



ASSIST - ASsessing the Social and economic Impacts of past and future Sustainable Transport policy in Europe

The ASTRA-EC model



Content of the presentation

- **Methodological approach of ASTRA-EC**
- **The structure of ASTRA-EC**
- **Application of ASTRA-EC for policy analysis**
- **Output of ASTRA-EC**
- **The ASTRA-EC user interface**
- **Some examples of results**



Methodological approach of ASTRA-EC

- Based on **System Dynamics** (implemented with Vensim®)
- SD applied computer simulation to **understand how systems change over time**
- The behaviour of systems is primary determined by its **feedback mechanisms**
- Reaching an **equilibrium** is **not foreseen** in System Dynamics models



Methodological approach of ASTRA-EC

- Build on existing ASTRA model (long record of experiences in European and national projects)
- Integration of transport – environment – technology – economy
- In ASTRA-EC several modifications, especially addition of segmentation income groups to improve modelling of social effects
- Spatial coverage: EU29 (EU27 + Norway and Switzerland), trade with world regions
- Spatial detail: mainly country, some variables at NUTS1 and NUTS2 level
- Time horizon: 1995 – 2050 (calibration/validation period 1995 – 2010)



The structure of ASTRA-EC

Population module

- Provides the development of population segmented in various social groups according to age structure and income group



The structure of ASTRA-EC

Transport module

- Provides **endogenously estimated matrices** of trips and tons by mode of transport
- **Passenger generation** based on trip rates for different population groups
- **Freight generation** based on economic production and trade
- **Distribution** modified over time via elasticities to generalized cost and an attractor indicator
- **Mode split** based on elasticities with respect to cost and time



The structure of ASTRA-EC

Economic Module

- Provides **macroeconomic framework** with supply side (GDP, employment, etc.) demand side (GDP, Final Demand, etc.) and sectoral interweavement (I/O-Tables)
- **Transport-related inputs** simulated at the micro level affect the macroeconomic variables
- **Income distribution** influencing households consumption, car purchasing and mobility behaviour



The structure of ASTRA-EC

Trade module

- Provides **monetary value of sectoral transactions**
 - intra-EU and
 - between EU and the rest of the world.
- Transport cost is a determinant of intra-EU trade



The structure of ASTRA-EC

Vehicle fleet module

- Provides **development of vehicle stock** driven by new registrations and scrapping
- Cars differentiated by emission standards, age, fuel technologies (Gasoline, Diesel, CNG, LPG, Biofuels, PHEV, BEV and FCEV)
- Demand for new cars derived from socio-economic drivers (income, age structure, fuel and car prices, etc.)
- Stock of buses, LDVs and HDVs derived from development of vehicle-km



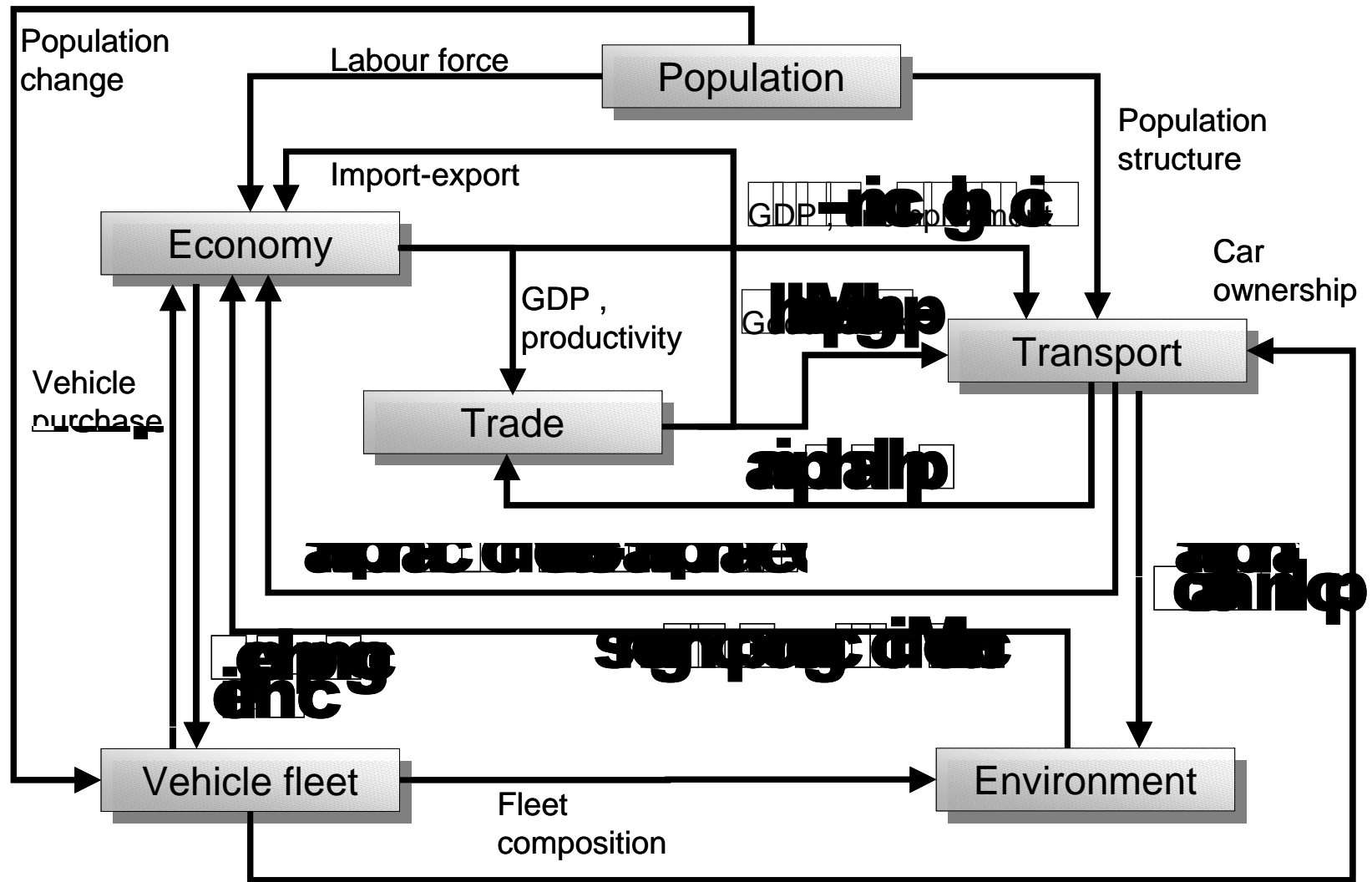
The structure of ASTRA-EC

Environmental module

- Calculates **fuel consumption, GHG and polluting emissions, external costs** from transport
- Direct (Tank-to-Wheel: hot and cold start) and indirect emissions
- Pollutants/GHG: CO₂, NO_x, CO, VOC and PM_{2.5} (not PM₁₀)
- External costs of GHG and polluting emissions, accidents



The structure of ASTRA-EC



Application for policy analysis

Pricing

- Car road charging schemes
- Urban road user charging
- Railway infrastructure charges
- EUROVIGNETTE' / road charging heavy-duty vehicles
- Internalisation of external costs by modes

Taxation

- 'Energy Taxation Directive'
- Vehicle taxation (circulation & registration)
- CO2 certificate
- Feebates (levels)



Application for policy analysis

Infrastructure

- TEN-T projects accelerated implementation
- Improving frequency and reliability of PT service

Internal Markets

- EU common job quality for truck drivers
- Elimination of restrictions on cabotage
- Railway liberalisation
- Integration of IWW into the transport system
- Simplification of formalities for ships travelling between EU ports
- Implementation of the Single European Sky Initiative



Application for policy analysis

Efficiency standards

- CO2 emission limits for HDV, LDV, cars
- Standards for controlling air pollution

Transport planning

- Promotion of energy efficiency commercial vehicles
- City logistic / Urban freight distribution / Urban consolidation centre

Research and innovation

- Electro-mobility Road
- H2 Fuel Cell vehicles
- Compulsory safety standards in road vehicles
- Increased replacement rate of inefficient and polluting vehicles



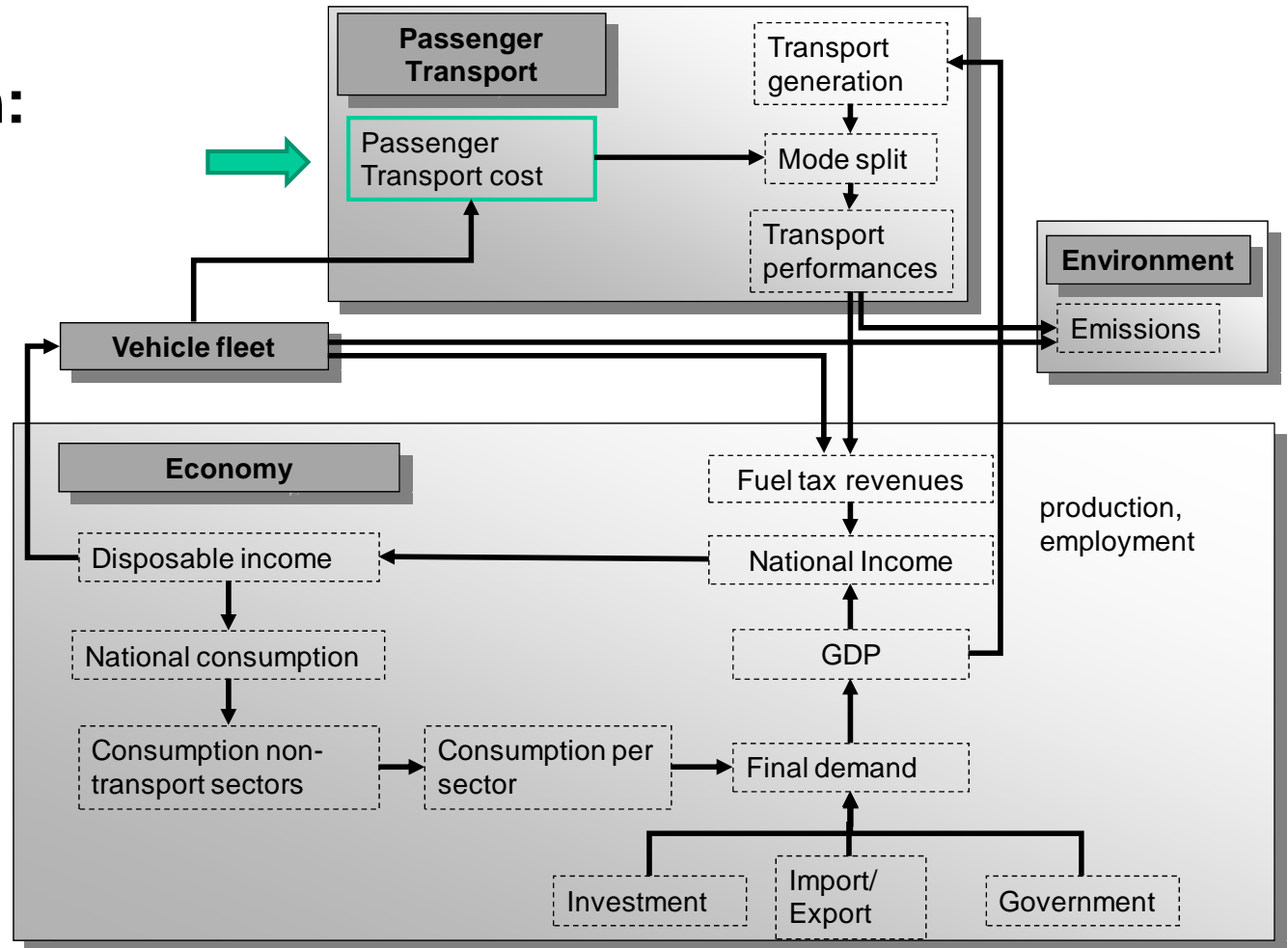
Application for policy analysis

Pricing / Taxation:

Direct / indirect impact on transport cost

Mode split affected through elasticities

Transport performances and expenditures affected



Output

ASTRA-EC produces several output indicators in various domains:

- **Transport:** passengers and freight activity, mode split, car ownership, car fleet composition,...
- **Environment:** fuel consumption, CO2 emissions, polluting emissions,...
- **Economy:** GDP, investment, expenditure for transport, fuel taxation revenues, transport charge revenues, value of externalities,...
- **Society:** employment, population distribution by income group, share of expenditure for transport on total consumption by income group, accidents, accessibility,...



Economic and social impacts

ASTRA-EC deals with economic impacts through the “micro-macro” bridges :

- Passenger transport and sectoral consumption
- Transport and sectoral investment
- Transport and sectoral employment
- Freight transport and total factor productivity
- Transport and intermediate inputs of input-output tables
- Transport and exports.

ASTRA-EC addresses social impacts in two ways:

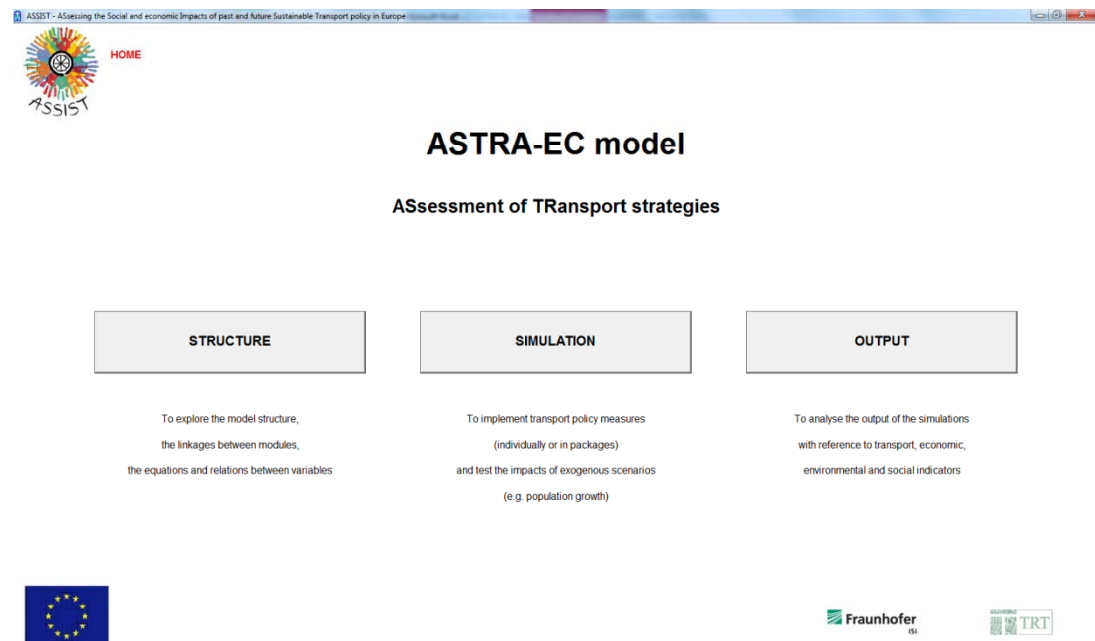
- Providing indicators related to the social dimensions such as safety (number of accident, fatalities), accessibility and employment
- Providing some results in the transport and economic domain segmented by income group



User interface

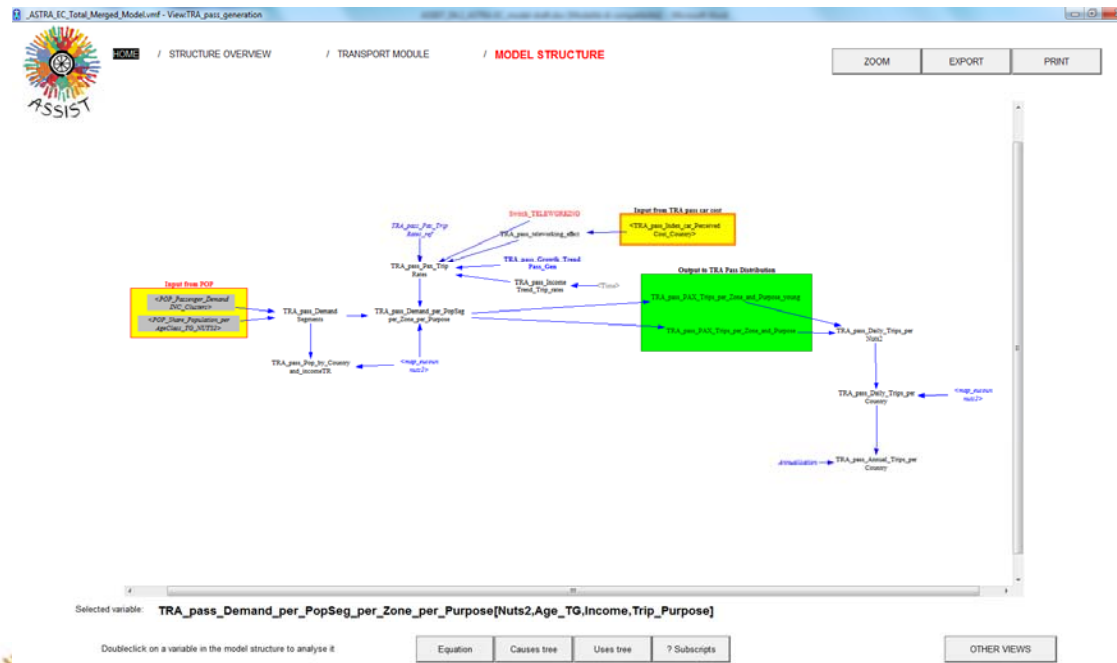
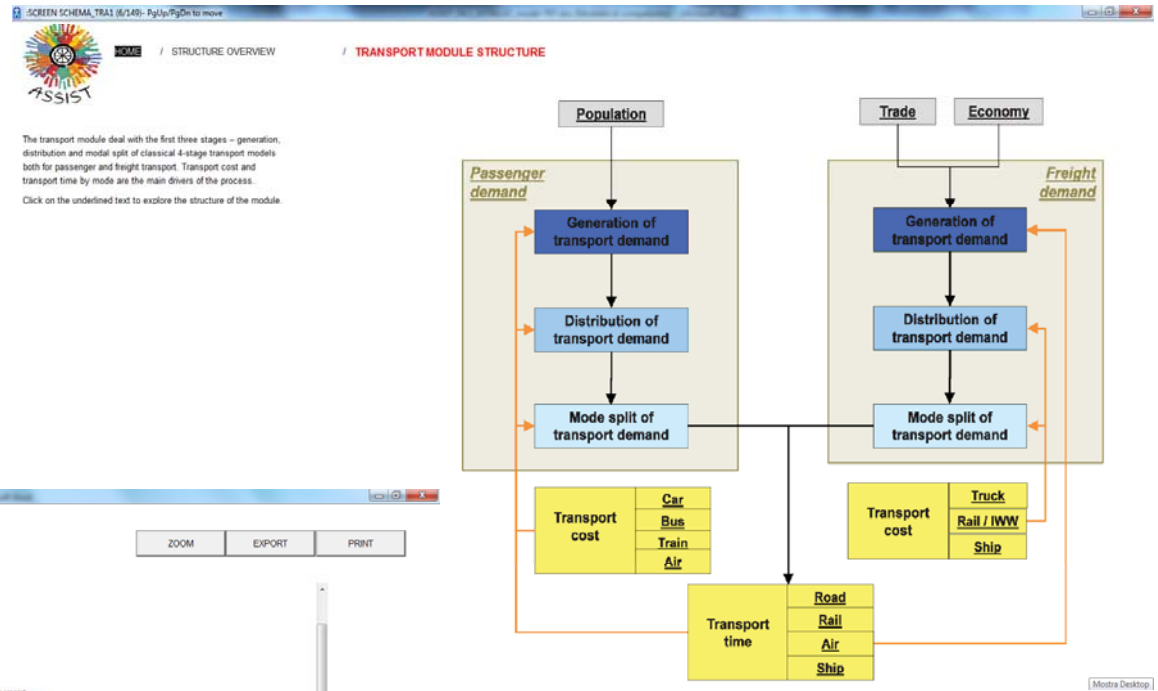
A user interface provides the possibility of accessing ASTRA-EC (also to non-modelling experts) for:

- exploring the model structure,
- carrying out simulations by changing model parameters
- read results and compare different scenarios.



User interface

The ASTRA-EC structure can be explored by means of schemes and model views



User interface

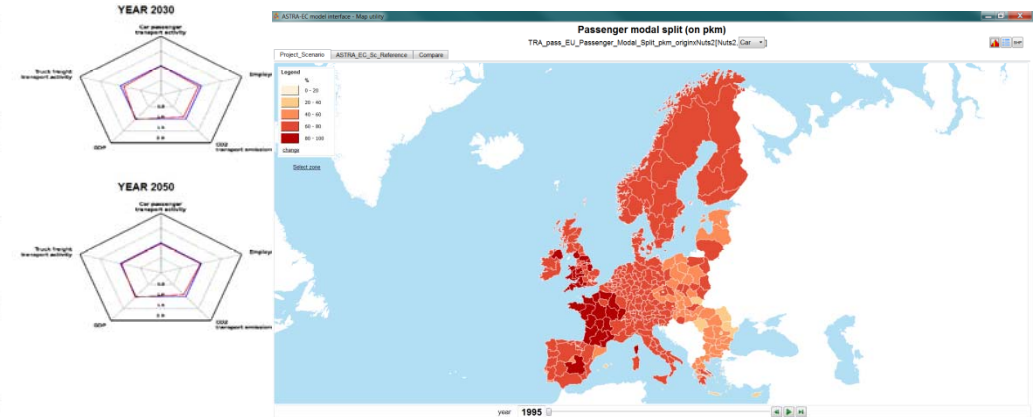
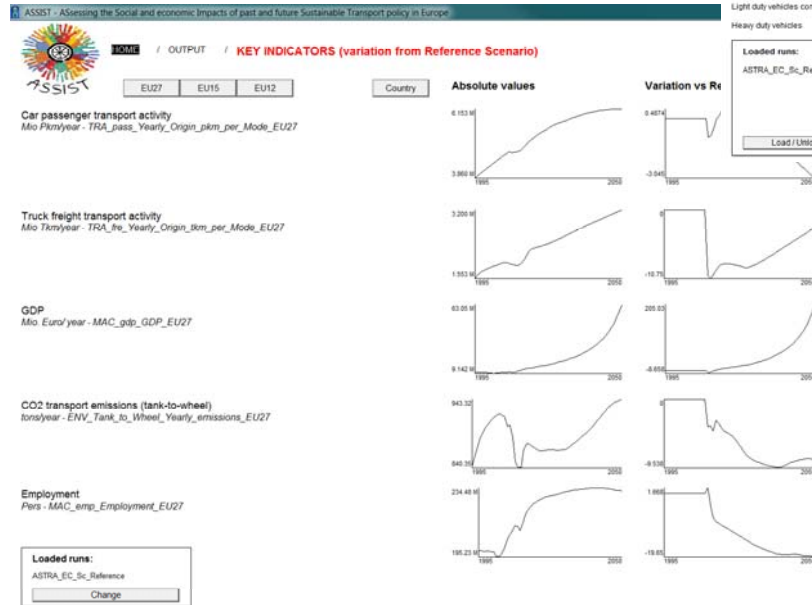
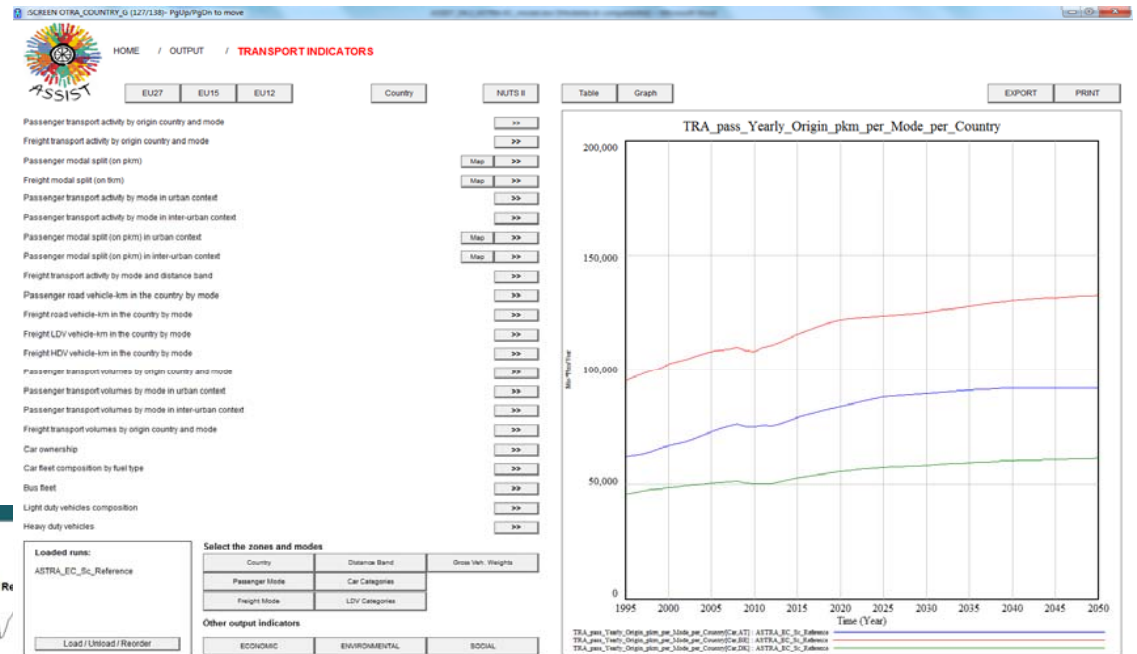
Policy measures can be implemented through sliders, buttons and also detailed exogenous files

	A	B	C	D	E	F
1	Transport policy	Car urban road charge scheme / access restriction				
2	Category	Pricing				
3	Sub-Category	Infrastructure Charging / Access Restrictions Schemes				
4						
5		The policy is set to charge car vehicles for entering in a urban area.				
6		The charge is applied based on trips (euro/trip) and can be differentiated by NUTS I zone (variable TRA_pass_urban_road_charge).				
7		The charge applies only to trips within a urban area: therefore, the share of trips in urban context by NUTS II zone and distance band is				
8						
9		Modify in the cell below the name of the file to save the input of the car pricing policy (default name Policy_1_1.tab).				
10		C:\ASTRA-EC interface\Policy_1_1.tab				
11						
12						
13	Sheet	Input Variables			Create the Tab file	
14	01	TRA_pass_urban_road_charge				
15						
16						
17	Legend of the subscripts					
18	Nuts1	<i>NUTS I zones for EU28 countries (35 zones)</i>				
19		AT1 - Ostösterreich		Ostösterreich		
20		AT2 - Südösterreich		Südösterreich		
21		AT3 - Westösterreich		Westösterreich		
22		BE1 - Région De Bruxelles-Capitale		Région De Bruxelles-Capitale		
23		BE2 - Vlaams Gewest		Vlaams Gewest		
24		BE3 - Région Wallonne		Région Wallonne		
25		BG3 - Severna I Iztocna Bulgaria		Severna I Iztocna Bulgaria		
26		BG4 - Yugozapadna I Yuzhna Tsentralna Bulgaria		Yugozapadna I Yuzhna Tsentralna Bulgaria		
27		CY0 - Kibris		Kibris		
28		CZ0 - Česká Republika		Česká Republika		
29		DE1 - Baden-Württemberg		Baden-Württemberg		
30		DE2 - Bayern		Bayern		
31		DE3 - Berlin		Berlin		
32		DE4 - Brandenburg		Brandenburg		
33		DE5 - Bremen		Bremen		
34		DE6 - Hamburg		Hamburg		
35		DE7 - Hessen		Hessen		



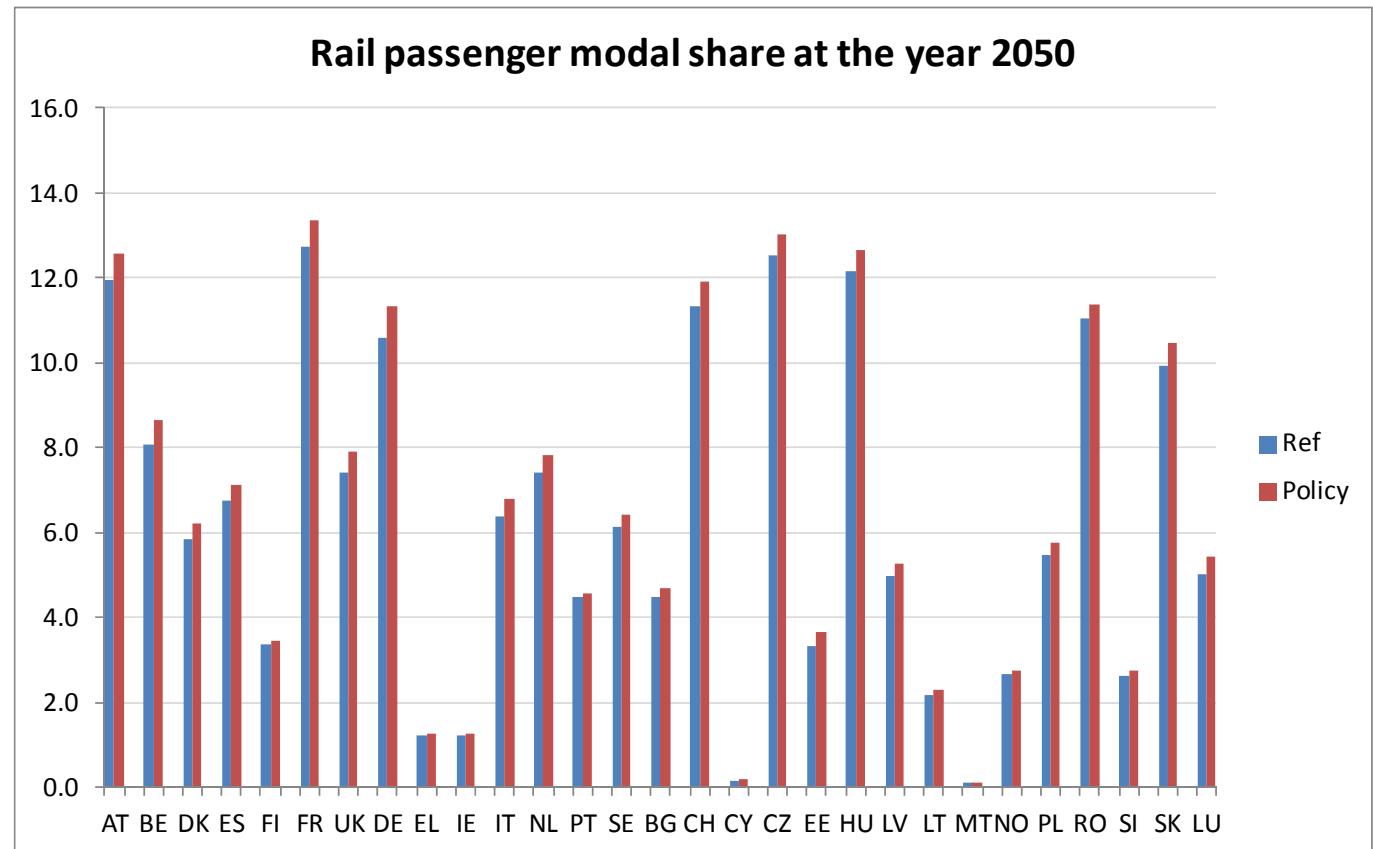
User interface

Scenario results can be read through several indicators in table, graph and map format



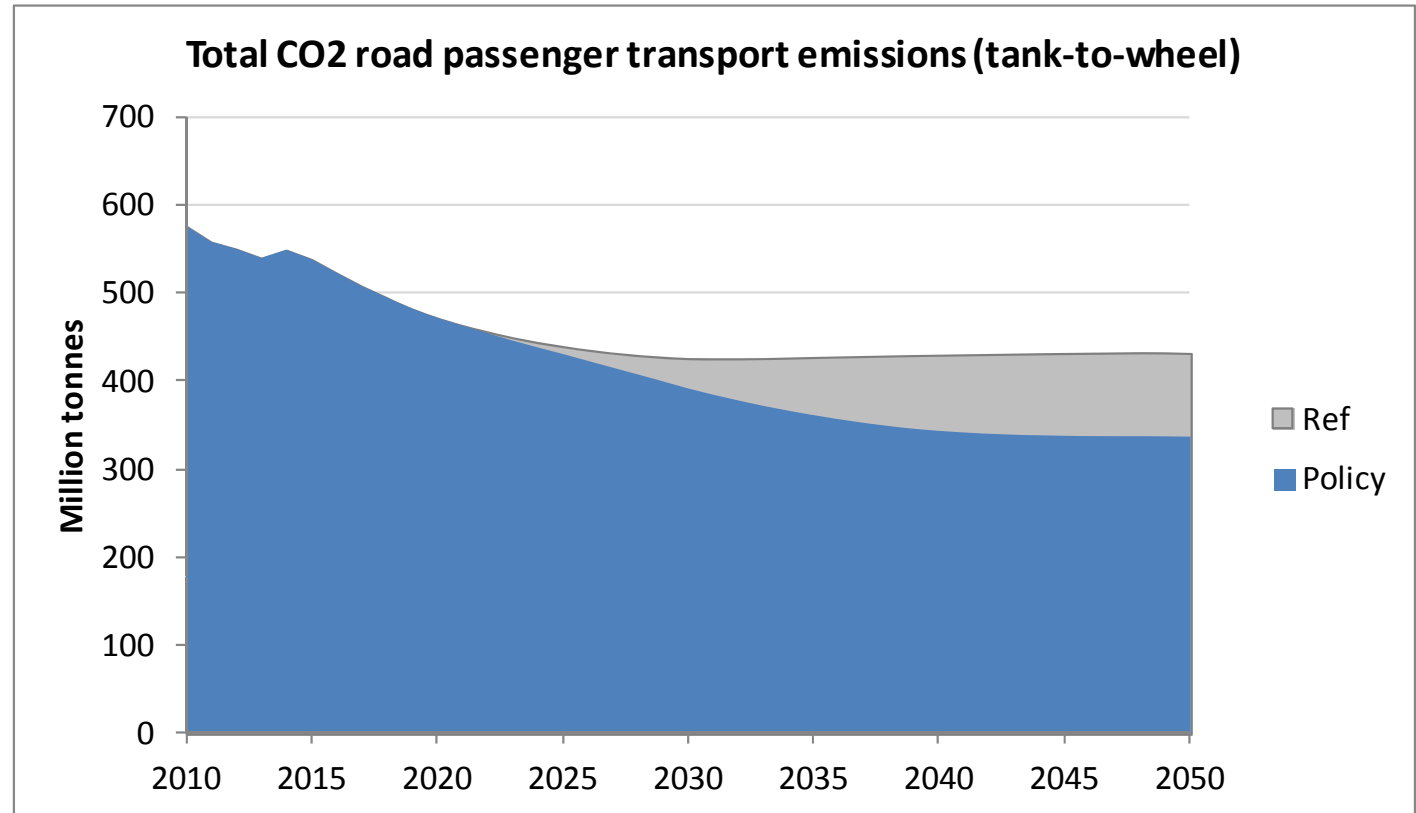
Examples of results

The impact of **liberalisation of domestic rail market** on rail mode share by country



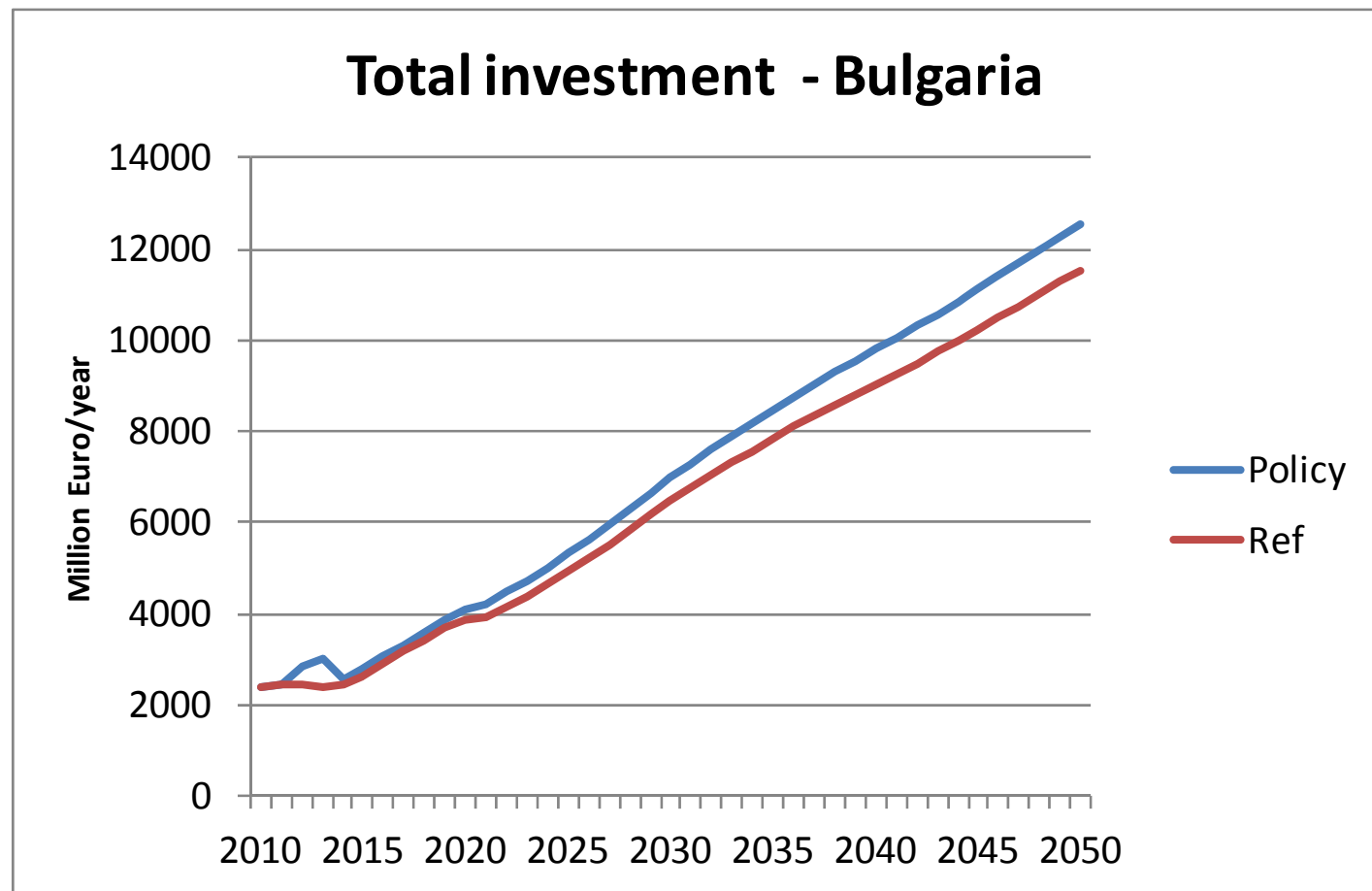
Examples of results

The impact of **CO2 emission limits** on road transport emissions



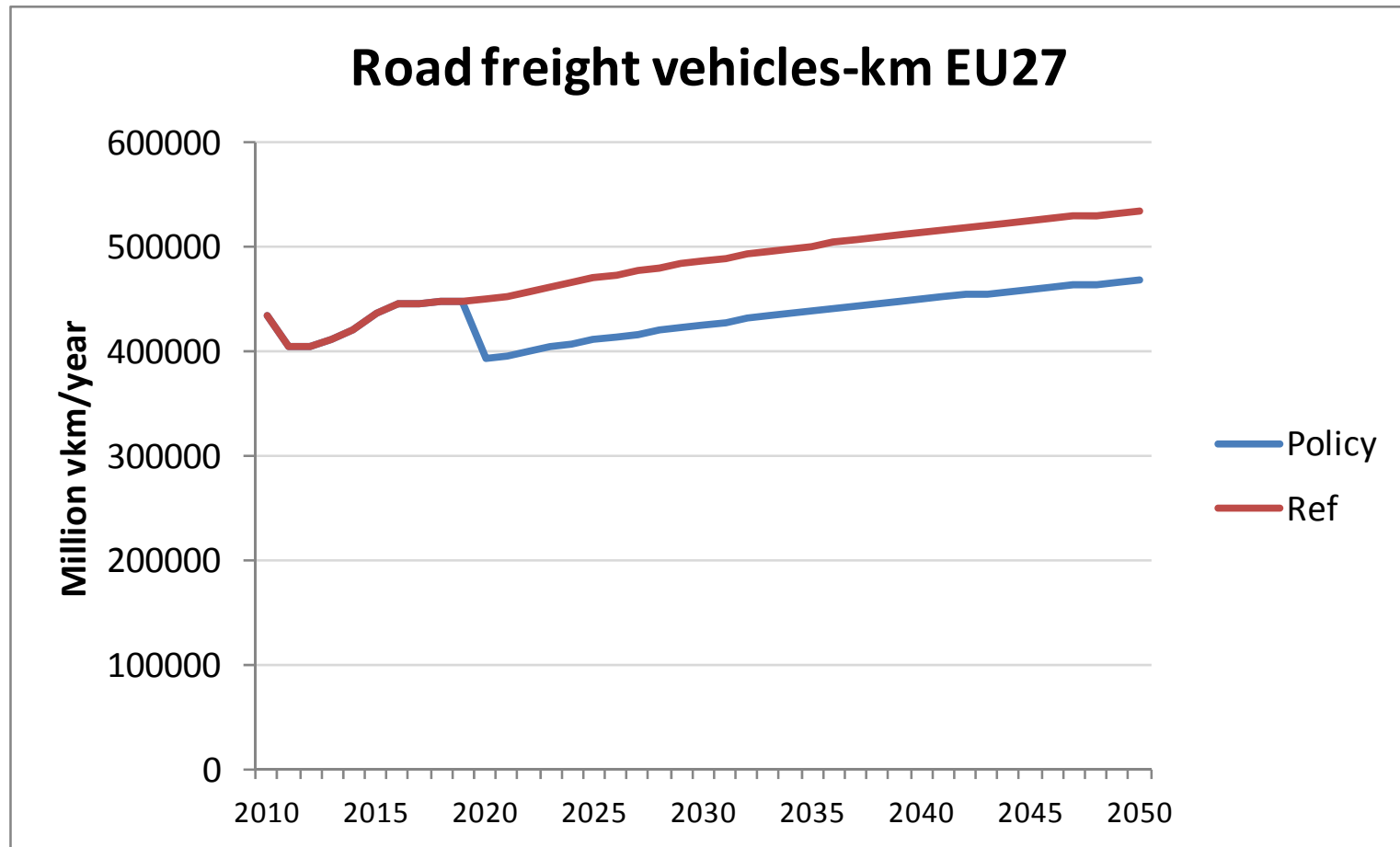
Examples of results

The impact of **Acceleration of TEN-T network completion** on investments in single countries



Examples of results

The impact of **City logistics** on road freight vehicles-km



Examples of results

The impact of **road pricing** on transport expenditure by income group

