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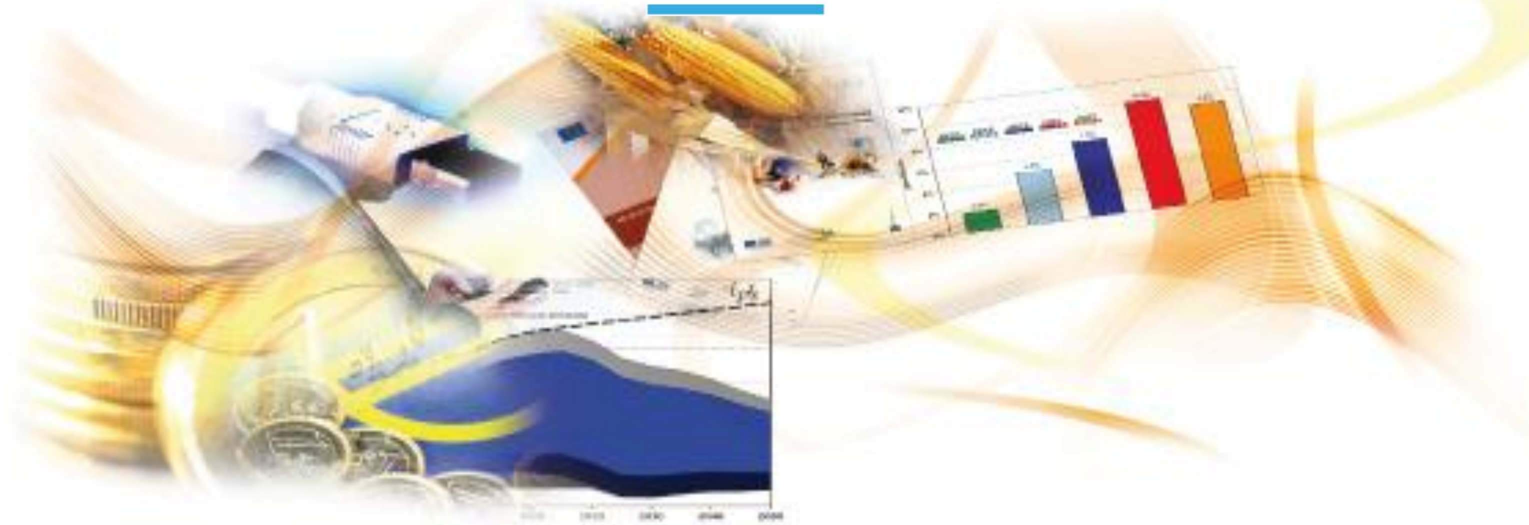

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Quantifying the Effects of Sustainable Urban Mobility Plans

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Executive Summary

Overview

In an effort to counteract negative effects stemming from urban transport activities, many cities in Europe have engaged in planning for the sustainability of urban mobility. As with any change concerning the transport sector, uneasiness about the prospect of having to change the way cities are currently organized -in order to cut down on transport-linked nuisances- has generated a great number of questions on the best way to achieve sustainability in urban transport.

The European Commission is considering a European support framework for the implementation of Sustainable Urban Mobility Plans in EU Member States. This consideration is consistent with the 2011 White Paper proposal to increase coordination between transport authorities and transport policy deciders. Consequently, an interest on how different urban measures can be used in order to render transport activities more sustainable has given way to research concerning the impacts and effects that policy measures might have on socio-ecological systems. These studies rely, mainly, on experts' opinions and past experiences in order to develop a common scorecard on how a transport system might react to different measures.

This technical note uses the expert scoring information available in current scientific literature in order to explore the impacts and effects that different urban measures may have in planning for sustainability on a European wide level.

The five steps of the assessment

1. Identify scientific literature sources for urban transport measure scorings (based on expert knowledge).

2. Create a single template that gathers and normalizes the scores found in the literature concerning impacts and effects of urban transport measures.

3. Assess the average urban profile of cities within NUTS3 zones according to current transport behaviour trends based on:
   - Transport activity
   - Population
   - Employment in NUTS3
   - Commuting rates
   - Rail and Road Accessibility
   - Urbanization rates
   - Density

4. Establish a tailored weighting system for the effects and impacts of urban measures according to the individual profile of each NUTS3

5. Quantify the potential range of effects of policy measures on CO2 emissions -for each NUTS3 zone- using transport demand and CO2 estimation results (MODEL-T, JRC) for the year 2030.

Methodology

Various studies on urban measure scorings have been carried out over the years and each one has developed a different approach pertaining to the scope of study of each report. As such, the studies consulted in the literature review for this note have different ways of scoring impacts and effects of measures (five different studies where chosen as sources for this note: KONSULT, TRANSPORD, VTPI, EC-Freight and EPOMM – values from these studies in annex). These differences are twofold, firstly different studies have different scoring scales; secondly different studies have different approaches as to how the effects and impacts of measures are scored. Thus, the challenge, for this technical note, consists in its ability to clearly identify the common elements in each study in order to develop a general scoring template that normalizes scores coming from various sources. This normalization is particularly tedious since it needs to be consistent across scoring categories and scoring scales. In order to achieve this normalization, scores on effects and impacts of urban measures from different sources were categorized into a single scoring template where their effects are defined through their ability to:

- avoid unsustainable transport practices,
- shift from unsustainable to sustainable transport modes,
- improve on current behaviour in transport activities.

The categorization of measure effects through the three-pronged A-S-I (for avoid, shift, improve) approach developed by GIZ in 2011, refers directly to urban measures' potential effects on transportation activities by identifying how different measures have different effects on current transport activities.

Furthermore, urban measures effects are not restricted to changes on the structure of urban transportation; they also have impacts on the whole socio-economic system. Consequently, scoring exercises also include information on how different urban measures may have an impact on economic, social and environmental issues. Thus, this note also aimed at including the scoring values coming from experts' opinions on these categories in a single impact matrix using the European Commission's Guidelines on Impact Assessment by identifying impacts on three levels (E-S-E):

- economic,
- social,
- environmental.

In order to be able to determine the potential effects of the different policy measures according to the subject of study, this note carries out an impact assessment concerning different territories in Europe by weighting the experts' scorings accordingly to the current trends in transport behaviour that characterize the different cities in Europe present in NUTS3 regions. The main logic behind the definition of weights is summarized by the idea that: since every city in Europe is different in size, density, population, etc., the effects of measures will surely vary from city to city. Therefore, in order to correctly assess how a determined set of measures can have an impact on different European cities, it is necessary to determine how different urban forms and organizational trends may react to the same set of measures. In other words, it is necessary to apply different weights to the possible effects of measures accordingly to the urban characteristics of European cities.

Results

In order to quantify the impacts that different measures might have, according to the profiles and weights, it was necessary to have mobility estimates in 2030 for urban transportation activities. For this, MODEL-T (JRC) mobility estimates and their inherent CO_2 emissions were used.

The 2030 values for CO_2 emissions were used as a reference to calculate the impact that each policy measure might have in CO_2 reductions for different city profiles in NUTS3 regions according to the effects presented in the experts' scorings and to its capacity to, avoid, shift or improve unsustainable practices. As these results are based on scorings pertaining to the potential range of reductions that each individual measure might entail, these results do not take into account overlapping effects. In other words, the effects of "measure packaging" are not reflected in these results. The following table should be read as the potential range of effects for individual measures. As such, it is important to underline that if all measures where to be implemented as a package, the overlapping effects would entail lower overall results.

Table 1 Potential CO_2 Reductions by Measure

Measure	Potential CO_2 reductions in ktonsCO_2
Investment and maintenance, including safety, security and accessibility	713 - 894
Public transport coverage (line density, stop density, walking distances between stops) & public transport frequencies.	917 - 1 150
Interoperable ticketing and payment systems	471 - 591
Taxi services (individual and collective)	578 - 724
Dedicated walking and cycling infrastructure investment and maintenance & Bike sharing schemes	781 - 979
Improvement of the efficiency of city logistics by the use of ICT	951 - 1 192
Measures to improve the energy efficiency and environmental performance of vehicles and/or use of alternative modes.	612 - 767

Corporate, school and personalised mobility plans (or workplace travel plans)	680 - 852
Car sharing & carpooling schemes.	442 - 554
Telecommunications	1 019 - 1 278
Multimodal connection platforms	306 - 383
Multimodal travel information provision	849 - 1 065
Park and Ride areas	510 - 639
Reallocation of road space to other modes of transport, e.g. dedicated bus lanes	985 - 1 235
Parking management	781 - 979
Dynamic traffic management measures	408 - 511
Low speed zones	476 - 596
Information and marketing campaigns	629 - 788
Promotion of eco-driving	153 - 192
Congestion charging zones (area and cordon charging)	1 495 - 1 874
Low emission zones	849 - 1 065
Totals	14 605 - 18 306

Furthermore, it was also possible to assess the effects of these policy measures for the defined NUTS3 profiles. As overlapping effects are not taken into account in these results, they reflect the potential range of reductions for measures.

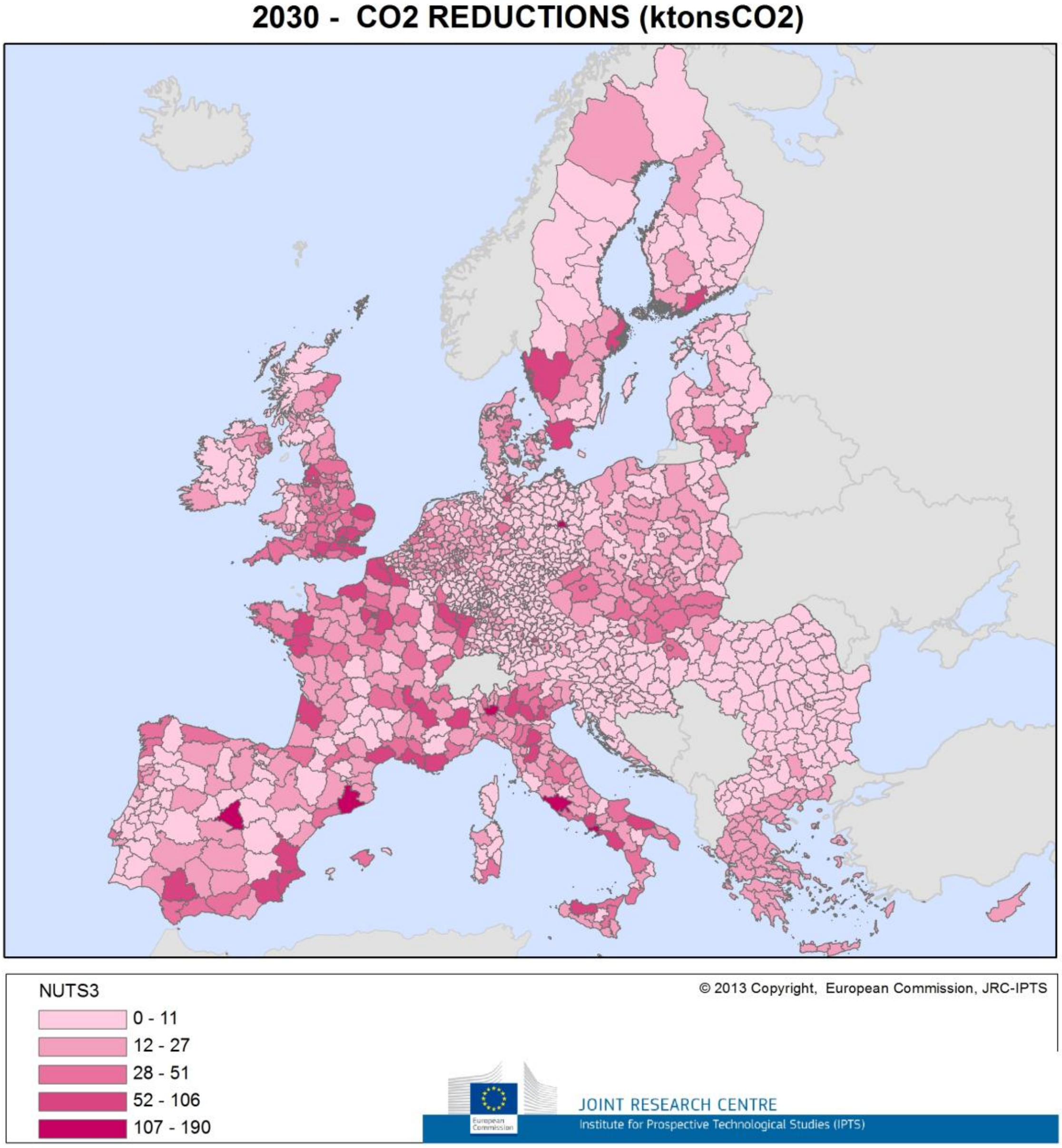

Figure 1 Potential CO_2 Reductions by NUTS3

Accordingly it was possible to aggregate these results –for presentation reasons- and quantify the potential range of reduction that the complete list of identified urban measures could have in each European country, without taking into account measure overlaps.

Table 2 Potential CO_2 Reductions by Country

Country-	Urban Emissions 2010 ktons CO_2	Urban Emissions 2030 ktons CO_2	Potential Reductions 2030 ktons CO_2	Percentage
AT	3 214	2 648	179 - 225	6.8% - 8.5%
BE	7 816	5 921	393 - 493	6.6% - 8.3%
BG	1 485	1 384	100 - 125	7.2% - 9.0%
CY	257	180	15 - 19	8.3% - 10.3%
CZ	3 482	3 686	263 - 330	7.1% - 9.0%
DE	44 488	38 055	2 697 - 3 381	7.1% - 8.9%
DK	2 761	2 153	151 - 189	7.0% - 8.8%
EE	418	507	37 - 47	7.4% - 9.2%
ES	16 275	15 051	1 064 - 1 333	7.1% - 8.9%
FI	2 554	2 350	163 - 204	6.9% - 8.7%
FR	38 249	30 777	2 156 - 2 702	7.0% - 8.8%
GR	2 633	2 850	187 - 234	6.6% - 8.2%
HR	761	1 020	70 - 88	6.9% - 8.6%
HU	2 085	2 365	166 - 208	7.0% - 8.8%
IE	1 252	1 063	67 - 84	6.3% - 7.9%
IT	37 073	31 285	2 250 - 2 821	7.2% - 9.0%
LT	1 251	1 430	100 - 125	7.0% - 8.7%
LU	418	326	27 - 34	8.2% - 10.3%
LV	615	800	52 - 65	6.5% - 8.1%
MT	177	141	9 - 11	6.3% - 8.0%
NL	7 886	6 961	478 - 599	6.9% - 8.6%
PL	6 918	8 934	625 - 784	7.0% - 8.8%
PT	2 756	2 792	186 - 233	6.6% - 8.3%
RO	1 726	2 272	163 - 205	7.2% - 9.0%
SE	5 685	4 335	321 - 403	7.4% - 9.3%
SI	296	284	20 - 25	6.9% - 8.7%
SK	2 162	2 831	201 - 252	7.1% - 8.9%
UK	45 823	36 729	2 465 - 3 090	6.7% - 8.4%
Total	240 515	209 130	14 605 - 18 306	7.0% - 8.8%

Introduction

In an effort to counteract negative effects stemming from urban transport activities, many cities in Europe have engaged in planning for the sustainability of urban mobility. As with any change concerning the transport sector, uneasiness about the prospect of having to change the way cities are currently organized -in order to cut down on transport-linked nuisances- has generated a great number of questions on the best way to achieve sustainability in urban transport.

The European Commission is considering proposing a European support framework for the implementation of Sustainable Urban Mobility Plans in EU Member States. This consideration is consistent with the 2011 White Paper proposal to increase coordination between transport authorities and transport policy deciders.

With the objective of coming up with new and innovative solutions aiming to achieve sustainability in transport activities, numerous studies have analysed different courses of action and their implications on the transport sector, the economy and society. All of them conclude that although planning for sustainability is not an easy task, it does not suppose shrinking economic activity.

Indeed, different studies (BANISTER & HICKMAN; KATO & ITO *et al;* LOPEZ-RUIZ & CROZET; SCHADE & HELFRICH *et al*; SCHIPPER & NG *et al*; SPERLING & LUTSEY; CREUTZIG, MULHOFF & ROMER) have looked into several options on how to plan for sustainable transport. These studies concur on the fact that new technologies (in motors, telecommunications, information services, etc.) and their widespread use will be necessary in order to attain considerable reductions in negative impacts linked to urban transport.

Furthermore, these studies also agree on the fact that new technologies, alone, will not be enough for countries and/or cities to achieve their sustainability objectives. Indeed, most works conclude that achieving sustainability in urban transport implies careful policy planning in order to increase the match between "green" transport supply and consumer demand through the use of incentive instruments and measures. Moreover, they clearly underline that expected technological progress in the transport sector cannot be effective if it is not accompanied by deep organizational and behavioural changes in transport activities.

Consequently, an interest on how different urban measures can be used in order to render transport activities more sustainable has given way to research concerning the impacts and effects that policy measures might have on socio-ecological systems. These studies rely, mainly, on experts' opinions and past experiences in order to develop a common scorecard on how a transport system might react to different measures.

This technical note uses the expert scoring information available in current scientific literature in order to explore the impacts and effects that different urban measures may have in planning for sustainability on a European wide level. For this, different policy measures will be categorized, according to their effects and impacts, using a common assessment template. This will allow for a correct matching between the predetermined list of measures, identified by DG-MOVE, in order to quantify their potential range of effects.

Figure 2 Synthetic view of the methodology used in this note

<u>The five steps of the assessment</u>

1. Identify scientific literature sources for urban transport policy measure scorings (based on expert knowledge).

2. Create a single template that gathers and normalizes the scores found in the literature concerning impacts and effects of urban transport measures.

3. Assess the average urban profile of cities within NUTS3 zones according to current transport behaviour trends based on:
    - Transport activity
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    - Commuting rates
    - Rail and Road Accessibility
    - Urbanization rates
    - Density

4. Establish a tailored weighting system for the effects and impacts of urban measures according to the individual profile of each NUTS3

5. Quantify the potential range of effects of measures on CO2 emissions -for each NUTS3 zone- using transport demand and CO2 estimation results (MODEL-T, JRC) for the year 2030.

Furthermore, this note will also synthesize and present detailed information for each policy coming from scientific literature and best practice reports for recent years. In order to organize the information gathered in this report, two levels of content and scope will be defined. The first level will include a general description of policy content and measures. The second level will include the scoring results of impacts for the measures presented.

Lastly, the note will include a list of examples for each set of measures coming from case studies in the EPOMM database. This source of information has been scanned thoroughly and the examples with the most information on real-world application of measures have been selected for this report. The EPOMM database was used to carry out this analysis because it combines the ELTIS Case Studies with their own database. The EPOMM database contains over 1600 factsheets. From these, over 50 where selected according to their informative value and needs for this report.

Methodology

Defining impacts according to experts' scores

Policy measure scoring methods are based on current knowledge about measures' impacts and are not –generally- based on model estimations. As such, the measures' scorecards presented in these studies are usually developed using a Delphi method. This method requires experts to answer a series of questions, concerning the impacts and effects that individual measures might have according to their expert opinion. This series of questions are answered in various rounds. After each round, average scores are derived from the experts' answers and these results are communicated at the beginning of the next round of questioning. In this manner, individual scorings in each round are influenced by the answers of the participating experts' peers. This iterative process is carried out until a convergence point in the scorecards is reached.

Various studies on urban measure scorings have been carried out over the years and each one has developed a different approach pertaining to the scope of study of each report. As such, the studies consulted in the literature review for this note have different ways of scoring impacts and effects of measures (five different studies where chosen as sources for this note: KONSULT, TRANSPORD, VTPI, EC-Freight and EPOMM – values from these studies in annex). These differences are twofold, firstly different studies have different scoring scales; secondly different studies have different approaches as to how the effects and impacts of measures are scored. Thus, the challenge, for this technical note, consists in its ability to clearly identify the common elements in each study in order to develop a general scoring template that normalizes scores coming from various sources. This normalization is particularly tedious since it needs to be consistent across scoring categories and scoring scales. In order to achieve this normalization, scores on effects and impacts of urban measures from different sources were categorized into a single scoring template where their effects are defined through their ability to:

- avoid unsustainable transport practices,
- shift from unsustainable to sustainable transport modes,
- improve on current behaviour in transport activities.

The categorization of measure effects through the three-pronged A-S-I (for avoid, shift, improve) approach developed by GIZ in 2011, refers directly to urban measures' potential effects on transportation activities by identifying how different measures have different effects on current transport activities. In order to better understand this approach it is necessary to refer to the ASIF methodology for calculating transport-linked GHG emissions developed by L. SCHIPPER for the World Bank (2000). The ASIF methodology is based on the following equation:

GHG = Activity x modal Share x energy Intensity x carbon intensity of Fuel

Where:
GHG means the GHG emissions of transport
Activity means transport performance (pkm, tkm) or vehicle-km
Modal Share means the modal-split of passenger and freight transport

Energy Intensity means the energy demand by mode and by fuel per pkm, tkm or Vkm
Fuel means the carbon intensity per unit of energy demand by fuel.

In this way, the A-S-I approach clearly uses the ASIF equation to convey information on how different urban measures may have an effect on transport activities -and their inherent environmental impacts- through their capacity to:

- avoid and/or reduce trips,
- shift to more environmentally friendly modes,
- and improve the energy intensity of transport activities -stemming from technological advance and/or behavioural change (in this case referring to routing changes and drive cycles -Schipper, 2000).

Furthermore, urban measures effects are not restricted to changes on the structure of urban transportation; they also have impacts on the whole socio-economic system. Consequently, scoring exercises also include information on how different urban measures may have an impact on economic, social and environmental issues. Thus, this note also aimed at including the scoring values coming from experts' opinions on these categories in a single impact matrix using the European Commission's Guidelines on Impact Assessment by identifying impacts on three levels (E-S-E):

- economic,
- social,
- environmental.

In order to group all sources into one impact/effect matrix we adapted the different scorings available in the referred sources. This was done by, firstly, identifying the categories of effects and impacts for all studies and adapting them to our effect/impact template accordingly with the A-S-I and E-S-E approach. This required deciding on the best configuration of categories -from consulted sources- that would fit our general template. The template developed for this note identifies the following categories accordingly to the effects and impacts categories found in the aforementioned reports:

Table 3 JRC categories & Source categories

JRC-IPTS categories	Categories in literature review
Economic	Efficiency Economic growth Finance
Social	Liveable streets Equity Safety Improving road safety
Environmental	Protection of the environment Increasing pro-environmental behaviour
Avoid	Reduce number of trips Sell the car

	Reducing accompanying trips
	Reducing parking problems
	Improving Travel Awareness
Shift	Change destination Change mode Increase Public Transport Patronage Increase walking use Increase cycling use
Improve	Change departure time Change route Move house

As each report uses a different scoring scale for different measures, a second step was necessary to build a common scaling system to be used in this report's template. In order to achieve this, all measures that matched DG-MOVE's list were identified in the different studies consulted. Afterwards, a consistency check on the average trend of scores was carried out for all measures that were assessed in all of the reports.

After this, assessing that the scores for measures that where common to all reports, and, that the average trend of the scores for these measures where consistent in all reports was necessary.

Once this consistency checked was accomplished, the scores for different measures were normalized to a common value scale that was then used to integrate policy measures that were not common to all studies. This allowed us to be able to complete most of the table of measures selected by DG-MOVE and thus have a full set of scorings that are consistent with the reviewed literature.

The following table presents the common template for the measures for which information was available in scientific literature. A low/medium scale was used as the values for each measure are relatively small because each measure's effect is presented individually.

Table 4 Average Scores for Measures According to A-S-I Effect

Measure	Avoid	Shift	Improve
Investment and maintenance, including safety, security and accessibility	MEDIUM	LOW	MEDIUM

Public transport coverage (line density, stop density, walking distances between stops) & public transport frequencies.	MEDIUM	MEDIUM	LOW
Interoperable ticketing and payment systems	LOW	MEDIUM	LOW
Taxi services (individual and collective)	LOW	LOW	LOW
Dedicated walking and cycling infrastructure investment and maintenance & Bike sharing schemes	MEDIUM	MEDIUM	LOW
Improvement of the efficiency of city logistics by the use of ICT	MEDIUM	LOW	MEDIUM
Measures to improve the energy efficiency and environmental performance of vehicles and/or use of alternative modes.	LOW	LOW	MEDIUM
Corporate, school and personalised mobility plans (or workplace travel plans)	MEDIUM	LOW	LOW
Car sharing & carpooling schemes.	MEDIUM	LOW	LOW
Telecommunications	MEDIUM	MEDIUM	LOW
Multimodal connection platforms	LOW	LOW	LOW
Multimodal travel information provision	MEDIUM	LOW	MEDIUM
Park and Ride areas	LOW	LOW	LOW
Reallocation of road space to other modes of transport, e.g. dedicated bus lanes	MEDIUM	MEDIUM	MEDIUM
Parking management	LOW	MEDIUM	MEDIUM
Dynamic traffic management measures	LOW	LOW	LOW
Low speed zones	LOW	MEDIUM	LOW
Information and marketing campaigns	LOW	LOW	MEDIUM
Promotion of eco-driving	LOW	LOW	LOW
Congestion charging zones (area and cordon charging)	MEDIUM	MEDIUM	MEDIUM
Low emission zones	LOW	MEDIUM	MEDIUM

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies.

**Note: - stands for not available

After this first template was constructed, it was also possible to quantify the potential CO_2 reductions stemming from the effects of avoiding, shifting and improving. This quantification was developed through the assessment of potential CO_2 effects for different measures found in literature and case studies. More information on this quantification as well as the values will be presented and used in the Summary of Results section.

The same procedure followed in the construction of the A-S-I general template was carried out for the Economic, Social and Environmental impacts according to the scores in the reviewed literature. A low/medium scale was also chosen in order to better reflect the relatively small effect of individual measures in the given time-frame (2030). These impacts reflect a low/medium effect in the categories present in table 1, and they are solely based on experts' opinions. In the case of the E-S-E general template, further quantification was not possible as there was not sufficient information for each measure on their full economic and social impacts.

However, the Environmental impact was partially assessed and quantified through the possible CO_2 reductions that each measure might imply. The quantified effects on CO_2 emissions for each measure are consistent with the results obtained in the quantification of the avoid-shift-improve effects.

Although no further quantification was possible for Economic and Social impacts, the following table summarizes the results for what is current knowledge for international experts concerning the impacts of different measures:

Table 5 Average Scores for Measures According to E-S-E Effect

Measure	Economic	Social	Environmental
Investment and maintenance, including safety, security and accessibility	-	LOW	MEDIUM
Public transport coverage (line density, stop density, walking distances between stops) & public transport frequencies.	MEDIUM	MEDIUM	MEDIUM
Interoperable ticketing and payment systems	LOW	LOW	LOW
Taxi services (individual and collective)	-	LOW	LOW
Dedicated walking and cycling infrastructure investment and maintenance & Bike sharing schemes	MEDIUM	MEDIUM	MEDIUM
Improvement of the efficiency of city logistics by the use of ICT	MEDIUM	MEDIUM	MEDIUM

Measures to improve the energy efficiency and environmental performance of vehicles and/or use of alternative modes.	-	LOW	LOW
Corporate, school and personalised mobility plans (or workplace travel plans)	LOW	MEDIUM	MEDIUM
Car sharing & carpooling schemes.	-	LOW	LOW
Telecommunications	LOW	LOW	MEDIUM
Multimodal connection platforms	MEDIUM	LOW	LOW
Multimodal travel information provision	LOW	LOW	MEDIUM
Park and Ride areas	LOW	LOW	LOW
Reallocation of road space to other modes of transport, e.g. dedicated bus lanes	LOW	LOW	MEDIUM
Parking management	LOW	LOW	MEDIUM
Dynamic traffic management measures	MEDIUM	LOW	LOW
Low speed zones	MEDIUM	MEDIUM	MEDIUM
Information and marketing campaigns	LOW	LOW	MEDIUM
Promotion of eco-driving	-	LOW	LOW
Congestion charging zones (area and cordon charging)	MEDIUM	MEDIUM	MEDIUM
Low emission zones	LOW	LOW	MEDIUM

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies.

**Note: - stands for not available

Defining weights according to urban profiles.

In order to be able to determine the possible effects of the different policy measures according to the subject of study, this note carries out an impact assessment concerning different territories in Europe by adapting the experts' scorings to the current trends in transport behaviour that characterize the different cities in Europe present in NUTS3 regions.

The main logic behind the definition of weights is summarized in the idea that: since every city in Europe is different in size, density, population, etc., the effects of measures will surely vary from city to city. Therefore, in order to correctly assess how a determined set of measures can have an impact on different European cities, it is necessary to determine how different urban forms and organizational trends may react to the same set of measures. In other words, it is necessary to apply different weights to the possible effects of measures accordingly to the urban characteristics of European cities. For this, this note uses an approach based on understanding how future policy measures could impact urban transportation activities according to current tendencies in mobility behaviour and urban forms.

The approach that was used to carry out this assessment relies on creating urban profiles. For this, it is necessary to understand cities as spaces where people and firms interact through the exchange of opportunities (defined as the sum of goods and services that can be consumed in a period of time, LINDER, 1970). Through this vision of a city, it is possible to define urban transportation as the backbone of these exchanges. In other words, every day activities in European cities consist of economic agents that are constantly optimizing their transport decisions by taking into account the opportunities they want/need to access (LINDER, 1970) and the cost (in terms of time and money) of accessing these opportunities. The cost that agents in cities will have to incur on in order to be able to access opportunities refers directly to modal characteristics (fuel, insurance, wear and tear, tickets, etc.) and the transport infrastructure's level of service. Both of these elements are intrinsic to each individual city in Europe.

This framework implies that the inherent principle of most sustainable transport measures -which is based on rendering unsustainable transport less attractive (through prices, modal speeds, infrastructure level of service, awareness courses, etc.) than sustainable transport (and vice versa)- will have different impacts on each individual city.

Therefore, this note develops a policy measure assessment analysis were different types of urban profiles are identified for NUTS3 regions in Europe. These urban profiles will be used to assess impacts accordingly with the wide range of different types of cities in Europe and experts' scorings coming from scientific literature.

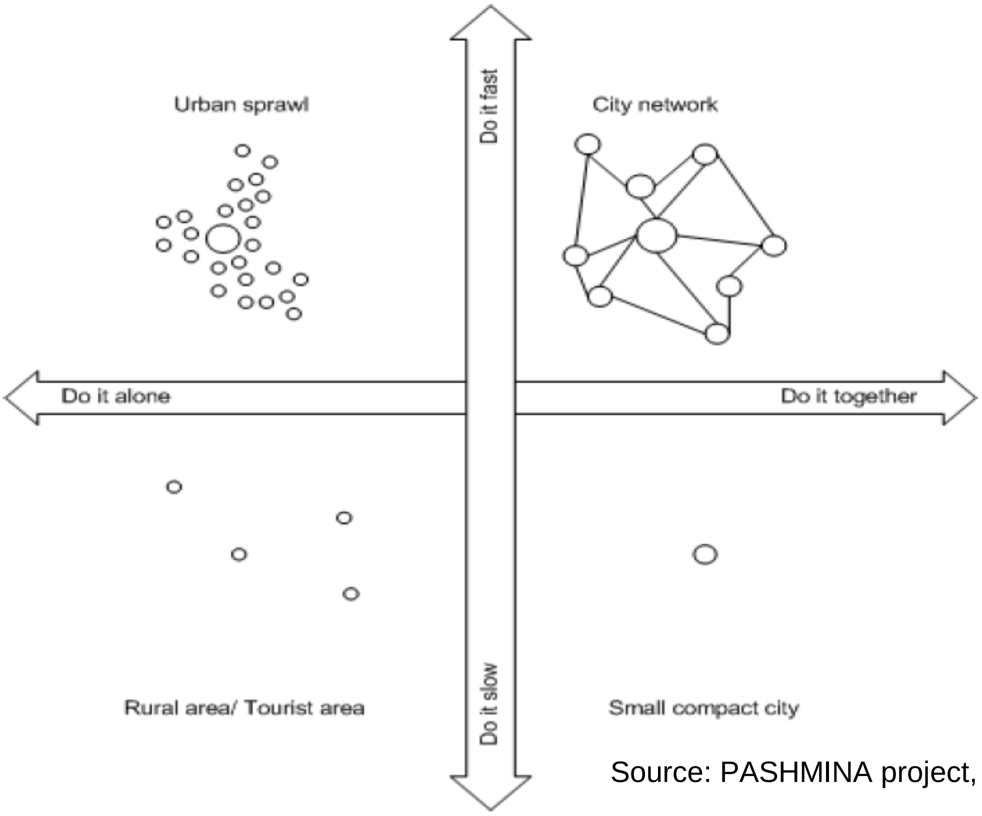
The important relationship existing between a city's opportunities and their accessibility is essential to the definition of urban profiles. This relationship sheds light on the importance of transportation services in cities in regards to the time and cost incurred by people and firms in order to carry out daily activities in a given territory.

The results from the PASHMINA project in 2011 have built on the important relationship between accessibility and opportunities and have proposed a categorization of urban forms by taking into account two key variables: transport time and opportunities.
Through the analysis of the key factors behind the different forms of urban settlements:

- population (where people live),
- consumption opportunities (where people consume private and public goods),
- production opportunities (where people produce);

the PASHMINA authors identify four patterns of concentration of population representing on-going urbanization processes:

- city network,
- urban sprawl,
- rural area,
- small compact city.



Source: PASHMINA project, 2011

Building on the urbanization patterns identified in the PASHMINA project, this note defined urban profiles that are adapted to the needs of this impact assessment. The importance of defining different profiles for urban zones present in the different NUTS3 regions lies in the need to differentiate impacts of measures according to the current structure of cities. We can certainly imagine that implementing urban measures aiming at incentivising bicycle use will have a higher impact on cities that have a very low share of bicycle use than in cities that already have elevated shares for this mode. This approach aims at taking these differences into account in order to deliver a realistic impact assessment.

Because of lack of data on specific urban characteristics, this report will use NUTS3 data that allows for an analysis of urban settlements within NUTS3 European regions. In order to achieve this categorization of cities within NUTS3 regions, individual profiles for different types of cities present in European NUTS3 regions were identified. These profiles are consistent with the urban categories developed by DG Agri, Eurostat, JRC and DG Regio as well as the PASHMINA categorization.

The creation of our urban profiles was carried out by taking into account the particular characteristics of cities within European NUTS3 regions concerning their:

- density,
- accessibility,
- employment,
- population,
- commuting averages.

These characteristics are all tightly linked to the share of different transport modes that are inherent to the functioning of cities within a NUTS3 region. As such, these characteristics are a key aspect to correctly assess the impact that different urban measures might have on different profile cities.

In order to build our urban profiles, a three step procedure was followed.

Firstly, a differentiating variable concerning rail and road accessibility by using the accessibility factor database made available by ESPON was factored in. This allows us to have a better grasp on how transport services are organized in different cities within NUTS3 regions.

Indeed, it is coherent to suppose that NUTS3 regions that have good rail accessibility are also regions that foster cities that favour public transportation within its urban cores. Nevertheless, NUTS3 regions with very good road accessibility do not necessarily imply a low use of public transport within its cities. Thus in order to reflect a more realistic differentiation of cities within NUTS3 regions the use of the Rail-Road accessibility differential was preferred. This indicator allows for a classification of the aforementioned regions according to the implied intensiveness of the region's road and/or public transport (PT). This approach is consistent with findings in studies on Transit Oriented Development (CERVERO, 1995 & 2007, LITMAN, 2007) as well as studies concerning the accessibility of railway stations (BRONS, 2009 & RIETVEL, 2000 DEBREIZON, 2007). In these studies, the accessibility of rail transport facilities is underlined as an important influencing factor in behaviour change concerning public transport. Furthermore, they also analyse the how public transport accessibility has been the backbone for rail transportation success in rail-intensive cities.
A particularly good example of this relationship can be found in the LITMAN paper, where he presents the following analysis: *"Rail transit tends to reduce per capita vehicle ownership and use, and encourage more compact, walkable development patterns, which can provide a variety of benefits to society. For example, my comparison of US cities according to their rail transit service quality (Litman, 2004) suggested that, compared with cities that lack rail transit, those with large rail transit systems have: 400% higher per capita transit ridership (589 versus 118 annual passenger-miles); 21% lower per capita motor vehicle mileage (1958 fewer annual miles); 887% higher transit commute mode split (13.4% versus 2.7%)."*

Secondly, the urban categories that were created in the DG Agri, Eurostat, JRC and DG Regio study were used in order to classify NUTS3 regions into four levels of urbanization, from most urban to least urban:

Level one was awarded to all NUTS3 that are:

- Predominantly urban region and Capital city region
- Predominantly urban regions and Second tier metro regions

Level two was awarded to all NUTS3 that where:

- Intermediate regions close to a city that were also Capital city regions
- Intermediate regions close to a city and second tier metro regions

- Intermediate regions close to a city (that where not capitals or second tier metro regions)

Level three was awarded to all NUTS3 that where:
- Predominantly rural regions close to a city
- Predominantly rural regions that where remote

Level four was awarded to
- Intermediate regions that are classified as being remote.

Once these four levels had been assessed, a categorization of the NUTS3 regions present in each of the four levels of urbanization was carried using the accessibility differential described before. Thus each one of the four levels of urbanization was categorized according to their current trend in mobility behaviour; NUTS3 regions that have a higher PT accessibility than car accessibility were awarded the label PT and vice versa:
- city network- road,
- city network-PT,
- urban sprawl-road,
- urban sprawl-PT,
- rural area[1],
- small compact city-road,
- small compact city-PT.

Thirdly, the creation of an indicator referring to how mobility behaviour is currently shaped within urban settings in NUTS3 regions consisted on including, into our analysis, data referring to commuting rates within regions as well as density levels for each NUTS3 region.

This data was used to calculate average commuting indicators for each NUTS3 region in Europe. As the original commuting dataset is only available, from EUROSTAT, on a NUTS2 basis, the data was adapted to NUTS3 basis by weighting commuting rates with employment and population data which is available for NUTS3.

The use of this information (accessibility, commuting rates and density) enabled the building of a composite indicator referring to average urban mobility behaviour that is used in the calculation of policy impacts as a proxy for the weights defining how different policy measures will have an effect on different cities.

This indicator is used in order to add or remove weight in order to better assess the impact that a given measure might have on different cities according to their defined profile. The weight that is added or removed is pondered against the European NUTS3 average.

[1] For rural areas it was decided to not create two categories (road and PT) because this category is predominantly composed by very small cities.

For example, a region that has a high car-PT accessibility differential will be assigned a higher weight for measures aiming at shifting, avoiding or improving unsustainable behaviour. Moreover, just as the car-PT differential has an impact, so do the commuting factors: the higher the commuting activity within a NUTS3 region, the bigger the impacts that will stem from measures aiming at encouraging more sustainable transportation behaviour. What is more, this extra weight is also influenced by density of the different NUTS3 regions. If density is low in NUTS3 regions, we suppose that the impact for measures looking for sustainability would have a lesser effect and vice versa. In the following table we have a selection of NUTS3 regions according to their profile indicators:

Table 6 Selection of NUTS3 Regions & Profile Indicators

NUTS3	Code	Population NUTS3 2010	Road Accessibility factor	Rail Accessibility factor	Commuting Indicator	Density
Munich	DE212	1 353 186	173	163	0.4	4282
Berlin	DE300	3 460 725	147	175	1.0	3878
Madrid	ES300	6 369 162	61	63	1.0	789
Barcelona	ES511	5 375 774	72	69	0.7	693
Sevilla	ES618	1 877 060	33	42	0.2	133
Paris	FR101	2 256 239	204	246	0.3	21319
Seine-Saint-Denis	FR106	1 530 463	197	226	0.1	6467
Val-de-Marne	FR107	1 335 073	197	219	0.1	5415
Rhone	FR716	1 740 620	149	171	0.3	530
Bouches-du-Rhône	FR824	1 977 112	96	135	0.4	389
Milano	ITC45	4 006 330	159	138	0.0	1998
Roma	ITE43	4 194 068	94	88	0.1	772
Amsterdam	NL326	1 267 128	160	182	0.6	1395
Inner London	UKI11	1 137 148	153	173	0.4	10309
Inner London	UKI12	1 967 739	153	200	0.6	9265

In order to link the profile weighting system to the experts' scores, we used information on measures' short, medium and long term effects present in the literature consulted. The logic behind this consisted in supposing that the effect of policy measures on different urban profiles grows or diminishes just as its effects grow/diminish over time. In other words, different measures have different effects in time according to each city's current transport patterns. For example, highly populated cities with high densities and important levels of PT shares will be slower to react to high impact measures looking for important modal shifts (as they already possess high levels of PT demand). This logic is also applicable for cities with high road transport use, where the impact of measures will have a fast/important effect.

Following this reasoning, the information for increasing/decreasing effects over time for each type of policy present in the literature was gathered and used to create a profile weight template averaging the scores from different studies and for different urban profiles. These results are presented in the following table. In order to read this table, it is important to keep in mind that this table presents the average of weights for all scoring studies. A clearer picture of how structural effects come into play by taking into accounts the described urban profiles will be offered in the Summary of Results section in form of a map with all NUTS3 regions depicted.

Table 7 Average Scores for Measures According to Weight

Measure	City Network	Urban Sprawl	Rural Area	Small Compact City
Investment and maintenance, including safety, security and accessibility	LOW	MEDIUM	LOW	LOW
Public transport coverage (line density, stop density, walking distances between stops) & public transport frequencies.	LOW	MEDIUM	LOW	LOW
Interoperable ticketing and payment systems	LOW	LOW	LOW	LOW
Taxi services (individual and collective)	LOW	LOW	LOW	MEDIUM
Dedicated walking and cycling infrastructure investment and maintenance & Bike sharing schemes	LOW	LOW	LOW	MEDIUM
Improvement of the efficiency of city logistics by the use of ICT	MEDIUM	LOW	MEDIUM	LOW
Measures to improve the energy efficiency and environmental performance of vehicles and/or use of alternative modes.	MEDIUM	LOW	MEDIUM	LOW
Corporate, school and personalised mobility plans (or workplace travel plans)	LOW	MEDIUM	LOW	LOW
Car sharing & carpooling schemes.	LOW	LOW	LOW	MEDIUM
Telecommunications	MEDIUM	LOW	MEDIUM	MEDIUM
Multimodal connection platforms	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Multimodal travel information provision	MEDIUM	LOW	MEDIUM	LOW
Park and Ride areas	LOW	LOW	LOW	LOW
Reallocation of road space to other modes of transport, e.g. dedicated bus lanes	MEDIUM	LOW	MEDIUM	MEDIUM
Parking management	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Dynamic traffic management measures	LOW	LOW	LOW	LOW

Low speed zones	LOW	MEDIUM	LOW	MEDIUM
Information and marketing campaigns	LOW	MEDIUM	LOW	MEDIUM
Promotion of eco-driving	LOW	MEDIUM	LOW	MEDIUM
Congestion charging zones (area and cordon charging)	LOW	MEDIUM	LOW	LOW
Low emission zones	LOW	MEDIUM	LOW	MEDIUM

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies.

**Note: - stands for not available

Consequently, by using the expert scores on measures' weights and individualizing them through the use of profiles, it was possible to create a tailored weight system (also refer to NUTS3 map in Summary of Results section) that was used to clearly identify the effects of different policy measures in regards to their potential in avoiding, shifting or improving unsustainable behaviour.

Detailed overview of measures

Public transport services

Public transport services are a big part of sustainable planning. Indeed, they not only offer a more sustainable mean of transportation, they also ensure a fairer access to transportation services disregarding economic differences within a given population. Furthermore, they ensure access and continuity within a given territory. In this sense, public transport services play a very important role in the economic, social and environmental fields. Because of this, measures directed at public transport are highly influential in shaping overall transport demand.

Investment and maintenance, including safety, security and accessibility

As it is stressed in the Connecting Europe Facility (CEF) project, investments in transportation services play a key role in the performance of the transport sector which, in turn, has important impacts on overall economic activity and competitiveness. The efficiency of transport systems are a key element to providing social and economic opportunities that in turn translate into better accessibility to markets, employment and additional investments. What is more, deficiency in transport services -be it on capacity, reliability, security or accessibility- are tightly linked to increased social costs that can hamper economic activity.

Furthermore, investments in rolling stock and their maintenance is a clear driver in public transport attractiveness. They not only ensure competitiveness, safety and security in public transportation but they are also a key factor in the bettering of accessibility for populations with mobility difficulties (physical and/or geographical).
In consequence, good planning in transport investment and maintenance is of the utmost importance in sustainability plans.

Inefficient planning in investment and maintenance can have negative impacts that represent important social costs. Thus sustainability plans take into account investment measures that are not only addressing transport needs in cities but that also address strategies to minimize negative nuisances that can be a result of new transport infrastructure such as mobility gaps, congestion, accidents, air quality and noise.

Overall, investment oriented measures tend to be carefully planned when implemented and play across the board on sustainability objectives. Thus the scoring assessments from experts tend to be very balanced on their impacts on social and environmental objectives. Nevertheless they tend to be more focused on effects in the medium to long-term.

Table 8 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	LOW	MED	-	LOW	MED	713 - 894	LOW	MED	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for Medium **Note: - stands for not available

Public transport coverage & public transport frequencies.

Public transport coverage is an issue that receives considerable attention and is seen as a key element in addressing sustainability concerns in urban settings. The key objective is aimed at increasing the use of public transport by: increasing the catchment area of the public transport network and increasing accessibility to opportunities (economic, social, etc.). In the last few decades, many European cities have decreased their public transport coverage in order to make way for private vehicle transport. Nevertheless, in current years, sustainability driven planning has renewed its interest in public transport coverage as a way to address economic, environmental and social problems created by nuisances stemming from increased personal vehicle use.

One of the most important factors in being able to shift passengers from personal vehicles to public transport is rendering public transport equally (if not more) attractive to personal vehicles. This can only be attained if the opportunities that are accessible to passengers (job opportunities, leisure, shops, hospitals, etc.) through the use of a car are equivalent to the accessible opportunities using the public transport network. In this manner, public transport coverage plays a key role in this. Nevertheless, public transport coverage goes hand in hand with other factors that ensure sustainability. As it is pointed out by A.T. Murray in his Strategic analysis of public transport coverage (2001):

- more effective price structures;
- enhanced travel comfort;
- better suitability and convenience of service—quality;
- reductions in travel time—efficiency;
- increased service access.

Scoring assessments from experts tend to show that public transport (PT) coverage and transport frequency measures are highly effective in shifting passengers to other PT modes and improving current practices. Furthermore, these measures are considered as being highly effective in all time frames (short, medium and long terms).

Table 9 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	MED	LOW	MED	MED	MED	917 - 1 150	LOW	MED	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Interoperable ticketing, payment systems & public transport pricing

Pricing in transport services is highly linked to the attractiveness of public transport services. Recently, in Europe, there has been a big effort made on the interoperability of public transport ticketing and also on the European Electronic Toll Services. The developments in Europe concerning ticketing services have enabled big developments in the standardization at a European-wide level. These standards are linked to its technical and legal feasibility[2], as well as on fare management.

Interoperable ticketing and payment systems are key elements for seamless travel (on urban, regional, national and/or European level) which is identified by experts as a high priority measure aimed at increasing the attractiveness of public transport and/or rendering movements in private vehicles more fluid. Nevertheless, these measures can have a higher or lower degree of impact in sustainable behaviours depending on the fare management system in place:

- welfare maximizing fare structures;
- profit maximizing fare structures.

Not surprisingly, in scoring assessments, the most promising results concerning sustainability come from welfare maximizing fare structures. This measure is defined as having high impacts in shifting to more sustainable behaviours and improving current practices. The impacts are mostly concentrated on environmental and social objectives in the short and medium term.

Table 10 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	MED	LOW	LOW	LOW	LOW	471 - 591	LOW	LOW	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Travel information provision systems

Information in transportation services has always been regarded as a way to open opportunities for infrastructure users (road, public transport, freight, etc.) and planners. It is regarded as a tool to better optimize transportation-linked choices whilst taking sustainability in mind. For planners as well as users, more information translates into bringing intelligence into mobility and this in turn means safer, optimized mobility. With this in mind, the EC-ITS Roadmap (EC-ITS, 2007) identifies numerous ITS applications that as the of future transport services. Among these applications seamless real-time travel and traffic information, including multi-modal journey planning and information systems are clearly established as important elements of the future of

[2] For more information on standardization documents published, go to: http://ec.europa.eu/transport/themes/its/road/application_areas/electronic_pricing_and_payment_en.htm

transportation. The ability of travel information systems to offer important data for users and planners is a key element in sustainable mobility planning.
Scoring assessments regard information services as a group of measures that may offer positive impacts on economic, social and environmental objectives. Furthermore they are regarded as influential in avoiding unsustainable practices and also represent an option for short-term effects on shifting to more sustainable transport options as well as improving current practices. What is more they offer sustainable solutions for passenger and freight transportation.

Taxi services (individual and collective)

Taxi services are commonly regarded as luxury and/or special transport services. Nevertheless, an increasing body of work shows that taxi services have an important role in sustainability planning. What is more, collective taxi services are increasingly seen as a way of offering tailored services where mass-transport is inefficient.
The high turn-over in fleets that is associated with taxi services offers a great opportunity for new vehicle technologies to enter the market and have an impact on the sustainability of passenger transport with positive effects on congestion in cities.
An increasing number of firms are beginning to offer alternative taxi services -for example on bicycles- that not only offer a solution to congested city-centres but also propose noise-reductions and cleaner transport.
Finally, taxi services are also used in Demand Responsive Transport, which is intended to catering specifically to the demands of users with the objective of promoting accessibility for users with little or no access (physical and/or geographical) to conventional public transport.

Table 11 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	LOW	-	LOW	LOW	578 - 724	LOW	LOW	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Dedicated walking and cycling infrastructure & bike sharing schemes

Several European cities have pushed towards developing cycling and walking infrastructures and results have been generally good. Nevertheless, some European cities show very high modal shares for walking and/or cycling trips whilst other cities have not fared as well. A 2004 report from the ECMT develops on the EU WALCYNG project's reported barriers for cycling concluding that they are linked to issues concerning: safety, security, distance, health, social status, weather and topology. What is more, a UNEP 210 report on developing cycling and walking emphasize on bolstering integration of infrastructures in order to better increase modal shares. The key issue seems to be the development of an integrated cycling infrastructure policy that focuses on safety, accessibility and cohesion of the network without forgetting specific needs on bicycle parking structures and integration with public transport infrastructures.

Besides the inherent impacts on economic, environmental and social aspects of walking and cycling, it is important to underline the high impacts that dedicated walking and cycling infrastructures can have on overall health of urban populations. Indeed, by addressing issues concerning perceived barriers for increased walking and cycling, the attractiveness of soft-modes would surely increase. This in turn would have an important impact on overall health benefits.

Furthermore, infrastructure development in cycling is not only concentrated on lanes for safe cycling. Bicycle sharing schemes have grown in popularity in the last decade and, from the first scheme in 1968 in Amsterdam, bike sharing has grown steadily in Europe. Today, nearly 80 European cities have established different types of systems. Although, the private sector is highly involved in developing these schemes and ridership in Europe has increased exponentially in recent years, these types of services and infrastructures are still limited in their development. Roughly 80% of bicycle sharing schemes in Europe are concentrated in only 5 countries: Spain, France, Germany, Italy & UK with most of them having been developed since the year 2000 (MIDGLEY).

Experts offering scorings for infrastructure measures for walking and cycling agree on the important impacts on the mid- and long-term on economic and social objectives. Nevertheless they also show the limited impacts that they might have on environmental objectives. This is due to the fact that it has been observed that cycling and walking tends to attract more ridership from public transport services and not from private vehicles.

Table 12 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	MED	LOW	MED	MED	MED	781 - 979	LOW	LOW	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
Edinburgh, 'Greenways' (Bus Priority Measures)	Greenways is an example of a public transport service improvement; in combination with improved conditions for pedestrians and cyclists; at a comparatively low cost.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=428

High level service bus routes in Lille (France)	As a whole, one can estimate a gain from 20 to 30 % over travel times if (condition necessary to the success) particular installations are implemented in the site and in the approach of the crossroads, in order to give the buses priority as compared to the rest of traffic.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2281
Cologne's 'Traffic Calendar', Germany	Improved traffic management within Cologne, as information about temporary (road traffic accidents, construction/maintenance works/events) and permanent (changes in the road network) are all collated in one place, which allows more efficient planning to be made.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2971
Mobility management for older people at the Verkehrsverbund Rhein-Sieg in Cologne, Germany	The Verkehrsverbund Rhein-Sieg (VRS) supports municipalities in establishing a systematic mobility management. The network of road safety in cities, towns and local authorities helps its members to achieve a coordinated strategy and implement new measures to support independent and sustainable mobility.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3211
Increasing bicycle use in Burgos	48 km of bike lane, the highest rate of km of bike lane per inhabitant of Spain More than 250 parking bike racks installed From 20-40 bikes per hour accounted in the main bike lane to more than 120-140 per hour Completely change of mind of the citizens	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2397
Public bicycle in Barcelona after its second year of implementation (Spain)	In average, each day, 35.000 trips are realized by public bicycle in winter, a number which reaches up to 58.000 trips in summer. The public bicycle has reached its maximum extension with 6000 bicycles and 400 stations. Each bicycle is used ten times a day in summer and six times in winter, and in central location the use can be 20 times per day and bicycle. It is calculated that each bicycle realizes 25 kilometres per day.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2115
Promotion of bicycle use and integration with PT services in Toulouse/France	There is a global increase in bicycle use even if the modal share remains very low (3% at the level of the whole conurbation of Toulouse), The intermodality including bicycle is very low, For distances about 2-3 km, bicycle modal share is equal to public transport modal share, There has been an important increase of safety conditions for cyclists.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2425

Public bicycle rental system in Krakow (Poland)	In 2009-2011 the number of rentals per month stood at 5.000 to 8.000.Average per-day during this time-period: 150-170From 2009-10 and 2010-11, an increase of circa 20% per year, in number of trips, was measured.The system now has about 6.000 registered riders and 4.000 active riders.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2147
Stimulating intermodality and e-bike commuting in employment areas in Greater Lyon, France	The main finding was a long term change in car use in the first demonstration site: 10% modal shift from SOV to Cycling. 20% of test-commuters purchased a bike.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3391
Bus-Rapid-Transit-Line (BRT) in Istanbul (Turkey)	Currently (March 09), everyday more than 500,000 passengers use the line. On the separate lane the average speed of the busses amounts to 40 km/h. Consequently the daily journey time is reduced from 2.5 hours to 40 minutes. One stop is frequented by 144 buses per hour. Thus, every 25 seconds a bus leaves. Hence, the waiting time at the bus stop is negligible. A bus on the BRT-line uses approximately between 0.3 and 0.4 litres of fuel for 100 km per passenger and consequently contributes hugely to the reduction of CO_2 emissions.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2107
Emergency and Information Pillars in Hamburg (Germany)	Since 2004, when video cameras were installed in all AKN-trains, damage due to vandalism has been reduced by 50% .	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1761
Revolutionised public transport with dedicated bus-tram-lane in Warsaw, Poland	Before the new solution was brought in, there were on average 1700 cars per hour running one direction. Since there was only one public lane left, the number of cars decreased by 40%, whereas tram passenger numbers have grown by 250%. Additionally, the transport authority has increased frequency on the four tram lines that operate along the route from 55 up to 60 departures per hour during peak hours	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3326

Real Time Countdown System, London, UK	Predictions are now 95% accurate. Operational costs have been reduced, with communication costs now only 20% of the previous level.TfL will be providing its live bus information as a syndicated data feed to allow application developers to create their own services and smartphone apps.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3388
Introduction of minibus services serving the higher parts of Donostia - San Sebastián, Spain	The objective of connecting the hillside districts to the city public transport network has clearly been achieved with over 800,000 passengers per year using the 3 minibus lines currently operating.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2846
Development and upgrade of the e-ticketing system in Brescia, Italy	Brescia participates in the CIVITAS MODERN Consortium with 14 measures. One of these involves carrying out research and demo activities in order to prototype and implement e-ticketing in the city. The aim is to strengthen intermodality among different PT modes and vectors through integrated ticketing systems over wide areas.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3137
ONE-TICKET, Integrating transport in South East Scotland	In the financial year ending March 2008 there were 23,758 ONE-TICKETs sold a growth from 3,968 in 2003, the first full year of operation. The most popular period of ticket is the 4-weekly ticket which has shown sustained growth. The usage of ONE-TICKETs is still small for an area with a population of 1.5m, and it is unlikely that it has effected any discernible modal split change.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2024
Introduction of the Unique Ticket (integrated ticket) in the region of Asturias, Spain	More than 80.000 unique tickets have been sold since is implementation. The ticket participates in 50% of the trips in the region. At the moment more than 40 private public transport operators and 2 public rail operators (RENFE & FEVE) provide services within the framework of the Unique Ticket. The Unique Ticket has meant economic savings for the user, and since it is promoting public transport use, it has also helped to keep emissions low.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2028
Network, Timetable and Tariff Integration in Verkehrsverbund Oberelbe (Germany)	Special benefits for the Verkehrsverbund Oberelbe Revenue increased by 17% from 1998-2003. Demand from 1998-2003 grew 7% for all of public transport, 20% for railway services alone.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2219

High quality bus service in Chur, Switzerland: Improvements of availability	The demand for public transport has increased since the introduction of the BUSvuCHUR 2000: 3.6 million; 2005: 4.6 million boardings per year. The main reason is the larger area covered by public transport service, especially the connection between the city and the nearby municipalities	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2020

City logistics and distribution

City logistics is a major issue in sustainable urban mobility plans. The number of different types of activities existing in cities explains that freight transportation services are, in general, difficult to optimize. A recent DG MOVE Study on Urban Freight Transportation (2012) clearly states that *"the structure of, and future trends in each of the following sectors will largely determine the nature of the challenges posed by UFT in the future:*

- *Retail (including e-commerce);*
- *Express, courier and post;*
- *Hotel, restaurant and catering (HoReCa);*
- *Construction;*
- *Waste."*

This report defines he root of the difficulty in planning for sustainability in urban logistics as a problem that lies in the "last mile". The main cause for this problem is the nature of urban freight itself. UFT depends on being able to offer a flexible service that –generally- delivers small parcels to individual customers, this leads to a certain number of inefficiencies that DG MOVE classifies in the following way:

- Low load factors and empty running;
- A high number of deliveries made to individual premises within a given time period;
- Long dwell times at loading and unloading points

Freight distribution centres & Freight delivery points

The essence of developing policies that push for a greater use of freight distribution centres and/or delivery points lies in tackling one of the biggest inefficiencies of freight urban transportation services: load factors. The freight industry's efficiency is largely dependent on being able to organize itself in order to realize economies of scale. This option is less feasible in urban freight than it is in long-run transport services. *For this reason, as a general rule, large-scale retail distribution and express/courier services tend to be more efficient than very fragmented distribution services to small retailers and in the Hotel-Restaurants-Catering industry* (DG MOVE)

Consequently, experts consider that organizing the necessary stake-holders in order to incentivize freight practices that can increase economies of scale and load factors could have an important impact on environmental objectives. This might lead to a higher use of Urban Consolidation Centres that would allow for higher load factors and an accrued effect on shifting to low-emission vehicles for urban freight distribution (the last mile). This could also imply the use of vehicle weight and/or size restrictions in the urban area or the creation of low emission zones.

Improvement of the efficiency of city logistics by the use of ICT

ICT in city logistics is aimed at controlling and monitoring freight operations whilst also gathering data in order to increase planning efficiency in overall functioning of urban freight transportation. What is more, the use of ICT can lead to improvements in fleet efficiency, productivity and increase safety and environmental performance. According to the KONSULT database: in a Good Practice Guide (341) issued by the Department for Transport (DfT) (2003) seven potential functions of fleet management systems were outlined:

- *data on the performance of both drivers and vehicles;*
- *vehicle tracking systems;*
- *text messaging communication;*
- *trailer tracking;*
- *paperless manifest and proof of delivery;*
- *traffic information and*
- *on-board navigation systems.*

Table 13 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	LOW	MED	MED	MED	MED	951 - 1 192	MED	LOW	MED	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Measures to improve the energy efficiency of vehicles and/or the use of alternative modes.

Urban freight transport is generally carried out with HDV's and LDV's using diesel engines. Because of this, an increase in other, less polluting, motor technologies could have a high impact on GHG emissions linked to urban freight activities. The 2012 DG MOVE report on measures in UFT sector point to the effects that measures aimed at increasing alternative means of transport might have on noise levels. In addition, they also point out that reduction in noise levels might open the possibility of a wider use of night deliveries (that would further the decrease congestion problems in urban settings during the day). The DG MOVE report underlines that there is a risk of slow penetration rates of more energy efficient technologies due to high capital costs, the uncertainty of the technology and the poor availability of refuelling infrastructure.

Table 14 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	MED	-	LOW	LOW	612 - 767	MED	LOW	MED	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

To offer more insight on this, we have summarized the data from the TansPord analysis (2010) which looks into the detail of performance improvements of vehicles:

	Relative CO_2 reduction potential 2020	Relative CO_2 reduction potential 2050	Feasibility	Cost (€/Ton CO_2 saved)
Diesel engine +	9%	15%	High	NA
Aerodynamics	9%	19%	High	1873
Hybrid electric vehicles	7%	10%	Medium	NA
Rolling resistance	7%	12%	High	NA
Intelligent vehicle technologies	5%	16%	Medium	1830
Transmission and driveline	5%	6%	High	664
Lightweight construction	2%	11%	High	NA

Source: GHG-TransPoRD (http://www.ghg-transpord.eu/ghg-transpord/downloads/GHG_TransPoRD_D2_1_GHG_reduction_potentials.pdf)

Selection of examples from the EPOMM database

Case	Remarks	Link
Alternative ways for distributing goods in Amsterdam: boat & bikes (The Netherlands)	Furthermore DHL was able to cut down 10 of its delivery vehicles per year. This means a yearly reduction of 150 000 km driven by DHL vans which would use 12 000 litre diesel.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1495
Street Management Improvements for Loading/unloading Enforcement (SMILE): Barcelona (Spain)	The level of space occupancy reduced from 81% to 57%. But the larger part of the reduction is attributable to the shorter stays of vehicles that park in the zone. The average	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=513

	length of stay of vehicles observed to carry out un/loading operations decreases from 19.54 minutes to 17.89 minutes.	
Electric and Hybrid Waste Collecting Vehicles in Sevilla, Spain	Based on the positive results, for 2011 an increase of the number of vehicles will be decided.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2717
Emission - free delivery service with cargo bikes in central Cambridge, UK	With each of its bikes travelling approximately 12.000 miles per year, Outspoken delivery contributes to a reduction of noise, exhaust fumes and traffic congestion and their expansion proves that transportation of goods does not necessarily include exhaust fumes and traffic congestion.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3015
Emission-free last mile delivery service in London, UK	A study carried out by the University of Westminster has verified that in using this system, a reduction in emissions of CO_2 of 62% per parcel can be achieved and that a 54% reduction in total miles travelled per parcel can be reached.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3014
Cargo by electro bicycle transporter in Berlin, Germany	The operator (messenger) is confident that in the next five years about 20 percent or 200 vehicles of common transporters can be substituted by Cargo-Cruisers.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1939

Mobility management

Mobility management is considered a key element in developing more sustainable patterns in transport activities. Whilst other measures for sustainable mobility concentrate on infrastructure, technology and/or regulation, mobility management focuses on behavioural change in order to create and integrate sustainable practices in everyday transportation activities. Although mobility management policies can, for the most part, work as stand-alone measures, they thrive in combination with infrastructure and regulation measures.

Corporate, school and personalised mobility plans

Mobility plans aim at supporting a change in individual and/or group travel behaviour. Mobility plans can be used on different settings and aiming at different types of travellers. They can be implemented in schools, companies, and also offered as a personalized service.

Through the use of telecommunications and better planning in employee mobility, corporate mobility plans normally aim at tackling parking shortages; improving accessibility; complying with regulations, reducing company car needs and/or fostering sustainable mobility practices. Corporate mobility plans aim at reducing car use and tend to reduce solo car driving through car-pooling. Experts' scorings show that the impact of corporate mobility plans on sustainability indicators tend to grow over time.

School mobility plans also tend to aim at increasing accessibility to schools by getting students to their destination in a safe and sustainable manner through the means of bus services or inciting car-pooling between parents and teachers. Furthermore, certain schools also try to implement alternative mobility plans like: walking buses or bicycle buses in order to spark more sustainable behaviours in students in a safe and environmental manner.

Personalized mobility plans aim at increasing the use of public and more sustainable means of transportation through awareness campaigns aimed at sparking a sense of personal responsibility in sustainability problems. These campaigns intend to achieve more sustainable behaviour in travel patterns by also offering information on transport alternatives that may be perceived as viable options by people.

Table 15 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	LOW	LOW	LOW	MED	MED	680 - 852	LOW	MED	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Car sharing & carpooling schemes.

Car sharing schemes have been introduced into different cities as a service that reduces the need to buy a personal car and offers a flexible alternative to conventional car hire services. Although these services do not necessarily imply a reduction in car use they do tend to curb vehicle ownership. What is more, they let drivers pay as they go.
Some low-car housing schemes have introduced car sharing as part of their development principles thus reducing the land-take of parking facilities.

Carpooling schemes differs from a car sharing plan in that the former requires drivers to possess their own vehicles. These schemes are an important part of corporate and school mobility plans and they have also increased as internet communications offer solutions for organizing pools.

Expert's scoring show that vehicle demand impacts for these schemes may not always be in terms of a reduction in car use, but it does offer alternative means of transportation with higher ridership factors in individual cars.

Table 16 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	LOW	LOW	-	LOW	LOW	442 - 554	LOW	LOW	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Telecommunications

Telecommunications have opened new opportunities for workers and companies to reduce transportation needs and offer new ways to organize working practices in a more sustainable way.

Firstly, telecommunications are an important part of increasing telecommuting practices that have the potential to reduce overall vehicle use, particularly during the peak commuting hours, and so lead to improvements in environmental and accident impacts.

Secondly, the growing efficiency of teleconferencing has also offered new ways for companies to conduct business meetings whilst reducing transportation needs.

The OPTIMISM project is a great source for ICT best practices and information (see annex). This project has looked into many ICT projects across Europe and gives a detailed assessment of impacts. OPTIMISM also offers a scoring assessment based on expert scoring which show the high potential of ICT in avoiding unsustainable behaviour patterns and improving current practices.

Table 17 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	MED	LOW	LOW	LOW	MED	1 019 - 1 278	MED	LOW	MED	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
Workplace mobility plans- Toulouse	Figures show that the WMPs have given results. Between 2001 and 2004, for example, Thales Alenia Space reduced the use of the car by its employees from 88.7% to 80% and increased the use of public transport from 1.5% to 5%, of the bicycle from 1.7% to 5% and carpooling from 3% to 5%.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3789
Mobility Management at Heathrow Airport, London, UK	Carpooling modal shift is + 2.7% from 1992 (4%) to 2009 (6.7%). Travelling by Public Transport has doubled from 1992 (12%) to 2009 (24.4%) with a modal shift of + 12.4%	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2821
Travel Planning by Merck Serono S.A., Geneva, Switzerland	The most significant change between 2006 and 2009 concerns the shift of use from individual car (from 72% to only 17%) to public transportation (from 13% to 47%). Other interesting results are the shifts towards car-pooling (from 4% to 16%) and Park and Ride/Rail	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2825

	(from 0% to 7%).	
Car sharing in La Rochelle	Total reduction of greenhouse gas emissions and other pollutants : CO_2 22 t/year PM10 6 kg/year NOx 76 kg/year	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=721
SMS ticketing system of public transport operator De Lijn, Belgium	However, during the pilot in 2007, 9% of users indicated they used the bus more due to the system of SMS-ticketing.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3426
Peterborough City TravelChoice Sustainable Transport Programme	Local residents in targeted areas have reduced car trips by 13% and increased levels of walking (up by 21%), cycling (25%) and public transport (13%). The increases in walking, cycling and public transport use have resulted in an 18% increase in daily time spent using physical active forms of travel.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1183
Organisational Model of Verkehrsverbund Oberelbe	The organisational model ensures an integrated public transport system and has led to the increased attractiveness of public transport. Between 1998 and 2006, the number of passengers increased by about 8%, from 181 to 196 million passengers.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2248
Two Operators Reduced to a one for Management of	The increase of users during the first year (12.07 %) leads to	http://www.epomm.eu/index.php?id=2

Public Transport in Metropolitan (Pamplona, Spain)	conclude that the changes in the management of the public transport system in Pamplona improved the service as a whole.	771&lang1=en&study_id=129
Multimodal Travel Planning (the Netherlands)	According to figures provided by 9292, a figure of approximately 1% is achieved in terms of modal shift effect. Moreover, 4% of the users changed their trip due to using the multimodal planner, mostly in favour of PT-solutions.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1760
Euskirchen - Integrated Transport Management with urban bus system and parking management in a medium-sized town	The number of passengers was constantly increasing between 2 and 5% per year (above German average). The total number of passengers in 2007 was about 4.917.000 boardings.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2035

Integration of transport modes

In John Preston's 2012 report for the OECD, the concept of integrated transport is defined by referring to the rungs of an integration ladder which include:

- *the integration of public transport information;*
- *the physical integration of public transport services;*
- *the integration of public transport fares and ticketing;*
- *the integration of infrastructure provision, management and pricing for public and private transport;*
- *the integration of passenger and freight transport;*
- *the integration of (transport) authorities;*
- *the integration between transport measures and land use planning policies;*
- *integration between general transport policies and the transport policies of the education, healthcare and social services sectors;*
- *the integration between transport policies and policies for the environment and for socio-economic development.*

In the report, these rungs are distinguished between horizontal integration (the first four rungs) and vertical integration (the remaining 5 rungs). Difficulties for a complete integration of transportation services have been historically linked to the fact that cars have represented the ideal way to offer seamless transport (regarded as unbeatable in door-to-door transportation). What is more, the fragmented ownership of public transport in many European cities has also been hailed as a barrier for integration. Nevertheless, renewed interest in sustainable mobility plans renders integration for seamless transport a key issue in the feasibility of sustainable mobility plans.

Multimodal connection platforms

The EC white paper on a single European transport (2011) area defines infrastructure as the key element that shapes mobility and concludes that *"no major change in transport will be possible without the support of an adequate network and more intelligence in using it."* In this setting, the white paper calls for an efficient multimodal network in cities. As such, multimodal connection platforms seem to be the key element in this network. The role of connection platforms are not only regarded as a way to better integrate urban transportation services but also as gateways for regional, national and international integrated transport. The European road-map to integrated transportation concludes that *"a transformation of the European transport system will only be possible through a combination of manifold initiatives <u>at all levels</u>."*

Table 18 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	LOW	MED	LOW	LOW	306 - 383	MED	MED	MED	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Multimodal travel information provision

Measures aiming at increasing multimodal travel information are directly geared towards offering advice to travellers in how to carry out their trips in the most efficient way. Information and communication technologies have opened multiple ways to deliver this information to travellers. Information on connections and arrival times are now a part of everyday travel in certain stations, airports and/or connection platforms in European cities. However there is also a growing trend to deliver this information in real-time over the internet on computers and on mobile devices.
Offering information to travellers has an impact not only in the attractiveness of transportation services but also in making trip-planning more efficient and sustainable.

As such, experts concur that these types of measures have important impacts on environmental, social and economic objectives. What is more, they also have an important influence in shifting to more sustainable practices and improving on current behaviours.

Table 19 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	LOW	MED	LOW	LOW	MED	849 - 1 065	MED	LOW	MED	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Park and Ride areas

Park and ride areas is a form of integrated transport that aims at optimizing travel chains by letting travellers use their cars for the parts of a trip that are not efficiently covered by public transportation services. Furthermore they allow travellers to switch to public transport in order to avoid congestion within city centres and decrease the environmental, social and economic impacts linked to car use in city centres in peak periods.
These types of measures allow for a more efficient use of resources whilst decreasing congestion levels. As such, park and ride measures in different European cities have had high impacts on sustainability objectives and have important effects on avoiding unsustainable travel at the same time that they increase overall efficiency of trips and offer an important shifting capability towards more sustainable transport means.

Table 20 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	LOW	LOW	LOW	LOW	510 - 639	LOW	LOW	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
Park and ride- a success, Edinburgh, UK	In total, Edinburgh council estimates that over 100,000 road trips into Edinburgh have been averted and with plans to expand both Hermiston and Ingliston and adding two new park-and-ride facilities this reduction in inner-city car trips will increase these figures further.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1706
Park and Ride in Groningen (The Netherlands) Preston Urban Traffic Management and Control (UTMC) System, Preston, UK	In the last few years, the use of the Citybus has steadily grown from 20,000 passengers in 1988 to 1.3 million passengers in 2006.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1700
Awareness for speed reduction and less car use/Graz (Austria)	As the mere feedback of the actual speed on average achieves a speed reduction of 9 km/h and especially takes away peak speed driving, and as those control devices do not cost much, this action is very	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2285

	recommendable to be taken up by other cities.	
Provision of local travel information, Cloughjordan, Tipperary, Ireland	Modal shift - Car ownership decreased by 2.5%; - Bicycle ownership increased by 7.3%; - The number of passenger trips per month on local bus services increased by 6.5% between September 2008 and June 2010.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2948

Road transport

Road network investment and maintenance

Road network investment and maintenance is seen as a two-fold measure for sustainable mobility. On one side, investment in road networks ensure the correct functioning of the infrastructure as well as the renewal and implementation of security measures necessary for safe road transport. On the other hand, maintenance of the road network is of vital importance for economic activity and to ensure the correct accessibility levels for cities and their services. The European Union Road Federation (ERF) believes that road maintenance is central to transport policy and crucial to improve social welfare in Europe.

Reallocation of road space to other modes of transport, e.g. dedicated bus lanes

Reallocation road space to other modes of transport is aimed at encouraging public transport use through land use planning. According to the KONSULT database, the measures includes: "*improving conditions for the efficient operation of public transport; locate land uses close to public transport services which serve them, and increase the demand for public transport, particularly by encouraging mode change from the private car.*" Expert scoring on this issue clearly shows that using road space for more sustainable means of transport have a clear impact on shifting passengers towards public transport as they tend to increase level of service and speeds on this mode. Furthermore, this measure also implies a higher level of GHG emissions from buses but lower pollutants from cars.

Table 21 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	MED	MED	LOW	LOW	MED	985 - 1 235	MED	LOW	MED	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Parking management & pricing

Parking management is aimed at having an influence on behaviours by controlling the ability for drivers to easily and/or cheaply park their cars after their trip. Thus, some European cities have used these types of measures to render parking costly and/or time consuming. This has had an important effect on controlling the amount of vehicles in certain zones and has also had an impact on trips shifting to public transport and/or alternative modes. Moreover, parking management programs also aim at controlling parking supply and in consequence reducing the land-take that parking infrastructures have on the urban space.

When implemented as part of a Mobility Plan site-based parking management is a powerful mechanism to influence people's choice of modes. This is especially true for a situation in which parking supply is below demand.

- curb car use in certain zones;
- eliminate parking problems and/or congestion problems linked to parking shortage;
- increase revenue that can be re-invested in other mobility measures.

Table 22 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	MED	MED	LOW	LOW	MED	781 - 979	MED	MED	MED	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Dynamic traffic management measures

Measures looking to manage traffic dynamically are aimed at increasing safety on networks whilst controlling flows in real-time in order to avoid congestion problems. These types of systems suppose a very high level of integration and co-ordination between traffic signals and real-time information from network use.
According to the Konsult policy database, these systems can be used to*:*

- *obtain better traffic performance from a road network by reducing delays to vehicles and the number of times they have to stop.*
- *balance capacity in a network, to attract or deter traffic from particular routes or areas, to give priority to specific categories of vehicles such as public transport*
- *arrange for queuing to take place in suitable parts of the network.*

Demand impacts usually reduce travel time, but reduced travel times and good network performance may increase road capacity. This may cause a shift in demand towards car use. UTC systems may not make a positive contribution to all policy objectives.

Table 23 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	LOW	MED	LOW	LOW	408 - 511	LOW	LOW	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Low speed zones

Low speed zones are a part of the ensemble of traffic calming measures that use physical and regulatory measures to reduce vehicle speeds and acceleration. These

measures are aimed at having an impact on driver's behaviour whilst ensuring and improvement for non-motorised travel. Moreover low speed zones tend to improve safety, comfort and liveability, whilst ensuring a sustainable level of vehicle mobility.
According to KONSULT database, two types of traffic calming measures can be identified:

- *segregation (volume control measures), in which extraneous traffic is removed;*
- *integration (speed control measures), in which traffic is permitted, but encouraged to respect safety and the environment.*

The evidence from case studies suggests that traffic calming is particularly effective in improving the 'liveability' of streets, providing additional protection to the local environment and reducing the incidence and severity of accidents. It is less effective in improving efficiency and stimulating economic growth but the overall trade-off would suggest a positive outcome from the implementation of traffic calming measures providing they have been carefully designed.

Table 24 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	MED	LOW	MED	MED	MED	476 - 596	LOW	MED	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
Citywide 30 km/h speed limit - City of Graz (Austria)	At the beginning when the speed limit was introduced a decrease of ca. 25% in serious accidents could have been reached.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1928
Barcelona's 'Green Zone' parking scheme, Spain	Mobility studies, carried out in connection with its introduction, indicate that it has had a direct influence on the 3.5% reduction in the average daily traffic intensity in parking-controlled areas. A reduction in illegal parking of between 51% and 64.4%, depending on	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1435

	which phase of the scheme it is.	
Parking policy as part of a comprehensive approach to mobility planning in Zurich	The management of parking provision should be part of a comprehensive approach to mobility planning in a city. Zurich has been actively managing parking provision in the city, both publically and privately provided, since the early 1990s as part of an ongoing transport policy to contain car traffic and promote public transport.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3142
Edinburgh, 'Greenways' (Bus Priority Measures)	Greenways is an example of a public transport service improvement; in combination with improved conditions for pedestrians and cyclists; at a comparatively low cost.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=428

Marketing campaigns and education

Information and marketing campaigns

In EMBARQ's (2011) report concerning the role of marketing campaign in transport, they define these types of measures as a way to *"attract new users that currently use private transport, such as cars and motorcycles, retain existing public transport users who might feel compelled to buy a private vehicle, and, secure political and financial support from government officials."*

Furthermore they offer a complete guide on communication tactics that can be applied to the public transport sector. From brand and identity development to user feedback systems and user education, the range of tools analysed by EMBARQ are comparable to the influence that marketing campaigns have been known to have on transport behaviour. Multiple examples show that marketing and information campaigns can translate into important effects on avoiding unsustainable practices, and shifting passengers towards more sustainable modes (public transport and/or non-motorised transport).

Nevertheless, information campaigns are not confined towards promoting public transportation. Numerous cities have undertaken information and educational campaigns for eco-driving (personal, public transport and freight) with very high effects on improving current practices.

Consequently experts score these types of measures as affordable but with high impacts on economic, social and environmental objectives of sustainability. What is more, they are measures that have short term impacts that settle in the middle and long-term.

Table 25 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	MED	LOW	LOW	MED	629 - 788	LOW	MED	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Promotion of eco-driving

Eco-driving promotion is aimed at educating drivers how to use their vehicles efficiently in order to reduce fuel consumption and accidents. As such, this measure is beneficial for private and professional drivers. Freight companies have introduced these types of measures in order to increase savings due to less fuel consumption, fewer accidents. What is more, eco-driving campaigns have been carried out in different cities in Europe. According to the EPOMM database, eco-driving reduces fuel consumption by 15 to 25%. The ECODRIVEN campaign catalogue (in annex) shows that various trainings have had similar impressive results.

Table 26 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	LOW	LOW	-	LOW	LOW	153 - 192	LOW	MED	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
The Big Commuter Experiment, Gothenburg (Sweden)	50133 motorists applied for the free ticket and 27498 of them met the criteria. The eligible motorists received a two-week public transport ticket through the post. If all 27498 travellers left the car at home for two weeks they saved approximately 2000 tonnes of carbon dioxide emissions.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3372
No ridiculous car trips - Malmö, Sweden	The campaign had a huge impact on the citizens of the city of Malmö. By deliberately using unconventional methods and a blend of humour and seriousness of advertising we reached the people and increased the awareness of the topic - ridiculous car trips.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1977
Regional bus service provider in Austria implements fuel economy trainings	First evaluations of the project show that the buses need 4,6% less fuel in daily operation.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1980

Access restriction schemes

More and more European cities have become interested in planning and implementing transport demand management strategies based on controlling access to certain urban areas. Different access restriction schemes have been implemented in the past with different objectives in sight. Certain cities have based restrictions on environmental issues, others have focused on congestion and a few have developed schemes that aim at increasing funding.

According to accessrestriction.com (a study financed by the EC), the current situation of these schemes can be defined as follows:

- *schemes were mainly driven by air quality targets, but other strategic objectives are forcefully emerging, including e.g. transport efficiency, economic growth etc.*
- *the type of access restriction: i.e. which traffic is specifically targeted? (passengers Vs freight, vehicle technology, time slots, etc.)*
- *the instruments adopted: they can be regulatory/prescriptive (bans, vehicle standards, etc.) or/and market based (road and/or parking pricing, bonuses, paying permits, incentives, etc.), while information based instruments can supplement/facilitate the implementation of both regulatory and economic instruments – the technical/technological solutions adopted to implement and enforce the schemes*

An overview of European cities that have implemented or will implement an access restriction scheme is available at: http://www.accessrestriction.eu

Urban pricing

Space is a finite resource, as such; its allocation is a key element of demand management in urban transport and a big objective when it comes to ensuring overall urban sustainability.

Furthermore, urban pricing is a measure aimed at allocating road space to public transport vehicles or to private vehicles with high occupancy in order to increase the transport capacity in a given territory whilst decreasing pollutants and other nuisances. Also, urban pricing can be used as a way to restrict access to certain areas of the city.

The OECD 2010 report on Critical Success Factors for Implementing Road Charging Systems suggests that road pricing incentivizes travellers faced with a road user charge, *"will be encouraged to make their own judgement on the value of their trip".* Furthermore it establishes that as "*roads are subject to congestion, which occurs as every additional trip made forces those vehicles already on the road to slow down. The introduction of a corrective charge will make each driver aware of the cost he imposes on other drivers."*

In this manner, urban pricing helps reduce traffic volumes, decreases nuisance from private vehicles and helps in shifting passengers towards more sustainable means of transport. This pushes the economy to look for more a more efficient way to conceive mobility by avoiding unsustainable practices and also improving sustainable behaviour patterns.

Finally, road pricing can be pushed in its welfare maximization strategy if it is conceived as an overall transport strategy where prices for public transport and alternative modes are set together with road charges.

Congestion charging zones

Congestion Pricing refers to variable road tolls. Depending on the level of congestion (peak hours vs. off-peak hours), access prices to determined zones go up or down. This measure aims at reducing peak-period traffic volumes to optimal levels.

In 2011, TILLEMA and VERHOEF published a paper on the evaluation of congestion charging schemes according economic surplus and/or geographical accessibility. In this paper they say: *"Therefore, the decision whether to use economic surplus measures or geographical accessibility indicators to a large extent depends on the research goal. If the goal is to gain a thorough insight into the monetary gains/losses resulting from a policy measure, economic measures, such as the rule-of-half or the logsum measure, are preferable. However, if there are concrete questions about the changes in accessibility of certain types of activity locations, geographical indicators, such as the contour and potential measures, are more appropriate".*

Experts score these types of measures as having high impacts on vehicle traffic and congestion levels. These measures tend to also have a very high potential of shifting passengers towards more sustainable modes. The use of these types of measures in combination with measures seeking higher levels of public transport and a higher use of alternative modes tends to have a long-term effect on behavioural patterns.

Table 27 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
MED	MED	MED	MED	MED	MED	1 495 - 1 874	LOW	MED	LOW	LOW

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Low emission zones

Low Emission Zones are aimed at encouraging the use of cleaner vehicles, and through this, the implementation of newer optimized motor technologies in order to reduce pollutant emissions in determined zones of the city.
Low emission zones are easy to implement and, depending on the enforcement mode of choice, cheaper than a lot of measures. The use of ICTs, to control the access of to the zones, could quickly drive up investment and maintenance costs. Furthermore, these zones have a high impact on pushing towards a renewal and/or change of vehicles used in the zone (especially freight vehicles). And, what is more, they can easily be used to

incentivize tighter emissions standards. Experts tend to score these types of measures as affordable and with high impacts on land-value and health.

Table 28 Individual Scoring Averages and Potential Range of CO_2 Reduction

Avoid	Shift	Improve	Economic	Social	Environmental	Potential Reductions Ktons CO_2	City Network	Urban Sprawl	Rural Area	Small Compact City
LOW	MED	MED	LOW	LOW	MED	849 - 1 065	LOW	MED	LOW	MED

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies. *Note: MED stands for MED **Note: - stands for not available

Selection of examples from the EPOMM database

Case	Remarks	Link
Barcelona, Spain, Access restrictions at Las Ramblas	Overall daily traffic has been reduced up to 15%, while the reduction of traffic during the access restriction time period has reduced by 40%.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2318
Cambridge (UK) Core Traffic Scheme Implementation of the „Umweltzone" (Environmental Zone) in the city centre of Berlin	Between 1993 and 2003 the number of private vehicles in the city centre fell by 15%. Reduction in diesel soot (BC) emissions: by 58 %; reduction in nitrogen oxide (NOx) emissions: by 20 %; reduction in PM10-immissions: by 7-10 %	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=730 http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1817
Low emission Zones (Umweltzone) in Germany	Model calculations suggest a reduction up to e.g. 10% PM10 after strict enforcement (only vehicles of emission group 4 are allowed to enter the LEZ in this scenario). First assessments using air quality measurements showed the effectiveness of this measure as well.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2172

Low Emission Zones (Miljøzone) in Denmark	Heavy duty vehicles as a main source of traffic related air pollutants are subject of regulation in Danish low emission zones (LEZ). Danish cities started to impose LEZ in September 2008. The number of cities and the extension of LEZ will increase while the emission standards are strengthened.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=2175
30 years of car restraint, Oxford, UK	The traffic restraint approach has proved very successful with city centre traffic levels having not increased over the last 30 years, whilst bus patronage has increased (the proportion of people using buses to enter the central area increased from 38% in 1991 to 53% in 2005), currently 15% of journeys to work by Oxford residents are made by bicycle and economic vitality has been preserved.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1367
Durham City: First Road User Charging Scheme in the UK	Traffic flow has been reduced by 90% and the use of public transport has increased dramatically	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=169
AREA C in Milan: from pollution charge to congestion charge (Italy)	Traffic average reduction: -34%	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3632
Valleta, Malta Controlled Vehicle Access	A 22% drop in the total number of individual cars visiting Valletta every day for any length of time	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1610

Central London Congestion Charging Scheme	Congestion inside the charging zone reduced by 26%, traffic levels by 21%	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=140
Znojmo, Czech Republic, Inner city access restriction	It is estimated that more than two thirds of drivers didn't drive to the centre of the town but decided, instead, to park outside this area and go to the centre on foot.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1560
Stockholm Congestion Charging Ring, Sweden	Traffic levels in central Stockholm fell by about 20% after the scheme was implemented, queuing times by 30-50% depending on location, and emissions by 14%. A small number of additional bus services have been funded with the revenue generated.	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=1174
Road pricing in Flanders: a field trial in Leuven, Belgium	There was a measurable change in mobility behaviour. The test users avoided driving during the peak period (60% drove during off-peak periods). They also avoided cutting through residential areas during peak hours (5% less).	http://www.epomm.eu/index.php?id=2771&lang1=en&study_id=3602

Introduction of clean technologies and alternative fuels

Investment in infrastructure for alternative fuels

According to the TransPord analysis on different motor technologies as well as alternative fuels, there are two main sectors where investment in infrastructure would be needed. One would be electric vehicle charging points and CNG/LPG charging stations. These are the only two technologies that the report classifies as being in the Medium range of feasibility in the next 10 years. Hydrogen is also feasible according to this report but only in the long-term. NEMRY and BRONS published a JRC technical note in 2010[3] on market penetration scenarios of electric drive vehicles where the needs in charging infrastructure are clearly assessed.
What is more, there is also a lot of information coming from one of the most ambitious country-wide charging network development plans: the ELMO project in Estonia[4].

Introduction of vehicles on alternative fuels

In the following tables we present results coming from the TransPord project. This project modelled and assessed the relative CO_2 reductions potential of different motor technologies. They also present an indicative cost level for each technology as well as its feasibility. Furthermore, in the same report we can also find information concerning alternative fuels and their feasibility. For more detailed information on any of these subjects, the TransPord site is recommended[5].

Measure Name	Relative CO_2 reduction potential 2020	Relative CO_2 reduction potential 2050	Feasibility	Cost (€/Ton CO_2 saved)
Injection Technology	10%	24%	High	933
Electrical System	10%	20%	Medium	2956
Heat/Cooling Management	10%	14%	Medium	1022
Lightweight Construction	8%	17%	Medium	7644
Engine Control System	7%	13%	Medium	3335
Hybrid Vehicles	7%	18%	Medium	5928
Aerodynamics/Resistance	7%	9%	High	1059
CNG/LPG E	6%	8%	Medium	4525

[3] ftp://ftp.jrc.es/pub/EURdoc/JRC58748_TN.pdf

[4] http://elmo.ee/charging-network/

[5] http://www.ghg-transpord.eu/ghg-transpord/

Battery Electric Vehicles	6%	77%	Low-Medium	5542
Electrical System - Energy Demand	5%	7%	High	NA
Drive and Transmission	3%	6%	Medium	14427
Hydrogen Fuel Cell Vehicles	0	8%	Medium	NA

Source: GHG-TransPoRD (http://www.ghg-transpord.eu/ghg-transpord/downloads/GHG_TransPoRD_D2_1_GHG_reduction_potentials.pdf)

Alternative fuels	Relative CO_2 reduction potential 2020	Relative CO_2 reduction potential 2050	Feasibility
Biodiesel	36%-58%	36%-58%	High
Bioethanol	32%-71%	32%-71%	High
Ligno-cellulosic ethanol	70%-87%	70%-87%	Medium
Synthetic fuels	93%-95%	93%-95%	Medium
Biomethane	50% against gas and 80%-86% against gasoline	50% against gas and 80%-86% against gasoline	High
Hydrotreated Vegetable Oil	26%68%	26%68%	Medium
Hydrogen from natural gas	-23% to -39%	57%	High
Hydrogen from coal gasification	-165%	40%	High
Hydrogen from water electrolysis	-123%	65%	Medium
Hydrogen from biomass	83%-88%	83%-88%	Medium

Source: GHG-TransPoRD (http://www.ghg-transpord.eu/ghg-transpord/downloads/GHG_TransPoRD_D2_1_GHG_reduction_potentials.pdf)

EU policy recommends that road charges should be fair and non-discriminatory for users.

Summary of quantified results

In order to quantify the impacts that different measures might have, according to the profiles and weights, it was necessary to have mobility estimates in 2030 for urban transportation activities. For this, MODEL-T (JRC) mobility estimates and their inherent CO_2 emissions were used.

The JRC's IPTS Model-T has the capability of clearly identifying the part of transportation activities that are carried out in urban settings as well as identifying passenger/tonne/vehicle-kilometres and CO_2 emissions for urban transport for passengers and freight.

Through the use of this model, it was possible to simulate the urban transport activity in each European country and calculate the average kilometres (for passenger and freight services) as well as the CO_2 emissions per capita for people living in the identified urban settings within each NUTS3 region.

These estimates were used to build a complete dataset of transport activities for the sum of urban settings present in each NUTS 3 territory in 2030. In order to render the estimations comparable to estimations coming from other models, the same vehicle motor technology trend present in the Reference scenario used by DG-Move was used for these calculations. In this manner, differences in results stem only from how different models define "urban transport".

The 2030 values for CO_2 emissions were used as a reference to calculate the impact that each policy measure might have in CO_2 reductions for different city profiles in NUTS3 regions according to the effects presented in the experts' scorings and to its capacity to, avoid, shift or improve unsustainable practices. As these results are based on scorings pertaining to the potential range of reductions that each individual measure might entail, these results do not take into account overlapping effects. In other words, the effects of "measure packaging" are not reflected in these results. The following table should be read as the potential range of effects for individual measures. As such, it is important to underline that if all measures where to be implemented as a package, the overlapping effects would entail lower overall results. Furthermore, negative values in table are explained by the fact that certain measures might have an overall positive effect on CO_2 emissions but also encourage higher use of personal vehicles.

Table 29 Potential CO_2 reductions by Measure

Measure	Avoid ktons CO_2	Shift ktons CO_2	Improve ktons CO_2	Potential CO_2 reductions in ktonsCO_2
Investment and maintenance, including safety, security and accessibility	255 - 319	204 - 256	255 - 319	713 - 894

Public transport coverage (line density, stop density, walking distances between stops) & public transport frequencies.	408 - 511	306 - 383	204 - 256	917 - 1 150
Interoperable ticketing and payment systems	153 - 192	255 - 319	64 - 80	471 - 591
Taxi services (individual and collective)	204 - 256	170 - 213	204 - 256	578 - 724
Dedicated walking and cycling infrastructure investment and maintenance & Bike sharing schemes	306 - 383	408 - 511	68 - 85	781 - 979
Improvement of the efficiency of city logistics by the use of ICT	408 - 511	-	544 - 681	951 - 1 192
Measures to improve the energy efficiency and environmental performance of vehicles and/or use of alternative modes.	153 - 192	204 - 256	255 - 319	612 - 767
Corporate, school and personalised mobility plans (or workplace travel plans)	408 - 511	204 - 256	68 - 85	680 - 852
Car sharing & carpooling schemes.	255 - 319	(-17) - (-21)	204 - 256	442 - 554
Telecommunications	306 - 383	510 - 639	204 - 256	1 019 - 1 278
Multimodal connection platforms	102 - 128	204 - 256	-	306 - 383
Multimodal travel information provision	331 - 415	119 - 149	399 - 500	849 - 1 065
Park and Ride areas	204 - 256	102 - 128	204 - 256	510 - 639
Reallocation of road space to other modes of transport, e.g. dedicated bus lanes	306 - 383	408 - 511	272 - 341	985 - 1 235
Parking management	178 - 224	340 - 426	263 - 330	781 - 979
Dynamic traffic management measures	204 - 256	-	204 - 256	408 - 511
Low speed zones	153 - 192	255 - 319	68 - 85	476 - 596
Information and marketing campaigns	187 - 234	204 - 256	238 - 298	629 - 788
Promotion of eco-driving	204 - 256	(-102) - (-128)	51 - 64	153 - 192
Congestion charging zones (area and cordon charging)	815 - 1 022	408 - 511	272 - 341	1 495 - 1 874
Low emission zones	204 - 256	306 - 383	340 - 426	849 - 1 065
Totals	5 742 - 7 197	4 485 - 5 621	4 379 - 5 488	14 605 - 18 306

Source: Calculated from the scorings based on experts' opinions in the KONSULT, EC-FREIGHT, EPOMM and TransProd studies.
*Note: All negative values refer to an increase in car use because congestion and/or overall cost goes down.

**Note: - stands for not available

Furthermore, it was also possible to assess the effects of these policy measures for the defined NUTS3 profiles. As overlapping effects are not taken into account in these results, they reflect the potential range of reductions for measures.

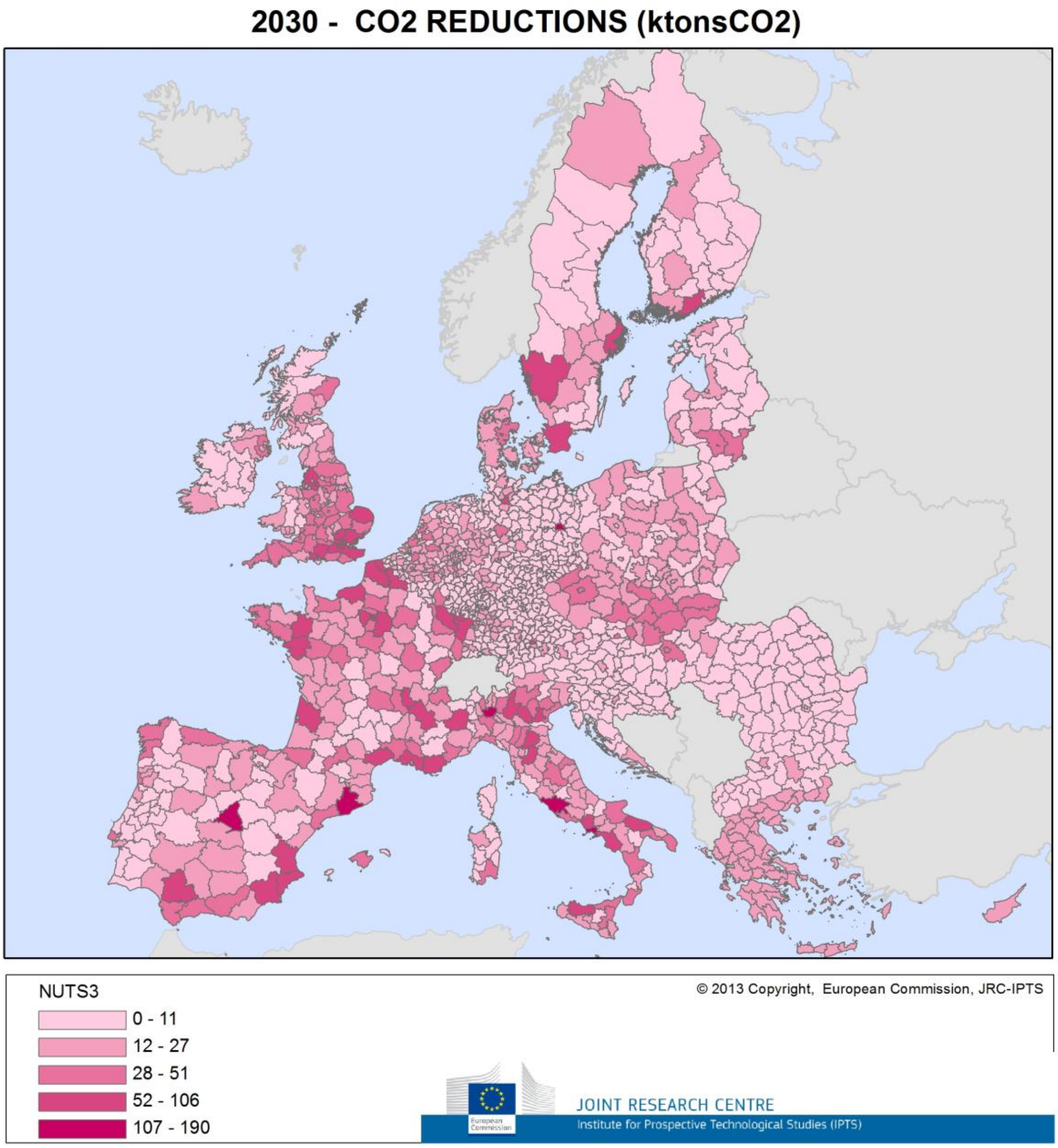


Figure 3 Potential CO_2 Reductions by NUTS3

Accordingly it was possible to aggregate these results –for presentation reasons- and quantify the potential range reduction that the complete list of identified urban measures could have in each European country, without taking into account measure overlaps.

Table 30 Potential CO_2 Reductions by Country

Country-	Urban Emissions 2010 ktons CO_2	Urban Emissions 2030 ktons CO_2	Potential Reductions 2030 ktons CO_2	Percentage
AT	3 214	2 648	179 - 225	6.8% - 8.5%
BE	7 816	5 921	393 - 493	6.6% - 8.3%
BG	1 485	1 384	100 - 125	7.2% - 9.0%
CY	257	180	15 - 19	8.3% - 10.3%
CZ	3 482	3 686	263 - 330	7.1% - 9.0%
DE	44 488	38 055	2 697 - 3 381	7.1% - 8.9%
DK	2 761	2 153	151 - 189	7.0% - 8.8%
EE	418	507	37 - 47	7.4% - 9.2%
ES	16 275	15 051	1 064 - 1 333	7.1% - 8.9%
FI	2 554	2 350	163 - 204	6.9% - 8.7%
FR	38 249	30 777	2 156 - 2 702	7.0% - 8.8%
GR	2 633	2 850	187 - 234	6.6% - 8.2%
HR	761	1 020	70 - 88	6.9% - 8.6%
HU	2 085	2 365	166 - 208	7.0% - 8.8%
IE	1 252	1 063	67 - 84	6.3% - 7.9%
IT	37 073	31 285	2 250 - 2 821	7.2% - 9.0%
LT	1 251	1 430	100 - 125	7.0% - 8.7%
LU	418	326	27 - 34	8.2% - 10.3%
LV	615	800	52 - 65	6.5% - 8.1%
MT	177	141	9 - 11	6.3% - 8.0%
NL	7 886	6 961	478 - 599	6.9% - 8.6%
PL	6 918	8 934	625 - 784	7.0% - 8.8%
PT	2 756	2 792	186 - 233	6.6% - 8.3%
RO	1 726	2 272	163 - 205	7.2% - 9.0%
SE	5 685	4 335	321 - 403	7.4% - 9.3%
SI	296	284	20 - 25	6.9% - 8.7%
SK	2 162	2 831	201 - 252	7.1% - 8.9%
UK	45 823	36 729	2 465 - 3 090	6.7% - 8.4%
Total	240 515	209 130	14 605 - 18 306	7.0% - 8.8%

Moreover, it was possible to quantify the reductions consistent with this analysis for each European country by classifying them according to the measures' ability to avoid unsustainable practices, shift towards more sustainable modes and improve on current practices.

Table 31 Details on Avoid-Shift-Improve

Country	Avoid ktons CO_2	Shift ktons CO_2	Improve ktons CO_2	Potential Reductions 2030 ktons CO_2
AT	71 - 88	55 - 69	54 - 67	179 - 225
BE	155 - 194	120 - 151	118 - 147	393 - 493
BG	39 - 49	31 - 38	30 - 38	100 - 125
CY	6 - 7	5 - 6	4 - 6	15 - 19
CZ	104 - 130	81 - 101	79 - 99	263 - 330
DE	1 060 - 1 329	828 - 1 038	809 - 1 014	2 697 - 3 381
DK	59 - 74	46 - 58	45 - 57	151 - 189
EE	15 - 18	11 - 14	11 - 14	37 - 47
ES	418 - 524	327 - 410	319 - 400	1 064 - 1 333
FI	64 - 80	50 - 63	49 - 61	163 - 204
FR	847 - 1 062	662 - 830	646 - 810	2 156 - 2 702
GR	73 - 92	57 - 72	56 - 70	187 - 234
HR	27 - 34	22 - 27	21 - 26	70 - 88
HU	65 - 82	51 - 64	50 - 62	166 - 208
IE	26 - 33	21 - 26	20 - 25	67 - 84
IT	884 - 1 108	691 - 867	675 - 846	2 250 - 2 821
LT	39 - 49	31 - 38	30 - 37	100 - 125
LU	11 - 13	8 - 10	8 - 10	27 - 34
LV	20 - 26	16 - 20	16 - 20	52 - 65
MT	4 - 4	3 - 3	3 - 3	9 - 11
NL	188 - 236	147 - 184	143 - 180	478 - 599
PL	246 - 308	192 - 241	188 - 235	625 - 784
PT	73 - 91	57 - 71	56 - 70	186 - 233
RO	64 - 80	50 - 63	49 - 61	163 - 205
SE	126 - 158	99 - 124	96 - 121	321 - 403
SI	8 - 10	6 - 8	6 - 7	20 - 25
SK	79 - 99	62 - 77	60 - 76	201 - 252
UK	971 - 1 217	756 - 948	738 - 925	2 465 - 3 090
Total	5 742 - 7 197	4 485 - 5 621	4 379 - 5 488	14 605 - 18 306

Annex

ICT Options Enhancing Co-modality in Passenger - Transport: OPTIMISM Project Review on Best Practices in Europe

OPTIMISM project (partially funded by EC, FP7 - http://www.optimismtransport.eu) aims to propose a set of strategies, recommendations and policy measures, through the scientific analysis of social behaviour, mobility patterns and business models, for integrating and optimising transport systems based on the assessment of the impact of co-modality and ICT solutions for transport. Deliverable 4.1 of the OPTIMISM project (CE DELFT, 2012)[6]: identified several ICT options enhancing co-modality in passenger transport; reviewed a plenty of existing and planned ICT projects or applications from various European countries; analysed their short and long term impacts and evaluated them based on several sustainable mobility indicators in order to identify best practices for further analyse. The Tables 1, 2, and 3 give a brief overview of the ICT applications/projects investigated in the deliverable which may provide useful insights to the Sustainable Urban Mobility Plans as being operational ICT solutions that enhance co-modality in passenger mobility[7]. Additionally, Table 4 demonstrates summary results of the broad assessment of ICT options based on their expected mobility, social, environmental and cost impacts.

Table 1: Overview of ICT Applications/Projects on Travel information services

Option	Modes involved	Country	Brief description
Static route planners			
Poznan Metropolitan Area Travel Planner	Bus, Tram	Poland	Static multi-modal route planner for the Poznan region.
Resrobot	All	Sweden	Static multi-modal route planner providing door-to-door travel information in Sweden and showing connections to rail stations in Norway, Denmark and Northern Germany.
Rejseplanen	Car, public transport, cycling, walking	Denmark	Static multi-modal route planner providing door-to-door travel information in Denmark (and parts of Sweden and Germany). Additionally, Rejseplanen covers an e-ticketing system for public transport.
Auto OV planner	Car and public transport	Netherlands	The Auto OV planner, a product of the Reisinformatiegroep in the Netherlands, was provided as an experiment to test the combination of providing travel information on both public transport and the car in the Netherlands.

[6] CE DELFT, 2012, Deliverable 4.1: Identification of ICT options enhancing co-modality, OPTIMISM (Optimising Passenger Transport Information to Materialize Insights for Sustainable Mobility) Project, 7th Framework Programme, Project No: 284892.

[7] ICT applications for inter-city or long distance transportation are not included in the tables.

Dynamic and real-time multimodal route planners			
Scotty	Car, bike, public transport, aviation	Belgium	Nationwide, multimodal route planner, providing both static and real-time travel information.
CAIRO	Public transport	Germany	Pilot iPhone/smartphone application that connects static as well as dynamic travel information on public transport, car-sharing and bike-rental. It also allows for electronic ticketing and might be personalised.
SMART-WAY	Public transport	Germany/Italy	Smartphone application providing a dynamic route planner. Field tests have been carried out in Dresden and Turin. A roll out across Europe is planned
Muoversiaroma.it	Car, public transport, walking	Italy	Real-time traveller information service which could be connected by mobile devices for Rome.
Luceverde	Car, public transport	Italy	Multi-modal, real-time traveller information system supplied by web and through smartphone applications in Rome and Lazio Region.
9292OV	Public transport	Netherlands	Static and real-time multi-modal route planner for the Netherlands.
Transport direct	All public and private modes	UK	Transport Direct (TD) aims to provide travellers with an integrated journey planning information service, including provision of real-time travel and transport information and through ticketing.
Infopoint	Car, public transport	Italy	Static and dynamic multi-modal route planner (incl. intermodal aspects as Park&Ride) for the city of Rome.
IC-IC	Aviation, car, public transport	Netherlands, Germany, France, Austria	Pilot of a real-time information system for air travellers. This system provides information with regard to facilities and services at the next immediate destination and/or next transport provider(s).
Reiseauskunft	Public trans., walking	Germany	Multimodal route planner covering public transport and walking.
Tussam	Public transport	Spain	Tussam (the public transport operator in Seville) implemented a service that allows checking for the latest updates of any delays to the service.
Personalized travel information			
Sixth sense transport	All	UK	An innovative, open, extensible technical platform which provides users understandings of the relationships between their own future transport plans and those of others. By using social networking principles personal transport options will be made clear.
GoAbout	Car, public transport, bicycles, walking	NL	Go About helps to plan trips by making use of an Outlook plug-in. Travel times are calculated automatically and are inserted in the traveler's calendar.
PTA project	All	NL	The PTA project in Amsterdam is aimed at developing a Personal Travel Assistant system, which combines available information from the various transport providers with a social network. The information is available via the web and mobile networks with the option to be linked to a personal agenda and to make smart combinations with other users.
Traffical	Car	NL	Outlook plug-in for Blackberry users to automatically receive travel advice when making appointments. Before departure most actual travel information will be send to the user via sms (only Blackberry).

i-Tour	All	European project	i-Tour will support and suggest the use of different transport modes taking into account user preferences and real-time information. i-Tour promotes a new data collection approach based on the information provided by the whole user community. PCs, PDAs and smart phones can be used to access i-Tour.
In-vehicle travel information			
SensorCity Assen	Car, public transport	Netherlands	A pilot project to test sensor-based ICT solutions. A part of the project is to predict travel times by car with the help of sensors installed in infrastructure of Assen and to provide an alternative by public transport in case public transport saves time compared to the car.
Virtual DRIP (vDRIP)	Car, public transport	Netherlands	A pilot project of the province of Noord-Holland in the Netherlands, which provide information normally shown on DRIPs via a mobile phone application, including a personal filter to show only the relevant messages to the car driver.
In-car navigation devices	Car	No specific country	Car drivers can use navigation devices to determine their route and to avoid having to read paper maps. Depending on the type of navigation device road transport information can be combined with public transport information.
Public transport in-vehicle information	Public transport	No specific country	Provision of travel information (arrival times, connections) in buses, trains, trams and metros.

Source: Recompiled from the Tables 4,5,6, and 7 of the OPTIMISM Project Deliverable 4.1 (CE DELFT, 2012).

Table 2: Overview of ICT Applications/Projects on Mobility Services

Option	Modes involved	Country	Brief description
Multimodal e-ticketing schemes			
Matka.fi	Public transport, aviation	Finland	Planned electronic ticket and information service compatible for all public transport modes and air traffic as well as airport transfers. The system includes a website with time tables and routing services.
SBB Online Fahrplan	Public transport, car, walking	Switzerland	E-ticketing system for public transport. Additionally, this system contains a multimodal route planner for all the modes mentioned.
Mobile phone ticketing schemes			
SMS Ticket for public transport in Wroclaw	Public transport	Poland	Mobile phone based ticketing application both for long-distance and urban trips by public transport.
Handy ticket system	Public transport	Germany	Mobile e-ticketing system for public transport. The system is accessible by mobile phone. The ticket is sent via SMS to the mobile phone.
Smart Cards			
Mobib-pass	Public transport, bike	Belgium	In the Brussels area the Mobib-pass can be used to access public transport and hire bikes.
Navigo	Public transport	France	Multimodal smart card usable in Paris
Seasonal ticket on smart card	Public transport	France	In La Rochelle, public transport users with a seasonal ticket can make use of a personal smart card.
Pastel	Public transport	France	In Toulouse a personalised multimodal travel card was introduced in 2007.
MITT	Public transport	Italy	In Trentino, users can access public transport and interchange parks by using a smart card.
OV chipkaart	Public	Netherlands	Smart card for accessing public transport in the Netherlands.

	transport		Will replace paper tickets completely in the near future.
Mobility card Mobility Mixx	Car, public transport, taxi	Netherlands	Smart card providing access to several business travel options, like public transport, taxis and shared cars. This smart card is provided by a commercial organisation.
T:card	Public transport	Norway	In the Trondheim area the t:card can be used to access buses, trams and regional coaches.
Coimbra conVida	Public transport, car	Portugal	In 2012 a multimodal smart card was introduced in Coimbra. By using this card travellers have access to buses and car & park facilities. The scheme may be extended in the future to rail transport and bike/car sharing schemes.
SL Access Card	Public transport	Sweden	Smart card that is used for electronic ticketing in the Stockholm county.
Oyster card	Public transport	UK	Contactless smart card that is used for electronic ticketing within the Greater London Region.
West midlands smart card	Public transport	UK	Smart card for public transport serves as an electronic ticket and will eventually replace all paper tickets in the West Midlands
Scottish smart card	Public transport	UK	Plans to develop smart card-based integrated ticketing products across the Scottish public transport network
IFM	Public transport	UK/France/Germany	Pilot of a multi-application Interoperable Fare Management (IFM) scheme. By using a smart card people could travel on local public transport networks in different countries (planned to be extended as an application for mobile phones).
Mobile phone payments			
Touch & Travel	Public transport	Germany	Smartphone based mobile ticketing application for long distance trains in Germany and inner-city public transport in Berlin, Potsdam and Frankfurt/Main. Extensions to other cities/regions are planned, but not yet specified.
MITT	Public transport	Italy	Tests are carried out to implement a system in which mobile phone smart cards are used as electronic wallets, based on Near Field Communication (NFC) technology in the Trentino area.
Bicycle sharing services			
City bike	Bicycles	Austria	Public bicycle sharing programme in Wien, organised by a public private partnership between the city and a private organisation (PPP).
Vélib	Bicycles	France	Public bicycle rental programme in Paris (PPP)
Vélo'v	Bicycles	France	Public bicycle programme in Lyon (PPP)
Call a bike	Bicycles	Germany	Bike-sharing scheme in six German cities (Berlin, Frankfurt, Cologne, Munich, Stuttgart and Karlsruhe). Scheme is run by Deutsche Bahn.
Dublinbikes	Bicycles	Ireland	Organised by a public private partnership Dublinbikes provides public bikes in Dublin since 2009.
BikeOne	Bicycles	Poland	In Krakow a public bike rental system is available.
Sevice bike rental	Bicycles	Spain	Community bicycle programme in Seville.
Bicing	Bicycles	Spain	Community bicycle programme in Barcelona.
OV-fiets (public transport bike)	Bicycles	Netherlands	At many railway stations in the Netherlands public bikes could be rented (also by using the 'OV chipkaart').
Stockholm city bikes	Bicycles	Sweden	Community bicycle programme in Stockholm
Car-sharing schemes in Europe			

Denzel Mobility CarSharing	Cars	Austria	Nationwide professional car sharing scheme organised by a single provider
Cambio	Cars	Belgium	Nationwide car-sharing scheme organised by four stakeholders: TaxiStop (environment & transport NGO), VAB (motorist club), Cambio (German commercial organisation) and NMBS (Belgian Railways). Additionally, also regional public transport companies are involved.
Danish car sharing schemes	Cars	Denmark	In Denmark 10 commercial car sharing schemes exist.
City Car Club	Cars	Finland	Car sharing scheme in Helsinki and surrounding area. In contrast to the other European schemes the cars of the City Car Club do not have a fixed parking space, but are variably allocated to 92 places (where needed).
French car sharing schemes	Cars	France	In France 18 commercial car sharing schemes exist.
German car sharing schemes	Cars	Germany	In Germany about 110 car sharing schemes are operational. The provider structure in German car-sharing is very heterogeneous and decentralised.
UK car sharing schemes	Cars	UK	Four large commercial and 12 smaller car-sharing providers are currently operational in the UK.
GoCar	Cars	Ireland	Regional car sharing scheme organised by sustainable transport consultancy, Mendes GoCar Limited, with help of the German provider Cambio.
Italian car sharing schemes	Cars	Italy	In Italy 12 regional car-sharing schemes exist, most of them organised by regional authorities.
Greenwheels	Cars	Netherlands	By far the largest car-sharing schemes in the Netherlands. Next to Greenwheels 5 smaller commercial car-sharing schemes exist in the Netherlands.
Carristur	Cars	Portugal	The only (small) car-sharing scheme in Portugal (Lisbon), organised by a subsidiary of the public transport operator of Lisbon.
Avancar	Cars	Spain	Commercial car-sharing provider in the Barcelona region
Swedish car sharing schemes	Cars	Sweden	In total 45 mostly small regional providers are operational in Sweden.
Mobility Co-operative	Cars	Switzerland	Large commercial car-sharing scheme that operates nation-wide.
Demand responsive transport systems			
TAD 106	Public Transport	France	DRT service in Toulouse region for low-density areas and low-traffic periods, in connection to the most important intermodal nodes.
Drin Bus	Public Transport	Italy	A flexible bus service that connects the hilly, low-density areas of Genoa through a ‘many to many’ (pickup/drop-of points) operational model.
DRT(?) system Potenza	Public Transport	Italy	DRT(?) service in Potenza aimed to support interchange with other transport systems in order to improve accessibility for peri-urban users.
Tele-Bus	Public Transport	Poland	DRT bus scheme in Krakow introduced in 2007. Daily services are managed by the Travel Despatch Centre. Booking can be made by phone and online.
DRT Cape Town	Public Transport	South Africa	In Cape Town a pilot of a demand responsive transport (DRT) service has been carried out. In

			addition to a standard booking centre, this DRT system included an Automatic-Vehicle Monitoring (AVM) system which enables real-time management of transport requests.
PubliCar	Public Transport	Switzerland	Nationwide DRT service especially aimed at low density areas. However, services in small town and during times of weak demand (e.g night services) are also provided. In many cases connections to the main public transport network are provided.
Taxi Dispatcher	Public Transport	Switzerland	Real-time on-line marketplace for taxi (and limousine) rides. Thanks to smart technology, the driver and customer inquiries are brought together efficiently. Customers and drivers only need a free application.

Source: Recompiled from the Tables 9,10,11,12,13,14 and 15 of the OPTIMISM Project Deliverable 4.1 (CE DELFT, 2012).

Table 3: Overview of ICT Applications/Projects on Transport Management Systems

Option	Modes involved	Country	Brief description
Transport management systems covering public transport modes			
Network West Midlands	Public Transport	UK	Based on signage installed at all bus, train and metro stops, consistent and up-to-date travel information will be gathered. This information will be used to provide travellers information services and eventually electronic ticketing.
Real-time control and infomobility system	Public transport, taxis	India	This scheme, which was tested in Delhi in 2010, is an advanced planning system linking public transport timetables and integrating taxi services. Information on vehicle positions and status of the vehicles (e.g. booking status of taxi) is sent to a control centre. This centre provides the operator with all necessary data to monitor the service status and to define any corrective actions to recover delays, manage faults and provide information to travellers by means of electronic displays at stops, mobile phones and the Internet. All the information is gathered by using on-board units and GPS devices.
Transport management systems covering al transport modes			
Improved traffic signal control	Road transport	UK	Based on individual vehicle position data the traffic signal control system in the UK is improved.
Travelwise centre	Road transport	UK	By incorporating the Nottingham SCOOT traffic monitoring and control system and the NCT bus tracking system the Travelwise Centre is mainly focussed on providing real-time traffic and travel information.
Budapest TCC	Road transport	Hungary	Transport management system of Budapest, including adaptive traffic control, VMSs displaying special information contents supporting route and travel mode choice and parking control systems.
VMZ Berlin	All	Germany	Management system to integrate the public, private and commercial transport of the city. Data is gathered by using webcams, traffic lights and infrared sensors. Based on this data outdoor electronic display panels and a network of other data centres are controlled. Data is also used to provide multimodal route information to travellers and as input in the decision making process to improve the Berlin traffic situation.
5T system	All	Italy	Transport management centre of Turin and Piemonte region, consisting of nine subsystems which are integrated in one system

			by the City Supervisor. Systems included are for example: traffic operation centre, public transport information services, urban traffic control, video-surveillance on urban busses and bus stops, etc.
Transport management system in Florence	All	Italy	Transport management system in Florence integrating different initiatives for improving urban mobility, like urban traffic flow supervising, Concerto (real-time tracking of freight vehicles) and Wi-Move (transport information gathering system based on a wi-fi hotspot network).
Mobinet	Car, public transport	Germany	A multimodal transportation management system for the Greater Munich Area, integrating the urban and regional car traffic, public transport, parking management and information services within a comprehensive data network with the help of the Mobinet Control and Information Centre (MCIC).
Sensorcity Assen	Car, public transport	The Netherlands	In this project participating motorists will test new ICT services enabled by a network of sensors in Assen, like multimodal travel advice. Car drivers receive travel time predictions for their route per car or per public transport in order to be able to choose for the most optimal route.

Source: Recompiled from the Tables 17 and 18 of the OPTIMISM Project Deliverable 4.1 (CE DELFT, 2012).

List eco-driving programs catalogued by ECODRIVEN.

Germany 2007. At the Frankfurt Motor Show in 2007 Ford and DVR trained 765 drivers and saw an average 20.7% reduction in fuel consumption.
UK 2008. In summer 2008 the Energy Saving Trust and Ford trained 494 car drivers and saw average fuel consumption reduction of 22.5% on a mixture of public and private roads. For the drivers whose training took place on public roads, the average reduction was 16.8%.
Finland 2008. From March- September 2008, Motiva with its ecodriving network trained 101 drivers as part of its Easy, Rider! campaign and saw an average reduction in fuel consumption of 14%. Austria. A long running study in Austria involved more than 1700 bus drivers and saw an average reduction in fuel consumption of 10.5% after ecodriving lessons. Average speeds were also slightly faster.
Greece 2008. A recent study in Greece covered passenger cars, trucks and trolley buses. For car drivers the average reduction in fuel consumption after tuition was 15.9%; for truck drivers 14.7%; and for trolley bus drivers approximately 25%.
Netherlands 1990-1998. The Netherlands have experience with ecodriving driver training courses since 1990. Many companies and organisations have trained their employees since. The results show that: on an indivial level fuel savings can increase up to 50% and on a fleet level the fuel savings vary from 5-10%, depending on the kind and number of supportive actions taken by the management. On the long run fuel savings at fleet level erode to half of the short run savings. Some individuals however even improve their fuel savings on the long run due to getting more skilled in using the feedback information of in-car gauges
Switzerland, 2000. Research by the Swissenergy programme funded by the Swiss Federal Office for Energy in 2000 indicates long term savings from ecodriving of approximately 10%
"Hamburger Wasserwerke" monitored the frequency of insurance claims before and after the introduction of an ecodriving programme that trained 91 drivers and reported a 22% decrease in insurance claims
Canon, Switzerland, who reported a 35% reduction in accident rates after ecodriving training.
A 5-years study in the Netherlands found that transport companies that had introduced ecodriving measures had 14% lower accident rates than companies that had not.

Measure scoring from LEEDS KONSULT

	Light rail	Off-street parking	New stations	BRT	Park & ride	Cycle routes	New rail services	Cycle lanes and priorities	Pedestrian Areas and Routes	Flexible working hours	Telecommunc ations	Company travel plans	Encouraging public transport use	ITS	Cycle parking provision	Urban Traffic control	Regulatory restrictions (permit)	Regulatory restrictions (plates)	Pyshical restrictions	Road user charging	Walefare maximizing fare structures
Change departure time	0	2	0	0	0	0	0	0	0	2	1	0	0	3	0	1	3	3	2	0	0
Change route	0	1	0	1	1	0	0	0	0	1	0	0	0	5	0	2	1	1	2	1	0
Change destination	1	2	0	1	0	2	0	2	0	0	3	0	0	0	0	0	0	0	1	0	1
Reduce number of trips	0	1	0	3	1	2	0	1	1	2	3	3	0	2	1	1	1	1	1	4	0
Change mode	3	2	3	3	1	2	2	2	1	2	2	2	0	0	1	0	3	3	2	4	2
Sell the car	1	0	4	0	1	1	1	1	0	0	0	1	0	2	0	1	1	1	1	4	1
Move house	1	1	3	3	2	1	0	1	1	0	2	1	0	0	0	0	1	1	1	3	0
Efficiency	2	1	3	2	1	3	2	2	1	1	2	2	2	4	1	3	3	3	1	5	2
Livable streets	2	1	2	1	1	3	0	4	4	2	0	2	4	0	0	1	2	2	1	3	2
Proctection of the env	2	2	3	2	1	1	1	2	2	1	2	2	3	4	1	1	2	2	1	4	2
Equity	2	1	2	2	0	2	2	3	3	1	1	3	1	2	1	1	1	1	1	3	2
Safety	3	2	2	1	0	2	1	2	4	1	2	2	3	4	1	1	1	1	1	3	1
Economic growth	2	2	2	1	0	2	1	2	3	1	2	2	2	2	0	1	1	1	1	3	0
Finance	5	2	2	2	2	3	3	2	2	0	0	0	0	4	0	3	0	0	2	5	3
Source: www.konsult.leeds.ac.uk																					

Measure scoring from EPOMM

	Light rail	Off-street parking	New stations	BRT	Park & ride	Cycle routes	New rail services	Cycle lanes and priorities	Pedestrian Areas and Routes	Flexible working hours	Telecomm uncations	Company travel plans	Encouraging public transport	ITS	Cycle parking provision	Urban Traffic control	Regulatory restrictions (permit)	Regulatory restrictions (plates)	Pyshical restrictions	Road user charging	Walefare maximizing fare
Change departure time	0	1	0	1	0	0	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1
Change route	1	1	0	0	0	1	1	0	0	1	1	1	1	1	1	0	0	0	0	1	1
Change destination	0	1	0	1	0	0	1	0	1	1	0	0	0	1	1	1	1	1	0	1	0
Reduce number of trips	1	1	0	1	1	1	1	1	0	0	1	0	0	0	1	1	0	0	0	0	0
Change mode	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0
Sell the car	0	1	0	1	1	0	1	0	1	1	1	0	1	1	1	1	0	0	1	0	1
Move house	0	1	0	1	1	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0	1
Change departure time	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1
Change route	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1
Change destination	1	1	0	1	1	1	1	0	1	1	0	0	1	1	1	1	1	1	0	0	0
Reduce number of trips	1	1	0	1	0	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1
Change mode	0	1	1	0	1	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1
Sell the car	0	1	0	1	0	1	1	0	1	1	1	0	1	1	1	0	0	1	0	0	0
Move house	0	1	0	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0	0
Change departure time	1	1	1	0	1	0	1	1	1	1	0	1	1	0	1	1	1	0	0	1	0
Change route	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1	0
Change destination	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Reduce number of trips	1	1	1	1	0	0	1	1	1	1	0	1	1	0	1	0	1	1	1	1	1
Change mode	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
Sell the car	1	1	1	0	0	0	1	1	1	0	1	1	0	1	1	0	1	1	0	1	0
Move house	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	1	0	0	0	1	0
Short term	**2**	**7**	**0**	**5**	**4**	**2**	**6**	**1**	**3**	**5**	**5**	**2**	**4**	**5**	**7**	**4**	**4**	**4**	**4**	**3**	**4**
Medium term	**4**	**7**	**3**	**6**	**4**	**5**	**6**	**5**	**6**	**6**	**6**	**3**	**5**	**4**	**7**	**3**	**5**	**5**	**1**	**4**	**4**
Long term	**7**	**7**	**6**	**2**	**3**	**3**	**7**	**7**	**7**	**5**	**4**	**7**	**6**	**4**	**7**	**4**	**5**	**4**	**4**	**6**	**3**

Measure	Offering integrated fares	Personalised Travel Assistance (PTA)	Multimodal information and trip advice	Bike rental	Travel awareness campaigns	Car sharing	Park and ride	Marketing	On demand public transport	Parking manage ment	School bus	Cycling bus	Walking bus	Mobility Educatio n	Site based parking management	Cycling facility improvments	General PT improvments	Car pooling	Eco driving	Telework	Car sharing	Reorganisation of PT schedules
Improving road safety	1	1	1	0	1	1	1	1	1	1	3	2	3	3	1	1	2	2	2	2	1	1
Increasing pro-environmental behaviour	2	2.5	3	2	3	3	2	2	2	1	1	3	3	3	2	4	2	2	4	1	2	1
Increase Public Transport Patronage	4	3	3	0	3	2	3	3	2	3	2	-1	-1	1	3	1	4	-1	-1	-1	0	4
Increase walking use	1	2	2	1	3	0	0	3	2	2	1	-1	5	3	2	1	2	-1	-1	-1	1	1
Increase cycling use	1	3	2	5	3	1	-1	3	1	3	-1	4	-1	2	2	4	0	-1	-1	-1	1	1
Reducing accompanying trips	1	3	2	1	3	2	2	3	2	3	2	4	4	1	3	2	2	2	0	1	2	1
Reducing parking problems	2	2	2	2	3	3	2	3	2	4	1	1	1	0	4	3	3	3	0	3	3	3
Improving Travel Awareness	1.5	2	3	3	4	2	1	4	2	2	2	3	2	4	2	2	3	2	1	2	2	2
Source: www.EPOMM.org																						

Measure scoring from VTPI

Unweighted Analysis	Distance-Based Pricing	Distance-Based Emission Fees	MM Programs & Institutional Reforms	Fuel Tax Increases	Land Use Management Strategies	Aviation Transport Management	Employee Trip Reduction Programs	Transportation Management Association	School & Campus Transport Management	Tourist & Special Event Transport Mgt.	Optional Pay-As-You-Drive Vehicle Fees	Mandatory Pay-As-You-Drive Vehicle Fees	Transit Benefit Tax Exemption	Land Use Management Strategies
Emission Reduction	2	3	3	3	3	2	2	2	1	1	2	3	2	2
Congestion Reduction	2	1	3	1	1	1	3	3	2	2	2	2	3	1
Road and Parking Cost Savings	2	1	3	1	1	1	3	3	2	2	2	2	3	2
Traffic Safety	2	1	2	1	1	0	2	2	2	2	3	3	2	2
Land Use Impacts	2	1	2	1	1	0	2	2	2	2	2	2	3	3
Consumer Costs	2	-1	2	-1	0	-1	2	2	2	2	2	2	3	1
Transportation Options	2	-2	2	-2	0	-2	3	2	3	2	3	3	3	2
Equity Impacts	2	0	2	0	0	0	3	2	3	1	3	3	3	2
Technical and Administrative Requir	-1	-3	-2	0	-1	-1	2	2	-1	-2	2	2	1	2
Public/Political Acceptability	0	-3	-3	-2	-1	-1	1	1	2	-1	2	2	2	0
Sums	**15**	**-2**	**14**	**2**	**5**	**-1**	**23**	**21**	**18**	**11**	**23**	**24**	**25**	**17**

Source: by Todd Litman, Victoria Transport Policy Institute (www.vtpi.org/mm_eval.xls)

Unweighted Analysis	Institutional Reforms	Transit Improvements and Incentives	Ridesharing	High Occupant Vehicle (HOV) Priority	Nonmotorized Transport Improvements and Encouragement	Road Pricing	Parking Management and Parking Pricing	Telework	TDM Marketing	Car-Free Planning and Vehicle Restrictions	Traffic Calming	Carsharing	Optional PAYD Insurance
Emission Reduction	2	1	1	2	2	2	3	1	2	1	1	1	2
Congestion Reduction	1	3	3	3	1	3	2	3	2	1	0	1	0
Road and Parking Cost Savings	2	3	3	3	2	2	3	2	2	1	1	2	1
Traffic Safety	2	2	2	1	0	1	1	2	2	1	3	2	3
Land Use Impacts	2	3	0	1	2	1	2	-1	2	1	3	2	2
Consumer Costs	2	2	2	2	2	-2	-2	2	2	1	0	3	0
Transportation Options	2	3	3	2	3	-3	-3	3	2	3	2	3	1
Equity Impacts	2	2	2	2	3	0	0	2	1	1	1	2	0
Technical and Administrative Requir	2	-1	-2	-3	-2	-3	-2	-2	2	-2	-2	2	-2
Public/Political Acceptability	-3	-2	2	1	2	-3	-2	2	1	-1	2	2	0
Sums	**14**	**16**	**16**	**14**	**15**	**-2**	**2**	**14**	**18**	**7**	**11**	**20**	**7**

Source: by Todd Litman, Victoria Transport Policy Institute (www.vtpi.org/mm_eval.xls)

Measure scoring from OPTIMISM

	Macro mobility impacts			Other mobility impacts				Environmental impacts			Costs		ransfer- abilit	Total
ICT options	Transport demand	Modal shift	Travel time	Safety	Congestion	Accessibility	Reliability	CO_2	Air pollution	Noise	Investment costs	O&M costs		
Travel information														
Static route planners	0,6	1,0	1,0	0,2	0,0	0,0	0,6	1,0	0,4	0,2	-1,0	0,0	2,0	5,4
Dynamic and real-time route planners	0,4	1,2	1,3	0,2	0,7	0,9	1,0	1,0	0,5	0,2	-0,9	-1,0	1,8	7,0
Personalized travel information services	0,4	1,4	1,6	0,0	1,2	0,6	0,8	1,0	0,4	0,0	0,0	0,0	1,8	8,8
Infrastructure-bounded travel inf. public transport	0,0	0,0	1,0	0,0	0,0	0,0	1,0	0,0	0,0	0,0	-1,0	-1,0	2,0	2,0
Infrastructure-bounded travel info. road transport	0,0	0,0	1,0	-1,0	1,0	0,0	0,0	0,0	0,0	0,0	-1,0	-1,0	2,0	1,0
In-vehicle information	0,0	0,5	1,3	1,0	1,0	0,0	0,5	0,5	0,5	0,3	-0,5	-0,5	1,8	6,3
Mobility services														
E-ticketing	0,8	1,3	0,0	0,3	0,3	0,3	1,0	1,0	0,8	0,3	-1,5	-0,5	2,0	5,0
Mobile phone ticketing	0,5	1,0	0,5	0,5	0,0	1,5	1,5	0,5	0,5	0,0	-1,5	-1,5	2,0	5,0
Multi-modal smart cards	1,0	1,2	1,1	0,1	0,6	1,4	0,8	0,9	0,8	0,0	-1,1	0,6	1,8	8,1
Mobile phone payments	0,8	0,8	0,8	0,0	0,6	1,8	0,6	0,6	0,6	0,0	-0,2	0,6	2,0	8,2
Bicycle sharing services	0,0	1,0	1,0	-0,8	0,4	1,0	1,0	0,9	1,0	0,2	-1,0	-0,9	2,0	5,8
Car sharing services	-1,0	2,0	-1,0	1,0	1,0	1,0	1,0	2,0	1,0	0,0	0,0	1,0	2,0	11,0
DRT	0,7	1,1	0,3	0,0	0,0	1,6	1,3	0,6	0,6	0,1	-0,6	-0,1	1,9	6,7
Transport management systems														
Public transport management systems	0,5	0,5	1,5	0,0	0,5	1,5	1,0	0,5	0,5	0,0	-1,0	-1,0	2,0	6,0
General transport management systems	0,6	1,0	1,8	0,8	1,9	0,6	0,9	1,0	1,1	0,1	-1,4	-1,1	1,0	7,6

Source: Source: CE DELFT, 2012, Deliverable 4.1: Identification of ICT options enhancing co-modality, OPTIMISM (Optimising Passenger Transport Information to Materialize Insights for Sustainable Mobility) Project, 7th Framework Programme, Project No: 284892, p. 78

Measure scoring from EC freight study

	Economic Impacts		Envionmental, Health & safety impacts				Value for Money for public sector	Transferability across EU	Urban area types
Measure	UFT Operational costs	Road Congestion	Air quality	GHG	Noise	Health & Safety			
Extending time windows	Lower	Lower	Better	Lower	Neutral	Higher	Good	High	1,2,3
Removal of vehicle size & weight restrictions over extensive areas	Lower	Lower	Better	Lower	Neutral	Neutral	Good	High	1,2,3
LEZ	Lower	Neutral	Better	Lower	Neutral	Higher	Moderate/poor	High	1
Harmonisation of regulations	Lower	Neutral	None	None	Neutral	Neutral	Good	High	1,2,3,4
Congestion charging	Higher	Lower	Better	Lower	Neutral	Neutral	Moderate/poor	Low/medium	1,2
Mobility credits	Neutral	Lower	Better	Lower	Neutral	Neutral	Moderate/poor	High	1,2,3
Indirect subsidies to “virtuous” UFT operators via differentiation	Lower	Lower	Better	Lower	Neutral	Neutral	Good	High	1,2,3
Zoning of retail & logistics activities to secure critical mass	Lower	Lower	Better	Lower	Lower	Neutral	Good	Moderate+	1,2,3,4
New developments with off-street loading/unloading facilities	Lower	Lower	Better	Lower	Neutral	Neutral	Good	Moderate+	1,2,3,4
Safeguarding of railconnected & waterconnected sites for future use	Lower	Lower	Better	Lower	Neutral	Neutral	Good	Moderate+	1,2
Requiring large-scale distribution sites to be rail & waterconnected	Lower	Lower	Better	Lower	Neutral	Neutral	Good	Moderate+	1,2
Network of onstreet designated loading & unloading bays	Lower	Lower	Better	Lower	Lower	Better	Moderate+	High	1,2,3
Development of rail- and/or waterborne connected logistics zones	Lower	Lower	Better	Lower	Neutral	Neutral	Moderate+	Good	1,2
Developing Urban Logistics Plans (ULPs)	Lower	Lower	Better	Lower	Lower	Higher	Good	High	1,2,3
Developing Freight Quality Partnerships, involving effective consultation	Lower	Lower	Better	Lower	Lower	Higher	Good	High	1,2,3
On-line one-stop shops for freigh	Lower	Lower	Better	Lower	Lower	Higher	Good	High	1,2
Indirect subsidies to support UCCs	Lower	Lower	Better	Lower	Lower	Neutral	Good	High	1,2,3
Planning permission requirements for CCCs for major construction sites	Lower	Lower	Better	Lower	Lower	Higher	Good	Moderate+	1,2,3
Planning permission requirements for DSPs	Lower	Lower	Better	Lower	Lower	Neutral	Good	Moderate+	1,2,3
Encouraging DSPs for existing businesses	Lower	Lower	Better	Lower	Lower	Neutral	Good	High	1,2,3
Developing network of ecommerce pickup points	Lower	Lower	Better	Lower	Lower	Neutral	Good	Moderate++	1,2,3
Lorry routing & signage strategies	Lower	Lower	Better	Lower	Lower	Higher	Good	High	1,2
Facilitating nighttime deliveries	Lower	Lower	Better	Lower	Neutral	Neutral	Good	Moderate++	1,2,3

* 1= Metropolis 2 = Other Large Urban Zone; 3 = Smaller Heritage Urban Area; 4 = Other Smaller Urban Area
\+ (depends on planning rules in different Member States) ++(may be cultural differences)

Source:http://ec.europa.eu/transport/themes/urban/studies/doc/2012-04-urban-freight-transport.pdf

Measure scoring from TransPord

Urban measures	Relative CO2 reduction potential 2020	Relative CO2 reduction potential 2050	Feasibility
National road user charging – average 7 cents/km	19%	19%	Low
Walking and cycling – visionary	30%	50%	Low
Smarter choices	9%	13.50%	High
Walking and cycling – basic	5%	15%	High
Urban distance based charging 7 cents/km	0.75%	15%	Medium
Speed limit reduction (70mph down to 60mph)	4.80%	4.80%	Medium
Land Use policy	0.50%	5%	Medium
Speed enforcement current limits	2.40%	2.40%	Medium
Public transport fare reduction (50%)	1.50%	6%	Medium
Public parking spaces (halved)	2.25%	4.50%	Medium-High
Urban cordon charges (4€ peak, 2€ off-peak)	0.15-0.6%	3%	Medium-High
Public parking charges (doubled)	1.50%	3%	High
Public transport quality bus corridors/high-tech bus/PRT/feeder schemes.	0.25%	1%	Medium
Urban traffic control systems	0.50%	1.13%	High
Parking Cash-out	0.56%	2.25%	Medium
PNR spaces and WPPL	0.31%	1.25%	Medium
Bus frequency +50%	-0.375% (for cars) +50% for buses	-1.5% (for cars) +50% for buses	High
Eco driving	10%	10%	Medium-High
Fuel consumption monitoring/benchmarking	5%	10%	Medium-High
Modal shift summary	For freight 19.3% and for passengers 9.8%		Medium
Sustainable freight transport summary	15%	28%	Medium-High
Optimized vehicle utilization summary	20%	20%	Low-Medium
Vehicle maintenance summary	2%	4.50%	Low-High
Feebate summary	5%	5%	High
Idling reduction HGV summary	10%	16%	Medium-High
Car labelling summary	5%	NA	Low-High

Source: GHG-TransPoRD (http://www.ghg-transpord.eu/ghg-transpord/downloads/G

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Abstract
The European Commission is considering a European support framework for the implementation of Sustainable Urban Mobility Plans in EU Member States. This consideration is consistent with the 2011 White Paper proposal to increase coordination between transport authorities and transport policy deciders. Consequently, an interest on how different urban measures can be used in order to render transport activities more sustainable has given way to research concerning the impacts and effects that policy measures might have on socio-ecological systems. These studies rely, mainly, on experts' opinions and past experiences in order to develop a common scorecard on how a transport system might react to different measures.

This technical note uses the expert scoring information available in current scientific literature in order to explore the impacts and effects that different urban measures may have in planning for sustainability on a European wide level.

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