

# STATISTICS ON ENERGY CONSUMPTION AND GREENHOUSE GAS EMISSIONS

## PRACTICAL EXERCISE

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It is intended the student get to know:

1. How to make energy conversions;
2. Understand an energy balance (e.g. Portugal)
3. Understand the Common Report Format (CRF), on the national greenhouse gas emissions inventory, as required by the UNFCCC.
  - a) Find and explore energy statistics and emissions of greenhouse gas (GHG) emissions for Portugal or Europe;
  - b) Build indicators and charts with added value;
  - c) Analyze economic sectors and interpret their performance in terms of energy consumption and greenhouse gas emissions.

### Guidelines:

## 1. Energy Unit Conversion

A first reading can be accessed herein:

<http://www.aps.org/policy/reports/popa-reports/energy/units.cfm>

**Joule (J)** is the basic energy unit of the International System of Units (SI). It is desirable that all energy units should be presented in J.

James Prescott Joule was a self-educated British physicist and brewer whose work in the middle of the 19th century contributed to the establishment of the energy concept. The international unit of energy bears his name.

"1 Joule [J] refers to the energy needed to raise a 102-g-apple 1 m."

**Watt (W)** is a unit of power (energy per unit time). Power units can be converted to energy units through multiplication with seconds [s], hours, [h], or years [yr]. For example, 1 kWh [kilowatt hour] = 3.6 MJ [MegaJoule].

**Calories** and/or kilocalories [cal and/or kcal] were commonly used to measure heat (energy) in the past and are still used sometimes today. Heating a gram of water 1 °C requires 1 cal.

Normally, we should prefer to use [The International System of Units](#). However, there are many other energy units. A still very frequent unit used in the energy business is "ton of oil equivalent" (toe). 1 toe equals 11630 kWh. It means that the energy content in one tonne of oil is the same as in 11 630 kWh.

The best option to manage energy units is through the use of converters. There are several online energy unit converters you may use. Here is one with many options: <https://www.unitjuggler.com/energy-conversion.html>

Also, you need to be familiar with the prefix used to manage energy numbers, as presented in the next table.

**Table 2.2** Prefixes commonly used

Factor	Prefix name	Symbol
<i>Multiple</i>		
$10^{18}$	Exa	E
$10^{15}$	Peta	P
$10^{12}$	Tera	T
$10^9$	Giga	G
$10^6$	Mega	M
$10^3$	kilo	k
$10^2$	hecto	h
$10^1$	deka	da
<i>Submultiple</i>		
$10^{-1}$	deci	d
$10^{-2}$	cents	c
$10^{-3}$	milli	m
$10^{-6}$	micro	$\mu$
$10^{-9}$	nano	n
$10^{-12}$	pico	p
$10^{-15}$	femto	f
$10^{-18}$	atto	a

## 2. ENERGY STATISTICS:


**SELECT JUST ONE CASE TO WORK:** 2.2 (EUROPE) OR 2.1. (PORTUGAL)

### 2.1. Portuguese Energy statistics

<http://www.dgeg.pt/>

Página inicial » à Direita Estatísticas e Preços » Balanços e Indicadores Energéticos

To facilitate the access to the last available energy balance, download it [here](#)

 **Direção-Geral de Energia e Geologia**  
Direção de Serviços de Planeamento Energético e Estatística

BALANÇO ENERGÉTICO tep	Hulha e Antracite	Coque de Carvão	Total de Carvão	Petróleo Bruto	Refugos e Produtos Intermédios
2018 provisório	1	2	3 = 1 + 2	4	5
IMPORTAÇÕES 01	2 772 977	6 606	2 779 583	13 004 816	980 878
PRODUÇÃO DOMÉSTICA 02					
VARIAÇÃO DE "STOCKS" 03	- 29 336	48	- 29 288	114 332	- 25 042
SAÍDAS 04	112 745	160	112 905		100 454
Exportações 04.01	112 745	160	112 905		100 454
Transportes Marítimos Internacionais 04.02					
Aviação Internacional 04.03					
CONSUMO DE ENERGIA PRIMÁRIA 05	2 689 568	6 398	2 695 966	12 890 484	905 466
PARA NOVAS FORMAS DE ENERGIA 06	2 684 480		2 684 480	12 875 012	284 078
Briquetes 06.01					
Coque 06.02					
Produtos de Petróleo 06.03				12 875 012	492 927
Hidrogénio 06.04					
Petroquímica 06.05					- 226 328
Eletricidade 06.06	2 684 480		2 684 480		
Cogeração 06.07					17 479

You may download the following files:

- *Balanços Energéticos (excel files in portuguese)*
- *Indicadores Energéticos (table with indicators in Portuguese)*
- *Energia em Portugal - Principais Números (document in Portuguese)*

Alternatively, you may access summarized Portuguese energy data at <https://www.observatoriodaenergia.pt>. Note that at the bottom of the graph you've selected, you may also export it for an excel file.

After understanding the energy balance, you are able to answer the following questions, and build graphics:

2.2.1. What is the mix of final energy forms in Portugal during 2018?

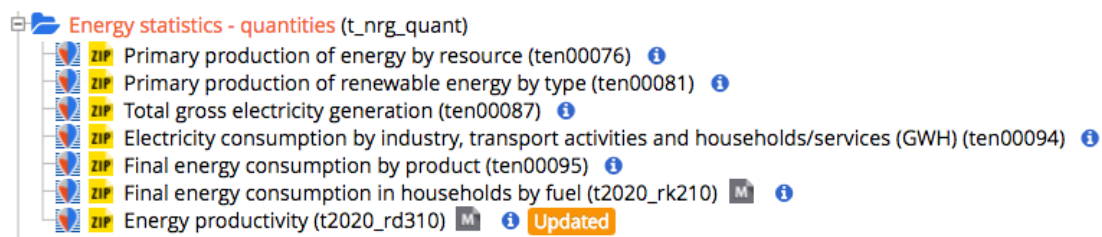
2.2.2. Choose a specific sector of activity - Agriculture and Fisheries, Industry, Transport, domestic, or Services-, and assess:

- How the energy mix of the final energy consumption in that sector (consider the main forms of final energy such as petroleum products, natural gas, electricity) has changed in the last 10 years? To answer this question, you have to download the Energy Balance of 2008.
- How much the total final energy consumption has increased or decreased in this period in that sector?

## 2.1. European Energy Statistics: EUROSTATS

<http://ec.europa.eu/eurostat/web/energy/data/main-tables>



Select



Download the file by clicking over the symbol 

Analyze the **Primary Production of energy by resource**: select a country of your interest and take a look at the consumption of natural gas and oil - note the units, you may explore the graph option.

Analyze the **Electricity consumption by industry, transport activities and households/services**: select a country of your interest and take a look at the different sectors of consumption, you may explore the graph option.

To manage the data, you may click over the sign (at the upper right)  and, in the next table, you may download the table by clicking here  Download

Now you may select the Excel format, and an excel file will be generated. Open the file in your excel program.

a. Convert to the IS units (J)

b. Decide a couple of indicators you find useful to explore (e.g. how has been evolved the energy consumption in industry in Portugal in the last decade, in comparison with Spain and the European Union?)

### 3. Explore Greenhouse gas emission data go:

<http://www.apambiente.pt/>

Página inicial»Instrumentos» Inventário Nacional de Emissões Atmosféricas (INERPA)

Submissões no âmbito da Convenção Quadro das Nações Unidas sobre Alterações Climáticas (UNFCCC):

- The Portuguese Greenhouse gas emission inventory file **Common Report Format (CRF)<sup>1</sup>. The last version is the one available (Versão de 15.04.2020)**. The CRF includes a large set of excel files that corresponds to the yearly emissions inventories since 1990.
- To facilitate the access to the most recent year available (2018), download it [here](#). Since the excel file contains a huge number of worksheets, the following table guides you through the most important for this exercise, but you may want to explore the other worksheets.
- To access other countries National Inventory Submissions 2020, click [here](#)

<b>Table1s1, e Table1s2</b>	Emissions by type of greenhouse gas in the combustion activities (ENERGY)
Table1.A(a)s1 a s4	energy consumption and implied emission factors in combustion activities
Table 1.D	International Bunkers (fuels consumed in the international shipping and aircrafts)
Table10s1 a Table10s5	GHG emissions trends 1990 to 2018 by sector and activity subcategories, per GHG
Table10s6	Summary of GHG emissions trends 1990-2018 by major activity sectors

<sup>1</sup> CRF is a common format for all countries to submit emissions report to the UNFCCC.

**TABLE 1 SECTORAL REPORT FOR ENERGY**  
(Sheet 1 of 2)

Inventory 2018  
Submission 2020 v1  
PORTUGAL

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	NO <sub>x</sub>	CO	NM VOC	SO <sub>2</sub>
	(kt)						
<b>Total Energy</b>	47510,24	15,08	1,95	142,63	237,80	54,67	39,43
<b>A. Fuel combustion activities (sectoral approach)</b>	46381,80	12,23	1,94	141,82	206,58	46,21	34,85
<b>1. Energy industries</b>	17704,78	0,60	0,50	23,08	6,59	1,84	14,17
a. Public electricity and heat production	15495,74	0,56	0,50	20,01	5,59	1,74	13,74
b. Petroleum refining	2209,05	0,04	0,00	3,07	1,00	0,10	0,43
c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO
<b>2. Manufacturing industries and construction</b>	7396,45	2,09	0,37	30,46	17,15	13,25	17,78
a. Iron and steel	97,83	0,00	0,00	0,13	0,05	0,04	0,00
b. Non-ferrous metals	NO	NO	NO	IE	IE	IE	IE
c. Chemicals	1072,21	0,02	0,01	1,46	0,69	0,07	0,35
d. Pulp, paper and print	1306,56	0,92	0,15	5,56	6,06	2,51	9,79
e. Food processing, beverages and tobacco	736,94	0,03	0,02	1,45	0,96	0,28	0,80
f. Non-metallic minerals	2611,22	1,02	0,08	15,80	7,17	9,67	6,07
g. Other (please specify)	1571,69	0,10	0,10	6,06	2,22	0,69	0,77
<b>3. Transport</b>	17068,38	0,90	0,53	73,85	77,38	16,06	2,12
a. Domestic aviation	498,12	0,02	0,01	3,07	1,55	0,17	0,13
b. Road transportation	16277,26	0,86	0,49	63,59	75,10	15,62	0,10
c. Railways	30,21	0,00	0,01	0,50	0,10	0,04	0,00
d. Domestic navigation	262,78	0,02	0,01	6,68	0,63	0,23	1,89
e. Other transportation	NO	NO	NO	NO	NO	NO	NO

(Table1s1)

After understanding the greenhouse gas (GHG) emissions inventory, and based on these worksheets, answer the following questions, by building adequate indicators and graphics:

3.1. What is the annual average rate of GHG emissions in the period 2000-2018 in the Energy sector (Table10s6)?

3.2. Choose the same sector of activity you chose for 2.2.2. - Agriculture and Fisheries, Industry, Transport, domestic, or Services – and, considering the emissions from Energy combustion, answer the following questions:

- i. What was the evolution of GHG emissions from 2008 to 2018 for that sector (Table10s1)?
- ii. What is the representativeness of your selected sector in the total national emissions in 2018 (Summary2)? How it compares with the year 2008? (to answer this last question, you must download the file regarding the year, 2008 – PRT\_2020\_2008\_xxxx.xls)
- iii. How does the evolution of emissions compare with the energy consumption you assessed in 2.2.2. in the period 2008 to 2018?