Local strategies for sustainable mobility. The case of Veneto region

Strategie locali per la mobilità sostenibile. Il caso del Veneto

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Abstract. Despite the growing interest in the topic of sustainable mobility, few studies have analysed this paradigm through the lens of literature dealing with local development. This contribution intends to contribute to this debate, first with a general overview of the concepts of smart cities, sustainable mobility and smart mobility, and then by exploring the policies implemented in the Veneto region with the aid of descriptive statistics. Finally, the results are discussed with an eye to the future of the Veneto region, a possible laboratory for experimenting with technological solutions connected to the theme of sustainable mobility.

Abstract. *Nonostante il crescente interesse verso il tema della mobilità sostenibile, pochi studi hanno analizzato questo paradigma attraverso la lente della letteratura che si occupa di sviluppo locale. Il presente contributo intende contribuire a questo dibattito, dapprima con una panoramica generale dei concetti di smart city, mobilità sostenibile e smart mobility, e successivamente esplorando le politiche attuate nel territorio Veneto con l'ausilio di statistiche descrittive. Infine vengono discussi i risultati con uno sguardo al futuro della regione Veneto, possibile laboratorio per sperimentare soluzioni tecnologiche connesse al tema della mobilità sostenibile.*

Keywords: *Sustainable mobility, Smart mobility, Smart city, Veneto region, Sustainable development*

1. Introduction

In the international scenario, the topic of sustainable mobility is on top of the agenda of managers and policymakers. During the last decades, relevant policy plans addressed the issue of sustainable mobility, calling for urgent actions to reduce its impact on planet and life of citizens (EU, 1992; World Business Council for Sustainable Development, 2004).

One of the main reasons for making the transition to a more environmentally friendly type of transport is to fight climate change, considering its significant impact on global warming (IPCC, 2022). In 2021 the IEA (International Energy Agency) pointed out that the transport sector is responsible for 37% (7.7 billion tonnes) of the total CO2 emissions. According to the latest data from the same year based on ISPRA (Istituto Superiore per la Protezione e Ricerca Ambientale) at the Italian level, 23% of greenhouse gas emissions derive from transport (70% are attributable to cars) (Bernetti, 2021). The environmental problems linked to traditional mobility (such as air and soil pollution, greenhouse gas emissions and climate change) are worsening their effects, and if action is not taken in time, the consequences for the planet preservation will be irreversible.

The concept of sustainable mobility takes the cue from the broader concept of sustainable development, which was coined in the 1980s and 1990s, when the need to ensure fair access to the earth's resources for future generations first began to be highlighted as a crucial goal.

The definition of sustainable mobility came from the sustainable development approach, expressed by the European Commission policy report released in 2006 (EU, 2006). This document calls for an action plan on energy efficiency, i.e. an European energy policy that aims to ensure competitiveness, security of supply and environmental protection. In particular, the document highlights the role of new transport policies to reduce energy consumption by improving the fuel efficiency of vehicles, including also different fuels, such as biofuels, natural gas, hydrogen, and electricity (EU, 2006). It has therefore become a priority to implement policies aimed to reduce the use of private cars, incentivising the use of alternative mobility tools, such as car sharing, bike sharing and cycling.

To reach sustainable mobility, the notion of smart city and smart mobility, becomes central. The notion of smart mobility, as in the case of smart city, does not include only technological development in terms of energy sources and ICT-related tools (e.g. platforms, edge computing). Smart mobility plays a crucial role in economic development with positive externalities on the life of citizens, relieving cities of traffic congestion, developing accessible services, improving the use of public spaces, encouraging physical activity

and promoting a healthier lifestyle (Enel X Italia S.r.l., 2022). Smart mobility can be a means to leverage the notion of smart city as an open field laboratory able to exploit the latest technological innovations for improving the well-being of urban contexts, creating more livable, economically vibrant, and sustainable communities.

Despite such growing interest, very few studies explicitly handled such sustainable mobility, adopting the perspective of the local development literature. With the aim to address such a gap, in this article, we review the concept of sustainable mobility, exploring its connection with smart city and smart mobility. Afterwards, we analyse the case of Veneto Region, showing its strategic trajectory towards smart mobility. Veneto is the third-largest region in Italy by GDP, and the fifth-largest by GDP per capita (ISTAT, 2023). It is rapidly changing its economy, with an impressive transition from an agricultural territory with only a few urban centres into a highly urbanized region. Success in managing the transition from a rural economy to a national reference area led to the definition of the region as the "Veneto model" (Pierantoni, 2015; Sacco, 2021). Nevertheless, the growth Veneto experienced has resulted in some negative externalities, including increased air pollution due to human activities[1]. The case study analysis is therefore of interest to test the relationship between the implementation of innovative strategies like smart mobility and strategies of local development.

The remainder of the paper laid out as follows. In the second section, the theoretical background on smart mobility is presented. In the third section, we show the results for the case of Veneto Region, collecting and critically examining some publicly available data related to smart mobility. The last section concludes with final remarks and future directions.

2. Theoretical background

In this literature review, we review the notion of smart city, sustainable mobility and smart mobility. Accordingly, the concepts of smart city and sustainable mobility serve to give an overview of this topic, while smart mobility complements the logical framework by adding the technological elements on the topic.

[1] https://corrieredelveneto.corriere.it/notizie/verona/cronaca/23_gennaio_31/citta-venete-piu-inquinate-verona-e-nella-top-ten-dello-smog-88a075a1-f581-48b0-8bf8-58cc37f03768.shtml

2.1. Smart city

Smart cities could be described as "cities that integrate investments in modern Information and Communication Technologies (ICT) infrastructure with the aim to promote sustainable economic development and high quality of life of its inhabitants, with their direct involvement in the co-design of innovative solutions to urban daily problems" (Caragliu et al., 2011).

This is a relatively new concept, but one that is gaining importance in an increasingly urbanised world with a growing demand for innovative solutions to deal with urban problems. Giffinger et al. (2007) were the first to provide a framework to measure this concept, presenting a definition of the 6 macroareas that characterise a smart city, namely, smart economy, smart people, smart governance, smart environment and smart mobility. Batagan (2011) adds two further categories, namely smart education and smart healthcare[2]. Afterwards, Appio et al (2019) explore the systemic connection between the abovementioned dimensions, showing the logical articulation of the different layers. For instance, the interaction between an innovative ecosystem (a smart economy) and the concentration of knowledge workers (smart people) needs of farseeing public management (e.g. public-private initiatives typical of smart governance) to improve their impact on local society, which is seen as the final scope of the whole smart city.

Other useful concepts to outline a smart city came from the article 'A Literature Survey on Smart Cities', by Yin et al. (2015), which offers four different definitions embracing different point of views:

- Technical infrastructure: 'instrumented, interconnected and intelligent city' (Harrison et al., 2010). This definition focuses on the connection between the physical, ICT, social and business infrastructure of a city.
- Domain of application: Giffinger et al. (2010) identify six different 'smart' characteristics of a smart city: economy, people, governance, mobility, environment and life. To be defined as such, one of these elements must be developed from a 'smart' perspective with the help of new digital technologies.
- Systems integration: definition based on the interconnection between different systems: "a system of cities connected by networks (Moss Kanter & Litow, 2009).
- Data processing: for Al Hader et al. (2009) 'sending and receiving data is the basis for monitoring and controlling the functional operational framework, which is necessary for intelligent management of network assets'.

While the first two definitions assume that a smart city, to be defined as such, has to possess the infrastructure and physical tools to make cities

[2] Smart education could be attributed to the previous category smart people, while healthcare is the novel contribution introduced by the author in the smart city literature.

'smarter', the latter two place more emphasis on the concept of network and the interconnection between systems, leaving space for the introduction of societal problems addressable by innovative technologies. Accordingly, one of the main features of smart cities is the use of digital technologies to collect and analyse data about the city in order to identify opportunities to improve the efficiency and quality of life of its inhabitants. For example, smart cities can use sensors and cameras to collect data on mobility and traffic in order to optimise transport and lighting systems and manage energy consumption more effectively.

Smart cities therefore also have a strong focus on environmental sustainability, using technologies such as energy saving and renewable energy production to reduce their impact on the environment. They also promote the use of sustainable means of transport, such as bicycles and electric vehicles, to reduce air and sound pollution. In addition to technology, smart cities also rely on collaboration and active citizen participation. For example, they can use online platforms to involve citizens in the planning and management of the city, creating a sense of community and shared responsibility, but with some problems attached. Indeed, smart cities also present some challenges, such as concerns over privacy and data security, as well as the need to ensure equal access to technologies for all citizens. It is important that governments and organisations are committed to managing these challenges responsibly and ensuring that smart cities truly benefit all their inhabitants.

It is nevertheless important to stress how recent analysis of the literature has shown the excessive focus of smart city on the technological spheres, with few contributions truly dealing with the social aspects as those included in sustainable development goals (Blasi et al., 2022a).

Smart cities represent a unique opportunity to address the challenges of modern cities and improve the lives of their inhabitants. With the use of advanced technologies and the active participation of citizens, smart cities can become models of sustainability and innovation for the future.

2.2. Sustainable Mobility

Before exploring the concept of sustainable mobility, it is necessary to explain what is meant by 'sustainability'. Hall (2002) offers a universally accepted definition of the term, namely: "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (UN. Secretary-General & World Commission on Environment and Development, 1987). The objective is to mitigate current people's needs while respecting the constraints of the environment, with both inter and in-

tra-generational approaches (Eppel, 1999; Glotzbach & Baumgartner, 2012). Above all, by reducing pollution and harmful emissions.

Sustainable mobility is a concept that therefore refers to the use of forms of transport that reduce environmental impact and promote a healthier lifestyle. In an increasingly urbanised world with a growing demand for travel, it is becoming increasingly significant to find ways of getting around more sustainably. This topic has been gaining rising prominence in the academic literature in recent years. The trend is increasing, with more than 100 new publications only in 2022 (Roman, 2022). This denotes an increased interest in scientific research given the topicality and urgency of moving towards environmentally friendly mobility. There are already traditional ways of promoting sustainable mobility, such as the use of public transport (buses, trams and metros) or the use of bicycles (in cycle lanes). The use of more innovative modes, such as scooters and electric (or hydrogen) cars that have a significantly lower environmental impact than internal combustion vehicles.

Sustainable mobility is acquiring importance as a vehicle to promote human development a là Sen (Sen, 2009). Active life practices contribute to basic needs of human beings. Walking and cycling are good physical exercises and can help reduce the risk of chronic diseases such as diabetes and obesity (e.g. for a level of cycling corresponding to the WHO recommendations for physical activity, i.e. 150 minutes, a 10% reduction in the risk of all-cause mortality was found compared to no cycling activity; Götschi et al., 2016). Furthermore, reducing traffic on roads and highways can help reduce the amount of air pollution, which is an important cause of respiratory diseases.

2.3. Smart mobility

Since the seminal contribution of Giffinger et al. (2007) in the smart city literature, smart mobility has been acknowledged as one of the six key dimensions.

Smart mobility in the Appio et al (2019) systemic vision of smart city can be interpreted as a precondition for smart environment and smart living.

Nevertheless, few papers have explicitly focused on smart mobility within the smart city notion (see Benevolo et al., 2011), thus representing an interesting sub-theme to explore.

Smart mobility' is a concept that refers to the use of advanced technologies to make transport systems more efficient, safe and sustainable and that combine the intelligent environment of Smart Cities with the notion of Sustainable mobility. It is an integrated system composed of different projects and actions all aimed at sustainability centered on the idea of improving connectivity without impacting the environmental conditions (Pinna et al., 2017).

Smart mobility is possible thanks to enabling technologies (Paiva et al., 2021) applied to address mobility challenges and transport issues, with the aim to a) develop efficient vehicles; b) mitigate problems, such as pollution levels, overcrowding, and sustainability; c) establish new infrastructure, both technical and electronic, to support transport solutions (Bıyık et al., 2021).

It is a growing trend worldwide, both for cities and rural areas, and represents an opportunity to address some of the challenges of modern mobility, such as increased traffic and air pollution. Technologies such as GPS and shared transport apps, for example, can make it easier for travelers to plan and rely on public transport or car sharing services.

Smart mobility also promotes the use of sustainable means of transport such as bicycles and electric scooters to reduce CO2 pollution. It also encourages the creation of pedestrian and bicycle zones, which promote walking and cycling instead of driving. Smart mobility therefore represents a unique opportunity to address modern mobility challenges and make transport systems more efficient, safe and sustainable. By using advanced technologies and promoting sustainable means of transport, smart mobility can help create more liveable cities and reduce the environmental impact of our travel.

Some of the most common traditional technologies used in smart mobility are as follows:

- GPS: Global Positioning System (GPS) is a technology that uses satellite signals to determine the position of a vehicle or person. This technology is used in many transport systems, such as car sharing apps or maps for public transport, to make it easier for travellers to plan and rely on transport.
- Shared transport apps: shared transport apps, such as Uber or Lyft, allow travellers to easily find and book a ride with a private driver or rental vehicle. These apps can help reduce traffic and air pollution as they allow several people to share a single vehicle.
- Electric bicycles and scooters: electric bicycles and scooters are environmentally friendly means of transport that can be used for short trips in the city. These vehicles can be rented through apps or rental stations and can help reduce traffic and air pollution.

There are also more innovative technologies in the automotive sector such as:

- ADAS (Advanced Driver Assistance Systems): these are driver assistance systems that use advanced technologies, such as sensors, cameras and GPS, to help the driver rely on vehicles more safely and comfortably. Such as the Automatic Emergency Braking (AEB) system, which detects the risk of collision with other vehicles or objects, and brakes the vehicle if the driver does not react. Or the lane-keeping system (LKA), which uses sensors and cameras to detect if the vehicle is moving out of its lane (Nason, 2022).

- Related and autonomous vehicles: connected vehicles are vehicles that use technologies such as GPS, cameras and sensors (such as ADAS) to collect and transmit data on location, traffic and energy consumption. This data can be used to optimise transport systems and improve road safety. This will enable future self-driving vehicles to move without the need for a human driver on board.

Among the technologies mentioned, the ones that are becoming more widespread are apps for shared transport (car sharing) and the use of electric bikes and scooters. For example, the city of Oslo in Norway is considered to be one of the most advanced smart cities globally, with a large number of electric vehicles on the road (in 2018 alone they were 31% of the total number of new cars registered; (Ruggieri et al., 2021) and numerous smart mobility projects in operation (such as that of the Norwegian car sharing company Vygruppen, with 250 vehicles available to citizens in the city of Oslo alone in 2020; Lougovoy, 2020).

3. The case of Veneto region

Veneto is one of the most polluted regions in Italy. Very often in local and national newspapers we hear about exceeding the emission limit, especially PM10 (particulate matter just a few nanometres in size). The *'Mal'aria di Città 2023'* report by Legambiente[3], which analysed the data of 95 Italian provinces setting the PM10 limit at an average of 10 milligrams per cubic metre of air per year, shows a clearly worsening situation: in 2022 Verona reached an annual average of 33 milligrams per cubic metre, placing it among the top 10 cities with the worst air in Italy. This is followed by three other provinces (Padua, Vicenza and Treviso), which also rank among the 20 most polluted provinces, with 23, 23 and 19 milligrams per year. From these values it is possible to assume the general interest with respect to the Veneto Region's study, given the persistence of the overruns. Moreover, according to the same report, in Verona as much as 42% of emissions were the effect of road traffic, showing that means of transport are the main source of fine particulate pollution.

Nevertheless, according to EY's 'Smart City Index'[4], there is an improving trend in the Veneto Region as regards the development of efficient smart cities, indicating that Veneto municipalities are working to counter this negative trend. Every year, EY draws up a ranking of Italian capitals based on

[3] https://www.legambiente.it/wp-content/uploads/2021/11/Rapporto_Malaria_2023.pdf
[4] https://www.ey.com/it_it/news/2022-press-releases/06/citta-del-futuro-e-nuovi-modi-di-lavorare

their development of networks and infrastructure, with a focus on environmental sustainability. In 2020 report, Veneto Region did not register any city in the top 10, with Padua and Treviso, located only in the top 20[5]. However, in the latest report of 2022 ('Human Smart City Index'), however, Padua and Venice improved their scoring, rising to seventh and ninth position respectively. The score improvement is due to a greater attention of these two provinces in implementing smart mobility and car sharing services, as will be shown in section 3.3.

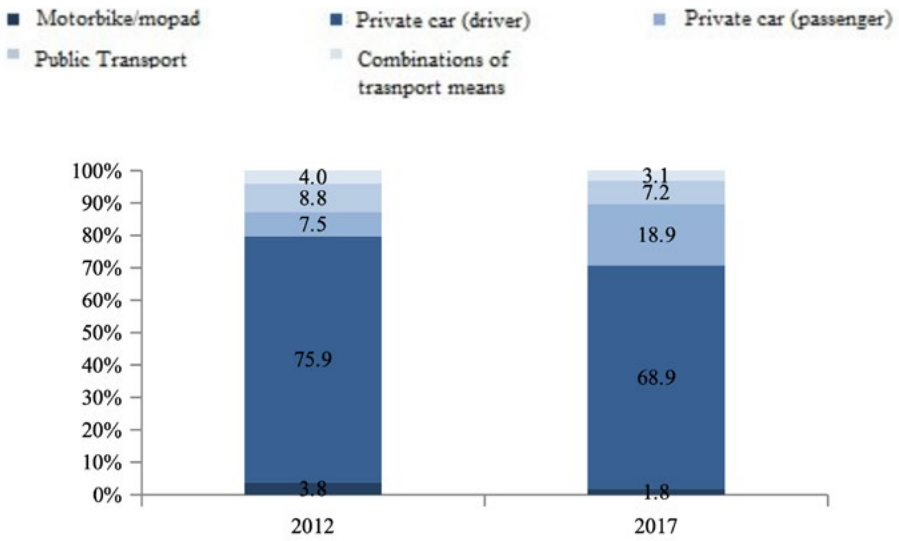
These two sides of the same coin (high level of pollution and high level of engagement of local governments in defining new urban models) show the importance of Veneto as a peculiar regional context to analyse Smart mobility.

In light of this data, this section aims to examine the issue at a regional level by analysing the steps taken by the regional government and municipal administrations in this regard. With the aid of graphs and tables from the Veneto Region's Regional Statistical System (Statistical Report 2021), it will first describe how the citizens of Veneto travel, then show the effects of such travel on air quality and climate and finally list the policies adopted to mitigate the phenomenon.

In order to understand how the Veneto region stands with regard to sustainable mobility, it is important to report which modes of travel are preferred by citizens. In figure 1 it can be seen that, although the trend is improving, the preferred vehicle in Veneto still remains the motorised one. In particular, the evolution of the percentage of trips made in the Veneto region using different modes of transport from 2012 to 2017 is shown. In 2012, 16.2% of trips were made on foot or by bicycle, while the rest (83.8%) were made by motorised transport, of which 3.8% by motorbike, scooter or moped, 75.9% by private car as a driver and 7.5% as a passenger. 8.8% of trips were by public transport and 4% by a combination of means. In 2017, the share of walking and cycling increased to 27%, while the share of motorised transport decreased to 73%. This could confirm the improved score of some cities in EY's 2022 ranking. Within the latter category, the percentage of trips made by motorbike, scooter or moped decreased to 1.8%, that by private car as driver decreased to 68.9% and that by private car as passenger increased to 18.9%. The proportion of journeys made by public transport decreased to 7.2% and that by a combination of means remained almost unchanged at 3.1%.

[5] https://www.ilgazzettino.it/pay/belluno_pay/la_classifica_belluno_terzultima_in_veneto_belluno_e_piu_smart_solo-5087805

Figure 1. Percentage of trips by motor mode used. Veneto - Years 2012 and 2017



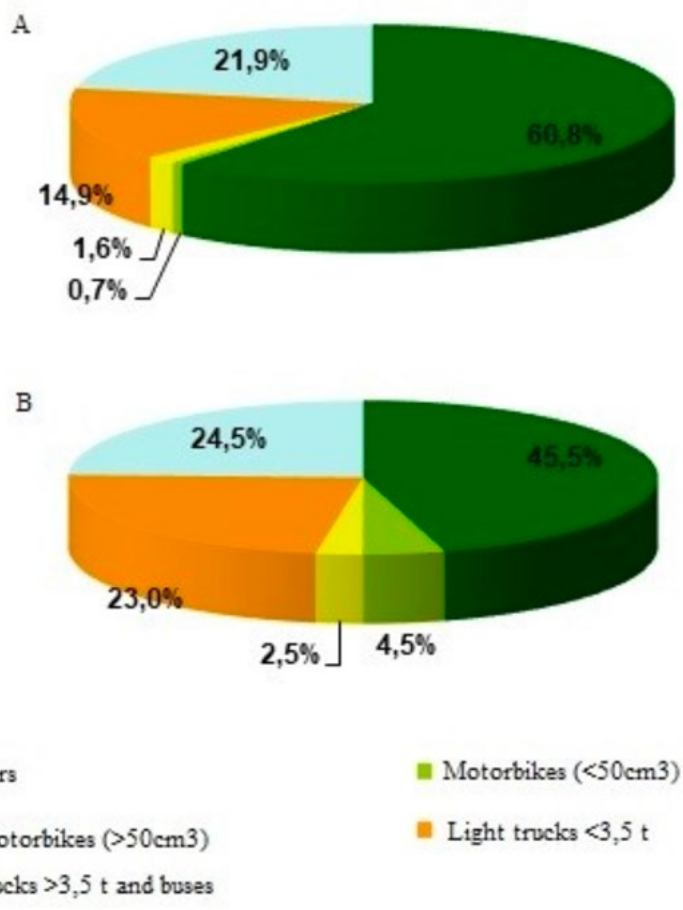
Source: Statistical Office of Veneto Region, 2021

Despite these encouraging signs of change, in 2016 Veneto region still displayed a motorisation rate only slightly lower than the national average (622 vehicles for 1000 inhabitants) (Statistical Office of Veneto Region, 2021) As far as emissions are concerned, however, in comparison with other Italian regions, Veneto actually has a higher proportion of cars with lower emission classes[6].

Concerning pollution, road transport accounts for 27% of the total pollution in Veneto, with 8,579 kt/y of CO2 and 2,000 t/y of PM10 in the atmosphere. Cars are the main emitting sector for both CO2 and PM10 (see figure 2), accounting for 60% and 45% respectively, followed by light vehicles with less than 3.5 t, which account for 14.9% and 23% respectively, and heavy vehicles and buses with more than 3.5 t, which account for 21.9% and 24.5% of CO2 and PM10 emissions. Mopeds and motorbikes contribute less to emissions. Geographically, the greatest vehicle pollution occurs on extra-urban roads, followed by motorways and urban roads. More PM10 is detected on city roads than on motorways. Thus, the data show that cities (and not suburban roads) are the main target of policies to reduce vehicle emissions.

[6] The Euro 3 or lower emission class, for example, includes vehicles with higher emission levels, while the Euro 6 class includes vehicles with lower emission levels. Although Euro 5 and 6 account for 30 per cent of the vehicles in the region, there are still many polluting cars with Euro 3 or lower classes (36 per cent).

Figure 2. Transport CO2 and PM10 emissions by emission sector (thousands of tonnes). Veneto - Year 2013

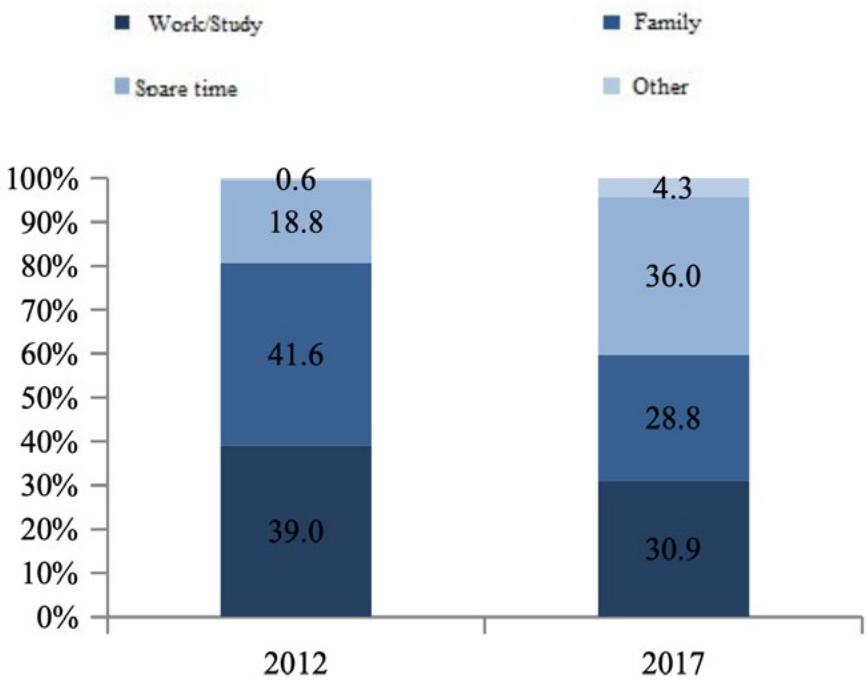


Source: Statistical Office of Veneto Region, 2021

With a view to designing a type of transport that is more environmentally sustainable, it is also important to understand what kind of journeys citizens make on a daily basis. Analysing the destinations of these trips, the data show that, in 2015, 7.1% of people who travelled in the region did so to study or work, moving from a provincial capital municipality to outside the provincial capital, 16.6% moved within the provincial capital, 44.4% moved from a non-principal municipality to outside the provincial capital, and 31.8% moved within the non-principal municipality (Statistical Office of Veneto Region, 2021). Furthermore, while in 2012, 39% of the trips were made for work or study, 41.6% for family or personal management, 18.8% for leisure

or entertainment and 0.6% for other places, in 2017, 30.9% of the trips were made for work or study, 28.8% for family or personal management, 36% for leisure or entertainment and 4.3% for other places. It can be seen that in 2017 there was an increase in the percentage of trips for leisure or entertainment and a decrease in those for work or study and for family or personal management (see figure 3). This could be due to the beginning of the spread of smart working, already in the pre-Covid era. But what travel-related problems do Veneto citizens complain about? If the least problem is noise, parking problems and traffic are the worst pitfalls for motorists. In particular, the most felt problem is air pollution, a sign that the issue of climate change remains unresolved, with PM10 values exceeding the limit on many days of the year[7].

Figure 3. Percentage of trips by type of activity (excluding trips to home). Veneto - Years 2012 and 2017



Source: Statistical Office of Veneto Region, 2021

[7] AN interesting project in this regard is the Veneto Region's 'Clean Venice' project on the use of bioethanol for Magigas D7® diesel in ACTV public transport in the province of Venice, which drove the regional PM10 reduction that year (-74% in the case of Euro 2 buses and -17% for Euro 3 buses) (https://www.magigas.it/prodotti-speciali-2/ and https://www.trasporti-italia.com/articoli/stampa_articolo/2574/veneto-pm10-in-calo-grazie-al-progetto-clean-venice).

In 2017 (see figure 4), as far as sustainable mobility in Veneto is concerned, Padua and Venice (the latter favoured by being a lagoon city) topped the list in terms of services offered. The 2 cities of Veneto present all the main smart mobility tools (car sharing, exchange car parks, bike sharing, road zones with 30 km/h speed limit and limited traffic zones) and show a virtuous behaviour that could still explain the increase in score in the EY 2022 ranking for these 2 cities. Treviso and Verona are equally in second place, followed by Belluno and Vicenza. At the tail end is Rovigo, which is still lacking in services oriented towards environmental sustainability: there are only exchange car parks and ZTL in the city area.

Figure 4. Services for sustainable mobility in Veneto's capital cities (*) (presence=1, absence=0) - Year 2017

Source: Statistical Office of Veneto Region, 2021

With regard to the availability of pedestrian areas and parking spaces in interchange car parks in the provincial capitals of the Veneto region, it can be seen in figure 5 (2017 data) that the availability varies greatly among the different municipalities. For example, Verona and Treviso have an availability of about 22 m2 per 100 inhabitants, while Vicenza and Belluno have an availability of about 21.6 m2 and 32.5 m2 per 100 inhabitants, respectively. On the contrary, Venice and Padua have an availability of about 505.5 m2 and 85.6 m2 per 100 inhabitants, while Rovigo has only 2.3 m2 per 100 inhabitants. As far as parking spaces in interchange car parks are concerned, availability is generally lower than in pedestrian areas. However, also in this case there are considerable differences between different municipalities. For

example, Treviso has a parking space availability of 7.9 per 1,000 circulating cars. Vicenza, Belluno and Padua, on the other hand, have 18.1, 16.3 and 38.4 parking spaces per 1,000 cars on the road. Venice and Rovigo have a parking space availability of 28 and 15.6 per 1,000 cars on the road. An exception is the case of Verona, the only city in Veneto with no parking spaces.

On the other hand, Padua has the highest density of bicycle lanes, placing Veneto above the Italian average (figure 5). It is interesting to note that, in general, the density of bicycle lanes has increased over the years for all the municipalities except Rovigo. As shown in fig. 24, as a result, Padua also has the highest cycling index (ease of moving by bicycle within a city expressed in equivalent metres per inhabitant) in the region, being among the top 10 in Italy (ninth place, 2015 data).

Figure 5. The density of cycle paths in provincial capitals - Years 2008:2017 (km per 100 km²)

	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Verona	32,7	39,7	40,7	40,7	44,7	44,7	44,7	44,7	44,7	44,7
Vicenza	45,7	47,5	51,5	64,8	70,4	69,9	72,2	72,9	73,5	75,5
Belluno	4,4	4,8	6,5	7,7	7,5	7,5	7,5	10,5	13	13,7
Treviso	77,7	77,7	107,1	107,1	107,1	107,1	108	109,6	109,6	109,6
Venezia	18,9	20,2	24,3	24,8	27,1	27,1	27,8	28,3	29,4	29,4
Padova	133	148,3	156,9	164,5	170,9	170,9	177,4	180,6	181,7	181,7
Rovigo	15,1	15,4	15,4	15,4	16,3	16,3	16,3	16,3	17,6	17,6
Italy	13,7	14,7	16,1	17,4	18,3	18,3	19,1	20,2	21,1	23,3

Source: Statistical Office of Veneto Region, 2021

Concerning public transport, in the two-year period 2017-2018, passengers on buses (LPT, local public transport) were on the rise, while passengers on Venice boats fell. It can be seen that the number of passengers transported increased in general between 2017 and 2018 for all types of local public transport services.

As for cycle tracks, in 2020 there were a total of 7,857 kilometres of cycle tracks in the Veneto region. of which 5,107 were vehicular promiscuous,

1,436 pedestrians promiscuous, 834 on reserved lanes and 480 on own lanes. A vehicular promiscuous route is a road that can be used by both vehicles and cyclists, while a pedestrian promiscuous route is a road that can be used by both pedestrians and cyclists. A reserved lane is a road reserved exclusively for bicycles and may be separated from the rest of the carriageway by physical elements, such as a pavement or hedge. A dedicated road, on the other hand, is a road reserved exclusively for cyclists and completely separated from the rest of the carriageway, such as a cycle lane. The province with the most kilometres for cycling is Vicenza with 633 kilometres. It is followed by Verona, Venice, Treviso, Padua, Rovigo, and in last place, Belluno with 160. Regional cycle routes are also being established to enhance the territory and sustainable tourism. Of the 10 in Italy, five concern the Veneto region. They are: the Ven.To cycle route, the Sun cycle route, the Garda cycle route, the Adriatic cycle route and the Trieste-Lignano Sabbiadoro-Venice cycle route for a total of 394 regional kilometres. The region has also created the Green Tour-Green on the Move project. This project consists of more than 600 km of cycle-pedestrian tracks in a ring route around the disused Treviso-Ostiglia railway, which extends across most of the Veneto region and touches the provinces of Venice, Treviso, Padua, Rovigo and Verona, the Lombardy province of Mantua and the Emilia Romagna province of Ferrara10[8].

Finally, the public transport fleet has to be analysed. In 2018, the bus fleet is still 'old'. While in the urban area, it is the recent Euro 5 and 6 that are in the lead with almost a dozen electric vehicles, in the extra-urban area there are still several Euro 3 and 4 buses on the road without any EV-powered vehicles. More generally, most of the buses used in Veneto belong to the euro classes E0-E2 and E3-E4. The most widespread fuel supply is diesel, followed by methane, LPG, electric and hybrid.

Regarding the average age of the bus fleet in Veneto with a prospect of renewal to 2025, which should bring down the age of the vehicles. The regional LPT fleet is in fact being modernised with an average age of about 13 years (there are still buses from the 1990s on the road), but within two years it should drop to 10 years. From 2018 to 2020, 461 buses have already been replaced, and from 2021 to 2034 it is planned to purchase an additional 1,750 Euro 6 or electric buses with PNRR funds, which will allow Euro 0 and 1 vehicles to be totally eliminated from the fleets. So, despite continuing emissions, an effort can be observed on the part of municipal political administrations to try to reduce air pollution in the near future.

[8] Among the positive externalities of these projects, it is estimated that in 10 years the number of deaths avoided with Green Tour is 406, cardiovascular diseases 535 and diabetes 2,617.

4. Discussion

Sustainable mobility is an important aspect of urban development, as it plays a crucial role in reducing gas emissions and promoting public health. Veneto region has made significant progresses in promoting sustainable mobility through various measures such as the development of cycling infrastructure, public transportation, and the promotion of electric mobility, performing above Italian average.

Descriptive results from section 3, (mainly taken from the Veneto Region's Regional Statistical System) offer interesting perspectives on the citizens' behaviour and the infrastructural readiness of Veneto region to support the sustainable mobility paradigm. In general terms, the region still has very high pollution rates and PM10 largely exceeds the limits set for many consecutive days a year. This negative trend has deleterious effects on air quality and leads to sudden and persistent climate changes. However, in an area where the motorised vehicle is still the preferred means of transport for citizens (contributing to the majority of emissions), good practices emerge in the area of sustainable mobility. In general, it emerges that the region has a very good overall performance and its provincial capitals are at the top of the national rankings. The most striking examples are those of Padua and Venice, which have considerably improved their scoring over the years thanks to the implementation of numerous smart mobility and alternative mobility services.

From a general comparison of the results of some sustainable mobility with the rest of Italy, it emerges how the green divide is approximately articulated in three parts (north, centre and south) (see https://assets.ey.com/content/dam/ey-sites/ey-com/it_it/topics/workforce/humansmartcityindex_2022.pdf by Ernst and Young) and Veneto Region perform well above the national average considering several aspects related to citizens behaviour and green and digital readiness.

This remaining part will discuss the positive externalities associated with the topic. The concepts of smart mobility and smart cities are in fact closely connected to that of local development. Sustainable mobility represents a flywheel for socio-economic development. Therefore, sustainability should not be seen as something that affects the ecological sphere but also the socio-economic dimensions within the area. A sustainable city is appealing for start-ups and companies at a European level that stimulate creativity and innovation, and it is capable of attracting new investments that allow for greater economic growth at a local level. Accordingly, smart cities are not only "smart" due to their technical and/or technological innovations, but are

ecosystems in which sustainability is maintained through the interactions of different urban components (Diaz et al., 2017).

In particular, it emerges that the transition towards sustainable mobility may be better tackled by cities equipped with ICT cutting-edge competencies, which at the same time have existing big challenges to solve, such as the livability of urban context due to high levels of pollution.

In this context, smart mobility represents an infrastructural precondition capable of proactively enabling the other six groups. Regarding the link between smart city and smart economy, the literature emphasises the role of entrepreneurship: many authors have highlighted how the level of entrepreneurship in smart cities tends to be higher than in traditional cities (Babaei Hazehjan et al., 2017). In response to the goal of making cities more livable, affordable social enterprises and tech for goods are interesting emergent forms of convergence between sustainable needs of cities and pioneering solutions (Carè et al., 2018; Deloitte, 2018). Modular buses "Next pods" have been recently experimented in Padua (https://www.next-future-mobility.com/) and urban intelligent solutions to near-time monitor fluvial and pedestrian mobility flows are experimented in Venice (https://www.mindicity.com/).

Local contexts characterized by wicked problems are becoming arena where innovative solutions are tested, contributing to a new notion of territorial competitive advantage (Bello, 2018). In this regard, cities represent the ideal testbed to experiment and validate protytipical solutions (Blasi et al., 2022a).

Smart cities have a high level of competitiveness in attracting the best ideas, offering a space for the identification of problems with high social impact and the related research of data-driven solutions. In fact, smart cities offer access to a large volume of data (big data), raw material that allows innovators to observe existing information and then convert this multitude of data to the development of new technologies and products (Radu and Voda, 2022). To enable thus convergence local administrations also play a significant role. Incentivising entrepreneurs to get involved in such projects, municipalities could promote public-private partnerships and also participate in the co-creation process (Quan and Solheim, 2023). This may reduce asymmetries thanks to wide knowledge of local governments of specific problem of each urban community. Nevertheless, to increase the effectiveness of such public-private partnerships, local governments should plan and coordinate an intelligent information system platform where typology, timing and frequency of data are agreed with private actors (Meneghetti et al., 2022). This is due to the fact that many data produced by transportation companies are not "used" (collected and purposefully interpreted) for strategies of local

mobility. On the other side many open data could contain different type of information, more actionable by firms and citizens.

Regarding this last category, the literature also highlights the role of the citizen as an active individual in the shared vision of participatory planning (Fistola, 2013). Citizens themselves, through their feedback, can facilitate the generation of ideas by collaborating with other stakeholders in the creation process (e.g. by financing projects in crowdfunding platforms) or become catalysts of ideas themselves by founding start-ups that aim to solve local problems or improve the quality of life in cities (Ambec and Lanoie, 2008).

5. Conclusions

In this article, we discuss the role of sustainable mobility in promoting local development. In particular, after reviewing the concept of sustainable mobility and its deep entrenchment with the concepts of smart city and smart mobility, we illustrate the case of Veneto Region and its initiatives towards sustainable mobility.

This paper has shown how the transport sector still has an important impact on CO2 emissions and thus on global warming, and how sustainable mobility is one of the policies considered necessary to address this problem.

Thanks to data from the Regional Statistical System of Veneto Region, we analysed travel modes, pollution levels and policies that encourage sustainable mobility. As can be seen, the Veneto region still has very high rates of pollution and PM10 largely exceeds the imposed limits on many consecutive days a year.

Considering the descriptive results of this study, we can underline the double-edged sword of a growing economy and the relative problem of sustainability (see the regional report at this link: https://venetosostenibile.regione.veneto.it/home).

However, in an area where the motorised vehicle is still the preferred means of transport by citizens, good practices emerge, in almost all provincial capital cities, with Padua and Venice ranked among the excellences. Other regions such as Piemonte, which can be comparable in terms of regional GDP show much more heterogeneous performance at the local level.

Insofar as we can speak of the Veneto as a virtuous case in Italy, which can be a forerunner to a different way of conceiving urban reality, one that is more sustainable. Veneto has the potential to become a laboratory for studying sustainable mobility at the local level, considering the good practices of some provinces in comparison to the national level. Local and regional policymakers should strictly cooperate to combine the long-term vision with

bottom-up initiatives aimed to test on pilot projects the feasibility of new modes of moving within cities. At the current stage, too much emphasis is placed on technological means (Batarra et al., 2018; Blasi et al., 2022a), without considering the crucial role of users. Hence, local governments should contribute to the development of such initiatives with more citizen engagement and civic participation. Adoption of sustainable modes of transport is first of all a matter of radically changing the daily routines of citizens, searching for solutions able to maintain high levels of comfort. Interestingly, creating such engagement is easier for medium cities which can rely on higher levels of relational capital which can favour more synergies with public initiatives (Blasi et al., 2022b).

This article is not without limits. The theme of urban logistics, crucial to create a systemic sustainable urban mobility has not been taken into account, as the perspective of this study is focused on modes and reasons of transportation of people rather than goods. Future studies could include this point.

The data used to describe the phenomenon of sustainable mobility are partial.

At the current stage, data, which are open, granular and on a longitudinal basis for NUTS-2 and NUTS-3 regions and municipalities could improve the quality of the debate, suggesting more targeted forms of benchmarking. A sharper (and shared) operational definition of sustainable mobility and smart mobility could drive the building of such public repositories, as much data on the topic are still fragmented.

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