libraries, …)	Cycle counters (automatic, manual)

5.3 Indicators by Category

Implementation of aforementioned measures requires relevant indicators. Globally, three types of indicators should be addressed considering sustainable transport and EE mobility namely economic, social, and environmental indicators. A descriptive summary of these indicators provided below should be used during the implementation of the measures.

Economic Indicators of Sustainable Transportation

Indicator	Description	Direction
User satisfaction	Overall transport system user satisfaction ratings.	More is better
Commute Time	Average door-to-door commute travel time.	Less is better
Employment Accessibility	Number of job opportunities and commercial services within 30- minute travel distance of residents.	More is better
Land Use Mix	Average number of basic services (schools, shops and government offices) within walking distance of homes.	More is better
Vehicle travel	Per capita motor vehicle-mileage, particularly in urban-peak conditions.	Less is better
Transport diversity	Variety and quality of transport options available in a community.	More is better
Mode share	Portion of travel made by efficient modes: walking, cycling, rideshare, public transit and telework.	More is better
Congestion delay	Per capita traffic congestion delay.	Less is better.
Affordability	Portion of household expenditures devoted to transport, particularly by lower-income households.	Less is better.
Cost efficiency	Transportation costs as a portion of total economic activity, and per unit of GDP.	Less is better.
Facility costs	Per capita expenditures on roads, parking and traffic services.	Less is better
Cost Efficiency	Portion of road and parking costs borne directly by users.	More is better
Delivery services	Quantity and quality of delivery services (international/intercity courier, and stores that offer delivery).	More is better
Commercial transport	Quality of transport services for commercial users (businesses, public agencies, tourists, convention attendees).	Higher is better
Planning Quality	Comprehensiveness of the planning process: whether it considers all significant impacts and uses best current evaluation practices.	More is better
Mobility management	Implementation of mobility management programs to address problems and increase transport system efficiency.	More is better
Pricing reforms	Portion of transport costs (roads, parking, insurance, fuel, etc.) that are efficiently priced (charged directly to users).	More is better
Land use planning	Applies smart growth land use planning practices, resulting in more accessible, multi-modal communities.	More is better

Social Indicators of Sustainable Transportation

Indicator	Description	Direction
User rating	Overall satisfaction of transport system by disadvantaged users.	More is better
Safety	Per capita crash disabilities and fatalities.	Less is better
Fitness	Portion of population that walks and cycles sufficient for fitness and health (15 minutes or more daily).	More is better
Community livability	Degree to which transport activities support community liveability objectives (local environmental quality).	More is better
Non-drivers	Quality of transport services and access for non-drivers.	More is better
Affordability	Portion of budgets spent on transport by lower income households.	Less is better
Disabilities	Quality of transport facilities and services for disabled people.	More is better
NMT transport	Quality of walking and cycling conditions.	More is better.
Inclusive planning	Substantial involvement of affected people, with special efforts to insure that disadvantaged and vulnerable groups are involved.	More is better

Environmental Indicators of Sustainable Transportation

Indicator	Description	Direction
Climate change emissions	Per capita fossil fuel consumption, and emissions of CO2 and other climate change emissions.	Less is better
Other air pollution	Per capita emissions of “conventional” air pollutants (CO2, VOC, NOx, articulates, etc.)	Less is better
Air pollution	Frequency of air pollution standard violations.	Less is better
Noise pollution	Portion of population exposed to high levels of traffic noise.	Less is better
Water pollution	Per capita vehicle fluid losses.	Less is better
Land use impacts	Per capita land devoted to transportation facilities.	Less is better
Habitat protection	Preservation of high-quality wildlife habitat (wetlands, old-growth forests, etc.)	More is better
Habitat fragmentation	Average size of roadless wildlife preserves.	More is better
Resource efficiency	Non-renewable resource consumption in the production and use of vehicles and transport facilities.	Less is better

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