

ELECTRICITY

Annual Electricity and Heat Statistics

International Workshop on Energy Statistics

Beijing, China

23-25 May 2016

Loïc Coënt

IEA Energy Data Centre

iea

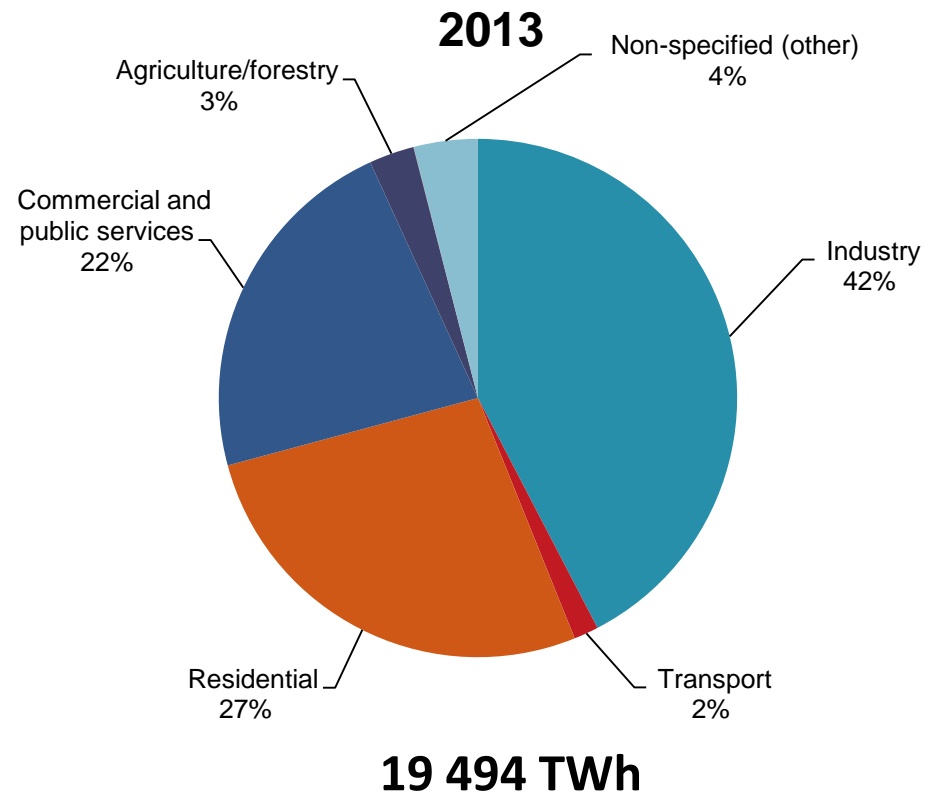
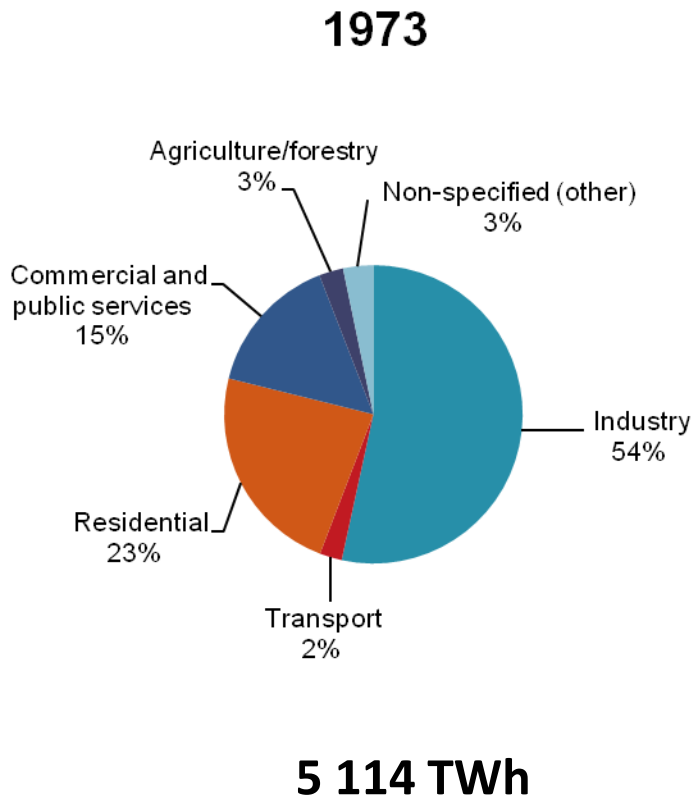


International Energy Agency

- Global Electricity trends 1973 - 2013
- Electricity and Heat statistics structure
- Data consistency checks
- Use of the data

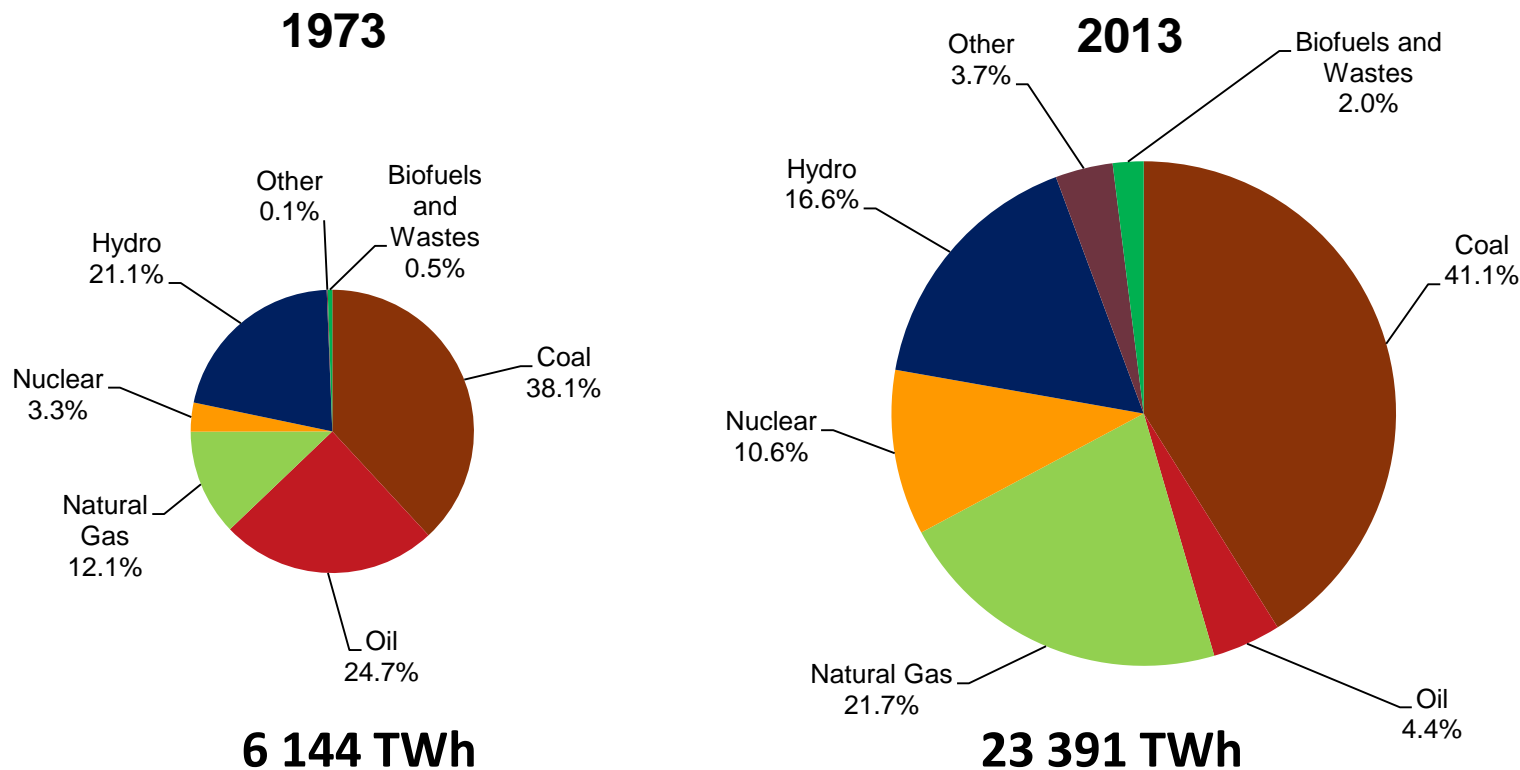
Global Electricity Trends 1973 - 2013

World sectoral electricity consumption



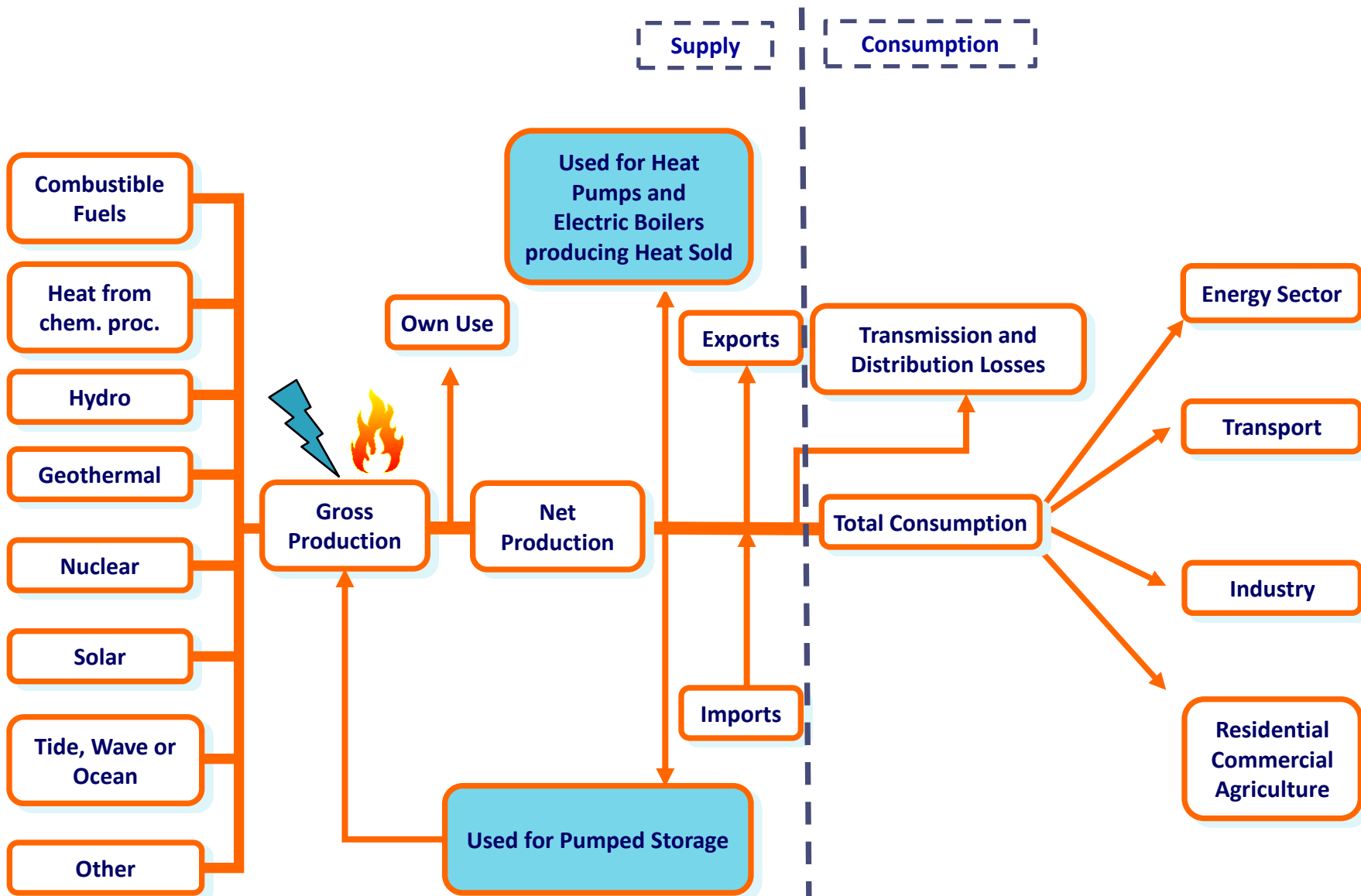
Global electricity consumption almost quadrupled in 40 years

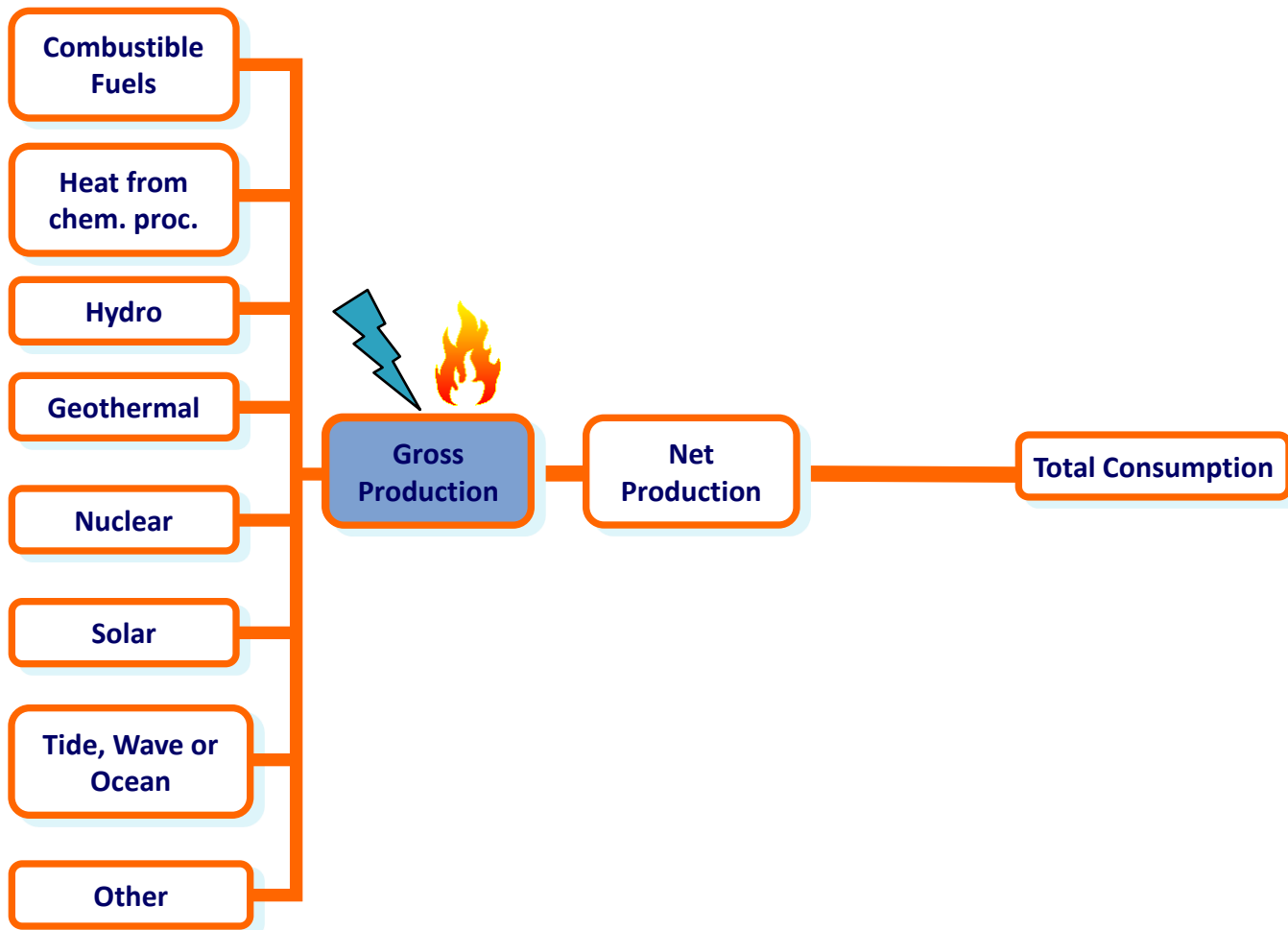
World Fuel Shares of Electricity



Coal remains the major fuel source for electricity despite the increased shares from other sources

Electricity and Heat statistics structure





- **Gross Electricity** - the sum of the electrical energy produced by all of the generating sets (including pumped storage) measured at the output terminals of the main generators.
- **Gross Heat** - is the heat produced by the installation, including the heat used by the installation's auxiliaries which use a hot fluid (for activities such as space heating) and losses in the installation/network heat exchanges, as well as heat from chemical processes used as a primary energy form.

Plant Boundary

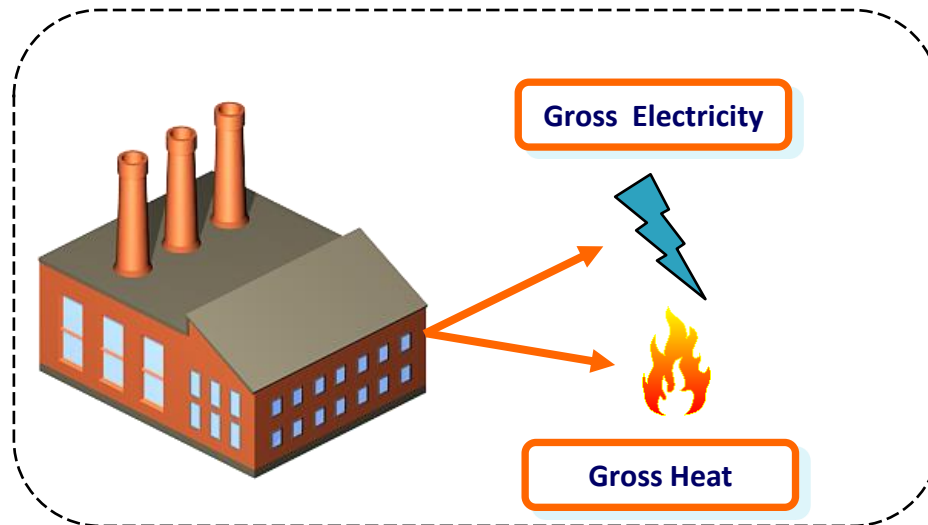


TABLE 1. Gross Electricity and Heat Production

Menu	MAIN ACTIVITY PRODUCER PLANTS			AUTOPRODUCER PLANTS			TOTAL	
	ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	ELECTRICITY (ONLY)	CHP	HEAT (ONLY)	MAIN ACTIVITY PRODUCER	AUTOPRODUCER
	A	B	C	D	E	F	G(=A+B+C)	H(=D+E+F)
ELECTRICITY UNIT: GWh (10⁶ kWh)								
Electricity	1	55 394	226	1 227	2 857		55 620	4 084
Nuclear	2						0	0
Hydro	3	23 772		421			23 772	421
<i>Pumped Hydro</i>	4						0	0
Geothermal	5						0	0
Solar	6							0
Tide, Wave and Ocean	7							0
Wind	8	38					38	0
Combustible Fuels	9	31 584	226	806	2 857		31 810	3 663
Heat from Chemical Sources	10							0
Other Sources	11							0
HEAT Unit: TJ								
Heat	12		0	0				0
Nuclear	13						0	0
Geothermal	14						0	0
Solar	15						0	0
Combustible Fuels	16						0	0
Heat Pumps	17						0	0
Electric Boilers	18						0	0
Heat from Chemical Sources	19							0
Other Sources	20						0	0

Type of Plant

Type of Producer

Details on the type of combustible fuel are also collected.

Sources of electricity and heat

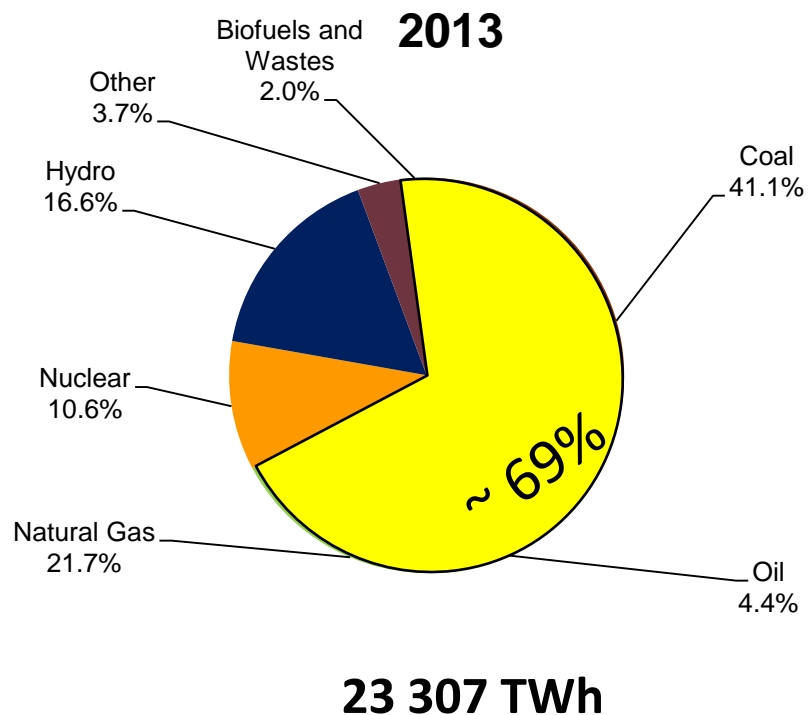
“Main activity” producer plants

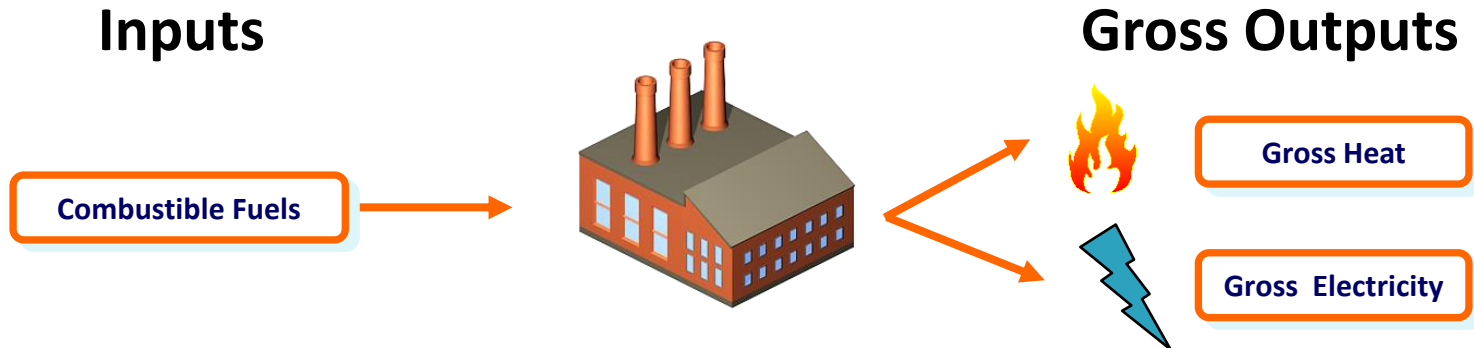
- Undertakings generating electricity and/or heat for sale to third parties as their primary activity
- Regardless whether they are state or privately owned

Autoproducers

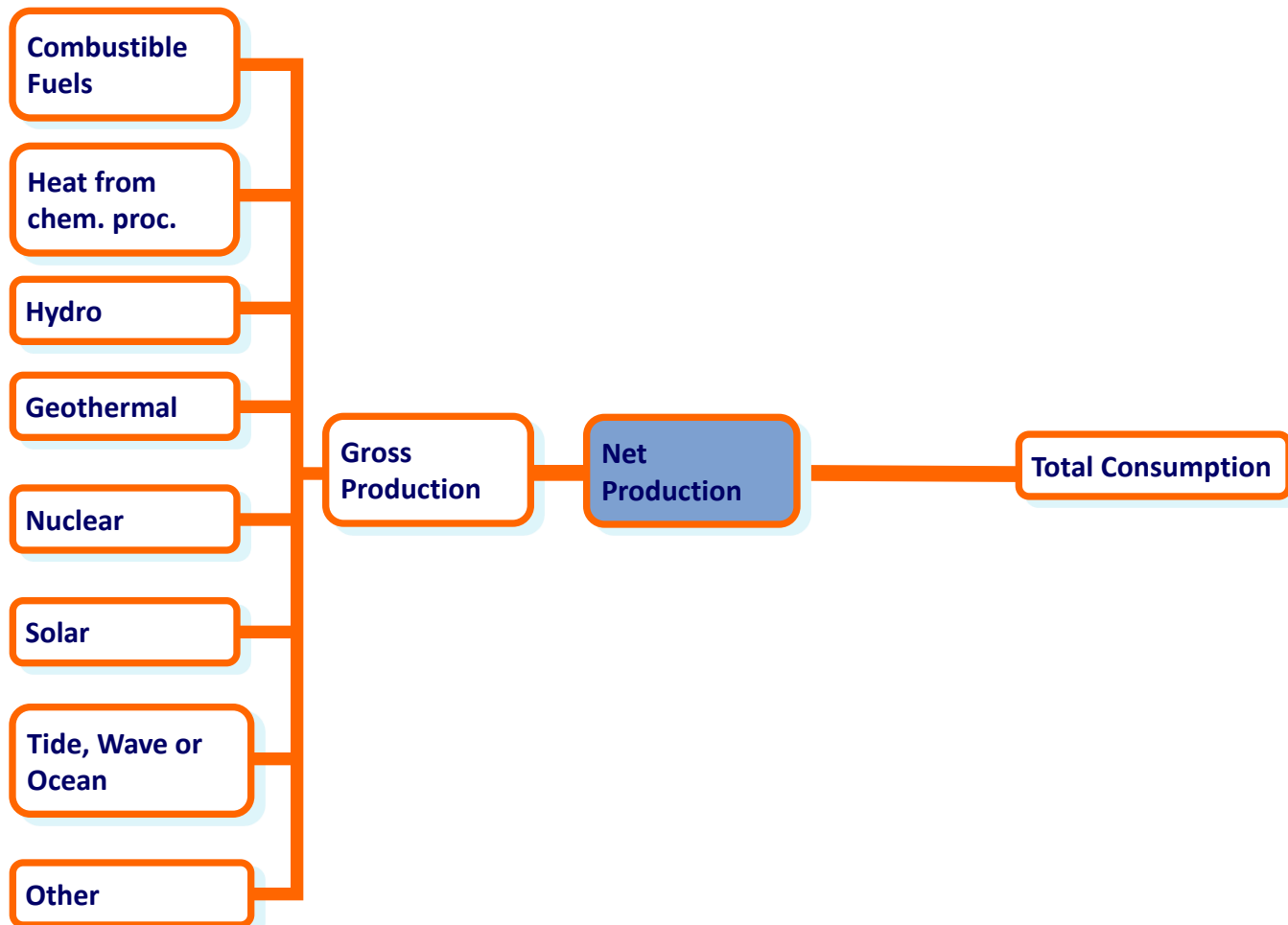
- Undertakings generating electricity and/or heat wholly or partially for their own use as support to their primary activity
- Again, regardless whether they are state or privately owned
- Examples: Steel mill, paper mill

World Fuel Shares of Electricity





- Coal and coal products
- Oil
- Natural gas
- Biofuels and wastes



Gross Electricity - the sum of the electrical energy produced by all of the generating sets (including pumped storage) measured at the output terminals of the main generators.

Gross Heat - is the heat produced by the installation, including the heat used by the installation's auxiliaries which use a hot fluid (for activities such as space heating) and losses in the installation/network heat exchanges, as well as heat from chemical processes used as a primary energy form.

$$\text{Gross production} - \text{Own Use} = \text{Net production}$$

Net Electricity

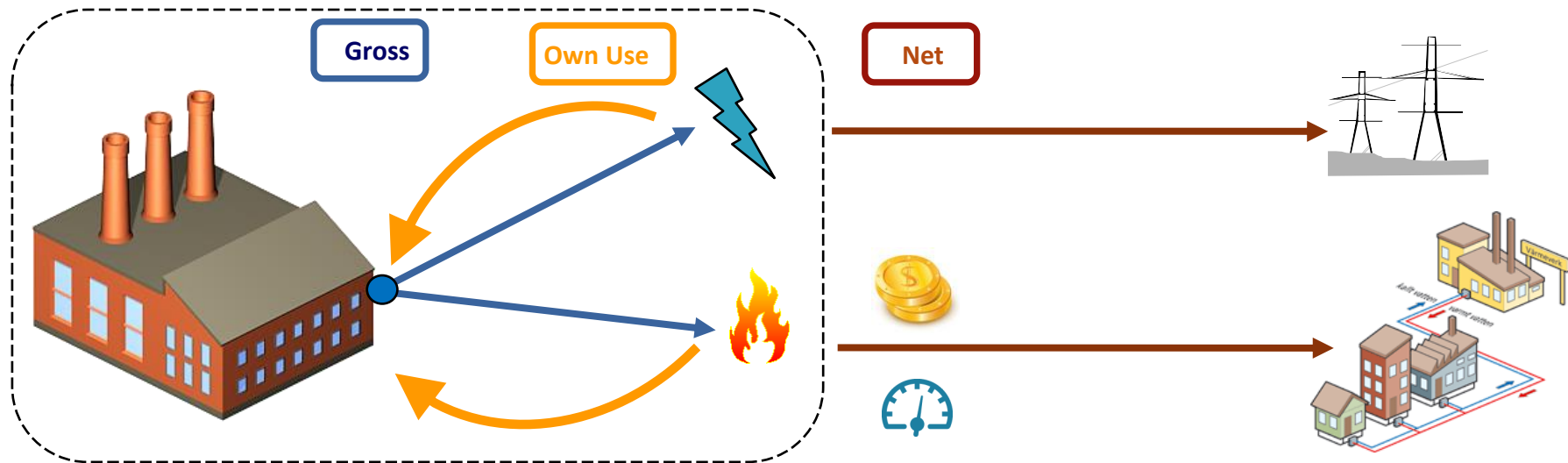
- The gross electricity production less the electrical energy absorbed by the generating auxiliaries and the losses in the main generator transformers.

Net Heat

- Is the heat supplied to the distribution system as determined from measurements of the outgoing and return flows

- Gross Electricity – all the electricity produced
- Gross Heat – all the heat produced
- Own Use – amount consumed to support the operations of the plant
- Net Electricity - Electricity sent to the grid
- Net Heat – Heat supplied to the distribution

Plant Boundary



▪ **Gross production** ~~Own Use~~ = **Net production**

Autoproducers

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

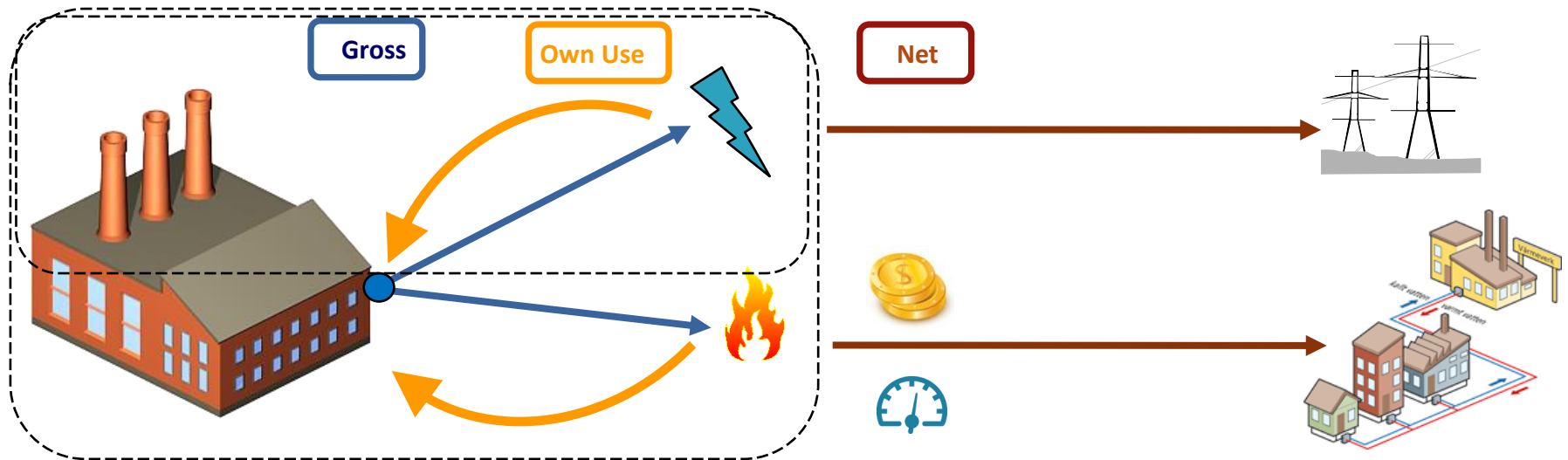
HEAT:

Gross Heat production

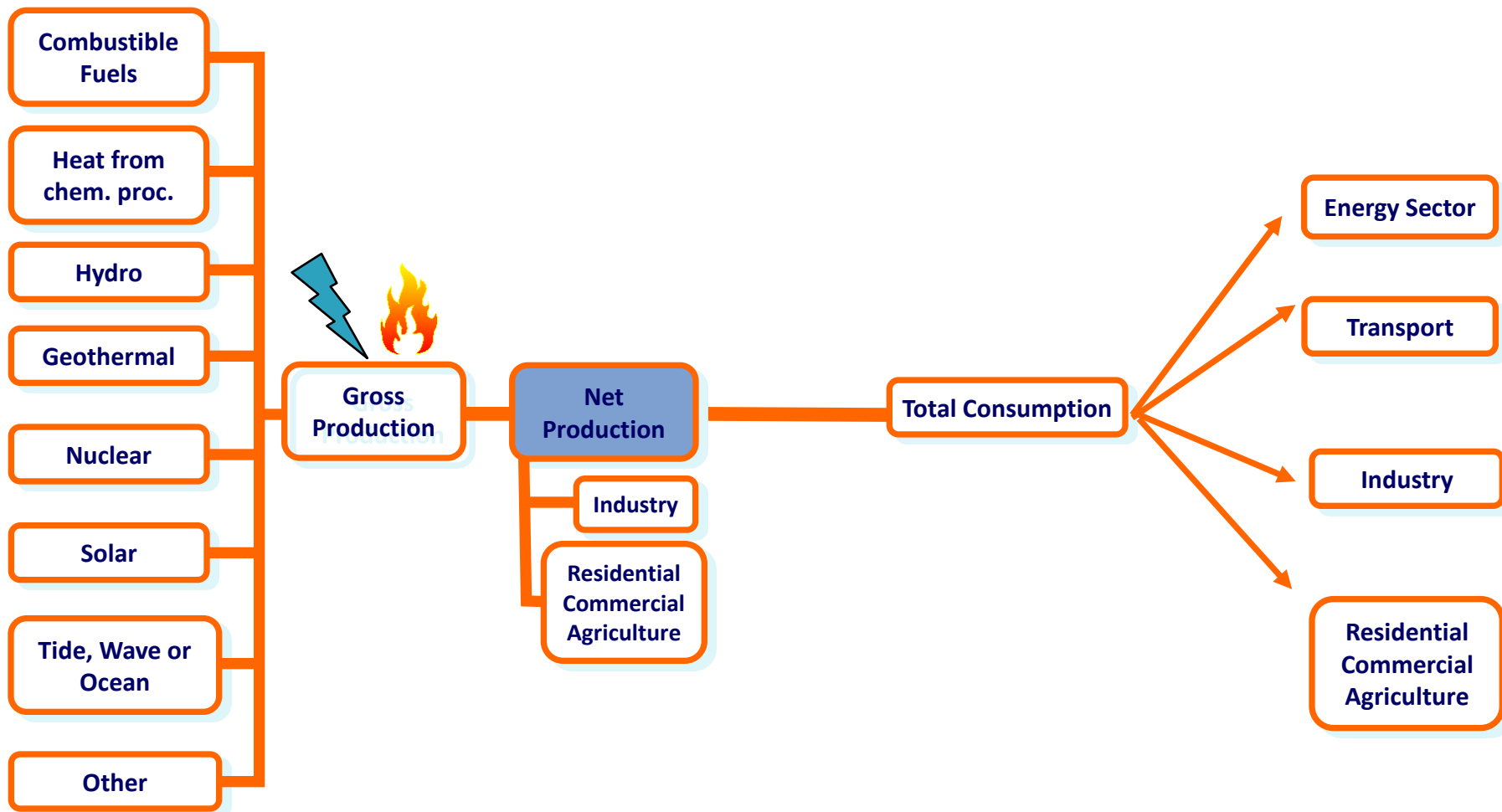
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Net Heat production

Autoproducer CHP and Heat Plants
Plant Boundary



Net electricity and heat production by Autoproducer (Table 5)



Trade (Table 8)

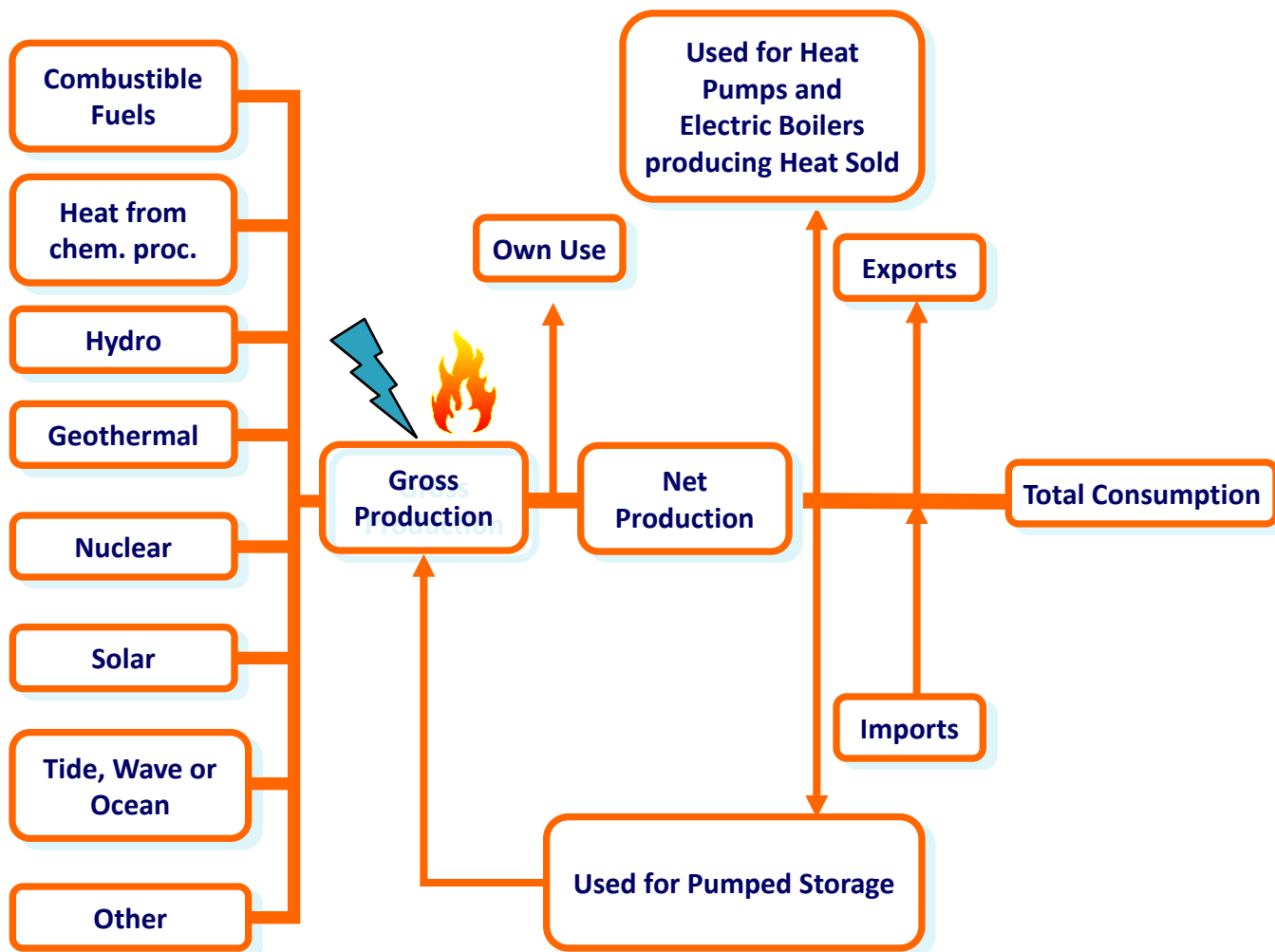


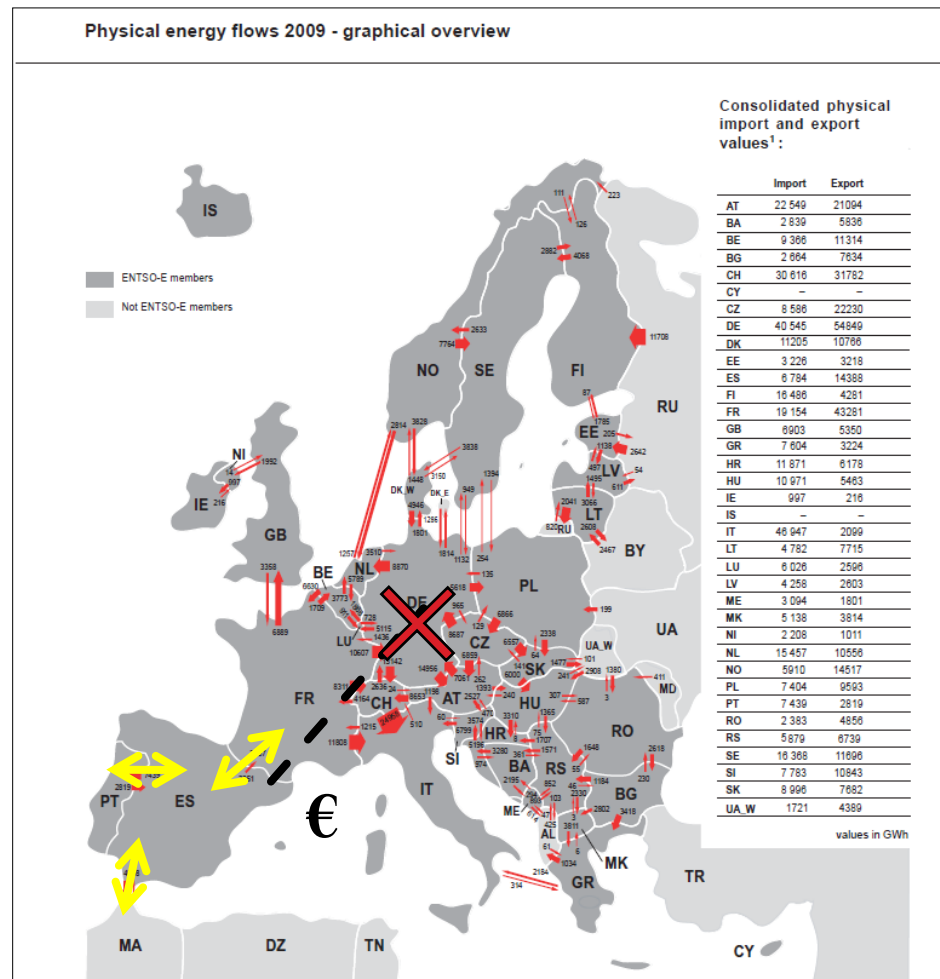
TABLE 8. Imports and Exports

- Non-specified/Other – for countries not listed, specify in Remarks page
- Reported differently from trade of most other fuels:
 - **Physical amounts crossing borders (not final destination)**

Menu		Report Electricity in Columns A and B (Unit = GWh)		Report Heat in Columns C and D (Unit = TJ)	
		IMPORTS A	EXPORTS B	IMPORTS C	EXPORTS D
Syria	55				
Tajikistan	56				
Turkey	57				
Turkmenistan	58				
Ukraine	59				
United Kingdom	60				
United States	61				
Uzbekistan	62				
<i>Non-specified/Other</i>	63	1 154			
TOTAL	64	1 154	0	0	0

TABLE 8. Imports and Exports

- Reported differently from trade of most other fuels:
 - **Physical amounts (not final destination)**
 - Equals amounts crossing borders either on land or underwater
- Example:
 - Physical electricity trade data for Spain is accounted for only with:
 - France
 - Portugal
 - Morocco (underwater cable)
 - X not Germany
- Exercise



Energy and Industry Sector Consumption (Table 4)

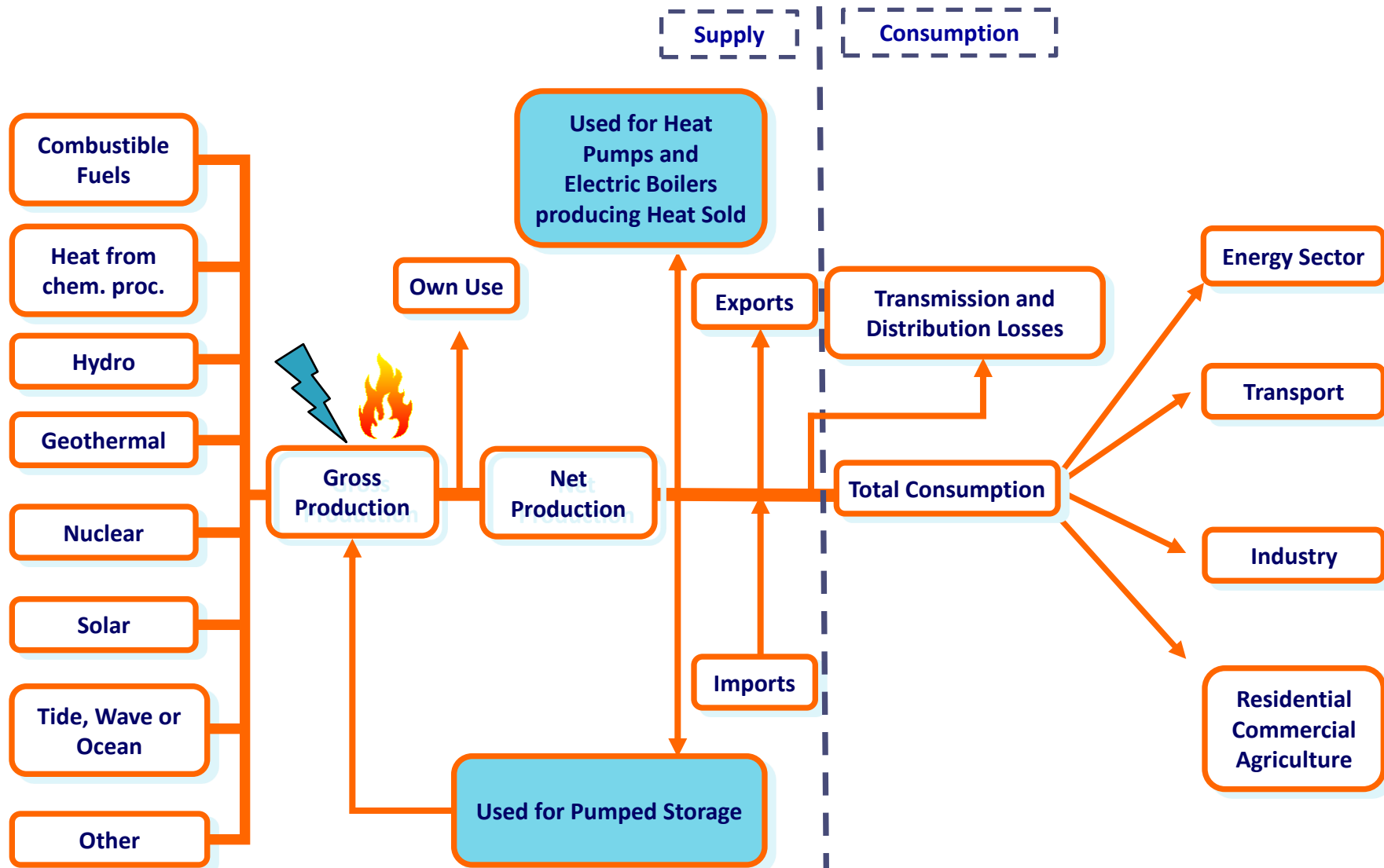


TABLE 3. Electricity and Heat Supply and Consumption

			ELECTRICITY (GWh)	HEAT (TJ)
			A	B
Menu				
Total gross production	1	(=)	59 704	
Own use	2	(-)	1 623	0
Total net production	3	(=)	58 081	
Total imports (balance)	4	(+)	1 154	
Total exports (balance)	5	(-)		
Used for heat pumps	6	(-)		
Used for electric boilers	7	(-)		
Used for pumped storage	8	(-)		
Used for electricity production	9	(-)		
Electricity/Heat supply	10	(=)	59 235	0
Distribution losses	11	(-)	5 081	
Final consumption (calculated)	12	(=)	54 154	0
Statistical differences	13		1	0
Final consumption (observed)	14		54 153	0
Energy sector	15		645	0
Industry sector	16		36 509	0
Transport sector	17		426	
<i>Rail</i>	18		426	
<i>Pipeline transport</i>	19			
<i>Road</i>	20			
<i>Not elsewhere specified (Transport)</i>	21			
Residential	22		8 749	
Commercial and public services	23		7 636	
Agriculture/Forestry	24			
Fishing	25		188	
Not elsewhere specified (Other sectors)	26			

= Total gross production

Own use = gross - net

= Total net production

= Trade totals

= Totals from sub-sectors

Technical Characteristics (Table 7)

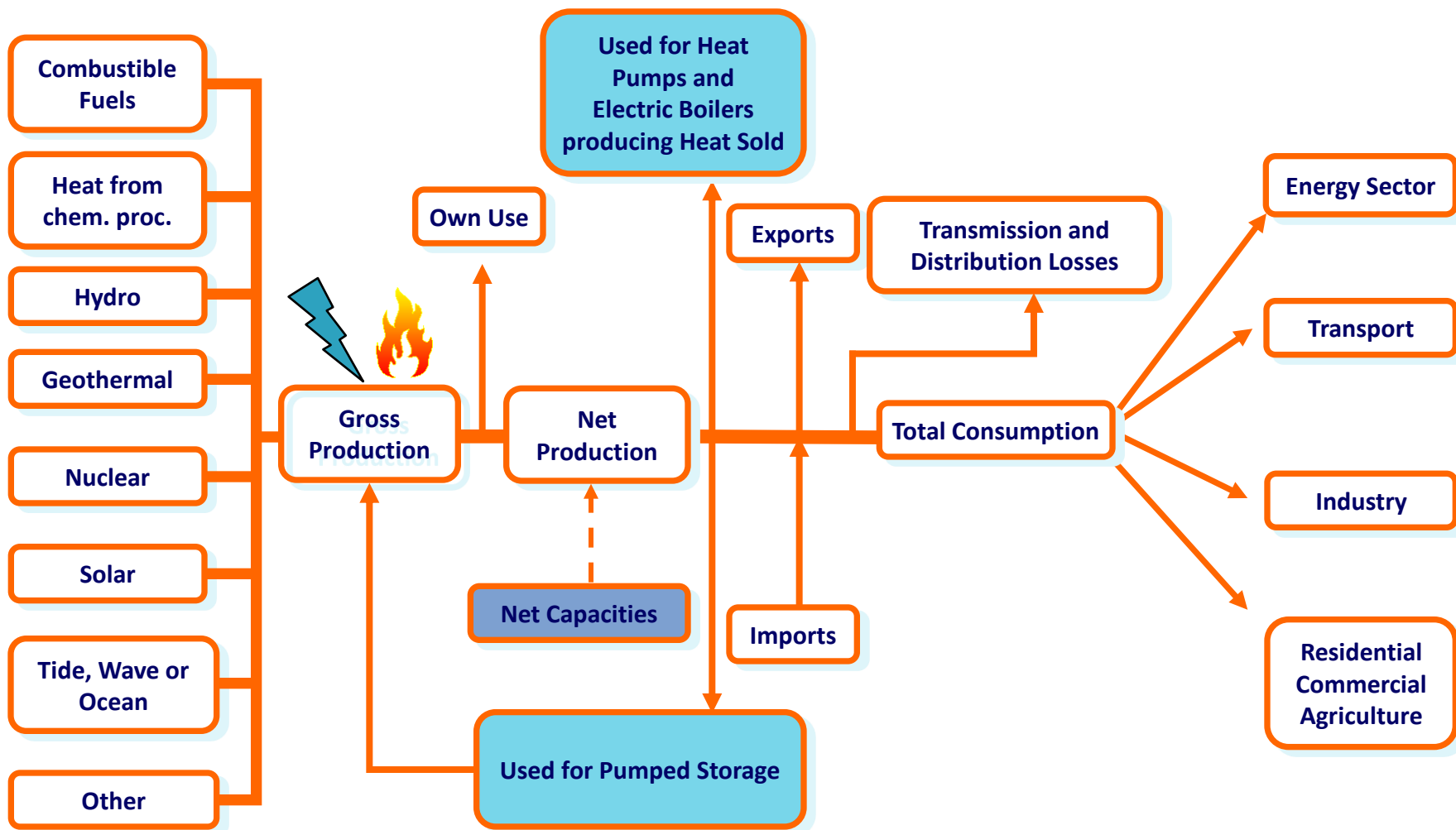
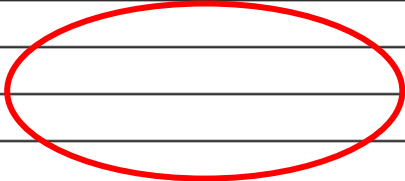


TABLE 7A. Net Maximum Electrical Capacity and Peak Load

CLASSIFICATION BY SOURCE		MAIN ACTIVITY PRODUCERS	AUTOPRODUCERS
		A	B
CLASSIFICATION BY SOURCE	1 - Total capacity	13 136	0
	2 - Nuclear		
	3 - Hydro	4 943	
	4a - Mixed plants		
	4b - Pure pumped storage		
	5 - Geothermal		
	6 - Solar photovoltaic		
	7 - Solar thermal		
	8 - Tide, wave and ocean		
	9 - Wind	20	
	10 - Combustible fuels	8 173	
11 - Other sources			
Combustible fuels: TYPE OF GENERATION	12 - Total conventional thermal	0	
	13 - Steam		
	14 - Internal combustion		
	15 - Gas turbine		
	16 - Combined cycle		
	17 - Other type of generation		

Total should = combustible fuels on row 10



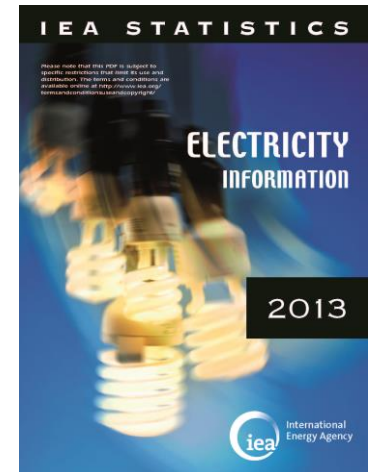
PEAK LOAD INFORMATION		MAIN ACTIVITY PRODUCERS	AUTOPRODUCERS
PEAK LOAD	18 - Peak load		
	19 - Capacity at peak		
	20 - Date of peak load occurrence		
	21 - Time of peak load occurrence		

TABLE 7B. Net Maximum Electrical Capacity of Combustible Fuels

					MAIN ACTIVITY PRODUCER PLANTS	AUTOPRODUCERS
COMBUSTIBLE FUELS: of which:		Primary Fuel (please list where not on Form)	Alternate Fuel (please list)	Second Alternate Fuel (please list)	A	B
SINGLE FUEL FIRED	1	- Coal + coal products			2 043	
	2	- Liquids fuels			1 220	
	3	- Natural gas			4 743	
	4	- Peat				
	5	- Biofuels and wastes			166	
MULTI-FIRED SOLIDS AND LIQUIDS	6					
	7					
	8					
TOTAL	9					
MULTI-FIRED SOLIDS AND NATURAL GAS	10					
	11					
	12					
TOTAL	13					
MULTI-FIRED LIQUIDS AND NATURAL GAS	14					
	15					
	16					
TOTAL	17					
MULTI-FIRED SOLIDS LIQUIDS AND NATURAL GAS	18					
	19					
	20					
TOTAL	21					

- Internal Consistency – (checks between tables internally)
- External Consistency – (comparison with other questionnaires)
- Data Relationship Analysis
 - Ratio of gross to net generation
 - Ranges of calorific values
 - Capacity factors
 - Distribution losses vs. energy supplied
 - Own use vs. total production
 - Efficiencies
- Fluctuations in time series data → cause?

- Electricity Information book
- Electronic online files
- Energy balances
- CO₂ emissions
- Energy efficiency indicators
- Data support for other IEA divisions/other organizations
- Country reviews
- Analysis
 - Assessing security of supply
 - Evolution of efficiencies
 - Environmental impacts
- Making policy and business decisions

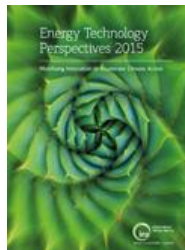
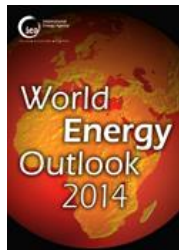


IEA

- Oil & Gas Medium Term -
 - Electricity demand for peaking – indicator of the gas demand



- World Energy Outlook
- Energy Technology Perspectives



Public

- Purchasers of Electronic Data:



- Media uses IEA figures:

- Ad hoc requests from:



- Japan – nuclear

- ◆ Analysts, reports pulled Electricity Information data out to assess % of power and installed capacity of Nuclear

- In response to Germany's call for shutting down reactors – capacity information was asked for avoided/new emissions

- Main activity power plant efficiency
- CHP power plant efficiency
- Share of generation from renewable fuels
- Share of generation from fossil fuels
- Electricity/GDP ratio
- Electricity per capita
- Energy efficiency (e.g. consumption per household)

ELECTRICITY

THANK YOU

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**International
Energy Agency**

Questionnaire Key Points

IEA Energy Statistics Training
Paris, France

29 February – 4 March 2016

Markus Fager-Pintilä
IEA Energy Data Center

iea



International
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Tables 1&2: Plants by energy source



Nuclear



Combustible fuels



Hydro



Geothermal



Wind

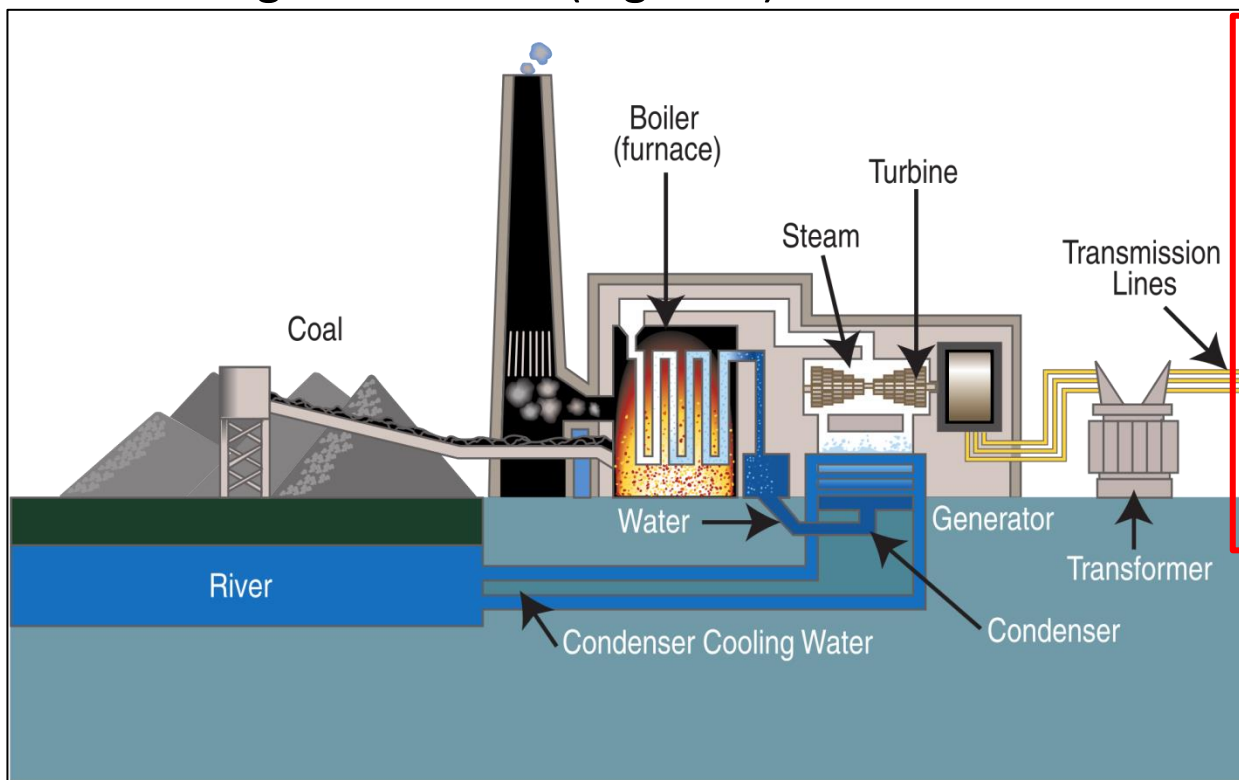


Waves, Tides

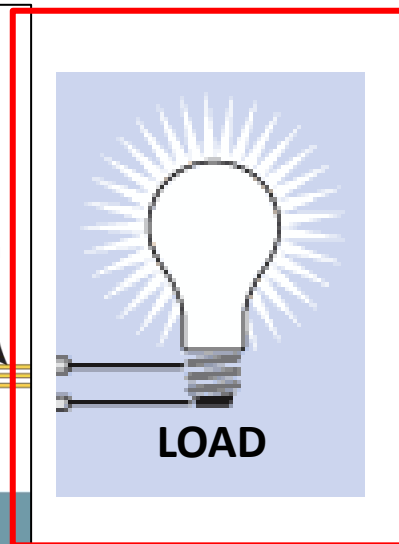


Solar

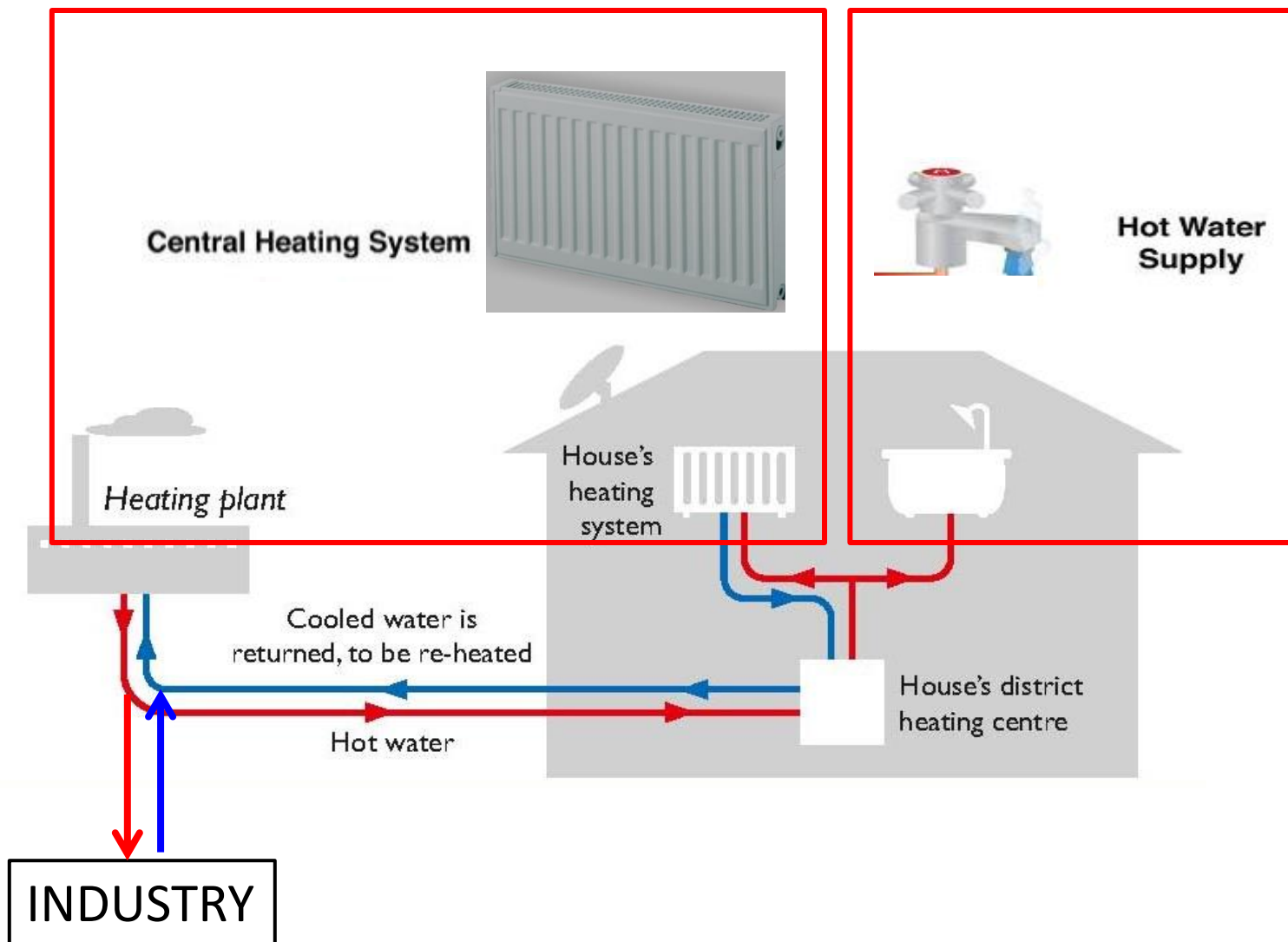
Condensing Power Plant (e.g. coal)



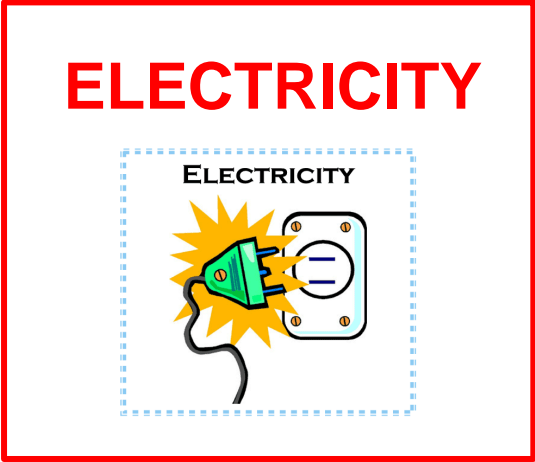
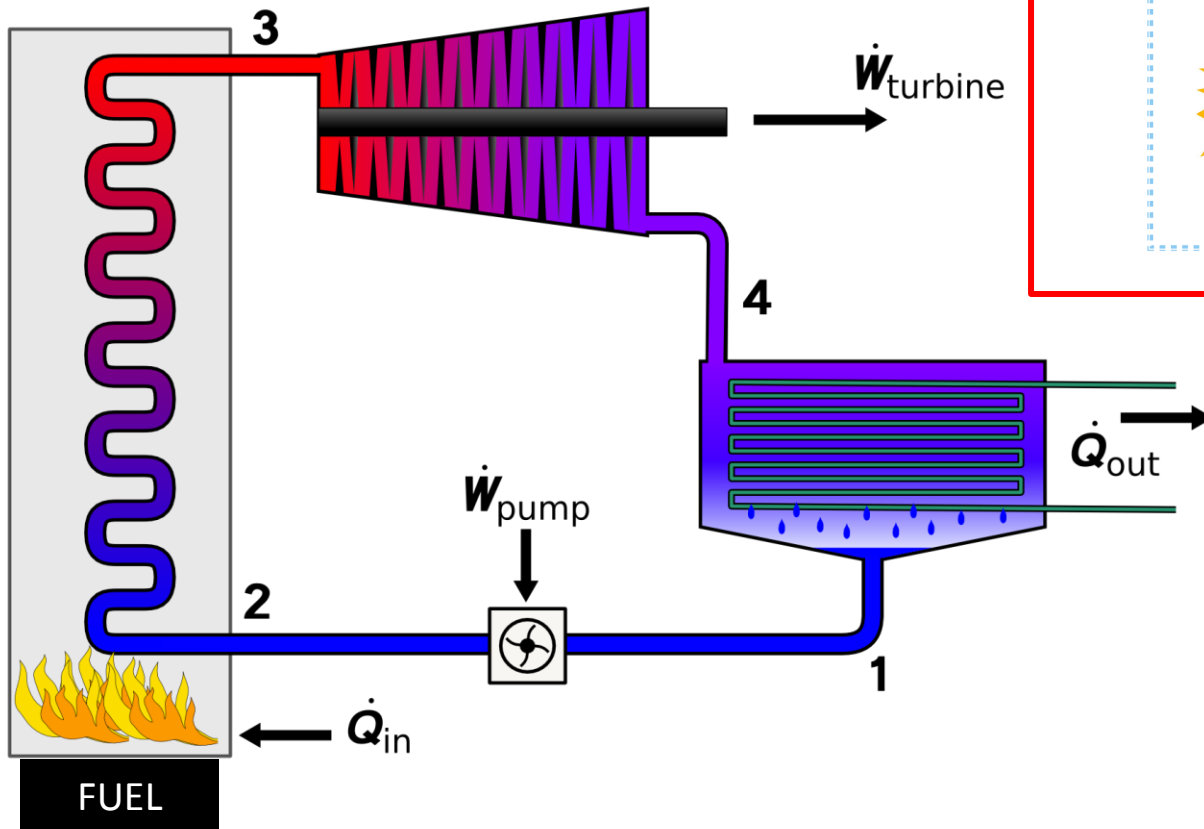
ELECTRICITY



Tables 1&2: Heat only power plant

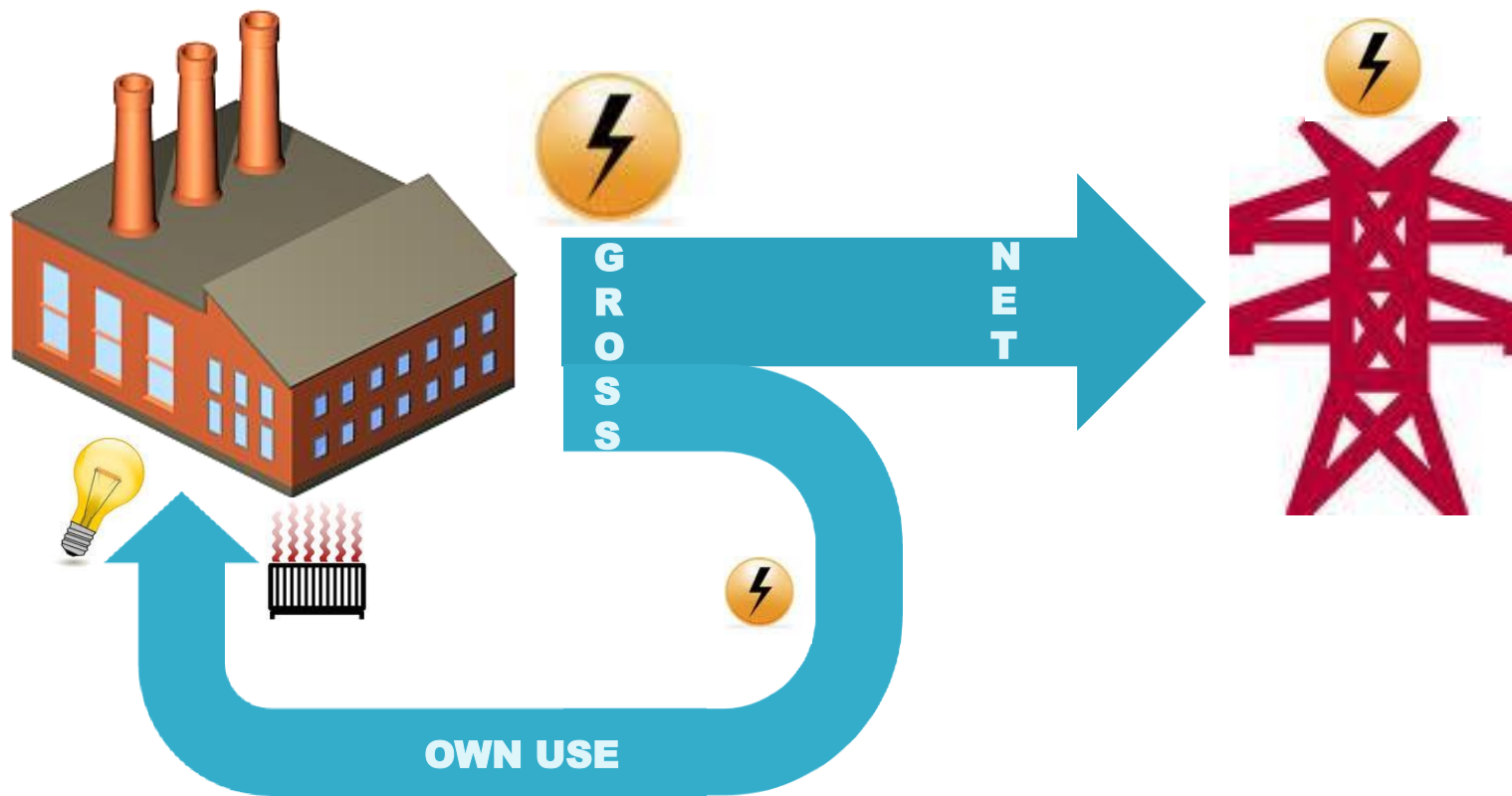


CHP = Combined heat and power



- **Main activity producer plants**
- **Autoproducers**
 - See “Fundamentals of Energy Statistics”-presentation, pages 16-17

Tables 1 vs. 2: Gross and net electricity production



- **GROSS:** electricity produced measured at output terminal of the main generator
- **OWN USE:** electricity absorbed by the generating auxiliaries + electricity lost in the final transformer
- **NET = GROSS – OWN USE**

Table 6: Fuel Input

				MAIN ACTIVITY PRODUCER PLANTS		
				ELECTRICITY (ONLY)	CHP	HEAT (ONLY)
Menu	FUELS		UNITS	A	B	C
	ANTHRACITE	Fuel input	1 10 ³ t			
		Fuel input	2 TJ (NCV)			
		Elec. prod.	3 GWh			
		Heat prod.	4 TJ			

For each combustible fuel:

INPUT shall:

- be reported both in natural (e.g. ktons) and energy units (e.g. TJ)
- match INPUT given in the other AQs. Check it!

$$\text{INPUT (TJ)} = \text{INPUT (ktons)} \times \text{NCV (TJ/ktons)}$$

NCV shall:

- be in reference ranges for a given fuel (reliability)
- match NCVs given in the other AQs

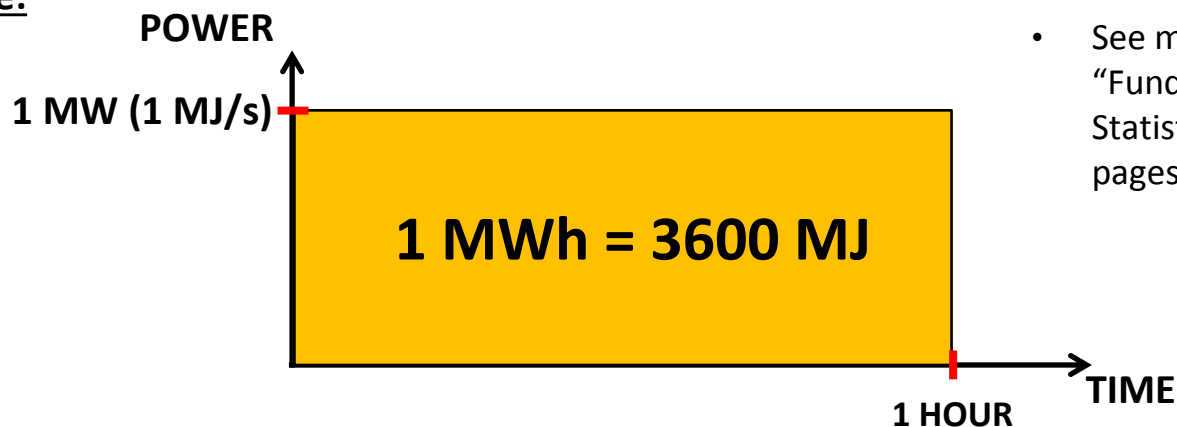
Note: See more on CVs in “Fundamentals of Energy Statistics”-presentation, pages 9-11

Table 6: Electricity/Heat production

2016				MAIN ACTIVITY PRODUCER PLANTS		
				ELECTRICITY (ONLY)	CHP	HEAT (ONLY)
Menu	FUELS		UNITS	A	B	C
ANTHRACITE	Fuel input	1	10 ³ t			
	Fuel input	2	TJ (NCV)			
	Elec. prod.	3	GWh			
	Heat prod.	4	TJ			

- Production (gross): electricity in GWh, heat in TJ
 - Energy = Power * time (Capacity multiplied by the time)

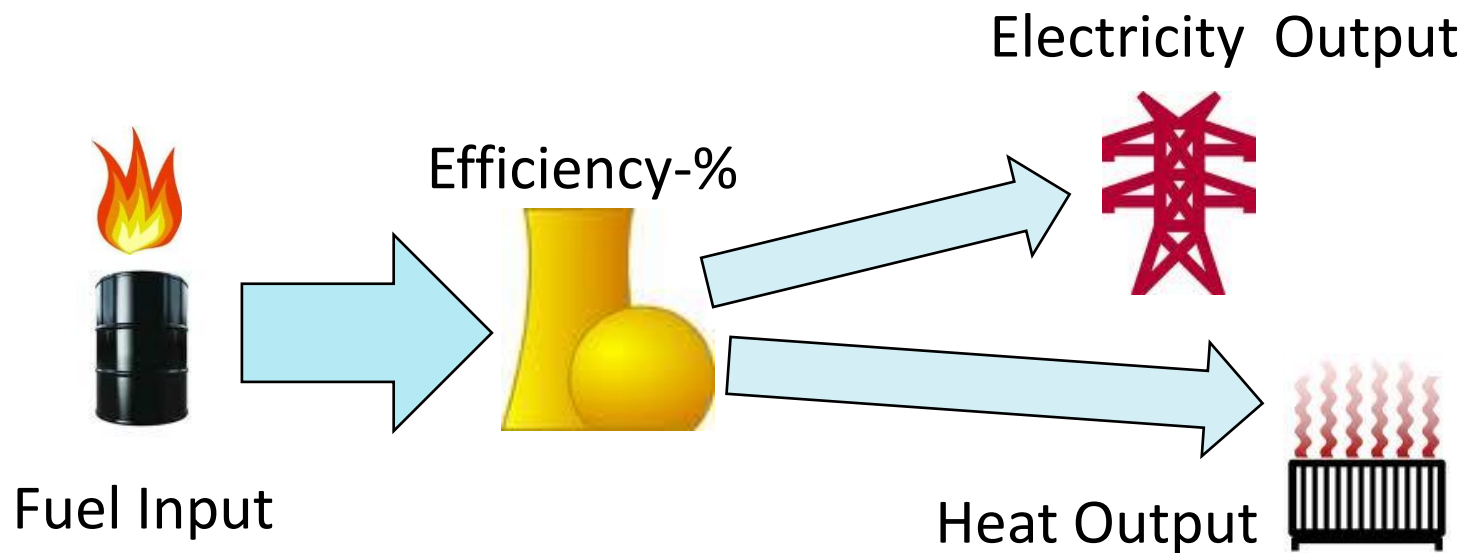
Example:



Notes:

- Power =/= Energy
- Unit for power = W = J / s
- See more on conversion in "Fundamentals of Energy Statistics"-presentation, pages 6-8

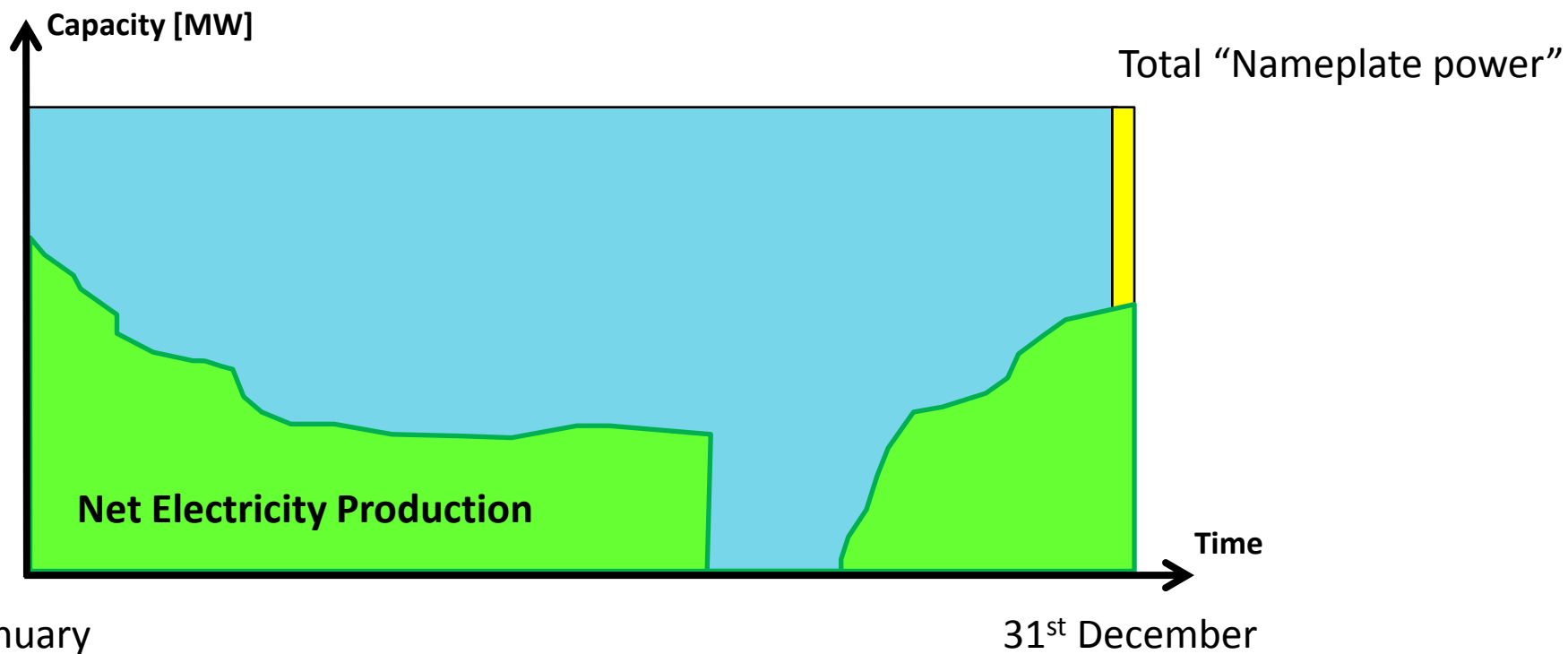
Produced energy = 1 MW * 1 hour = 1 MWh = 1 MW * 3600 seconds = 3600 MJ



$$\text{EFFICIENCY} = \text{OUTPUT} / \text{INPUT (NCV)} \quad (\text{all in energy units})$$

Efficiency shall:

- be in reference ranges for different production types
- be always < 100%



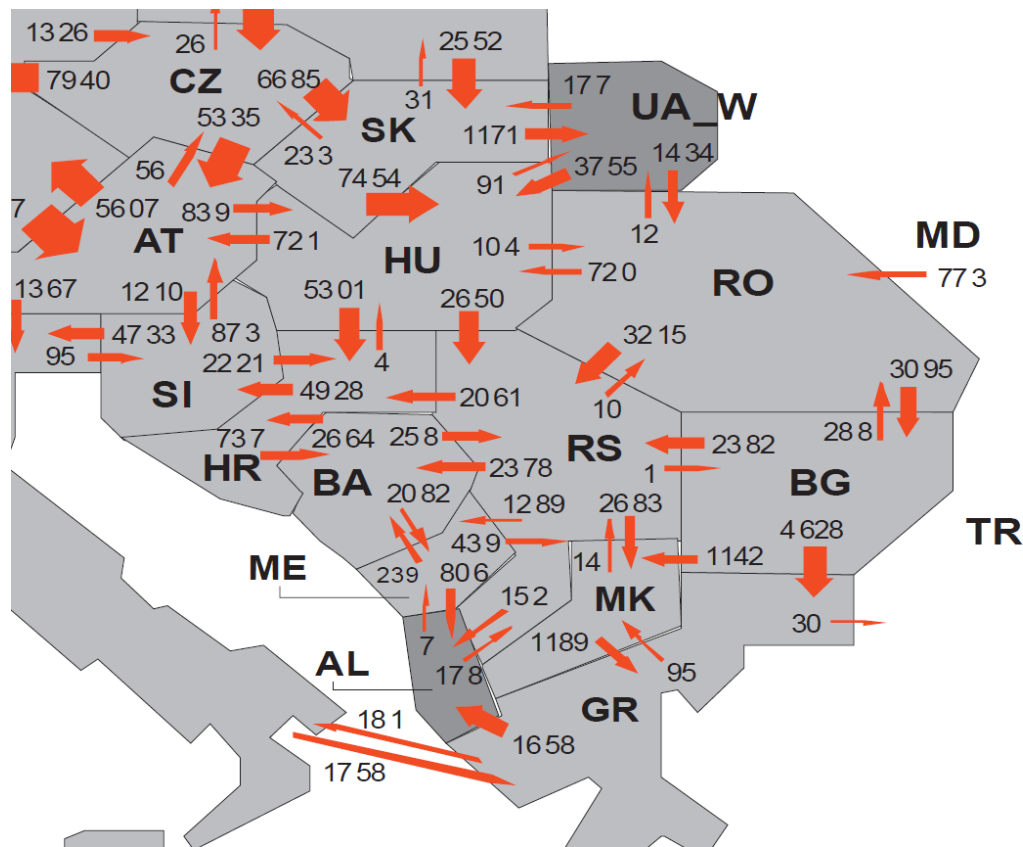
$$\text{Capacity factor [\%]} = \frac{\text{actual production}}{\text{maximum potential production}}$$

Capacity factor shall:

- be in reference ranges for different production types
- be always < 100%

Table 8: Electricity and Heat Trade

- **ALL** the quantities of electricity and heat crossing national borders must be accounted **including transit**
- **Note** that this **differs from** the trade rule for all **other** energy commodities!



Let's see an example:

Table 8: Electricity and Heat Trade (example)

- Example **GAS**: transit trade should NOT be accounted under import/export
- Example **ELECTRICITY**: transit trade SHOULD be accounted under import/export

