



Energy balances as a first tool for informing policies:

Introduction to the energy balances

Francesco Mattion

Paris, 21 May 2019



IEA #energyefficientworld

The importance of energy balances

- How to read an energy balance?
- Aggregated indicators from the energy balances
- Example of applications of aggregated indicators

Practical exercise

The importance of energy balances: bringing all information together

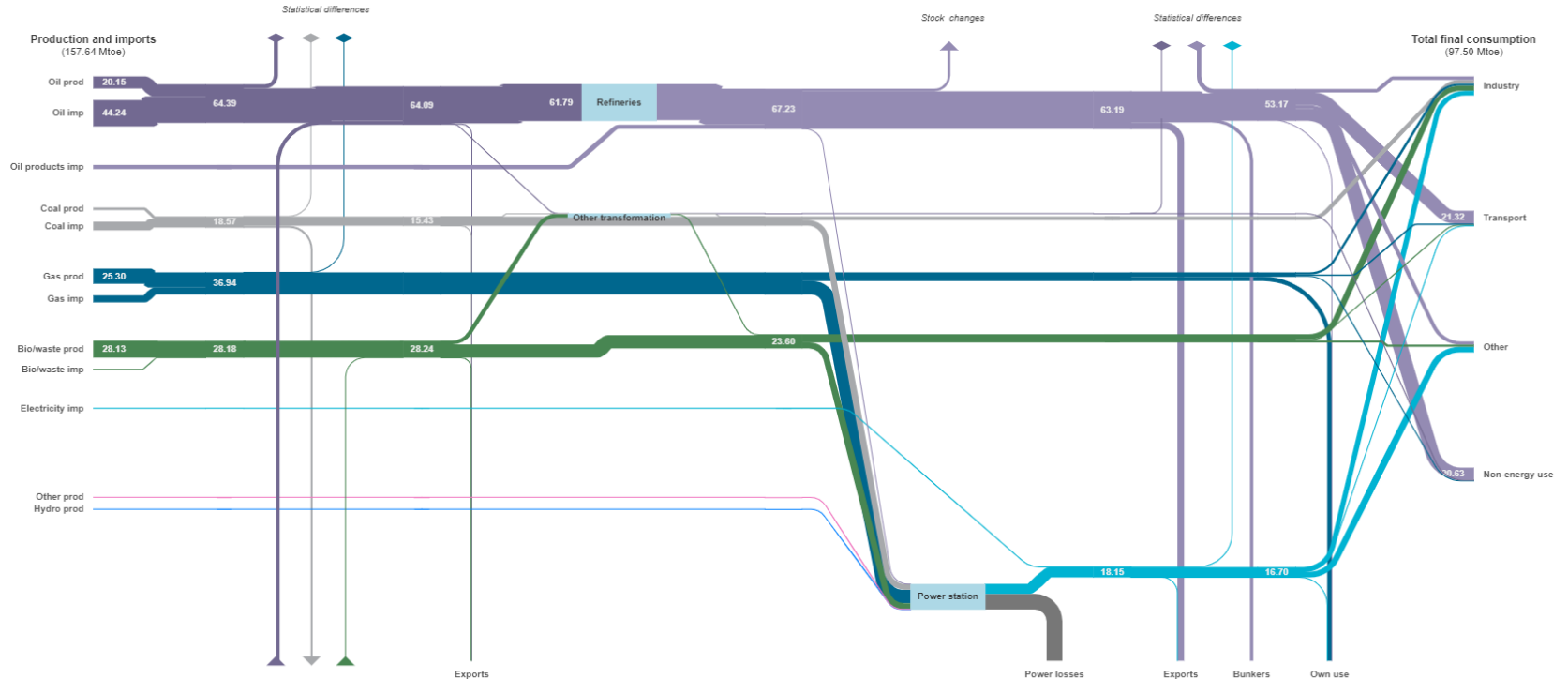


“...An accounting **framework** for compilation of data on **all energy products entering, exiting, and used** within the **national territory** of a given **country** during a reference period.”

The complete picture – Sankey diagram example of energy balance

Thailand
BALANCE (2016)

Millions of tonnes of oil equivalent



“Energy balances” are the starting point to develop energy indicators

- **To understand overall energy use in country**, from supply, to transformation and final consumption sectors.
- **To estimate high-level indicators and CO₂ emissions** from the energy sector
- **To assess data completeness and check quality** of the various energy commodity balances

How to read an energy balance?

The energy balance table

World

2016

Million tonnes of oil equivalent											
SUPPLY AND CONSUMPTION	Coal ¹	Crude oil ²	Oil products	Natural gas	Nuclear	Hydro	Geotherm./ Solar/ etc.	Biofuels/ Waste	Electricity	Heat	Total
Production	3657.19	4473.27	-	3032.41	679.65	349.22	225.63	1344.87	-	1.76	13763.99
Imports	795.23	2379.32	1329.40	915.52	-	-	-	23.92	62.11	0.01	5505.50
Exports	-833.43	-2354.63	-1414.63	-932.53	-	-	-	-19.44	-62.25	-0.01	-5616.91
Stock changes	111.90	-15.32	-7.21	19.55	-	-	-	-0.06	-	-	108.86
TPES	3730.89	4482.63	-92.43	3034.95	679.65	349.22	225.63	1349.29	-0.14	1.77	13761.45
Transfers	-1.36	-233.00	262.09	-	-	-	-	-	-	-	27.73
Statistical differences	28.63	11.25	14.35	-11.26	-	-	0.09	0.84	-1.14	-0.35	42.41
Electricity plants	-1672.04	-40.48	-178.55	-868.18	-672.06	-349.22	-177.96	-120.97	1811.30	-0.72	-2268.88
CHP plants	-623.84	-0.01	-17.99	-314.57	-7.59	-	-2.56	-60.58	335.99	239.30	-451.86
Heat plants	-23.38	-0.83	-10.95	-61.70	-	-	-1.56	-13.13	-0.46	102.63	-9.39
Blast furnaces	-207.69	-	-0.05	-0.01	-	-	-	-0.04	-	-	-207.78
Gas works	-13.32	-	-2.17	5.42	-	-	-	-0.27	-	-	-10.34
Coke/pat.fuel/BKB/PB plants	-89.82	-	-2.32	-0.03	-	-	-	-0.12	-	-	-92.29
Oil refineries	-	-4246.76	4165.65	-	-	-	-	-	-	-	-81.11
Petrochemical plants	-	35.90	-35.37	-	-	-	-	-	-	-	0.53
Liquefaction plants	-12.08	15.16	-	-16.47	-	-	-	-	-	-	-13.40
Other transformation	-0.30	10.75	-0.54	-13.01	-	-	-	-90.54	-	-0.68	-94.32
Energy industry own use	-75.28	-11.24	-208.00	-296.17	-	-	-0.00	-13.46	-181.96	-36.50	-822.61
Losses	-4.91	-8.69	-0.47	-18.71	-	-	-0.01	-0.14	-169.65	-22.26	-224.84
TFC	1035.50	14.68	3893.25	1440.26	-	-	43.63	1050.88	1793.94	283.18	9555.32
Industry	826.95	6.66	299.71	537.77	-	-	0.92	198.33	746.69	135.57	2752.60
Transport	0.07	0.01	2533.20	101.89	-	-	-	81.97	30.73	-	2747.87
Residential	72.73	-	209.30	431.24	-	-	31.64	728.60	488.44	99.20	2061.15
Services	33.90	-	85.72	187.45	-	-	7.88	28.28	395.52	36.99	775.73
Agriculture/Forestry	16.08	0.01	104.20	9.66	-	-	2.07	9.84	52.79	3.21	197.87
Fishing	0.00	-	5.68	0.06	-	-	0.05	0.01	0.55	0.05	6.41
Non-specified other	30.08	0.01	18.27	3.42	-	-	1.06	3.84	79.21	8.16	144.05
Non-energy use	55.70	8.00	637.17	168.78	-	-	-	-	-	-	869.64

- Columns present the "commodity balances" for all products
- All data are comparable thanks to a common energy unit
- Total energy can be defined

Source: IEA 2018, World Energy Balances

➤ How to convert mass to energy units?

A. Density

B. Calorific value

C. Carbon content



➤ How to convert mass to energy units?

A. Density

B. Calorific value

C. Carbon content



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

Understanding the main energy flows

World

2016

Million tonnes of oil equivalent

SUPPLY AND CONSUMPTION	Coal ¹	Crude oil ²	Oil products	Natural gas	Nuclear	Hydro	Geotherm./ Solar/ etc.	Biofuels/ Waste	Electricity	Heat	Total
Production	3657.19	4473.27	-	3032.41	679.65	349.22	225.63	1344.87	-	1.76	13763.99
Imports	795.23	2379.32	1329.40	915.52	-	-	-	23.92	62.11	0.01	5505.50
Exports	-833.43	-2354.63	-1414.63	-932.53	-	-	-	-19.44	-62.25	-0.01	-5616.91
Stock changes	111.90	-15.32	-7.21	-19.55	-	-	-	-0.06	-	-	108.86
TPES											761.45
Transfers											27.73
Statistical differences											42.41
Electricity plants											268.88
CHP plants											451.86
Heat plants											-9.39
Blast furnaces	-207.69	-	-0.05	-0.01	-	-	-	-0.04	-	-	-207.78
Gas works	-13.32	-	-2.17	5.42	-	-	-	-0.27	-	-	-10.34
Coke/pat.fuel/BKB/PB plants	-89.82	-	-2.32	-0.03	-	-	-	-0.12	-	-	-92.29
Oil refineries	-	-4246.76	4165.65	-	-	-	-	-	-	-	-81.11
Petrochemical plants	-	35.90	-35.37	-	-	-	-	-	-	-	0.53
Liquefaction plants	-12.08	15.16	-	-16.47	-	-	-	-	-	-	-13.40
Other transformation	-0.30	10.75	-0.54	-13.01	-	-	-	-90.54	-	-0.68	-94.32
Energy industry own use											822.61
Losses											224.84
TFC											555.32
Industry											2752.60
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Residential	72.73	-	209.30	431.24	-	-	31.64	728.60	488.44	99.20	2061.15
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Non-energy use	55.70	8.00	637.17	168.78	-	-	-	-	-	-	869.64

Supply

Transformation & own use

Final consumption

Rows present energy flows across energy products

Three main “blocks” of flows

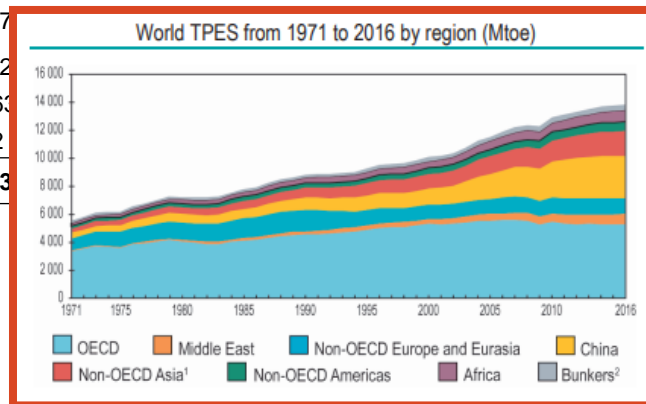
1: Energy supply

World

2016

Million tonnes of oil equivalent

SUPPLY	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geotherm./Solar/etc.	Biofuels/Waste	Electricity	Heat	Total
Production	3657.19	4473.27						1344.87	-	1.76	13763.99
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Stock changes	111.90	-15.32						-0.06	-	-	108.86
TPES	3730.89	4482.63						1349.29	-0.14	1.77	13761.45



Source: IEA 2018, World Energy Balances; IEA 2018, Key World Energy Statistics

“High-level” information: **TPES, Totals, etc...**

2: Transformation and own use

	Coal and peat	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geothermal, solar, etc.	Biofuels and waste	Electricity	Heat	Total*
Electricity plants	-355445	0	-31163	-119138	-20839	-27438	-31647	-21908	231911	0	-375667
CHP plants	-9940	0	-360	-178	0	0	0	0	3536	1068	-5875
Heat plants	0							0	0	0	0
Gas works	-30							0	0	0	-30
Oil refineries	0	-508585	501625	0	0	0	0	0	0	0	-6960
Coal transformation	-18358	0	0	0	0	0	0	0	0	0	-18358
Liquefaction plants	0	465	0	862	0	0	0	0	0	0	-397
Other transformation	0	0						0	-16141	0	-16190
Energy industry		-628								-65	-62651
Losses		-200								-33	-36890

Transforming energy sources

Input
(coal)



Output
(electricity)

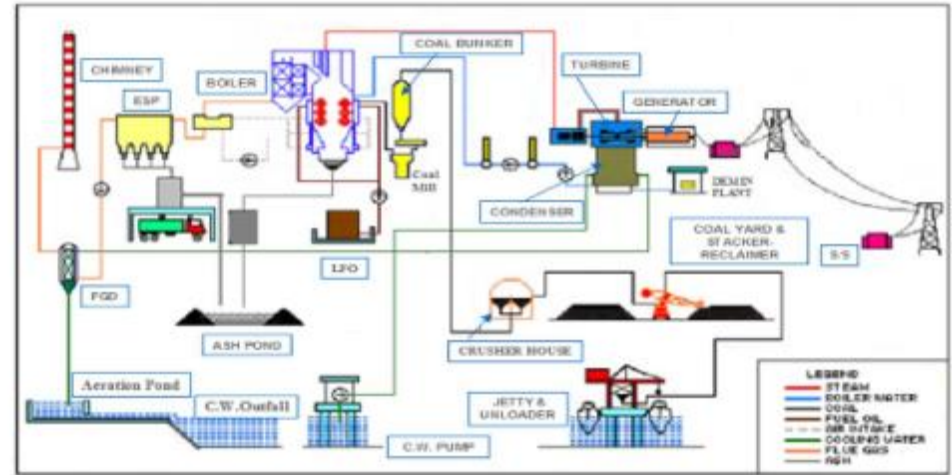
The concept of transformation efficiency = output / input

➤ What is the average efficiency for a **coal electricity-only** power plant?

A. 37%

B. 52%

C. 65%



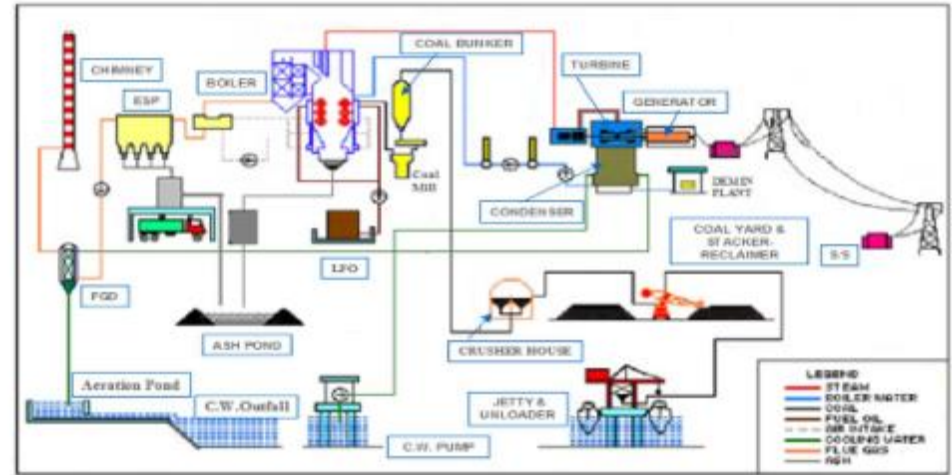
Source: IEA, World Energy Balances, 2018

➤ What is the average efficiency for a **coal electricity-only** power plant?

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Source: IEA, World Energy Balances, 2018

3: Final consumption

World

2016

Million tonnes of oil equivalent

FINAL CONSUMPTION	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Geother m./Solar/ etc.	Biofuels/ Waste	Electricity	Heat	Total
TFC	1035.50	14.68	3893.25	1440.26	-	-	43.63	1050.88	1793.94	283.18	9555.32
Industry	826.95	6.66	299.71	537.77	-	-	0.92	198.33	746.69	135.57	2752.60
Transport	0.07	0.01	2533.20	101.89	-	-	-	81.97	30.73	-	2747.87
Residential	72.73	-	209.30	431.24	-	-	31.64	728.60	488.44	99.20	2061.15
Services	33.90	-	85.72	187.45	-	-	7.88	28.28	395.52	36.99	775.73
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Fishing	0.00	-	5.68	0.06	-	-	0.05	0.01	0.55	0.05	6.41
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Non-energy use	55.70	8.00	637.17	168.78	-	-	-	-	-	-	869.64

Delivery of energy products to all final consumers (sectors)

➤ What is the largest energy-consuming sector globally?

- **Buildings**



- **Transport**

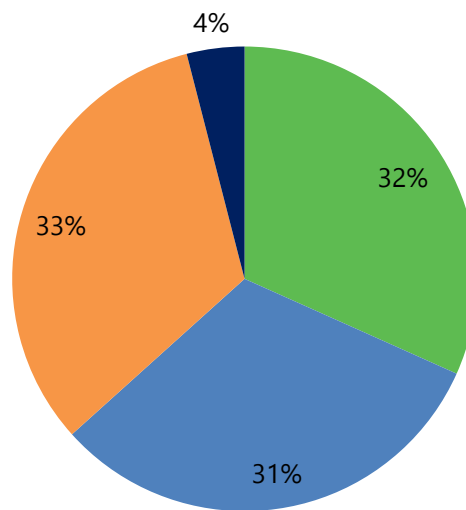


- **Industry**



➤ What is the largest energy-consuming* sector globally?

- **Buildings**
- **Transport**
- **Industry**



** Total Final Consumption
excluding non-energy uses*

- Industry
- Transport
- Buildings
- Other

Source: IEA, World Energy Balances, 2018

Aggregated indicators from the energy balances

From energy balances we derive high-level information

World

2016

Million tonnes of oil equivalent

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Blast furnaces	-207.69	-	-0.05	-0.01	-	-	-	-	-	-	-
Gas works	-13.32	-	-2.17	5.42	-	-	-	-	-	-	-
Coke/pat.fuel/BKB/PB plants	-89.82	-	-2.32	-0.03	-	-	-	-	-	-	-
Oil refineries	-	-4246.76	4165.65	-	-	-	-	-	-	-	-
Petrochemical plants	-	35.90	-35.37	-	-	-	-	-	-	-	0.53
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Residential	72.73	-	209.30	431.24	-	-	31.64	728.11	-	-	728.11
Services	33.90	-	85.72	187.45	-	-	7.88	28.11	-	-	28.11
Agriculture/Forestry	16.08	0.01	104.20	9.66	-	-	2.07	9.74	-	-	9.74
Fishing	0.00	-	5.68	0.06	-	-	0.05	0.05	-	-	0.05
Non-specified other	30.08	0.01	18.27	3.42	-	-	1.06	3.54	-	-	3.54
Non-energy use	55.70	8.00	637.17	168.78	-	-	-	-	-	-	869.64

Supply

Energy intensity,
Self-sufficiency ...

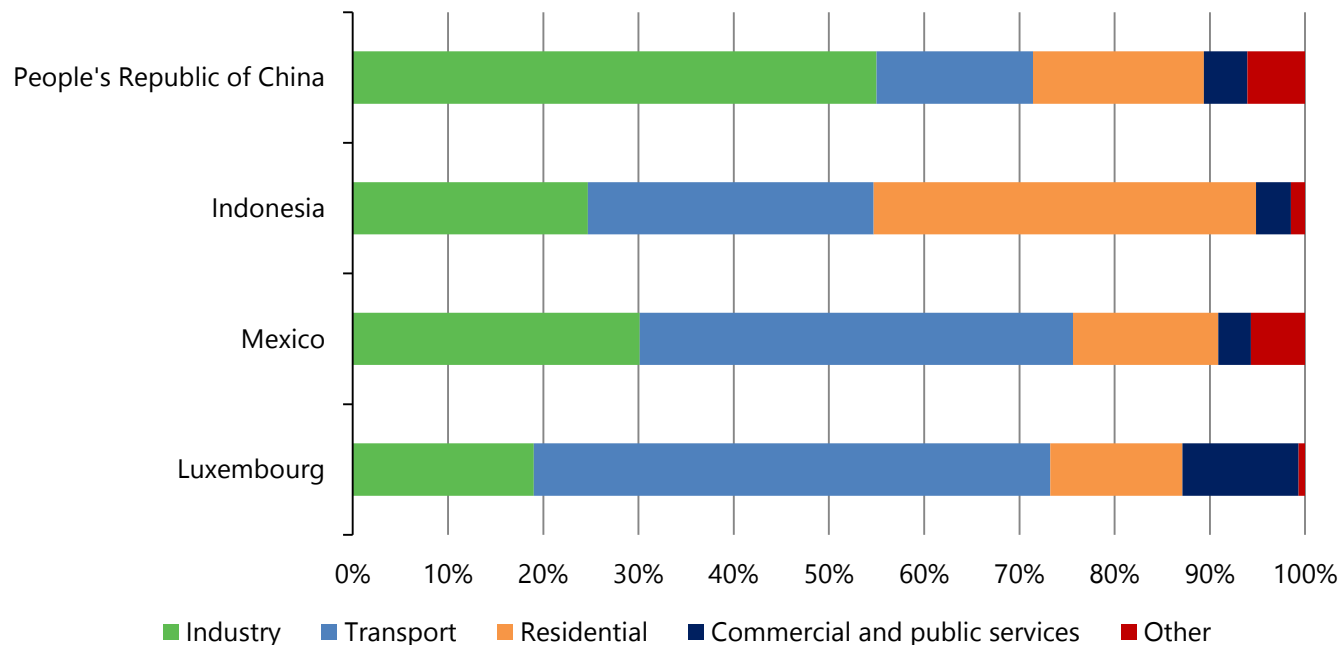
Transformation

Efficiencies of
transformation sector

Final
consumption

Shares of energy
consumption by sector

...understand the shares of sectors in total final consumption



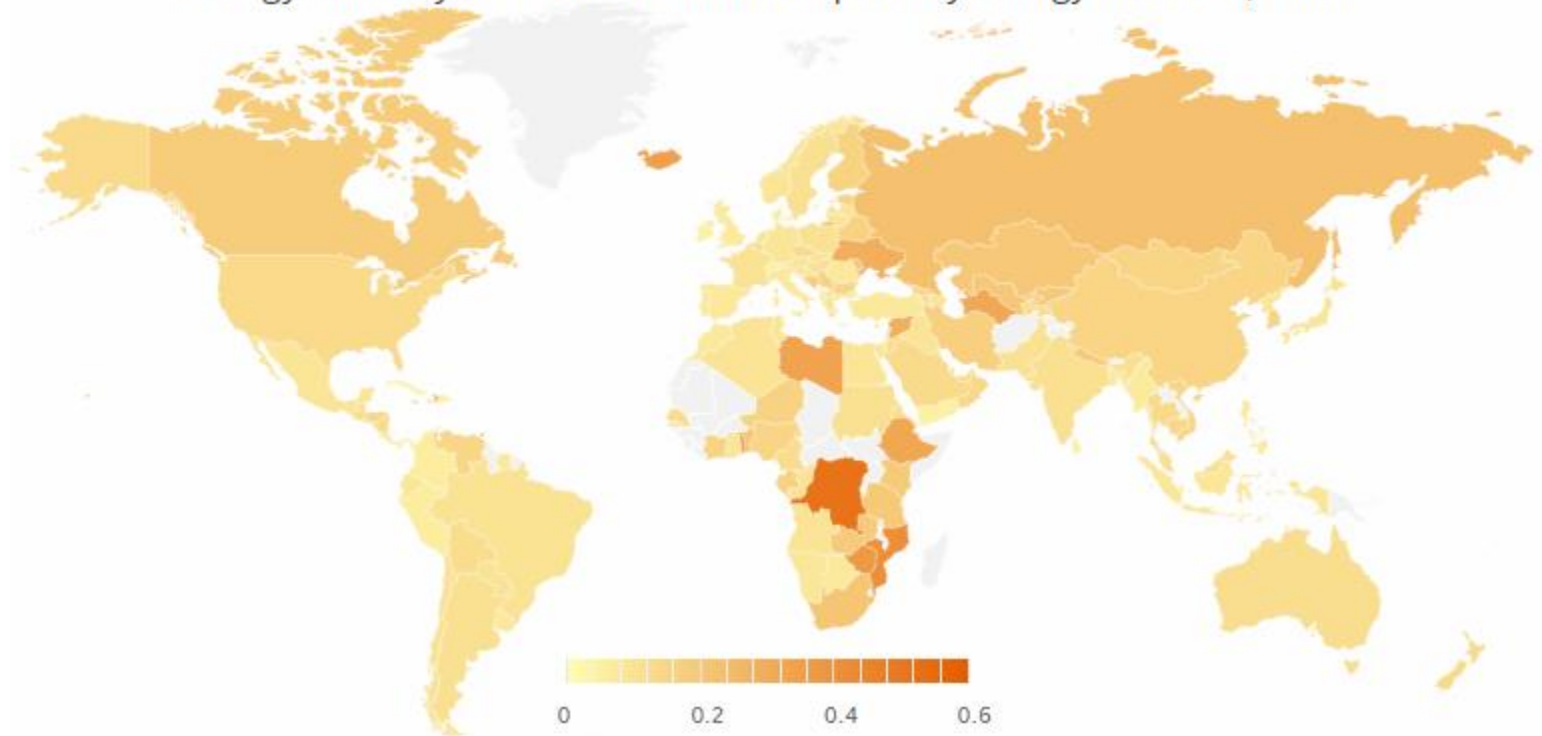
** Total Final Consumption
excluding non-energy uses*

*Source, IEA World Energy
Balances, 2018*

Key to understand where energy is used and to define policy priorities

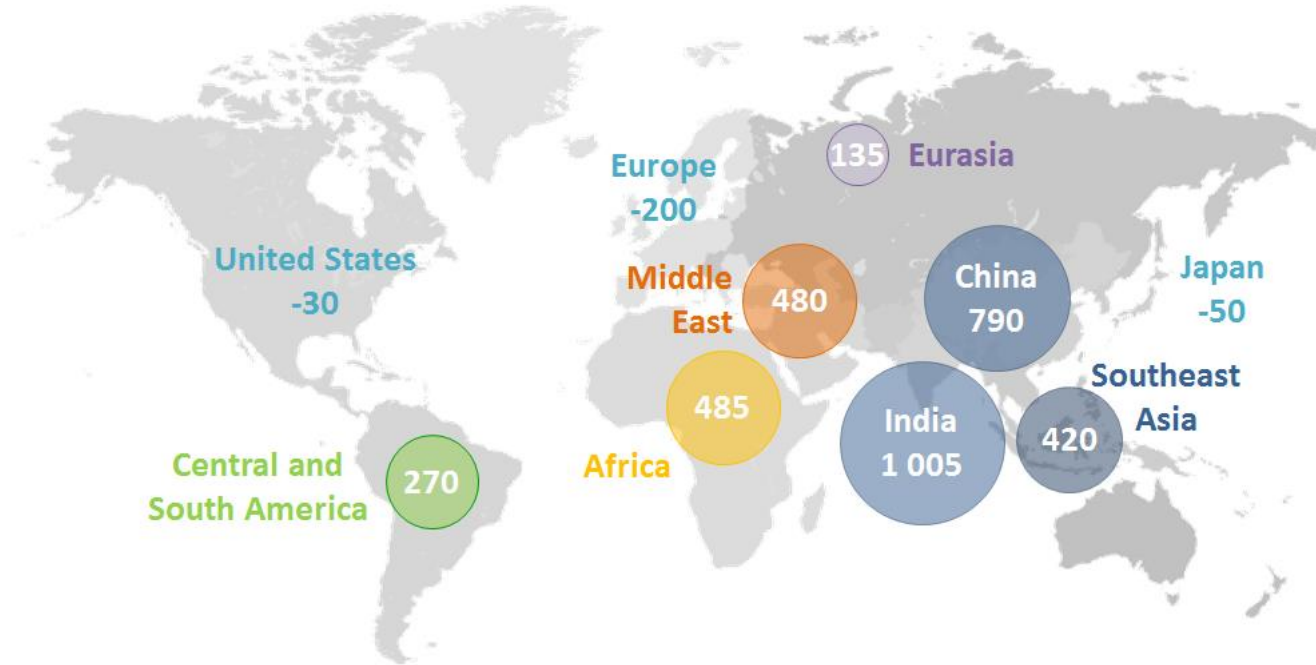
...calculate aggregated energy intensities and other indicators

Energy intensity measured in terms of primary energy and GDP, 2016



Energy (TPES) per unit of GDP: Tracking SDG 7.3 at global level

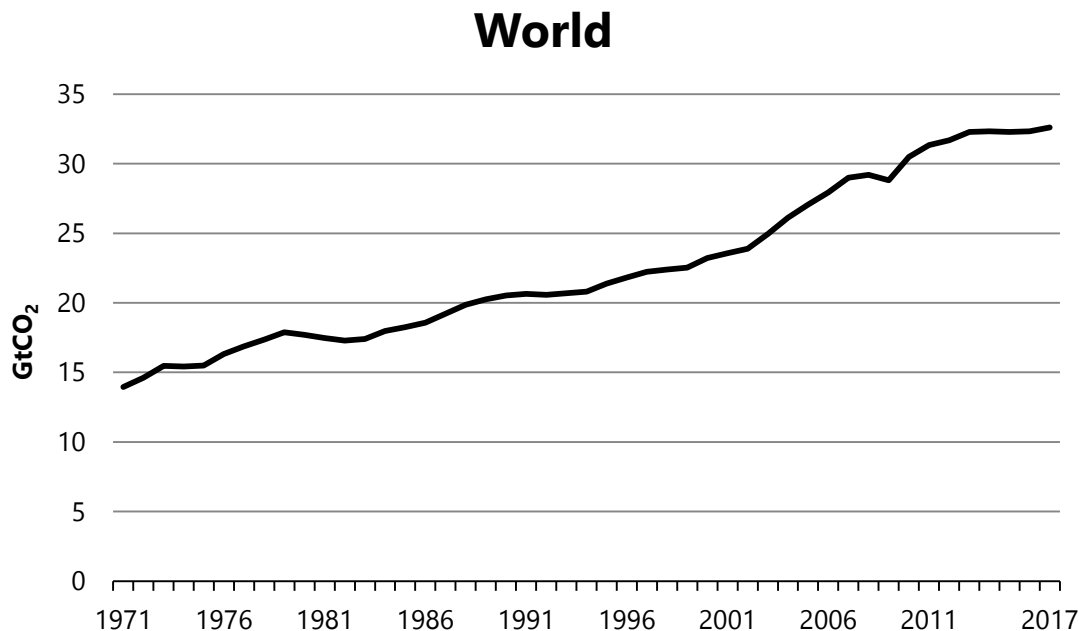
Change in energy demand, 2016-40 (Mtoe)



Source: IEA, World Energy Outlook, 2017

Comparability of energy statistics across countries is key

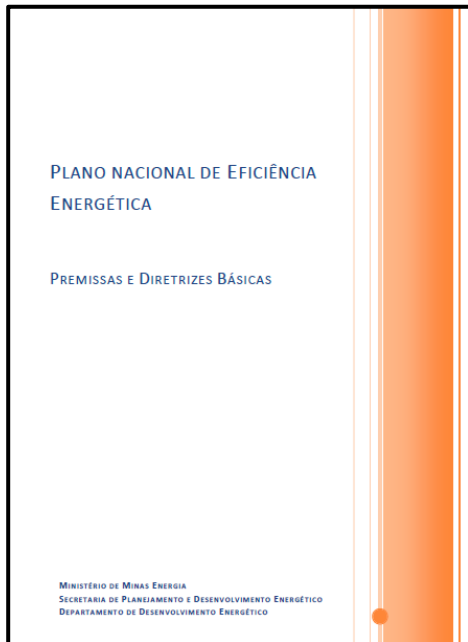
... estimate CO₂ emissions from fuel combustion



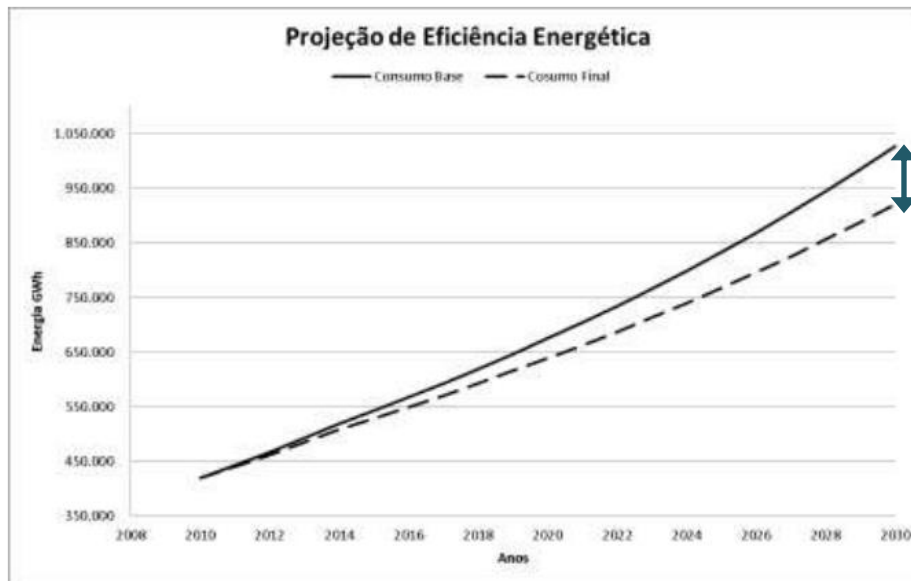
Source: IEA, World CO₂ Emissions from Fuel Combustion, 2018

Based on energy balances and IPCC methodologies

National Energy Efficiency plan



Electricity consumption projections



Reduction: 100 TWh by 2030

Fonte: Ministério de Minas e Energia - MME



Thailand
20-Year Energy Efficiency
Development Plan
(2011 - 2030)



- **20-year Energy Efficiency Development Plan (EEDP)** is formulated with a target to reduce energy intensity by 25% in 2030 compared with that in 2005.
- or*
- reduction of final energy consumption by 20% in 2030, or about 30,000 ktoe.

Department of Energy: *post 2015 National Energy Efficiency Strategy (draft) with targets up to 2030*

To promote energy efficiency as the 'first fuel' in driving balanced, socially inclusive and environmentally sustainable economic growth, boosting job creation and leading technological innovation across the region

Expected 2030 impacts (reduction in final energy consumption) from 2015:

Economy-wide - 29%

Industry Sector - 15%

Public & commercial sector - 37%

Residential sector - 33%

Agriculture sector - 30%

Transport sector - 39%

Public buildings
goal and target
(see Page 9)

Municipal
services goal
and targets
(see Page 11)

Residential
sector goal and
targets
(see Page 12)

Commercial
buildings sector
goal and target
(see Page 15)

Industry sector
goal and targets
(see Page 17)

Agriculture
sector goal and
target
(see Page 20)

Transport
sector goal and
target
(see Page 22)

Production &
distribution
goal and targets
(see Page 24)

Public buildings
measures

Municipal
services
measures

Residential
sector measures

Commercial
buildings
measures

Industry sector
measures

Agriculture
sector measures

Transport
sector measures

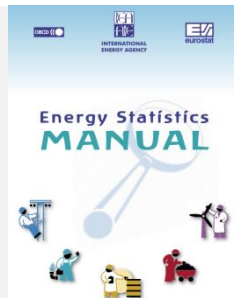
Production &
distribution
measures

Resources on Energy Statistics

The IEA produced a comprehensive Energy Statistics Manual covering most of our data collection methodologies, consistently with the IRES framework.

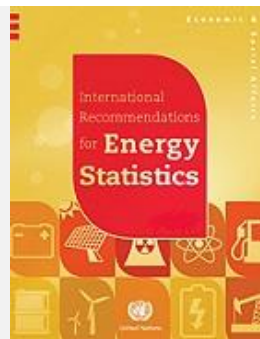
A comprehensive Energy Statistics Manual available in 10 languages.

Click on the manual to download it free of charge!



Visit the **IEA's Statistics website** to access additional resources, including our questionnaires, glossary and documentation related to our data collection methodologies.

To learn more about the international framework for energy statistics, please refer to the United Nations' International Recommendations for Energy Statistics (IRES).



How does IEA disseminate energy balances data?

WORLD ENERGY BALANCES

Paper and pdf publication, CD-Rom and online data service

Available at: <http://data.iea.org/>



WORLD ENERGY STATISTICS

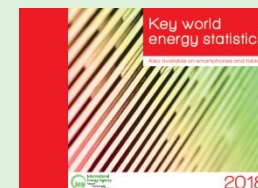
Paper and pdf publication, CD-Rom and online data service

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Key World Energy Statistics

Annual booklet and mobile device app





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