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Regional Capacity Building Activity on Measurement of Inland Transport CO_2 Emissions and Mitigation Policies – Technical Workshop

Geneva, 8-10 October 2013

Evaluating CO_2 emissions in inland transport and climate change mitigation

ForFITS: a monitoring and assessment tool "For Future Inland Transport Systems"

The ForFITS input file and its setup for the pilot case of France

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ForFITS model: data requirements

Even if ForFITS has the capacity to adapt to different levels of data availability, the model does require a substantial amount of data, for:

- the characterization of the transport system in the base year (historical inputs)
- the definition of the context in which the transport system should evolve (projections)

Information on the initial and final times, the characterization of the areas, and the selection of the modelling approach for the powertrain choice (exogenous or endogenous), are also firm needs

Minimum data requirements (other inputs are defined by default data and can be modified)

Historical inputs

- GDP, population
- Vehicle stock: number of vehicles by powertrain, average travel and loads, average fuel consumption
- New vehicle registrations: same detail used for stocks needed for the base year, 5 and 10 years earlier (data in between are taken into account with linear interpolations)

Projections

- GDP and population
- Fuel prices (cost and taxation)
- Vehicle shares between two and three wheelers
- Pkm shares for different public transport modes (e.g. due to the construction of urban rail)
- Modal shares of light road freight vehicles
- Evolution of the network extension for pipelines
- With endogenous powertrain selection (optional), discount rate and powertrain shares

Need for coherence for inputs on each AREA, SERVICE, MODE, VEHICLE CLASS and POWERTRAIN

ForFITS model: default data

A wide set of default data are included in the ForFITS Excel file

These default data are used to characterizing several parameters of the ForFITS model

They concern the following input categories:

M Data absolutely required
Corresponding to the minimum data requirements

A Inputs expected to be introduced by the user
The default value in ForFITS is for guidance only
This category includes policy inputs that allow exploring different scenarios

B Input containing technical information (e.g. technological potential and costs by powertrain)
These data may be maintained unchanged
The defaults are set on the basis of research activities involving literature reviews and statistical analyses (further information on this is provided in the relevant section of the ForFITS manual)

C Inputs on structural characteristics of the model
Unless the users acquired significant experience with the model, these inputs shall not be modified: changes to these inputs will result in significant modifications to the model behaviour

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ForFITS model: data requirements

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Full data requirements

TIME PERIOD ANALYZED	
Initial and final projection times	
Base year and final year	
INITIAL CONDITIONS	
Initial transport system	
Vehicle stock	
Vehicles	
Number of active vehicles	M
Powertrain group shares in each vehicle class	M
Travel	
Annual travel per vehicle	M
Load	
Vehicle load	M
Fuel consumption	
Vehicle fuel consumption	M
Fuel consumption gap by powertrain group	C
New vehicle registrations	
Base year	
Vehicles	
Newly registered vehicles	M
Powertrain group shares in each vehicle class	M
Fuel consumption	
Vehicle fuel consumption	M
Fuel consumption gap by powertrain group	C
Base year-5	
Vehicles	
Newly registered vehicles	M
Powertrain group shares in each vehicle class	M
Fuel consumption	
Vehicle fuel consumption	M
Fuel consumption gap by powertrain group	C
Base year-10	
Vehicles	
Newly registered vehicles	M
Powertrain group shares in each vehicle class	M
Fuel consumption	
Vehicle fuel consumption	M
Fuel consumption gap by powertrain group	C
Economic & demographic data	
Base year	
Population	M
GDP	M
GDP deflator	M

ECONOMIC AND DEMOGRAPHIC INPUTS (PROJECTIONS)	
Economic & demographic data	
Over time	
Population growth	M
GDP growth	M
TRANSPORT SYSTEM CHARACTERISTICS	
Transport system over time	
Passenger	
Area characterization	M
Passenger transport system index	A
Environmental culture index	A
Freight	
Constant parameters	
Haul length	B
Vehicle capacity ratios	B
Load factor ratios	B
Hauls per vehicle ratios	B
Base year	
Shares of tonnes lifted by good type	M
Shares of tonnes lifted by transport distance	
Short & medium distance / all	A
Short distance / short + medium	A
Very large distance / large + very large	A
Shares of tonnes lifted by transport zone	A
Over time	
Shares of tonnes lifted by transport zone	A
Tonnes lifted by haul distance	A
Shares of tonnes lifted by good type	A
Shares of tonnes lifted by large-freight sub-mode	A
PRICES AND TAXES (BASE YEAR AND PROJECTIONS)	
Fuel prices and taxes	
Fuel cost	
Base year	M
Over time	M
Fuel taxes	
Base year	M
Over time	M
Road pricing	
Cost of vehicle-km	A
FUEL CHARACTERISTICS (BASE YEAR AND PROJECTIONS)	
Fuel characteristics: CO2 emission factors	
Base year	M
Over time	A

FUEL CONSUMPTION (PROJECTIONS)	
All modes but air, NMT and pipelines	
Fuel consumption characteristics	
Index of performance	A
Fuel consumption characteristics by powertrain	
Passenger two wheelers	B
Passenger three wheelers	B
Passenger LDVs	B
Passenger vessels	B
Passenger large road	B
Passenger rail	B
Freight two wheelers	B
Freight three wheelers	B
Freight LDVs	B
Freight vessels	B
Freight large road	B
Freight rail	B
Air transport	
Fuel consumption per km	A
Pipelines	
Energy consumption per km	A
TECHNOLOGY CHOICE (PROJECTIONS)	
Powertrain technology choice switch	
Choice switch (endogenous / exogenous)	M
Discount rate	M
A) EXOGENOUS TECHNOLOGY CHOICE INPUTS	
Powertrain technology & ICE fuel: shares	
Powertrain technology	M
ICE fuel	M
B) ENDOGENOUS TECHNOLOGY CHOICE INPUTS	
Powertrain technology & ICE fuel: availability	
Powertrain technology	M
ICE fuel	M
Vehicle costs by powertrain group	B
VEHICLE & POWERTRAIN COSTS (PROJECTIONS)	
All modes but air, NMT and pipelines	
Vehicle costs by powertrain group	
Passenger modes	A
Freight modes	A
Air transport	
Air vehicle cost (base year)	B
Air vehicle cost (over time)	B
MODAL SHARES (EXOGENOUS PROJECTIONS)	
Modal shares	
Modal shares between 2- and 3-wheelers	M
Pkm shares in public transport modes	M
Vehicle shares in light road freight modes	M

VEHICLE CLASSES (EXOGENOUS PROJECTIONS)	
Vehicle shares within modes & sub-modes	
Personal passenger two wheelers	A
Personal passenger three wheelers	A
Personal passenger LDVs	A
Personal passenger vessels	A
Public passenger NMT	A
Public passenger two wheelers	A
Public passenger three wheelers	A
Public passenger LDVs	A
Public passenger vessels	A
Public passenger large road	A
Public passenger rail	A
Air passenger	A
Medium road freight vehicles	A
Heavy road freight vehicles	A
Freight two wheelers	A
Freight three wheelers	A
Freight LDVs	A
Freight vessels (maritime/deep sea)	A
Freight rail	A
Freight air	A
Freight pipelines	A
OTHER INPUTS (PROJECTIONS)	
Pipelines	
Distance travelled/network extension	M
Crew costs	
Crew cost per day (base year)	B
Crew cost per day (over time)	A
DEMAND GENERATION PARAMETERS	
Passenger	
Drivers as fucntions of GDP per capita	
Personal passenger vehicles (PPV) per capita	C
Pkm share on PPV in PPV + public transport	C
Pkm share on air mode in total pkm	C
People per active bike	C
Personal vessels (boats) per capita	C
Environmental culture multipliers	
Personal passenger vehicles (PPV) per capita	C
Personal passenger LDVS	C
Pkm share on PPV in PPV + public transport	C
Pkm share on air mode in total pkm	C
People per active bike	C
Vehicle travel cost multipliers	
Personal passenger vehicles (PPV) per capita	C
Personal passenger LDVS	C
People per active bike	C
Personal vessels (boats) per capita	C
Elasticities as functions of GDP per capita	
Annual personal vehicle travel to cost of driving	C
Pkm on public transport vehicles to cost of driving	C
Pkm on air vehicles to cost of driving	C
Freight	
Drivers as fucntions of GDP per capita	
Share of light vehicles in total road freight	C
Elasticities	
Tkm to the cost of tkm	C
Load factors to the cost of tkm	C

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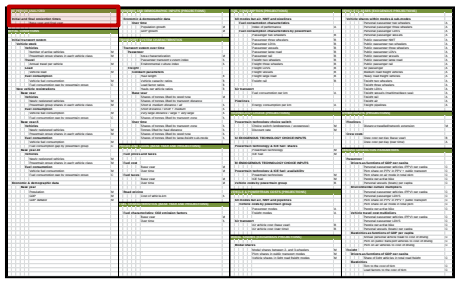
Inputs on the time period modelled



Modelling switches

Modelling switches and setup parameters

Initial and final projection times

Base year and final year

	BASE	FINAL
YEAR	2010	2040

Powertrain technology choice switch

Choice switch (endogenous / exogenous)
(either exogenous, requiring powertrain shares directly, or endogenous, requiring inputs on powertrain availability)

POWERTRAINS	endogenous (from model)

=> inputs on powertrain shares in the 'Pwtrn shares (over time)'

Discount rate
(required to perform endogenous technology choice)

Discount rate	25%

Notes on the inputs on the time period modelled

- Base year: always the same (consistency for all inputs needed)
- Inputs over time needed for the whole period
- All variables are calculated over this time period

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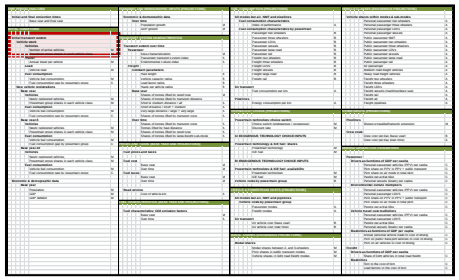
Inputs on the initial conditions (base year)

(1/3)



User inputs (BASE Y)

Number of active vehicles (vehicle stock): information for passenger and freight LDVs published by the Comité des Constructeurs Français d'Automobiles (CCFA). Distribution across vehicle classes based on a specific report of the International Energy Agency (IEA). Buses based on report for European Commission. Trucks based on assumptions checked against Eurostat data. Passenger rail based assumptions on number of trains per bus. Air: based on population and aircrafts per capita of USA.

Road: shares of vehicles in stock by powertrain based on Eurostat, CCFA and info for new registrations (e.g. IEA report) aggregated over historical years (up to 2010). Trucks and buses nearly 100% diesel. Rail: local and intercity (exclusing high speed) assumed 50% diesel and 50% electric.

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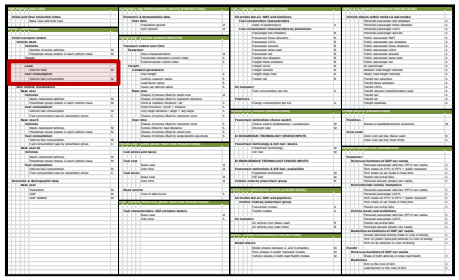
Inputs on the initial conditions (base year)

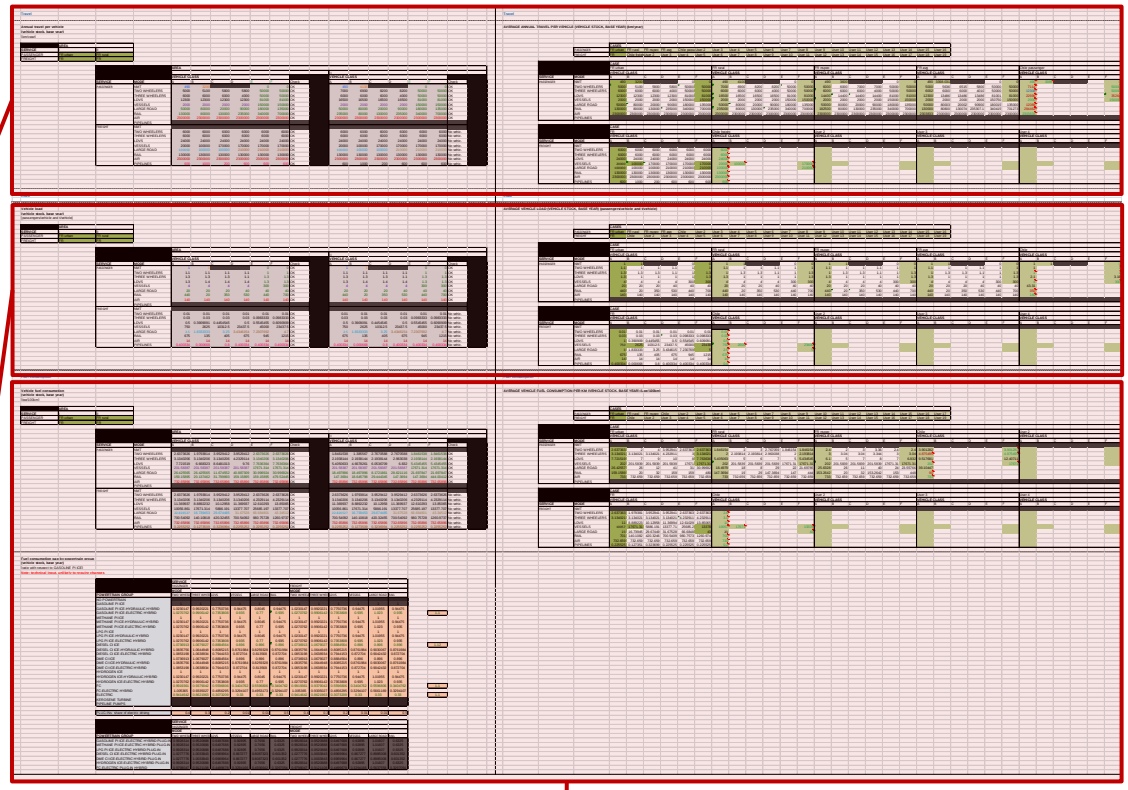
(2/3)



User inputs (BASE Y)

Vehicle travel: estimations based on assumption on speed (km/h) time of vehicle usage (hours/day and days/week), checked against statistics (e.g. from ministère du développement durable).
Continental data available in the ICCT roadmap model.

Vehicle loads: based on assumptions on load factors and information on capacity defining each class.
Continental data available in the ICCT roadmap model.



Fuel consumption per km: estimates based on detailed IEA report for LDVs, IEA publications (e.g. on energy efficiency indicators, such as IEA, 2004), IEA statistics on energy use in transport combined with vkm data, technical estimates based on published information (e.g. Kenworthy, 2003), data on new vehicle registrations and vehicle scrappage assumptions.
Continental data available in the ICCT roadmap model.

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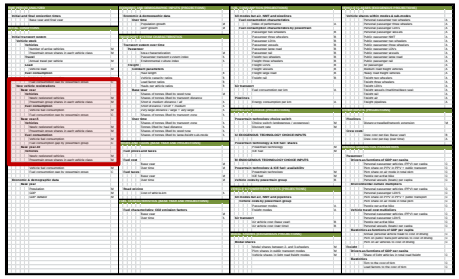
Inputs on the initial conditions (base year)

(3/3)

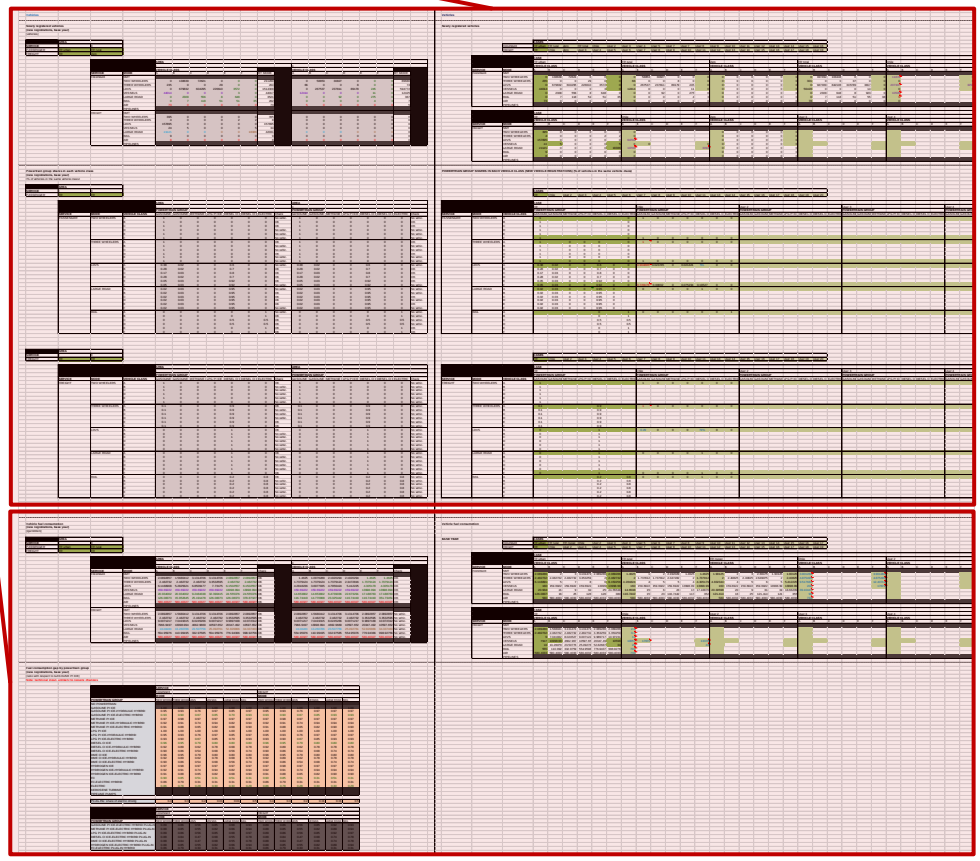


User inputs (BASE Y)

New vehicle registrations: similar tables for base year, base year-5 and base year-10

New vehicle registrations: based on assumptions on average vehicle age (by mode) and data on stock.
Road data checked against information from ACEA, EEA and Eurostat.
Base year-10 contains data representative of the earlier decade. Base year-5 averages of BY-6 to BY-4.
Shares of vehicles by powertrain based on Eurostat, ACEA, IEA report and assumptions (non-road modes).

Fuel consumption per km: estimates based on detailed IEA report for LDVs, IEA publications (e.g. on energy efficiency indicators, such as IEA, 2004), other published information (e.g. EEA, ministère du développement durable).
Ratios amongst fuel consumption per km different powertrains based on technical estimates.
This sort of information may be available from energy efficiency agencies (e.g. ADEME, in France), energy efficiency databases (e.g. ODYSEEE, in Europe) and analyses of environmental NGOs dealing with transport (e.g. ICCT and T&E).
Continental data available in the ICCT roadmap model.



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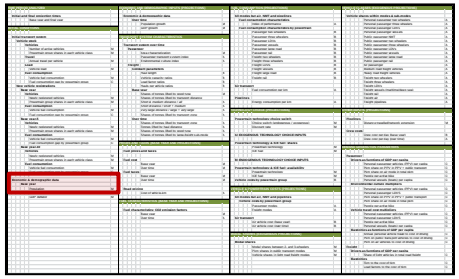
Economic and demographic data (base year)



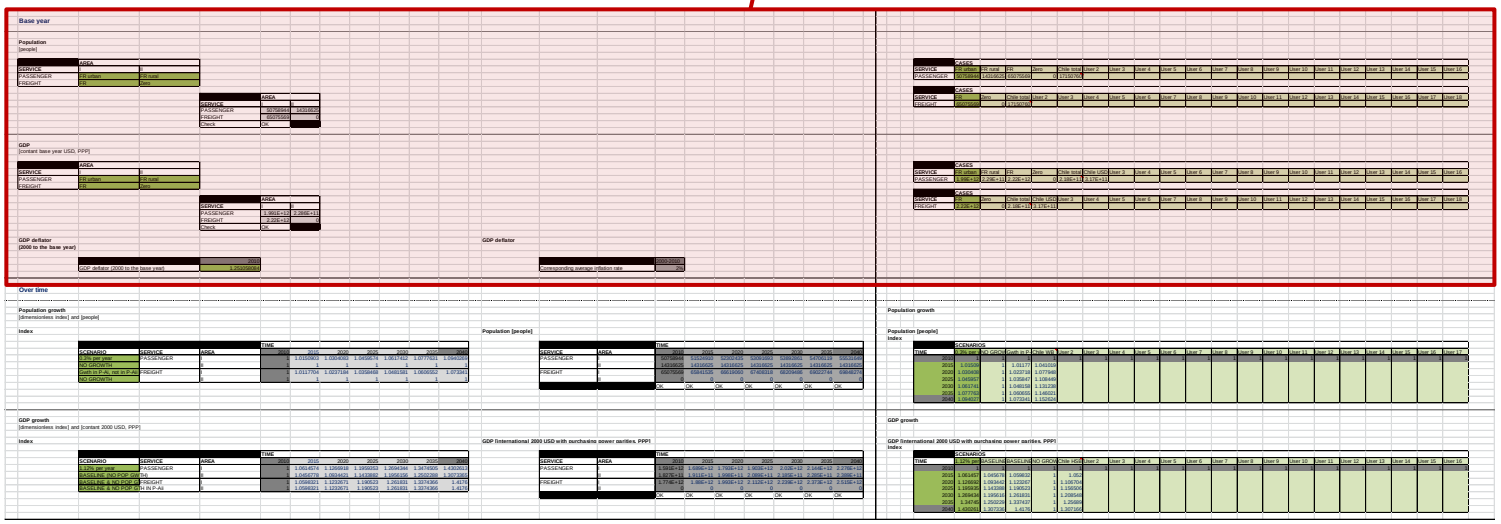
Socio-economic data

BASE YEAR

Population (and urban share): data from World Bank, also available from UN

GDP: data from OECD statistics; urban vs. rural ratio assumed (improvement needed)

Information typically available from national statistical offices (INSEE for France)



PROJECTIONS

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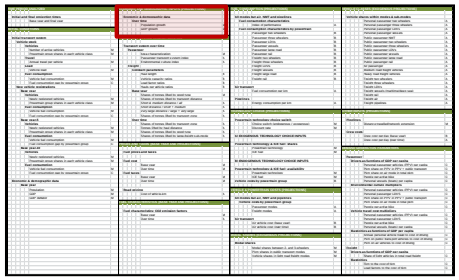
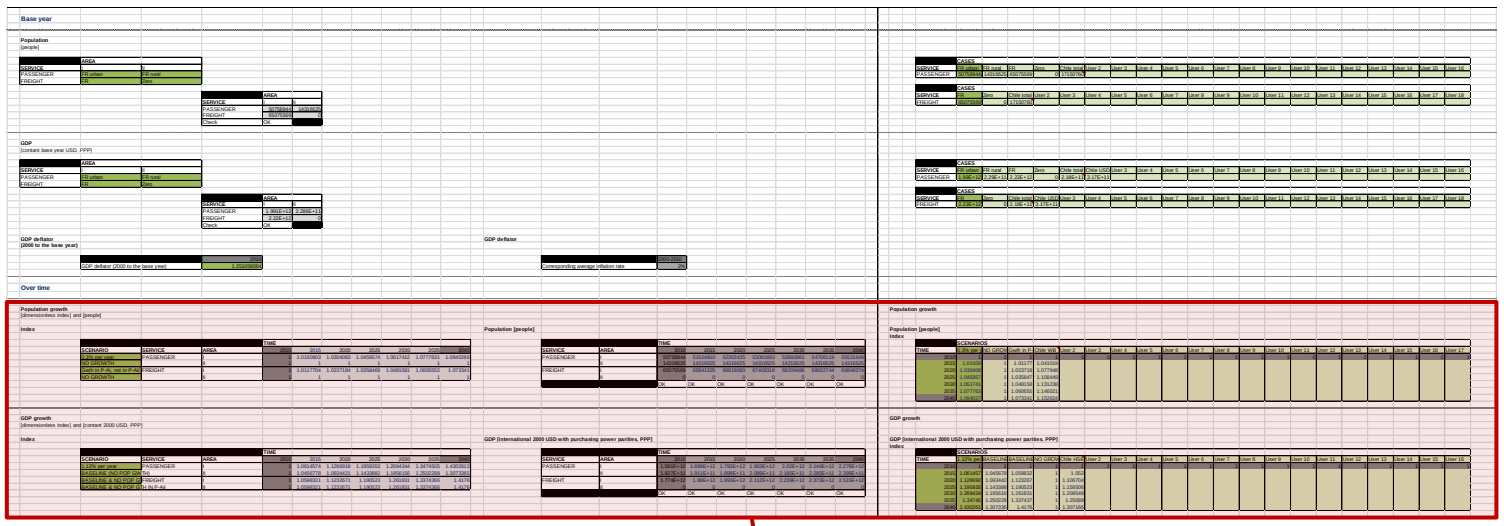
Economic and demographic data (projections)



Socio-economic data

BASE YEAR



PROJECTIONS
Population: currently based on assumptions. Population projections available from UN and other sources (see GDP)
GDP: currently based on assumptions. Projections available from specific studies from banks (e.g. HSBC), international organizations (e.g. OECD), consulting companies (e.g. pwc)

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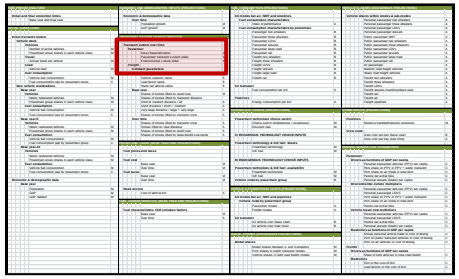
Passenger transport system over time



Transport system (over time)

Area characterization
Urban, non-urban, or non specified

Passenger transport system index
0 Focus on personal vehicles, low density of population, significant presence of urban sprawl, horizontal urban development
1 Very high density of population, strong focus on public transport, geographcal and other constraints leading to the vertical development of the urban area

Passenger transport system index in the base year

Area characterization
[switch]

Selection switches	SERVICE	AREA	
	PASSENGER	URBAN	NON-URBAN

Note
Inputs characterizing each area affect the way the way other aprameters are affected by changes in key modelling inputs having an impact on demand generation and modal choice

Passenger transport system index
[index]

Variation index

SCENARIO	AREA	TIME 2010	2015	2020	2025	2030	2035	2040
CONSTANT	I	1	1	1	1	1	1	1
CONSTANT	II	1	1	1	1	1	1	1

Explanatory table for index values

0	Focus on personal vehicles, low density of population, significant presence of urban sprawl, horizontal urban development
1	Very high density of population, vers strong focus on public transport, geographical and other constraints leading to the vertical development of the urban area

Examples:

0 to 0.3	Rural areas, low-density cities (e.g. urban areas with significant sprawl, frequent in North American cities)
0.6 to 0.8	Densely populated areas (e.g. dense cities in Asia)

Passenger transport characteristic index [values from 0 to 1]

AREA	2010	2015	2020	2025	2030	2035	2040
I	0.58	0.556181	0.556181	0.556181	0.556181	0.556181	0.556181
II	0.08	0.063654	0.063654	0.063654	0.063654	0.063654	0.063654
	OK	OK	OK	OK	OK	OK	OK

Passenger transport system index

Variation index

TIME	SCENARIOS CONSTAN	GROWING	User 2	User 3	User 4	User 5
2010	1	1	1	1	1	1
2015	1	1.043097				
2020	1	1.086194				
2025	1	1.129291				
2030	1	1.172388				
2035	1	1.215485				
2040	1	1.258582				

Environmental culture index
[index]

Variation index

SCENARIO	SERVICE	AREA	TIME 2010	2015	2020	2025	2030	2035	2040
CONSTANT	PASSENGER	I	1	1	1	1	1	1	1
CONSTANT		II	1	1	1	1	1	1	1

Explanatory table for inputs

0	Low "environmental culture"
1	High "environmental cultyer"
0.5	initial value by default (the user can cgange it)

Environmental culture index [values from 0 to 1]

SERVICE	AREA	TIME 2010	2015	2020	2025	2030	2035	2040
PASSENGER	I	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	II	0.5	0.5	0.5	0.5	0.5	0.5	0.5
		OK	OK	OK	OK	OK	OK	OK

Variation index

TIME	SCENARIOS CONSTAN	GROWING	User 2	User 3	User 4	User 5
2010	1	1	1	1	1	1
2015	1	1.166667				
2020	1	1.333333				
2025	1	1.5				
2030	1	1.666667				
2035	1	1.833333				
2040	1	2				

Environmental culture index: behavioural aspects, initialized to 0.5 in the base year
0 → Low "environmental culture"; 1 → High "environmental culture"

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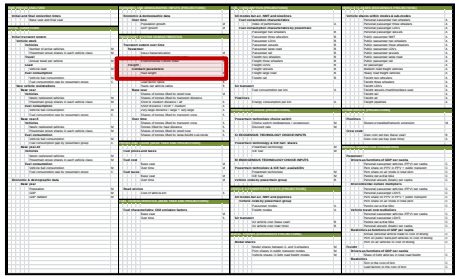
Freight transport system over time
Constant values

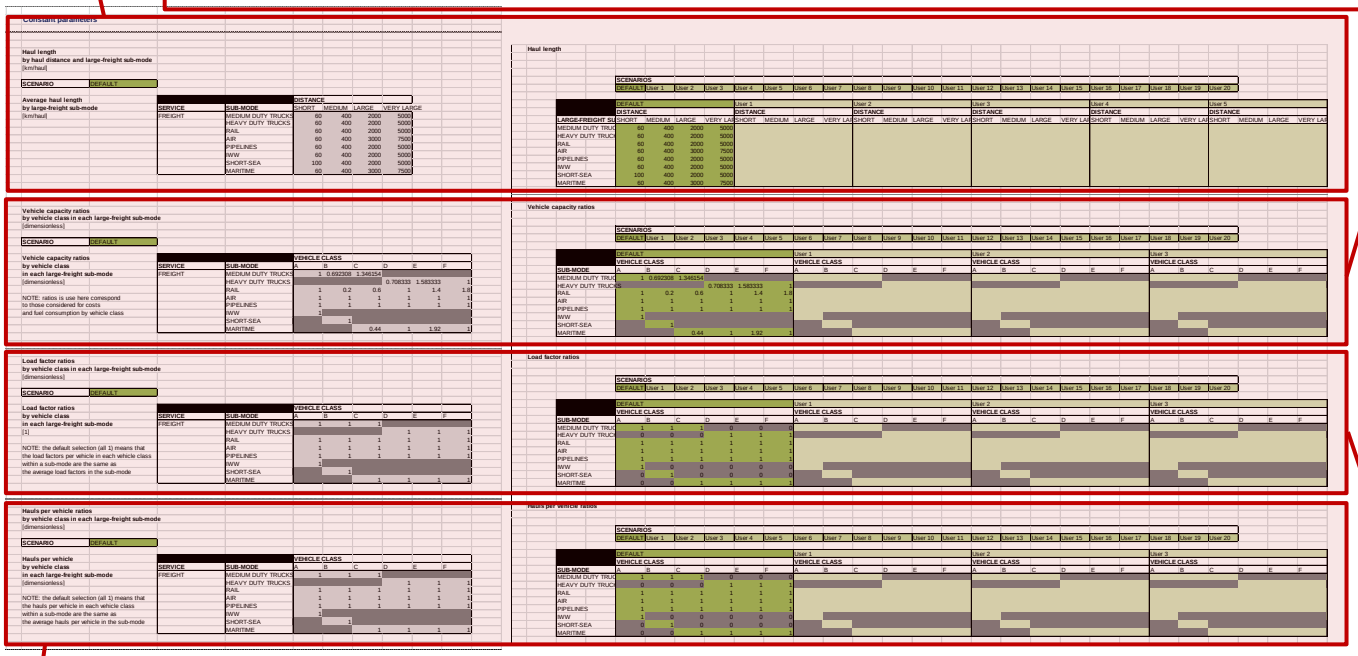
(1/3)



Transport system (over time)

Haul length: defined as average distance for each large-freight sub-mode

Vehicle capacity ratios: defined by default according to the default vehicle classification. Vehicles in classes A (and sometimes F) represent the average of each large-freight sub-mode and are used as reference for the ratio (value = 1)



Load factor ratios: currently assumed = 1 to reflect the same load factor in all classes

Hauls per vehicle ratios: currently assumed = 1 to reflect the same hauls in all classes

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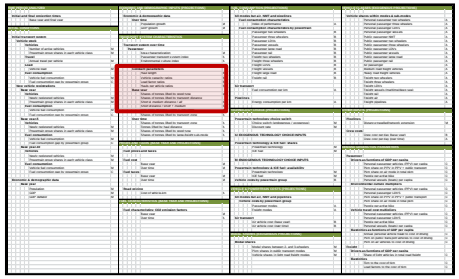
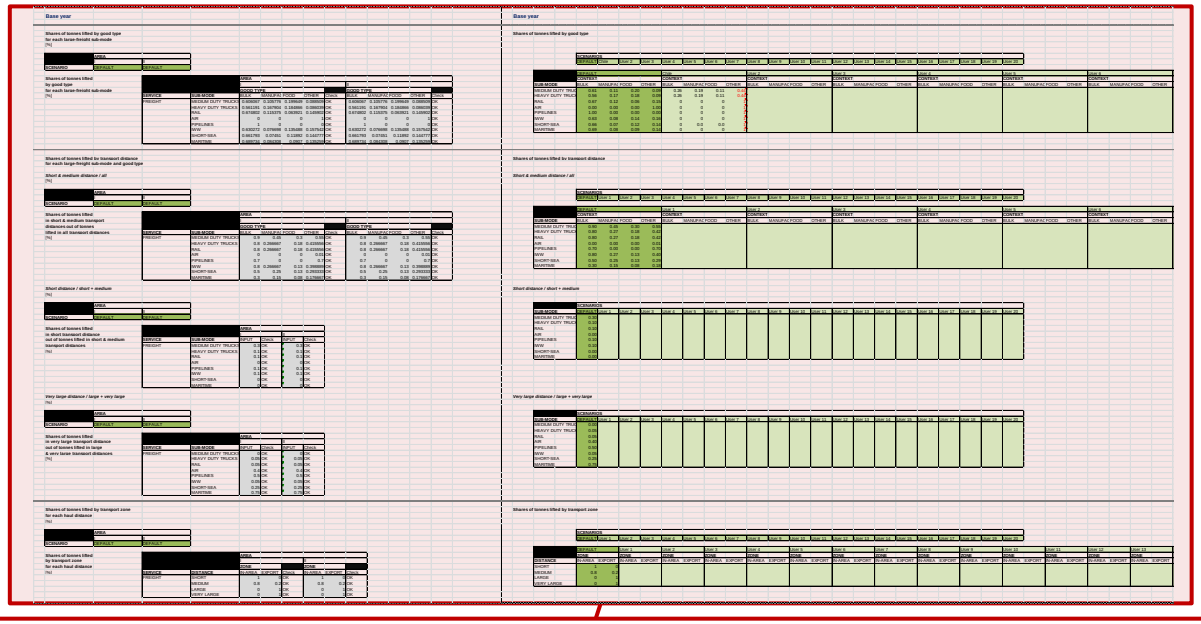
Freight transport system over time

Base year

(2/3)



Transport system (over time)



Shares defining the structure of the freight transport system in the base year

- tonnes lifted by good type
- transport distance, divided amongst: a) short & medium distance transport in all large-freight transport, b) short distance in short + medium, c) very large distance in large + very large
- transport zone, to take into account the relevance of imports and exports with respect to local consumption

Information based on Eurostat data (EU averages). This can be improved using French data

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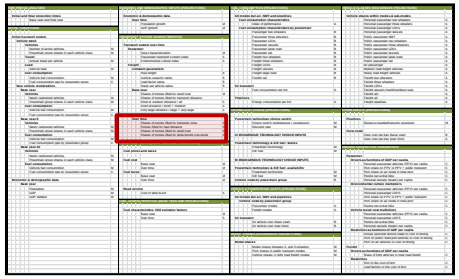
Freight transport system over time

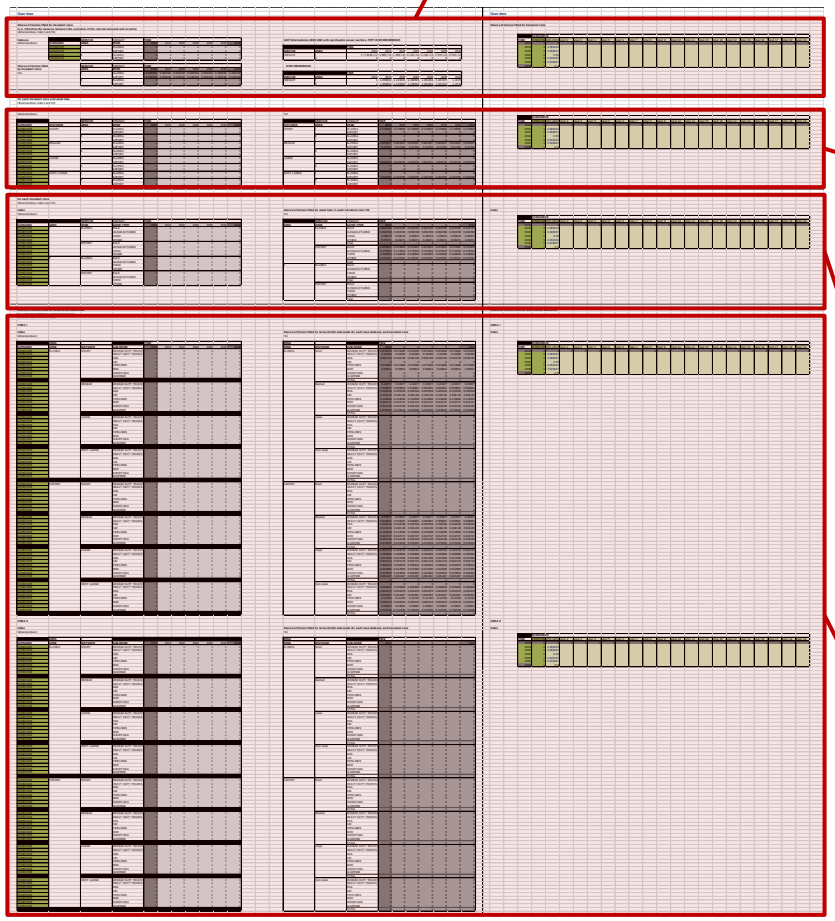
Over time

(3/3)



Transport system (over time)

Evolution of the shares of tonnes lifted by transport zone (reflecting the balance between the evolution of the internal demand and exports)



Scenario-related inputs
Reference data are constant by default

Evolution of shares of tonnes lifted by haul distance for each area and transport zone (reflecting higher/lower importance of different haul distance, e.g. to mimic growth in local sourcing)
Policy input

Shares of tonnes lifted by good type (reflecting changes in the structure of the economy, such as shift from primary materials to manufactured goods)

Shares of tonnes lifted by large-freight sub-mode (reflecting changes in the competitiveness of different large- freight sub-modes over other options)

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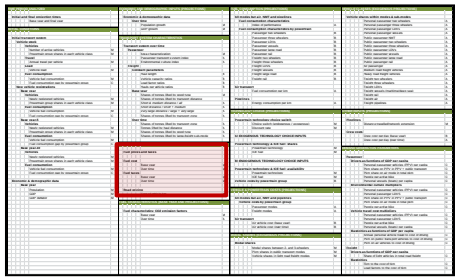
Prices and taxes (projections)



User inputs (over time)

Fuel costs before taxes: calculated ion the basis of cost after tax and tax rates
Information available from IEA statistics on energy prices and taxes and GIZ (international fuel prices and taxes)

Cost per vkm due to taxation that is specific to each vkm by road modes
Zero by default (no road pricing)
Need for weighted averages to be properly working

Fuel taxation: available from IEA statistics on energy prices and taxes and GIZ (international fuel prices and taxes)
Information on fuel prices also available from national energy-related institutions (e.g. authorities, commissions)

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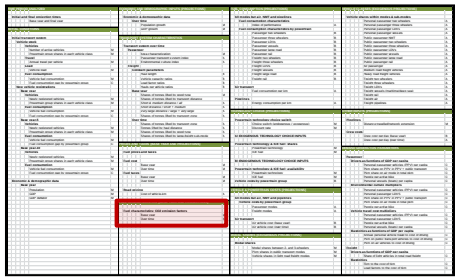
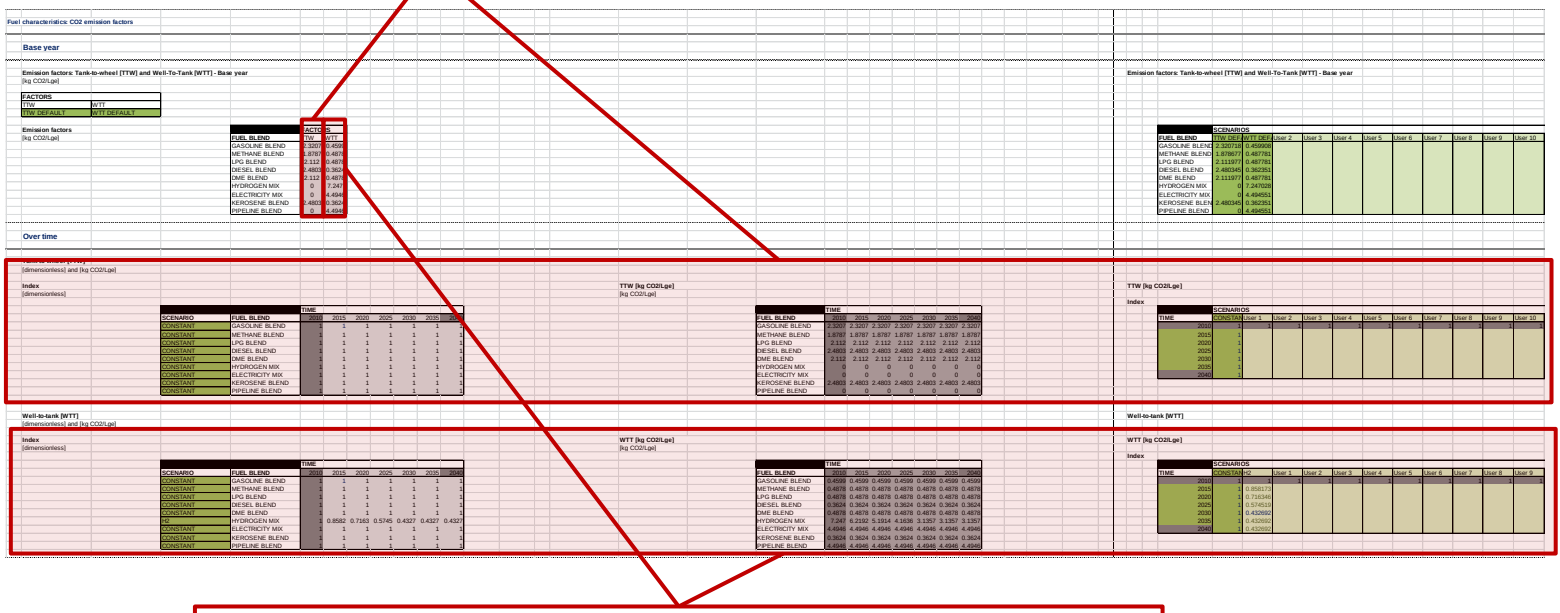
Fuel characteristics (base year and projections)



User inputs (over time)

Tank-To-Wheel (TTW)
Base year data based on IPCC emission factors
Projections: scenario-related inputs



Well-To-Tank (WTT)
Need for data referring to fuel blends, not specific fuels
This means that emission factors shall take into account for expected alternative fuel shares in projections
Current defaults refer to conventional fuels

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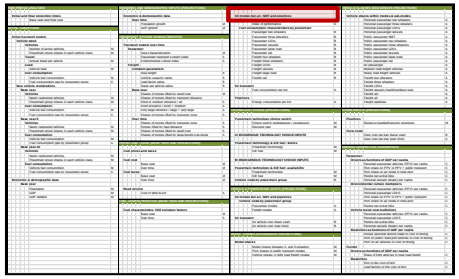
Index of performance



User inputs (over time)

- Needed to consider cases where the fuel consumption reduction potential is partly used to increase vehicle performance
- It can be based for instance on the expected evolution of vehicle power over time
- By default, this is set to remain constant

Index of performance
(excluding air, NMT and pipelines)

Index
[dimensionless]

			TIME						
SCENARIO	SERVICE	MODE	2010	2015	2020	2025	2030	2035	2040
CONSTANT	PASSENGER	TWO WHEELERS	1	1	1	1	1	1	1
CONSTANT		THREE WHEELERS	1	1	1	1	1	1	1
CONSTANT		LDVS	1	1	1	1	1	1	1
CONSTANT		VESSELS	1	1	1	1	1	1	1
CONSTANT		LARGE ROAD	1	1	1	1	1	1	1
CONSTANT		RAIL	1	1	1	1	1	1	1
CONSTANT	FREIGHT	TWO WHEELERS	1	1	1	1	1	1	1
CONSTANT		THREE WHEELERS	1	1	1	1	1	1	1
CONSTANT		LDVS	1	1	1	1	1	1	1
CONSTANT		VESSELS	1	1	1	1	1	1	1
CONSTANT		LARGE ROAD	1	1	1	1	1	1	1
CONSTANT		RAIL	1	1	1	1	1	1	1

Index of performance

Index

	SCENARIOS																				
TIME	CONSTAN	GROWING	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	User 10	User 11	User 12	User 13	User 14	User 15	User 16	User 17	User 18	User 19	User 20
2010	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2015	1	1.033333																			
2020	1	1.066667																			
2025	1	1.1																			
2030	1	1.133333																			
2035	1	1.166667																			
2040	1	1.2																			

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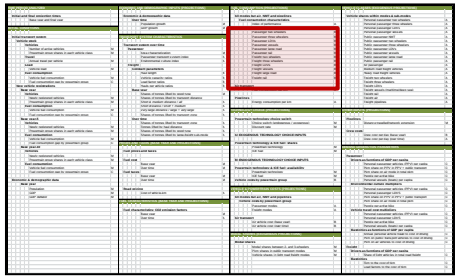
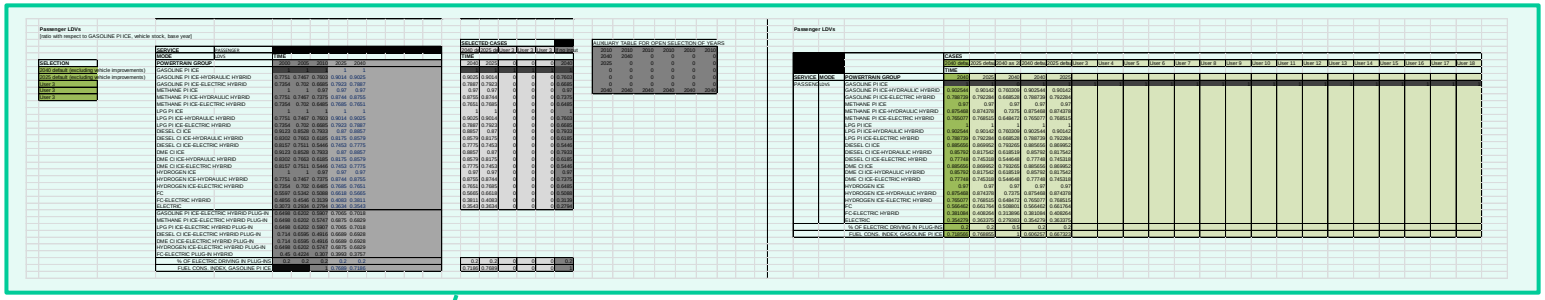
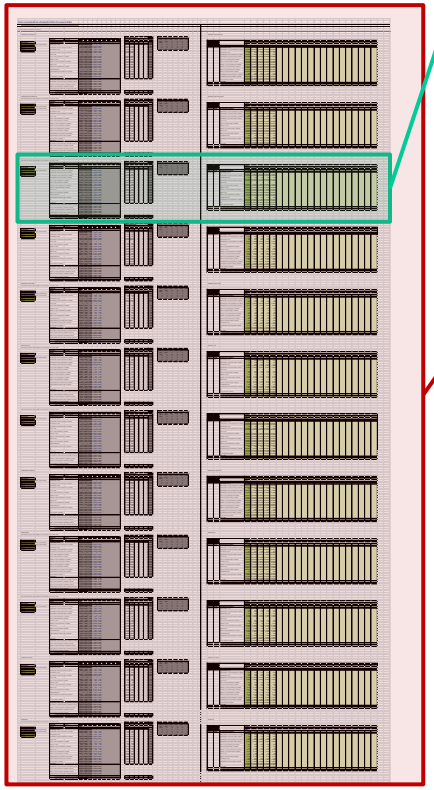
Fuel consumption characteristics by powertrain



Pwtrn potential





Fuel consumption evolution by service, mode and powertrain
Tables containing information on the energy saving potential of each powertrain technology

- Comparative index with reference technology (GASOLINE PI ICE)
- Index to consider evolution of GASOLINE PI ICE technology due to technology-specific improvements over time
- For plug-ins, information on the share of electric driving (reflecting battery capacity)

Default assumptions are based on a large amount of published information and coupled with vehicle costs: see UNECE, 2012 (Tables 7 and 8)

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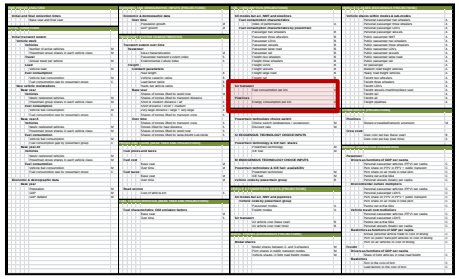
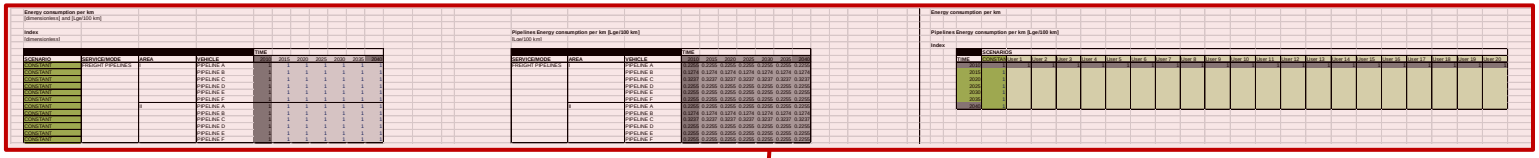
Fuel consumption projections
Air and pipelines



User inputs (over time)

Air transport: base year consumption entered as part of the base year information
Projections of fuel consumption per km entered here, through an index
Default scenarios include constant values and evolution along the trend of the past decade
Other technical estimates (e.g. based on literature assessing the fuel consumption of aircrafts) are appropriate



Pipelines: base year consumption entered as part of the base year information
Projections of fuel consumption per km entered here, through an index
Default evolution: constant values of consumption per km
Other technical estimates would be appropriate
Note: for pipelines, each cubic metre transported is considered as a "vehicle". Fuel consumption values should refer to the movement of this unit over 100 km

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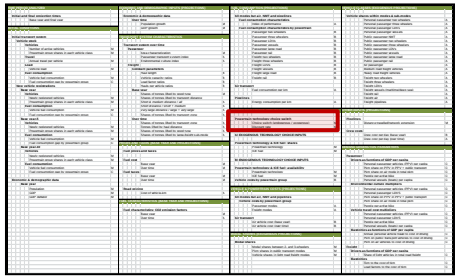
Powertrain technology choice switch



Modelling switches

Modelling switches and setup parameters

Initial and final projection times

Base year and final year

	BASE	FINAL
YEAR	2010	2040

Powertrain technology choice switch

Choice switch (endogenous / exogenous)
(either exogenous, requiring powertrain shares directly, or endogenous, requiring inputs on powertrain availability)

POWERTRAINS	endogenous (from model)

=> inputs on powertrain shares in the 'Pwtrn shares (over time)'

Discount rate
(required to perform endogenous technology choice)

Discount rate	25%

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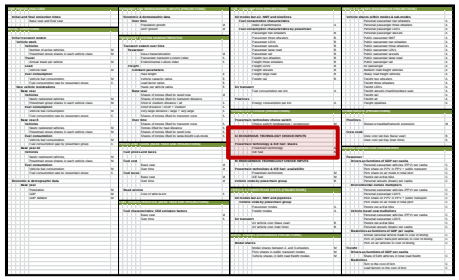
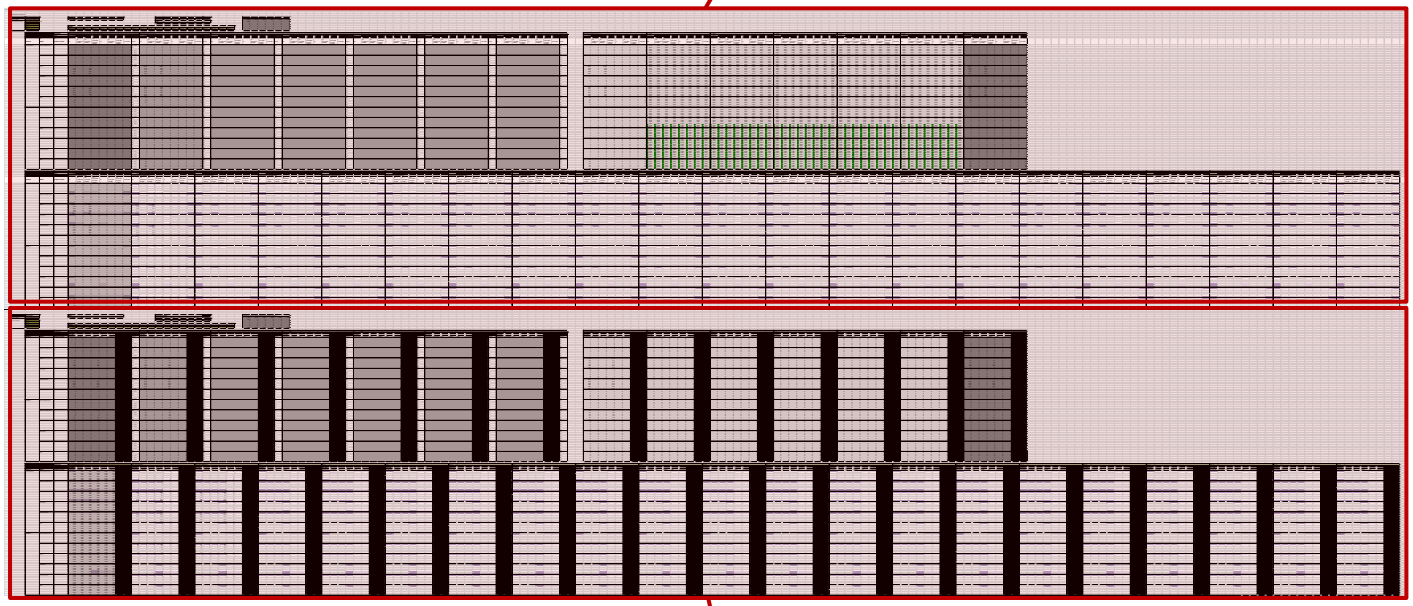
Powertrain technology & ICE fuel: shares



Pwtrn shares

Direct input of powertrain shares (EXOGENOUS POWERTRAIN CHOICE)
Region-specific inputs depend on local characteristics and user-driven scenarios
Default available: constant shares (base year shares self-calculated with other user inputs)

Powertrain technology
ICE, ICE-HYDRAULIC HYBRID, ICE-ELECTRIC HYBRID, ICE-ELECTRIC PLUG-IN HYBRID, fuel cell (FC), FC-ELECTRIC HYBRID, FC-ELECTRIC PLUG-IN HYBRID, ELECTRIC



ICE fuel: inputs on shares of ICE powertrains by fuel (GASOLINE, METHANE, LPG, DIESEL, DME, HYDROGEN)

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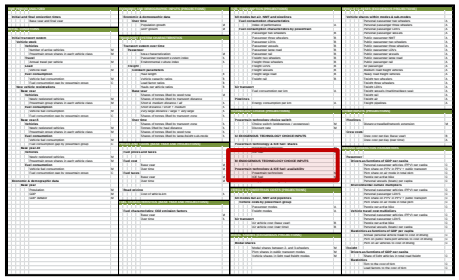
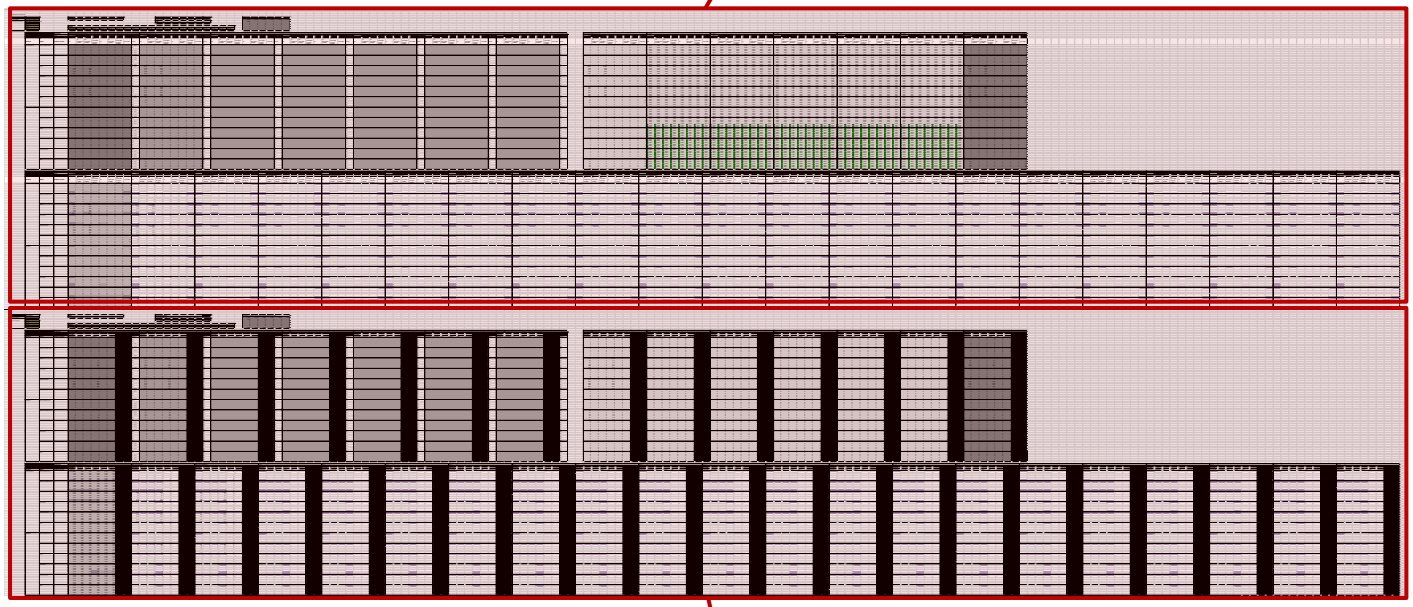
Powertrain technology & ICE fuel: availability



Pwtrn availability

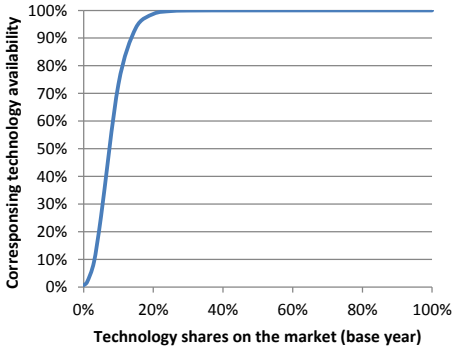
ENDOGENOUS POWERTRAIN CHOICE, same structure of Pwtrn shares
Region-specific inputs depend on local characteristics and user-driven scenarios
Default available: full availability, double than base year

Powertrain technology
ICE, ICE-HYDRAULIC HYBRID, ICE-ELECTRIC HYBRID, ICE-ELECTRIC PLUG-IN HYBRID, fuel cell (FC), FC-ELECTRIC HYBRID, FC-ELECTRIC PLUG-IN HYBRID, ELECTRIC



ICE fuel: inputs on shares of ICE powertrains by fuel (GASOLINE, METHANE, LPG, DIESEL, DME, HYDROGEN)

Availability: default values for the base year based on the curve below (roughly estimated with values for hybrids and diesels)



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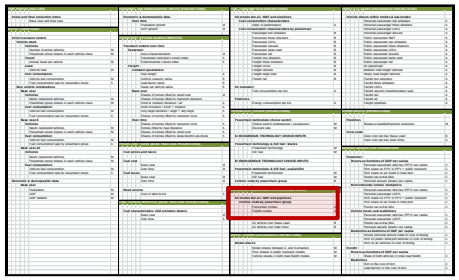
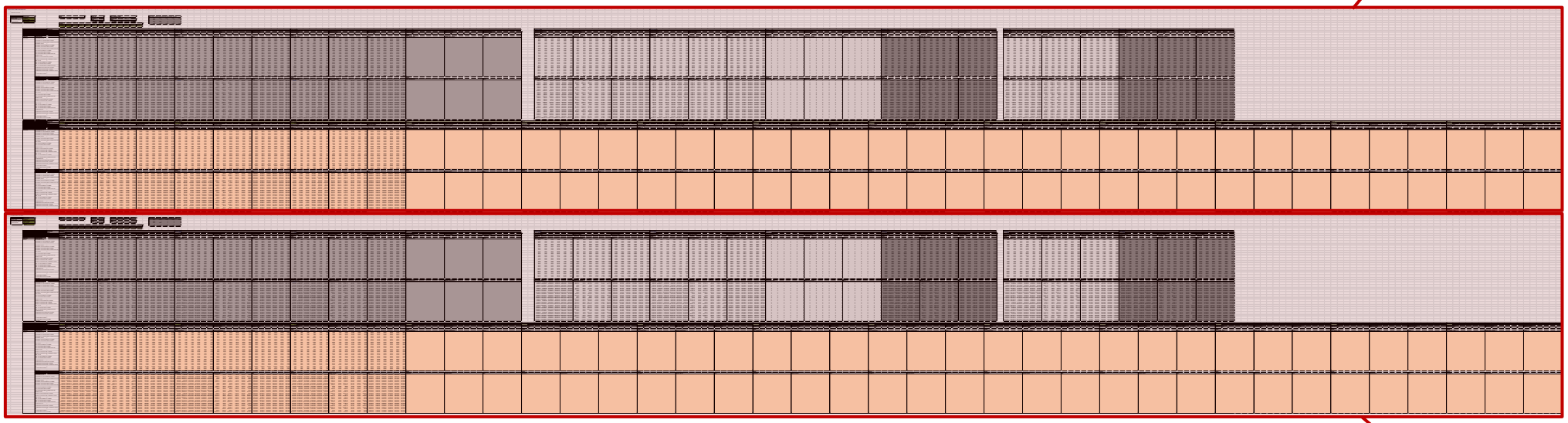
Powertrain cost



Cost inputs by pwtrn

Most complex input tables
Contains information on costs , linked to information on potentials
All powertrain technologies included
All data are based on technical estimates, suitable for developed countries (default values based on technical assessments available for developed countries): see UNECE, 2012 (Tables 7 and 8), for reference on sources used
Costs may be lower in developing countries, for the same potentials (labour cost difference, possibility to take advantage of technologies already exploited at large scale level)

Passenger vehicles



Freight vehicles

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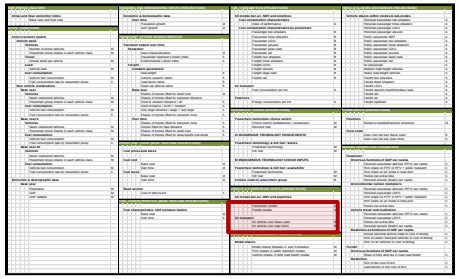
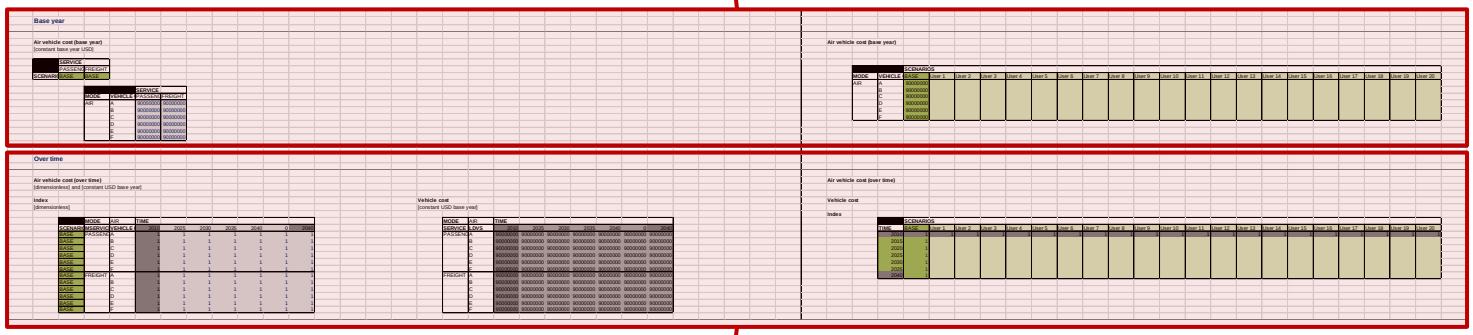
Air vehicle costs



Other costs

- To be associated with technological potential for fuel savings in aviation
- Currently not characterized beyond information on the order of magnitude of the cost of an airplane (based on figures released by the main aviation companies for civil aircrafts)

Base year



Projections (constant by default)

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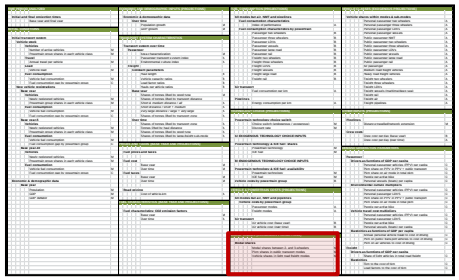
Modal shares

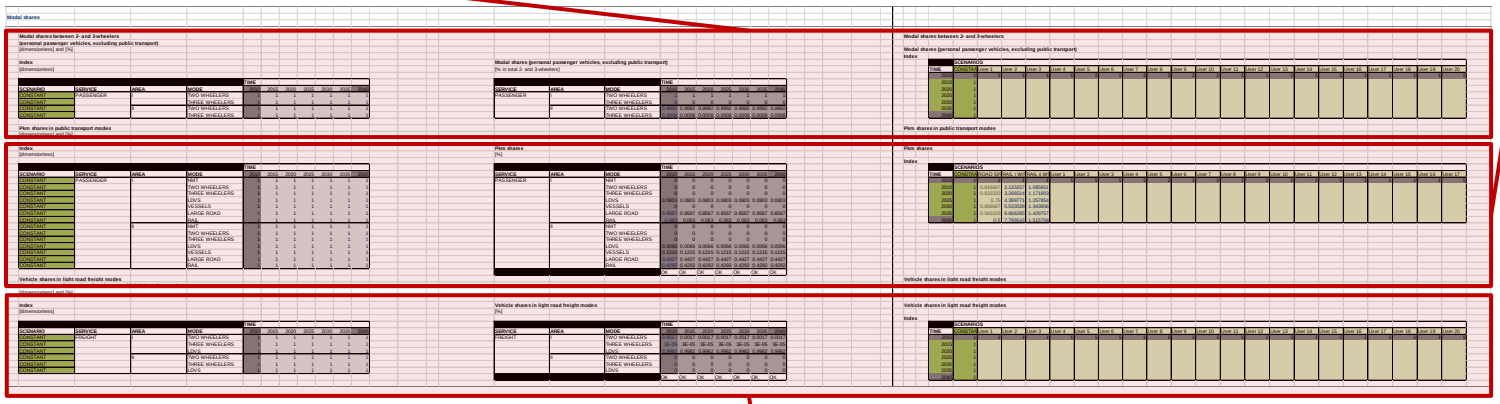


User inputs (over time)

Needed to characterize modes beyond the detail achieved in the demand generation module

Modal shares between 2- and 3-wheelers

Pkm shares in public transport modes



Vehicle shares in light road freight modes

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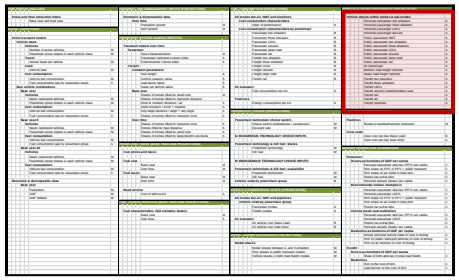
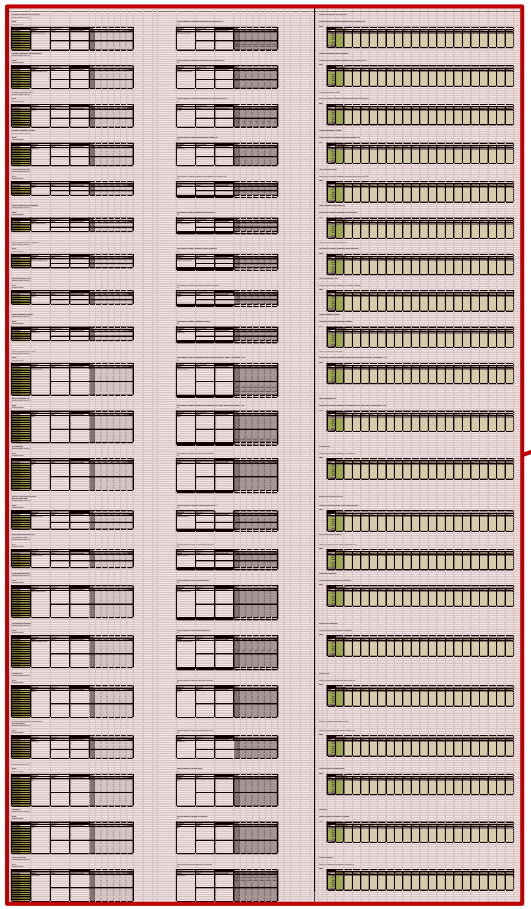
Vehicle shares



User inputs (over time)

Needed to characterize vehicle classes beyond the detail achieved in the demand generation module



Personal passenger two wheelers
Personal passenger three wheelers
Personal passenger LDVs
Personal passenger vessels
Public passenger NMT
Public passenger two wheelers
Public passenger three wheelers
Public passenger LDVs
Public passenger vessels
Public passenger large road
Public passenger rail
Air passenger
Medium road freight vehicles
Heavy road freight vehicles
Freight two wheelers
Freight three wheelers
Freight LDVs
Freight vessels (maritime/deep sea)
Freight rail
Freight air
Freight pipelines

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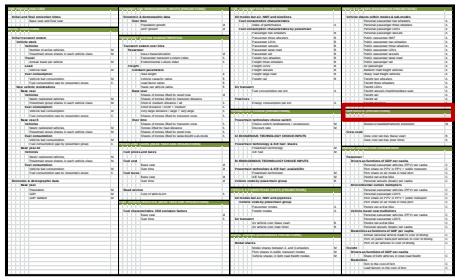
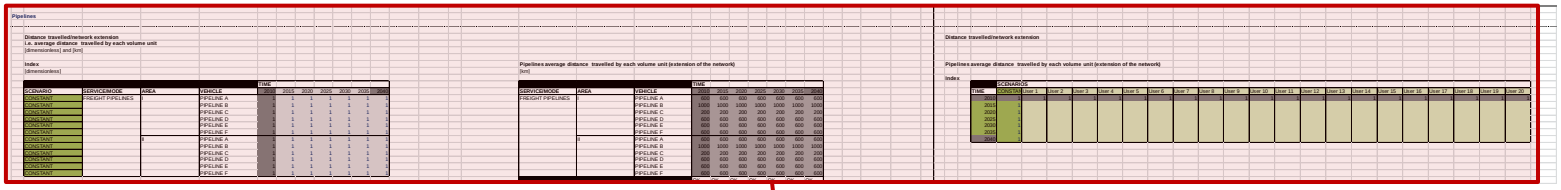
Pipelines: distance travelled/network extension



User inputs (over time)



Pipelines: distance travelled/network extension
Evolution of the average distance travelled by each volume unit transported by pipeline
Base year data entered earlier ('User inputs (BASE Y)' tab).

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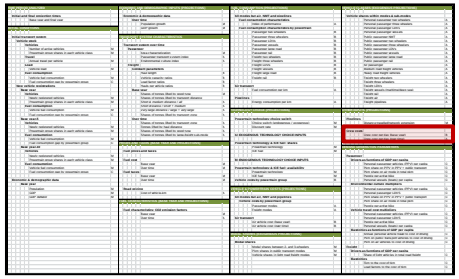
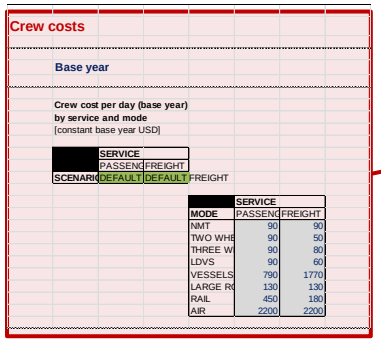
Crew costs



Other costs



Crew costs

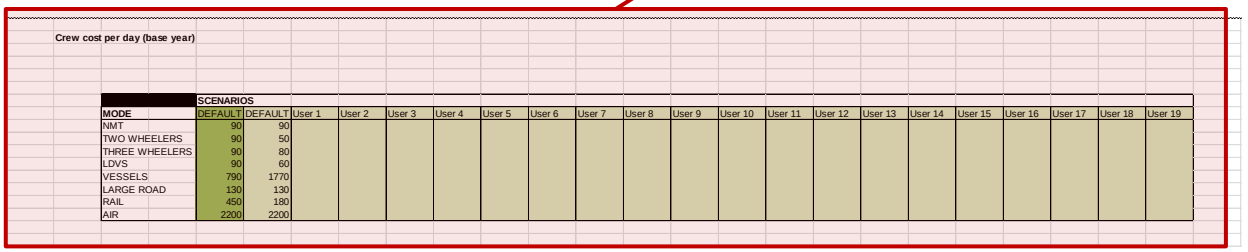
Base year

Crew cost per day (base year)
by service and mode
[constant base year USD]

	SERVICE	
SCENARIO	PASSENG DEFAULT	FREIGHT DEFAULT

	SERVICE	
MODE	PASSENG	FREIGHT
NMT	90	90
TWO WHE	90	50
THREE W	90	80
LDVS	90	60
VESSELS	790	1770
LARGE R	130	130
RAIL	450	180
AIR	2200	2200

Default data containing assumptions on the average cost per day of crew costs, considering an indicative number of people in the crew for public transport and air transport vehicles and an indicative gross salary per month.
Defaults are calibrated on an estimation of likely European values.



Crew cost per day (base year)

	SCENARIOS																				
MODE	DEFAULT	DEFAULT	User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	User 10	User 11	User 12	User 13	User 14	User 15	User 16	User 17	User 18	User 19
NMT	90	90																			
TWO WHEELERS	90	50																			
THREE WHEELERS	90	80																			
LDVS	90	60																			
VESSELS	790	1770																			
LARGE ROAD	130	130																			
RAIL	450	180																			
AIR	2200	2200																			

Over time

Crew cost per day (over time)
by service and mode
[dimensionless] and [constant USD base year]

Index
[dimensionless]

SCENARIO	SERVICE	MODE	TIME						
			2010	2015	2020	2025	2030	2035	2040
BASE	PASSENG	NMT	1	1	1	1	1	1	1
BASE		TWO WHE	1	1	1	1	1	1	1
BASE		THREE W	1	1	1	1	1	1	1
BASE		LDVS	1	1	1	1	1	1	1
BASE		VESSELS	1	1	1	1	1	1	1
BASE		LARGE RO	1	1	1	1	1	1	1
BASE		RAIL	1	1	1	1	1	1	1
BASE		AIR	1	1	1	1	1	1	1
BASE	FREIGHT	NMT	1	1	1	1	1	1	1
BASE		TWO WHE	1	1	1	1	1	1	1
BASE		THREE W	1	1	1	1	1	1	1
BASE		LDVS	1	1	1	1	1	1	1
BASE		VESSELS	1	1	1	1	1	1	1
BASE		LARGE RO	1	1	1	1	1	1	1
BASE		RAIL	1	1	1	1	1	1	1
BASE		AIR	1	1	1	1	1	1	1

Crew cost per day [constant USD base year]
[constant USD base year]

SERVICE	MODE	TIME						
		2010	2015	2020	2025	2030	2035	2040
PASSENG	NMT	90	90	90	90	90	90	90
	TWO WHE	90	90	90	90	90	90	90
	THREE W	90	90	90	90	90	90	90
	LDVS	90	90	90	90	90	90	90
	VESSELS	790	790	790	790	790	790	790
	LARGE RO	130	130	130	130	130	130	130
	RAIL	450	450	450	450	450	450	450
	AIR	2200	2200	2200	2200	2200	2200	2200
FREIGHT	NMT	90	90	90	90	90	90	90
	TWO WHE	50	50	50	50	50	50	50
	THREE W	80	80	80	80	80	80	80
	LDVS	60	60	60	60	60	60	60
	VESSELS	1770	1770	1770	1770	1770	1770	1770
	LARGE RO	130	130	130	130	130	130	130
	RAIL	180	180	180	180	180	180	180
	AIR	2200	2200	2200	2200	2200	2200	2200

Crew cost per day (over time)

Crew cost per day [constant USD base year]

Index

TIME	SCENARIOS																			
	BASE	User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8	User 9	User 10	User 11	User 12	User 13	User 14	User 15	User 16	User 17	User 18	User 19
2010	1																			
2015	1																			
2020	1																			
2025	1																			
2030	1																			
2035	1																			
2040	1																			

Crew cost per day over time
Evolution of the crew cost over time (e.g. due to changes in labour cost and income profiles)
Not a major transport input, maintained constant (in constant prices) by default

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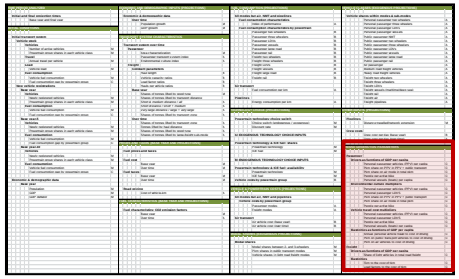
Demand generation control parameters



Data in the sheet **Demand generation parameters**

They include information on the faimilies of driving curves used in the model (e.g. for vehicle ownership) and on all elasticities.

Passenger

- Drivers as functions of GDP per capita

Personal passenger vehicles (PPV) per capita, pkm share on PPV in PPV + public transport, pkm share on air mode in total pkm, people per active bike, personal vessels (boats) per capita

- Environmental culture multipliers

Personal passenger vehicles (PPV) per capita, PP LDVS, pkm share on PPV in PPV + public transport, pkm share on air mode in total pkm, people per active bike

- Vehicle travel cost multipliers

Personal passenger vehicles (PPV) per capita, personal passenger LDVS, people per active bike, personal vessels (boats) per capita

- Elasticities as functions of GDP per capita

Annual personal vehicle travel to cost of driving, pkm on public transport vehicles to cost of driving, pkm on air vehicles to cost of driving

Freight

- Drivers as functions of GDP per capita: share of light vehicles in total road freight
- Elasticities: tkm to the cost of tkm, load factors to the cost of tkm