

## 35. Energy cons (new reg) (area)

### Overview

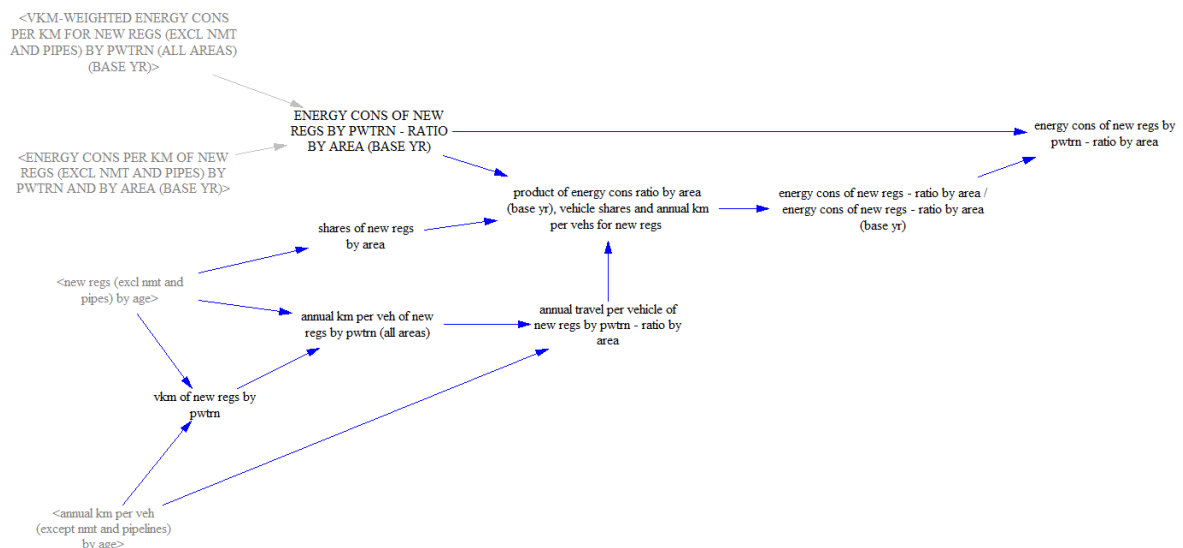
#### Target

This view is intended to calculate the ratio by area and over time of the energy consumption per km of newly registered vehicles, for each powertrain technology. This is needed because the inputs on the energy consumption per km of new vehicle registrations over time are introduced without being differentiated by area (view "energy cons (new reg) (region)").

#### Structure

Figure 35.1 shows the Vensim sketch of this view. The calculations flow from left to right.

Figure 35.1 Vensim sketch



### Detailed description of the view

#### Inputs

The energy consumption (EC) per km of vehicles registered at the base year (BY), either weighted according to the vkm and for all areas or differentiated by powertrain and by area, enter this view as inputs (grey variables on the top left). Both variables are calculated in the "energy cons (historical)" view. They are used here to establish a ratio by area for the energy consumption of new registrations (age ZERO) at the base year (top left of the view):

$$EC \text{ ratio } (BY) \text{ area}_i = \frac{EC \text{ per km age ZERO vehicles at the BY in area}_i}{EC \text{ per km age ZERO vehicles at the BY (all areas - vkm weighted)}}$$

Other inputs are the new registrations (NR) over time by age (from the view "vehicles by age") and the annual travel per vehicle over time by age (from the view "travel per vehicle by age"). These two variables, taken at the age subscript ZERO, enable to calculate the vehicle activity over time (by powertrain and by area) concerning new vehicle registrations (bottom left of the view):

$$vkm \text{ of } NR_{age \text{ ZERO}} (\text{over time}) = NR_{age \text{ ZERO}} \times \text{Annual km per } NR_{age \text{ ZERO}}$$

## Outputs

The shares of new registrations (by area) in the total amount of new registrations, as well as the ratio (over time) between the annual travel of vehicles in one area and the average travel for all areas, are instrumental for the following calculations. They are evaluated as follows:

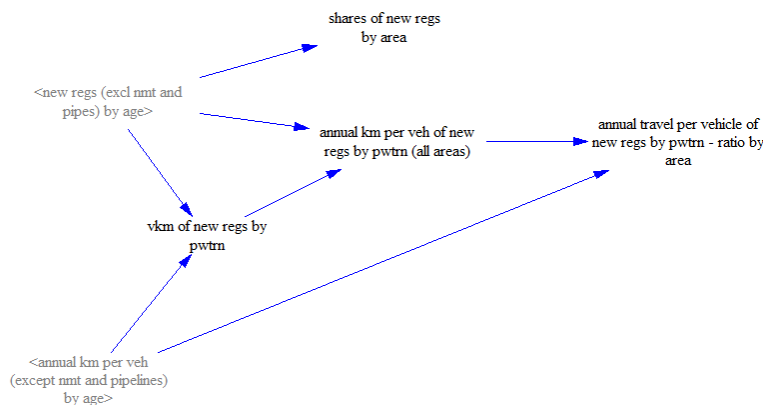
$$\text{Shares by area (over time)} = \frac{NR (age \text{ ZERO})_{area \ i}}{\sum_{areas} NR (age \text{ ZERO})_{area \ i}}$$

$$\text{Travel ratio by area (over time)} = \frac{\text{Annual km per } NR (age \text{ ZERO})_{area \ i}}{\text{Annual km per } NR_{age \text{ ZERO}} (\text{all areas})}$$

$$\text{Annual km per } NR_{age \text{ ZERO}} (\text{over time})(\text{all areas}) = \frac{\sum_{areas} vkm \text{ of } NR (age \text{ ZERO})_{area \ i}}{\sum_{areas} NR (age \text{ ZERO})_{area \ i}}$$

These calculations are also shown in Figure 35.2.

Figure 35.2 Vensim sketch of the calculation of: a) the shares of new registrations (by area) in the total amount of new registrations; and b) the ratio (over time) between the annual travel of vehicles in one area and the average travel for all areas



The variables calculated earlier are used for the estimation of the ratio by area and over time of the energy consumption per km of newly registered vehicles, differentiated for each powertrain. This is achieved building on the disaggregation of the energy consumption by area and following the calculation flow outlined by the set of the equations below.

$$\text{Energy consumption} = \sum_{areas} \text{Energy consumption}_{area \ i}$$

$$EC \text{ per km} \times \text{Annual km per vehicle} \times \text{Number of vehicles} =$$

$$= \sum_{areas} EC \text{ per km}_{area \ i} \times \text{Annual km per vehicle}_{area \ i} \times \text{Number of vehicles}_{area \ i}$$

Having multiplied and divided the  $\text{Number of vehicles}_{area \ i}$  by the total number of vehicles, as follows:  $\frac{\text{Number of vehicles}_{area \ i}}{\text{Number of vehicles}} \times \text{Number of vehicles}$ , the earlier equation can be expressed as follows:

$$1 = \sum_{areas} EC\ ratio_{area\ i} \times Travel\ ratio_{area\ i} \times Vehicle\ shares_{area\ i}$$

Assuming that  $EC\ ratio_{area\ i}$  equals  $EC\ ratio\ (BY)_{area\ i}$  (available input) multiplied by an index describing the evolution over time of the energy consumption ratio of new vehicle registrations (for each powertrain) by area ( $EC\ ratio$ ), allows to re-write the earlier equation as:

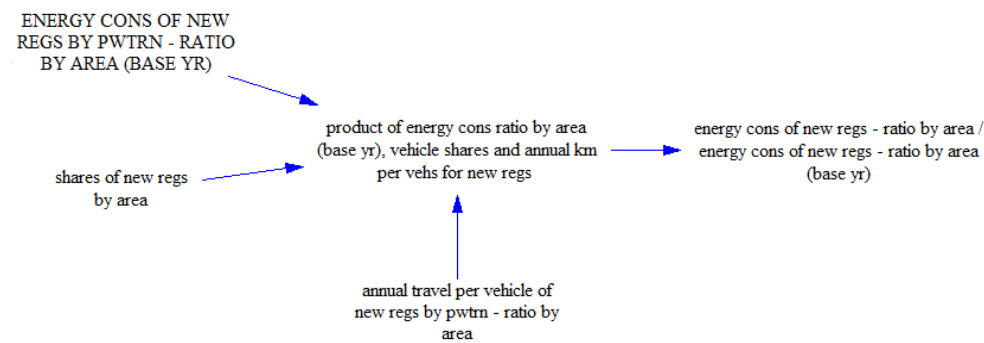
$$1 = \sum_{areas} EC\ ratio\ (BY)_{area\ i} \times EC\ ratio \times Travel\ ratio_{area\ i} \times Vehicle\ shares_{area\ i}$$

The  $EC\ ratio$  over time is isolated from the equation above, as follows:

$$EC\ ratio = \frac{1}{\sum_{areas} EC\ ratio\ (BY)_{area\ i} \times Travel\ ratio_{area\ i} \times Vehicle\ shares_{area\ i}}$$

The same set of calculations, performed in Vensim, is shown in Figure 35.3.

Figure 35.3 Calculation of the index describing the evolution over time of the energy consumption ratio of new vehicle registrations (for each powertrain) by area



Finally, the ratio by area and over time of the energy consumption of newly registered vehicles, for each powertrain, is calculated (Figure 35.4) according to the assumption mentioned earlier and reported below:

$$EC\ ratio_{area\ i} = EC\ ratio\ (BY)_{area\ i} \times EC\ ratio$$

This variable is used in the view "energy cons by age" to disaggregate by area the user inputs on energy consumption per km of new vehicle registrations.

Figure 35.4 Calculation of the ratio by area and over time of the energy consumption of newly registered vehicles, for each powertrain

