CIVITAS
Sustainable and smart mobility for all
2030

CIVITAS indicators

Estimated energy demand (ENG_EF_ED1)

DOMAIN

Transport	Environment	**Energy**	Society	Economy

TOPIC	**Energy efficiency**	
IMPACT	**Transport energy demand** *Reducing the energy demanded for mobility*	**ENG_EF**

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 is an estimation of the energy demanded for transport. **It is a relevant indicator when the policy action is aimed at reducing the amount of energy used for mobility and 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 in the experiment city for each 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:

- Gasoline, Diesel, Biodiesel, Bioethanol: 1000 litres
- LPG, CNG, 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.

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: **0.75**

METHOD OF CALCULATION

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

- **Calculation of the extrapolation factor to compute yearly transport activity**. 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 technologies' shares by model of transport**. This step builds on the composition of the fleet.
- **Definition of the vector of energy demand** in the monitored period for all 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.** 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.

c) **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.

d) **Number of vehicles in the fleets or roads modes in the pilot area by technology**. This input is not expected for trams and metros. The fuel types to be considered are the followings:
   - **Gasoline**
   - **Diesel**

- **Biodiesel**
- **Bioethanol**
- **LPG**
- **CNG**
- **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:

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

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:

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

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:

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

Where:

$Vehicles_m^e$ = number of vehicles of 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:

$$\boldsymbol{EstEngDem^e} = \sum_m \boldsymbol{YrlyAct_m} * \boldsymbol{TechShr_m^e} * \boldsymbol{EngFact_m^e}$$

Where:

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

NORMALISED VARIATION INDEX

This indicator is made of several values. In order to derive the contribution of this indicator to the overall change induced on the domain "Energy", an **"average"** value is required. The average, **computed within the supporting tool without the need for any input**, consists of total amount of energy demand expressed in terms of tonnes of oil equivalent (toe), according to the following equation.

$$TotEngDem = \sum_e (EstEngDem^e * ConvFact^e)$$

A successful experiment corresponds to a lower value of this "average".

A "normalised variation index" 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 respecting this requirement is obtained **within the supporting tool without the need for any input** as:

$$NMIEngDem = \left(2 - \frac{TotEngDem[AE]}{TotEngDem[BAU]}\right) * 100$$

Where:

$TotEngDem[AE]$ = Value of the total energy demanded in the After-experiment condition

$TotEngDem[BAU]$ = Value of the total energy demanded in the BAU condition

ALTERNATIVE INDICATORS

This indicator deals with the demand of energy for transport activity in the pilot area. It is an estimated indicator, rather than an observed measure, 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_EF_ED2, which is a modelled measure. If an urban transport model exists and it does already estimate energy consumption, this alternative indicator is superior to the one described in this factsheet. If an urban transport model does not exist, this alternative indicator is probably not available.

Another alternative indicator ENG_EF_ED3 is based on observed energy supply rather than on modelled demand. At the same time, even observed supply is probably estimated (as collecting data from all refuelling stations along the whole pilot period is probably unfeasible) and it does not cover energy used for recharging electric vehicles at home. However, it is likely that this alternative indicator is overall more significant than the one described in this factsheet if the latter is not based on urban model activity. The effort required to compute the indicator is larger.