International Energy Agency

From Statistics to Energy Balances

Taylor MORRISON

Ankara, 11th December 2024

Energy Balances

WORLD ENERGY BALANCES (2022 edition)

World

2020 - Petajoules

SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural Gas	Nuclear	Hydro	Geotherm. solar etc.	Biofuels & waste	Electricity	Heat	Total
Production	160001	176809	-	139092	29195	15627	14899	57002	-	69	592625
Imports	32711	94137	52082	41946	-	-	2689	1534	2689	0	225099
Exports	-34572	-93079	-54485	-43106	-	-	-2666	-1008	-2666	-0	-228915
Intl. marine bunkers	x	x	x	x	x	x	x	x	x	x	
Intl. aviation bunkers	x	x	x	x	x	x	x	x	x	x	
Stock changes	-1503	-1504	-1674	502	-	-	-	-14	-	-	-4194
TES	**156637**	**176364**	**-4077**	**138434**	**29195**	**15627**	**14922**	**57513**	**23**	**69**	**584616**
Transfers	-138	-10896	12319	-	-	-	-	-0	-	-	1285
Statistical differences	-2248	408	-994	-2341	-	-	1002	94	996	7	-4079
Electricity plants	-68148	-1514	-4918	-38796	-29002	-15627	69175	-5394	81355	-	-94224
CHP plants	-29914	-0	-547	-13626	-192	-	26107	-3454	14826	11421	-21626
Heat plants	-971	-18	-410	-2500	-1	-	4044	-575	-	4126	-431
Blast furnaces	-7754	-	-6	-2	-	-	-	-2	-	-	-7764
Gas works	-908	-	-119	277	-	-	-	-54	-	-	-805
Coke/pat. fuel/BKB plants	-4021	-	-83	-1	-	-	-	-5	-	-	-4110
Oil refineries	-	-165908	162673	-	-	-	-	-	-	-	-3236
Petrochemical plants	-	1440	-1438	-	-	-	-	-	-	-	2
Liquefaction plants	-901	888	-	-768	-	-	-	-	-	-	-782
Other transformation	-11	548	-26	-946	-	-	-35	-3804	-17	-18	-4274
Energy industry own use	-2865	-336	-8127	-12545	-	-	-10043	-625	-8212	-1831	-34541
Losses	-77	-288	-5	-1023	-	-	-7807	-10	-6976	-831	-9210
TFC	**38681**	**687**	**154240**	**66163**	**-**	**-**	**97364**	**43685**	**81996**	**12942**	**400819**
INDUSTRY	**31640**	**120**	**12382**	**25544**	**-**	**-**	**40492**	**10093**	**34172**	**6280**	**120270**
Iron and steel	13213	0	239	2510	-	-	5236	201	4697	539	21399
Chemical and petrochemical	2971	1	2586	6646	-	-	7944	105	4808	3137	20254
Non-ferrous metals	1214	0	151	693	-	-	4454	4	4208	246	6517
Non-metallic minerals	8400	-	1489	2711	-	-	2497	567	2341	156	15665
Transport equipment	27	-	76	543	-	-	1252	2	1110	142	1900
Machinery	353	-	177	1370	-	-	3967	8	3824	143	5876
Mining and quarrying	256	-	937	493	-	-	1512	13	1428	84	3210
Food and tobacco	778	0	326	2109	-	-	2762	1883	2196	566	7857
Paper, pulp and printing	419	-	135	1140	-	-	2127	2539	1571	556	6359
Wood and wood products	11	-	72	135	-	-	538	482	431	108	1239
Construction	150	0	1552	285	-	-	794	300	755	39	3082
Textile and leather	197	-	74	477	-	-	1530	56	1132	398	2333
Non-specified	3651	119	4565	6431	-	-	5879	3933	5672	167	24578
TRANSPORT	**38**	**1**	**94960**	**4669**	**-**	**-**	**1471**	**3812**	**1471**	**-**	**104951**
Domestic aviation	-	-	4016	-	-	-	-	-	-	-	4016
Road	-	-	75021	2161	-	-	324	3757	324	-	81264
Rail	1	-	1147	-	-	-	966	24	966	-	2139
Pipeline transport	-	1	12	2477	-	-	115	-	115	-	2605
Domestic navigation	-	-	2157	3	-	-	-	5	-	-	2165
Non-specified	36	0	223	18	-	-	65	0	65	-	343
OTHER	**4766**	**1**	**17533**	**28527**	**-**	**-**	**55401**	**29780**	**46353**	**6663**	**136008**
Residential	2336	-	9021	19943	-	-	29164	28057	22620	4667	88520
Comm. and public services	1009	-	3128	7986	-	-	18493	1128	16544	1548	31745
Agriculture/forestry	547	0	4280	448	-	-	2885	475	2647	146	8635
Fishing	0	-	265	3	-	-	32	0	28	2	300
Non-specified	874	0	839	148	-	-	4828	119	4514	299	6807
NON-ENERGY USE	**2237**	**565**	**29366**	**7423**	**-**	**-**	**-**	**-**	**-**	**-**	**39590**
in industry/transf./energy	2228	565	27197	7423	-	-	-	-	-	-	37413
of which: feedstocks	..	..	..	..	..	..	..	..	..	..	..
in transport	-	-	476	-	-	-	-	-	-	-	476
in other	9	0	1693	-	-	-	-	-	-	-	1702
Electricity and Heat Output											
Electr. generated - GWh	**9452492**	**111260**	**556689**	**6334959**	**2673939**	**4340911**	**2565688**	**684607**	**-**	**3676**	**26720546**
Electricity plants	*6995826*	*111260*	*507551*	*5024660*	*2658495*	*4340912*	*2555485*	*407146*	*-*	*2831*	*22601335*
CHP plants	*2456666*	*-*	*49138*	*1310299*	*15444*	*-*	*10203*	*277461*	*-*	*845*	*4119211*
Heat generated - TJ	**7039840**	**15666**	**520221**	**6236761**	**25012**	**-**	**612997**	**1204293**	**28284**	**78887**	**15654789**
CHP plants	*6248229*	*31*	*171998*	*4202075*	*23961*	*-*	*66939*	*736219*	*809*	*27204*	*11449451*
Heat plants	*791611*	*15635*	*348223*	*2034686*	*1052*	*-*	*546058*	*468073*	*27475*	*51683*	*4205338*

- I. What is an energy balance
- II. Why we create energy balances
- III. How energy balances are calculated
- IV. IEA energy balance layout
- V. Uses of energy balances

IEA 2024. CC BY 4.0.

Question 1 – Go to www.menti.com and use the code 7841 9154

Is your country producing a national energy balance?

IEA 2024. CC BY 4.0.

I. What is an Energy Balance?

IEA 2024. CC BY 4.0.

Energy balances are a compact source of information

SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural Gas	Nuclear	Hydro	Geotherm. solar etc.	Biofuels & waste	Electricity	Heat	Total
Production	160001	176809	-	139092	29195	15627	14899	57002	-	69	592625
Imports	32711	94137	52082	41946	-	-	2689	1534	2689	0	225099
Exports	-34572	-93079	-54485	-43106	-	-	-2666	-1008	-2666	-0	-228915
Intl. marine bunkers	x	x	x	x	x	x	x	x	x	x	
Intl. aviation bunkers	x	x	x	x	x	x	x	x	x	x	
Stock changes	-1503	-1504	-1674	502	-	-	-	-14	-	-	-4194
TES	**156637**	**176364**	**-4077**	**138434**	**29195**	**15627**	**14922**	**57513**	**23**	**69**	**584616**
Transfers	-138	-10896	12319	-	-	-	-	-0	-	-	1285
Statistical differences	-2248	408	-994	-2341	-	-	1002	94	996	7	-4079
Electricity plants	-68148	-1514	-4918	-38796	-29002	-15627	69175	-5394	81355	-	-94224
CHP plants	-29914	-0	-547	-13626	-192	-	26107	-3454	14826	11421	-21626
Heat plants	-971	-18	-410	-2500	-1	-	4044	-575	-	4126	-431
Blast furnaces	-7754	-	-6	-2	-	-	-	-2	-	-	-7764
Gas works	-908	-	-119	277	-	-	-	-54	-	-	-805
Coke/pat. fuel/BKB plants	-4021	-	-83	-1	-	-	-	-5	-	-	-4110
Oil refineries	-	-165908	162673	-	-	-	-	-	-	-	-3236
Petrochemical plants	-	1440	-1438	-	-	-	-	-	-	-	2
Liquefaction plants	-901	888	-	-768	-	-	-	-	-	-	-782
Other transformation	-11	548	-26	-946	-	-	-35	-3804	-17	-18	-4274
Energy industry own use	-2865	-336	-8127	-12545	-	-	-10043	-625	-8212	-1831	-34541
Losses	-77	-288	-5	-1023	-	-	-7807	-10	-6976	-831	-9210
TFC	**38681**	**687**	**154240**	**66163**	**-**	**-**	**97364**	**43685**	**81996**	**12942**	**400819**
INDUSTRY	**31640**	**120**	**12382**	**25544**	**-**	**-**	**40492**	**10093**	**34172**	**6280**	**120270**
TRANSPORT	**38**	**1**	**94960**	**4669**	**-**	**-**	**1471**	**3812**	**1471**	**-**	**104951**
OTHER	**4766**	**1**	**17533**	**28527**	**-**	**-**	**55401**	**29780**	**46353**	**6663**	**136008**
NON-ENERGY USE	**2237**	**565**	**29366**	**7423**	**-**	**-**	**-**	**-**	**-**	**-**	**39590**

International Recommendations on Energy Statistics: "…Accounting **framework** for compilation of data on **all energy products entering, exiting, and used** within the national territory of a given **country** during a reference period."

IEA 2024. CC BY 4.0.

Energy balances are a compact source of information

SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural Gas	Nuclear	Hydro	Geotherm. solar etc.	Biofuels & waste	Electricity	Heat	Total
Production	160001	176809	-	139092	29195	15627	14899	57002	-	69	592625
Imports	32711	94137	52082	41946	-	-	2689	1534	2689	0	225099
Exports	[illegible]	[illegible]	[illegible]	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-0	-228915
Intl. marine bunkers	x	x	x	x	x	x	x	x	x	x	x
Intl. aviation bunkers	x	x	x	x	x	x	x	x	x	x	x
Stock changes	-1503	-1504	-1674	502	-	-	-	-14	-	-	-4194
TES	**156637**	**176364**	**-4077**	**138434**	**29195**	**15627**	**14922**	**57513**	**23**	**69**	**584616**
Transfers	-138	-10896	12319	-	-	-	-	0	-	-	1285
Statistical differences	-2248	408	-994	-2341	-	-	1002	-	996	7	-4079
Electricity plants	-68148	-1514	-4918	-38796	-29002	-15627	69175	-	81355	-	-94224
CHP plants	-29914	-0	-547	-13626	-192	-	26107	-	14826	11421	-21626
Heat plants	-971	-18	[illegible]	-2500	-1	-	4044	-	-	4126	-431
Blast furnaces	-7754	-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-2	-	-	-7764
Gas works	-908	-	119	277	-	-	-	-54	-	-	-805
Coke/pat. fuel/BKB plants	-4021	-	-83	[illegible]	[illegible]	[illegible]	-	-5	-	-	-4110
Oil refineries	-	-165908	[illegible]	-	-	-	-	-	-	-	-3236
Petrochemical plants	-	1440	-1438	-	-	-	-	-	-	-	2
Liquefaction plants	-901	888	-	-768	-	-	-		-	-	-782
Other transformation	-11	548	-26	-946	-	-	-35	-	-17	-18	-4274
Energy industry own use	-2865	-336	-8127	-12545	-	-	-10043	-	-8212	-1831	-34541
Losses	-77	-288	-5	-1023	-	-	-7807	-	-6976	-831	-9210
TFC	**38681**	**687**	**154240**	**66163**	**-**	**-**	**97364**	13496	**81996**	**12942**	**400819**
INDUSTRY	**31640**	**120**	**12382**	**25544**	**-**	**-**	**40492**	-	**34172**	**6280**	**120270**
TRANSPORT	**38**	**1**	**94960**	**4669**	**-**	**-**	**1471**	-	**1471**	**-**	**104951**
OTHER	**4766**	**1**	**17533**	**28527**	**-**	**-**	**55401**	**13496**	**46353**	**6663**	**136008**
NON-ENERGY USE	**2237**	**565**	**29366**	**7423**	**-**	**-**	**-**	-	**-**	**-**	**39590**

Supply

Transformation and energy industries own use

Final consumption

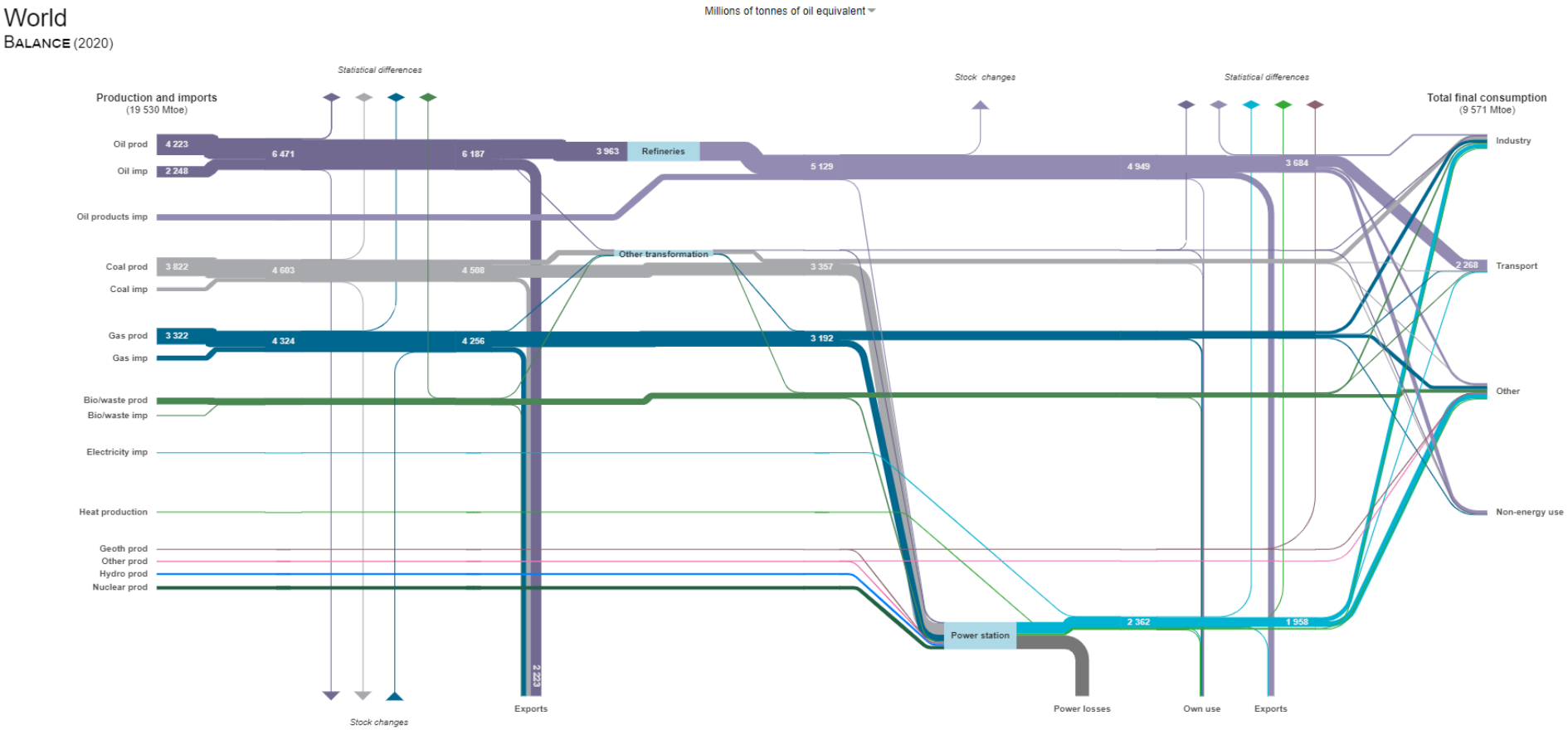
Comparable information for all products

Comparable energy units (TJ)

Global picture of energy situation in a country

IEA 2024. CC BY 4.0.

Energy balance can be depicted as a Sankey chart



IEA 2024. CC BY 4.0.

II. Why do we create energy balances?

IEA 2024. CC BY 4.0.

So we can compute and monitor:

- Total energy supply and consumption as well as patterns for the whole energy market
- Relative weight of different energy sources in the total mix
- Consumption shares across sectors of economic activity
- Energy intensity, dependence on energy imports and other socio-economic indicators
- Similarities or differences with other countries' energy systems

- Data quality (e.g. high statistical difference, efficiency in transformation sector as a quality indicator)

IEA 2024. CC BY 4.0.

III. How energy balances are calculated

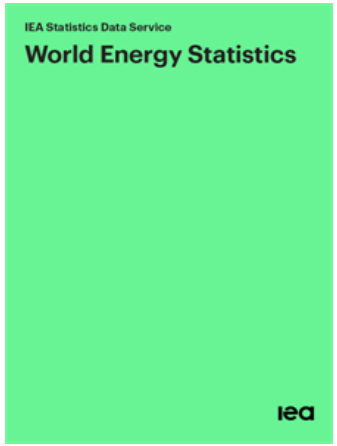
IEA 2024. CC BY 4.0.

Flow of data processing at the IEA

Annual Questionnaires
OR
National publications, websites

- Coal
- Oil
- Natural gas
- Renewables
- Electricity & Heat

Commodity statistics



Energy balances

IEA 2024. CC BY 4.0.

Question 2 - Go to www.menti.com and use the code 7841 9154

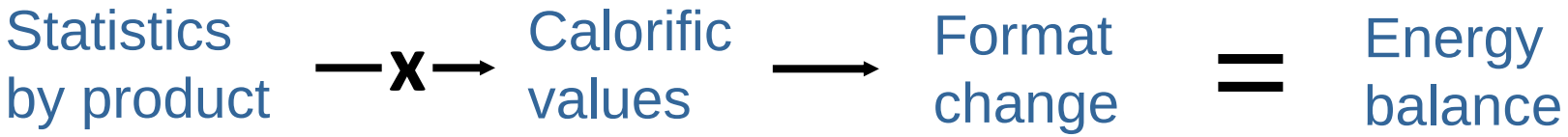
- To convert mass (*energy statistics*) to energy units (*energy balances*), what do we need?

  - **Density**
  - **Calorific value**
  - **Carbon content**

Typically in units of energy per mass **(kJ/kg)**

IEA 2024. CC BY 4.0.

From energy statistics to energy balance – How?



A calorific value

- is the amount of heat obtained from one unit (mass or volume) of the fuel and is the only way to convert a fuel quantity from **physical units** (mass or volume) into **energy units** (e.g. kJ).

IEA 2024. CC BY 4.0.

Calorific values – Key to data quality

Commodity balances	Bituminous coal kt	Product 2 m3	…
Production	100		
Import	20		
Export	40		
Supply	**80**		
Statistical differences	*0*		
Input to Electricity	50		
…			
Final consumption	30		
….			

Net Calorific Values	Bituminous coal TJ/kt	Pro… TJ/…
Production	23	
Import	25	
Export	22.5	
Input to Electricity	22	
…		
Final consumption	20	

Energy balance (excerpt)	Bituminous coal TJ	Product 2 TJ	…
Production	2300		
Import	500		
Export	900		
Supply	**1900**		
Statistical differences	*200*		
Input to Electricity	1100		
…			
Final consumption	600		
….			

Need to collect good data for **physical quantities** AND **calorific values**

IEA 2024. CC BY 4.0.

Energy balance methodological choices:

1. Common unit of account
2. Net vs. Gross calorific value approach
3. Calorific values by product
4. Primary energy form for energy transformations that do not involve combustion
5. 2 methods to calculate the primary energy equivalent: Physical energy content vs. Partial substitution method

IEA 2024. CC BY 4.0.

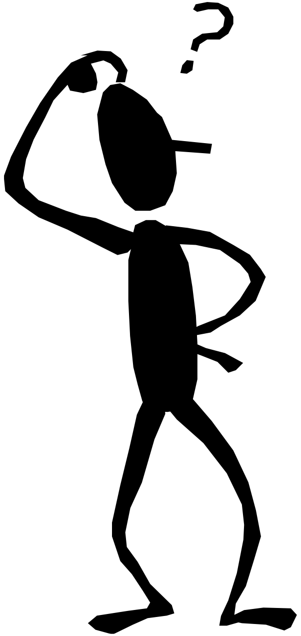
1. Which energy unit?

Btu

toe

Joules

Watt-hours



The IEA opted for:

Joules

World

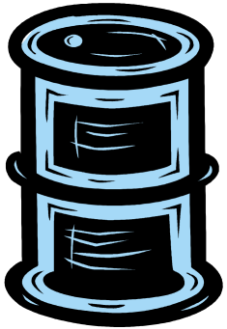
2019 - unit PJ	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geotherm., solar, wind, etc.	Biofuels and waste	Electricity	Heat	Total
Production	167549	190442	-	143639	30461	15195	13513	56539	-	95	617338
Imports	35644	102662	56858	42995	-	-	2589	1341	2589	0	242089
Exports	-37098	-102077	-60177	-44313	-	-	-2606	-1076	-2606	0	-247347
International marine bunkers	-	-	-	-	-	-	-	-	-	-	-
International aviation bunkers	-	-	-	-	-	-	-	-	-	-	-
Stock changes	-3720	-177	-167	-1537	-	-	-	9	-	-	-5591
TES	**162376**	**190851**	**-3486**	**140784**	**30461**	**15195**	**13496**	**56813**	**-17**	**96**	**606490**
Transfers	-104	-9823	11218	-	-	-	-	-	-	-	1291
Statistical differences	-1850	839	-107	-881	-	-	998	33	963	36	-968
Electricity plants	-72727	-1417	-5727	-38996	-30315	-15195	71105	-5156	81984	-	-98427
CHP plants	-29624	0	-575	-13993	-146	-	26012	-3364	14971	11182	-21690
Heat plants	-1042	-22	-359	-2552	-	-	4078	-540	-	4155	-437
Blast furnaces	-7902	-	-6	-1	-	-	-	-2	-	-	-7912
Gas works	-706	-	-120	254	-	-	-	-40	-	-	-612
Coke/pat. Fuel/BKB plants	-4138	-	-86	-1	-	-	-	-5	-	-	-4230
Oil refineries	-	-182111	178099	-	-	-	-	-	-	-	-4012
Petrochemical plants	-20	-	-	-	-	-	-	0	-	-	-20
Liquefaction plants	-953	892	-	-730	-	-	-	-	-	-	-791
Other transformation	-12	562	-25	-999	-	-	-33	-3637	-14	-19	-4144
Energy industry own use	-3433	-357	-8949	-13438	-	-	-10182	-680	-8392	-1790	-37039
Losses	-99	-317	-8	-1041	-	-	-8082	-8	-7244	-837	-9554
TFC	**39786**	**599**	**168375**	**68405**	**-**	**-**	**97392**	**43415**	**82252**	**12823**	**417973**
INDUSTRY	**32571**	**65**	**12208**	**25700**	**-**	**-**	**40540**	**9895**	**34439**	**6066**	**120979**
Iron and steel	13566	1	246	2607	-	-	5300	198	4734	566	21919
Chemical and petrochemical	2975	1	2462	6383	-	-	7578	103	4697	2881	19503
Non-ferrous metals	1171	0	152	720	-	-	4365	5	4123	242	6412
Non-metallic minerals	8616	0	1616	2674	-	-	2414	490	2281	133	15810
Transport equipment	33	-	82	565	-	-	1274	1	1121	153	1955
Machinery	289	-	197	1357	-	-	4035	6	3877	158	5884
Mining and quarrying	285	-	1005	501	-	-	1571	9	1478	93	3371
Food and tobacco	885	0	340	2062	-	-	2714	1752	2182	532	7753
Paper, pulp and print	483	0	142	980	-	-	2202	2648	1664	539	6457
Wood and wood products	15	-	80	129	-	-	535	451	431	104	1210
Construction	152	0	1530	327	-	-	803	289	750	52	3100
Textile and leather	237	0	86	478	-	-	1617	79	1209	408	2498
Not-specified	3862	62	4270	6917	-	-	6132	3864	5893	203	25106
TRANSPORT	**40**	**0**	**110471**	**4963**	**0**	**0**	**1510**	**3987**	**1510**	**0**	**120972**
Domestic aviation	-	-	5817	-	-	-	-	-	-	-	5817
Road	-	-	83071	2231	-	-	292	3948	292	-	89541
Rail	2	-	1377	-	-	-	1027	23	1027	-	2430
Pipeline transport	-	0	13	2694	-	-	123	-	123	-	2830
Domestic navigation	-	-	2414	3	-	-	-	6	-	-	2423
Non-specified	38	0	210	27	-	-	68	0	68	-	344
OTHER	**5101**	**1**	**17752**	**29591**	**-**	**-**	**55342**	**29533**	**46302**	**6757**	**137319**
Residential	2530	-	8933	20286	-	-	28236	27794	21859	4613	87780
Commercial and public servic	1115	-	3155	8723	-	-	19557	1109	17458	1722	33659
Agriculture/forestry	558	0	4488	438	-	-	2907	536	2681	141	8928
Fishing	0	-	263	2	-	-	33	1	28	2	299
Non-specified	897	0	912	142	-	-	4609	93	4276	278	6653
NON-ENERGY USE	**2074**	**533**	**27945**	**8152**	**-**	**-**	**-**	**-**	**-**	**-**	**38703**
in industry/transformat/energ	2065	533	25914	8152	-	-	-	-	-	-	36664
of which: feedstocks	*142*	*530*	*19096*	*8121*	-	-	-	-	-	-	*27891*
in transport	-	-	467	-	-	-	-	-	-	-	467
in other	9	0	1563	-	-	-	-	-	-	-	1572
Electricity and Heat Output											
Electr. generated - GWh	**9914448**	**113259**	**633912**	**6346009**	**2789694**	**4220733**	**2262594**	**655310**	**-**	**3916**	**26935958**
Electricity plants	*7440453*	*113259*	*583822*	*5003184*	*2778655*	*4220733*	*2251979*	*384285*	-	*3061*	*22776370*
CHP plants	*2473995*	-	*50090*	*1342824*	*11039*	-	*10615*	*271025*	-	*854*	*4159588*
Heat generated - TJ	**6853127**	**17900**	**480296**	**6284406**	**25647**	**-**	**635391**	**1172748**	**27835**	**104608**	**15601957**
CHP plants	*6001382*	*35*	*179890*	*4204503*	*25647*	-	*83489*	*732696*	*369*	*45372*	*1045373*
Heat plants	*851746*	*17865*	*300406*	*2079902*	-	-	*551902*	*439851*	*27466*	*59236*	*16665812*

IEA 2024. CC BY 4.0.

2. Net vs. Gross calorific values?

The difference between NCV and GCV is the latent heat of vaporisation of the water produced during combustion

5%



5%

10%

IEA uses Net Calorific Values (NCVs)

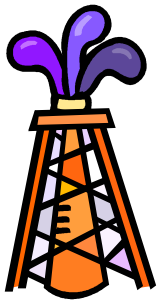
IEA 2024. CC BY 4.0.

3. Choice of calorific values by product

For Coal, Natural Gas, Crude Oil and Oil products

Calorific values vary:

- over **time** (i.e. vary from year to year)
- between **commodities** (i.e. coal ≠ oil products)
- from **country** to country
- from **flow** to flow (in some cases, i.e. trade ≠ consumption)



IEA 2024. CC BY 4.0.

4a. How to determine primary equivalents for non-combustible sources?

- **Combustible sources** have measurable inputs in the context of a transformation (i.e. natural gas input for gas-fired generation)

- But how about non-combustible sources like **nuclear, geothermal, solar, wind, wave**?

  The output is clear (electricity, heat), but how much is the related amount of primary energy?

	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geotherm., solar, wind, etc.	Biofuels and waste	Electricity	Heat	Total
Electricity plants	-72727	-1417	-5727	-38996	?	?	?	-5156	81984	-	-98427

IEA 2024. CC BY 4.0.

4b. What is the primary energy form for non-combustible sources?

- We need to define the form of primary energy to be considered in the supply part for the following sources:

Heat for:

- nuclear electricity
- geothermal (heat and electricity)
- solar thermal (heat and electricity)

Electricity for:

- hydro
- wind
- wave/ocean
- solar photovoltaics

→ **First energy form downstream** for which **multiple energy uses** are practical

IEA 2024. CC BY 4.0.

5a. Method for calculating the primary energy equivalent (non-combustible sources)

IEA opted for:
Physical energy content method

- **Primary energy equivalent** refers to the physical energy content of the primary energy source chosen in the previous step.
- **Implied efficiencies are:**

Heat as primary energy form

- 33% nuclear for electricity generation
- Geothermal { 10% for electricity generation; 50% for heat generation
- Solar thermal { 33% for electricity generation; 100% for heat generation

Electricity as primary energy form

- 100% hydro
- 100% wind
- 100% solar-PV

IEA 2024. CC BY 4.0.

5b. Examples: primary energy equivalent calculation

Primary energy equivalent	Implied Efficiencies		Energy Outputs
1 000 TJ Wind	100%	Wind	1 000 TJ electricity
3 030 TJ Nuclear	33%	Nuclear	1 000 TJ electricity
10 000 TJ Geothermal	10%	Geothermal	1 000 TJ electricity
2 000 TJ Geothermal	50%	Geothermal	1 000 TJ heat

Primary energy equivalent = Energy outputs ÷ Implied efficiencies

IEA 2024. CC BY 4.0.

Question 3 – Go to www.menti.com and use the code 7841 9154

What is the primary energy equivalent for solar thermal with 1000 TJ of **electricity** produced?

IEA 2024. CC BY 4.0.

IV. IEA energy balance layout

IEA 2024. CC BY 4.0.

Key structural features of the IEA energy balance

SUPPLY AND CONSUMPTION	Coal	Crude oil	Oil products	Natural Gas	Nuclear	Hydro	Geotherm. solar etc.	Biofuels & waste	Electricity	Heat	Total
Production	160001	176809	-	139092	29195	15627	14899	57002	-	69	592625
Imports	32711	94137	52082	41					2689	0	225099
Exports	-34572	-93079	-54485	-43					-2666	-0	-228915
Intl. marine bunkers	x	x	x	x					x	x	
Intl. aviation bunkers	x	x	x	x					x	x	
Stock changes	-1503	-1504	-1674						-	-	-4194
TES	**156637**	**176364**	**-4077**	**138**					**23**	**69**	**584616**
Transfers	-138	-10896	12319						-	-	1285
Statistical differences	-2248	408	-994	-2341	-	-	1002	94	996	7	-4079
Electricity plants	-68148	-1514	-4918	-38796	-29002	-15627	69175	-5394	81355	-	-94224
CHP plants	-29914	-0	-547	-13626	-192	-	26107	-3454	14826	11421	-21626
Heat plants	-971	-18	-410	-2500	-1	-	-4044	-575	-	4126	-431
Blast furnaces	-7754	-	-6						-	-	-7764
Gas works	-908	-	-119						-	-	-805
Coke/pat. fuel/BKB plants	-4021	-	-83						-	-	-4110
Oil refineries	-	-165908	162673						-	-	-3236
Petrochemical plants	-	1440	-1438						-	-	2
Liquefaction plants	-901	888	-						-	-	-782
Other transformation	-11	548	-26						-17	-18	-4274
Energy industry own use	-2865	-336	-8127	-					-8212	-1831	-34541
Losses	-77	-288	-5						-6976	-831	-9210
TFC	**38681**	**687**	**154240**						**81996**	**12942**	**400819**
INDUSTRY	**31640**	**120**	**12382**	**25544**	**-**	**-**	**40492**	**10093**	**34172**	**6280**	**120270**
TRANSPORT	**38**	**1**	**94960**	**4669**	**-**	**-**	**1471**	**812**	**1471**	**-**	**104951**
OTHER	**4766**	**1**	**17533**	**28527**	**-**	**-**	**55401**	**780**	**46353**	**6663**	**136008**
NON-ENERGY USE	**2237**	**565**	**29366**	**7423**	**-**	**-**	**-**	**-**	**-**	**-**	**39590**

Supply

- Refined products and electricity are secondary energy products.
- Production equals to zero to avoid double counting

Transformation

- Negative value represents an input, positive value represents an output
- Transformation losses appear in the Total columns as negative figures

TES
Total Energy Supply

IEA 2024. CC BY 4.0.

V. Uses of energy balances

IEA 2024. CC BY 4.0.

Using the energy balance with economic indicators

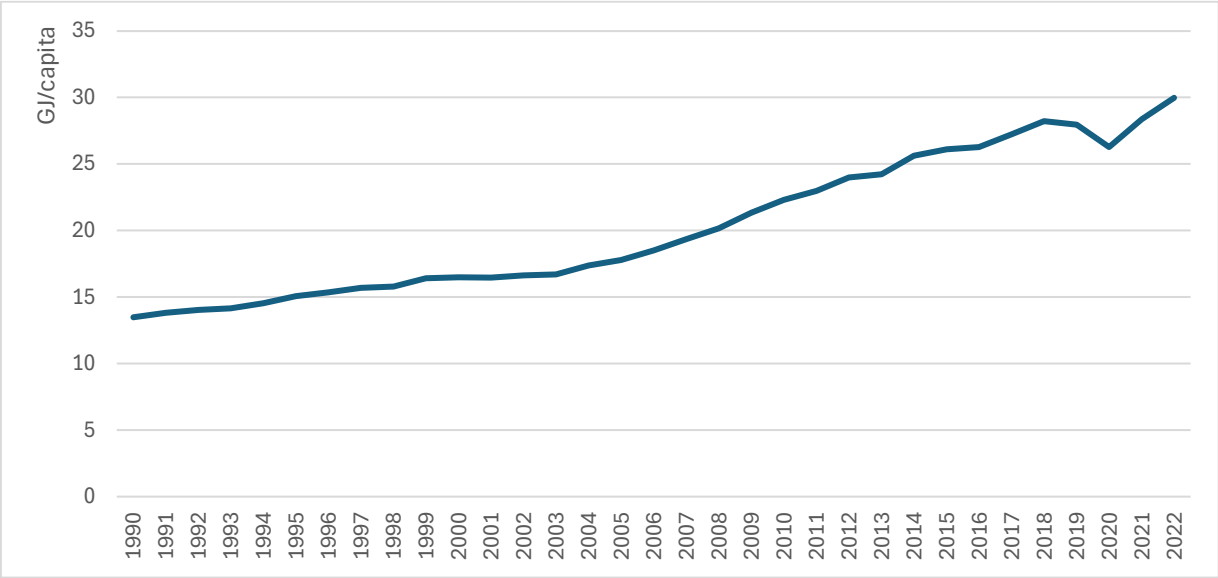
- Population
- GDP

- Energy Production/TES
- Net Oil Imports/GDP
- TES/GDP
- TES/Population
- Oil Supply/GDP
- Oil Supply/Population
- Electricity Consumption/GDP
- Electricity Consumption/Population

IEA 2024. CC BY 4.0.

Developing high-level indicators

Total energy supply (TES) per capita: India



- TES per capita
- TES per GDP
- TES per GDP (PPP)
- Net energy imports
- Total CO_2 emissions
- CO_2 emissions per capita
- CO_2 emissions per GDP
- CO_2 emissions per GDP (PPP)
- CO_2 intensity (TES/ CO_2)
- Electricity final consumption

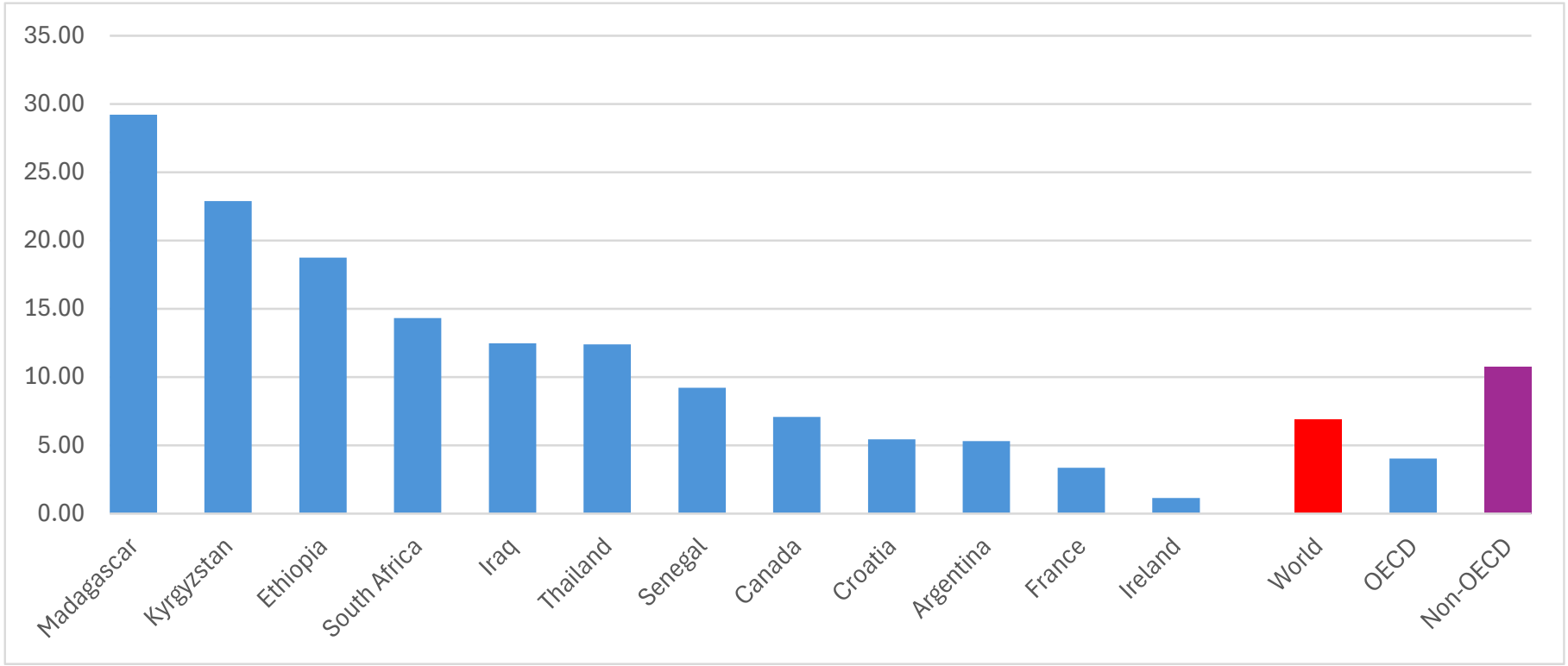
www.iea.org/statistics/

Coupling **energy balances data** with various **macro-economic variables**

Source:
IEA, World Energy Balances, 2024

IEA 2024. CC BY 4.0.

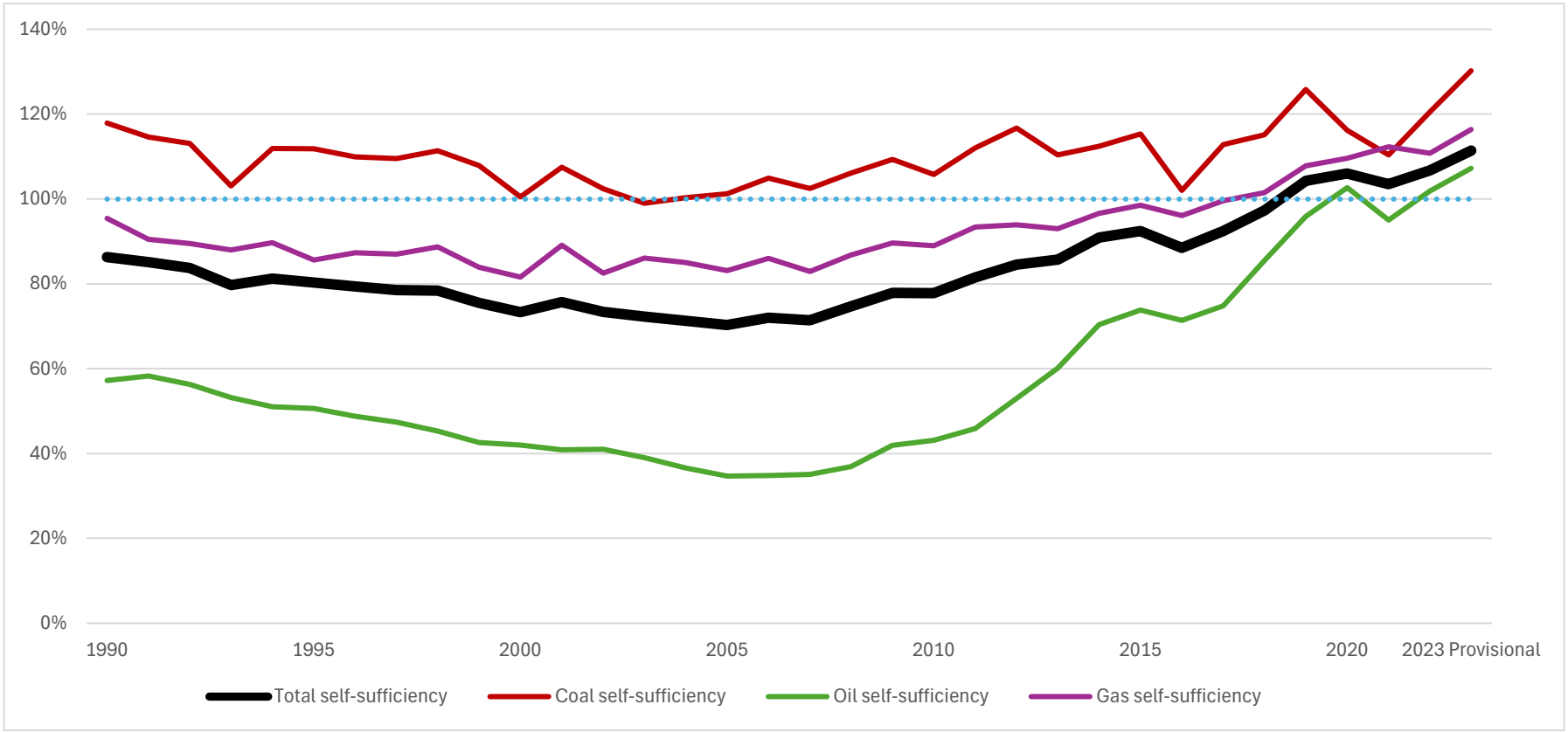
TES/GDP, 2022 (GJ/thousand 2015 USD)



Source:
IEA, World Energy Balances, 2024

IEA 2024. CC BY 4.0.

Self-sufficiency – Production/TES (Example: United States)



Source:
IEA, World Energy Balances, 2024

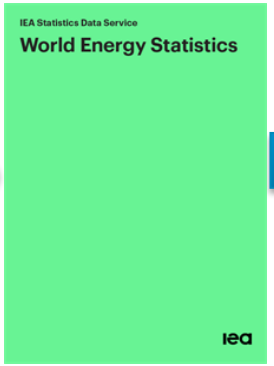
IEA 2024. CC BY 4.0.

Using balances to estimate CO_2 emissions

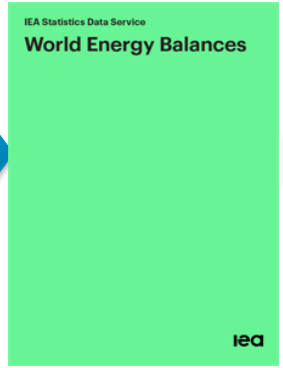
Annual Questionnaires
OR
National publications, websites

- Coal
- Oil
- Natural gas
- Renewables
- Electricity & Heat

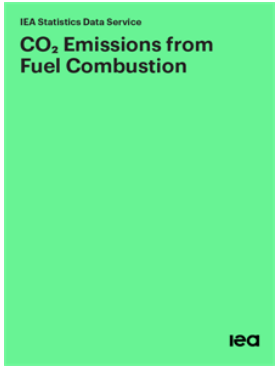
Commodity statistics



Energy balances



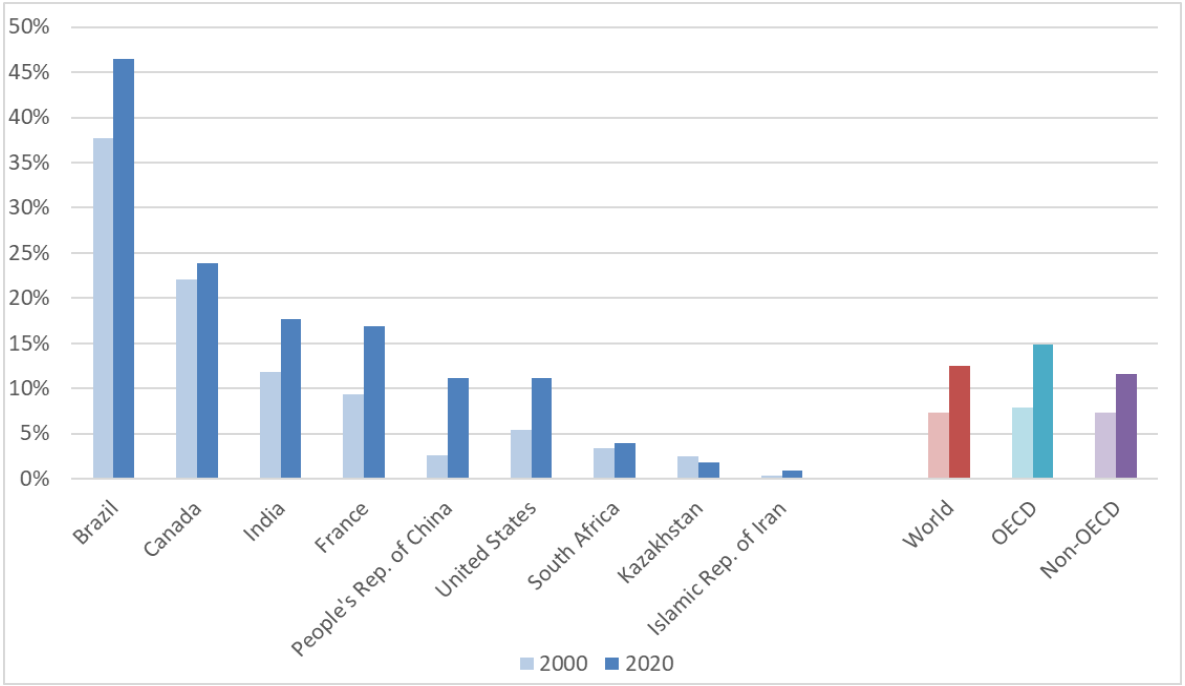
CO_2 emissions



IEA 2024. CC BY 4.0.

Tracking official SDG targets

Modern renewables share in TFEC, 2000 - 2020



Derived from IEA's Energy Balances:

- **SDG 7.2** on renewable energy
- **SDG 7.3** on energy efficiency
- **SDG 9.4** on emissions per value added

Further targets monitored by IEA:

- **SDG 7.1** on access to electricity
- **SDG 7.1** on access to clean cooking
- **SDG 12.c** on rationalising fossil-fuel subsidies

Source:
IEA, World Energy Balances, 2022

https://www.iea.org/data-and-statistics/data-product/sdg7-database

IEA 2024. CC BY 4.0.

Conclusion: Good Energy Balances…

- … require good quality statistics (physical data & calorific values)
- … are a compact source of energy information
- … enable accurate checks of energy statistics (i.e. efficiencies)
- … constitute the foundation for basic energy indicators, energy accounts and for CO_2 emissions estimates

BALANCES@iea.org

IEA 2024. CC BY 4.0.

How does IEA disseminate energy balances data?

WORLD ENERGY BALANCES

Free highlights, online data service:
https://www.iea.org/data-and-statistics/data-product/world-energy-balances

WORLD ENERGY STATISTICS

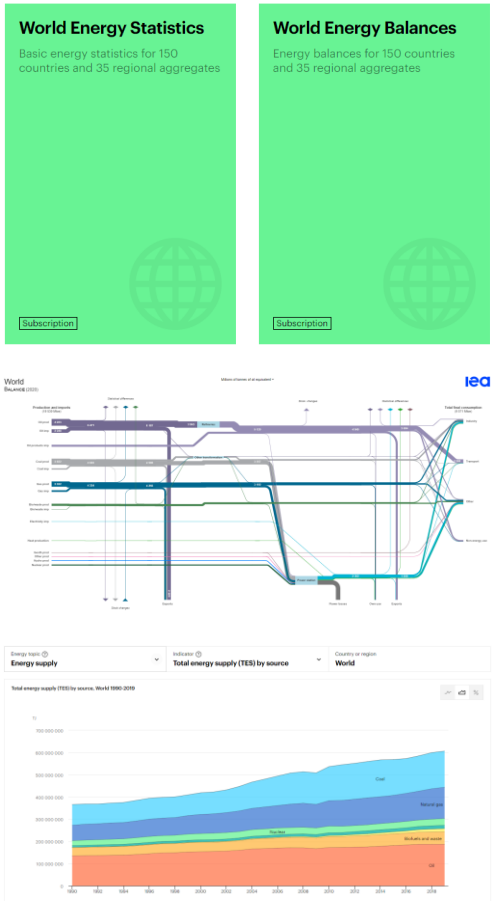
Online data service:
https://www.iea.org/data-and-statistics/data-product/world-energy-statistics

SANKEY (returning soon)

https://www.iea.org/data-and-statistics/data-tools/energy-sankey

ENERGY STATISTICS DATA BROWSER

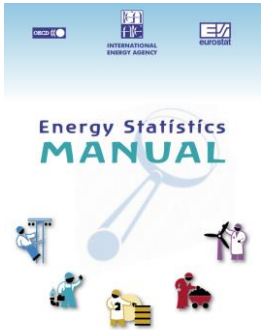
https://www.iea.org/data-and-statistics/data-tools/energy-statistics-data-browser



IEA 2024. CC BY 4.0.

Learn more about energy statistics

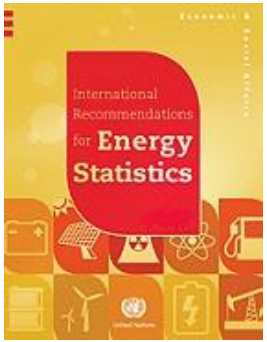
Energy Statistics Manual



- Available in 10 languages
- Data collection methodologies
- Consistent with the IRES framework

Click here

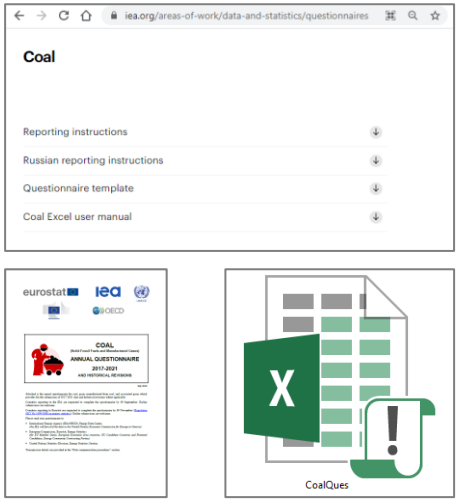
United Nations' International Recommendations for Energy Statistics (IRES)



- Available in 6 languages
- International framework for energy statistics

Click here

IEA Statistics website



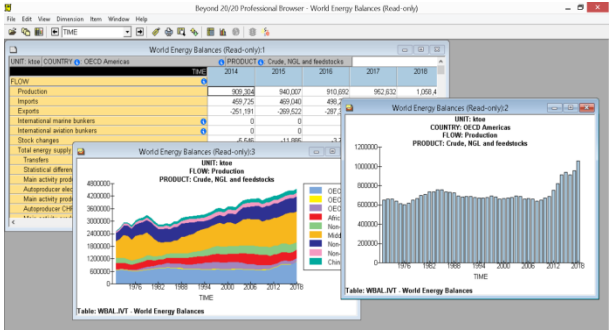
- Questionnaires
- Reporting instructions

Click here

IEA 2024. CC BY 4.0.

Beyond data collection

Data services for purchase



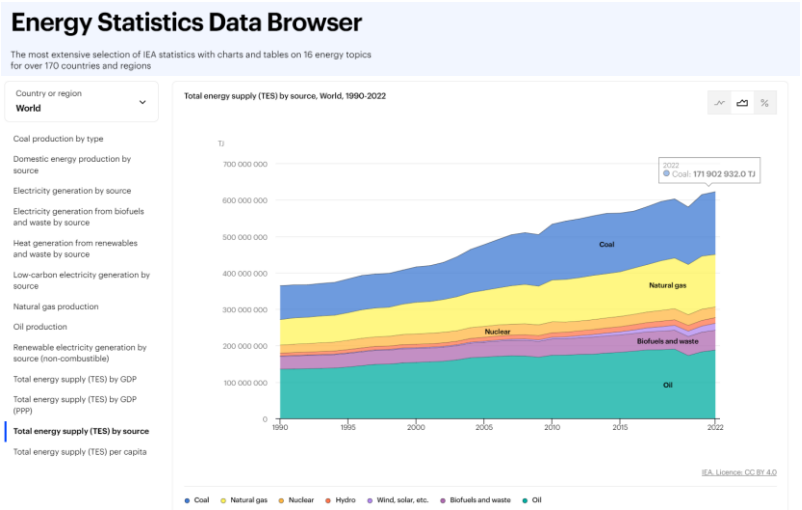
[Energy Carbon Tracker]
[World Energy Balances & Statistics]
[Monthly Oil Data Service]
[Oil Information]
[Natural Gas Information]
[Coal Information]
[Electricity Information]
[Renewables Information]
[Energy Efficiency Indicators]
[Greenhouse gas emissions from energy]
[Energy Prices]
[Projections: Energy Policies of IEA Countries]

Free products

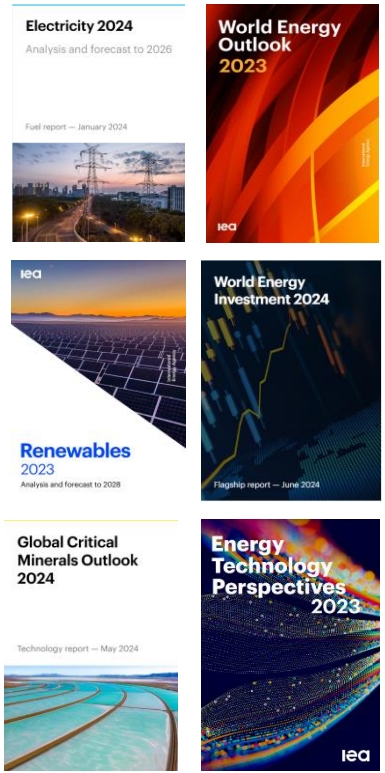
[Real-Time Electricity Tracker]
[Data and Statistics data browser]
[Energy Statistics Roadmap]
[Weather for Energy Tracker]
[Monthly OECD oil], [gas] and [electricity statistics]

Annual highlights

[Energy balance], [CO_2 emissions], [Energy Technology RD&D], [Efficiency indicators], [Gas Trade Flows]



Data support for the Agency



IEA 2024. CC BY 4.0.

Thank you!
Any questions?

BALANCES@iea.org

IEA 2024. CC BY 4.0.