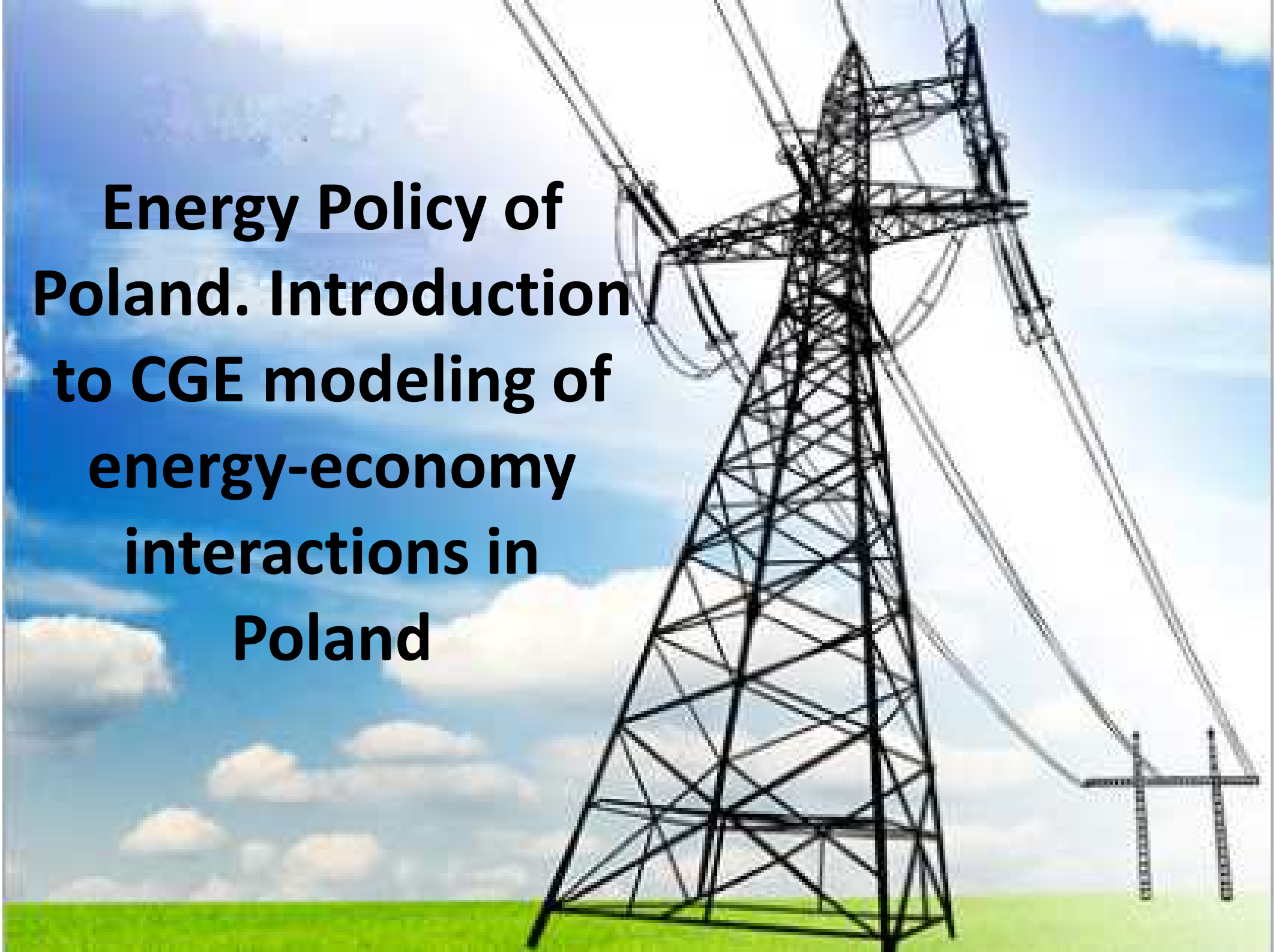
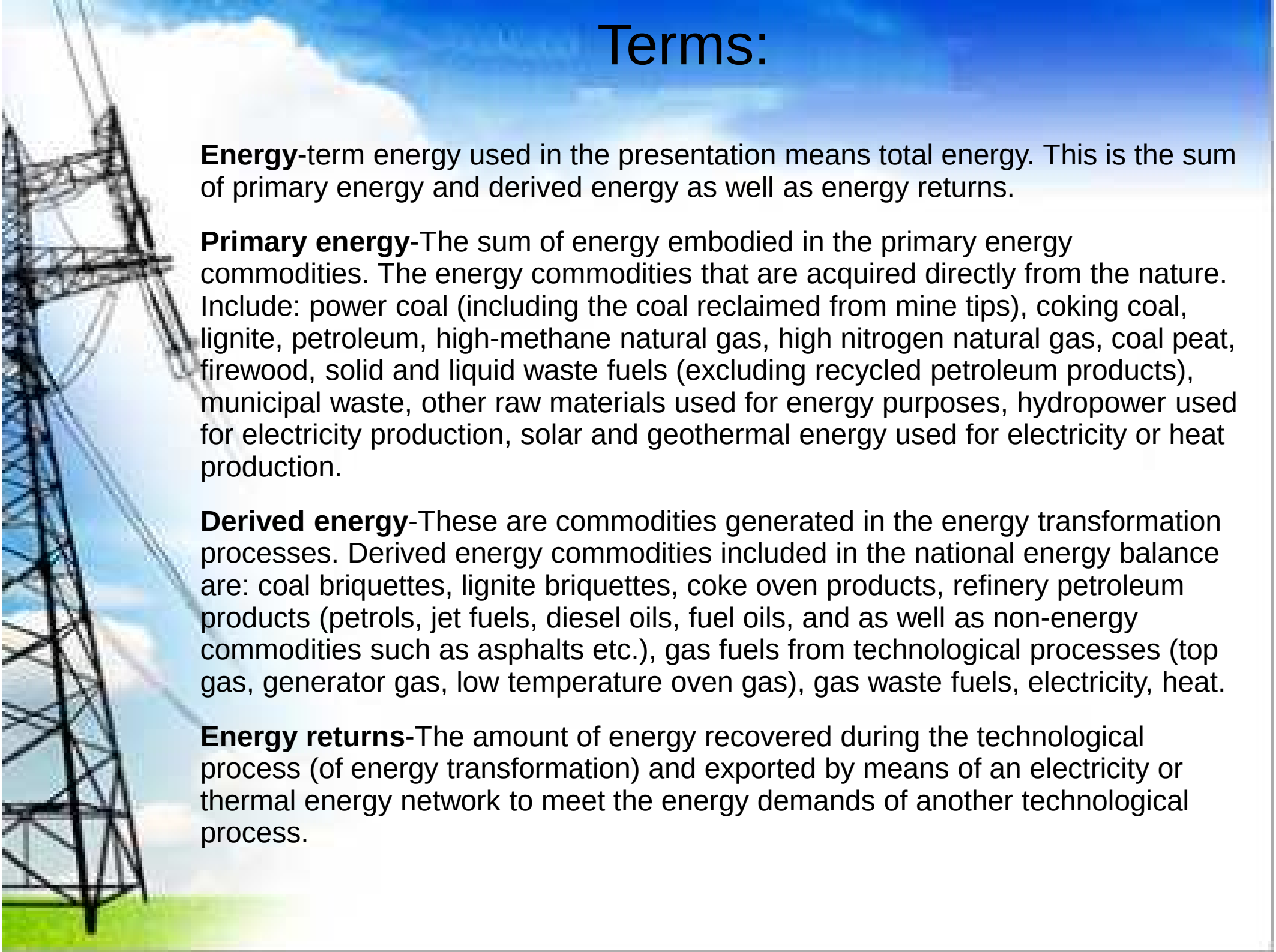


Energy Policy of Poland. Introduction to CGE modeling of energy-economy interactions in Poland

Agenda:

- Energy basic data
- Energy policy of Poland
  - Main challenges in energy policy of Poland
  - Primary directions of energy policy
  - Basic indicator of energy policy implementation
- Basic information about creation models CGE in energy policy
  - Input-Output Tables



Terms:

Energy-term energy used in the presentation means total energy. This is the sum of primary energy and derived energy as well as energy returns.

Primary energy-The sum of energy embodied in the primary energy commodities. The energy commodities that are acquired directly from the nature. Include: power coal (including the coal reclaimed from mine tips), coking coal, lignite, petroleum, high-methane natural gas, high nitrogen natural gas, coal peat, firewood, solid and liquid waste fuels (excluding recycled petroleum products), municipal waste, other raw materials used for energy purposes, hydropower used for electricity production, solar and geothermal energy used for electricity or heat production.

Derived energy-These are commodities generated in the energy transformation processes. Derived energy commodities included in the national energy balance are: coal briquettes, lignite briquettes, coke oven products, refinery petroleum products (petrols, jet fuels, diesel oils, fuel oils, and as well as non-energy commodities such as asphalts etc.), gas fuels from technological processes (top gas, generator gas, low temperature oven gas), gas waste fuels, electricity, heat.

Energy returns-The amount of energy recovered during the technological process (of energy transformation) and exported by means of an electricity or thermal energy network to meet the energy demands of another technological process.

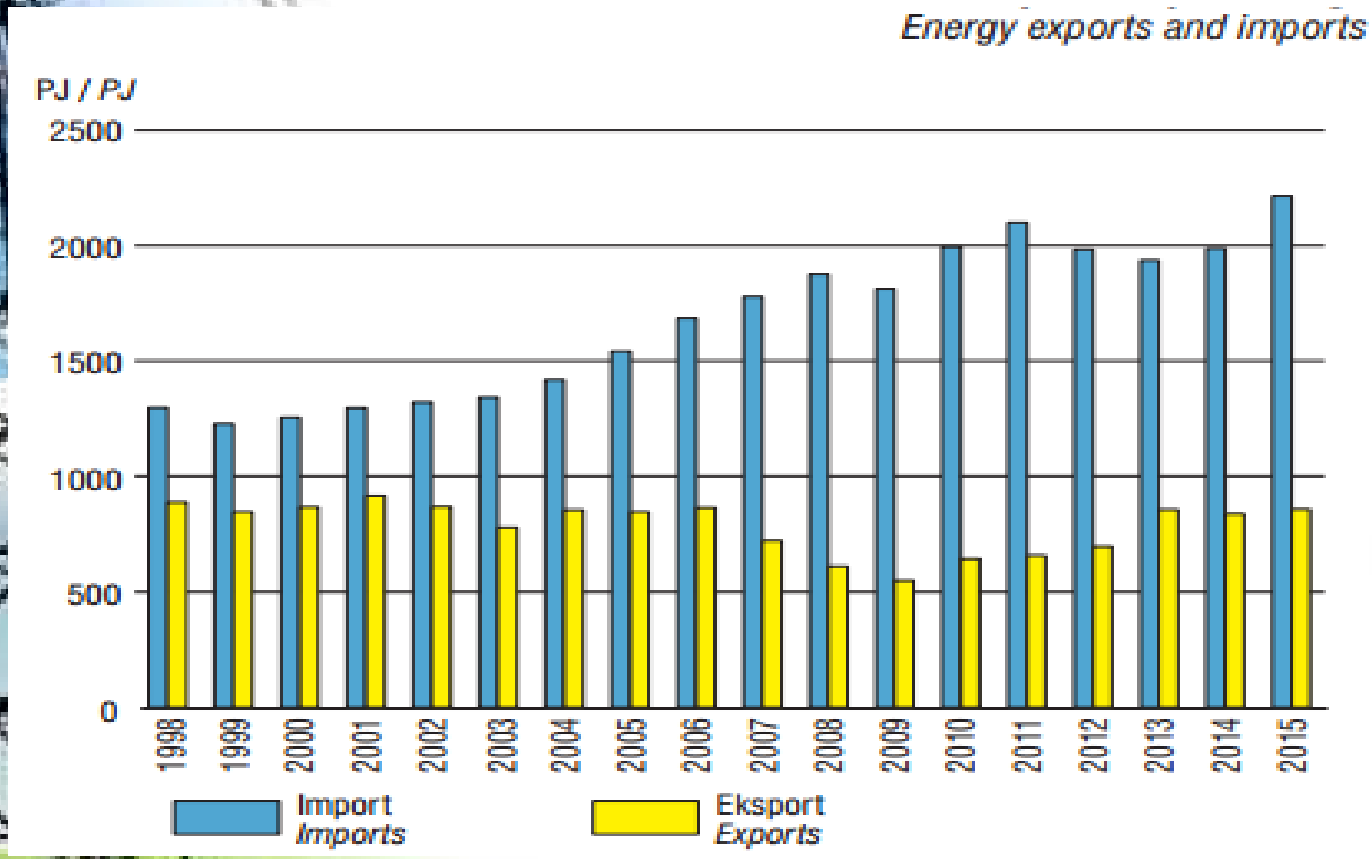
Basic information

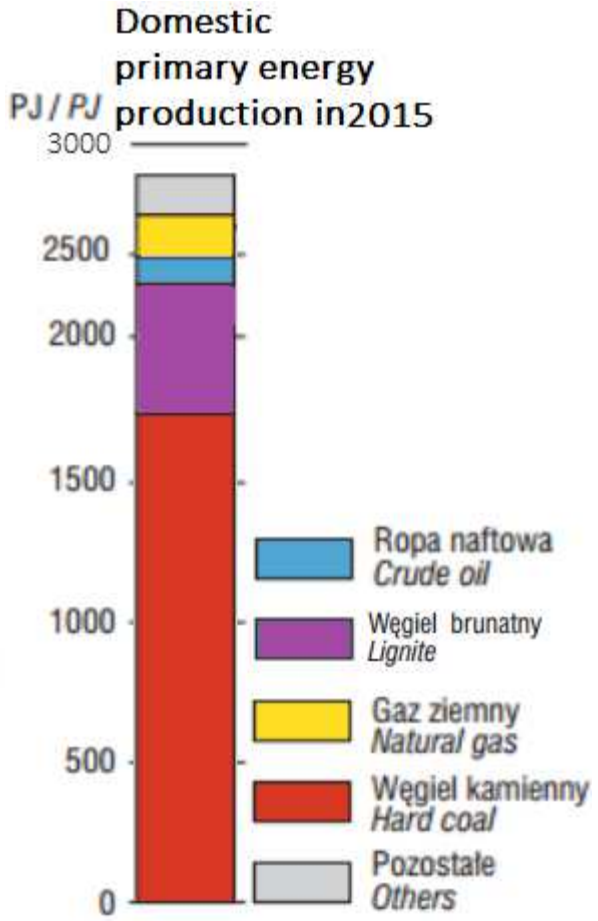
Domestic energy* production in 2015 [TJ] 2 869 751

Imports in 2015 [TJ] 2 086 581

Export in 2015 [TJ] 893 614

Energy dependency in 2015-28,6%





* term energy used in the presentation means total energy.

Renewable energy

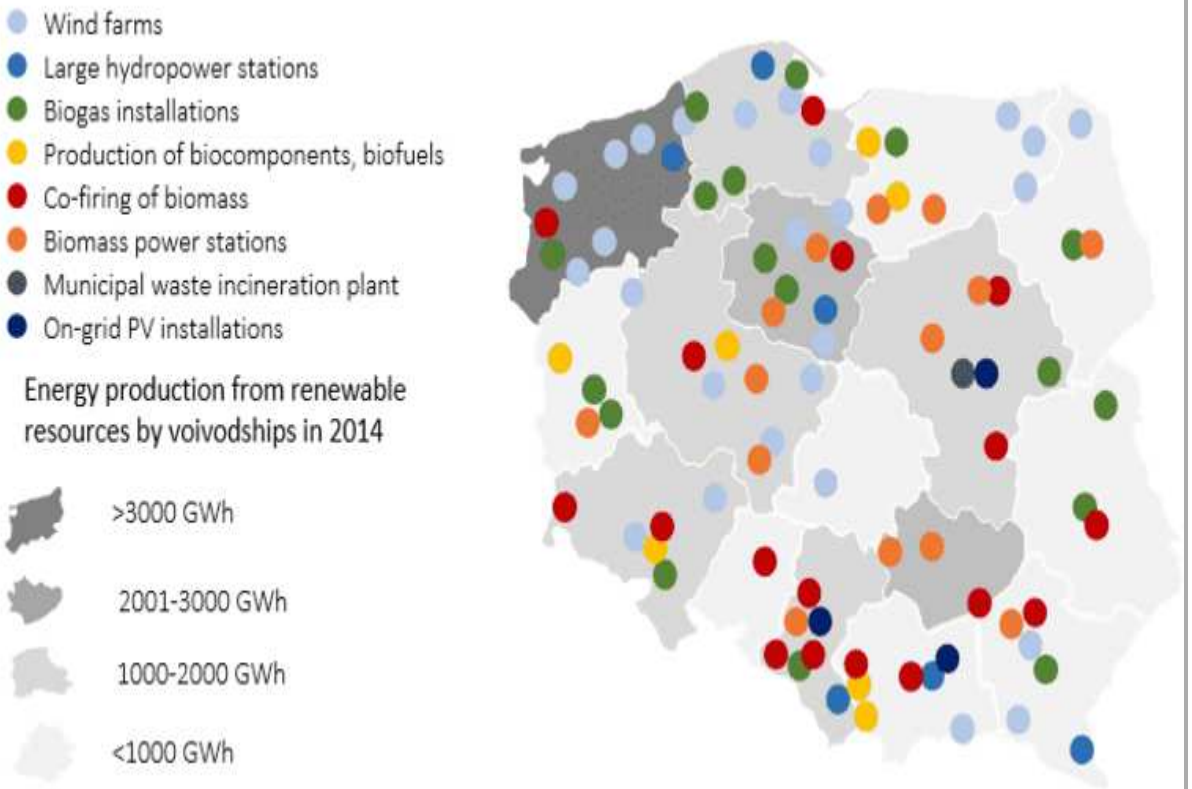
Share of renewable energy in total primary energy in 2015
12,7%

Renewable energy installations (electricity)

Type of installation	Quantity	Power (MW)
biogas power-stations	267	198
biomass power-stations	36	1033
photovoltaic power-stations	225	51
wind power-stations	1003	4254
hydro-electric power-stations	754	982
co-fired technology	44	n/a

Source: Energy Regulatory Office (as of December 2015)

Renewable energy on the map of Poland



Potential of renewable energy in Poland

Potential of renewable energy in Poland

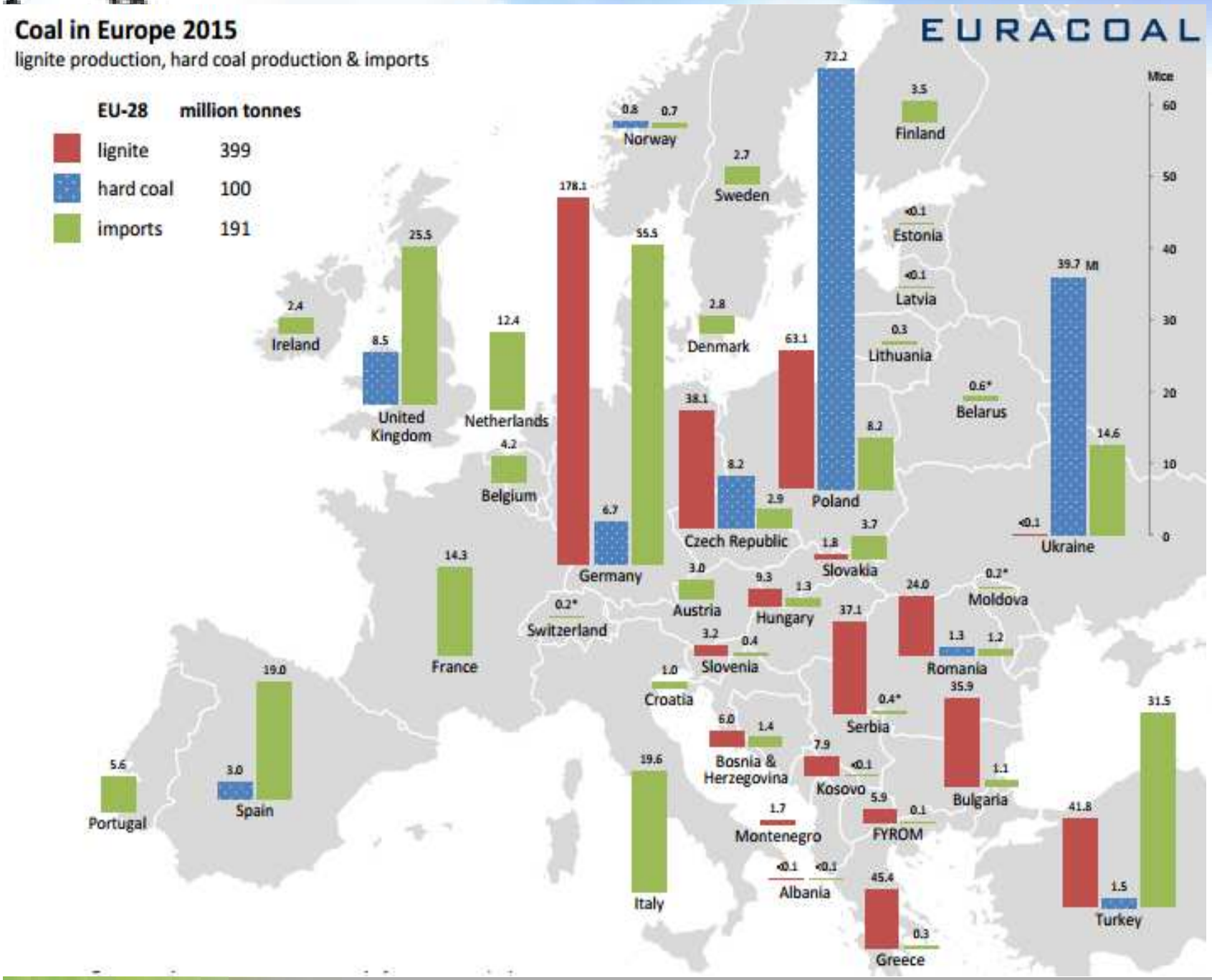
Type of renewable energy source	Real economic potential*- final energy in 2020	Utilization of economic potential in 2020 (real market potential**)	
	[TJ]	[TJ]	[%]
Biomass:	**600167.8**	**533117.5**	**88.8**
solid dry waste	165930.8	149337.7	90.0
biogas (liquid waste)	123066.3	72609.1	59.0
wood (forests)	24451.8	24451.8	100.0
Energy crops	286718.9	286718.9	100.0
Wind energy	**444647.6**	**119913.3**	**27.0**
Solar energy:	**83312.2**	**19422.2**	**23.3**
thermal	83152.9	19262.9	23.2
photovoltaic	159.3	159.3	100.0
Hydropower	**17.9744**	**11.144,2**	**62.0**

Source: Możliwości wykorzystania odnawialnych źródeł energii w Polsce do roku 2020, IEO

*__economic potential__-expected revenues (based on local market prices) minus generation costs, considered over the expected lifetime of the generation asset.

**__market potential__-market potential is the amount of energy we expect to be generated through market deployment of renewable technologies after considering the impact of current or future market factors, such as incentives and other policies, regulations, investor response, and the economic competition with other generation sources.

Place in Europe – production in 2015



Place in Europe:

- Hard coal -1
- Lignite -2

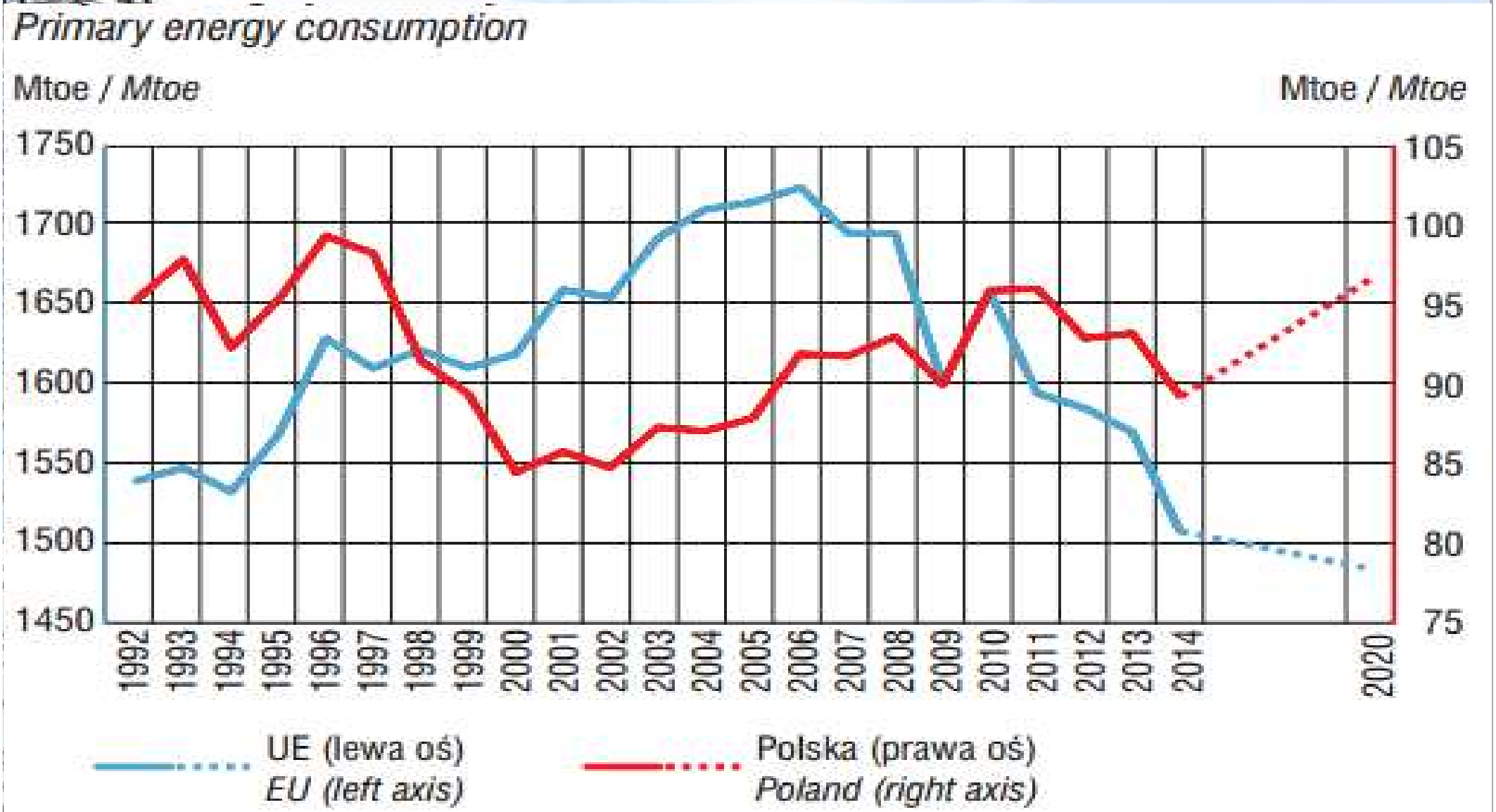
*green columns represent the total volume of imports of hard coal and lignite

Energy Policy of Poland until 2030

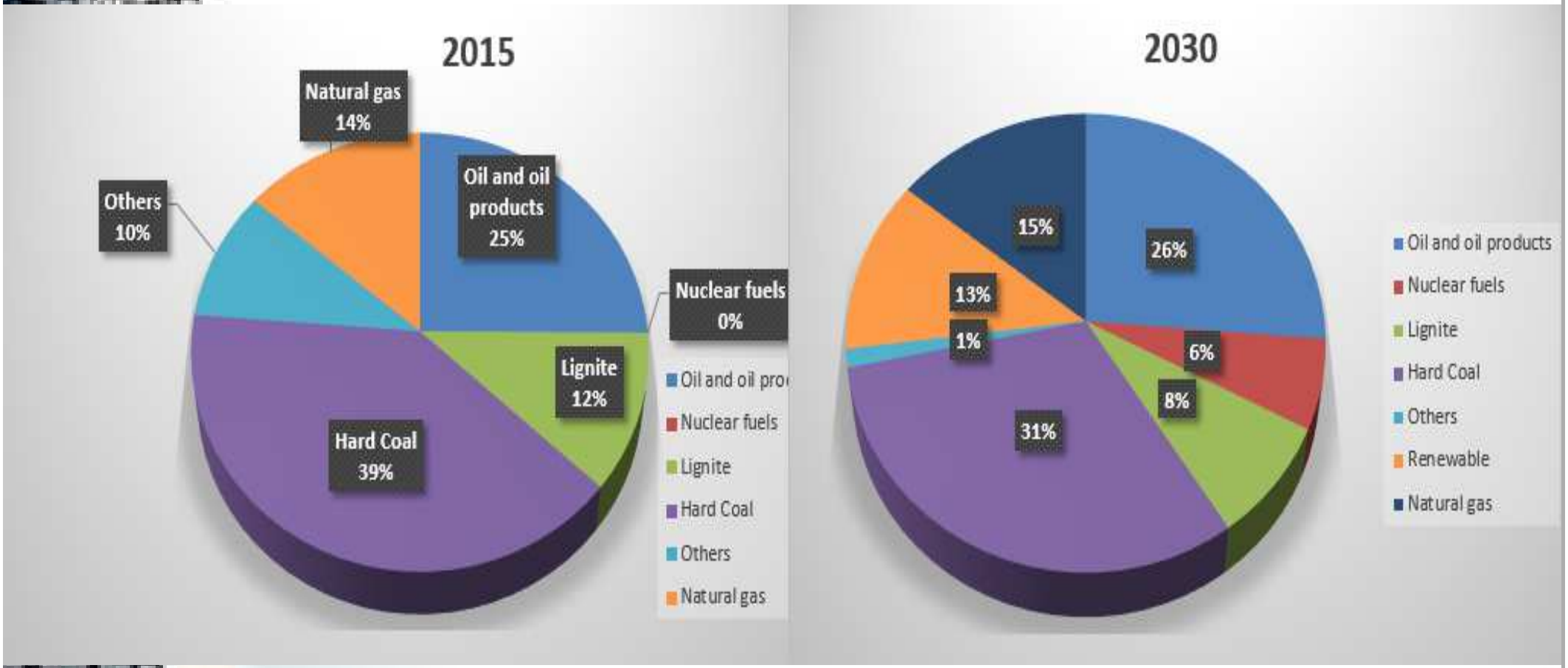
Main challenges according to the government in 2010:

1.High demand for energy
2.Change primary energy by carriers
3.Significant dependence on external supplies of natural gas and almost full dependence on external supplies of crude oil
4.Commitments in the field of environmental protection including climate protection

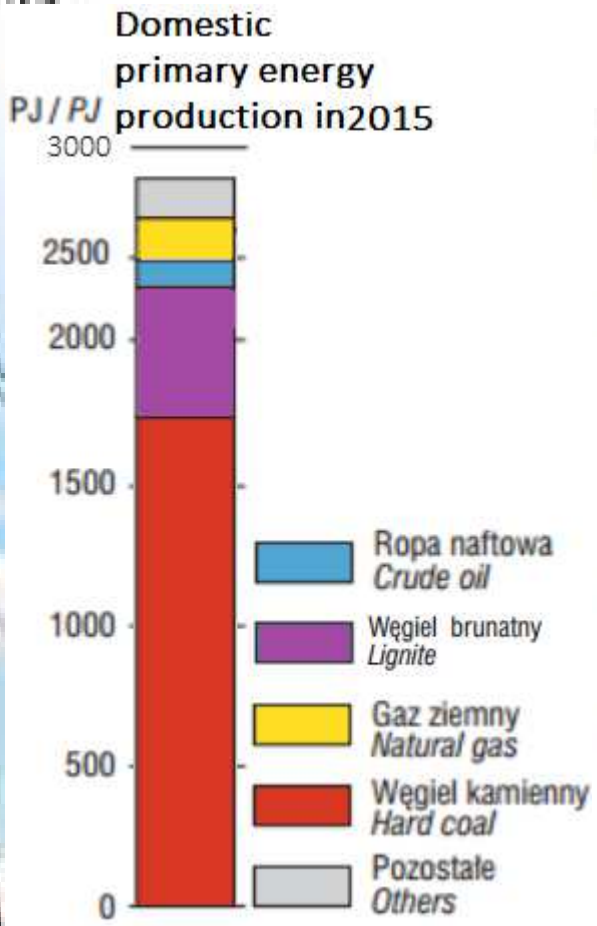
1.High demand for primary energy consumption

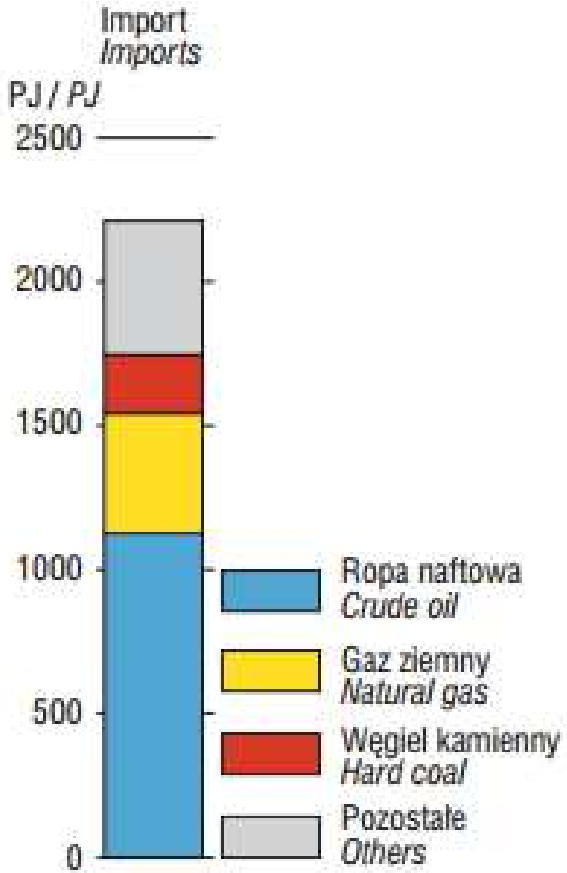


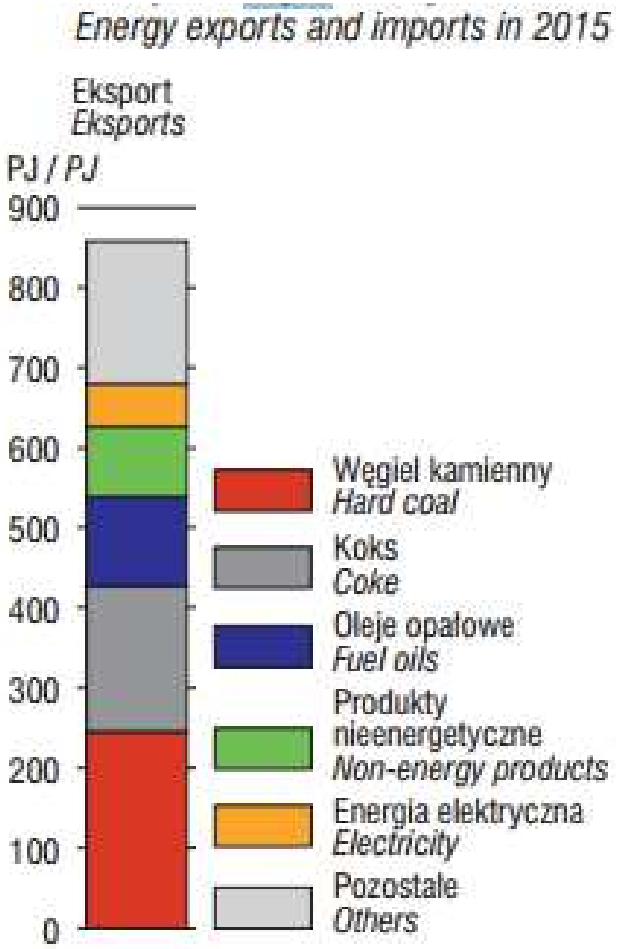
2.Expectation for demand on primary energy by carriers (%)



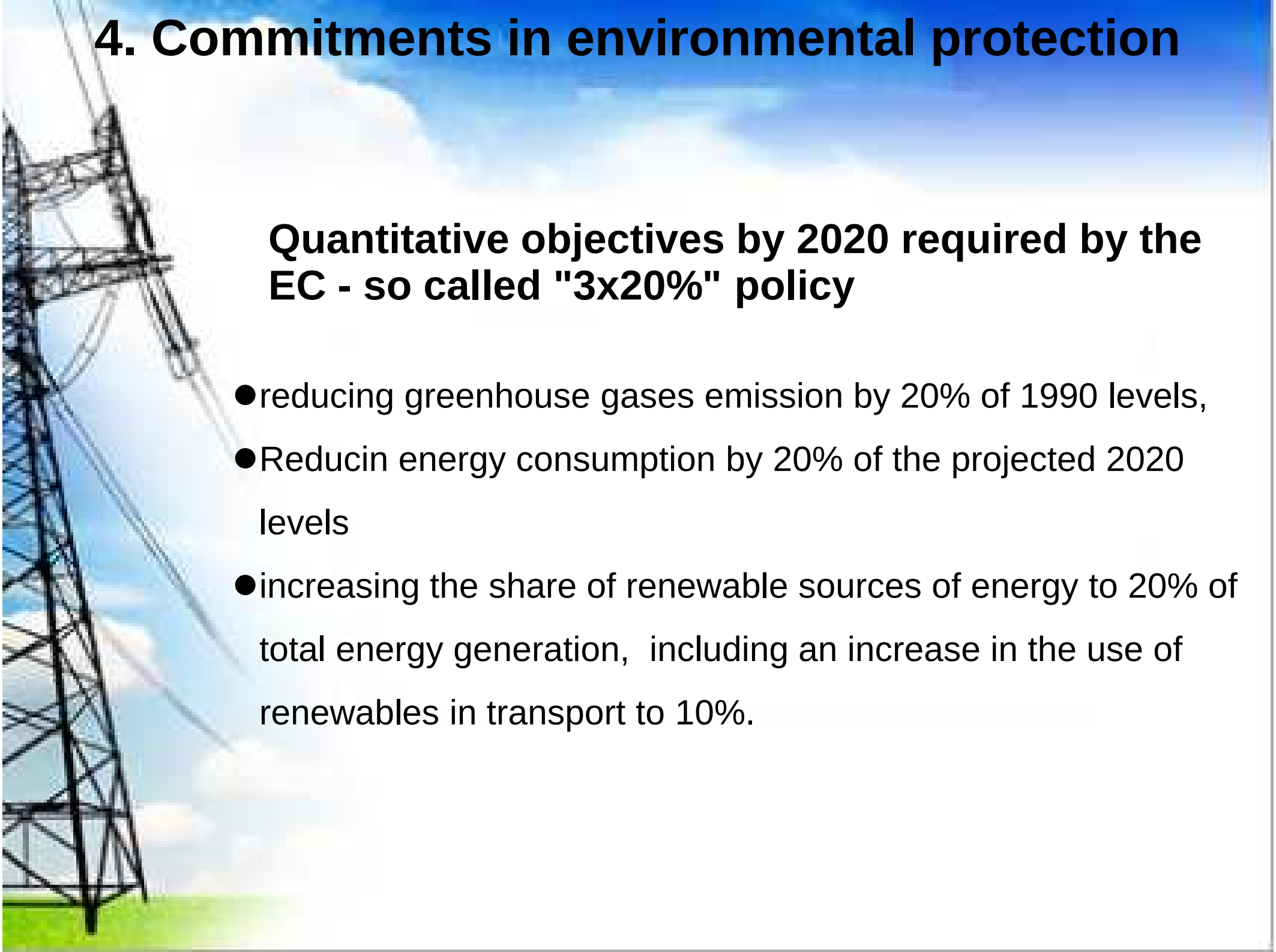
3.Dependence on external supplies of gas and oil







4. Commitments in environmental protection

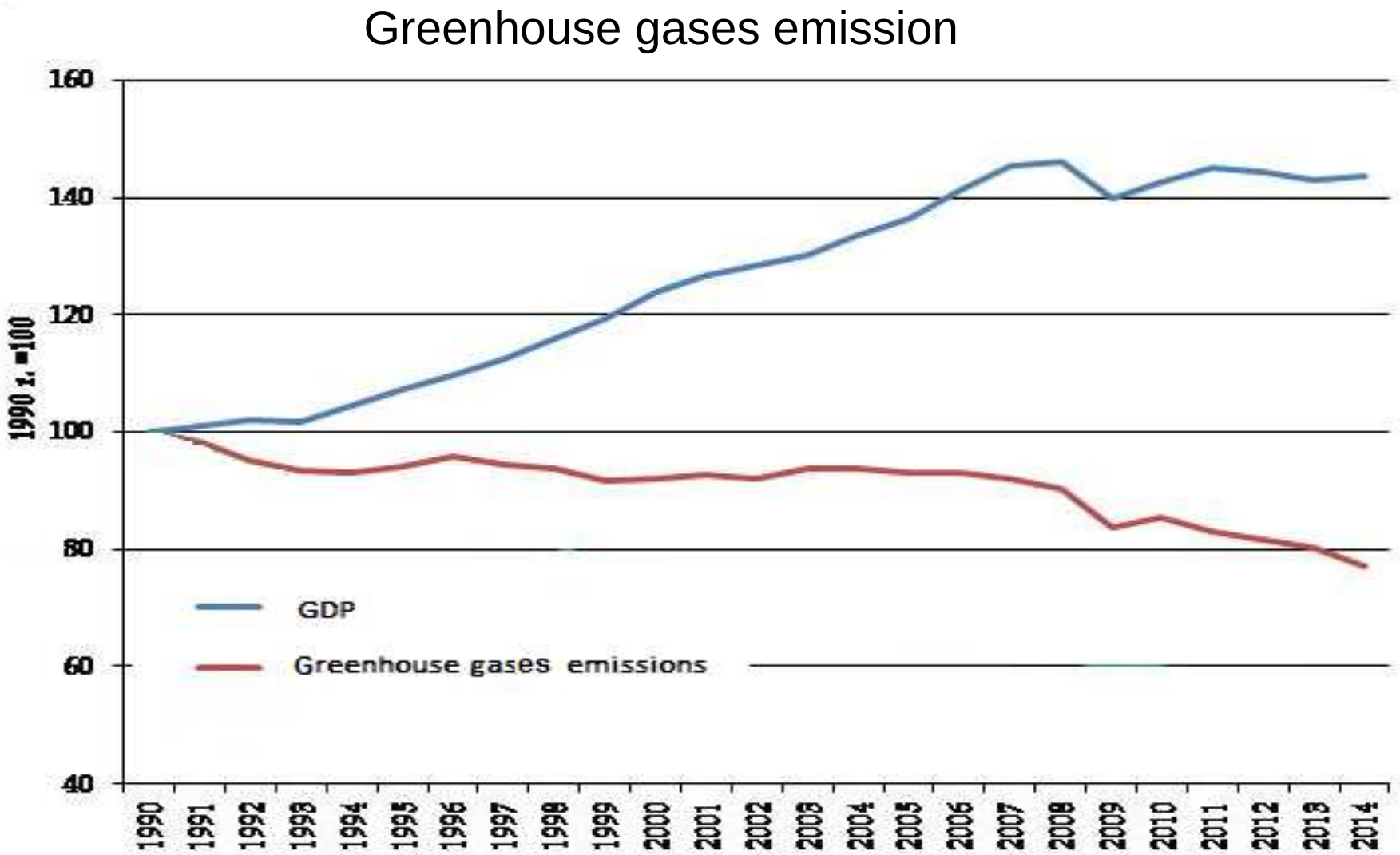


Quantitative objectives by 2020 required by the EC - so called "3x20%" policy

- reducing greenhouse gases emission by 20% of 1990 levels,
- Reducin energy consumption by 20% of the projected 2020 levels
- increasing the share of renewable sources of energy to 20% of total energy generation, including an increase in the use of renewables in transport to 10%.

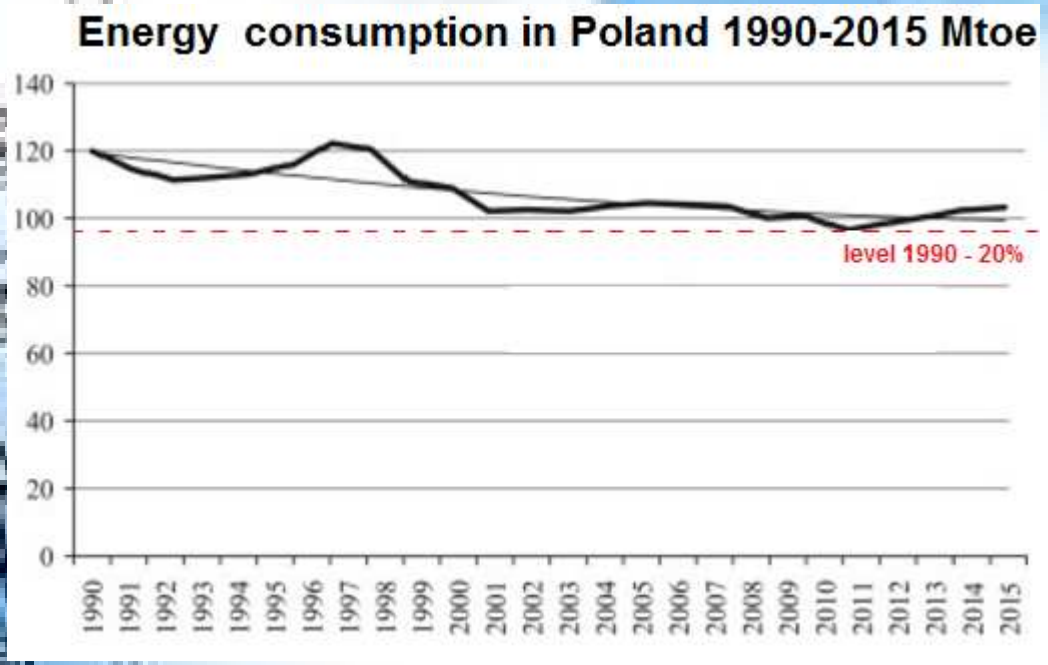
4. Realization of "3x20%" policy in Poland

- Reducing greenhouse gases emission by 20% of 1990 levels

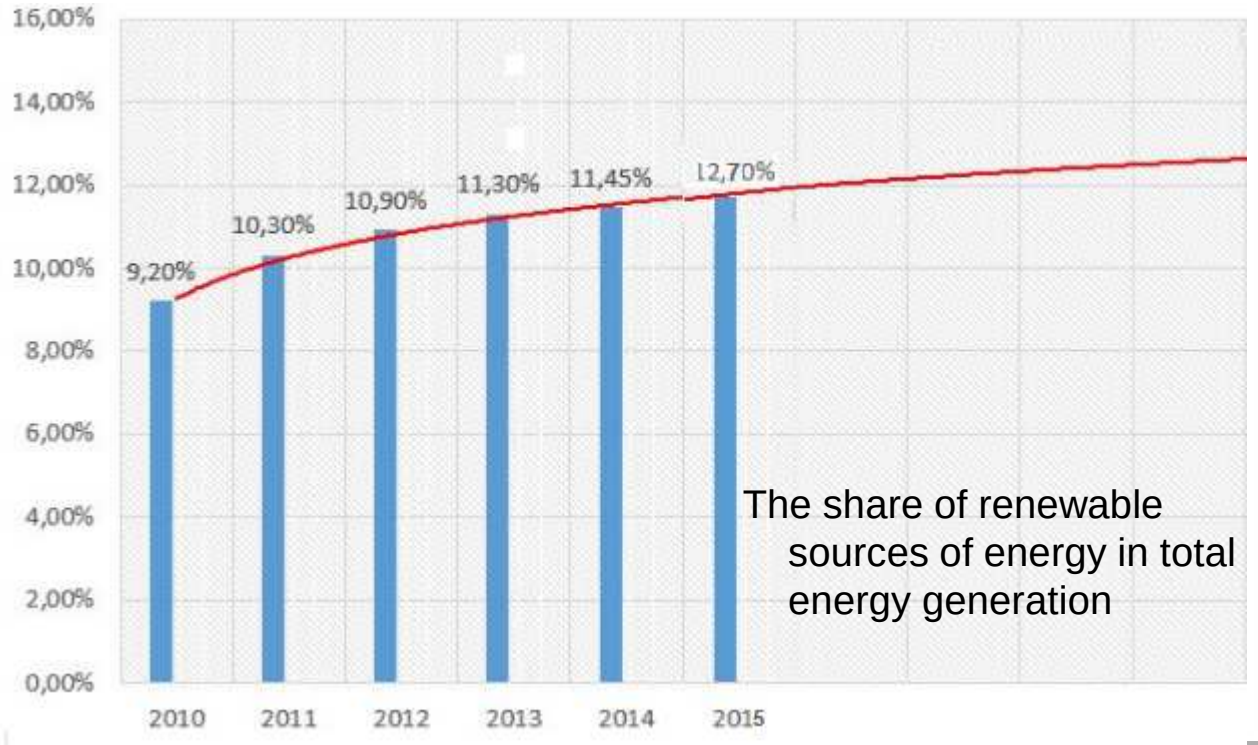


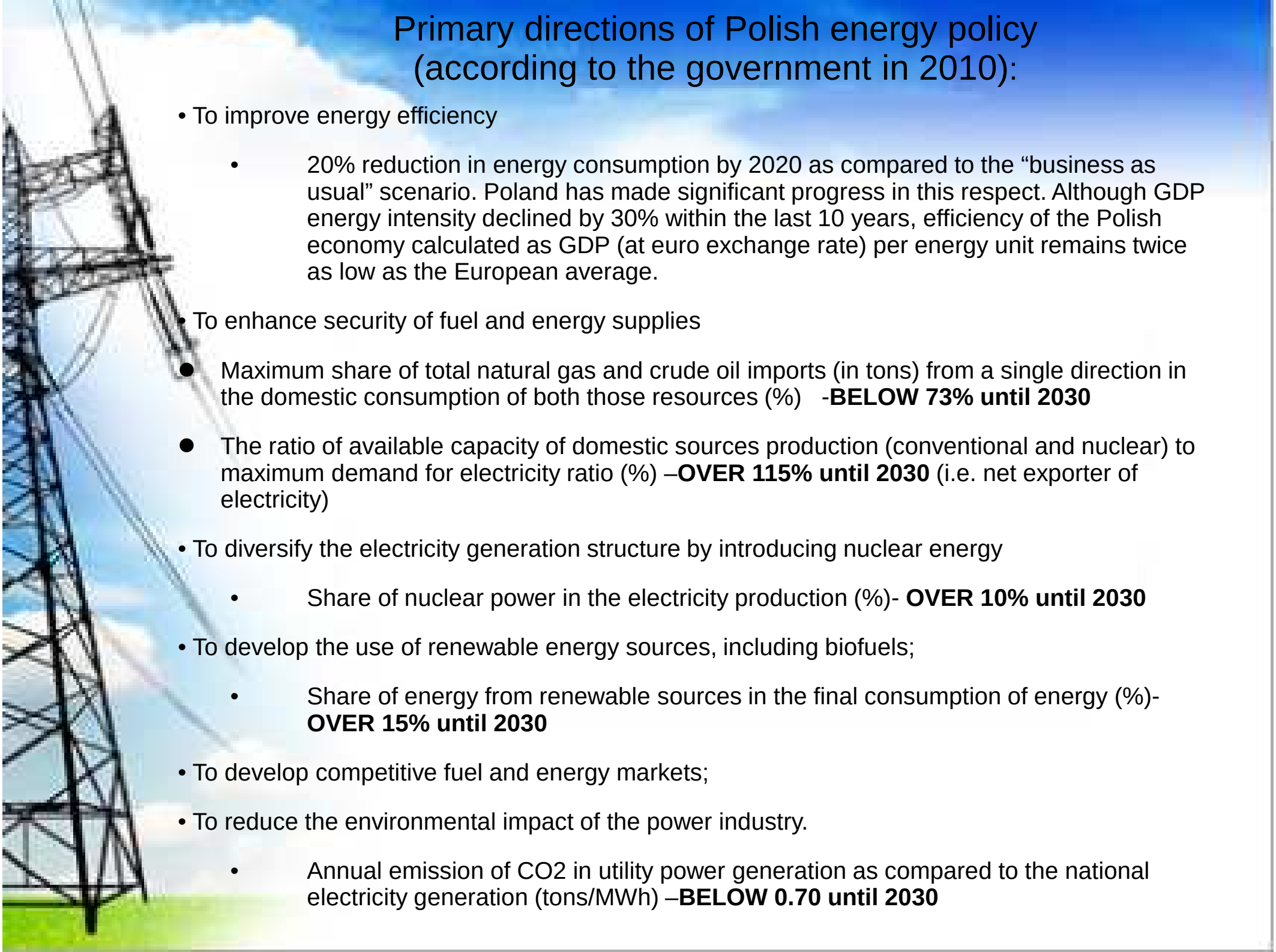
4. Realization "3x20%" policy in Poland

- Reducing energy consumption by 20% of the projected 2020 levels



- Increasing the share of renewable resources of energy to 20% in total energy generation





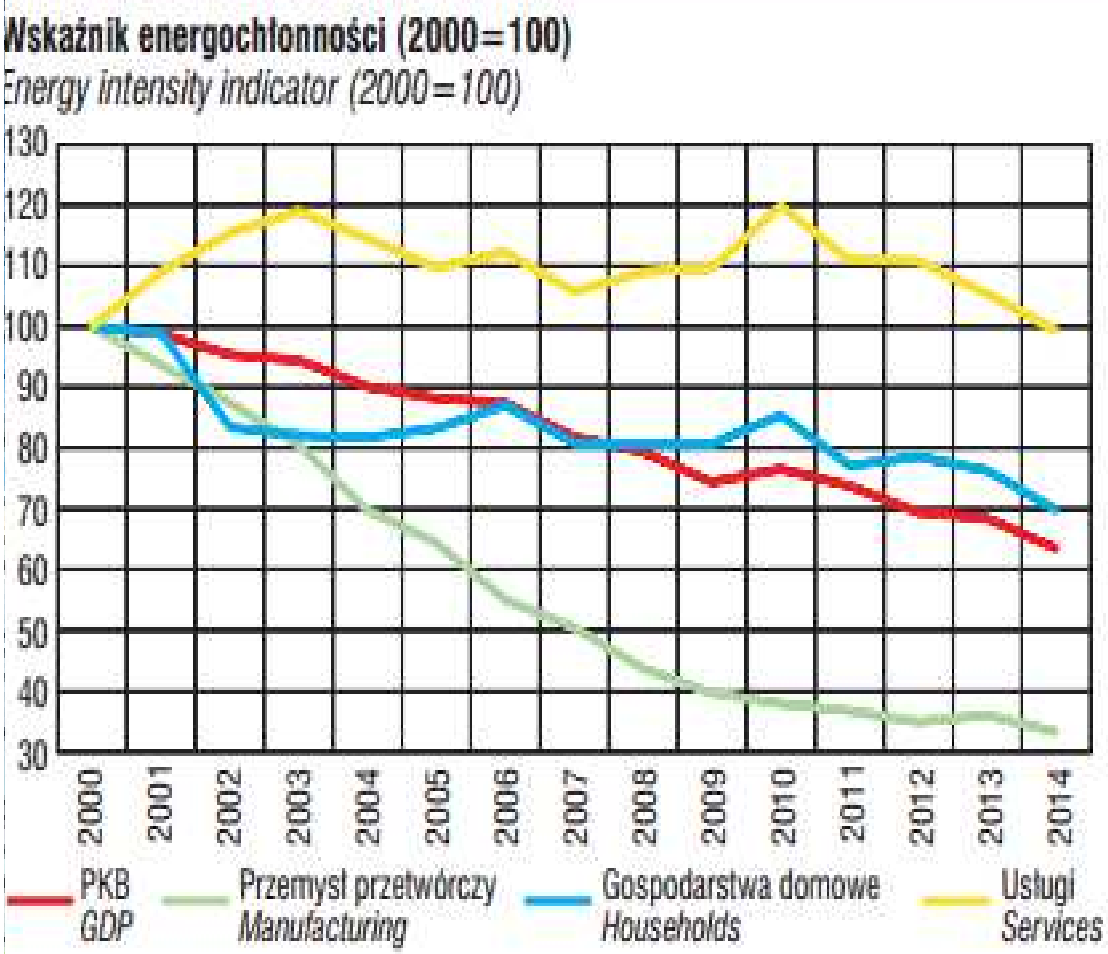
Primary directions of Polish energy policy (according to the government in 2010):

- To improve energy efficiency
  - 20% reduction in energy consumption by 2020 as compared to the “business as usual” scenario. Poland has made significant progress in this respect. Although GDP energy intensity declined by 30% within the last 10 years, efficiency of the Polish economy calculated as GDP (at euro exchange rate) per energy unit remains twice as low as the European average.
- To enhance security of fuel and energy supplies
  - Maximum share of total natural gas and crude oil imports (in tons) from a single direction in the domestic consumption of both those resources (%) -**BELOW 73% until 2030**
  - The ratio of available capacity of domestic sources production (conventional and nuclear) to maximum demand for electricity ratio (%) –**OVER 115% until 2030** (i.e. net exporter of electricity)
- To diversify the electricity generation structure by introducing nuclear energy
  - Share of nuclear power in the electricity production (%)- **OVER 10% until 2030**
- To develop the use of renewable energy sources, including biofuels;
  - Share of energy from renewable sources in the final consumption of energy (%)- **OVER 15% until 2030**
- To develop competitive fuel and energy markets;
- To reduce the environmental impact of the power industry.
  - Annual emission of CO2 in utility power generation as compared to the national electricity generation (tons/MWh) –**BELOW 0.70 until 2030**

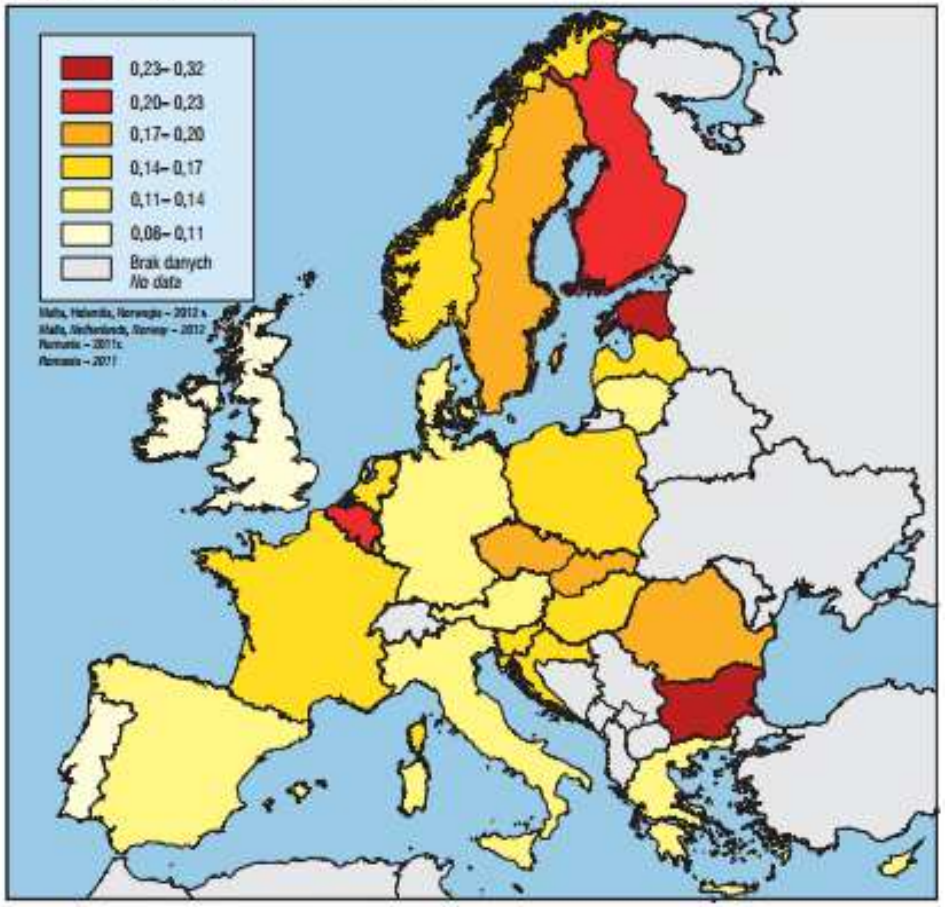
Energy efficiency

20% reduction in energy consumption by 2020 as compared to the “business as usual” scenario. Poland has made significant progress in this respect. Although GDP energy intensity declined by 30% within the last 10 years, efficiency of the Polish economy calculated as GDP (at euro exchange rate) per energy unit remains twice as low as the European average.

Energy efficiency



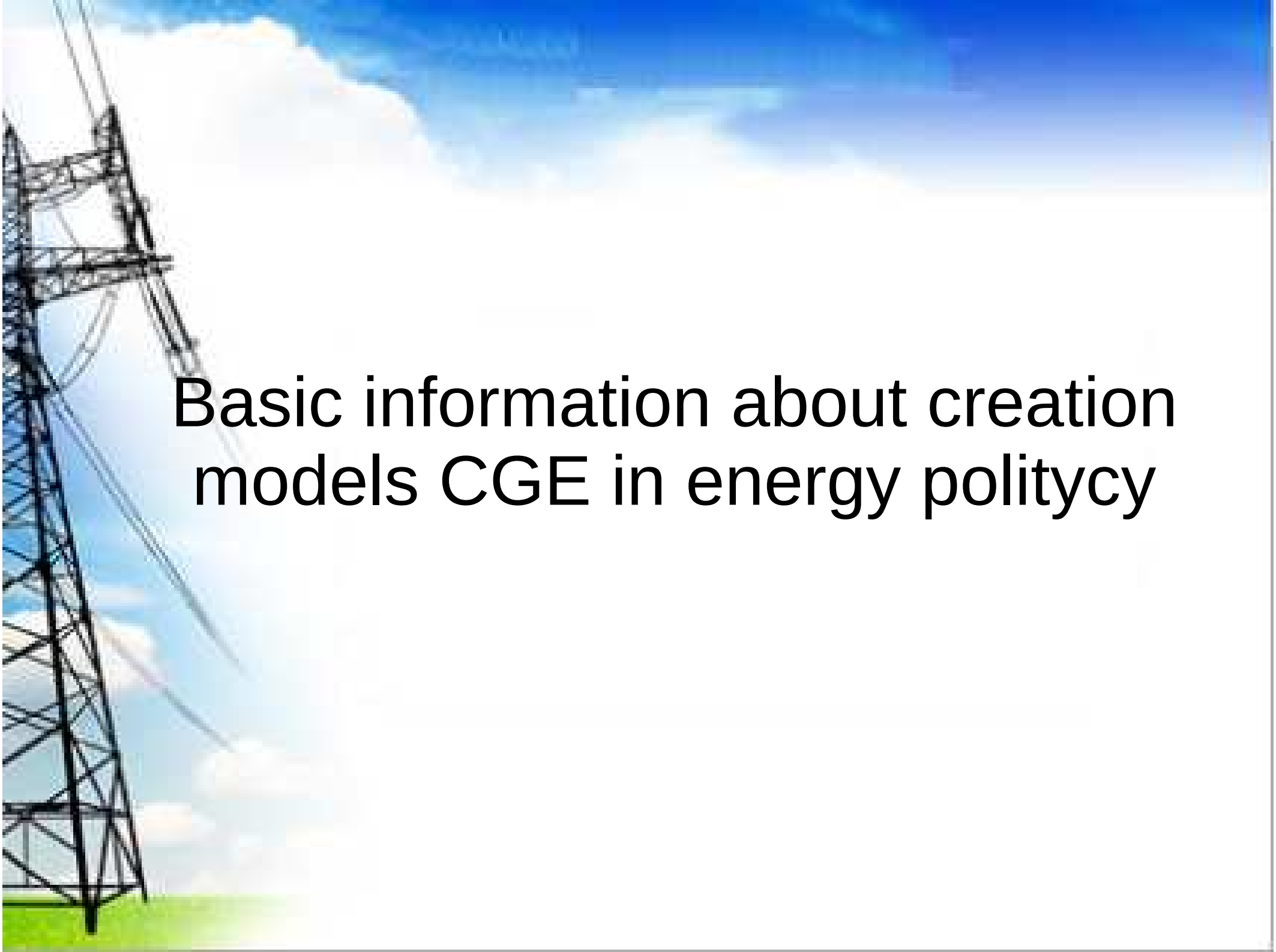
Primary energy intensity at purchasing power parities (ppp) with climatic corrections (kgoe/EUR 2005) in 2013



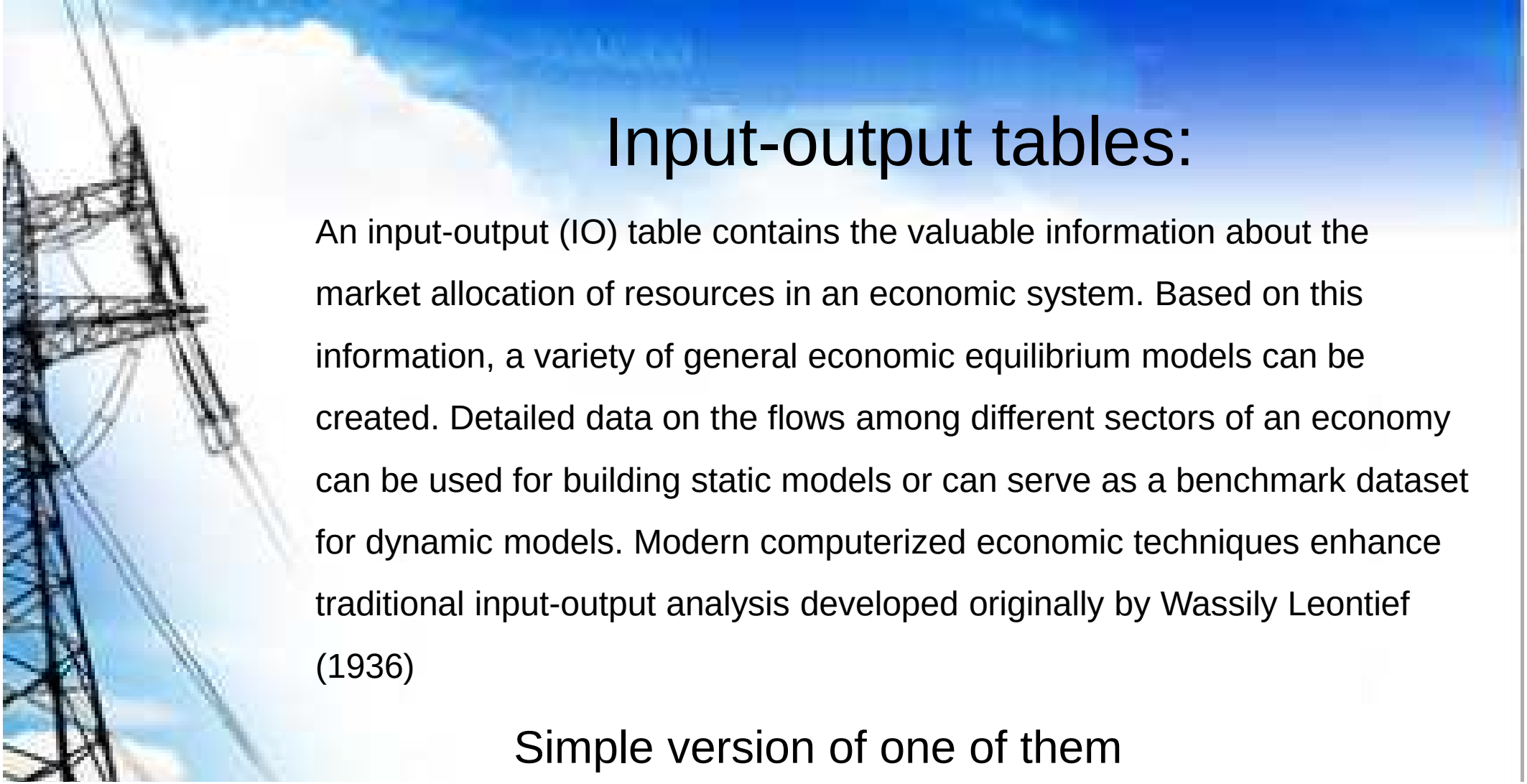
Źródło: Odyssee.
Source: Odyssee.

Table 1. Basic indicators of energy policy implementation monitoring

Item number	Name of indicator	Baseline value 2007	Expected value by 2030	Data source
1.	Annual average change in primary energy consumption in the country since 2005 (%)	2,7	Below 1	Central Statistical Office
2.	Hard coal and lignite extraction to domestic consumption (in tons) ratio (%)	105	Over 100	Central Statistical Office
3.	Maximum share of total natural gas and crude oil imports (in tons) from a single direction in the domestic consumption of both those resources (%)	85	Below 73	Ministry of Economy
4.	Generation capacity of domestic generation sources (conventional and nuclear) to maximum demand for electricity ratio (%)	130	Over 115	Ministry of Economy
5.	Share of nuclear power in the electricity production (%)	0	Over 10	Ministry of Economy
6.	Share of energy from renewable sources in the final consumption of energy (%)	7.7	Over 15	Ministry of Economy
7.	Annual emission of CO_2 in utility power generation as compared to the national electricity generation (tons/MWh)	0.95	Below 0.70	Ministry of Economy



Basic information about creation models CGE in energy politycy



Input-output tables:

An input-output (IO) table contains the valuable information about the market allocation of resources in an economic system. Based on this information, a variety of general economic equilibrium models can be created. Detailed data on the flows among different sectors of an economy can be used for building static models or can serve as a benchmark dataset for dynamic models. Modern computerized economic techniques enhance traditional input-output analysis developed originally by Wassily Leontief (1936)

Simple version of one of them

Table 2.1

		Industry	Construction	Agriculture	Transport	Lease	Communal	Education	Banking	Others
		1	2	3	4	5	6	7	8	9
Industry	1	543,377,284	90,450,789	40,031,134	69,881,621	48,621,711	45,998,503	46,163,329	45,953,488	2,563,330
Construction	2	2,744,031	666,058	362,993	2,327,089	2,825,451	4,020,760	6,967,433	3,446,843	91,201
Agriculture and forestry	3	37,566,006	390	51,371,826	322	3,801,253	109,103	1,338,161	1,257,834	3,562
Transport and communications	4	16,612,675	8,206,444	2,834,779	8,191,387	30,506,774	1,540,011	4,945,306	14,901,200	514,268
Lease, advertising, trade	5	2,769,076	1,109,196	47,138	3,482,954	13,054,082	114,156	1,598,547	4,811,450	210,904
Communal services	6	1,607,517	650,550	565,958	3,794,739	6,025,608	1,344,537	16,275,651	7,477,728	227,030
Education, medicine	7	1,725,368	181,173	78,343	291,094	1,746,561	58,715	8,271,628	1,551,860	20,767
Banking, insurance	8	6,637,802	402,377	114,784	843,702	5,092,641	560,312	348,630	6,539,254	44,269

Input-output tables. Construction

		INTERMEDIATE USE				FINAL USE				
		by Production Sectors				Private	Gov't			OUT-
		1	2	...j...	n	consum.	consum.	Invest.	Export	PUT
	1									
Domestic	2									
Production	:									
	i			A			B			C
	:									
	n									
	1									
	2									
Imports	:									
	i			D			E			F
	:									
	n									
Value added:										
-labor										
-capital				G			H			I
-indirect										
taxes										
INPUT				J						

An IO table describes the flows among the various sectors of the economy. It represents the value of economic transactions in a given period of time. Transactions of goods and services are broken down by intermediate and final use. An IO table also shows the cost structure of production activities: intermediate inputs, compensation to labor and capital, taxes on production. Table 1 illustrates a general structure of an IO table, according to the European System of Integrated Economic Accounts (Eurostat, 1986)


Thank you