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On-line Tool for the Assessment of Sustainable Urban Transport Policies

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Abstract

European cities face increasing challenges to their citizens' mobility. Urban transport systems are integral elements of the European transport system and are therefore of concern for the Common Transport Policy. Thus, the 2011 Transport White Paper calls for cities to implement a range of strategies to face these challenges - strategies include: land-use planning, pricing schemes, efficient public transport services, infrastructure for non-motorised modes and charging/refuelling of clean vehicles to reduce emissions – and encourage to develop Urban Mobility Plans (SUMPs) that bring all of these elements together.
Tools and guidance documents are key instruments for the development of these strategies in order to help city authorities understanding the range of possible actions and steps to successful implementation. This paper presents an overview of the web based policy support tool developed in the European Urban Roadmaps study, supported by DG Move and underpinned by a range of stakeholders' engagement activities.
The aim of the web based tool is to support authorities of small and medium sized cities in Europe who may not have the resource to major policy assessment and modelling work. The tool provide the local transport policy maker with the ability to readily identify, develop, screen and assess different measures and policies scenarios, thereby enabling city authorities to quickly gather a sense of the scale of impacts that could be expected. It is adaptable to different city circumstances, covers all the transport/travel modes that are used in urban areas and provides quantitative outputs covering a range of different metrics, including costs and cost effectiveness, covering the time period until 2030.
The development of the tool is complemented by the preparation of different road maps, designed to provide examples of policy selections that could be implemented by a city to work towards the European Commission goals for sustainable urban transport until the year 2030.

Keywords: SUMP; on-line tool; policy scenarios; policy assessment; urban transport.

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1. Background

Cities in Europe are vital centres of economic activity, innovation and employment. Many of them face increasing challenges to their mobility systems such as congestion, air quality, ambient noise, CO2 emissions, accidents and urban sprawl. These have significant negative impacts on the environment, health and economic performance of cities and can often affect a much broader area than the city itself. Many of these problems are expected to increase in the future as cities continue to grow in size and face demographic changes such as ageing populations.

Urban transport systems are integral elements of the European transport system and are therefore of concern for the Common Transport Policy. Urban transport faces a number of sustainable development challenges. The 2011 Transport White Paper sets ambitious targets to address these challenges. In particular, the targets will require city authorities to start the process of developing and assessing possible local policy measures that will enable them to reduce the use of conventionally fuelled vehicles, improve local air quality and reduce the number of accidents occurring within their geographical areas. Meeting these targets will not happen autonomously as a result of technological development or market forces and consequently, policy action is needed at the city level in order to ensure that the objectives for urban transport are met.

There is a wide range of instruments available to implement this policy effort, including land-use planning, pricing schemes, infrastructure for non-motorised modes, charging/refuelling of clean vehicles to reduce emissions, and many others. These instruments should be part of a meaningful strategy in order to develop cost-effective interventions. The availability of tools and guidance documents is central to the development of cost-effective strategies, helping policy-makers to understand the range of possible actions and steps to successful implementation.

Whilst there are already a wide variety of transport tools and models available, many of these are full-featured, commercially available software packages that are used for highly detailed traffic and transport modelling. Such tools are useful in being able to model the impacts of transport schemes and policies in detail, but their complexity means that they are not accessible to staff in city authorities with no background or experience in modelling. By contrast, there are other, simpler tools available but these are often not focused on the development of city-level plans, and in many cases, these tools are not easy to use.

For this reason in 2013 DG MOVE launched a “Study on European Urban Transport Roadmaps 2030”, a four-year project with the specific objective of providing effective and user-friendly policy support tools to assist a large number and wide range of city authorities throughout Europe to identify and implement the most cost-effective policies to achieve European urban transport policy goals.

The tool allows city authorities in developing and analysing policy scenarios and roadmaps and has been designed to support the assessment of a wide range of transport policy measures and to provide users with quantified estimates of the impacts and costs of individual policy measures as well as combinations of these measures. The target audience for this tool is smaller and medium sized cities in Europe, up to about a population of 1 million, who do not necessarily have the resources to develop their own bespoke transport appraisal models.

The tool operates in a web-based software environment to enable ease and use and to avoid the need for cities to have access to specific software packages; all what is required to access the tool is an internet connection and a web browser. In addition, the tool is accompanied by guidelines (user guides) to help users understand issues such as policy design, best practice and data gathering that will help real-world implementation.

This paper presents the main features of the Urban Transport Roadmaps 2030 policy support tool and is structured as follows: in section 2 the main objectives and functionalities of the tool are introduced; the structure of the tool and of its modules is described in section 3 while section 4 provides an overview of the next steps of the tool development. Final conclusions are presented in section 5.

2. Objectives and functionality of the tool

The development of the tool was centred on the following core objectives:

- To provide cities with the ability to readily identify, develop, screen and assess different transport policies and measures;
- To allow cities to explore different urban transport policy scenarios, thereby enabling city authorities to quickly gather a sense of the scale of impacts that could be expected based on illustrative policy scenarios;
- To provide cities with quantitative outputs covering a range of different metrics, including costs and cost effectiveness, covering the time period up to 2030;
- To be adaptable to different city circumstances;
- To be very easy to use, and in particular be accessible and usable by people with no background or experience in transport modelling;
- To have visually attractive interface and outputs and to provide very high quality graphical outputs that can be used by city authorities to communicate with a wide range of stakeholders;
- To be readily accessible and not rely on users having access to specific types of software or be limited to users with computers that run on particular operating systems;
- To cover all of the transport/travel modes that are used in urban areas, i.e. cars, vans, heavy goods vehicles, buses, bicycles, motorised two wheelers and walking.

Based on these objectives, the key functionalities of the tool have been defined as listed in Table 1.

Table 1. Tool's key functionalities

Input functionality	**Rationale**
Ability to choose from a pre-defined list of city types	In order to make it easy for users to carry out analysis, the model incorporates a pre-defined set of city types.
Ability to view a pre-defined set of policy options	Rather than requiring users to create policy measures from scratch, the tool includes a pre-defined set of policy measures that users can view and work with.
Ability to capture exogenous conditions (at the national and broader level)	The tool offers users the opportunity to select from a range of exogenous conditions (for example National level factors) including energy prices and energy taxation levels.
Ability to select, edit and group policy options	In addition to the pre-defined policy options, more advanced users may want to edit the pre-defined measures or create groups of measures.
Ability to represent increased penetration of alternatively fuelled vehicles for each mode of transport	Given the high level 2011 Transport White paper target to halve the use of conventionally powered cars in cities by 2030, it is important for the tool to be able to quantify the deployment of different types of alternatively fuelled vehicles (e.g. electric vehicles, hydrogen fuel cell vehicles, etc.)
Output functionality	**Rationale**
Ability to quantify the impacts of policy measures on individual modes of transport and on multiple modes of transport	Some policy measures only affect single modes of transport whilst others have multi-modal effects. The tool is able to analyse both types of measure.
Calculation of impacts on Economic, Transport and Environmental Factors	The calculation of impacts is a key area of functionality required in the tool. Importantly, in order to enable city authorities to produce roadmaps, the tool is able to provide them with robust projected impacts based on sounds evidence.
	Additionally, the tool is able to provide users with estimates of the cost effectiveness of different policy measures. This enables them to make rational choices for their roadmaps.
User interface functionality	**Rationale**
Easy to use interface for controlling the tool	The tool has very simple controls that do not rely on prior experience of using models. With this in mind, the tool operates in a web-based environment with a minimal requirement for users to input datasets.
Unique URL address	Provides for unique storage of roadmaps, allowing a range of users to access and compare them.

3. Structure of the tool

To deliver these key functionalities the tool was developed around four main structural elements as illustrated in Figure 1. These elements, developed into dedicated modules described in the sections below, comprise:

1. City type selection
2. Policy selection
3. Calculation framework
4. Tool outputs

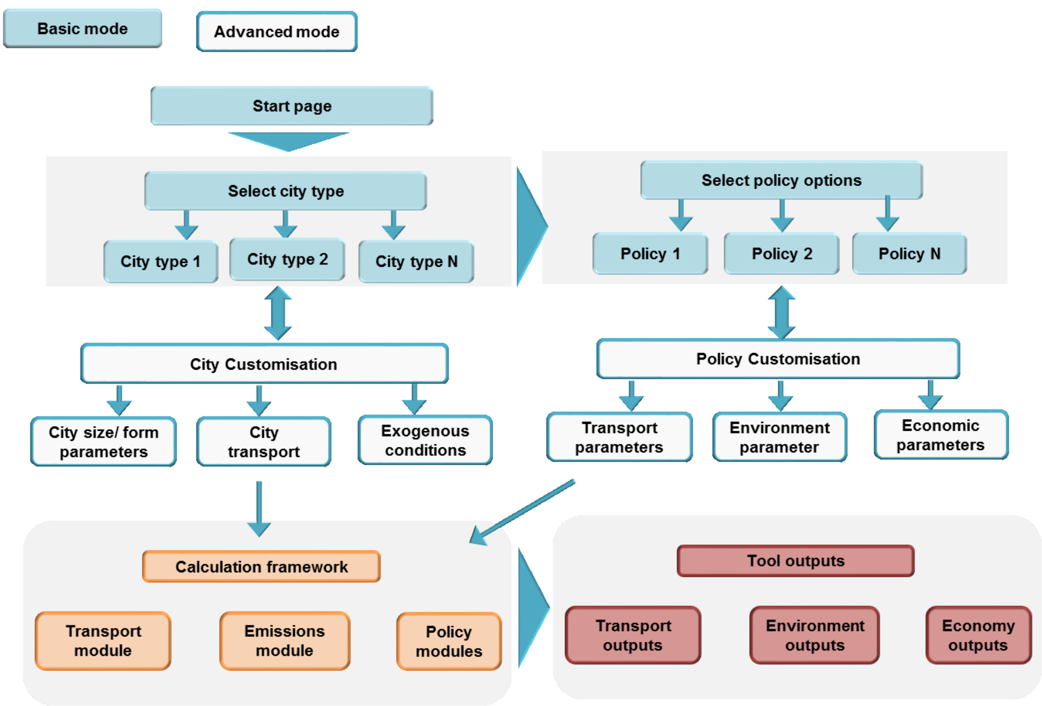

Fig. 1. Outline structure of the tool

3.1. The city type selection module

The ***city type selection*** module is the main entry point of the tool and allows the user to select a primary city type to represent their city. Each primary city type is associated with a set of default city and transport parameters that allows the model to set up the most appropriate basic transport patterns. This allows simple and quick initial configuration of the model. The key information needed by the module includes:

- ***City type:*** Small city (<100,000 inhabitants), Small city with large historical cores, Medium city (100,000 – 500,000 inhabitants), Large city (500,000 to 1 million inhabitants) and very large cities (over 1 million inhabitants, in either monocentric or polycentric forms).
- ***Country:*** Country average national data is used to automatically set the initial values of parameters such as e.g. car ownership, vehicle fleet composition, car ownership taxes, energy mix for electricity generation, etc.
- ***Population:*** Population (total and by zone) at the base year and its trend.
- ***Economy***: City economy type (e.g. relevance of the industrial sector, which influences freight traffic patterns).

- ***City users:*** Share of incoming trips with respect to internal trips, main transport mode used to enter the urban area, including multimodal trips (e.g. park & ride is also simulated within the tool).
- ***City population distribution:*** Share of inhabitants living in three area types: urban core, outskirts with good transit service and outskirts with poor transit service.
- ***Relevance of non-car modes of transports***: Use of public transport, existence of tram and metro lines, use of bikes, use of motorbikes.
- ***Road congestion level.***

More advanced users find in the tool the possibility to customize the default data using their own local data so as to provide a more accurate representation of the city, both on the demand and on the supply side. If not customised by the user, the default values of the following variables are based on average data derived from the model database:

- Socio-demographic trends: population trend and sprawling trend,
- Average income level per capita,
- Transport trends: mode split trend, share of freight traffic and its trend,
- Availability of electric or fuel cell refuelling stations ,
- Public transport fares and operating costs,
- Extension of reserved paths for bus/tram or bike,
- Extension of regulated parking and parking fares,
- Existence and level of service of park & ride,
- Existence and level of service of car sharing,
- Vehicle fleet composition by fuel type for car and bus ,

The user can also choose among alternative trends for exogenous trends influencing the development of transport activity and its effects:

- technology: penetration of innovative vehicle technology in the fleet, trends of fuel economy and polluting emission factors,
- energy and mobility: fuel resource price, car ownership trend, trip rates trend, energy mix for electricity generation,
- policy at the national or super-national level: fuel taxation, vehicle taxation.

3.2. The policy selection module

Having selected a city type, and potentially customised it, within the ***policy selection*** module the user can then select various policies to apply in their city.

The definition of policy measures to be included in the tool was a key step of the project. During the process of scoping the design and development of the tool, a wide range of urban transport policy measures was assessed and available data on these measures (i.e. implementation costs, expected impacts, etc.) was researched. The wide knowledge base to identify relevant policy measures included peer reviewed journals, policy focused research and previous consultancy projects.

The ELTIS, CIVITAS and EPOMM websites provided a wide range of examples of individual actions to promote sustainable mobility. A long list of policy measures was identified from these sources by clustering the actions (often very focused and context specific) into broader measures. This list was further scrutinised in order to group them into different policy types and the screening process allowed for the identification of a set of core policy measures detailed in Table 2.

Within the policy selection module policy measures are associated with default parameters, again allowing the user a simple and quick way to use the tool. As with the city types, the default data for the policy options can be customised to refine the policy measure, for example by adjusting tariff values for a charging scheme. These policy measures can be simulated individually or combined together in consistent scenarios and roadmaps.

Table 2. Urban Transport Roadmaps 2030 Policy Measures

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

3.3. The calculation framework

The calculation framework includes the equations used for the background calculations building on the pre-coded values of parameters as well as on the user input provided through the interface. It is the core of the tool that uses the city type parameters and policy measure parameters to calculate the policy measures impacts in the selected city.

In the calculation framework the urban mobility system is described at a strategic level (e.g. networks are not represented). Urban mobility is described from 2015 until 2030 on a yearly basis. A reference trend of the urban mobility and of its effects (e.g. local pollution) is computed; the impact of policy measures is measured in terms of modifications of such trend.

The calculation framework comprises three key elements (Figure 2):

- ***The transport module***, which calculates the base transport patterns for the city and then adjusts them in relation to the policies.
- ***The emissions module***, which calculates the emissions and environmental data associated with the transport activity.
- ***The policy modules***, which translates the policies into impacts.

3.3.1. The transport module

The ***passenger transport demand*** sub-module deals with the estimation of trip generation and mode split for passenger mobility. Passenger-km numbers depend on average trip distances, which are different according to the living zones (shorter in the core urban area, longer in the outskirts). Vehicle-km numbers depend on occupancy rates, which can also be affected by policies. Trip generation is based on trip frequencies by journey purpose and urban population and the same variables influence mode split. Policy measures can change mobility trend and give rise to mode switches.

Main elements affecting mode split and transport activity are travel times and costs. Travel time by mode is calculated building on a base speed by mode, which changes over time due to the effects of road traffic levels. Importantly, in addition to congestion, road speed depends also on whether or not there are reserved lanes for public transport and bicycles[†]. A dedicated sub-module (***incoming passenger demand***) estimates passenger trips entering the city from other areas.

Mobility-related costs are computed for both individuals and city administration. The costs considered for individuals are:

- for private cars, fuel costs as well as local charges (parking, road pricing) and fixed costs (insurance, ownership taxes);
- for motorbikes, fuel costs only;
- for other modes the expenditure for purchasing transport services (public transport, bike sharing, car sharing) are considered.

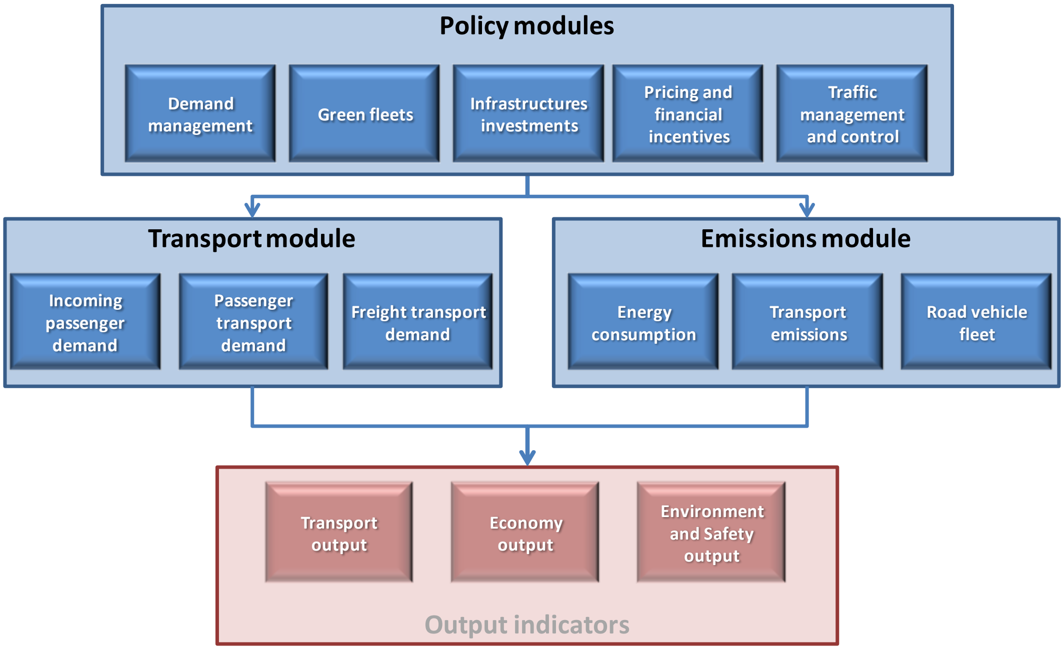

Fig. 2. Outline structure of the calculation framework

From the public administration point of view, the costs are those for operating public transport services and, when policy measures are activated, for their implementation and operation. Costs are modelled net of the revenues obtained from public transport users, from parking, and from road charging. Revenues for services and taxes not controlled at the local level (e.g. car ownership taxes, fuel taxes) are not accounted for.

The number of freight vehicles is estimated in the freight transport demand sub-module as a percentage of the total number of passenger car vehicles. Within the module there is a differentiation by freight traffic typology and truck size. Three types of freight traffic are considered: distribution of products to retailers, mail services (couriers delivering to and collecting packages from offices and households) and other types of freight transport (e.g. movements of building materials, transport of input for the industrial process or of products of local industries). This

† Reserved lanes of this nature improve the journey speeds of public transport modes and of bicycles and reduce the speed of cars as they reduce the space on the carriageway.

distinction is introduced for two reasons. First, several measures are focussed on urban deliveries and therefore affect only one component of freight traffic. Second, the types of vehicles used for mail distribution are different from the vehicles used for transporting input to an industry. The module also calculates the amount of transhipped shipments (those which arrive in a platform within the urban area to be consolidated). This amount could be currently zero in many urban areas but can become different from zero when certain policies are activated. Finally, performances related to vehicle-km are estimated, taking into account the urban part of the overall trip distance.

3.3.2. The emissions module

In the road vehicle fleet sub-module, the fleet composition in terms of fuel type evolves over time driven by the penetration of innovative vehicles such as hybrid electric, battery electric and fuel cells. This trend is defined by the technological scenario selected in the exogenous conditions. The composition by Euro emission standard is also taken into account in order to estimate the average polluting emission and fuel consumption factors of the fleet.

The car sharing vehicle fleet as well as the LDV fleet for distribution of goods from the urban delivery platforms are treated separately under the assumption that their compositions are different from the private car and truck fleet (e.g. the car sharing fleet is usually made up of new vehicles and from urban delivery platforms also electric vehicles can be used).

Road vehicle fleet composition is the main input of the transport emissions module to estimate fuel consumption, pollutant and CO2 emissions. Total values are computed by applying mode-specific consumption and emission factors to the transport performance in vehicle-kilometres travelled (provided by the passenger transport module, incoming trips module and freight module). Tank-to-wheel CO2 emissions are estimated directly from fuel consumption by applying the fuel carbon content factors to each fuel type. For electricity consumption (tram, metro, electric cars), the energy mix for power generation is taken into account in order to estimate the emissions despite the fact that such emissions do not usually occur in urban areas. The energy mix changes over time at the country level according to the energy scenario.

3.3.3. The policy modules

Each policy measure is simulated in a dedicated policy module and each policy module is linked to one or more of the core modules described above to read input and to feed back the related impact.

Different measures can have impacts on the same variables (e.g. the transport mode shares) and these measures can be either independent or have a mutual influence. Impacts of independent measures are modelled in additive terms, while for the mutually influencing measures impacts are smoothed or amplified. Each policy module includes specific variables, but all share a similar concept that is based on the following input:

- The time when the measure is activated or enters into force.
- The ramp-up period for the full implementation of the measure. Some measures are relatively easy to implement and it can be safely assumed that their impacts occur in the same year of implementation. Other measures are more complex (e.g. infrastructures) and need several years before being fully implemented and/or to achieve their full effect after an adaptation period.
- The specific policy characteristics and intensity. For instance, for road charging the parameters include the value of the charge, its differentiation between vehicle types, and the size of the charged area.

Based on these input the policy module:

- Identifies the variables affected by the measures. For instance, the introduction of urban delivery centres increases the share of freight deliveries transhipped and consolidated at urban platforms. The prioritisation of public transport improves its speed and therefore its modal share. Here the user has the chance of modulating some of the effects.
- Quantifies the implementation and management costs of the measures. Some policies have almost direct no costs associated with them except administrative costs (e.g. the introduction of a legal and regulatory framework for urban freight transport), but most of them require investment to build infrastructure (e.g. park and ride facilities,

reserved lanes, etc.) and a yearly management and management cost (e.g. as is the case for road charging schemes).

3.4. The outputs module

The ***outputs module*** provides the numerical and graphical representations of the impacts of the transport policies on the city. The indicators for scenario assessment (in absolute values as well as in terms of absolute and relative difference with respect to the reference scenario) are segmented into three domains:

- *Transport impacts*, including mode share, average trip distances and traffic levels;
- *Environment outputs*, covering CO_2, CO, PM, NO_x and VOC emissions and accident rates;
- *Economic outputs*, providing the direct cost/benefits associated with the policies, and the social cost of emissions and accidents.

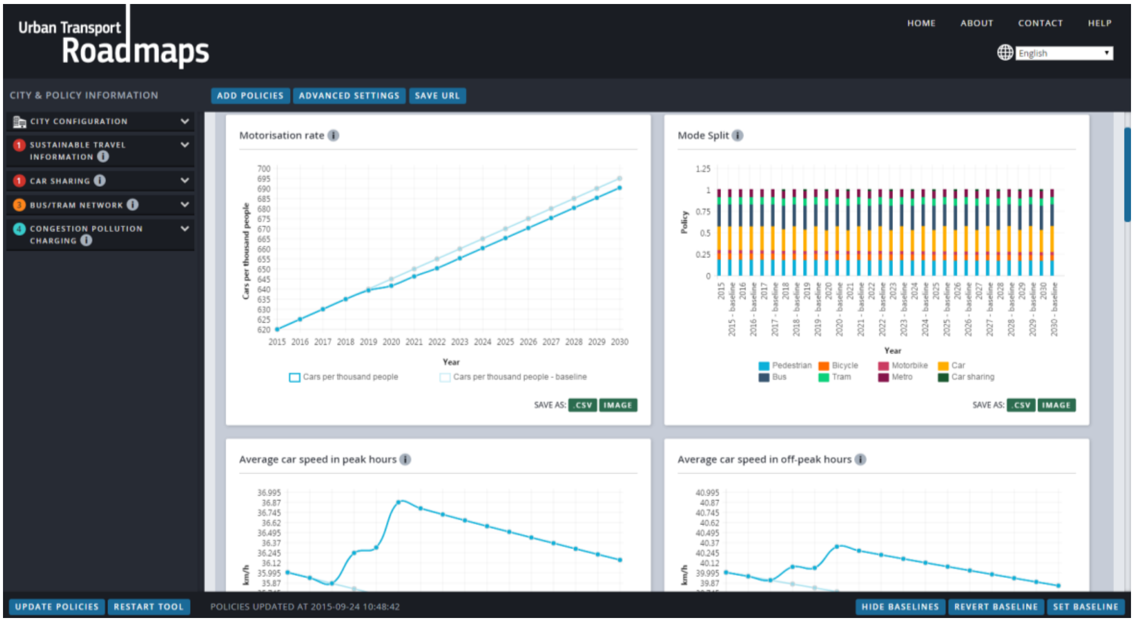

Fig. 3. Tool’s interface

3.5. Data sources

With reference to the exogenous assumptions related to technology, energy and national taxation trends, the quantification of projections were defined based on recent studies, such as e.g. European Commissions (2013), Krail et. al. (2014), Fiorello et. al. (2012).

The parameters driving the calculation framework (including the impacts of the policies) have been estimated on the basis of a wide range of data sources: travel surveys, Eurostat database, national statistics, modelling source (e.g. ASTRA-EC model, TREMOVE model), policy focused researches, professional literature, project reports, urban traffic studies, conference papers.

4. Steps of tool development

A prototype web-based version of the tool including the draft calculation framework and user interface is currently being finalised. A beta version of the tool has been handed over for full testing to selected case study cities beginning of September 2015. From September to October 2015 tester cities - supported by the project team - will use the tool to develop their scenarios and roadmaps customised on their urban environment and will provide feedbacks that will contribute in the tool development. The on line version of the tool will be publicly available beginning 2016. The tool will be available in 10 European languages. In the course of the years 2016 and 2017 the tool will be promoted throughout the 28 European countries via launch events encompassing both online webinars and in-person events.

5. Conclusions

This paper has introduced the main features of the Urban Transport Roadmaps 2030 policy support tool. The tool has been developed within the four-year project "Study on European Urban Transport Roadmaps 2030", promoted and financed by DG MOVE of the European Commission. The tool has been designed to help city authorities in developing and analysing policy scenarios and roadmaps. It allows policy screening of a wide range of transport policy measures and of their combinations providing users with quantified estimates of their impacts and costs. The tool operates in a web-based software environment to enable ease and use and to avoid the need for cities to have access to specific software packages. It is conceived to work with a limited amount of data provided by users and with different levels of customisation of its applications. The tool cannot replace detailed transport and land use models but it is expected to be useful for initial policy analysis especially for smaller and medium sized cities that might not have the resources to develop more complex modelling applications.

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