United Nations Statistics Division

Electricity and Heat

Name

Workshop on Energy Statistics for ASEAN Countries

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http://unstats.un.org/unsd/energy

Overview

- Introduction
- Energy statistics
  - Primary and secondary electricity and heat
  - Energy equivalence for primary electricity and heat
  - Main trends in electricity production
  - Type of producer
  - Electricity and heat supply and demand process
- Final remarks

Electricity and Heat

Introduction

- **Electricity** can be produced through different processes, such as the conversion of energy contained in falling or streaming **water**, **wind** or **waves**; the direct conversion of **solar radiation** through photovoltaic processes in semiconductor devices (solar cells); or by the **combustion of fuels**.
- The distinction between different production processes is important for energy statistics and may be obtained by disaggregating information on the production side

Electricity and Heat

Introduction

- **Heat** is the energy obtained from the translational, rotational and vibrational motion of the constituents of matter, as well as changes in its physical state. It can also be produced by different production processes.
- It is usually sold in the form of steam or hot water
- For the purposes of energy statistics **heat only represents quantities of energy for sale** (or generated and consumed directly by direct use of solar thermal or geothermal).

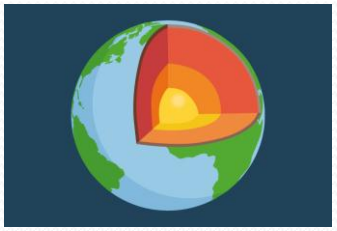
Primary electricity and heat

Hydro

Solar PV

Wind

Tide, wave, marine



Heat from geothermal

Heat from solar thermal

Heat from nuclear

Heat from chemical sources

Secondary electricity and heat

Secondary electricity and heat are produced by burning combustible fuels such as coal, natural gas, oil, renewables and wastes.

Secondary electricity refers also to electricity coming from **solar heat**, **nuclear heat**, **geothermal heat** and **heat from chemical sources**.

Secondary heat is also produced by transforming electricity to heat in **electric boilers** or **heat pumps.**

Energy equivalent for primary electricity and heat

Consistently with IRES energy balances, specific notional efficiencies are applied to electricity and heat generation (to back calculate primary energy):

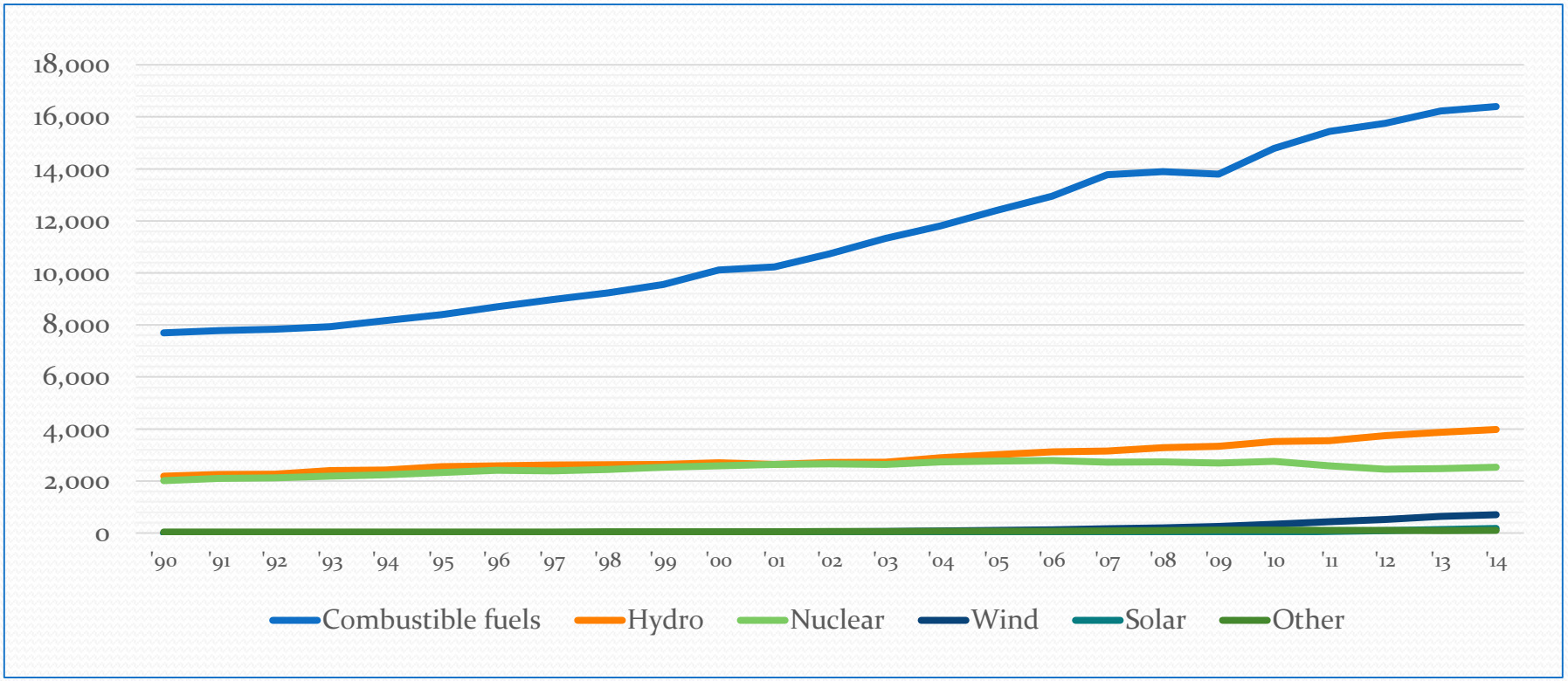
- 100% for *electricity* from **hydro**, **wind**, **tide, wave, ocean and solar PV**;
- 33% for *electricity* from **nuclear heat** or **solar thermal**;
- 100% for *heat* from **solar thermal, nuclear** and **chemical sources**;
- 50% for *heat* produced from **geothermal heat**;
- 10% for *electricity* from **geothermal heat**.

Energy equivalent for primary electricity and heat

Production of **primary electricity** is calculated as

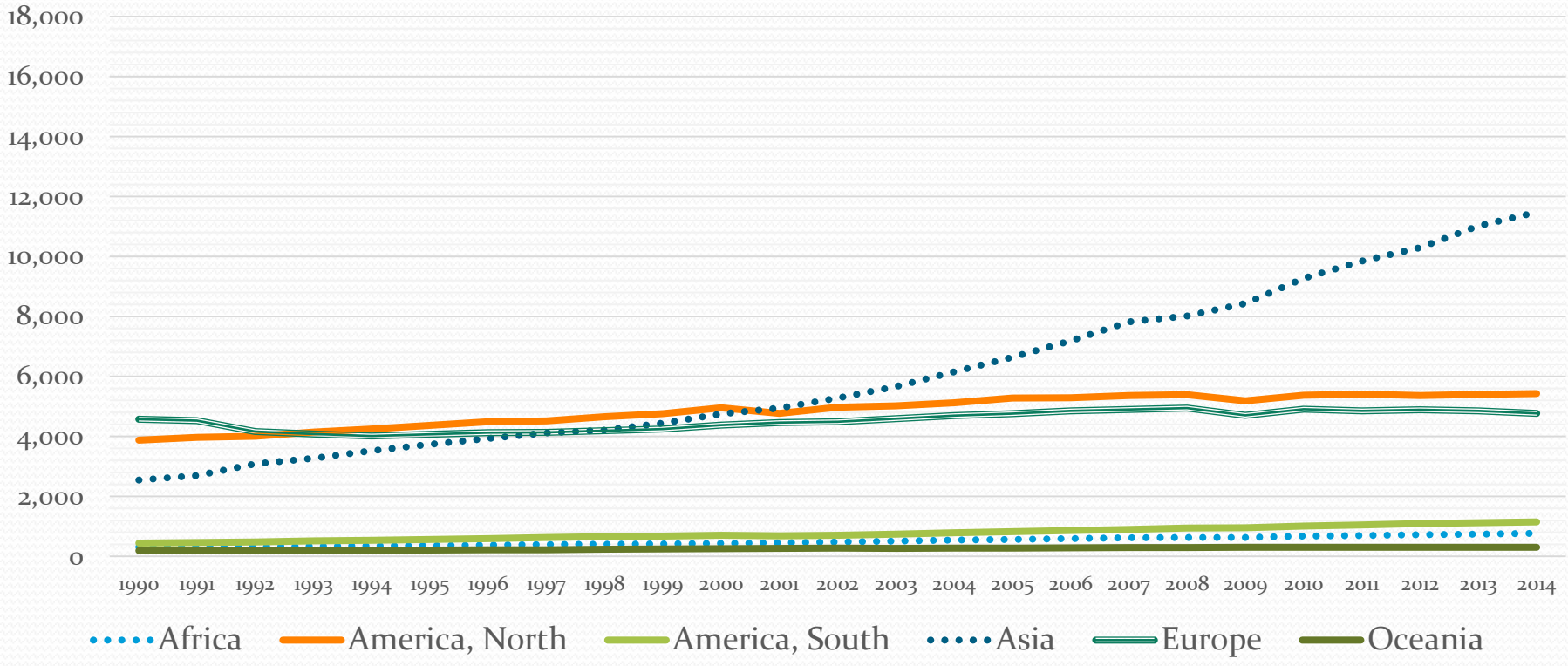
Production of **primary heat** is calculated as

Production of electricity by type *(TWh)*



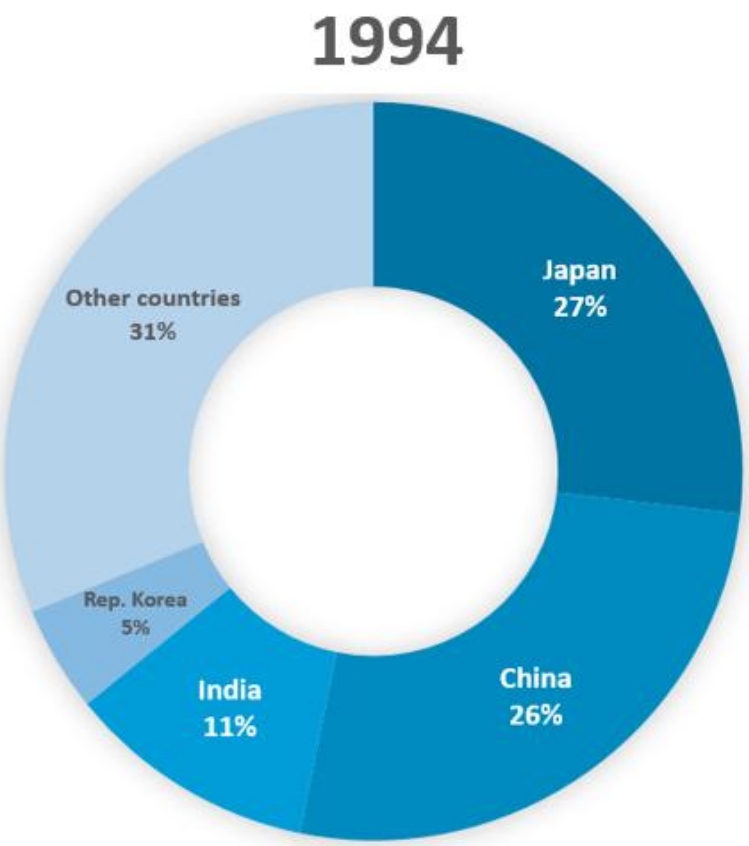
- Total production of electricity **doubled** (1990-2014)
- Thermal production represents **69%** of total electricity
- In 2014, **wind and solar** combined are 195 times larger than in 1990 but still represent only 3.7% of total production

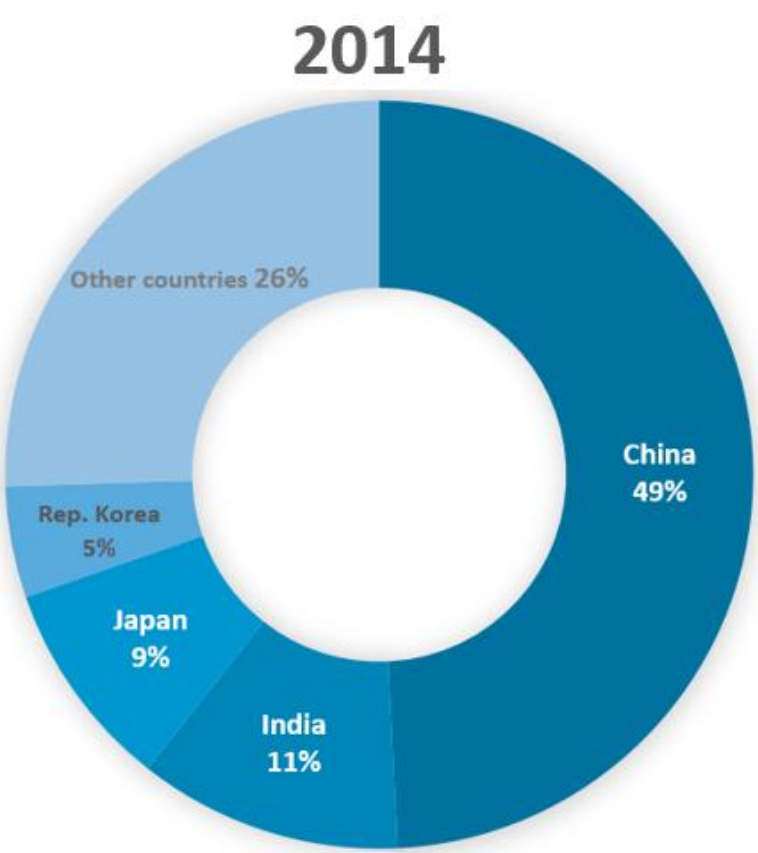
Production of electricity by region *(TWh)*



- **Asia** produced **almost half of the world electricity** in 2014 (48%), up from 21% in 1990.
- The fastest growth has taken place **after the year 2000**.

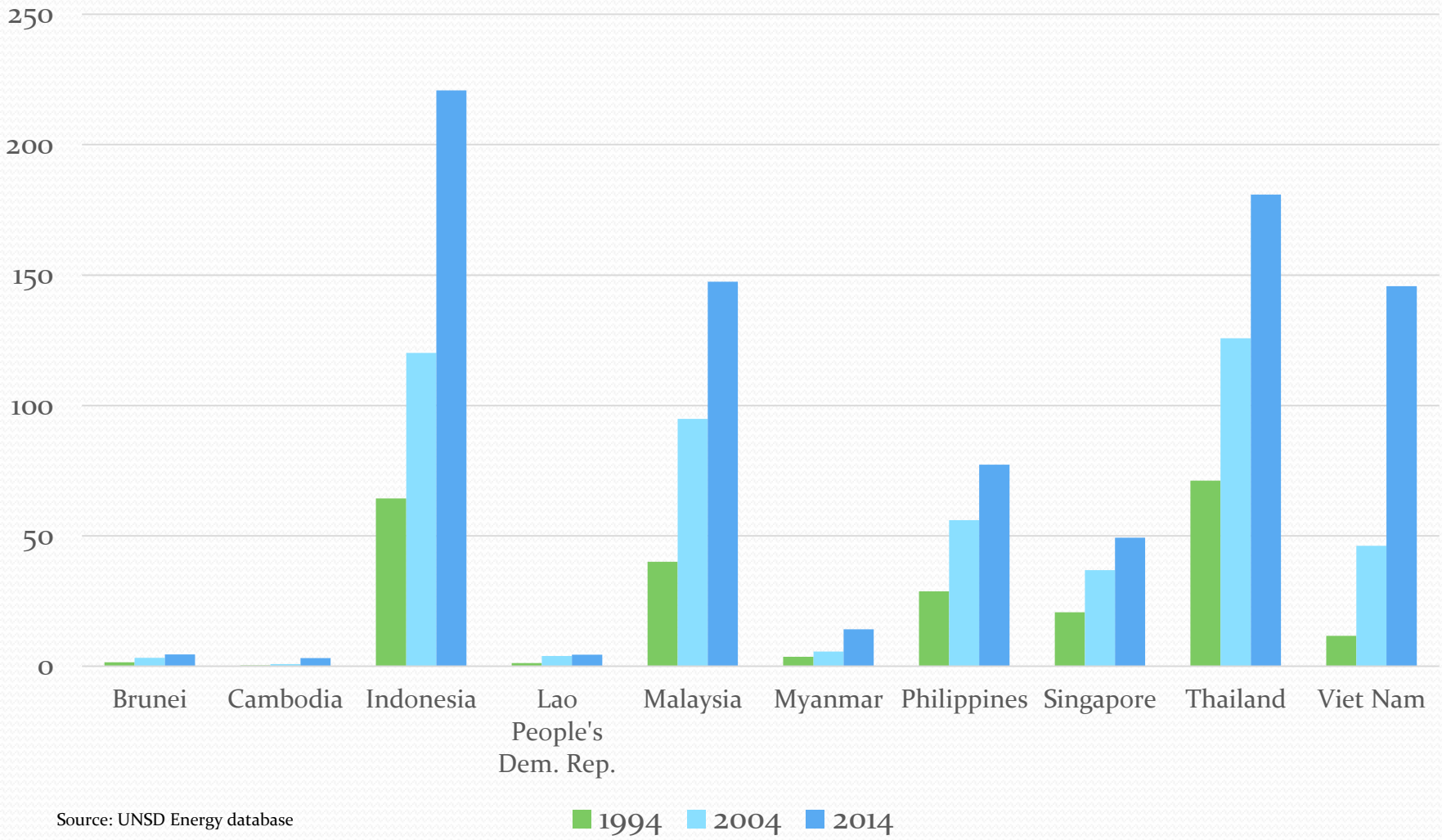
Production of electricity in Asia





Source: UNSD Energy database

Production of electricity in ASEAN countries *(TWh)*



Source: UNSD Energy database

Statistics on electricity and heat

Type of producers

Statistics on electricity and heat are collected according to the **type of producer** and **type of generating plant**.

Two types of producers are distinguished:

1) **Main Activity Producer**. These are units that produce electricity or heat **as their principal activity**. Formerly known as public utilities, these enterprises **may be privately or publicly owned** companies.

Statistics on electricity and heat

Type of producers

2) Autoproducers

- **electricity:** units that produce electricity but for which the production **is <u>not</u> their principal activity**.

- **heat:** units that produce heat **for sale** but for which the production **is <u>not</u> their principal activity**.
  - Deliveries of fuels for heat generated by a unit for its own purposes are classified as **final consumption**, and not as transformation inputs.

Statistics on electricity and heat

Some examples of autoproducer

- **Geographically remote industries** that have no access to electricity
- **Iron and steel works** requiring coke and the heat from it for their own production purposes
- **Sugar mills** that burn the bagasse they produce for generating steam, and process heat and electricity
- Enterprises whose primary activity is the **production of animal products** and use their animal waste as fuel in a biogas system to generate electricity for its own use or to sell to a local market
- Many industrial establishments and commercial organizations may have electricity generating equipment that they can turn on **in the event of failure in the public supply system**
- **Households** that use solar panels for generating electricity for their own use (and sometimes even for sale to third parties)

Statistics on electricity and heat

Challenges

The collection of data on electricity and heat production by autoproducer can be challenging.

Enterprise surveys, **use of business registers** and **household surveys** can all be useful sources to obtain information on electricity and heat by autoproducer.

Statistics on electricity and heat

Type of generating plants

- **Electricity plants** refer to plants producing only electricity. The electricity may be obtained directly from natural sources such as hydro, geothermal, wind, tidal, marine, solar energy or from fuel cells, or from the heat obtained from the combustion of fuels or nuclear reactions.

- **CHP** plants refer to plants which produce both heat and electricity from at least one generating unit in the plant ("co-generation" plants).

- **Heat plants** refer to plants (including heat pumps and electric boilers) designed to produce heat only for deliveries to third parties.

What data need to be reported

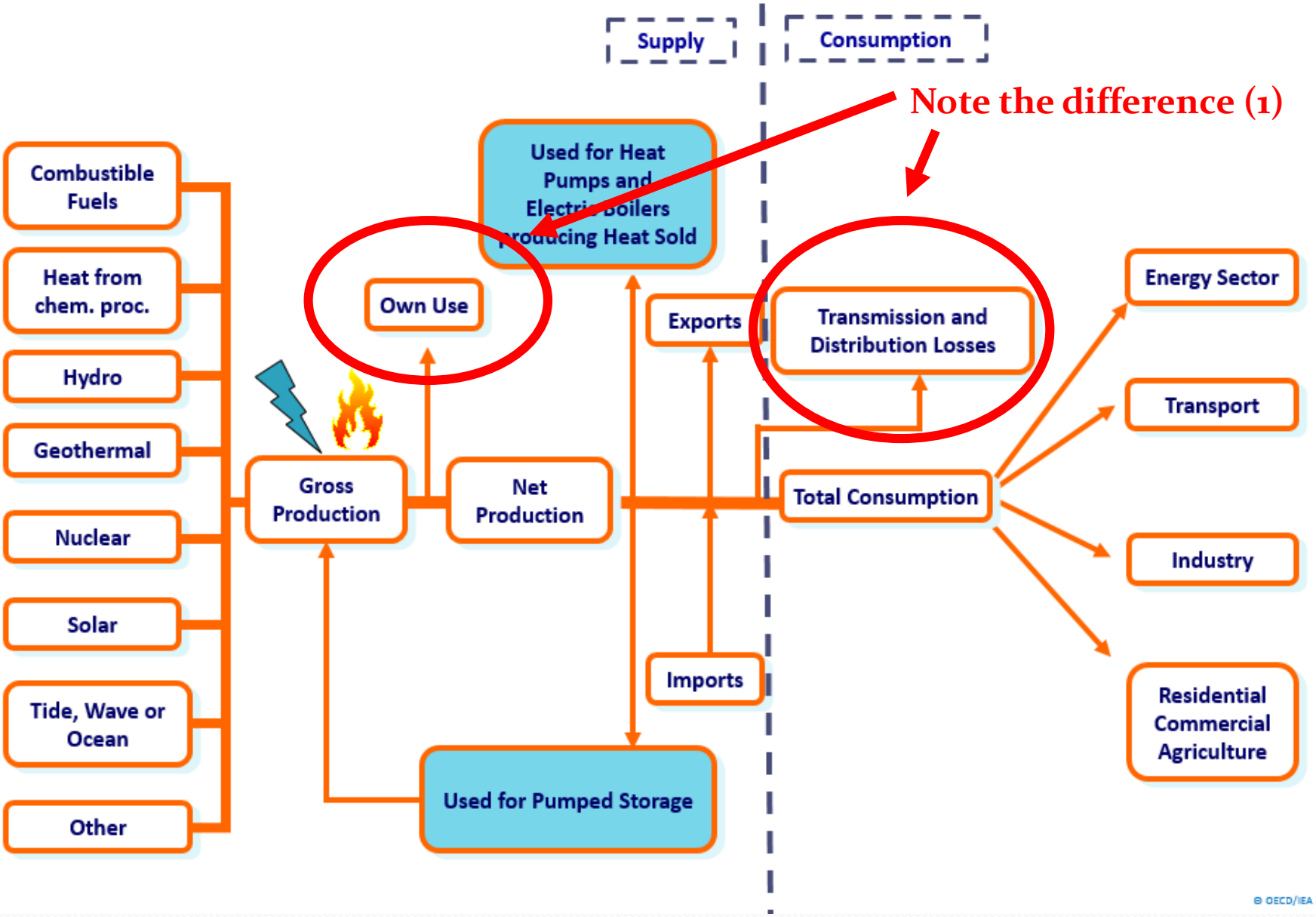
	Electricity plant	CHP plant	Heat plant
Main activity producers	Report all production and all fuel used	Report all electricity and heat produced and all fuel used	Report all heat produced and all fuel used
Autoproducers		Report all electricity produced and **heat sold** with corresponding fuel used	Report **heat sold** and corresponding fuel used

Measurement units

- The unit of measurement for **electricity** is usually the **kilowatt hour** (kWh), which refers to the energy equivalent of 1000 watt (joules per second) over a one-hour period. Thus, 1 kilowatt-hour equals 3.6 x 10^6 joules. This allows one to perceive the electrical energy in terms of the time an appliance of a specified wattage takes to "consume" this energy.

- **Heat** quantities, on the other hand, are usually measured in **calories** or **joules**.

Electricity and heat supply and demand process

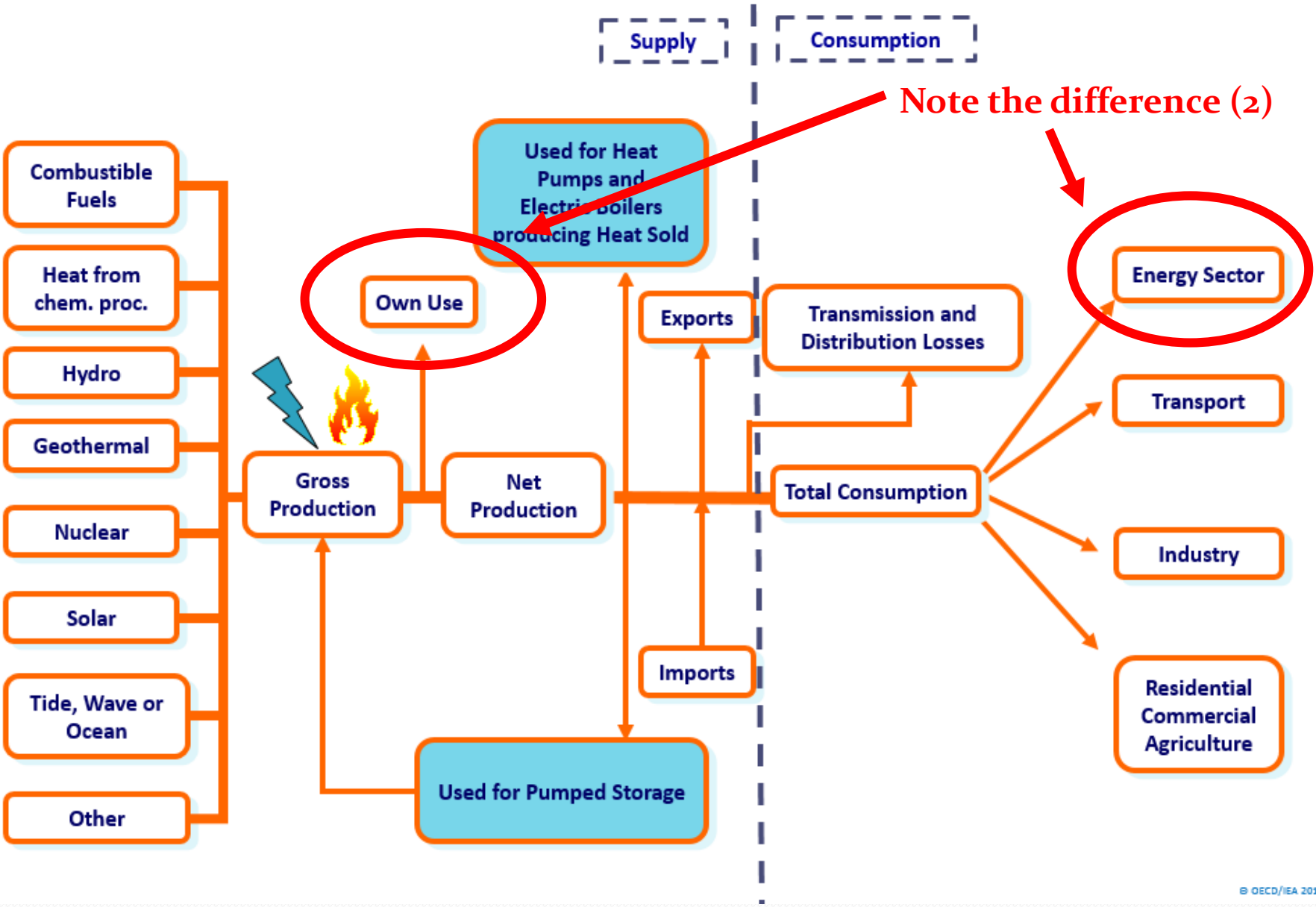


Own use by electricity, CHP and heat plants vs Losses

- **Own use by electricity, CHP and heat plants** refers to the consumption of electricity and heat for the direct support of the production and preparation for use of fuels and energy, except heat not sold.

- **Losses** refer to losses during the transmission, distribution and transport of heat and electricity. Losses of geothermal heat after production and pilferage of electricity are also included.

Electricity and heat supply and demand process

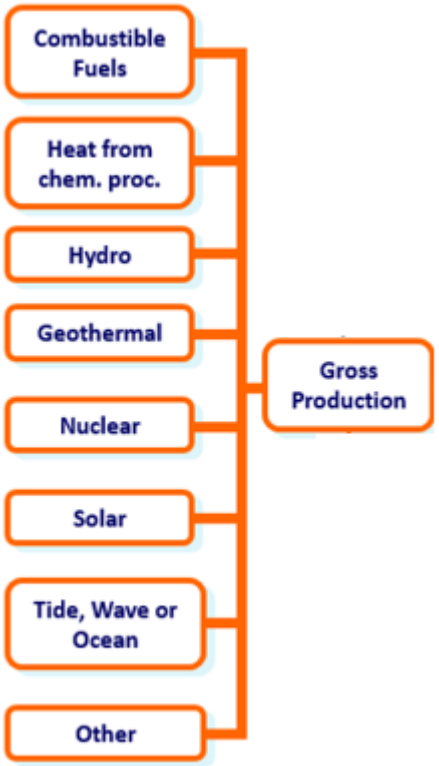


Energy Industries own use

Energy Industries Own Use refers to the consumption of electricity and heat for the direct support of the production and preparation for use of fuels and energy, by industries in the energy sector such as **coal mines**, **oil refineries**, **oil and gas extraction** etc.

As we have seen, consumption by electricity, CHP and heat plants is accounted for separately.

Gross electricity and heat production

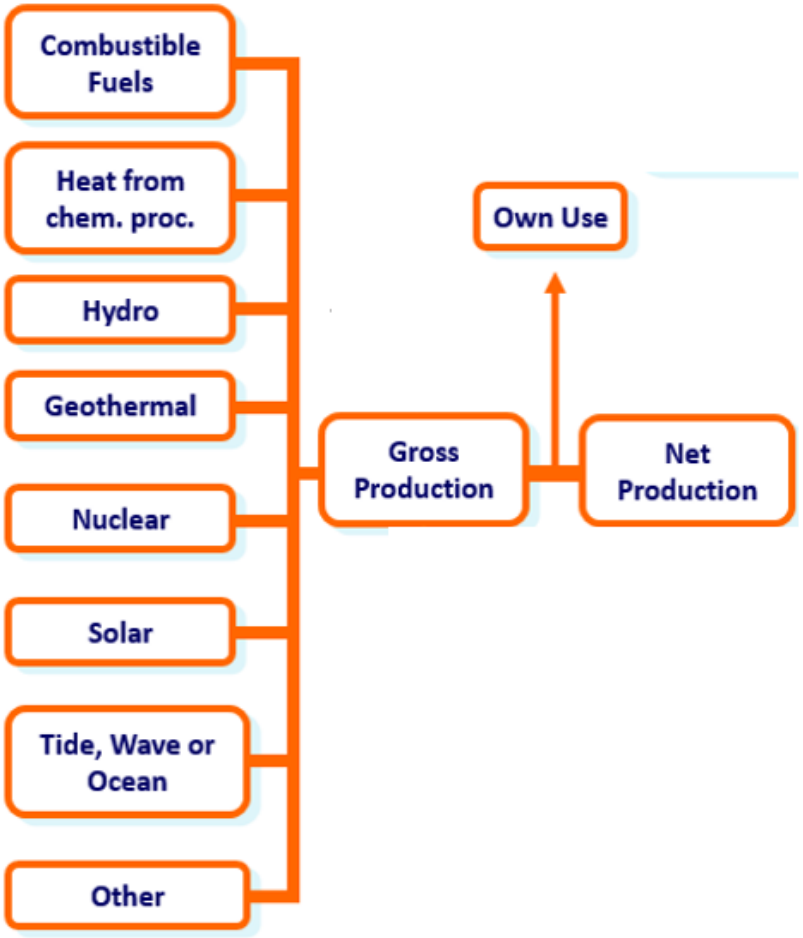


Gross electricity production is the sum of the electricity generated by all units/installations (including pumped storage) measured at the output terminals of the generators.

Gross heat production is the total heat produced by the installation and includes the heat used by the installation's auxiliaries which use a hot fluid (liquid fuel heating, etc.) and losses in the installation/network heat exchanges, as well as heat from chemical processes used as a primary energy form.

The production of heat by autoproducer covers
only the heat sold to third parties
➡ gross heat production = net heat production

Net electricity and heat production



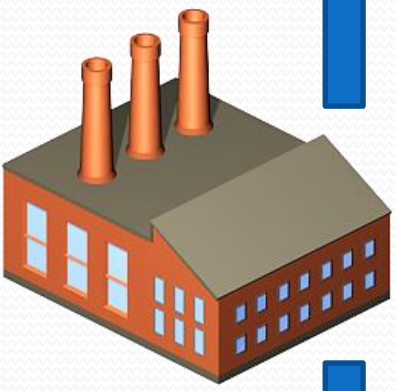
Gross production – Own use = Net production

Net electricity production is equal to the gross electricity production *less the electrical energy absorbed by the generating auxiliaries* and the *losses* in the main generator transformers.

Net heat production is the heat *supplied to the distribution system* as determined from measurements of the outgoing and return flows.

Own use is defined as the difference between gross and net production.

Net electricity and heat production



Gross electricity
Main Activity and Autoproducer

− **Own use**

= **Net electricity = Electricity sent to the grid**

Gross heat
Main Activity

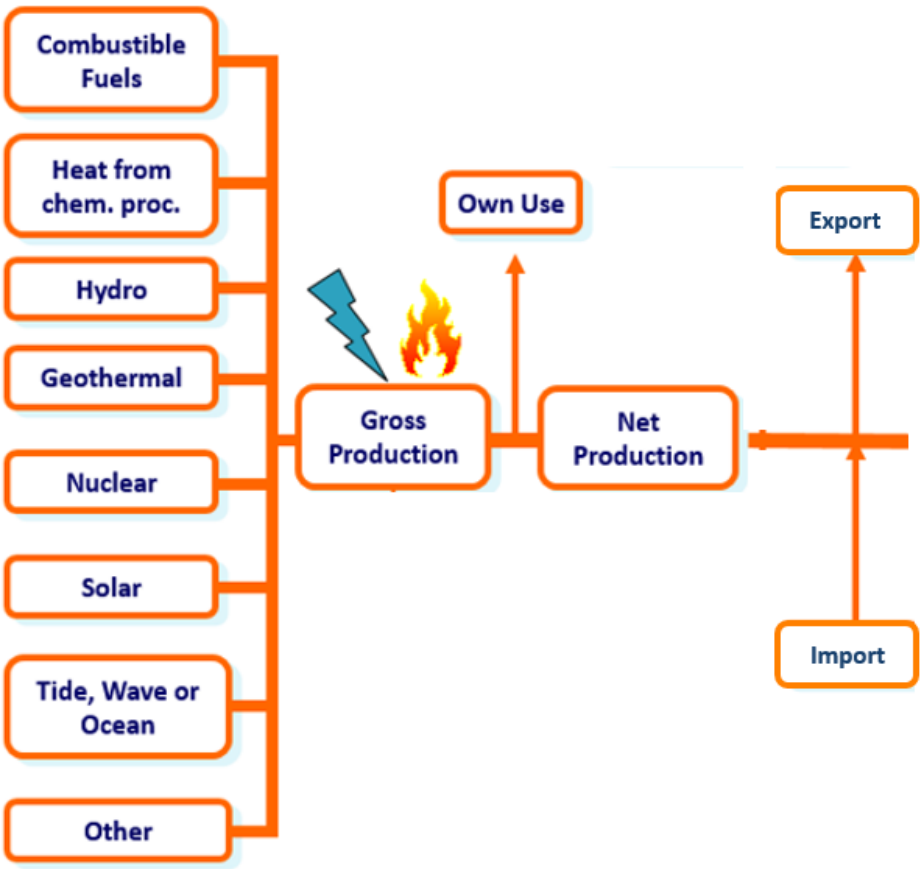
− **Own use**

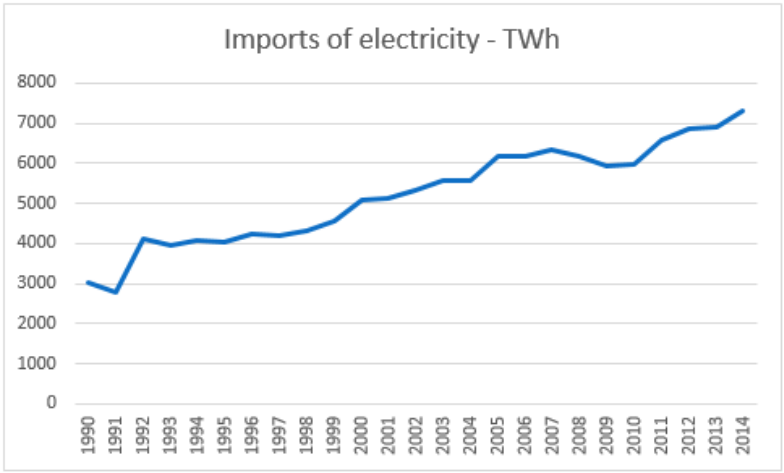
= **Net heat = Heat supplied to the distribution**

Gross heat
Autoproducer

= **Net heat**
Only heat **sold** to third parties is reported

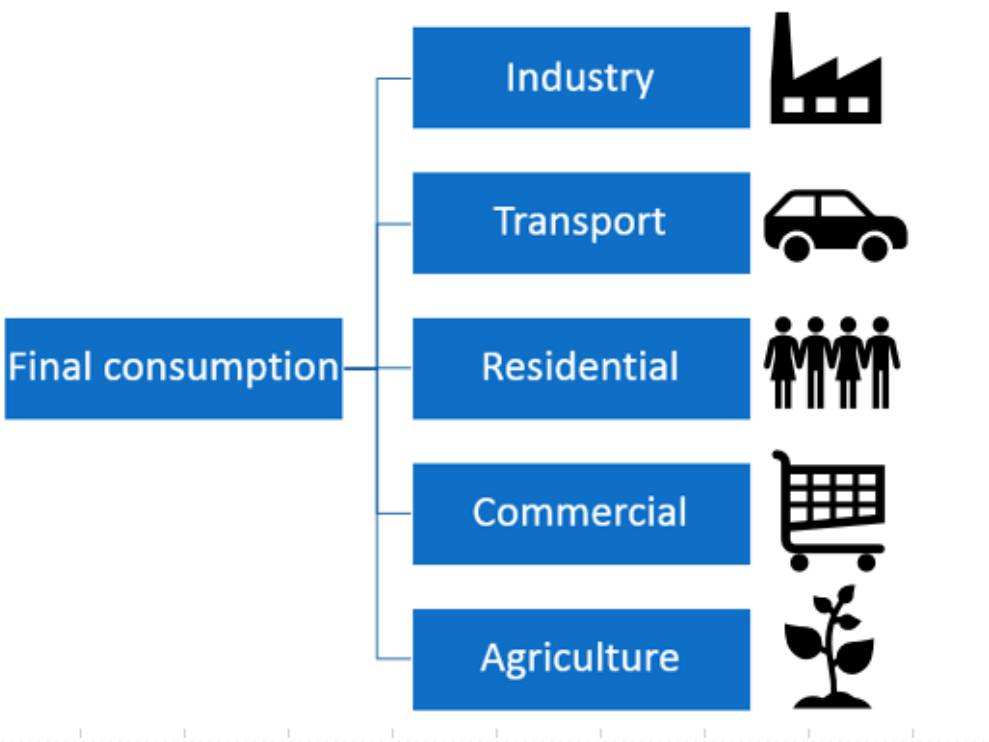
Import and export of electricity



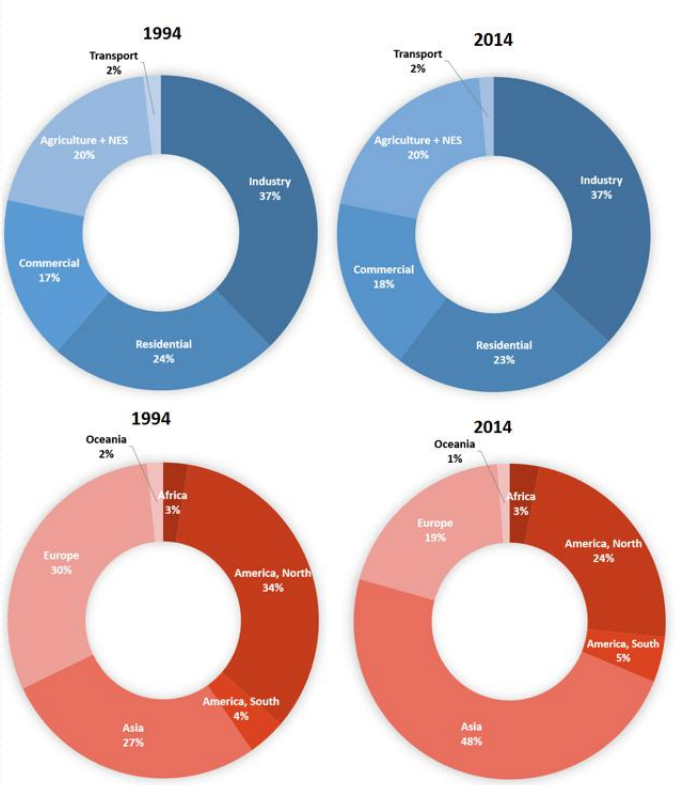


Trade of **electricity** has been growing in the last decades.
World imports have increased by **almost 2.5 times** between 1990 and 2014
Trade of **heat**, on the other hand, is virtually non-existent

Final consumption



Electricity consumption



- Electricity consumption grew by **88%** over the last decades (1994-2014).
- The electricity consumption structure **by sector** has minimally changed over the same period.
- Electricity consumption in Asia is **more than three times larger in 2014** compared to 1994.

Final remarks

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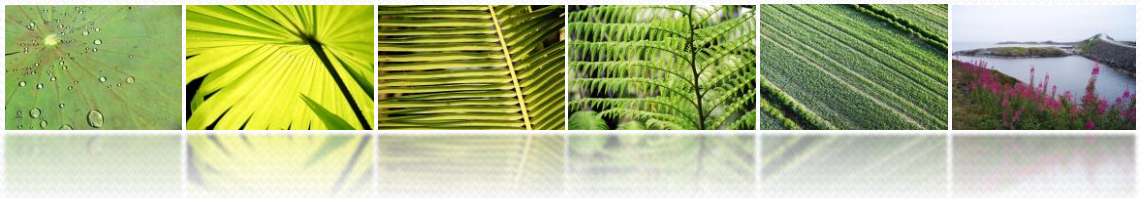

Thank you.

http://unstats.un.org/unsd/energy/