



UNITED NATIONS
ECONOMIC COMMISSION FOR EUROPE
SUSTAINABLE ENERGY DIVISION

ENERGY POLICY OF POLAND UNTIL 2030

ENERGY EFFICIENCY IMPROVEMENT PROGRAMME

LEON KURCZABINSKI, PhD





POWER INDUSTRY IN POLAND

(1/5)



- **Poland has one of the biggest resources of coal in Europe - 70% of Europe's known coal reserves**

Coal warrants to Poland:

- **High level of energy safety (possibility of 100 % production of electrical energy and of heat for central heating sector and for industrial needs)**
- **The lowest costs of electrical energy and heat production**
- **Low level of energy poverty**
- **Competitiveness of economy**

Poland has not possibility of importation of other fuels in reasonable prices



POWER INDUSTRY IN POLAND (2/5)



ELECTRICITY GENERATION

- CAPACITY INSTALLED IN POWER PLANTS 38 490 MW
- CAPACITY OF THE BIGGEST THERMAL P.P. (4440) 5 035 MW
- ELECTRICITY PRODUCTION 162 502 GWh / y
- ELECTRICITY GENERATION EFFICIENCY (THERMAL PLANTS) av. 36,6 % net
- ELECTICITY PRODUCTION IN COGENERATION approx 20 %
- ELECTRICITY CONSUMPTION PER CAPITA 4 140 kWh

STRUCTURE OF ELECTRICITY GENERATION BY SOURCES

SOURCE	GWh / Y	%
HARD COAL	84 566	52,1
LIGNITE	56 959	35,0
NATURAL GAS	3 149	1,9
HYDRO	2 762	1,7
WIND	5 823	3,6
OTHERS	9 243	5,7



POWER INDUSTRY IN POLAND (3/5)



HEAT GENERATION - CENTRAL HEATING SYSTEM

• CAPACITY INSTALLED IN CHP	59 265 MWt
• HEAT PRODUCTION	434 700 TJ
• CENTRAL HEATING SYSTEM (HEATING BUILDINGS AND HOT WATER)	260 000 TJ
• HEAT GENERATION EFFICIENCY	av. 80 % net

STRUCTURE OF HEAT GENERATION BY SOURCES

SOURCE	%
COAL	76,0
NATURAL GAS	10,0
OIL	9,5
RENEWABLE	4,5
OTHERS	1,0



POWER INDUSTRY IN POLAND (4/5)



IMPORT DEPENDANCE

- NATURAL GAS 69,3 %
- CRUDE OIL 99,5 %
- NUCLEAR 100 %

TOTAL IMPORT DEPENDANCE (2012)

- POLAND 31,6 %
- GERMANY 61,6 %
- FRANCE 50,4 %
- SPAIN 83,7 %
- UK 39,0 %
- EU - 27 52,6 %



POWER INDUSTRY IN POLAND (5/5)



TOTAL CONSUMPTION OF COAL

TOTAL HARD COAL 74 - 76 MT /Y

PROFESSIONAL (PUBLIC) THERMAL POWER PLANTS ELECTRICITY GENERATION AND CHP

- HARD COAL 38 - 44 MT / Y
- LIGNITE 60 - 64 M

INDUSTRIAL AND NON-PROFESSIONAL CHP PLANTS HEAT AND HOT WATER PRODUCTION FOR INDUSTRY AND CENTRAL HEATING SECTOR

- HARD COAL 13,5 - 16,5 MT / Y

HOUSEHOLDS SECTOR AND SMALL CONSUMERS - HEAT AND HOT WATER (WITHOUT PUBLIC CHS)

11,5 - 12,5 MT /Y

CO₂ EMISSION 314 MT / Y - 1 % OF THE WORLD EMISSION



FUTURE OF THE POWER INDUSTRY IN POLAND (1/6)



LEGAL CONDITIONS

ENERGY - CLIMATIC PACKAGE 3 X 20 % (+ 10 % BIOFUELS)

- **DIRECTIVE 2010/75/EU (IED)** ON INDUSTRIAL EMISSIONS (integrated pollution, prevention and control)
- **DIRECTIVE 2009/29/EC (ETS)** - GREENHOUSE GAS EMISSION ALLOWANCE TRADING
- **DIRECTIVE 2009/31/EC** - ON THE GEOLOGICAL STORAGE OF CO₂
- **DIRECTIVE 2009/28/EC** - PROMOTION OF ENERGY FROM RENEWABLE SOURCES
- **DIRECTIVE 2003/96/WE** - TAXATION OF ENERGY PRODUCTS AND ELECTRICITY

ENERGY ROADMAP 2050 - LOW CARBON EUROPE (80%)

ELIMINATION OF FOSSIL FUELS !!!!



FUTURE OF THE POWER INDUSTRY IN POLAND (2/6)



NATURAL AND POLITICAL CIRCUMSTANCES

- LIMITED POSSIBILITIES OF IMPORTATION OF THE NATURAL GAS (IN RATIONAL PRICES) - ... **SHALE GAS ?**
- FULL IMPORT DEPENDENCE OF THE CRUDE OIL AND NUCLEAR FUEL
- LIMITED POSSIBILITIES OF IMPORTATION OF THE ELECTRICAL ENERGY (MAX. 10 000 GWh - LACK OF THE TRANSBORDER CONNECTIONS)
- NATURAL POSSIBILITIES OF THE RENEWABLE ENERGY PRODUCTION - 12 - 14 % (WIND + BIOMASSE)



FUTURE OF THE POWER INDUSTRY IN POLAND

(3/6)



ENERGY POLICY OF POLAND UNTIL 2030 (Ministry of Economy)

PRIMARY DIRECTIONS

- **IMPROVEMENT OF THE ENERGY EFFICIENCY**
- **ENHANCEMENT OF THE SECURITY OF FUELS AND ENERGY SUPPLIES**
- **DIVERSIFICATION OF THE ELECTRICITY GENERATION STRUCTURE BY INTRODUCING NUCLEAR ENERGY**
- **DEVELOPMENT OF RENEWABLE ENERGY SOURCES, INCLUDING BIOFUELS**
 - **DEVELOPMENT OF COMPETITIVE FUEL AND ENERGY MARKETS**
- **REDUCTION OF THE ENVIRONMENTAL IMPACT OF THE POWER INDUSTRY**



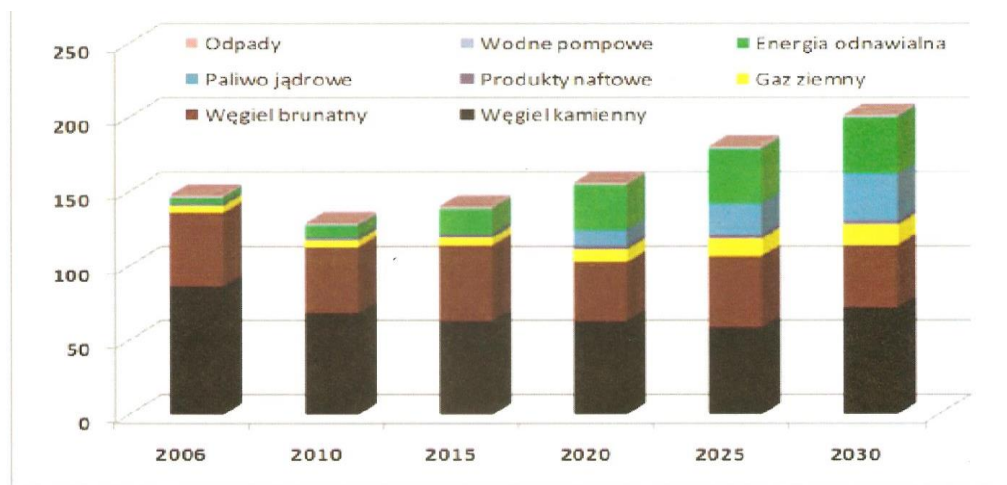
FUTURE OF THE POWER INDUSTRY IN POLAND (4/6)



FORECAST OF THE ELECTRICITY CONSUMPTION

	2010	2020	2030
TWh	156,3	182,3	209,5

FUTURE NEEDS = equivalent of 20(30) MT / y of coal



Źródło: Prognoza zapotrzebowania na paliwa i energię do 2030 roku. Załącznik 2 do „Polityki i energetycznej Polski do 2030 roku” przyjętej przez RM 10.11.2009 r.



FUTURE OF THE POWER INDUSTRY IN POLAND (5/6)



ENERGY EFFICIENCY = PRIORITY OF THE ENERGY POLICY

MAIN OBJECTIVES

- **ENHANCEMENT OF THE EFFICIENCY OF POWER GENERATION - HIGHLY EFFICIENT GENERATION UNITS: from 36% to 44% (RETROFIT and BAT)**
- **TWOFOLD INCREASE (AS COMP. TO 2006) OF HIGHLY EFFICIENT COGENERATION TECHNOLOGY BY 2025 - from 20% to 50%**
- **LIMITATION OF THE GRID LOSS DURING TRANSMISSION AND DISTRIBUTION (MODERNISATION EXISTING AND BUILDING OF NEW GRIDS INCL. SMART GRIDS)**
- **INCREASE OF THE EFFICIENCY OF END - USE OF ENERGY (INDUSTRY AND HOUSEHOLDS SECTOR) - REDUCTION OF ENERGY CONSUMPTION: 25-40%**
- **IMPROVEMENT OF ENERGY MANAGEMENT**



FUTURE OF THE POWER INDUSTRY IN POLAND



MAIN INVESTMENTS IN THE POWER SECTOR

NEEDS FOR ENERGY SECURITY - 1000 MW/ year OF NEW CAPACITY
INSTALLED IN THE POWER PLANTS ...?

HARD COAL AND LIGNITE (TO 2020):

- MODERNIZATION OF THE OLD (6556 MW) AND BUILDING OF THE NEW HIGH EFFICIENCY GENERATION UNITS (5358) -...**CCS READY ?**
- ELECTRICITY AND HEAT PRODUCTION IN COGENERATION

NATURAL GAS

- GAS - STEAM CHP UNITS (2200 MW)

NUCLEAR

- PWR REACTOR? (4800 MW)

RENEWABLE

- WIND - ca. 8300 WIND POWER UNITS (2 MW)

PLANNED CAPITAL COSTS ca 100 BLN EURO



RECENT INVESTMENTS „TAURON - LAGISZA” POWER PLANT - 2009



CAPACITY OF UNIT

460 MWe

ELECTRICITY GENERATION EFFICIENCY

45 %

HARD COAL - SUPERCRITICAL CIRCULATING FBC, with additional system of energy recovery from exhaust gases





RECENT INVESTMENTS „PGE - BELCHATOW” POWER PLANT - 2011



CAPACITY OF UNIT	858 MW
ELECTRICITY GENERATION EFFICIENCY	44,4 %
LIGNITE - SUPERCRITICAL PC - NEXT STAGE CCS READY ? (29,95 MPa/564 °C)	

REMARKS:

Capital costs of unit	1,5	bln Euro
Capital costs of CCS READY	0,625	bln Euro
Net efficiency with CCS	~ 30	%



PLANNED ENERGY-INVESTMENTS BASING ON HARD COAL AND LIGNITE 2015 - 2019



INVESTMENT P.P./CAPACITY	INVESTOR	CAPACITY OF NEW ENERGY-BLOC MW	COSTS OF INVESTMENT BLN EURO
OPOLE (2018) 1492 MW	PGE (RAFAKO, POLIMEX, MOSTOSTAL)	2 x 900 (45,5%)	2,3
KOZIENICE (2017) 2750 MW	ENEA (HITACHI-POWER POLIMEX-MOSTOSTAL)	1075 (45,6%)	1,18
RYBNIK (2018?) 1775 MW	EDF (ALSTOM)	900	1,22
JAWORZNO 3(2019) 1345 MW	TAURON PE	910 (46%)	1,22
TURÓW (2019) 1498,8 MW	PGE	460	0,61
POLNOC (2018?)	KULCZYK INVESTMENT	2 x 780-1050	2,93
ZABRZE (2016?) 475 MW	FORTUM POWER AND HEAT	135	0,25
TYCHY (2016) 290 MW	TAURON PE	50-60	0,13



FUTURE OF THE POWER INDUSTRY IN POLAND



OPOLE P.P. 1492 MW+ 2x 900 MW (n = 45,5%)



NEW EFFICIENT TECHNOLOGIES



HARD COAL AND LIGNITE - ANALYSED TECHNOLOGIES according to unitary discounted electricity generation costs **Euro / MWh - without CO2 emission payment**

• SUPERCRITICAL*) STEAM PC UNIT - LIGNITE	46,4
• SUPERCRITICAL STEAM CFBC - HARD COAL	47,6**
• SUPERCRITICAL STEAM PC UNIT - HARD COAL	53,6
• GAS-STEAM CHP - 3 PRSSURE HEAT RECOVERY STAM GENERATOR (HRSG) - NATURAL GAS	62,2
• GAS-STEAM CHP - 2 PRESSURE HRSG - NATURAL GAS	67,1
• GAS-STEAM UNIT - NATURAL GAS	70,7
• STEAM CHP - BIOMASS (medium scale)	80,5
• NUCLEAR POWER UNIT - PWR - REACTOR	85,4***

With 40 Euro / t CO2 payment**

UNITARY ELECTRICITY GENERATION COSTS 73,2 - 86

With 60 Euro / t CO2 payment***

UNITARY ELECTRICITY GENERATION COSTS 85,4 - 101,3

*) $P > 25 \text{ MPa}$, $t > 600 \text{ }^{\circ}\text{C}$, $n = 44\text{-}46\%$ / (Heat Recovery Steam Generator)



EFFICIENT TECHNOLOGIES vs CCS



ACCORDING TO THE ANALYSIS MADE FOR 3 PROJECTS:

**1 POWER PLANT PRODUCES ELECTRICAL ENERGY FOR NEEDS OF 3 P.P
WITH CCS**

	WITHOUT CCS	WITH CCS
CAPITAL COSTS, \$/kW (%)	100	166
UNIT COST OF ELECTICAL ENERGY, \$/MWh (%)	100	146
NET EFFICIENCY %	40,5 - 44,5	28,7 - 30,5
EMISSION OF CO ₂ , kg/MWh (%)	100	0,14
RELATIVE DECREASE OF EFFICIENCY, %	29,14 - 31,46	



THANK YOU



l.kurczabinski@khw.pl

www.khw.pl