12. Demand (freight, travel and load by mode)

Overview

Target

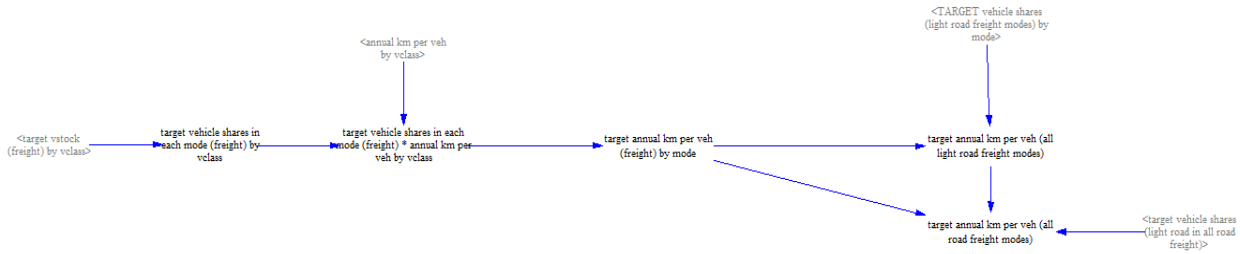
The target of this view is to calculate the annual travel per vehicle and the load per vehicle at the mode level. Both variables are detailed by vehicle class in the views "travel per vehicle (freight)" and "load (freight)" respectively. In case of annual travel per vehicle, the aggregates result from averages weighted by vehicle shares. On the other hand, the vehicle load is always achieved through the definition, i.e. tkm divided by vkm.

For the understanding of the view, all road freight modes refer to TWO WHEELERS, THREE WHEELERS, LDVS and LARGE ROAD. LARGE ROAD corresponds to the road fraction of large-freight (also including RAIL, AIR, PIPELINES and VESSELS) and is excluded from light road freight.

Structure

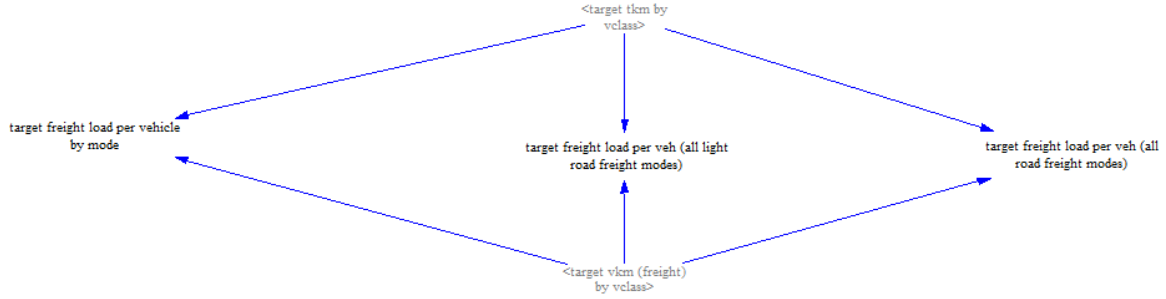
The view is structured in two different rows. The first row is dealing with the annual travel per vehicle. The annual km per vehicle class is the starting point to aggregate at different levels through inputs on vehicle shares. Figure 12.1 shows how the annual travel per vehicle is calculated by mode and subsequently for all light road freight modes as well as for all road freight modes.

Figure 12.1 Aggregates on annual travel per vehicle – Vensim sketch



The second row (Figure 12.2) targets the vehicle load firstly disaggregated by mode, and then by area for all light road freight modes as well as for all road freight modes. The calculations consist always in quotients between aggregates on tkm and vkm.

Figure 12.2 Aggregates on vehicle load – Vensim sketch



Detailed description of the view

Inputs

Annual travel per vehicle

The annual travel per vehicle by vehicle class for freight service is calculated in the view "travel per vehicle (freight)". This is the variable that is averaged across the different vehicle classes in this view.

The "target vstock (freight) by vclass" is a variable calculated in the "demand (freight)" view. It is used here to evaluate vehicle shares when weighting the average travel across vehicle classes.

Vehicle shares in light road freight modes are entered by the user in the "User inputs (over time)" sheet of the ForFITS Excel file. They are necessary to aggregate the annual travel across the light freight modes.

The projected share of light freight vehicles in total road freight, calculated in the view "demand (light road freight veh shares)", is used here to evaluate the annual travel per vehicle by area for all road freight modes.

Load per vehicle

The tkm and vkm, disaggregated by vehicle class, both come from "demand (freight)".

Outputs

Annual travel per vehicle

The annual travel per vehicle by mode is calculated as the average across the travel by vehicle class weighted by the share of each vehicle class in the total fleet, as in the equation below.

$$Annual\ travel\ per\ vehicle\ by\ mode = \sum_{vclasses} Annual\ travel\ by\ vclass \times Shares\ by\ vclass$$

The shares by vehicle class used in the former equation correspond to the ratio between the number of vehicles disaggregated by vehicle class and their modal total (see equation below).

$$Shares\ by\ vehicle\ class = \frac{Vehicle\ stock\ by\ vehicle\ class}{Vehicle\ stock\ by\ mode} = \frac{Vehicle\ stock\ by\ vehicle\ class}{\sum_{vclasses} Vehicle\ stock\ by\ vclass}$$

The same operation is performed to aggregate across the vehicle classes of light freight modes.

$$Annual\ travel\ by\ area\ (for\ all\ light\ freight\ modes) =$$
$$= \sum_{light\ freight\ modes} Annual\ travel\ by\ light\ freight\ mode \times Shares\ by\ light\ freight\ mode$$

Finally, the annual travel for all road freight modes is calculated through the average between the travel in light freight and the travel in LARGE ROAD weighted by the vehicles share of each one in total road freight fleet:

$$Annual\ travel\ per\ vehicle\ by\ area\ (for\ all\ road\ freight\ modes) = \\ = Travel\ for\ light\ freight\ modes \times Light\ freight\ share + Travel\ for\ LARGE\ ROAD \times (1 - Light\ freight\ share)$$

Load per vehicle

The load per vehicle is calculated as the ratio between tkm and vkm. Since the inputs on tkm and vkm are detailed by vehicle class, both are aggregated at different levels according to the output targeted.

Load per vehicle by mode:

$$Load\ per\ vehicle\ by\ mode = \frac{tkm\ by\ mode}{vkm\ by\ mode} = \frac{\sum_{vclasses} tkm\ by\ vclass}{\sum_{vclasses} vkm\ by\ vclass}$$

Load per vehicle by area (for all light freight modes):

$$Load\ per\ vehicle\ by\ area\ (for\ all\ light\ freight\ modes) = \frac{tkm\ for\ all\ light\ freight\ modes}{vkm\ for\ all\ light\ freight\ modes}$$

Where:

$$\frac{tkm\ for\ all\ light\ freight\ modes}{vkm\ for\ all\ light\ freight\ modes} = \frac{tkm\ [TWO\ and\ THREE\ WHEELERS + LDVS]}{vkm\ [TWO\ and\ THREE\ WHEELERS + LDVS]}$$

Load per vehicle by area (for all road freight modes):

$$Load\ per\ vehicle\ by\ area\ (for\ all\ road\ freight\ modes) = \frac{tkm\ for\ all\ road\ freight\ modes}{vkm\ for\ all\ road\ freight\ modes}$$

$$\frac{tkm\ all\ road\ freight\ modes}{vkm\ all\ road\ freight\ modes} = \frac{tkm\ [TWO\ and\ THREE\ WHEELERS + LDVS + LARGE\ ROAD]}{tkm\ [TWO\ and\ THREE\ WHEELERS + LARGE\ ROAD]}$$