"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 694638"

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EE Benchmarking methodology

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Abstract	The main objective of this work is to produce an energy benchmarking study in small and medium size enterprises (SMEs) for the NACE Rev. 2 subsector codes 24, 25 and 28.

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Version	Date	Author	Reason	Sections
1	31/08/2016	AIN	Initial Release	All
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AMENDMENTS IN THIS RELEASE:

Section Title	Section Number	Amendment Summary
Second page, before table of contents.		Disclaimer inclusion
Mehodology	2.	Include formulas and clarifications

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1 INTRODUCTION AND OBJECTIVES

The main objective of this work is to produce an energy benchmarking study in small and medium size enterprises (SMEs) for the NACE Rev. 2 subsector codes 24, 25 and 28.

C24: MANUFACTURE OF BASIC METAL

C25: MANUFACTURE OF FABRICATED METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT

C28: MANUFACTURE OF MACHINERY AND EQUIPMENT N.E.C.

With an annual energy consumption of: < 38GWh for sector C24,

> 0.5 GWh for sector C25 and

> 0.5 GWh for sector C28

This study aims to be an energy analysis tool for these subsectors, to offer companies the possibility to establish comparisons with others in the same subsector, as well as to enable them to control their evolution over time.

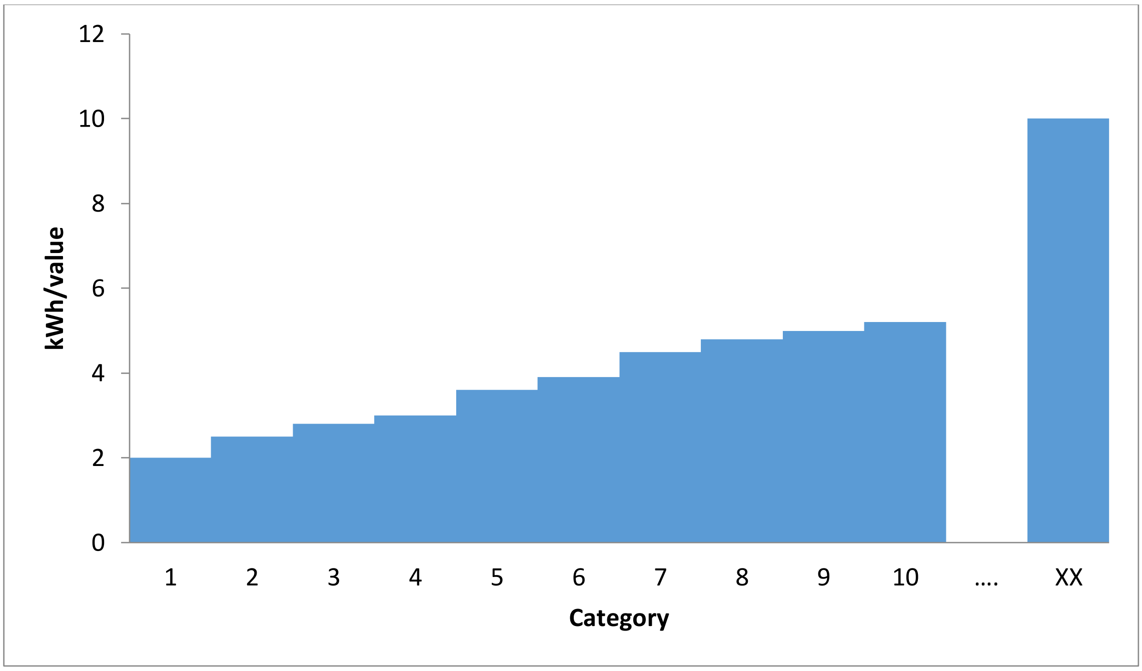
The two main objectives of this study are:

- To categorize the company within a ranking with regard to others in the same sub-sector.
- To establish the savings potential that a company could reach in terms of their position in that ranking.

To that end, this study has been divided into two phases: in the first, the methodology (current phase) will be defined and in the second that methodology will be applied using the data obtained from energy audits to be carried out. As a result of the application of the methodology following the audits, the methodology described herein may be reviewed.

2 METHODOLOGY

The starting point for the development and application of the methodology will be the creation of an energy ranking. This ranking will establish certain energy categories for each of the energy indicators defined in Table 1. Energy efficiency indicators for Benchmarking. This will be represented in a bar chart of the type shown below:



The data on each axis will be as follows:

The X axis will show the energy categories with category 1 being the most efficient; and the Y axis the energy efficiency indicator which will be used as a comparison and whose values will be provided by the completed energy audits.

Each category will represent an energy situation that will reflect different technologies used in each discipline. These categories will be determined through energy analysis of results obtained from audits that will be carried out.

Since it is practically impossible for two companies in the same sub-sector to have the same production process, different rankings will be created for the different indicators.

Rankings for each energy efficiency indicator and sub-sector will be determined in such a way that any company will know, simultaneously, its energy position within its subsector and in the discipline specified by the energy efficiency indicator, as well as the potential saving that can

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be achieved. For this purpose, thirteen rankings will be created for each subsector as indicated in Table 1.

Each discipline, and hence each energy efficiency indicator, is in turn affected by different influencing factors some of which will need to be considered so that the benchmarking can be comparable across countries the European Union.

The following table shows the energy efficiency indicators which will be used to establish the methodology, as well as the influencing factors for each one.

INDICATORS OF ENERGY EFFICIENCY FOR THE BENCHMARKING				
INDICATORS (IEE) AND INFLUENCE FACTORS (IF)				**VALUE**
IEE_1	**Total energy consumption per production value**			**kWh / €**
IEE_2	**Total carbon dioxide emission per production value**			**t_{CO2}/€**
IEE_3	**Displacement power factor for reactive energy**			**Cosϕ**
IEE_4	**Energy consumption in illumination**			**kWh / (m^2 x working hours)**
	IF_1.1	Lamp type:		
			Fluorescent	
			Mercury Vapour	
			Metal Halide	
			High-Pressure Sodium	
			Low-Pressure Sodium	
			Led	
	IF_1.2	Control type		
	IF_1.3	Hours day lighting		
IEE_5	**Energy consumption in HVAC (Heating, Ventilating and Air Conditioning)**			
IEE_5.1	**Energy consumption in heating.**			**kWh / (m^2 x working hours)**
	IF_5.1.1	Type of equipment		
	IF_5.1.2	Type of energy consumed		
	IF_5.1.3	Regulation type		
	IF_5.1.4	Day degrees		
IEE_5.2	**Energy consumption in cooling.**			**kWh / (m^2 x working hours)**
	IF_5.2.1	Type of equipment		
	IF_5.2.2	Regulation type		
	IF_5.2.3	Day degrees		

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IEE_6	**Energy consumption in compressed air**		**kWh / Production units (unit, Kg, m3 of compressed air demand..)**
	IF_6.1	Work pressure	
	IF_6.2	Regulation type	
IEE_7	**Energy consumption in process boilers**		**kWh / Production units (unit, Kg, ..)**
	IF_7.1	Fuel type	
	IF_7.2	Boiler type	
	IF_7.3	Regulation type	
IEE_8	**Energy consumption in furnace**		**kWh / Production units (unit, Kg, ..)**
	IF_8.1	Fuel of energy consumed	
IEE_9	**Energy consumption in electric motors**		**Average efficiency (%)**
	IF_9.1	Number of electric motors	
	IF_9.2	Power	
	IF_9.3	Age of electric motors or Efficiency level	
	IF_9.4	Maintenance and Operation	
IEE_10	**Energy consumption in pumps and fans**		**% Saving**
	IF_10.1	Number of electric motors	
	IF_10.2	Power	
	IF_10.3	Number of electric motors with variable speed drive	
	IF_10.4	Average percentage of speed variation (each electric motor)	
IEE_11	**Energy consumption in process cooling systems**		**kWh / Production units (unit, Kg, ..)**
	IF_11.1	Type of process cooling systems	
IEE_12	**Energy efficiency in photovoltaic plants**		
IEE_12.1			**Performance ratio**

IEE_12.2			Generated electricity /Total electricity consumed in the company
	IF_12.1	Peak Power	
	IF_12.2	Type of PV modules (monocrystalline, polycristalline etc.)	
	IF_12.3	Inclination and orientation od modules	
	IF_12.4	Location	

IEE_13	Energy efficiency of solar thermal energy plants		m2 of panels/number of workers
	IF_13.1	Type of solar collector	
	IF_13.2	Local climatic conditions	

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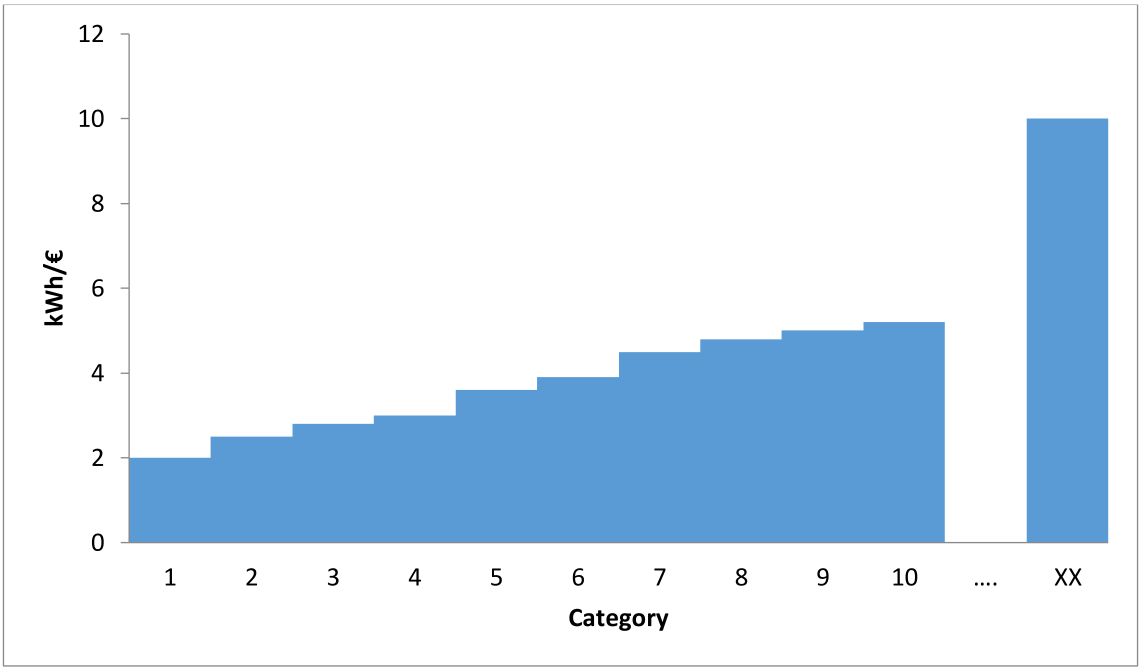
The relationships between the different influencing factors set for each energy efficiency index are given below:

2.1 IEE1. Total energy consumption per production value. kWh/€

To establish this indicator, the total energy consumption and the economic value of production in 2015 will be taken into account.



For this value to be comparable between different countries it needs to be harmonised. For this purpose, we will establish a correction factor Fh_v. The resulting energy efficiency indicator will be:

$$IEE1 = \frac{kWh}{€} xFh\_v$$

This harmonization factor will take into account Purchasing Power Parities (EU28=1) for GDP (Gross Domestic Product) of each country. Average value of the years 2007 to 2016 will be used.

These values can be obtained from the statistical office of the European Union, EUROSTAT.

These values are:

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	Average value (10 years)
France	1,105
Italy	0,996
Poland	0,562
Spain	0,919
European Union (28 countries)	1,000

Note: To obtain the value of Poland, an exchange value of Zloty / € = 4,2207 has been considered.

The correction factor for each country will be:

	F_{h_v}
France	0,905
Italy	1,004
Poland	1,779
Spain	1,088

The categories will be formed in bands of production values.

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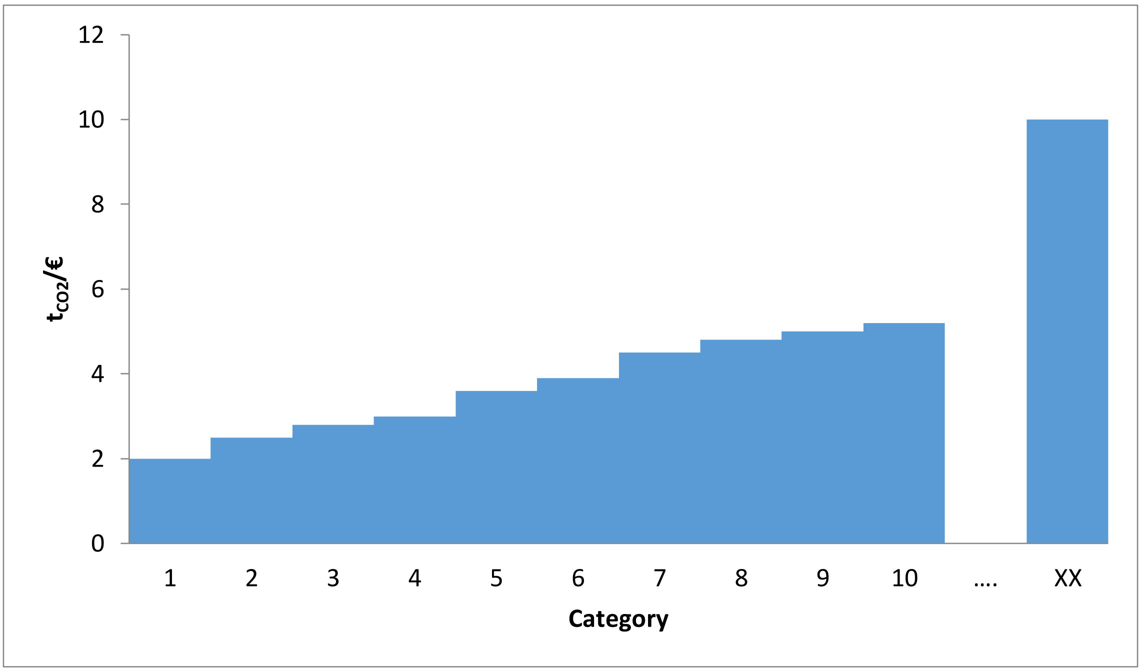
2.2 IEE2. Total carbon dioxide emission per production value. $t_{CO2}/€$

To establish this indicator, the energy consumption per type of energy source and the economic value of production in 2015 will be taken into account.



Total emission of CO2 for fuel = fuel consumption x fuel emission factor

Total emission of CO2 for electricity = electricity consumption x electricity emission factor

To calculate emission of carbon dioxide, the reference values of the fuel calculation factors, approved by Regulation 601/2012 of the European Commission, can be used.

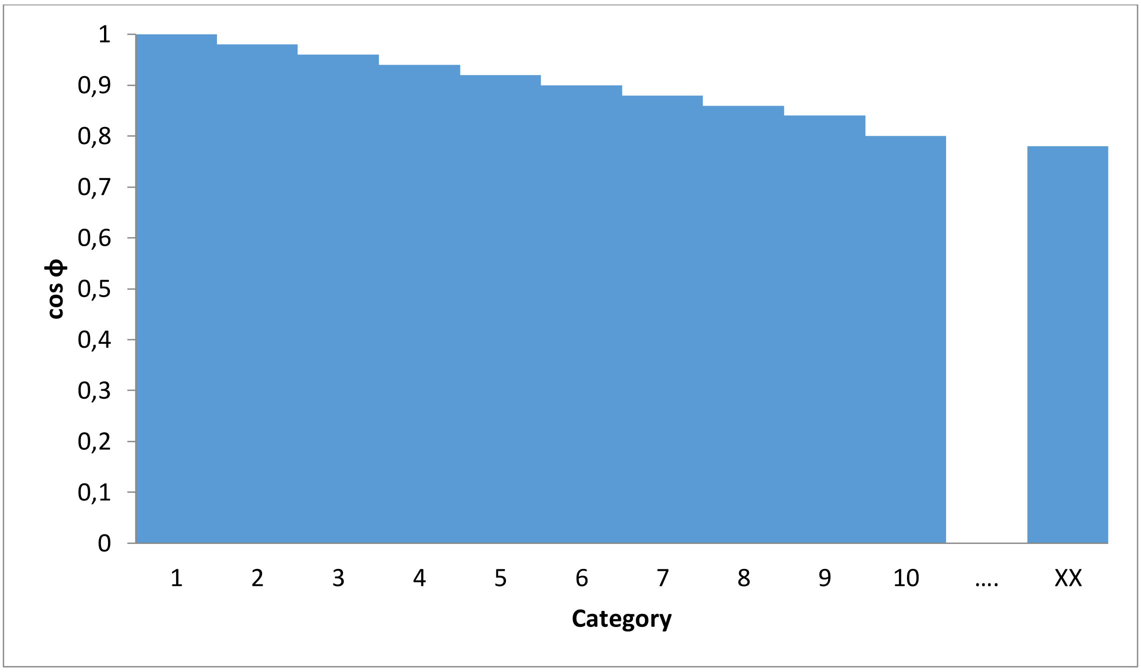
Annex VI of: http://eur-lex.europa.eu/legal-content/ES/TXT/?uri=CELEX%3A32012R0601

In the case of electricity, each country will use its reference value, because it depends on its energy mix.

The categories will be formed in bands of production values.

2.3 IEE3. Displacement power factor for reactive energy. Cosφ

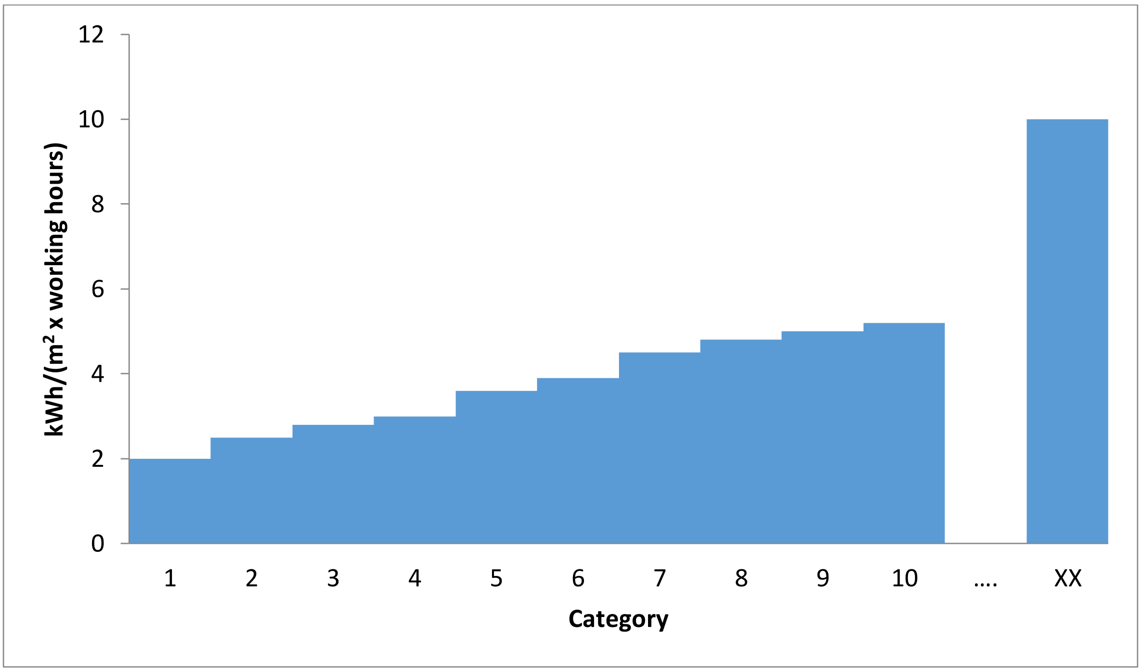
This indicator can be obtained from the electricity bills.



The categories will be grouped according to levels of annual electricity consumption.

2.4 IEE4. Energy consumed in lighting. kWh/(m^2 x working hours)

To establish this indicator, the energy consumption in lighting, the illuminated surface and the number of working hours in 2015 will be taken into account.



This indicator of energy efficiency is specially influenced by the following factors:

- The type of lamp used. In industry, the following technologies are mainly used:
  - Fluorescent lamps
  - Mercury vapour lamps
  - Metal halide lamps
  - High pressure sodium vapour lamps.
  - Low pressure sodium vapour lamps.
  - Led
- The type of control. There are usually two situations
  - Manual control: corresponds to the usual practice of lighting on and off by the worker.

- Control by natural light controllers, and progressive regulation. One sensor of light, installed in a strategic location, measures the level of natural light received and automatically adjusts the input of artificial light to what is necessary.

For this value to be comparable between different countries an important factor to considerer is the number of daylight hours. Due to the different geographical situations of European countries, the number of daylight hours varies between one and another. Therefore, the value of this indicator will be harmonized with regard to the hours of daylight available in each of the countries, with the factor Fh_a. The resulting energy efficiency indicator will be:

$$IEE4 = \frac{kWh}{(m^2 x \; working \; hours)} xFh\_a$$

The values of hours of sunshine obtained from the World Meteorological Organization are taken into account to calculate the value of Fh_a.

http://www.wmo.int/datastat/wmodata_en.html

http://data.un.org/Data.aspx?d=CLINO&f=ElementCode%3a15

The values used are the average annual values of the meteorological stations of each country in the last collection period. (1961-1990, 30 years).

Therefore, the values used are:

	Average value (30 years) hours/year
France	2.107
Italy	2.270
Poland	1.507
Spain	2.543

Fh_a are relative values that show the ratio between different countries for the same content.

E.g. If mean number of hours of sunshine per year in Spain are 100 and in France 82,89, then the Fh_a between France and Spain is 1,21. This means that one hour of sunshine in France equals 1,21 hours of sunshine in Spain.

With this base the following values of Fh_a are obtained:

	F_{h_a}
France	1,21
Italy	1,12
Poland	1,69
Spain	1,00

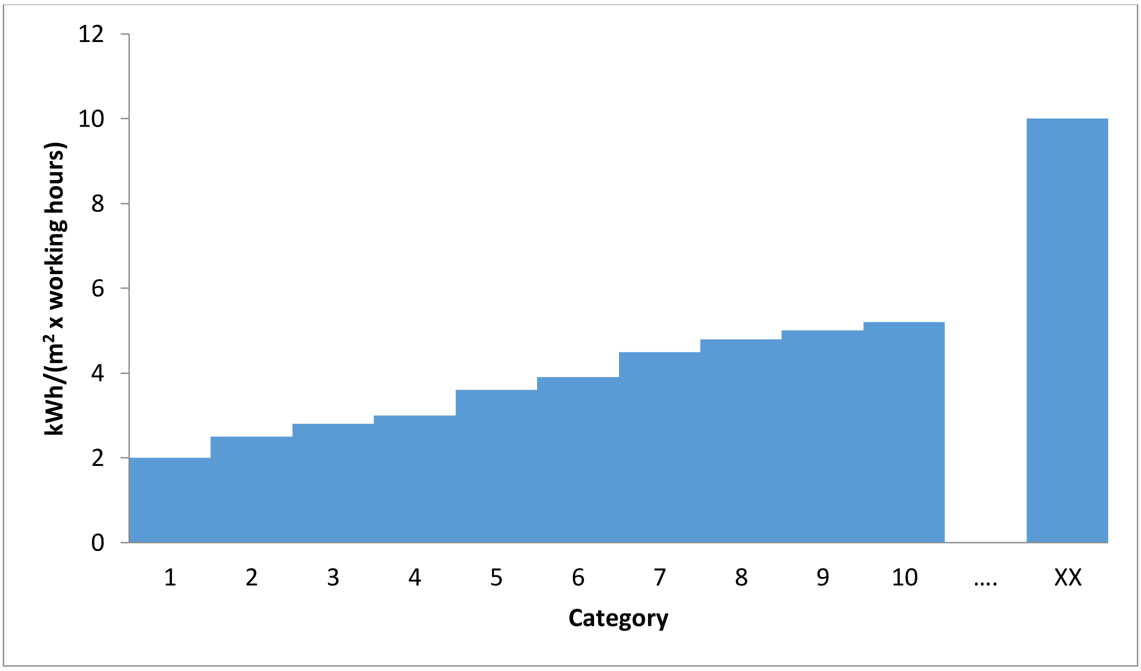
For this indicator categories will be established by technology groups (type of lamp) and control type.

2.5 IEE5. Energy consumed in air conditioning.

In this discipline we differentiate between heating and cooling.

2.5.1 IEE5.1. Energy consumed in heating. kWh/(m² x working hours)

To establish this indicator, the energy consumption in heating, the type of equipment used, the heated area and the number of hours of work during 2015 will be taken into account.



This indicator of energy efficiency is specially influenced by the following factors:

- The type of equipment used - in industry, the following technologies are mainly used:
  - Conventional or regular boiler
  - Low-temperature heating system
  - Condensing boiler
  - Unit heaters
- The type of energy consumed.
  - Coal
  - Fuel
  - Gasoil

  - Natural gas
  - Biomass
  - Electricity
- The type of regulation – there are usually two options:
  - On/off regulation: corresponds to the usual practice of on/off of equipment.
  - Automatic regulation by modulating burner.

For this value to be comparable between different countries an important factor to considerer is the Heating Degrees-Day. Due to the different geographical and meteorological situations in European countries, the heating degrees-day varies between one and another. Therefore, the value of this indicator will be harmonized, with regard to the heating degrees-day in each of the countries, with the factor Fh_c. The resulting energy efficiency indicator will be:

$$IEE5.1 = \frac{kWh}{(m^2 x working\ hours)} x Fh\_c$$

The values of degree-days for heating obtained from the statistical office of the European Union, EUROSTAT are taken into account to calculate the value of Fh_c.

http://ec.europa.eu/eurostat/data/database

The values used are the average values of the last 20 years of each country. (1997-2016).

Therefore, the values used are:

	Average value (20 years) Degree-days for heating
France	2.373,55
Italy	1.920,06
Poland	3.420,47
Spain	1.784,27

Fh_c are relative values that show the ratio between different countries for the same content.

E.g. If mean number of degree-days for heating in Poland are 100 and in Spain 52,16 then the Fh_c between Poland and Spain is 1,92. This means that one degree-day for heating in Spain equals 1,92 degree-days in Poland.

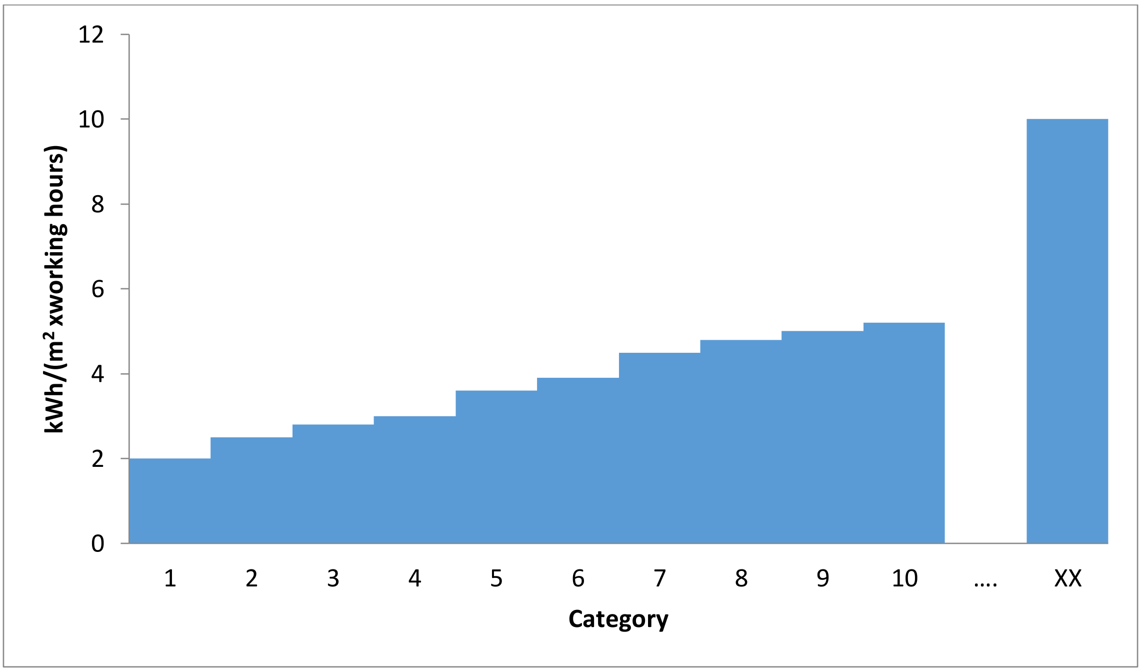
With this base the following values of Fh_c are obtained:

	Fh_c
France	1,44
Italy	1,78
Poland	1,00
Spain	1,92

For this indicator categories will be established by groups according to equipment type used, type of energy consumed and regulation type.

2.5.2 IEE5.2. Energy consumed in Cooling. kWh/(m2 x working hours)

To establish this indicator, the energy consumption in cooling, the cooling area and the number of hours of work during 2015 will be taken into account.



This indicator of energy efficiency is specially influenced by the following factors:

- The type of equipment used - in industry, the following technologies are mainly used:
    - Mechanical ventilation

  - Individual cooling systems
  - Central systems of air-air (roof top)
- The type of regulation – there are usually two options:
  - On/off regulation: corresponds to the usual practice of on/off of equipment.
  - Automatic regulation.

For this indicator to be comparable between different countries an important factor to considerer is the Cooling Degrees-Day. Due to the different geographical and meteorological situations of the European countries, the cooling degrees-day varies between one and another. Therefore, the value of this indicator will be harmonized, with regard to the cooling degrees-day in each of the countries, with the factor Fh_r. The resulting energy efficiency indicator will be:

$$IEE5.2 = \frac{kWh}{(m^2 x\ working\ hours)} xFh\_r$$

The values of degree-days for cooling obtained from the statistical office of the European Union, EUROSTAT are taken into account to calculate the value of Fh_r.

http://ec.europa.eu/eurostat/data/database

The values used are the average values of the last 20 years of each country. (1997-2016).

Therefore, the values used are:

	Average value (20 years) Degree-days for cooling
France	42,21
Italy	210,28
Poland	17,99
Spain	213,45

Fh_r are relative values that show the ratio between different countries for the same content.

E.g. If mean number of degree-days for cooling in Spain are 100 and in France 19,78 then the Fh_r between Spain and France is 5,06. This means that one degree-day for cooling in France equals 5,06 degree-days in Spain.

With this base the following values of Fh_r are obtained:

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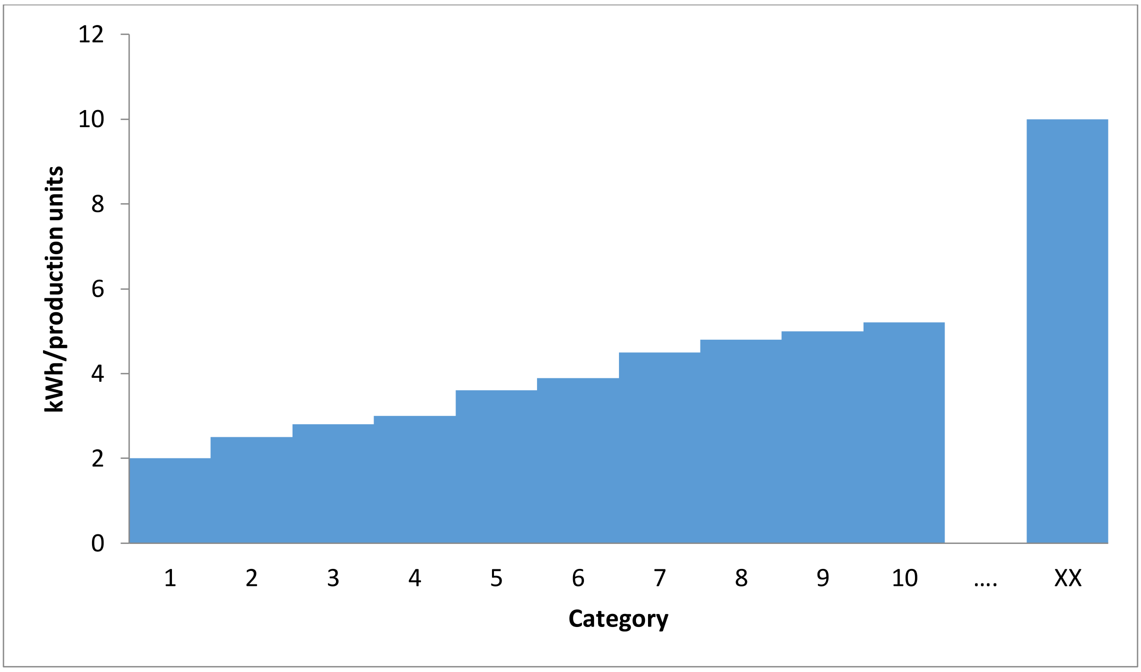
	Fh_r
France	5,06
Italy	1,02
Poland	11,87
Spain	1,00

For this indicator, categories will be established by groups according to equipment type used and regulation type.

2.6 IEE6. Energy consumed in compressed air. kWh/Production units (Unit, Kg, m3 of compressed air demand...)

To establish this indicator, the energy consumption in compressed air production during 2015, the working pressure and the type of regulation will be taken into account.



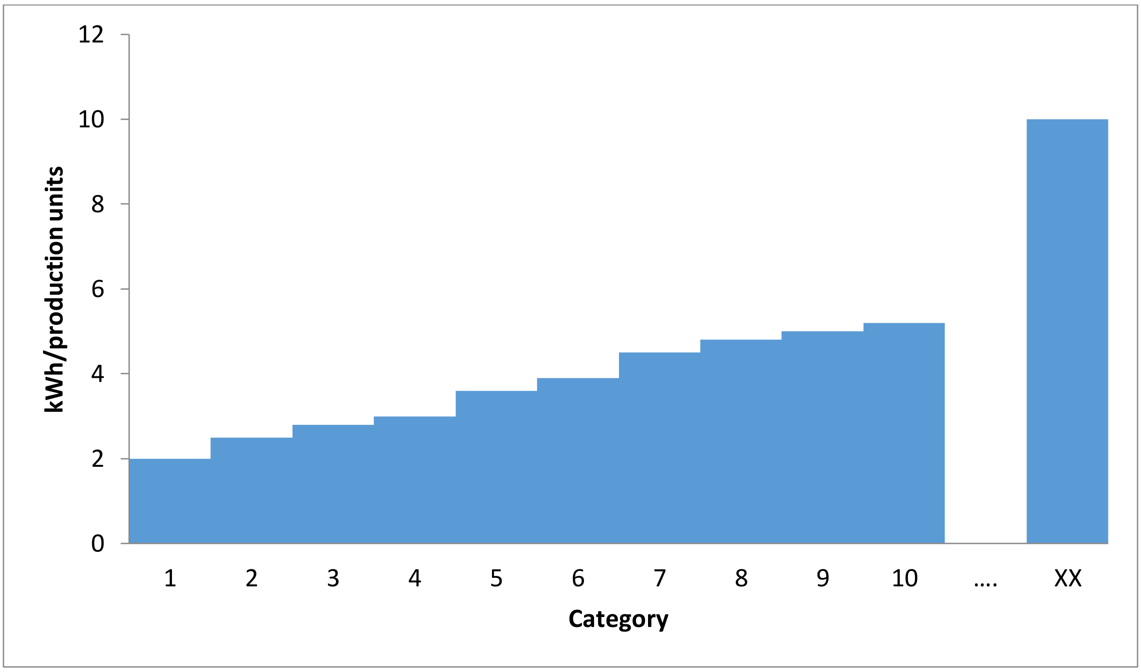
This indicator of energy efficiency is influenced by the following factors:

- The working pressure.
- The type of regulation – there are usually two options:
    - Compressor without variable speed drive technology.
    - Compressor with variable speed drive technology.

For this indicator, categories will be established by groups according to working pressure (e.g. Pw < 6 bar; 6 < Pw < 8 bar and Pw > 8 bar) and regulation type

2.7 IEE7. Energy consumed in process boilers. kWh/Production units

To establish this indicator, the energy consumption in process boilers during 2015, the type of boiler, the type of energy consumed and the type of regulation will be taken into account.



This energy efficiency indicator is specially influenced by the following factors:

- The type of boiler - in the industry, according to the needs of the process, the following types of boilers can be used:
  - Conventional hot water boiler
  - Thermal oil boiler
  - Steam boiler
- The type of energy consumed.
  - Fuel
  - Gasoil
  - Natural gas
  - Biomass
- The type of regulation – there are usually two options:
  - On/off regulation - corresponds to the usual practice of on/off of equipment.

- Automatic regulation by modulating burner.

For this indicator, categories will be established by groups according to the type of boiler, type of energy consumed and regulation type.

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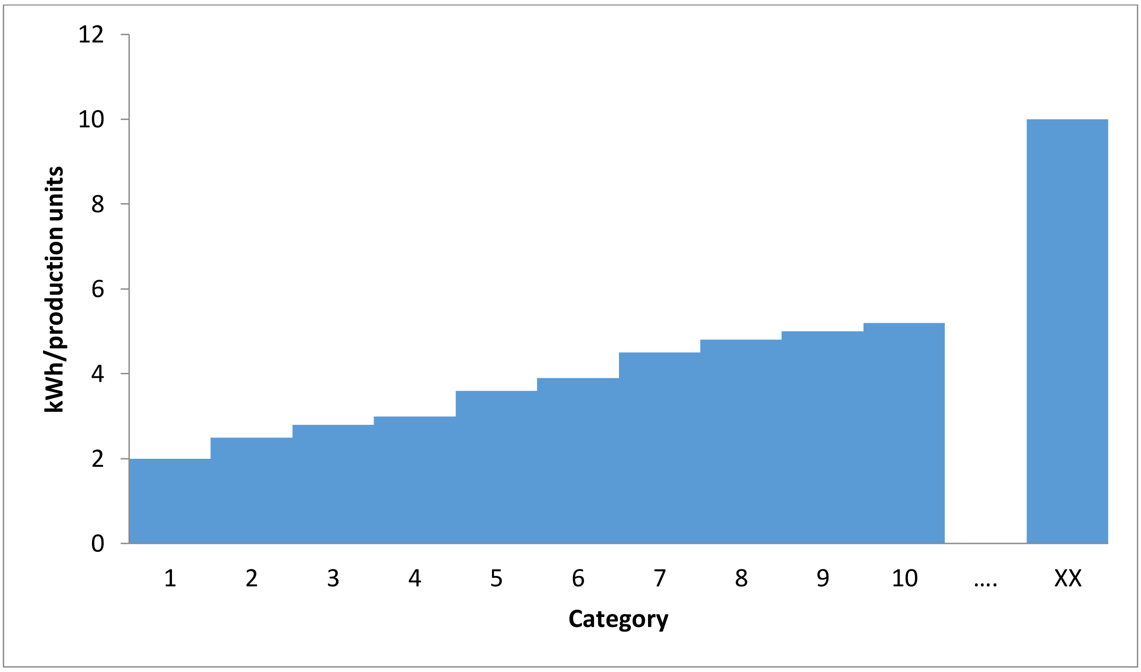
2.8 IEE8. Energy consumed in furnaces. kWh/Production units

To establish this indicator, the energy consumption in furnaces during 2015 and the type of energy consumed will be taken into account.



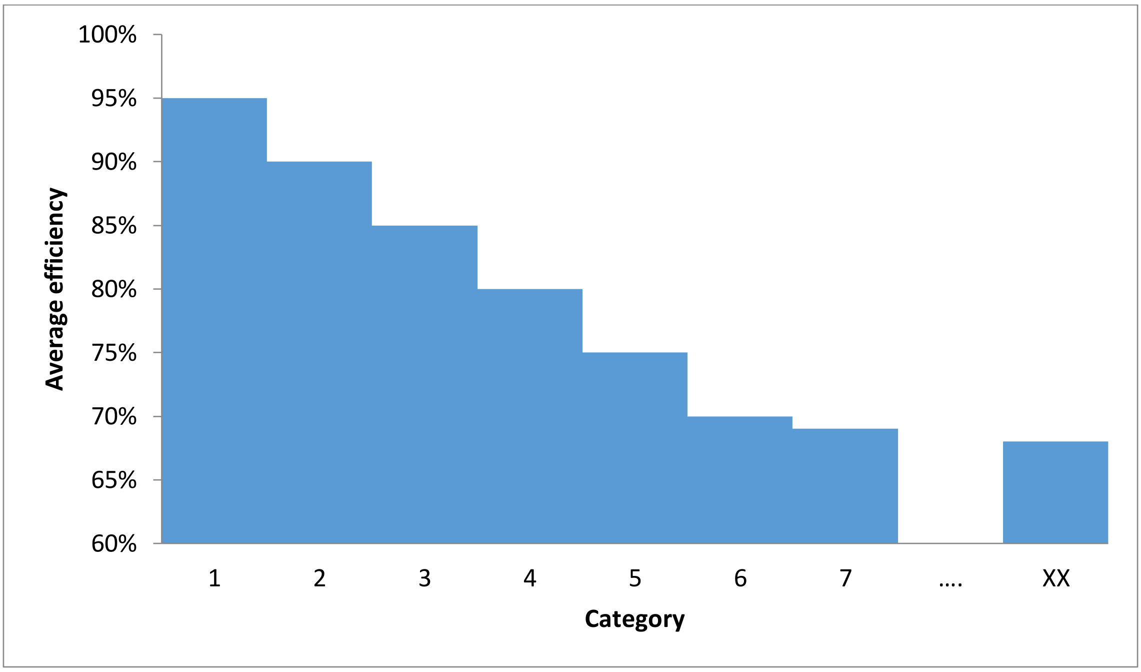
This energy efficiency indicator is specially influenced by:

- The type of energy consumed.
  - Fuel
  - Gasoil
  - Natural gas
  - Electricity

For this indicator, categories will be established by groups according to the type of energy consumed.

2.9 IEE9. Energy consumed in electrical motors. Average efficiency (%)

To establish this indicator, the power of electric motors, the year of manufacture and/or nominal efficiency level and the type of regulation will be taken into account.



Only low voltage asynchronous squirrel cage motors will be taken into account.

This indicator is specially influenced by the year of manufacture of electrical motors. This is a key to establishing the electrical motor nominal efficiency factor.

According to the year of manufacture, electric motors are classified according to their energy efficiency at various levels.

In 1998, the first energy classification at a European level took place, called CEMEP. In this classification three levels of efficiency are established, EFF1, EFF2 and EFF3. According to these levels, electric motors have to comply with a value of nominal efficiency, according to their power and the number of poles. The following table shows the minimum efficiency that motors must meet depending on their classification, power and number of poles.

	EFF1 η_n		EFF2 η_n		EFF3 η_n	
kW	2 POLES	4 POLES	2 POLES	4 POLES	2 POLES	4 POLES
1.1	>= 82.8	>= 83.8	>= 76.2	>= 76.2	< 76.2	< 76.2
1.5	>= 84.1	>= 85	>= 78.5	>= 78.5	< 78.5	< 78.5
2.2	>= 85.6	>= 86.4	>= 81	>= 81	< 81	< 81
3	>= 86.7	>= 87.4	>= 82.6	>= 82.6	< 82.6	< 82.6
4	>= 87.6	>= 88.3	>= 84.2	>= 84.2	< 84.2	< 84.2
5.5	>= 88.6	>= 89.2	>= 85.7	>= 85.7	< 85.7	< 85.7
7.5	>= 89.5	>= 90.1	>= 87	>= 87	< 87	< 87
11	>= 90.5	>= 91	>= 88.4	>= 88.4	< 88.4	< 88.4
15	>= 91.3	>= 91.8	>= 89.4	>= 89.4	< 89.4	< 89.4
18.5	>= 91.8	>= 92.2	>= 90	>= 90	< 90	< 90
22	>= 92.2	>= 92.6	>=90.5	>=90.5	< 90.5	< 90.5
30	>= 92.2	>= 93.2	>= 91.4	>= 91.4	< 91.4	< 91.4
37	>= 93.3	>= 93.6	>= 92	>= 92	< 92	< 92
45	>= 93.7	>= 93.9	>= 92.5	>= 92.5	< 92.5	< 92.5
55	>= 94	>= 94.2	>= 93	>= 93	< 93	< 93
75	>= 94.6	>= 94.7	>= 93.6	>= 93.6	< 93.6	< 93.6
90	>= 95	>= 95	>= 93.9	>= 93.9	< 93.9	< 93.9

Source: CEMEP

For electric motors whose nominal efficiency is not known, an energy efficiency is assumed at the boundary between the classes EFF2 and EFF3 if never repaired. If the electrical motor has been repaired, an additional loss of 0.5% for each repair is considered.

Subsequently, the energy classification CEMEP is replaced by the one developed in Regulation (EC) No. 640/2009. These regulations establish the following levels of efficiency:

	IE1 ηn			IE2 ηn			IE3 ηn		
kW	2 POLES	4 POLES	6 POLES	2 POLES	4 POLES	6 POLES	2 POLES	4 POLES	6 POLES
0.75	72.1	72.1	70	77.4	79.6	75.9	80.7	82.5	78.9
1.1	75	75	72.9	79.6	81.4	78.1	82.7	84.1	81
1.5	77.2	77.2	75.2	81.3	82.8	79.8	84.2	85.3	8.25
2.2	79.7	79.7	77.7	83.2	84.3	81.8	85.9	86.7	84.3
3	81.5	81.5	79.7	84.6	85.5	83.3	87.1	87.7	85.6
4	83.1	83.1	81.4	85.8	86.6	84.6	88.7	88.6	86.8
5.5	84.7	84.7	83.1	87	87.7	86	89.2	89.6	88
7.5	86	86	84.7	88.1	88.7	87.2	90.1	90.4	89.1
11	87	87	86.4	89.4	89.8	88.7	91.2	91.4	90.3
15	88.7	88.7	87.7	90.3	90.6	89.7	91.9	91.1	91.2
18.5	89.3	89.3	88.6	90.9	91.2	90.4	92.4	92.6	91.7
22	89.9	89.9	89.2	91.3	91.6	90.9	92.7	93	92.2
30	90.7	90.7	90.2	92	92.3	91.7	93.3	93.6	92.9
37	91.2	91.2	90.8	92.5	92.7	92.2	93.7	93.9	93.3
45	91.7	91.7	91.4	92.9	93.1	92.7	94	94.2	93.7
55	92.1	92.1	91.9	93.2	93.5	93.1	94.3	94.6	94.1
75	92.7	92.7	92.6	93.8	94	93.7	94.7	95	94.6
90	93	93	92.9	94.1	94.2	94	95	95.2	94.9

For this indicator, the categories will be established by power range groups. The calculation of the average efficiency in each range will be the weighted average of the electrical motors included in that range.

E.g.: In the category 1 the following motors are included:

Electrical Power (kW)	Year of manufacture	Level of efficiency
1,1	1980	EFF3
0,75	2001	EFF2
1,5	2001	EFF1
0,75	1985	EFF3

According to the motor, the power, the year of manufacture or level of efficiency and the tables corresponding to the minimum efficiency guaranteed by the regulations, the following nominal performance are obtained:

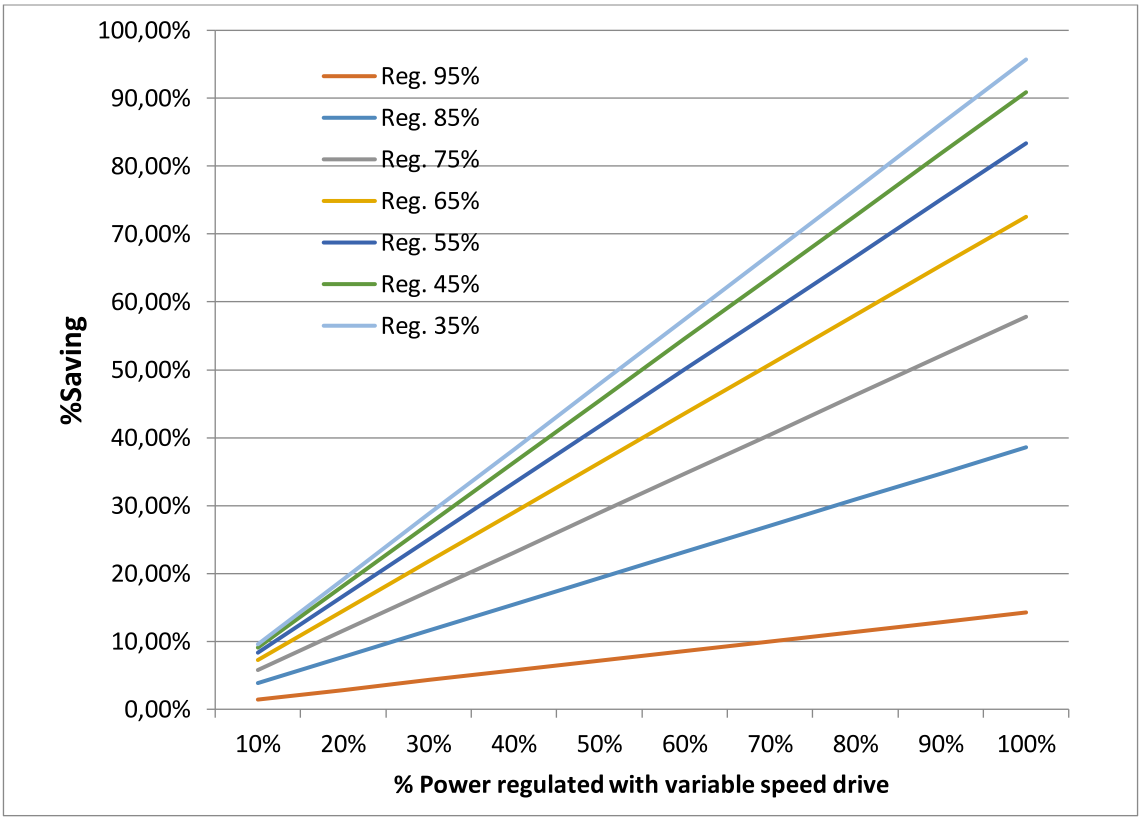
Electrical Power (kW)	Year of manufacture	Level of efficiency	Nominal efficiency
1,1	1980	EFF3	76,20%
0,75	2001	EFF2	79,45%
1,5	2001	EFF1	88,00%
0,75	1985	EFF3	76,30%

The average efficiency (%) for the category 1 will be:

((1,1*0,76)+(0,75*0,79)+(1,5*0,88)+(0,75*0,76)) / (1,1+0,75+1,5+0,75) = 81,13%

2.10 IEE10. Energy consumed in pumps and fans. % saving

To establish this indicator, installed power for pumps and fans and the flow control type will be taken into account.



As types of regulation, we distinguish two options, one without regulation and other with regulation by speed variable drives.

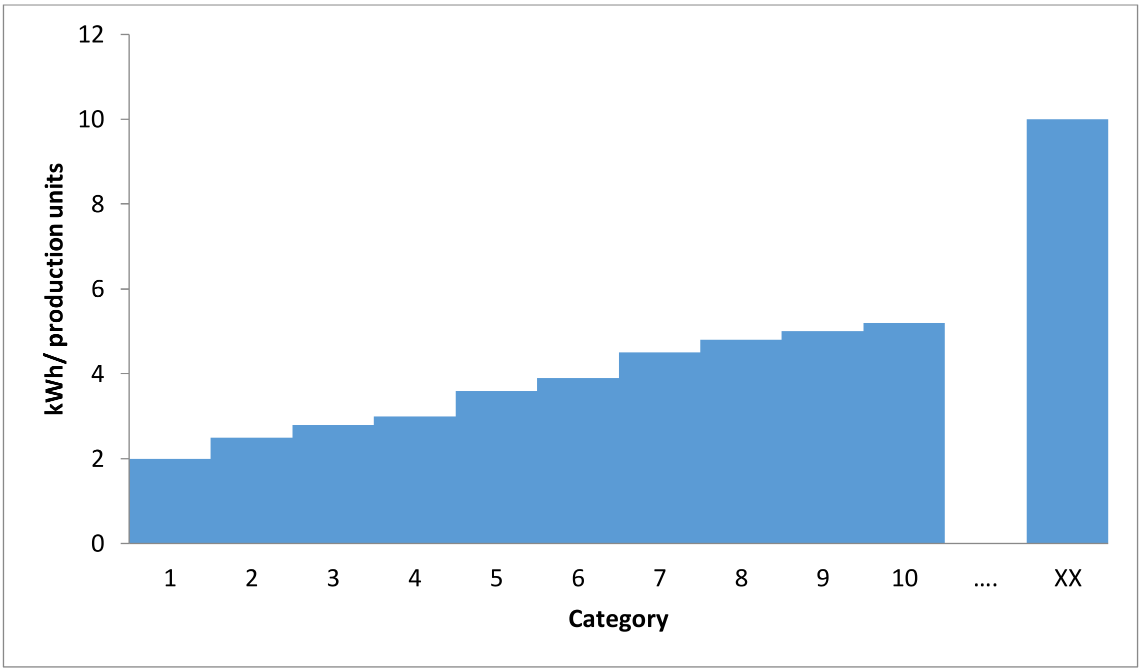
This indicator, through energy audits, will show the saving levels by installing variable speed drives on pumps and fans that we find in SMEs.

For example, a company has 100 kW installed in pumps and fans, of which 10 kW are regulated with variable speed drives (10% power regulated with variable speed drives) and the average regulation is 85% (the average percentage of load is 85%), we can evaluate that the percentage savings that the variable speed drives provide is 3, 86%.

$$\% \text{ saving} = 100 \text{ kW}*(10/100)*(1-(85/100)^3) = 3{,}86 \%$$

2.11 IEE11. Energy consumed in process cooling systems. kWh/Production units

To establish this indicator, the energy consumption in process cooling systems during 2015 and the facility type will be taken into account.



As process cooling systems we will establish the following types:

- Cold facility with chiller (vapour-compression refrigeration system)
- Absorption cooling technology
- Cold facility with cooling tower

For this indicator, the categories will be established as per type of cold facility.

2.12 IEE12. Energy efficiency in photovoltaic plants.

Two indicators of energy efficiency are established.

To establish these indicators, the Peak Power, the type of PV modules (monocrystalline, polycrystalline etc...), the inclination and orientation of modules and the location will be taken into account.

2.12.1 IEE12.1 Performance ratio = Final productivity / Reference productivity

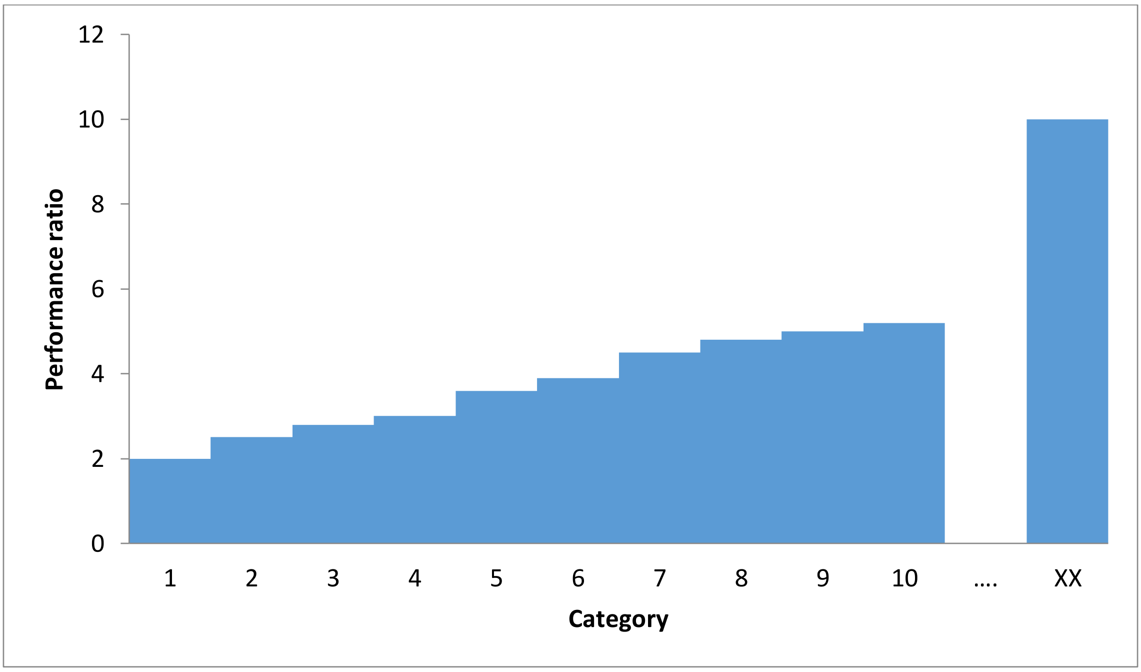
Where:

Final productivity = Actual generated energy.

Reference productivity = Energy that would be obtained if it had worked all the time in standard reference conditions.

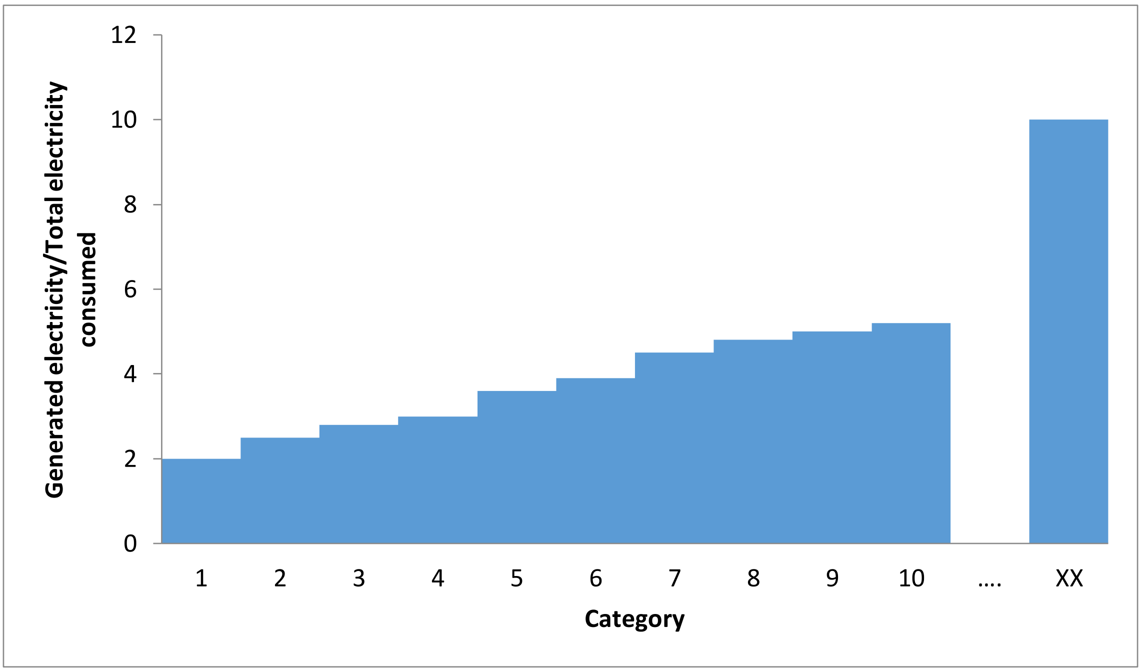
To obtain the reference productivity, we can take into account the model data PVGIS (Photovoltaic Geographical Information System), developed by the Joint research centre, institute for Energy and Transport of the European Commission, taken from homogenised data across Europe.

http://re.jrc.ec.europa.eu/pvgis/



For this indicator, the categories will be established by groups of facilities as per range of installed peak power. (e.g. Category 1 = Facilities with installed power less or equal to 10 kWp; Category 2 = Facilities with installed power between 10 and 20 kWp; .....).

2.12.2 IEE12.2 Generated electricity /Total electricity consumed in the company.



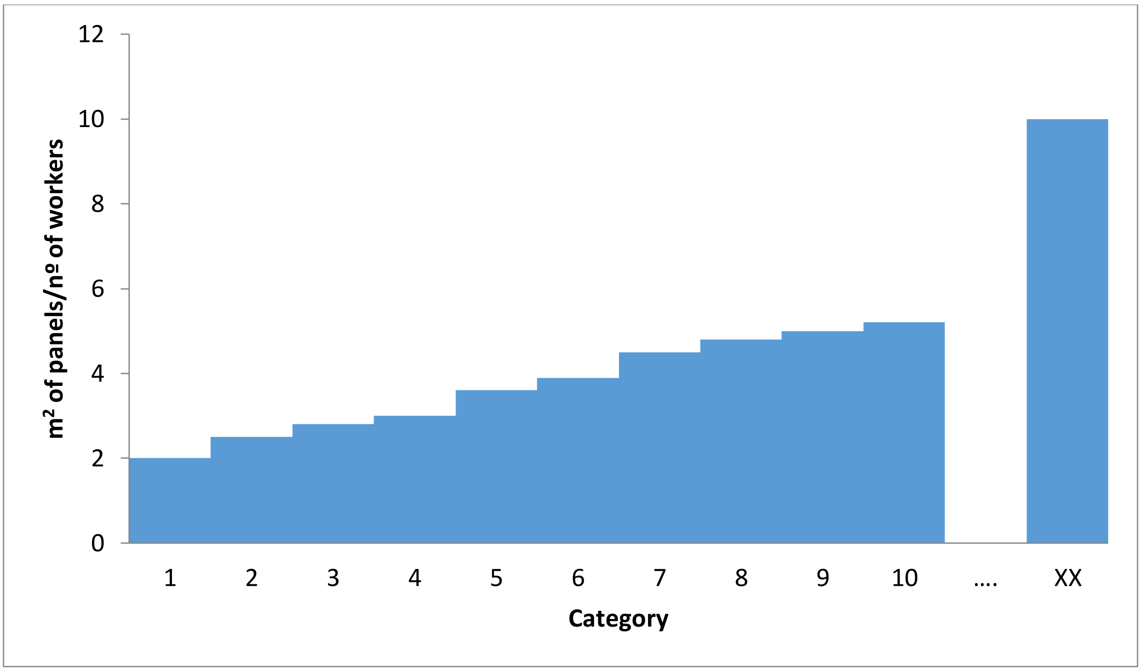
With this indicator we can learn the degree of coverage of self-consumption

For this indicator, the categories will be established by groups of facilities as per ranges of installed peak power.

2.13 IEE13. Energy efficiency of solar thermal energy plants. m2 of panels/number of workers

Only solar facilities for domestic hot water will be taken into account.

To establish this indicator, the surface of solar panels, the number of workers and the type of solar collector are taken into account.



The most common types of solar collector are:

- Flat plate solar collector.
- Evacuated tube collector.
- Solar collector of Ultra High Vacuum (UHV) technology
- Compound parabolic solar collector.

For this indicator, the categories will be established according to type of solar collector.

For this indicator to be comparable between countries it needs to be harmonised. To do this we establish a correction factor Fh_t. The resulting energy efficiency indicator will be:

$$IEE13 = \frac{m^2\ solar\ panels}{nº\ workers} xFh\_t$$

This correction factor will take local climatic conditions into account.