MICAT
Multiple Impacts Calculation Tool

Empirical basis of Economic Impacts Import Dependency

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

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Executive Summary

The indicator describes the share of an energy carrier's domestic consumption which needs to be imported from abroad. It is generally calculated using primary production (PP), gross inland consumption (GIC), and non-energy uses (NE) as inputs in the following formula:

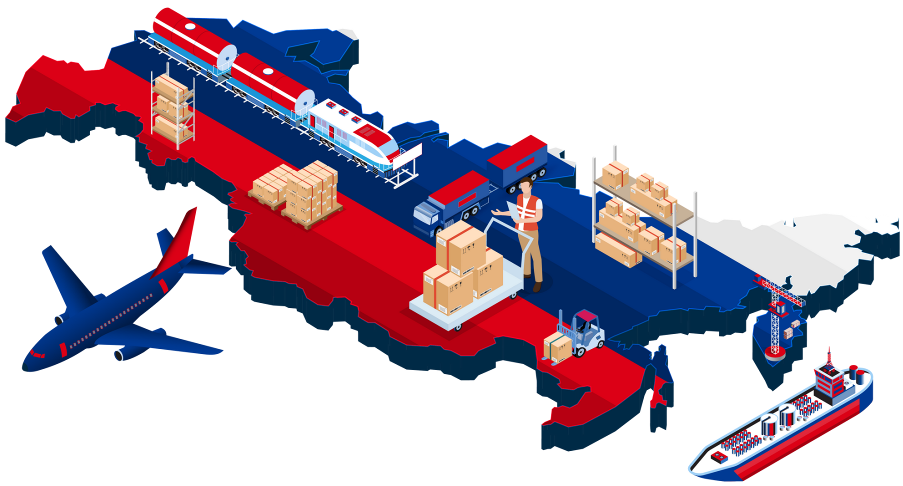
$$ID_e = 1 - \frac{PP_e}{GIC_e - NE_e}$$

Thus, the impact relationship taking energy savings into account results in the following equation:

$$\Delta ID_{c,e} = PP_{c,e}\left[\frac{1}{GIC_{c,e} - NE_{c,e}} - \frac{1}{\left(GIC_{c,e} - \sum_u \Delta E_{c,u} \cdot k_{c,e,u}\right) - NE_{c,e}}\right]$$

Import Dependency is very relevant and has been pushed even further into the political spotlight by Russia's war in Ukraine. Nearly exclusively relevant on the European and national level, the data needs are generally covered by Eurostat and PRIMES.

It might be worth discussing which quantification approach is most fruitful, the classical or one basing itself on the Energy Efficiency First principle. Moreover, an aggregation with the MI supplier diversity would enhance the meaningfulness of this indicator. However, a monetisation of the impact is not recommended, since the correct inclusion of monetary benefits of the indicator would significantly exceed the scope of this project.



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Scope of MI Indicator

Definition

A country's import dependency describes its reliance on non-domestic energy carriers. Thereby, it can be vulnerable to supply disruptions it cannot compensate for and energy price volatility. It is defined by the share of combusted energy carriers originating from abroad. The indicator can also be calculated for single energy carriers.

Relevance on EU, national and/or local level

Given the generally low primary production in the majority of EU countries, the issue of import dependency has been picked up by the European Commission in their 2014 Energy Security Strategy. Relying on instruments and directives such as the EU ETS, the EED, and the EPBD, the Commission emphasises the role of energy efficiency in reducing energy needs and thereby import dependency [1].

Depending on the degree of import dependency, the problem is more central to some member states than to others, also placing it on the national agenda. A lack of supplier diversity often further exacerbates this issue (see MI supplier diversity).

Given the fact that wholesale energy markets operate nationally, import dependency is not of any major relevance on a local level. Moreover, the benefits of reduced exposure to the associated risks of energy price volatility and outages through local measures are not described in this indicator, which is calculated at least on a national level.

Impact pathway figure

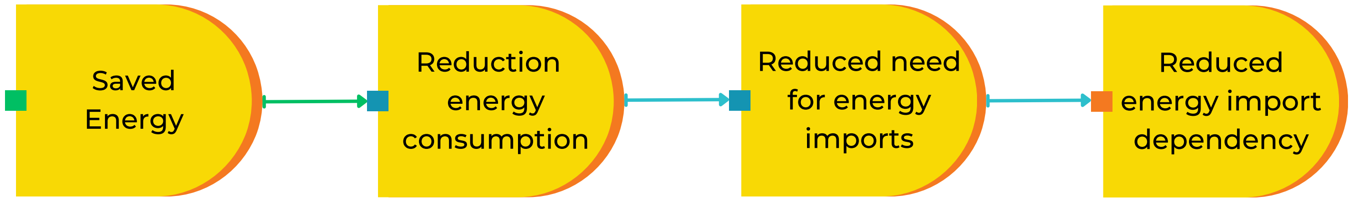

Figure 1 : Impact pathway for the indicator import dependency

[1] European Commission, 2014

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Overlaps with other MI indicators and potential risk of double-counting

This indicator is strongly linked to general energy savings. Since the impacts of import dependency are internalised in wholesale energy prices, their effect is overwhelmingly included in the economic benefits for consumers. Furthermore, the impacts of an elevated import dependency on energy prices inevitably depends on the prevalent supplier diversity, therefore it is difficult to clearly attribute price effects to either indicator. However, the proposed formula accounts for the benefits from energy savings for customers and only considers the surcharge on the imported share of energy carriers. Possibly, these effects are also assessed within the MI energy price effects, which could engender double-counting.

Quantification method

Description

Generally, in order to calculate import dependency, inland primary production is divided by the domestic consumption for energy uses (as non-energy uses have been subtracted, such as resources as feedstock). This share of domestically covered energy consumption is then subtracted from one to calculate the share of energy consumption covered by imports, thus the import dependency.

Therefore, the import dependency of a member state for an energy carrier can be calculated by subtracting the relevant primary production (PP_e) divided by the difference between gross inland consumption (GIC_e) and non-energy uses (NE_e) from one:

$$ID_e = 1 - \frac{PP_e}{GIC_e - NE_e}$$

Potential savings $\Delta E_{s/u}$ (either disaggregated to sector (s) or end-use (u) level) to that specific energy carrier (with a relevant fuel mix $k_{e,s/u}$) would reduce gross inland consumption without altering any other variable:

$$ID_e = 1 - \frac{PP_e}{(GAE_e - \sum_{s/u} \Delta E_{s/u} \cdot k_{e,s/u}) - NE_e}$$

This figure can then be calculated for every relevant energy carrier. Although an aggregation by weighting with the combusted energy quantity is possible, it would cushion stark import dependencies for certain energy carriers, which is particularly important in member states with different level of dependence for fossil fuels and given the different predominant exporting countries of the resources.

A differentiation between sectors or end-uses would not be expedient, since all savings impact the overall wholesale market for the related energy carrier in the same way and no sectoral targets regarding import dependency exist.

The quantification should be done using a top-down approach, with the majority of required data available on a national level from Eurostat and Odyssee-Mure.

The issue linked to this formula is that for very import dependent resources significant actions regarding energy efficiency entail little to no changes in the indicator. Thereby, important reductions in import volumes cannot be accounted for within this indicator. Therefore, an additional second approach is proposed, based on the idea of energy efficiency as 'first fuel'. Instead of reducing the value of the energy consumption by the related savings, the savings are accounted as primary production, as if they replaced the originally used fuel in a scenario with a constant business-as-usual energy consumption:

$$ID_e = 1 - \frac{PP_e + \sum_{s/u} \Delta E_{s/u} \cdot k_{e,s/u}}{GIC_e - NE_e}$$

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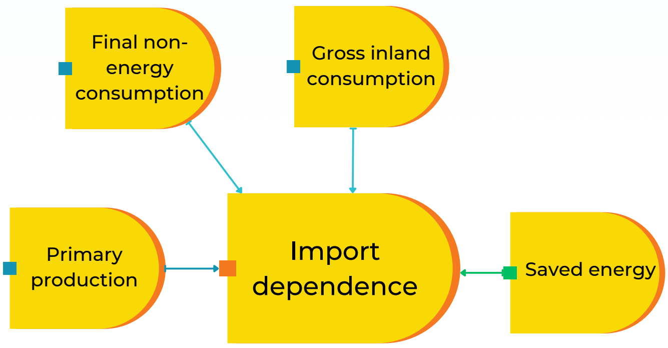

Figure 2 : Quantification of the indicator import dependency

Methodological challenges

In order to properly monetise the impacts of import dependency, the local cost difference between imported and locally extracted fossil fuels is to be known. Alternatively, a European average could be determined using a bottom-up approach, but this would lead to significant inaccuracies, since this difference is strongly correlated to the degree of integration and connection of a country, as well as to its supplier diversity and general geopolitical situation.

However, the main benefit of a reduced import dependency lies in the diminished supply vulnerability and the associated risk of price volatility or even outages. Since these associated benefits only occur sporadically and depend on a multitude of factors involving inter alia energy and climate policies in other countries and geopolitical conflicts, implementing a sound monetisation of this benefit would go beyond the scope of this project. Furthermore, the need for strategic reserves and hedging of potential future fluctuations decreases through energy efficiency. Yet again, the relevant monetisation is nearly impossible, since no figures for the premium necessary for volatility internalisation in the European Union are to be found.

Data requirements

Two approaches with a different level of sophistication present themselves. If the envisaged measure aims at the reduction of the consumption of a single energy carrier, a standalone calculation for this specific product can be performed. The assessment of the measure's impact on import dependency is therefore significantly more accurate, since strong variations between import ratios for different energy carriers within a single country are common. This method can and should also be used if the mix of saved energy carriers is known. It would require the primary production, gross inland consumption, and non-energy uses for the examined fuel(s). If electricity or heat is saved, the respective local generation energy carrier mix is to be used. If unknown, the mean national mix can be used as a substitute. Another option can be to determine the saved energy carriers for electricity and heat generation on a merit-order basis.

Alternatively, in case the mix of saved energy carriers is unknown, the general unspecific equation can be employed using the same data but with total values. The underlying assumption is then that the ratio of saved fuels corresponds to the national energy carrier mix.

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Impact factor/functional relationship

Total aggregation:

$$\Delta ID_{c,e} = PP_{c,e}\left[\frac{1}{GIC_{c,e} - NE_{c,e}} - \frac{1}{(GIC_{c,e} - \Delta E_c \cdot k_{c,e}) - NE_{c,e}}\right]$$

Sectoral disaggregation:

$$\Delta ID_{c,e} = PP_{c,e}\left[\frac{1}{GIC_{c,e} - NE_{c,e}} - \frac{1}{(GIC_{c,e} - \sum_s \Delta E_{c,s} \cdot k_{c,e,s}) - NE_{c,e}}\right]$$

End-use disaggregation:

$$\Delta ID_{c,e} = PP_{c,e}\left[\frac{1}{GIC_{c,e} - NE_{c,e}} - \frac{1}{(GIC_{c,e} - \sum_u \Delta E_{c,u} \cdot k_{c,e,u}) - NE_{c,e}}\right]$$

First fuel approach:

$$\Delta ID_{c,e} = \frac{-\Delta E_c \cdot k_{c,e}}{GIC_{c,e} - NE_{c,e}} = \frac{-\sum_s \Delta E_{c,s} \cdot k_{c,e,s}}{GIC_{c,e} - NE_{c,e}} = \frac{-\sum_u \Delta E_{c,u} \cdot k_{c,e,u}}{GIC_{c,e} - NE_{c,e}}$$

Monetisation

Because the scale of the unquantifiable benefits significantly exceeds the quantifiable benefits (which would also come alongside significant methodological challenges), a monetisation of the import dependency is not recommended. Issuing a figure for the monetary value of the quantifiable share of the indicator would sell the benefits at less than fair value and undermine the central point of this indicator.

Aggregation

An aggregation of results with the indicator supplier diversity would be very expedient. A high import dependency can be cushioned by a variety of reliable supplying countries, while a low supplier diversity is generally not particularly problematic in case of a low import dependency. Thus, merely the combination of both MI is really meaningful and useful.

Conclusion:

The indicator import dependency is very relevant and has been pushed even further into the political spotlight by Russia's war in Ukraine. Nearly exclusively relevant on the European and national level, the data needs are generally covered by Eurostat and PRIMES. It might be worth discussing which quantification approach is most fruitful, the classical or one basing itself on the Energy Efficiency First principle. Moreover, an aggregation with the MI supplier diversity would enhance the meaningfulness of this indicator. However, a monetisation of the MI is not recommended, since the correct inclusion of monetary benefits of the indicator would significantly exceed the scope of this project.

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