METHODOLOGY EUROPEAN ENERGY EFFICIENCY SCOREBOARD

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I. OVERALL SCOREBOARD (LEVELS, TRENDS AND POLICIES)

The objective of the European Energy Efficiency Scoreboard is to assess and score the energy efficiency performances and policies of the European Union countries[1] and Switzerland by country and by sector (households, transport, industry and services). The scores are calculated on the following energy efficiency components:

- the energy efficiency level,
- the energy efficiency progress (i.e. energy efficiency trends),
- the energy efficiency policies,
- the overall energy efficiency score, i.e. a combination of these three components.

For each of the three criteria each country is scored with a score between 0 and 1 on the basis of a variety of indicators (extracted from the ODYSSEE Database) and of energy policies (extracted from the MURE Database). Details are explained below in the corresponding sections.

The scoreboard can be viewed, either by component or by country; in the latter case, the scoring is detailed for each country by component.

The overall energy efficiency score is obtained as an average of the three scores obtained for "energy efficiency level", "energy efficiency progress" and "energy efficiency policies" (i.e. one third weighting).

II. SCORING OF LEVELS AND TRENDS (BASED ON ODYSSEE-INDICATORS)

1. Scoring methodology for individual indicator

The scoring methodology is based on the OECD Composite Indicator methodology[2]. This method allows the countries to be compared in a relevant range where minimum and maximum values indicators define the best and worst scores and countries are ranked between these two extrema. The indicators are calculated and **normalized so that they range between 0 and 1** following this formula:

$$Normalized\ score = \frac{Indicator - Min\ indicator}{(Max\ indicator - Min\ indicator) * direction} + 0.5 * (1 - direction)$$

Indicator: The indicator value of the country.
Min indicator: The minimum indicator value across all countries.
Max indicator: The maximum indicator value across all countries.
Direction: The favored direction in the level of indicator; -1 if the decline is favored, 1 if the incline is favored.

[1] By European Union we understand the EU27 (excluding the UK)
[2] https://www.oecd.org/sdd/42495745.pdf

Example of calculation of score for cars: case of Austria

Unit consumption of cars (goe/pkm)	
aut	0.050
bel	0.040
cyp	0.064
esp	0.044
fin	0.030
fra	0.033
gbr	0.036
grc	0.025
hun	0.038
irl	0.039
ita	0.024
lat	0.043
lth	0.040
lux	0.040
mlt	0.042
nld	0.042
rom	0.022

Max indicator : 0.064
Min indicator : 0.022
Direction = -1 (decline in the indicator is favored)
Austria = 0.05

Normalized score calculation for Austria :

$$\frac{0.05 - 0.022}{(0.064 - 0.022)*(-1)} + 0.5 * (1-(-1)) = 0.33$$

2. Calculation of scores by sector

The scoring of sectors is done as follows:

- Scoring is done separately for four sectors (households, transport, industry and services) and for all sectors together.
- The score by sector is based on scores calculated for selected indicators representative of end-uses in buildings or modes in transport. For industry the score is directly based on an aggregate indicator that already accounts for the energy efficiency characteristics of the various industrial branches.
- The **score by sector** is calculated as a weighted score of each indicator. The weights correspond to the average shares over the last 3 years of each end-use or transport mode in the sector consumption (see example below in the case of transport in Austria).
- The sectoral score is normalized to a range of 0 (corresponding to the lowest country value for a sector) to 1 (corresponding to the highest country value for a sector). The scale is set by the EU countries: highest value from a EU country = 1, lowest value from an EU country = 0. Non-EU countries can therefore in principle reach values above 1 (best EU country) or below 0 (EU country with lowest value).

Example of calculation of score for a sector: case of transport Austria

The score of the sector (transport) is calculated by weighing the indicator scores.

Transport **level score** for Austria: $0.33 * 58\% + 0.96 * 25\% + 0.95 * 12\% + 0.70 * 3\% + 0.57 * 2\% = \mathbf{0.58}$
The score is normalized from 0 to 1 so as to give 1 to the highest value, 0 to the lowest: if the highest value for the sector is 0.91 and the lowest 0.30, the **normalized level score of** transport for Austria is:

$$\frac{(0.58-0.30)}{(0.91-0.30)} = \mathbf{0.46}$$

The same is done for the calculation of the trend score.

Austria (fictive example)	Cars	Trucks and light vehicles	Air	Public transport passengers	Rail and fluvial goods
Level scores normalized	0.33	0.96	0.95	0.70	0.57
Weigths (share of each mode in transport consumption)	58%	25%	12%	3%	2%

For the sectoral score (as well as for the global score described in section 3), two scores are proposed: one for "level" based on the level indicators, and one for "trend" based on the indicators' trends:

- The score based on the **level** of the indicator is calculated as a moving **average of the last three years** to smoothen yearly variations (i.e. 2017-2019 for the 2021 scoreboard).

  Warning: for 2023 and 2024 scores, the level of the indicator is not based on 2020 to avoid the effect of the Covid crisis. It is the average of 2019 and 2021 for 2023 scores, and 2021-2022 for 2024 scores.
- The second score is based on the **trend** indicator since 2010 (variation 2019--2021 for the 2023 scoreboard).

3. Calculation of global scores

The sectoral scores calculated as indicated in section 2 are then aggregated to a global score for levels and trends separately, by weighting the sector scores with the share in the final energy consumption.

- The global score results from the sectoral scores weighted by the average share over the last 3 years of each sector in the total final energy consumption.
- Then again, the resulting values are normalized from 0 to 1 (scale set by EU countries), with 1 given to the country with the highest score, and 0 to the country with the lowest sectoral or overall score in the same way as described in section 2 for each sector.

III. Scoring of Policies (based on MURE Energy Efficiency Policies)

1. Scoring methodology for policies

The objective of the **policy part** of the European Energy Efficiency Scoreboard is to assess and score the energy efficiency policies of the European Union countries and Switzerland by country and by sector (households, transport, industry and services). The main advantage of this scoreboard is to present progress in policy development according to a standardised method over time and across countries. Though there are other scorecards of energy efficiency policies, in particular the International Scorecard of the American Council for an Energy Efficient Economy ACEEE, the policy part of the European Energy Efficiency scoreboard has a unique feature worldwide: **It is the only scoreboard, which relies on the quantitative impacts collected from energy efficiency evaluations (output-based scoring, based on energy savings).**

This scoreboard makes use of the information in the MURE database on energy savings ("policy output") and compares the savings with the final energy consumption of the sector or total final energy

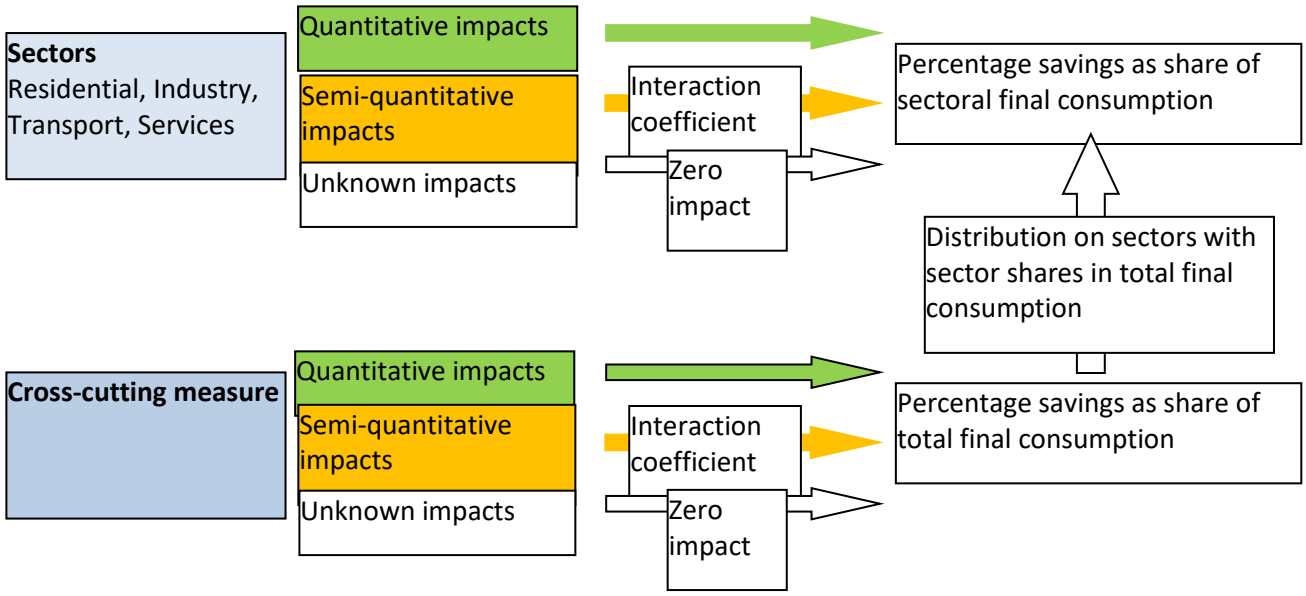
consumption for a given year (at present 2021). By default, the scoring period comprises ongoing measures from 2010 to present. Impacts are calculated for 2030.

The information on impacts in terms of energy savings for each measure in the MURE database may take two forms: quantitative and semi-quantitative estimates (see Figure 1).

- *Quantitative* information from dedicated evaluations of measure impacts, mostly from evaluations at national level. This information is gathered in formal tables and can be retrieved for the policy scoreboard. At present around 40% of all policy measures in the MURE database have such a quantitative policy impact evaluation.

- *Semi-quantitative expert estimates* on measure impacts which group the measures in three categories: measures saving less than 0.1% of the sector energy consumption (low impact measures), measures saving from 0.1 to less than 0.5% of the sector energy consumption (medium impact measures), and measures saving more than 0.5% (high impact measures). For measures in the cross-cutting database the percentages refer to the overall final energy consumption of the country. These estimates have been made by the National Teams in the MURE project, who have an excellent knowledge of the energy efficiency policies and measures in their countries. Nearly all measures in the database have been classified in such a manner.

Figure 1: Basic methodology for the output-based Scoreboard (related to energy consumption)



The methodology for determining the savings from energy efficiency policies is described in Figure 1:

- Quantitative impacts are extracted from the MURE database for the time frame 2020 for those measure where such impacts are provided. Only ongoing measures are taken into account. It is assumed that measures with quantitative estimates already include the interaction with other measures. Frequently this is the case. In some cases, energy savings have to be derived from CO_2-savings. Those were converted to energy savings, using average CO_2-emission factors of the sector and the countries.
- Semi-quantitative estimates are converted to quantitative estimates by using 0.1%, 0.3% (as the average of the category 0.1 to less than 0.5%) and 0.5% of the sectoral final energy consumption to characterize the measure impacts. These categories were established from typical measure impacts where quantitative savings are available. Measures without a quantitative impact where

classified by country experts. In order to consider interaction between those measures, a default interaction coefficient of 0.01% per measure is integrated into the calculation.

- Measures without a quantitative or semi-quantitative estimate are considered as "zero impact" in order to give a malus to measures, which are not characterized. In such a manner, the monitoring practice in the country is also taken into account.
- Savings from the cross-cutting sector, which contains measures that concern all sectors, are established in a similar manner. The savings from the cross-cutting measures are then distributed over the four sectors (residential services, transport and industry) according to the sector share in final energy consumption.

An example for the calculation procedure is provided below.

Calculation steps of Policy Scores:

Step 1: Calculation of energy savings (ES) for one sector s from measures j with <u>quantitative</u> impacts

For each country: $ES_{s,\ quantitative} = SUM\ (ES)_{s,j}$ s: sector, j: individual measure

In the example below, the quantitative savings add up to 55 PJ

Country: Germany, Sector s: Housholds		
Measure Number j	Measure Title	Quantitative Impact in 2020 (PJ)
1	Building regulation	27.0
2	Subsidy scheme	18.0
3	Information programme	3.0
4	Energy label	7.0
	ES(s, quantitative) =	**55.0**

Step 2: Calculation of energy savings (ES) for one sector s from measures j with <u>semi-quantitative</u> impacts

a. Calculation of ES based on semi-qualitative evaluation (low, medium, high)

Scale: low = 0.1%, medium = 0.3%, high = 0.5% of sector final energy consumption. Depending on the sector $ES_{s,semi\text{-}quantitative} = SUM\ (Scale_{s,j})^* FEC2016_s$

Where $FEC2016_s$ is the Final Energy Consumption of the sector s in a country

b. Calculation of interaction coefficients

Interaction Factor (IF_s) =0.99^(n-1)$_s$ (for n measures in the sector s) assuming 1% loss of impact at each interaction

Recalculation of ES with interaction

$ESI_{s,\ semi\text{-}quantitative} = ES_{s,semi\text{-}quantitative} * IF_s$

Country: Germany, Sector s: Housholds		Final energy consumption households 2016 (PJ):		2327
Measure Number j	Measure Title	Impact category	Semi-quantitative impact (% of final demand of sector	Quantitative Impact in 2020 (PJ)
1	Subsidy scheme	High	0.5%	11.6
2	Saving obligation	Medium	0.3%	7.0
3	Information programme	Low	0.1%	2.3
4	Audit scheme	Low	0.1%	2.3
			ES(s, semi-quantitative) =	**23.3**
			ES(s, semi-quantitative, including interaction factor) =	**22.4**

Step 3: Calculation of total energy savings (ES)

$ES_s = ES_{s,\ quantitative} + ES_{s,\ semi\text{-}quantitative}$

For Germany total savings in the household sector are calculated as 55.0 + 22.4 = 77.4 PJ

Step 4: Distribution of savings from cross-sectoral measures on each sector

	Savings ESI	Sector final consumption 2016	Sector savings including cross-cutting savings
	PJ	PJ	PJ
Households	77.4	2327	83.4
Transport	38.3	2695	45.2
Industry	42.4	2631	49.2
Services	18.5	1474	22.3
Cross-cutting	23.5	9127	
		(=overall final energy)	

2. Calculation of scores by sector

The sector results are then first normalised by dividing the (absolute) savings by the sectoral final energy consumption of the country in 2016. Finally for each sector, the results for each country are then normalised to scale from 0 to 1 which is spanned up by the country with the highest savings (=1) and the lowest savings (=0), according to a similar formula as for the indicator-based parts of the European Energy Efficiency Scoreboard (see above):

$$Normalized\ score = \frac{Policy\ Score - Min\ Policy\ Score}{(Max\ Maximum\ Policy\ Score - Min\ Policy\ Score)}$$

Policy Score: The policy Score achieved by a country.
Min Policy Score: The minimum Policy Score across all EU countries.
Max Policy Score: The maximum Policy Score across all EU countries.

The scale is set by the EU countries. Non-EU countries may exceed 1 or show values below zero.

Normalisation of Policy Scores for one sector:

The savings obtained above for the household sector of 83.4 PJ (including the share of cross-cutting measures related to households) is normalised to the sector final energy consumption 2327 PJ:

83.4 PJ/2327 PJ =	3.58%

The score of the sector is normalized from 0 to 1 so as to give 1 to the highest value, 0 to the lowest: if the highest value for the sector is 4.38% and the lowest 1.55%, the normalized level score of households for Germany is:

$$\frac{(3.58-1.55)}{(4.38-1.55)} = \mathbf{0.71}$$

3. Calculation of global scores

The sectoral scores calculated as indicated in section 2 are then aggregated to a global score for policies, by weighting the sector scores with the share in the final energy consumption. Then again, the resulting values are normalised from 0 to 1 (scale set by EU countries), with 1 given to the country with the highest score, and 0 to the country with the lowest sectoral or overall score in the same way as described in section 2 for each sector.

Annex 1: List of indicators used to calculate the scores by sector

Households

End-use	Indicator	Weighting factor
Heating	Consumption for heating per m^2 scaled to EU climate and equivalent to central heating[3]	Share of heating in total households consumption
Other thermal uses	Consumption per dwelling for cooking and water heating	Share of cooking + ½ of water heating in total households consumption
Appliances	Specific consumption of electricity per dwelling for appliances (including AC) and lighting	Share of appliances (incl. AC) & lighting in households consumption
Solar penetration	% of dwellings with solar water heater	½ share of water heating in households consumption

Transport

Modes	Indicator	Weighting factor
Cars	Specific consumption (goe/pkm)	Share of cars in total transport consumption
Trucks and light vehicles	Specific consumption (goe/tkm)	Share of trucks and light vehicles in total transport consumption
Air	Specific consumption (koe/pass)	Share of air in total transport consumption
Modal split: -Passengers -Goods	 % of traffic by public mode % of traffic by rail and water	 Share of buses and rail passengers in total transport consumption Share of water and rail freight consumption in total transport

Services

End-use	Indicator	Weighting factor
Thermal end-uses	Thermal end-uses consumption per employee scaled to EU climate	Share of thermal end-uses in total services
Electricity	Specific consumption of electricity per employee (including AC and excluding thermal uses[4])	Share of specific electricity consumption in total services

Industry

Category	Indicator
Indicator of trend	ODEX (energy efficiency index)[5]
Indicator of level	Adjusted energy intensity at EU industry structure[6]

[3] The consumption for heating scaled to EU climate is obtained by multiplying the heating consumption of households per m2 at normal climate by the ratio mean number of heating degree days of a country over mean number of heating degree days of the EU average (mean degree days are taken from Eurostat). The indicator equivalent to central heating is then obtained by dividing the unit consumption by (% of central heating + (1-% of central heating)*25%). This correction assumes that a dwelling with central heating (i.e. with all rooms well heated) consumes 25% more than a dwelling with room heating, where generally a stove provides heat to the main room only.

[4] For countries for which data by end-use are not available, the total electricity consumption is taken.

[5] ODEX measures the energy efficiency progress. The index is calculated as a weighted average of sub-sectoral indices of unit consumption by branch; the weight used is the share of each branch in the total energy consumption of industry. The evaluation is carried out at the level of 10 branches: the unit consumption is expressed in terms of energy used per ton produced for energy intensive products (steel, cement and paper) and in terms of energy used related to the production index for the other branches.

[6] The energy intensity of industry at EU structure represents a fictitious value of the industrial intensity calculated by taking for each industrial branch the actual sectoral intensity of the country and the EU industrial structure (i.e.

Countries notes

Global

- Ireland: global level score calculated with a level score of industry based on industrial intensity.
- Malta: global score calculated with a score of industry based on industrial intensity.

Households

- Denmark: as the split between space and water heating is not available, it is assumed that 80% of this consumption is used for space heating and 20% for water heating.
- Norway: space heating, water heating and electrical appliances consumption come from non-official statistics (not public), cooking consumption is estimated assuming the same unit consumption as for Sweden.
- Slovakia: cooking consumption is estimated assuming the same unit consumption as for Slovenia.
- Belgium: average area of dwellings has been estimated using surface area of new dwellings, annual construction of dwellings and stock of dwellings.

Transport

- Malta: as the road consumption by type of vehicle is not available, these data have been estimated by Enerdata.
- Romania, Sweden: as the road consumption by type of vehicle is not available from 2012 and 2014 respectively, these data have been estimated by Enerdata (based on a methodology using unit consumption per car equivalent).
- Estonia: same comment as for Romania and Sweden but for the whole period

Industry

- Ireland: as some industrial VA are missing, the adjusted industry intensity to EU structure cannot be calculated. Therefore, the industry score is based only on trend score (so equal to ODEX score).
- Malta: no score for Malta due to lack of data by branch and the small size of the industry

Services

- Austria, Belgium, Croatia, Cyprus, Estonia, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Norway, Poland, Czech Republic, Romania, Slovakia, Slovenia: As data by end-use are not available, the total fuel consumption (fossil fuels+ district heating) is taken for the thermal end-uses indicator and the total electricity consumption is taken for the electricity indicator.

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the share of each branch in the value added of industry). For Finland and Sweden, as pulp & paper represents around half of the total industrial consumption, the adjusted indicator is based on physical quantities instead of value added for pulp & paper (production of paper and pulp) and on VA for the other branches.