Energy balance - old methodology

Statistics Explained

This article presents the basic methodology information about energy balances compiled and disseminated by Eurostat .

What is an energy balance?

The energy balance is a table matrix represented by rows and columns. The concept of "energy balance" is an accounting framework for the compilation and understanding of data on all energy products entering, exiting and being used in a country. The energy balance is the most complete statistical accounting of energy products and their flow in the economy. Columns of the energy balance represent energy products (fuels). Rows represent energy flows.

The energy balance expresses all forms of energy in a common accounting unit. The balance shows the relationships between supply, inputs to the energy transformation processes and their outputs as well as the actual energy consumption by different sectors of end-use.

Example of complete energy balance of Eurostatsee here .

EU-28, 2014 (ktoe)	Total (all products)	Solid fossil fuels	Crude oil & petroleum products	Gas	Nuclear heat	Renewable energies	Non-renewable wastes	Electricity	Derived heat
+ Primary production	770 722	149 335	70 030	117 019	226 132	195 814	12 392		
+ Primary production receipt	9 370		9 370						
+ Other sources (recovered products)	4 909	685	3 968	256					
+ Recycled products	1 125		1 125						
+ Imports	1 411 681	159 831	882 362	320 253		15 704	255	33 270	5
+ Stock changes	- 9 349	- 4 041	358	- 5 451		- 220	6		
- Exports	530 788	37 293	362 306	89 161		10 057	29	31 937	5
- Bunkers	41 622		41 622						
- Direct use	10 116		10 116						
Gross inland consumption	1 605 931	268 517	553 168	342 917	226 132	201 241	12 624	1 332	0
Transformation input	1 277 176	253 214	627 959	102 222	226 132	57 134	9 297	192	1 026
+ Conventional thermal power stations	357 010	190 639	12 879	92 227		51 703	8 536		1 026
+ Nuclear power stations	226 132				226 132				
+ District heating plants	19 484	3 816	1 048	8 521		5 146	761	192	
+ Coke ovens	39 002	38 367	624	11					
+ Blast furnaces	13 421	13 421							
+ Gas works	736	710	1	25					
+ Refineries	613 159		613 159						
+ Patent fuel plants	245	171	74						
+ BKB/PB plants	4 958	4 958							
+ Charcoal production plants	227					227			
+ Coal liquefaction plants	839	839							
+ For blended natural gas	231		175			56			
+ Gas-To-Liquids (GTL) plants									
+ Non-specified Transformation Input	1 734	293		1 439		2			
Transformation output	932 177	33 008	612 716	21 162		69		209 643	55 579
+ Conventional thermal power stations	173 718							134 296	39 422
+ Nuclear power stations	75 437							75 348	89
+ District heating plants	16 068								16 068
+ Coke ovens	35 927	28 712		7 214					
+ Blast furnaces	13 421			13 421					
+ Gas works	526			526					
+ Refineries	612 716		612 716						
+ Patent fuel plants	207	207							
+ BKB/PB plants	4 089	4 089							
+ Charcoal production plants	69					69			
Exchanges, transfers and returns	2 428		2 428			- 61 990		61 990	
Consumption of the energy branch	77 518	669	31 050	18 131		912	62	22 536	4 159
Distribution losses	24 960	48	47	2 810		25	0	17 505	4 525
Available for final consumption	1 160 881	47 595	509 255	240 915		81 249	3 264	232 733	45 870
Statistical difference	*- 191*	*- 499*	*2 277*	*- 2 198*		*- 129*	*- 0*	*32*	*326*
Final non-energy consumption	99 387	1 518	84 020	13 849					
Final energy consumption	1 061 684	46 576	422 957	229 264		81 378	3 264	232 701	45 544
+ Industry	274 769	35 281	27 671	87 233		20 523	3 033	85 764	15 263
+ Iron and Steel	51 085	23 882	1 076	15 335		38	49	10 314	392
+ Chemical and Petrochemical	52 612	2 831	7 834	18 050		339	367	15 580	7 610
+ Non-ferrous metals	8 948	290	281	3 058		3	12	5 177	126
+ Non-metallic minerals	33 998	4 816	6 019	13 336		1 426	2 373	5 798	230
+ Transport eEquipment	7 874	68	381	2 390		17	0	4 398	620
+ Machinery	18 578	95	1 116	6 312		119	1	10 316	619
+ Mining and Quarrying	2 746	175	726	552		39		1 167	87
+ Food, Beverages and Tabacco	28 191	1 235	1 766	13 151		977	11	9 798	1 254
+ Paper, Pulp and Printing	31 667	1 076	698	7 421		11 613	123	8 387	2 349
+ Wood and Wood products	8 051	45	144	530		4 591	41	2 237	464
+ Construction	6 752	22	3 199	2 132		100	0	1 242	57
+ Textile and Leather	4 404	57	256	2 122		19	0	1 793	158
+ Not elsewhere specified (Industry)	19 862	687	4 175	2 845		1 243	55	9 559	1 299
+ Transport	352 936	9	330 493	2 956		14 141		5 338	
+ Rail	6 222	9	2 049			31		4 134	
+ Road	289 782		274 174	1 448		14 097		64	
+ International aviation	44 259		44 259						
+ Domestic aviation	5 307		5 307						
+ Domestic navigation	4 300		4 295			5			
+ Pipeline transport	1 561		1	1 466				94	
+ Not elsewhere specified (Transport)	1 505		408	42		9		1 046	
+ Other sectors	433 979	11 286	64 793	139 075		46 713	231	141 599	30 281
+ Commercial and public services	141 224	1 038	15 284	41 858		4 314	224	69 364	9 143
+ Residential	263 222	9 093	33 821	92 167		40 216	7	67 511	20 407
+ Agriculture / Forestry	23 608	1 115	12 566	3 730		1 999		3 923	274
+ Fishing	1 092		1 024	1		33		34	
+ Not elsewhere specified (Other)	4 833	40	2 098	1 318		152		767	458

Example of simplified energy balance of Eurostat Source: Eurostat (nrg_100a)

The purpose of energy balances

The energy balance is a multi-purpose tool to:

- Enhance the relevance of energy statistics by providing comprehensive and reconciled data on the energy situation;
- Provide comprehensive information on the energy supply and demand 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 of statistical information between different reference periods and between different countries;
- Provide data for the calculation of greenhouse gas emissions from fuel combustion;
- Provide the essential basis for calculating various indicators of each energy product's role in the country's economy (energy efficiency, share of renewable energy, energy savings, consumption of energy by sector and others);
- Provide an input for modelling and forecasting.

Technical specificity of Eurostat's energy balance

- The energy balance is constructed for each calendar year. Currently energy balances for all EU-28 Member States are available starting in year 1990. Eurostat data also cover 11 non-EU countries and for most of them data are also available starting in 1990.
- The energy balance covers the national territory of a given country. The trade of energy commodities between countries is covered in the imports and exports.
- The energy balance calculated by Eurostat is available in thousands of tons of oil equivalent (ktoe) or in terajoules (TJ).

Construction of the energy balances

Eurostat collects energy statistics on the basis of Regulation (EC) No 1099/2008 on energy statistics. Annual data for coal (solid fossil fuels and manufactured gases), natural gas, oil (crude oil and petroleum products), electricity and heat, renewables and waste are transmitted to Eurostat in the form of commodity balances expressed in fuel specific units (tonnes for coal, GWh for electricity, TJ for heat). These data form the input into the process of the energy balance construction.

The construction of the energy balance is based firmly on the first law of thermodynamics which states that the amount of energy within any closed system is fixed and can be neither increased nor diminished unless energy is brought in or sent out.

The data from the commodity balances are converted to values expressed in a common energy unit (TJ).

For calculating the energy equivalents the "physical energy content" method is used. The general principle of the physical energy content method is that the primary energy form should be the first energy form in the production process for which various energy uses are practiced.

For combustible energy products (for example coal, crude oil, natural gas, biomass, waste) it is their energy content. The energy content of such a product is characterized by its net calorific value. For non-combustible products the application of the "physical energy content" method 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.

There are some specific assumptions made by Eurostat. Should the amount of heat produced in the nuclear reactor not be known, the primary energy equivalent is calculated from the electricity generation by assuming an efficiency of 33 %. In the case of electricity and heat generated with geothermal energy, if the actual amount of

geothermal heat is not known, the primary energy equivalent is calculated assuming an efficiency of 10 % for electricity production and 50% for derived heat production.

Once all amounts of all fuels are converted to the chosen common energy unit, the quantities can be presented into the energy balance structure. Eurostat's energy balance has the following key segments:

Supply (Gross inland energy consumption)

Supply covers production (primary and recovered products, imports, exports, stock changes and international marine bunkers) which allows for calculation of the so-called "gross inland energy consumption".

The Gross inland energy consumption is the most important aggregate of the energy balance. For the total of all products this is the total energy demand of a country. However, for individual products its interpretation is different. For primary products (those directly harvested from nature) it shows their supply. For derived products (manufactured products, secondary products) it covers only their international trade and stock changes, as production of these products is recorded in the transformation output. Consequently, Gross inland energy consumption for derived products can be negative - in which case its original primary form supply was accounted for in the form of a primary product.

Transformation input

This section of the energy balance records products that undergo transformations in various processes. This includes for example production of electricity and heat in power plants, refining of crude oil into petroleum products and production of derived coal products.

Transformation output

This section of the energy balance records products that are the result of transformation processes. The difference between transformation output and transformation input are transformation losses.

Energy sector

The energy sector refers to the energy use of the energy industries performing energy production and energy transformation. It reflects the energy consumption needed for direct support operations of the transformation processes. Of course it does not include the amount of energy present as input and output during the actual transformation. By way of an example, the pre-heating of the oven in the coke oven plants is considered energy use by the energy sector; the heat of the actual transformation process of coking an amount of coking coal into coke oven coke is not.

Exchange, Transfers, Returns

This is essentially a pure statistical accounting element designed to move energy amounts between columns (products). This is introduced to overcome some practical classification and presentation issues resulting from changes of the characteristics of an energy product or from changes in their use. This also includes the renaming of products that no longer meet their original specifications.

It is important to note the treatment of non-combustible renewable energy sources producing electricity (hydro, wind and solar photo-voltaic). In this row the energy balance quantities of primary renewable energy form are transferred into the electricity.

Distribution losses

This flow covers losses that occur during the transmission, distribution and transport of fuels, electricity and heat. Losses can also include venting and flaring of manufactured gases and losses of geothermal heat after production.

Available for final consumption

This is a calculated aggregate in the energy balance: Available for final consumption = Gross inland consumption – Transformation input + Transformation output + Exchanges, transfers and returns – Consumption of the energy branch – Distribution losses. It represents the quantity of energy products (in whatever form) that is available to final end-users on the internal market. Negative values for the element "Available for final consumption" indicate

inaccuracies in statistical data collections or reporting.

Final non-energy consumption

This section of the energy balance records fuels that were not combusted (not burned) by end-users. It applies for coal, oil and gas. These energy products were used for their chemical and physical properties rather than for their energy content. For example, the use of fossil fuels in the chemical industries for specific chemical reaction processes, the use of lubricants and greases to reduce frictions and the use of bitumen for road surfaces. By definition, renewable energy sources used for non-energy purposes are outside of the scope of energy statistics (such as wood used in the construction sites or wood used for furniture making).

Final energy consumption

This section of the energy balance records products consumed (used) at the various sectors of end-use. The "Final energy consumption" is split into 3 main sectors: industry, transport and other. These main sectors are further dis-aggregated into the sub-categories of end-users.

For example:

- oil products used for powering cars are included in the transport sector in the road transport sub-category;
- derived heat used for heating of individual houses (district heating) is shown as consumption of other sectors in the sub-category residential sector;
- electricity used in commercial buildings is recorded under other sectors in the services sub-category.

Statistical difference

This is a calculated aggregate of the energy balance: Statistical difference = Available for final consumption – Final non-energy consumption – Final energy consumption.

While the Statistical difference can be a measure of the quality of data – it symbolizes the statistical balance between supply and consumption of energy, its zero value might also be a result of a methodological approach that attributes non-surveyed elements of energy into, among others, one of the following categories: not elsewhere specified, stock changes or distribution losses. Consequently, in some cases low values of statistical difference might indicate data of higher quality than a balance with a statistical difference equal to zero.

Interpretation of empty cells, zeros and not available data points

The statistical data collection system in the joint IEA-Eurostat-UNECE 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 (no consumption)
- Consumption is negligible (quantity is less than 0.5 of the respective reporting unit)

All these cases are shown as “zero” in the joint IEA-Eurostat-UNECE annual energy questionnaires. Consequently, any of these data points observed in the disseminated data should be interpreted with caution and additional information might be needed for its proper interpretation.

Data sources

Energy balances are available in Eurostat’s database in the energy domain . For selected years, energy balances are also available in the MS Excel and pdf formats . Finally Eurostat also developed a Sankey diagrams tool for a graphical and dynamic presentation. For more information, please see also links and references below.

See also

- Sankey diagrams for energy balance

Database

- Energy (nrg) , see:

Energy statistics - quantities, annual data (nrg_quant)

Dedicated section

- Energy

Publications

- Energy data (2020 edition)
- Energy balance sheets - 2017 data (2019 edition)
- Energy balance sheets - 2016 data (2018 edition)
- Energy balance sheets - 2015 data (2017 edition)
- Energy balance sheets - 2014 data (2016 edition)
- Energy balance sheets - 2013 data (2015 edition)

Methodology

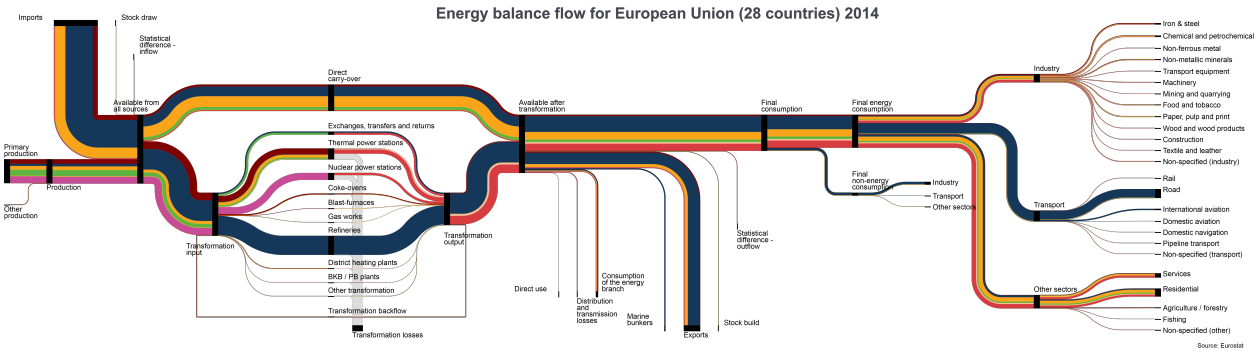
- Energy statistics, European and national metadata (ESMS metadata file)
- Energy statistics - quantities, annual data (ESMS metadata file)

Legislation

- Regulation (EC) No 1099/2008 on energy statistics
- Summaries of EU legislation: Common system for the production of energy statistics

Visualisations

The Eurostat Sankey diagrams tool published on the Eurostat website allows the visualisation of energy balances. Sankey diagrams allow the user to get an overview of the main energy flows and how they contribute to the global energy balance.



Example of Sankey diagram of complete energy balance of Eurostat Source: Eurostat (nrg_110a)

External links

- United Nations Statistics Division - Energy Balances
- United Nations Statistics Division - International Recommendations for Energy Statistics
- International Energy Agency

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