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Study On European Urban Transport Roadmaps 2030

Urban transport policy roadmaps

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Ricardo Energy & Environment

TRT

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Contact:

Guy Hitchcock
Ricardo Energy & Environment
Gemini Building, Harwell, Didcot, OX11 0QR
t: +44 (0)1235 75 3327
e: guy.hitchcock@ricardo.com

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Author:

Claudia de Stasio (TRT), Davide Fiorello (TRT), Francesca Fermi (TRT), Guy Hitchcock (Ricardo Energy & Environment), Sujith Kollamthodi (Ricard Energy & Environment)

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1 Introduction

1.1 Background and objectives of the policy roadmaps

Cities in Europe are vital centres of economic activity, innovation and employment. Many of them face increasing challenges to their mobility systems such as congestion, air quality, ambient noise, CO_2 emissions, accidents and urban sprawl. These have significant negative impacts on the environment, health and economic performance of cities and can often affect a much broader area than the city itself. Many of these problems are expected to increase in the future as cities continue to grow in size and face demographic changes such as ageing populations.

Urban transport systems are integral elements of the European transport system and are therefore of concern for the Common Transport Policy. Urban transport faces a number of sustainable development challenges. The 2011 Transport White Paper sets ambitious targets to address these challenges. Meeting these targets will not happen autonomously as a result of technological development or market forces and consequently, policy action is needed at the city level in order to ensure that the objectives for urban transport are met.

There is a wide range of instruments available to implement this policy effort, including land-use planning, pricing schemes, infrastructure for non-motorised modes, charging/refuelling of clean vehicles to reduce emissions, and many others. These instruments should be part of a meaningful strategy in order to develop cost-effective interventions.

This study on developing EU Urban Transport Roadmaps to 2030 is aimed at playing an important role in supporting cities to meet the Transport White Paper objectives for urban transport through the provision of a web based policy support tool, supported by detailed policy roadmaps and underpinned by a range of stakeholders' engagement activities.

The availability of tools and guidance documents is central to the development of cost-effective strategies, helping policy-makers to understand the range of possible actions and steps to successful implementation.

The development of the policy roadmaps is focused on the achievement of the EU's 2030 objectives for urban transport, as specified in the 2011 Transport White Paper. Roadmaps describe the specific steps that need to be taken to implement a strategy and the timing required for each step, taking the urban context into account. The development of the roadmaps helps to recognise that different types of policy measures are appropriate for different types of cities. The analysis of scenarios and roadmaps help to assess the impact of the European urban mobility policies in the long term.

1.2 Defining a policy roadmap

The definition of a roadmap starts from setting objectives, i.e. defining a scenario where some changes have occurred in order to improve the current conditions from some relevant point of view (for this study the sustainability of urban transport and mobility). The scenarios also define the policy content in terms of measures aimed at meeting the objectives. The measures included in the scenarios can be diverse in nature, objective and complexity. Their implementation requires time and resources and should consider the local conditions, the stakeholders involved and other practical aspects.

These practical aspects can be fully specified only with reference to real cases where the policy measures are applied. However, the ambition of this study is to provide more than just a list of theoretical measures. Therefore the policy scenarios are supported by roadmaps.

Roadmaps define how each scenario can be achieved (i.e. the specific steps that will need to be taken and the timing required for each step) in a hypothetical urban context. The roadmaps

also discuss the implementation issues that should be taken into account and identify the main stakeholders that should be involved.

In order to define a representative roadmap the following key steps have to be followed:

(a) *The identification of the basic components of the scenarios*. These components are the policy measures available to define a scenario to move towards the objectives.

(b) *The classification of the contributions that each component can provide to the scenarios*. The policy measures are different, some require physical investments others are mainly a matter of setting (and enforcing) different rules. Also, the type of impact expected from each instrument is different, some have complementary effects, and some may have conflicting effects.

(c) *Grouping of measures in consistent scenarios*. Having in mind the objectives and building on the classification of the policy instruments, a coherent package of measures can be defined. Alternative scenarios can be developed according to the nature of the measure, the strength of the interventions, their expected effectiveness and implementation costs.

(d) *The specification of the pathway to proceed towards specific scenario goals*. The final step makes the roadmap more than a list of potential measures as the practical issues related to the implementation of the policy measures are considered: timing, relationships between different interventions, stakeholders involved and others.

1.3 Content of the report

Local conditions are very relevant for the definition of roadmaps. Therefore the purpose of this study cannot be to come up with detailed roadmaps for a specific urban context. The development of roadmaps within this project has two main objectives:

- First, to identify alternative policy scenarios and implementation roadmaps, selecting different subsets of instruments among all the potential policy measures identified in previous steps of the project.
- Second, to define practical examples for experimenting with the policy support tool to show how the tool can help for policy screening purposes.

Three alternative policy scenarios are developed in this report:

1. **Promote and Regulate.** A scenario based on changing behaviour by means of push and pull incentives.
2. **Plan and Build.** A scenario oriented on investments in the technology and transport infrastructure.
3. **Charge and Provide.** A scenario focused around the use of economic incentives like road charging and parking pricing.

The combination of these three scenarios and alternative assumptions on background conditions (e.g. technological progress, energy shortage, taxation policies, etc.) produces five policy roadmaps.

These roadmaps do not represent recommended policy interventions; rather, they have been conceived to show how different policy instruments can be grouped together in consistent policy packages and to serve as case studies for the policy support tool.

For each roadmap the following elements are provided in this report:

- A short description of the initial conditions, i.e. of the hypothetical city where the roadmap is applied, of the mobility issues it faces and of the objectives the local authorities would like to achieve;
- A graphical description of the temporal sequence of measures and of their impacts on the city context. In this description a classification of the measures as enabling

measures (i.e. the main measures of the roadmap) and ancillary measures is also shown;

- A narrative description of the content of the measures applied at different time steps and of the expected transformation of the city context;
- A discussion of relevant implementation issues that should be considered;
- A list of key stakeholders that should be involved in the planning and implementation process.

The format of the report is as follows: Chapter 2 provides an overview of the assumptions of the background trends. Chapter 3 details the key urban policy measures considered for the definition of the roadmaps – setting the scene for the following chapters. Chapter 4 describes the policy scenarios, resulting from the combination of a subset of measures under a given assumption regarding the background conditions. Chapter 5 sets out how each roadmap is implemented in a hypothetical urban context, discussing the implementation issues and identifying the main stakeholders involved. Finally Chapter 6 outlines the impacts of the policy roadmaps resulting from the use of the web-based tool of the EU Roadmaps to 2030 study. Chapter 7 draws the conclusions on the analysis of the policy roadmaps and their implementation.

2 Background trends

In a given city, the urban environment at the horizon of the year 2030 will depend of course on the choices that the city itself will be making concerning the transport system (infrastructure and services), transport regulation and land use planning. Transport policy choices at the local level are a key factor to shape the future of urban mobility and the overall liveability of the city. The roadmaps considered in this report address this key factor.

Nevertheless the impacts of policies implemented at the urban level are not the only factors influencing the development of the future conditions. Other aspects play a significant role such as the technological development of the vehicle fleet, the availability of renewable energy or policy choices at the national or European level. These aspects are exogenous to the urban level, i.e. cannot be influenced by the local decisions. A policy assessment exercise should take these aspects into account as the impact of different measures can be affected (i.e. amplified or smoothed) by the underlying exogenous conditions.

There is some uncertainty on how exogenous conditions could develop in the future. Taking a point in the future – like the year 2030 – the availability of energy, the uptake of renewable sources and the overall market availability of innovative engines are a matter of forecasts and projections. Producing such forecasts is outside the scope of this study, and it is important to recognise that exogenous conditions may vary and can be taken into account in terms of alternative trends by country.

The first trend is the **reference** trend as defined by recent studies, namely European Energy and Transport Trend to 2050[1] and GHG-TransPoRD. This trend is rather conservative, for most of the elements considered limited changes are expected in the next 15 years.

The second trend is an **alternative** one which includes different assumptions regarding **technological development** as well as higher **energy prices** and also a national policy environment in terms of **green taxation**, with higher fuel duties and car ownership taxes with respect to the reference trend, where no specific actions are undertaken.

The content of the two alternative background trends is described in the two following sections.

2.1 Reference trend

The reference trend is defined on the basis of recent studies providing projections on technology and energy indicators.

2.1.1 Vehicle technology

With reference to the penetration of innovative vehicles in car fleet (hybrid electric, battery electric, fuel cells) and Light Duty Van (LDV) fleet (battery electric), the trend has been developed on the basis of the Reference scenario of the PRIMES-TREMOVE model, released in 2013 for the European Energy and Transport Trend to 2050.

In this scenario it is assumed that by 2030 the share of hybrid vehicles will be 28.5% of the car fleet, while battery electric vehicles will represent about 1% and fuel cells around 0.1% only (Table 2-1). With reference to LDVs, the PRIMES-TREMOVE model forecasts a share of 1.6% of battery electric vehicles (including also plug-in hybrids) in 2030. Starting from this data, it is also assumed for the purpose of the tool that the proportion of battery-electric LDVs is higher among vehicles used for freight distribution from urban logistics platforms[2]. The assumed share in this case is 3.6% of the fleet.

Concerning bus technology, without specific policy measures the penetration of innovative vehicles is assumed to follow an average trend based on data from PRIMES-TREMOVE model

[1] European Commission, 2013. EU Energy, Transport And GHG Emissions: Trends To 2050 - Reference Scenario 2013

[2] It is assumed for the purpose of the tool that the use of electric and hybrid electric vehicles for urban distribution is higher than in the total LDV fleet. In the recent years the use of (hybrid) electric vehicles has being already tested and implemented in this context in several cities (i.e. see Pelletier et. Al. (2014).

(0.03% absolute growth for CNG, 0.4% for hybrid electric and 0.03% for battery electric). When the green fleet policy is activated under the reference scenario it is assumed that innovative buses are mainly hybrid electric vehicles, with a small share of CNG and battery electric vehicles. Since the share of innovative buses depends on the activation of a specific policy and the impact of this policy depends on local conditions, in Table 2-2 we report an example of the share of innovative buses in the whole fleet in Italy (data are differentiated by country).

The Heavy Goods Vehicle (HGV) fleet is assumed to include diesel vehicles only over the whole time period.

Table 2-1: Reference trend: cars and LDVs vehicle technology in Italy

Vehicle	Vehicle technology	Share of the total vehicle fleet		
		2015	2020	2030
Cars	Hybrid electric	0.4%	8.9%	28.5%
	Battery electric	0%	0.1%	0.9%
	Fuel cells	0%	0%	0.1%
LDVs	Electric (hybrid and battery)	0%	0.1%	1.6%
LDVs from urban platforms	Electric (hybrid and battery)	0%	1.1%	3.6%

Source: Elaborations on the PRIMES-TREMOVE reference scenario for European Energy and Transport Trend to 2050

Table 2-2: Reference trend: bus vehicle technology in Italy

Vehicle	Vehicle technology	Composition of innovative vehicles		
		2015	2020	2030
Bus	CNG	12.0%	12.2%	12.5%
	Hybrid electric	0.1%	2.0%	6.1%
	Battery electric	0.0%	0.2%	0.4%
	Diesel	87.9%	85.6%	81.0%
	Total	100%	100%	100%

Source: Elaborations on the PRIMES-TREMOVE rreference scenario for European Energy and Transport Trend to 2050

2.1.2 Fuel economy

The average car fuel consumption trend is estimated in terms of yearly improvement rate (i.e. fuel consumption reduction) by fuel type on the basis of data from the reference scenario[3] of the ASTRA-EC model (developed for the ASSIST project)[4]. Considering the driving activity within an urban context, the improvement rate assumed for gasoline, diesel, CNG and LPG vehicles is about 1.3-1.5 % per year, while for innovative vehicles an improvement rate of about 0.4 % per year is supposed.

The average fuel consumption of motorbike, LDV, HGV and buses is also improved at rates proportional to the car trend.

[3] The ASTRA EC model reference scenario is calibrated in line with the EU Energy and Transport trends.
[4] Krail, M., Schade, S., Fermi, F., Fiorello, D., Laparidou, K. (2014): Approach and Results of the Validation of the ASTRA-EC Model, Deliverable D5.1 of ASSIST (Assessing the social and economic impacts of past and future sustainable transport policy in Europe). Project co-funded by European Commission 7th RTD Programme. Fraunhofer-ISI, Karlsruhe, Germany.

Table 2-3: Reference trend: car average fuel consumption change

Vehicle	Vehicle technology	Yearly fuel consumption growth rate
Car	Gasoline	-1.3%
	Diesel	-1.5%
	CNG	-1.3%
	LPG	-1.3%
	Hybrid electric	-0.5%
	Battery electric	-0.4%
	Fuel cells	-0.4%

Source: ASSIST project (2014)

2.1.3 Polluting emissions factors

The ASSIST reference scenario is also used for the trend of pollutant emissions by transport mode. This trend is the consequence of vehicle fleet renewal and progressively more restrictive Euro Emission standards. **Table 2-4** reports the reference trend of polluting emission factors for PM, CO, VOC and NO_x with reference to driving activity within an urban context.

Table 2-4: Reference trend: polluting emissions factors

Pollutant	Mode	Yearly growth rate
PM	Car	-3.6%
	Motorbike	-5.1%
	Bus	-3.4%
	LDV	-5.7%
	HGV	-14.3%
CO	Car	-1.7%
	Motorbike	-5.9%
	Bus	-2.1%
	LDV	-1.6%
	HGV	-2.5%
NOx	Car	-6.7%
	Motorbike	-1.3%
	Bus	-3.3%
	LDV	-8.3%
	HGV	-7.0%
VOC	Car	-5.5%
	Motorbike	-3.1%
	Bus	-1.1%
	LDV	-1.7%
	HGV	0.6%

Source: ASSIST project (2014)

2.1.4 Energy price

The reference assumptions regarding energy supply are expressed in terms of fuel prices. End-user fuel price is made of two components: resource fuel price and fuel taxation. Fuel taxation is considered under the assumptions on car taxation (see 2.1.5 below).

In the ASSIST reference scenario a moderate increase (in real terms) of resource price is expected. Namely, gasoline and diesel resource price is assumed to grow by 0.4% per year, CNG prices grow by 1.1% per year and LPG prices grow by 0.6% per year. Electricity prices are expected to decline by 0.6% per year, while hydrogen price is assumed constant.

Table 2-5: Reference trend: energy price

Vehicle	Fuel	Yearly growth rate
Pure fuel price trend	Gasoline	0.4%
	Diesel	0.4%
	CNG	1.1%
	LPG	0.6%
	Electricity	-0.6%
	Hydrogen	0.0%

Source: ASSIST project (2014)

2.1.5 Car taxation

In the reference trend it is considered that at the national and European level no specific fiscal instruments are activated to promote sustainable mobility. Nevertheless fuel taxes are expected to grow in real terms. Gasoline and diesel taxes are assumed to grow by 0.4% per year, CNG fuel tax is assumed to remain constant, while LPG taxes are assumed to grow by 0.6% per year. Electricity and hydrogen taxes are assumed to decline by 0.6% and respectively 3.1% per year (Table 2-6). Car ownership taxes are assumed to remain stable.

Table 2-6: Reference trend: energy taxation

Vehicle	Fuel	Yearly growth rate
Fuel tax trend	Gasoline	0.4%
	Diesel	0.4%
	CNG	0.0%
	LPG	0.6%
	Electricity	-0.6%
	Hydrogen	-3.1%

Source: ASSIST project (2014)

2.1.6 Car ownership

Car ownership influences personal mobility. A recent survey in the 28 EU countries[5] has shown that a significant correlation exists between the motorisation rate and the market share of cars in daily trips. Urban policies can influence car ownership, which however originates also from several social and economic factors that are not under the control of urban authorities. This factor is therefore considered an exogenous trend in the reference scenario. Based on the European Energy and Transport Trend to 2050 projections, car ownership in the reference scenario is different country by country as reported in **Table 2-7**. Growth is stronger in countries starting from lower values and limited in countries where the motorisation rate is already high.

[5] Fiorello D., Zani L.,(2015): "EU Survey on issues related to transport and mobility – Final Report". Study on behalf of JRC-IPTS of the European Commission, Milan.

Table 2-7: Reference trend: Car ownership

Country	Car ownership at 2015 (cars/1000 inhabitants)	Yearly change 2015 – 2030 (cars/1000 inhabitants)
BE - Belgium	490	2.0
BG - Bulgaria	390	5.0
CZ - Czech Republic	475	5.0
DK - Denmark	400	1.0
DE - Germany	540	0.5
EE - Estonia	490	7.0
IE - Ireland	420	1.0
EL - Greece	470	2.0
ES - Spain	480	3.0
FR - France	525	2.0
HR - Croatia	340	6.0
IT - Italy	620	2.0
CY - Cyprus	550	-2.0
LV - Latvia	310	3.0
LT - Lithuania	590	3.0
LU - Luxemburg	660	0.5
HU - Hungary	320	4.0
MT - Malta	580	-2.0
NL - The Netherlands	470	1.0
AT - Austria	550	2.0
PL - Poland	500	4.0
PT - Portugal	430	1.0
RO - Romania	220	5.0
SI - Slovenia	530	6.0
SK - Slovakia	350	8.0
FI - Finland	570	1.0
SE - Sweden	475	2.0
UK - United Kingdom	475	2.0

Source: EUROSTAT, Elaborations on the European Energy and Transport Trend to 2050

2.1.7 Energy mix for electricity generation

Although it is not the case in this reference trend (but it is in the alternative trend, see section 2.2), when a significant share of battery electric cars is assumed to enter the vehicle fleet, the impact on greenhouse emissions depends on the energy mix for electricity generation. Using electricity produced from fossils fuels will generate indirect emissions from electric vehicles at the power stations, whereas using renewable sources means that electric cars are true zero-emissions vehicles.

The European Energy and Transport Trend to 2050 is used as a reference for the energy mix for electricity generation and its trend over time in the reference scenario. Data is differentiated by country as shown in the following tables (Table 2-8 and

Table **2-9**) for the years 2015 and 2030.

Table 2-8: Reference trend: Energy mix for electricity generation at 2015

Country	Solid fuels	Oil	Gas	Nuclear	Renewables
BE - Belgium	2.1%	0.5%	39.5%	41.9%	16.0%
BG - Bulgaria	44.3%	0.2%	9.8%	30.5%	15.2%
CZ - Czech Republic	42.0%	0.0%	5.0%	40.3%	12.7%
DK - Denmark	32.9%	0.6%	22.4%	0.0%	44.1%
DE - Germany	37.8%	0.2%	17.4%	15.5%	29.1%
EE - Estonia	80.7%	0.9%	8.0%	0.0%	10.4%
IE - Ireland	37.6%	0.2%	36.3%	0.0%	25.9%
EL - Greece	48.4%	9.7%	13.3%	0.0%	28.6%
ES - Spain	11.1%	5.1%	27.5%	19.1%	37.2%
FR - France	2.6%	0.2%	6.6%	73.0%	17.6%
HR - Croatia	9.0%	1.3%	34.7%	0.0%	55.0%
IT - Italy	16.9%	1.5%	48.3%	0.0%	33.3%
CY - Cyprus	0.0%	90.5%	0.0%	0.0%	9.5%
LV - Latvia	0.9%	0.7%	42.6%	0.0%	55.8%
LT - Lithuania	0.0%	0.6%	85.3%	0.0%	14.1%
LU - Luxemburg	0.0%	0.0%	77.9%	0.0%	22.1%
HU - Hungary	18.9%	1.8%	21.9%	48.0%	9.4%
MT - Malta	0.0%	99.3%	0.0%	0.0%	0.7%
NL - The Netherlands	28.7%	0.8%	50.2%	3.0%	17.3%
AT - Austria	9.0%	0.5%	16.9%	0.0%	73.6%
PL - Poland	86.1%	0.5%	3.9%	0.0%	9.5%
PT - Portugal	14.8%	3.3%	23.5%	0.0%	58.4%
RO - Romania	30.1%	3.5%	9.8%	17.7%	38.9%
SI - Slovenia	25.2%	0.0%	14.2%	33.3%	27.3%
SK - Slovakia	5.4%	0.0%	7.6%	62.0%	25.0%
FI - Finland	9.1%	0.1%	11.9%	45.9%	33.0%
SE - Sweden	0.5%	0.4%	1.5%	39.3%	58.3%
UK - United Kingdom	27.9%	0.4%	40.7%	16.3%	14.7%

Source: European Energy and Transport Trend to 2050

Table 2-9: Reference trend: Energy mix for electricity generation at 2030

Country	Solid fuels	Oil	Gas	Nuclear	Renewables
BE - Belgium	2.5%	1.3%	53.3%	0.0%	42.9%
BG - Bulgaria	41.2%	0.8%	14.7%	26.2%	17.1%
CZ - Czech Republic	22.7%	0.0%	7.9%	55.4%	14.0%
DK - Denmark	0.8%	0.5%	25.6%	0.0%	73.1%
DE - Germany	22.9%	0.3%	24.4%	0.0%	52.4%
EE - Estonia	55.3%	0.0%	13.5%	0.0%	31.2%
IE - Ireland	3.0%	0.2%	30.7%	0.0%	66.1%
EL - Greece	12.3%	4.5%	38.7%	0.0%	44.5%
ES - Spain	9.5%	0.6%	25.6%	16.1%	48.2%
FR - France	0.0%	0.1%	3.8%	58.4%	37.7%
HR - Croatia	3.2%	1.2%	26.1%	0.0%	69.5%
IT - Italy	17.1%	1.4%	33.0%	0.0%	48.5%
CY - Cyprus	0.0%	0.4%	68.1%	0.0%	31.5%
LV - Latvia	0.9%	0.6%	30.8%	0.0%	67.7%
LT - Lithuania	0.0%	0.1%	25.5%	61.2%	13.2%
LU - Luxemburg	0.0%	0.0%	56.4%	0.0%	43.6%
HU - Hungary	3.0%	0.6%	8.5%	72.4%	15.5%
MT - Malta	0.0%	1.1%	61.0%	0.0%	37.9%
NL - The Netherlands	23.5%	1.1%	35.5%	3.7%	36.2%
AT - Austria	0.5%	0.4%	10.1%	0.0%	89.0%
PL - Poland	53.6%	0.1%	7.4%	22.1%	16.8%
PT - Portugal	0.4%	0.2%	11.0%	0.0%	88.4%
RO - Romania	17.5%	2.6%	14.7%	19.0%	46.2%
SI - Slovenia	19.6%	0.0%	13.9%	31.6%	34.9%
SK - Slovakia	5.4%	0.1%	6.2%	64.4%	23.9%
FI - Finland	4.4%	0.0%	6.0%	59.2%	30.4%
SE - Sweden	0.7%	0.1%	0.9%	40.8%	57.5%
UK - United Kingdom	2.6%	0.6%	37.2%	9.3%	50.3%

Source: European Energy and Transport Trend to 2050

2.2 Alternative trend

The alternative trend incorporates different assumptions regarding the elements of the reference trend. More specifically the alternative trend provides a more favourable background for improving the sustainability of urban transport: faster development of vehicle technology, higher fuel prices due to energy shortage as well as green taxation at the national level.

2.2.1 Vehicle technology

In the alternative trend a faster penetration of innovative vehicles in the passenger car fleet (hybrid electric, battery electric, fuel cells) and freight LDV fleet (battery electric) is assumed. The assumptions are based on the technological scenario of the GHG-TransPoRD project[6]. In

[6] Fiorello D., Schade W., Akkermans L., Krail M., Schade B., Shepherd S. (2012): Results of the technoeconomic analysis of the R&D and transport policy packages for the time horizons 2020 and 2050. Deliverable D4.1 of GHG-TransPoRD: Project co-funded by European Commission 7th RTD Programme. TRT Trasporti e Territorio SRL, Milan, Italy.

this project, different scenarios were developed to fulfil the major target of the European Transport White Paper of 2011 of reducing GHG emissions of transport by 60% until 2050.

In this technological trend it is assumed that by 2030 almost half of the car fleet will be made up of alternatively fuelled vehicles. Namely the share of hybrid vehicles should be about 15%, battery electric vehicles 25% and fuel cells around 4% (Table 2-10). With reference to freight LDVs, the assumption implemented is one out of four will be a battery electric vehicles in 2030 (and as far as LDVs used for urban distribution of goods from logistic platforms, even one out of three vehicles).

Furthermore, under this alternative trend also a larger share of hybrid electric and CNG buses than in the reference scenario is assumed when the green fleet policy is activated (depending also on the policy input[7], Table 2-11).

Table 2-10: Alternative trend: cars and LDVs vehicle technology in Italy

Vehicle	Vehicle technology	Share of the total vehicle fleet		
		2015	2020	2030
Car	Hybrid electric	0.4%	8.7%	15.3%
	Battery electric	0%	3.6%	25.1%
	fuel cells	0%	0%	4.0%
LDV	Electric (hybrid and battery)	0%	4.8%	26.3%
LDVs from urban platforms	Electric (hybrid and battery)	0%	7.8%	33.3%

Source: Elaborations on the GHG-TransPoRD project - Technological scenario (2012)

Table 2-11: Alternative trend example: bus vehicle technology in Italy with the application of green fleet policy

Vehicle	Vehicle technology	Composition of innovative vehicles		
		2015	2020	2030
Bus	CNG	12.0%	16.3%	18.5%
	Hybrid electric	0.1%	3.9%	9.1%
	Battery electric	0.0%	0.2%	0.4%
	Diesel	87.9%	79.6%	72.0%
	Total	100%	100%	100%

Source: Elaborations on the GHG-TransPoRD project - Technological scenario (2012)

2.2.2 Fuel economy

The average car fuel consumption is assumed to improve at double speed than in the reference scenario. The improvement rate for gasoline, diesel, CNG and LPG vehicles is therefore about -2.6 / -3.0 % per year, while for innovative vehicles a growth rate of about -0.8 % / -1% per year is implemented (

Table 2-12).

The average fuel consumption of motorbike, LDV, HGV and buses is also improved at rates proportional to the car trend.

[7] Green fleet policy assuming 3 years investment period from 2019, with the aim of a limited reduction of pollution and fuel consumption

Table 2-12: Alternative trend: car average fuel economy

Vehicle	Vehicle technology	Yearly growth rate
Car	Gasoline	-2.6%
	Diesel	-3.0%
	CNG	-2.5%
	LPG	-2.5%
	Hybrid electric	-1.1%
	Battery electric	-0.8%
	fuel cells	-0.8%

Source: Study on Urban Transport Roadmaps 2030

2.2.3 Air pollutant emissions factors

With reference to air pollutant emissions, the reduction of the emission factor per vkm is amplified by 50% with respect to the reference scenario of the ASTRA-EC model, under the assumption of a faster renewal of the vehicle fleet in terms of Euro Emission standards (Table 2-13).

Table 2-13: Alternative trend: polluting emissions factors

Pollutant	Mode	Yearly growth rate
PM	Car	-5.3%
	Motorbike	-7.6%
	Bus	-5.1%
	LDV	-8.5%
	HGV	-21.5%
CO	Car	-2.6%
	Motorbike	-8.9%
	Bus	-3.1%
	LDV	-2.5%
	HGV	-3.7%
NOx	Car	-10.0%
	Motorbike	-2.0%
	Bus	-5.0%
	LDV	-12.5%
	HGV	-10.5%
VOC	Car	-8.2%
	Motorbike	-4.6%
	Bus	-1.6%
	LDV	-2.6%
	HGV	0.0 %

Source: Study on Urban Transport Roadmaps 2030

2.2.4 Energy price

Resource fuel price is assumed to develop faster than in the reference trend as result of lower energy supply. The trend has been estimated on the basis of the fossil fuel shortage scenario of the ASSIST project: by 2030 gasoline and diesel resource prices are expected to grow by

1.7% and 3% per year respectively, CNG by 2.2%, LPG by 1.1%. Electricity prices are expected to grow by 2.2% per year, while hydrogen prices by 1.1% per year (Table 2-14).

Table 2-14: Alternative trend: energy price

Vehicle	Fuel	Yearly growth rate
Pure fuel price trend	Gasoline	1.7%
	Diesel	3.0%
	CNG	2.2%
	LPG	1.1%
	Electricity	2.2%
	Hydrogen	1.1%

Source: ASSIST project (2014)

2.2.5 Car taxation

In the alternative trend the implementation of green taxation, namely fuel and car ownership taxes, are higher than in the reference trend. Fuel taxes are supposed to grow in all countries at the growth rate needed to raise the current average EU level to current highest level (Table 2-15). Car ownership taxes are supposed to be progressively increased even if at the limited pace of 2% per year.

Table 2-15: Alternative trend: fuel taxation

Vehicle	Fuel	Yearly growth rate
Fuel tax trend	Gasoline	1.8%
	Diesel	2.7%
	CNG	6.6%
	LPG	3.2%
	Electricity	0.0%
	Hydrogen	0.0%

Source: Study on Urban Transport Roadmaps 2030

2.2.6 Car ownership

Because of higher energy costs and also of green taxation (see below) a slower development of car ownership is expected in comparison to the reference scenario. The impact on car ownership simulated at EU level in the HOP! Project (Macro-economic impact of High Oil Prices) (2008) has been used as a reference to estimate the alternative trend. Again, the value of motorisation rate at the year 2030 is different country by country (

Table 2-16).

Table 2-16: Alternative trend: Car ownership

Country	Yearly change 2015 – 2030 (cars/1000 inhabitants)
BE - Belgium	1.6
BG - Bulgaria	4.0
CZ - Czech Republic	4.0
DK - Denmark	0.8
DE - Germany	0.4
EE - Estonia	5.6
IE - Ireland	0.8
EL - Greece	1.6
ES - Spain	2.4
FR - France	1.6
HR - Croatia	4.8
IT - Italy	1.6
CY - Cyprus	-2.4
LV - Latvia	2.4
LT - Lithuania	2.4
LU - Luxemburg	0.4
HU - Hungary	3.2
MT - Malta	-2.4
NL - The Netherlands	0.8
AT - Austria	1.6
PL - Poland	3.2
PT - Portugal	0.8
RO - Romania	4.0
SI - Slovenia	4.8
SK - Slovakia	6.4
FI - Finland	0.8
SE - Sweden	1.6
UK - United Kingdom	1.6

Source: Elaborations on the HOP! Project (Macro-economic impact of High Oil Prices) (2008)

2.2.7 Trip rates

In this alternative scenario it is assumed that higher energy prices lead to reductions in personal mobility. This assumption is translated into a slight reduction of trip rates, i.e. the assumed average number of trips made per individual. The assumed reduction is 0.3% per year for working trips and respectively 0.6% for personal trips.

2.2.8 Energy mix for electricity generation

Another assumption is that in the alternative trend the uptake of renewable energy sources is faster than in the reference trend. Namely, the share of renewable resources for electricity production is assumed to be higher than in the reference trend. Following the assumptions made in GHG-TransPoRD, an average share of 60% for renewable sources is expected in the

year 2030 at the EU level. In each country (Table 2-17) the share can be higher or lower than this average depending on the current level as well as on the development expected in the reference trend.

Table 2-17: Alternative trend: share of renewable sources in the energy mix for electricity generation at 2030

Country	Renewables in the reference trend	Renewables in the alternative trend
BE - Belgium	42.9%	57.9%
BG - Bulgaria	17.1%	23.1%
CZ - Czech Republic	14.0%	18.9%
DK - Denmark	73.1%	98.0%
DE - Germany	52.4%	70.7%
EE - Estonia	31.2%	42.1%
IE - Ireland	66.1%	89.1%
EL - Greece	44.5%	60.0%
ES - Spain	48.2%	65.0%
FR - France	37.7%	50.8%
HR - Croatia	69.5%	93.7%
IT - Italy	48.5%	65.4%
CY - Cyprus	31.5%	42.5%
LV - Latvia	67.7%	91.3%
LT - Lithuania	13.2%	17.8%
LU - Luxemburg	43.6%	58.8%
HU - Hungary	15.5%	20.9%
MT - Malta	37.9%	51.1%
NL - The Netherlands	36.2%	48.8%
AT - Austria	89.0%	98.0%
PL - Poland	16.8%	22.7%
PT - Portugal	88.4%	98.0%
RO - Romania	46.2%	62.3%
SI - Slovenia	34.9%	47.1%
SK - Slovakia	23.9%	32.2%
FI - Finland	30.4%	41.0%
SE - Sweden	57.5%	77.5%
UK - United Kingdom	50.3%	67.8%

Source: Study on Urban Transport Roadmaps 2030

3 Urban policy measures

The scenarios defined to improve the sustainability of urban transport consist of the implementation of various policy measures. Policy measures are the elementary components that are used for defining the roadmaps that will be described later. In this section the key urban policies that are considered for the definition of the roadmaps are introduced.

3.1 Key urban policy measure

A wide range of policy measures exist that are potentially useful for setting up urban strategies aimed at addressing transport sustainability. Sources such as the ELTIS, CIVITAS and EPOMM websites provide a wide range of examples of individual actions to promote sustainable mobility. These existing catalogues of solutions and best practice formed the basis for developing a prioritised set of policy measures. A long list of policy measures was identified from these sources by clustering the actions (often very focused and context specific) into broader measures. From this long list of measures a set of key policy measures was identified based on criteria including:

- Policy type (i.e. demand management; green fleets; infrastructure investment; pricing and financial incentives; and traffic management/control);
- Institutional level of implementation (i.e. by national or local authorities);
- Effectiveness on key impact areas, cost distribution, and transport modes covered.

The set of 19 short-listed policy measures are detailed below in Table 3-1.

Table 3-1: Key policy measures

Policy Type	Measure
Demand Management	• Sustainable travel information and promotion • Bike Sharing Scheme • Car sharing (Car Clubs) • Delivery and Servicing Plans • Land-use planning - density and transport infrastructure
Green Fleets	• Green energy refuelling infrastructures • Green public fleets
Infrastructure Investments	• Bus, trolley and tram network and facilities • Walking and cycling networks and facilities • Park and ride • Metro network and facilities • Urban Delivery Centres and city logistics facilities
Pricing and financial incentives	• Congestion and pollution charging • Parking pricing • Public Transport integrated ticketing and tariff schemes
Traffic management and control	• Legal and regulatory framework of urban freight transport • Prioritising Public Transport • Access regulation and road and parking space reallocation • Traffic calming measures

3.2 Classification of policies

The first classification criterion was the policy type as shown in Table 3-1. In the definition of these groups, an element of pragmatism was required, reflecting that there would always be some level of overlap between the measures and the different groups.

A second classification criterion was the type of impact expected. Four major categories of impact were defined and for each measure the level of impact was assessed. This assessment was made according to literature and also using the results of tests made with the policy support tool. The purpose of this classification was to identify the most promising measures depending on the specific objective of the policy intervention i.e. to reduce accidents or reduce emissions.

Table 3-2 summarises the classification of the key measures according to the level of expected impact of each policy measure.

A different way to classify policy measures is to consider the transport modes that are affected by the measures directly or indirectly. A direct effect occurs when a transport mode is the object of the measure. For instance, a bike sharing scheme is directly aimed at promoting cycling and parking pricing measures address car use. Since transport modes are in competition, indirect effects occur as well. For instance, when walking and cycling facilities make pedestrian and cycling trips safer and more comfortable then there can be an adverse impact on public transport demand. Also positive indirect impacts can be assumed. For instance, bike sharing can be an alternative to public transport but can also be complementary to public transport.

Based on literature and on the outcome of tests made with the policy support tool the classification of the key measures according to their influence on transport modes is provided in Table 3-3.

A further element of categorisation concerns implementation costs in terms of size and distribution between different groups. This type of classification addresses efficiency and distributional aspects associated with the various measures. In the definition of scenarios for promoting sustainable mobility, these two aspects are very relevant as resources are finite and any intervention can be more or less politically sensitive depending on the burden of costs for various groups. According to data drawn from the literature, a classification of measures according to costs was defined as shown in

Table 3-4.

Table 3-2: Key policy measures classified according to impact by policy outcome

Policy type	Measure	Impact by policy outcome			
		GHG /AQ emissions	Congestion	Accessibility /Social inclusion	Safety
Demand management	Sustainable travel information and promotion	Medium	Low/Medium	Low	
	Bike sharing scheme	Low	Low/Medium	Low	
	Car sharing (Car Clubs)	Low (Air Quality could be medium if LEVs used)	Low	Low/Medium	
	Delivery and servicing plans	Medium	Low		Low
	Land use planning - density and transport infrastructure	Medium	Low/Medium	High/Medium	Low/ Medium
Green fleets	Green energy refuelling infrastructures	Medium/ high(b)			
	Green Public fleets	Low/Medium			Low
Infrastructure investment	Bus, trolley and tram network and facilities	Medium	Medium	Medium	Low
	Walking and cycling network and facilities	Low (links with PT too)	Low/Medium	Medium/High	Low
	Park and ride	Low	Low/Medium	Low/Medium	Low
	Metro network and facilities	Medium	Medium/High	Medium	Medium
	Urban Delivery Centres and city logistics facilities	Low / Medium	Low/Medium		Low
Pricing and financial incentives	Congestion and pollution charging	Medium	Medium	Low(d)	Low
	Parking pricing	Medium	Medium	Low(d)	
	Public Transport integrated ticketing and tariff schemes	Low	Low	Low/Medium	
Traffic management and control	Legal and regulatory framework of urban freight transport	Low	Low/Medium	Low(d)	Low
	Prioritising public transport	Low/medium	Low		Low
	Access regulations and road and parking space reallocation	Low	Low/Medium	Low/Medium	Low
	Traffic calming measures	Low	Low		Low/medium

(a) Air Quality could be medium if electric vehicles are used

(b) Depends on fuel and use in vehicles

(c) For air quality only

(d) Potentially adverse effect

Table 3-3: Key policy measures classified according to impact by mode

Policy type	Measure	Impact by mode			
		Public Transport	Walking/ Cycling	Car	Freight
Demand management	Sustainable travel information and promotion	✓	✓	✓	
	Bike sharing scheme	✓	✓		
	Car sharing (Car Clubs)	✓	✓	✓	
	Delivery and servicing plans				✓
	Land use planning - density and transport infrastructure	✓	✓	✓	✓
Green fleets	Green energy refuelling infrastructures	✓		✓	✓
	Green Public fleets	✓			
Infrastructure investment	Bus, trolley and tram network and facilities	✓			
	Walking and cycling network and facilities		✓		
	Park and ride	✓		✓	
	Metro network and facilities	✓			
	Urban Delivery Centres and city logistics facilities				✓
Pricing and financial incentives	Congestion and pollution charging	✓		✓	✓
	Parking pricing			✓	
	Public Transport integrated ticketing and tariff schemes	✓			
Traffic management and control	Legal and regulatory framework of urban freight transport				✓
	Prioritising public transport	✓			
	Access regulations and road and parking space reallocation	✓	✓	✓	
	Traffic calming measures			✓	✓

Table 3-4: Key policy measures classified according to implementation costs

Policy type	Measure	Distribution of implementation costs			
		Citizens	Businesses	City	Government
Demand management	Sustainable travel information and promotion			Low	
	Bike sharing scheme	Low	Low	Low	
	Car sharing (Car Clubs)	Low(b)		Low(a)	
	Delivery and servicing plans		Low(b)	Low	
	Land use planning - density and transport infrastructure	Low (b)	Low	Low/ Medium	
Green fleets	Green energy refuelling infrastructures			Medium	Medium
	Green Public fleets		Medium/ High	Medium	
Infrastructure investment	Bus, trolley and tram network and facilities		Medium	Medium/ High	Medium
	Walking and cycling network and facilities			Low/ Medium	Low/ Medium
	Park and ride	Low	Medium	Medium/ High	
	Metro network and facilities			High	High (very)
	Urban Delivery Centres and city logistics facilities		Low	Medium	
Pricing and financial incentives	Congestion and pollution charging	Medium/ High	Medium	Medium(c)	
	Parking pricing	Medium/ high	Medium	Low	
	Public Transport integrated ticketing and tariff schemes			Medium/ high(d)	
Traffic management and control	Legal and regulatory framework of urban freight transport		Medium		
	Prioritising public transport			Medium/ high	
	Access regulations and road and parking space reallocation			Low/ medium	
	Traffic calming measures			Low	

(a) Costs depend on the scheme chosen

(b) In principle cost savings could be achieved

(c) Revenues are in principle larger than costs at least in medium-longer term

(d) Costs are significant if this measure include the implementation of an integrated ticketing system

4 Policy scenarios

Bearing in mind the goals of the 2011 Transport White Paper and in particular the target of halving the use of conventionally fuelled cars in cities by 2030, which is the time horizon of this study, a policy initiative at the urban level is needed. The policy measures presented in the previous section together make up the toolbox that can be used to implement this initiative. As shown with the different classifications provided, measures differ in scope, effectiveness, implementation costs and distribution. A policy initiative is expected to select some of the potential measures and to combine them in order to define a realistic policy scenario.

In this section we introduce five alternative policy scenarios. Each scenario results from the combination of a subset of measures under a given assumption regarding the background conditions (see section 2). Namely, three alternative policy approaches are defined and two of these are considered under two different exogenous trends.

The three alternative policy approaches are defined as follows:

1. **Promote and Regulate**, based on changing behaviour by information and promotion.
2. **Plan and Build**, focused on investments in the technology and infrastructure.
3. **Charge and Provide**, considering the use of economic incentives like road charging and parking pricing.

Each policy approach includes a subset of enabling measures, i.e. a group of main interventions and also some ancillary measures to support the application and the impact of the enabling measures.

One aspect of the “Plan and Build” approach is the promotion of innovative vehicle technologies. At the urban level the policy effort directed at this is focused on providing re-charging infrastructures for electric vehicles or funds to renew the bus fleet with low or zero-emissions vehicles. However, interventions to promote “greener” vehicles are effective as far as such vehicles are actually available in the market and are competitive. This condition is not under city authorities’ control. Therefore, the effectiveness of the “Plan and Build” strategy is significantly dependent on exogenous conditions. In order to take this aspect into account, this approach is analysed (see section 5 below) with two different background trends. In one scenario the reference exogenous conditions are assumed. In the other scenario the alternative trend (see section 2 for details) is assumed as far as technological development and energy supply are concerned.

The “Charge and Provide” approach is related to the use of economic incentives like road charging and parking pricing. It is fair to assume that this strategy can be more effective if also other economic instruments are activated like vehicle taxation and fuel duties. These other instruments are decided at a national or even super-national level and therefore represent again an exogenous condition. Thus, also this strategy is analysed in two scenarios: one assuming the reference trend and the other assuming the alternative trend where green taxation is activated at a broad level.

Table 4-1 summarises the content of each policy approach.

One aspect of the “Plan and Build” approach is the promotion of innovative vehicle technologies. At the urban level the policy effort directed at this is focused on providing re-charging infrastructures for electric vehicles or funds to renew the bus fleet with low or zero-emissions vehicles. However, interventions to promote “greener” vehicles are effective as far as such vehicles are actually available in the market and are competitive. This condition is not under city authorities’ control. Therefore, the effectiveness of the “Plan and Build” strategy is significantly dependent on exogenous conditions. In order to take this aspect into account, this approach is analysed (see section 5 below) with two different background trends. In one scenario the reference exogenous conditions are assumed. In the other scenario the alternative trend (see section 2 for details) is assumed as far as technological development and energy supply are concerned.

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Table 4-1: Composition of the three policy strategies

Policy type	Measure	Promote and Regulate	Plan and Build	Charge and Provide
Demand management	Sustainable travel information and promotion	Enabling	Ancillary	Ancillary
	Bike sharing scheme	Enabling		Ancillary
	Car sharing (Car Clubs)	Enabling		Ancillary
	Delivery and servicing plans	Enabling	Ancillary	
	Land use planning - density and transport infrastructure		Enabling	
Green fleets	Green energy refuelling infrastructures		Enabling	
	Green Public fleets		Enabling	
Infrastructure investment	Bus, trolley and tram network and facilities		Enabling	Enabling
	Walking and cycling network and facilities	Ancillary		Enabling
	Park and ride		Enabling	
	Metro network and facilities		Enabling	
	Urban Delivery Centres and city logistics facilities		Enabling	
Pricing and financial incentives	Congestion and pollution charging			Enabling
	Parking pricing	Enabling		Enabling
	Public Transport integrated ticketing and tariff schemes	Ancillary		Enabling
Traffic management and control	Legal and regulatory framework of urban freight transport			Ancillary
	Prioritising public transport	Ancillary	Ancillary	Enabling
	Access regulations and road and parking space reallocation	Enabling		Ancillary
	Traffic calming measures	Enabling		

Enabling measure
Ancillary measure

The combination of the three policy approaches, which are described in the paragraphs below, and of the assumptions on the background conditions produces the five policy scenarios summarised in Table 4-2.

Table 4-2: Summary of the policy scenarios

Policy scenario	Urban Strategy	Background Conditions
1	**Promote and Regulate**	Reference
2	**Plan and Build - reference**	Reference
3	**Plan and Build - alternative**	Alternative
4	**Charge and Provide - reference**	Reference
5	**Charge and Provide - alternative**	Alternative

4.1 Promote and regulate

The “Promote and Regulate” approach is especially focused on the behavioural side. It is centred on policy measures targeted at inducing a more sustainable mobility behaviour of citizens. Sustainable modes are promoted by dedicated campaigns including personalised marketing actions. Also, the use of shared vehicles (cars and bikes) is supported and integrated ticketing is implemented to promote the use of public transport. At the same time, car mobility is regulated; traffic restrictions are introduced, traffic calming measures are applied in the urban area and parking is regulated and charged. Delivery and servicing plans are promoted to improve the sustainability of urban freight transport.

Considering the classifications of measures introduced in Section 3, this strategy involves all transport modes and its effects are supposed to be especially concentrated on reducing congestion and improving safety, also with positive impacts on air quality.

It is a relatively low cost strategy for the municipality also with limited costs for citizens and business and basically no financial support required from government.

The “Promote and Regulate” approach is aimed at the short to medium term. Some of its measures are relatively fast to implement, others need some more time and resources but basically there are no long term programmes.

4.2 Plan and Build

The “Plan and Build” approach is oriented on the technology and infrastructure side. This approach aims to change the urban environment and its existing transport facilities. It can be considered a long term strategy. Land use planning plays a key role in this perspective. The development of new settlements is framed within a sustainable perspective and liveability and affordability of the existing urban area are promoted in order to stop and reverse urban sprawl. At the same time new public facilities are built to increase transport supply and improve its reliability. Investments also include new structures to rationalise urban freight transport as well as infrastructures and transport means to support the breakthrough of low-carbon vehicles.

The focus of this strategy is especially on public transport, with less emphasis on other transport alternatives. More than for other approaches effects are expected in terms of improved accessibility although emissions savings and reduced congestion are also major targets.

Given the role of infrastructure this approach is an expensive one. The financial effort of the urban authority is substantial and at the same time also large contributions from governmental funds are needed.

The “Plan and Build” strategy is ambitious and long term as many of its measures need time to be implemented and provide results.

4.3 Charge and Provide

The “Charge and Provide” approach is a sort of mix between the two first approaches. It includes regulations and behavioural incentives as well as the provision of infrastructures and services. Economic instruments play a key role in this approach. Their role is twofold. On the

one hand they are used for changing the behaviour of citizens by adopting the “user pays” or “polluter pays” principle. On the other hand they are used to generate resources to support sustainable mobility by improving public transport, walking and cycling facilities. The provision of transport alternatives include shared modes and measures targeted at influencing individual behaviour extending to access limitations, promotion of sustainable modes and restrictions to urban freight movements.

Improving air quality and reducing congestion are the major goals of this approach. The use of charges makes mobility more expensive and therefore, despite improvements to transport supply, accessibility is probably not much improved. The measures included in this strategy are also not the most effective to tackle safety issues.

The implementation costs of this strategy are well below the costs of the “Plan and Build” strategy but are higher than in the “Promote and Regulate” option as some infrastructure is included. However this strategy also produces resources for the city authorities thanks to the charges applied. However this means that this approach is expensive for citizens and businesses and so is politically challenging to implement.

The “Charge and Provide” strategy is generally focused on obtaining results in the medium term.

5 The policy roadmaps

The scenarios define the policy content of roadmaps aimed at improving the sustainability of urban mobility. The measures included in the scenarios are diverse in nature, objective and complexity. Their implementation requires time and resources and should consider the local conditions, the stakeholders involved and other practical aspects.

These practical aspects can be fully specified only with reference to real cases where the policy measures are applied. However, the ambition of this study is to provide more than just a list of theoretical measures. Therefore the policy scenarios are supported by roadmaps.

Roadmaps define how each scenario can be achieved (i.e. the specific steps that will need to be taken and the timing required for each step) in a hypothetical urban context. The roadmaps also discuss the implementation issues that should be taken into account and identifies the main stakeholders that should be involved.

In the following paragraphs the roadmaps corresponding to the three policy scenarios defined in the previous chapter are described. For each roadmap the following elements are provided:

- A short description of the initial conditions, i.e. of the hypothetical city where the roadmap is applied, of the mobility issues it faces and of the objectives the local authorities would like to achieve;
- A graphical description of the temporal sequence of measures and of their impacts on the city context. In this description also a classification of the measures as enabling measures (i.e. the main measures of the roadmap) and ancillary measures is shown;
- A narrative description of the content of the measures applied at different time steps and of the transformation induced to the city context;
- A discussion of relevant implementation issues that should be considered;
- A list of key stakeholders that should be involved in the planning and implementation process.

5.1 Promote and regulate roadmap

5.1.1 Initial conditions

Villafantas[8] is a city with a good track record in transport planning and management. Over the years the city has developed a high quality public transport service and other facilities to improve the sustainability of transport. Traffic, air quality and safety for pedestrian are therefore better than in other cities. At the same time, however there is a high motorisation rate and cars are widely used when alternatives are available.

The city authorities want to further improve the sustainability of the urban transport system but they do not want to invest a large amount of money. The cost for the maintenance of transport facilities and for the provision of transport services is a relevant item in the budget of the city and the level of infrastructure is already good so the city authorities do not see the need for major infrastructural investments or for other heavy interventions. The approach is to implement relatively light interventions aimed at promoting the use of existing and new alternatives to private transport and to regulate the use of cars and goods vehicles in the city.

The municipal authorities intend to pursue the objective of halving the use of conventional vehicles travelling in the city by 2030. The plan is heavily based on promoting sustainable modes and regulating the use of private cars and freight transport.

[8] Fictitious name

5.1.2 Roadmap description

Initial phase

In the initial conditions the city has some congestion and pollution problems despite a good level of public transport supply. Cars are often used when alternatives are available because many individuals are not used to travelling by public transport and do not have a clear perception of its level of service while the car can be used basically everywhere. Delivery of goods generates congestion in some areas and periods of the day.

The policy effort starts with the implementation of short term measures and with the design of more complex measures. **Traffic calming** interventions are designed in terms of content, locations and priorities and some initial projects are implemented.

The design of the interventions takes into account that a plan to **restrict the use of car in certain areas** of the city is defined and implemented. In some roads traffic is totally forbidden, in other roads parking spaces are removed or limited and alternative parking areas are identified.

Part of the traffic restrictions involve a **different treatment for low emissions or zero emission vehicles**. These types of vehicles are allowed to use some roads and parking spaces forbidden to conventional vehicles.

Together with parking restrictions and parking space reallocation, a different regulation is applied to all parking areas in the city. This regulation includes a **parking tariff** strategy aimed at making car trips more expensive especially when their destination is in more congested areas.

In addition to overall traffic restrictions, which are also applied to trucks, specific **time limitations are identified for urban goods delivery**. Most freight vehicles cannot circulate in peak time.

While the interventions to regulate the use of cars in the urban area are designed and their implementation starts, a campaign is made to **improve citizens' knowledge about the level of service of local public transport** and to demonstrate that it can be a competitive alternative to the car. At the same time the **user information system of the public transport provider is redesigned** in order to improve its effectiveness, add new functionality and reach more citizens.

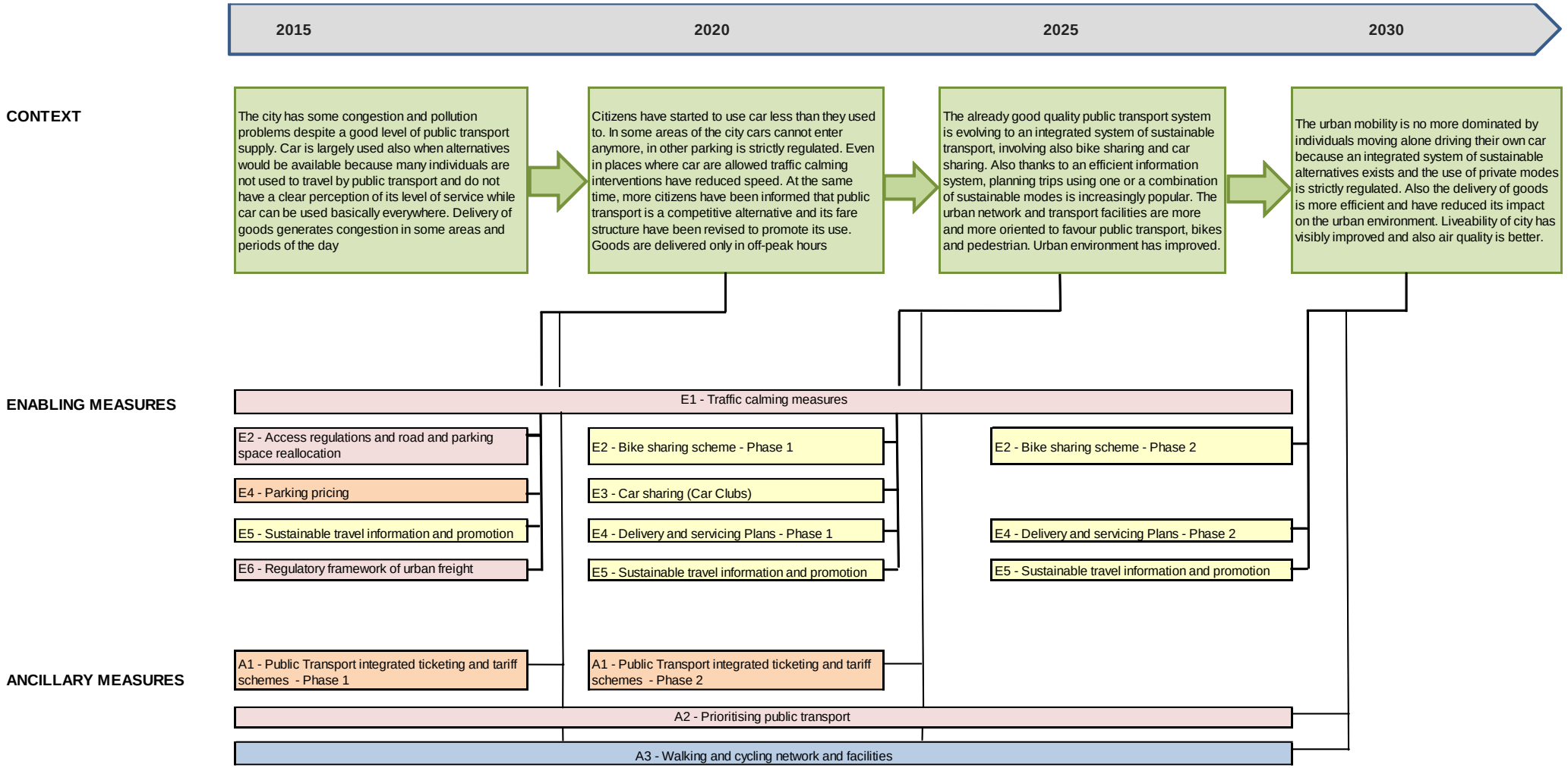
These actions represent the bulk of the initial phase of the roadmap. Other accompanying measures are started at the same time.

The tariff system of the public transport service is revised with the aim of promoting its regular use for commuting but also to attract city users, tourists, etc. At the same time, a working group is appointed for defining a plan to introduce a smart travel card to integrate ticketing of urban public transport with regional services and, in perspective, with other transport services.

Then, in order to further improve public transport and promote it as a competitive alternative a plan is drawn up for implementing interventions aimed at **prioritising the circulation of buses and trams**. These interventions take advantage of traffic limitations and include technology investment.

Finally, aiming at promoting other sustainable mobility solutions and not only public transport, a plan is prepared for building a **network of cycling lanes and pedestrian paths**. Streets where these facilities should be introduced are selected taking into account traffic calming interventions and traffic restrictions defined with other measures.

Figure 5-1: Overview of the "Promote and Regulate" roadmap



Short term

In the short term, the impact of the policy effort is limited but visible. Citizens start to use cars less than they used to. In some areas of the city cars cannot enter anymore, whilst in others parking is strictly regulated. Even in places where cars are allowed, traffic calming interventions have reduced vehicle speeds. At the same time, more citizens have been informed that public transport is a competitive alternative and its fare structure has been revised to promote its use. Goods are delivered only in off-peak hours.

The interventions are introduced. In particular, the implementation of **traffic calming** interventions, the **prioritisation of public transport** and the construction of **cycling lanes and pedestrian paths** occur in accordance with the city's plans.

With some traffic limitations and parking restrictions already in place and a cycle lane network under development, the city has become more bike-friendly and the administration launches a tender to provide a **bike-sharing service**, initially in the city centre where there are more roads where cars are excluded or where traffic calming measures are in place and demand is higher.

At the same time, a **car sharing service** is started aimed at extending the availability of transport alternatives late in the evening, when public transport services are necessarily reduced.

On the freight side, after the regulation of urban freight transport was introduced the need for reorganising goods delivery has arisen for various activities and organisations. Organisation are then encouraged to define **delivery and servicing plans**. In particular joint plans adopted by groups of organisations are promoted aiming at consolidating and reducing delivery vehicles accessing e.g. shopping districts.

The new mobility solutions (bike sharing, car sharing) are advertised and specific target populations receive **tailored information about the availability of new services**. The user information system of the public transport provider is improved to integrate the other transport solutions and to promote the integrated ticketing. Indeed, the **integrated ticketing** of urban public transport services and regional services based on a smart travel card is implemented. When bike sharing and car sharing services come into operation, the functionality of the smart card is extended to cover the payment of these services, either integrated or not integrated with public transport.

Medium term

Due to the measures implemented, the already good quality public transport system evolves to an integrated system of sustainable transport, that also includes bike sharing and car sharing. Also thanks to an efficient information system, planning trips using one or a combination of sustainable travel modes is increasingly popular. The urban network and transport facilities are more and more oriented to favour public transport, bikes and pedestrians. Due to these changes, the urban environment improves.

Infrastructure measures such as **traffic calming** interventions, the **prioritisation of public transport** and the construction of **cycling lanes and pedestrian paths** are completed.

The **bike sharing service is extended** to most of the urban area, following the development of reserved cycling lanes.

The user information system of the public transport provider has developed into **a single portal where citizens can plan their trips** considering different alternative or combinations of alternatives, receive real time updates, purchase tickets and access other services.

On the freight side **delivery and servicing plans** have been developed and implemented.

Long term

The measures included in the roadmap have been fully implemented and have developed their effects. Urban mobility is no longer dominated by individuals travelling alone driving their own car because an integrated system of sustainable alternatives exists and the use of private modes is strictly regulated. Also the delivery of goods is more efficient and has reduced its impact on the urban environment. The liveability of the city has visibly improved and also air quality is better.

5.1.3 Implementation issues

This roadmap includes several interventions at a very local level to restrict car access, build cycling lanes, regulate parking, calm traffic etc. These interventions are soft ones in comparison to large infrastructure investments but can have significant impacts for those living in the zones involved. Aspects like the availability of parking places for residents when a pedestrian zone is created or highway capacity when part of the carriageway is used to build a cycling lane should be carefully considered to avoid strong oppositions. These aspects and the content of several measures require that a significant effort is dedicated to the design phase. The various components of the roadmap should be planned in an integrated fashion even when they are under different measures.

Finally, even if infrastructure interventions are limited, some traffic calming and traffic prioritisation measures will incur costs. The overall cost of the measures is probably not negligible so budget constraints should be considered.

Considering more detail, the following implementation aspects linked to the specific measures should be taken into account:

- **Traffic calming** interventions can be very different in nature. Some are basically only a matter of regulation (e.g. setting speed limits) others require some civil engineering work and some investment. The budget for the whole roadmap should be carefully considered.
- The planning phase for **traffic restrictions and parking regulations** requires the involvement of citizens and stakeholders to ensure that benefits of restrictions and regulations are understood and unavoidable disadvantages are offset. Also, the dialogue with citizens and stakeholders can allow to collect useful information to design the measures.
- **Parking regulation and pricing** is often a very politically sensitive measure. In many places, citizens are used to parking their cars close to their final destination, often for free. This habit is often perceived as a right and any attempt to modify this situation can give rise to strong opposition.
- Delivery of goods (time, frequency, etc.) is often dictated by retailers' preferences and constraints rather than by hauliers. The **regulatory framework for urban freight transport** should be therefore discussed also or even especially with the representatives of activities receiving goods.
- **Public transport ticket prices** can be a powerful instrument to attract demand but attractive tariffs may not be economically viable for public transport operator in terms of revenues. Financial support to the transport operator might be needed.
- **Integrated ticketing** cannot be planned or decided at the urban level alone. The cooperation of regional operators and probably of urban operators of other cities is needed. A single city can stimulate the other institutions but cannot proceed independently.
- Effective measures to **prioritise public transport** can reduce space for cars (e.g. if parking lots kerbside are removed to build a reserved lane) and generate local congestion. The same applies to cycling lanes. Especially at an early stage, when most of the trips are made by car, interventions can be unpopular.

- **Car sharing** services are commercially viable only in cities over a certain dimension. Cities below 50,000 inhabitants are probably too small to attract car sharing operators. Alternative forms of car sharing (e.g. the sharing of private and/or public vehicle fleets) might be more viable and might be supported by the municipal authorities under the form of tax breaks.
- **Bike sharing** schemes are generally characterised by low profitability and therefore might need to be subsidised by the municipality. To increase revenues, bikes might be customised for displaying advertising messages of private clients who pay for the publicity.
- The effectiveness of **bike sharing** depends on several practical conditions, e.g.:
    - stations and bikes are well maintained;
    - system easy to understand;
    - various types of registration offered;
    - combination and synergies with PT;
    - fees structured to encourage use for short trips;
    - effective redistribution systems to redistribute bikes.
- **Integrating different transport services** (buses, car sharing, bike sharing, etc.) is appealing from a user perspective, but when transport services are provided by independent private operators, integration may be difficult because each provider perceives others as competitors. Problems might arise especially in terms of revenue redistribution. Opposition may be expected from operators whose freedom to set fares may be reduced. From a social point of view cooperation is preferable but from a private point of view competition might prevail. The role of the public institutions here is critical either in terms of setting rules or even in terms of establishing a single public operator for all services.

5.1.4 Main stakeholders involved

The city authorities are the main actors who will be focusing on achieving the sustainability targets. However, the involvement of various stakeholders is advisable as their cooperation, from the design phase onwards, is a key requirement for successful implementation of a roadmap. The main relevant stakeholders for the “Promote and Regulate” roadmap are:

- **Local business associations** (e.g. associations of retailers). Traffic restrictions, parking pricing as well as a tighter regulatory framework for goods delivery can be perceived by retailers and other actors as detrimental for their business. Especially as far as goods distribution is concerned it is fundamental that real world problems and constraints are considered and plans are not based on abstract concepts. Local business associations should be therefore involved very early in the planning of the measures.
- **Regional transport operators.** Unless the city is very large and several public transport providers operate in the urban area, integrated ticketing is especially relevant to integrate urban transport with regional transport. So its development should necessarily involve the regional transport operators (which would also share the financial burden).
- **Urban transport operators in other cities.** A ticketing system that integrates urban and regional transport is meaningful when more cities are part of the network. Therefore the public transport operators in other cities should be involved in the design and the implementation of such a system.
- **Logistics suppliers**. The regulatory framework for goods delivery impacts on the operation of the logistics suppliers. Their involvement would be of benefit for setting realistic rules and targets.

5.2 Plan and Build roadmap

5.2.1 Initial conditions

Predstivice[9] is a city that has grown quite rapidly in the last twenty years. The growth however has been quite sprawling and accompanied by a huge increase of road traffic which has significantly reduced the quality of the urban environment and the level of safety for pedestrians.

Despite the demographic growth, Predstivice has not enjoyed economic development. Most of the industrial companies located in the city suffered from the weak economic conditions and the budget policy at the national level reduced funding to local institutions. Partly due to a lack of resources and partly due to insufficient planning capacity, Predstivice city authorities have not invested in transport facilities and have even welcomed new spontaneous residential developments as a source of revenues from local taxes.

Now building on a new approach to economic policy at the national level, Predstivice city authority wants to tackle its traffic-related problems as well as economic problems by means of ambitious infrastructure investment and a city development plan. They want to place Predstivice as a lead city in the promotion of electric mobility and, at the same time, reduce urban sprawl and improve public transport facilities. City authorities are aware that this roadmap needs time to improve sustainability but their goal is also to provide a positive shock to the local economy.

5.2.2 Roadmap description

Initial phase

The starting point is a city experiencing significant (and increasing) congestion and pollution problems. Existing public transport services in the city are largely insufficient to cater for demand and some neighbourhoods are very poorly served, meaning that car use is basically the only available transport alternative.

A strategic **urban land use plan** is the pivot of the whole roadmap. The first act of the local administration is to draw up a detailed plan for the future development of the city aimed at reducing land use, traffic and pollution, and increasing liveability of the urban environment. The plan specifies targets and guidelines for the other interventions. The plan includes fiscal and regulatory measures for the use of empty dwellings in the city centre for social housing purposes.

On the transport side, the short term intervention elaborated in the plan is the **development of the bus network**, especially aimed at providing an adequate service for neighbourhoods which are currently very poorly connected. The development will start as soon as possible after the completion of the plan.

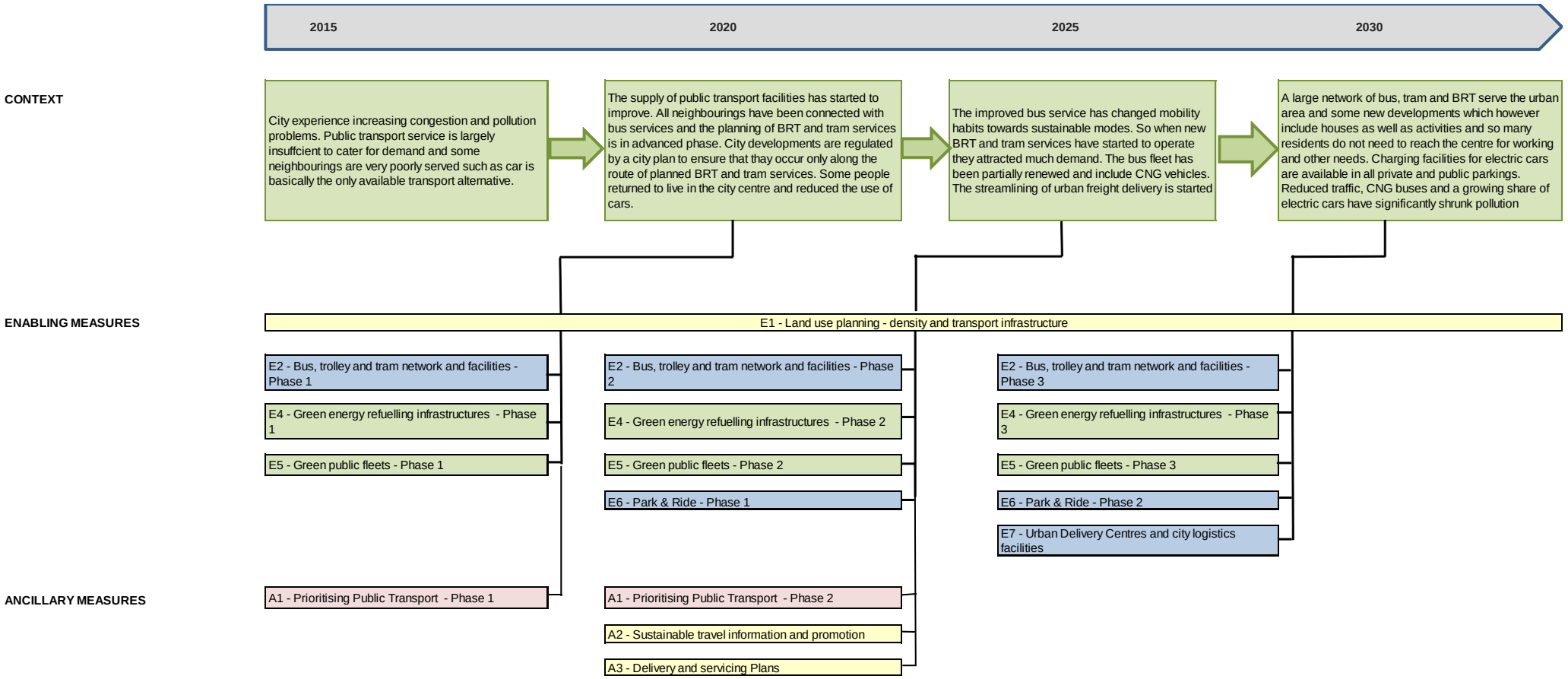
The improvement of the bus service requires **expansion and modernisation of the bus fleet**. The municipality finances a renewal plan to progressively replace older vehicles with modern ones, including LPG vehicles. The first order for new buses is also placed early.

Still on the transport side, but on the longer term, one component of the roadmap is the development of **Bus Rapid Transit (BRT) lines on main routes**. In this initial phase the BRT lines and the new city developments are conceived together to ensure that the public transport service is effective and attracts demand.

Another component of the plan is the promotion of zero emissions vehicles in the urban area by means of the **provision of battery recharge facilities throughout the city**: public parking, garages, private parking places of firms, offices, etc. Development of these facilities is started in the initial phase of the plan.

[9] Fictitious name

Figure 5-2: Overview of the "Plan and Build" roadmap



The improvement of the bus service requires the extension of lines and increase of frequency. An accompanying measure that can produce results in the short term before the service is extended is the **prioritisation of public transport** (for example at crossroads or with reserved lanes). This intervention can require some infrastructure investment but in many instances it can be applied only with regulation or limited works.

Short term

The short term effect of the roadmap is that the supply of public transport facilities has started to improve. All neighbourhoods have been connected with bus services and the planning of BRT and tram services is at an advanced phase. City developments are regulated by a city plan to ensure that they occur only along the route of planned BRT and tram services. Some people return to live in the city centre and have reduced their use of cars.

The urban **land use plan** is always the reference for developing and implementing the other measures. The content of the plan is revised and adapted to take new circumstances into account but keeping the objectives unchanged.

The **development of the bus network** continues and the construction sites for the **first BRT lines** are opened following the priority indicated in the urban plan. Also the **renewal of the bus fleet** proceeds.

After the first "low cost" interventions, more structural modifications in the road networks are realised to **give priority to buses**: reserved lines are protected and traffic lights are increasingly equipped with bus detection devices to turn green when buses approach crossroads.

A new front concerning public transport supply is opened: the development of **Park&Ride terminals** at the border of the city centre starts, in the location identified by the city plan. Some terminals are located close to the BRT line but some are served by bus lines. These terminals are designed to attract demand from outside the city, especially from areas where population is dispersed and providing direct transport services is not convenient.

Having improved the public transport system, there is room to promote the use of this alternative (and also of other sustainable transport solutions). **Advertising, personalised information**, and other instruments are used to increase citizen's knowledge about the alternatives available to car usage.

At the same time, considering that cars continue to be the preferred choice of many citizens, the **provision of battery recharge facilities** in the city is continued to support a technological renewal of the car fleet.

Finally, freight traffic is also considered in the city plan. With the infrastructure effort primarily dedicated to passenger transport, one measure initially promoted is the adoption of **delivery and services plans** to reduce the number of freight vehicles used for the distribution of goods to city retailers.

Medium term

In the medium term the improved bus service is effective in changing mobility habits towards sustainable alternatives. So when the first new BRT and tram services operate they attract much demand. Furthermore the **renewal of the bus fleet** continues, many buses are new and some of them are low emissions vehicles so the environmental impact is further reduced.

The policy effort is however continued following the indications of the urban **land use plan**. In particular, after the completion of the first **BRT lines** and the launch of the service, the development of other lines starts.

At the same time, the first **Park&Ride terminals** are also completed and the construction of others is started.

In most of the city battery recharge stations are already available and the final part of the plan for the **provision of battery recharge facilities** throughout the city is started.

The streamlining of urban freight delivery thanks to **delivery and services plans** has made progress and now that the investment effort for passenger facilities has been largely completed, the piece of the transport infrastructure roadmap included in the City Plan concerning freight is started. The construction of **city logistics facilities** is initiated. These platforms will collect and consolidate freight shipments, allowing the last leg of the distribution journey to be made with low or zero-emissions vehicles.

Long term

In the long term all the measures of the urban plan have been implemented. A large network of bus, tram and BRT services serve the urban area and some new developments which include houses as well as services/employer so many residents do not need to travel to the city centre for working and other needs. Charging facilities for electric cars are available in many locations throughout the city. Reduced traffic, less polluting buses and a growing share of electric cars have significantly shrunk pollution.

5.2.3 Implementation issues

A plan heavily based on new infrastructures involves a lot of civil engineering works throughout the city for a long period. Drawbacks associated with such a plan can be significant. Citizens should have a very clear perception of the long term advantages for tolerating prolonged inconveniences. Information on the plan for engineering works should be provided well in advance of the start of construction.

Infrastructure development also means large investments. Citizens may be doubtful about the fair use of public resources so an observatory should be arranged to monitor expenditure, provide transparency on beneficiaries and minimise the risk of mismanagement.

The following implementation aspects linked to the specific measures should be taken into account:

- The formulation of a strategic **land use urban plan** is a complex task requiring many experts, studies, data collection, surveys, and modelling exercises to define and assess alternatives. Also the strategic land use urban plan should be formulated with the involvement of citizens and stakeholders. Participation is of utmost importance to raise support.
- The strategic land use urban plan should include the **mobilisation of unused dwellings** where there is a significant amount of those. However, it should be considered that policy instruments required for this purpose (taxation, purchase of houses at regulated prices) should not be under the jurisdiction of the urban authorities. A favourable policy environment at the national level could be needed.
- **City developments** should be the result of private investments. Nevertheless there is a strong role for public authorities. During the construction phase they ensure that developments are in line with plan's requirements and that all required infrastructure (power, water, sewage, etc.) are included. After the completion of these developments, public services (kindergarten, schools, etc.) should be provided.
- **New infrastructure** is a key component of this roadmap. The financial effort for building all the planned facilities is substantial and may exceed the budgets available to local authorities. Substantial contributions are probably needed from either regional, national or international institutions or from private funds in form of some public-private partnership.
- The **improvement of public transport** can also include starting innovative services (e.g. dial a ride) especially where traditional bus lines might be very expensive.

- Effective measures to **prioritise public transport** can reduce space for cars (e.g. if parking lots kerbside are removed to build a reserved lane) and generate local congestion. Especially in an early stage, when most of the trips are made by car, interventions can be unpopular.

5.2.4 Main stakeholders involved

The city authority is the main actor of the roadmap aimed at achieving the sustainability targets. However, the involvement of various stakeholders is advisable as their cooperation, from the design phase onwards, is a key requirement to ensure a successful implementation of the roadmap. The main relevant stakeholders for the "Plan and Build" roadmap are:

- **Landlords and estate developers**. The cornerstone of the roadmap is the control of urban developments. This objective can however conflict with the interests of landlords and estate developers. Also the provision of social housing, by putting a downwards pressure on housing rents, may be unwelcome to property owners, especially if taxation or other measures are applied to put unused dwellings on the market at affordable prices.
- **Local banking system**. Very significant financial resources are needed for new transport infrastructures. Unless funds are available from other public or private entities, the cooperation of the banking sector to provide finance is crucial.
- **Local transport operators**. Local transport operators should manage the improvement of the public transport supply and therefore they are key stakeholders for the design of the new infrastructures and services.
- **Local business associations** (e.g. associations of retailers). Especially as far as the regulatory framework for urban goods distribution is concerned, it is fundamental that real world problems and constraints are considered and plans are not based on abstract concepts. Furthermore activities (shops, private services) should be located in new developments. Local business associations should be therefore involved very early in the planning of the measures.
- **Public service authorities.** New developments should host houses and activities but also public services such as kindergartens, schools, post offices, etc. Some services are managed by urban authorities but others are under the jurisdiction of regional or national authorities or even private operators.
- **Electricity suppliers.** The provision of recharge facilities requires the establishment of partnerships with electric power providers, which have the technology and the experience to build facilities and connect them to the grid network.
- **Logistics suppliers**. The regulatory framework for goods delivery impacts on the operation of the logistics suppliers. Their involvement would be of benefit for setting realistic rules and targets.

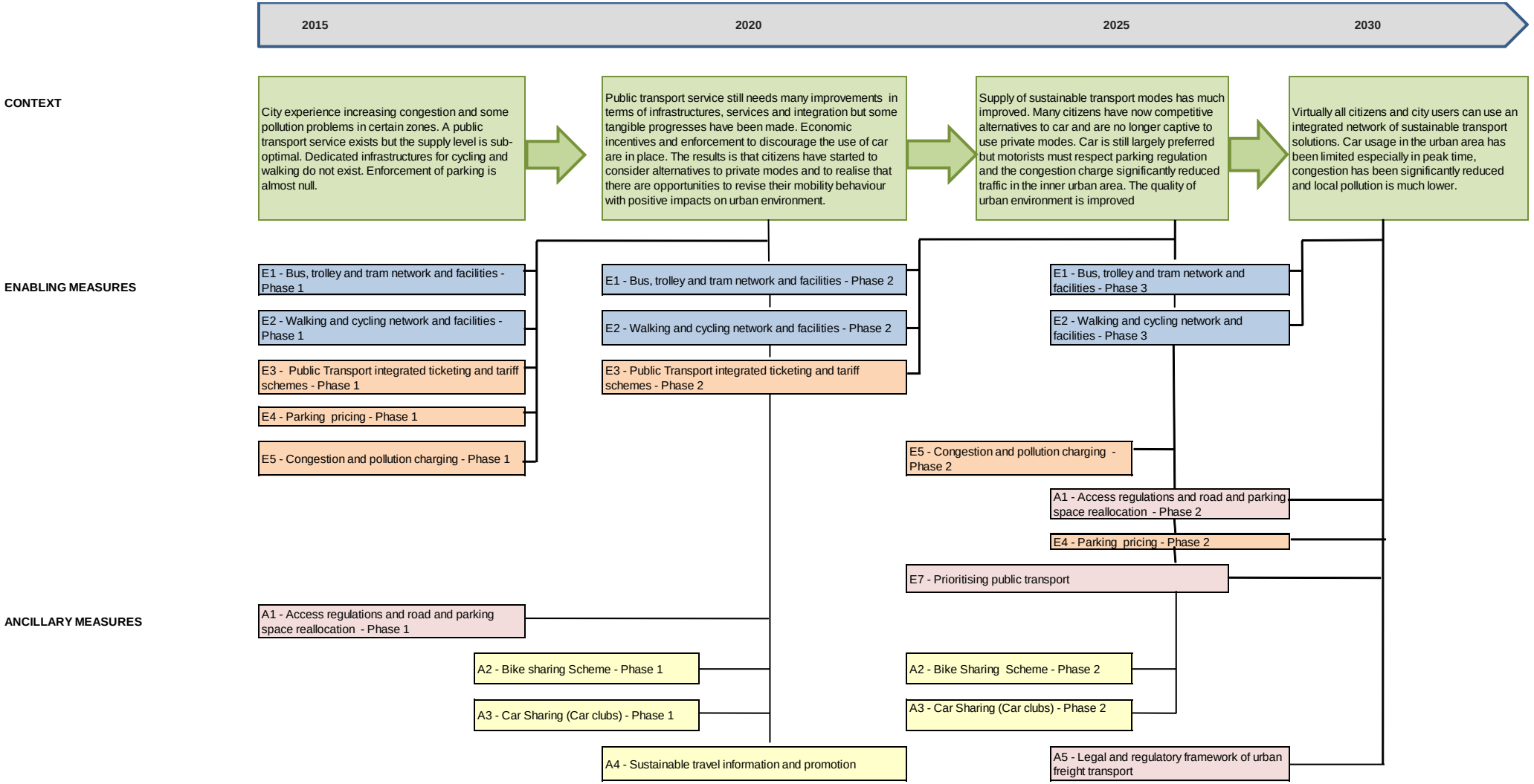
5.3 Charge and Provide roadmap

5.3.1 Initial conditions

Silverport[10] is a city with very limited experience in transport planning and environmental issues. It is a coastal city and for its geographic location it does not experience major problems with poor air quality, but traffic congestion is becoming a problem especially during the peak periods, when commuters reach the city centre mostly by car.

[10] Fictitious name

Figure 5-3: Overview of the "Charge and Provide" roadmap



Silverport city has an historic centre surrounded by a railway line and therefore it cannot expand the road network unless huge investments are made. But the city suffers from economic problems and high levels of unemployment, especially among young people. Huge infrastructure investments are not economically viable, especially in the current situation.

Notwithstanding, the new local government of the city has a specific focus on mobility issues and wants to tackle urban traffic problems in order to provide better living conditions for citizens.

The city is characterised by a compact city centre where commercial activities and part of the tertiary sector is located. It is surrounded by the modern part of the city whose road network is radial and converging to the centre. Distances are not large and the city is quite flat. Weather conditions are generally good, with few rainy days in the year.

5.3.2 Roadmap description

Initial phase

Mobility in the city is not very sustainable; a public transport service exists but the supply level is sub-optimal. Dedicated infrastructures for cycling and walking do not exist. Enforcement of parking regulation is almost non-existent. Therefore, the car is the dominant mobility alternative and the city experiences congestion and pollution problems in certain zones

The **improvement of public transport services** starts with low cost interventions. In particular, a careful review of the current public transport supply is made in order to remove existing inefficiencies and to guarantee a more reliable service.

At the same time a working group is appointed for defining a plan to introduce a smart travel card for **integrating ticketing** of urban public transport with regional services and, in perspective, with other transport services.

Parking regulation and pricing are introduced and enforced in the urban area. This measure is adopted to manage car use, improve the urban environment and raise funds for additional investment in transport facilities.

With the same purpose, after a careful planning phase, a **congestion charge** to enter the city centre is implemented. Monitoring infrastructure is installed, the payment system is set up and all other facilities (signs, information panels, etc.) are put in place, prior to the charging scheme being introduced.

As a flanking measure, the planning and implementation of a **new pedestrian zones** is started also using the **reallocation of road and parking space**.

Short term

Public transport services still needs many improvements in terms of infrastructure, services and integration but some tangible progress has been made. Economic incentives and enforcement to discourage the use of cars are now in place. The result is that citizens have started to consider alternatives to private transport modes and to realise that there are opportunities to revise their mobility behaviour with positive impacts on urban environment.

The additional financial resources generated from parking pricing and the congestion charging scheme allow the further **expansion of public transport supply**. Frequencies on backbone lines are improved and new lines connecting peripheries and the charged area are set up.

Also, **integrated ticketing** of urban public transport services and regional services based on a smart travel card is started. Also congestion charge to enter the city centre and parking can be paid using the same smart card.

Part of the revenues from parking pricing and congestion charging are also earmarked for starting the **extension of walking and cycling networks**. A network or reserved cycling lanes

connecting key destinations (e.g. universities, secondary schools, main companies) is gradually being implemented.

A **car sharing** operator starts its pilot in the city, after having agreed with the municipality special conditions for entering and parking in the congestion charging area.

Also a **bike sharing** system is implemented. Bike sharing stations are developed at the interchange between the railway station and the city's long-distance coach station, as well as at other hot spots (university, city centre).

When bike sharing and car sharing services are fully operating, the functionality of the smart card used for integrated ticketing are extended to also cover the payment of these services, either integrated or not integrated with public transport.

Advertising the improvements of the public transport service and the availability of new services and mobility opportunities is the objective of a **campaign to promote sustainable transport** which is being implemented with the support of all transport operators.

Medium term

Thanks to the investments in public transport services, cycling lanes and walking paths (paid for from the revenues raised from car parking and congestion charging) and also thanks to the introduction of car sharing and bike sharing services, the supply of sustainable transport modes has much improved. Many citizens now have competitive alternatives to the car and are no longer limited to using private transport modes. The car is still largely preferred but motorists must respect parking regulations and the congestion charge has significantly reduced traffic in the inner urban area. The quality of the urban environment is improved.

Public transport supply is further improved through increased frequencies and provision of new services. Furthermore, measures for the **prioritization of public transport** are implemented. For instance, given that cars now use less space it is easier to use part of the road to build reserved bus lanes.

Also the **cycling network** is further extended in order to connect different zones of the cities. **Pedestrian areas** are increasingly being implemented especially in zones where shops and leisure activities are located.

Bike sharing is gradually extended in the urban area for serving more zones. Bike sharing stations are fully integrated in the public transport network and bike is an alternative also for the "last mile" of commuters' trip.

Since citizens now have various competitive alternatives to car, the **congestion charge** zone is extended, covering a bigger part of the urban area.

The extension of the charged area provides new incentives to the **car sharing** operator which decides to expand the vehicle fleet. New economic conditions are negotiated with the municipal authorities and new revenues are available from the car sharing initiative.

Low emission zones and parking areas are also progressively implemented in the city in order to stimulate the shift to non-conventionally fuelled vehicles and improve the sustainability also of trips made by car.

After the initial effort concentrated mainly on personal mobility, also freight traffic is considered. A **legal and regulatory framework for urban freight transport** is established in order to regulate the access of commercial freight vehicles by setting up fixed delivery time windows, defining a primary network of roads for use by delivery vehicles and reducing conflicts with pedestrians and cyclists.

Long term

In the long term virtually all citizens and city users can use an integrated network of sustainable transport solutions. Car usage in the urban area has been limited especially in peak time, congestion has been significantly reduced and local pollution is much lower.

5.3.3 Implementation issues

When the roadmap is implemented citizens can enjoy a significantly improved public transport service. However, since the budget is initially limited, parking pricing and road charging play key initial roles in order to raise funds. However, these measures are generally very unpopular. Although an immediate cost can be more than offset by larger benefits enjoyed later, the time lag between the higher costs and the improved transport service is politically challenging.

The following implementation aspects linked to the specific measures should be taken into account:

- **Road user charging** is generally not popular at least before its introduction. The overall strategy of the roadmap should be clearly explained to citizens, especially to make clear that the provision of better services and the charging policy are linked together. The planning phase requires the involvement of citizens and stakeholders to ensure that benefits of restrictions and regulations are understood.
- **Road user charging** can be linked to instruments such as mobility credits, which enable objections concerning equity to be tackled even if the complexity of the system increases and there are no experiences of practical applications of this principle.
- **Parking regulation and pricing** is often a very politically sensitive measure. In many places citizens are used to parking their cars close to their final destinations, often for free. This habit is often perceived as a right and any attempt to modify this situation can give rise to strong opposition.
- **Integrated ticketing** cannot be planned or decided at the urban level alone. The cooperation of regional operators and probably of urban operators of other cities is needed. A single city can stimulate the other institutions but cannot proceed independently.
- **Car sharing** services are commercially viable only in cities over a certain dimension. Cities with fewer than 50000 inhabitants are probably too small to attract car sharing operators. Alternative forms of car sharing (e.g. the sharing of private and/or public vehicle fleets) might be more viable and might be supported by the municipal authorities under the form of tax breaks.
- **Bike sharing** schemes are generally characterised by low profitability and therefore might need to be subsidised by the municipality. To increase revenues, bikes might be customised for displaying advertising messages of private clients who pay for the publicity.
- The effectiveness of **bike sharing** depends on several practical conditions, e.g.:
    - stations and bikes are well maintained;
    - the system is easy to understand;
    - various types of registration are offered;
    - combination and synergies with public transport;
    - fees structured to encourage use for short trips;
    - effective redistribution systems to redistribute bikes.
- **Integrating different transport services** (buses, car sharing, bike sharing, etc.) is appealing from a user perspective, but when transport services are provided by independent private operators, integration may be difficult because each provider perceives others as competitors. Problems might arise especially in terms of revenues redistribution. Opposition may be expected from operators whose freedom to set fares may be reduced. From a social point of view, cooperation is preferable but from a

private point of view competition might prevail. The role of the public institutions here is critical either in terms of setting rules or even in terms of establishing a single public operator for all services.

- **Pedestrian and cycling facilities** should be designed as a network and not as independent interventions here and there (e.g. a cycling lane in a road not connected to a full cycling network). When several cycling and walking interventions are implemented at the same time or in quick succession, the impacts of interventions can be far greater due to their synergic effect.
- Delivery of goods (time, frequency, etc.) is often dictated by retailers' preferences and constraints rather than by hauliers. The **regulatory framework for urban freight transport** should be therefore discussed also or even especially with the representatives of activities receiving goods.

5.3.4 Main stakeholders involved

The city authorities are the main actors of the roadmap aimed at achieving the sustainability targets. However, the involvement of various stakeholders is advisable as their cooperation, since the design phase, is a key requirement for a successful implementation of roadmap content. The main relevant stakeholders for the “Charge and Provide” roadmap are:

- **Local transport operators**. The local transport operators should manage the improvement of the public transport supply and therefore they are key stakeholders for the design of the new infrastructures and services.
- **Local business associations** (e.g. associations of retailers). Especially as far as the regulatory framework for urban goods distribution is concerned it is fundamental that real world problems and constraints are considered and plans are not based on abstract concepts. Local business associations should be therefore involved very early in the planning of the measures.
- **Regional transport operators.** Unless the city is very large and several public transport providers operate in the urban area, integrated ticketing is especially relevant to integrate urban transport with regional transport. So its development should necessarily involve the regional transport operators (which would also share the financial burden).
- **Urban transport operators in other cities.** A ticketing system integrating urban and regional transport is meaningful when more cities are part of the network. Therefore the public transport operators in other cities should be involved in the design and the implementation of such a system.

6 Impact of the roadmaps

The web based policy support tool has been used to quantify the impacts of the policy roadmaps described in the chapter above. Nevertheless, since the urban mobility system is described in the tool at a strategic level, several assumptions have been made and a simplified approach has been required in some cases to represent the strategy of each policy roadmap.

Each policy roadmap has been applied to a specific but hypothetical city configuration in a nominal country, according to the overview provided in the general description of the roadmap.

6.1 "Promote & Regulate"

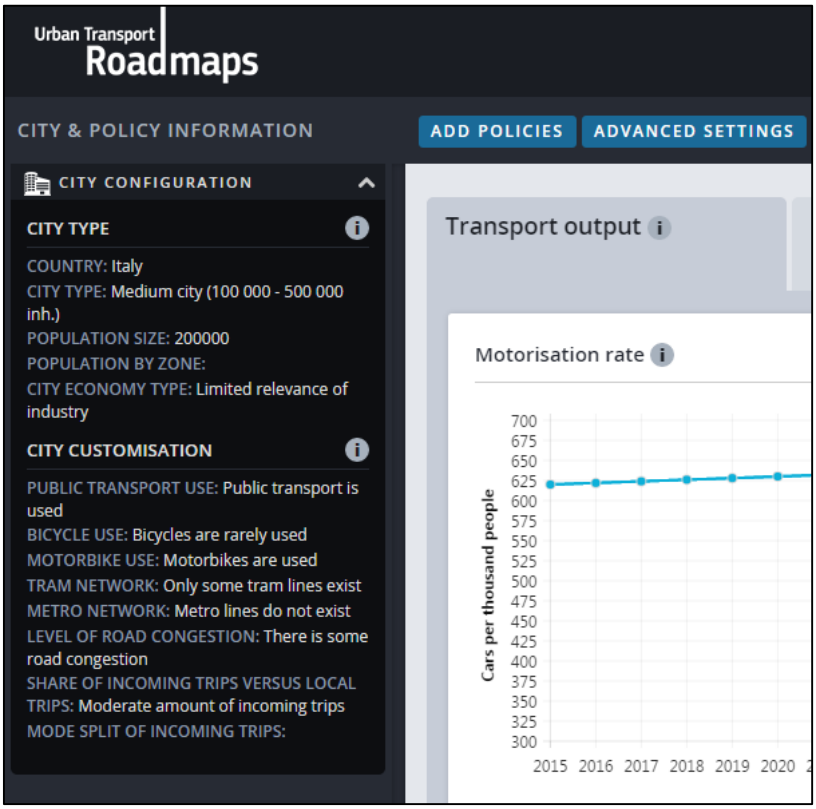
6.1.1 Implementation of the roadmap in the policy support tool

The "Promote and Regulate" roadmap has been applied to a hypothetical medium size city of about 250,000 inhabitants in Italy, assuming a period of stagnation in terms of population growth and without sprawling issues. Some road congestion is observed at the base year, although private motorised modes are used by about 48% of the internal mobility (car 44% and motorbike 4%). Public transport services are used (although not extensively, about 20% mode share) and provide bus and tram rides in the urban area with a limited amount of reserved lanes (between 5% and 15% of the public transport network length). Bikes are rarely used and a limited number of bike reserved paths exist (1% or less of the road network length). Most of the parking lots are free; only 10% of parking slots in the urban area are charged with a tariff of 1 Euro/hour.

Table 6-1: "Promote and Regulate" roadmap: Initial configuration

Context	Indicator	Value
City	City type	Medium city (100,000 – 500,000 inh.)
	Population	250,000 inhabitants
	Country	Italy
	Population trend	Stagnation (0% growth)
	Sprawling trend	No sprawl
	City economy	Limited relevance of industry
	Income	Medium average income per capita
Mobility	Road congestion	There is some road congestion
	Mode split of internal mobility	Pedestrian 30% Bike 2% Motorbike 4% Car 44% Bus 16% Tram 4% (no metro)
	Parking fare	1 euro/h
	Parking regulation	Most of parking lots are free (10% of parking slots in the urban area are charged)
	Public transport reserved lanes	Limited amount (5% to 15% of the public transport network length)
	Total PT network	300 km
	Cycling reserved lanes	Negligible amount (Less than 1% of road network)
	Car sharing service	Not available
	Park & ride service	Not available

Figure 6-1: "Promote and Regulate" roadmap: Overview of the web based initial configuration



The implementation of the policies follows the description of the roadmap (see section 5.1) as far as possible, although some simplifications have been required to simulate the timing of the interventions in different phases.

In order to regulate the use of cars and goods vehicles in the city, **traffic calming measures** are implemented from the beginning. In modelling terms, the policy is applied from 2016, with 11 years ramp-up period to simulate a gradual extension of traffic calming zones, up to 40% in urban core and 20% in outskirts good transit zone at the year 2027 (when the implementation ends).

An accompanying measure related to PT services is the **prioritisation of Public Transport.** Within the web based tool, the policy is applied from 2016 and it is modelled assuming a focus on the implementation of priority systems at traffic lights on 30% of the bus network. The building of additional bus reserved lanes is not foreseen.

Concerning **walking and cycling network/facilities**, the roadmap assumes an increasing implementation of new walking areas and extension of the cycling network over the whole period. In modelling terms, the policy is implemented focusing on reserved cycle reserved lanes. It is assumed that their development begins in 2016 and lasts for 12 years (i.e. the network is completed in the year 2028). At the end of the period, 30 km of cycling reserved lanes are added (from about 10 km to 40 km).

The roadmap involves the implementation of the policy related to **parking regulation and pricing**, enforcing the application and enlarging the area subject to the charge. Within the web based tool, the policy is applied from 2016 increasing the parking tariff with respect to the base year (1.2 euro/h, increased by 0.20 euro/h) and enlarging to 25% the share of urban area where parking is regulated (from 10% at base year). Furthermore, the roadmap suggests the progressive implementation of **low emission zones and parking areas** from 2016, in order to restrict the use of cars in certain areas of the city and stimulate the shift to non-conventionally fuelled vehicles. Therefore, in the model, parking tariffs are discounted from 2016 for hybrid electric vehicles, battery electric vehicles, and hydrogen fuel cell vehicles. In addition, low emission zones are implemented where only low emission alternatively fuelled vehicles are

allowed to operate. The low emission zones comprise 15% of the network in the urban core of the city and 5% of the network in the outskirts with a good transit service.

The policy related to **Public Transport integrated ticketing and tariffs scheme** aims at implementing some forms of integrated ticketing and revise the tariff schemes to make the PT service more attractive. Within the web based tool, it is assumed that the policy is applied since 2016 with a slight revision of the tariffs and with six years needed for the implementation of integrated ticketing. The fares are revised as follows with respect to the base year: the ticket fare for commuters is reduced by 0.05 Euro and the regular ticket is increased by 0.05 euro (i.e. commuters pay 0.55 Euro/trip and regular ticket costs 1.25 euro/trip).

In order to promote alternative forms of mobility, a **bike sharing** service is developed after a few years, with a gradual extension over time in the urban area for serving more zones. Within the web based tool, the policy is applied from 2020, with 5 years ramp-up period (the implementation ends in 2024). The service is provided with an annual fee of 40 Euro/year and the urban area served by bike sharing stations is gradually increased to cover up to 40% of the urban area at the year 2024.

At the same time, also a **car sharing** operator is expected to start its pilot in the city. In modelling terms, a one way service (cars can be collected and returned in any point in the city) is assumed to be available from 2020. The annual fee is 20 Euro/year, while the usage fee is 15 Euro/h (0.25 Euro/min). The average walking time to pick up a car is about eight minutes.

The roadmap also includes the implementation of policies related to **sustainable travel information and promotion**, in order to communicate to citizens the availability of new services and mobility opportunities. In the web based tool, the policy is applied from 2016.

At the same time, a **legal and regulatory framework for urban freight transport** is established in order to regulate the access of commercial freight vehicles by setting up fixed delivery time windows. In modelling terms, the policy is activated from 2016.

A few years later, also **delivery and services plans** are applied with the aim of reducing the number of freight vehicles used for the distribution of goods to city retailers. In modelling terms, the policy is applied from 2020 and after 2 years results are fully achieved.

Table 6-2: "Promote and Regulate" roadmap: implementation

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
Demand Management	Sustainable travel information and promotion	Yes From 2016		
	Bike sharing scheme		Yes, Phase 1 Start in 2020 completed in 2024 Tariff: 40 euro/year Coverage: 8% of the urban area in the year 2020 progressively increased up to 40% at 2024	Yes, Phase 2
	Car sharing (Car Clubs)		Yes, Phase 1 Start in 2020. System: one way Tariff: 20 euro/year, 15 euro/h (0.25 Euro/min) Coverage: 8 minutes walking to pick up a car	Yes, Phase 2
	Delivery and Servicing Plans		Yes From 2020	

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
	Land-use planning - density and transport infrastructure			
Green Fleets	Green energy refuelling infrastructures			
	Green public fleets			
Infrastructure Investments	Bus, trolley, tram network and facilities			
	Walking and cycling network and facilities	Yes, Phase 1 Start in 2016, completed in 2028 30 km extension of cycling reserved lanes (from 10 km to 40 km)	Yes, Phase 2	Yes, Phase 3
	Park and ride			
	Metro network and facilities			
	Urban Delivery Centres and city logistics facilities			
Pricing and financial incentives	Congestion and pollution charging			
	Parking pricing	Yes From 2016 Tariff: 1.2 euro/h (increased by 0.20 euro from base year) Coverage: 25% of urban area (compared to10% in base year) From 2016 Low emission parking: parking tariff discounted for Hybrid electric, Battery electric, fuel cells vehicles		
	Public Transport integrated ticketing and tariff schemes	Yes, Phase 1 From 2016 New fares and integrated ticketing (5 year ramp-up for integrated ticketing) • Fare working -0.05 euro (0.55 euro/trip from 0.6 euro/trip) • Fare personal +0.05 euro (1.25 euro/trip from 1.2 euro/trip)	Yes, Phase 2	
Traffic management and control	Legal and regulatory framework of urban freight transport	Yes From 2016		
	Prioritising Public Transport	Yes Start in 2016, completed in 2025 • No additional reserved lanes • Bus prioritisation on 30% of the bus network		
	Access regulations and road and parking space reallocation	Yes From 2016 low emission zones (15% of the		

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
		urban core road network and 5% of the network in outskirts with good transit service)		
	Traffic calming measures	Yes Start in 2016, completed in 2027 Gradual increase of traffic calming zones, up to 40% in urban core and 20% in outskirts good transit zone at 2030 (0% outskirts poor transit)		

6.1.1 Impact of the roadmap

The roadmap has been simulated using the policy support tool. The simulation covered the policy scenario (see Section 4) associated with this roadmap under the assumption of reference exogenous trends.

First of all, with reference to the target of halving the use of conventional vehicles accessing the city centre by 2030 (with respect to 2015) the policy roadmap is relatively close to the objective, achieving a reduction of about 37% of vehicle-km travelled by conventional cars (gasoline/diesel). Nevertheless, it should be noted that already in the reference scenario there is a 28% reduction of the vehicle-km travelled by conventional cars as effect of the penetration of hybrid vehicles in the fleet. Therefore the additional impact of the roadmap is a further 9% reduction in the year 2030.

Figure 6-2: "Promote and Regulate" roadmap: impacts on conventional car vehicle-km

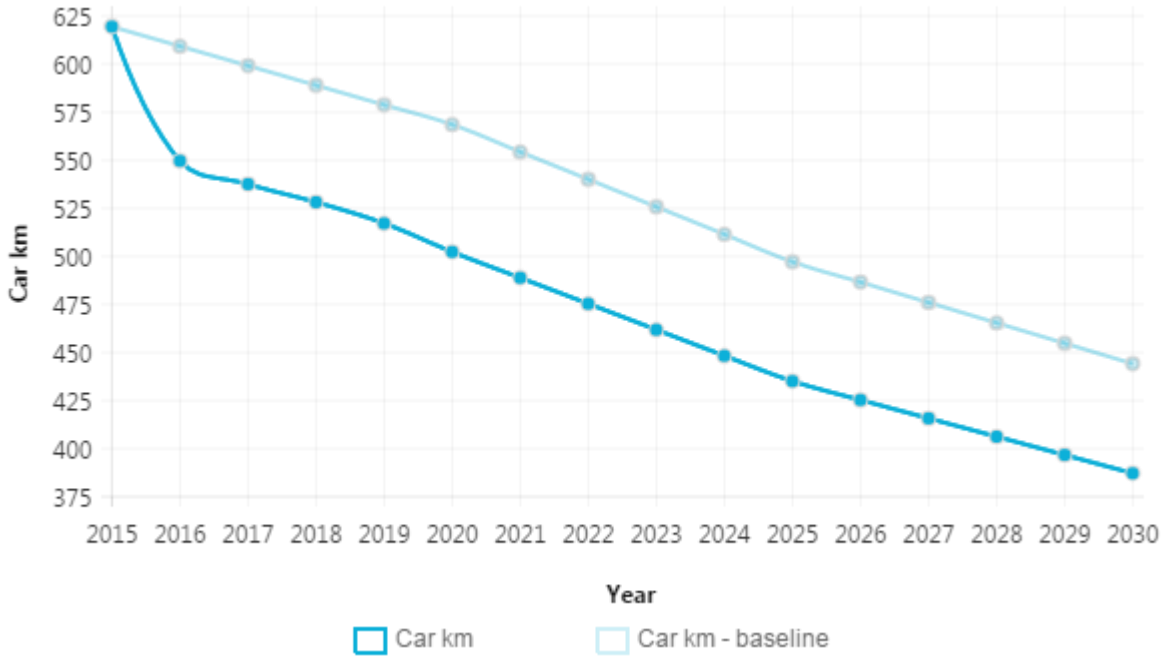
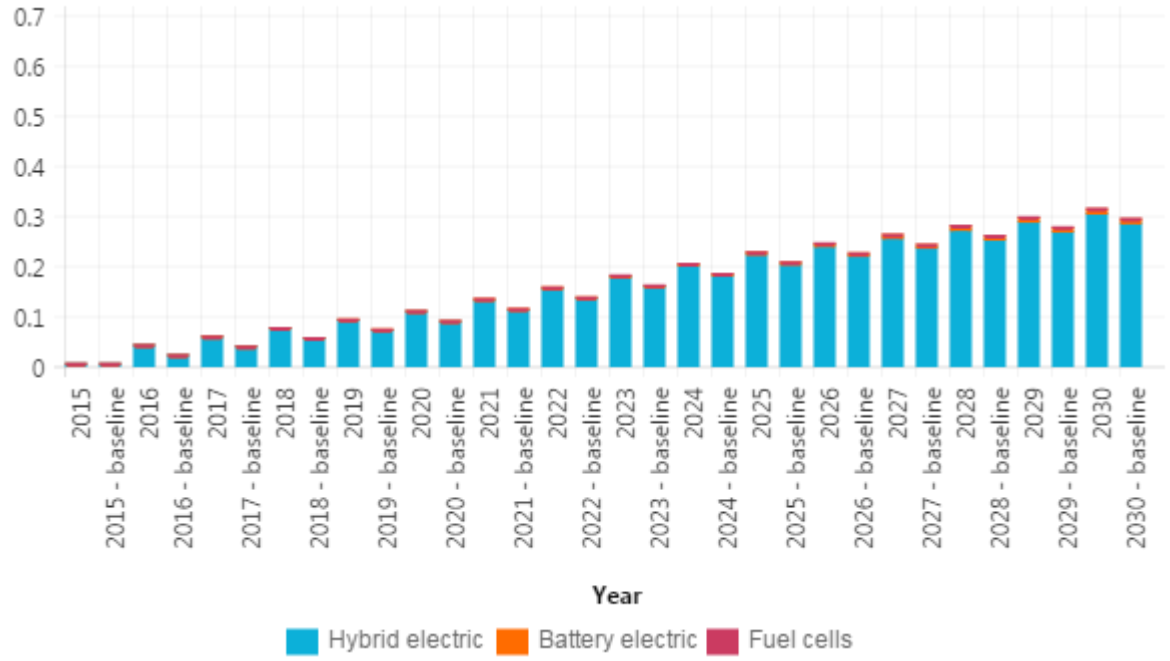


Figure 6-3: "Promote and Regulate" roadmap: impacts on penetration of alternatively fuelled car vehicle

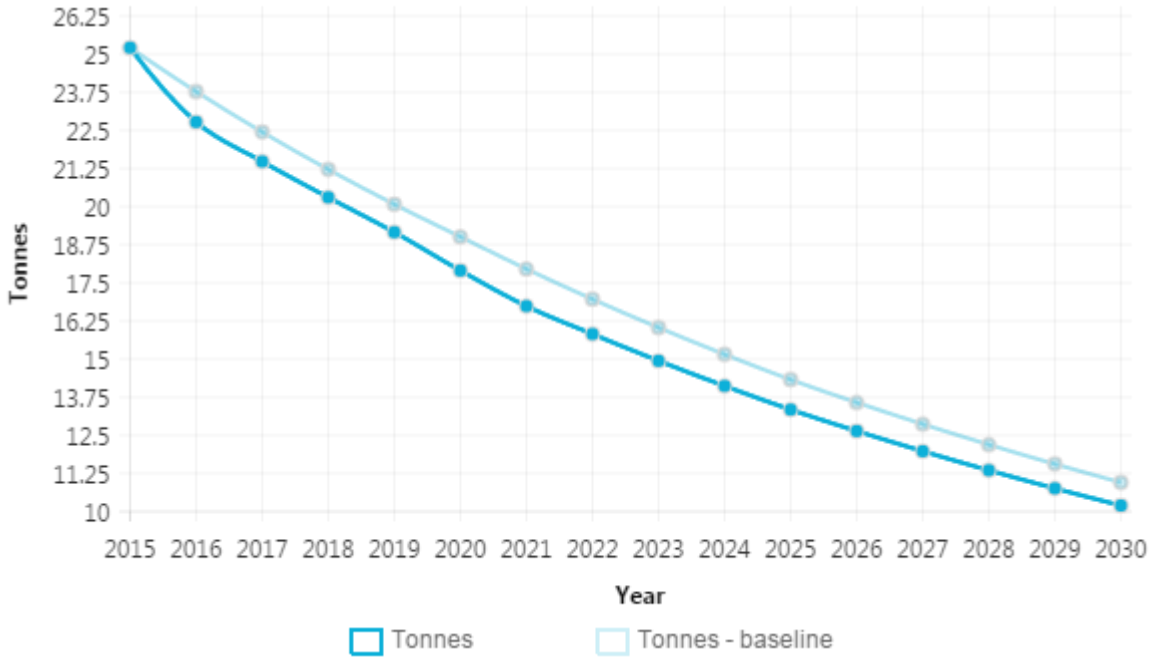


This impact is mainly related to the mode shift induced by the roadmap. Considering all mobility in the urban area (i.e. including also incoming trips from outside the city) the mode share of public transport increases by up to 26% by 2030 in comparison to 24% in the reference scenario. At the same time, the share of passenger car traffic decreases to 37% at 2030 (from 43% in the reference scenario). Some contribution comes also from more innovative vehicles in the fleet: 31% instead of 29%.

Despite fewer car trips, the average speed of cars in peak time reduces by around 4% with respect to the reference scenario. This effect is due to the implementation of policies mainly focusing on the regulation of the use of cars (e.g. traffic calming in many parts of the city specifically aimed at reducing car speed) and the prioritisation of public transport combined with the improvement of its services. Taking also into account that some demand shifts on public transport and that this alternative is slower than car (despite the traffic and the bus prioritisation in the roadmap), the economic value of total travelled time is higher in the policy scenarios than in the reference scenario.

Already in the reference scenario, CO_2 and PM emissions are reduced by 15% and 56% respectively thanks to the fleet renewal. The impact of the roadmap is in the order of a further 5 - 6% reduction. The environmental benefit is therefore lower than the reduction of the vehicle-km travelled by conventional cars.

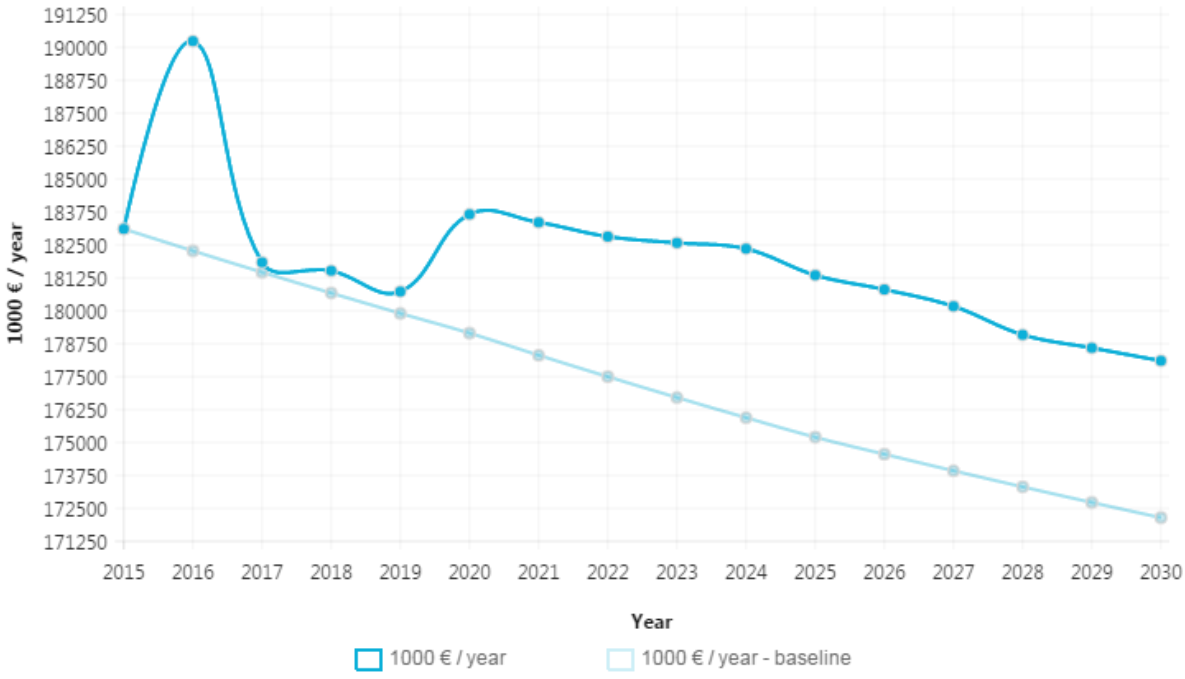
Figure 6-4: "Promote and Regulate" roadmap: impacts on PM yearly emissions



A positive effect of the roadmap is estimated on the safety side; fatalities per 100,000 inhabitants are reduced by 5% in comparison to the reference scenario.

Looking at the impacts in terms of transport social monetary cost, the roadmap shows an increased cost for the city: about 6 million euro per year from 2020 to 2030. The bill is however mainly paid by citizens: the average yearly expenditure for transport per individual is 4% higher.

Figure 6-5: "Plan and build" roadmap: impacts on transport social monetary costs



From the local authority point of view, thanks to some extra revenues (some 23% more revenues than in the reference scenario considering the whole period 2015-2030 with discounted values) resulting from parking pricing and the additional PT users, the investments in the policies are financially covered and the economic balance of the roadmap is positive:

the net financial result[11] of the local administration for the transport sector is always in deficit but with respect to the reference scenario the negative difference between expenditure and revenues is reduced by about 33 million Euros considering the whole period 2015-2030.

Figure 6-6: "Promote and Regulate" roadmap: impacts on transport expenditure of the local authority

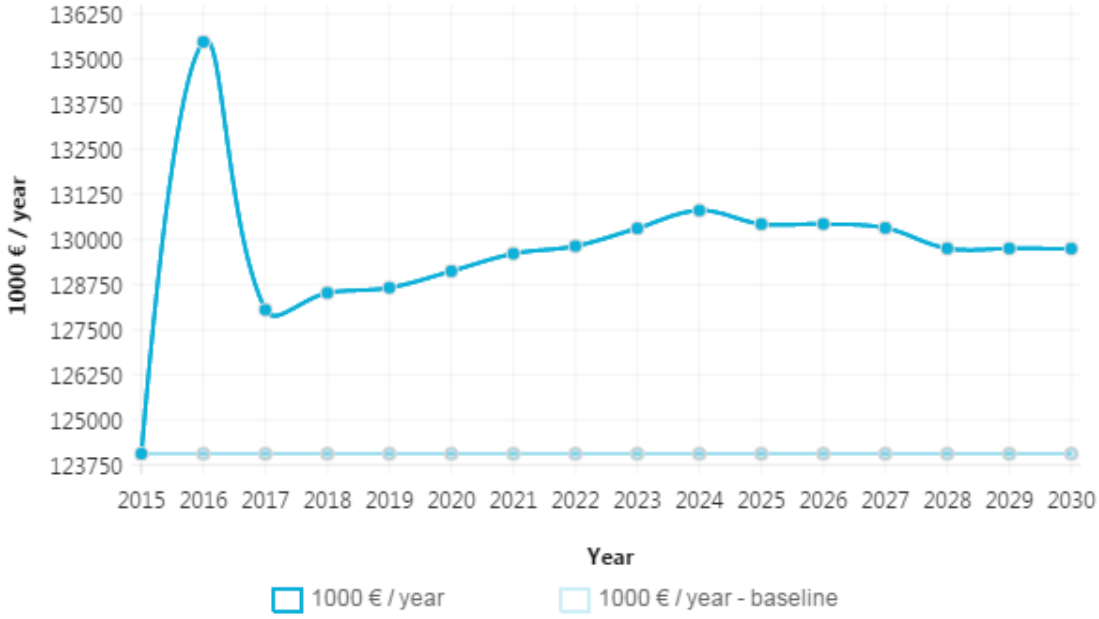
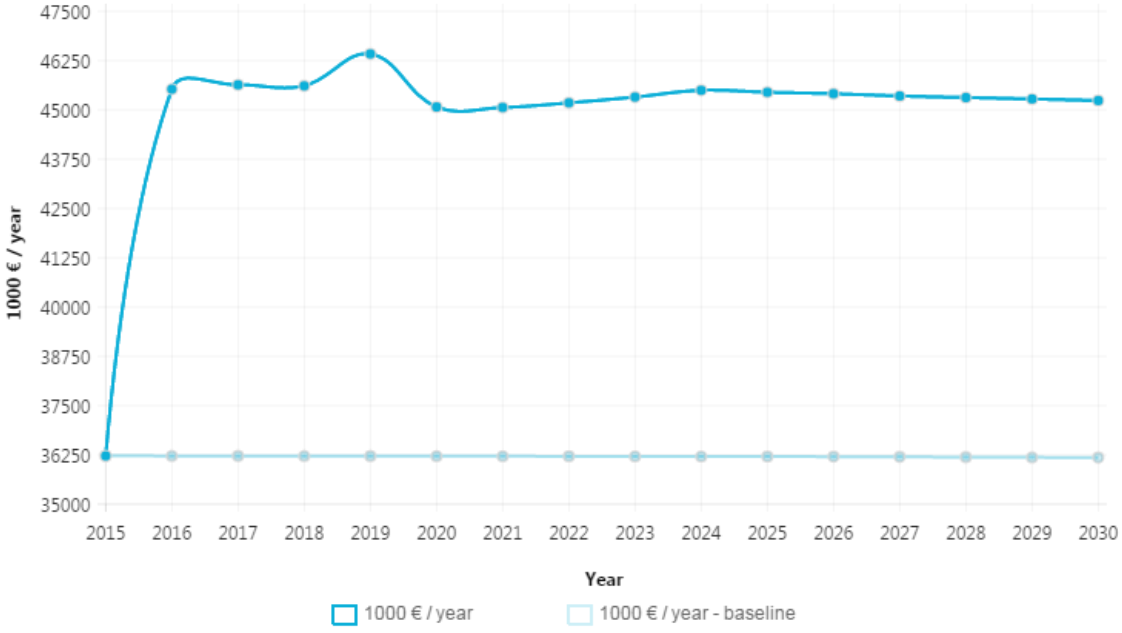


Figure 6-7: "Promote and Regulate" roadmap: impacts on transport revenues of the local authority



For the local authority the implementation of the roadmap is therefore financially positive.

All in all, this approach is an example of a roadmap with limited ambitions and limited effects.

Table 6-9 below provides some key results extracted from the output of the tool. The main indicators are reported with their value at the base year 2015, at the year 2030 according to the reference trend (without the implementation of the policy scenario) and at the year 2030 according to the roadmap implementation. The percentage variations with respect to both the base year and reference trend at 2030 are also provided.

[11] Difference between the total revenues and the total transport expenditure for the public administration. The difference is computed year by year, cumulated over the whole period 2015-2030 and discounted to base year values with a discount rate of 5%.

Table 6-3: "Promote and Regulate" roadmap: main impacts at the year 2030

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030
Transport	Vkm travelled by conventional cars (gasoline/diesel) (Mio vkm/year)	Abs. Value	619.5	444.1	387.9
		% Diff. to base year		-28.3%	-37.4%
		% Diff. to Reference		0.0%	-12.7%
	Car mode share		41.9%	43.2%	37.5%
	PT mode share		23.9%	23.8%	25.9%
	Average distance per trip (km)	Abs. Value	3.2	3.2	3.2
		% Diff. to base year		0%	0%
		% Diff. to Reference		0%	0%
	Average car speed in peak hours (km/h)	Abs. Value	36.0	35.2	33.9
		% Diff. to base year		-2.2%	-5.9%
		% Diff. to Reference		0.0%	-3.8%
	Value of travelled time per individual (1000 Euro/year)	Abs. Value	3.586	3.560	3.678
		% Diff. to base year		-0.7%	2.6%
		% Diff. to Reference			3.3%
	Penetration of alternatively fuelled car vehicles		0.5%	29.4%	31.3%
Environment and safety	CO2 emissions (t/year)	Abs. Value	138,461	116,865	110,632
		% Diff. to base year		-15.6%	-20.1%
		% Diff. to Reference			-5.3%
	PM emissions (t/year)	Abs. Value	25.2	10.9	10.2
		% Diff. to base year		-56.7%	-59.5%

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030
		% Diff. to Reference			-6.4%
	Fatalities per 100,000 inhabitants	Abs. Value	6.3	5.7	5.4
		% Diff. to base year		-8.8%	-13.7%
		% Diff. to Reference			-5.4%
Economy	Transport expenditure per individual (1000 Euro/year)	Abs. Value	1.147	1.124	1.167
		% Diff. to base year		-2.0%	1.7%
		% Diff. to Reference			3.8%
	Transport expenditure of public administration 2015-2030 (million Euro)	Abs. Value		1,412	1,474
		% Diff. to Reference		0.0%	4.4%
	Revenues of public administration 2015-2030 (million Euro)	Abs. Value		412	508
		% Diff. to Reference		0.0%	23.3%
Economic balance	Net financial result of Public administration 2015-2030 (million Euro)	Abs. Value		-1,000	-966
		Abs. difference		0	33

6.2 "Plan & Build"

6.2.1 Implementation of the roadmap in the policy support tool

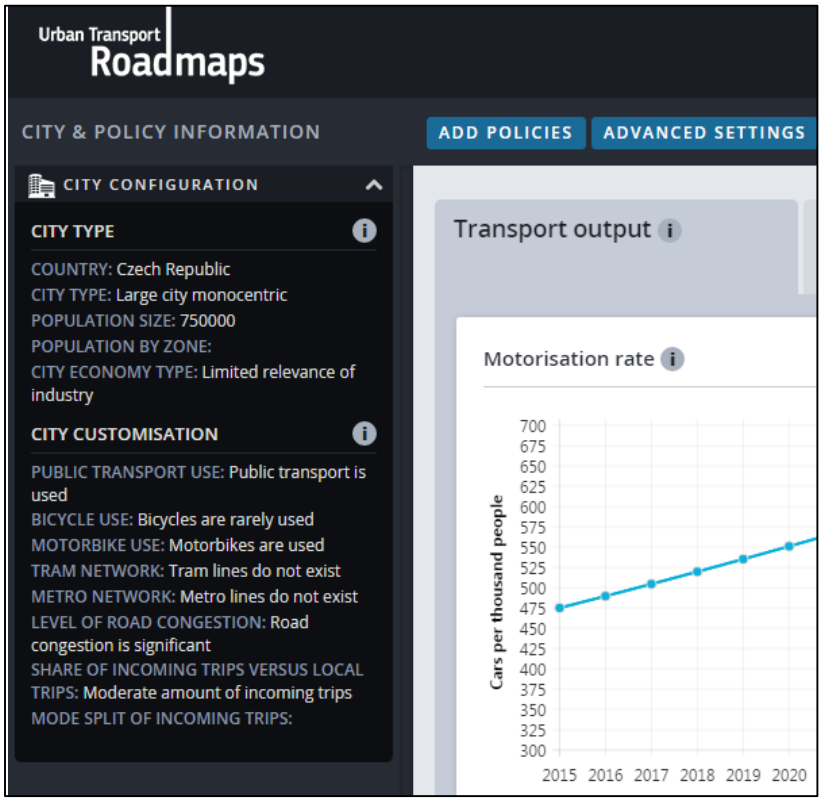
The "Plan and Build" roadmap has been applied to a hypothetical large, mono-centric city of about 750,000 inhabitants in Czech Republic, assuming a period of stagnation in terms of population growth and with some sprawling issues. Road congestion is significant at the base year, since private motorised modes are used by more than 50% of the internal mobility (car 47% and motorbike 4%). Public transport services are used (although not extensively) and provide bus rides in the urban area with a limited amount of reserved lanes (between 5% and 15% of the public transport network length). Bikes are rarely used and cycling reserved paths are almost negligible (1% or less of the road network length).

Most of parking lots are free: only 10% of parking slots in the urban area are charged with a tariff of 1 euro/hour.

Table 6-4: "Plan and Build" roadmap: Initial configuration

Context	Indicator	Value
City	City type	Large city mono-centric
	Population	750,000 inhabitants
	Country	Czech Republic
	Population trend	Stagnation (0% growth)
	Sprawling trend	Some sprawl
	City economy	Limited relevance of industry
	Income	Medium average income per capita
Mobility	Road congestion	Road congestion is significant
	Mode split of internal mobility	Pedestrian 32% Bike 2% Motorbike 4% Car 47% Bus 15% (no tram, no metro)
	Parking fare	1 euro/h
	Parking regulation	Most of parking lots are free (10% of parking slots in the urban area are charged)
	Public transport reserved lanes	Limited amount (5% to 15% of the public transport network length)
	Total PT network	700 km
	Cycling reserved lanes	Negligible amount (less than 1% of road network)
	Car sharing service	Not available
	Park & ride service	Not available

Figure 6-8: "Plan and Build" roadmap: Overview of the web based initial configuration



The implementation of the policies has followed as much as possible the description of the roadmap (see section 5.2), although some simplifications have been required to simulate the timing of the interventions in different phases.

The roadmap involves first of all the implementation of the policy related to **urban land use planning** which is critical to the whole roadmap. In modelling terms, the plan for the future development of the city is implemented assuming a twofold approach, aiming on one hand at restoring living places in the urban core and on the other hand planning new sustainable settlements. In addition, the provision of public houses in the urban core is foreseen.

The policy related to **bus network and facilities** aims at providing a more reliable PT supply, improving the service at a first step and extending the network with Bus Rapid Transit (BRT) lines on main routes afterwards. Within the web based tool BRT are assimilated to tram lines. It is assumed that the policy is implemented from 2016: a moderate improvement of frequency (the assumed average reduction of headways is 3 minutes) is foreseen on 30% of the existing bus network, combined with a 30 km extension of the **tram network and facilities**.

An accompanying measure related to PT services is the **prioritisation of Public Transport.** Within the web based tool, the policy is applied from 2016 and it is modelled assuming a focus on the implementation of priority systems at traffic lights on 20% of the bus network. The building of additional bus reserved lanes is not foreseen.

The improvement of bus service requires also the implementation of the policy related to **green public fleets**: starting from 2016, an investment of the city authority for 9 years is assumed to purchase 'clean' public transport vehicles (i.e. substitution of about 50 vehicles per year).

Another component of the plan is the promotion of zero emissions vehicles in the urban area by means of the provision of **battery recharge infrastructures** throughout the city. Within the web based tool, the policy is applied from 2016. It is modelled assuming that the urban area served by electric fuelling stations is gradually increased to cover up to 30% of the urban area.

A new front concerning public transport supply is opened with the development of **Park&Ride** terminals at the border of the city centre. In modelling terms, the policy is implemented

assuming that their development begins in 2020 and lasts for 3 years (i.e. the parks and PT network facilities are completed in the year 2023). At the end of the period, 4,000 new parking slots are provided, with a PT connection to the city centre covered by 15 km of rides with a frequency every 15 minutes.

Having improved and enlarged the PT services, an accompanying measure required is the implementation of the policy related to **sustainable travel information and promotion**, in order communicate to citizens the availability of new services and mobility opportunities. In the web based tool, the policy is applied from 2020.

On the freight side, **delivery and services plans** are applied to reduce the number of freight vehicles used for the distribution of goods to city retailers. In modelling terms, the policy is applied from 2020 and after 2 years results are fully achieved.

The last piece of the transport infrastructures roadmap designed in the City Plan concerns freight. **City logistics facilities** are built to collect and consolidate freight shipments: within the web based tool, the policy starts in 2025 and it is completed by 2029 with the construction of three centres.

Table 6-5: "Plan and Build" roadmap: implementation

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
Demand Management	Sustainable travel information and promotion		Yes From 2020	
	Bike sharing scheme			
	Car sharing (Car Clubs)			
	Delivery and Servicing Plans		Yes From 2020	
	Land-use planning - density and transport infrastructure	Yes Land-use plan: partially restore living places in the urban core and partially plan new sustainable settlements. Provision of social housing in the urban core: unitary provision cost of social housing of 600 euro/sqm, unitary rent of social housing of 100 euro/sqm		
Green Fleets	Green energy refuelling infrastructures	Yes Start in 2016 Supporting battery electric vehicles Coverage: progressive increase of availability of electric fuelling stations up to 30% of the urban area		
	Green public fleets	Yes Start in 2016, completed in 2025 Target on reducing fuel consumption: 15% of fleet renewal (about 50 vehicles per year)		
Infrastructure Investments	Bus, trolley, tram network and facilities	Yes Start in 2016 moderate improvement of frequency on 30% of the PT network 30 km tram network extension (BRT)		

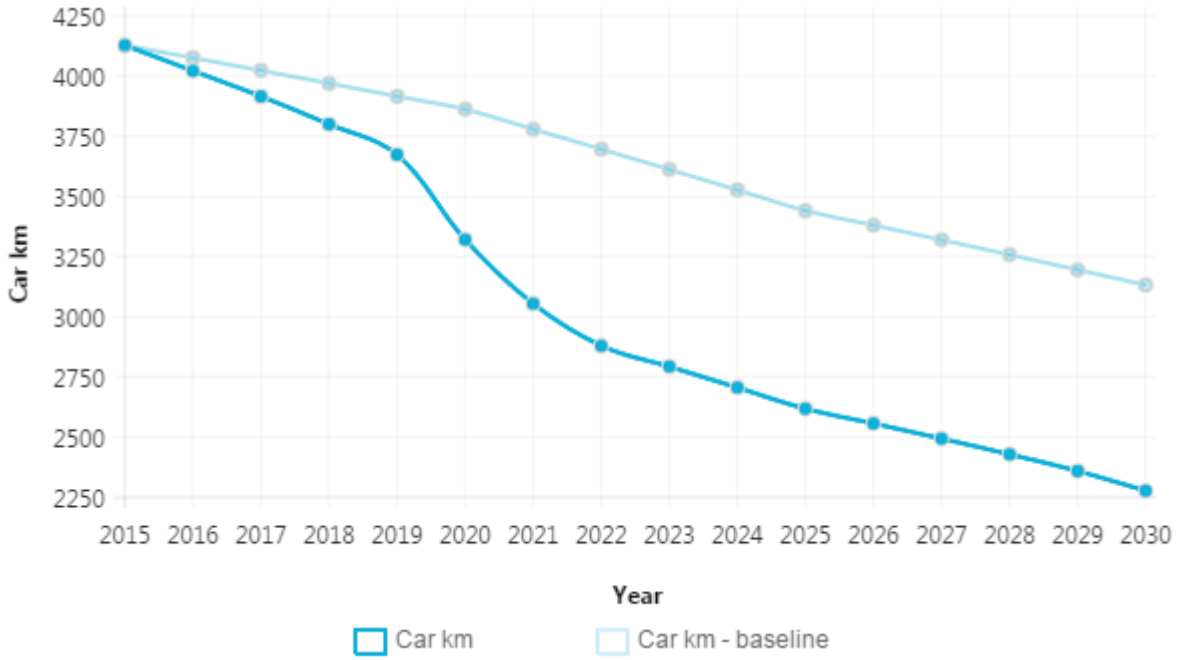
Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
	Walking and cycling network and facilities			
	Park and ride		Yes Start in 2020, completed in 2023 P&R capillarity of rides: 15 km P&R frequency of rides: 15 minutes P&R capacity of parks: 4000 slots	
	Metro network and facilities			
	Urban Delivery Centres and city logistics facilities			Yes Start in 2025 Building 3 new delivery centres
Pricing and financial incentives	Congestion and pollution charging			
	Parking pricing			
	Public Transport integrated ticketing and tariff schemes			
Traffic management and control	Legal and regulatory framework of urban freight transport			
	Prioritising Public Transport	Yes From 2016 • No new reserved lanes • Bus prioritisation on 20% of the bus network		
	Access regulations and road and parking space reallocation			
	Traffic calming measures			

6.2.2 Impact of the roadmap

The roadmap has been simulated using the policy support tool. The simulation covered the two policy scenarios (see Section 4) associated to this roadmap; the case under the assumption of reference exogenous trend as well as the case when an alternative trend is implemented (see paragraph 2.2) where a faster development of vehicle technology and higher fuel prices due to energy shortage is assumed.

First of all, with reference to the target of halving the use of conventional vehicles accessing the city centre by 2030 (with respect to 2015) the policy roadmap is close to the objective, achieving a reduction of about 45% of vehicle-km travelled by conventional cars (gasoline/diesel). The impact is further enhanced in combination with the alternative trend, which allows to overcome the target with a reduction of about 58%. Technology already plays a role; in the reference scenario there is a 24% reduction of the vehicle-km travelled by conventional cars as effect of the penetration of hybrid vehicles in the fleet. However the roadmap is also effective. First the roadmap support an even faster renewal of the fleet. The share of alternatively fuelled vehicles in 2030 is about 29% in the reference scenario and grows to 41% in the roadmap scenario under the reference trend and to 51% under the alternative trend.

Figure 6-9: "Plan and build" roadmap: impacts on conventional car vehicle-km with Reference trend



Another contribution provided by the roadmap is modal shift. Considering the whole mobility in the urban area (i.e. including also incoming trips from outside the city) the mode share of public transport is increased by 2030 up to 34% in comparison to 27% in the reference scenario. At the same time, the car share is decreased to 37% (44% in the reference scenario).

Furthermore, land use planning allows the slowdown in the growth of average trip distances due to the sprawling of the city. In the reference scenario the average trip in the year 2030 is 8% longer than in the year 2015. In the roadmap scenario the growth is limited to 5%.

As a whole, the roadmap adds a further 27% reduction of vehicle-km travelled by conventional cars (or 44% under the assumption of faster technological development).

The modal shift also has some positive effects on congestion; the average speed of cars in peak hours improves by some 4% with respect to the reference case (even though the speed is almost unchanged with respect to the base year; the roadmap prevents a worsening of the situation rather than providing an improvement). Congestion reduction does not mean that less time is spent travelling on average. On the contrary, since public transport is slower than cars (despite the traffic and the bus prioritisation in the roadmap), the economic value of total travelled time is higher in the policy scenarios than in the reference scenario.

Already in the reference scenario CO_2 and PM emissions are reduced by 14% and, respectively 55%, thanks to the fleet renewal. The impact of the roadmap is in the order of a further 9% reduction for CO_2 and 11% reduction for PM. The environmental benefit is related to the reduction of the vehicle-km travelled by conventional cars, especially considering the penetration of innovative vehicles in the fleet, but it is less than directly proportional. The

alternative trend, thanks to the faster technological improvements, produces stronger results on the environmental side.

Another positive effect of the roadmap is estimated on the safety side: fatalities per 100,000 inhabitants are reduced by 11% in comparison to the reference scenario.

Figure 6-10: "Plan and build" roadmap: impacts on PM yearly emissions with Reference trend

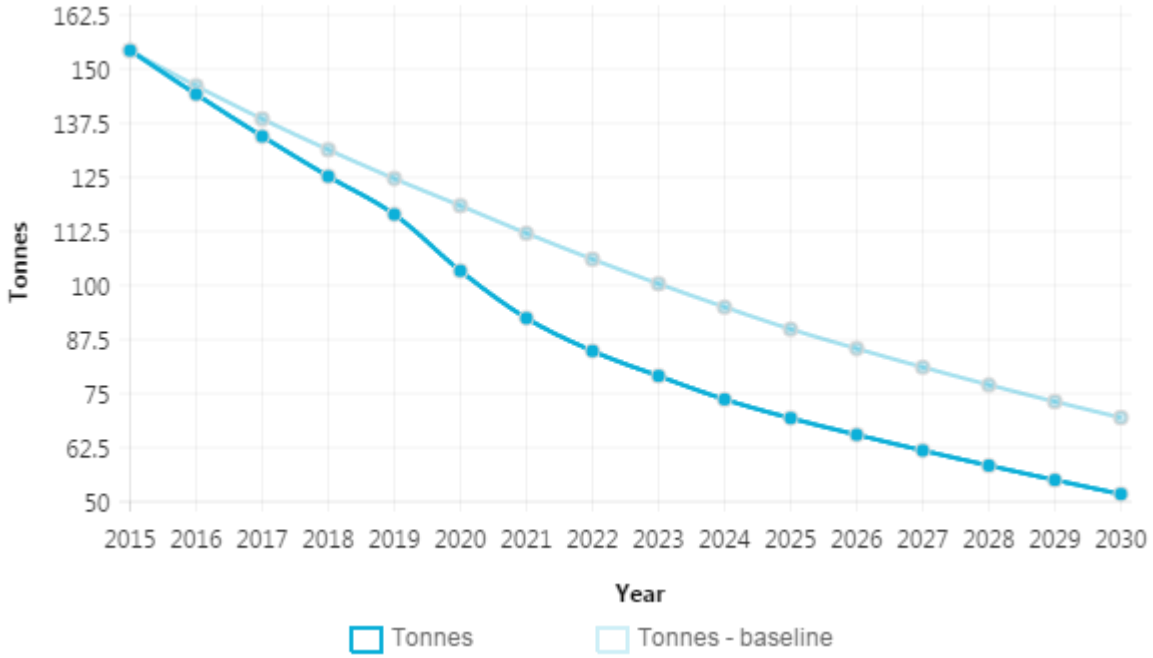
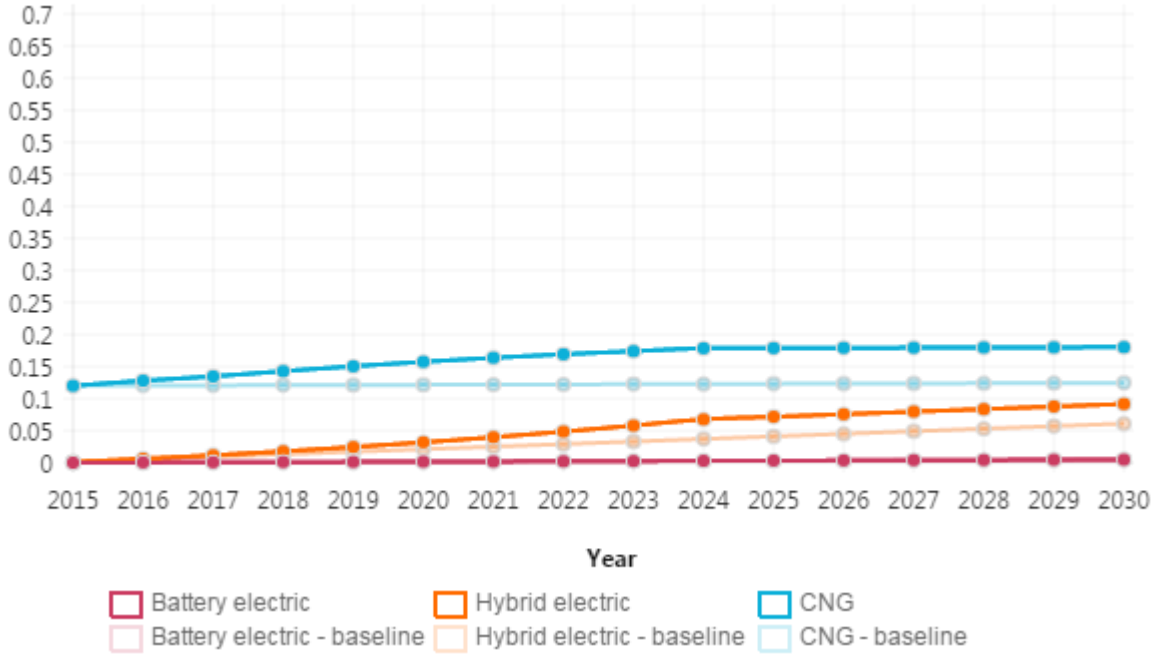


Figure 6-11: "Plan and build" roadmap: impacts on penetration of alternatively fuelled bus vehicles with Reference trend



The plan is heavily based on new infrastructures which mean large investments for the city authority: transport expenditures are increased by 15% with respect to the reference scenario and revenues are increased only by some 10% with respect to the reference scenario (considering the whole period 2015-2030 with discounted values). As a result, the economic

balance of the roadmap is negative: the net financial result[12] of the local administration for the transport sector is in deficit already in the reference scenario (about 5.9 billion Euros considering the whole period 2015-2030), but the negative difference between expenditure and revenues is increased in the roadmap to about 6.8 billion Euros (considering the whole period 2015-2030).

Figure 6-12: "Plan and build" roadmap: impacts on transport expenditure of the local authority with Reference trend

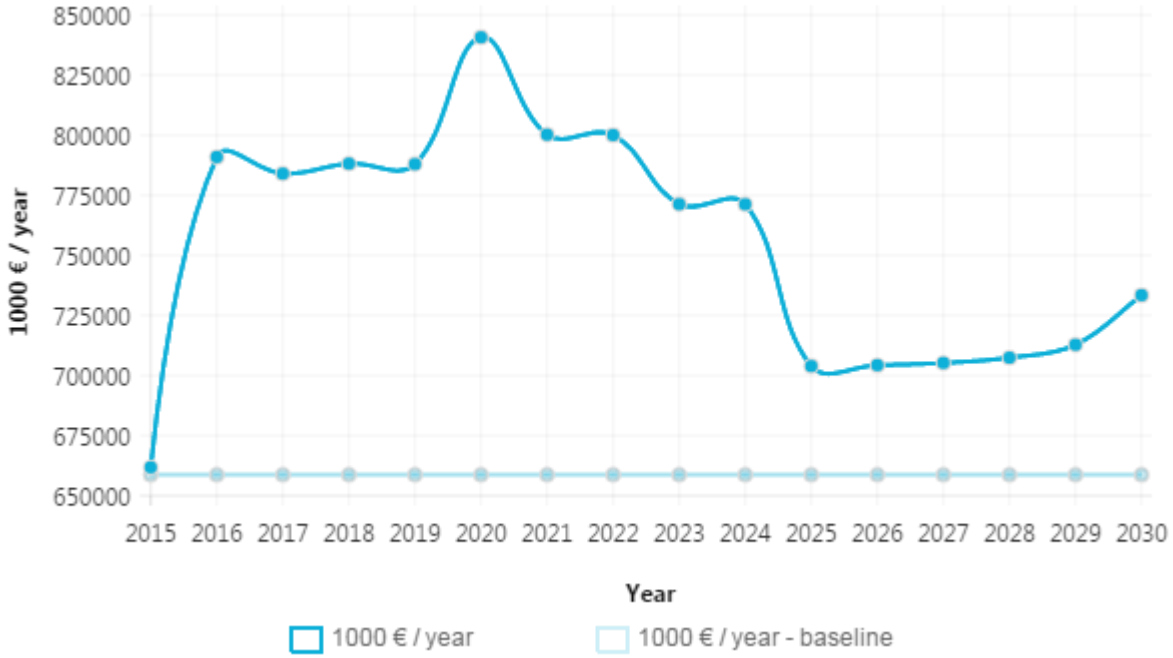
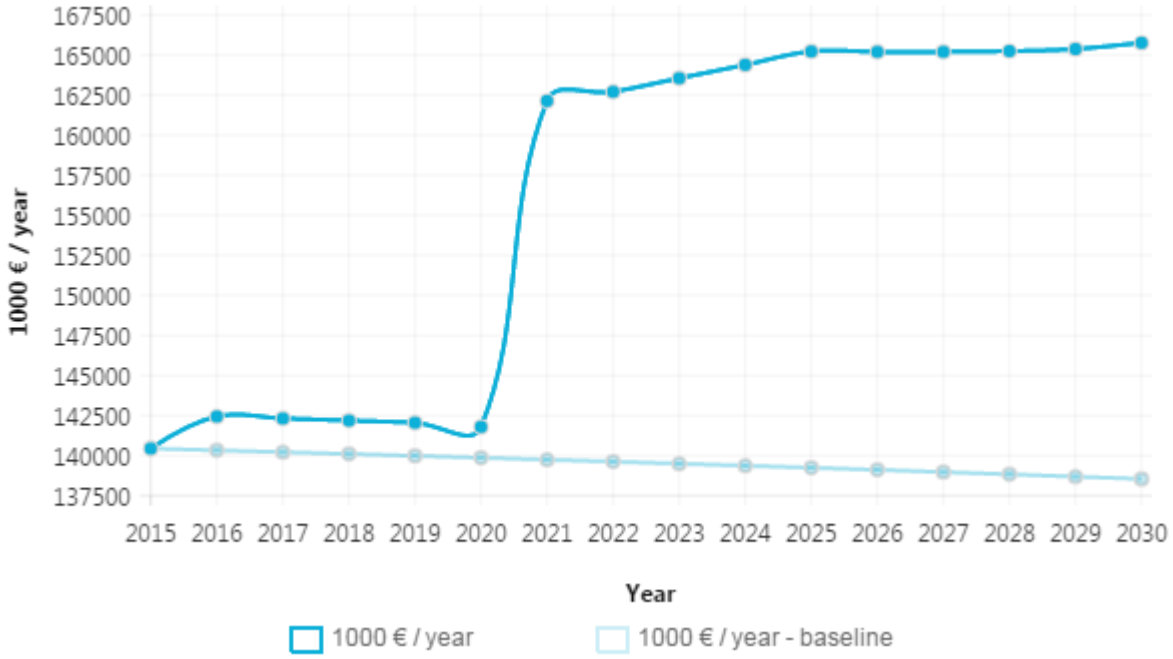


Figure 6-13: "Plan and build" roadmap: impacts on transport revenues of the local authority with Reference trend



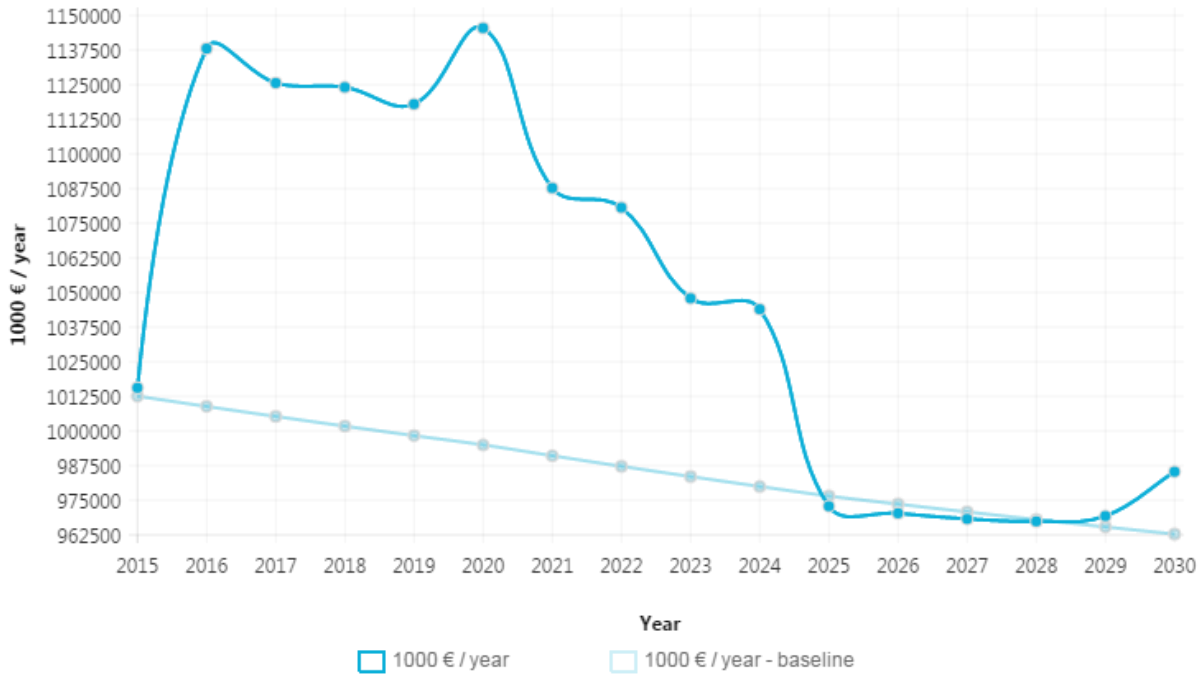
For the local authority the implementation of the roadmap is therefore financially challenging (of course it can be considered that at least part of the new infrastructures might be financed by other public bodies such as regional or national authorities or by European funds).

[12] Difference between the total revenues and the total transport expenditure for the public administration. The difference is computed year by year, cumulated over the whole period 2015-2030 and discounted to base year values with a discount rate of 5%.

Nevertheless, citizens can benefit from the public investments; the average yearly expenditure for transport per individual slightly decreases (-2%) and even significantly decreases (-10%) when faster technological development and energy shortage are considered. The contribution of exogenous conditions to cost savings is substantial.

Looking at the impacts in terms of transport social monetary costs, the roadmap shows an increased cost for the city until 2025 (up to 150 million euro in 2020), while in the last 5 years the costs are in line with the reference. As mentioned above, the bill is mainly paid by the local authority.

Figure 6-14: "Plan and build" roadmap: impacts on transport social monetary costs with Reference trend



In a nutshell, this is an example of an ambitious roadmap providing significant effects but at a significant cost.

Table 6-6 below provides some key results extracted from the output of the tool. The main indicators are reported with their value at the base year 2015, at the year 2030 according to the reference trend (without the implementation of the policy scenario) and at the year 2030 according to the roadmap implementation with both the reference and alternative trend. The percentage variations with respect to both the base year and reference trend at 2030 are also provided.

Table 6-6: "Plan and Build" roadmap: main impacts at the year 2030

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030	Roadmap + alternative trend in 2030
Transport	Vkm travelled by conventional cars (gasoline/diesel) (Mio vkm/year)	Abs. Value	4,128.4	3,132.6	2,278.2	1,748.5
		% Diff. to base year		-24.1%	-44.8%	-57.6%
		% Diff. to Reference			-27.3%	-44.2%
	Car mode share		40.5%	43.9%	37.2%	37.0%
	PT mode share		27.5%	26.8%	34.1%	34.3%
	Average distance per trip (km)	Abs. Value	5.22	5.66	5.48	5.48
		% Diff. to base year		8.4%	5.0%	5.0%
		% Diff. to Reference			-3.2%	-3.2%
	Average car speed in peak hours (km/h)	Abs. Value	18	17.4	18.2	18.7
		% Diff. to base year		-3.3%	0.9%	3.9%
		% Diff. to Reference			4.4%	7.5%
	Value of travelled time per individual (1000 Euro/year)	Abs. Value	4.713	4.892	5.609	5.173
		% Diff. to base year		3.8%	19.0%	9.8%
		% Diff. to Reference			14.7%	5.7%
	Penetration of alternatively fuelled car vehicles		0.0%	29.4%	41.3%	51.4%
Environment and safety	CO2 emissions (t/year)	Abs. Value	758,369	651,433	584,472	444,941
		% Diff. to base year		-14.1%	-22.9%	-41.3%
		% Diff. to Reference			-10.3%	-31.7%
		Abs. Value	154.3	69.4	51.76	30.49

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030	Roadmap + alternative trend in 2030
	PM emissions (t/year)	% Diff. to base year		-55.0%	-66.5%	-80.2%
		% Diff. to Reference			-25.4%	-56.1%
	Fatalities per 100,000 inhabitants	Abs. Value	9.9	9.4	8.4	7.8
		% Diff. to base year		-4.5%	-15.3%	-21.3%
		% Diff. to Reference			-11.3%	-17.5%
Economy	Transport expenditure per individual (1000 Euro/year)	Abs. Value	0.954	1.041	1.017	0.941
		% Diff. to base year		9.1%	6.6%	-1.4%
		% Diff. to Reference			-2.3%	-9.6%
	Transport expenditure of public administration 2015-2030 (1000 Euro)	Abs. Value		7,516	8,624	8,627
		% Diff. to Reference			14.7%	14.8%
	Revenues of public administration 2015-2030 (1000 Euro)	Abs. Value		1,589	1,750	1,697
		% Diff. to Reference			10.2%	6.8%
Economic balance	Net financial result of Public administration 2015-2030 (million Euro)	Abs. Value		-5,927	-6,873	-6,930
		Abs. difference		0	- 946	- 1,003

6.3 "Charge and Provide"

6.3.1 Implementation of the roadmap in the policy support tool

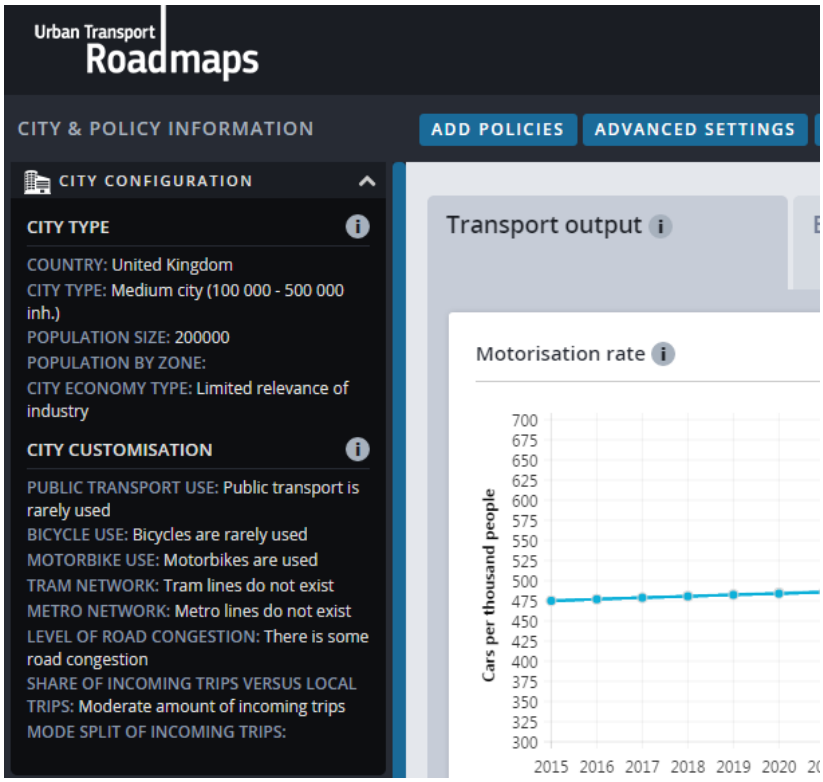
The "Charge and Provide" roadmap has been applied to a hypothetical medium size city of about 200,000 inhabitants in United Kingdom, assuming a period of stagnation in terms of population growth and without sprawling issues. Some road congestion is observed at the base year, although private motorised modes are used by almost 60% of the internal mobility (car 55% and motorbike 4%). Public transport services are used (although not extensively) and provide bus rides in the urban area with a marginal amount of reserved lanes (less than 5% of the PT network). Bikes are rarely used and cycling reserved paths are almost negligible (1% or less of the road network length).

Most of parking lots are free: only 10% of parking slots in the urban area are charged with a tariff of 1 euro/hour.

Table 6-7: "Charge and Provide" roadmap: Initial configuration

Context	Indicator	Value
City	City type	Medium city (100,000 – 500,000 inh.)
	Population	200,000 inhabitants
	Country	United Kingdom
	Population trend	Stagnation (0% growth)
	Sprawling trend	No sprawl
	City economy	Limited relevance of industry
	Income	Medium average income per capita
Mobility	Road congestion	There is some road congestion
	Mode split of internal mobility	Pedestrian 30% Bike 1% Motorbike 4% Car 55% Bus 10% (no tram, no metro)
	Parking fare	1 euro/h
	Parking regulation	Most of parking lots are free (10% of parking lots in the urban area are charged)
	Public transport reserved lanes	marginal amount (less than 5% of PT network)
	Total PT network	300 km
	Cycling reserved lanes	Negligible amount (less than 1% of road network)
	Car sharing service	Not available
	Park & ride service	Not available

Figure 6-15: "Charge and Provide" roadmap: Overview of the web based initial configuration



The implementation of the policies has followed the description of the roadmap (see section 5.3) as far as possible, although some simplifications have been required to simulate the timing of the interventions in different phases.

The policy related to **bus network and facilities** aims at providing a more reliable public transport service, removing inefficiencies as a first step and extending the network afterwards, once that financial resources from pricing policies are available. Within the web based tool, it is assumed that the policy is implemented from 2016, with a ramp-up period of nine years, i.e. the interventions are completed in the year 2025. A moderate improvement of frequency (the assumed average reduction of headways is three minutes) is foreseen on 30% of the bus network, combined with a 20 km extension of the network (starting from a total network length of about 300 km).

Concerning **walking and cycling network and facilities**, the roadmap assumes an increasing implementation of new walking areas and extension of cycling network over the whole period. In modelling terms, the policy is implemented focusing on cycling reserved lanes. It is assumed that their development begins in 2016 and lasts for 12 years (i.e. the network is completed in the year 2028). At the end of the period, 25 km of cycling reserved lanes are added (from about 5 km to 30 km).

The roadmap involves the implementation of the policy related to **parking regulation and pricing**, enforcing the application and enlarging the area subject to the charge. Within the web based tool, the policy is applied since 2016 maintaining the parking tariff unchanged with respect to the base year (1 euro/h) and enlarging to 20% the share of urban area where parking is regulated (from 10% at base year). Furthermore, the roadmap suggests the progressive implementation of **low emission zones and parking areas** from 2025, in order to stimulate the shift to non-conventionally fuelled vehicles. Therefore, in the model parking tariffs are discounted from 2025 for hybrid electric vehicles, battery electric vehicles and hydrogen fuel cell vehicles. In addition, low emission zones are implemented where only low emission alternatively fuelled vehicles are allowed to operate. These low emission zones comprise 20% of the network in the urban core of the city and 10% of the network in the outskirts with a good transit service.

The policy related to **Public Transport integrated ticketing and tariffs scheme** aims at implementing some forms of integrated ticketing to make the public transport service more

attractive. Within the web based tool, it is assumed that the policy is applied from 2016 with five years needed for the implementation of integrated ticketing. The fares are unchanged with respect to the base year. The integration between Public Transport and bike sharing tariffs cannot be simulated with the tool.

According to the roadmap, a **congestion road charging** policy is planned in the inner city centre starting in 2018. In modelling terms, the policy is implemented as a **congestion charge** with the following tariffs: 2 Euro/trip for car and LDVs, 3 Euro/trip for HGVs. The charge is applied only during weekdays (not during the weekends) and the area of implementation is about 5% of the urban area.

In order to promote alternative forms of mobility, a **bike sharing** service is developed after a few years, with a gradual extension over time in the urban area for serving more zones. Within the web based tool, the policy is applied from 2020, with a five-year ramp-up period (the implementation ends in 2024). The service is provided with an annual fee of 40 Euros/year and the urban area served by bike sharing stations is gradually increased to cover up to 40% of the urban area at the year 2024.

At the same time, a **car sharing** operator is expected to start its pilot in the city, with a gradual increase of the car sharing vehicle fleet over time in the urban area especially in parallel to the extension of the road charged zone. In modelling terms, a one way service (cars can be collected and returned in any point in the city) is assumed to be available from 2020. The annual fee is 20 Euro/year, while the usage fee is 15 Euro/h (0.25 Euro/min). The average walking time to pick up a car is about eight minutes.

The roadmap involves also the implementation of the policy related to **sustainable travel information and promotion**, in order to communicate to citizens the availability of new services and mobility opportunities. In the web based tool, the policy is applied from 2022.

In the last stage of the roadmap, a **legal and regulatory framework for urban freight transport** is established in order to regulate the access of commercial freight vehicles by setting up fixed delivery time windows. In modelling terms, the policy is activated from 2025.

Finally, in order to further stimulate the mode shift from private modes, the policy related to **prioritising Public Transport** is implemented. Within the web based tool, the policy is applied from 2025 and it is assumed that 2 years are need to complete the implementation. The policy is modelled assuming an extension of the bus reserved lanes (12 more km in addition) and the implementation of priority systems at traffic lights on 20% of the bus network.

Table 6-8: "Charge and Provide" roadmap: implementation

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
Demand Management	Sustainable travel information and promotion		Yes From 2022	
	Bike sharing scheme		Yes, Phase 1 Start in 2020 completed in 2024 Tariff: 40 euro/year Coverage: 8% of the urban area in the year 2020 progressively increased up to 40% at 2024	Yes, Phase 2
	Car sharing (Car Clubs)		Yes, Phase 1 Start in 2020. System: one way Tariff: 20 euro/year, 15 euro/h (0.25 Euro/min)	Yes, Phase 2

Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
			Coverage: 8 minutes walking to pick up a car	
	Delivery and Servicing Plans			
	Land-use planning - density and transport infrastructure			
Green Fleets	Green energy refuelling infrastructures			
	Green public fleets			
Infrastructure Investments	Bus, trolley, tram network and facilities	Yes, Phase 1	Yes, Phase 2	Yes, Phase 3
		Start in 2016, completed in 2025 • moderate improvement of frequency on 30% of the network • 20 km bus network extension		
	Walking and cycling network and facilities	Yes, Phase 1	Yes, Phase 2	Yes, Phase 3
		Start in 2016, completed in 2027 25 km extension of cycling reserved lanes (from 5 km to 30 km)		
	Park and ride			
	Metro network and facilities			
	Urban Delivery Centres and city logistics facilities			
Pricing and financial incentives	Congestion and pollution charging	Yes, Phase 1		Yes, Phase 2
		Congestion charge from year 2018 Tariffs: • 2 euro/trip per car • 2 euro/trip per LDV • 3 euro/trip per HGV Coverage: 5 % of city area		
	Parking pricing	Yes		
		From 2016 Tariff: 1 euro/h (unchanged from base year) Coverage: 20% of urban area (compared to10% in base year). From 2025 Low emission parking: parking tariff discounted for Hybrid electric, Battery electric, fuel cells vehicles		
	Public Transport integrated ticketing and tariff schemes	Yes, Phase 1	Yes, Phase 2	
		From 2016 integrated ticketing (5 year ramp-up for integrated ticketing)		
Traffic management and control	Legal and regulatory framework of urban freight transport			Yes From 2025

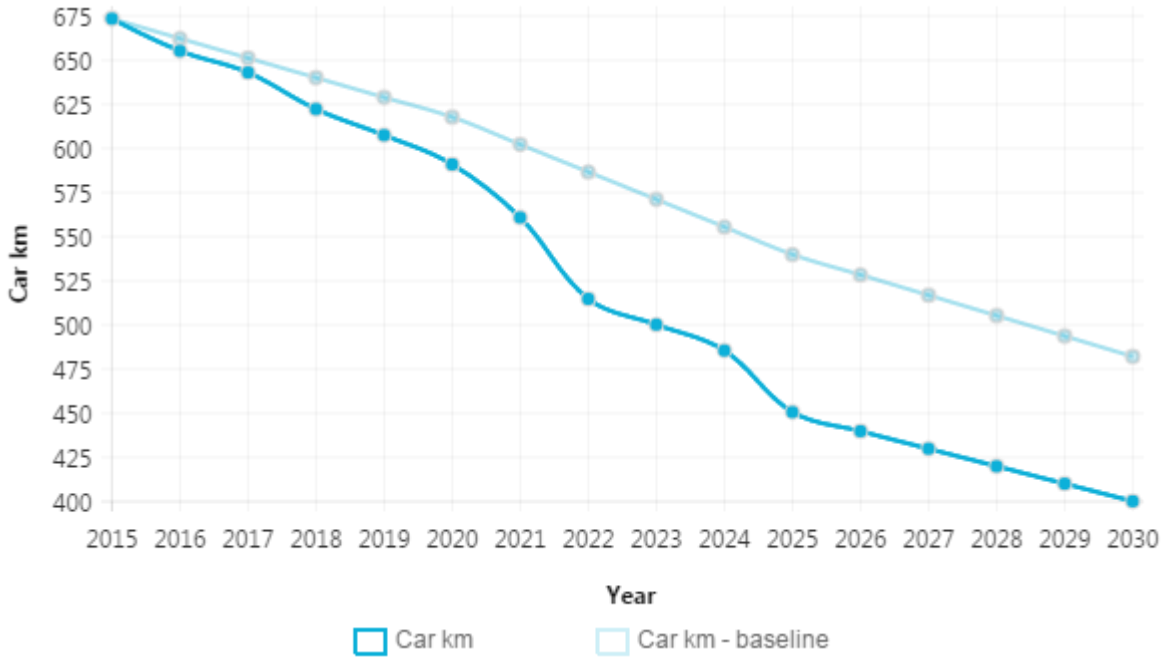
Policy Type	Measure	2016 - 2019	2020 - 2024	2025 - 2030
	Prioritising Public Transport			Yes Start in 2025, completed in 2027 • 12 km of reserved lanes added to initial 8 km at base year. • Bus prioritisation on 20% of the bus network
	Access regulations and road and parking space reallocation			Yes From 2025 low emission zones (20% of the urban core road network and 10% of the network in outskirts with good transit service)
	Traffic calming measures			

6.3.2 Impact of the roadmap

The roadmap has been simulated using the policy support tool. The simulation covered the two policy scenarios (see section 4) associated to this roadmap: the case under the assumption of reference exogenous trend as well as the case when an alternative trend is assumed (see paragraph 2.2) and green taxation is applied at the national level.

First of all, with reference to the target of halving the use of conventional vehicles accessing the city centre by 2030 (with respect to 2015) the policy roadmap is close to the objective, achieving a reduction of about 41% of vehicle-km travelled by conventional cars (gasoline/diesel). The impact is consistently enhanced in combination with the alternative trend, which allows to overcome the target with a reduction of about 57%. It should be noted that already in the reference scenario there is a 28% reduction of the vehicle-km travelled by conventional cars as effect of the penetration of hybrid vehicles in the fleet. Therefore the additional impact of the roadmap is a further 13% reduction (or 29% under the assumption of alternative trend) in the year 2030.This impact is mainly the result of modal shift. Considering all mobility in the urban area (i.e. including also incoming trips from outside the city) the modal share of public transport increases to 23% by 2030, in comparison to 14% in the reference scenario. At the same time, the share of passenger cars in traffic decreases to 43% (53% in the reference scenario). Some contribution also comes from more innovative, alternatively fuelled vehicles in the fleet: 31% instead of 29%. The same mode shift is observed under the assumption of alternative trend, but the penetration of innovative vehicles provides a stronger contribution (about 47% of total fleet).

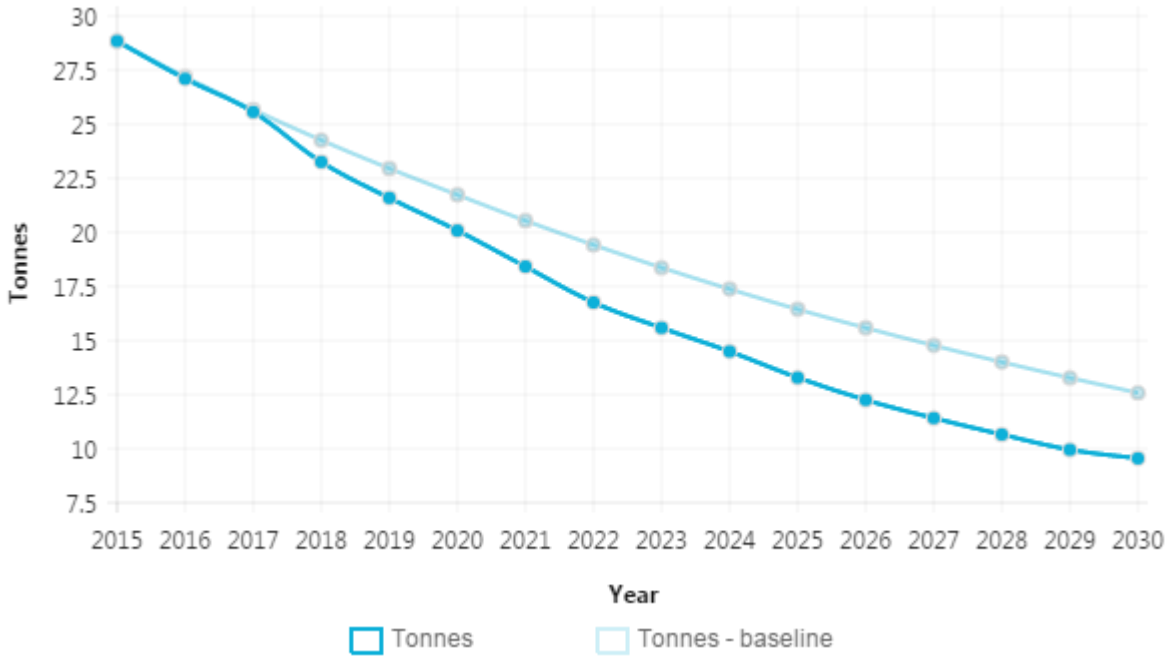
Figure 6-16: "Charge and Provide" roadmap: impacts on conventional car vehicle-km with Reference trend



The mode shift has a positive effect on congestion: average speed of cars in peak time is improved by some 5% with respect to reference and by 2% with respect to the base year (stronger improvements are estimated with the alternative trend, 7% and 5% respectively). However, congestion reduction does not mean that less time is spent travelling on average. On the contrary, since public transport is slower than car journeys (despite the traffic and the bus prioritisation in the roadmap), the economic value of total travelled time is higher in the policy scenarios than in the reference scenario.

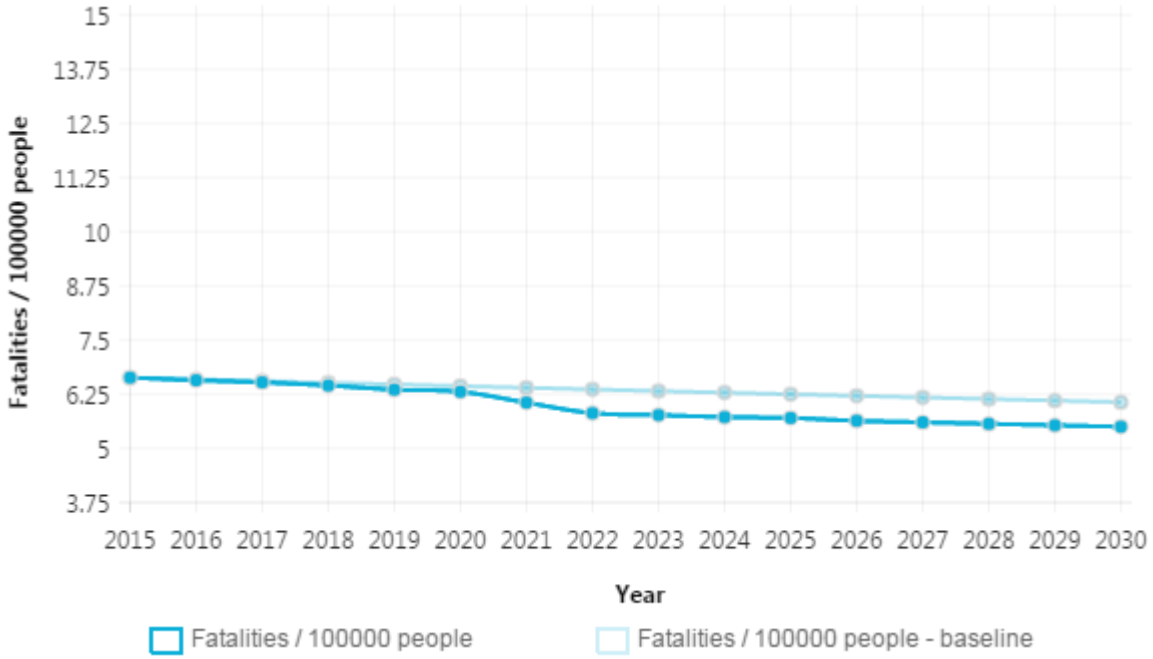
In the reference scenario, CO_2 and PM emissions are reduced by 14% and, 56% respectively by 2030, thanks to the fleet renewal. The impact of the roadmap is in the order of a further 6% reduction of CO_2 and 24% reduction of PM. The environmental benefit is therefore less than directly proportional to the reduction of the vehicle-km travelled by conventional cars. The alternative trend, thanks to the faster technological improvements, produces stronger results on the environmental side (-33% of CO_2 and -62% - of PM).

Figure 6-17: "Charge and Provide" roadmap: impacts on PM yearly emissions with Reference trend



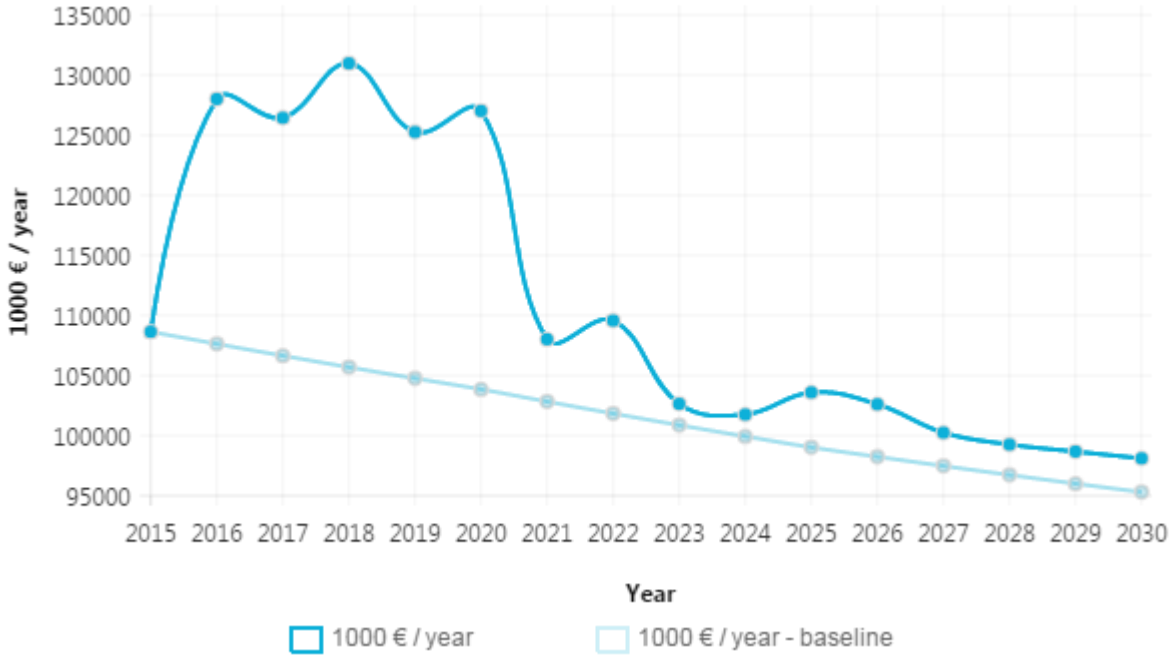
A positive effect of the roadmap is estimated on the safety side: fatalities per 100,000 inhabitants are reduced by 10% (16% with alternative trends) in comparison to the reference scenario.

Figure 6-18: "Charge and Provide" roadmap: impacts on fatalities per 100,000 inhabitants with Reference trend



Looking at the impacts in terms of transport social monetary cost, the roadmap shows an increased cost for the city until 2022 (up to 25 million euro in 2018), while in the last 8 years the costs are more or less in line with the reference. The bill is however mainly paid by citizens. The average yearly expenditure for transport per individual is 10% higher than the base year. When the scenario with the alternative exogenous trend is simulated, the financial impact for the citizens is reduced (5% higher than base year). This is due to the reduction of personal mobility generated by energy shortage

Figure 6-19: "Charge and Provide" roadmap: impacts on transport social monetary costs



From the local authority point of view, thanks to the extra revenues (some 53% more revenues than in the reference scenario from 2015 to 2030) resulting especially from parking pricing, road charging and the additional PT users, the investments in the policies (29% more than in the reference) are financially covered and the economic balance of the roadmap is positive. The net financial result[13] of the local administration for the transport sector is always in deficit but with respect to the reference scenario the negative difference between expenditure and revenues is reduced by about 113 million Euro (considering the whole period 2015-2030). For the local authority, the implementation of the roadmap is therefore financially positive.

Figure 6-20: "Charge and Provide" roadmap: impacts on transport expenditure of the local authority with Reference trend

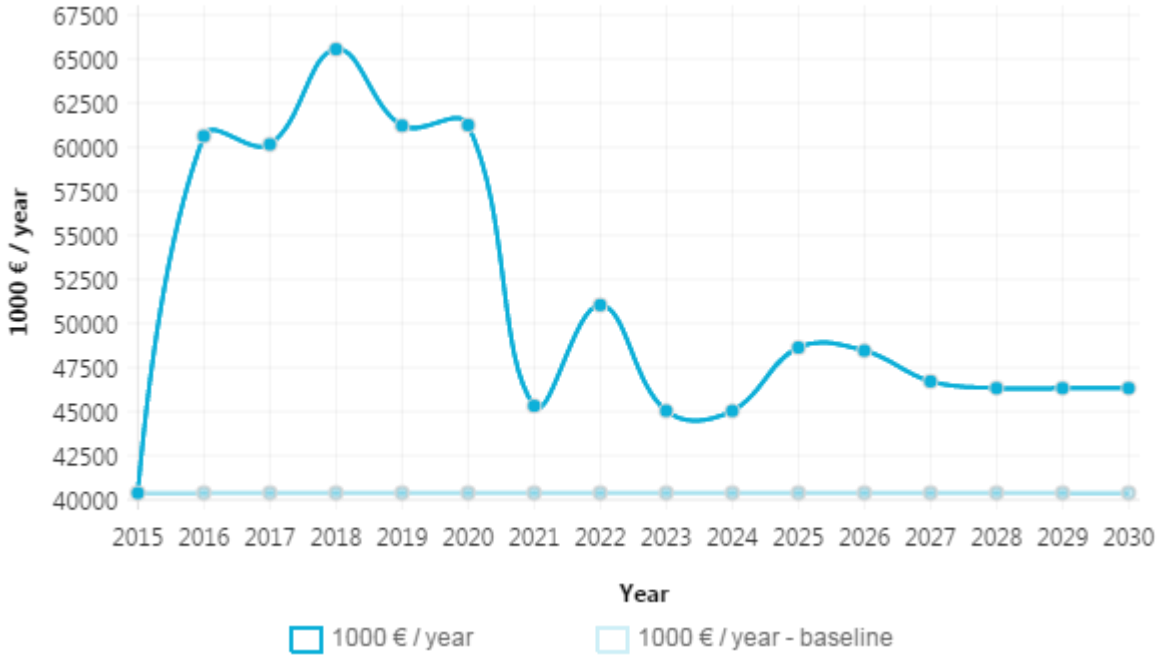
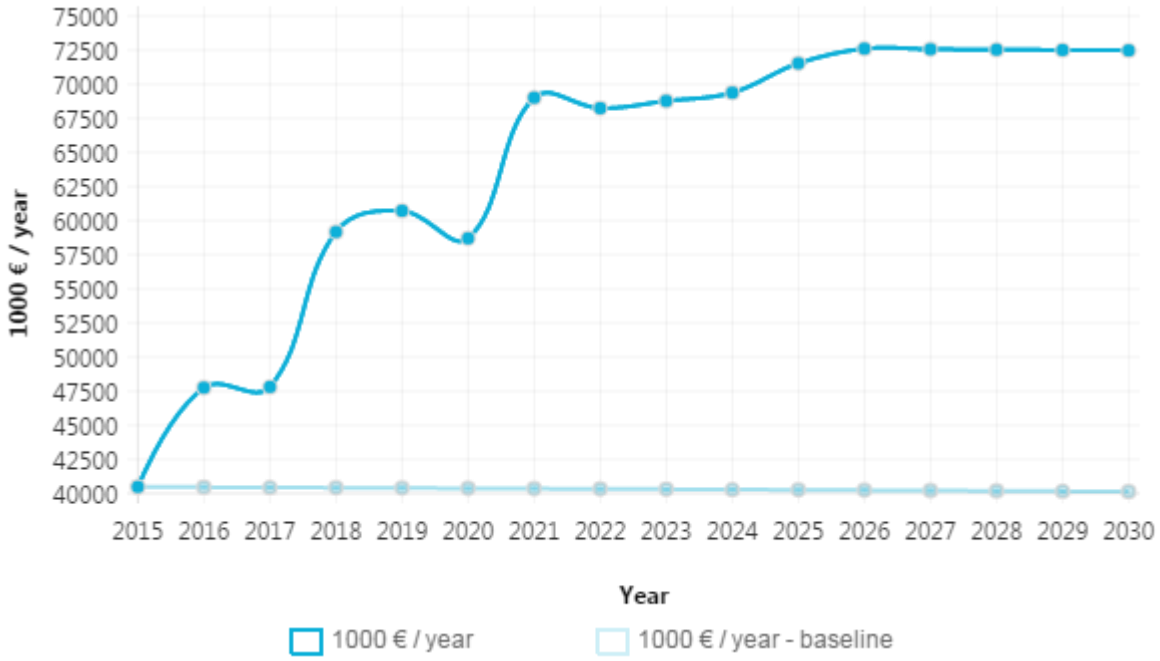


Figure 6-21: "Plan and build" roadmap: impacts on transport revenues of the local authority with Reference trend



[13] Difference between the total revenues and the total transport expenditure for the public administration. The difference is computed year by year, cumulated over the whole period 2015-2030 and discounted to base year values with a discount rate of 5%.

In summary, this is an example of roadmap providing visible impacts, financially balanced from the administration point of view but politically challenging for the effort (also in economic terms) required by citizens.

Table 6-9 below provides some key results extracted from the output of the tool. The main indicators are reported with their value at the base year 2015, at the year 2030 according to the reference trend (without the implementation of the policy scenario) and at the year 2030 according to the roadmap implementation with both the reference and alternative trend. The percentage variations with respect to both the base year and reference trend at 2030 are also provided.

Table 6-9: "Charge and Provide" roadmap: main impacts at the year 2030

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030	Roadmap + alternative trend in 2030
Transport	Vkm travelled by conventional cars (gasoline/diesel) (Mio vkm/year)	Abs. Value	673.4	482.1	400.2	290.6
		% Diff. to base year		-28.4%	-40.6%	-56.8%
		% Diff. to Reference			-17.0%	-39.7%
	Car mode share		52.3%	53.5%	43.3%	43.60%
	PT mode share		14.5%	14.3%	23.4%	23.20%
	Average distance per trip (km)	Abs. Value	3.2	3.2	3.2	3.2
		% Diff. to base year		0%	0%	0%
		% Diff. to Reference		0%	0%	0%
	Average car speed in peak hours (km/h)	Abs. Value	36	35.1	36.8	37.7
		% Diff. to base year		-2.5%	2.1%	4.6%
		% Diff. to Reference			4.7%	7.3%
	Value of travelled time per individual (1000 Euro/year)	Abs. Value	2.546	2.523	2.837	2.613
		% Diff. to base year		-0.9%	11.4%	2.6%
		% Diff. to Reference			12.4%	3.6%
	Penetration of alternatively fuelled car vehicles			29.40%	30.90%	46.90%
Environment and safety	CO2 emissions (t/year)	Abs. Value	141,963	121,999	115,157	81,238
		% Diff. to base year		-14.1%	-18.9%	-42.8%
		% Diff. to Reference			-5.6%	-33.4%
	PM emissions (t/year)	Abs. Value	28.8	12.6	9.6	4.8
		% Diff. to base year		-56.3%	-66.8%	-83.3%
		% Diff. to Reference			-24.2%	-61.9%

Domain	Indicator		Base year (2015)	Reference trend in 2030	Roadmap + Ref trend in 2030	Roadmap + alternative trend in 2030
	Fatalities per 100,000 inhabitants	Abs. Value	6.6	6.1	5.5	5.1
		% Diff. to base year		-7.6%	-16.7%	-22.7%
		% Diff. to Reference			-9.8%	-16.4%
Economy	Transport expenditure per individual (1000 Euro/year)	Abs. Value	0.869	0.821	0.958	0.910
		% Diff. to base year		-5.5%	10.2%	4.7%
		% Diff. to Reference			16.7%	10.8%
	Transport expenditure of public administration 2015-2030 (million Euro)	Abs. Value		460	592	592
		% Diff. to Reference		0.0%	28.8%	28.8%
	Revenues of public administration 2015-2030 (million Euro)	Abs. Value		459	704	677
		% Diff. to Reference		0.0%	53.5%	47.5%
Economic balance	Net financial result of Public administration 2015-2030 (million Euro)	Abs. Value		-1	112	85
		Abs. difference	-	0	113	86

7 Conclusions

This report has presented and analysed the policy content of alternative approaches aimed at improving sustainability of urban mobility, supported by roadmaps describing how each scenario could be achieved (i.e. the specific steps that will need to be taken and the timing required for each step) in hypothetical urban contexts. Timing and resources to implement the policy measures have been detailed, considering local conditions, stakeholders involved, implementation issues and other practical aspects. Furthermore, the uncertainty on how exogenous conditions could develop in the future has been taken into account.

The roadmaps developed for this study focused on different approaches (behavioural changes, investments on technologies and infrastructures, financial instruments) and included measures of diverse nature, objective and complexity. It is worth underlining that these roadmaps have an illustrative purpose. They do not represent recommended policy interventions. They have been conceived to show how different policy instruments can be associated in consistent policy packages and to serve as illustrations for the policy support tool. The intention was to explore different approaches aimed at improving sustainability of urban transport and to translate them into combinations of the urban policy instruments identified as key measures in Urban Roadmap 2030. It was deliberate to use all the measures to define the roadmaps and to avoid too much overlapping between the content of roadmaps (i.e. to limit the measures used in more than one roadmap).

The analysis and quantification of the impacts of the roadmaps has shown how policies can correspond to different levels of ambition and effects, resulting in a variety of situations in terms of impacts, budget constraints for the city authority, public acceptability, drawbacks associated with the policies and so on. The analysis also provided extensive examples of how the policy support tool developed for the EU Urban Transport Roadmaps to 2030 study could provide guidance and information on the costs and benefits of different strategies, actually supporting local decision making processes on transport policy.

Once the policy support tool has been made available, city authorities will be able to design their own roadmaps aimed at improving sustainability of urban mobility and to use the tool to get a first glance of the various aspects of their implementations and possibly revise the overall strategy. The roadmaps developed here will be available to guide users in developing their own roadmaps.

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The Gemini Building
Fermi Avenue
Harwell
Didcot
Oxfordshire
OX11 0QR
United Kingdom

t: +44 (0)1235 753000
e: enquiry@ricardo.com

ee.ricardo.com