CIVITAS
Sustainable and smart mobility for all
2030

# CIVITAS indicators

## Greenhouse gases emissions (ENV_DC_CE2)

### DOMAIN

| Transport | **Environment** | Energy | Society | Economy |
|---|---|---|---|---|

| | | |
|---|---|---|
| **TOPIC** | **Decarbonisation** | |
| **IMPACT** | **Transport greenhouse gases emissions**<br>*Reducing the greenhouse gases emissions of urban mobility* | **ENV_DC** |

### Category

| **Key indicator** | Supplementary indicator | State indicator |
|---|---|---|

## CONTEXT AND RELEVANCE

Transport activity is a relevant source of greenhouse gas emissions. A significant share of transport activity occurs in the urban context. Reducing the greenhouse gas emissions generated by urban mobility is a significant contribution to sustainability.

This indicator is an estimation of the amount of urban mobility greenhouse gases emissions. **It is a relevant indicator when the policy action is aimed at reducing the impact of urban mobility and transport on climate. A successful action is reflected in a LOWER value of the indicator.**

## DESCRIPTION

The indicator is directly the quantity of emissions expressed in **tonnes/year**:

## METHOD OF CALCULATION AND INPUTS

There two methods for the calculation of the indicator. One method is extracting the value of emissions from an urban transport model, if there is a city transport model and if the model provides an estimation of the greenhouse gas emissions. This method has zero complexity and, assuming that the model is reliable, results have a good level of significance. However, if an urban model does not exist, its complexity becomes high because building an urban transport model is not straightforward.

An alternative method is estimating greenhouse gas emissions building on energy use for urban transport activity. The energy use should be available by fuel type. Energy use by fuel type can be obtained from different sources. One option is collecting energy supplied at refuelling stations and energy operators (see factsheet related to the indicator ENG_EF_ED1). Another option is estimating energy used building on vehicle fleets, mileage and use factors (see factsheet related to the indicator ENG_EF_ED3). A third option is extracting energy consumption from an urban transport model, if there is a city transport model and if the model provides energy consumption by fuel type (but not greenhouse gas emissions, otherwise the first method can be applied). This method is not very complex; more complex than extracting emissions from an existing model, but definitely less complex than building an urban transport model to estimate emissions. Its level of significance depends on the source of energy use, but on average it can be considered a bit less significant than method 1 (e.g., because energy use based on operators' data does not consider electricity for home recharging).

**Whatever the method used, the greenhouse gas emissions should be computed exogenously and then coded in the supporting tool**.

| METHOD 1 | | METHOD 2 | |
|---|---|---|---|
| **Greenhouse gas emissions drawn from an urban transport model** | | **Greenhouse gas emissions estimated from energy consumption by fuel type** | |
| Complexity |  | Complexity |  |
| Significance |  | Significance |  |

The estimation process is explained below for both methods.

## Method 1

**Energy supplied collected from refuelling stations and energy operators**

Significance: **0.50**

**The following information is needed** to compute the indicator:

a) **The amount of energy sold in a period of four weeks** for each fuel type. 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 experiment area** (e.g., there are not refuelling stations for biofuels or hydrogen) **they are excluded from the indicator** and from the data collection.
The amount of energy supplied should be collected from refuelling stations and, as far as electricity is concerned, operators providing recharging facilities.
The number of energy operators providing recharging facilities for electric vehicles in one urban area, is generally limited; it should be feasible contacting all operators and collecting data for all charging points.
The number of refuelling stations for LPG, CNG and, where existing, hydrogen should also be small; again, it should be feasible collecting data from all stations.
For gasoline and diesel, the number of refuelling stations is larger and collecting data from all stations could be hardly feasible. **At least 20 stations supplying gasoline and diesel should be monitored**. The selection should be made aiming at a representative sample in terms of coverage of the whole territory of the urban area and size of the stations.

The experiment would result in a modification of the amount of energy supplied in the monitored refuelling/recharging stations in a period of four weeks.

### METHOD OF CALCULATION

The indicator should be computed **exogenously** according to the following steps:

- **Identification of the existing refuelling/recharging stations.**
- **Identification of the operators managing recharging facilities for electric vehicles**.

- **Definition of a sample of refuelling stations supplying gasoline and diesel** if their total number is too large for collecting data from all of them.
- **Collection of data from the operators and the refuelling stations**
- **Estimation of total amount of gasoline and diesel supplied** in case the data is collected from a sample of stations (see equation below).

## EQUATIONS

If the amount of gasoline and diesel is collected from a sample of refuelling stations, the total value of energy supplied for these two fuel types should be estimated according to the following equation:

$$\boldsymbol{EngSupl^{e}} = \frac{\sum_{s} \boldsymbol{EngSupl_{s}^{e}}}{\boldsymbol{n}} * \boldsymbol{N}$$

Where:

$EngSupl_{s}^{e}$ = Amount of fuel type *e* supplied by sampled refuelling station *s* in the monitored four weeks

$n$ = Number of sampled refuelling stations

$N$ = Total number of refuelling stations supplying fuel type *e* in the urban area

## Method 2

**Greenhouse gas emissions estimated from energy consumption by fuel type**

Significance: **0.50**

**The following information is needed** to compute the indicator:

a) **The amount of energy used in a given period** for each relevant fuel type. 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 experiment area they are not considered**.

b) **The carbon content** of each fossil fuel type. This element consists of a set of values based on chemical characteristics of the fossil fuels. The following vales can be used (for biofuels and hydrogen), more specific values based on the method of production can be available in the experiment site):
   Gasoline: 2.31 kg/l

Diesel: 2.68 kg/l
Biodiesel: 0.38 kg/l (production cycle)
Biodiesel: 0.40 kg/l (production cycle)
LPG: 1.51 kg/kg
CNG: 2.74 kg/kg
Biomethane: 0.20 kg/l (production cycle)
Hydrogen: 1.5 kg/kg (production cycle)

For Electricity, the carbon content

The experiment would result in a modification of the amount of energy used. The carbon content of each fuel is fixed.

## METHOD OF CALCULATION

The indicator should be computed **exogenously** according to the following steps:

- **Identification of the existing refuelling/recharging stations.**
- **Identification of the operators managing recharging facilities for electric vehicles**.
- **Definition of a sample of refuelling stations supplying gasoline and diesel** if their total number is too large for collecting data from all of them.
- **Collection of data from the operators and the refuelling stations**
- **Estimation of total amount of gasoline and diesel supplied** in case the data is collected from a sample of stations (see equation below).

## EQUATIONS

If the amount of gasoline and diesel is collected from a sample of refuelling stations, the total value of energy supplied for these two fuel types should be estimated according to the following equation:

$$\boldsymbol{EngSupl^{e}} = \frac{\sum_{s} \boldsymbol{EngSupl_{s}^{e}}}{\boldsymbol{n}} * \boldsymbol{N}$$

Where:

$EngSupl_{s}^{e}$ = Amount of fuel type *e* supplied by sampled refuelling station *s* in the monitored four weeks

$n$ = Number of sampled refuelling stations

$N$ = Total number of refuelling stations supplying fuel type *e* in the urban area

## ALTERNATIVE INDICATORS

This indicator deals with the consumption of energy for transport activity in the urban area. It is an indicator based on observed data; therefore, it provides an objective measure. On the other hand, it does not include the energy used for recharging electric vehicles at home, which is currently a significant share of total energy used for vehicle recharging. The alternative indicators ENG_EF_ED2 and ENG_EF_ED3 are theoretical estimations based on different methodology and data, rather than observed values, but in principle they include the whole energy use, including home-recharging.