

## 30. Activity, loads and stock by age

### Overview

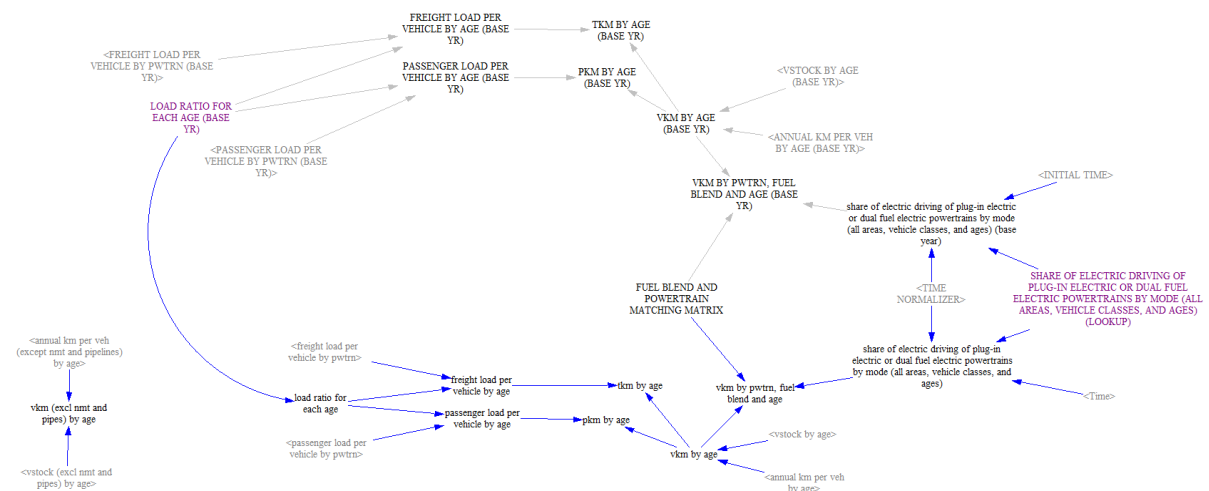
#### Target

The target of this view is to provide generate information on transport activity (vkm, pkm, tkm) by region, area, service, mode, vehicle class, powertrain and age (vkm are also further differentiated calculated by fuel blend). Calculations start from the vehicle stock and flow through vkm to evaluate pkm and tkm run on vehicles belonging to different age cohorts. Data on the average travel per vehicle are used to convert vehicle stock into vkm, and data on the average vehicle loads to convert vkm into pkm and tkm.

#### Structure

Figure 30.1 illustrate the appearance of the view. The sketch is composed of two main groups of calculations, one for the base year (top) and one for data over time (bottom). An auxiliary calculation of vkm for all modes except non-motorized transport (NMT) and pipelines is located on the bottom left of the view.

Figure 30.1 Activity, loads and stock by age: general appearance of the Vensim sketch



### Detailed description of the view

#### Inputs

Inputs on the vehicle stocks, the average vehicle travel and the loads per vehicle enter this view as shadow variables (i.e. variables calculated in other views).

Data on the vehicle stock come from the view "vehicles by age", average travel is calculated in the view "travel per vehicle by age".

Loads come from the "loads (passenger)" and "loads (freight)" views via the view "activity, loads and stock aggregates" and are modified here to distribute the average load per vehicle across the

different age vehicles that composed the vehicle stock. ForFITS is designed to allow a distribution that depends on inputs on the ratios for each age:

$$\text{Load per vehicle by age} = \text{Average load per vehicle (stock)} \times \text{Load ratio by age}$$

Load ratios by age are currently set to 1. This assumption reflects that vehicle load is not considered to be a parameter likely to change significantly with the vehicle aging. As a result, age does not influence the passenger/ tonnes carried, and the load per vehicle is distributed uniformly across the different age subscripts.

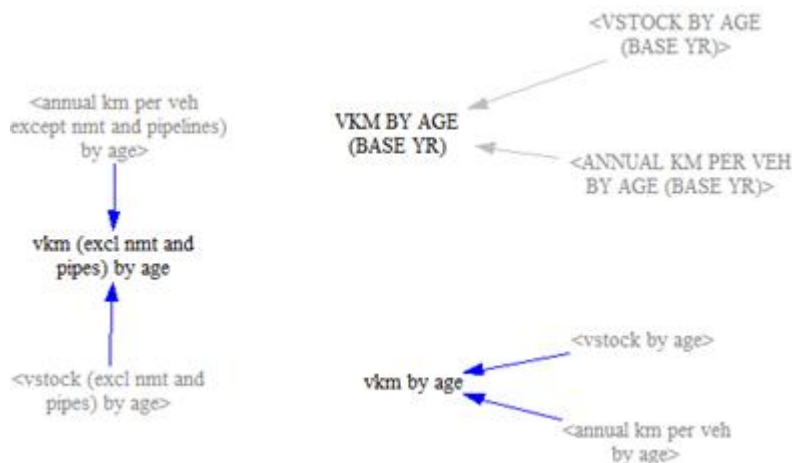
The share of electric driving of plug-in vehicles, required for the valuation of vkm by powertrain, fuel blend and age (Figure 30.3), can change with variations in the technological characteristics of batteries and user behaviour and is therefore one the user inputs requested in the ForFITS Excel file ("Pwtrn potential" sheet and "FUEL CONSUMPTION (PROJECTIONS)", "All modes but air, NMT and pipelines" and "Fuel consumption characteristics by powertrain" headings in the "table of contents" tab).

### Outputs and calculations performed in this view

The first output of this view is the transport activity, expressed in terms of  $\left(\frac{\text{vehicles} \times \text{km}}{\text{year}}\right)$  by region, area, service, mode, vehicle class, powertrain and age cohort. Vkm are calculated in three cases in this view (base year, over time, and over time for all modes excluding NMT and pipelines) (Figure 30.2), always according to the following equation:

$$vkm_{age\ i} = \text{vehicle stock}_{age\ i} (\text{vehicles}) \times \text{Annual travel per vehicle}_{age\ i} \left(\frac{\text{km}}{\text{year}}\right)$$

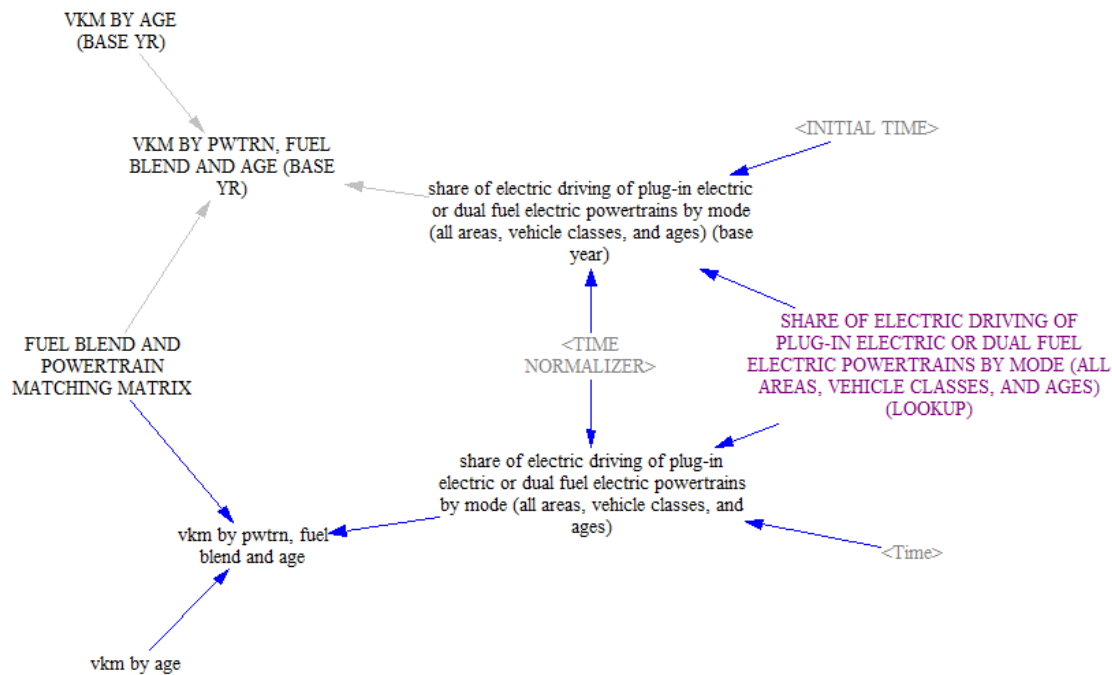
Figure 30.2 VKM calculations



The transport activity, expressed as  $\left(\frac{\text{vehicles} \times \text{km}}{\text{year}}\right)$ , is also disaggregated by fuel blend in this view.

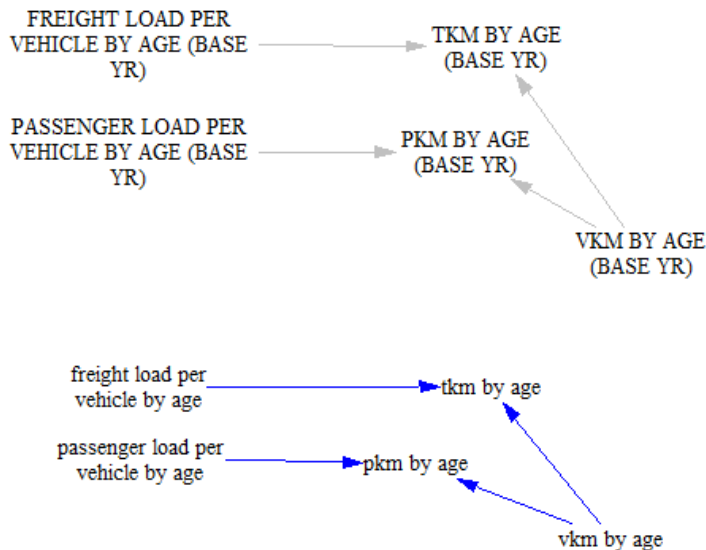
This (Figure 30.3) requires coupling each powertrain with the respective fuel blend. Since plug-in vehicles use two external energy sources (electricity and another fuel blend), the calculation of vkm by powertrain, fuel blend and age cannot only rely on a matrix associating powertrains with fuel blends, but it also requires information on the share of electric driving of plug-in vehicles.

Figure 30.3 Evaluation of vkm by powertrain, fuel blend and age



The last output provided over time is the transport activity, expressed in terms of pkm and tkm, by age.

Figure 30.4 Transport activity, expressed in terms of pkm and tkm, by age



This is the result of the product between vkm by age and the load per vehicle by age:

$$\begin{aligned}
 pkm_{age\ i}(\text{passenger}) & \left( \frac{\text{passengers} \times km}{\text{year}} \right) = \\
 & = vkm_{age\ i} \left( \frac{\text{vehicles} \times km}{\text{year}} \right) \times \text{Load per vehicle}_{age\ i} \left( \frac{\text{passengers}}{\text{vehicle}} \right)
 \end{aligned}$$

$$tkm_{age\ i} (freight) \left( \frac{\text{tonnes} \times km}{\text{year}} \right) = \\ = vkm_{age\ i} \left( \frac{\text{vehicles} \times km}{\text{year}} \right) \times Load\ per\ vehicle_{age\ i} \left( \frac{\text{tonnes}}{\text{vehicle}} \right)$$

The same methodology is used to deduce the transport activity (vkm, pkm, tkm) by age over time and at the base year.