Multiple Impacts Calculation Tool

Empirical basis of Environmental Impacts Energy (cost) savings

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101000132.

Executive summary

This indicator describes the energy saved with the proposed measures. This is done for final and primary energy consumption, the latter taking the conversion processes necessary for the generation of hydrogen and synthetic fuels, electricity, and heat into account. In the course of the monetisation, the value of the saved fuels is assessed.

While the characterisation as a multiple impact rather than as the main impact can be debated, it is highly relevant to quantify it for a meaningful cost-benefit analysis.

This indicator has a high relevance at all governance levels, since the energy and accompanying cost savings are accruing at the implementation level. Thus, this results in low energy bills for their constituents, a major interest of all involved government levels.

This impact has several possible overlaps with other indicators, such as import dependency, material resources, avoided investments in grid and capacity expansion, and alleviation of energy poverty and equality. However, since it is the central indicator of energy efficiency, it will be the one to be monetised and the avoidance of double counting will be done in the course of monetising the other conflicting MI.

It is calculated by multiplying the savings from the different improvement actions with their respective fuel split allocation vector, resulting in the savings disaggregated by final energy carrier:

$$\Delta E_{c,ss,u,e,y} = \Delta E_{c,ss,u,y} \cdot \lambda_{c,ss,u,e,y} = \Delta E_{c,ss,u,y} \cdot \lambda_{c,ss,e,y} \cdot \chi_{c,ss,u,e}$$

In this equation, $\Delta E_{c,ss,u,y}$ describes the generated energy savings, $\lambda_{c,ss,u,e,y}$ the assumed relevant improvement action fuel mix, $\lambda_{c,ss,e,y}$ the (sub-)sectoral fuel mix, and $\chi_{c,ss,u,e}$ the assumed ratio between improvement action and (sub-)sectoral fuel mix vectors, issued from models, in this case PRIMES.

The indicator will be monetised using energy price data from Enerdata. These include taxes and differ between sectors. The energy cost $\Delta E_{c,e,ss,u,y}$ are calculated using the following formula ($P_{c,e,s,y}$ being the energy prices):

$$\Delta E_{c,e,ss,u,y} = \Delta E_{c,e,ss,u,y} \cdot EP_{c,e,s,y}$$

This indicator can be aggregated with any monetised multiple impact representing a profit and not merely a turnover.

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Quantification method

Description

The quantification of final energy savings is straightforward and merely involves the allocation of a fuel mix to every improvement action and make it possible to generate it from the relevant (sub-)sector's energy mix. Thus, for every improvement action, a vector describing the ratio of a given energy carrier's prevalence in the energy savings compared to the prevalence in the whole (sub-)sector's consumption is calculated. This vector can be multiplied with any new (sub-)sectoral fuel mix, then normalised, resulting in an improvement action-level fuel split. Multiplying the savings from the different improvement actions with their respective fuel split allocation vector results in the savings disaggregated by final energy carrier:

$$\Delta E_{c,ss,\ u,e,y} = \Delta E_{c,ss,u,y} \bullet \lambda_{c,ss,u,e,y}$$

$$= \Delta E_{c,ss,u,y} \bullet \lambda_{c,ss,e,y} \bullet \chi_{c,ss,u,e}$$

In this equation, $\Delta E_{c,ss,u,y}$ describes the generated energy savings, $\lambda_{c,ss,u,e,y}$ the assumed relevant improvement action fuel mix, $\lambda_{c,ss,e,y}$ the (sub-)sectoral fuel mix, and $\chi_{c,ss,u,e}$ the assumed ratio between improvement action and (sub-)sectoral fuel mix vectors, issued from models, in this case PRIMES. The underlying assumption is that, in case the user does not specify which energy carriers are saved, the proportion of energy carriers among the savings are identical to their share of the energy mix typical for the relevant improvement action.

In order to calculate the primary energy savings, the final energy consumption is translated into primary energy consumption (the lists of final and primary energy carriers are shown in Table 1). This is done by remapping hardly transformed energy carriers (oil, coal, gas, and biomass and waste) to the list of primary energy carriers and calculate the conversion of transformed energy carriers (electricity, heat, and H2 and e-fuels).

The formula for this is shown below:

$$\Delta E_{\mathrm{P},e,ss,u,y} = \Delta E_{\mathrm{P}_{\mathrm{con}},e,ss,u,y} + \Delta E_{\mathrm{P}_{\mathrm{map}}e,ss,u,y}$$

$\Delta E_{\mathrm{P}_{\mathrm{con}},e,ss,u,y} =$ Converted primary energy saving from electricity and heat generation

$\Delta E_{\mathrm{P}_{\mathrm{map}}e,ss,u,y} =$ Mapping of $\Delta E_{e,ss,u,y}$ to primary energy carriers

$\Delta E_{e,ss,u,y} =$ Additional primary energy savings from final energy savings without conversion

id	Final energy carriers	Primary energy carriers
1	Electricity	Oil
2	Oil	Coal
3	Coal	Gas
4	Gas	Biomass and renewable waste
5	Biomass and waste	Renewable energy sources
6	Heat	Others
7	H2 and e-fuels	

Table 1 : List of MICAT final and primary energy carriers

The conversion is using data from Eurostat to assess the energy carriers that flow into the generation of electricity and heat. In a first stage, hydrogen and e-fuels are defined to be generated from electricity (such as electrolysis).

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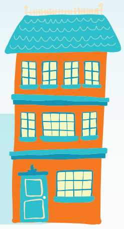

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