CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Estimated non-fossil energy demand (ENG_DC_FC1)

DOMAIN

Transport	Environment	**Energy**	Society	Economy

TOPIC	**Decarbonization**	
IMPACT	**Non-fossil energy demand in transport** *Increasing the share of non-fossil energy in the transport sector*	**ENG_DC**

Category

Key indicator	Supplementary indicator	State indicator

CONTEXT AND RELEVANCE

Transport activity is a source of pollution and greenhouse gas emissions. Emissions are a consequence of energy use, and their volume depends on two main elements: the amount of energy used, and the sources of the energy used. Improving the sustainability of urban transport implies that either the amount of energy used is reduced or that the role of renewable energy is increased, or both. This indicator focuses on the latter approach.

This indicator is an estimation of the non-fossil fuel energy demanded for transport. **It is a relevant indicator when the policy action is aimed at increasing the amount of renewable energy used for transport. A successful action is reflected in a LOWER value of the indicator.**

DESCRIPTION

The indicator is the set of values providing the amount of energy used yearly in the experiment area for each non-fossil fuel type. Therefore, the indicator is **multidimensional**, made of **several values**.

The indicator is expressed in **various units of measurement**, depending on the fuel type:

- Biodiesel, Bioethanol: 1000 litres
- Biomethane, Hydrogen: 1000 kilograms
- Electricity: 1000 Kwh

Not all the fuel types are necessarily included in the indicator; if some fuel type is not relevant in the experiment context, it can be skipped.

METHOD OF CALCULATION AND INPUTS

Energy demand is estimated using fleet composition and transport activity. The former element can be based on observed data on existing vehicles. The latter element (transport activity in terms of vehicle-km) for the relevant transport modes (car, commercial vehicle, motorcycles, buses and so on) is necessarily the result of an estimation. The most realistic source for this estimation is an urban transport model. If this is the case, the estimation is expected to be reliable and based on local conditions. An urban transport model is not available everywhere. If a model does not exist, transport activity is hardly quantifiable and calculating this indicator is probably not feasible. It should also be noted that after extracting transport activity by mode from the transport model, some steps must be performed to scale the values to a conventional period of one year.

The indicator is computed within the supporting tool. The calculation process and the inputs required are explained below.

Method 1

Transport activity provided by a transport model

Significance: **0.50**

METHOD OF CALCULATION

The indicator is computed **within the supporting tool** according to the following steps:

- **Identification of the period covered by the transport model** (e.g., one peak hour, two peak hours, whole day, etc.)**.**
- **Identification of the share of daily of traffic covered by the transport model.** The share of traffic covered by the transport model depends on the modelled period (e.g., one peak hour, two peak hours, whole day, etc.) and on the distribution of transport activity in the 24 hours. This distribution is different in different contexts. If a transport model exists, this parameter is usually known. If not, 10% is a reasonable value for a morning peak hour.
- **Definition of the factor to extrapolate from day to year.** Most of the models refer to an average working day. If so, this term depends on the number of working days per year. Again, if a model exists, this parameter is usually known. If not, 270 working days/year can be considered.
- **Calculation of the extrapolation factor**. The extrapolation factor should be the product of two terms above (see the following equations).
- **Application of the extrapolation factor and calculation of the yearly transport activity by mode of transport** (see the following equations).
- **Calculation of the fuel technologies' shares by mode of transport**. This step builds on the composition of the fleet.
- **Definition of the vector of energy demand** in the monitored period for non-fossil fuel types.

INPUTS

The following information should be provided to compute the indicator:

a) **Transport activity by mode of transport in the pilot area and in the period covered by the model.** If available and relevant, the activity for the following transport modes should be provided:
   - **Cars**
   - **Motorcycles**
   - **Buses (including trolleybuses)**
   - **Light duty vehicles (trucks < 3.5 tonnes)**
   - **Heavy duty vehicles (trucks > 3.5 tonnes)**
   - **Trams**
   - **Metros**

b) **Share of daily of traffic covered by the transport model.** If a transport model exists, this parameter is usually known. If not, 10% is a reasonable value for a morning peak hour.

c) **Factor to extrapolate from day to year.** If a model exists, this parameter is usually known. If not, 270 working days/year can be considered.

d) **Number of vehicles in the fleet in the pilot area by technology**. This input is not expected for trams and metros. The fuel types to be considered are the following:

- **Biodiesel**
- **Bioethanol**
- **Biomethane**
- **Hydrogen**
- **Electricity**

If some of these fuel types are not relevant in the pilot area they can be excluded from the input.

Another input required for the estimation is the energy use per vehicle-km (for each fuel type and mode). **This element is already coded in the supporting tool**.

EQUATIONS

The extrapolation factor is computed **within the supporting tool** as:

$$\boldsymbol{ExtpFact = \frac{1}{DayModShr} * DaytoYear}$$

Where:

$DayModShr$ = share of daily of traffic covered by the transport model

$DaytoYear$ = Factor to extrapolate from day to year

Example, if $DayModShr$ = 16% of daily traffic, and 270 working days ($DaytoYear$) are considered, the extrapolation factor is:

$$ExtpFact = \frac{1}{0.16} * 270 = 1687$$

The yearly activity by mode of transport is computed **within the supporting tool** as:

$$\boldsymbol{YrlyAct_m = ModAct_m * ExtpFact}$$

Where:

$ModAct_m$ = modelled activity of transport mode *m* in the pilot area

The technology share for the fleet of a given transport mode is computed **within the supporting tool** according to the equation:

$$\boldsymbol{RnwTechShr_m^e = \frac{Vehicles_m^e}{\sum_e Vehicles_m^e}}$$

Where:

$Vehicles_m^e$ = number of vehicles of non-fossil fuel technology *e* in the fleet of transport mode *m* in the pilot area.

The indicator is computed **within the supporting tool** according to the equation:

$$\boldsymbol{RnwEstEngDem^e = \sum_m YrlyAct_m * RnwTechShr_m^e * EngFact_m^e}$$

Where:

$EngFact_m^e$ = amount of non-fossil energy type *e* per vehicle-km required by mode *m*.

NORMALISED VARIATION INDEX

This indicator consists of the energy demand values per non-fossil fuel type. To assess the contribution of this indicator to the overall change induced on the domain "Energy", the **total non-fossil energy demand** is calculated and **expressed in tonnes of oil equivalent** (toe). This total is **computed by the supporting tool automatically**, using the following equation:

$$TotRnwEngDem = \sum_e (RnwEstEngDem^e * ConvFact^e)$$

Where:

$RnwEstEngDem^e$ = Yearly energy demand of **non-fossil fuel type** *e*.

$ConvFact^e$ = Conversion factor from the native unit to toe for non-fossil fuel type *e*.

A successful experiment corresponds to a higher value of this total energy demand.

A **Normalised Variation Index** (NMI) can be used to compute the summary impact of the pilot in the domain "Energy". For this purpose, it is required that the value index becomes larger as the pilot is successful. The index is **automatically obtained within the supporting tool** without the need for any additional input as:

$$NMIRnwEngDem = \left(\frac{TotRnwEngDem[AE]}{TotRnwEngDem[BAU]}\right) * 100$$

Where:

$RnwEngDem[AE]$ = Value of the renewable energy demand in the After-experiment condition

$RnwEngDem[BAU]$ = Value of the renewable energy demand in the BAU condition

ALTERNATIVE INDICATORS

This indicator deals with the demand of renewable energy for transport activity in the pilot area. It is an estimated indicator, rather than an observed measure or the result of an estimation, but in principle it includes the whole demand, including energy used for recharging electric vehicles at home, which is currently a significant share of total energy used for recharging electric vehicles.

An alternative indicator is **ENG_DC_FC2**, which is a **modelled** measure. This indicator is computed by retrieving the energy demand from a transport model. Therefore, it has the same significance as the indicator described in this factsheet, but its computation is slightly less complex due to the smaller number of inputs and steps to be performed. This alternative indicator can be employed in cases

where the existing transport model for the experiment area does provide information on energy demand per fuel type.

Alternative indicator **ENG_DC_FC3** is based on **observed** energy supply at public charging stations and hydrogen or biomethane fuel stations, rather than on estimated demand. However, its significance is nonetheless limited, as it does not account for energy used to charge electric vehicles at home, and fuelling or charging within the experiment area does not necessarily imply that transport activity takes place there. It should also be noted that the effort required to compute the indicator is larger compared to extracting information from an urban transport model, when one exists, as it requires requesting and collecting information from charging stations providers and fuel stations operators.

To assess **total fuel** demand (i.e., fossil and non-fossil fuels), indicators **ENG_EF_ED1, ENG_EF_ED2** and **ENG_EF_ED3** can be used. These indicators allow to evaluate measures that aim to decrease energy use by the transport sector in the experiment area.