Urban Mobility

Urban Mobility Next #5

Costs and benefits of the sustainable urban mobility transition

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Glossary:

Policy measures: range of options that cities currently have at their disposal to lead the transition to sustainable urban mobility. The study model can simulate their impact individually or as part of a broader policy group. For more details please refer to Annex 1.

Policy groups: coherent sets of policy measures. 6 policy groups have been modelled in the study: shared mobility and demand management, innovative services, green public transport and logistics fleets & charging infrastructure, pricing schemes, transport infrastructure, traffic management and control. For more details please refer to Annex 1.

Policy scenarios: also referred to as transition pathways in the study, the policy scenarios consist of different combinations of policy measures. 3 policy scenarios have been modelled in the study (Promote and regulate, plan and build, mixed). For more details please refer to Annex 1.

Net balance: the sum of revenues and externalities generated by measures, minus their implementation costs.

Externalities: social costs linked to CO_2 emissions, air pollutant emissions (considering NOx, VOC, CO and PM2.5), noise and accidents (fatalities and injured people). In this report, the applied monetary values are those adopted by the European Commission handbook of 2019 (Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities).

Executive summary

The present report is a short version of a study on costs and benefits of the sustainable urban mobility transition, realised by transport and modelling experts from TRT Trasporti e Territorio.[1]

Based on 12 city prototypes, costs and benefits have been evaluated compared to a business-as-usual baseline. Three potential policy scenarios have been modelled, building pathways to decarbonisation and sustainable mobility in cities, in line with EIT Urban Mobility strategic agenda, the Sustainable and Smart Mobility Strategy objectives, and the Green Deal targets for the transport sector of -55% and -90% greenhouse gas emissions by 2030 and 2050 compared to 1990 levels.

Policy Scenario 1 (named "Promote and Regulate") assumes mostly promotion and regulation of 19 sustainable mobility options, Policy Scenario 2 ("Plan and Build") focuses on 14 infrastructure building and technology related actions, and Policy Scenario 3 ("Mixed") is a mix of the two approaches, with 23 measures related to both technological innovations and behavioural change. **In all three policy scenarios, the group of 779 EU-27 cities are able to reach the Green Deal CO_2 reduction targets in 2050** thanks to the implementation of policy measures and an ambitious fleet decarbonisation. On the other hand, in the **Business-as-Usual (BAU) scenario** (simulated with the EU Reference assumptions on vehicle technology evolution) **emission would only be be reduced of 65% in 2050, compared to 2019 levels.**
The main differences between the scenarios are their ability to meet the Green Deal 2030 target, as well as the impacts of implemented measures on other indicators such as cost effectiveness, modal split, private car ownership, and fatalities.

Depending on the policies implemented, the sustainable urban mobility transition in European cities **could lead to net benefits of up to €177bn by 2030 and €698bn by 2050** (Scenario 3). Of these net benefits, saved costs from reduced CO_2 emissions, pollution, noise, and fatalities (externalities) amount to €79bn in 2030 and €264bn in 2050.
In order to achieve that, European cities will need extra investments in sustainable mobility measures compared to business-as-usual scenario of **€86bn by 2030 and €150bn by mid-century.** On average, each euro invested in the **transition can generate up** to 3,06€ (2,14 in revenues and 0,92 in externalities) by 2030, and from €2,32 to €5,66by mid-century (i.e. up to €3,90 in revenues, and €1,76 in externalities). All costs and revenues, as well as externalities, are discounted and cumulated from 2019.

Both the Promote and Regulate and the Plan and Build scenarios **fail to meet the 2030 Green Deal objectives, before overcoming the target by 2050. The analysis shows that meeting the 2030 target requires ambitious reduction of private motorised transport in urban areas, which is one of Scenario 3's most distinctive feature compared to the Promote and Regulate and the Plan and Build scenarios.**

For small and medium city prototypes **in the short term (2030), pricing schemes are the most cost-effective measures to reduce urban transport CO_2 emissions in line with the Green Deal objectives.** For large city prototypes, innovative services and shared mobility and demand management are the better choice. Looking in more details at the urban mobility transition for the next decade, the following policies per city size are the most cost-effective ones to decarbonise urban mobility:

- For **small cities** (from 50 000 to 100 000 inhabitants), pricing schemes (congestion and pollution charging, parking pricing, public transport integrated ticketing and tariff schemes) and transport infrastructure (bus & tram network and facilities, walking and cycling networks and facilities, urban delivery centres) are the most effective revenue-generating options to address the Green Deal objectives by 2030. On the contrary, traffic management and control (legal framework for logistics and new mobility, traffic calming measures, prioritising public transport) are the least effective tools to reduce CO_2 emissions.

- For **medium cities** (from 100 000 to 500 000 inhabitants), pricing schemes, innovative services (DRT, autonomous vehicles, ITS), as well as shared mobility and demand management policies, are the most effective groups. By contrast, transport infrastructure measures are the least effective ones.

- For **large cities** (above 500 000 inhabitants), innovative services, shared mobility and demand management and pricing schemes are the best levers to reduce CO_2 emissions in a cost- effective way. On the opposite, transport infrastructure is the least effective policy group.

By 2050, the effectiveness of the different policy groups[2] to meet the 90% CO_2 emission reduction objective for the transport sector slightly evolves compared to 2030:

- For **small cities**, pricing schemes are the most effective revenue-generating options to address Green Deal objectives by 2050. On the contrary, traffic management and control are the least effective tools to reduce CO_2 emissions.

- For **medium cities**, innovative mobility services, pricing schemes, and shared mobility and demand management policies are the most effective groups. By contrast, traffic management and control measures are the least effective measures.

- For **large cities**, innovative services and shared mobility and demand management policies are the best levers to reduce CO_2 emissions in a cost- effective way. On the opposite, transport infrastructure is the least effective policy group.

The transition will also impact mobility behaviours and safety in urban areas. **Scenario 3 is the one that would help reduce the most the use of private motorized modes**, with a modal share being reduced to 14% in the four prototype regions by 2050. Interestingly, this reduction is accompanied by the highest percentage of carsharing modal split.

Looking at car ownership in 2050, Scenario 2 and Scenario 3 are the two most effective policy mixes, attaining a 23% and 44% reduction respectively. The highest drops in car ownership levels are encountered in large cities, where many alternatives to the private car are available.

In 2050, Scenario 3 brings a 63% reduction in urban fatalities (from 2,6 per 100 000 inhabitants in 2019 to 1 per 100 000 inhabitants in 2050), compared to base year levels. For Scenario 2, this trend is mainly driven by the construction of active mobility infrastructure (walking and cycling lanes) which significantly improves the safety of pedestrian and cyclists. On the other hand, the reduction on the number of deaths of Scenario 1 and 3 is mainly due to the implementation of traffic management and control measures (30km/h speed limits, pedestrian areas, etc.)

1. Introduction

1.1 Objective of the study

The study evaluates the investments needed for European cities to transition to sustainable urban mobility by 2030 and 2050, and assesses the revenues and benefits derived from it. Three different transition pathways – also referred to in the report as scenarios - have been shaped in line with the EIT Urban Mobility strategic objectives[3], as well as on those laid out in the European Green Deal[4] and the EU Smart and Sustainable Mobility Strategy[5].

The impacts of these urban mobility transition scenarios are quantified in terms of costs, revenues, and social benefits by 2030 and 2050, thus helping to answer to the following research questions:

- How much will the transition to sustainable urban mobility cost? What are its costs and benefits, including the monetization of all externalities?
- What range of costs can be identified according to city variables?
- What are the most cost-efficient measures to accelerate sustainable urban mobility?
- For different types of measures, what are the investments needed?

1.2 Methodology

The quantified analysis of the costs and benefits of the transition to sustainable urban mobility in European cities by 2030 and 2050, has been accomplished using the assessment tool MOMOS[6] (Sustainable MObility Model) a quantitative tool which allows to simulate the impacts of different mobility transition pathways on a range of indicators, including costs and environmental benefits, for different types of cities.

The tool allowed to derive the quantification of the transition to sustainable urban mobility taking into account the differences among European cities in terms of size, geographic location, transport infrastructures, citizens socio-economic background, etc. The three different scenarios have been applied to "city prototypes" that consider both city dimension (Large, Medium, Small size[7]) and the geographic location area (Northern Europe, Central Europe, Southern and Eastern Europe), for a total combination of 12 city prototypes. Thus, data collected from 30 European reference cities have been used to approximate relevant urban and transport variables that define each city prototype.

Table 1: List of reference cities for each of the 12 city prototypes

	Southern Europe	Central/ Western Europe	Northern Europe	Eastern Europe
Small City	Alessandria (IT) Faro (PT) Zadar (HR)	Klagenfurt (AT) La Rochelle (FR) Leuven (BE)	Galway (IR) Lahti (FI)	Daugavpils (LV) Tartu (EE) Zilina (SK)
Medium City	Perugia (IT) Ljubljana (SI)	Bielefeld (DE) Eindhoven (NL)	Uppsala (SE) Oulu (FI)	Gdynia (PL) Klaipeda (LT) Szeged (HU) Timisoara (RO)
Large City	Athens (EL) Barcelona (ES)	Bordeaux (FR) Munich (DE)	Copenhagen (DK) Dublin (IR) Göteborg (SE)	Prague (CZ) Sofia (BG)

Source: TRT

The model's outputs for the 12 prototypes have then been generalized for the 779 EU27 cities based on the number of cities, and of their population, falling into each of the 12 city categories. In total, 779 European cities have been considered in the analysis outputs. The full list of these cities, alongside the prototype they belong to, is available in the study's long version.

Three scenarios, based on different combinations of policy measures selected from important EU initiatives such as ELTIS and CIVITAS, have been considered (see section 1.3 for a description of the scenarios).

1.3 Analytical framework

The MOMOS assessment tool provides estimations of mobility trends in urban areas quantifying indicators on transport (modal split, vehicle fleet evolution, car ownership, congestion, etc.), safety & environmental (air pollutant and GHG emissions, energy consumption, fatalities, etc.) as well as economic impacts (cost and revenues for the city, externalities, etc.) of transport policy measures from the base year (set as 2019) until 2030 and 2050.

The adaptation of the model for the application to the various city prototypes listed in table 1 is performed through a set of transport parameters, that allow the model to reproduce the most appropriate urban transport patterns. For example, small cities might have in general a reduced availability of public transport infrastructures compared to large cities, and so on.

By differently combining the policy measures, three transition scenarios have been built through subsets of policies, whose combination and interaction define the scenario itself:

- **Scenario 1 "Promote and Regulate"** is mostly based on transforming transport demand towards a more sustainable mobility behaviour of citizens through information, regulations, and promotion of innovative and shared mobility services. The approach of this scenario is aimed at the short to medium term. Some of its measures are relatively fast to implement with few investments costs associated, others need some more time and resources but basically there are no long-term programmes.

- **Scenario 2 "Plan and Build"** is focused on transport supply investments in technologies and infrastructures. The aim is to change the urban environment and its existing transport facilities, with a more long-term strategy. The focus is especially on public transport, with less emphasis on other transport alternatives (e.g. shared mobility). Autonomous vehicles and Demand-Responsive Transport are also a crucial part of this scenario. This strategy is ambitious and long term, as many of its measures need time to be implemented and provide results. With respect to the first scenario, this one requires higher investments, due to the infrastructures that need to be build and maintained.

- **Scenario 3 "Mixed"** is a mix between the two previous scenarios. It considers policies from each of the two previous scenarios and intensifies their reach in order to reach the target of -55% of CO_2 emissions reduction by 2030. It assumes changes in urban mobility (as well as in the other transport sectors) and extreme shifts in how people move (with also related acceptability issues) in addition to the foreseen trend of fleet decarbonisation. This is done including regulations and behavioural incentives as well as the provision of infrastructures and services. Economic instruments play a key role in this approach and their role would be twofold. On the one hand, they are used for changing the behaviour of citizens by adopting the "user pays" or "polluter pays" principle (for example, road pricing policies are a cornerstone of this scenario). On the other hand, they are used to generate resources to support sustainable mobility by improving public transport, walking, and cycling facilities.

Annex 1 lists all the measures that contribute to the definition of each scenario.

1.4 Input Data

In order to represent the characteristics at the base year, as well as the trends in place in each city prototype, the modelling tool requires a set of input data to reproduce different city circumstances, related to socio-demographic aspects as well as mobility features. These cover characteristics such as population, urban growth, average income, congestion level, as well as public transport infrastructure, innovative services, parking, traffic management solutions, etc.

Annex 2 lists and describes all the data inputs that have been collected for the 30 reference cities and used to define the representative inputs of the 12 city prototypes. Inputs related to base year refers to 2019.

Building on the input data, the implementation of a range of sustainable urban policy measures has been modelled. Measures have been consolidated into six policy groups:

1. **Shared mobility and demand management** (Mobility as a Service, vehicle sharing, delivery plans, teleworking)

2. **Innovative services** (Autonomous vehicles, Demand Responsive Transport, Intelligence Transport Services)

3. **Greening public transport and logistics** (Green fleets and charging infrastructure)

4. **Pricing schemes** (Congestion and pollution charging, parking pricing, public transport integrated ticketing and tariff schemes)

5. **Transport infrastructure** (Bus and tram network and facilities, walking and cycling networks and facilities, urban delivery centres)

6. **Traffic management and control** (legal framework for logistics and new mobility, traffic calming measures, prioritising public transport)

Annex 3 presents and elaborates on the rationale for each policy measures and their implementation, and outlines wherever there are policy input differences among the prototypes (based on the city dimension and geography).

Info box: EIT Urban Mobility supported projects and start-ups contribution to policy groups

Shared mobility and demand management

Vianova is a platform to better collaborate and communicate between cities and mobility operators. Vianova acts as a trusted third party to facilitate secured and bilateral data sharing, ensuring privacy protection with GDPR compliant data exchange and storage services.

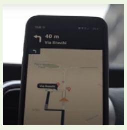
Volvero is a drive sharing app where owners share their vehicles with a community of drivers. The Volvero platform creates a system in which one can have a car, a motorcycle, or commercial vehicle in the most efficient and sustainable way saving time and money by sharing it with a broad community of users. Owners can generate a new stream of revenue by sharing vehicles with a community of vetted drivers, increasing the usage of idle vehicles (up to 30%) while reducing the need for parking areas (-5%).

VEOMO

Veomo simplifies access to mobility information, creating awareness about new forms of mobility. Veomo Mobility Info visualises real-time mobility information at a glance and on provides a large overview of devices (including distance to car, bike, and scooter sharing, waiting times for taxi services etc)

Veomo solutions can be used in corporate buildings to inform tenants about mobility options in the vicinity, to improve the attractiveness of locations and reduce parking space requirements

Innovative services



City Restarts aims to create a reliable and safe taxi sharing system accessible for all and offering an alternative to private cars. City Restarts contributes to the creation of cost-efficient, reliable, comfortable and safe shared mobility services to increase the offer of sustainable transport modes. The project sets up an on-demand shared ride system into Milan´s taxi fleet. The technology matches riders with the best vehicle taxi in real-time, and routes that taxi in a smart way through the city. The service makes mobility more inclusive and economic, as final fares can be up to 50% less compared to traditional taxi service fares.

multiDEPART

Multidepart is a project to develop a multi-operator tool to plan, manage, and monitor demand responsive transport (DRT) solutions. The project targets Public Transport Authorities (PTAs). It aims to facilitate the harmonization and scalability of DRT services across European cities.

Started in 2021, this project is currently under development.

Greening public transport and logistics

Bia optimises EV charging to lower costs, ensures green charging and enables clean, reliable energy grids. Bia incentivises charging with renewable energy (up to 70% of CO_2 saved), sends optimal schedules to charge when energy is at its cheapest (lowers cost of up to 50%), and avoid battery dwelling at high state of charge to minimise battery degradation (leads to up to 40 less battery degradation)

Bia also provides comprehensive data management visualisation and analytics for EV charging. It enables real time optimised EV charging based on customer priorities.

Evio's multi-sided platform provides out-of-the box and value-added services to different electric mobility players, leveraging electric utilities' portfolio of services.

Evio makes chargers widely available by combining public charging networks with private charging points shared by users, allowing sharing of private chargers in condominium or private garages. A smart and agnostic platform for electric vehicle charging connects car drivers, charging owners and all the relevant players in the ecosystem with a business model that incentivizes sustainable charging, sharing and monetisation, even in private spaces.

1.5 Exogenous Assumptions

The reference scenario adopted in this study follows the assumptions related to the vehicle technology composition of the EU Reference scenario 2020. Conversely, the three alternative scenarios are simulated with a more ambitious penetration of innovative vehicle technologies inspired from the EU "Fit for 55" MIX policy scenario (as an example, it is assumed a share of about 85% of car electric vehicles in total European fleet by 2050).

That said, this study considers only the costs affecting the local authorities (administration, public transport operators, service providers), such as costs for the green fuel recharging urban infrastructure to support the evolution of vehicle technologies. Other relevant costs associated (government incentives, costs for the automotive sector, etc.), belonging to external entities and are not considered within this study.

2. Impact of the sustainable mobility transition in EU27 cities

In quantifying the cost of the sustainable urban mobility transition, the study considers the cost of externalities. These costs are estimated taking into account CO_2 emissions, air pollutant emissions (considering NOx, VOC, CO and PM2.5), noise and accidents (fatalities and injured people). The applied monetary values are those adopted by the European Commission handbook of 2019[8].

The impacts of sustainable mobility measures on cities in the EU 27 is broken down in the following indicator categories:

- Modal split
- Car ownership
- Fatalities
- CO_2 emissions
- Economic outputs

2.1 Modal Split

Private motorized (private cars, both as driver or passenger, and motorbikes) modal share decreases in all three scenarios by 2030 and 2050 but with an important differentiation: while Scenario 1 and 2 show a reduction of -11% and -8% respectively, Scenario 3 reduces the modal share of private cars by 24%, more than halving the private car use. This significant reduction is the consequence of an extreme intensification of policies implemented in the "Mixed" scenario (compared to the other two) to allow it reaching the Green Deal target already by 2030.

In fact, such short-term objective would only be possible through drastic changes in how people move (i.e., the modal split). The need to achieve such a drastic impact on modal split could be reduced if policies were designed to push faster fleet turnover in favour of EVs. The potential for policy measures feedback on fleet turnover is something that should be further investigated.

Also, active modes (walking, cycling and micro-mobility) show a significant growth in both Scenario 1 and 3 by 2030 (+6% and +9% respectively). Then, the share remains constant until 2050.

For what concerns public transport (metro, tram, buses, and DRT, when implemented) modal share, Scenario 2 is definitely the one with the largest increase in 2050 (+ 18%). This impact is justified by the implementation of new public transport infrastructures foreseen in this scenario.

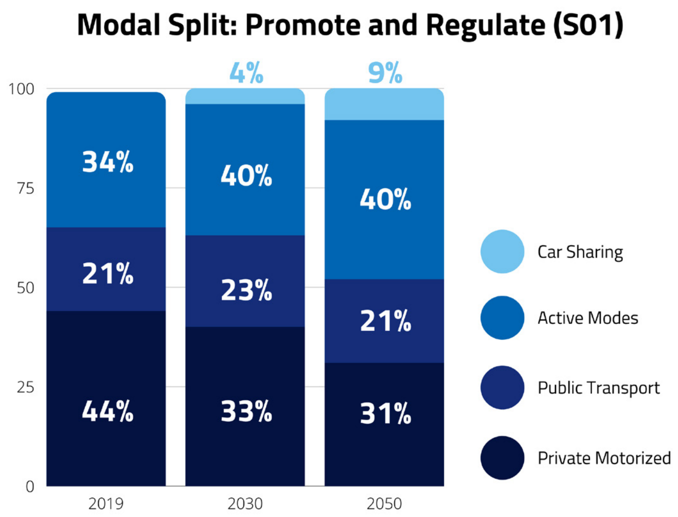
This substantial growth in 2050 hinders the scenario's uptake of active modes, which indeed are stable over time.

In particular, in large cities Scenario 2 will bring the public transport modal share to values between 37% (Central/Western) and 56% (Eastern).

In addition, it is worth highlighting the growth of car sharing, which is only implemented in Scenario 1 and 3. This growth is more evident in the Mixed scenario, where car sharing utilization is definitely boosted by the parallel implementation of autonomous vehicles.

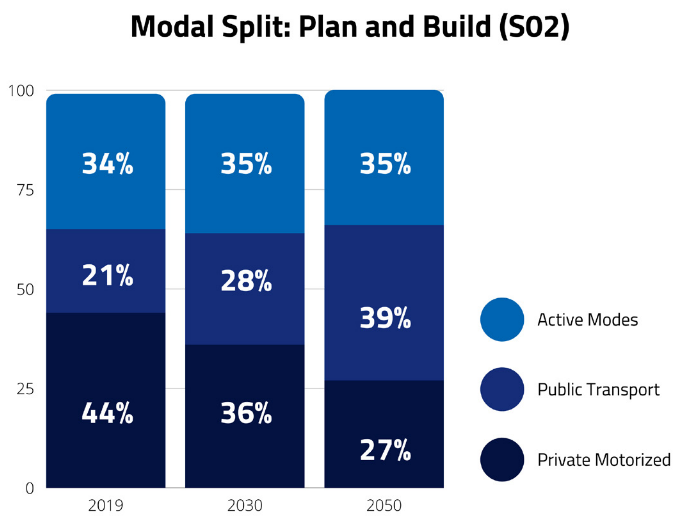
Finally, looking at the different city prototypes, **Scenario 3 is the one that reduces the most the use of private motorized modes**. In 2050, in large cities, this percentage drops to around 10% in the four prototype regions. This reduction is accompanied by the highest percentage of carsharing modal split though. Of course, the (lower) initial car modal share compared to small and medium cities also plays a crucial role in explaining this number.

Figure 1: Aggregated Modal Split for Scenario 1 "Promote and Regulate" in 2019, 2030, 2050. All EU27 cities



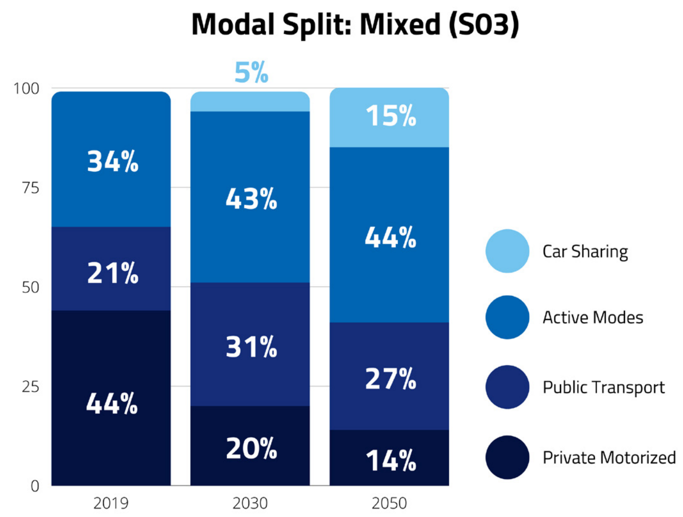
Source: TRT

Figure 2: Aggregated Modal Split for Scenario 2 "Plan and Build" in 2019, 2030, 2050. All EU27 cities



Source: TRT

Figure 3: Aggregated Modal Split for Scenario 3 "Mixed" in 2019, 2030, 2050. All EU27 cities



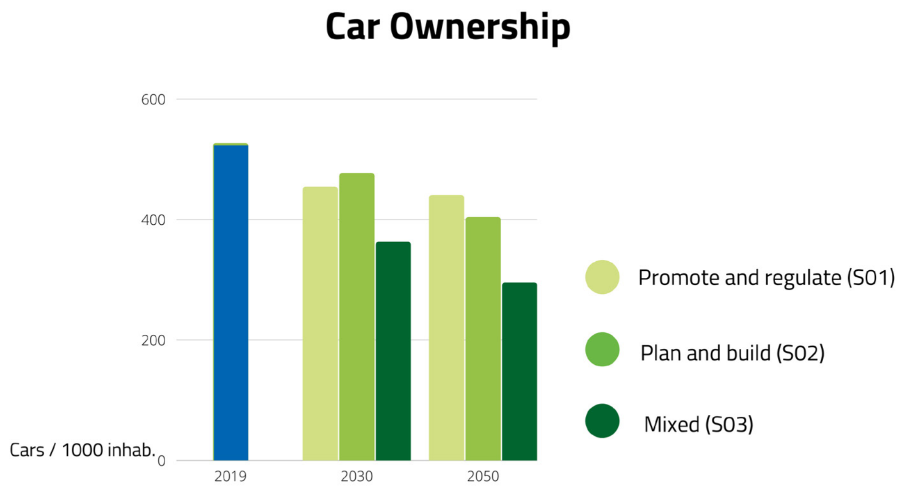
Source: TRT

2.2 Car Ownership

First of all, Figure 4 shows that Scenario 3 is the one with the highest reduction in car ownership (-31% in 2030, - 44% in 2050). On the other hand, Scenarios 1 and 2 entail smaller reduction in the number of cars owned. In particular, the reduction associated to the second scenarios are more substantial by 2050, when the effects of alternative transport infrastructures, which characterize the "Plan and Build" scenario kick in. For the "Promote and Regulate" scenario, the number of cars per inhabitants will only decline by 16% by 2050. A possible explanation might be that policies mostly focused on promotion and taxation have impact on the cost of cars use (and this impact declines with the increase EVs penetration). However, these policies are not as capable of changing long-term decision on car ownership, as, for example, the uptake of autonomous vehicles combined with a large diffusion of shared mobility services.

The highest drops in car ownership levels are encountered in large cities. This might be explained by the wide range of alternative modes that large cities offer, making cars redundant for urbanites

Figure 4: Car Ownership level for the study scenarios in 2019, 2030, 2050



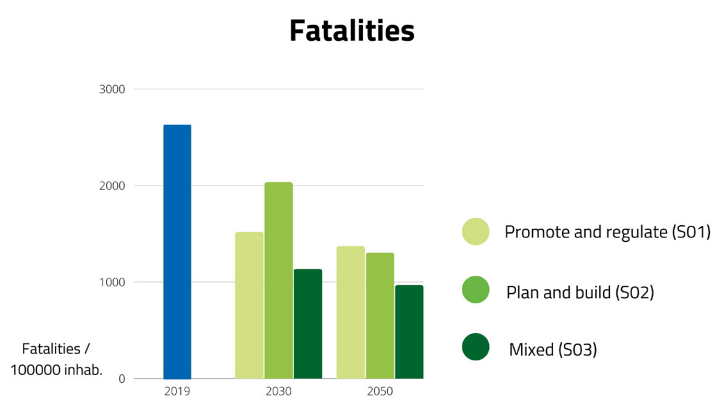
Source: TRT

2.3 Fatalities

A third key indicator, and a fundamental parameter to assess sustainable mobility, is represented by the number of transport **fatalities** occurred in urban areas.

Figure 5 shows, in 2030, that Scenario 2 is the one with the lowest reduction. However, by 2050 all three scenarios obtain considerable reductions in fatalities, measured between -48% (scenario 1) and -63% (Scenario 3). For Scenario 2, this trend is mainly driven by the construction of active mobility infrastructure (walking and cycling lanes) which significantly improves the safety of pedestrian and cyclists. On the other hand, the reduction on the number of deaths of Scenario 1 and 3 is mainly due to the implementation of traffic management and control measures (30km/h). It is possible to notice that in several prototypes Scenario 3, thanks to combination of cycling infrastructures and management measures, brings the number of urban fatalities to **less than 1 every 100,000 inhabitants**. The best results are obtained in small cities.

Figure 5: Number of fatalities for the study scenarios in 2019, 2030, 2050. All EU27 cities



Source: TRT

2.4 CO_2 emissions (tank-to-wheel)

CO_2 emissions level is key to assess the impact of the different scenarios on the sustainable mobility transition.

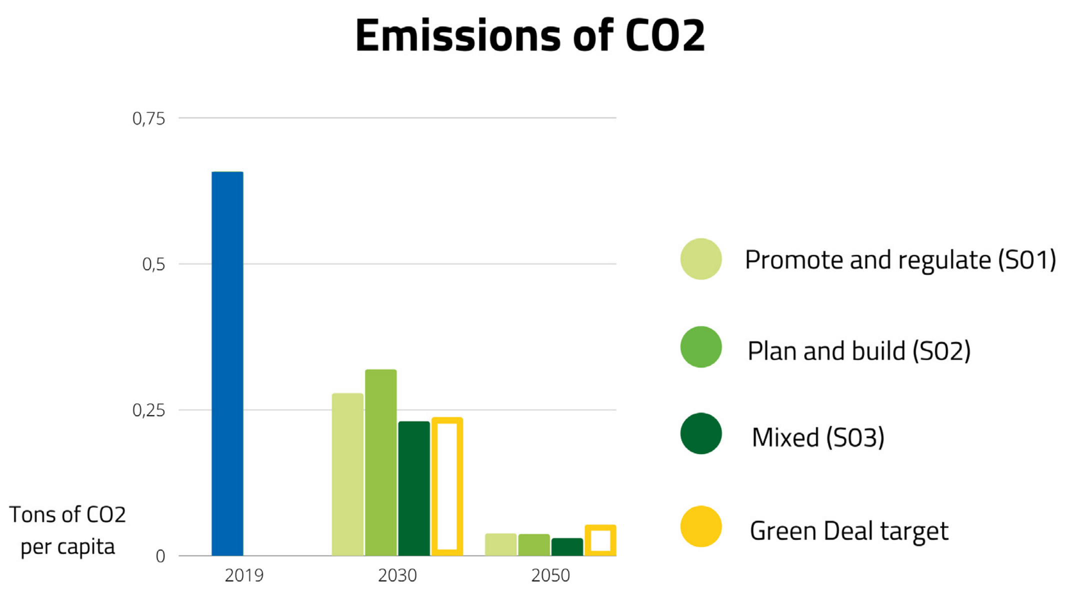
Figure 6 shows that all three policy scenarios are able to gradually reach and overtake the Green Deal target by 2050. However, only Scenario 3 (with its intensified policy measures mainly resulting in substantial change in the modal split) allows to reach the objective also by 2030.

In particular, by 2030, Scenario 1, more focussed on short-term actions in comparison to Scenario 2, gets quite close to the target (0.278 ton CO_2/capita, whereas the estimated target is 0.237 ton CO_2/capita). On the other hand, the Plan and Build scenario, relying on long-term infrastructural actions, still generates a higher amount of greenhouse gases (0.319 ton CO_2/ capita). **By 2050, the three scenarios attain CO_2 emissions reductions of about -94% (compared to 2019 levels)**.

In case no policy measure foreseen in the three transition scenarios is implemented (BAU scenario with the EU Reference assumptions on vehicle technology evolution), the CO_2 emissions will only decline from 0.657 ton per capita in 2019 to 0.490 ton per capita in 2030 and to 0.231 ton per capita in 2050, **respectively about -25% and -65% compared to 2019 levels**.

Considering the 12 prototypes (see Annex I – Output Indicators), the results show similar trends, with all three policy scenarios reaching the Green Deal target in 2050, and Scenario 3 doing it also in 2030. The lowest values of CO_2 per capita will be reached in small cities in northern and eastern Europe, where in 2050 each citizen will be responsible for the emission of as low as 0,016 t per year of greenhouse gases.

Figure 6: Emissions of CO_2 (Tank-to-wheel) for the study scenarios in 2019, 2030, 2050. All EU27 cities



Source: TRT

2.5 Economic outputs

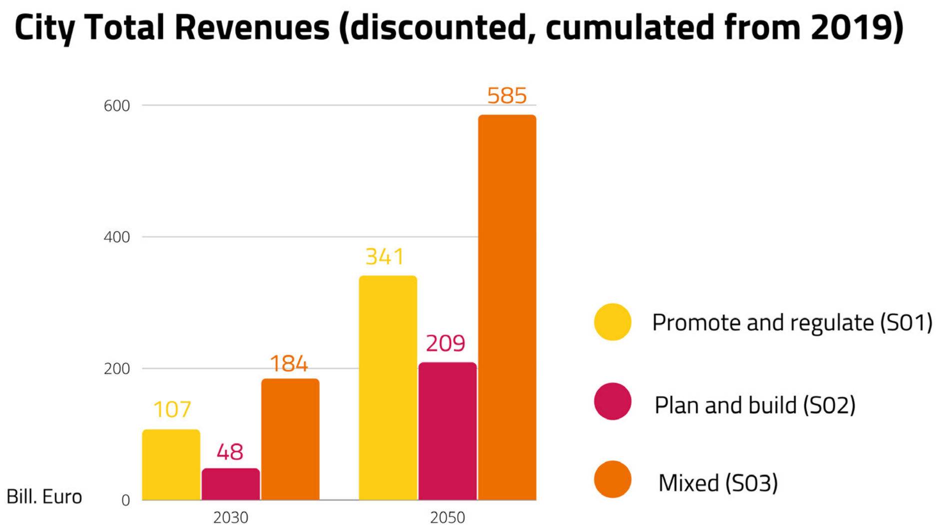
Most of the policy measures implemented in the transition pathways have specific costs (for implementation and management) and revenues associated with. Considering the net difference between costs and revenues, and adding to the equation the monetization of externalities, it is possible to estimate the net cost/benefit of the sustainable urban mobility transition of each policy scenario for the entire EU27 context.

It is important to underline that the **costs and revenues considered are only the incremental ones associated with the implemented policies, with respect to the Business-as-Usual Scenario (BAU)**, in which no policy measures are activated. Thus, costs and revenues do not represent the total city costs and revenues, but only the economic impacts of the specific set of policies implemented in the scenario. All costs and revenues are discounted and cumulated from 2019.

Figure 7 and Figure 8 illustrate the **revenues and costs** associated with the three policy transition pathways. These values are considered for both the public administration and the external providers. A differentiation among these two players not always is straightforward, due to the fact that, in some cities, certain services (e.g., car sharing) might be in charge of the public administration, while in others of an external provider.

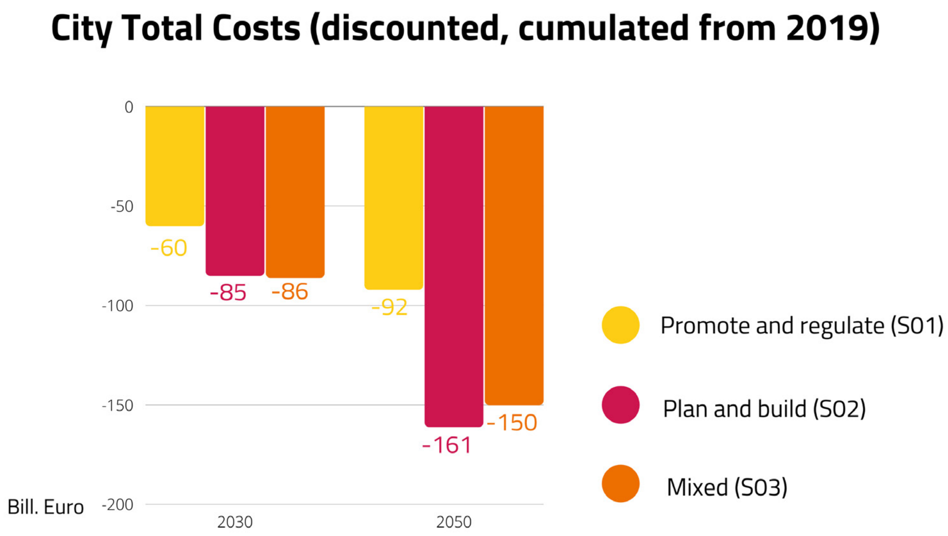
Generally speaking, Scenario 2 has the larger costs associated with. Intuitively, this is mainly due to the investments needed to upgrade the public transport infrastructures. Also, this is the scenario with the smallest revenues, while pricing and ticketing policies, which are active in the other two scenarios, are generating higher revenues.

Figure 7: City Total Revenues for the study scenarios in 2030 and 2050. All EU27 cities



Source: TRT

Figure 8: City Total Costs for the study scenarios in 2030 and 2050. All EU27 cities



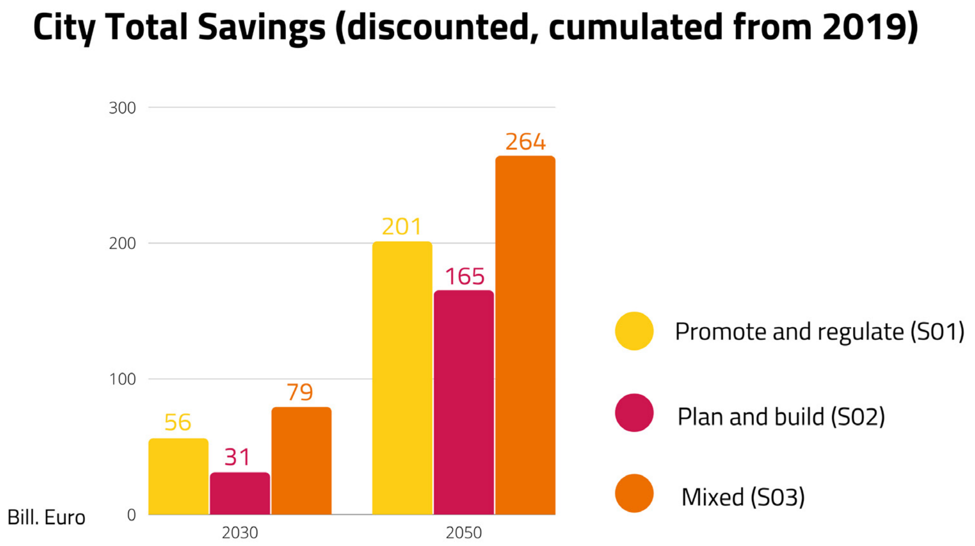
Source: TRT

In addition to the costs and revenues of the policies, it is necessary to also take into account the **externalities** associated with their implementation. In fact, reductions in air pollutants and CO_2 emissions, less fatalities, and less noise contribute indirectly to the generation of social benefits. **The monetization of these benefits, alongside the net difference between total revenues and costs, generates the cities' net balance.**

Figure 9 illustrates the difference in external cost savings for the three scenarios at EU27 level. According to its long-term nature, Scenario 2 is the one with smallest external cost savings in 2030. By 2050, the three scenarios are set to generate between 165 and 264 billion of external cost savings (discounted and cumulated from 2019).

In particular, the calculated external cost savings are the result of reductions in CO_2 emissions (accounting for between 31% and 64% of the total externalities depending on scenarios), road accidents (19-53%), air pollutants emissions (10-20%), and noise (2-6%).

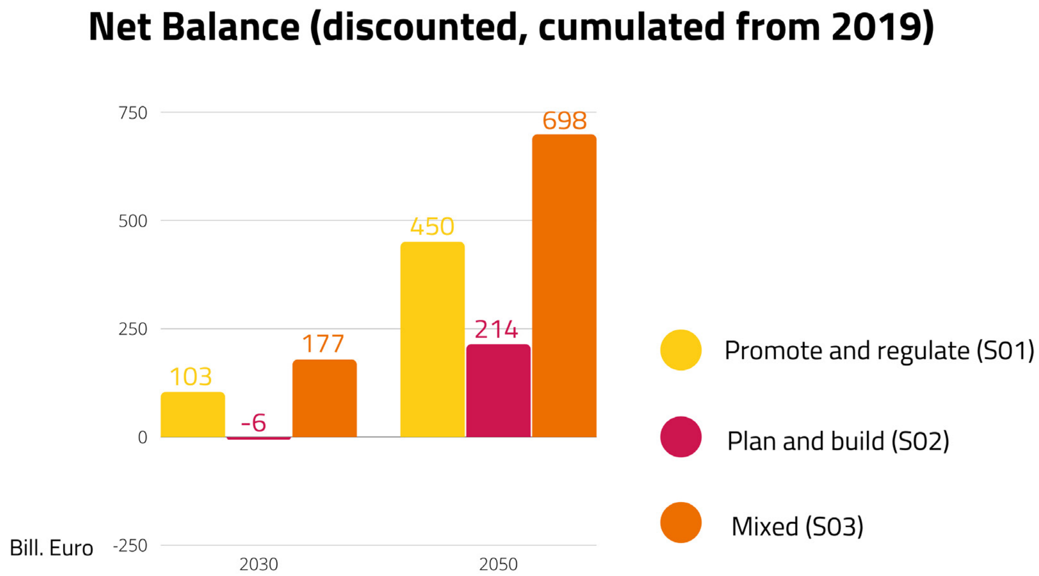
Figure 9: External Costs Savings for the study scenarios in 2030 and 2050. All EU27 cities



Source: TRT

Figure 10 offers the Net Balance for the entire EU27 context. The results clearly indicate that Scenarios 1 and 3 are the preferred ones from an economic point of view. Moreover, for Scenario 1 and 3, the balance would be positive also if the external costs savings were excluded. This is not true for Scenario 2 in 2030, that shows a positive balance only considering also the contribution of external costs.

Figure 10: Net Balance for the study scenarios in 2030 and 2050. All EU27 cities

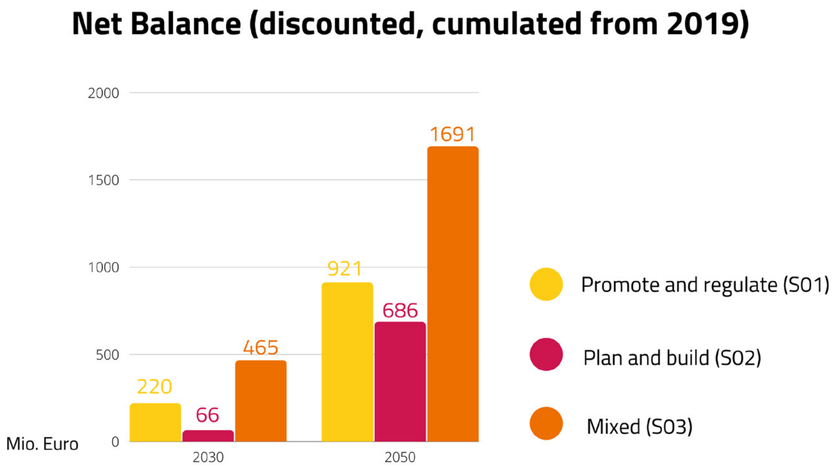


Source: TRT

The numbers presented in the previous three charts consider the sum of costs and revenues of all 779 EU27 cities.

To better comprehend the magnitude of costs and benefits associated with a **single city**, it is possible to look at the net balance of a single prototype. Figure 11 illustrates, as an example, the economic result of the Central/ Western European Medium City Prototype. Results for all city prototypes are available in the long version of the report.

Figure 11: Net Balance for the study scenarios in 2030 and 2050 for prototype Medium Central/ Western European City



Source: TRT

Finally, considering the entire EU27 cities population it is possible to obtain the **Net Balance per capita**. Keeping in mind that these values are cumulated over years, in the worst case (Scenario 2) the net balance per capita in Europe is slightly over 1 200€ per capita until 2050. This means on average about 40€ per capita per year of net benefits. On the other hand, Scenario 3 entails on average a positive net balance per capita of around 130 € per year. Expressed differently, each euro invested in the transition can generate up to 3,06€ (2,14 in revenues and 0,92 in externali ties) by 2030, and from €2,32 to €5,66 by mid-century (i.e. up to €3,90 in revenues, and €1,76 in externalities).

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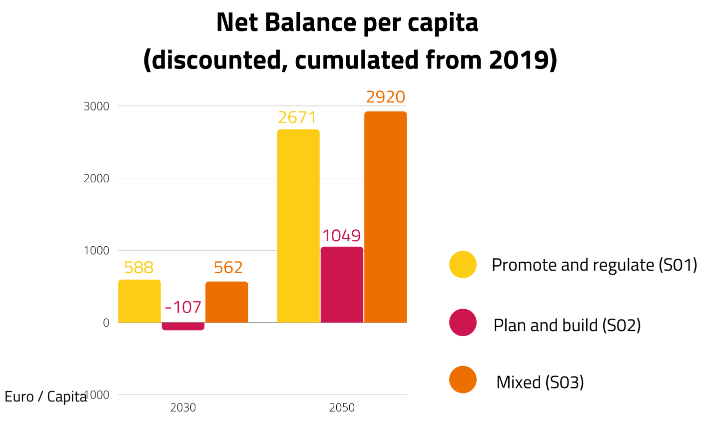
Figure 12: Net Balance per capita for the study scenarios in 2030 and 2050. All EU27 cities



Source: TRT

3. Policy measures' effectiveness

While the results presented above consider the urban mobility transition scenarios in their totality, it is also possible to evaluate costs and revenues of single policy groups (e.g., shared mobility and demand management, innovative services, pricing schemes, etc.), as well as the CO_2 reduction that is attributable to it.

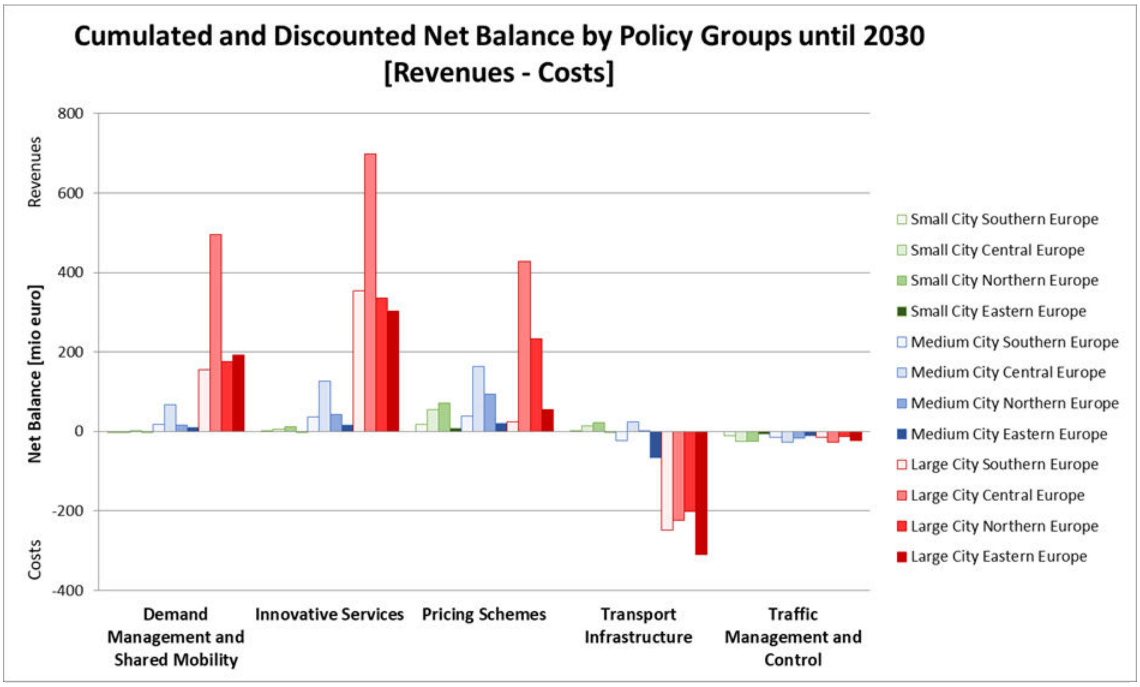
In particular, these calculations are performed by comparing an "empty" scenario with no policy measures activated[10], and scenarios in which each group of policy measures is activated separately. This way, it is possible to understand how much each group of policy measures is responsible in terms of reduction of CO_2 emissions and to calculate the net costs associated to it.

Looking at the **costs and revenues of the five policy groups**, the following two figures highlight how each of them results into a profit (positive) or a loss (negative) in each of the 12 city prototypes. This is represented with cumulated costs as of 2030 (Figure 13) and as of 2050 (Figure 14).

As of 2030, innovative services followed by shared mobility and demand management and pricing schemes are the group of measures that accounts for the highest revenues. This is true for each city prototype. On the other hand, transport infrastructure is particularly expensive in large cities.

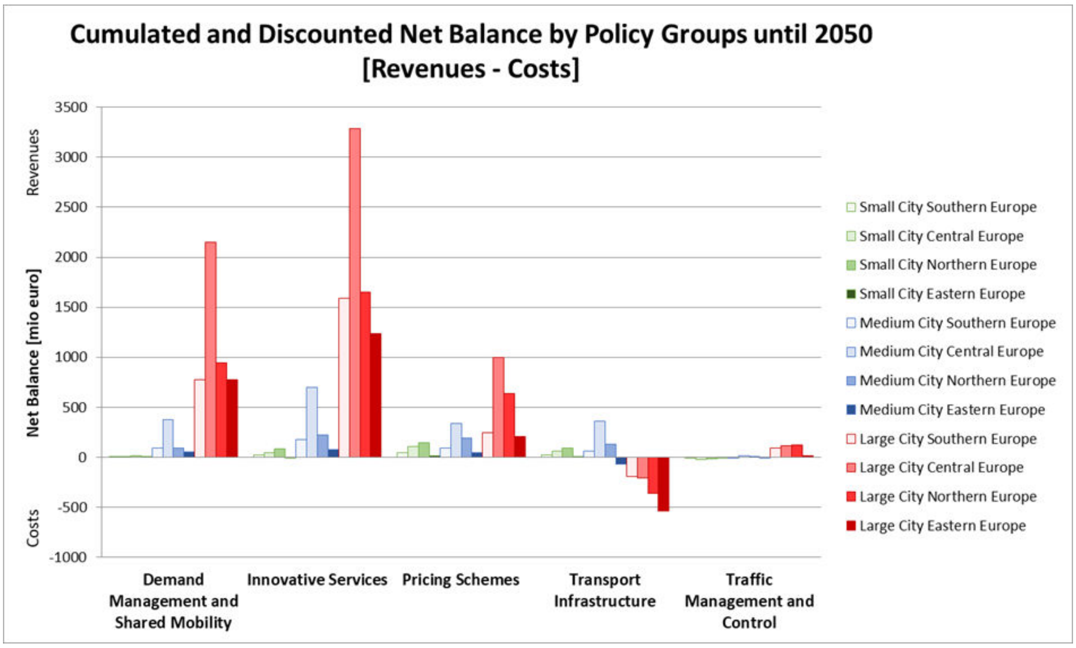
Looking at the values in 2050, it is possible to notice how both shared mobility and demand management and innovative services significantly increase their revenues compared to pricing schemes (particularly in large cities). On the other hand, transport infrastructure remains the most expensive group of measure, especially in large cities where the implementation of additional metro lines has a considerable impact on their net balance. Interestingly, traffic management and control is the group of policies that entails the smallest differences among the 12 city prototypes.

Figure 13: Cost and Revenues of Policy Groups by 2030



Source: TRT

Figure 14: Cost and Revenues of Policy Groups by 2050



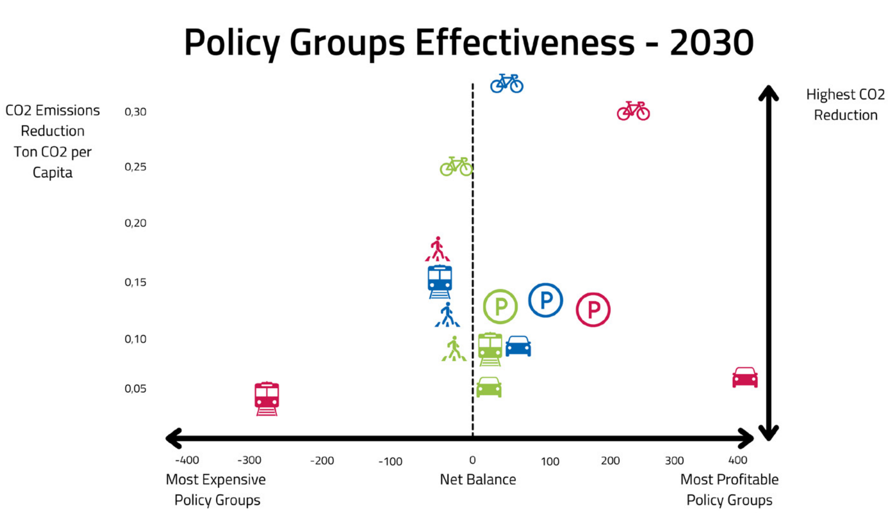
Source: TRT

The **policy effectiveness** of measures, considering net balance and CO_2 reduction, are shown in Figure 15 and Figure 16.

In 2030, the policy group that brings the highest reduction of greenhouse gas emission is the shared mobility and demand management. These results are confirmed for the three city dimensions. On the other hand, in large cities, transport infrastructure is the most expensive policy group as well as the worst one in terms of CO_2 emissions reduction. Looking at the revenues, innovative services is the policy group with the highest revenues associated in large cities, while pricing schemes is the most profitable in small and medium cities.

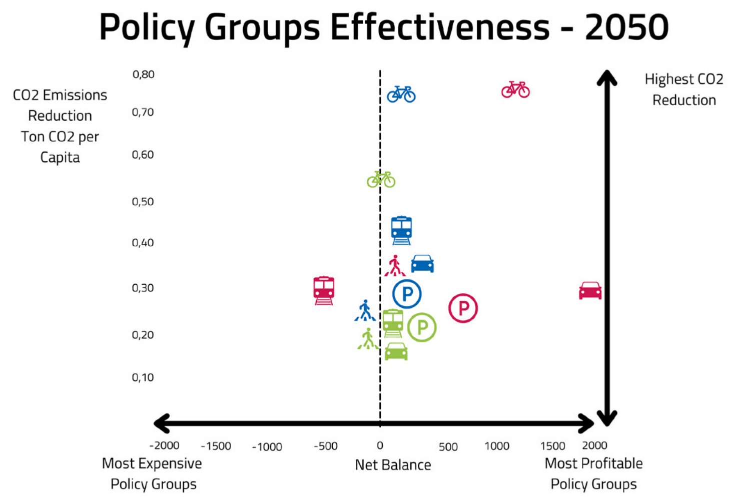
In 2050, shared mobility and demand management is still the policy group with the highest CO_2 reduction. In large cities, innovative services is the group with the highest revenues, while transport infrastructure is still the one with the highest costs.

Figure 15: Policy Groups Effectiveness by 2030



Source: TRT

Figure 16: Policy Groups Effectiveness by 2050

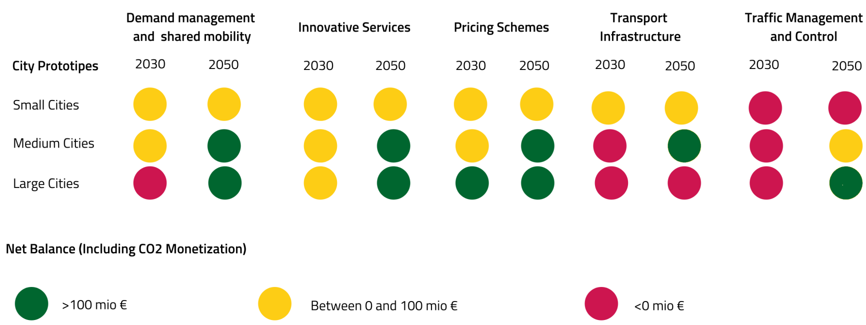


Source: TRT

The two graphs above consider two variables: CO_2 reduction and net balance of costs and revenues. However, each variable can assume a different value, depending on how each city prioritizes one or the other. In order to combine the two variables together, it is possible to monetize the CO_2 reduction, as shown in Figure 17 highlighting the effectiveness of each policy group for the three city sizes, both in 2030 and in 2050.

Innovative services and shared mobility and demand management are the most effective group in large cities and medium cities. In small cities, pricing schemes results to be the most effective group. On the other hand, transport infrastructure is the least effective policy group in large cities. In medium and small cities, traffic management and control are not very effective instead.

Figure 17: Policy Groups effectiveness (with monetization of CO_2)



Source: TRT

4. Conclusions

Urban mobility in EU27 cities can reach the Green Deal target in terms of greenhouse gas emissions provided investments in sustainable mobility policies are increased by an estimated €86 billion until 2030 (Scenario 3) and by €92-161 billion until 2050 (all scenarios). On average, each euro invested in the transition can generate up to €3,06 (€2,14 in revenues and €0,92 in externalities) by 2030, and from €2,32 to €5,66 by 2050 (i.e. up to €3,90 in revenues, and €1,76 in externalities).

The implementation of appropriate sustainable transport policy measures is necessary to reach the Green Deal target, as the BAU scenarios would only lead to 25% CO_2 reduction by 2030 and 65% CO_2 reduction by 2050 compared to 2019 levels.
Results show that only Scenario 3 can reach the 2030 target,highlighting the magnitude of the challenge. Scenario 3 does so thanks to intensified policies that generate more drastic changes in mobility behaviour and substantially reduce the private car modal split, which might entail important acceptability issues. Still, the need to achieve such a drastic impact on modal split could be reduced if policies were designed to push faster fleet turnover in favour of EVs. The potential for policy measures feedback on fleet turnover, which is something that goes beyond this study, is something that should be further investigated.

In terms of CO_2 reduction, the policy effectiveness analysis shows that, for all city sizes, shared mobility and demand management is the policy group that generates the highest impacts by 2030 and 2050. After that, there are some differences, based on city dimensions, in terms of policy groups affecting greenhouse gas emissions. In small cities, pricing schemes is preferrable over the other groups. In medium cities, transport infrastructure is the second "greenest" policy measure. Finally, in large cities, traffic management and control is the second-best option.

In terms of **economic results of the policy scenarios, which considers costs, revenues, and the external cost savings generated by the implementation of sustainable policy measures,** Scenarios 1 and 3 have positive net balances for all prototypes. Their magnitude increases with the city dimension, while the value per capita does not entail substantial differences due to city dimension. On the other hand, in 2030 Scenario 2 results into a negative net balance in more than half of the 12 city prototypes. However, the benefits of the infrastructural investments kick-in in the longer term resulting into positive net balances for almost all prototypes by 2050.

Looking at the **economic results of single policy groups**, innovative services and shared mobility and demand management are the two groups guaranteeing the highest revenues in large cities, while pricing schemes is the better option in small and medium cities (especially in the shorter period). On the other hand, transport infrastructure results to be most expensive group of policy measures, especially in large cities where the implementation of additional metro lines (not foreseen in small and medium cities) might have a considerable share on their net balance.

Finally, it is interesting to look at the **costs/revenues and the CO_2 monetization attributable to each policy group** (policy effectiveness). In the short term, pricing schemes is the most effective group for small and medium cities, while innovative services win in large cities and medium cities. On the other side, transport infrastructure is the least effective in large cities, while traffic management and control is the worst in small and medium cities. In the long term, pricing schemes remains the favoured options for small cities, while innovative services followed by shared mobility and demand management are more effective for medium and large cities.

Accessibility of study results

A web page containing an interactive tool has been designed in order to make the calculation results accessible on the internet:
https://public.tableau.com/views/CostsandBenefitsoftheUrbanMobilityTransitioninEurope/HOME?:language=en-US&:display_count=n&:origin=viz_share_link

The interactive web page will be accessible online on the EIT Urban Mobility website (starting November 2021) and will allow to explore the costs and benefits of the different sustainable urban mobility transition scenarios.

This user guided interface makes it possible for the reader to analyse the full results of the analysis and in particular to browse the values of the different indicators, in the three scenarios and with reference to the 12 city prototypes, as well as the EU27 context.

Annexes

Annex 1: List of policy measures associated to each scenario

Policy Group	Policy Measure	S01: Pro-mote and Regulate	S02: Plan and Build	S03: Mixed
Shared Mobility and Demand Manage-ment	Sustainable travel information and promotion (behaviour)	X		X
	Mobility as a Service (MaaS)	X		X
	Bike sharing	X		X
	Micro mobility	X		X
	Carsharing	X		X
	Delivery and servicing plan	X		X
	Teleworking	X		X
Innovative Services	Autonomous vehicles		X	X
	Demand-responsive transport (DRT)		X	X
	Intelligent Transport Systems (ITS)		X	X
Green Public Trans-port and Logistics Fleets & Charging Infrastructure	Electric energy refuelling infrastructure	X	X	X
	Hydrogen energy refuelling infrastructure	X	X	X
	Green public fleet	X	X	X
	Green logistics fleet	X	X	X
Pricing Schemes	Congestion and pollution charging	X		X
	Parking pricing	X		X
	Public transport integrated ticketing and tariff schemes	X		X
Transport Infrastruc-ture	Bus network and facilities		X	X
	Tram network and facilities		X	
	Walking and cycling networks and facilities		X	X
	Park and ride (multimodal mobility hubs)		X	X
	Metro network facilities and light rail		X	
	Urban Delivery Centres and city logistics facilities		X	X
Traffic management and control	Legal and regulatory framework of urban freight transport	X		X
	Legal and regulatory framework of new mobility services	X		X
	Prioritizing Public Transport		X	
	Access regulation and street space reallocation	X		X
	Traffic calming measures	X		X
	Pedestrian Areas	X		X

Source: TRT

Annex 2: List of data inputs used for the reference cities

Group	Input data	Description	Sources
Urban Characteristics	Population	Population of the city	National Statistics Database
	Population Structure	Age distribution of the city population	National Statistics Database
	Population Growth	Expected trend of the population growth	European Commission, JRC projections[12]
	Population Distribution	Population distribution between city centre and outskirts	National Statistics Database
	Urban Growth	Population shifts between city centre and outskirts	National Statistics Database, EUROSTAT
	Average Income	Average income of the city population	National Statistics Database, EUROSTAT
	Economy	Economy city type, representing the relevance of industrial sector for the city in terms of employees working in manufacturing, construction and public utilities	European Commission Report[13]
Urban Mobility Characteristics	Motorization Rate	Number of private cars per capita	ACEA Report on Vehicles in use[14]
	Motorization Rate Change	Annual growth of the motorization rate	ACEA Report on Vehicles in use
	Modal Split	Modal split with respect to the urban area only (walk, bike, car, motorbike, bus, tram, metro)	TEMS - The EPOMM modal split tool[15], JRC mobility survey 2018
	Modal Split Change	Modal split trend over time in absence of policy activation	Assumption of business-as-usual trend
	Congestion Level	Qualitative description of road congestion in the city (significant, only during rush hour, negligible)	TOM TOM index, Google Maps Traffic Layer
	Incoming Trips	Share of incoming trips in the urban area, with respect to the total amount of trips within the area	Assumptions based on available city planning documents
	Modal Split of the Incoming Trips	Modal Split of the incoming trips into the urban area (private car, bus, train)	Assumptions based on available city planning documents
	Freight Vehicles Rate	Share of freight vehicles with respect to the total vehicles (freight and cars) travelling in the urban area	Assumptions based on selected traffic counts and available city planning documents
	Freight Vehicles Rate Change	Annual change in the share of freight vehicles with respect to total vehicles travelling in the area	Assumptions based on selected traffic counts and available city planning documents

Group	Input data	Description	Sources
Public Transport Characteristics	Ticket price	Ticket price for monthly passes and single tickets	Public Transport Operators Reports and Official Websites
	Cost	Implementation and management costs for public transport operators	Public Transport Operators Reports
	Network	Length of the network	Public Transport Operators Reports
	Average Speed	Average speed of the vehicles	Public Transport Operators Reports
	Transport Service Offer	Annual vehicle-kilometre	Public Transport Operators Reports
	Bus Vehicle Fleet	Composition of the fleet, with respect to the fuel type	ACEA Report on Vehicles in use
Park & Ride	Parking Capacity	Number of parking lots	Public Transport Operators Reports
	Network Extension	Length of the public transport routes connected with P&R park	
	Public Transport Frequency	Frequency of Park & Ride connection service	
	Tariff	Tariff for single use or subscription related to parking only (the cost of using PT not considered)	
Infrastructure and Traffic Management	Paid Parking	Number of paid parking lots in the urban area	City Annual Reports
	Parking Price	Average hourly parking price	Public Transport Operators
	Public Transport Reserved Lane	Length of the public transport reserved lanes	Public Transport Operators
	Bike Lane	Length of the bike lanes in the urban area	City Annual Reports
	Electric Charging Stations	Number of electric charging stations	City Annual Reports
	Hydrogen Charging Station	Number of hydrogen filling stations	City Annual Reports
Car Sharing	Subscribers	Number of subscribers	Carsharing Providers Official Websites
	Type	Station Based or Free-Floating service	
	Tariff	Fixed and hourly average tariff	
	Vehicle Fleet	Number of car sharing vehicles	
Bike Sharing	Vehicle Fleet	Number of bicycles of the bike Sharing service	Bike Sharing Providers Official Websites
	Electric Fleet	Share of electric bicycles in the fleet	
	Tariff	Fixed and hourly average tariff	

Group	Input data	Description	Sources
Vehicle Access Regulation	Limited Traffic Zone	Qualitative quantification of the share of urban area under Limited Traffic Zone	urbanaccessregulations.eu, City Annual Reports
	Pedestrian Areas	Qualitative quantification of the share of urban area with pedestrian areas	
Traffic Calming Measures	Traffic Calming Area	Share of the urban area under 30 km/h speed limit	City Annual Reports
Road vehicle fleet composition	Vehicle fleet	Vehicle fleet composition by fuel type and emission standard (for conventional fuels) for private cars, car sharing cars, Light Duty Vehicles and Heavy Duty Vehicles. It is assumed that national data can be used as representative data for vehicle fleet composition also at urban level.	ACEA Report on Vehicles in use, National Statistics Database

Source: TRT

Annex 3: Policy measures implementation rationale

Policy Group	Policy Measure	Policy Implementation Rationale
Shared Mobility and Demand Management	Sustainable travel information and promotion (behaviour)	This policy aims at promoting sustainable mobility solutions through travel information and promotion campaigns to change people's travel behaviour. The intensity of this policy effort is defined according to EU cities SUMPs.
	Mobility as a Service (MaaS)	The policy assumes that a MaaS platform is implemented in the city, allowing to integrate various forms of mobility services into a single service. It is assumed that the integration includes public transport (bus, tram, metro and DRT when implemented), car sharing, bike sharing and micromobility. Impacts concern transport time and transport cost for the services involved, becoming more attractive for the users. The policy assumes that the impacts are larger in medium and large cities with respect to small cities. Parameters are set based on literature on MaaS and existing cities examples / pilots.
	Bike sharing	The policy assumes an enhancement of the bike sharing scheme already in place at the base year. The tariff is considered unchanged, while the vehicle fleet is enlarged in order to enhance the coverage of the service within the urban area. Targets in terms of bikes per inhabitants are set and differentiated depending on the size of the city. Parameters are based on cities examples and SUMPs objectives
	Micro mobility	The policy assumes the diffusion of micromobility (all small lightweight devices travelling below 25 km/h), also in the form of shared services. In particular, an increase of electric devices is assumed, with different pace and penetration depending on city size (lower in small cities, higher in medium and large cities). Parameters are set based on cities examples and SUMPs objectives.
	Car Sharing	The policy assumes an enhancement of the car sharing scheme already in place at the base year. The tariff is considered unchanged, while the vehicle fleet is enlarged in order to enhance the coverage of the service within the urban area. Targets in terms of vehicle fleet are set and differentiated depending on the size of the city. Parameters are based on cities examples.
	Delivery and servicing plan	The policy represents the implementation of detailed plans to consolidate and reduce delivery and servicing vehicles accessing a site or building. The expected impact is a reduction of the number of goods vehicles entering the urban area as result of more efficiency. Parameters are based on cities examples.
	Teleworking	The policy assumes an increasing adoption of telework and smart working, resulting in a change of trips generated per person, especially for commuting purposes. The intensity of the policy has been set based on literature review, and differentiated depending on the city dimension (the impacts expected to be larger in large cities)

Policy Group	Policy Measure	Policy Implementation Rationale
Innovative Services	Autonomous vehicles	The uptake of autonomous driving is simulated for public transport (in the form of demand-responsive transport) and car sharing services, assuming a large penetration of AVs by 2050 and a large coverage of the urban area where the AV services are provided. The uptake of private autonomous vehicles is not considered in the policy. Parameters have been designed on the basis of the EU Study on exploring the possible employment implications of connected and automated driving[16]
	Demand-responsive transport (DRT)	Demand-responsive transport is simulated as a new PT service, partially replacing the existing bus routes in the area where DRT is offered. DRT is expected to be provided in a limited part of the urban area. Parameters have been designed on the basis of literature review on DRT applications
	Intelligent Transport Systems (ITS)	The diffusion of Intelligent Transport Systems is expected to improve safety and efficiency in road transport, in terms of urban travel time, energy consumption, air pollutant emissions. The design of the policy is based on the European Commission studies related to the Intelligent Transport Systems Directive.[17]
Green Public Transport and Logistics Fleets & Charging Infrastructure	Electric energy refuelling infrastructure	The availability of electric refuelling infrastructures is simulated assuming an increased number of stations in order to support the penetration of electric vehicles in the fleet. The target is based on the objectives of Green Deal, differentiated by city size (more infrastructure in large cities)
	Hydrogen energy refuelling infrastructure	The availability of hydrogen refuelling infrastructures is simulated assuming an increased number of stations in order to support the penetration of fuel cell vehicles in the fleet. The target is based on the objectives of Green Deal, differentiated by city size (more infrastructure in large cities)
	Green public fleet	The policy assumes an increased penetration of electric vehicles in the bus fleet, on top of the exogenous trend related to technology development already assuming the diffusion of innovative vehicles. The setup of parameters has been designed on the basis of examples of renewal objectives of SUMPs.
	Green logistics fleet	The policy assumes a large penetration of electric vehicles in the light duty vehicle fleet used for logistic distribution, on top of the exogenous trend related to technology development already assuming the diffusion of innovative vehicles. The setup of parameters has been designed on the basis of examples of renewal objectives of SUMPs.
Pricing Schemes	Congestion and pollution charging	It is assumed that a congestion charging scheme is implemented in a limited area of the city, applied to both cars and freight vehicles. The charge is in place during the day for all vehicles (also alternative vehicles). The setup of parameters has been designed based on existing application of the policy.
	Parking pricing	The policy assumes to increase the amount of parking slots subject to pricing in the urban area. The parking tariff is assumed to be unchanged, although a discount of 20% is foreseen for hybrid electric vehicles, and of 40% for electric/hydrogen vehicles
	Public transport integrated ticketing and tariff schemes	The policy is designed to support public transport users, i.e. implementing a discounted tariff for regular commuters and increasing tariff for infrequent users. Furthermore, it is assumed that an integrated ticketing systems is in place, resulting in seamless travels and no requirement to buy tickets whilst switching either transport modes or services.

Policy Group	Policy Measure	Policy Implementation Rationale
Transport Infrastructure	Bus network and facilities	The policy consists of making the bus transport service more accessible. This means improving bus stops, stations, etc. but also extending the service (new lines, better frequency). Both these two elements influence the mode share of bus improving its attractiveness. The setup of parameters has been designed on the basis of examples of renewal objectives of SUMPs. The policy is not implemented in the large cities.
	Tram network and facilities	The policy consists of making the tram transport service more accessible. This means improving tram stops, stations, etc. but also extending the service (new lines, better frequency). Both these two elements influence the mode share of tram improving its attractiveness. The setup of parameters has been designed on the basis of examples of renewal objectives of SUMPs. The policy is not implemented in the small cities.
	Walking and cycling networks and facilities	The policy is aimed at making pedestrian and cycling trips easier and safer. The implementation of the measure consists of assuming that, when these facilities are provided, the mode share of pedestrian and bicycle modes grows at the expense of competing modes. Furthermore, also accident rates are reduced because it is assumed that citizens can walk and cycle in protected lanes, pathways, etc. thus reducing the risk of being hit by motor vehicles. The setup of parameters has been designed on the basis of cities examples and objectives of SUMPs
	Park and ride (multimodal mobility hubs)	The concept of Park and Ride is modelled assuming that parking areas are provided at the border of the city area with efficient public transport connections to the city centres. This means that a larger share of trips incoming from external zones by car will interchange to public transport. The intensity of the effect depends on the features of the Park and Ride service, i.e. its cost, the capacity of the parking areas, the coverage of the urban area by means of the public transport services and its frequency. The Park and Ride tariff is assumed to be unchanged, whereas parking capacity is increased. Moreover, public transport frequency is improved in medium and large cities, accordingly with cities examples and objectives of SUMPs.
	Metro network facilities and light rail	The policy consists of making the metro transport service more accessible. This means improving metro stops, stations, etc. but also extending the service (new lines, better frequency). Both these two elements influence the mode share of metro. The setup of parameters has been designed on the basis of cities examples and objectives of SUMPs. The policy is activated only in large city prototypes.
	Urban Delivery Centres and city logistics facilities	The policy is modelled assuming that logistics platforms are created at the border and within the urban area in appropriate locations to serve as hubs for the final distribution. A share of the shipments arriving from outside the city pass through the delivery centres, where loads are consolidated and distributed in a more efficient way, increasing the load factor of vehicles, shortening consignment routes and using cleaner vehicles. This means fewer freight vehicles-km in the urban area. The number of logistic platforms has been set on the basis of examples of renewal objectives of SUMPs. The larger the city size, the larger the number of logistic platforms.

Policy Group	Policy Measure	Policy Implementation Rationale
Traffic management and control	Legal and regulatory framework of urban freight transport	For the modelling of this policy the assumption is that the activity of freight modes in the urban area is regulated to reduce traffic especially in some zones and times of the day. Therefore, when this measure is activated, a reduction of freight vehicles within the urban area is modelled and the reduction is larger in peak time. The setup of parameters has been designed on the basis of cities examples.
	Legal and regulatory framework of new mobility services	The policy aims at improving the new mobility services such as car-sharing, bike-sharing, micro-mobility and MaaS. When this policy is activated, an improvement in these transport modes is modelled.
	Prioritizing Public Transport	The policy requires regulations but also appropriate infrastructures such as reserved lanes and automated traffic lights to give way to buses and trams when they approach crossroads. The modelling of the measure assumes that such infrastructures are realised. The result is an improvement of public transport speed, making PT more attractive. The setup of parameters has been designed on the basis of city characteristics. In medium and large city prototypes, longer reserved lanes are assumed.
	Access regulation and road and parking space reallocation	The policy aims at reducing the space available for using cars and for parking cars in order to increase the liveability of the urban space. The assumption is that the restrictions applied make it less convenient to use a car for some trips and so there is a reduction in the share of cars in traffic. Another outcome of this policy is the reduced risk of accidents. The share of urban area where restrictions are applied has been designed on the basis of cities examples and SUMPs.
	Traffic calming measures	The policy assumption is the implementation of traffic calming measures in the urban area, making the use of cars less convenient for a portion of trips. A reduction in accident rates is also foreseen. Traffic calming consists of regulation (e.g., zones with maximum allowable speed of 30 km/h) but also in various physical interventions (e.g., to restrict carriageways). The share of urban area where restrictions are applied has been designed on the basis of examples of renewal objectives of SUMPs.
	Pedestrian Areas	The policy is aimed at making pedestrian trips easier and safer. The implementation of the measure assumes that when pedestrian areas are provided pedestrian trips grow at the expenses of competing modes. Furthermore, also accident rates are reduced because it is assumed that citizens can walk in protected spaces thus reducing the risk of being hit by motor vehicles. The setup of parameters has been designed on the basis of cities examples and SUMPs.

Source: TRT

References

[1] The long version of this report can be accessed here:
https://www.eiturbanmobility.eu/wp-content/uploads/2021/10/Final-report_Long-version.pdf
[2] For a full description of the different policies, please refer to Annex 3.
[3] EIT Urban Mobility strategic agenda:
https://www.eiturbanmobility.eu/wp-content/uploads/2021/04/210329_SA_EIT-UM-branded_Final-published.pdf
[4] EU Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[5] EU Smart and Sustainable Mobility Strategy:
https://ec.europa.eu/transport/sites/default/files/2021-mobility-strategy-and-action-plan.pdf
[6] MOMOS tool: http://www.trt.it/en/tools/momos/
[7] In the study, small cities are from 50 000 to 100 000, medium from 100 000 to 500 000, and large above 500 000 inhabitants
[8] Sustainable Transport Infrastructure Charging and Internalisation of Transport Externalities:
https://ec.europa.eu/transport/themes/sustainable/studies/sustainable-transport-infrastructure-charging-and-internalisation_en
[9] As explained in Table 4, in this study are only considered as part of the carsharing and demand-responsive transport fleet, and not as private vehicles
[10] Scenario with only ambitious exogenous conditions for vehicle technology
[11] For a full description of the different policies, please refer to Annex 3.
[12] https://urban.jrc.ec.europa.eu/thefutureofcities/urbanisation#figure7b
[13] https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/
[14] ACEA (2019), ACEA Report Vehicles in use Europe 2019
(https://www.acea.auto/files/ACEA_Report_Vehicles_in_use-Europe_2019-1.pdf)
[15] http://tems.epomm.eu/
[16] European Commission (2020), Study on exploring the possible employment implications of connected and automated driving
[17] Ricardo et al. (2019), Support study for Impact Assessment of Cooperative Intelligent Transport Systems,
https://op.europa.eu/en/publication-detail/-/publication/426495e6-81c1-11e9-9f05-01aa75ed71a1

Urban Mobility

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