MICAT

Multiple Impacts Calculation Tool

Empirical basis of Economic Impacts on GDP

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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E3-Modelling

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Executive Summary

The indicator presented in this factsheet describes the impacts of energy saving measures on GDP. GDP or value added implications of planned policies or measures are of primary concern, thus an ex-ante assessment of changes in GDP can serve as an indicator for the performance of specific energy efficiency policies and measures. We follow a static multiplier approach to estimate the creation (or reduction) of Value Added due to the additional demand generated in specific sectors that deliver the investments associated with the energy efficiency measures. Here we limit the analysis to estimating in a static approach the GDP impacts resulting from the demand for energy efficiency goods and consider that the energy saving measures generate additional demand for goods and do not substitute existing demand or investments. Similarly, we do not make any explicit assumptions on the financing of the measures. The analysis does not take into consideration the impacts on GDP from **i) changes in fossil fuel imports or changes in overall trade of energy carriers, ii) changes in prices and factor markets, and iii) changes in the fiscal budget**. A key step in order to estimate the GDP impacts is the calculation of the output multipliers based on IO-Analysis. The methodology relies on the allocation of investment expenditure to demand by economic activities, which is based on expert judgement and assumed uniform by country and sector that applies the measures. The indicator describes that for each million € invested into a specific energy saving measure, additional GVA is generated.

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Scope of MI Indicator

Definition

Energy efficiency measures create demand for products with subsequent income and value-added implications. GDP or Value Added implications of planned policies or measures are of primary concern, thus an ex-ante assessment of changes in GDP can serve as an indicator for the performance of specific energy efficiency policies and measures. We follow a static multiplier approach to estimate the creation (or reduction) of Value Added due to the additional demand generated in specific sectors that deliver the investments associated with the energy efficiency measures.

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Relevance on EU, national and/or local level

GDP as a standard and the most common national measure, reflects the magnitude of a country's economy. It measures the value added created through the production of goods and services in a country during a certain period. It could also be described as the key indicator which is used to assess national accounts or even as a comparison measure between countries and regions. GDP is a key indicator for the socioeconomic assessment of policies at all levels of policy-making, from the EU to national and even local level. Together with the indicator of Employment, these two can be considered as the primary economic indicators of ex-ante policy impact assessment. The GDP indicator is common in most European Commission Impact Assessment documents for climate and energy policies, including the latest documents associated with the Fit-for-55 policy package. Nevertheless, it is not usual to use aggregated measures in order to capture local level adjustments. Thereby, there is low dependence for GDP indicator and the local level.

Impact pathway figure

The methodology adopted to perform the assessment of the GDP indicator of the different measures is composed from the following steps:

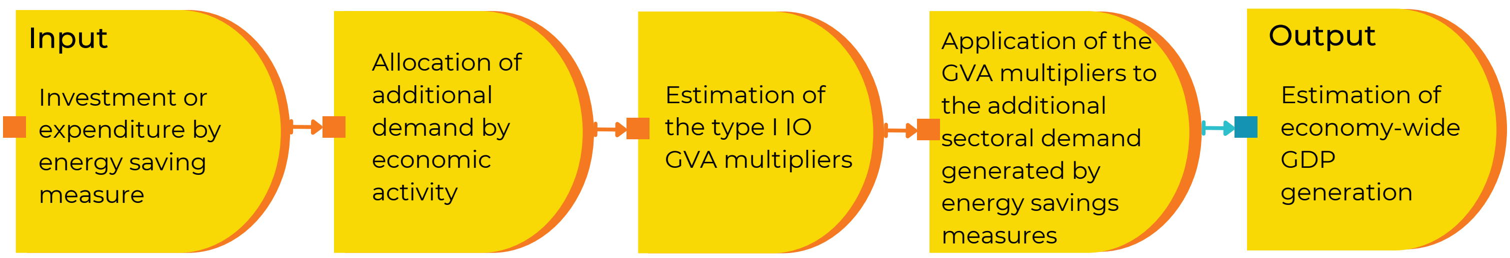

Figure 1: Quantification steps for the estimation of the GDP MI| indicator

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

There are strong overlaps with several other economic indicators due to the general, economy-wide coverage of the GDP indicator. Given the strong overlaps, particularly with the MIs Employment effects, Turnover on energy efficiency, Energy price effects, there could be a risk of double-counting.

Quantification method

Steps:

- Receive as input the investment expenditure by type of energy saving measure
- Calculation of type I gross value-added multipliers based on the IO table
- Associate the investment expenditure to specific demand of goods and services to allocate the additional generated demand by economic activity
- Application of the respective multipliers by economic activity and estimation of aggregate GVA multiplier by type of energy efficiency measure
- Estimation of economy-wide GVA generation by applying the multiplier to the level of expenditure by type of measure.

Description

A key step in order to estimate the GDP impacts is the calculation of the output multipliers based on IO-Analysis. The GVA Multiplier provides a quantification of the total demand that will be generated in the economy by 1 m. € of additional final demand of a specific sector. This considers the share of imported goods, the direct and indirect effects through the structure of the IO table. In particular the Type I multipliers that are used in this analysis include the direct and indirect impacts, referring to changes in output levels considering sectoral inter-dependencies (IO coefficients) and import dependence by sector. As described in Figure 1, we follow the steps shown below for the quantification of this indicator.

In the second step, the Leontief type I multipliers are calculated by country given the technology coefficients and the consumption preferences of a given economy. This type of analysis does not consider capacity constraints and thus no consideration is taken for the change in prices and the markets of primary factors. The technical coefficient matrix A consists of all technical coefficients as its elements a_{ij} . For every country and for each branch the technical coefficient a_{ij} is calculated as the ratio of the intermediate consumption to total supply for each industry.

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The GVA multiplier effect is calculated based on the following formula:

$$coeffGVA_j = \sum_i GVART_i \bullet L_{i,j} \quad (1)$$

where:

$GVART_i$: the ratio of gross value added to total supply for the industry I derived by the IO table.
$L_{i,j}$: the ij-element of the Leontief inverse Matrix $L = (I - A)^{-1}$, where i is the sector providing intermediate inputs to the production of sector j
$coeffGVA_j$: the total gross value added that will be generated in the economy for an additional demand of 1 m€ in sector j.

Leontief Inverse Matrix L:

$$L = (I - A)^{-1} \quad (2)$$

I: Identity matrix
A: direct requirements matrix, the ratio of the intermediate consumption to total supply for each industry.

The **third step** of our methodological approach assumes a table that associates the investment expenditure of each energy efficiency measure to the specific demand of one goods and services. This table aims to allocate the additional generated demand to each of the 65 identified economic activities so that the impacts of energy efficiency measures are dispersed over a number of NACE sectors. The table has been constructed according to expert judgement and thus changing the default assumptions of sectoral allocation by energy efficiency measure can be redefined by the users. Below, in Table 1 we provide a few examples of the allocation of demand by economic activity for the measures of "Building envelope", "Heating fuel switch", and "Energy efficient heating". The numbers in Table 1 express the shares by which the investment expenditure is allocated to each economic activity.

Economic activity	Nace-code	Building envelope	Heating fuel switch	Energy-efficient heating
Other non-metallic mineral products	C23	20%		
Basic metals	C24	20%		
Computer, electronic and optical products	C26			5%
Electrical equipment	C27		15%	5%
Machinery and equipment n.e.c.	C28		50%	50%
Repair and installation services of machinery and equipment	C33		10%	15%
Constructions and construction works	F	40%	10%	10%
Retail trade services, except of motor vehicles and motorcycles	G47	10%	10%	10%
Architectural and engineering services; technical testing and analysis services	M71	10%	5%	5%

Table 1: Examples of sectoral allocation of investment expenditure by energy saving measure

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As a next step, the GVA multipliers of each of the sectors identified in the table of sectoral allocation are then multiplied by the respective share in Table 1 to provide the overall Employment coefficient in jobs per 1m. € of investments. Finally, to estimate the annual additional employment generated by investment for energy saving measures we multiply the investment expenditure by measure with the above coefficient as shown in the equation (3) below.

$$coeffTOTGVA_{m,c} = \sum_{j} coeffGVA_{j,m,c} \bullet es_{j,m} \quad (3)$$

where,

j : subsector/activities
m : measure / end-use
c : country
$es_{j,m}$: Allocation share of Energy Saving Investment (m) to sector (j)

At the final step, we estimate the economy-wide GDP generation by applying the level of expenditure by type of measure with the gross value added effect generated in the total economy by 1 m€ expenditure, see equation (4).

Methodological challenges

The 2015 SIOT tables from Bulgaria are not available on Eurostat. Czechia, Ireland, Luxemburg and Malta data are deficient. Sweden data are unbalanced (i.e., SIOT is not symmetric) however this country is not excluded. The GVA impact of certain energy saving measures cannot be quantified, thus by default cannot be calculated, as these cannot be associated with the purchase of specific economic activities or are too generic. The methodology assumes only the GVA impacts from the generated additional demand, thus not assuming any other structural changes, e.g. due to the drop of activity in certain sectors, nor the effects of changes in income and prices or the effects on trade balance due to changes in energy imports and exports. Finally, the methodology relies on the allocation of investment expenditure to demand by economic activities, which is based on expert judgement and assumed uniform by country and sector that applies the measures.

Data requirements

The starting point of the analysis is the latest available Symmetric Input Output tables (SIOT) by EU Member State, which are available in Eurostat for year 2015. The sectoral resolution adopted in our analysis is the 64 sectors in NACE rev2. 2-digit, in line with the CPA resolution. Additionally, in order to evaluate the exact effect on the Employment, the sectoral demand contributions should be assumed.

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Impact factor/functional relationship

The associated additional GDP is proportional to the Energy Saving Investments. Every investment in energy saving measure is attributed to sectors and the total effect on GDP is calculated as shown below:

$$GDP_{m,c,y} = coeffTOTGVA_{m,c} \bullet Inv_y \quad (4)$$

where,

m : measure / end-use
c : country
y : year
Inv_y : Energy Saving Investments

In conclusion, GDP effect depends on impact factor coefficient per country and subsectors – which are determined as aggregation of industries or product groups of the IO-table – and the sectoral investment demand assumptions – which are set by default or according to user's choice. Thus, GDP level is determined by the impact factor and the Investment according to energy saving allocation measures.

Monetisation

The indicator is already expressed in terms of million EUR.

Aggregation

The indicator could be aggregated with other indicators, though overlaps and double counting should be considered.

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Conclusion

Below we provide examples for the calculation of the impact on GDP for three selected EU Member States, namely Germany, Italy and Poland.

Germany

			Annual energy saving expenditure in million €						
Subsector	Measure	Country	2020	2025	2030	2035	2040	2045	2050
Machinery	Space heating and cooling	Germany	150	150	150	150	150	150	150
			Annual GVA generated by investment for energy saving measures						
Coefficient for GVA Effect in m. € per 1m. € of investments			2020	2025	2030	2035	2040	2045	2050
0.62			93.5	93.5	93.5	93.5	93.5	93.5	93.5

Table 2: Calculation of the impact on GDP for Germany

Therefore, it can be derived that for each million € invested into Machinery industry for Space heating and cooling - energy efficient measure, 0.62 million are annually generated as GVA, thus a 150 million € - Investment would annually generate 93.5 million GVA.

Italy

			Annual investments in million €						
Subsector	Measure	Country	2020	2025	2030	2035	2040	2045	2050
Average tertiary	Building envelope	Italy	150	150	150	150	150	150	150
			Annual GVA generated by investment for energy saving measures						
Coefficient for GVA Effect in m. € per 1m. € of investments			2020	2025	2030	2035	2040	2045	2050
0.72			108.7	108.7	108.7	108.7	108.7	108.7	108.7

Table 3: Calculation of the impact on GDP for Italy

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Therefore, it can be derived that for each million € invested into Average tertiary sector for Building envelope - energy efficient measure, 0.72 million are annually generated as GVA, thus a 150 million € - Investment would annually generate 108.7 million GVA.

Poland

			Annual investments in million €						
Subsector	Measure	Country	2020	2025	2030	2035	2040	2045	2050
Construction	Fuel switch	Poland	150	150	150	150	150	150	150
			Annual	**GVA**	**generated**	**by investment**	**for energy**	**saving**	**measures**
Coefficient for GVA Effect in m. € per 1m. € of investments			2020	2025	2030	2035	2040	2045	2050
0.49			73.3	73.3	73.3	73.3	73.3	73.3	73.3

Table 4: Calculation of the impact on GDP for Poland

Therefore, it can be derived that for each million € invested into Construction sector for Fuel switch energy efficient measure, 0.49 million are annually generated as GVA, thus a 150 million € investment would annually generate 73.3 million € GVA.

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