TREMOVE model details

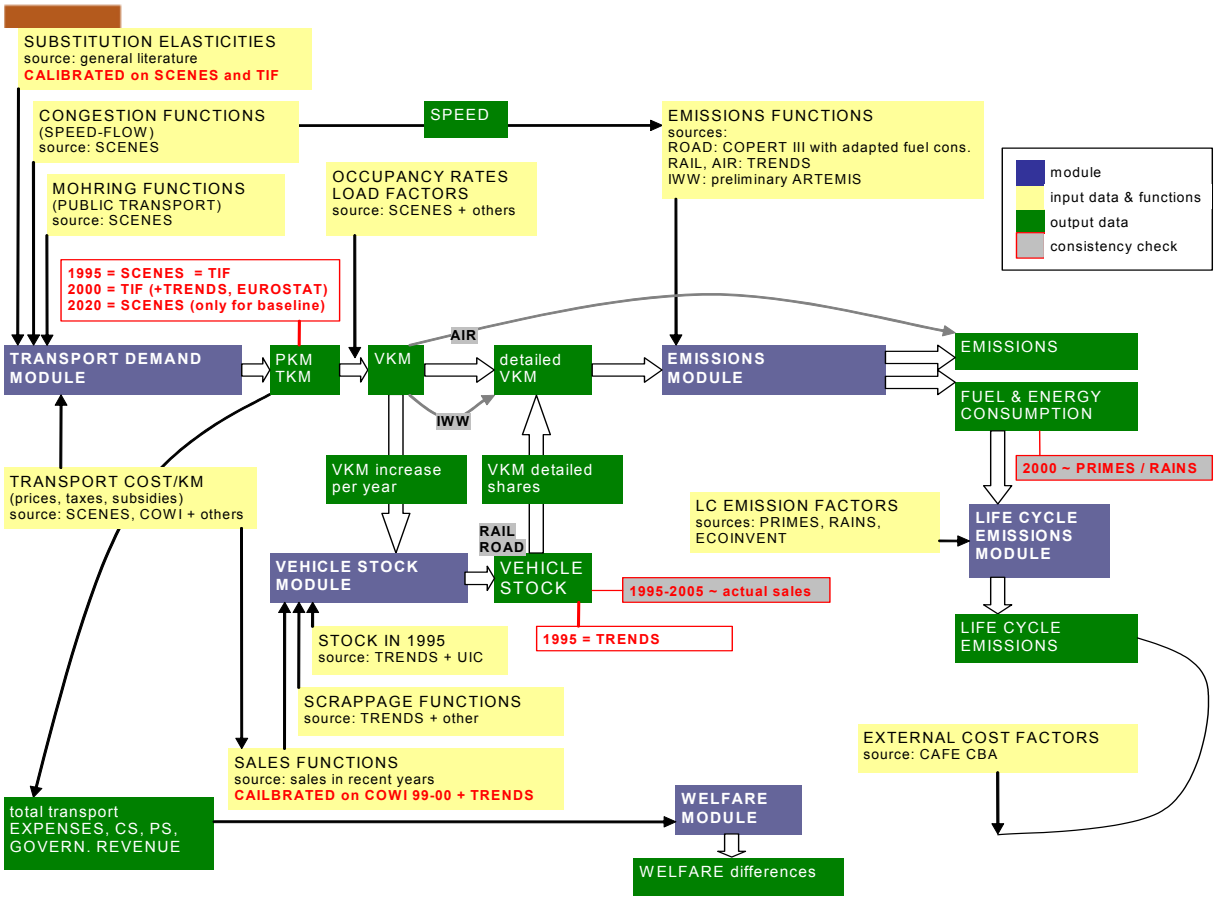
Focus on changes v2.44 -> v2.50

Code simplifications

Extended Simulation capabilities

Bart Van Herbruggen

TRANSPORT & MOBILITY LEUVEN



Interaction modules

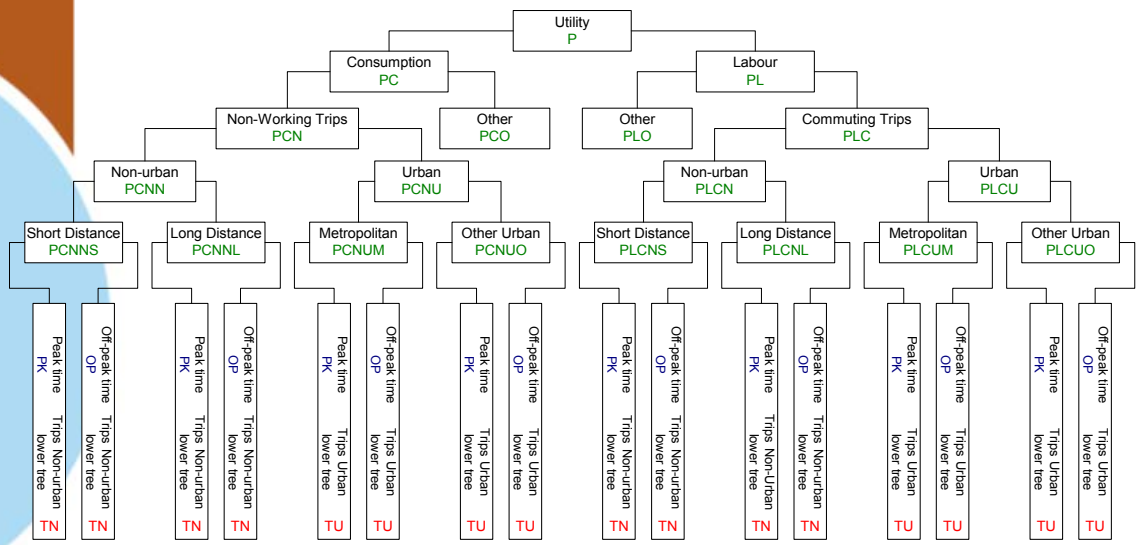
Simplified interaction between demand and vehicle stock modules

- Interaction parameters and code lines reduced with approx. 50%
- Idem for .gdx exchange files

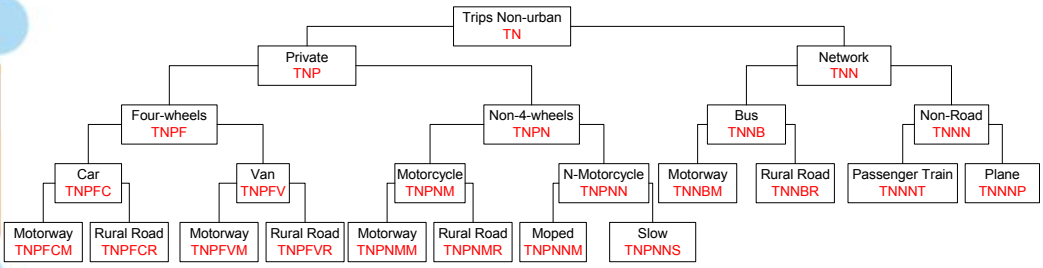
Restructured CES trees

1. No subnodes (no exogenous splits), substitution processes modelled endogenous between all nodes of the trees
   E.g. Car/LDV; moped/motorcycle; train/metro&tram
2. Full consistency with categorisation in vehicle stock module

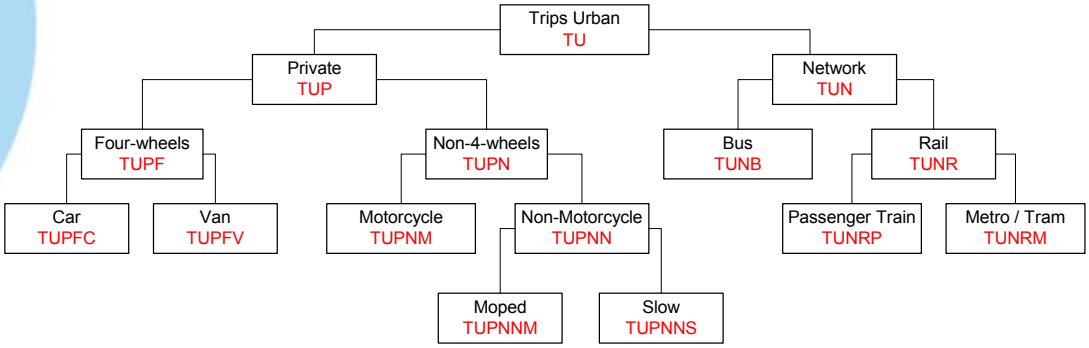
PRIVATE TRANSPORT: UPPER TREE



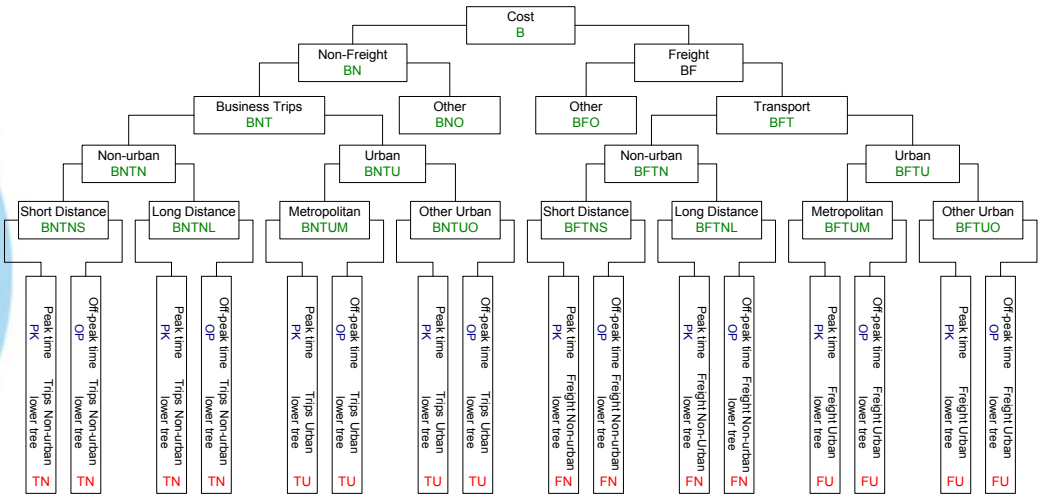
LOWER TREE: TRIPS NON-URBAN



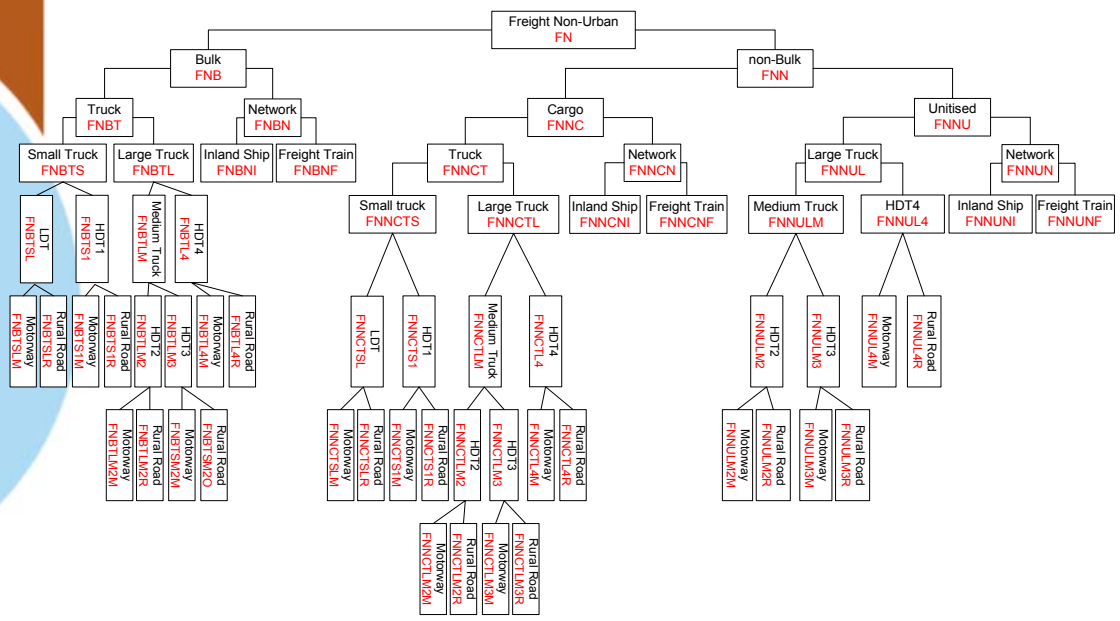
LOWER TREE: TRIPS URBAN



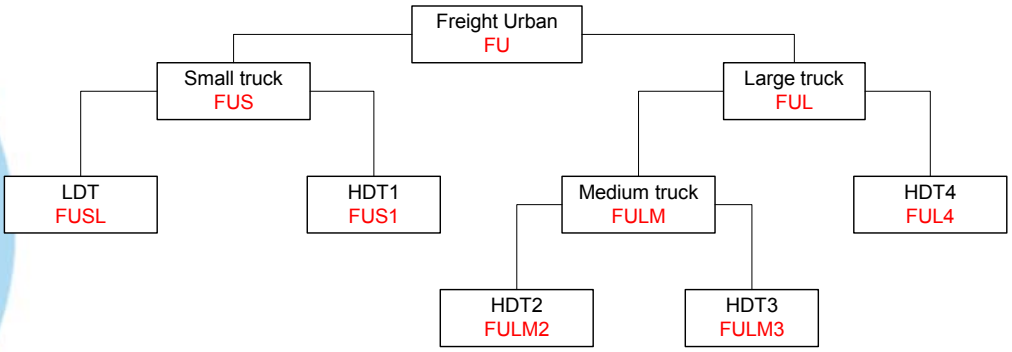
UPPER TREE: BUSINESS



LOWER TREE: FREIGHT NON-URBAN



LOWER TREE: FREIGHT URBAN



Restructured CES trees

3. 4 heavy truck types (HDT) are now separate categories in demand module
   - All road occupancy and load factors now modelled in demand module
   - Substitution between truck types (based on generalised price changes) is modelled endogenous
   - No separate coding for trucks in vehicle stock (coding lines reduced by 25%) – All road modes now use exactly the same code

Restructured CES trees

4. Separate modelling for VAN and Light Duty Truck (LDT)
   - Split of N1 transport in passenger and freight
   - Substitution endogenous between VAN and CAR
   - Substitition endogenous between LDT and small HDT categories
   - Separate gen. price modelling for VAN and LDT
   - Separate logit purchase choice model for VAN and LDT (same coëfficients, but other prices)

   - This does not lead to extra code lines, just a restructuring of the set definitions in GAMS

Restructured CES trees

5. Joined metro and tram categories

   - Distinction metro vs tram is difficult to make, different in each city, data unavailabilities

   - Endogenous modelling substitution metro/tram vs bus vs train
     - No exogenous split train vs metro vs tram

   - Joint modelling of frequency and occupancy in demand module (Mohring effect)

   - Default energy consumption factor can be altered easy by user (e.g. city case study)

   - Simplification instead of unnecessary complexity
   - Easier introduction of data from other transport models

Restructured CES trees

6. Joined bus and coach categories

- Distinction bus vs coach is difficult to make and different in national fleet and activity statistics
- Bus and coach modelled together in demand and vehicle stock module
- Split to COPERT bus (3) and coach (3) types only made in emissions module – default split can be adapted by user
- Simplification instead of unnecessary complexity
- Easier introduction of data from other transport models

Restructured CES trees

7. Joined small and large car categories

- Choice between all car types modelled in one discrete sales choice logit in vehicle stock module
- Ability to include utility change from e.g. downsizing policies is lost
- Simplification instead of unnecessary complexity
- Easier introduction of data from other transport models

BPR congestion function

- Tested different functional forms on :
  - Applicability for aggregate region (> 1 link)
  - Enabling marginal external cost calculation (slope)
  - Input data available from transport models (as SCENES)
  - Easy calibration (31 countries * 4 road types * 36 years)
- Bureau of Public Roads (USA)

BPR congestion function

$$T(q) = T_f \cdot \left(1 + \alpha \cdot \left(\frac{q}{C}\right)^{\beta}\right)$$

α : parameter that is standard taken as 0.15
β : parameter that is standard taken as 4

q : flow, available from SCENES (peak and off-peak)
T(q) : travel time, available from SCENES (peak and off-peak

Peak and off-peak equations enable to calibrate :

T_f : the free flow travel time
C : the capacity

Infrastructure charging

- Road charge input parameter – EURO per vkm
  - By category
  - By road type
  - By peak versus off-peak
  - By year
- Baseline = ASSESS Partial B Scenario
  - Tax for road trucks on motorways
  - Current : Existing taxes (EUROVIGNET, Maut, Road tolls France, Switzerland, …)
  - 2010-2020-2030 : Distance based taxes
- Can be easily adapted for infra. charging simulations
- Fleet statistics/Copert 3 <> 16 Ton
  - Suggestion for FLEETS project : <> 12 ton

Money price components

1. Money price (excl. network tax)

   Split up in « Money price components »

2. Network tax
3. Travel time price
4. Waiting time price

Money price components

V2.44 Private road modes (excl. HDT) :

By type	By category	By node
Detailed calculation by •Vehicle type •Vehicle vintage	Fix cost Fix tax Fix VAT Variable cost Variable tax Variable VAT	Money price

Reported in pivot table

Money price components

V2.50 Private road modes (excl. HDT) :

By type	By category	By node
Detailed calculation by •Vehicle type •Vehicle vintage	Purchase cost Purchase VAT Registration tax Ownership tax Insurance cost Insurance tax Repair/maint. cost Repair/maint. Tax Fuel cost Fuel tax Fuel VAT	Money Price

Reported in pivot table

Money price components

V2.44 Heavy duty trucks :

By type	By category (2)	By node
Detailed calculation by •Vehicle type •Vehicle vintage *Only fuel*	Fuel cost Fuel tax Other cost = SCENES tariff – fuel cost&tax – network tax	Money Price = *SCENES tariff – network tax* Large Trucks Small trucks

Reported in pivot table

Money price components

V2.50 Heavy duty trucks :

By type (4)	By category (4)	By node
Detailed calculation by •Vehicle type •Vehicle vintage *All components*	Purchase cost Registration tax Ownership tax Insurance cost Insurance tax Repair/maint. Cost Repair/maint. tax Fuel cost Fuel tax Driver labour cost Driver labour tax **Other cost =** **SCENES tariff** **– fuel cost&tax** **– network tax**	Money price = *SCENES tariff – network tax* <3.5 Ton 7.5 – 16 Ton 16 -32 Ton >32 Ton

Money price components

V2.44 Non-road transport modes and bus

Input	By category	By node
SCENES tariff (minus network tax)	Variable cost	Money price
Cost Coverage	Variable tax (subsidy)	
VAT rate	Variable VAT	*= SCENES tariff – network tax*

Reported in pivot table

Money price components

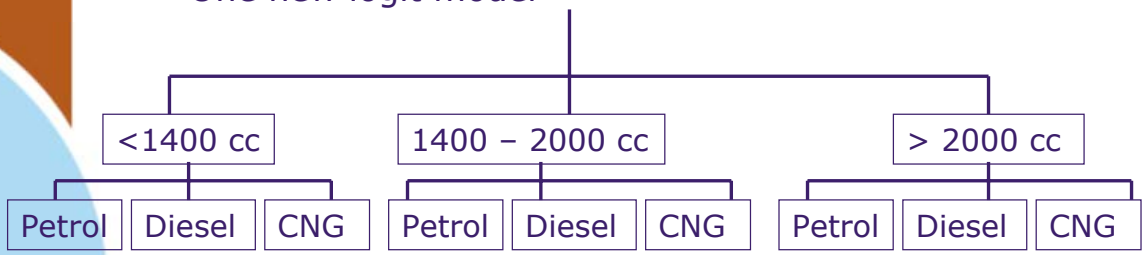
V2.50 Non-road transport modes and bus

Input	By category	By node
SCENES tariff (minus network tax)	Other cost	Money price
Cost Coverage	Other tax (subsidy)	
VAT rate	Other VAT	*= SCENES tariff – network tax*

Reported in pivot table

Car purchase choice

- One new logit model



- Parameters :
  - Size
  - Fuel type
  - (Variable) fuel cost & tax - EURO per vkm
  - (Fixed) other price components - EURO per year
  - Fuel availability (for CNG) - % of fuel stations
  - Acceleration - seconds to 100 km/h

Car purchase choice

- Exogenous LPG (retrofit) share
- Exogenous H_2 share

- Calibration data :
  - Historic timeseries of car prices and market shares is not public available at EU
  - Timeseries constructed based on :
    - TRENDS 1995 shares
    - COWI (Polke) 1999-2000 market share and price dataset
    - CO_2 Monitoring dB 2002-2003 market shares
    - ACEA 1995-2005 public stats on overall diesel market share
  - Need for EU wide dataset on market shares, prices and other parameters (Polke, GlobalInsight, FLEETS project, …)

Copert 4 (also in v2.44)

- Based on draft report LAT July 2006 (not public)
  - And later updates by LAT
  - Updated hot emission factors
  - New classification for trucks and busses
  - Combined with Copert 3 cold and evaporative emissions

- Modifications to CO2 and fuel consumption
  - Diesel car FC desaggregation by engine size class
  - Cars : real world mark up (2002 Monit. dB + 19.5% - TNO)
  - Evolution towards 140g for cars (TNO)
  - Airco, TPMS, LRRT, LVL, GSI (TNO)
  - Fuel efficiency improvements other road modes, except HDT
    - As PRIMES (NEC) has constant 1995-2030 truck fuel consumption