

D2.3 Electric Key Performance Indicators (KPIs)

Prepared by:

UPM







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1. Introduction

In this task of the SCOoPE project, 50 average electrical Key Performance Indicators (KPIs) and 50 best electrical Key Performance Indicators have been selected. The Extended Value Stream Mapping previously delivered for each sector has been used to identify the electric energy consuming processes, mainly cold storage, refrigeration, freezing, cutting, handling, aspiration and ventilation. The "average" KPI is the mean value; the "best" KPI is the most favourable value of the indicator found in the sector or industry, and the reference for benchmarking.

Bibliography has been consulted in reference technical and scientific publications. In a second stage, experts in the involved sectors have been enquired, and finally, companies working for these sectors have been consulted.

These electrical KPIs have been set up at 4 levels: industry level; product level; process level; and equipment level. They are structured in the following groups:

The first 14 KPIs are indicators of industry level; they reflect the general electrical performance. They include the consumption of all the industry, including auxiliary and horizontal activities:

- Electricity cost (KPIs 1-2; respectively, average and best KPI).
- S Load factor (KPIs 3-4).
- 6 Minimum demand (KPIs 5-6).
- Power factor (KPIs 7-8).
- Standing charges (KPIs 9-10).
- Source electricity use (KPIs 11-12).
- Sustainability index (KPIs 13-14).

The next 6 KPI are devoted to the electrical consumption of three typical horizontal processes: air conditioning in rooms and spaces, lighting, and compressed air.

- Lighting (KPIs 15-16).
- Compressed air (KPIs 17-18).
- Air conditioning (KPIs 19-20).

Six additional KPIs are devoted to the electrical consumption of the processes of cold storage, cooling, refrigeration and freezing of products. Typically these activities are the main electrical consumption in three considered sectors (dairy, meat, and fruits/vegetables) and can be significant in the fourth sector (drying).

- Usage of cold rooms (KPIs 21-22).
- Power per cold room volume (KPIs 23-24).
- Consumption per cold room volume (KPIs 25-26).

Ten additional KPIs are devoted to the efficiency of the equipment: heat pumps, chillers, air conditioning units, compressors and electrical engines.

- Efficiency of air conditioning unit (KPIs 27-28).
- S Chiller efficiency (KPIs 29-30).
- heat pump efficiency (KPIs 31-32).
- Compressor efficiency (KPIs 33-34).
- Selectrical motor efficiency (KPIs 35-36).







These previous KPIs are used in all sectors of the project. The rest of KPIs correspond to the electrical consumption of products and specific processes of only one sector. 16 KPIs belong to products of the dairy sector:

- UHT milk (KPIs 37-38).
- Pasteurized milk (KPIs 39-40).
- Skimmed and semi-skimmed milk (KPIs 41-42).
- Condensed milk (KPIs 43-44).
- Milk powder (KPIs 45-46).
- Yoghourt (KPIs 47-48).
- Cheese (KPIs 49-50).
- Sutter (KPIs 51-52).

14 KPIs belong to the drying sector:

- Solution of the Consumption per mass water removed in dried corn (KPIs 53-54).
- Sometion per mass water removed in dried rice (KPIs 55-56).
- Consumption per mass water removed in dried winter cereals (KPIs 57-58).
- Solution of Consumption of Consumpti
- S Aspiration consumption in drying (KPIs 61-62).
- Handling consumption in drying (KPIs 63-64)
- Solution value of the value of

20 KPIs belong to the fruit/vegetables sector:

- 5 Tomato concentrates (KPIs 67-68).
- Diced tomatoes (KPIs 69-70).
- Fresh tomato (KPIs 71-72).
- Orange juice (KPIs 73-74).
- Fruit juice (KPIs 75-76).
- Some Canned fruit (KPIs 77-78).
- Frozen concentrated juice (KPIs 79-80).
- Frozen fruit (KPIs 81-82).
- Frozen potato (KPIs 83-84).
- § Fruit purées (KPIs 85-86).

Finally, 14 KPIs belong to the meat sector:

- Pig carcass (KPIs 87-88).
- Bovine carcass (KPIs 89-90).
- Sheep carcass (KPIs 91-92).
- 9 Poultry carcass (KPIs 93-94).
- S Rabbit carcass (KPIs 95-96).
- Sometimes of the second sec
- Frozen meat (KPIs 99-100).





2. All sectors

Industry	Product	Process	Equipment
level	level	level	level
Cost		Lighting	Air cond. unit
(KPI 1)		(KPI 15)	(KPI 27)
Load factor (KPI 3)		Compressed air (KPI 17)	Chiller (KPI 29)
Minimum		Air conditioning	Heat pump
(KPI 5)		(KPI 19)	(KPI 31)
Power factor (KPI 7)			Compressor (KPI 33)
Charges		Cold usage	Motor
(KPI 9)		(KPI 21)	(KPI 35)
Sources (KPI 11)		Cooling power (KPI 23)	
Sustainability (KPI 13)		Cooling consumption (KPI 25)	

Figure 1. Scheme of the electric KPIs used in the four industrial sectors studied in the SCOoPE project: dairy, meat elaboration, cereal drying, and fruit and vegetables. Each KPI can be directly visualized on the scheme, according to the four levels, which are the following: industry level, product level, process level, and equipment level. In the scheme, only electrical processes are considered. For each of these KPIs, there is the "average KPI" version and the "best KPI" version.





Electrical average KPI-1. Average electricity cost.









INDICATOR	Average	electricit	y cost				
Sector (NACE code)	All sectors Subsector All subsectors						
	Industry level						
Level of indicator	The indicator includes all the electrical energy consumption, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrica	ıl process	i				
Energy source	Any source						
Description of the INDICATOR	Average electricity cost of a company, in Euros per kWh. This cost includes all aspects and taxes. This indicator can be easily calculated with a full annual set of electricity bills. Data available about the cost of the electrical energy can be found (Eurostat, 2016).						
Upper Lever	-						
Lower level	Product	level					
	Unit	Euros/k\	Wh	Name	E aKPI L1 NA average electricity cost		
Associated Variables	This data usually depends on the size of the industry. Big facilities normally show lower values.						
Best or Average KPI	Average	!	KPI	Value	0.12 euros/kWh		
Source	Electricity production, consumption and market overview. Eurostat 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Energy_price_statistics Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-energy-using-kpi.aspx						





Electrical best KPI-2. Best electricity cost.









INDICATOR	Don't also also in the second						
	Best electricity cost						
Sector (NACE code)	All sectors Subsector All subsectors						
Land of the Parks	Industry le						
Level of indicator	The indica including a				rical energy consumption, e industry.		
Thermal or Electrical process	Electrical process						
Energy source	Any source	Э					
Description of the INDICATOR	Electricity cost of a company, in Euros per kWh. This continuous all aspects and taxes. This indicator can be east calculated with a full annual set of electricity bills. Data available about the cost of the electrical energy can found (Eurostat, 2016).						
Upper Lever	-						
Lower level	Product le	vel					
Accorded Variables	Unit	Euros/k	Wh	Name	E bKPI L1 NA best electricity cost		
Associated Variables	This data usually depends on the size of the industry. Big facilities normally show lower values.						
Best or Average KPI	Best		KPI	Value ().05 euros/kWh		
	Electricity	Electricity production, consumption and market overview.					
	Eurostat 2016.						
	http://ec.europa.eu/eurostat/statistics-						
	explained/index.php/Energy price statistics						
Source	Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems						
	http://w3.u	<u>sa.sieme</u>	ns.co	m/buildin	gtechnologies/us/en/ener		
	gy-efficien	cy/retail-a	and-co	ommercia	<u>ll-</u>		
	systems/p	ages/mar	nage-	energy-us	sing-kpi.aspx		





2.3. Electrical average KPI-3. General load factor.









INDICATOR	General load factor						
Sector (NACE code)	All sectors	All sectors Subsector All subsectors					
	Industry level						
Level of indicator		includes all the diary processes of t		energy consumption,			
Thermal or Electrical process	Electrical proc	ess					
Energy source	Any source						
Description of the INDICATOR	The load factor is a term used by utilities to express the amount of electricity used over a period of time compared to how much electricity could have been used at peak demand. Expressed as a %, this KPI is average demand (kW) divided by peak demand (kW). Typically, the load factor is calculated for monthly time blocks. The formula for calculating the load factor requires only a simple division and multiplication, from data of the electricity bill. In the month required, firstly it is necessary to obtain the electrical energy consumption, in kWh/month. Then the peak demand (kW) must be obtained, again from the electrical bill. The energy that could have been used at peak demand, in kWh/month, can be calculated as the peak demand (kW) multiplied by the number of hours of the month. Finally, the electrical energy consumption (kWh/month) divided by the energy that could have been used at peak demand (kWh/month) is the general load factor in this month. The annual value can be calculated as average of the monthly values.						
Upper Lever	-						
Lower level	Product level		_				
Associated Variables	Unit	%, average demand (kW) divided by peak demand (kW)	Name	E aKPI L1 NA general load factor			
	This indicator, load factor, quantifies behavioural changes at a location, both good and bad. The values of this indicator can be useful for the calculation of the optimum contracted power.						
Best or Average KPI	Average KPI Value 50%						
Source	Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-energy-using-kpi.aspx						





Electrical best KPI-4. General load factor.









INDICATOR	DIOATOR Opposed to add for the					
INDICATOR	General load factor					
Sector (NACE code)	All sectors	Subsector	All subsectors			
	Industry	level				
Level of indicator		icator includes all the gauxiliary processes of t	electrical energy consumption, he industry.			
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The load factor is a term used by utilities to express the amount of electricity used over a period of time compared to how much electricity could have been used at peak demand. Expressed as a %, this KPI is average demand (kW) divided by peak demand (kW). Typically, the load factor is calculated for monthly time blocks. The formula for calculating the load factor requires only a simple division and multiplication, from data of the electricity bill. In the month required, firstly it is necessary to obtain the electrical energy consumption, in kWh/month. Then the peak demand (kW) must be obtained, again from the electrical bill. The energy that could have been used at peak demand, in kWh/month, can be calculated as the peak demand (kW) multiplied by the number of hours of the month. Finally, the electrical energy consumption (kWh/month) divided by the energy that could have been used at peak demand (kWh/month) is the general load factor in this month. The annual value can be calculated as					
Upper Lever	-					
Lower level	Product	level %, average demand				
Associated Variables	Unit	(kW) divided by peak demand (kW)	general load factor			
7.0000iatou variabioo	This indicator, load factor, quantifies behavioural changes at a location, both good and bad. The values of this indicator can be useful for the calculation of the optimum contracted power.					
Best or Average KPI	Best KPI Value 80%					
Source	Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-energy-using-kpi.aspx					
	Chorgy-C	Johns Remoder				





Electrical average KPI-5. General average minimum demand.









INDICATOR	General	General average minimum demand				
Sector (NACE code)	All sectors	Subsector		All sub	sectors	
	Industry					
Level of indicator		icator include g auxiliary pro			energy consumption, try.	
Thermal or Electrical process	Electrica	ıl process				
Energy source	Any sou					
Description of the INDICATOR	This indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar technologies. Measurement periods must ensure representative					
Upper Lever	-					
Lower level	Product	level				
Associated Variables	Unit	demand wi	minimum ith respect f average	Name	E aKPI L1 NA general average minimum demand	
	This ind	icator depend	ds on the sy	ystems o	of the industry working	
		•	of producti	on, in	some cases auxiliary	
Best or Average KPI	processes. Average KPI Value 30%					
Dest of Average III I	Managing energy using key performance indicators. Whit				nce indicators. White	
	Paper, June 2014. Siemens Retail & Commercial Systems					
Source	http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-					
	efficiency/retail-and-commercial-systems/pages/manage-					
	energy-using-kpi.aspx					





Electrical best KPI-6. General average minimum demand.

(O	*	•

All subsectors Subsector All subsectors	INDICATOR	General average minimum demand							
The indicator includes all the electrical energy consumption, including auxiliary processes of the industry. Thermal or Electrical process Energy source Any source This indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar technologies. Measurement periods must ensure representative results. Upper Lever Lower level Product level This indicator depends on the systems of the industry working out of the periods of production, in some cases auxiliary processes. Best or Average KPI Best KPI Value O% Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Sector (NACE code)	All			sectors				
Energy source This indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar technologies. Measurement periods must ensure representative results. Upper Lever	Level of indicator	The indi	The indicator includes all the electrical energy consumption,						
This indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar technologies. Measurement periods must ensure representative results. Upper Lever Lower level Product level White demand with respect to kW of average demand This indicator depends on the systems of the industry working out of the periods of production, in some cases auxiliary processes. Best or Average KPI Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Thermal or Electrical process	Electrica	Electrical process						
requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar technologies. Measurement periods must ensure representative results. Upper Lever Lower level Product level Associated Variables This indicator depends on the systems of the industry working out of the periods of production, in some cases auxiliary processes. Best or Average KPI Best KPI Value 0% Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Energy source	,	rce						
Lower level Unit Unit	•	requirements of a site at its lowest point of utilization. For some industries this may be at 2 A.M., or for others at 11 P.M. It is calculated in %, in kW of minimum demand with respect to kW of average demand. Expressed in %, this indicator seeks to identify the minimum power requirements of a site at its lowest point of utilization. For some buildings this may be at 2 A.M., or for others at 11 P.M. Regardless of the time of day, it serves as a leading indicator of opportunities to gain control over the specific load profile of that location and to over time reduce electrical consumption. This indicator usually requires specific measurements of electrical power demand at 2 A.M., or at 11 P.M., unless these data are available in the industry. These measurements can be made with electrical digital energy analyzers or similar							
Associated Variables Unit What is indicator depends on the systems of the industry working out of the periods of production, in some cases auxiliary processes. Best or Average KPI Best KPI Value 0% Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-									
Associated Variables This indicator depends on the systems of the industry working out of the periods of production, in some cases auxiliary processes. Best or Average KPI Best KPI L1 NA general average minimum demand KPI Value 0% Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Lower level	Product							
out of the periods of production, in some cases auxiliary processes. Best or Average KPI Best KPI Value 0% Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Associated Variables		demand with respect to kW of average demand		general average minimum demand				
Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-		out of the periods of production, in some cases auxiliar							
Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-	Best or Average KPI	Best	KPI Value	0%					
energy-using-kpi.aspx	Source	http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-							





2.7. Electrical average KPI-7. Average power factor.

	CJ

INDICATOR	Average power factor					
Sector (NACE code)	All sectors	Subsector	All subsectors	i		
	Industry	level				
Level of indicator		icator includes all the co auxiliary processes.	ensumption of	the industry,		
Thermal or Electrical process		l process				
Energy source	Any sou					
Description of the INDICATOR	The indicator is the ratio of the real power flowing to the industry to the apparent power in the industry. The annual average can be usually calculated with a complete sequence of annual electricity bills. Firstly it is necessary to calculate the total annual electrical consumption (EC, in kWh), and the total annual reactive energy consumption (REC, in kVArh) using the information of the bills. Then the ratio REC/EC is the value of a trigonometric function, characteristic of the electrical system (REC/EC is the tangent of the angle characteristic of the system; so the angle can be also calculated). The cosine of this angle is the annual average power system. Installation of capacitor banks is economically feasible if their installation compensates the increase in the electricity bill produced by the reactive power; so reactive power must be measured and must be present in the electricity bill. If reactive power is not measured, the capacitor banks have no economical interest. The methodology of calculation can be found in the Reference Document on Best Available Techniques for Energy Efficiency, of					
Upper Lever	-					
Lower level	Product	level		E 1/5: 1 /		
Associated Variables	Unit	Dimensionless	Name	E aKPI L1 NA average power factor		
	This indicator depends mainly on the installation of capacitor banks. Technically it depends on the ratio between the industry power in kW, and the installed power capacitor in kVAr.					
Best or Average KPI	Average	KPI Value 0.	95			
Source	Efficience http://eip 2009.pd	ce Document on Best Avairy. European Commission, Fob.jrc.ec.europa.eu/refererentor correction (page 190-190-190-190-190-190-190-190-190-190-	ebruary 2009 nce/BREF/ENE	0,		





2.8. Electrical best KPI-8. Average power factor.

INDICATOR	Average power factor							
Sector (NACE code)	All sectors	Subsector	All subs	ectors				
	Industry	level						
Level of indicator		The indicator includes all the consumption of the industry, including auxiliary processes.						
Thermal or Electrical process	Electrica	Electrical process						
Energy source	Any sou							
Description of the INDICATOR	The indicator is the ratio of the real power flowing to the industry to the apparent power in the industry. The annual average can be usually calculated with a complete sequence of annual electricity bills. Firstly it is necessary to calculate the total annual electrical consumption (EC, in kWh), and the total annual reactive energy consumption (REC, in kVArh) using the information of the bills. Then the ratio REC/EC is the value of a trigonometric function, characteristic of the electrical system (REC/EC is the tangent of the angle characteristic of the system; so the angle can be also calculated). The cosine of this angle is the annual average power system. Installation of capacitor banks is economically feasible if their installation compensates the increase in the electricity bill produced by the reactive power; so reactive power must be measured and must be present in the electricity bill. If reactive power is not measured, the capacitor banks have no economical interest. The methodology of calculation can be found in the Reference Document on Best Available Techniques for Energy Efficiency, of							
Upper Lever	-							
Lower level	Product	level		E bKPI	L1 NA			
A	Unit	Dimensionless	Name	average factor	power			
Associated Variables	banks. ⁻	dicator depends main Technically it depend on kW, and the installed	s on the ratio	between the				
Best or Average KPI	Best KPI Value 1							
Source	Efficiend	ce Document on Bes by. European Commis opcb.jrc.ec.europa.eu/ f	sion, February	[,] 2009	0,			
	Power fa	actor correction (page	190-192)					





Electrical average KPI-9. Electricity standing charges.









INDICATOR	Electricity	y standing c	harges				
Sector (NACE code)	All sectors	Subsecto	r		All sub	sectors	
	Industry	level					
Level of indicator		cator includ auxiliary pr				energy co ry.	nsumption,
Thermal or Electrical process	Electrica	l process					
Energy source	Any sour	ce					
Description of the INDICATOR	Percentage of standing charges -fixed costs, excluding taxes- with respect to total electricity costs -standing charges + energy costs + taxes-, in %. This indicator can be easily calculated with a full annual set of electricity bills. The information needed -standing charges, energy costs and taxes- is included in the bill.						
Upper Lever	-						
Lower level	Product I	evel					
Associated Variables	Unit	%, fixed respect electricity of	to	with total	Name	E aKPI electricity charges	L1 NA standing
Associated Valiables	This indicator strongly depends on the contracted power of the industry with the electrical supply company. An excessive contracted power is a typical problem which increases this KPI.						
Best or Average KPI	Average KPI Value 15%						
Source	Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-energy-using-kpi.aspx					tems <u>/energy-</u>	





2.10. Electrical best KPI-10. Electricity standing charges.









				U U		
INDICATOR	Electricity	standing charges				
Sector (NACE code)	All sectors	Subsector	All subs	sectors		
	Industry le	vel				
Level of indicator		ator includes all th uxiliary processes o		0,	sumption,	
Thermal or Electrical process	Electrical p	process				
Energy source	Any source	e				
Description of the INDICATOR	Percentage of standing charges -fixed costs, excluding taxes- with respect to total electricity costs -standing charges + energy costs + taxes-, in %. This indicator can be easily calculated with a full annual set of electricity bills. The information needed -standing charges, energy costs and taxes- is included in the bill.					
Upper Lever	-					
Lower level	Product le	vel				
Accordated Veriables	Unit	%, fixed costs verspect to to electricity costs	with cotal Name	E bKPI electricity charges	L1 NA standing	
Associated Variables	industry v	ator strongly depend vith the electrical power is a typical p	supply con	npany. An e	excessive	
Best or Average KPI	contracted power is a typical problem which increases this KPI. Best KPI Value 8%					
Source	Managing energy using key performance indicators. White Paper, June 2014. Siemens Retail & Commercial Systems http://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/retail-and-commercial-systems/pages/manage-energy-using-kpi.aspx					





2.11. Electrical average KPI-11. Source electricity use.









INDICATOR	Source electricity use							
Sector (NACE code)	All sectors	Subsecto		All sub	sectors			
Level of indicator	The indica	Industry level The indicator indicates the percentage of site electrical energy with respect to source electrical energy, in %.						
Thermal or Electrical process	Electrical	process						
Energy source	Calculated	d considerir	g the source	es				
Description of the INDICATOR	The indicator is the percentage of site electrical energy with respect to source electrical energy, in %. This KPI usually requires specific measurements of electrical supply from different sources, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Measurement periods must ensure representative results. Once the distribution of the electrical supply from different sources is determined, it is possible to calculate the percentage of site electrical energy with respect to source electrical energy, taking into account the efficiency of this concept for the different electrical sources. Data available about the percentage of site electrical energy with respect to source electrical energy, for the different							
Upper Lever	-							
Lower level	Product le	vel						
Associated Variables	Unit	%		Name	E aKPI source use	L1 NA electricity		
Associated Variables	This KPI depends on the sources of electrical energy industry. It is necessary to identify and quantify these s in %, usually every year.							
Best or Average KPI	Average KPI Value 30%							
Source	Eurostat 2	Electricity production, consumption and market overview. Eurostat 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity_production,_consumption_and_m						





2.12. Electrical best KPI-12. Source electricity use.









INDICATOR	Source 6	electricity use				
Sector (NACE code)	All sectors	Subsector*	All sub	sectors		
	Industry	level				
Level of indicator		cator indicates the percenect to source electrical e	-			
Thermal or Electrical process	Electrica	ıl process				
Energy source	Calculat	ed considering the sourc	es			
Description of the INDICATOR	The indicator is the percentage of site electrical energy with respect to source electrical energy, in %. This KPI usually requires specific measurements of electrical supply from different sources, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Measurement periods must ensure representative results. Once the distribution of the electrical supply from different sources is determined, it is possible to calculate the percentage of site electrical energy with respect to source electrical energy, taking into account the efficiency of this concept for the different electrical sources. Data available about the percentage of site electrical energy with respect to source electrical energy, for the different					
Upper Lever	-					
Lower level	Product	level				
	Unit	%	Name	E bKPI L1 NA source electricity use		
Associated Variables	This KPI depends on the sources of electrical energy of the industry. It is necessary to identify and quantify these sources in %, usually every year.					
Best or Average KPI	Best	KPI Value	100%	6		
Source	Electricity production, consumption and market overview. Eurostat 2016. http://ec.europa.eu/eurostat/statistics- explained/index.php/Electricity_production, consumption_and_ market_overview					





2.13. Electrical average KPI-13. Sustainability index.









INDICATOR	Sustaina	ability index							
Sector (NACE code)	All sectors	ors Subsector		All subsec	etors				
Level of indicator	The inc	Industry level The indicator includes all the electrical energy consumption, including auxiliary processes of the industry.							
Thermal or Electrical process		al process							
Energy source	Calculat	ed conside	ing the source	S					
Description of the INDICATOR	Percentage of site electrical energy from sustainable sources with respect to total site electrical energy, in %. This KPI usually requires specific measurements of electrical supply from different sources, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Measurement periods must ensure representative results. With respect to the electrical supply from the grid, the relative importance of renewable energy sources in relation to EU-28 net electricity generation grew between 2004 and 2014 from 13.5 % to 24.9 %. Data available about the relative importance of renewable energy sources in relation to EU-28 net electricity generation can be found								
Upper Lever	-								
Lower level	Product	level			E 1/DI 14 114				
	Unit	%		Name	E aKPI L1 NA sustainability index				
Associated Variables	This KPI depends on the sources of electrical energy of the industry. It is necessary to identify and quantify these sources in %, usually every year.								
Best or Average KPI	Average KPI Value 24.9%								
Source	Electricity production, consumption and market overview. Eurostat 2016. http://ec.europa.eu/eurostat/statistics- explained/index.php/Electricity production, consumption and market overview								





2.14. Electrical best KPI-14. Sustainability index.









INDICATOR	Sustains	ability index				
INDICATOR	All	ability illuex				
Sector (NACE code)	sectors	Subsecto	r	All subsec	ctors	
	Industry	level				
Level of indicator	I		ides all the rocesses of th		energy consumption,	
Thermal or Electrical process	Electrica	al process				
Energy source	Calculated considering the sources					
Description of the INDICATOR	Percentage of site electrical energy from sustainable sources with respect to total site electrical energy, in %. This KPI usually requires specific measurements of electrical supply from different sources, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Measurement periods must ensure representative results. With respect to the electrical supply from the grid, the relative importance of renewable energy sources in relation to EU-28 net electricity generation grew between 2004 and 2014 from 13.5 % to 24.9 %. Data available about the relative importance of renewable energy sources in relation to EU-28 net electricity generation can be found (Eurostat, 2016).					
Upper Lever	-					
Lower level	Product	ievei			E bKPI L1 NA	
	Unit	%		Name	sustainability index	
Associated Variables	industry.	•	sary to identif		ctrical energy of the ntify these sources in	
Best or Average KPI	Best KPI Value 100%					
Source	Electricity production, consumption and market overview. Eurostat 2016. http://ec.europa.eu/eurostat/statistics-explained/index.php/Electricity production, consumption and mar					





2.15. Electrical average KPI-15. Electrical consumption in lighting.

INDICATOR	Electrical consumption in lighting (ACC)						
Sector (NACE code)	All subsectors All subsectors						
Level of indicator	Process level (lighting) The indicator includes the electrical energy, consumed in this specific process of lighting, consumed per square meter of spaces with lighting, and year. The indicator does not include the consumption of other auxiliary processes of the industry.						
Thermal or Electrical process	Electrica	Electrical process					
Energy source	Any sou	rce					
Description of the INDICATOR	This indicator is determined by the equation: ACC = E / LS (kWh/m²) where E represents the annual electrical energy consumption of the process (lighting) in kWh, and LS designates the surface (m²) of spaces. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual consumption must be calculated or estimated. Additionally, it is necessary to determine the area of spaces with lighting to determine the indicator per unit of area. The methodology is based in experiments referred in the paper of Atkinson et al. (1995).						
Upper Lever	Product level						
Lower level	Equipm	ent level		E aKPI L3 NA			
Associated Variables	Unit kWh/m² area of spaces with lighting Name electrical consumption lighting						
	This indicator depends on the lighting needs of the involved spaces.						
Best or Average KPI	Average	KPI Value	40 k	Wh/ m ²			
Source	B.A. Atkinson, J. McMahon, J. Lin, D.C. Fisher, S.J. Pickle. 1995. Modeling U.S. Industrial Lighting Energy Consumption and Savings Potential. Lawrence Berkeley Laboratory, University of California. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich).						





2.16. Electrical best KPI-16. Electrical consumption in lighting.

INDICATOR	Electrical consumption in lighting (ACC)				
Sector (NACE code)	All sectors	Subsector	All sub	sectors	
Level of indicator	Process level (lighting) The indicator includes the electrical energy, consumed in this specific process of lighting, consumed per square meter of spaces with lighting, and year. The indicator does not include the consumption of other auxiliary processes of the industry.				
Thermal or Electrical process	Electrica	al process			
Energy source	Any sou				
Description of the INDICATOR	This indicator is determined by the equation: ACC = E / LS (kWh/m²) where E represents the annual electrical energy consumption of the process (lighting) in kWh, and LS designates the surface (m²) of spaces. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual consumption must be calculated or estimated. Additionally, it is necessary to determine the area of spaces with lighting to determine the indicator per unit of area. The methodology is based in experiments referred in the paper of Atkinson et al. (1995).				
Upper Lever	Product				
Associated Variables	Unit	ent level kWh/m² area of spaces with lighting	Name	E bKPI L3 NA electrical consumption in lighting	
	This indicator depends on the lighting needs of the involved spaces.				
Best or Average KPI	Best KPI Value 10 kWh/ m² B.A. Atkinson, J. McMahon, J. Lin, D.C. Fisher, S.J. Pickle. 1995. Modeling U.S. Industrial Lighting Energy Consumption and Savings Potential. Lawrence Berkeley Laboratory, University of California. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich).				





2.17. Electrical average KPI-17. Specific Electrical Consumption in compressed air (CAC) per ton of product.

INDICATOR	Speci produ		al Consum	ption	in compres	sed air (CAC) per ton of	
Sector (NACE code)	All se		sector	All su	ubsectors		
Level of indicator	The in proce	Process level (compressed air) The indicator includes the electrical energy, consumed in this specific process (production of compressed air), per ton of product. The indicator does not include the consumption of other auxiliary processes of the industry.					
Thermal or Electrical process	Electr	Electrical process					
Energy source	Any s	ource					
Description of the INDICATOR	This indicator is determined by the equation: CAC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (compressed air) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual or monthly consumption must be calculated or estimated. Additionally, it is necessary to determine the corresponding tons of product processed in this period. The methodology is based in the work of the California Energy Commission (2013).						
Upper Lever	Product level						
Lower level	Equip	ment level					
	Unit	kWh/t		Nam	e consu	I L3 NA specific electrical mption in compressed air of product	
Associated Variables		ndicator de ss or indust		the c	compressed	air needs of considered	
Best or Average KPI	Avera	ge			KPI Value	5 kWh/ t	
Source	A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9144&rep=rep1&type=pdf . California Energy Commission. 2013. California's Food Industry. Compressed Air Challenge.						
		<u>www.cifar.u</u> allenge_Fin			ects/media/0	Californias_Compressed_A	
	II_Ch	anenge_rin	аі_кероп.	pul			





2.18. Electrical best KPI-18. Specific Electrical Consumption in compressed air (CAC) per ton of product.

INDICATOR	Specific Electric	cal Consumptic	n in compr	essed air (CAC) per ton of product			
Sector (NACE code)	All sectors	Subsector	All subsec	, ,,			
	Process level (
Level of indicator	The indicator includes the electrical energy, consumed in this specific process (production of compressed air), per ton of product. The indicator does not include the consumption of other auxiliary processes of the industry.						
Thermal or Electrical process	Electrical proce	Electrical process					
Energy source	Any source						
Description of the INDICATOR Upper Lever	This indicator is determined by the equation: CAC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (compressed air) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual or monthly consumption must be calculated or estimated. Additionally, it is necessary to determine the corresponding tons of product processed in this period. The methodology is based in the work of the California Energy Commission (2013).						
Lower level	Product level	ol					
Associated Variables	Unit Name E bKPI L3 NA specific electrical consumption in compressed air per ton of product						
Best or Average KPI	Best	KDI	Value	2 kWh/ t			
Source	A. Carlsson-Ka A data survey. Stockholm Uni Zürich). California Ene Industry. Energ http://citeseerx&type=pdf . California Ener Air Challenge.	inyama and M. iversity, and S ergy Commiss y Efficiency Ini .ist.psu.edu/viev rgy Commission r.ucdavis.edu/p	Faist. 200 Swiss Fede sion. 2008 tiative: Ado wdoc/downle	O. Energy Use in the Food Sector: eral Institute of Technology (ETH B. California's Food Processing ption of Industrial Best Practices pad?doi=10.1.1.183.9144&rep=rep1 fornia's Food Industry. Compressed ia/Californias Compressed Air Ch			





2.19. Electrical average KPI-19. Electrical consumption in air conditioning.

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INDICATOR	Electrical consumption in air conditioning (ACC)					
Sector (NACE code)	All sectors	All sectors Subsector All subsectors				
Level of indicator	Process level (air conditioning) The indicator includes the electrical energy, consumed in this specific process of air conditioning, consumed per square meter of air conditioned spaces and year. The indicator does not include the consumption of other auxiliary processes of the industry.					
Thermal or Electrical process	Electrical proce	ess				
Energy source	Any source					
Description of the INDICATOR	This indicator is determined by the equation: ACC = E / CS (kWh/m²) where E represents the annual electrical energy consumption of the process (air conditioning) in kWh, and CS designates the surface (m²) of air conditioned spaces. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual consumption must be calculated or estimated. Additionally, it is necessary to determine the area of air conditioned spaces to determine the indicator per unit of area. The methodology is based in experiments referred in the paper of Carlsson-Kanyama and Faist (2000).					
Upper Lever	Product level					
Lower level	Equipment level					
Associated Variables	Unit KWh/m² surface of air conditioned spaces Name E aKPI L3 NA electrical consumption in air conditioning					
	conditioned spaces.					
Best or Average KPI	Average	KPI Value		Wh/ m ²		
Source	A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.					





2.20. Electrical best KPI-20. Electrical consumption in air conditioning.





INDICATOR	Electrical consumption in air conditioning (ACC)				
Sector (NACE code)	All sectors	Subsector All subsectors			
Level of indicator	Process level (air conditioning) The indicator includes the electrical energy, consumed in this specific process of air conditioning, consumed per square meter of air conditioned spaces and year. The indicator does not include the consumption of other auxiliary processes of the industry.				
Thermal or Electrical process	Electrica	l process			
Energy source	Any sou				
Description of the INDICATOR	This indicator is determined by the equation: ACC = E / CS (kWh/m²) where E represents the annual electrical energy consumption of the process (air conditioning) in kWh, and CS designates the surface (m²) of air conditioned spaces. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies; measurement periods must ensure representative results. With the information obtained, annual consumption must be calculated or estimated. Additionally, it is necessary to determine the area of air conditioned spaces to determine the indicator per unit of area. The methodology is based in experiments referred in the paper of Carlsson-Kanyama and Faist (2000).				
Upper Lever	Product level				
Lower level Associated Variables	Unit	ent level kWh/m² surface of air conditioned spaces	Name	E bKPI L3 NA electrical consumption in air conditioning	
	This indicator depends on outside temperatures and other weather conditions, and on the temperatures required in the air conditioned spaces.				
Best or Average KPI	Best	KPI Value		Wh/ m ²	
Source	A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.				





2.21. Electrical average KPI-21. Usage of cold rooms volume.



INDICATOR	Usage o	of cold rooms vo	olume (UC	R)	
Sector (NACE code)	All sectors	Subsector		All subs	sectors
	Process	level (cooling)			
Level of indicator		cator shows th per volume unit			on (refrigerated in cold
Thermal or Electrical process	Electrica	al process			
Energy source	Any sou				
Description of the INDICATOR	The UCR value is determined by the equation: UCR = RM / Vtotal (t/m³) where RM represents the annual amount of refrigerated product (t), and Vtotal is the total volume of cold rooms (m³). Annual production (tons) can be obtained from industry recordings; it is necessary to check if all this production was refrigerated in the considered cold rooms. The inner dimensions (m³) of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Product				
Lower level	Equipme				E 1/DI I 0 1/4
Associated Variables	Unit t/m³ volume of cold rooms Name				
Best or Average KPI	Average		Pl Value	0.7 t/	m^3
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





2.22. Electrical best KPI-22. Usage of cold rooms volume.









INDICATOR	Usage o	f cold rooms volume (UC	R)			
Sector (NACE code)	All sectors	Subsector	All sub	sectors		
	Process level (cooling)					
Level of indicator		The indicator shows the annual production (refrigerated in cold rooms) per volume unit of the cold rooms.				
Thermal or Electrical process	Electrica	l process				
Energy source	Any sou					
Description of the INDICATOR	The UCR value is determined by the equation: UCR = RM / Vtotal (t/m³) where RM represents the annual amount of refrigerated product (t), and Vtotal is the total volume of cold rooms (m³). Annual production (tons) can be obtained from industry recordings; it is necessary to check if all this production was refrigerated in the considered cold rooms. The inner dimensions (m³) of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016).					
Upper Lever	Product level					
Lower level	Equipme					
	Unit	t/m ³ volume of cold rooms	Name	E bKPI L3 NA usage of cold rooms volume		
Associated Variables	This UCR depends on the stock management of the industry. Partially loaded cold rooms will decrease the value of the indicator; and the use of partially loaded cold rooms promotes energy waste.					
Best or Average KPI	Best	KPI Value	2.5 t/	/m³		
Source	J. Nunes points of industry	Best KPI Value 2.5 t/m³ J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411.				





2.23. Electrical average KPI-23. Cooling installed power per unit of cold room volume.

INDICATOR	Cooling installed power per unit of cold room volume (NPC)					
Sector (NACE code)	All sectors	Subsector	All subsectors			
	Process	level (cooling)				
Level of indicator	The indicator shows the average measured power of all refrigeration compressors, P_{total} , per cold rooms volume, Vtotal.					
Thermal or Electrical process	Electrica	al process				
Energy source	Any sou	rce				
Description of the INDICATOR	The NPC value is determined by the equation: NPC = P_{total} / Vtotal (kW/m³) where P_{total} represents the average measured power of all refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m³). The power of all refrigeration compressors (P_{total}) can be measured in an audit with digital power analyzers, obtaining a final average value in the measurement period, which should be a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (P_{total}) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V), electrical current (C) and power factor (PF). In the usual three-phase electrical supply systems, P_{total} can be calculated with the equation: $P_{total} = 1.732 * V * C * PF$					
	infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016).					
Upper Lever	Product	level				
Lower level	Equipme	ent level				
Associated Variables	Unit	kW/m³ volume of cold rooms	Name E aKPI L3 NA cooling power per unit of cold room volume			
ASSOCIATED VALIABLES		er technical factors,	he temperature of the cold rooms, including local weather and room			
Best or Average KPI	Average	KPI Va	lue 0.1 kW/m³			
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411					





2.24. Electrical best KPI-24. Cooling installed power per unit of cold room volume.









Sector (NACE code)	NDICATOR					
Process level (cooling)	INDICATOR	Cooling installed power per unit of cold room volume (NPC)				
The indicator shows the average measured power of a refrigeration compressors, Ptotal, per cold rooms volume, Vtotal. Thermal or Electrical process Energy source The NPC value is determined by the equation: NPC = Ptotal / Vtotal (kW/m³) where Ptotal represents the average measured power of a refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m²). The power of all refrigeration compressors (Ptotal) can be measured in an audit with digital power analyzers, obtaining a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (Ptotal) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V) electrical current (C) and power factor (PF). In the usual three phase electrical supply systems, Ptotal can be calculated with the equation: Ptotal = 1.732 * V * C * PF The inner dimensions of the cold rooms can be determined with infarred rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and including local weather and room and including local weather and room and inclu	Sector (NACE code)		Subsector All subsectors			
refrigeration compressors, P _{total} , per cold rooms volume, Vtotal. Thermal or Electrical process Energy source The NPC value is determined by the equation: NPC = P _{total} / Vtotal (kW/m³) where P _{total} represents the average measured power of a refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m³). The power of all refrigeration compressors (P _{total}) can be measured in an audit with digital power analyzers, obtaining a final average value in the measurement period, which should be a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (P _{total}) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V) electrical current (C) and power factor (PF). In the usual three phase electrical supply systems, P _{total} can be calculated with the equation: P _{total} = 1.732 * V * C * PF The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). The methodology of Nunes et al. (2016). The methodology of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and the refriences.		Process level (cooling)				
Any source	Level of indicator	The indicator shows the average measured power of all				
The NPC value is determined by the equation: NPC = Ptotal / Vtotal (kW/m³) where Ptotal represents the average measured power of a refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m³). The power of all refrigeration compressors (Ptotal) can be measured in an audit with digital power analyzers, obtaining a final average value in the measurement period, which should be a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (Ptotal) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V) electrical current (C) and power factor (PF). In the usual three phase electrical supply systems, Ptotal can be calculated with the equation: Ptotal = 1.732 * V * C * PF The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). Upper Lever Lower level Equipment level Associated Variables This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and other technical factors, including local weather and room and technical factors.	Thermal or Electrical process	Electrica	al process			
NPC = P _{total} / Vtotal (kW/m³) where P _{total} represents the average measured power of a refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m³). The power of all refrigeration compressors (P _{total}) can be measured in an audit with digital power analyzers, obtaining a final average value in the measurement period, which should be a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (P _{total}) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V) electrical current (C) and power factor (PF). In the usual three phase electrical supply systems, P _{total} can be calculated with the equation: P _{total} = 1.732 * V * C * PF The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016). Upper Lever Product level Equipment level Associated Variables This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room	Energy source	•				
Lower level Unit kW/m³ volume of cold rooms Name E bKPI L3 NA cooling power per unit of cold room volume This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room	Description of the INDICATOR	NPC = P_{total} / Vtotal (kW/m³) where P_{total} represents the average measured power of all refrigeration compressors (kW), and Vtotal is the total volume of cold rooms (m³). The power of all refrigeration compressors (P_{total}) can be measured in an audit with digital power analyzers, obtaining a final average value in the measurement period, which should be a good estimation of the annual mean value. Therefore, it is advisable that the measurement period be a representative period. This electrical power (P_{total}) can be also determined with a digital multimeter and a clamp meter, measuring: voltage (V), electrical current (C) and power factor (PF). In the usual three-phase electrical supply systems, P_{total} can be calculated with the equation: $P_{total} = 1.732 * V * C * PF$ The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016).				
Associated Variables Name E bKPI L3 NA cooling power per unit of cold rooms Name Nam	• •					
Associated Variables Unit RW/m² volume of cold rooms Name power per unit of cold room volume	Lower level					
This indicator depends on the temperature of the cold rooms and other technical factors, including local weather and room	Associated Variables		cold rooms	Name power per unit of color room volume		
		This indicator depends on the temperature of the cold rooms, and other technical factors, including local weather and room maintenance.				
U U	Best or Average KPI	Best KPI Value 0.032 kW/m ³				
Source points on the energy sustainable development of the food	Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





2.25. Electrical average KPI-25. Specific Electrical Consumption (SEC) per volume unit of the cold rooms.

INDICATOR	Specific Electrical Consumption (SEC) per volume unit of the				
	cold rooms				
Sector (NACE code)	All sectors	Subsector	All sub	sectors	
	Process level (cooling)				
Level of indicator	The indicator shows the annual electrical energy spent in cold rooms per volume unit of the cold rooms.				
Thermal or Electrical process	Electrical process				
Energy source	Any sou	rce			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / Vtotal (kWh/m³) where E represents the annual electrical energy consumption of cold rooms (kWh), and Vtotal is the total volume of cold rooms (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. It is necessary to disaggregate the annual consumption of the cold rooms, or to take measurements of the electrical consumption, with digital power analyzers (or grid analyzers), to extrapolate the annual consumption of the cold rooms. The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Product level				
Lower level	Equipment level				
Associated Variables	Unit	kWh/m ³ volume of cold rooms	Name	E aKPI L3 NA specific electrical consumption per volume unit of the cold rooms	
	This SEC depends on the temperature of the cold rooms, an other technical factors, including local weather and room maintenance.				
Best or Average KPI	Average	KPI Value	350 k	κWh/m³	
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





2.26. Electrical best KPI-26. Specific Electrical Consumption (SEC) per volume unit of the cold rooms.

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INDICATOR	Specific Electrical Consumption (SEC) per volume unit of the cold rooms			
Sector (NACE code)	All subsectors All subsectors			
Level of indicator	Process level (cooling) The indicator shows the annual electrical energy spent in cold rooms per volume unit of the cold rooms.			
Thermal or Electrical process	Electrical process			
Energy source	Any source			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / Vtotal (kWh/m³) where E represents the annual electrical energy consumption of cold rooms (kWh), and Vtotal is the total volume of cold rooms (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. It is necessary to disaggregate the annual consumption of the cold rooms, or to take measurements of the electrical consumption, with digital power analyzers (or grid analyzers), to extrapolate the annual consumption of the cold rooms. The inner dimensions of the cold rooms can be determined with infrared rangefinders as described in the study of Nunes et al. (2016). The methodology is based in audits referred in the paper of Nunes et al. (2016).			
Upper Lever	Product level			
Lower level	Equipment level			
Associated Variables	Unit KWh/m³ volume of cold rooms			
This SEC depends on the temperature of the color other technical factors, including local weather maintenance.				
Best or Average KPI	Best KPI Value 120 kWh/m ³			
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411			





2.27. Electrical average KPI-27. Efficiency of air conditioning unit.

INDICATOR	Efficiency of	air conditioning	unit (ACE	ER)
Sector (NACE code)	All sectors	Subsector	All subse	ectors
	Equipment I	evel (air conditio	ning unit)	
Level of indicator	The indicate conditioning		ergy effici	ency ratio (EER) of an air
Thermal or Electrical process	Electrical pro	ocess		
Energy source	Any source			
Description of the INDICATOR Upper Lever	The indicator value is determined by the equation: ACEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh). The energy efficiency ratio (EER) of the air conditioning units can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).			
Lower level	Process leve	- -		
Associated Variables		s of the inlet and		E aKPI L4 NA efficiency of air conditioning unit ors: among them, on the uid, and on the age of the
Best or Average KPI	Average	KPI Value	4 (dir	nensionless)
Source	California Processing Industrial Be http://citese rep=rep1&ty A. Carlsson Food Sector Stockholm U (ETH Zürich D. Kaya an conditioners	Energy Comm Industry. Energest Practices. erx.ist.psu.edu/vie pe=pdf. -Kanyama and - A data survey. Jniversity, and S). d H. Alidrisi. 20	ission. 2 y Efficier wdoc/dow M. Faist. wiss Fede 16. Energ tems. Tu	2008. California's Food acy Initiative: Adoption of vaload?doi=10.1.1.183.9144& 2000. Energy Use in the eral Institute of Technology gy savings potential in air rkish Journal of Electrical





2.28. Electrical best KPI-28. Efficiency of air conditioning unit.

INDICATOR	Efficiency of air conditioning unit (ACEER)				
Sector (NACE code)	All sectors	Subsector	All subse	ctors	
	Equipment le	evel (air conditior	ning unit)		
Level of indicator	The indicator shows the energy efficiency ratio (EER) of an air				
	conditioning		ongy omore	ney rane (==n, en an an	
Thermal or Electrical process	Electrical pro	ocess			
Energy source	Any source				
Description of the INDICATOR	The indicator value is determined by the equation: ACEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh). The energy efficiency ratio (EER) of the air conditioning units can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).				
Upper Lever	Process leve		(====).		
Lower level	-	<u> </u>			
Associated Variables		· -		E bKPI L4 NA efficiency of air conditioning unit	
	conditioning	unit.		, and on the age of the air	
Best or Average KPI	Best	KPI Value	•	dimensionless)	
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.91 44&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.				





2.29. Electrical average KPI-29. Efficiency of chiller.

INDICATOR	Efficiency of chiller				
Sector (NACE code)	All sectors	Subsector	А	ıll subsec	tors
	Equipment level (chiller)				
Level of indicator	The indi	cator shows the	energy	efficiency	ratio (EER) of a chiller.
Thermal or Electrical process	Electrica	al process			
Energy source	Any sou				
Description of the INDICATOR	The indicator value is determined by the equation: CEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh) The energy efficiency ratio (EER) of the chillers can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).				
Upper Lever Lower level	Process	ievei			
Associated Variables			n severa		E aKPI L4 NA efficiency of chiller among them, on the and on the age of the
Best or Average KPI			KPI Valı	11 0 4 (d	dimensionless)
Source	Average KPI Value 4 (dimensionless) California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.				





2.30. Electrical best KPI-30. Efficiency of chiller.









INDICATOR	Efficiency of chiller				
Sector (NACE code)	All sectors	Subsector	All subsec	ctors	
Level of indicator		ent level (chiller) cator shows the energy ef	ficiency rat	io (EER) of a chiller.	
Thermal or Electrical process	Electrica	l process			
Energy source	Any sou	rce			
Description of the INDICATOR Upper Lever	The indicator value is determined by the equation: CEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh) The energy efficiency ratio (EER) of the chillers can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000). Process level				
Lower level	-				
Associated Variables		Dimensionless C depends on several tures of the inlet and out		•	
Best or Average KPI	Best	KPI Value	6 (dime	ensionless)	
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.				





2.31. Electrical average KPI-31. Efficiency of heat pump.







					U		
INDICATOR	Efficienc	y of heat pu	mp				
Sector (NACE code)	All sectors	Subsector		All subs	ectors		
	Equipme	ent level (hea	it pump)				
Level of indicator	The indi	cator shows	the energ	y efficien	cy ratio (EEF	R) of a	heat
Thermal or Electrical process	Electrica	al process					
Energy source	Any sou						
Description of the INDICATOR	The indicator value is determined by the equation: HPEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh) The energy efficiency ratio (EER) of the heat pumps can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).						
Upper Lever	Process	level					
Lower level	-						
Associated Variables	Unit	Dimensionl		Name	E aKPI efficiency pump the comp	L4 of	NA heat
		tures of the			d, and on the		
Best or Average KPI	Average		(PI Value	`	nsionless)		
	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.183.9 <a citeseerx.ist.psu.edu="" download?doi="10.1.183.9</a" href="http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.183.9 <a citeseerx.ist.psu.edu="" download?doi="10.1.183.9</a" href="http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.183.9 						





2.32. Electrical best KPI-32. Efficiency of heat pump.









INDICATOR	Efficiency of heat pump					
Sector (NACE code)	All sectors	Subsector		All subse	ectors	
Level of indicator	Equipme	nt level (hea	t pump)		
	The indic	cator shows	the en	ergy effici	ency ratio (EER) of a heat	
Thermal or Electrical process	Electrical	process				
Energy source	Any sour					
Upper Lever Lower level	The indicator value is determined by the equation: HPEER = Thermal energy supplied (kWh) / Electrical energy consumed (kWh) The energy efficiency ratio (EER) of the heat pumps can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the thermal energy supplied, that can be calculated with the temperatures of the process. It is advisable that the measurement period be a representative period. In some cases the EER can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000). Process level					
Associated Variables	Unit	Dimension	ess	Name	E bKPI L4 NA efficiency of heat pump	
		ures of the i			ors: among them, on the uid, and on the age of the	
Best or Average KPI	Best		KPI V	alue 6	(dimensionless)	
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich). D. Kaya and H. Alidrisi. 2016. Energy savings potential in air conditioners and chiller systems. Turkish Journal of Electrical Engineering & Computer Sciences 24: 935-945.					





2.33. Electrical average KPI-33. Efficiency of electrical compressor.

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INDICATOR	Efficiency of electrical compressor (EEC)				
Sector (NACE code)	All sectors	Subsecto		All sub	sectors
	Equipme	nt level (ele	ctrical compre	essor)	
Level of indicator	The indic	ator shows	the efficiency	of an el	ectrical compressor.
Mechanical or Electrical process	Electrical	process			
Energy source	Any sour				
Description of the INDICATOR	The isentropic efficiency of a compressor or pump is defined as the ratio of the work input to an isentropic process, to the work input to the actual process between the same inlet and exit pressures. The efficiency of the electrical compressors can be measured with specific measurements. It is advisable that the measurement period be a representative period. In some cases the efficiency can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).				
Upper Lever	Process	level			
Lower level	-				
Associated Variables	Unit	Dimensionless		Name	E aKPI L4 NA efficiency of electrical compressor
Associated Variables	This indicator depends on several factors: among them, on the temperatures of the inlet and outlet fluid, and on the age of the electrical compressor.				
Best or Average KPI	Average		KPI Value	,	dimensionless)
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich).				





2.34. Electrical best KPI-34. Efficiency of electrical compressor.

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INDICATOR	Efficiency of electrical compressor (EEC)				
INDICATOR	-	y or electrica	ii compressoi	(EEC)	
Sector (NACE code)	All sectors	Subsector	•	All sub	sectors
	Equipme	nt level (ele	ctrical compre	essor)	
Level of indicator	The indic	ator shows	the efficiency	of an el	ectrical compressor.
Mechanical or Electrical process	Electrical	process			
Energy source	Any sour	ce			
Description of the INDICATOR Upper Lever	The isentropic efficiency of a compressor or pump is defined as the ratio of the work input to an isentropic process, to the work input to the actual process between the same inlet and exit pressures. The efficiency of the electrical compressors can be measured with specific measurements. It is advisable that the measurement period be a representative period. In some cases the efficiency can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).				
	Process	ievei			
Lower level	-				<u> </u>
Associated Variables	Unit	Dimensionless		Name	E bKPI L4 NA efficiency of electrical compressor
Associated Variables	This indicator depends on several factors: among them, on the temperatures of the inlet and outlet fluid, and on the age of the electrical compressor.				
Best or Average KPI	Best		KPI Value	0.9 (dimensionless)
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption of Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.9 144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technology (ETH Zürich).				





2.35. Electrical average KPI-35. Efficiency of electrical motor.









INDICATOR	Efficiency	y of electrica	al motor				
Sector (NACE code)	All sectors	Subsector All subsectors					
	Equipment level (electrical motor)						
Level of indicator	The indic	ator shows	the efficiency	of an el	ectrical motor.		
Mechanical or Electrical process	Electrical	process					
Energy source	Any sour	ce					
Description of the INDICATOR	The indicator value is determined by the equation: EME = Mechanical energy supplied (kWh) / Electrical energy consumed (kWh) The efficiency of the electrical motors can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the mechanical energy supplied. It is advisable that the measurement period be a representative period. In some cases the efficiency can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).						
Upper Lever	Process	level					
Lower level	-						
Associated Variables	Unit	Dimensionless		Name	E aKPI L4 NA efficiency of electrical motor		
Associated Variables		cator deper e electrical		al factors	s: among them, on the		
Best or Average KPI	Average		KPI Value	0.85	(dimensionless)		
Source	California Energy Commission. 2008. California's For Processing Industry. Energy Efficiency Initiative: Adoption Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in Food Sector: A data survey. Stockholm University, and Swiss Federal Institute of Technolog (ETH Zürich).						





2.36. Electrical best KPI-36. Efficiency of electrical motor.

	ı							
INDICATOR	Efficienc	Efficiency of electrical motor						
Sector (NACE code)	All sectors	rs Subsector All subsectors						
	Equipme	Equipment level (electrical motor)						
Level of indicator	The indi	cator shows	the efficiency	y of a ele	ectrical motor.			
Mechanical or Electrical process	Electrica	al process						
Energy source	Any sou	rce						
Description of the INDICATOR	The indicator value is determined by the equation: EME = Mechanical energy supplied (kWh) / Electrical energy consumed (kWh) The efficiency of the electrical motors can be measured in an audit with digital power analyzers, obtaining the electrical energy consumed, and the mechanical energy supplied. It is advisable that the measurement period be a representative period. In some cases the efficiency can be estimated with the age of the equipment. The methodology is based in experiments referred in the work of Carlsson-Kanyama and Faist (2000).							
Upper Lever	Process	level						
Lower level	-				E bKPI L4 NA			
Associated Variables	Unit Dimensionless Name E bKPI L4 efficiency electrical motor							
Associated Variables		icator dependence electrical		al factors	s: among them, on the			
Best or Average KPI	Best		KPI Value		(dimensionless)			
Source	California Energy Commission. 2008. California's Food Processing Industry. Energy Efficiency Initiative: Adoption Industrial Best Practices. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.183.144&rep=rep1&type=pdf. A. Carlsson-Kanyama and M. Faist. 2000. Energy Use in the Food Sector: A data survey. Stockholm University, and Swiss Federal Institute Technology (ETH Zürich).							





3. MILK sector

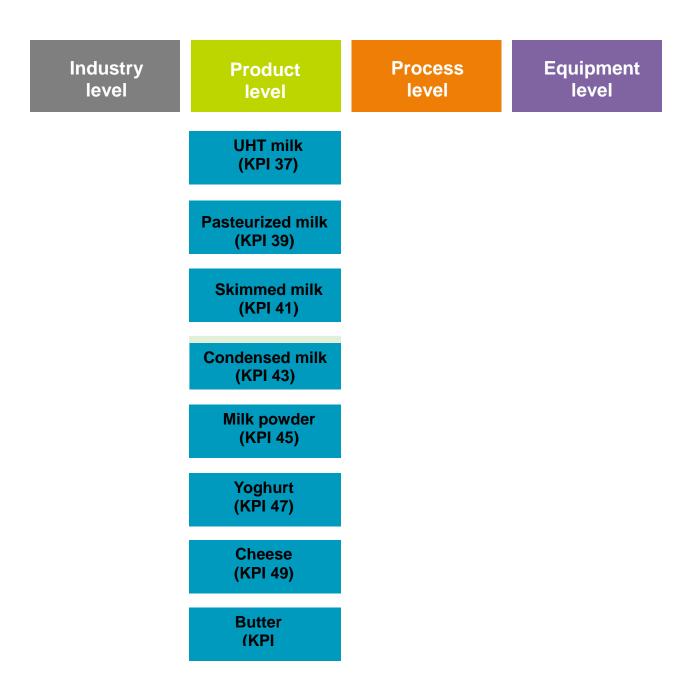


Figure 2. Scheme of the electric KPIs selected in the milk sector. For each of these KPIs, there is the "average KPI" version and the "best KPI" version.





3.1. Electrical average KPI-37. Specific Electrical Consumption (SEC) per volume unit of UHT milk.

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INDICATOR		Specific Electrical Consumption (SEC) per volume unit of UHT							
Sector (NACE code)	milk	NACE 10.5 Subsector Milk							
Sector (NACE code)					IVIIIK				
Level of indicator	The indic	Product level (UHT milk) The indicator includes all the electricity necessary to produce one m³ of UHT milk, including auxiliary processes of the industry.							
Thermal or Electrical process	Electrical	Electrical process							
Energy source	Any source								
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / UHT (kWh/m³) where E represents the annual electrical energy consumption (kWh), and PM designates the annual volume of UHT milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the UHT milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the UHT milk. Specific electrical requirement of UHT milk is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a								
Upper Lever	Industry le								
Lower level	Process le	evel							
Accorded Mariebles	Unit		kWh/m³	Name	E aKPI L2 N3 specific electrical consumption per volume unit of UHT milk				
Associated Variables		norm			the size of the industry. Big values of specific electrical				
Best or Average KPI	Average	KPI	Value		60 kWh/m ³ . Density considered: 1.03 kg/l				
	Energy requirements in food processing. 1992. FAO Co Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm								
(Energy efficiency			ency in a la energía	agri-food (Extrem	sas del sector agroalimentario di companies). 2014. Agencia adura energy agency).				
	http://www.agenex.net/guias- altercexa/2_EF_ENERG_EN_EMPRES GROALIMENTARIO.pdf				MPRESAS_DEL_SECTOR_A				





3.2. Electrical best KPI-38. Specific Electrical Consumption (SEC) per volume unit of UHT milk.

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unit of Offi fillik.	0 10 -11				50)			
INDICATOR	Specific Elec	Specific Electrical Consumption (SEC) per volume unit of UHT milk						
Sector (NACE code)	NACE 10.5	Subsec	tor	Milk				
Level of indicator	The indicato	Product level (UHT milk) The indicator includes all the electricity necessary to produce one m³ of UHT milk, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrical pro	Electrical process						
Energy source	Any source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / UHT (kWh/m³) where E represents the annual electrical energy consumption (kWh), and PM designates the annual volume of UHT milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the UHT milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the UHT milk. Specific electrical requirement of UHT milk is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 55 and 60 kWh/m³.							
Upper Lever	Industry leve							
Lower level Associated Variables	Unit kWh/m³ Name E bKPI L2 N3 specific electrical consumption per volume unit of UHT milk This SEC usually depends on the size of the industry. Bit facilities normally show lower values of specific electrical consumption per volume unit of UHT milk							
Best or Average KPI	consumption. Best KPI Value 55 kWh/m³. Dens considered: 1.03 kg/l							
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SEC_TOR_AGROALIMENTARIO.pdf							





3.3. Electrical average KPI-39. Specific Electrical Consumption (SEC) per volume unit of pasteurized milk.

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per volume unit of paster		. ((OEO)				
INDICATOR	•	Specific Electrical Consumption (SEC) per volume unit of pasteurized milk						
Sector (NACE code)	NACE 10.5	Subsector	Milk					
Level of indicator	The indicator	Product level (pasteurized milk) The indicator includes all the electricity necessary to produce one m³ of pasteurized milk, including auxiliary processes of the						
Thermal or Electrical process	Electrical process							
Energy source	Any source	•						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and PM designates the annual volume of pasteurized milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the pasteurized milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the pasteurized milk. Specific electrical requirement of pasteurized milk is already characterized in FAO documents in 1992, with values around 200 MJ/t (55 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 25 and 30 kWh/m³.							
Upper Lever	Industry level							
Lower level Associated Variables	Unit kWh/m³ Rame E aKPI L2 N electrical consurvolume unit of p milk							
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.							
Best or Average KPI	Average KPI Value 30 kWh/m³. considered: 1.03 kg/l					Density		
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_A GROALIMENTARIO.pdf					mentario Agencia		





3.4. Electrical best KPI-40. Specific Electrical Consumption (SEC) per volume unit of pasteurized milk.

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INDICATOR	Specific Electrical Consumption (SEC) per volume unit of pasteurized milk							
Sector (NACE code)	NACE 10.5	Subse	ctor	Milk				
Level of indicator	The indicator	Product level (pasteurized milk) The indicator includes all the electricity necessary to produce one m³ of pasteurized milk, including auxiliary processes of the						
Thermal or Electrical process		Electrical process						
Energy source	Any source							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and PM designates the annual volume of pasteurized milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the pasteurized milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the pasteurized milk. Specific electrical requirement of pasteurized milk is already characterized in FAO documents in 1992, with values around 200 MJ/t (55 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 25 and 30 kWh/m³.							
Upper Lever	Industry level							
Lower level	Process level	<u> </u>				1/D1 10 NO '''		
Associated Variables	Unit kWh/m³ Name E bKPI L2 N3 specifical consumption volume unit of pasteu milk					rical consumption per		
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.							
Best or Average KPI	Rest KPI Vallie				25 kWh/m ³ . Density considered: 1.03 kg/l			
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf							





3.5. Electrical average KPI-41. Specific Electrical Consumption (SEC) per volume unit of skimmed and semi-skimmed milk.



volume unit of skimmed s						
INDICATOR	Specific Electrical Consumption (SEC) per volume unit of skimmed and semi-skimmed milk					
Sector (NACE code)	NACE 10.5 Subsector Milk					
Gector (NAGE code)						
Level of indicator	Product level (skimmed and semi-skimmed milk) The indicator includes all the electricity necessary to produce one m³ of skimmed and semi-skimmed milk, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / SM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and SM designates the annual volume of skimmed and semi-skimmed milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the skimmed and semi-skimmed milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the skimmed and semi-skimmed milk. Specific electrical requirement of skimmed and semi-skimmed milk is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 60 and 80 kWh/m³.					
Upper Lever	Industry level					
Lower level	Process level					
Associated Variables	Unit kWh/m³ E aKPI L2 N3 specific electrical consumption per volume unit of skimmed and semi-skimmed milk					
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Average KPI Value 70 kWh/m³. Density considered: 1.04 kg/l					
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGROALIMENTARIO					





3.6. Electrical best KPI-42. Specific Electrical Consumption (SEC) per volume unit of skimmed and semi-skimmed milk.

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unit of skinnied and sem											
INDICATOR	Specific E skimmed a				•	(SEC) pe	r volu	ıme	unit	of
Sector (NACE code)	NACE 10.5	S	ubsec	tor		Milk					
Level of indicator Thermal or Electrical process	Product level (skimmed and semi-skimmed milk) The indicator includes all the electricity necessary to produce one m³ of skimmed and semi-skimmed milk, including auxiliary processes of the industry. Electrical process										
Energy source	Any source)									
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / SM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and SM designates the annual volume of skimmed and semi-skimmed milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the skimmed and semi-skimmed milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the skimmed and semi-skimmed milk. Specific electrical requirement of skimmed and semi-skimmed milk is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 60 and 80 kWh/m³.										
Upper Lever	Industry le										
Lower level Associated Variables	Unit	vei kWh	ı/m³		Name	el vo	ectrica Iume	I L2 al cons unit ni-skim	of :	tion skimn	per ned
	This SEC on normally sl					fic ele	ectrica	l cons	ump	tion.	
Best or Average KPI	Best			KPI \	Value	60 cor					sity
Source	Best KPI Value 60 kWh/m³. Density considered: 1.04 kg/l Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AGROALIMENTARIO.pdf							ario ncia			





3.7. Electrical average KPI-43. Specific Electrical Consumption (SEC) per volume unit of condensed milk.

INDICATOR	Specific Electrical Consumption (SEC) per volume unit of condensed milk							
Sector (NACE code)	NACE 10.5	Subsector	Milk					
	Product level	condensed m	nilk)					
Level of indicator	The indicator	The indicator includes all the electricity necessary to produce one m³ of condensed milk, including auxiliary processes of the						
Thermal or Electrical process	Electrical process							
Energy source	Any source							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and CM designates the annual volume of condensed milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the condensed milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the condensed milk. Specific electrical requirement of condensed milk is already characterized in FAO documents in 1992, with values around 220 MJ/t (60 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 77 and 82 kWh/m³.							
Upper Lever	Industry level							
Lower level	Process level							
Associated Variables	Unit	kWh/m³	Name	E aKPI L2 N3 specific electrical consumption per volume unit of condensed milk				
		•		e size of the industry. Big alues of specific electrical				
Best or Average KPI	Average	KPI V	'alue	77 kWh/m³. Density considered: 1.30 kg/l				
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGOALIMENTARIO.pdf							





3.8. Electrical best KPI-44. Specific Electrical Consumption (SEC) per volume unit of condensed milk.



INDICATOR	Specific Electrical Consumption (SEC) per volume unit of condensed milk						
Sector (NACE code)	NACE 10.5 Subsector Milk						
Level of indicator	Product level (condensed milk) The indicator includes all the electricity necessary to produce one m³ of condensed milk, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrical process						
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CM (kWh/m³) where E represents the annual electrical energy consumption (kWh), and CM designates the annual volume of condensed milk produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the condensed milk, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the condensed milk. Specific electrical requirement of condensed milk is already characterized in FAO documents in 1992, with values around 220 MJ/t (60 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 77 and 82 kWh/m³.						
Upper Lever	Industry level						
Lower level	Process level						
Associated Variables	Unit kWh/m³ F bKPI L2 N3 specific electrical consumption per volume unit of condensed milk						
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.						
Best or Average KPI	Best KPI Value 60 kWh/m³. Density considered: 1.30 kg/l						
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AGROALIMENTARIO.pdf						





3.9. Electrical average KPI-45. Specific Electrical Consumption (SEC) per ton of full cream milk powder.

INDICATOR	Specific Elec	trical Consum _l	otion (SEC	c) per ton of full cream milk		
Sector (NACE code)	NACE 10.5	Subsector	Milk			
	Product level	(milk powder)				
Level of indicator	The indicator	includes all t		ity necessary to produce a processes of the industry.		
Thermal or Electrical process	Electrical pro	cess				
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / MP (kWh/t) where E represents the annual electrical energy consumption (kWh), and MP designates the annual production of milk powder produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the milk powder, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the milk powder. Specific electrical requirement of milk powder is already characterized in FAO documents in 1992, with values around 290 MJ/t (80 kWh/t). Present references (2014) indicate a range of specific electrical consumption from 425 and 450 kWh/t.					
Upper Lever	Industry level	<u> </u>				
Lower level	Process level					
Associated Variables	Unit	kWh/t	Name	E aKPI L2 N3 specific electrical consumption per ton of milk powder		
Associated Variables		•		of the industry. Big facilities electrical consumption.		
Best or Average KPI	Average	KPI	Value	425 kWh/t		
Source	Average KPI Value 425 kWh/t Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGR OALIMENTARIO.pdf					





Electrical best KPI-46. Specific Electrical Consumption (SEC) per ton of full cream milk powder.

INDICATOR	Specific Electrical Consumption (SEC) per ton of full cream milk powder						
Sector (NACE code)	NACE	NACE 10.5 Subsector Milk					
,	Produ	ct level (milk powder)				
Level of indicator	The in	The indicator includes all the electricity necessary to produce a ton of milk powder, including auxiliary processes of the industry.					
Thermal or Electrical process	Electri	cal proc	ess				
Energy source	Any so	ource					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / MP (kWh/t) where E represents the annual electrical energy consumption (kWh), and MP designates the annual production of milk powder produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the milk powder, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the milk powder. Specific electrical requirement of milk powder is already characterized in FAO documents in 1992, with values around 290 MJ/t (80 kWh/t). Present references (2014) indicate a range of specific electrical consumption from 425 and 450 kWh/t.						
Upper Lever	Indust	ry level					
Lower level	Proces	ss level					
Associated Variables	Unit kWh/t Name spe					E bKPI L2 N3 specific electrical consumption per ton of milk powder	
	facilitie		•			of the industry. Big f specific electrical	
Best or Average KPI	Best		KPI '	Valu	ie 400	kWh/t	
Source	Best KPI Value 400 kWh/t Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGO OALIMENTARIO.pdf						





Electrical average KPI-47. Specific Electrical Consumption (SEC) per volume unit of yoghourt.

INDICATOR	Specific Electri	cal Co	onsumption ((SEC) per v	volume unit of yoghourt		
Sector (NACE code)	NACE 10.5 Subsector Yoghourt						
	Product level (yoghourt)						
Level of indicator		The indicator includes all the electricity necessary to produce one m³ of yoghourt, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical proce	ess					
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / Y (kWh/m³) where E represents the annual electrical energy consumption (kWh), and Y designates the annual volume of yoghourt produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the yoghourt, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the yoghourt. Specific electrical requirement of yoghourt is already characterized in FAO documents in 1992, with values around 270 MJ/t (75 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 50 and 55 kWh/m³.						
Upper Lever	Industry level						
Lower level	Process level						
Associated Variables	Unit	kWh	/m³	Name	E aKPI L2 N3 specific electrical consumption per volume unit of yoghourt		
		•	•	ecific elec	he industry. Big facilities trical consumption.		
Best or Average KPI	Average		KPI Value	conside			
Source	Energy requirements in food processing. 1992. FAO Corporat Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentari (Energy efficiency in agri-food companies). 2014. Agenci extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AGR_OALIMENTARIO.pdf						





Electrical best KPI-48. Specific Electrical Consumption (SEC) per volume unit of yoghourt.

	0:6			(050)				- 6
INDICATOR	yoghourt							
Sector (NACE code)	NACE 10.5 Subsector Yoghourt							
Level of indicator	The indicator	Product level (yoghourt) The indicator includes all the electricity necessary to produce one m³ of yoghourt, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrical prod	cess						
Energy source	Any source							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / Y (kWh/m³) where E represents the annual electrical energy consumption (kWh), and Y designates the annual volume of yoghourt produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the yoghourt, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the yoghourt. Specific electrical requirement of yoghourt is already characterized in FAO documents in 1992, with values around 270 MJ/t (75 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 50 and 55 kWh/m³.							
Upper Lever	Industry level							
Lower level Associated Variables	Unit This SEC us facilities norr				al cor unit o of the	nsumpt of yogho e indus	ourt stry. E	er Big
Best or Average KPI	consumption. Best	KPI Value			Dens	sity con	sidere	ed:
Source	Best KPI Value 50 kWh/m³. Density considered 1.03 kg/l Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGIOALIMENTARIO.pdf						io ia	





3.13. Electrical average KPI-49. Specific Electrical Consumption (SEC) per ton of cheese.

INDICATOR	Specific Electrical Consumption (SEC) per ton of cheese							
Sector (NACE code)	NACE 10.5	NACE 10.5 Subsector Cheese						
Level of indicator	The indicator	Product level (cheese) The indicator includes all the electricity necessary to produce a ton						
Thermal or Electrical	of cheese, inc	luding auxiliary pr	ocesses of t	the industry.				
process Energy source	·							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CH (kWh/t) where E represents the annual electrical energy consumption (kWh), and CH designates the annual production of cheese produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the cheese, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the cheese. Specific electrical requirement of cheese is already characterized in FAO documents in 1992, with values around 360 MJ/t (100 kWh/t). Present references (2014) indicate a range of specific electrical consumption from 265 and 285 kWh/t.							
Upper Lever	Industry level							
Lower level	Process level							
A two IV . talls	Unit	kWh/t	Name	E aKPI L2 N3 specific electrical consumption per ton of cheese				
Associated Variables		• .		the industry. Big facilities trical consumption.				
Best or Average KPI	Average	KPI Value	265 kV	Vh/t				
Source	Average KPI Value 265 kWh/t Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentari (Energy efficiency in agri-food companies). 2014. Agenci extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AGR_OALIMENTARIO.pdf							





3.14. Electrical best KPI-50. Specific Electrical Consumption (SEC) per ton of cheese.

A		
٨	6)
4	7	

INDICATOR	Specific	Electrical	Consump	otion (SEC	c) per ton of cheese		
Sector (NACE code)	NACE 1	10.5 Sul	osector	Cheese			
Level of indicator	The ind	Product level (cheese) The indicator includes all the electricity necessary to produce a ton of cheese, including auxiliary processes of the industry.					
Thermal or Electrical process	Flectric	al process					
Energy source		•					
Description of the INDICATOR	Any source The SEC value is determined by the equation: SEC = E / CH (kWh/t) where E represents the annual electrical energy consumption (kWh), and CH designates the annual production of cheese produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the cheese, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the cheese. Specific electrical requirement of cheese is already characterized in FAO documents in 1992, with values around 360 MJ/t (100 kWh/t). Present references (2014) indicate a range of specific electrical consumption from 265 and 285 kWh/t.						
Upper Lever	Industry						
Lower level	Process	s level					
A	Unit	kWh/t		Name	E bKPI L2 N3 specific electrical consumption per ton of cheese		
Associated Variables		normally	•		size of the industry. Big lues of specific electrical		
Best or Average KPI	Best		KPI Valu	ue	250 kWh/t		
Source	Energy requirements in food processing. 1992. FAO Corporat Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentari (Energy efficiency in agri-food companies). 2014. Agenci extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AGOALIMENTARIO.pdf				del sector agroalimentario ompanies). 2014. Agencia ra energy agency).		





3.15. Electrical average KPI-51. Specific Electrical Consumption (SEC) per volume unit of butter.

INDICATOR	0 % 51 () 10 () () () () () () () ()							
INDICATOR	Specific Electrical Consumption (SEC) per volume unit of butter							
Sector (NACE code)	NACE 10.5 Subsector Butter							
	Product lev	Product level (butter)						
Level of indicator		tor includes all th	•	necessary to produce one m ³ of the industry.				
Thermal or Electrical process	Electrical p	rocess						
Energy source	Any source)						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / B (kWh/m³) where E represents the annual electrical energy consumption (kWh), and B designates the annual volume of butter produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the butter, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the butter. Specific electrical requirement of butter is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 220 and 240 kWh/m³.							
Upper Lever	Industry lev							
Lower level	Process le	vel						
Associated Variables	Unit kW	h/m³	Name	E aKPI L2 N3 specific electrical consumption per volume unit of butter				
Associated variables		•		e of the industry. Big facilities electrical consumption.				
Best or Average KPI	Average	KPI V	CC	nsidered: 0.91 kg/l				
Source	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGR OALIMENTARIO.pdf							





Electrical best KPI-52. Specific Electrical Consumption (SEC) per volume unit of butter.

INDICATOR	Specific E	lectrical C	onsumpt	ion (SEC) per volume unit of butter				
Sector (NACE code)	NACE 10.	5 Subse	ector	Butter					
	Product level (butter)								
Level of indicator					ity necessary to produce one sses of the industry.				
Thermal or Electrical process	Electrical	process							
Energy source	•	Any source							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / B (kWh/m³) where E represents the annual electrical energy consumption (kWh), and B designates the annual volume of butter produced (m³). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the butter, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the butter. Specific electrical requirement of butter is already characterized in FAO documents in 1992, with values around 325 MJ/t (90 kWh/m³). Present references (2014) indicate a range of specific electrical consumption from 220 and 240 kWh/m³.								
Upper Lever	•	Industry level							
Lower level	Process level								
Associated Variables	Unit	kWh/m³		Name	E bKPI L2 N3 specific electrical consumption per volume unit of butter				
Associated Valiables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.								
Best or Average KPI	Best		KPI Va	lue 9	•				
Source	Documen http://ww Eficiencia (Energy extremeña http://ww altercexa	Energy requirements in food processing. 1992. FAO Corporate Document Repository. http://www.fao.org/docrep/004/t0515e/T0515E03.htm Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AGR OALIMENTARIO.pdf							





4. CEREAL DRYING sector

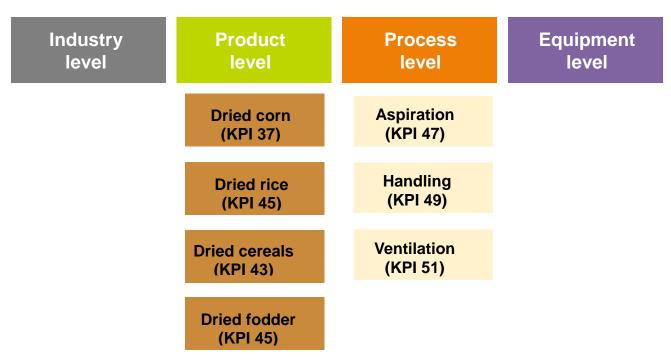


Figure 3. Scheme of the electric KPIs selected in the cereal drying sector. For each of these KPIs, there is the "average KPI" version and the "best KPI" version.





4.1. Electrical average KPI-53. Specific Electrical Consumption (SEC) per ton of water removed in dried corn.

INDICATOR	Specific Election in dried corn	Specific Electrical Consumption (SEC) per ton of water removed in dried corp								
Sector (NACE code)	NACE 10.6	Subsector	Corn drying							
Level of indicator	unit mass vincluding aux	The indicator includes all the electrical energy necessary per unit mass water removed in the process of corn drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the								
Thermal or Electrical process	Electrical pro									
Energy source		nly depending on the ue is determined by	energy source of the process.							
Description of the INDICATOR	SEC = E / W where E rep (kWh), and W in the corn d considered of electrical cornoveyors, electrical bill processes of disaggregate of consumpti (tons) can be in addition, the the beginning removed in the The mass of dried corn (m mw = mr * (M being MCi the drying run (%) the corn exiting The methodo of Billiris and	resents the annual VR designates the arrying process. For that the heat is graying process, and other pelectrical energy corror of the industry. If the consumption by the consumption of the corn drying proces water removed (mwater remove	electrical energy consumption innual tons of water removed (t) he values of the indicator, it is generated with a fuel boiler; aspiration, lighting, ventilation, processes. Insumption is obtained from the fighther than the fight							
Upper Lever	Industry level									
Lower level	Process leve									
LOWEI IEVEI	FIDUESS IEVE	<u> </u>								





	Unit kWh/t water removed (kWh of electricity consumption.			Name	E aKPI specific consumpti of water r dried corn	•	ton		
Associated Variables	With this indicator, it is advisable to include, in additional average moisture content of the corn at the begand at the end of the drying process. With this addinformation it is possible to calculate the electrical necessary per ton of dried corn. The value of this electrical indicator is obviously depending on the energy source of the process at technology of heat generation. If heat is generated in boiler, electrical consumption usually includes fan operation produce the warm air flow, and auxiliary processes.								
Best or Average KPI	Average		KPI Value	130 (kWh	kWh/t wate n of	r remo			
Source	management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 Kudra, T. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572								





4.2. Electrical best KPI-54. Specific Electrical Consumption (SEC) per ton of water removed in dried corn.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water										
INDICATOR		removed in dried corn									
Sector (NACE code)	10.6	Subsector	Corn drying								
Level of indicator	The including this product	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of corn drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.									
Thermal or Electrical process Energy source		cal process	e energy source of the process.								
Description of the INDICATOR	SEC = where (kWh), (t) in th is conselectrical conveyor. The an electrical process disaggr of conselectrical disaggr of conselectrical and disaggr of conselectrical the beg remove The man of dried mw = n being N drying in the corr	and WR designates the e corn drying process. Fisidered that the heat is all consumption includes ors, elevators, and other nual electrical energy coal bill of the industry. Sees different from cornegate the consumption because the consumption is can be obtained from industrion, the annual average ginning and at the ended in the corn drying process of water removed (many of the corn (many) with the equation, * (MCi-MCf) / (100-MCMCi the average moisture run (%, w.b.) and MCf the exiting a drying run (%,	l electrical energy consumption annual tons of water removed for the values of the indicator, it is generated with a fuel boiler; aspiration, lighting, ventilation, processes. Insumption is obtained from the lift the industry includes other in drying, it is necessary to by sector, and to assign a value Annual production of dried cornustry recordings. If data include, moisture content of the corn at of the drying process, water ess can be calculated. W) can be related with the mass ion: If) It content of the corn entering a the average moisture content of the content of the corn entering a the average moisture content of the content of the corn entering a the average moisture content of the content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the average moisture content of the corn entering a the corn e								
		s and Siebenmorgen (20	14).								
Upper Lever	Industry	<u> </u>									
Lower level	Process	s level									





Associated Variables	annual	(kWh consump is indicate average i	vater removed of electricity ption) or, it is advisal moisture conter of the drying	ole to in	of water dried corr clude, in a corn at th	electri ion per f removed addition, f e beginn	ton I in the
	informa	tion it is	possible to o	•			
	necessary per ton of dried corn. The value of this electrical indicator is obviously different						
	depending on the energy source of the process and the technology of heat generation. If heat is generated in a fuel						
	boiler, electrical consumption usually includes fan operating to produce the warm air flow, and auxiliary processes.						
	produce the warm a		n air now, and a		cWh/t wate	er remov	ved
Best or Average KPI	Best		KPI Value	(kWh	n of umption)	electric	city
			and T.J. Siebenmorgen. 2014. Energy use and				
	efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2):						
	217-226						
Source	S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science						
	and Nutrition, 25(1), 1-486						
	Kudra, T. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572						
	=(=), = :: = == := := := := := := := := := :=						





4.3. Electrical average KPI-55. Specific Electrical Consumption (SEC) per ton of water removed in dried rice.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried rice											
Sector (NACE code)	NACE 10.6 Rice drying											
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of rice drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.											
Thermal or Electrical process	Electrical process											
Energy source	Indicator highly depending on the energy source of the process.											
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / WR (kWh/t) where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the rice drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, compressors, cleaners, and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from rice drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to rice drying. Annual production of dried rice (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the rice at the beginning and at the end of the drying process, water removed in the rice drying process can be calculated. The mass of water removed (m_W) can be related with the mass of dried rice (m_r) with the equation: $m_W = m_r * (MCi-MCf) / (100-MCf)$ being MCi the average moisture content of the rice entering a drying run (%, w.b.) and MCf the average moisture content of the rice exiting a drying run (%, w.b.). The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).											
	<u> </u>											
Upper Lever	Industry level											
Lower level	Process level											





	Unit	kWh/t v (kWh consum	of	,	Name	con of	aKPI ecific nsumptio water re ed rice	•	ton
	With this indicator, it is advisable to include, in addition, the annual average moisture content of the rice at the beginning								
Associated Variables		•		the drying				•	•
	informa	tion it is	s po	ssible to d	alculate	the	electric	cal ene	ergy
	necess	ary per to	on of	dried rice.					
	The value of this electrical indicator is obviously different							rent	
	depending on the energy source of the process and the							the	
				generation.		_			
	1			sumption us	-			peratin	g to
	produce the warm air flow, and auxiliary processes.								
			I/DL V-I		130 kWh/t water remov				
Best or Average KPI	Average	e		KPI Value	(kWh		of	electr	icity
	NA A D	tilliris and T.I. Sighanm		consumption) norgen. 2014. Energy use and					
					•		•	•	
	efficiency of rice drying systems II. Commercial, cross-flow								
	dryer measurements. Applied Engineering in Agriculture 30(2): 217-226							J(Z).	
Source	S. Gunasekaran and T.L. Thompson. 1986. Optimal energy							ergy	
	manage	ement in	graiı	n drying. Cı	itical Re	view	s in Foo	od Scie	nce
	and Nutrition, 25(1), 1-486								
				ergy aspect	-	-			
	2(5), 91	7-932. d	loi:htt	tp://dx.doi.o	rg/10.108	081/DRT-120038572			





4.4. Electrical best KPI-56. Specific Electrical Consumption (SEC) per ton of water removed in dried rice.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried rice											
Sector (NACE code)	NACE 10.6 Rice drying											
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of rice drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.											
Thermal or Electrical process	Electrical process											
Energy source	Indicator highly depending on the energy source of the process.											
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / WR (kWh/t) where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the rice drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, compressors, cleaners, and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from rice drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to rice drying. Annual production of dried rice (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the rice at the beginning and at the end of the drying process, water removed in the rice drying process can be calculated. The mass of water removed (m_W) can be related with the mass of dried rice (m_r) with the equation: $m_W = m_r^*$ (MCi-MCf) / (100-MCf) being MCi the average moisture content of the rice entering a drying run (%, w.b.) and MCf the average moisture content of the rice exiting a drying run (%, w.b.)											
Upper Lever	Industry level											
Lower level	Process level											





	Unit		er removed electricity on)	Name		L2 N electrication per to removed i	al on	
	With th	is indicator,	it is advisal	ole to in	clude, in a	addition, th	ıe	
	annual	average mo	oisture conte	nt of the	rice at th	e beainnin	ıa	
Associated Variables		J	f the drying			J	•	
	informa	tion it is p	ossible to c	alculate	the elect	ical energ	JУ	
	necessa	ary per ton o	of dried rice.					
	The value of this electrical indicator is obviously different							
	depending on the energy source of the process and the							
	technology of heat generation. If heat is generated in a fuel							
		oiler, electrical consumption usually includes fan operating to						
	produce the warm air flow, and auxiliary processes.							
			,			er remove	d	
Best or Average KPI	Best		KPI Value	(kWh	of	electricit	tv	
3				,	sumption)			
	M.A. B	illiris and T	.J. Siebenm	orgen. 2	2014. Ener	gy use an	ıd	
	efficiency of rice drying systems II. Commercial, cross-flow							
	_		ts. Applied E	ngineerir	ng in Agric	ulture 30(2)	:):	
	217-226	_						
Source	S. Gunasekaran and T.L. Thompson. 1986. Optimal energy							
	management in grain drying. Critical Reviews in Food Science							
	and Nutrition, 25(1), 1-486							
	Kudra,	T. 2004. Er	nergy aspects	s in dryii	ng. Drying	Technolog	JУ	
	2(5), 91	7-932. doi:h	nttp://dx.doi.or	rg/10.108	81/DRT-12	0038572		





4.5. Electrical average KPI-57. Specific Electrical Consumption (SEC) per ton of water removed in dried winter cereals.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried winter cereals						
Sector (NACE code)	NACE 10.6 Subsector Winter cereals drying						
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of winter cereals drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.						
Thermal or Electrical process	Electrical process						
Description of the INDICATOR	Indicator highly depending on the energy source of the process. The SEC value is determined by the equation: $SEC = E / WR \text{ (kWh/t)}$ where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the winter cereals drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, compressors, cleaners and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from winter cereals drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to winter cereals drying. Annual production of dried winter cereals (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the winter cereals at the beginning and at the end of the drying process, water removed in the winter cereals drying process can be calculated. The mass of water removed (m_w) can be related with the mass of dried winter cereals (m_r) with the equation: $m_w = m_r * (MCi-MCf) / (100-MCf)$ being MCi the average moisture content of the winter cereals entering a drying run (%, w.b.) and MCf the average moisture content of the winter cereals exiting a drying run (%, w.b.) The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).						





Upper Lever	Industry leve					
Lower level	Process leve	el				
	Unit	nit kWh/t water removed (kWh of electricity consumption)				noved in
Associated Variables	With this indicator, it is advisable to include, in addition, the annual average moisture content of the winter cereals at the beginning and at the end of the drying process. With the additional information it is possible to calculate the electrical energy necessary per ton of dried winter cereals. The value of this electrical indicator is obviously different depending on the energy source of the process and the technology of heat generation. If heat is generated in a full boiler, electrical consumption usually includes fan operating produce the warm air flow, and auxiliary processes.					Is at the With this electrical different and the in a fuel
Best or Average KPI	Average KPI Value			130 (kWh	kWh/t water	removed electricity
Source	M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 Kudra, T. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572					





4.6. Electrical best KPI-58. Specific Electrical Consumption (SEC) per ton of water removed in dried winter cereals.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried winter cereals					
Sector (NACE code)	NACE 10.6 Subsector Winter cereals drying					
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of winter cereals drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.					
Thermal or Electrical process	Electrical process					
Energy source	Indicator highly depending on the energy source of the process.					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / WR (kWh/t) where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the winter cereals drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, compressors, cleaners and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from winter cereals drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to winter cereals drying. Annual production of dried winter cereals (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the winter cereals at the beginning and at the end of the drying process, water removed in the winter cereals drying process can be calculated. The mass of water removed (m_w) can be related with the mass of dried winter cereals (m_r) with the equation: $m_w = m_r^*$ (MCi-MCf) / (100-MCf) being MCi the average moisture content of the winter cereals exiting a drying run (%, w.b.) The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).					





Upper Lever	Industry						
Lower level	Process	s level					
	Unit	kWh/t wat (kWh of consumption	er removed electricity on)	Name	E bKPI specific consumpti of water r dried winter	emove	ton d in
Associated Variables	With this indicator, it is advisable to include, in addition, the annual average moisture content of the winter cereals at the beginning and at the end of the drying process. With the additional information it is possible to calculate the electrical energy necessary per ton of dried winter cereals. The value of this electrical indicator is obviously different depending on the energy source of the process and the technology of heat generation. If heat is generated in a further boiler, electrical consumption usually includes fan operating produce the warm air flow, and auxiliary processes.					t the this trical erent the fuel	
Best or Average KPI	Best KPI Value			(kWh	kWh/t wate of umption)	r remo	
Source	M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 Kudra, T. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572					ergy ence	





4.7. Electrical average KPI-59. Specific Electrical Consumption (SEC) per ton of water removed in dried fodder.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried fodder						
Sector (NACE code)	NACE 10.6 Subsector Fodder drying						
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of fodder drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.						
Thermal or Electrical process	Electrical process						
Energy source	Indicator highly depending on the energy source of the process.						
Description of the INDICATOR	The SEC value is determined by the equation: $SEC = E / WR \text{ (kWh/t)}$ where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the fodder drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from fodder drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to fodder drying. Annual production of dried fodder (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the fodder at the beginning and at the end of the drying process, water removed in the fodder drying process can be calculated. The mass of water removed (m_W) can be related with the mass of dried fodder (m_r) with the equation: $m_W = m_r^* \text{ (MCi-MCf) / (100-MCf)}$ being MCi the average moisture content of the fodder entering a drying run (%, w.b.) and MCf the average moisture content of						





	The methodology is based in experiments referred in the paper of Pöllinger (2014).					
Upper Lever	Industry	Industry level				
Lower level	Process	s level				
	Unit (kWh/t water removed (kWh of electricity consumption)			Name		L2 N1 electrical on per ton emoved in er
Associated Variables	With this indicator, it is advisable to include, in addition annual average moisture content of the fodder at the begin and at the end of the drying process. With this additional information it is possible to calculate the electrical er necessary per ton of dried fodder.					
	The value of this electrical indicator is obviously different depending on the energy source of the process and the technology of heat generation. If heat is generated in a fuel boiler, electrical consumption usually includes fan operating to produce the warm air flow, and auxiliary processes.					s and the d in a fuel
Best or Average KPI	Average KPI Value 100 kWh/t water removed (kWh of electricity consumption)				r removed electricity	
	T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572					
Source	A. Pöllinger. 2014. Comparison of different hay dryin techniques. International Conference of Agricultura Engineering, Ageng 2014, Zurich					nay drying Agricultural
	http://www.geyseco.es/geystiona/adjs/comunicaciones/30 C07110001.pdf					nes/304/





4.8. Electrical best KPI-60. Specific Electrical Consumption (SEC) per ton of water removed in dried fodder.

INDICATOR	Specific Electrical Consumption (SEC) per ton of water removed in dried fodder							
Sector (NACE code)	NACE 10.6 Subsector Fodder drying							
Level of indicator	Product level The indicator includes all the electrical energy necessary per unit mass water removed in the process of fodder drying, including auxiliary processes of the industry. Heating needs in this process are considered as been generated by a fuel boiler, so this indicator only includes electric energy for managing the products.							
Thermal or Electrical process	Electrical process							
Energy source	Indicator highly depending on the energy source of the process.							
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / WR (kWh/t) where E represents the annual electrical energy consumption (kWh), and WR designates the annual tons of water removed (t) in the fodder drying process. For the values of the indicator, it is considered that the heat is generated with a fuel boiler; electrical consumption includes aspiration, lighting, ventilation, conveyors, elevators, and other processes. The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from fodder drying, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to fodder drying. Annual production of dried fodder (tons) can be obtained from industry recordings. If data include, in addition, the annual average moisture content of the fodder at the beginning and at the end of the drying process, water removed in the fodder drying process can be calculated. The mass of water removed (m_W) can be related with the mass of dried fodder (m_r) with the equation: $m_W = m_r * (MCi-MCf) / (100-MCf)$ being MCi the average moisture content of the fodder exiting a drying run (%, w.b.) and MCf the average moisture content of the fodder exiting a drying run (%, w.b.)							
Unner Lever								
Upper Lever	Industry level							
Lower level	Process level							





	Unit		er removed electricity on)	Name		electrical tion per ton removed in	
	With th	is indicator,	it is advisal	ole to in	clude, in a	addition, the	
		•	isture conten		-	•	
Associated Variables		•	the drying			0 0	
Associated variables				•			
	information it is possible to calculate the electrical energy necessary per ton of dried fodder. The value of this electrical indicator is obviously different						
	depending on the energy source of the process and the technology of heat generation. If heat is generated in a fue						
	boiler, electrical consumption usually includes fan operating						
	produce	the warm a	ir flow, and a	ιuxiliary μ	processes.		
	40 kWh/t water rem						
Best or Average KPI	Best		KPI Value	(kWh	of	electricity	
-				consi	umption)	•	
	T. Kudr	a. 2004. Er	ergy aspects	s in dryir	ng. Drying	Technology	
	2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering, Ageng 2014, Zurich						
Source							
	Ŭ	0. 0	·				
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	<u>C071</u>	<u>10001.pdf</u>					
	<u> </u>						





4.9. Electrical average KPI-61. Specific Electrical Consumption (SEC) in aspiration per ton of product.

	Specific Flec	trical Consum	ntion (SE	(C) in aspiration per ton of			
INDICATOR	product	1					
Sector (NACE code)	NACE 10.6 Subsector All subsectors of drying						
	Process level	(aspiration)					
Level of indicator	The indicator includes the electrical energy, consumed in this specific process of aspiration, necessary per ton of product. The indicator does not include auxiliary processes of the drying industry.						
Thermal or Electrical process	Electrical pro	cess					
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (aspiration) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).						
Upper Lever		(all drying sub					
Lower level	Equipment le	vel					
Associated Variables	Unit	kWh/t dried product	Name	E aKPI L3 N1 specific electrical consumption in aspiration per ton of product			
	This indicator depends on outside temperatures and other weather conditions, and on the temperatures required in the process.						
Best or Average KPI	Average	KPI Value		2 kWh/t			
Source	 M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering. Ageng 2014. Zurich http://www.geyseco.es/geystiona/adjs/comunicaciones/304/C07110001.pdf 						





Electrical best KPI-62. Specific Electrical Consumption (SEC) in aspiration per ton of product.

Specific Electrical Consumption (SEC) in aspiration per ton of						
		7 til Odb	occiois of drying			
The indicato specific proceindicator doeindustry.						
	cess					
The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (aspiration) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).						
		bsectors)			
Equipment le	;vei		E bKPI L3 N1 specific			
Unit	kWh/t dried product	Name	electrical consumption in aspiration per ton of product			
Best			1 kWh/t			
M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering, Ageng 2014, Zurich.						
	product NACE 10.6 Process leve The indicator specific procesindicator docindustry. Electrical process (aspected and service an	Process level (aspiration) The indicator includes the specific process of aspiration indicator does not include industry. Electrical process Any source The SEC value is determined second second in the process (aspiration) in kill product processed. This KPI usually requires consumption of the procest the industry. These measurements are mergy analyzers or simple necessary to determine the period considered. Merepresentative results. The methodology is based of Billiris and Siebenmorge product level (all drying suit Equipment level Unit Whit kWh/t dried product KWh/t dried product KWh/t dried product This indicator depends of weather conditions, and opposes. Best KPI Valimate Report of the process of significant second in the product for the process of significant second in the process of significant seco	Process level (aspiration) The indicator includes the electric specific process of aspiration, nece indicator does not include auxiliating industry. Electrical process Any source The SEC value is determined by the SEC = E / PT (kWh/t) where E represents the electrical process (aspiration) in kWh, and product processed. This KPI usually requires specific consumption of the process, unless the industry. These measurements energy analyzers or similar technic necessary to determine the tons period considered. Measurements representative results. The methodology is based in experion of silliris and Siebenmorgen (2014) Product level (all drying subsectors Equipment level Whit kWh/t dried product KWh/t dried product KWh/t dried product KWh/t dried product Name This indicator depends on outsi weather conditions, and on the transport of the process. Best KPI Value M.A. Billiris and T.J. Siebenmorg efficiency of rice drying systems II. measurements. Applied Engineering 226 S. Gunasekaran and T.L. Thomy management in grain drying. Critic and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in 2(5), 917-932. doi:http://dx.doi.org/A. Pöllinger. 2014. Comparison techniques. International Control of the contr			





Electrical average KPI-63. Specific Electrical Consumption (SEC) in handling per ton of product.

INDICATOR	Specific Elec	trical Consun	nption (SE	EC) in handling per ton of			
	product	Subsector	A II l	antana af diada a			
Sector (NACE code)	NACE 10.6	, 3					
Level of indicator	Process level (handling) The indicator includes the electrical energy, consumed in this specific process of handling, necessary per ton of product. The indicator does not include auxiliary processes of the drying industry. Electrical process						
Thermal or Electrical process	Electrical pro	cess					
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (handling) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).						
Upper Lever	Product level	(all drying sul	bsectors)				
Lower level	Equipment le	vel					
Associated Variables	Unit Name E aKPI L3 N1 specific electrical consumption in handling per ton of product						
	process.						
Best or Average KPI Source	Average KPI Value 2 kWh/t M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering. Ageng 2014. Zurich. http://www.geyseco.es/geystiona/adjs/comunicaciones/304/C07110001.pdf						





Electrical best KPI-64. Specific Electrical Consumption (SEC) in handling per ton of product.

Specific Elec	trical Consun	nption (S	SEC) in handling per ton of			
product						
	, ,					
The indicator includes the electrical energy, consumed in this specific process of handling, necessary per ton of product. The indicator does not include auxiliary processes of the drying industry.						
Electrical pro	cess					
Any source						
The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (handling) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014). Product level (all drying subsectors)						
Unit	kWh/t dried product	Name	E bKPI L3 N1 specific electrical consumption in handling per ton of product			
Best	KPI Val	lue 1	kWh/t			
M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering, Ageng 2014, Zurich						
	product NACE 10.6 Process leve The indicator specific process indicator does industry. Electrical process (har product process (har pro	Process level (handling) The indicator includes the specific process of handling indicator does not include industry. Electrical process Any source The SEC value is determin SEC = E / PT (kWh/t) where E represents the exprocess (handling) in kWhord product processed. This KPI usually requires consumption of the process the industry. These measurements are measurements are methodology is based of Billiris and Siebenmorge product level (all drying sulfations and Siebenmorge) This indicator depends weather conditions, and or process. Best KPI Validation (all drying system as a surements) KPI Validation (all drying system as a surement in grain drying and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy and 2(5), 917-932. doi:http://dx. A. Pöllinger. 2014. Cotechniques. International	Process level (handling) The indicator includes the electric specific process of handling, neces indicator does not include auxilial industry. Electrical process Any source The SEC value is determined by the SEC = E / PT (kWh/t) where E represents the electrical process (handling) in kWh, and product processed. This KPI usually requires specific consumption of the process, unless the industry. These measurements energy analyzers or similar technecessary to determine the tons period considered. Measureme representative results. The methodology is based in experion of Billiris and Siebenmorgen (2014) Product level (all drying subsectors Equipment level Unit KWh/t dried product Name			





Electrical average KPI-65. Specific Electrical Consumption (SEC) in ventilation per ton of product.



INDICATOR	Specific Electrical Consumption (SEC) in ventilation per ton of product						
Sector (NACE code)	NACE 10.6 Subsector All subsectors of drying						
	Process leve	l (ventilation)					
Level of indicator	specific proce indicator doe industry.	•					
Thermal or Electrical process	Electrical pro	cess					
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (ventilation) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014).						
Upper Lever	Product level (all drying subsectors)						
Lower level	Equipment level						
Associated Variables	Unit	kWh/t dried product	Name	E aKPI L3 N1 specific electrical consumption in ventilation per ton of product			
	This indicator depends on outside temperatures and other weather conditions, and on the temperatures required in the process.						
Best or Average KPI	Average	KPI Va	alue 4	4 kWh/t			
Source	M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering, Ageng 2014, Zurich						
	http://www.gey	<u>/seco.es/geystior</u>	na/adjs/co	municaciones/304/C07110001.pdf			





4.14. Electrical best KPI-66. Specific Electrical Consumption (SEC) in ventilation per ton of product.

	A:			50)			
INDICATOR	Specific Electrical Consumption (SEC) in ventilation per ton of product						
Sector (NACE code)	NACE 10.6	Subsector	All subs	ectors of drying			
Level of indicator	Process level (ventilation) The indicator includes the electrical energy, consumed in this specific process of ventilation, necessary per ton of product. The indicator does not include auxiliary processes of the drying industry.						
Thermal or Electrical process	Electrical pro	ocess					
Energy source	Any source	Any source					
Description of the INDICATOR Upper Lever	The SEC value is determined by the equation: SEC = E / PT (kWh/t) where E represents the electrical energy consumption of the process (ventilation) in kWh, and PT designates the tons of product processed. This KPI usually requires specific measurements of electrical consumption of the process, unless these data are available in the industry. These measurements can be made with electrical energy analyzers or similar technologies. Additionally, it is necessary to determine the tons of product processed in the period considered. Measurement periods must ensure representative results. The methodology is based in experiments referred in the paper of Billiris and Siebenmorgen (2014). Product level (all drying subsectors)						
Lower level	Equipment level						
Associated Variables	Unit Name Name E bKPI L3 N1 specific electrical consumption in ventilation per ton of product						
Best or Average KPI	Best	KPI V	alue 2	2 kWh/t			
Source	M.A. Billiris and T.J. Siebenmorgen. 2014. Energy use and efficiency of rice drying systems II. Commercial, cross-flow dryer measurements. Applied Engineering in Agriculture 30(2): 217-226 S. Gunasekaran and T.L. Thompson. 1986. Optimal energy management in grain drying. Critical Reviews in Food Science and Nutrition, 25(1), 1-486 T. Kudra. 2004. Energy aspects in drying. Drying Technology 2(5), 917-932. doi:http://dx.doi.org/10.1081/DRT-120038572 A. Pöllinger. 2014. Comparison of different hay drying techniques. International Conference of Agricultural Engineering, Ageng 2014, Zurich						
	http://www.geyseco.es/geystiona/adjs/comunicaciones/304/C07110001.pdf						





5. FRUIT AND VEGETABLES sector

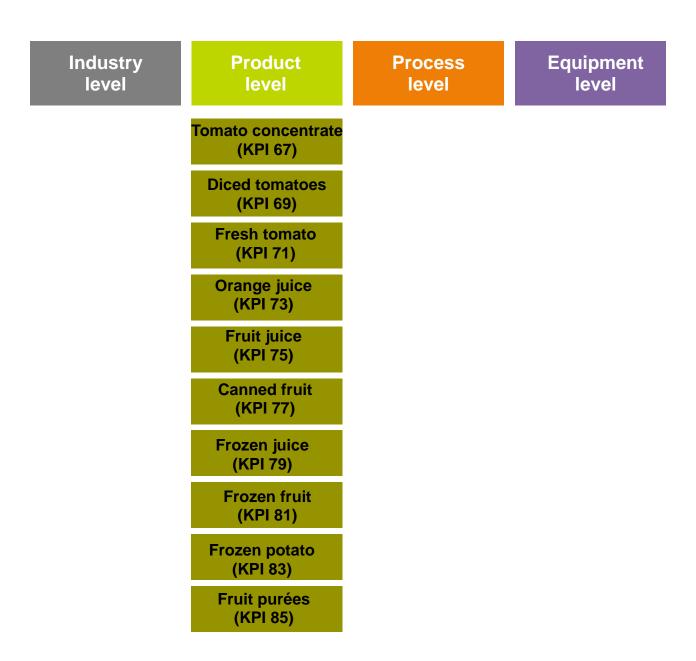


Figure 4. Scheme of the electric KPIs selected in the fruit and vegetables sector. For each of these KPIs, there is the "average KPI" version and the "best KPI" version.





5.1. Electrical average KPI-67. Specific Electrical Consumption (SEC) per ton of tomato concentrate.

INDICATOR	Specific Electrical Consumption (SEC) per ton of tomato concentrate							
Sector (NACE code)	NACE 10.3 Subsector Tomato concentrate							
,	Product level	(tomato conce	entrate)					
Level of indicator	The indicator ton of tomator industry.	•						
Thermal or Electrical process	Electrical pro	cess						
Energy source	Any source	•						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / TC (kWh/t) where E represents the annual electrical energy consumption (kWh), and TC designates the annual mass of tomato concentrate produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the tomato concentrate, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the tomato concentrate. Specific electrical requirement of tomato concentrate was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0131 toe/t (150 kWh/t).							
Upper Lever	Industry level							
Lower level	Process leve	el						
	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of tomato concentrate						ion per	
Associated Variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.							
Best or Average KPI	Average KPI Value 150 kWh/t							
Source	Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf					Agencia		





5.2. Electrical best KPI-68. Specific Electrical Consumption (SEC) per ton of tomato concentrate.

INDICATOR	Specific Electrical Consumption (SEC) per ton of tomato concentrate					
Sector (NACE code)	NACE 10.3 Subsector Tomato concentrate					
	Product leve	l (tomato conc	entrate)			
Level of indicator	The indicator includes all the electricity necessary to produce a ton of tomato concentrate, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical pro	cess				
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / TC (kWh/t) where E represents the annual electrical energy consumption (kWh), and TC designates the annual mass of tomato concentrate produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the tomato concentrate, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the tomato concentrate. Specific electrical requirement of tomato concentrate was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0131 toe/t (150 kWh/t).					
Upper Lever	Industry level					
Lower level	Process leve	el				
Associated Variables	Unit kWh/t Name E bKPI L2 N4 specific electrical consumption per ton of tomato concentrate					
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Best KPI Value 100 kWh/t					
Source	Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf					





5.3. Electrical average KPI-69. Specific Electrical Consumption (SEC) per ton of diced tomatoes.



INDICATOR	Specific Electrical Consumption (SEC) per ton of diced tomatoes					
Sector (NACE code)	NACE 10.3 Subsector Tomato					
Level of indicator	Product level (diced tomatoes) The indicator includes all the electricity necessary to produce a ton of diced tomatoes, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / DT (kWh/t) where E represents the annual electrical energy consumption (kWh), and DT designates the annual mass of diced tomatoes produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the diced tomatoes, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the diced tomatoes. Specific electrical requirement of diced tomatoes was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0035 toe/t (40 kWh/t).					
Upper Lever	Industry level					
Lower level	Process level					
Associated Variables	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of diced tomatoes This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical					
Best or Average KPI	consumption. Average KPI Value 40 kWh/t					
Source	Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf					





5.4. Electrical best KPI-70. Specific Electrical Consumption (SEC) per ton of diced tomatoes.

Sector (NACE code) NACE 10.3 Subsector Tomato		Specific Floo	etrical Consum	ntion (SE	C) per ton of diced			
Product level (diced tomatoes) The indicator The indicator includes all the electricity necessary to produce a ton of diced tomatoes, including auxiliary processes of the industry.	INDICATOR	· ·	. , , , .					
The indicator includes all the electricity necessary to produce a ton of diced tomatoes, including auxiliary processes of the industry. Thermal or Electrical process Energy source The SEC value is determined by the equation: SEC = E / DT (kWh/t) Where E represents the annual electrical energy consumption (kWh), and DT designates the annual mass of diced tomatoes produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the diced tomatoes, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the diced tomatoes. Specific electrical requirement of diced tomatoes was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0035 toe/t (40 kWh/t). Upper Lever Industry level Lower level Process level This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption. Best or Average KPI Best KPI Value 30 kWh/t Efficiencia energética en empresas del sector agroalimentario. (Finerry, efficiency, in agrifond companies), 2014. Agencia	Sector (NACE code)	NACE 10.3	Subsector	Tomato				
Energy source Any source The SEC value is determined by the equation: SEC = E / DT (kWh/t) where E represents the annual electrical energy consumption (kWh), and DT designates the annual mass of diced tomatoes produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the diced tomatoes, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the diced tomatoes. Specific electrical requirement of diced tomatoes was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0035 toe/t (40 kWh/t). Upper Lever Industry level Process level Unit kWh/t Name E bKPI L2 N4 specific electrical consumption per ton of diced tomatoes This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption. Best or Average KPI Best KPI Value 30 kWh/t Efficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-frond companies) 2014. Agencia	Level of indicator	The indicator includes all the electricity necessary to produce a ton of diced tomatoes, including auxiliary processes of the						
Any source	Thermal or Electrical process	Electrical process						
The SEC value is determined by the equation: SEC = E / DT (kWh/t) where E represents the annual electrical energy consumption (kWh), and DT designates the annual mass of diced tomatoes produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the diced tomatoes, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the diced tomatoes. Specific electrical requirement of diced tomatoes was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0035 toe/t (40 kWh/t). Upper Lever Industry level Process level Unit Name E bKPI L2 N4 specific electrical consumption per ton of diced tomatoes This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption. Best or Average KPI Best KPI Value 30 kWh/t	-	•	·					
Lower level Unit kWh/t Name E bKPI L2 N4 specific electrical consumption per ton of diced tomatoes	Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / DT (kWh/t) where E represents the annual electrical energy consumption (kWh), and DT designates the annual mass of diced tomatoes produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the diced tomatoes, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the diced tomatoes. Specific electrical requirement of diced tomatoes was already characterized in documents of the Extremadura energy agency						
Associated Variables Unit Name E bKPI L2 N4 specific electrical consumption per ton of diced tomatoes			•					
Associated Variables This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption. Best or Average KPI Best KPI Value 30 kWh/t Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies) 2014 Agencia	Lower level	Process level						
facilities normally show lower values of specific electrical consumption. Best or Average KPI Best KPI Value 30 kWh/t Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies) 2014 Agencia	Associated Variables	Unit kWh/t Name electrical consumption per ton of dice						
Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies) 2014 Agencia		facilities normally show lower values of specific electrical						
(Energy efficiency in agri-food companies) 2014 Agencia	Best or Average KPI	Best	KPI Val	ue 30 l	kWh/t			
extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-	Source	(Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-						
altercexa/2_EF_ENERG_EN_EMPRESAS_DEL_SECTOR_AG ROALIMENTARIO.pdf				IN_EIVIPRE	SAS_DEL_SECIUK_AG			





5.5. Electrical average KPI-71. Specific Electrical Consumption (SEC) per ton of fresh tomato.

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INDICATOR	Specific Electrical Consumption (SEC) per ton of fresh tomato						
Sector (NACE code)	NACE 10.3 Subsector Tomato						
	Product level (fresh tomato)						
Level of indicator	The indicator includes all the electricity necessary to produce a ton of fresh tomato, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrical process						
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FT (kWh/t) where E represents the annual electrical energy consumption (kWh), and FT designates the annual mass of fresh tomato produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the fresh tomato, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the fresh tomato. Specific electrical requirement of fresh tomato was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0024 toe/t (28 kWh/t).						
Upper Lever	Industry level						
Lower level	Process level						
Associated Variables	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of fresh tomato						
Associated Variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.						
Best or Average KPI	Average KPI Value 28 kWh/t						
Source	Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf						





5.6. Electrical best KPI-72. Specific Electrical Consumption (SEC) per ton of fresh tomato.

INDICATOR	Specific Electrical Consumption (SEC) per ton of fresh tomato					
Sector (NACE code)	NACE 10.3 Subsector Tomato					
	Product level	l (fresh tomato)			
Level of indicator				city necessary to produce a y processes of the industry.		
Thermal or Electrical process	Electrical pro	cess				
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FT (kWh/t) where E represents the annual electrical energy consumption (kWh), and FT designates the annual mass of fresh tomato produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the fresh tomato, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the fresh tomato. Specific electrical requirement of fresh tomato was already characterized in documents of the Extremadura energy agency in 2014, with values around 0.0024 toe/t (28 kWh/t).					
Upper Lever	Industry level					
Lower level	Process leve	el				
Associated Variables	Unit kWh/t Name E bKPI L2 N4 specific electrical consumption per ton of fresh tomato					
Associated variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Best	KPI Valu	e 20 l	kWh/t		
Source	Eficiencia energética en empresas del sector agroalimentario (Energy efficiency in agri-food companies). 2014. Agencia extremeña de la energía (Extremadura energy agency). http://www.agenex.net/guias-altercexa/2 EF ENERG EN EMPRESAS DEL SECTOR AG ROALIMENTARIO.pdf					





5.7. Electrical average KPI-73. Specific Electrical Consumption (SEC) per ton of orange juice.



INDICATOR	Specific Electrical Consumption (SEC) per ton of orange juice					
Sector (NACE code)	NACE 10.3 Subsector Orange juices					
	Product level (orange juice)					
Level of indicator	The indicator includes all the electricity necessary to produce a ton of orange juice, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / OJ (kWh/t) where E represents the annual electrical energy consumption (kWh), and OJ designates the annual mass of orange juice produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the orange juice, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the orange juice. Electrical requirement of several types of canned juice was already characterized in documents of the University of California in 2008, with values around 75 BTU/lb (48 kWh/t). Specific results for orange juice can be found in documents of the SENSE Project Number 288974, with values around 0.15 kWh/l (185 kWh/t) considering a density of 0.8 kg/l. Other studies for orange juice showed values around 60 kWh/t (Waheed et al., 2008).					
Upper Lever	Industry level					
Lower level	Process level					
	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of orange juice					
Associated Variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Average KPI Value 135 kWh/t					
Source	Harmonised Environmental Sustainability in the European food and drink chain. 2013. ESU-services Ltd. Document co-funded by European Commission within the Seventh Framework Programme, SENSE Project Number 288974. M.A. Waheed, S.O. Jekayinfa, J.O. Ojediran, O.E. Imeokparia. 2008. Energetic analysis of fruit juice processing operations in Nigeria. Energy 33: 35–45 Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry. 2008. Lawrence					





Berkeley National Laboratory, University of California. https://www.energystar.gov/ia/business/industry/Food-Guide.pdf

5.8. Electrical best KPI-74. Specific Electrical Consumption (SEC) per ton of orange juice.



INDICATOR	Specific Electrical Consumption (SEC) per ton of orange juice					
Sector (NACE code)	NACE 10.3 Subsector Orange juices					
	Product level (orange juice)					
Level of indicator	The indicator includes all the electricity necessary to produce a ton of orange juice, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / OJ (kWh/t) where E represents the annual electrical energy consumption (kWh), and OJ designates the annual mass of orange juice produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the orange juice, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the orange juice. Electrical requirement of several types of canned juice was already characterized in documents of the University of California in 2008, with values around 75 BTU/lb (48 kWh/t). Specific results for orange juice can be found in documents of the SENSE Project Number 288974, with values around 0.15 kWh/l (185 kWh/t) considering a density of 0.8 kg/l. Other studies for orange juice showed values around 60 kWh/t (Waheed et al., 2008).					
Upper Lever	Industry level					
Lower level	Process level					
	Unit KWh/t Name E aKPI L2 N4 specific electrical consumption per ton of orange juice					
Associated Variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Best KPI Value 60 kWh/t					
Source	Harmonised Environmental Sustainability in the European food and drink chain. 2013. ESU-services Ltd. Document co-funded by European Commission within the Seventh Framework Programme, SENSE Project Number 288974. M.A. Waheeda, S.O. Jekayinfab, J.O. Ojediranb, O.E. Imeokparia. 2008. Energetic analysis of fruit juice processing operations in Nigeria. Energy 33: 35–45 Energy Efficiency Improvement and Cost Saving Opportunities					





for the Fruit and Vegetable Processing Industry. 2008. Lawrence Berkeley National Laboratory, University of California. https://www.energystar.gov/ia/business/industry/Food-Guide.pdf

5.9. Electrical average KPI-75. Specific Electrical Consumption (SEC) per ton of fruit juice.

INDICATOR	Specific Electrical Consumption (SEC) per ton of fruit juice					
Sector (NACE code)	NACE 10.3 Subsector Fruit juices					
	Product level	(fruit juice)				
Level of indicator		The indicator includes all the electricity necessary to produce a ton of fruit juice, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical prod	cess				
Energy source	Any source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CJ (kWh/t) where E represents the annual electrical energy consumption (kWh), and CJ designates the annual mass of fruit juice produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the fruit juice, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the fruit juice. Specific electrical requirement of fruit juice was already characterized in documents of the University of California in 2008, with values around 75 BTU/lb (48 kWh/t).					
Upper Lever	Industry level					
Lower level	Process level					
Associated Variables	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of fruit juice This SEC usually depends on the size of the industry. Bit facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Average	KPI Valu	e 4	8 kWh/t		
Source	Energy Efficiency Improvement and Cost Saving Opportunities for the Fruit and Vegetable Processing Industry. 2008. Lawrence Berkeley National Laboratory, University of California. https://www.energystar.gov/ia/business/industry/Food-Guide.pdf					





5.10. Electrical best KPI-76. Specific Electrical Consumption (SEC) per ton of fruit juice.

INDICATOR	Specific Electric	cal Consumpti	on (SEC)	per ton of fruit juice	
Sector (NACE code)	NACE 10.3	Subsector	Fruit jui	ces	
	Product level (f	ruit juice)			
Level of indicator			-	y necessary to produce a cesses of the industry.	
Thermal or Electrical process	Electrical process				
Energy source	Any source				
Description of the INDICATOR	(kWh), and C produced (t). The global election obtained from products are in annual electric measurements representative fruit juice.	(kWh/t) sents the annual designates ctrical energy of the electrical included, it is call consumption of this seperiod, to exist the equirement of the electrical requirements of the elec	ual electr the ann consumpti I bill of necessa on of the specific trapolate ent of the U	rical energy consumption hual mass of fruit juice ion of the industry can be the industry. If several ary to disaggregate the e fruit juice, or to take consumption over a the consumption of the fruit juice was already university of California in	
Upper Lever	Industry level				
Lower level	Process level				
Associated Variables	Unit	kWh/t	Name	E bKPI L2 N4 specific electrical consumption per ton of fruit juice	
Associated Variables		•		size of the industry. Big es of specific electrical	
Best or Average KPI	Best	KPI Valu	ie 30) kWh/t	
Source	for the Fruit Lawrence Be California.	and Vegeta rkeley Natio	ble Prod nal Lab	cost Saving Opportunities cessing Industry. 2008. coratory, University of s/industry/Food-	





Electrical average KPI-77. Specific Electrical Consumption (SEC) per ton of canned fruit (or vegetable).

	Cassifia Elas	trical C	`anaı ımr	tion (CE	C) nor top of conned fruit	
INDICATOR	•	Specific Electrical Consumption (SEC) per ton of canned fruit (or vegetable)				
Sector (NACE code)	NACE 10.3	Subs	ector	Canne	d F&V	
	Product level	`				
Level of indicator	The indicator includes all the electricity necessary to produce a ton of canned fruit (or vegetable), including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
	The SEC value is determined by the equation:					
	SEC = E / CF	•	•			
	where E represents the annual electrical energy consumption (kWh), and CF designates the annual mass of canned fruit (vegetable) produced (t). The global electrical energy consumption of the industry can be seen to be a support of the industry can be seen to be s				al mass of canned fruit (or ption of the industry can be	
D 1 (1 (1 NIDIO 170)					of the industry. If several	
Description of the INDICATOR	•				ssary to disaggregate the	
			-		canned fruit (or vegetable), pecific consumption over a	
				-	•	
	representative period, to extrapolate the consumption of the canned fruit.					
	Specific electrical requirement of canned fruit was already					
	characterized in documents of the University of California				-	
	2008, with values around 87 BTU/lb (56 kWh/t).					
Upper Lever	Industry level					
Lower level	Process leve	l				
					E aKPI L2 N4 specific	
Associated Variables	Unit	kWh/	't	Name	electrical consumption per ton of canned fruit (or vegetable)	
7.0000.000 7.0.100.000	This SEC us	ually	depends	on the	size of the industry. Big	
		•	•		lues of specific electrical	
	consumption.	•			•	
Best or Average KPI	Average		KPI Val	ue 5	66 kWh/t	
	Energy Efficie	ency In	Energy Efficiency Improvement and Cost Saving Opportunities			
	for the Fruit and Vegetable					
		-	getable			
	Processing	Industi	getable y. 200	3. Law	rence Berkeley National	
Source	Processing Laboratory, U	Industi niversi	getable ry. 200 ty of Cal	8. Law ifornia.		
Source	Processing Laboratory, U https://www.e	Industi niversi	getable ry. 200 ty of Cal	8. Law ifornia.	rence Berkeley National	
Source	Processing Laboratory, U	Industi niversi	getable ry. 200 ty of Cal	8. Law ifornia.		





Electrical best KPI-78. Specific Electrical Consumption (SEC) per ton of canned fruit (or vegetable).

INDICATOR	Specific Electrical Consumption (SEC) per ton of canned fruit (or						
	vegetable)						
Sector (NACE code)	NACE 10.3	Subsector	Canned F&V				
Level of indicator	Product level	(canned fruit)					
	The indicator	The indicator includes all the electricity necessary to produce a					
	ton of canned	d fruit (or vege	able), including auxiliary	processes			
	of the industry.						
Thermal or Electrical process	Electrical prod	cess					
Energy source	Any source						
Description of the INDICATOR			by the equation:				
	SEC = E / CF	,					
	•		nual electrical energy co	•			
		-	he annual mass of cann	ied fruit (or			
	vegetable) pro	` ,	e to the				
	_	• • • • • • • • • • • • • • • • • • • •	consumption of the indus	•			
			al bill of the industry.				
	•	•	s necessary to disagg n of the canned fruit (or	•			
		•	f this specific consumpt	• ,			
	representative period, to extrapolate the consumption of the canned fruit.						
	Specific electrical requirement of canned fruit was already						
	characterized in documents of the University of California in						
	2008, with values around 87 BTU/lb (56 kWh/t).						
Upper Lever	Industry leve		(,				
Lower level	Process leve						
Associated Variables	Unit	kWh/t	Name E bKPI L2 N	14 specific			
			electrical consu	imption per			
			ton of canned	d fruit (or			
			vegetable)				
	This SEC us	sually depends	on the size of the inc	dustry. Big			
	facilities norr	mally show le	wer values of specific	c electrical			
	consumption.						
Best or Average KPI	Best	KPI Va					
Source			ent and Cost Saving Op	oportunities			
	for the Fruit a	•					
		•	•	/ National			
	Laboratory II	Indiviousity of Co	fornia	Processing Industry. 2008. Lawrence Berkeley National Laboratory, University of California.			
	•	•					
	•	•	a/business/industry/Food	l-Guide.pdf			





5.13. Electrical average KPI-79. Specific Electrical Consumption (SEC) per ton of frozen concentrated juice.

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INDICATOR	· •	Specific Electrical Consumption (SEC) per ton of frozen concentrated juice				
Sector (NACE code)	NACE 10.3	Subsector	Frozen	concentra	ate juice	
	Product level (fro	zen concent	rated juic	e)		
Level of indicator	The indicator includes all the electricity necessary to produce a ton of frozen concentrated juice, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical process					
Energy source	Any source					
Description of the INDICATOR	The SEC value is SEC = E / FCJ where E represe (kWh), and FC concentrated juid The global electrobtained from the products are in annual electrical or to take meas representative progression concentral Specific electrical already charact California in 2006	(kWh/t) ents the annotate the electrical energy of the electrical cluded, it is consumption urements of eriod, to exited juice. al requirements of erized in description of the electrical energy of the electrical in description of the electrical in description of the electrical electrical energy of the electrical elec	ual electres the a (t). consumpt l bill of necessin of the fithis spectrapolate locument	rical energannual maion of the the industrozen concific constants of the	industry stry. If saggregation centrate umption trated juice university of the saggregation in trated juice university of the saggregation in the	can be several ate the d juice, over a of the dece was sity of
Upper Lever	Industry level				•	<u> </u>
Lower level	Process level					
Associated Variables		kWh/t	Name	E aKPI electrica per to concenti	l consun of rated juic	imption frozen
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Average	KPI Valu	i e 51	5 kWh/t		
Source	Energy Efficience for the Potato Lawrence Berk California. https://www.ener Guide.pdf	and Vegeta celey Natio	able Pro nal Lab	cessing looratory,	Industry. Univers	2008.





5.14. Electrical best KPI-80. Specific Electrical Consumption (SEC) per ton of frozen concentrated juice.

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INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen concentrated juice					
Sector (NACE code)	NACE 10.3	Subsector	Frozen	concentrat	e juice	
Level of indicator	Product level (frozen concentrated juice) The indicator includes all the electricity necessary to produce a ton of frozen concentrated juice, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical pro	Electrical process				
Energy source	Any source					
Description of the INDICATOR	SEC = E / F where E rep (kWh), and concentrated The global e obtained fro products are annual election or to take m representation frozen conce Specific elec- already char	ue is determine CJ (kWh/t) presents the an FCJ designary	nual electes the local bill of the spectrapolate and of the documents.	etrical energy annual metricon of the formal the industrial frozen consideration consideration consideration consideration concentrial consideration concentrial consideration concentrial consideration concentrial consideration c	industry stry. If saggregation sumption trated juice University	can be several ate the d juice, over a of the ce was sity of
Upper Lever	Industry leve	el				
Lower level	Process leve	el				
Associated Variables	Unit	kWh/t	Name	E bKPI electrical per tor concentra	consu n of ated juice	imption frozen
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.					
Best or Average KPI	Best	KPI Va	-	00 kWh/t		
Source	for the Pot Lawrence California.	iency Improvem ato and Vege Berkeley Nati energystar.gov/	table Pr onal La	rocessing aboratory,	Industry. Univers	





5.15. Electrical average KPI-81. Specific Electrical Consumption (SEC) per ton of frozen fruit.

INDICATOR	Specific Electr	rical Consumpti	on (SEC)	per ton of frozen fruit		
Sector (NACE code)	NACE 10.3	Subsector	Frozen	fruit		
	Product level	(frozen fruit)				
Level of indicator	The indicator includes all the electricity necessary to produce a ton of frozen fruit, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical proc	Electrical process				
Energy source	Any source					
Description of the INDICATOR	SEC = E / FF where E representative frozen fruit. Specific elect where E representative frozen fruit. Specific elect where E representative frozen fruit. Specific elect characterized	esents the annual rectrical energy of the electrical included, it is east of this energy of this energy of the electrical requirements.	ual electre the annumental bill of a necession of the specific trapolate ent of the U	rical energy consumption ual mass of frozen fruit ion of the industry can be the industry. If several ary to disaggregate the frozen fruit, or to take consumption over a the consumption of the rozen fruit was already University of California in		
Upper Lever	Industry level					
Lower level	Process level					
Associated Variables	Unit	kWh/t	Name	E aKPI L2 N4 specific electrical consumption per ton of frozen fruit		
Associated Variables		• •		size of the industry. Big es of specific electrical		
Best or Average KPI	Average	KPI Valu	ie 420	0 kWh/t		
Source	for the Fruit Lawrence B California.	t and Vegeta erkeley Natio	ble Prod nal Lab	cost Saving Opportunities cessing Industry. 2008. coratory, University of s/industry/Food-		





Electrical best KPI-82. Specific Electrical Consumption (SEC) per ton of frozen fruit.

INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen fruit			
Sector (NACE code)	NACE 10.3	Subsector	Frozen fruit	
Lovel of indicator	Product level	,		
Level of indicator			e electricity necessary to produ auxiliary processes of the indus	
Thermal or Electrical process	Electrical prod	cess		
Energy source	Any source			
	SEC = E / FF where E repr (kWh), and	(kWh/t) resents the an	ed by the equation: inual electrical energy consum s the annual mass of frozen	
Description of the INDICATOR	obtained fror products are	m the electric included, it	consumption of the industry can cal bill of the industry. If several is necessary to disaggregate	veral the
	measurement representative frozen fruit. Specific elec characterized	ts of this e period, to e ctrical requirer I in documents	tion of the frozen fruit, or to specific consumption over extrapolate the consumption of ment of frozen fruit was alrest of the University of Californ 50 BTU/lb (420 kWh/t).	r a fithe eady
Upper Lever	Industry leve		90 D1 0/18 (420 KVV1)/t).	
Lower level	Process leve			
Associated Variables	Unit	kWh/t	Name E bKPI L2 N4 sperifical consumper ton of frozen fruit	ption
Associated variables		mally show lo	s on the size of the industry. ower values of specific elec	•
Best or Average KPI	Best	KPI Va	lue 300 kWh/t	
Source	for the Fruit Lawrence E California.	t and Vegeta Berkeley Nati	•	.800





5.17. Electrical average KPI-83. Specific Electrical Consumption (SEC) per ton of frozen potato.

INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen potato				
Sector (NACE code)	NACE 10.3 Subsector Frozen potato				
Level of indicator	Product level (frozen potato) The indicator includes all the electricity necessary to produce a ton of frozen potato, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical process				
Energy source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FP (kWh/t) where E represents the annual electrical energy consumption (kWh), and FP designates the annual mass of frozen potato produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the frozen potato, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the frozen potato. Specific electrical requirement of frozen potato was already characterized in documents of the University of California in 2008, with values around 635 BTU/lb (410 kWh/t).				
Upper Lever	Industry level				
Lower level	Process level				
Associated Variables	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of frozen potato				
7.0000.u.ou vanasioo	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.				
Best or Average KPI	Average KPI Value 410 kWh/t				
Source	Energy Efficiency Improvement and Cost Saving Opportunities for the Potato and Vegetable Processing Industry. 2008. Lawrence Berkeley National Laboratory, University of California. https://www.energystar.gov/ia/business/industry/Food-Guide.pdf				





Electrical best KPI-84. Specific Electrical Consumption (SEC) per ton of frozen potato.

INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen potato
Sector (NACE code)	NACE 10.3 Subsector Frozen potato
Level of indicator	Product level (frozen potato) The indicator includes all the electricity necessary to produce a ton of frozen potato, including auxiliary processes of the industry.
Thermal or Electrical process	Electrical process
Energy source	Any source
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FP (kWh/t) where E represents the annual electrical energy consumption (kWh), and FP designates the annual mass of frozen potato produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the frozen potato, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the frozen potato. Specific electrical requirement of frozen potato was already characterized in documents of the University of California in 2008, with values around 635 BTU/lb (410 kWh/t).
Upper Lever	Industry level
Lower level	Process level
Associated Variables	Unit kWh/t Name E bKPI L2 N4 specific electrical consumption per ton of frozen potato This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.
Best or Average KPI	Best KPI Value 300 kWh/t
Source	Energy Efficiency Improvement and Cost Saving Opportunities for the Potato and Vegetable Processing Industry. 2008. Lawrence Berkeley National Laboratory, University of California. https://www.energystar.gov/ia/business/industry/Food-Guide.pdf





Electrical average KPI-85. Specific Electrical Consumption (SEC) per ton of fruit purées.

INDICATOR	Specific Electrical Consumption (SEC) per ton of fruit purées				
Sector (NACE code)	NACE 10.3 Subsector Fruit purées				
	Product level (fruit purées)				
Level of indicator	The indicator includes all the electricity necessary to produce a ton of fruit purées, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical process				
Energy source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FP (kWh/t) where E represents the annual electrical energy consumption (kWh), and FP designates the annual mass of fruit purées produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the fruit purées, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the fruit purées. Specific electrical requirement of fruit purées was already characterized in documents of the Northwest Food Processors Association in 2010, with values around 1850 BTU/lb (1200 kWh/t).				
Upper Lever	Industry level				
Lower level	Process level				
Associated Variables	Unit kWh/t Name E aKPI L2 N4 specific electrical consumption per ton of fruit purées				
Associated variables	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.				
Best or Average KPI	Average KPI Value 1200 kWh/t				
Source	Energy Intensity Baseline of the Northwest Food Processing Industry. 2010. Northwest Food Processors Association. http://www.nwfpa.org/legacy/images/pdfs/energy_intensity_nwfp_industry.pdf				





5.20. Electrical best KPI-86. Specific Electrical Consumption (SEC) per ton of fruit purées.

INDICATOR	Specific Electrical Consumption (SEC) per ton of fruit purées				
Sector (NACE code)	NACE 10.3	Subsector	Fruit purées		
	Product level (fruit purées)				
Level of indicator	The indicator includes all the electricity necessary to produce a ton of fruit purées, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical process				
Energy source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FP (kWh/t) where E represents the annual electrical energy consumption (kWh), and FP designates the annual mass of fruit purées produced (t). The global electrical energy consumption of the industry can be obtained from the electrical bill of the industry. If several products are included, it is necessary to disaggregate the annual electrical consumption of the fruit purées, or to take measurements of this specific consumption over a representative period, to extrapolate the consumption of the fruit purées. Specific electrical requirement of fruit purées was already characterized in documents of the Northwest Food Processors Association in 2010, with values around 1850 BTU/lb (1200 kWh/t).				
Upper Lever	Industry level				
Lower level	Process level				
Associated Variables	Unit	kWh/t	Name	E bKPI L2 N4 specific electrical consumption per ton of fruit purées	
	This SEC usually depends on the size of the industry. Big facilities normally show lower values of specific electrical consumption.				
Best or Average KPI	Best	KPI Value	800 kV	/h/t	
Source	Energy Intensity Baseline of the Northwest Food Processing Industry 2010 Northwest Food Processors Association http://www.nwfpa.org/legacy/images/pdfs/energy_intensity_nwfp_industry.pdf				





6. MEAT AND POULTRY sector

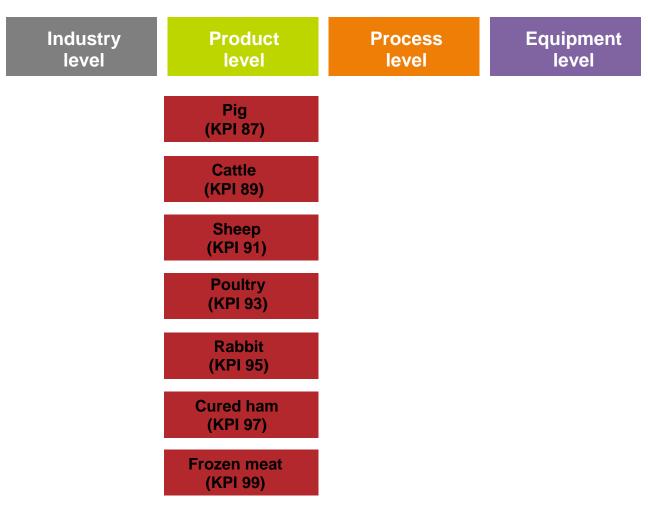


Figure 5. Scheme of the electric KPIs selected in the meat sector. For each of these KPIs, there is the "average KPI" version and the "best KPI" version.





${\bf 6.1.}\, Electrical\,\, average\,\, KPI-87.\,\, Specific\,\, Electrical\,\, Consumption\,\, (SEC)\,\, per\,\, carcass\,\, ton$ of pig.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of pig					
Sector (NACE code)	NACE 10.1	Subsector	Pig slau	ughtering		
, ,	Product level	(pig)				
Level of indicator				ity necessary to produce a cesses of the industry.		
Thermal or Electrical process	Electrical proc	Electrical process				
Energy source	Any source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of pig carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of pig carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of pig carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).					
Upper Lever	Industry level					
Lower level	Process level					
Associated Variables	Unit	kWh/t carcass	Name	E aKPI L2 N2 specific electrical consumption per carcass ton of pig		
Associated variables	The size of the industry influences the ratio. This indicate usually higher in small industries than in big industries.					
Best or Average KPI	Average KPI Value 155 kWh/t carcass					
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411					





6.2. Electrical best KPI-88. Specific Electrical Consumption (SEC) per carcass ton of pig.

INDICATOR	Specific Elect	rical Consumption	(SEC) p	er carcass ton of pig	
Sector (NACE code)	NACE 10.1	Subsector	Pig sla	ughtering	
	Product level	Product level (pig)			
Level of indicator	The indicator includes all the electricity necessary to produce a ton of carcass, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical				
Energy source	Any source	Any source			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of pig carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of pig carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of pig carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Industry level				
Lower level	Process leve	l			
Associated Variables	Unit	kWh/t carcass	Name	E bKPI L2 N2 specific electrical consumption per carcass ton of pig	
	The size of the industry influences the ratio. This indicator i usually higher in small industries than in big industries.				
Best or Average KPI	Best	KPI Value	36 k\	Wh/t carcass	
Source	points on the industry – Ca	e energy sustaina	able dev Portugue	P.D. Gaspar. 2016. Key velopment of the food ese sausages industry. views 57: 393–411	





$\textbf{6.3.} \ \textbf{Electrical} \ \textbf{average} \ \textbf{KPI-89.} \ \textbf{Specific} \ \textbf{Electrical} \ \textbf{Consumption} \ (\textbf{SEC}) \ \textbf{per carcass} \ \textbf{ton}$ of cattle.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of cattle				
Sector (NACE code)	NACE 10.1	Subsector	Cattle	slaughtering	
	Product level (d	cattle)	•		
Level of indicator	The indicator includes all the electricity necessary to produce a ton of carcass, including auxiliary processes of the industry.				
Thermal or Electrical process	Electrical				
Energy source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / BC (kWh/t) where E represents the annual electrical energy consumption (kWh), and BC designates the annual tons of cattle carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of cattle carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of cattle carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Industry level				
Lower level	Process level			E aKPI L2 N2	
Associated Variables	Unit kWh/t carcass Name E aKPI specific consumption carcass ton				
	The size of the industry influences the ratio. This indicator usually higher in small industries than in big industries.				
Best or Average KPI	Average	KPI Value	150 l	kWh/t carcass	
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





6.4. Electrical best KPI-90. Specific Electrical Consumption (SEC) per carcass ton of cattle.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of cattle				
Sector (NACE code)	NACE 10.1	Subsector	Cattle	slaughtering	
	Product level	(cattle)			
Level of indicator			•	necessary to produce a ses of the industry.	
Thermal or Electrical process	Electrical				
Energy source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / BC (kWh/t) where E represents the annual electrical energy consumption (kWh), and BC designates the annual tons of cattle carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of cattle carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of cattle carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Industry level				
Lower level	Process level			E bKPI L2 N2	
Associated Variables	Unit kWh/t carcass Name E bKPI L specific e consumption carcass ton or				
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.				
Best or Average KPI	Best	KPI Value		Wh/t carcass	
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





6.5. Electrical average KPI-91. Specific Electrical Consumption (SEC) per carcass ton of sheep.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of sheep					
Sector (NACE code)	NACE 10.1	Subsector	Sheep	slaughtering		
Level of indicator	Product level (sheep) The indicator includes all the electrical energy necessary to produce a ton of carcass, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / LC (kWh/t) where E represents the annual electrical energy consumption (kWh), and LC designates the annual tons of sheep carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of sheep carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of sheep carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).					
Upper Lever	Industry level					
Lower level	Process leve	l				
Associated Variables	·					
	The size of the industry influences the ratio. This indicusually higher in small industries than in big industries.					
Best or Average KPI	Average	KPI Value	155	kWh/t carcass		
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411					





6.6. Electrical best KPI-92. Specific Electrical Consumption (SEC) per carcass ton of sheep.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of sheep						
Sector (NACE code)	NACE 10.1	Subsector	Sheep	slaughtering			
Level of indicator	Product level (sheep) The indicator includes all the electrical energy necessary to produce a ton of carcass, including auxiliary processes of the industry.						
Thermal or Electrical process	Electrical	Electrical					
Energy source	Any source						
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / LC (kWh/t) where E represents the annual electrical energy consumption (kWh), and LC designates the annual tons of sheep carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of sheep carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of sheep carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).						
Upper Lever	Industry level						
Lower level	Process level						
Associated Variables	Unit	E bKPI L2 N2 specific electrical consumption per carcass ton of sheep					
	The size of the industry influences the ratio. This indicusually higher in small industries than in big industries.						
Best or Average KPI	Best	KPI Value	36 k	Wh/t carcass			
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411						





6.7. Electrical average KPI-93. Specific Electrical Consumption (SEC) per carcass tonof poultry.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of poultry				of				
Sector (NACE code)	NACÉ 1	0.1	Subse	ctor	Poultry	slaught	ering		
	Product	level	(poultry)						
Level of indicator	The indicator includes all the electricity necessary to produce a ton of carcass, including auxiliary processes of the industry.					 Э а			
Thermal or Electrical process	Electrica	al							
Energy source	Any sou								
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of poultry carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of poultry carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of poultry carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016). There are values of reference in the study "Guía de la producción limpia para el Sector de matadero y transformación de carne avícola de la Comunidad Valenciana", IMPIVA, 2009.								
Upper Lever	Industry level								
Lower level	Proces	s level							
Associated Variables	Unit kWh/t carcass Name E aKPI L2 N2 spect electrical consumpt per carcass ton poultry					umpti			
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.					is			
Best or Average KPI	Average			PI Valu			carcass		
Source	IMPIVA. 2009. Guía de la producción limpia para el Sector de matadero y transformación de carne avícola de la Comunidad Valenciana. J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411								





6.8. Electrical best KPI-94. Specific Electrical Consumption (SEC) per carcass ton of poultry.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of poultry					
Sector (NACE code)	NACE 10.1	Subsector	Poultry	slaughtering		
	Product level	(poultry)				
Level of indicator	The indicator includes all the electricity necessary to produce a ton of carcass, including auxiliary processes of the industry.					
Thermal or Electrical process	Electrical					
Energy source	Any source	Any source				
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of poultry carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of poultry carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of poultry carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016). There are values of reference in the study "Guía de la producción limpia para el Sector de matadero y transformación de carne avícola de la Comunidad Valenciana", IMPIVA, 2009.					
Upper Lever	Industry level					
Lower level	Process leve			1		
Associated Variables	Unit	kWh/t carcass	Name	E bKPI L2 N2 specific electrical consumption per carcass ton of poultry		
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.					
Best or Average KPI	Best	KPI Value		Wh/t carcass		
Source	IMPIVA. 2009. Guía de la producción limpia para el Sector de matadero y transformación de carne avícola de la Comunidad Valenciana. J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411					





$\textbf{6.9.} \textbf{Electrical} \ \textbf{Consumption} \ (\textbf{SEC}) \ \textbf{per carcass ton}$ of rabbit.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of rabbi			
Sector (NACE code)	NACE 10.1	Subsector	Rabbit	slaughtering
	Product leve	l (rabbit)		
Level of indicator			-	necessary to produce a ses of the industry.
Thermal or Electrical process	Electrical			
Energy source	Any source			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of rabbit carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of rabbit carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of rabbit carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).			
Upper Lever	Industry leve			
Lower level	Process leve	el	_	
Associated Variables	Unit	kWh/t carcass	Name	E aKPI L2 N2 specific electrical consumption per carcass ton of rabbit
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.			
Best or Average KPI	Average	KPI Value		kWh/t carcass
	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411			





Electrical best KPI-96. Specific Electrical Consumption (SEC) per carcass ton of rabbit.

INDICATOR	Specific Electrical Consumption (SEC) per carcass ton of rabbit				
Sector (NACE code)	NACE 10.1	Subsector	Rabbit	slaughtering	
	Product level	(rabbit)			
Level of indicator			•	necessary to produce a ses of the industry.	
Thermal or Electrical process	Electrical				
Energy source	Any source	Any source			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / PC (kWh/t) where E represents the annual electrical energy consumption (kWh), and PC designates the annual tons of rabbit carcass produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of rabbit carcass, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of rabbit carcass. Annual production (tons of carcass) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).				
Upper Lever	Industry leve				
Lower level	Process leve	l			
Associated Variables	Unit	kWh/t carcass	Name	E bKPI L2 N2 specific electrical consumption per carcass ton of rabbit	
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.				
Best or Average KPI	Best	KPI Value		Wh/t carcass	
	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese sausages industry. Renewable and Sustainable Energy Reviews 57: 393–411				





Electrical average KPI-97. Specific Electrical Consumption (SEC) per ton of cured ham.

INDICATOR	Specific Elect	Specific Electrical Consumption (SEC) per ton of cured ham				
Sector (NACE code)	NACE 10.1	Subsector	Cured h	nam production		
Level of indicator	Product level (cured ham) The indicator includes all the electrical energy necessary to produce a ton of cured ham, including auxiliary processes of the industry, such as meat defrosting before starting curing process.					
Thermal or Electrical process	Electrical					
Energy source	Any source					
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CH (kWh/t) where E represents the annual electrical energy consumption (kWh), and CH designates the annual tons of cured ham produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of cured ham, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of cured ham. Annual production (tons) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).					
Upper Lever	Industry leve					
Lower level	Process leve	l				
Associated Variables	Unit	kWh/t cured ham	Name	E aKPI L2 N2 specific electrical consumption per ton of cured ham		
		•		ne ratio. This indicator is in big industries.		
Best or Average KPI	Average	KPI Valu	i e 50	00 kWh/t cured ham		
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese ham industry. Renewable and Sustainable Energy Reviews 57: 393–411					





6.12. Electrical best KPI-98. Specific Electrical Consumption (SEC) per ton of cured ham.

INDICATOR	Specific Electrical Consumptio	n (SEC) per ton of cured ham		
Sector (NACE code)	NACE 10.1 Subsector	Cured ham production		
Level of indicator	Product level (cured ham) The indicator includes all the electrical energy necessary to produce a ton of cured ham, including auxiliary processes of the industry, such as meat defrosting before starting curing process.			
Thermal or Electrical process	Electrical			
Energy source	Any source			
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / CH (kWh/t) where E represents the annual electrical energy consumption (kWh), and CH designates the annual tons of cured ham produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. If the industry includes other processes different from the production of cured ham, it is necessary to disaggregate the consumption by sector, and to assign a value of consumption to the production of cured ham. Annual production (tons) is obtained from industry recordings. The methodology is based in audits referred in the paper of Nunes et al. (2016).			
Upper Lever	Industry level			
Lower level	Process level			
Associated Variables	Unit kWh/t cured	Name E bKPI L2 N2 specific electrical consumption per ton of cured ham		
	The size of the industry influences the ratio. This indicator is usually higher in small industries than in big industries.			
Best or Average KPI	Best KPI Value	300 kWh/t cured ham		
Source	J. Nunes, P.D. Silva, L.P. Andrade and P.D. Gaspar. 2016. Key points on the energy sustainable development of the food industry – Case study of the Portuguese ham industry. Renewable and Sustainable Energy Reviews 57: 393–411			





6.13. Electrical average KPI-99. Specific Electrical Consumption (SEC) per ton of frozen meat.

INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen meat			
Sector (NACE code)	NACE 10.1	Subsector	Frozen	meat production
Level of indicator	Product level (frozen meat) The indicator includes the electrical energy necessary to produce a ton of frozen meat, from carcass. So the basic processes considered in this indicator are cutting, deboning and freezing, and the auxiliary processes involved.			
Thermal or Electrical process	Electrical			
Energy source	Any source)		
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FM (kWh/t) where E represents the annual electrical energy consumption (kWh) of cutting, deboning, freezing and the auxiliary processes involved, and FM designates the annual tons of frozen meat produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. Annual production (tons) is obtained from industry recordings. The methodology is based in the work referred in the paper of Ramírez et al. (2006).			
Upper Lever	Industry le	evel		
Lower level	Process le	evel		
Associated Variables	Unit	kWh/t of finished product (boneless cut frozen meat)	Name	E aKPI L2 N2 specific electrical consumption per ton of frozen meat
	As KPI is given in tons of finished product, we use the following carcass cutting yields to convert kilograms of boneless cut meat to dress carcass weight: 1.53 for cattle, 1.37 for pork and 1.8 for poultry. Note that frozen poultry products demand more energy not only because of higher refrigeration requirements but also because the meat is submitted to higher temperatures during scalding.			





Best or Average KPI	Average	KPI Value	Electrical consumption (cutting and deboning): 60 kWh/t finished product (cattle, pig and poultry) Electrical consumption (freezing process): 300 kWh/t finished product (frozen cattle meat) 400 kWh/t finished product (frozen pig meat) 900 kWh/t finished product (frozen poultry meat)		
Source	C.A. Ramirez, M. Patel, K. Blok. 2006. How much energy to process one pound of meat? A comparison of energy use and specific energy consumption in the meat industry of four European countries. Energy 31: 2047–2063 M. Swain. 2008. Energy use in food refrigeration. Calculations, assumptions and data sources. FRPERC JOB NO. 2006013, University of Bristol, UK				





6.14. Electrical best KPI-100. Specific Electrical Consumption (SEC) per ton of frozen meat.

INDICATOR	Specific Electrical Consumption (SEC) per ton of frozen meat			
Sector (NACE code)	NACE 10.1	Subsector	Frozen	meat production
Level of indicator	Product level (frozen meat) The indicator includes the electrical energy necessary to produce a ton of frozen meat, from carcass. So the basic processes considered in this indicator are cutting, deboning and freezing, and the auxiliary processes involved.			
Thermal or Electrical process	Electric	al		
Energy source	Any sou	ırce		
Description of the INDICATOR	The SEC value is determined by the equation: SEC = E / FM (kWh/t) where E represents the annual electrical energy consumption (kWh) of cutting, deboning, freezing and the auxiliary processes involved, and FM designates the annual tons of frozen meat produced (t). The annual electrical energy consumption is obtained from the electrical bill of the industry. Annual production (tons) is obtained from industry recordings. The methodology is based in the work referred in the paper of Ramírez et al. (2006).			
Upper Lever	Industry level			
Lower level	Proces	s level		E aKPI L2 N2
Associated Variables	Unit kWh/t of finished product (boneless cut frozen meat) Name Name Respectific elect consumption per of frozen meat As data is given in tons of finished product, we use following carcass cutting yields to convert kilograms boneless cut meat to dress carcass weight: 1.53 for cattle, for pork and 1.8 for poultry.			
	Note that frozen poultry products demand more energy not only because of higher refrigeration requirements but also because the meat is submitted to higher temperatures during scalding.			





			Electrical consumption (cutting and deboning): 50 kWh/t finished product (cattle, pig and poultry)		
			Electrical consumption		
Best or Average KPI	Best	KPI Value	(frozing process):		
			250 kWh/t finished product		
			(frozen cattle meat) 350 kWh/t finished product		
			(frozen pig meat)		
			800 kWh/t finished product		
			(frozen poultry meat)		
	C.A. Ramirez, M.	Patel, K. Blok.	2006. How much energy to		
	process one pound of meat? A comparison of energy use a				
	specific energy consumption in the meat industry of				
Source	European countries. Energy 31: 2047–2063				
	M. Swain. 2008. Energy use in food refrigeration. Calculations,				
	assumptions and data sources. FRPERC JOB NO. 2006013,				
	University of Bristol, UK				