MICAT

Multiple Impacts Calculation Tool

Empirical basis of Economic Impacts Energy Price Effect

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E3-Modelling

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Executive Summary

The indicator describes the effect of energy efficiency measures on the energy prices. We discuss which energy prices can be affected by energy efficiency, and whether energy efficiency can have a meaningful impact on energy prices.

We focus the analysis on electricity and heat/steam prices which are produced almost exclusively in the EU and therefore are subject to limited effects from global trade.

We find that different efficiency measures, while contributing to improving overall system efficiency, could have upward and/or downward trends on electricity and steam/heat demand and therefore also different effects on energy prices.

It is clear that only policies with large impacts at national level may have an impact on the prices, but that the direct link between energy efficiency and prices is difficult to establish.

We suggest a functional form, however we explain the limitations of the calculation of such an indicator.

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Scope of MI Indicator

Definition

Energy savings result in reduction of final energy consumption and reduce the amount of energy purchased. Reduction of the energy demand can contribute to the reduction of energy prices, but this contribution is tightly linked to contribution of other factors such as changes in energy mix, fuel substitution potential in economic sectors and trading conditions of main energy carriers. Thus, an effect of energy efficiency measures on energy prices is not easy to isolate.

Relevance on EU, national and/or local level

End user energy prices are composed of multiple components:

- Production cost of energy carrier and market conditions
- Transmission and distribution
- Excise duties and other taxes

Energy carriers should further be split into domestically produced energy carriers and internationally traded energy carriers. From a European perspective, fossil fuels – with the exception of lignite – are mostly imported goods traded on the international energy markets. Electricity, while being traded within Europe, is to a large extent domestically produced in most EU countries. Steam/heat is a domestic – generally local – energy carrier. In future, it is expected that additional energy carriers may be introduced into the market such as hydrogen and e-fuels: similarly to electricity, it is expected that these may be produced domestically, however also international trade is increasingly envisaged.

Single energy efficiency measures in single regions or countries cannot have a significant impact on energy prices; however, energy prices are intrinsically linked to energy demand as the recent developments of the gas price has shown.

The war in Ukraine has caused a huge disruption in the natural gas supply to Europe, leading to extremely high natural gas prices in the first half of 2022. However, since August 2022 prices have been steadily declining in the EU gas market and a downward trend is also expected in the future.[1]

The reduction in gas prices has been linked to the mild winter in Europe (and the US), improved energy efficiency, diversification of gas supply, as well as behavioural changes. However, the triggers for the reduction in gas consumption were the combination of high prices and the mild weather rather than specific energy efficiency policies. Furthermore, other geopolitical factors, such as the low demand from countries such as China have also played a significant role in the development of gas prices.

On general terms, energy efficiency measures can influence energy carrier prices to a limited extent and only for energy carriers sourced within the EU, where geopolitical factors play a relatively minor role.

Further, in order to assess energy carrier prices formed on international competitive markets, one would require a world-wide referencing process, which is not applicable in the current context.

[1] https://blogs.worldbank.org/opendata/bubble-trouble-whats-behind-highs-and-lows-natural-gas-markets

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Impact pathway figure

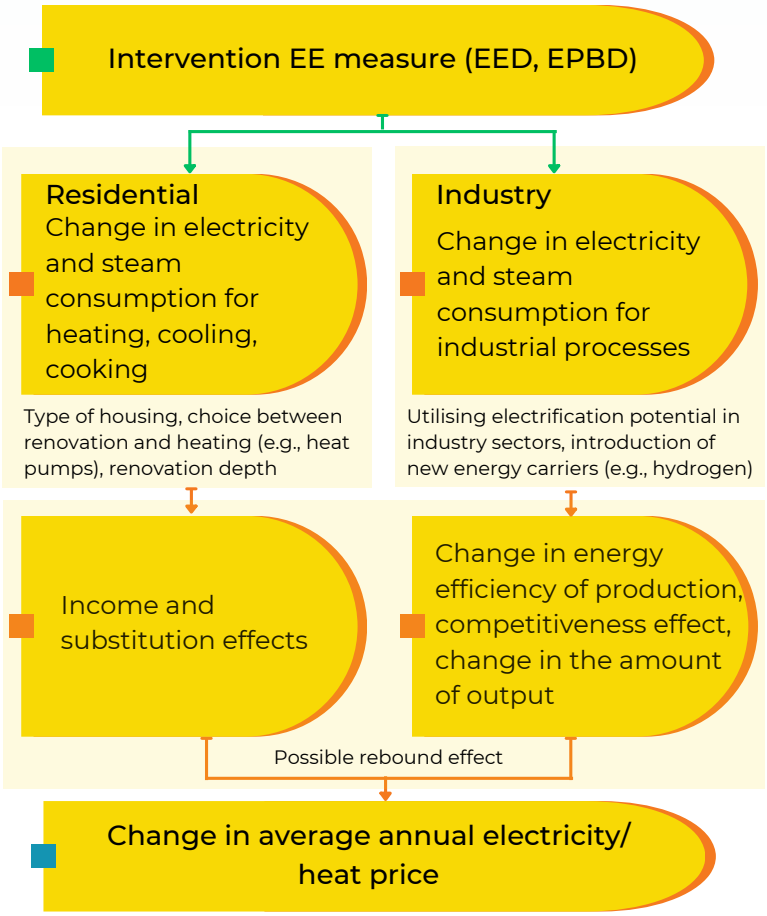

Figure 1 : Possible impacts of energy efficiency measures on the energy prices

Overlaps with other MI indicators and potential risk of double counting

This indicator is not directly linked to any other MI indicator. No double counting with other indicators evaluated in the context of MICAT is considered.

Quantification method

Description

The quantification of the energy price effect relies on the estimation of elasticities of the change in energy prices relative to energy quantities induced by energy efficiency measures.

Only steam/heat and electricity prices are assumed to be affected by the changes in energy efficiency. However, overlapping effects are assumed to take place which do not fully allow to isolate the effect of energy efficiency measures on the energy carriers.

At an individual level policies/measures are not able to modify the energy carrier demand to such an extent so as to influence the energy prices.

Further efficiency measures may have upward and downward effects on the energy quantities and may therefore have "contradictory" effects on the market.

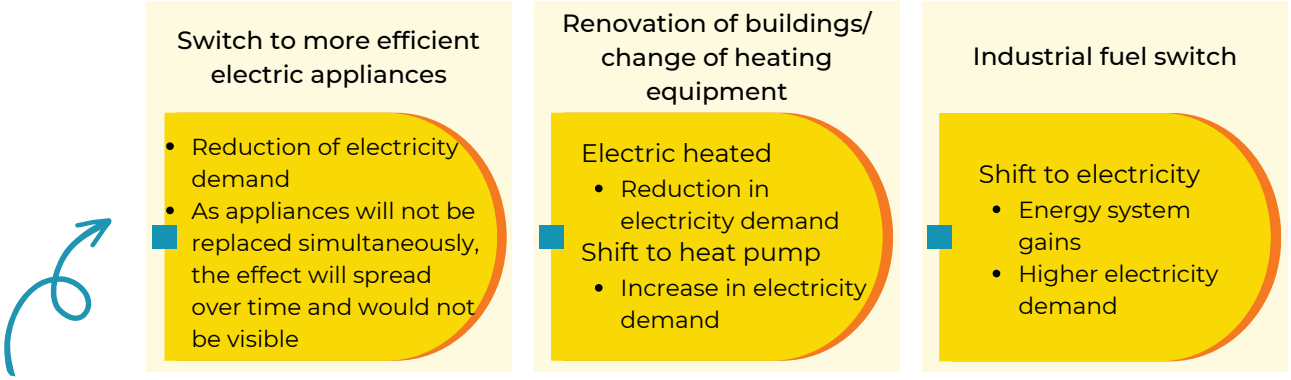

Figure 2: Exemplary effects of energy efficiency measures on electricity demand

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Also, a shift to district heating or changes in the industrial heat demand will result in overall system-wide energy savings but will lead to an increase in steam/heat demand, so the effect on energy carrier prices is not evident.

Further, the changes in the prices will require also the adaptation of the power system to meet the "new" demand after the application of the energy efficiency measures and it is difficult to isolate what part of the change in prices is due to the change in energy demand compared to what may be due to other policies (e.g. policies increasing RES shares in power generation).

Methodological challenges

The key challenge in linking energy efficiency and energy prices is the multiple effects that energy efficiency may have on energy demand and therefore indirectly on the market for energy carriers.

The main aim of energy efficiency measures is to induce energy savings: energy savings can either reduce demand for the energy carrier which was initially used (less oil, gas, electricity) or induce fuel switching (e.g. a shift to an electric heat pump). Energy efficiency can therefore lead to a reduction in demand for energy carriers, which relieves the stress on the market and therefore reduces prices. On the other hand, if energy efficiency leads to a fuel shift – as is expected in the context of the energy transition – it may lead to higher demand for specific energy carriers e.g., electricity or district heating. In this case, the effect on prices could potentially have both upward and downward trend.

The quantification of such an indicator would require information about scenarios with and without the efficiency measures, the relative changes in prices of end user prices.

Higher demand for an energy carrier would in general lead to high prices. However, in a number of cases prices might also decrease. In the power market, and the load curve may be smoothed if demand takes place off-peak (e.g., with smart charging for electric vehicles), leading to improved system utilization and thus lower average prices.

Data requirements

The quantification of such an indicator would require information about scenarios with and without the efficiency measures, the relative changes in prices of end user prices.

Impact factor/functional relationship

To measure an effect of change in electricity (heat) price due to a change in quantity of electricity (heat) consumed, we estimate the price elasticity μ on EU, national and sectoral levels:

$$\frac{P_i^1 - P_i^0}{P_i^0} = \mu_i \frac{Q_i^1 - Q_i^0}{Q_i^0}$$

where Q_i^0 and Q_i^1 are the quantities for the energy consumed in baseline and in scenario with EE intervention in sector i. P_i^0 and P_i^1 are electricity and heat prices in the baseline and EE intervention scenario for the sector i .[2]

[2] Reuter, M., Patel, M. K., Eichhammer, W., Lapillonne, B., & Pollier, K. (2020). A comprehensive indicator set for measuring multiple benefits of energy efficiency. Energy policy, 139, 111284.

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Monetisation

The energy price effect would be directly monetised as it is expressed as a change in prices therefore in €/energy unit.

Aggregation

This indicator can provide meaningful results at national level for different energy efficiency policy strengths; at local level this indicator does not have a meaningful impact.

Conclusion:

The effect of energy efficiency measures on electricity and heat prices is not easily specified in a quantitative manner: efficiency measures can have both upward and downward effects on energy prices. Often the scale of energy efficiency measures is also not sufficient to trigger a change in the energy prices and the cause effect is not always easy to determine.

Possible price effects from energy efficiency measures are described in this document, however the quantification of this element remains problematic.