Energy balance guide

Methodology guide for the construction of energy balances

&

Operational guide for the energy balance builder tool

31 January 2019

eurostat

Table of Content

Introduction

Glossary & acronyms

EDAMIS	Electronic Data files Administration and Management Information System (the current implementation of the Single Entry Point concept of Eurostat)
IRES	International Recommendation for Energy Statistics
NACE Rev. 2	Statistical classification of economic activities

What is an energy balance?

The energy balance is the most complete statistical accounting of energy products and their flow in the economy. The energy balance allows users to see the total amount of energy extracted from the environment, traded, transformed and used by end-users. It also allows seeing the relative contribution of each energy carrier (fuel, product). The energy balance allows studying the overall domestic energy market and monitoring impacts of energy policies. The energy balance offers a complete view on the energy situation of a country in a compact format, such as on energy consumption of the whole economy and of individual sectors.

The energy balance presents all statistically significant energy products (fuels) of a country and their production, transformation and consumption by different type of economic actors (industry, transport, etc.). Therefore, an energy balance is the natural starting point to study the energy sector.

In a simplified way, we can say that an energy balance is a matrix, where columns are energy products (fuels) and rows are energy flows (production – transformation – consumption sectors).

In a more complex understanding, as stated in IRES, an energy balance is an accounting framework for the compilation and reconciliation of data on all energy products entering, exiting and used within the national territory of a given country during a reference period.

Purpose of this document

This document describes the methodology for constructing energy balances in Eurostat. This methodology is applicable for energy balances constructed by Eurostat and disseminated in January 2019 (and all subsequent editions until new methodology is released). The methodology applies in a uniform manner to all countries and all time periods (starting in 1990 or as far back as country specific historic time series allow).

This document also serves as an operational guide for the Eurostat's energy balance builder tool and describes how to use this tool.

This document does **not** describe how data should be reported (please see reporting instructions and documents on filling in the questionnaires) and also it does **not** describe how data should be checked for coherence, consistency and plausibility (please see respective data validation manuals and convention on error detection).

Note on error correction and data editing

Every entity compiling energy balances has to make certain methodology choices for the creation and presentation of energy balances, taking into account the known limitation of available energy statistics. These methodological choices made by Eurostat for compilation of energy balances shall not be considered as error correction or data editing of received data transmissions.

Why energy balances are constructed?

Main reasons for constructing energy balances

In 1976 the United Nations Statistical Commission agreed on the use of energy balances as the key instrument in the coordination of work on energy statistics and the provision of data in a suitable form for understanding and analysing the role of energy in the economy.

The energy balance presents all statistically significant energy products (fuels) of a country and their production, transformation and consumption by different type of economic actors (sectors). Therefore, an energy balance is the expected starting point to study the energy sector. It provides data and allows performing an analysis in the following key areas:

- The domestic energy market (energy production, trade, transformation and end-use);
- Evolution of the energy supply and demand (import dependency, energy intensity);
- Sustainable development (fossil fuel combustion, share of renewable energies);
- Input to energy modelling and forecasting.

A similar approach is described in IRES, where the purpose of an energy balance is described as a multi-purpose tool to:

- Enhance the relevance of energy statistics by providing comprehensive and reconciled data on the energy situation on a national territory basis;
- Provide comprehensive information on the energy supply and demand in the national territory in order to understand the energy security situation, the effective functioning of energy markets and other relevant policy goals, as well as to formulate energy policies;
- Serve as a quality tool to ensure completeness, consistency and comparability of basic statistics;
- Ensure comparability between different reference periods and between different countries;
- Provide data for the estimation of CO_2 emissions with respect to the national territory;
- Provide the basis for indicators of each energy product's role in a country's economy;
- Calculate efficiencies of transformation processes occurring in the country (e.g., refining, electricity production by combustion of fuels, etc.);
- Calculate the relative shares of the supply/consumption of various products (including renewables versus non-renewables) of a country's total supply/consumption;
- Provide an input for modelling and forecasting.

All in all, energy balance is extremely useful and powerful tool for analysis of energy. It provides information that allows answering many questions. Naturally, not all questions are answered by energy balances and therefore complementing indicators are needed and are also calculated and disseminated by Eurostat (and European Commission in general). Such indicators include:

- Detailed data on origin and destinations of international trade;
- Technical data on energy installations (generation and production capacities, data on fuel stockholding, various product or flow specific indicators);
- Additional disaggregation of certain statistics into specific subcategories, that is in general not available for all fuels or all block of energy balance.

The use of energy balances

By presenting all the data for all energy products in a common energy unit, the energy balance allows users to see the total amount of energy extracted from the environment, traded, transformed and used by end-users. It also allows seeing the relative contribution of each different energy carrier (fuel, product). The energy balance allows studying the overall domestic energy market, monitoring impacts of energy policies and assessing some of their impacts. The energy balance offers a complete view on the energy situation of a country in a compact format, for the whole economy and for each individual consumption sector.

More generally, a number of questions can be asked by looking at data in the energy balance. The energy balance can be used as a high-level check on the data quality: the coherence and accuracy of reported energy statistics for individual energy products. Large statistical differences in energy units, apparent energy gains, significant losses in transformation processes, unexplained variations in indicators may all indicate underlying data problems.

Energy balance is also the starting point for the construction of several indicators, such as import dependency. Certain aggregates of energy balance contribute to cross domain indicators, such as energy intensity (energy per GDP).

Energy balances in European policy decision making

The European Energy Strategy and Energy Union need to be underpinned by statistical evidence for sound decision making. To this end, energy balances are a key input for the Commission's impact assessments in the area of energy policies.

As energy is vital to many sectors of economy, energy data are used for other purposes too, notably transport and climate change.

The European Union's energy policy targets include the need for secure energy supplies, sustainable energy consumption and lower fossil fuel dependence. Energy balances help assessing progress in these areas. They are also a key input for monitoring the energy efficiency target of the Europe 2020 strategy.

Directive 2012/27/EU on energy efficiency and its implementation measures refer to the aggregates of energy balances published by Eurostat. In the context of Eurostat's work on sustainable development indicators, energy balances provide a central contribution to Affordable and clean energy.

Prerequisites for the construction of energy balances

There are three types of prerequisites required for constructing energy balances:

- Complete and validated energy statistics (no big data gaps, no major errors)
- Methodology assumptions for constructing energy balances
- IT tools that allows to apply the methodology on received data to create and disseminate energy balances

Energy statistics

Eurostat constructs energy balances on the basis of data transmissions defined in Regulation (EC) No 1099/2008 on energy statistics. More specifically, annexes A and B of this Regulation define energy products and energy flows of annual energy statistics. All reporting countries are transmitting these energy data to Eurostat via EDAMIS. For the construction of energy balance of a country, all of the following datasets (as defined in EDAMIS) have to be completed and successfully validated (without any major data problem):

- ENERGY_ELECT_A (annual questionnaire for electricity & heat)
- ENERGY_NTGAS_A (annual questionnaire for natural gas)
- ENERGY_NUCLEAR_A (annual questionnaire for nuclear statistics)
- ENERGY_PETRO_A (annual questionnaire for oil)
- ENERGY_RENEW_A (annual questionnaire for renewables & waste)
- ENERGY_SOLID_A (annual questionnaire for coal)

This is very important for the process of constructing the energy balance since all data transmitted to Eurostat have the official legal status. For EU Member States, these data transmissions can be used for assessing legal compliance with the legislative framework of the European Union. Consequently energy balances constructed from these official data transmission are also considered as official data source and as such, energy balances are also used for the assessment of legal compliance with the legislative framework of the European Union, wherever relevant.

Methodology assumption

There is a huge set of methodology assumption that needs to be made when constructing energy balances. Many of these assumptions are listed and elaborated in chapter 8 of IRES. In this document, chapters 4, 5 and 6 covers the vast majority of methodology choices made by Eurostat.

IT tools

Eurostat produces energy balances for all reporting countries in its internal production database. In order to allow reporting countries to produce energy balances according to Eurostat methodology themselves, at any moment countries desire, Eurostat has developed a MS Excel tool: Energy balance builder tool. Chapter 10 of this document describes the operation of this MS Excel file with Visual Basic macros.

General methodology aspects

When constructing energy balance one has to bear in mind the first law of thermodynamics. The law of conservation of energy states that the total energy of an isolated system is constant; energy can be transformed from one form to another, but can be neither created nor destroyed. The first law is often formulated by stating that the change in the internal energy of a closed system is equal to the amount of heat supplied to the system, minus the amount of work done by the system on its surroundings. Consequently energy gains are not possible and if present, they are results of either statistical discrepancy (data of low accuracy) or not fully considering all input products in the scope of energy statistics.

Simplified scheme for constructing energy balances

The first step is to construct commodity balances for each energy carrier in natural measurement units of the energy carrier – either physical unit (tonnes and cubic meters) or energy units (GWh for electricity and TJ for heat).

The second step is to convert the commodity balance in various units into a common energy unit, by multiplying all the data by the appropriate conversion factor (calorific value for energy carrier in physical units and unit conversion factor for energy carriers measured in energy units).

The third step refers to organising the columns and rows of the energy balance to avoid double counting of energy. For example the production of secondary products is shown in the production row in commodity balances and it is reported as a transformation output in the energy balance.

The choice of the primary energy form

The choice of the primary energy form defines the boundaries of energy statistics. The general principle of Eurostat's approach is that the primary energy form should be the first energy form in the production process for which various energy uses are in reality practiced. **Eurostat's methodology is based on the physical energy content method.** For directly combustible energy products (for example coal, crude oil, natural gas, biofuels, waste) it is their actual energy content measured by their gross and net calorific values. For products that are not directly combustible, the application of this principle leads to the choice of heat as the primary energy form for nuclear, geothermal and solar thermal; and to the choice of electricity as the primary energy form for solar photovoltaic, wind, hydro, tide, wave, ocean.

The measurement of the primary energy form for the not directly combustible fuels is done as gross electricity production for those where electricity is the primary energy form and as gross heat production for those where heat is the primary energy form.

According to obligations in Regulation (EC) No 1099/2008 on energy statistics the reporting is covering geothermal and solar thermal inputs needed for electricity and/or heat production from these sources. In a similar way, the heat generated by nuclear reactors has to be declared according to the reporting obligations on annual nuclear statistics. If countries do not have information on energy inputs available, but only the amount of electricity and/or heat produced is known, the reporting countries are advised to use the following efficiencies to estimate inputs:

- For electricity from geothermal sources: 10%
- For derived heat from geothermal sources: 50%
- For electricity from concentrating solar: 33%
- For derived heat from solar thermal energy: 100%
- For electricity and derived heat from nuclear sources: 33%

The choice of units in the energy balance

The data for the different products need to be expressed in a common energy unit. The unit chosen can be any energy unit: terajoule (TJ), gigawatt hour (GWh), thousands tons of oil equivalent (ktoe), million tons of oil equivalent (Mtoe), etc.

The unit adopted by Eurostat is the joule. The joule is a derived unit of energy in the International System of Units. It is the energy dissipated as heat when an electric current of one ampere passes through a resistance of one ohm for one second. This definition forms one of the basis of conversion between energy units: **1 GWh = 3.6 TJ**.

Historically, a unit used for energy balances is also the tonne of oil equivalent. It corresponds roughly to the average quantity of energy contained in a tonne of crude oil. Based on its energy content definition of 10^7kilocalories, the following conversion can be derived: **1 Mtoe = 41 868 TJ**.

Energy balance can be converted from one energy unit into another. Eurostat offers energy balance data in TJ, ktoe and GWh in its database. The Eurostat's balance builder tool adds Mtoe. The table below presents the conversion factors between various energy units.

To: / From:	**TJ**	**Mtoe**	**GWh**
TJ		/ 41 868	/ 3.6
Mtoe	× 41 868		× 11 630
GWh	× 3.6	/ 11 630	

The choice of a heating value (calorific value)

The energy balance can be expressed in the "net" or "gross" energy content, where net/gross refer to the calorific values used for conversion.

The quantity known as gross calorific value (GCV) (or higher heating value or gross energy or upper heating value or higher calorific value) is determined by bringing all the products of combustion back to the original pre-combustion temperature, and in particular condensing any water vapour produced. This is the same as the thermodynamic heat of combustion since the enthalpy change for the reaction assumes a common temperature of the compounds before and after combustion, in which case the water produced by combustion is condensed to a liquid, hence yielding its latent heat of vaporization.

The quantity known as net calorific value (NCV) (or lower heating value or lower calorific value) is determined by subtracting the heat of vaporization of the water vapour from the higher heating value. This treats any H_2O formed as a vapour. The energy required to vaporize the water therefore is not released as heat.

As the net calorific value represents the amount of energy that can be actually used, **Eurostat adopted the methodology of using the net calorific values for its energy balances**. This applies to conversion of all energy carriers (products, fuels) of energy balance for all flows of energy balance.

The actual choice of calorific values

Related to the choice of heating value is the actual choice of net calorific values used. **Eurostat set up a cascade system for the choice of the net calorific values used for the construction of energy balances**.

1. The net calorific values are covered by the data transmission obligations in Regulation (EC) No 1099/2008 on energy statistics. If reporting countries fulfil their reporting obligations, Eurostat uses for the construction of energy balances the values transmitted by countries.
2. For primary and secondary coal product, also a reporting of gross calorific values is foreseen. If net calorific values are not provided but gross calorific values are provided, Eurostat will use the estimate of net calorific value. The estimation is based on the assumption that GCV = 1.05 × NCV (the gross calorific value is 5% higher than the net calorific value).
3. For primary and secondary coal products, if specific sectoral calorific values are not provided but calorific values for other sectors are provided, then the arithmetic average of available calorific values is used for constructing the energy balance.

   For oil products in table 1 of the oil questionnaire (crude oil, NGL, refinery feedstock, additives/oxygenates or other hydrocarbons), if an average calorific value is not reported but calorific values for production, imports or exports are provided, then the arithmetic average of available calorific values is used for constructing the energy balance.
4. If no calorific values are provided by a reporting country, Eurostat uses the net calorific values enacted in Commission Regulation (EU) No 601/2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.
5. For products not covered by the Commission Regulation (EU) No 601/2012, the net calorific values used are Eurostat's estimates. These estimates take into account the Commission Decision 2007/589/EC establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

The references to the European legislation are based on the consolidated versions of legal acts as available on 16 August 2017. In practical terms, Commission Decision 2007/589/EC and Commission Regulation (EU) No 601/2012 refer to the 2006 IPCC Guidelines.

For coal and coal products, it should be noted that calorific value reported under "For other uses" are used (among other flows) also for the following flows of the energy balance: recovered products, stock changes, autoproducers, gas works, coal liquefaction plants, final non-energy consumption and distribution losses.

The table below presents overview of calorific values with respect to point 4 (green shading) and point 5 (yellow shading).

Product	Net calorific value (TJ/kt)
Anthracite	26.7
Coking coal	28.2
Other bituminous coal	25.8
Sub-bituminous coal	18.9
Lignite	11.9
Patent fuels	20.7
Coke oven coke	28.2
Gas coke	28.2
Coal tar	28.0
Brown coal briquettes	19.0
Peat	9.76
Peat products	16.0
Oil shale and oil sands	8.9
Crude oil	42.3
Natural gas liquids	44.2
Refinery feedstocks	43.0
Additives and oxygenates	42.5
Other hydrocarbons (w/o bio)	42.5
Refinery gas	49.5
Ethane	46.4
Liquefied petroleum gases	47.3
Motor gasoline (w/o bio)	44.3

Product	Net calorific value (TJ/kt)
Aviation gasoline	44.3
Gasoline-type jet fuel	44.3
Kerosene-type jet fuel	44.1
Other kerosene	43.8
Naphtha	44.5
Gas oil and diesel oil (w/o bio)	43.0
(Residual) Fuel oil	40.4
White spirit and SPB	40.2
Lubricants	40.2
Bitumen	40.2
Petroleum coke	32.5
Paraffin waxes	40.2
Other oil products	40.2
Charcoal	29.5
Pure biogasoline	27.0
Blended biogasoline	27.0
Pure biodiesels	27.0
Blended biodiesels	27.0
Pure bio jet kerosene	44.0
Blended bio jet kerosene	44.0
Other liquid biofuels	27.4

Creating the matrix

The energy balance is presented as a matrix: a 2 dimensional table with rows and columns. This matrix can be created in different energy units, for different geographical regions and also for different time periods. While the choice for unit, country and time period is intuitive and has user specific needs, the choice of rows and columns needs to be harmonised within one methodology approach.

The subsequent 2 chapters describe the columns and rows of Eurostat energy balance. The easiest way to see the actual link between the matrix and source data for every individual position of energy balance is to actually work with the Eurostat's energy balance builder tool.

Essentially every cell of the energy balance matrix is created with a link[1] to the source data cell (mostly one data item, but for several data cells it is a sum, difference or other formula) with combination of a conversion factor to TJ (calorific values). For many cells of the energy balance this link is direct one to one relationship between the balance and the source data.

Consequently, the actual detailed calculation methodology is described in the most exhaustive level of details in the actual MS Excel file representing the Eurostat's energy balance builder tool.

[1] Tracing precedent cell in MS Excel is facilitated with keyboard shortcut: Ctrl + [

Products (columns of the energy balance)

This chapter presents the availability of energy products (fuels) in the energy balances as calculated and disseminated by Eurostat.

Simplified energy balance

The main purpose of the simplified energy balance is to fit on one page A4 design. Its aim is to provide a quick overview of energy situation in a country in a given year.

The table below lists products of the simplified energy balance as presented in Eurostat's database:

Eurobase code	Eurobase dissemination label: EN
TOTAL	Total
C0000X0350-0370	Solid fossil fuels
C0350-0370	Manufactured gases
P1000	Peat and peat products
S2000	Oil shale and oil sands
O4000XBIO	Oil and petroleum products (excluding biofuel portion)
G3000	Natural gas
RA000	Renewables and biofuels
W6100_6220	Non-renewable waste
N900H	Nuclear heat
H8000	Heat
E7000	Electricity

The Eurostat dissemination codes for energy products (fuels) were created based on the Standard International Energy Product Classification present in IRES and adapted by Eurostat in the framework of the Standard Code Lists initiative. These codes are derived from the DSD[2] for energy statistics and no code contradiction is present.

Simplified energy balance can be also called "aggregated energy balance".

Below is an example of the header (the top row) of the simplified energy balance of Eurostat, designed for table width of A4 page layout, so that it can be suitable for printing.

Total	Solid fossil fuels	Manufac-tured gases	Peat and peat products	Oil shale and oil sands	Oil and petroleum products	Natural gas	Renewables and biofuels	Non-renewable waste	Nuclear heat	Heat	Electricity

[2] Data Structure Definition (DSD) is the crucial SDMX element that defines the structure of an organised collection of data by means of concepts with specific roles and their representation.

Complete energy balance

The table below lists products of the simplified energy balance as presented in Eurostat's database:

Eurobase code	Eurobase dissemination label: EN
TOTAL	**Total**
C0000X0350-0370	**Solid fossil fuels**
C0110	Anthracite
C0121	Coking coal
C0129	Other bituminous coal
C0210	Sub-bituminous coal
C0220	Lignite
C0320	Patent fuels
C0311	Coke oven coke
C0312	Gas coke
C0340	Coal tar
C0330	Brown coal briquettes
C0350-0370	**Manufactured gases**
C0360	Gas works gas
C0350	Coke oven gas
C0371	Blast furnace gas
C0379	Other recovered gases
P1000	**Peat and peat products**
P1100	Peat
P1200	Peat products
S2000	**Oil shale and oil sands**
O4000XBIO	**Oil and petroleum products**
O4100_TOT	Crude oil
O4200	Natural gas liquids
O4300	Refinery feedstocks
O4400X4410	Additives and oxygenates (excluding biofuel portion)
O4500	Other hydrocarbons
O4610	Refinery gas
O4620	Ethane
O4630	Liquefied petroleum gas
O4652XR5210B	Motor gasoline (excluding biofuel portion)
O4651	Aviation gasoline
O4653	Gasoline-type jet fuel
O4661XR5230B	Kerosene-type jet fuel (excluding biofuel portion)
O4669	Other kerosene
O4640	Naphtha
O4671XR5220B	Gas oil and diesel oil (excluding biofuel portion)
O4680	Fuel oil
O4691	White spirit and special boiling point industrial spirits
O4692	Lubricants
O4695	Bitumen
O4694	Petroleum coke
O4693	Paraffin waxes
O4699	Other oil products n.e.c.

Eurobase code	Eurobase dissemination label: EN
G3000	**Natural gas**
RA000	**Renewables and biofuels**
RA100	Hydro power
RA500	Tide, wave and ocean
RA300	Wind power
RA420	Solar photovoltaic
RA410	Solar thermal
RA200	Geothermal
R5110-5150_W6000RI	Primary solid biofuels
R5160	Charcoal
R5300	Biogases
W6210	Renewable municipal waste
R5210P	Pure biogasoline
R5210B	Blended biogasoline
R5220P	Pure biodiesels
R5220B	Blended biodiesels
R5230P	Pure bio jet kerosene
R5230B	Blended bio jet kerosene
R5290	Other liquid biofuels
RA600	Ambient heat (heat pumps)
W6100_6220	**Non-renewable waste**
W6100	Industrial waste (non-renewable)
W6220	Non-renewable municipal waste
N900H	**Nuclear heat**
H8000	**Heat**
E7000	**Electricity**

The complete energy balance offers a huge level of details and is available only in a database format or in the MS Excel file format; it is not suitable for printing on paper.

Additional products and aggregates

Additional products and product aggregates enhancing the complete energy balance can be defined and used in data dissemination and for analytical purposes. These products or aggregates are not presented together with the complete energy balance, but could be included in specific data dissemination tables that complement the dissemination of energy balances.

Eurobase code	Eurobase dissemination label: EN
C0000	Coal and manufactured gases
C0100	Hard coal
C0200	Brown coal
C0300	Coal products
O4000	Oil and petroleum products
O4100_TOT_4200-4500	Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons
O4100_TOT_4200-4500XBIO	Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons (excluding biofuel portion)
O4600	Oil products
O4600XBIO	Oil products (excluding biofuel portion)
R5000	Biofuels
RA110	Pure hydro power
RA120	Mixed hydro power
RA130	Pumped hydro power
RA310	Wind on shore
RA320	Wind off shore
RA400	Solar
R5100	Solid biofuels
R5110	Fuelwood, wood residues and by-products
R5111	Wood pellets
R5140	Black liquor
R5120	Bagasse
R5130	Animal waste
R5150	Other vegetal material and residues
W6000RI	Renewable fraction of industrial waste
R5210	Biogasoline
R5210E	Bioethanol
R5230	Bio jet kerosene
R5220	Biodiesels
R5310	Biogases from anaerobic fermentation
R5311	Landfill gas
R5312	Sewage sludge gas
R5319	Other biogases from anaerobic fermentation
R5320	Biogases from thermal processes
W6200	Municipal waste

Hierarchical relationships between all products and all aggregates

The next table presents hierarchical presentation of all products and all aggregates. The hierarchical relationship is ordinary sum (addition) and is valid for all instances in data presentation of energy balances by Eurostat.

Label	Simplified balance	Complete balance
Total	✓	✓
Coal and manufactured gases		
Solid fossil fuels	✓	✓
Hard coal		
Anthracite		✓
Coking coal		✓
Other bituminous coal		✓
Brown coal		
Sub-bituminous coal		✓
Lignite		✓
Coal products		
Patent fuels		✓
Coke oven coke		✓
Gas coke		✓
Coal tar		✓
Brown coal briquettes		✓
Manufactured gases	✓	✓
Gas works gas		✓
Coke oven gas		✓
Blast furnace gas		✓
Other recovered gases		✓
Peat and peat products	✓	✓
Peat		✓
Peat products		✓
Oil shale and oil sands	✓	✓
Oil and petroleum products (excluding biofuel portion)	✓	✓
Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons (excluding biofuel portion)		
Crude oil		✓
Natural gas liquids		✓
Refinery feedstocks		✓
Additives and oxygenates (excluding biofuel portion)		✓
Other hydrocarbons		✓
Oil products (excluding biofuel portion)		
Refinery gas		✓
Ethane		✓
Liquefied petroleum gas		✓
Motor gasoline (excluding biofuel portion)		✓

Label	Simplified balance	Complete balance
Aviation gasoline		✓
Gasoline-type jet fuel		✓
Kerosene-type jet fuel (excluding biofuel portion)		✓
Other kerosene		✓
Naphtha		✓
Gas oil and diesel oil (excluding biofuel portion)		✓
Fuel oil		✓
White spirit and special boiling point industrial spirits		✓
Lubricants		✓
Bitumen		✓
Petroleum coke		✓
Paraffin waxes		✓
Other oil products n.e.c.		✓
Natural gas	✓	✓
Renewables and biofuels	✓	✓
Biofuels		
Solid biofuels		
Primary solid biofuels		✓
Fuelwood, wood residues and by-products		
Black liquor		
Bagasse		
Animal waste		
Other vegetal material and residues		
Renewable fraction of industrial waste		
Charcoal		✓
Liquid biofuels		
Biogasoline		
Pure biogasoline		✓
Blended biogasoline		✓
Biodiesels		
Pure biodiesels		✓
Blended biodiesels		✓
Bio jet kerosene		
Pure bio jet kerosene		✓
Blended bio jet kerosene		✓
Other liquid biofuels		✓
Biogas		✓
Biogases from anaerobic fermentation		
Landfill gas		
Sewage sludge gas		
Other biogases from anaerobic fermentation		
Biogases from thermal processes		
Renewable municipal waste		✓
Hydro		✓

Label	Simplified balance	Complete balance
Pure hydro power		
Mixed hydro power		
Pumped hydro power		
Tide, wave, ocean		✓
Geothermal		✓
Wind		✓
Wind on shore		
Wind off shore		
Solar		
Solar thermal		✓
Solar photovoltaic		✓
Ambient heat (heat pumps)		✓
Non-renewable waste	✓	✓
Industrial waste		✓
Non-renewable municipal waste		✓
Nuclear heat	✓	✓
Heat	✓	✓
Electricity	✓	✓

In addition, the following relationships are defined:

Label	Simplified balance	Complete balance
Oil and petroleum products		
Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons		
Oil products		

Label	Simplified balance	Complete balance
Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons		
Crude oil, NGL, refinery feedstocks, additives and oxygenates and other hydrocarbons (excluding biofuel portion)		
Biofuels for blending		

Label	Simplified balance	Complete balance
Oil products		
Oil products (excluding biofuel portion)		
Blended biogasoline		✓
Blended biodiesels		✓
Blended bio jet kerosene		✓

Label	Simplified balance	Complete balance
Municipal waste		
Renewable municipal waste		✓
Non-renewable municipal waste		✓

Flows (rows of the energy balance)

Eurostat's energy balance has 3 blocks:

- Top block: Supply
- Medium block: Transformation input, Transformation output, Consumption of the energy branch and Distribution losses
- Bottom block: Final non-energy consumption and Final energy consumption (disaggregated into subsectors of industry, transport and other sectors)

In the medium block, the difference between transformation input and transformation output constitutes the transformation losses.

Supply (top block)

The top block – Supply – covers the top down approach from the perspective of production, trade and stock changes. As recommended in IRES, international maritime bunkers as well as international aviation are excluded at the top block of the energy balance.

Primary production

Primary production represents any kind of extraction of energy products from natural sources. It takes place when the natural sources are exploited, for example extraction of lignite in coal mines or extraction of crude oil. It also includes electricity and heat according to the choice of the primary energy form (electricity generation using hydro, wind and solar PV).

Transformation of energy from one form to another, such as electricity or heat generation in power plants using natural gas or coke oven coke production in coke ovens is included in the transformation output (middle block of the energy balance) and not on the primary production. Therefore primary production for all secondary fuels is zero.

Recovered and recycled products

For coal this includes recovered slurries, middlings and other low-grade coal products, which cannot be classified according to type of coal. This includes coal recovered from waste piles and other waste receptacles.

For petroleum products, these are finished (petroleum) products which pass a second time through the marketing network, after having been once delivered to final consumers (for example used lubricants which are reprocessed).

Imports

Imports represent all entries into the national territory excluding transit quantities. However, if electricity is transited through a country, the amount is reported as both an import and an export. Data reflect amounts having crossed the national territorial boundaries, whether customs clearance has taken place or not. Quantities of crude oil and products imported under processing agreements (i.e. refining on account) are included. Petroleum products imported directly by the petrochemical industry should be included.

Exports

Exports represent all exits from the national territory excluding transit quantities. However, if electricity is transited through a country, the amount is reported as both an import and an export. Data reflect amounts having crossed the national territorial boundaries, whether customs clearance has taken place or not. Quantities of crude oil and products exported under processing agreements (i.e. refining on account) are included. Petroleum products exported directly by the petrochemical industry should be included.

Change in stock

The difference between the opening stock level and closing stock level for stocks held on national territory. Stock changes do not refer to reserves (proven or probable) of not yet extracted products, such as underground deposits of crude oil, natural gas and coal.

Positive value for stock changes means stock draw (fuel put in stocks in previous years was used during the reference year). Negative value for stock changes means stock build (fuel was put in stocks during the reference year and can be used in future).

For natural gas, variations of stocks represent also the quantities of gas introduced into and removed from the transportation systems. For natural gas it refers to recoverable natural gas stored in special storage facilities (depleted gas and/or oil field, aquifer, salt cavity, mixed caverns, or other) as well as liquefied natural gas storage. Cushion gas should be excluded.

For non-blended liquid biofuels, stock changes may include stock changes of liquid biofuels destined to be blended.

Gross available energy

This aggregate is calculated with the following arithmetic definition:

Gross available energy =	+ Primary production + Recovered & Recycled products + Imports – Export + Stock changes

For total of all products, the *Gross available energy* is one of the most important aggregate of energy balance and represents the quantity of energy necessary to satisfy all energy demand of entities operating under the authorities of the geographical entity under consideration.

Its interpretation for individual products is different. For secondary products, which are produced as transformation output and not as primary productions, the *Gross available energy* can be negative.

International maritime bunkers

Quantities of fuels delivered to ships of all flags that are engaged in international navigation. The international navigation may take place at sea, on inland lakes and waterways, and in coastal waters. Excluded are:

- consumption by ships engaged in domestic navigation. The domestic/international split should be determined on the basis of port of departure and port of arrival, and not by the flag or nationality of the ship,
- consumption by fishing vessels,
- consumption by military forces,
- aviation bunkers.

International aviation

Quantities of fuels delivered to aircrafts for international aviation. The domestic/international split is determined on the basis of departure and landing locations and not by the nationality of the airline. Excludes fuels used by airlines for their road vehicles (see Not elsewhere specified (Transport)) and military use of aviation fuels (see Not elsewhere specified (Other)).

Total energy supply

This aggregate reflects on the recommendations in IRES for calculation of key aggregates of energy balances. This is an aggregate with the following arithmetic definition:

Total energy supply =	+ Primary production + Recovered & Recycled products + Imports – Export + Stock changes – International maritime bunkers – International aviation

For total of all products, the *Total energy supply* is one of the most important aggregate of energy balance and represents the quantity of energy necessary to satisfy inland consumption (inland fuel deliveries) of the geographical entity under consideration.

Its interpretation for individual products is different. For secondary products, which are produced as transformation output and not as primary productions, the *Total energy supply* can be negative.

Transformation input (medium block)

The transformation of energy is generally executed by energy industries. However, many entities that are not a part of energy industries are also involved in the transformation and production of energy products. This is to satisfy their own needs or to deliver (sell) these products to third parties. Consequently this transformation of energy products is recorded in the energy balances in the middle block (transformation input and transformation output). The most typical example is companies producing their own electricity and or heat (so called autoproducers). Another example is blast furnaces because its by-product, blast furnace gas and other types of recovered gases, are often captured and used as energy product.

Transformation input covers all inputs into the transformation plants destined to be converted into derived products. Transformation is only recorded when the energy products are physically or chemically modified to produce other energy products, electricity and/or heat. Quantities of fuels used for heating, operation of equipment and in general in support of the transformation are not included (see Energy sector).

The Transformation input and Transformation output includes real energy product transformations as well as virtual product transformations with pre-defined efficiencies. These virtual transformations cover the following aspects:

- blending of various products into each other (100% efficiency)
- methodological transformations of electricity produced from non-combustible renewables such as hydro and wind (100% efficiency)
- methodological transformations of electricity produced from nuclear heat, solar thermal and geothermal (efficiency depending on data availability – see chapter 4)
- interproduct transfers, backflows and exchanges between petroleum refineries and petrochemical industries (100% conversion ratio measured in tons)

Note: Please see also notes for Transformation output.

In energy balance, this is an aggregate with the following arithmetic definition:

Transformation input =	+ Electricity & heat generation + Coke ovens + Blast furnaces + Gas works + Refineries & petrochemical industry + Patent fuel plants + BKB & PB plants + Coal liquefaction plants + For blended natural gas + Liquid biofuels blended + Charcoal production plants + Gas-to-liquids plants + Not elsewhere specified

Electricity & heat generation

In energy balance, this is an aggregate with the following arithmetic definition:

Electricity & heat generation =	+ Main activity producer electricity only + Main activity producer CHP + Main activity producer heat only + Autoproducer electricity only + Autoproducer CHP + Autoproducer heat only + Electrically driven heat pumps + Electric boilers + Electricity for pumped storage + Derived heat for electricity production

- **Main activity producer electricity only**

  Quantities of fuels used to produce electricity in electricity only units/plants by main activity producers.

- **Main activity producer CHP**

  Quantities of fuels used to produce electricity and/or heat in CHP units/plants by main activity producers.

- **Main activity producer heat only**

  Quantities of fuels used to produce heat in heat only units/plants by main activity producers.

- **Autoproducer electricity only**

  Quantities of fuels used to produce electricity in electricity only units/plants by autoproducers.

- **Autoproducer CHP**

  All quantities of fuels used to produce electricity and the proportional part of fuels used to produce heat sold in CHP units/plants by autoproducers. The proportional part of fuels used to produce heat that was not sold (auto-consumed heat) is included in the specific sector of final energy consumption based on NACE classification. Heat not sold but delivered to other entities under non-financial agreements or entities with different ownership is reported on the same principle as heat sold.

- **Autoproducer heat only**

  The proportional part of fuels that corresponds to the quantity of heat sold in heat only units/plants by autoproducers. The proportional part of fuels used to produce heat that was

not sold (auto-consumed heat) is included in the specific sector of final energy consumption based on NACE classification. Heat not sold but delivered to other entities under non-financial agreements or entities with different ownership is reported on the same principle as heat sold.

- **Electrically driven heat pumps**

  The electricity used in heat pumps corresponding to the Derived heat in Transformation output.

- **Electric boilers**

  The electricity used in electric boilers corresponding to the Derived heat in Transformation output.

- **Electricity for pumped storage**

  The electricity consumed by pumping the water uphill in hydro-electric pumped storage power plants and mixed plants.

- **Derived heat for electricity production**

  Purchased derived heat consumed as input to electricity generation. It includes also heat from chemical processes (primary energy form of heat and not waste heat of energy processes) used for electricity generation.

Coke ovens

Quantities of fuels used in coke ovens to produce coke oven coke and coke oven gas.

Blast furnaces

Quantities of fuels entering the blast furnace vessel, whether through the top along with the iron ore, or through the tuyeres in the bottom along with the heated blast air.

Gas works

Quantities of fuels used to produce gas work gas in gas works and in coal gasification plants.

Refineries & petrochemical industry

In energy balance, this is an aggregate with the following arithmetic definition:

Transformation input: Refineries & petrochemical industry =	+ Refinery intake + Backflows from petrochemical industry + Products transferred + Interproduct transfers + Direct use + Petrochemical industry intake

- **Refinery intake**

  This is defined as the total observed amount of Crude oil, Natural gas liquids, Additives/Oxygenates and Other hydrocarbons that have entered the refinery process.

- **Backflows from petrochemical industry**

  This flow represents the backflows from the petrochemical industry to refineries. These are finished or semi–finished products which are returned from petrochemical industry to refineries for processing, blending or sale. They are usually by–products of petrochemical manufacturing. For integrated petrochemical industries this flow can be estimated. Transfers from one refinery to another within the country should be excluded. Transformation input represents the products that *disappear* from their availability for further use in the economy and Transformation output represents Refinery feedstocks that *appears* for further use. In tons the sum of reported backflows of individual products has to be equal to the Refinery feedstocks.

- **Products transferred**

  Products transferred are energy products, e.g. in the case of oil, products which are reclassified as refinery feedstock for further processing in the refinery, without delivery to final consumers. For example, Naphtha imported for upgrading would be first reported as imports of Naphtha and then as Products transferred. Transformation input represents the products that *disappear* from their availability for further use in the economy and *appears* in the Transformation output as Refinery feedstocks.

- **Interproduct transfers**

  Interproduct transfers result from reclassification of products either because their specification has changed or because they are blended with another product. For example, quantities of kerosene may be reclassified as gasoil after blending with the latter in order to meet its winter diesel specification. In the annual questionnaire this operation would produce negative “Interproduct transfers” for kerosene and positive for gasoil. The sum of reported Interproduct transfers in tons should equal to zero. As Transformation input the reported “Interproduct transfers” with negative sign are shown, but with positive sign. This represents the products that *disappear* from their availability for further use.

- **Direct use**

  Crude oil, Natural gas liquids, Additives/Oxygenates and Other hydrocarbons which are used directly without being processed in petroleum refineries are reported as Direct use. These products *disappear* from their availability for further use in for Refineries & Petrochemical industry and *appear* as available products for the rest of the economy under Primary product receipts. The sum of reported Direct use in tons should equal to Primary product receipts in tons.

- **Petrochemical industry intake**

  Returns from petrochemical industry cover finished or semi-finished products, which are returned from final consumers to refineries for processing, blending or sale. They are usually by-products of petrochemical manufacturing processes. Transfers from one refinery to another within the country are excluded.

Patent fuel plants

Quantities of fuels used in patent fuel plants to produce patent fuel.

BKB & PB plants

Quantities of fuels used to produce brown coal briquettes (BKB) in BKB plants and quantities of fuels used in peat briquettes plants to produce peat briquettes (PB).

Coal liquefaction plants

Quantities of fuel used to produce synthetic oil.

For blended natural gas

Quantities of gases blended with natural gas into the gas grid (gas network).

Liquid biofuels blended

Quantities of liquid biofuels blended with their fossil counterparts.

Charcoal production plants

Quantities of solid biofuels converted to charcoal.

Gas-to-liquids plants

Quantities of gaseous fuels converted to liquid fuels.

Not elsewhere specified

Quantities of fuels used for transformation activities not included elsewhere.

Transformation output (medium block)

Transformation output is the result of the transformation process of energy products. This output covers production of derived products (secondary products, by-products and co-products). Transformation output refers always to gross production of derived products, i.e. the products used for the own consumption of the transformation plants are included in the transformation output and their use is reported in the Energy sector.

This part of the energy balance has the most elements of reorganisation of data between the reported format of annual questionnaires and the energy balance matrix.

For many products the transformation output is reported as production in the annual questionnaire. For primary products this is attributed to Primary production (see supply) and secondary products it is attributed to transformation output.

When reading the energy balance from the top to the bottom, it can be noted that several products already exported or used as transformation input are only now appearing as transformation output. Also it should be noted that in the full production chain, especially with respect to petrochemical industry and oil refineries, the products can pass several cycles of transformation.

Note: Please see also notes for Transformation input.

In energy balance, this is an aggregate with the following arithmetic definition:

Transformation output =	+ Electricity & Heat generation + Coke ovens + Blast furnaces + Gas works + Refineries & Petrochemical industry + Patent fuel plants + BKB & PB plants + Coal liquefaction plants + Blended in Natural gas + Liquid biofuels blended + Charcoal production plants + Gas-to-liquids plants + Not elsewhere specified

Electricity & Heat generation

In energy balance, this is an aggregate with the following arithmetic definition:

Electricity & Heat generation =	+ Main activity producer electricity only + Main activity producer CHP + Main activity producer heat only + Autoproducer electricity only + Autoproducer CHP + Autoproducer heat only + Electrically driven heat pumps + Electric boilers + Pumped hydro + Other sources

- **Main activity producer electricity only**

  This category includes production of electricity in electricity only units/plants by main activity producers.

- **Main activity producer CHP**

  This category includes production of electricity and/or derived heat in CHP units/plants by main activity producers.

- **Main activity producer heat only**

  This category includes production of derived heat in heat only units/plants by main activity producers.

- **Autoproducer electricity only**

  This category includes production of electricity in electricity only units/plants by autoproducers.

- **Autoproducer CHP**

  This category includes production of electricity and/or derived heat in CHP units/plants by autoproducers. Only derived heat sold in included; heat auto-consumed is excluded.

- **Autoproducer heat only**

  This category includes production of derived heat in heat only units/plants by autoproducers. Only derived heat sold in included; heat auto-consumed is excluded.

- **Electrically driven heat pumps**

  This category includes the derived heat output from electrically driven heat pumps only where the heat is sold to third parties.

- **Electric boilers**

  This category includes the heat from electric boilers where the output is sold to third parties.

- **Pumped hydro**

  It includes pure pumped storage plants generation and the pumped storage generation portion of mixed plants. In case the production of electricity from water previously pumped uphill is not known, it is calculated as 73% of the electricity used for pumping water uphill.

- **Other sources**

  This category includes electricity and heat produced from other sources not specified above, For example: electricity from fuel cells or the recovered waste heat from industry sold to third parties. Electricity and derived heat produced from waste heat originating from energy driven processes are excluded from reporting in this category (production is reported under specific products).

  This category also includes the heat originating from processes without direct energy input, such as a chemical reaction (for example the treatment of zinc oxide ore with hydrochloric acid).

Coke ovens

Quantities of coke oven coke and coke oven gas produced in coke ovens.

Blast furnaces

Quantities of blast furnace gas and other recovered gases produced in blast furnaces.

Gas works

Gas work gas produced in gas works. Includes the output of coal gasification plants.

Refineries & petrochemical industry

In energy balance, this is an aggregate with the following arithmetic definition:

Transformation output: Refineries & Petrochemical industry =	+ Refinery output + Backflows + Products transferred + Interproduct transfers + Primary product receipts + Petrochemical industry returns

- **Refinery output**

  This is production of petroleum products at a refinery. This category excludes Refinery losses and includes Refinery fuel.

- **Backflows**

  This flow represents the backflows from the petrochemical industry to refineries. These are finished or semi–finished products which are returned from petrochemical industry to refineries for processing, blending or sale. They are usually by–products of petrochemical manufacturing. For integrated petrochemical industries this flow can be estimated. Transfers from one refinery to another within the country should be excluded. Transformation input represents the products that *disappear* from their availability for further use in the economy and Transformation output represents Refinery feedstocks that *appears* for further use. In tons the sum of reported backflows of individual products has to be equal to the Refinery feedstocks.

- **Products transferred**

  Products transferred are energy products, e.g. in the case of oil, products which are reclassified as refinery feedstock for further processing in the refinery, without delivery to final consumers. For example, Naphtha imported for upgrading would be first reported as imports of Naphtha and then as Products transferred. Transformation input represents the products that *disappear* from their availability for further use in the economy and *appears* in the Transformation output as Refinery feedstocks.

- **Interproduct transfers**

  Interproduct transfers result from reclassification of products either because their specification has changed or because they are blended with another product. For example, quantities of kerosene may be reclassified as gasoil after blending with the latter in order to meet its winter diesel specification. In the annual questionnaire this operation would produce negative “Interproduct transfers” for kerosene and positive for gasoil. The sum of reported Interproduct transfers in tons should equal to zero. As Transformation output the reported “Interproduct transfers” with positive sign are shown. This represents the products that *appear* for further use.

- **Primary product receipts**

  Crude oil, Natural Gas Liquids, Additives/Oxygenates and Other hydrocarbons which are used directly without being processed in petroleum refineries are reported as Direct use. These products *disappear* from their availability for further use in for Refineries & Petrochemical industry and *appear* as available products for the rest of the economy under Primary product receipts. The sum of reported Direct use in tons should equal to Primary product receipts in tons.

- **Petrochemical industry returns**

  This represents products produced by the petrochemical industry that are available as Backflows from petrochemical industry for further processing in refineries. By definition, this line is equal to Transformation input - Backflows from petrochemical industry. It is necessary to include in the energy balance the production of these products to ensure balance between inputs and outputs of commodities.

Patent fuel plants

Quantities of patent fuel produced in patent fuel plants.

BKB & PB plants

Quantities of brown coal briquettes (BKB) and quantities of peat briquettes (PB) produced in BKB or PB plants.

Coal liquefaction plants

Quantities of liquid fuels produced in Coal liquefaction plants.

Blended in Natural gas

Quantities of gases blended with natural gas into the gas grid (gas network).

Liquid biofuels blended

Quantities of liquid biofuels blended with their fossil counterparts.

Charcoal production plants

Quantities of charcoal produced.

Gas-to-liquids plants

Quantities of liquid fuels produced from gaseous fuels input.

Not elsewhere specified

Quantities of fuels produced in transformation activities not included elsewhere.

Energy sector (medium block)

The consumption of the energy sector covers the consumption of own-produced energy and of energy purchased by energy producers and transformers in operating their installations. This means quantities consumed by the energy industry to support the extraction (mining, oil and gas production) or plant operations of transformation activities. This corresponds to NACE Rev. 2 Divisions 05, 06, 19 and 35, NACE Rev. 2 Group 09.1 and NACE Rev. 2 classes 07.21 and 08.92.

Excludes quantities of fuels transformed into another energy form (see Transformation input) or used in support of the operation of oil, gas and coal slurry pipelines (see Transport sector).

This is an aggregate with the following arithmetic definition:

Energy sector =	+ Own use in electricity & heat generation + Coal mines + Oil & natural gas extraction plants + Patent fuel plants + Coke ovens + BKB & PB plants + Gas works + Blast furnaces + Petroleum refineries (oil refineries) + Nuclear industry + Coal liquefaction plants + Liquefaction & regasification plants (LNG) + Gasification plants for biogas + Gas-to-liquids (GTL) plants + Charcoal production plants + Not elsewhere specified (energy)

Elements in this section are included in energy balances with exactly the same conceptual definition as in the reported data based on the definitions in Regulation (EC) No 1099/2008 on energy statistics and in the reporting instructions and, naturally, converted with calorific values from reported units to the energy units of the energy balance. Consequently only a brief summary of these elements is provided here.

Own use in electricity & heat generation

Quantities of fuels consumed as energy for support operations at plants with Electricity only, Heat only and CHP units.

Coal mines

Quantities of fuels consumed as energy to support the extraction and preparation of coal within the coal mining industry. Coal burned in pithead power stations should be reported in the Transformation Sector.

Oil & natural gas extraction plants

Quantities of fuels consumed in the oil and natural gas extraction facilities. Excludes pipeline losses (see Distribution losses) and energy quantities used to operate pipelines (see Transport sector).

Patent fuel plants

Quantities of fuels consumed as energy for support operations at patent fuel plants.

Coke ovens

Quantities of fuels consumed as energy for support operations in coke ovens (coking plants).

BKB & PB plants

Quantities of fuels used as energy for support operations in BKP/PB plants (briquetting plant).

Gas works

Quantities of fuels consumed as energy for support operations at gas works and coal gasification plants.

Blast furnaces

Quantities of fuels consumed as energy for support operations at blast furnaces.

Petroleum refineries (oil refineries)

Quantities of fuels consumed as energy for support operations at petroleum refineries (oil refineries).

Nuclear industry

Quantities of fuels consumed as energy for support operations for the manufacture of chemical materials for atomic fission and fusion and related processes.

Coal liquefaction plants

Quantities of fuels consumed as energy for support operations at coal liquefaction plants.

Liquefaction & regasification plants (LNG)

Quantities of fuels consumed as energy for support operations in natural gas liquefaction and regasification plants.

Gasification plants for biogas

Quantities of fuels consumed as energy for support operations in biogas gasification plants.

Gas-to-liquids (GTL) plants

Quantities of fuels consumed as energy for support operations in Gas-to-liquid conversion plants.

Charcoal production plants

Quantities of fuels consumed as energy for support operations in charcoal production plants.

Not elsewhere specified (energy)

Quantities of fuels related to energy activities not included elsewhere.

Distribution losses (medium block)

This category includes quantities of fuel losses which occur due to transport and distribution, including pipeline losses. Specifically for electricity, transmission losses are included here.

Energy available for final consumption (medium block)

This is an aggregate with the following arithmetic definition:

Energy available for final consumption =	+ Total energy supply – Transformation input + Transformation output – Energy sector – Distribution losses

Final non-energy consumption (bottom block)

Elements in this section are included in energy balances with exactly the same conceptual definition as in the reported data based on the definitions in Regulation (EC) No 1099/2008 on energy statistics and in the reporting instructions and, naturally, converted with calorific values from reported units to the energy units of the energy balance.

The level of details is fuel specific and therefore the level of details in the energy balance is a compromise between the level of detailed available and the relative importance of the non-energy consumption. By definition, the consumption of energy from renewable sources for non-energy purposes is excluded from the scope of energy statistics (for example use of wood for the building construction or use of wood furniture manufacturing or passive use of solar energy for heating buildings).

In the energy balance, the final non-energy consumption is disaggregated into the following elements:

Non-energy use industry/transformation/energy

- Non-energy use in transformation sector
- Non-energy use in energy sector
- Non-energy use in industry sector

Non-energy use in transport sector

Non-energy use in other sectors

Depending on actual data availability, the following arithmetic relationships apply:

Final non-energy consumption =	+ Non-energy use industry/transformation/energy + Non-energy use in transport sector + Non-energy use in other sectors

Non-energy use industry/transformation/energy =	 + Non-energy use in transformation sector + Non-energy use in energy sector + Non-energy use in industry sector

Final energy consumption (bottom block)

Elements in this section are included in energy balances with exactly the same conceptual definition as in the reported data based on the definitions in Regulation (EC) No 1099/2008 on energy statistics and in the reporting instructions and, naturally, converted with calorific values from reported units to the energy units of the energy balance. Consequently only a brief summary of these elements is provided here.

This is an aggregate with the following arithmetic definition:

Final energy consumption =	+ Industry sector + Transport sector + Other sectors

In the energy balance, the final energy consumption is further disaggregated into Industry sector, Transport sector and Other sectors. Each of these sectors have several subsectors.

Industry sector

This refers to fuel quantities consumed by the industrial undertaking in support of its primary activities. For heat only or CHP units, only quantities of fuels consumed for the production of heat used by the entity itself (heat auto-consumed) are included. Quantities of fuels consumed for the production of heat sold and for the production of electricity are reported as Transformation input.

This is an aggregate with the following arithmetic definition:

Industry sector =	+ Iron & steel + Chemical & petrochemical + Non-ferrous metals + Non-metallic minerals + Transport equipment + Machinery + Mining & quarrying + Food, beverages & tobacco + Paper, pulp & printing + Wood & wood products + Construction + Textile & leather + Not elsewhere specified (industry)

- **Iron & steel**: NACE Rev. 2 Groups 24.1, 24.2 and 24.3; and NACE Rev. 2 Classes 24.51 and 24.52 (transformation input in blast furnaces is included in the transformation sector)
- **Chemical & petrochemical**: NACE Rev. 2 Divisions 20 and 21
- **Non-ferrous metals**: NACE Rev. 2 Group 24.4; and NACE Rev. 2 Classes 24.53 and 24.54
- **Non-metallic minerals**: NACE Rev. 2 Division 23
- **Transport equipment**: NACE Rev. 2 Divisions 29 and 30
- **Machinery**: NACE Rev. 2 Divisions 25, 26, 27 and 28
- **Mining & quarrying**: NACE Rev. 2 Divisions 07 (excluding 07.21) and 08 (excluding 08.92); NACE Rev. 2 Group 09.9
- **Food, beverages & tobacco**: NACE Rev. 2 Divisions 10, 11 and 12
- **Paper, pulp & printing**: NACE Rev. 2 Divisions 17 and 18
- **Wood & wood products**: NACE Rev. 2 Division 16.
- **Construction**: NACE Rev. 2 Division 41, 42 and 43
- **Textile & leather**: NACE Rev. 2 Divisions 13, 14 and 15
- **Not elsewhere specified (industry)**: NACE Divisions 22, 31 and 32

Transport sector

This refers to energy used in all transport activities irrespective of the NACE category (economic sector) in which the activity occurs. Fuels used for heating and lighting at railway, bus stations, shipping piers and airports are reported in the "Commercial and Public Services" and not in the Transport sector.

This is an aggregate with the following arithmetic definition:

Transport sector =	+ Rail + Road + Domestic aviation + Domestic navigation + Pipeline transport + Not elsewhere specified (transport)

- **Rail**

  Quantities of fuels used by rail traffic, including industrial railways and rail transport as part of urban or suburban transport systems (for example trains, trams, metro).

- **Road**

  Quantities of fuels used in road vehicles. Includes fuel used by agricultural vehicles on highways and lubricants for use in road vehicles. Excludes energy used in stationary engines (see Other sector), for non-highway use in tractors (see Agriculture), military use in road vehicles (see Other sector – Not elsewhere specified), bitumen used in road surfacing and energy used in engines at construction sites (see Industry sub-sector Construction).

- **Domestic aviation**

  Quantities of fuels delivered to aircraft for domestic aviation. Includes fuel used for purposes other than flying, e.g. bench testing of engines. The domestic/international split is determined on the basis of departure and landing locations and not by the nationality of the airline. This includes journeys of considerable length between two airports in a country with overseas territories. Excludes fuels used by airlines for their road vehicles (see Not elsewhere specified (Transport)) and military use of aviation fuels (see Not elsewhere specified (Other)).

- **Domestic navigation**

  Quantities of fuels delivered to vessels of all flags not engaged in international navigation (see International marine bunkers). The domestic/international split should be determined on the basis of port of departure and port of arrival and not by the flag or nationality of the ship.

- **Pipeline transport**

  Quantities of fuels used as energy in the support and operation of pipelines transporting gases, liquids, slurries and other commodities. Includes energy used for pump stations and maintenance of the pipeline. Excludes energy used for the pipeline distribution of natural or manufactured gas, hot water or steam from the distributor to final users (to be reported in the energy sector), energy used for the final distribution of water to household, industrial, commercial and other users (to be included in Commercial and Public Services) and losses occurring during this transport between distributor and final users (to be reported as distribution losses).

- **Not elsewhere specified (transport)**

  Quantities of fuels used for transport activities not included elsewhere. Includes fuels used by airlines for their road vehicles and fuels used in ports for ships' unloaders, various types of cranes.

Other sectors

This is an aggregate with the following arithmetic definition:

Other sectors =	+ Commercial & public services + Households + Agriculture & forestry + Fishing + Not elsewhere specified (other)

- **Commercial & public services**

  Quantities of fuels consumed by business and offices in the public and private sectors. NACE Rev. 2 Divisions 33, 36, 37, 38, 39, 45, 46, 47, 52, 53, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 74, 75, 77, 78, 79, 80, 81, 82, 84 (excluding Class 84.22), 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96 and 99. Fuels used for heating and lighting at railway, bus stations, shipping piers and airports should be reported in this category and also including fuels used for all non-transport activities of NACE Rev. 2 Division 49, 50 and 51.

- **Households**

  Quantities of fuels consumed by all households including “households with employed persons”. NACE Rev. 2 Divisions 97 and 98.

- **Agriculture & forestry**

  Quantities of fuels consumed by users classified as agriculture, hunting and forestry; NACE Rev. 2 Divisions 01 and 02.

- **Fishing**

  Quantities of fuels delivered for inland, coastal and deep-sea fishing. Fishing should cover fuels delivered to ships of all flags that have refuelled in the country (include international fishing) and energy used in the fishing industry. NACE Rev. 2 Division 03.

- **Not elsewhere specified (other)**

  Quantities of fuels used for activities not included elsewhere (such as NACE Rev. 2 Class 84.22). This category includes military fuel use for all mobile and stationary consumption (e.g. ships, aircraft, road and energy used in living quarters), regardless of whether the fuel delivered is for the military of that country or for the military of another country.

Statistical differences

In Eurostat's energy balance, the item statistical differences represents the difference between the top and medium blocks on one side and the bottom block on the other side. Negative statistical differences indicate higher observed final consumption than available from the supply and transformation. Positive statistical differences indicate that the observed final consumption is lower than available from the supply and transformation.

This is an aggregate with the following arithmetic definition:

Statistical differences =	+ Energy available for final consumption – Final non-energy consumption – Final energy consumption

Presence of flows in the energy balance

The next table indicates which flows are shown in the Eurostat's simplified energy balances and which flows are shown in the Eurostat's complete energy balance.

Eurobase code	Eurostat dissemination label: EN	Simplified balance	Complete balance
PPRD	Primary production	✓	✓
RCV_RCY	Recovered and recycled products	✓	✓
IMP	Imports	✓	✓
EXP	Exports	✓	✓
STK_CHG	Change in stock	✓	✓
GAE	**Gross available energy**	✓	✓
INTMARB	International maritime bunkers	✓	✓
INTAVI	International aviation	✓	✓
NRGSUP	**Total energy supply**	✓	✓
TI_E	**Transformation input - energy use**	✓	✓
TI_EHG_E	**Transformation input - electricity and heat generation - energy use**	✓	✓
TI_EHG_MAPE_E	Transformation input - electricity and heat generation - main activity producer electricity only - energy use		✓
TI_EHG_MAPCHP_E	Transformation input - electricity and heat generation - main activity producer combined heat and power - energy use		✓
TI_EHG_MAPH_E	Transformation input - electricity and heat generation - main activity producer heat only - energy use		✓
TI_EHG_APE_E	Transformation input - electricity and heat generation - autoproducer electricity only - energy use		✓
TI_EHG_APCHP_E	Transformation input - electricity and heat generation - autoproducer combined heat and power - energy use		✓
TI_EHG_APH_E	Transformation input - electricity and heat generation - autoproducer heat only - energy use		✓
TI_EHG_EDHP	Transformation input - electricity and heat generation - electrically driven heat pumps		✓
TI_EHG_EB	Transformation input - electricity and heat generation - electric boilers		✓
TI_EHG_EPS	Transformation input - electricity and heat generation - electricity for pumped storage		✓
TI_EHG_DHEP	Transformation input - electricity and heat generation - derived heat for electricity production		✓
TI_CO_E	Transformation input - coke ovens - energy use	✓	✓
TI_BF_E	Transformation input - blast furnaces - energy use	✓	✓
TI_GW_E	Transformation input - gas works - energy use	✓	✓
TI_RPI_E	**Transformation input - refineries and petrochemical industry - energy use**	✓	✓
TI_RPI_RI_E	Transformation input - refineries and petrochemical industry - refinery intake - energy use		✓
TI_RPI_BPI_E	Transformation input - refineries and petrochemical industry - backflows from petrochemical industry - energy use		✓
TI_RPI_PT_E	Transformation input - refineries and petrochemical industry - products transferred - energy use		✓

Eurobase code	Eurostat dissemination label: EN	Simplified balance	Complete balance
TI_RPI_IT_E	Transformation input - refineries and petrochemical industry - interproduct transfers - energy use		✓
TI_RPI_DU_E	Transformation input - refineries and petrochemical industry - direct use - energy use		✓
TI_RPI_PII_E	Transformation input - refineries and petrochemical industry - petrochemical industry intake - energy use		✓
TI_PF_E	Transformation input - patent fuel plants - energy use	✓	✓
TI_BKBPB_E	Transformation input - brown coal briquettes and peat briquettes plants - energy use	✓	✓
TI_CL_E	Transformation input - coal liquefaction plants - energy use	✓	✓
TI_BNG_E	Transformation input - for blended natural gas - energy use	✓	✓
TI_LBB_E	Transformation input - liquid biofuels blended - energy use	✓	✓
TI_CPP_E	Transformation input - charcoal production plants - energy use	✓	✓
TI_GTL_E	Transformation input - gas-to-liquids plants - energy use	✓	✓
TI_NSP_E	Transformation input - not elsewhere specified - energy use	✓	✓
TO	**Transformation output**	✓	✓
TO_EHG	**Transformation output - electricity and heat generation**	✓	✓
TO_EHG_MAPE	Transformation output - electricity and heat generation - main activity producer electricity only		✓
TO_EHG_MAPCHP	Transformation output - electricity and heat generation - main activity producer combined heat and power		✓
TO_EHG_MAPH	Transformation output - electricity and heat generation - main activity producer heat only		✓
TO_EHG_APE	Transformation output - electricity and heat generation - autoproducer electricity only		✓
TO_EHG_APCHP	Transformation output - electricity and heat generation - autoproducer combined heat and power		✓
TO_EHG_APH	Transformation output - electricity and heat generation - autoproducer heat only		✓
TO_EHG_EDHP	Transformation output - electricity and heat generation - electrically driven heat pumps		✓
TO_EHG_EB	Transformation output - electricity and heat generation - electric boilers		✓
TO_EHG_PH	Transformation output - electricity and heat generation - pumped hydro		✓
TO_EHG_OTH	Transformation output - electricity and heat generation - other sources		✓
TO_CO	Transformation output - coke ovens	✓	✓
TO_BF	Transformation output - blast furnaces	✓	✓
TO_GW	Transformation output - gas works	✓	✓
TO_RPI	**Transformation output - refineries and petrochemical industry**	✓	✓
TO_RPI_RO	Transformation output - refineries and petrochemical industry - refinery output		✓
TO_RPI_BKFLOW	Transformation output - refineries and petrochemical industry - backflows		✓
TO_RPI_PT	Transformation output - refineries and petrochemical industry - products transferred		✓

Eurobase code	Eurostat dissemination label: EN	Simplified balance	Complete balance
TO_RPI_IT	Transformation output - refineries and petrochemical industry - interproduct transfers		✓
TO_RPI_PPR	Transformation output - refineries and petrochemical industry - primary product receipts		✓
TO_RPI_PIR	Transformation output - refineries and petrochemical industry - petrochemical industry returns		✓
TO_PF	Transformation output - patent fuel plants	✓	✓
TO_BKBPB	Transformation output - brown coal briquettes and peat briquettes plants	✓	✓
TO_CL	Transformation output - coal liquefaction plants	✓	✓
TO_BNG	Transformation output - blended in natural gas	✓	✓
TO_LBB	Transformation output - liquid biofuels blended	✓	✓
TO_CPP	Transformation output - charcoal production plants	✓	✓
TO_GTL	Transformation output - gas-to-liquids plants	✓	✓
TO_NSP	Transformation output - not elsewhere specified	✓	✓
NRG_E	**Energy sector - energy use**	✓	✓
NRG_EHG_E	Energy sector - electricity and heat generation - energy use	✓	✓
NRG_CM_E	Energy sector - coal mines - energy use	✓	✓
NRG_OIL_NG_E	Energy sector - oil and natural gas extraction plants - energy use	✓	✓
NRG_PF_E	Energy sector - patent fuel plants - energy use	✓	✓
NRG_CO_E	Energy sector - coke ovens - energy use	✓	✓
NRG_BKBPB_E	Energy sector - brown coal briquettes and peat briquettes plants - energy use	✓	✓
NRG_GW_E	Energy sector - gas works - energy use	✓	✓
NRG_BF_E	Energy sector - blast furnaces - energy use	✓	✓
NRG_PR_E	Energy sector - petroleum refineries (oil refineries) - energy use	✓	✓
NRG_NI_E	Energy sector - nuclear industry - energy use	✓	✓
NRG_CL_E	Energy sector - coal liquefaction plants - energy use	✓	✓
NRG_LNG_E	Energy sector - liquefaction and regasification plants (LNG) - energy use	✓	✓
NRG_BIOG_E	Energy sector - gasification plants for biogas - energy use	✓	✓
NRG_GTL_E	Energy sector - gas-to-liquids plants - energy use	✓	✓
NRG_CPP_E	Energy sector - charcoal production plants - energy use	✓	✓
NRG_NSP_E	Energy sector - not elsewhere specified - energy use	✓	✓
DL	**Distribution losses**	✓	✓
AFC	**Available for final consumption**	✓	✓
FC_NE	**Final consumption - non-energy use**	✓	✓
TI_NRG_FC_IND_NE	Transformation input, energy sector and final consumption in industry sector - non-energy use		✓
TI_NE	Transformation input - non-energy use		✓
NRG_NE	Energy sector - non-energy use		✓
FC_IND_NE	Final consumption - industry sector - non-energy use		✓
FC_TRA_NE	Final consumption - transport sector - non-energy use		✓
FC_OTH_NE	Final consumption - other sectors - non-energy use		✓
FC_E	**Final consumption - energy use**	✓	✓
FC_IND_E	**Final consumption - industry sector - energy use**	✓	✓

Eurobase code	Eurostat dissemination label: EN	Simplified balance	Complete balance
FC_IND_IS_E	Final consumption - industry sector - iron and steel - energy use	✓	✓
FC_IND_CPC_E	Final consumption - industry sector - chemical and petrochemical - energy use	✓	✓
FC_IND_NFM_E	Final consumption - industry sector - non-ferrous metals - energy use	✓	✓
FC_IND_NMM_E	Final consumption - industry sector - non-metallic minerals - energy use	✓	✓
FC_IND_TE_E	Final consumption - industry sector - transport equipment - energy use	✓	✓
FC_IND_MAC_E	Final consumption - industry sector - machinery - energy use	✓	✓
FC_IND_MQ_E	Final consumption - industry sector - mining and quarrying - energy use	✓	✓
FC_IND_FBT_E	Final consumption - industry sector - food, beverages and tobacco - energy use	✓	✓
FC_IND_PPP_E	Final consumption - industry sector - paper, pulp and printing - energy use	✓	✓
FC_IND_WP_E	Final consumption - industry sector - wood and wood products - energy use	✓	✓
FC_IND_CON_E	Final consumption - industry sector - construction - energy use	✓	✓
FC_IND_TL_E	Final consumption - industry sector - textile and leather - energy use	✓	✓
FC_IND_NSP_E	Final consumption - industry sector - not elsewhere specified - energy use	✓	✓
FC_TRA_E	**Final consumption - transport sector - energy use**	✓	✓
FC_TRA_RAIL_E	Final consumption - transport sector - rail - energy use	✓	✓
FC_TRA_ROAD_E	Final consumption - transport sector - road - energy use	✓	✓
FC_TRA_DAVI_E	Final consumption - transport sector - domestic aviation - energy use	✓	✓
FC_TRA_DNAVI_E	Final consumption - transport sector - domestic navigation - energy use	✓	✓
FC_TRA_PIPE_E	Final consumption - transport sector - pipeline transport - energy use	✓	✓
FC_TRA_NSP_E	Final consumption - transport sector - not elsewhere specified - energy use	✓	✓
FC_OTH_E	**Final consumption - other sectors - energy use**	✓	✓
FC_OTH_CP_E	Final consumption - other sectors - commercial and public services - energy use	✓	✓
FC_OTH_HH_E	Final consumption - other sectors - households - energy use	✓	✓
FC_OTH_AF_E	Final consumption - other sectors - agriculture and forestry - energy use	✓	✓
FC_OTH_FISH_E	Final consumption - other sectors - fishing - energy use	✓	✓
FC_OTH_NSP_E	Final consumption - other sectors - not elsewhere specified - energy use	✓	✓
STATDIFF	**Statistical differences**	✓	✓

Complementing indicators

The energy balance is complemented with a set of several key indicators.

Gross electricity and heat production

The blocks of energy balance matrix do not allow seeing electricity and heat generation from each specific fuel. Therefore the matrix is complemented by the rows that allow showing electricity and heat production from each fuel.

Note: The total electricity and heat production by fuel can be lower than total transformation output due to category "Other sources". This category cannot be attributed to any specific fuel.

Gross electricity production =	+ Main activity producer electricity only + Main activity producer CHP + Autoproducer electricity only + Autoproducer CHP
Gross heat production =	+ Main activity producer CHP + Main activity producer heat only + Autoproducer CHP + Autoproducer heat only

Attention: Gross electricity and heat production can be shown in the same energy units as the rest of the energy balance or for convenience reasons, also in more natural units measuring electricity (GWh, TWh) and heat (TJ, GJ).

Gross inland consumption

This aggregate is calculated to ensure continuity and transition from the old Eurostat energy balance into the new Eurostat energy balance. This is an aggregate with the following arithmetic definition:

Gross inland consumption =	+ Gross available energy – International maritime bunkers

Its interpretation for individual products is different. For secondary products, which are produced as transformation output and not as primary productions, the *Gross inland consumption* can be negative.

Gross inland consumption (Europe 2020-2030)

In order to allow comparison with Europe 2020 targets established prior to the actual methodology of energy balance, this indicator estimates Gross inland consumption to that calculated under the old methodology – the methodology in place at the time of establishing the Europe 2020 targets. This indicator should be used also for tracking progress towards Europe 2030 targets. This is an aggregate with the following arithmetic definition:

Gross inland consumption (Europe 2020-2030) =
+ Gross available energy [All products total]
– Gross available energy [Ambient heat (heat pumps)]
– International maritime bunkers [All products total]

This aggregate is calculated only for *All products total*.

Primary energy consumption (Europe 2020-2030)

This indicator reflects on the definition given in Article 2 of the Directive 2012/27/EU as well as the methodology of energy balances in place at the time of establishing the Directive and Europe 2020 targets. This indicator should be used also for tracking progress towards Europe 2030 targets. This is an aggregate with the following arithmetic definition:

Primary energy consumption (Europe 2020-2030) =
+ Gross inland consumption (Europe 2020-2030)
– Final non-energy consumption

This aggregate is calculated only for *All products total*.

Final energy consumption (Europe 2020-2030)

In order to allow comparison with Europe 2020 targets established prior to the actual methodology of energy balance, this indicator estimates Final energy consumption to that calculated under the old methodology – the methodology in place at the time of establishing the Directive and Europe 2020 targets. This indicator should be used also for tracking progress towards Europe 2030 targets. This is an aggregate with the following arithmetic definition:

Final energy consumption (Europe 2020-2030) =
+ Final energy consumption [All products total]
– Final energy consumption [Ambient heat (heat pumps)]
+ International aviation [All products total]
+ Transformation input Blast furnaces [All products total]
– Transformation output Blast furnaces [All products total]
+ Energy sector Blast furnaces [Solid fossil fuels]
+ Energy sector Blast furnaces [Manufactured gases]
+ Energy sector Blast furnaces [Peat and peat products]
+ Energy sector Blast furnaces [Oil shale and oil sands]
+ Energy sector Blast furnaces [Oil and petroleum products]
+ Energy sector Blast furnaces [Natural gas]

This aggregate is calculated only for *All products total*.

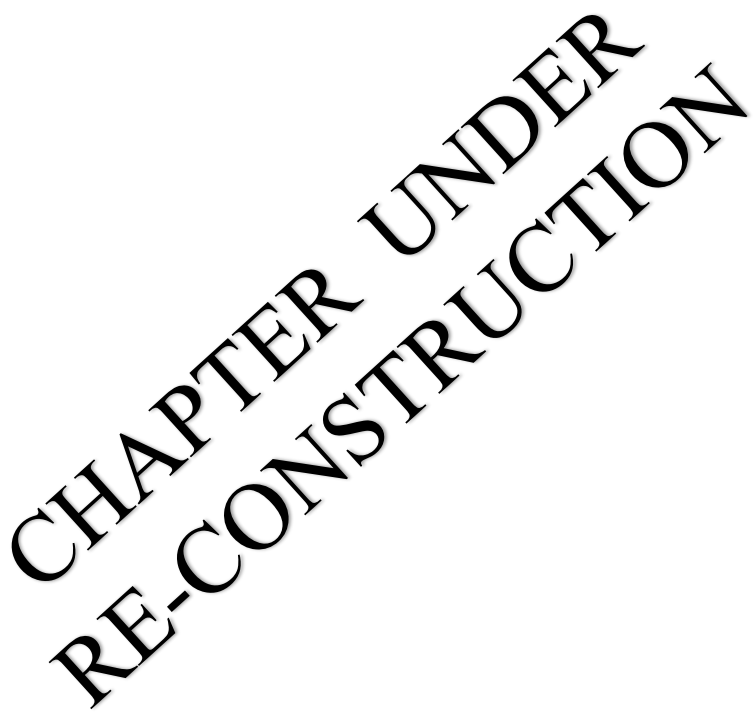
Presence of complementing indicators in the energy balance

The next table indicates which complementing indicators are shown in the Eurostat's simplified balances and which flows are shown in the Eurostat's complete balance.

Eurobase code	Eurostat dissemination label: EN	Simplified balance	Complete balance
GEP	**Gross electricity production**	✓	✓
GEP_MAPE	Main activity producer electricity only		✓
GEP_MAPCHP	Main activity producer CHP		✓
GEP_APE	Autoproducer electricity only		✓
GEP_APCHP	Autoproducer CHP		✓
GHP	**Gross heat production**	✓	✓
GHP_MAPCHP	Main activity producer CHP		✓
GHP_MAPH	Main activity producer heat only		✓
GHP_APCHP	Autoproducer CHP		✓
GHP_APH	Autoproducer heat only		✓
GIC	**Gross inland consumption**	✓	✓
GIC2020	**Gross inland consumption (Europe 2020-2030)**	✓	✓
PEC2020	**Primary energy consumption (Europe 2020-2030)**	✓	✓
FEC2020	**Final energy consumption (Europe 2020-2030)**	✓	✓

Examples of practical use

This chapter aims to demonstrate how certain information can be extracted form energy balances. For demonstration we will use the simplified energy balance for EU-28 for year 2017 calculated on the basis of data transmitted by 28 January 2019.



Consistency with IRES

IRES (International Recommendation for Energy Statistics)

This chapter describes the similarities and differences between the energy statistics and energy balances in Eurostat and the International Recommendations for Energy Statistics (IRES) as published by United Nations Statistics Division. As energy balances are the final outcome of a long process, any discrepancy at any place in the production chain will naturally manifest also in the energy balance. Therefore the Eurostat's assessment, comments and relevant observations are performed specifically for each chapter of IRES and especially for each key recommendation vis-à-vis the technical aspects of energy statistics and methodology for constructing energy balances.

Chapter 1. Introduction

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 1. as listed in Table 1.1: 1.17, 1.20, 1.22 and 1.49.

Eurostat is the statistical office of the European Union. Eurostat was established in 1953 to meet the requirements of the Coal and Steel Community. Over the years its task has broadened and when the European Community was founded in 1958 it became a Directorate-General (DG) of the European Commission. Eurostat's key role is to supply statistics to other DGs and supply the Commission and other European Institutions with data so they can define, implement and analyse Community policies.

Eurostat does not work alone. Since the early days of the Community it was realised that decisions on and planning and implementation of Community policies must be based on reliable and comparable statistics. So the European Statistical System (ESS) was built up gradually with the objective of providing comparable statistics at EU level.

The European Statistical System (ESS) is the partnership between the Community statistical authority, which is the Commission (Eurostat), and the national statistical institutes and other national authorities responsible in each Member State for the development, production and dissemination of European statistics. Member States collect data and compile statistics for national and EU purposes. The ESS functions as a network in which Eurostat's role is to lead the way in the harmonization of statistics in close cooperation with the national statistical authorities. ESS work concentrates mainly on EU policy areas; and with the extension of EU policies, harmonization has been extended to nearly all statistical fields.

Statistical activities of Eurostat are to be considered as official statistics. This is built on several key legislative acts:

- Regulation (EC) No 223/2009 on European statistics
- Commission Regulation (EU) No 557/2013 as regards access to confidential data for scientific purposes
- Commission Decision 2012/504/EU on Eurostat
- Regulation (EC) No 99/2013 on the European statistical programme 2013-17
- Regulation (EU) 2017/1951 amending Regulation (EU) No 99/2013 on the European statistical programme 2013-17, by extending it to 2020

Especially for energy statistics, the key legislative acts which oblige provision of statistical information in the area of energy, which implementation is mandatory for all countries of the European Union are:

- Regulation (EC) No 1099/2008 on energy statistics
- Regulation (EU) 2016/1952 on European statistics on natural gas and electricity prices

- Council Directive 2009/119/EC imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products
- Council Decision 1999/280/EC regarding a Community procedure for information and consultation on crude oil supply costs and the consumer prices of petroleum products

Eurostat has a policy of encouraging free re-use of its data, both for non-commercial and commercial purposes. All statistical data, metadata, content of web pages or other dissemination tools, official publications and other documents published on its website, can be reused without any payment or written licence provided that:

- the source is indicated as Eurostat;
- when re-use involves modifications to the data or text, this must be stated clearly to the end user of the information.

There is no special procedure or requirement for a written licence. Anybody can just download the material and use it (unless the material is listed in the limited list[3] of exceptions).

The European Statistical Training Programme (ESTP) provides European statisticians the opportunity to participate in international training courses, workshops and seminars at postgraduate level. Courses under the ESTP have a truly international dimension to meet the challenges of comparable statistics at European and international level. Courses focus on harmonised European concepts and legislation, as well as the implementation practices at national level.

The programme is coordinated by Eurostat. Courses are delivered either at Eurostat premises in Luxembourg or in national training sites of EU and European Free Trade Association (EFTA) countries. The ESTP programme is tailored to meet the specific needs of the European Statistical System (ESS) by taking into account the different levels of statistical knowledge and working experiences. It comprises courses in Official Statistics, IT applications, Research and Development and Statistical Management. Through a balanced combination of theory and practice and a variety of approaches (workshops, group discussions, lectures and exercises) the training s intend to provide adequate solutions, including, in some cases, the simulation of real work situations.

Officials and employees of National Statistical Institutes or corresponding Competent National Authorities (CNA) of EU Member States, EFTA countries, candidate countries and potential candidates as well as Eurostat can apply.

Chapter 2. Scope of energy statistics

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 2. as listed in Table 1.1: 2.6, 2.7 and 2.9.

European statistical regulation is output oriented. As such, it does not prescribe countries how activities shall be performed, but the definitions and technical criteria on the output. Therefore recommendation and encouragement 2.6 and 2.7 fall under the subsidiarity[4] principle. The coherence with these two recommendations is evident by the actual delivery of these data to Eurostat and by the overall organisation of the statistical systems in the EU Member States.

Coherence with main recommendation and encouragement 2.9 is also ensured in Eurostat's energy statistics. For fossil fuels, use of energy products for non-energy purposes is clearly identified and reported in addition to use for energy purposes (combustion). Fuels of renewable origin are included if and only if they are used for energy purposes in active systems; use of renewable energy in its passive form is excluded.

[3] There are only very few exceptions, please see our website for more detailed information http://ec.europa.eu/eurostat/about/our-partners/copyright

[4] In areas in which the European Union does not have exclusive competence, the principle of subsidiarity seeks to safeguard the ability of Member States to take decisions and action and authorises intervention by the Union when the objectives of an action cannot be sufficiently achieved by the Member States, but can be better achieved at Union level, 'by reason of the scale and effects of the proposed action'.

IRES sections 2.13 and 2.14 dealing with production boundary and reference territory are fully coherent with practices deployed in Eurostat. Other recommendations and encouragements of this chapter are further elaborated in more details in other chapters.

Chapter 3. Standard International Energy Products Classification (SIEC)

Eurostat considers that it is mostly coherent with main recommendations and encouragements for Chapter 3. as listed in Table 1.1: 3.1.

Eurostat collects data on the basis of definitions in Annexes of Regulation (EC) No 1099/2008 on energy statistics. This is a binding legislation on the territory for the European Union and agreed with representatives of EU Member States (European Council and European Parliament). Therefore these definitions are by its legal status internationally agreed. Moreover these definitions are fully consistent with the activities executed in the framework of the Energy Community Contracting Parties. Cooperation activities and joint work on data collections with harmonised product definitions and reporting templates includes also the International Energy Agency and International Energy Forum (Joint Organisations Data Initiative).

Naturally, classification of energy products in Eurostat's statistical framework sometimes apply a higher level of disaggregation when the European context justifies the provision of more detailed data and on the other side we aggregate some energy products if their consumption is insignificant at European level. However, there is no fundamental contradiction with SIEC since both classifications are consistent and comparable.

However, there is one key difference between SIEC and the Eurostat's framework. This difference concerns non-combustible energy sources of renewable origin, such as solar energy, wind energy, hydro energy and ambient heat captured by heat pumps. These are considered in the Eurostat's energy statistics as energy products and for the purpose of energy and heat generation are treated via the "Transformation input" and "Transformation output" in the same way as combustible fuels. Naturally this has implications that manifest also in the energy flows and in energy balance (see comments for chapter 5 and chapter 8).

In addition, consistent with the treatment of other energy sources, Eurostat includes ambient heat captured by heat pumps as a fuel in the renewable energy category that can either be used to produced heat for sale (input in transformation for heat production) or used directly by end-users (final energy consumption).

Chapter 4. Measurement units and conversion factors

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 4. as listed in Table 1.1: 4.27, 4.28, 4.34, 4.38, 4.39, 4.44, 4.60, 4.65 and 4.67.

Coherency is evident by the overall design of the data collection: the questionnaires, the reporting instructions, the manuals and the discussion material from the Eurostat's Energy Statistics Working Group meetings. Relationships between units are well explained and documented. In data collection as well as in data dissemination the measurement units are always clearly indicated.

Collection of calorific values is mandatory (defined in Annexes of Regulation (EC) No 1099/2008 on energy statistics). For products where discrepancies in calorific values in production, trade and consumption are expected, calorific values are collected in more details; in products with more stable heat content, only one value for production, trade, consumption is collected. The default values used, in case of calorific values are not reported, are documented in the methodology section of the publication on energy balances. The overall approach towards default calorific values ultimately refers to IPCC 2006 guidelines, which is also the one described and recommended in IRES.

In dissemination data are available in physical units (tonnes), where appropriate as well as in energy units (both ktoe and TJ). In addition, some indicators are available also in GWh and Mtoe.

Chapter 5. Energy Flows

Eurostat considers that it is mostly coherent with main recommendations and encouragements for Chapter 5. as listed in Table 1.1: 5.9, 5.23, 5.24, 5.26, 5.77 and 5.80.

Coherency is evident by the overall design of the data collection: the questionnaires, the reporting instructions, the manuals and the discussion material from the Eurostat's Energy Statistics Working Group meetings. Eurostat's classification is based on NACE Rev. 2, which is fully coherent with ISIC Rev. 4.

However, there is one key difference with respect to the Eurostat's framework. This difference concerns non-combustible energy sources of renewable origin, such as solar energy, wind energy, and hydro energy. These are considered in the Eurostat's energy statistics as energy products and for the purpose of energy and heat generation are treated via the "Transformation input" and "Transformation output" in the same way as combustible fuels. Naturally, this has implications that manifest also in the energy products and in energy balance (see comments for chapter 3 and chapter 8).

Chapter 6. Statistical Units and Data Items

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 6. as listed in Table 1.1: 6.3, 6.75, 6.78 and 6.84. Other main recommendations and encouragements for Chapter 6 as listed in Table 1.1: 6.5, 6.9 and 6.21 are outside the legislative competence of Eurostat (subsidiarity principle) and are not evaluated by Eurostat.

With respect to most of the elements from 6.4 to 6.37, the subsidiarity principle comes into play again. European statistical regulation is output oriented. As such, it does not prescribe countries how activities shall be performed and specificities of technical modalities of these activities (national energy statistical programmes, statistical units, but the technical criteria on the statistical data output to be delivered to Eurostat. Therefore recommendation and encouragement in this part of IRES fall under the subsidiarity principle. The coherence with these principles is partly addressed by the quality reports published by Eurostat and detailed assessment is better to be performed at national level. However, as in general the energy statistics is of high quality with no significant reporting problems, currently Eurostat does not see any significant value added in the detailed analysis and assessment across countries for these elements.

Concerning the elements 6.38 – 6.93, general coherence is evident by the overall design of the data collection: the questionnaires, the reporting instructions, the manuals and the discussion material from the working group. Several data collections are due to split of responsibilities not executed in the Energy statistics unit of Eurostat, but under responsibility of different departments of Eurostat, European Commission or other bodies of governance structures of the European Community in general.

Chapter 7. Data collection and compilation

All main recommendations and encouragements for Chapter 7. as listed in Table 1.1: 7.5, 7.10, 7.13, 7.18, 7.29, 7.33, 7.39, 7.41, 7.47, 7.48, 7.67 and 7.68 are outside the legislative competence of Eurostat (subsidiarity principle) and are not evaluated by Eurostat.

European statistical regulation is output oriented. As such, it does not prescribe countries how statistical activities shall be performed and also it does not set specificities of technical modalities of these activities (organisation of national statistical system, frequency of survey, use of administrative data, etc.). These choices are to be made on national level. Eurostat only monitors the technical criteria on the statistical data output that are delivered to it (data quality issues). Therefore all recommendations and encouragements in this chapter fall under subsidiarity principle and are not evaluated by Eurostat – evaluation can be provided only on national level.

Chapter 8. Energy balances

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 8. as listed in Table 1.1: 8.1, 8.5, 8.9(a), 8.9(h), 8.9(j), 8.10, 8.12, 8.14, 8.22, 8.29, 8.35, 8.36, 8.37, 8.40, 8.42, 8.45, 8.51, 8.52, 8.53, 8.54, 8.55 and 8.59.

Eurostat considers that it is mostly coherent with main recommendations and encouragements for Chapter 8. as listed in Table 1.1: 8.30, 8.48.

In general, the overall high level of coherency is evident by the overall design of the data collection: the questionnaires, the reporting instructions, the manuals and the discussion material from the Eurostat's Energy Statistics Working Group meetings as well as by the availability of information in data disseminated by Eurostat: in this case the complete energy balances, the simplified energy balances and the available additional information (complementing data and indicators, metadata and quality reports).

As noted in IRES 8.6, the scope of an energy balance is determined, inter alia, by the territory, product and flow boundaries. Therefore all discrepancies noted in this document with respect to chapters 3 and 5 are applicable also for chapter 8.

While the presentation of the Eurostat official energy balance differs in some elements from the one described in IRES, the conversion is possible and can be regarded as a purely numerical/technical exercise. The key principles of compiling the energy balance and its presentation as 3 blocks (supply, transformation, consumption) matrix (with energy products as columns and energy flows as rows) is fully available in the energy balance of Eurostat.

Order of rows and columns might be different, but all key elements are present: total and intermediate aggregate for energy products and energy flows including all details and intermediate aggregates as defined in IRES chapter 8. *Total energy supply*, as the key aggregate of the top block, is calculated in Eurostat's energy balance.

The middle block of Eurostat's energy balance is more detailed than recommended in IRES. The middle block shows separately *Transformation input* and *Transformation output*. Therefore it is not necessary to use positive and negative signs as recommended in IRES 8.30. Numerically the recommended approach can be derived as *Transformation output* minus *Transformation input*.

Concerning statistical difference, Eurostat believes that current IRES approach is creating some confusion. In 8.9(f) is stated "*A separate row is reserved for statistical difference, calculated as the numerical difference between the total supply of an energy product and the total use of it*" and later repeated in 8.45 "*the statistical difference is the numerical difference between the total supply of an energy product and the total use of it*." However, for several products (for example electricity and motor gasoline), their supply is available only as transformation output (the middle block of the energy balance). Therefore, statistical difference calculated as demonstrated on an example in 8.45 represents its desired outcome only for primary products (for example anthracite, natural gas and crude oil). In this respect, there is also a statement in 8.15 "*A separate row should be reserved for statistical difference and placed between the top and middle blocks of the balances*." It seems the intention of IRES was to recommend that statistical difference is calculated as the difference between "the top block" on one side and "the middle and bottom blocks" on the other side.

In the energy balances produced by Eurostat, statistical difference is calculated as difference between "the top and middle blocks" on one side and "the bottom block" on the other side. As the middle block contains both – supply and demand – calculation example in 8.45 is subject to similar conceptual and methodological limitations as calculation implemented in Eurostat's energy balance.

Eurostat never edits official data transmitted by countries. However, imputation is done for estimation of missing data (mostly calorific values). Methodological choices done with respect to construction of energy balances are not considered data imputation.

With respect to IRES 8.7 as technology advances, new sources of energy may become available and should be reflected in the balances. The ambient heat captured by heat pumps is included in Eurostat's energy balances as of January 2019 edition.

Chapter 9. Data quality assurance and metadata

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 9. as listed in Table 1.1: 9.13, 9.15, 9.20, 9.21, 9.27, 9.28, 9.38, 9.41 and 9.42.

Eurostat is committed to delivering data of high quality. The elements described in IRES Chapter 9. are fully coherent with the quality dimensions defined in the European legal acts for energy statistics, the European Statistics Code of Practice and also the Quality Assurance Framework of the European Statistical System. In the energy domain, all these principles are implemented in the current system for collecting, compiling and disseminating energy data, thus fully coherent with IRES recommendations and in several aspects going beyond IRES. The quality report on energy statistics is available as Eurostat's website as well as detailed metadata (including national metadata).

Concerning IRES 9.41 and its recommendation and encouragement for SDMX standards, Eurostat already undertook some significant work on the SDMX developments in general. Specifically for energy domain, Eurostat is gradually progressing with the initial developments and implementation of the first drafts of harmonised code lists and harmonised data structure definitions in its data collection templates. At wider international level, in 2018 Eurostat presented these SDMX developments to the Oslo Group and together with the International Energy Agency presented to the InterEnerStat.

Chapter 10. Dissemination

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 10. as listed in Table 1.1: 10.2: 10.3, 10.4, 10.12, 10.15, 10.16, 10.17, 10.19, 10.20, 10.22, 10.24, 10.25, 10.26, 10.27 and 10.28.

In general, the overall high level of coherency is evident by the overall design of the data dissemination in Eurostat. Eurostat has a policy of encouraging free re-use of its data, both for commercial and non-commercial purposes. All data are available in electronic format on Eurostat website. Release calendar for energy statistics is available as well as metadata. In 2016 Eurostat complemented the energy balances dissemination in the database format, pdf and MS Excel file format with the interactive tool producing Sankey diagrams. A revision policy for energy statistics is in place on the basis of gentlemen's agreement since October 2015.

Concerning IRES 10.28 and its recommendation and encouragement for SDMX standards, Eurostat already undertook some work on the SDMX developments in general and specifically for energy domain, Eurostat, in close collaboration with the Oslo Group on energy statistics and the InterEnerStat members, is gradually progressing with the developments of data structure definitions and code lists.

Chapter 11. Uses of basic energy statistics and balances

Eurostat considers that it is fully coherent with main recommendations and encouragements for Chapter 11. as listed in Table 1.1: 11.28, 11.33 and 11.34.

Physical energy flow accounts are mandatory for EU Member States and data used are coherent with energy statistics. The process of creating physical energy flow accounts is well documented.

On the basis of Eurostat's energy balances, several key policy indicators are developed and used for monitoring of progress towards legislative and voluntary targets.

CO_2/GHG accounting methodology is taking into account the energy statistics and explanation of discrepancies between energy statistics and activity data in emission inventories is mandatory based on European legislation.

The Eurostat's energy balance builder tool

The Eurostat's energy balance builder tool performs the calculation and construction of energy balances in the same way as described in the previous chapters of this document and also as implemented in the IT environment of Eurostat.

The main benefit derived from the use of the Eurostat's energy balance builder tool is that reporting countries can at any moment reproduce the calculation done by Eurostat. The tool offers full transparency on how the construction of energy balances is done from the source data. Its application prevents any irregularities from varying parameters and rules used in different calculation methods. Also it ensures harmonised and comparable results for anybody trying to construct energy balance according to Eurostat's methodology.

Data requirements

The tool is based on the methodological framework using the information gained through annual statistics on energy as covered under Annex B of Regulation (EC) No 1099/2008 on energy statistics. The annual energy questionnaires are the necessary prerequisite for the use of the Eurostat's energy balance builder tool:

- annual questionnaire for electricity & heat
- annual questionnaire for natural gas
- annual questionnaire for nuclear statistics
- annual questionnaire for oil
- annual questionnaire for renewables & waste
- annual questionnaire for coal

Energy data from the above-mentioned questionnaires are linked with formulas to construct and calculate the energy balance. The balance builder tool does not check the correctness of the annual energy questionnaires. It is assumed that all annual energy questionnaires are filled in completely with no mistakes and errors — the internal consistencies within each questionnaire as well as the cross questionnaire consistencies have to be respected.

Software requirements

The annual energy questionnaires and the balance builder tool itself were developed in the Microsoft Excel file format. Both use built-in Visual Basic macros. Therefore, users have to enable the use of Visual Basic macros. Security confirmations (to enable macro execution) might vary, depending on the version of MS Excel installed.

The tools is MS Excel file with Visual Basic macros enabled (xlsm file format) developed and tested in MS Windows 10. MS Excel version 12.0 (Excel 2007) and version 16.0 (Excel 2016) were used during development and testing. Compatibility with similar versions of Microsoft products is expected, however compatibility on other software platforms cannot be guaranteed and ensured by Eurostat.

While there has not been exhaustive testing in different environments, compatibility with MS Windows 7 and MS Windows 8 using MS Excel version 12.0 or more recent, is expected. The tool might not work properly with MS Excel version 11.0 or earlier versions. Our tests of non-Microsoft software solutions indicate that Visual Basic macros are not functional and consequently the tool does not work properly.

Loading data from annual questionnaires

This version of the tool will work only with the “new” annual energy questionnaires (version to be used to transmit data for reference years 2017 and subsequent vintages). It is not possible to use the “old” annual energy questionnaires.

Energy data from the annual energy questionnaires must be exported to CSV format using the export function (built-in macro in the questionnaires).

Subsequently, the data have to be imported into the balance builder tool using the inbuilt procedures (Visual Basic macros accessible from the sheet ‘MAIN’).

- Load RENEWABLES (annual questionnaire for renewables & waste)
- Load COAL (annual questionnaire for coal)
- Load OIL (annual questionnaire for oil)
- Load GAS (annual questionnaire for natural gas)
- Load ELECTRICITY (annual questionnaire for electricity & heat)
- Load NUCLEAR (annual questionnaire for nuclear statistics)

Important note: Depending on the performance of the computer/laptop operating the tool, the loading macros take some time (the longest it takes for loading the oil questionnaire). This is due to the number of data points to be loaded – all products and all flows for all time periods. Afterwards switching between the years is nearly instant with no time lag. It is recommended to test the functionality by loading the questionnaires in the following sequence nuclear – natural gas – electricity – renewables – coal – oil (from the shortest to the longest loading time). It is also recommended to close other applications running on the PC, especially on the PC with low performance.

The link between the balance and source data

Sheet BALANCE-RAW has the structure of the Eurostat's energy balance with the elements in physical units. After selecting any green cells and pressing **Ctrl + [** MS Excel will jump into the item in the sheets, where data from annual questionnaires are copied (keyboard shortcut of MS Excel for the trace precedent cells command). Formulas in blue cells are more complex and require more detailed analysis as they usually have more than one precedent cell.

The results

When all required data have been loaded, the energy balances are available on sheets SIMPLIFIED BALANCE and COMPLETE BALANCE. The units can be selected (GWh, Mtoe, ktoe and TJ) and the desired year can be selected via the drop down menu (combo box) in the top left part of the sheet.

While the visible results are displayed with 1 decimal place, MS Excel has much more decimal places as fragments of the actual arithmetical calculations. This virtual precision is to a certain extend fictitious – the raw data are reported with maximum 3 decimal places and the number of valid digits is therefore limited.

The statistical data collection system in the annual energy questionnaires cannot distinguish between the following cases:

- Data are not available to the reporting authority
- Data are confidential and not shown
- Energy quantity is a real zero (aka no consumption)
- Consumption is negligible (quantity is less than 0.5 of the respective reporting unit or less

than 0.0005 in case reporting country is using 3 decimal places for reporting)

All these cases are represented as “zero” in the annual questionnaires and consequently with value zero in the balance builder. In default settings with 1 decimal place the symbol “0.0” indicates value between 0 and 0.05 and symbol “-0.0” indicates a value between -0.05 and 0. Values bigger than 0.05 and lower than -0.05 are indicated by the respective value rounded to one decimal place.

The non-feasible combinations are marked as red on sheet BALANCE_RAW and are shown with letter “Z” on sheets SIMPLIFIED BALANCE and COMPLETE BALANCE. The non-feasible combinations are either methodologically not feasible (for example solid fossil fuels cannot be a transformation output of the gas-to-liquids plants) or data are not available in the data reporting templates/questionnaires (for example natural gas and solid fossil fuels used in domestic aviation).

Forecasting & Scenario building up to 2030

The tool can be also used for forecasting, scenario building or estimating future energy balance by entering data into empty cells for future periods on input sheets COAL, ELE, GAS, OIL, REN and NUC. Naturally, if respective csv files are created, data for these years can be also loaded.

The tool does not make these estimates itself; it is responsibility of the user to enter the values correctly and consistently. The tool only provides positions for time periods from 1990 to 2030.

Full transparency & Eurostat's assistance

There are no hidden sheets and some elements are password protected. This is in order to ensure that changes are not made accidentally.

The password to unprotect the sheets is "**Eurostat**". The unprotecting can be done also automatically by running the Visual Basic macro *UNprotectAllSheets*.

While Eurostat promotes full transparency on the methodology as well as promotes reusability of its deliverables, once calculating elements are modified Eurostat cannot be responsible for the accuracy and coherency of results.

Eurostat can offer assistance with the use, operation and methodology explanation. For all assistance regarding the actual results, Eurostat need to require also the transmission of the input files (the csv files to be loaded into the tool).

Bug reporting and error correction

If you discover a questionable elements related to calculation (methodology and its implementation), please let us know. We will be please to discuss it with you. Also if you observe issues of stability and crashes, please let us know. If we discover bug and/or errors, we will try to correct them as soon as possible.

ESTAT-ENERGY@EC.EUROPA.EU

Technical notes for facilitation of automatisation

Password to unprotect: Eurostat

Cell controlling year selection: 'COMPLETE BALANCE'!F5

Cell controlling unit selection: 'COMPLETE BALANCE'!D5

Cell controlling country selection (using country label): ‘MAIN’!D9

Area with country labels: 'MAIN'!AX60:AX101

Area with country codes: 'MAIN'!AY60:AY101

Literature and information sources

Several documents published by Eurostat, draft documents available only as internal version, presentations, websites and other information sources of Eurostat where analysed when preparing this document. In addition, the following sources of information were analysed when preparing this document. These sources offer additional information for readers that would like to have search for more information.

- International Recommendations for Energy Statistics; United Nations; 2016
- Energy Statistics Compilers Manual; United Nations; 2016
- Energy Statistics Manual; International Energy Agency – Eurostat; 2004 edition
- Energy statistics methodology; Eurostat; 1988
- Concepts and methods in energy statistics, with special reference to energy accounts and balances; United Nations; 1982

In order to better understand the energy statistics as well as energy balances disseminated by Eurostat, it is highly recommended to analyse the quality reports on EU energy statistics. These reports are available on Eurostat's website: http://ec.europa.eu/eurostat/web/energy/methodology