

## 27. Load (passenger)

### Overview

#### Target

The view is intended to calculate the passenger load per vehicle over time.

It relies on base year user information on the number of passengers per vehicle by area, mode and vehicle class. Over time, the average load is influenced by a number of elements, differing for transport taking place on personal vehicles and for collective transport (including both air and public transport).

For personal vehicles, loads are primarily following changes in vehicle ownership.

Modifications of pkm and vkm estimated in the relevant "demand" views ("demand (passenger, air)" and "demand (passenger, public)", respectively, for air transport and public transport) are reflected in changes of the loads on collective passenger transport modes (i.e. air and public transport). For these modes, the "load (passenger)" view takes care of evaluating how this is converted into changes to the number of passengers per vehicle.

#### Structure

Figure 27.1 shows the general appearance of the view. The average load of passenger vehicles is approached considering personal vehicles on the right side (Figure 27.2), and collective transport modes (air and public transport) on the left (Figure 27.3).

Figure 27.1 Vensim sketch of the "load (passenger)" view

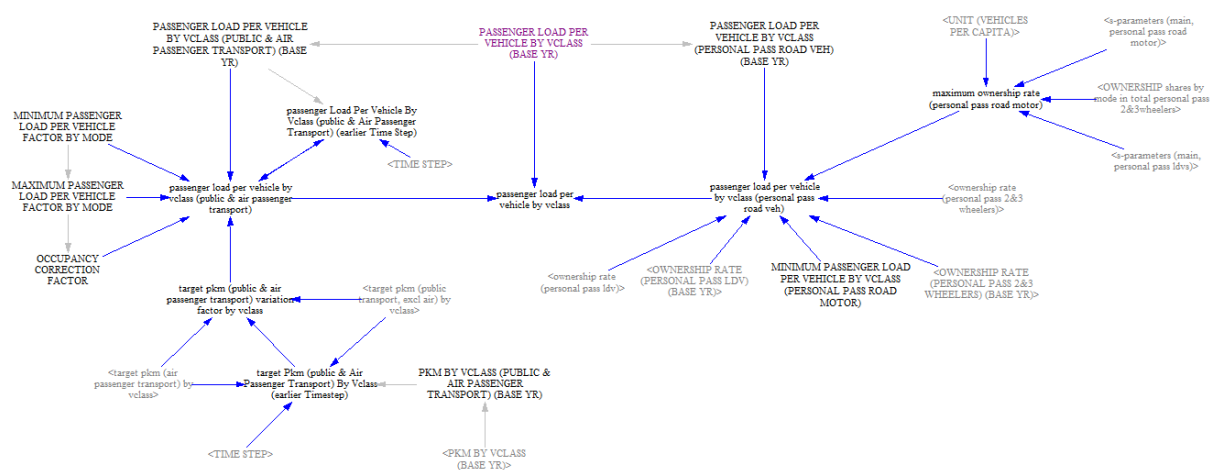


Figure 27.2 Vensim sketch: focus on personal vehicles

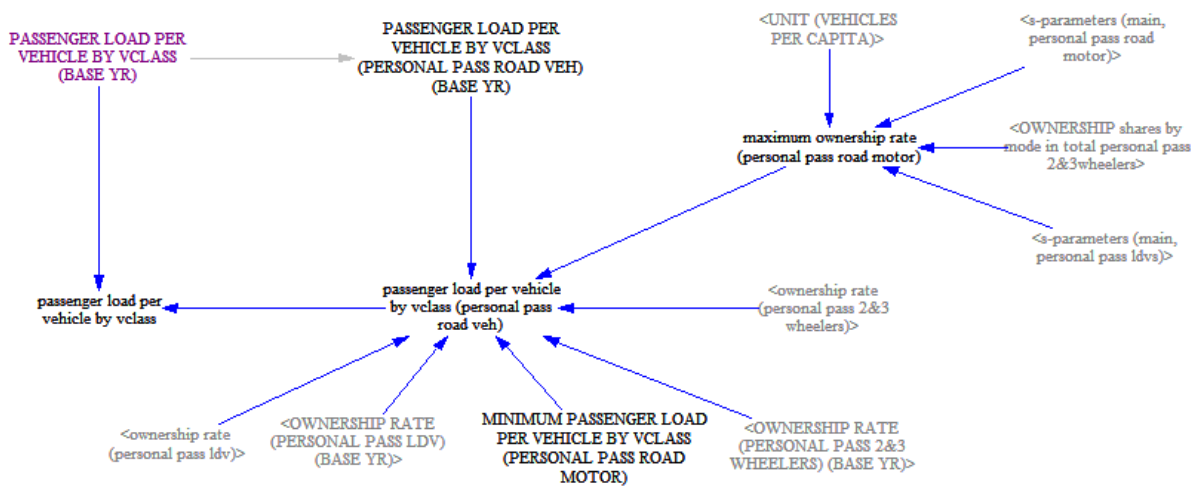
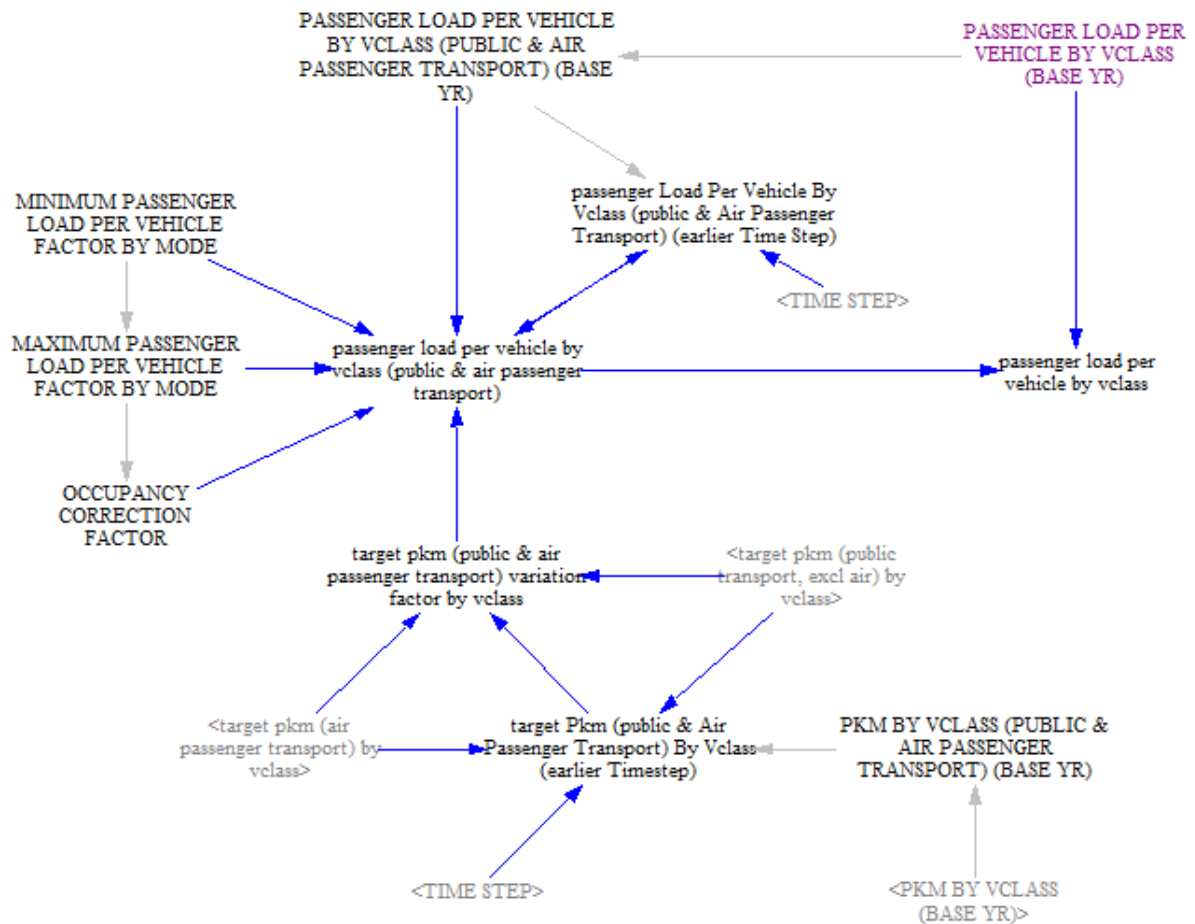


Figure 27.3 Vensim sketch: focus on public transport and air transport

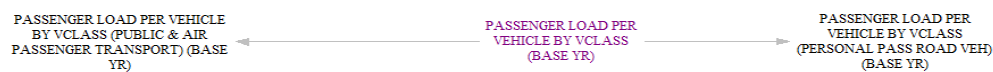


## Detailed description of the view

### Inputs and general calculation flow

The variable "PASSENGER LOAD PER VEHICLE BY VCLASS (BASE YR)" is an exogenous input introduced in the ForFITS Excel file by the user (see the headings "INITIAL CONDITIONS, "Initial transport system", "Vehicle stock", "Load" and "Vehicle load" in the "Table of contents" tab, as well as the corresponding table in the "User inputs (BASE Y)" tab). This input is split into section dealing with personal passenger vehicles and vehicles belonging to collective transport modes (air and public transport. The latter includes non-motorized, road and rail vehicles) (Figure 27.4). This is due to the different treatment of the evolution of the passenger load in these two sections.

**Figure 27.4** Distribution of the information on base year passenger loads, in Vensim, between sections dealing with personal and collective passenger transport

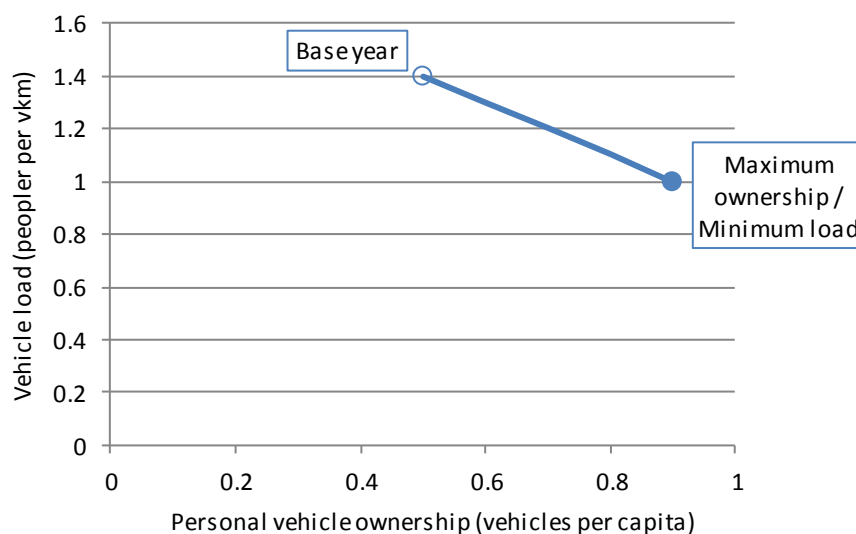


### Personal vehicles

In ForFITS, the variation of the number of passengers per vehicle in case of personal motorized road modes (TWO WHEELERS, THREE WHEELERS, LDVS) is assumed to depend on the evolution of the vehicle ownership over time.

The variable "MINIMUM PASSENGER LOAD PER VEHICLE BY VCLASS (PERSONAL PASS ROAD MOTOR)" is set to 1. It intends to represent the minimum number of passengers using personal passenger road vehicles (including TWO WHEELERS, THREE WHEELERS and LDVS). This variable is assumed to correspond to the vehicle load assumed by personal vehicles when their ownership rates reach the asymptotic values (i.e. the "MAXIMUM OWNERSHIP RATE (PERSONAL PASS ROAD MOTOR)", achieved asymptotically for extremely high levels of GDP per capita).

**Figure 27.5** Assumed evolution of loads on personal vehicles



Vehicle loads are assumed to vary linearly for values of vehicle ownership between the base year and the maximum (Figure 27.5): an increase of the vehicle ownership provokes a decrease of the passenger load per vehicle, while a reduction of the ownership leads to an increment of the number of passengers per vehicle. The minimum passenger load per vehicles is estimated to correspond to the situation where the vehicle ownership is at its maximum.

The passenger load for personal vehicles in case of VESSELS and NON-MOTORISED TRANSPORT is considered to remain always constant at the base year value.

### Air and public transport

The evolution of the target pkm in air and public transport, calculated in the views "demand (passenger, air)" and "demand (passenger, public)", results in a variation of the passenger load per vehicle over time (i.e. on the ratio pkm/vkm). For variations within a range limited by a minimum and maximum passenger load, changes in pkm are not passed to vkm. For variations exceeding these limits, the average load remains fixed and the changes are absorbed by variations of vkm.

The changes of the passenger load per vehicle within the minimum to maximum range are assumed proportional to those of the target pkm:

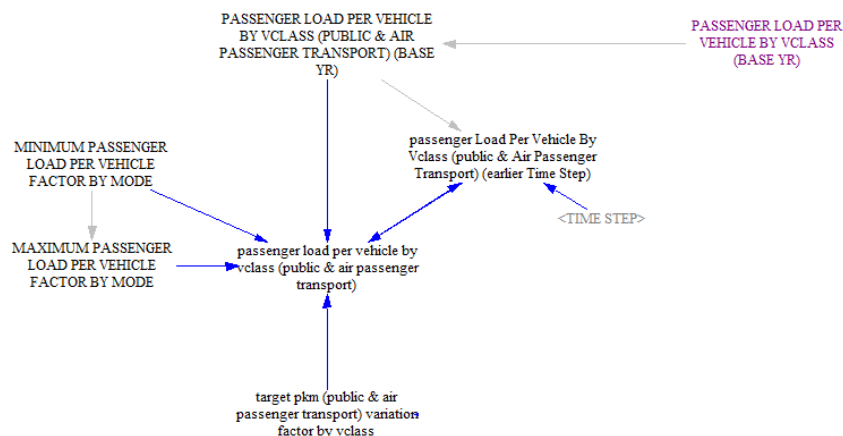
$$\begin{aligned} \text{Passenger load per vehicle (over time)} &= \\ &= \frac{\text{Target pkm}}{\text{Target pkm at earlier TIME STEP}} \times \text{Passenger load per vehicle at earlier TIME STEP} \end{aligned}$$

When the result of the equation above falls out of the range set by the minimum and maximum factors multiplied by the initial passenger load per vehicle then the value is corrected as follows (Figure 27.6):

*If load per vehicle > Maximum factor × Load per vehicle at the base year*  
 → *Load per vehicle = Passenger load per vehicle at the base year*

*If load per vehicle per vehicle < Minimum factor × Load per vehicle at the base year*  
 → *Load per vehicle = Minimum factor × Passenger load per vehicle at the base year*

Figure 27.6 Vensim sketch: public transport and air transport loads



Currently, in order to avoid steps in the modelling results, the minimum passenger load per vehicle factor is in principle set to be 1 in all the modes. The existing equations also set the maximum factor to 1. This means that the current settings of ForFITS are such that a change of the target pkm has no repercussion on the number of passengers per vehicle and is reflected entirely on variations of vkm.

Taking also into account the considerations explained at the end of the view "travel per vehicle (passenger)" regarding the constant annual travel per vehicle over time, the current version of ForFITS is set in a way that changes the target pkm changes in air and public transport are fully translated into changes on the vehicle stock.

## Outputs

The variable "PASSENGER LOAD PER VEHICLE BY VCLASS", located in the centre, summarizes the information on the loads of passenger vehicles over time, disaggregated by area, mode and vehicle class.

This variable gathers the results obtained for the personal vehicles and for air and public transport (Figure 27.7).

**Figure 27.7** Calculation of the passenger load per vehicle by vehicle class in Vensim

