AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Expectation to Japan's Clean Coal Technologies

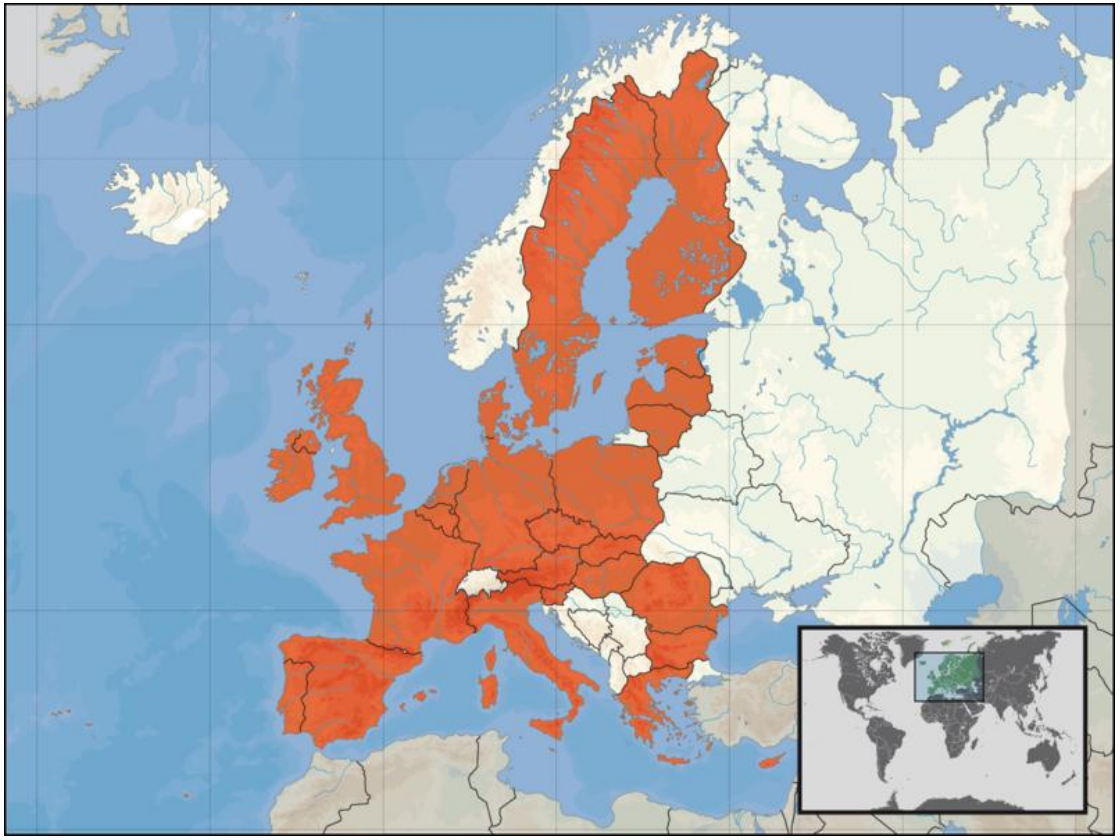
Professor Janusz S. Szmyd (D.Sc., Ph.D.)

Rector's Representative for Cooperation with Japan

Japan-Poland Clean Coal Seminar2014
Warsaw, Poland, June 2, 2014

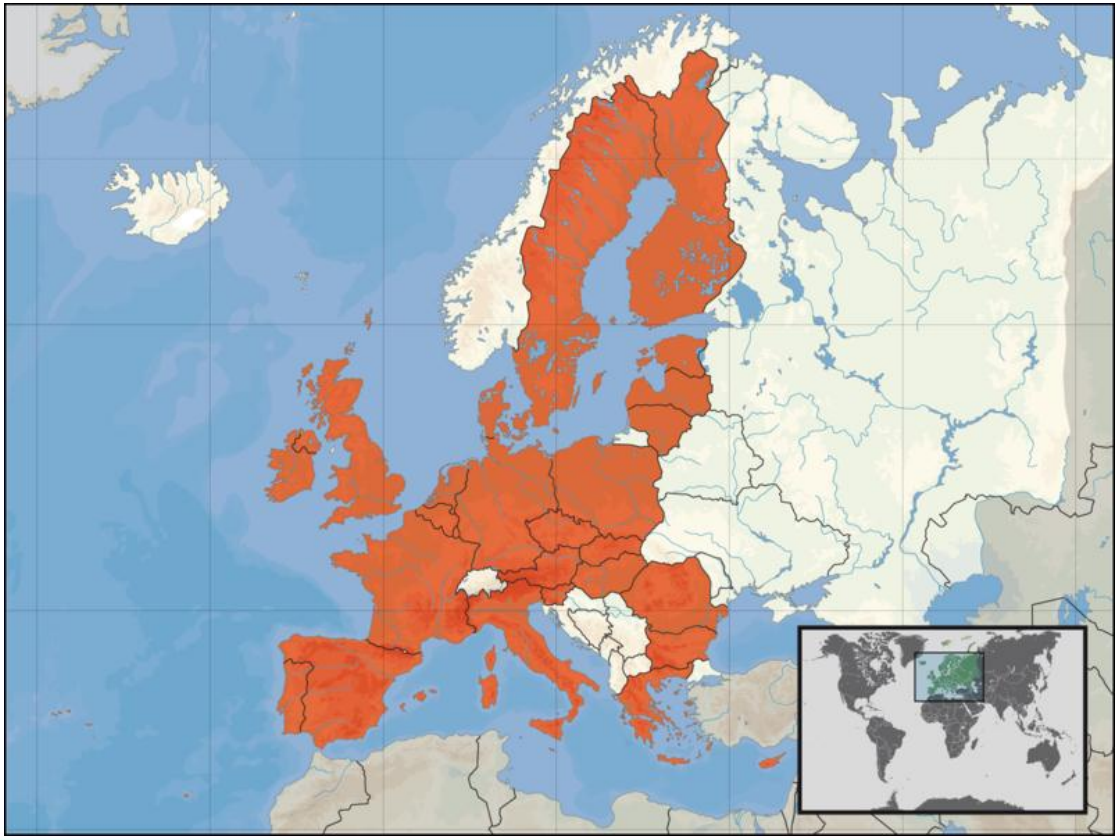
Introduction

Today, the European Union imports more than 50% of its energy, mostly in the form of oil and gas, from outside the Union.



Introduction

The EU Member States consume more than 1,725 million tonnes of oil every year at a cost of 500 billion Euros.



Introduction

Many of the regions of the world that supply our energy are geographically remote and some may be politically unstable.

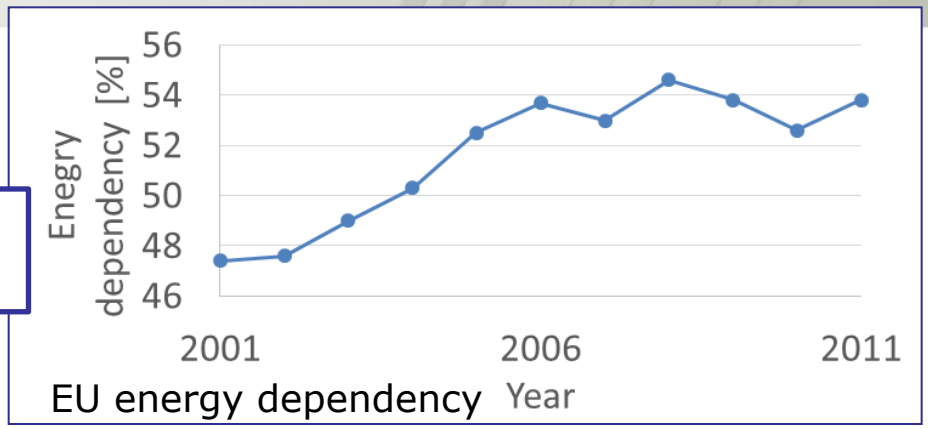
Introduction

For a world (for EU Member States) critically dependent on energy, maintaining a reliable and secure supply is essential.

Energy Dependency

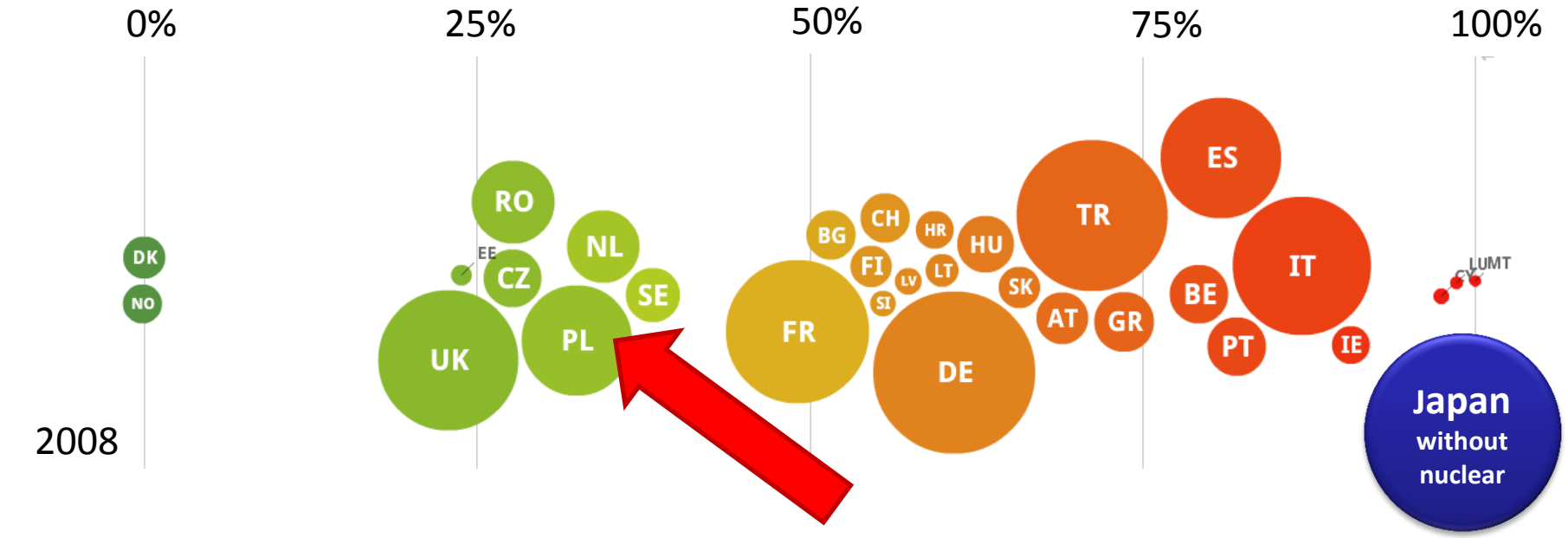
Energy dependency shows the extent to which a country relies upon imports in order to meet its energy needs.

EU – 54.6%
Poland – 30.6%



Energy Dependency on Import

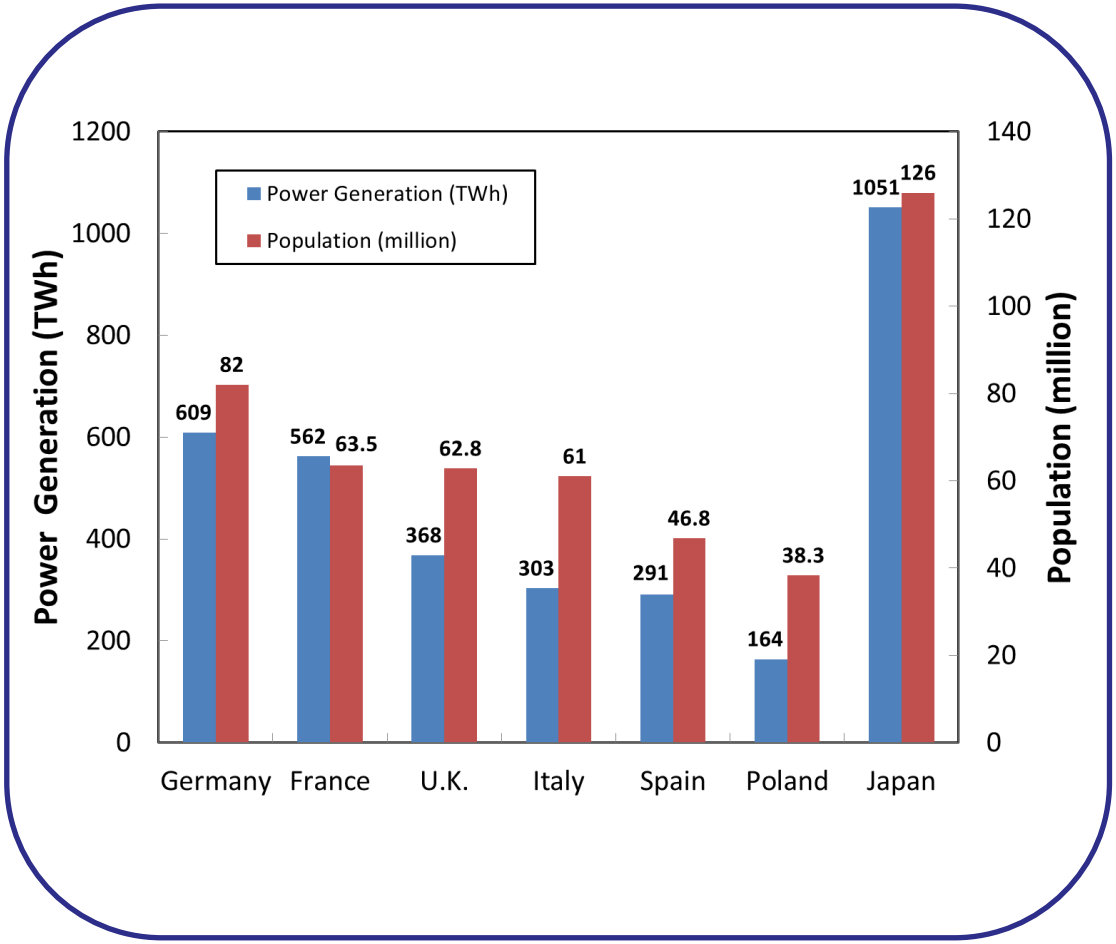
What proportion of gross energy consumption is from imports?

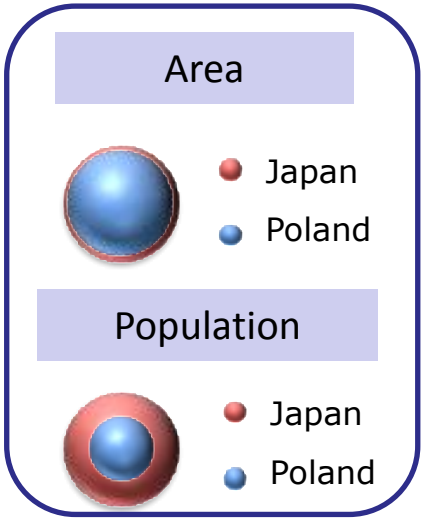


Area of the circle is proportional to the population

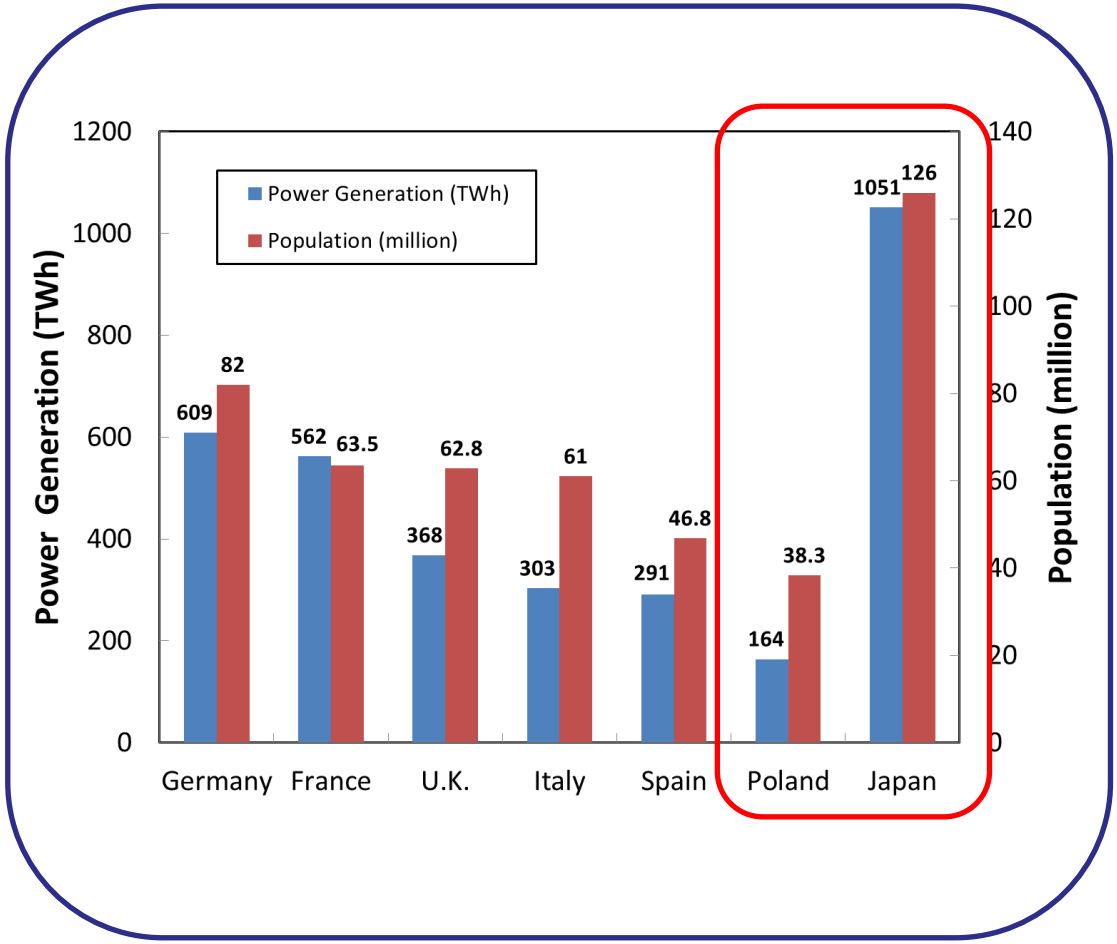
Source: http://energy.publicdata.eu/

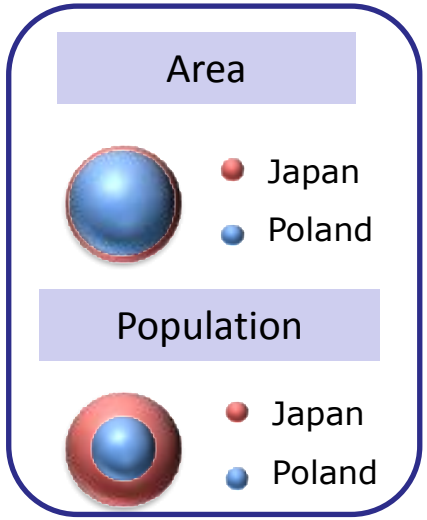
Power Generation in Europe

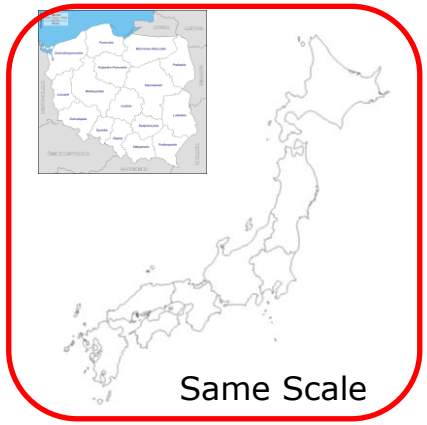




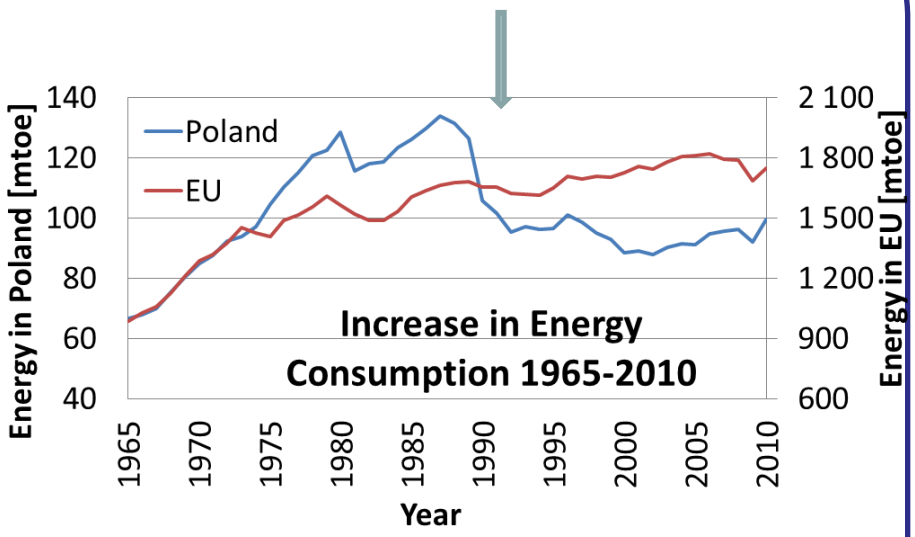
Power Generation in Europe





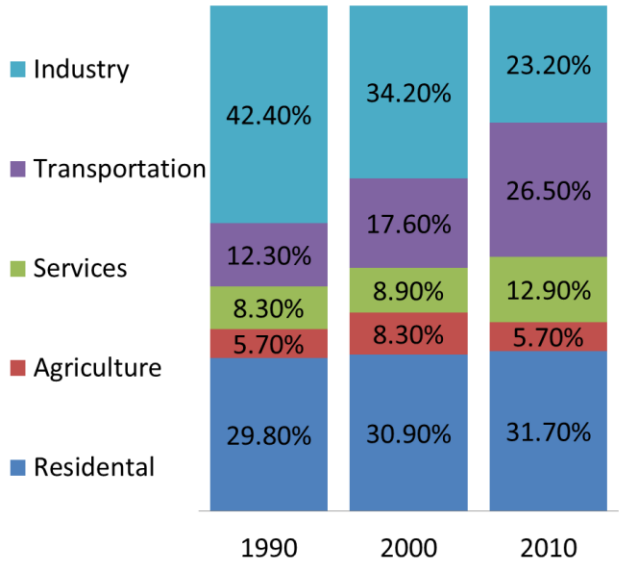


Polish Energy Consumption Trend

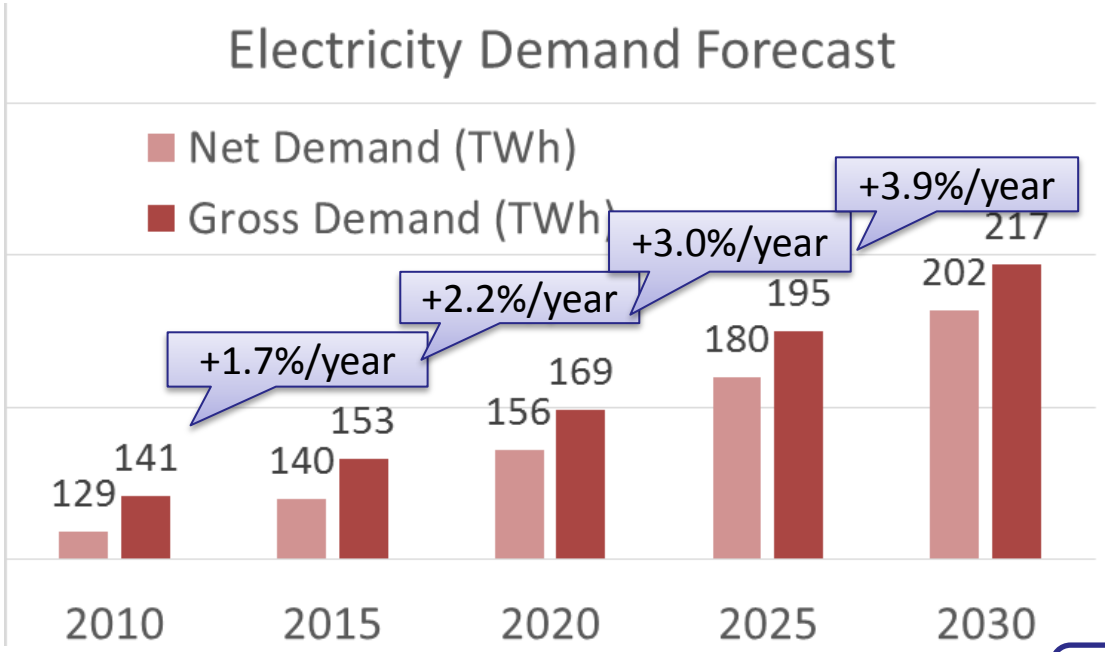


Energy Consumption in Poland and Europe

Polish Energy Consumption by Sectors



Polish Electricity Demand Forecast

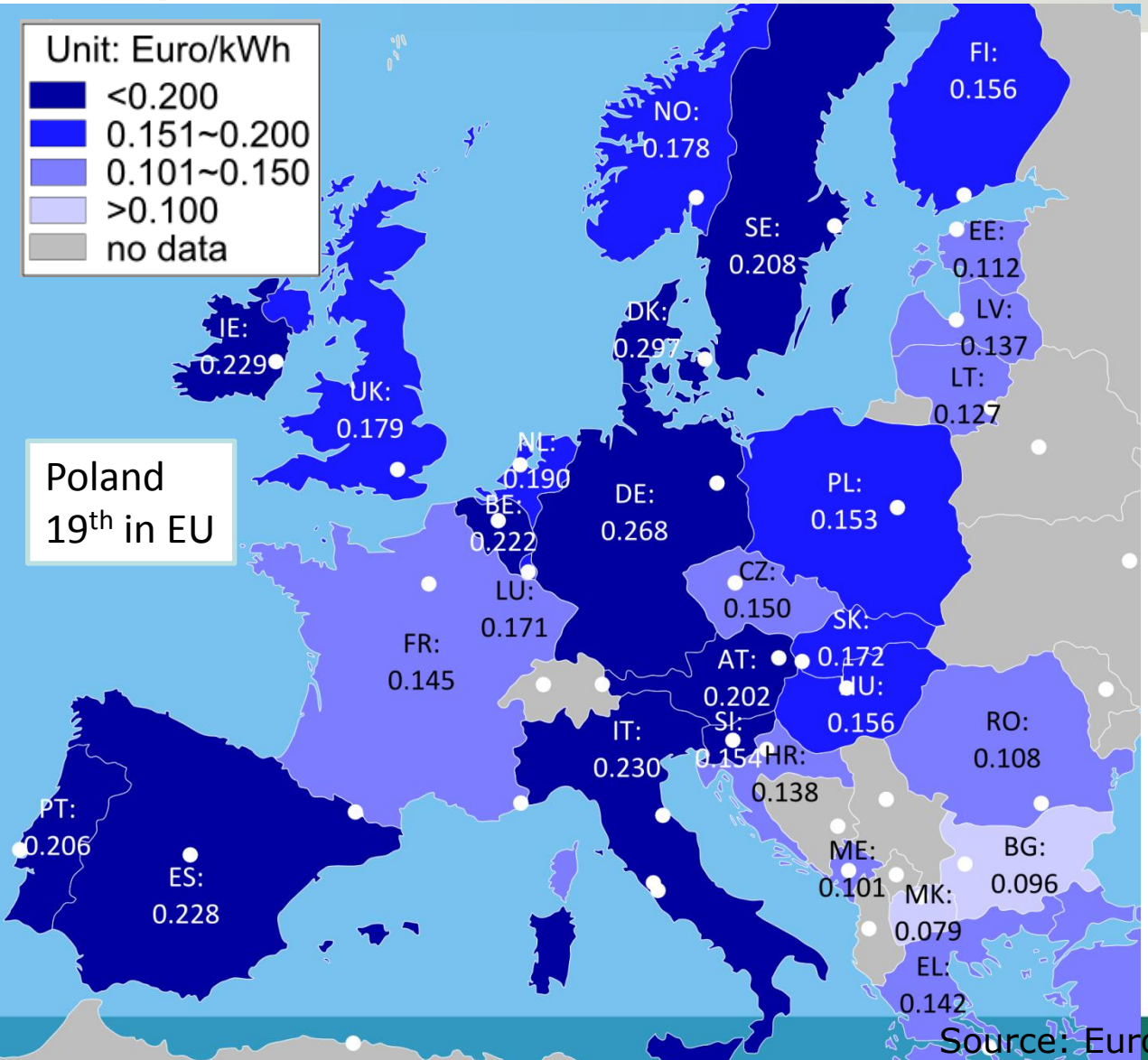


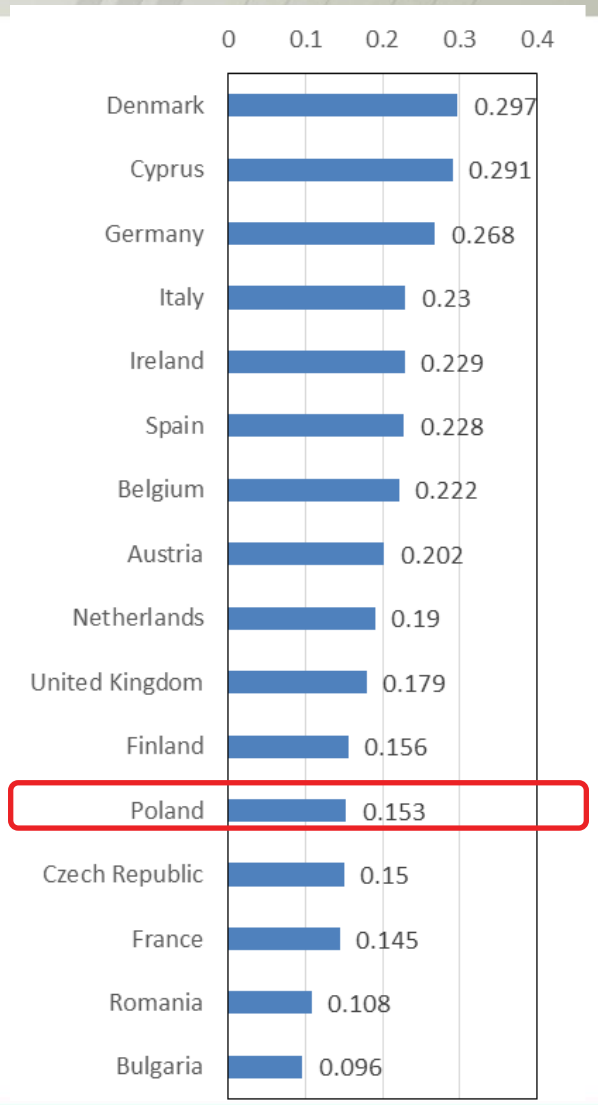
Assumptions:
- Increasing energy efficiency
- Security of energy system
- Introduction of Nuclear
- Development of RES
- Environment preservation

Zero energy economic growth
Reducing the energy intensity

Source: Ministry of Economy

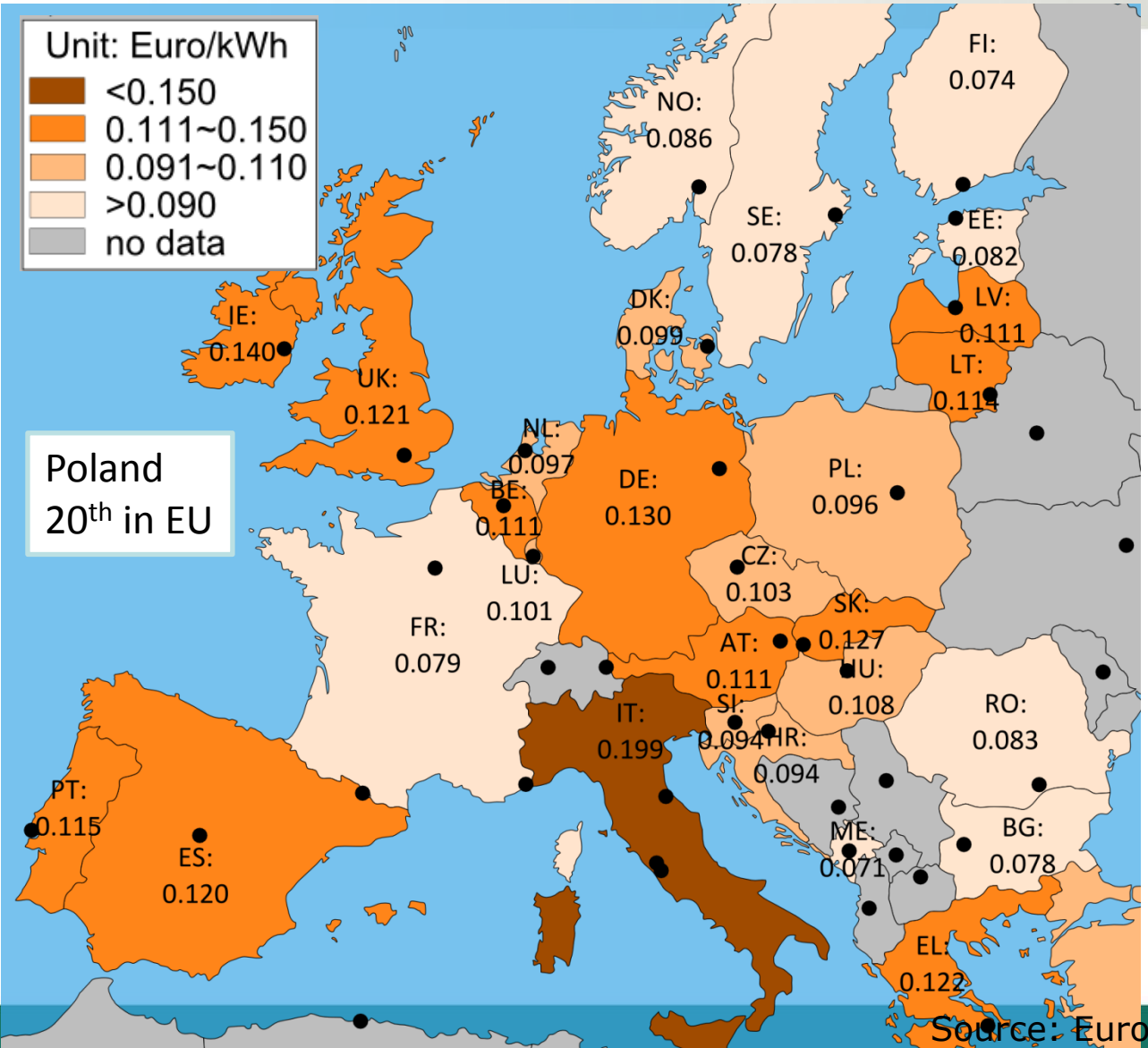
Electricity Prices in Europe for Residential Euro/kWh

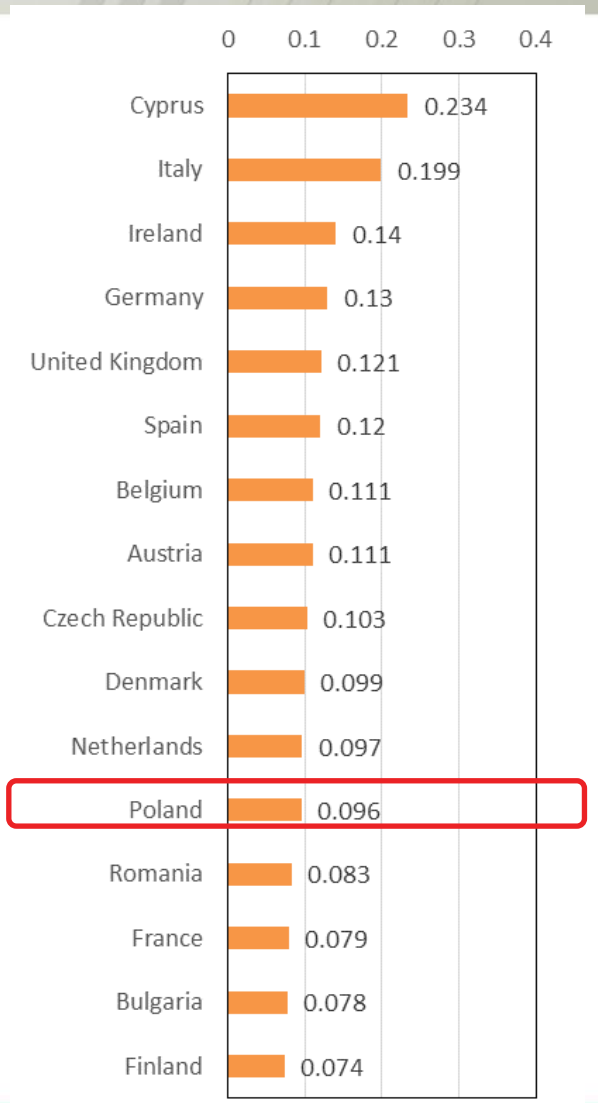




Source: Eurostat, European Comission, 2010

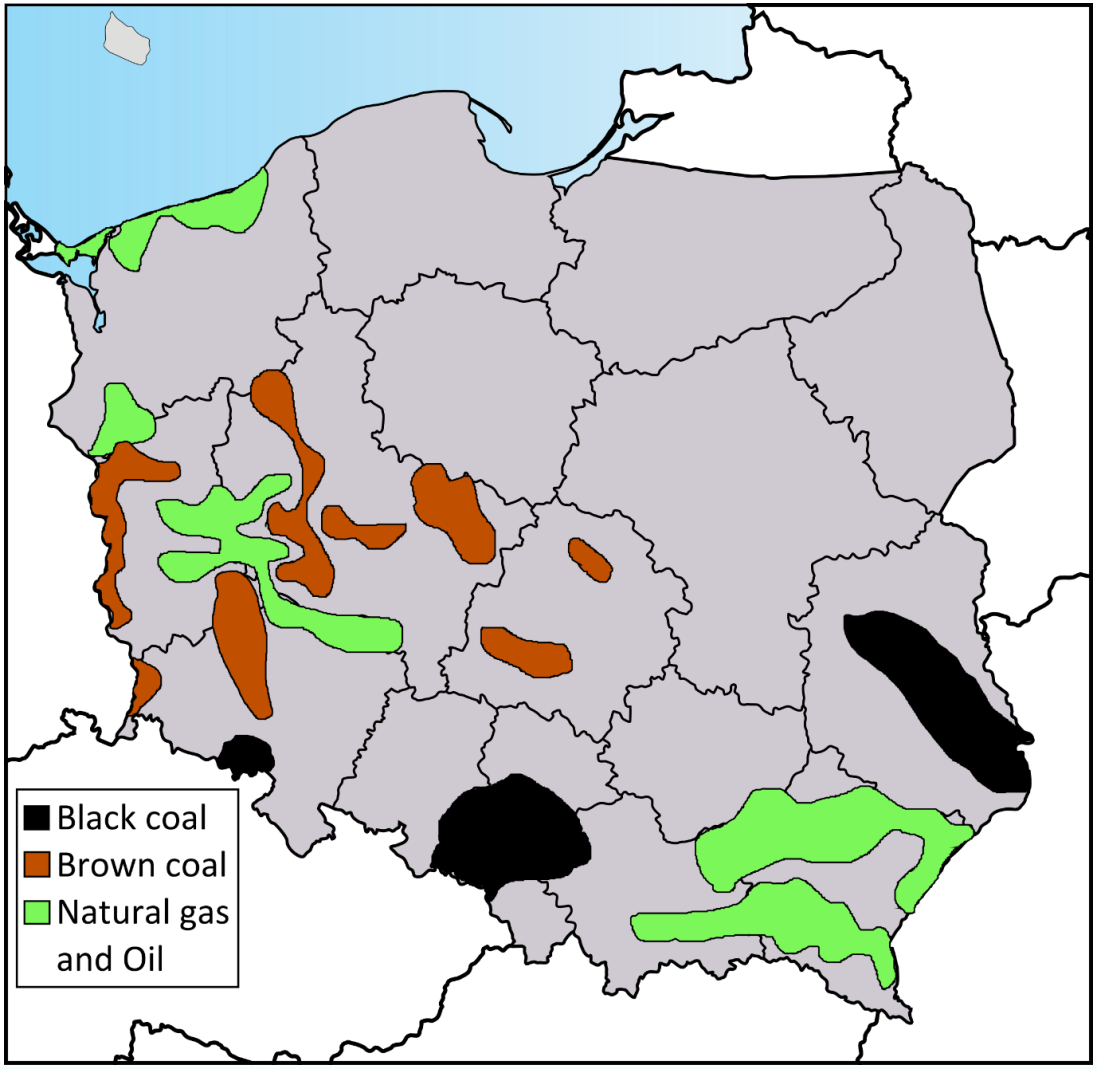
Electricity Prices in Europe for Industry Euro/kWh





Source: Eurostat, European Comission, 2010

Resources of Poland: Black Coal, Brown Coal, Natural Gas and Oil



Coal Resources and Reserves

	Resources	Reserves
Black Coal	44.2 Gt	16.9 Gt
Lignite	60.0 Gt	14.9 Gt

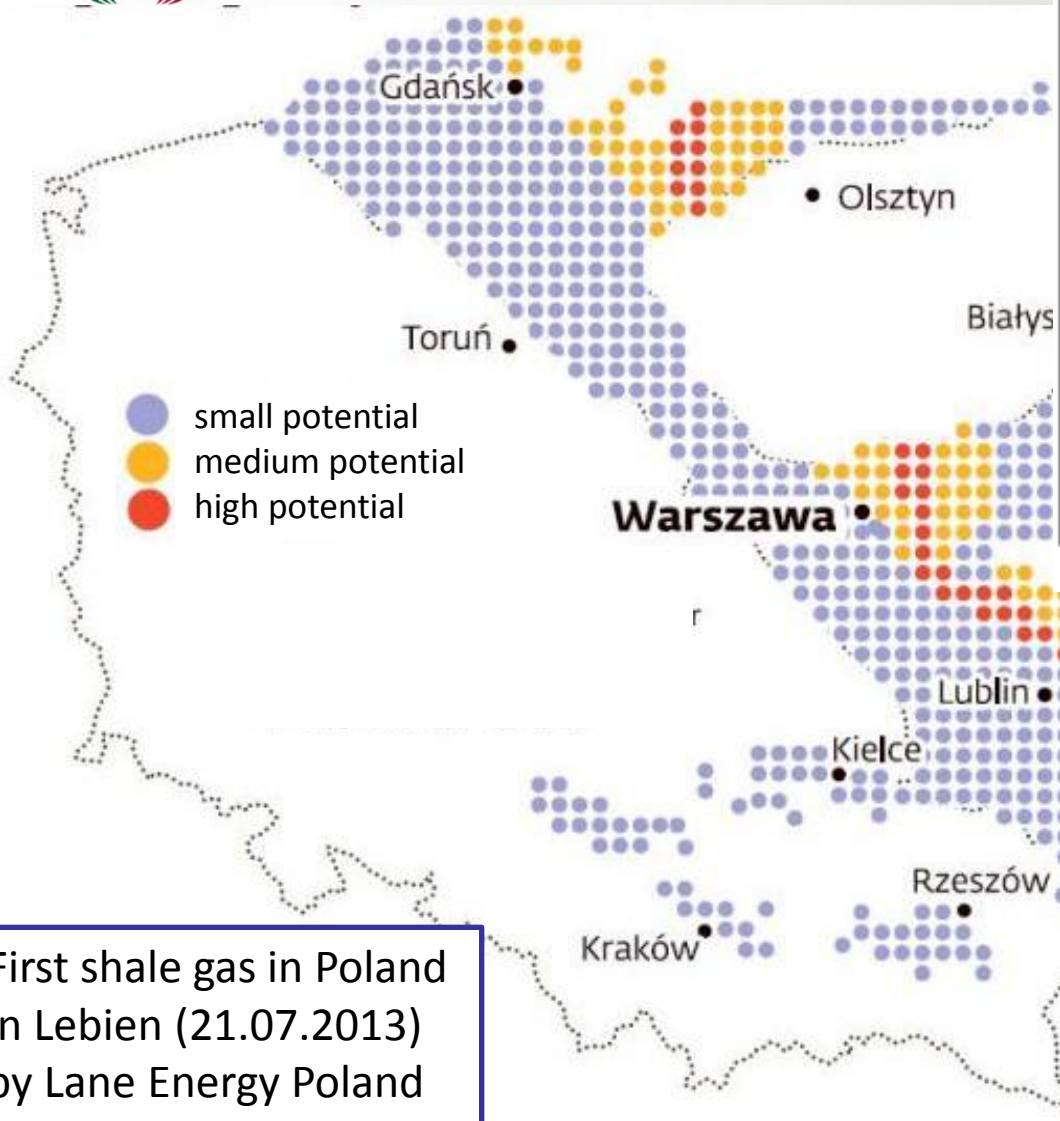
Annual Coal Production

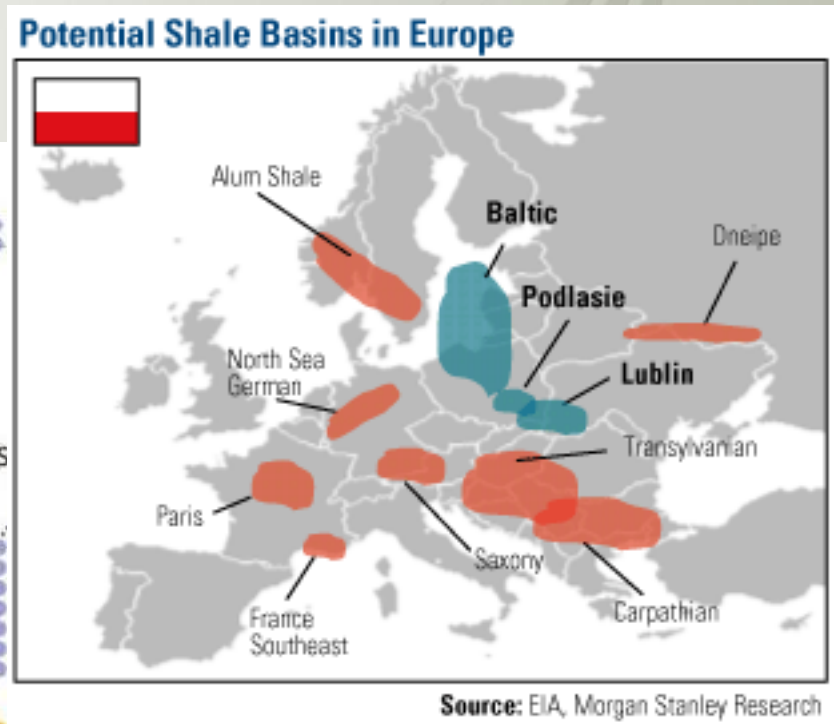
	Production/year (saleable output)
Black Coal	76.6 Mt
Lignite	56.3 Mt

Employment in Coal Industry

	Person
Black Coal	114 100
Lignite	16 300

Shale-gas in Poland





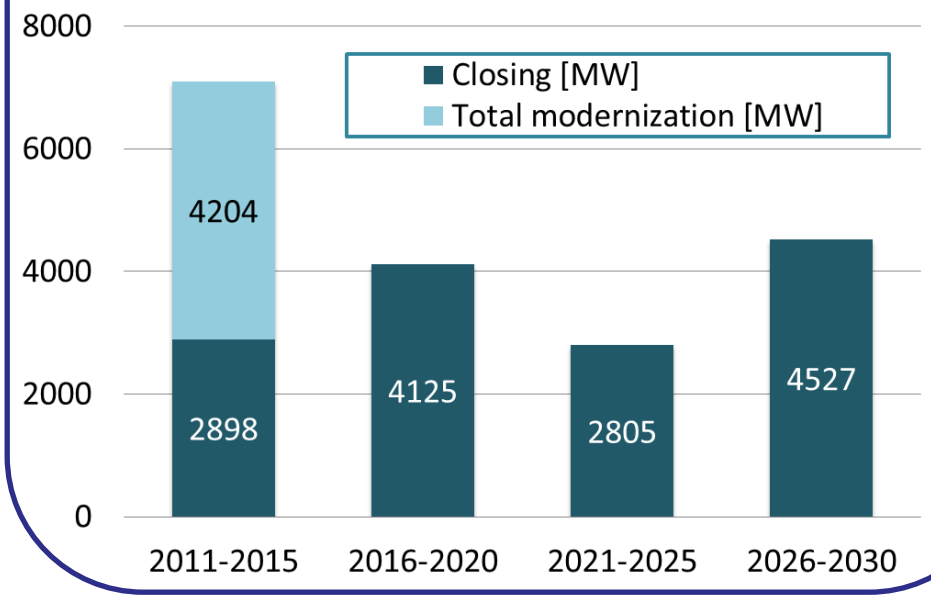
First shale gas in Poland in Lebien (21.07.2013) by Lane Energy Poland (ConocoPhilips)

In 2012 Polish resources were estimated for 346-768 mld m^3 (minimal estimation – 38mld m^3 and maximal 1.92bln m^3)

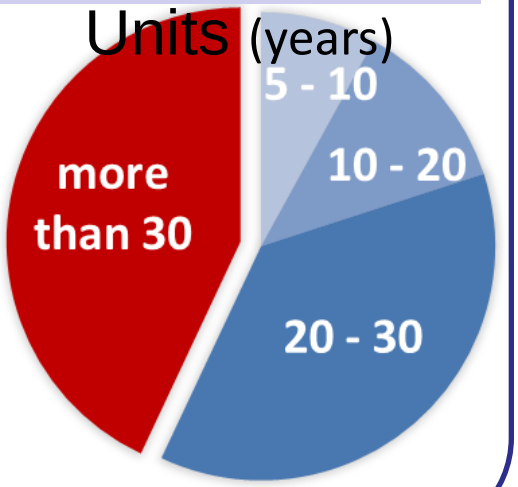
Source: DGP, EIA,PwC

Aged Plants and Units planned to be closed

Units Planned to be closed (MW)



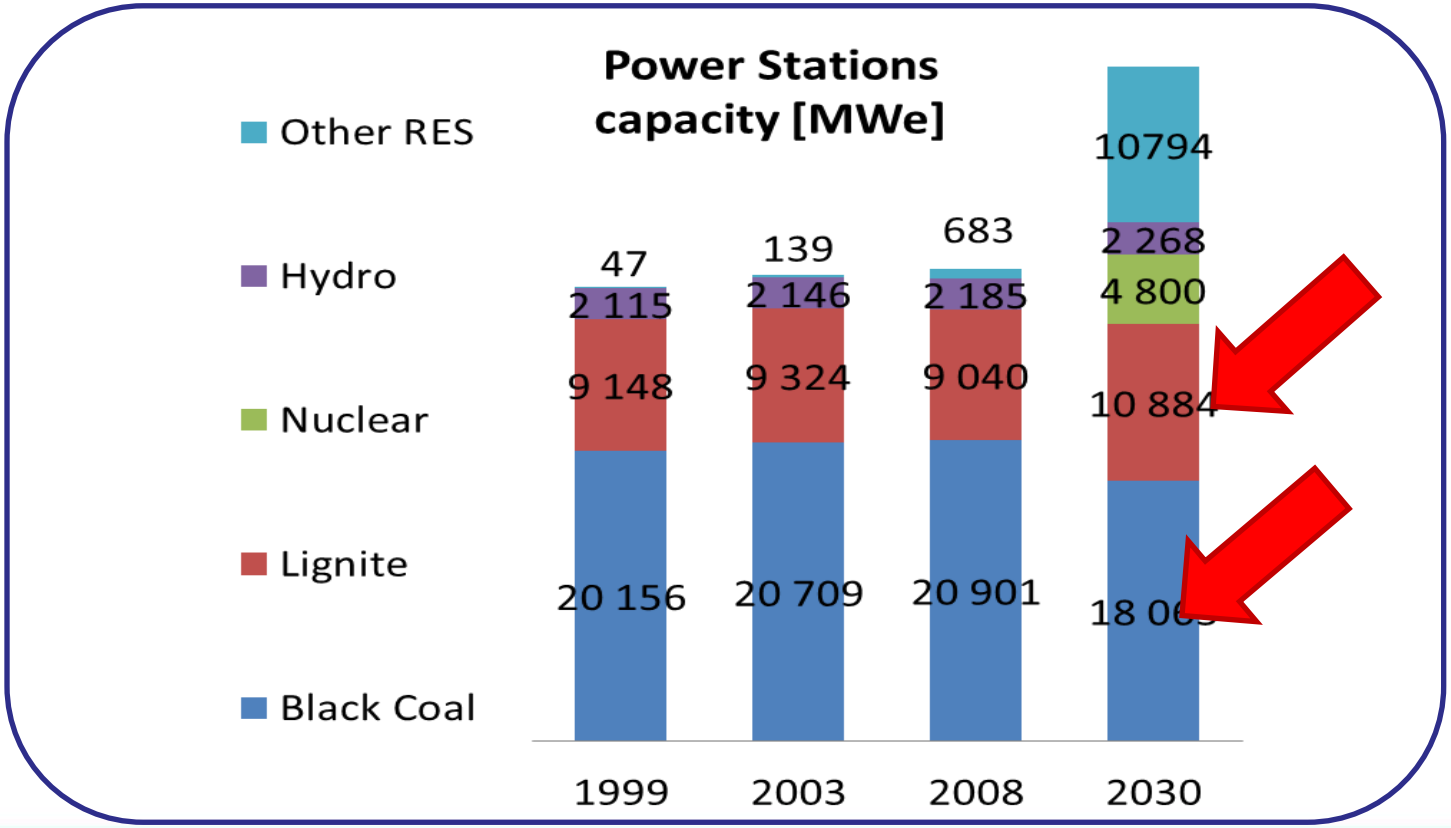
Age of Polish Power Generation Units (years)



Source: Ministry of Economy

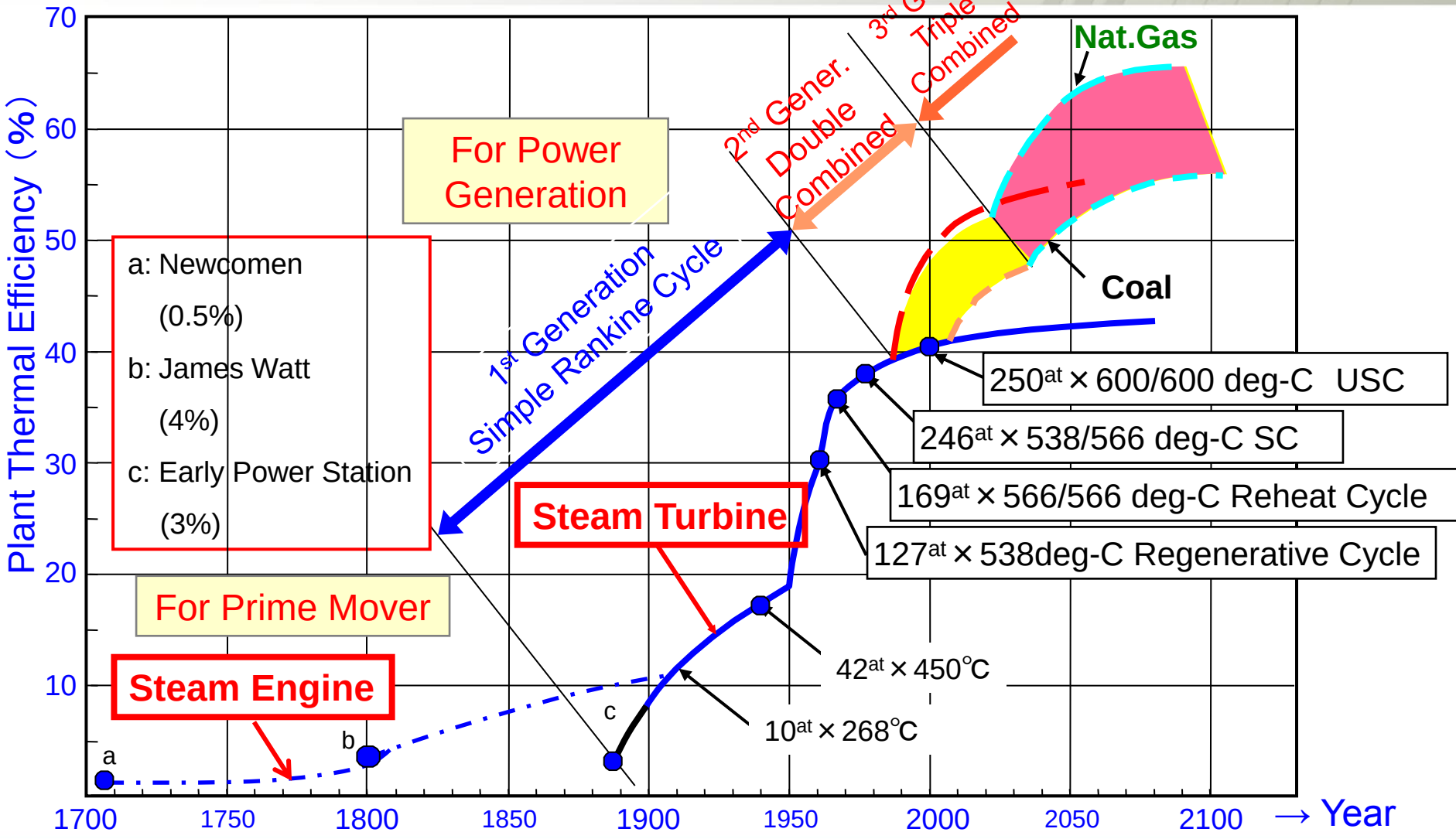
Power Generation in Poland

	1999	2003	2008	2030
Total Installed Capacity [MWe]	34 260	35 419	35 599	51 412
Max Power Demand [MWe]	22 821	23 454	25 121	



Source: Ministry of Economy

History of thermal efficiencies



Source: Prof. Kaneko materials

The biggest CFB 460 MW (UCP)

Tauron Wytwarzanie S.A. – Elektrownia Łagisza

The biggest CFB 460 MW (UCP)

GRUPA TAURON
POŁUDNIOWY KONCERN ENERGETYCZNY

Kozienice II Power Plant

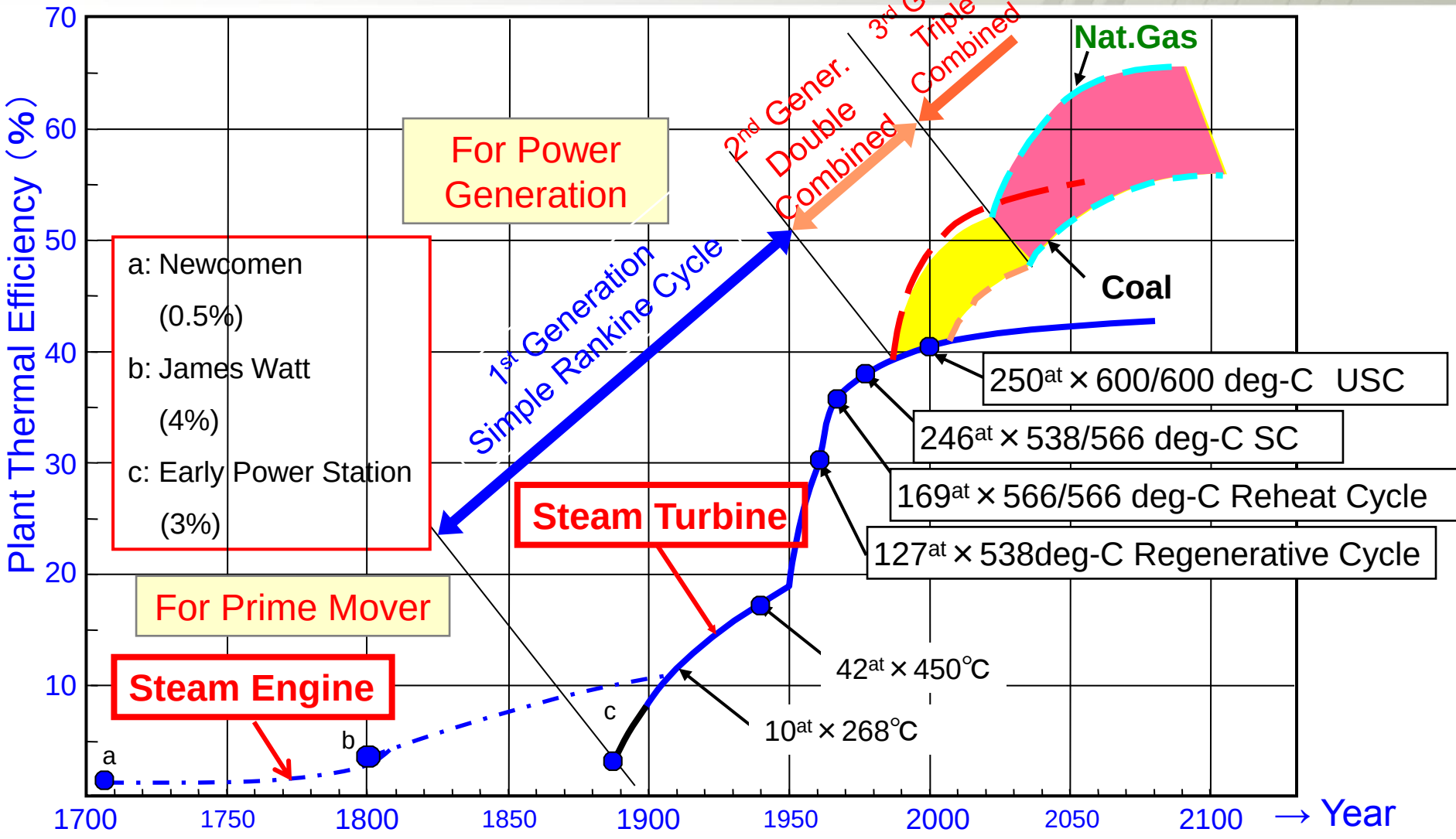
1075 MW
Supercritical power plant

Constructor:
Hitachi Power Europe
and Polimex – Mostostal

Finish of construction:
2017

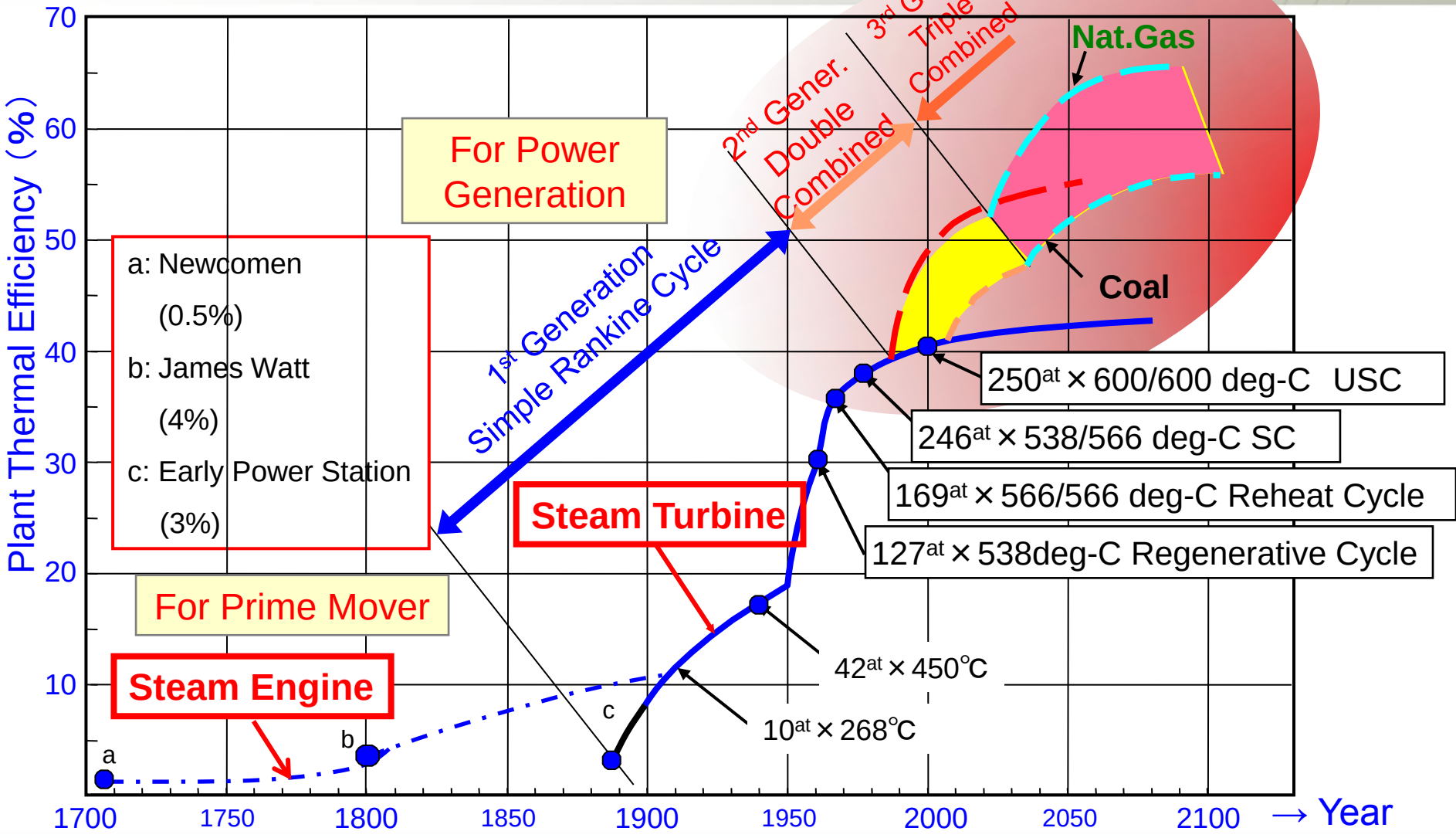
Source: Ministry of Treasury Republic of Poland, wnp.pl

History of thermal efficiencies



Source: Prof. Kaneko materials

History of thermal efficiencies

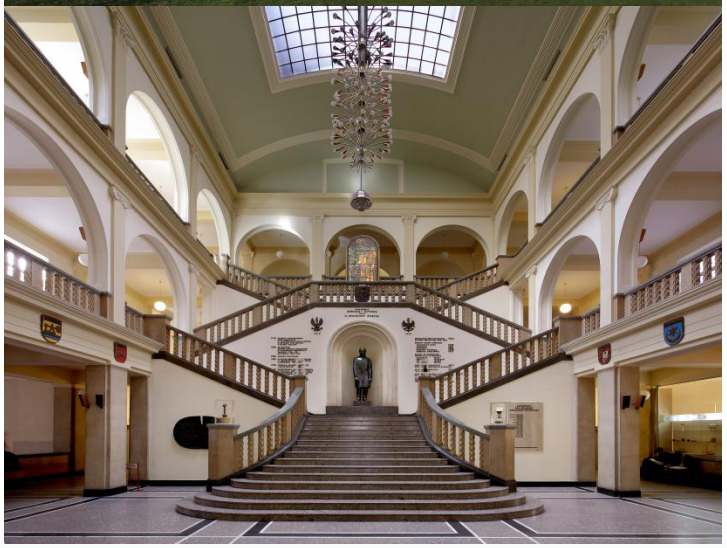


Source: Prof. Kaneko materials

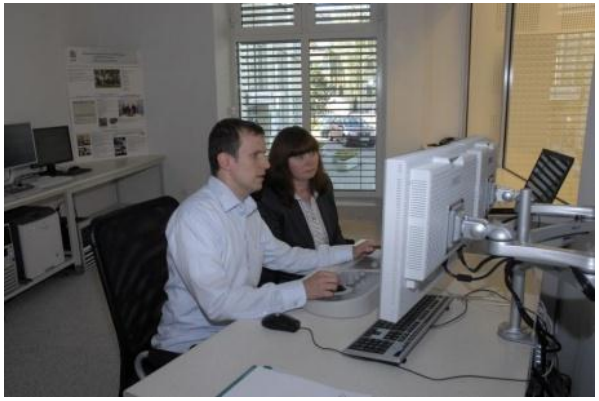
Japanese National Project of IGCC: Nakoso 250 MW IGCC Power Plant

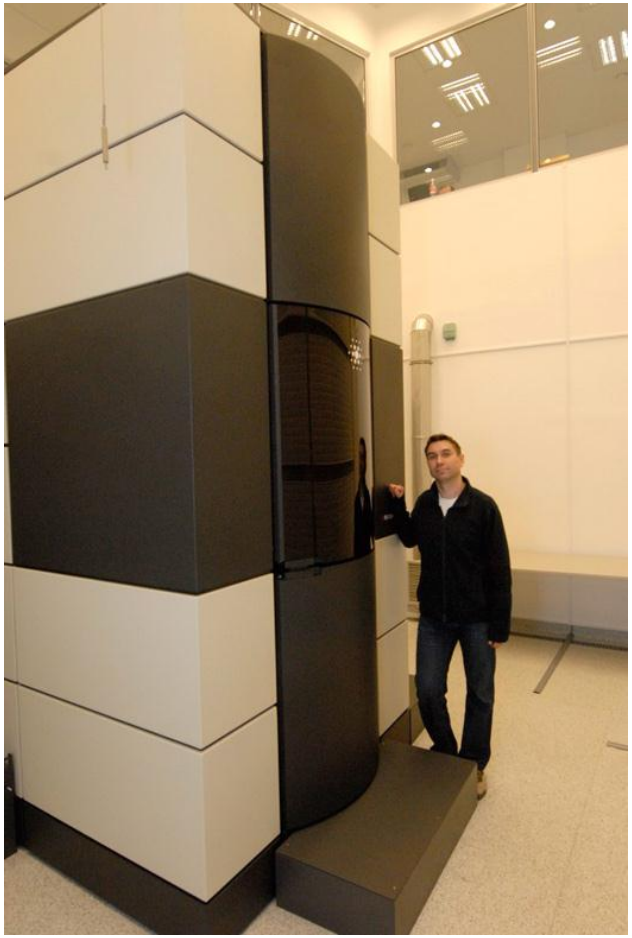
Source: Mitsubishi Heavy Industries

AGH-UST (since 1919) Facts and figures



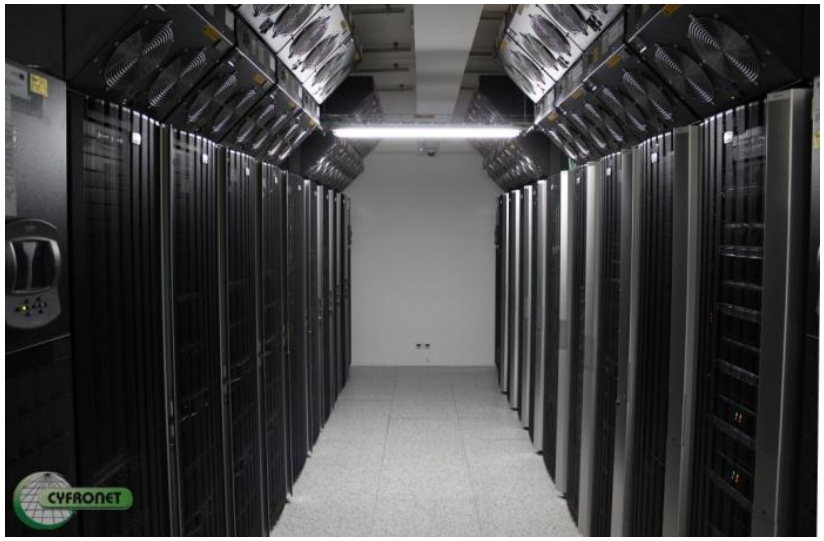
AGH-UST (since 1919) Facts and figures

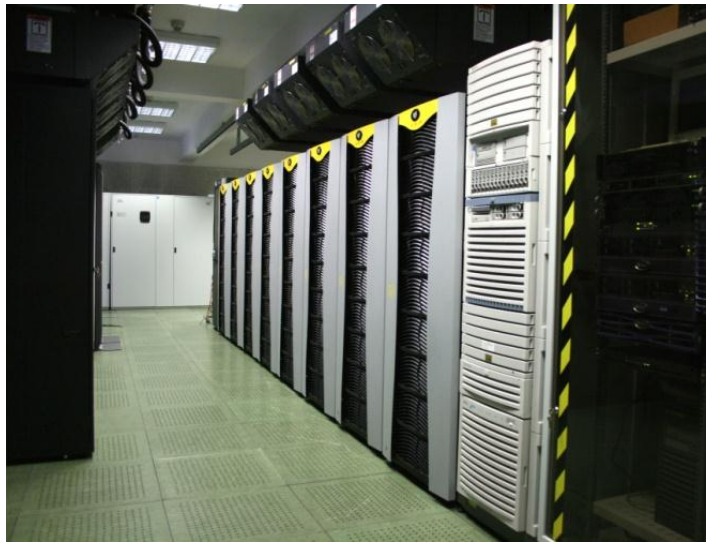




(S)TEM FEI Titan Cubed G-2 60-300.

AGH-UST (since 1919) Facts and figures



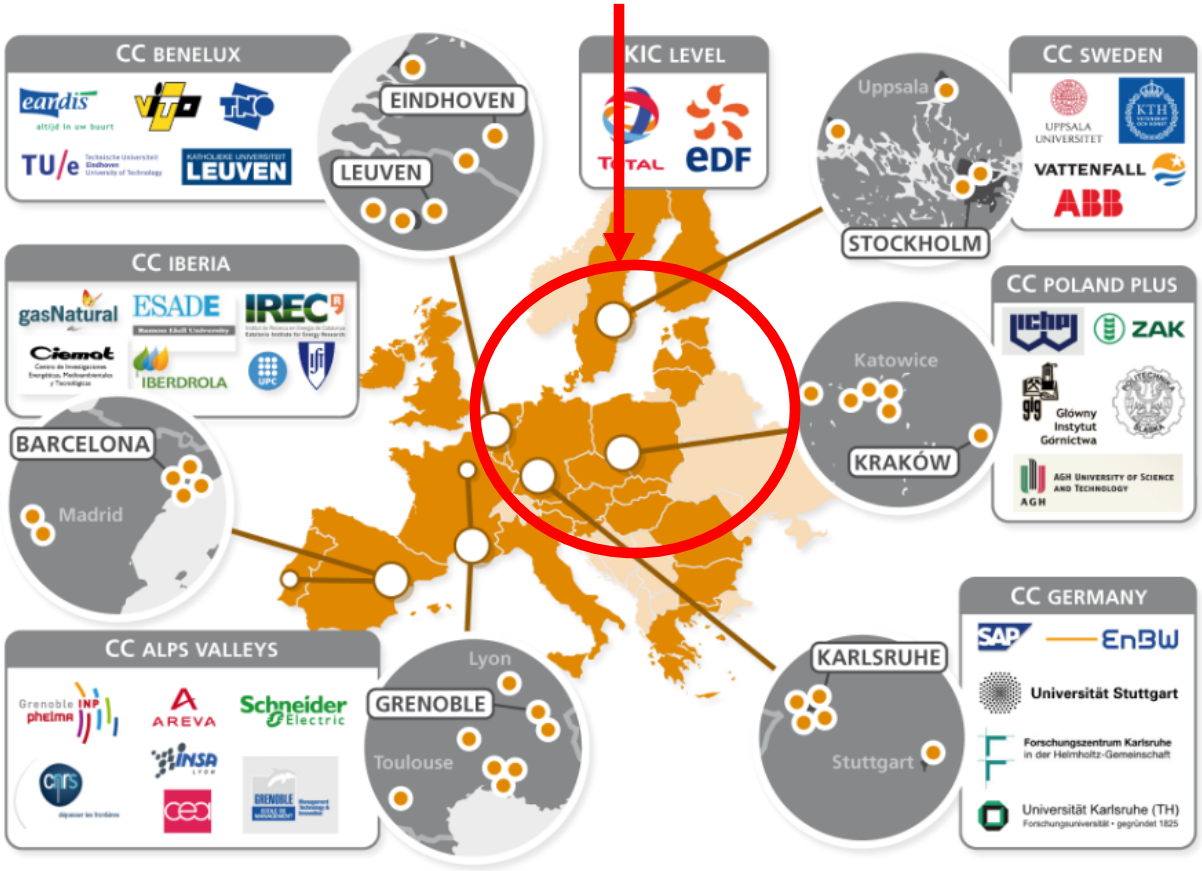


CYFTONET AGH-UST High Performance Computers

AGH-UST (since 1919) Facts and figures

KIC InnoEnergy project

One of the nodes is coordinated by AGH-University of Science and Technology



Prof. T. Szmuc

Source: KIC InnoEnergy

AGH-UST (since 1919) Facts and figures

Coal Gasification Technology project

Prof. M. Sciazko

Prof. W. Nowak

Scientific-Industrial Consortium *"Gasification of Coal"* led by AGH

Time:

5 years (2010– 2015)

Budget:

26,3 mln USD–The National Center for Research and Development

3,2 mln USD– Industry

One of the largest research projects under way at the AGH

Highlights:

- Underground and surface gasification
- Design of demonstration facilities
- Coal gasification technology expertise
- Strategy to develop coal gasification technology in Poland

AGH-UST (since 1919) Facts and figures

Coal Gasification Technology

Project of IHI Corporation:

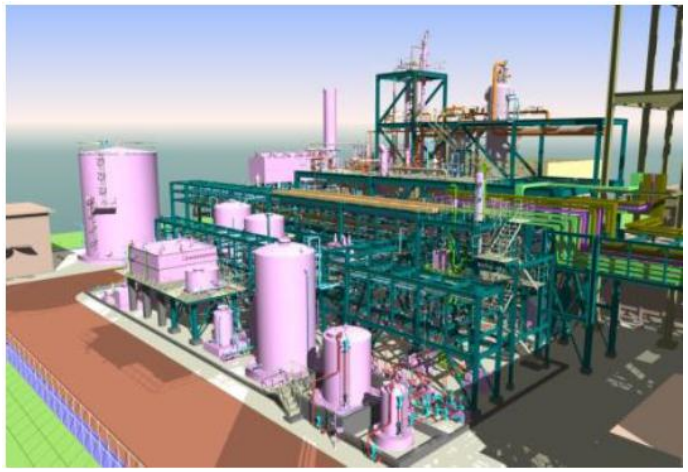
TIGAR – Twin Ihi GASifier
– Dual Fluidized Bed Gasifier

IHI

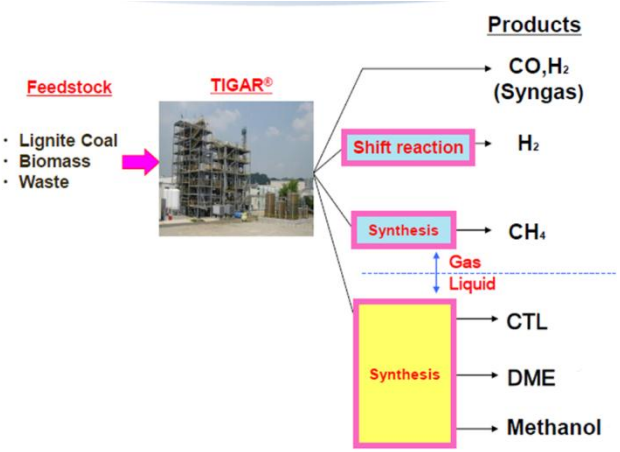
Realize your dreams

Prof. M. Sciazko

Prof. W. Nowak



Model of prototype plant in Indonesia

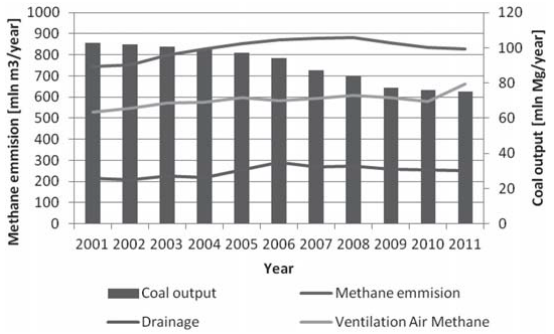


Various applications of products: GT, GE fuel, fuel cell, ammonia, synthesis natural gas, transportation fuel, chemical raw material

Source: IHI materials

AGH-UST (since 1919) Facts and figures

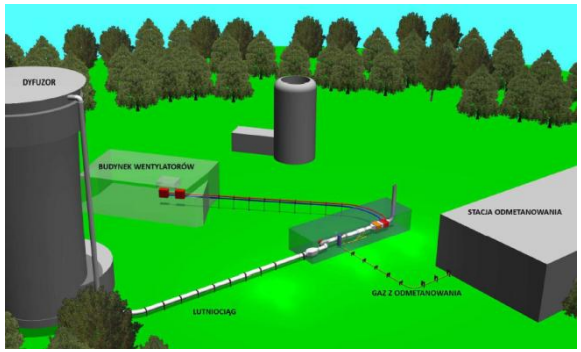
Utilization of the methane from Polish mines



Yearly reserves of methane in ventilation air of hard coal mines (2011) was amounted for about **662.5 mln m³** :

LHV: **2,1 ·10⁸ GJ**
Value: **394 mln USD**
Heating of **300 thousand houses**

and their volume is increased each year



Prepared laboratory-scale IUMK-1 and pilot-scale IUMK-100 installations

Professor Nawrat research group

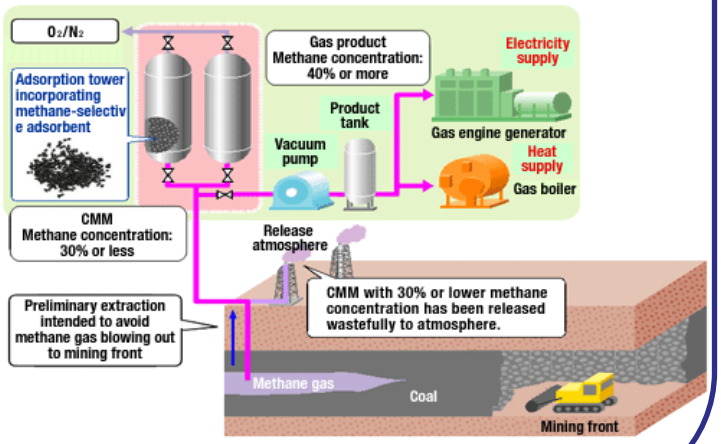
Prof. S. Nawrat

INNOWACYJNA GOSPODARKA
NARODOWA STRATEGIA SPÓJNOŚCI
AGH
PROJEKT WSPÓŁFINANSOWANY ZE ŚRODKÓW UNII EUROPEJSKIEJ

AGH-UST (since 1919) Facts and figures

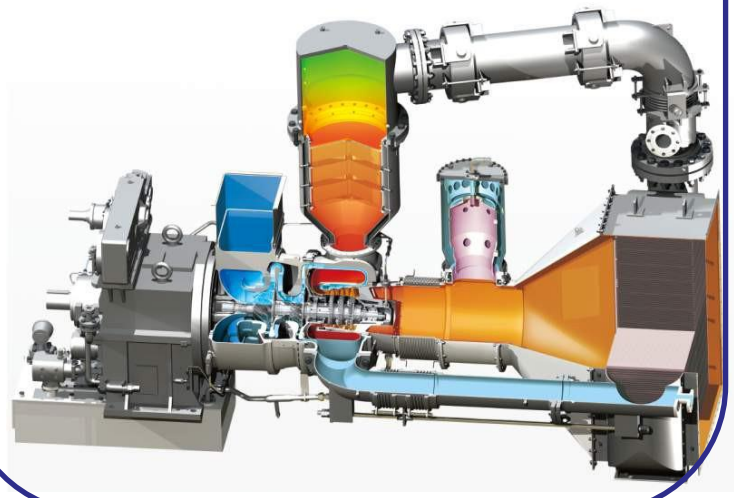
Project of Osaka Gas Co. Ltd.:
Low-concentration CMM (Coal Mine Methane) Technology

Design Your Energy 夢ある明日を
大阪ガス GROUP



Project of *Kawasaki Heavy Industries, Ltd.* :
High efficiency gas turbine for CMM and VAM (Ventilation Air Methane)

Kawasaki



Prof. S. Nawrat

Source: Osaka Gas, Kawasaki Heavy Industry

AGH-UST (since 1919) Facts and figures

Fundamental Drying Test of Polish Lignite

Prof. S. Kaneko

Prof. J. S. Szmyd

The University of Tokyo

Development of Innovative Self-Heat Recuperation Drying System for Lignite

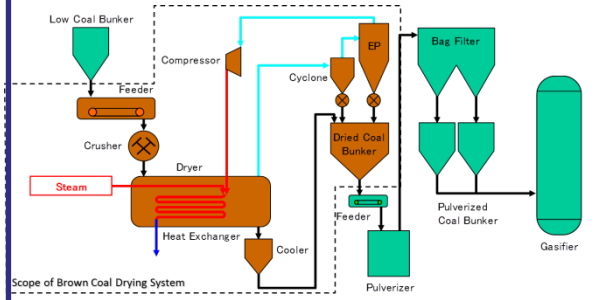
東京大学
THE UNIVERSITY OF TOKYO

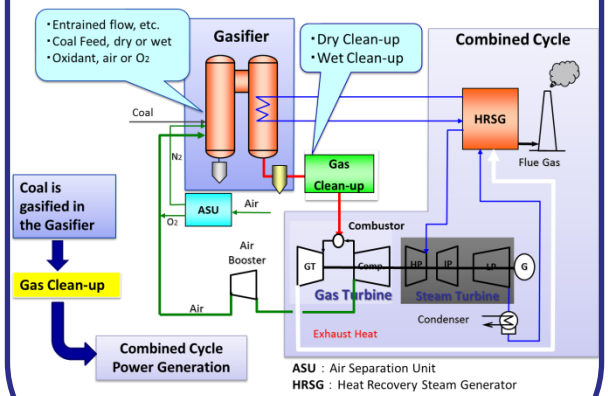
JCOAL Japan Coal Energy Center

GOALS:

- Fundantal Drying Test of Polish Lignite
- Basic Drying Test of Polish Lignite using 10TPD SFBD
- Design of 200 TPD Pilot SFBD Plant
- Construction and Operation of Pilot Plant

AGH





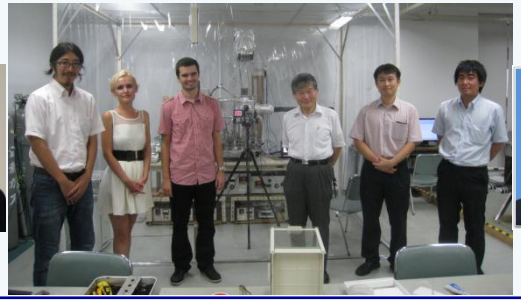
Future Project Schedule
- Fundamental Drying Test of Polish Lignite

		Phase 1		Phase 2		Phase 3	
		2013	2014	2015	2016	2017	2018
Fundanetal Drying Test of Polish Lignite	Belchatow Lignite	→					
	Lignite B		→				
Basic Drying Test of Polish Lignite using 10TPD SFBD				→			
Design of 200 TPD Pilot SFBD Plant					→		
Construction of 200 TPD Pilot Plant						→	
Operation of 200 TPD Pilot Plant							→

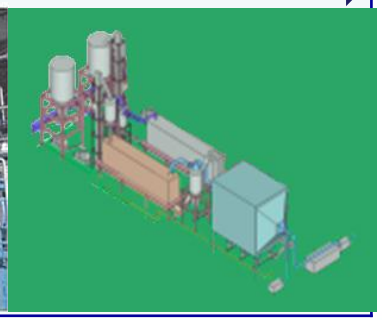
Japan (Univ. of Tokyo)

Japan or **Poland**

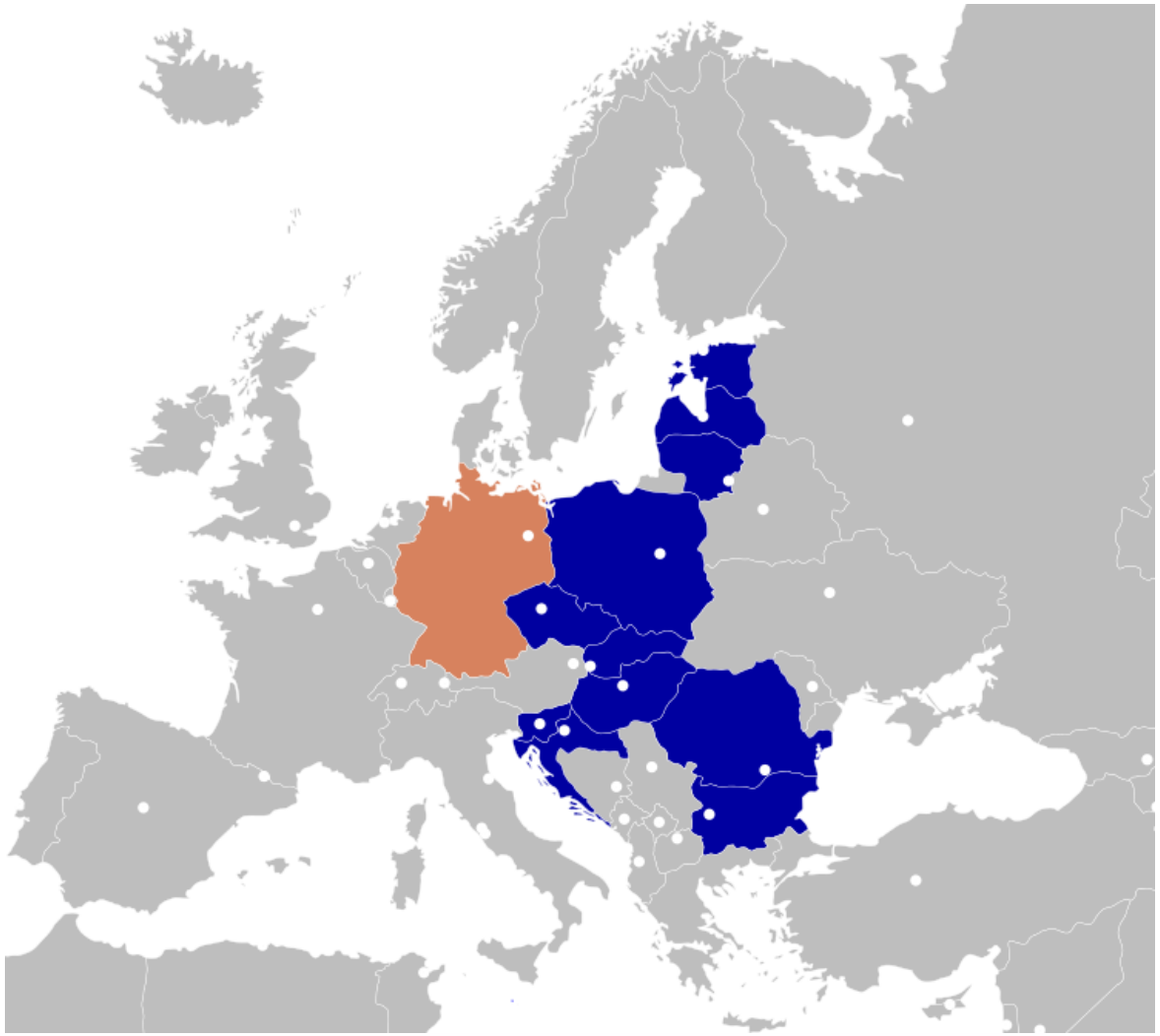
Poland (Lignite Power Station)





EU-11 and Germany

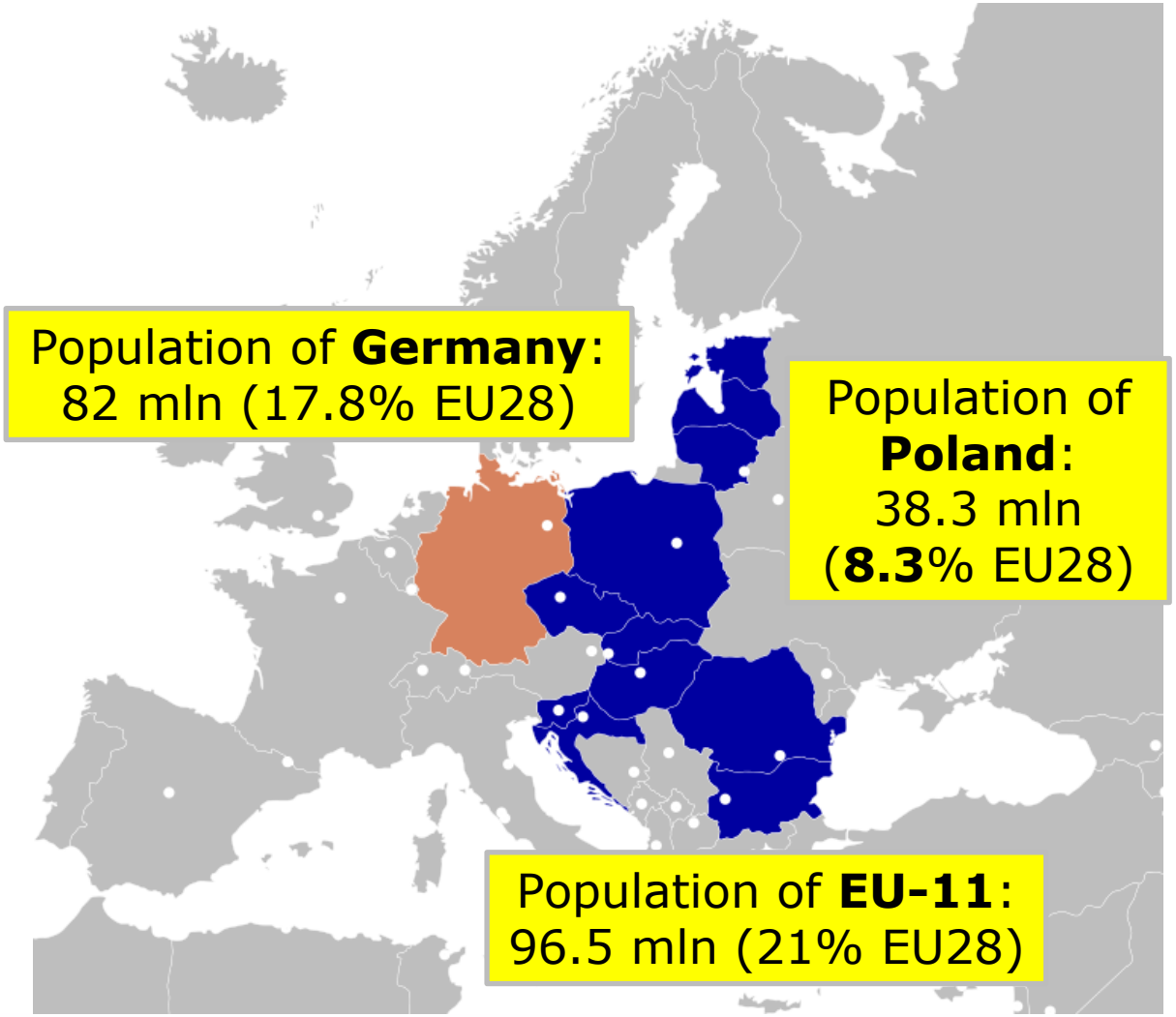


Central Europe EU-11

- Bulgaria
- Croatia
- Czech Republic
- Estonia
- Hungary
- Latvia
- Lithuania
- Poland
- Romania
- Slovakia
- Slovenia

Cooperation between EU-11 and Japan

EU-11 and Germany: Population

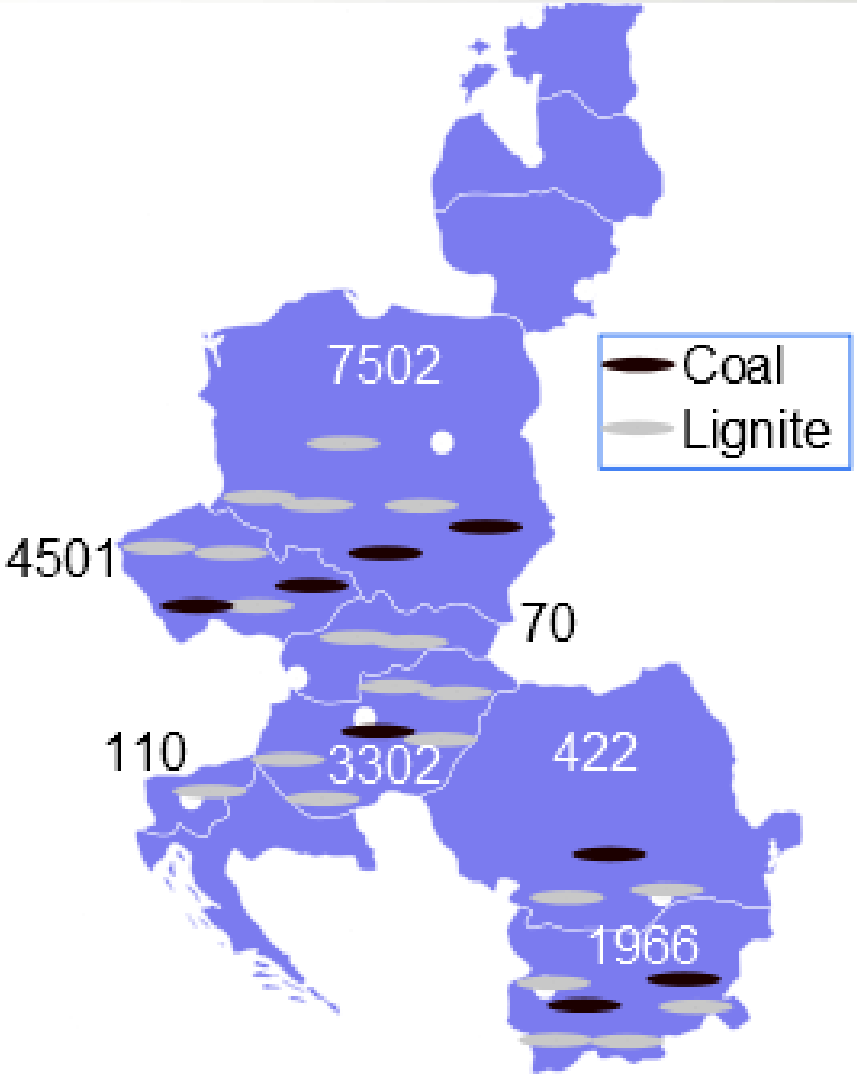


Central Europe EU-11

- Bulgaria
- Croatia
- Czech Republic
- Estonia
- Hungary
- Latvia
- Lithuania
- Poland
- Romania
- Slovakia
- Slovenia

Cooperation between EU-11 and Japan

Main coal and lignite deposits in EU-11 countries (Mt)



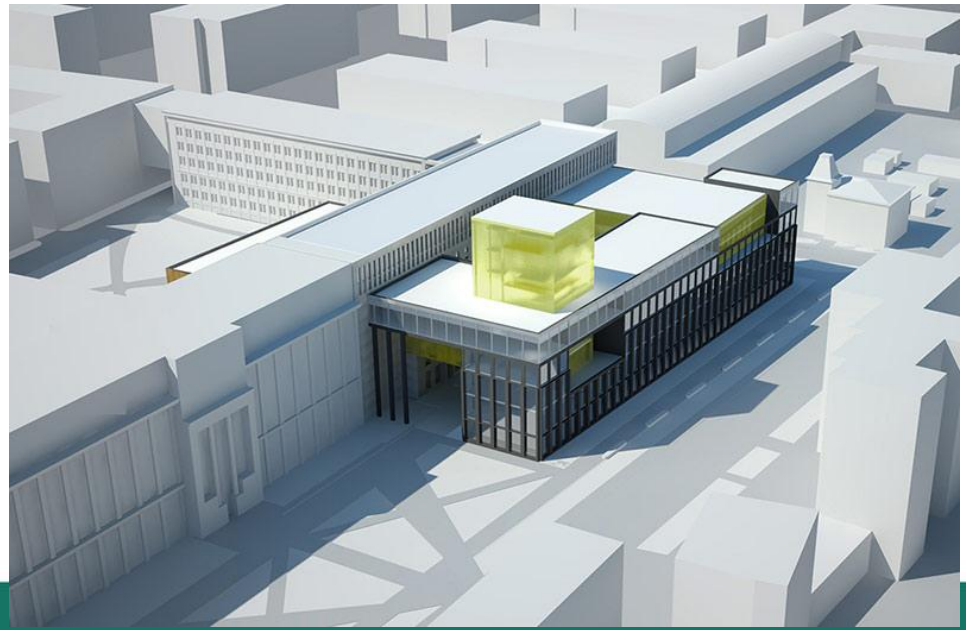
Poland has the largest coal and lignite reserves among all EU-11 countries!

Poland as the **leader** in research and development of new technologies

AGH-UST (since 1919) Facts and figures
Agreements with Japanese Universities

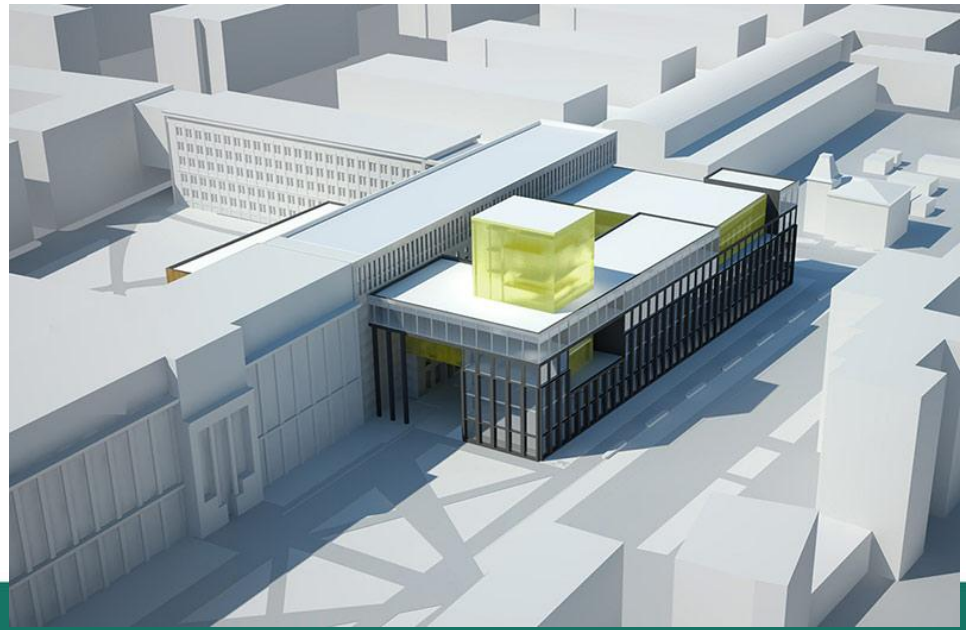
- **The University of Tokyo**, 2013-2018
- **Kyoto Universit**, from 1983
- **Kyushu University**, from 2000
- **Hokkaido University**, from 2007
- **Shibaura Institute of Technology**, from 2004
- **University of Toyama**, 2008-2013
- **Muroran Institute of Technology**, 2009-2014
- **Kumamoto University**, from 2010
- **Ryukoku University**, from 2010
- **Tokyo Metropolitan University**, 2011-2016
- **Rigaku Corporation**

AGH-UST (since 1919) Facts and figures
Energy Engineering Centre



- **Largest investment** in the history of the AGH UST
- Construction: start –Oct. 2013, finish – Nov. 2014
- 38 laboratories design for research in the field of energy engineering designed for R&D and cooperation with industry

AGH-UST (since 1919) Facts and figures
Energy Engineering Centre



KGHM INTERNATIONAL

Sumitomo

Existing commercial cooperation: **The Sierra Gorda Project** - joint venture between KGHM International Ltd., Sumitomo Metal Mining and Sumitomo Corporation in Chile (copper**,** **molybdenum** and gold ore).

Thank you for your kind attention
ご清聴ありがとうございました

Wishing for further cooperation between Poland and Japan
これからもポーランドと日本のよりよい関係とさらなる協力が実現することを願っています