POLITECHNIKA GDAŃSKA
WYDZIAŁ ELEKTROTECHNIKI I AUTOMATYKI

NUCLEAR POWER

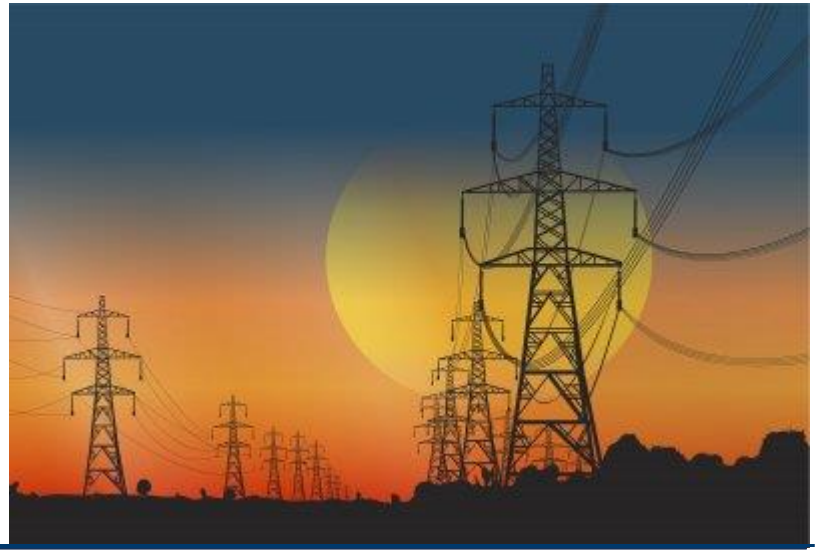
LECTURE 3

Gdańsk 2018

NUCLEAR POWER – LECTURE 3

1. Power system:
   a) structure
   b) energy sources
   c) power grid
   d) consumer
2. Classification of the power plant in the NPS
3. Basic parameters of steam power plants
4. Basic parameters of gas power plants

POWER SYSTEM

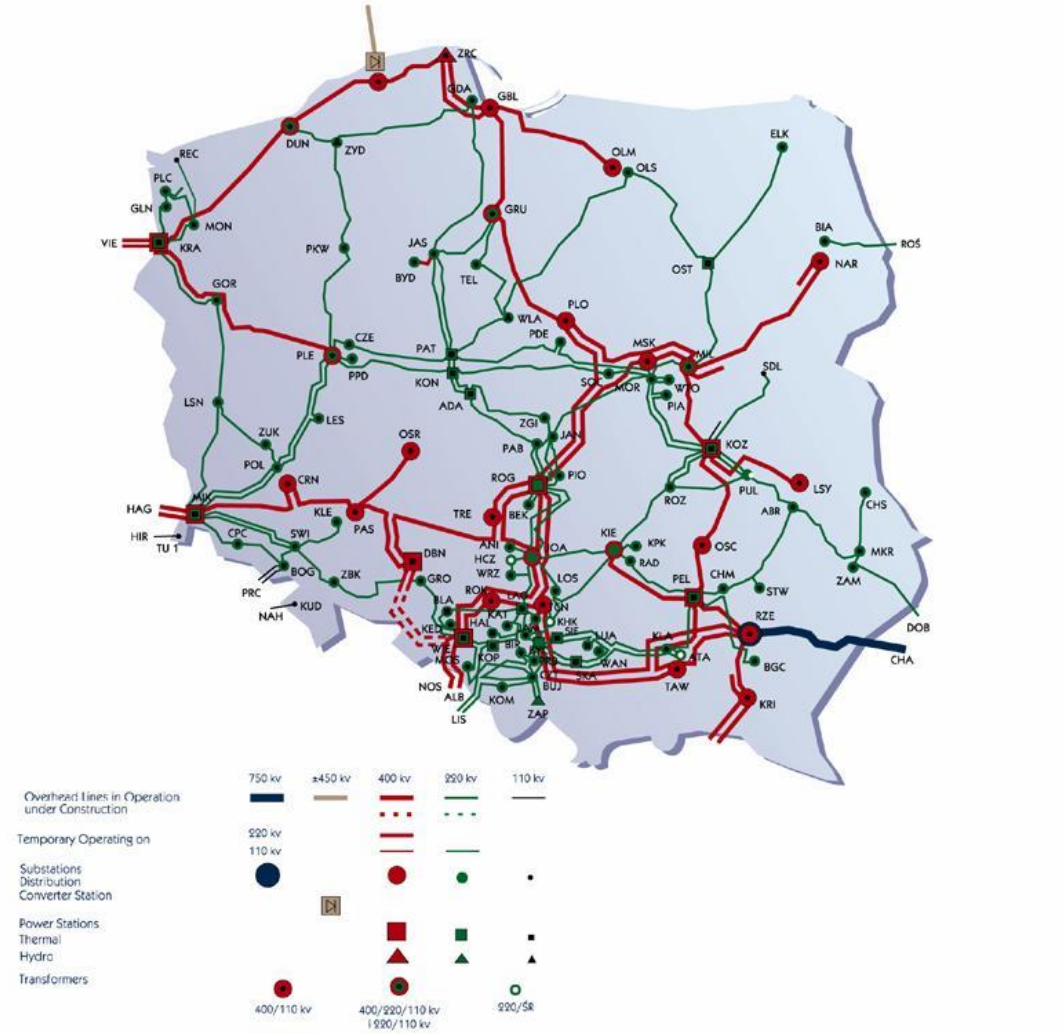


POWER SYSTEM

The power system is a system that includes many devices functionally connected with each other:

- generation sources (power plants)
- systems used for transmission, processing and distribution of electricity
- consumers consuming energy in various types of receivers

in order to carry out the process of **continuous** electricity supply to recipients.

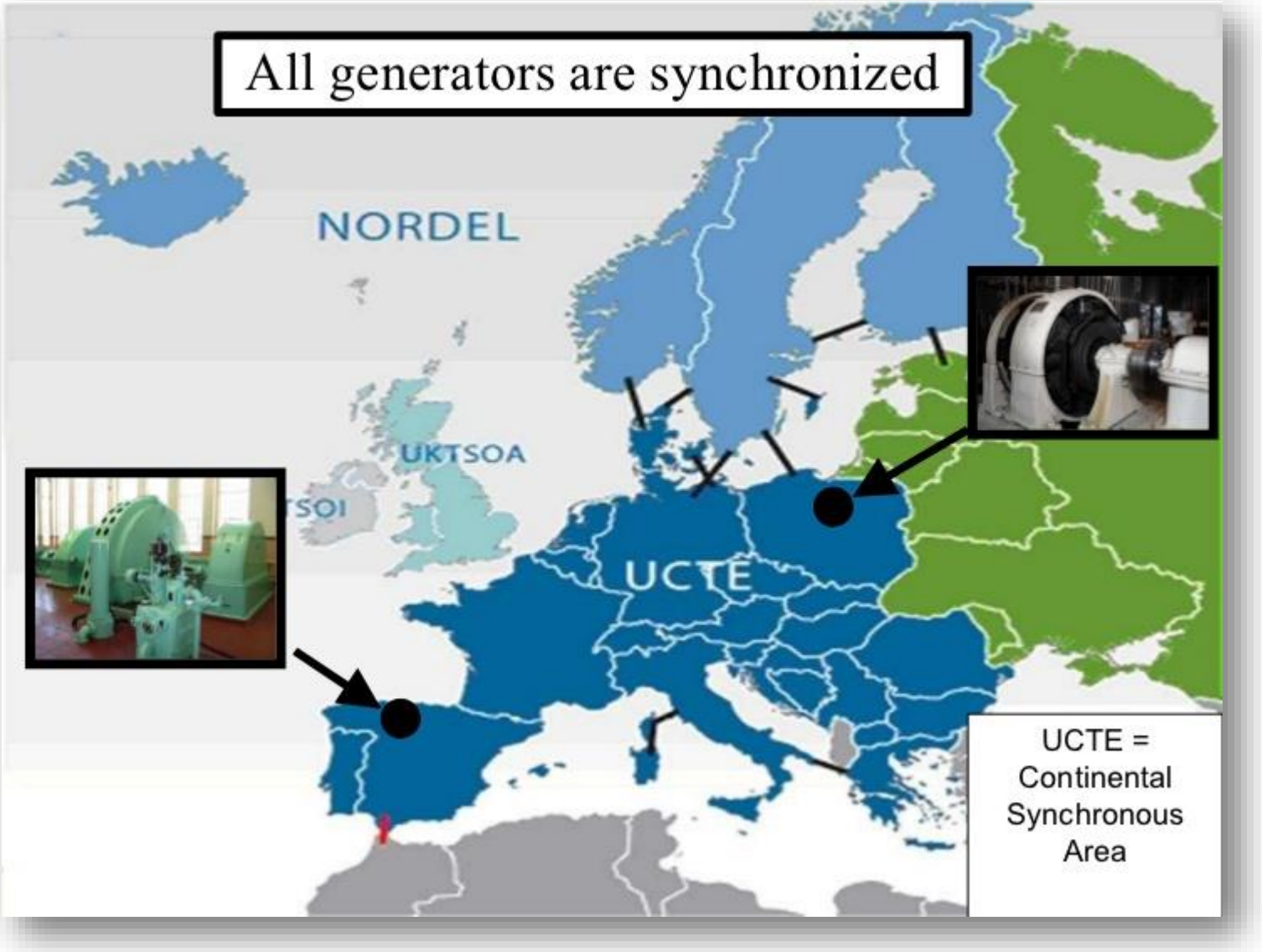


POWER SYSTEM

Features of the power system:

- electricity generation, transmission and processing take place virtually simultaneously;
- no possibility to store electricity;
- each deprivation of energy consumers (even short-term) causes large losses;
- particularly high reliability of system operation is required;
- the system is vastly territorial, covers the whole country and is linked to other national power systems (UCPTE - EEC + Poland, Czech Republic, Slovakia, Hungary).

POWER SYSTEM



Power plant classification

The most commonly used classification criteria:

- the type of primary energy used;
- administrative affiliation;
- working time during the year (depending on the unit cost of electricity generation).

Distribution of power plants due to their administrative affiliation:

- professional power plants;
- industrial power plants.

POWER SYSTEM - ENERGY SOURCES

Distribution of power plants due to the type of primary energy used

Thermal power stations

are plants producing electricity on an industrial scale and using the energy of organic (conventional) or nuclear fuels for this purpose.

Hydroelectric power plants

convert potential energy of water (energy of water fall) into mechanical energy in a water turbine, and then into electric energy in a generator driven by a water turbine.

Unconventional power plants:

solar power plants; wind farms; marine power plants

POWER SYSTEM - ENERGY SOURCES

Depending on the type of heat engine, thermal power plants are divided into

classic steam power plants (conventional),

working medium is steam generated in the boiler, performing work in a steam turbine;

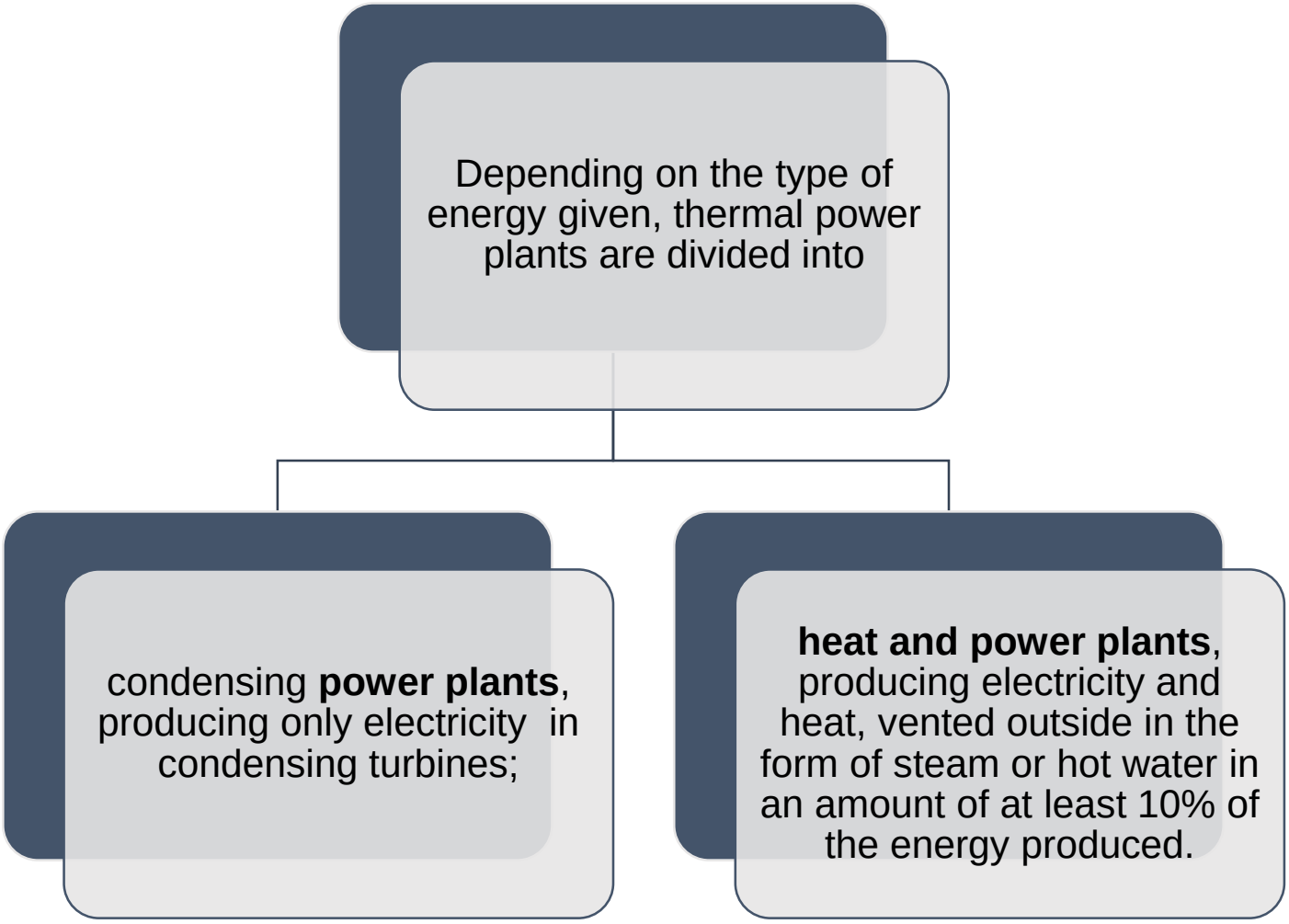
nuclear steam power plants,

thermal energy provides the working medium with nuclear fuel in the reactor;

gas power plants,

working medium is gas that is the product of fuel combustion and performs work in a gas turbine

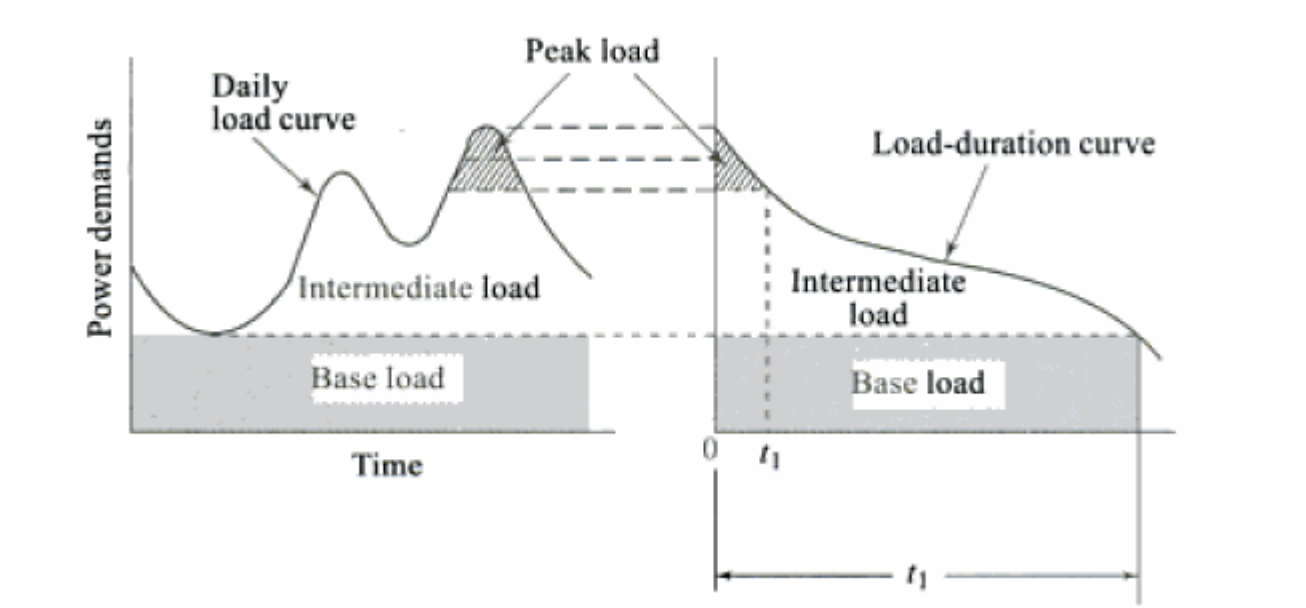
POWER SYSTEM - ENERGY SOURCES



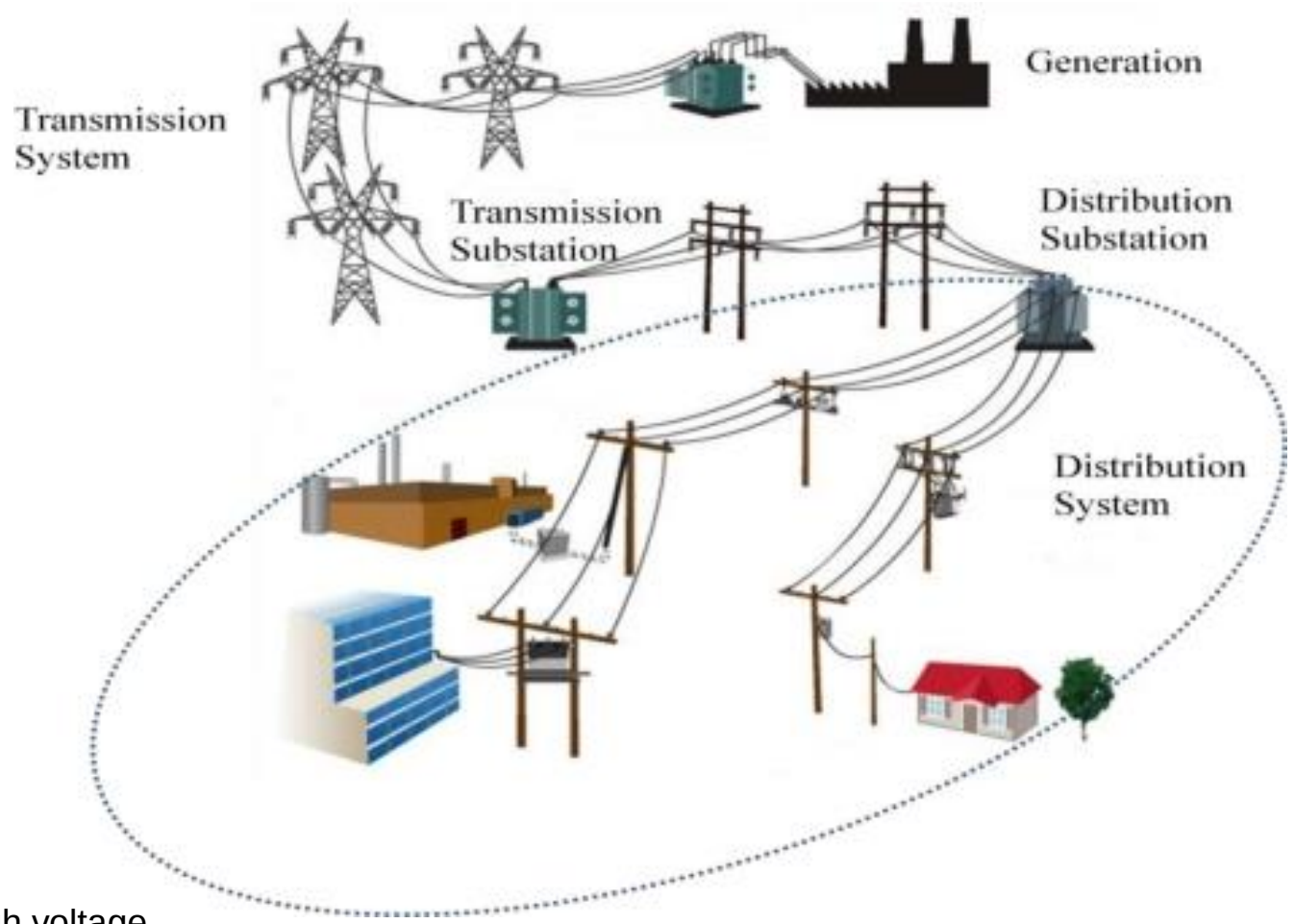
POWER SYSTEM - ENERGY SOURCES

Depending on the type of working time during the year

- Baseload power plant
- Intermediate load power plant
- Peak load power plant



POWER SYSTEM – POWER GRID



HV – high voltage
MV – medium voltage
LV – low voltage

POWER SYSTEM – ELECTRICAL ENERGY

Features of electric Energy:

- the most universal form of energy
- harmless to the environment during the use phase, affecting the environment at the "production" stage
- lack of practical storage possibilities (only by converting it into other forms of energy)
- the need to adapt production to the changing demand by customers

POWER SYSTEM – CONSUMERS

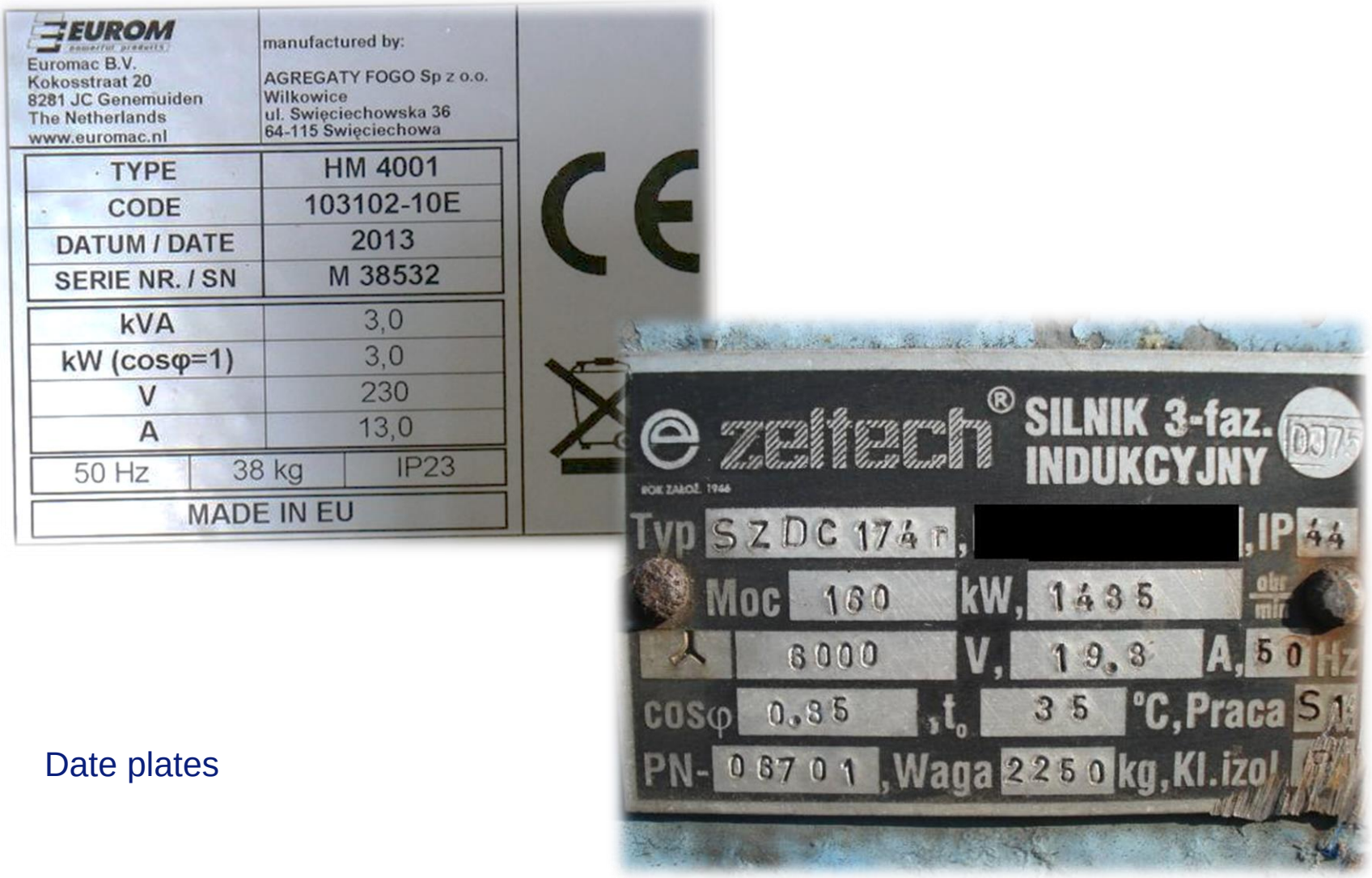
Rated/Nominal power P_n

power, which consumer can

be permanetly loaded

Peak power P_s - max consumed power

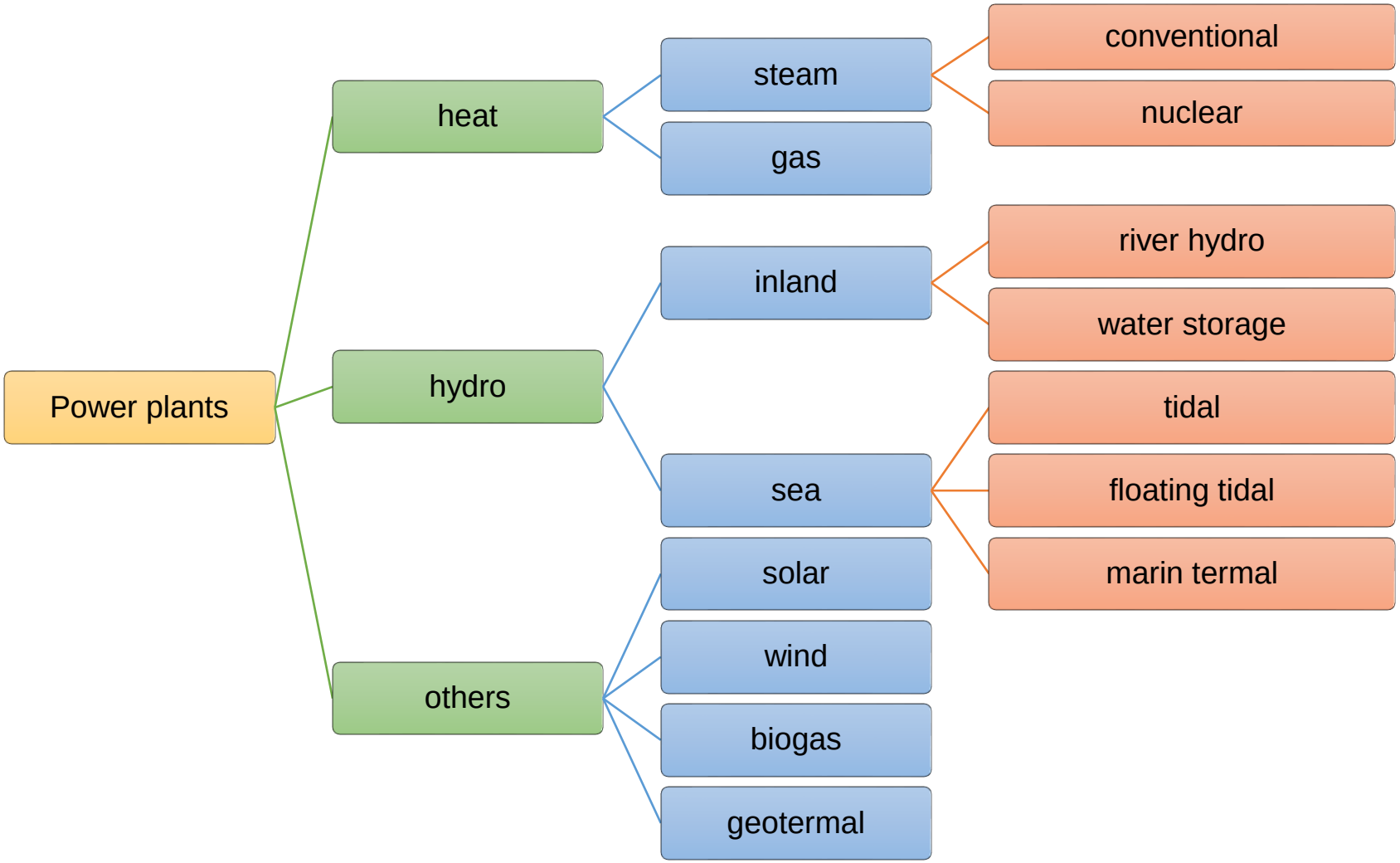
POWER SYSTEM – CONSUMERS



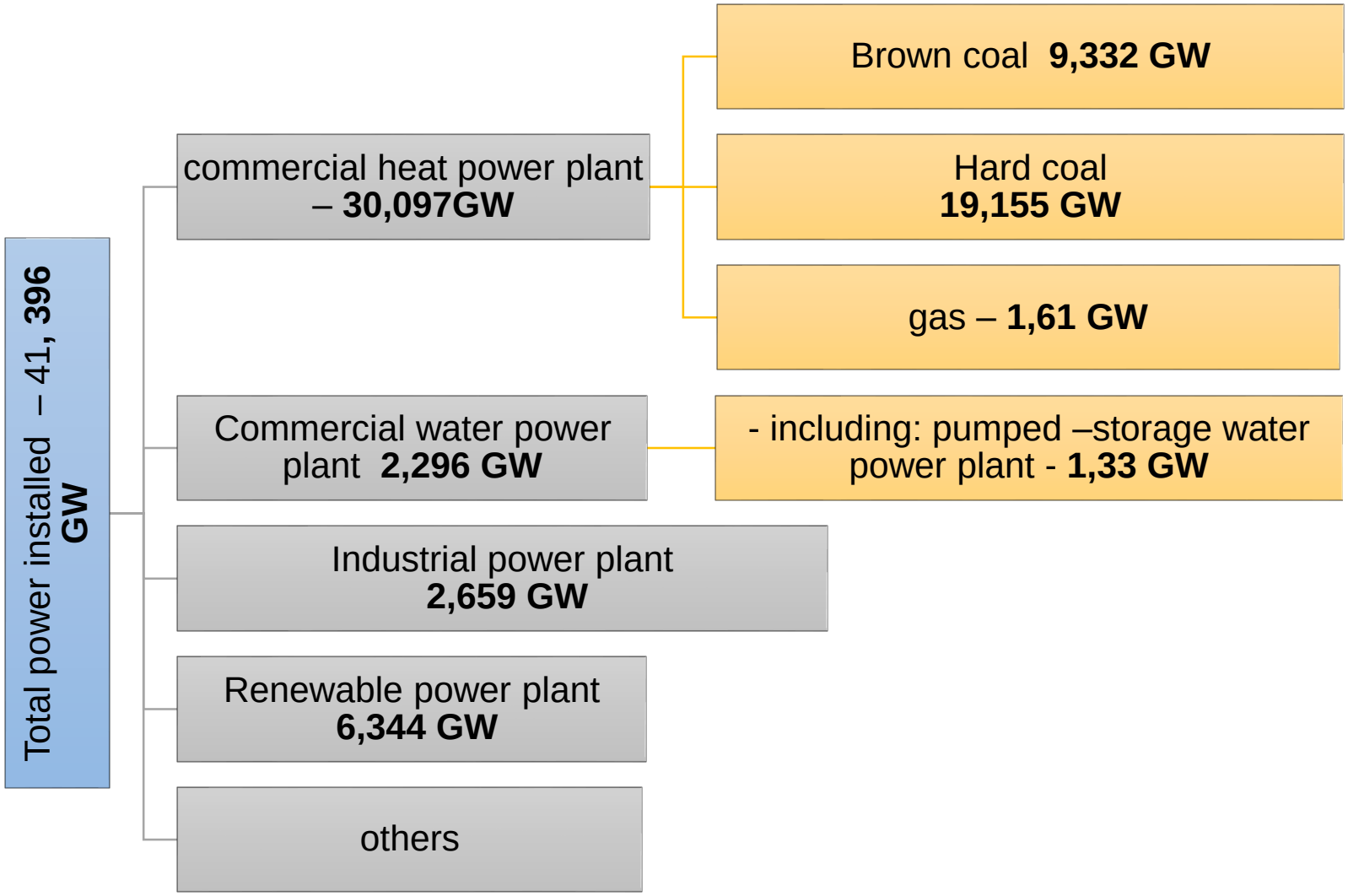
Date plates

CLASSIFICATION OF THE POWER PLANT IN THE NPS

CLASSIFICATION OF THE POWER PLANT

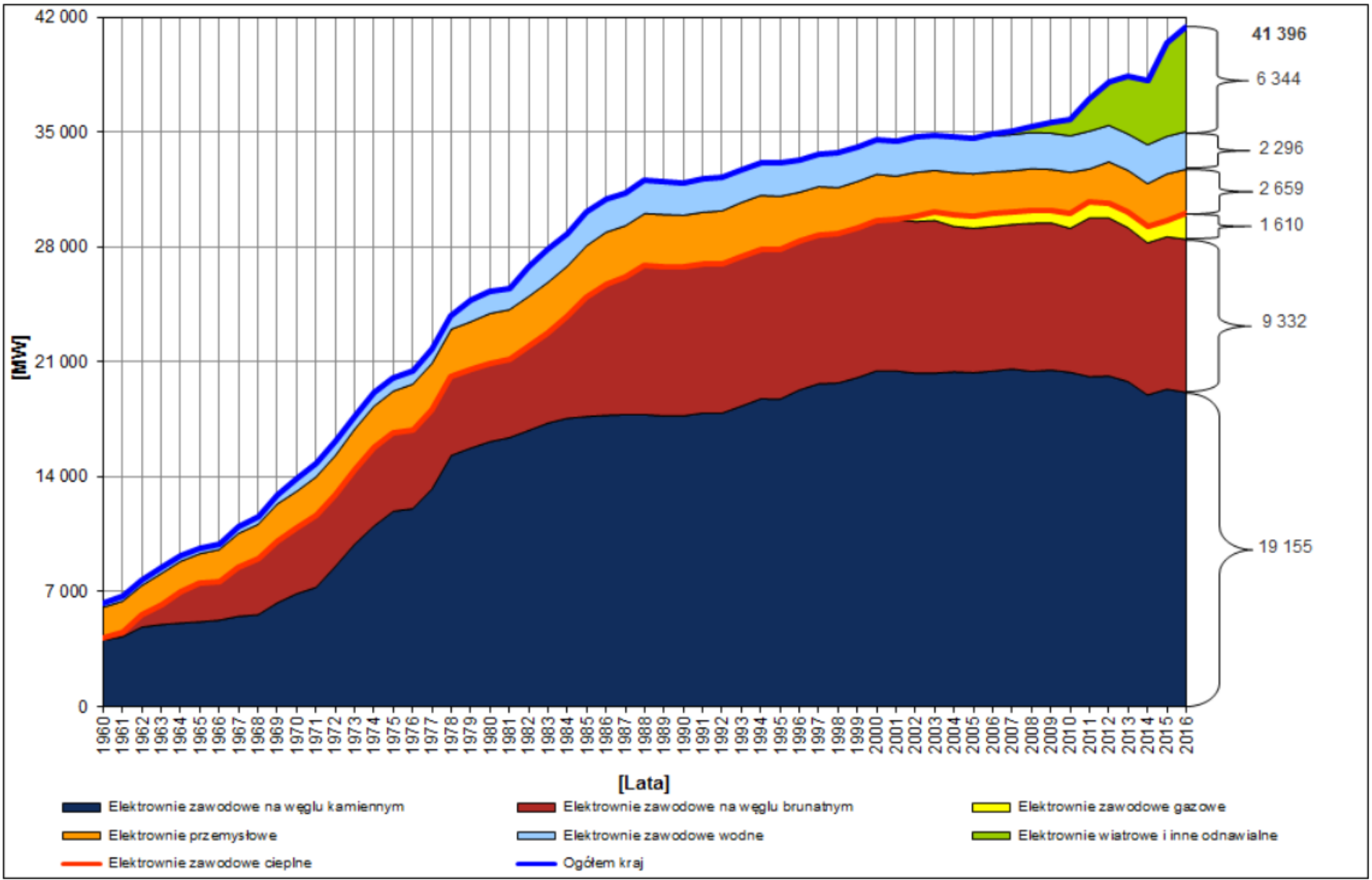


POWER INSTALLED IN POLISH ELECTROENERGETIC SYSTEM (31.12.2016 R.)



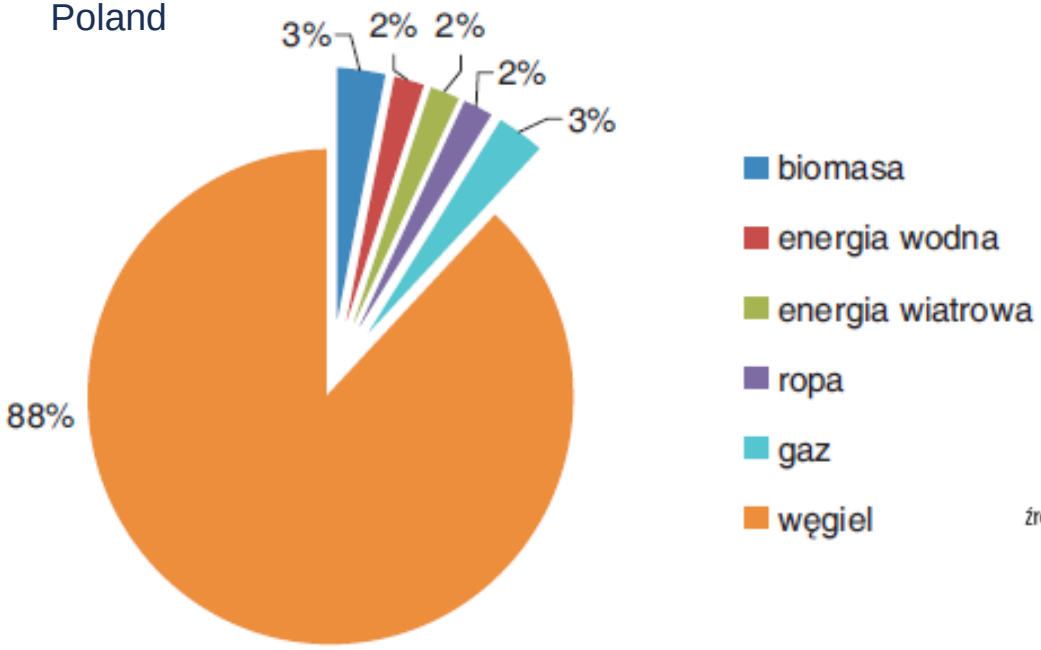
Dane wg Kwartalnika Agencji Rozwoju Regionalnego, portal CIRE.pl

INCREASE OF POWER INSTALLED IN POLISH ELECTROENERGETIC SYSTEM 1960 ÷ 2016 (according to PPS data)



THE STRUCTURE OF ELECTRICITY PRODUCTION ACCORDING SOURCES

Poland



Źródło: Poland Energy Report, Enerdata, Lipiec 2012

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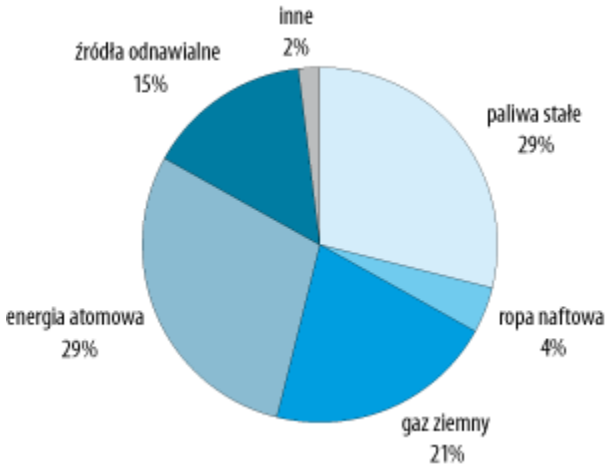


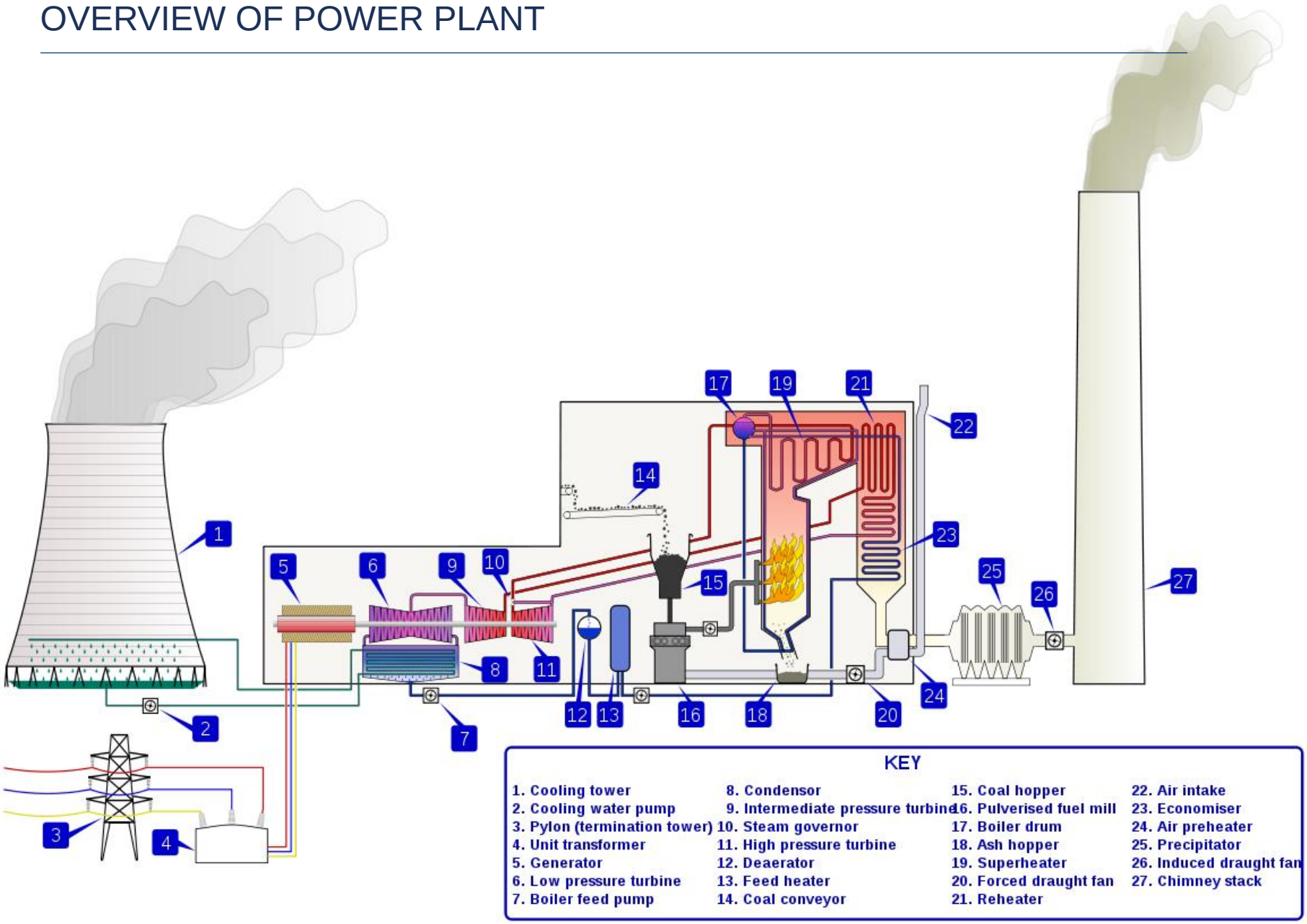
Opracowanie IBnGR na podstawie: „Europe's current and futures energy position. Demand – resources – investments", 2008, Commission Staff Working Document, EC, COM (2008) 744, Brussels.

PRODUCTION AND CONSUMCION OF ELECTRIC ENERY IN 1990÷2016 [GWH]

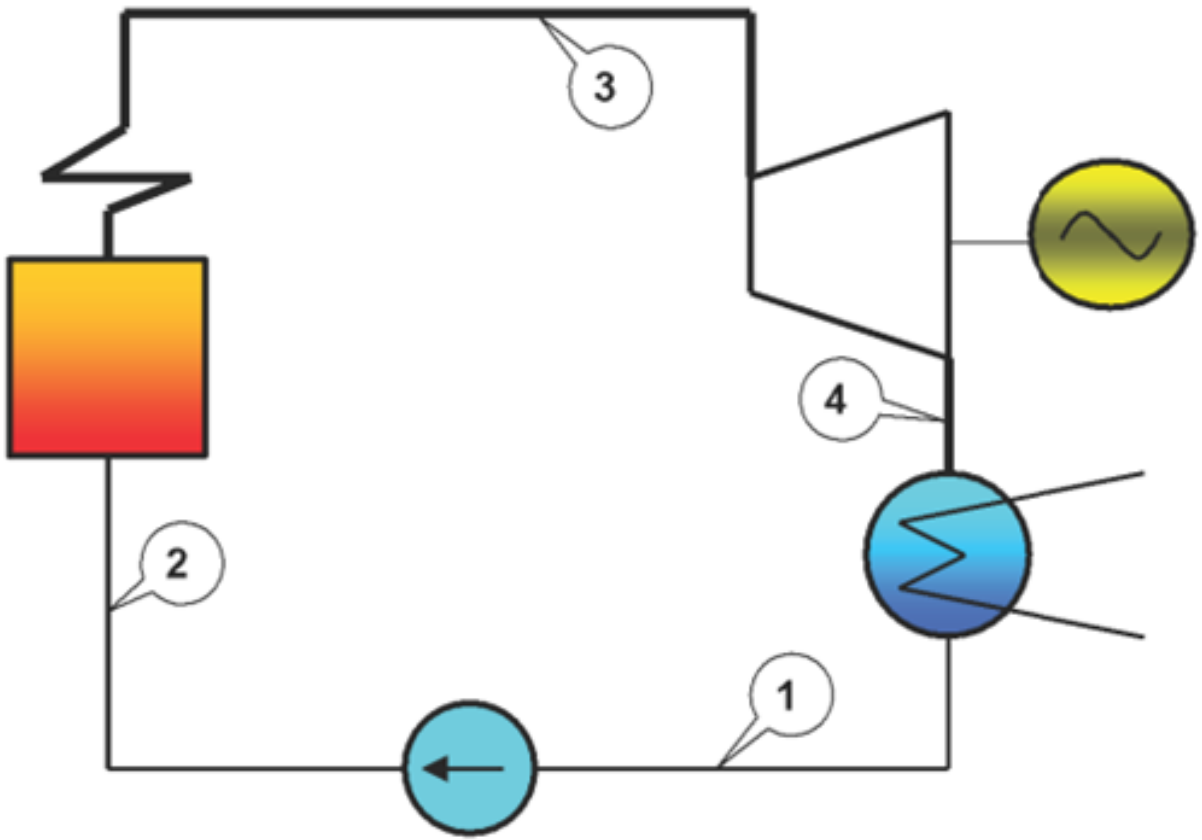
Rok	Krajowa produkcja energii	z tego:					Krajowe zużycie energii
		Elektrownie zawodowe	Elektrownie zawodowe		Elektrownie wiatrowe i inne odnawialne	Elektrownie przemysłowe	
			Elektrownie wodne	Elektrownie cieplne			
1990	**136 336**	128 199	3 300	124 899	0	8 137	**135 275**
1991	**134 610**	126 783	3 388	123 395	0	7 827	**131 922**
1992	**132 835**	124 557	3 564	120 993	0	8 278	**128 803**
1993	**133 747**	125 264	3 553	121 711	0	8 483	**131 336**
1994	**134 890**	126 422	3 744	122 678	0	8 468	**132 211**
1995	**138 701**	130 176	3 814	126 362	0	8 525	**135 900**
1996	**142 717**	134 352	3 839	130 513	0	8 365	**139 593**
1997	**142 414**	134 380	3 739	130 641	0	8 034	**140 228**
1998	**142 244**	134 554	4 243	130 311	0	7 690	**138 770**
1999	**141 286**	133 692	4 157	129 535	0	7 593	**136 351**
2000	**144 417**	136 762	3 984	132 778	0	7 655	**138 043**
2001	**144 574**	136 412	4 057	132 355	0	8 159	**137 843**
2002	**143 233**	135 123	3 722	131 401	0	8 110	**136 165**
2003	**150 751**	142 494	3 146	139 348	0	8 257	**140 590**
2004	**153 362**	144 821	3 525	141 296	0	8 541	**144 069**
2005	**156 024**	147 616	3 587	144 029	0	8 407	**144 838**
2006	**160 848**	152 498	2 822	149 676	69	8 280	**149 847**
2007	**159 528**	150 865	3 908	146 957	446	8 216	**154 170**
2008	**155 567**	146 845	2 515	144 330	678	8 044	**154 980**
2009	**150 923**	141 872	2 751	139 121	846	8 203	**148 718**
2010	**156 342**	146 107	3 268	142 839	1 312	8 923	**154 987**
2011	**163 153**	151 319	2 529	148 790	2 833	9 000	**157 909**
2012	**159 853**	146 833	2 264	144 569	4 025	8 991	**157 013**
2013	**162 501**	147 435	2 762	144 673	5 895	9 171	**157 980**
2014	**156 567**	140 290	2 520	137 770	7 256	9 020	**158 734**
2015	**161 772**	141 901	2 261	139 640	10 114	9 757	**161 438**
2016	**162 626**	140 727	2 399	138 328	11 769	10 130	**164 625**

HEAT POWER PLANT

OVERVIEW OF POWER PLANT



HEAT LAYOUT THERMAL POWER PLANT



THERMAL POWER PLANT

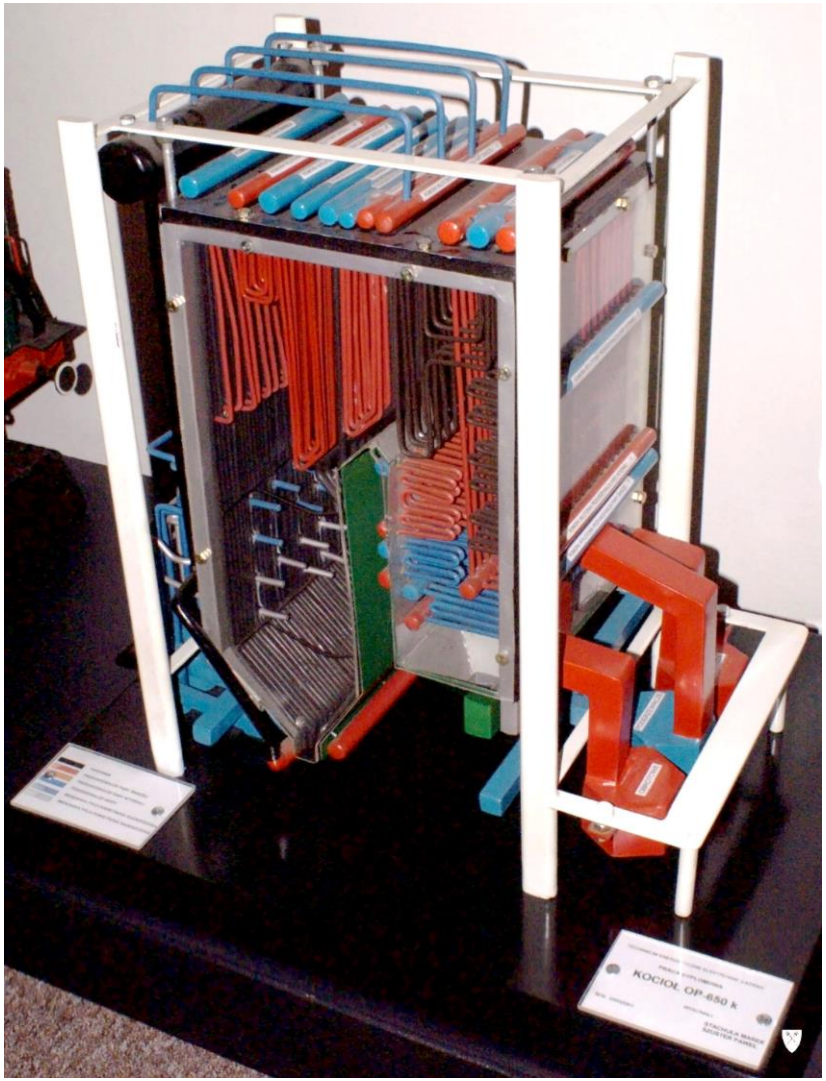


Foto. Rafako

THERMAL POWER PLANT

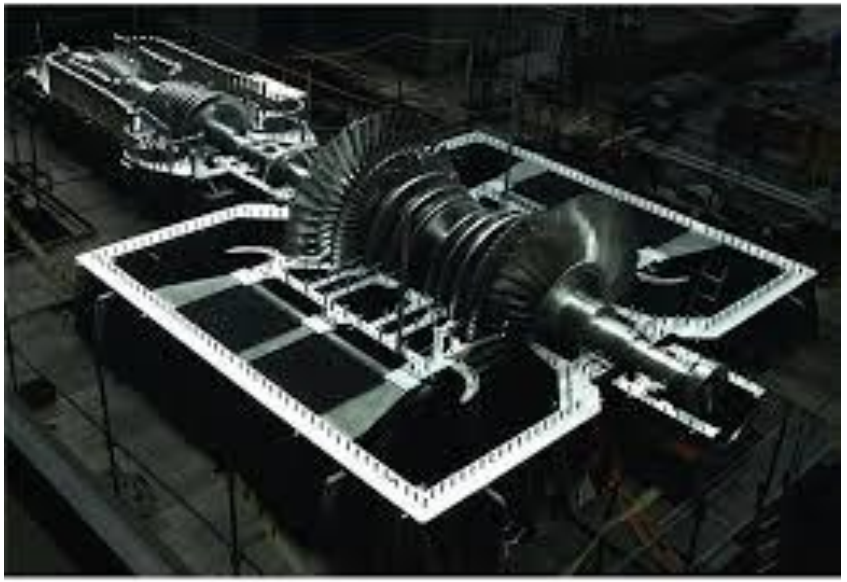


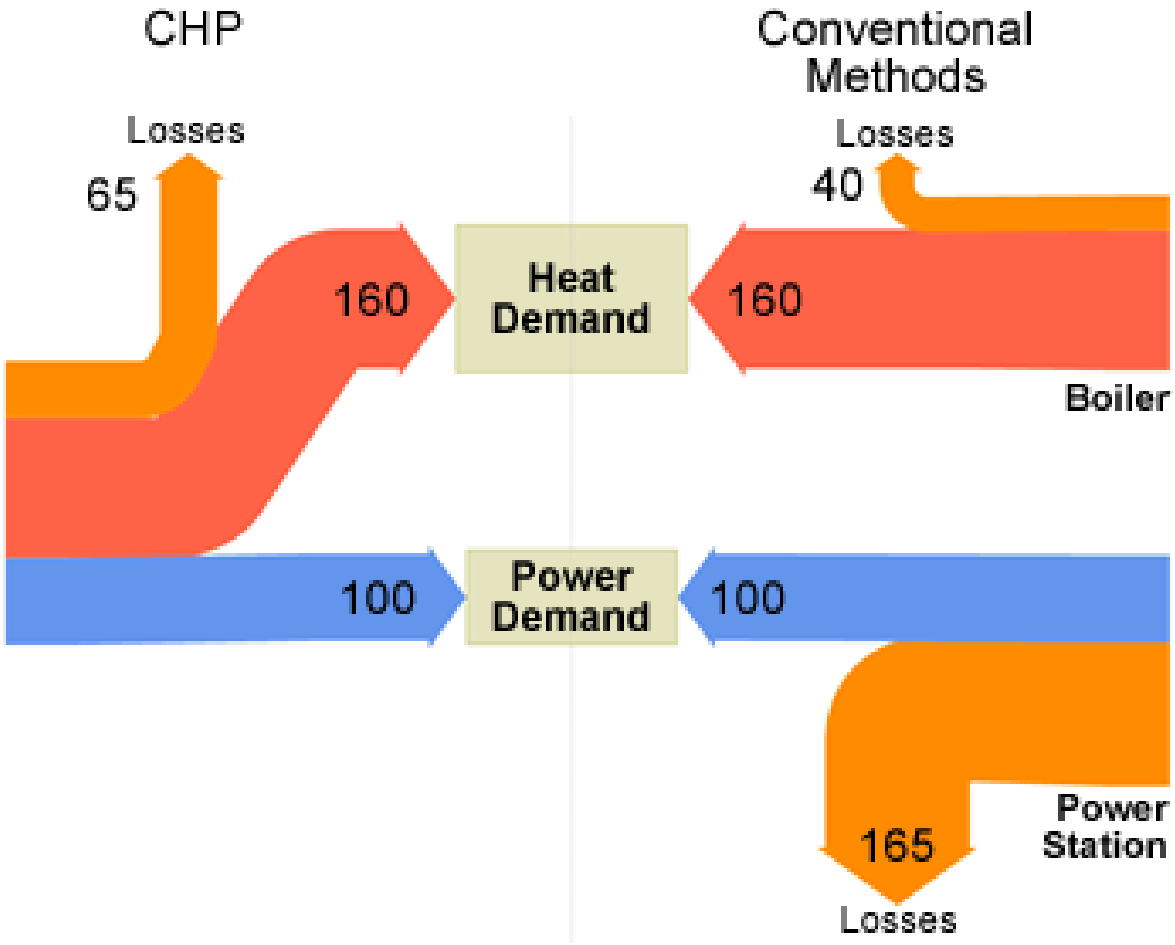
Foto. Skoda Power

THERMAL POWER PLANT

ENERGY VALUES OF FUEL

- biomass 6-15 MJ/kg
- hard coal 19-26 MJ/kg
- brown coal 8-21 MJ/kg
- crude oil 39-42 MJ/kg
- natural gas 34,8-35,8 MJ/nm^3
- biogas 40-50 MJ/kg

SANKEY CHART

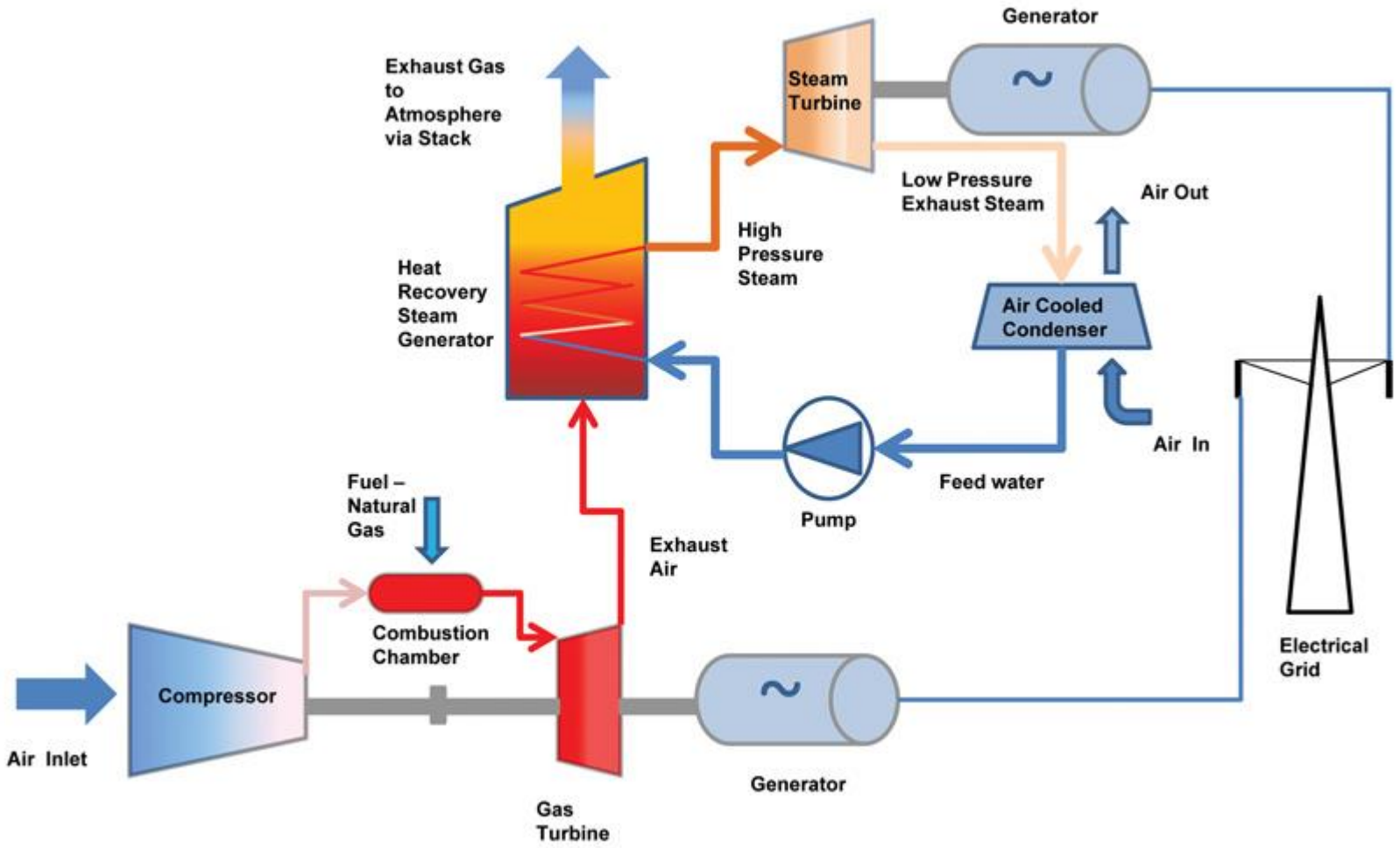


GAS POWER PLANT

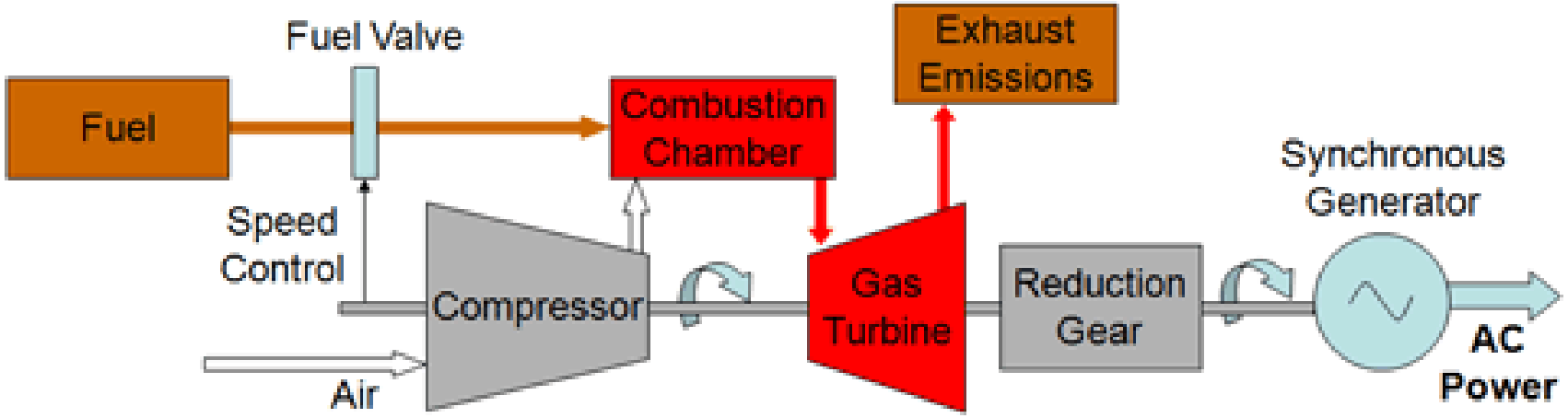
GAS POWER PLANT IN POLAND

Lp.	Nazwa obiektu	Rodzaj bloku	Moc elektryczna	Moc cieplna	Data uruchomienia
1	Elektrociepłownia Lublin- Wrotków	BGP	235 MW	150 MWt	2002
2	Elektrociepłownia Zielona Góra	BGP	198 MW	135 MW	2004
3	Elektrociepłownia Gorzów	BGP	65,5 MW	112 MWt	1999
4	Elektrociepłownia Rzeszów	BGP100	101MW	76 MWt	2003
5	Elektrociepłownia Nowa Sarzyna	BG	116 MW	70 MW	2000
6	Elektrociepłownia Siedlce	BG	22,4 MW	14,6MWt	2002
7	Elektrociepłownia Władysławowo	BG	11 MW	18 MWt	2002

COMBINED GAS AND STAM POWER PLANT



GAS POWER PLANT



Gas Turbine Electric Power Generation

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Thank you for your attention