A Vision for the Development of Renewable Energy Sources in Poland to 2050

Grzegorz Wiśniewski

Institute for Renewable Energy (EC BREC IEO)

Plan of this Presentation

1. "15%" – a new way of showing RES in obligations for 2020 in the European Commission's Climate Package of 21 January 2008
2. The point of departure (2005) for implementation of the Climate Package in RES in Poland
3. Current forecasts for the development of renewable energy in Poland
4. Evaluation of the potential for RES development in the expert study by the Institute for Renewable Energy for the Ministry of Economy, December 2007
5. Long-term scenario for the provision of clean energy carriers for Poland to 2050 – an expert study by the Institute for Renewable Energy for Greenpeace Polska –September 2008
6. Summary

”15%”- a new way of showing RES in obligations for 2020 in the European Commission’s Climate Package ”*A Reward for Effective Parties*”

- Previous way of calculation of RES contribution to energy balance (1995-2010)
  - Reference of the RES contribution to primary energy consumption
    - => a large denominator – small contribution (4.8% in Poland in 2005)
    - => no possibility to show losses in conversion and transmission of energy
    - => objectives for 2010; 12 % for the EU (the White Paper of 1997, 7.5 % for Poland (RES Strategy of 2001)
- New way of calculation of RES contribution proposed by the European Commission in January 2008 (2005-2020)
  - Reference of RES contribution to final energy consumption
    - => the denominator smaller by 20-50% - higher percentage contribution or RES (7.2 % in 2005)
    - => the denominator reflects the losses and own needs of the energy sector which, if excessive, make the attainment of the goals more difficult
    - the numerator is the total of the final consumption of renewable energy: electricity (gross), fuels for heating and cooling and final consumption of fuels and energy in transport (flexibility in fixing partial goals by Member States), however, there are environmental and effectiveness restrictions (in counting biomass and ineffective heat pumps and solar collectors towards the objective) and green energy and exported biofuels are not counted towards such an objective.
    - => aim for 2020; 20 % for the EU, 15 % for Poland 15% (7.2+11.5%=18.7% was expected).

Calculation of the 15 % Objective for 2020

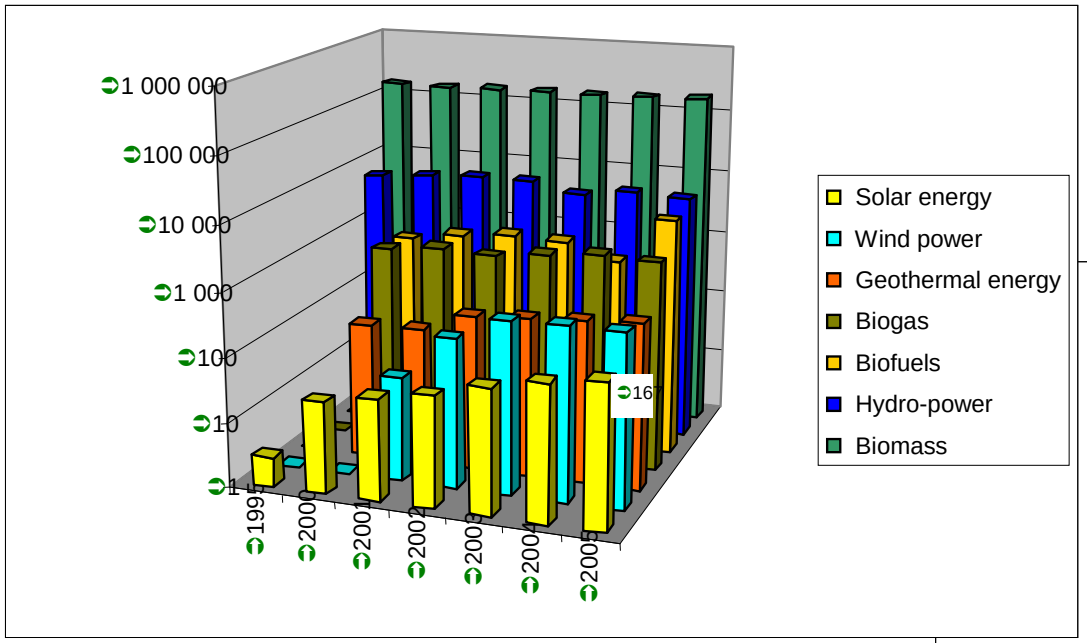
and of Interim Objectives for 2012, 2014, 2016 and 2018

$$15\% = \frac{OZE_C + OZE_E + OZE_B + OZE_{ZWW}}{FZE + PW + S}$$

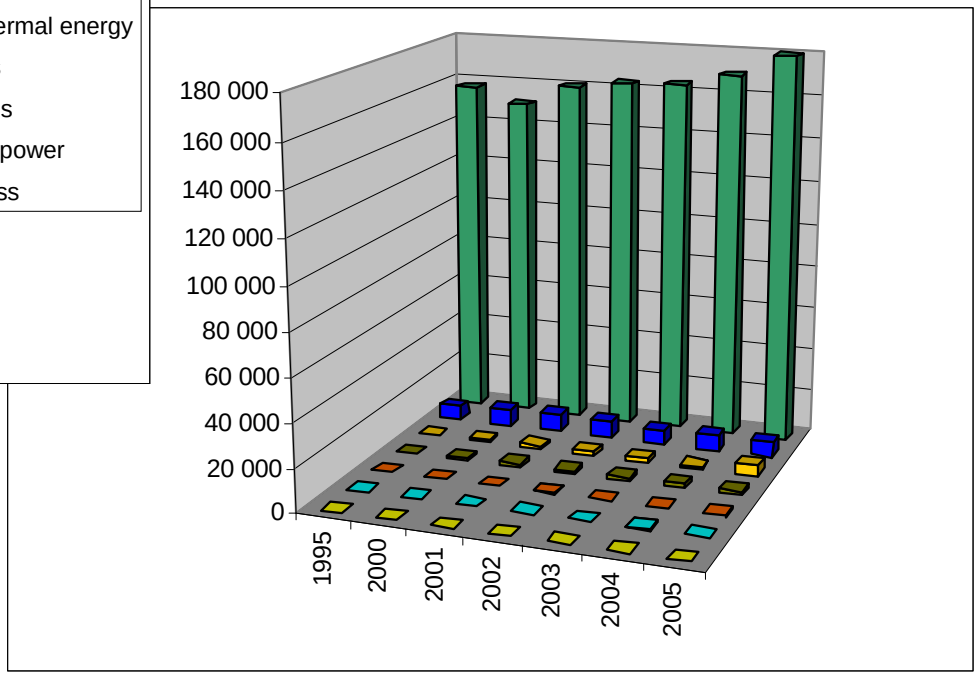
- OZEC - consumption (~production) of green heat [TJ]
- OZEE - consumption (~production) of green electricity [TJ]
- OZEB - consumption (~production) of biofuels [TJ]
- OZE_{ZWW} - consumption of biomass for own needs of RES and secondary (derivative) energy (e.g. heating input in the biogas plant with heat from a biogas engine) [TJ]
- FZE - final consumption of energy [TJ]
- PW - consumption of energy for own needs of the energy sector [TJ]
- S - fuel and energy losses in transfer and distribution [TJ]

Production of Energy From Renewable Sources in Poland in 1995-2005 [TJ]

Energy from RES, 2005	*TJ according to Eurostat*	*%*
Electricity	15 111	8,6
Biofuels	1 937	1,1
Green heat	159 467	90,9
Total RES	**176 515**	**100,0**



Logarithmic Scale



Decimal Scale

Forecast Contribution of RES to Final and Primary Energy in 2020

Document/Forecast for 2020	Primary Energy	Converted to Final Energy
Ministry of Environment, **Renewable Energy Development Strategy, *2000***	14.0%	16.8%
EC BREC, ESD, Use of SAFIRE Model for Generation of Development Scenarios for Renewable Energy Sources in Poland until 2020, *2001*	8.2%-11.2%	9.8-13.4
ARE S.A., An Environmental Scenario for the Development of the Polish National Energy Sector, 2002[I]	5.5%-13.5%	6.6-16.2
Fraunhofer ISI, EEG, KEMA, ECOFYS, REC, *FORRES 2020: Analysis of the renewable energy's evolution up to 2020*, 2003	6%-18.5%	7.2-22.2
Ministry of Economy, *Poland's Energy Policy until 2030, draft dated 2007*	9%	10.8

Average forecast contribution: 13-14%

Evaluation of Renewable Energy Sources and Potential for Their Utilisation until 2020, 2007

Expert study by Institute for Renewable energy:

"The Potential for Utilisation of Renewable Energy Sources until 2020" for the Ministry of Economy, December 2007
http://www.mg.gov.pl/NR/rdonlyres/AC0AF2CE-748F-4BD7-9DC9-10E94257B732/48364/MozliwosciwykorzystaniaOZE2020.pdf

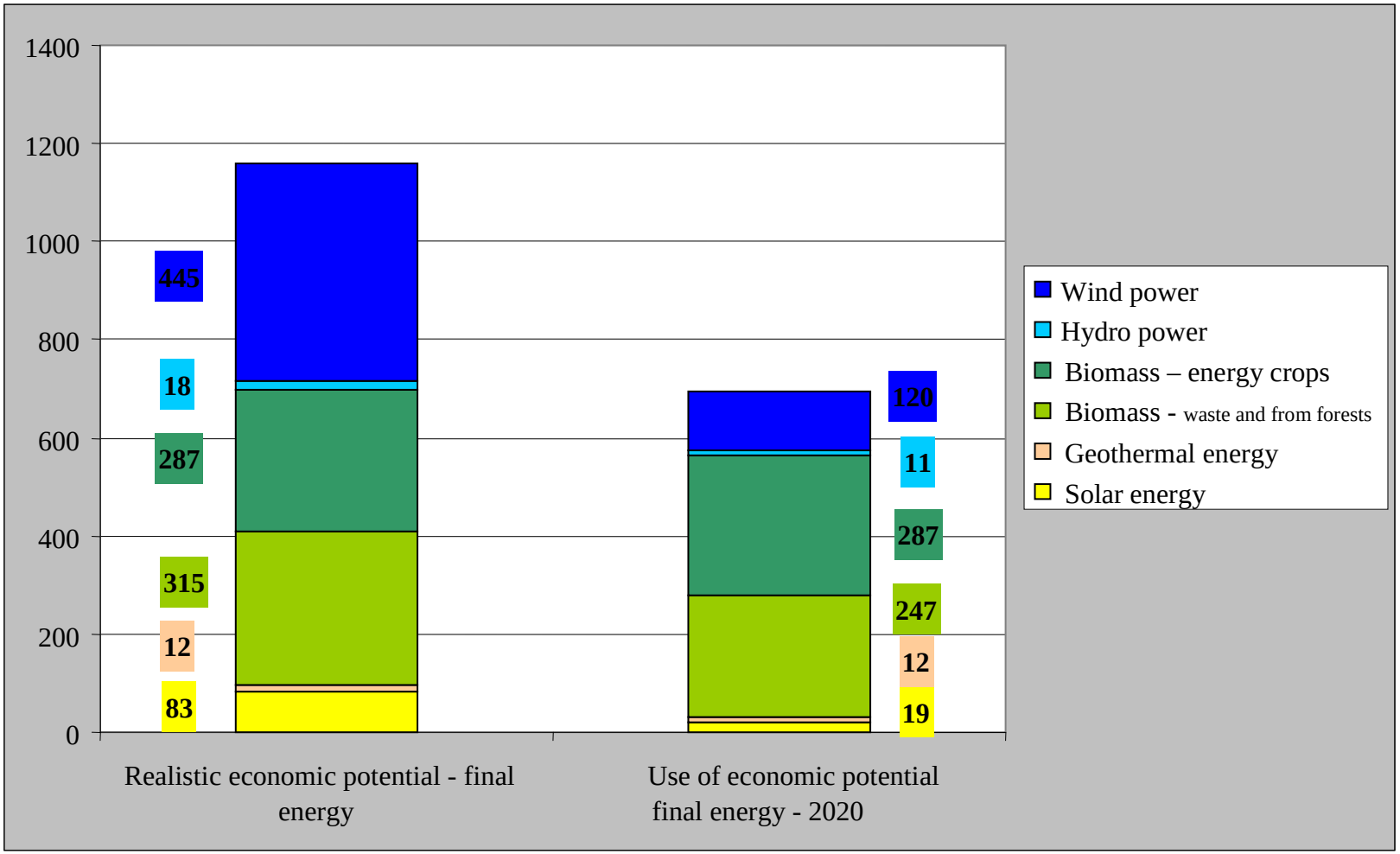
Aim: evaluation of the potential of RES and restrictions to their utilisation and determination of realistic potential in 2020

Renewable Energy Sources

Realistic Potential of RES and its Utilisation in 2005

RES Potential	Realistic Technical Potential – Final Energy	Utilisation of Realistic Technical Potential in 2005	
	[TJ]	[TJ]	[%]
Solar energy including:	**83 312**	**150**	**0,18**
Thermal including:	83 153	150	0,18
• production of hot tap water	36 492	150	0,41
• central heating	46 661	0	0,00
• photovoltaics	159	0	0,11
Geothermal energy including:	**12 367**	**1 535**	**12,4**
• deep	4 200	535	12,7
• Shallow	8 167	1 000	12,2
Biomass including:	**600 168**	**192 097**	**32,0**
• dry solid waste	165 931	160 976	97,0
• biogas (wet waste)	123 066	2 613	2,12
• fire wood (forests)	24 452	24 452	100,0
• energy crops including:	286 719	4 056	1,41
• cellulose-yielding crops	145 600	0	0,00
• sugar/starch/ethanol yielding crops	21 501	2 558	11,90
• rape – biodiesel	37 980	1 498	3,94
• corn ensilages biogas	81 638	0	0,00
Hydro-power	**17 974**	**7 351**	**40,90**
Wind power including	**444 648**	**922**	**0,21**
• on-shore	377 243	922	0,24
• off-shore	67 405	0	0,00
Total	**1 158 469**	**202 055**	**17%**

Economic Potential of Renewable Energy Sources and its Possible Use in 2020, according to Institute for Renewable Energy



The contribution of RES (696 PJ) to final energy consumption in 2020 - 3 226 PJ (according to ''energy-consuming" assumptions to the PEP'2030 project, 2007) may be up to **21.6%,** and **17.7%** if export of solid and liquid biofuels is included).

Biomass

- **Realistic economic potential**: **600 PJ**
  - including: dry solid waste - 166, biogas (wet waste) - 123; fire wood (forests) - 24; energy crops – 287 (cellulose, oil, starch, green ensilages)
- **Utilisation status:**
  - waste biomass (dry) and fire wood – used
  - biogas – limited use, farm biogas – not used
  - no plantations of energy crops
- **Forecast:**
  - waste biomass utilisation will continue (the potential will be fully used in a short term)
  - biogas utilisation will develop; first from waste (until 2015), then biogas from crops will gradually take over
  - energy crop plantations will develop: first for biofuels for transport (1st generation), then (after 2015) cellulose and green crops for ensilages. Intensity of utilisation depends on the pace of development of other technologies (wind power, biogas from waste)
- **Risks:**
  - plantations: intensification of agricultural production – a threat to the sustainability of agriculture and competition against food production (a risk of decisions made by particular farmers)
  - environmental threats: unknown implications of the development of large plantations
  - export of processes solid and liquid fuels: restricted possibility of meeting national objectives.

Wind

- **Realistic economic potential** : **445 PJ**
  - on-shore – 377, off-shore - 67
- **Utilisation status**:
  - on-shore potential – only 0.22%
  - large number of projects under preparation (26 GW according to PSE Operator)
- **Forecast**:
  - up to 10 % of project now under preparation may be implemented by 2012
  - 30% of on-shore economic potential (15 GW) and 10% of off-shore economic potential (0.5 GW) may be used by 2020; this estimate based on the growth pace of European markets
  - utilisation of the off-shore potential after 2015, depending on strategic decisions (the central government, grid operators, large power groups);
  - quicker growth possible after 2015 owing to market availability of a new generation of large power plants (above 5 MW) and to the better opportunities for connection to the grid (trans-European electric power grids)
- **Risks:**
  - environmental: limitation of space use due to existing and proposed protected areas and lack of coherent policy concerning investment at such areas
  - smaller production of energy than planned: lack of experience regarding the productivity of wind turbines in Polish climate conditions
  - development possibilities restricted, particularly before 2015, due to non-optimum siting of projects (possibilities of the connection to the grid and land availability temporarily unavailable)
  - incompatibility of the power system (above 3-6 GW of installed capacity)
  - support system for green electricity (no objective for electricity for 2020)

Water

- **Realistic economic potential**: **18 PJ (**5 TWh/year**)**
  - general economic potential estimated at 8.5 TWh but the construction of the Lower Vistula Cascade (3.5 TWh) by 2020 seems unrealistic given the economic prospects and current environmental restrictions
- **Utilisation status**:
  - 41% of the economic potential used
- **Forecast**:
  - According to TEW, the development will continue on the basis of small hydroelectric power plants (theoretically to 10 MW but in practice approx. 1 MW) with the 10 MW/year increase of installed power
  - 62% of the economic potential may be used by 2020 (11 PJ); the present use of the economic potential of hydro-power in the EU is 67%

- **Risks:**
  - siting: full implementation of the NATURA 2000 network in Poland and restrictions following European legislation (the so-called Water Framework Directive) may restrict siting possibilities for hydro-electric power plants below 10 MW too)
  - increase of the costs and extension of time of project implementation due to exhaustion of suitable sites for construction of hydro power plants on existing weirs and problems with commencement of construction on new ones
  - use of the potential by small plants is related to individual decisions by small investors; in view of procedural difficulties, high project costs and no assistance from the state (a programme for optimising the development of the sector) the potential may not be fully used.

Solar Energy

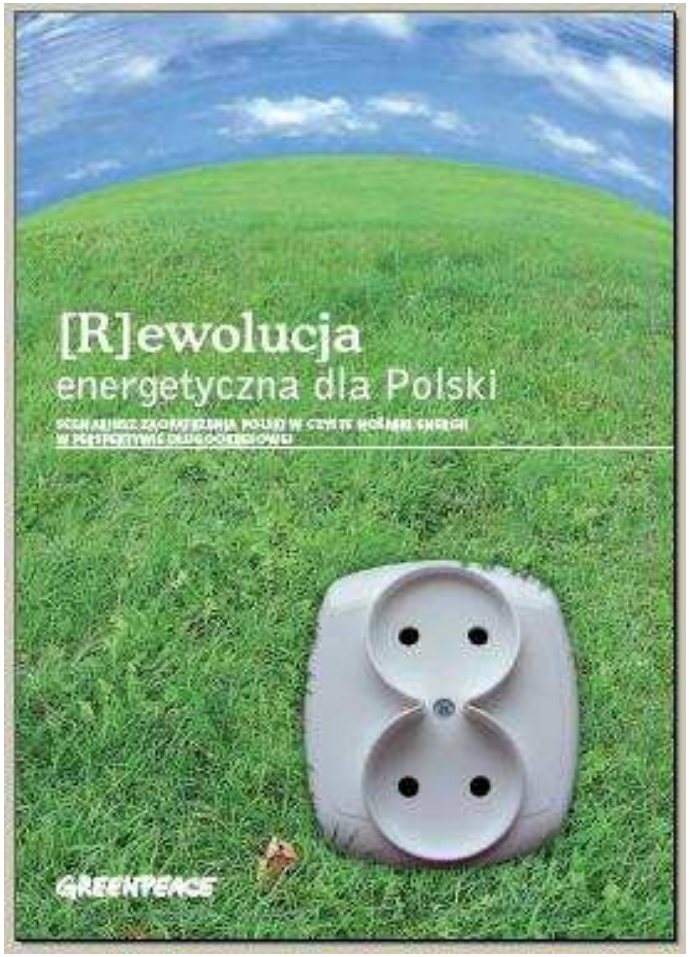
- **Realistic economic potential**: **83 PJ**
  - production of hot tap water - 36 PJ
  - space heating - 47 PJ (without passive systems)
  - photovoltaics
- **Utilisation status**:
  - 0.15 PJ
  - 0.2% of the economic potential used
- **Forecast:**
  - 40% of the solar collector potential for hot water production used , quick growth in the coming years
  - 10 % of the potential of "combined" active solar systems for space heating used by 2020
  - sector growth by 40%/year
  - 20 PJ/year and 0.4 m2 of the solar collector area per person will be achieved in 2020 (the EU plans approximately 0,5 m2/ca on average)

- **Risks:**
  - individual decisions made by small investors (owners of houses under construction and being upgraded) with lack of legal solutions and systemic support.

Geothermal Energy

- **Realistic economic potential**: **12,4 PJ**
  - deep geothermic – 4.2 PJ
  - shallow geothermics - 8.2 PJ
- **Utilisation status** :
  - 1.5 PJ
  - 12 % of the economic potential used
- **Forecast**:
  - Deep geothermics:
    - potential mainly used by town heating companies located in the Polish Lowland (more than 40 companies identified with good location and producing hot tap water thus fully utilising the potential of the borehole.
    - practical use of the economic potential is hindered by access to EU funding for 2007-2013 (EUR 90 million)
  - Shallow geothermics:
    - providing 5-7% of flats, private houses and multi-family and group use buildings **under construction** with heat pumps with horizontal and vertical exchangers
    - the potential will primarily be used by rich investors in villas or group use buildings, whose owners will a) be interested in air conditioning, and b) obtain public funds for projects.
- **Risks:**
  - discouraging experience (technical and economic) with deep geothermics in the past may adversely affect decisions of heating companies
  - unknown preferences and behaviour of developers of residential buildings and private investors and owners of single family houses. In the case of shallow geothermics with heat pumps, the price of electricity has a strong influence on the feasibility of heat pump purchase and construction of ground heat exchangers (the contribution of electricity is 40% of heat gain)
  - the development of geothermics is related to the pace and model of development of construction industry and housing.

Scenario Modelling for the Development of Renewable Energy until 2050 – September 2008



Use of MASEP/Markal Model for the Simulation of RES Development Scenarios until 2050 with Regard to 2020

"**Scenariusz zaopatrzenia Polski w czyste nośniki energii w perspektywie długookresowej**"

(Scenario for Providing Poland with Clean Energy Carriers in the Long-Term Perspective)

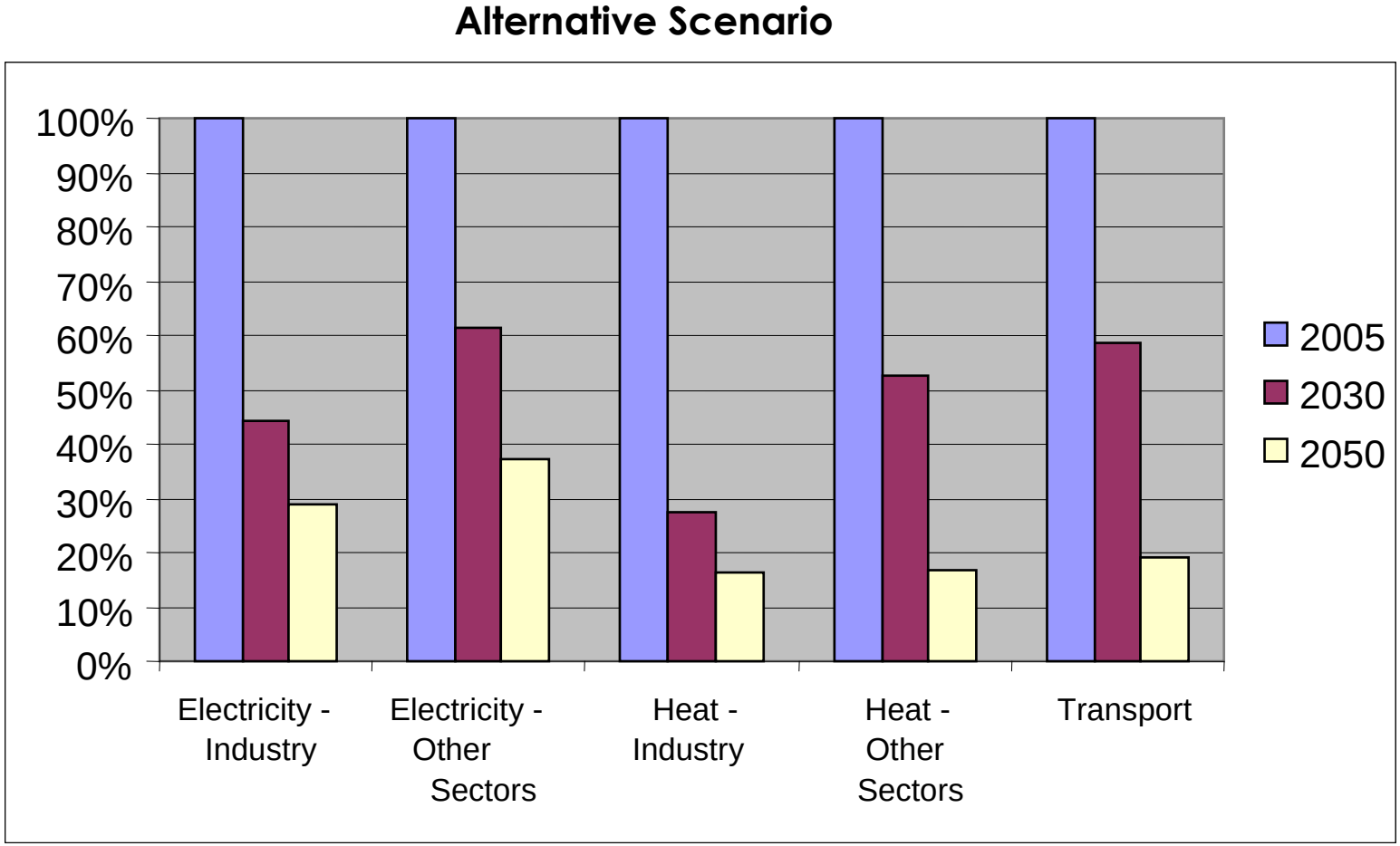
EC BREC Institute for Renewable Energy
DLR Institute for Technical Thermodynamics, Stuttgart

Published by **Greenpeace Polska**, October 2008

http://www.greenpeace.org/raw/content/poland/press-centre/dokumenty-i-raporty/rewolucja-energetyczna-polska.pdf

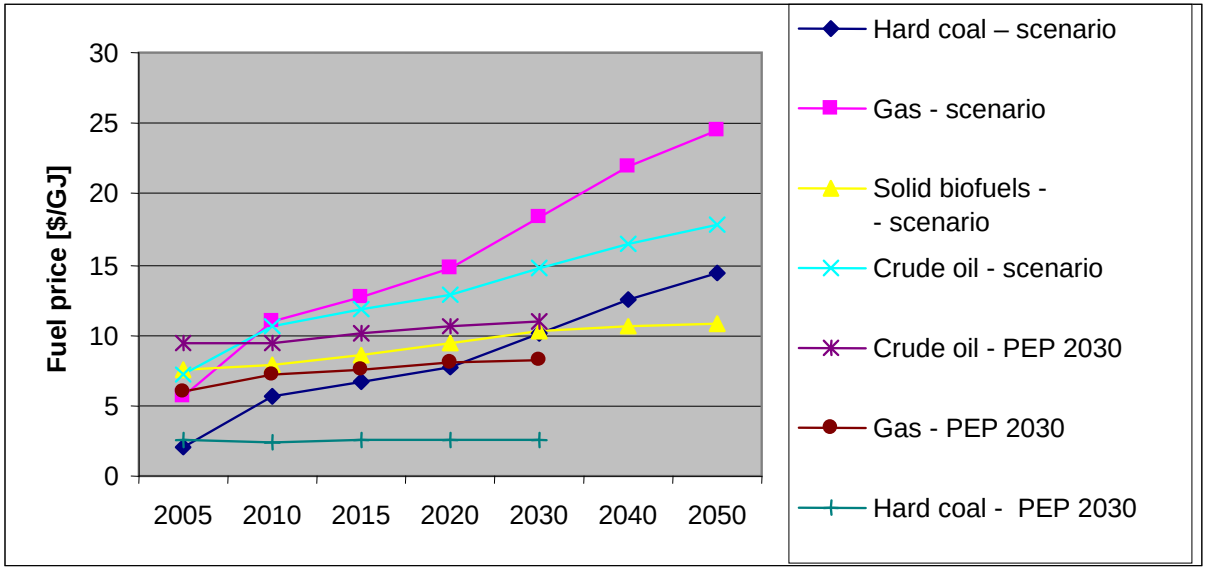
Assumptions to Scenarios (1)

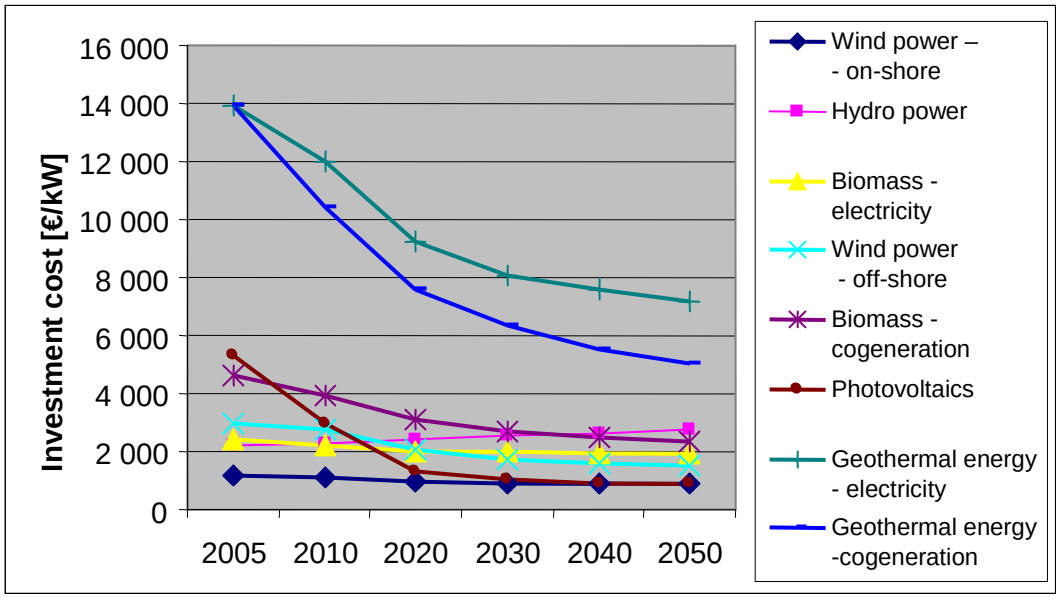
Energy consumption in economy sectors in 2030 and 2050 compared with the base year (2005)



Assumptions to Scenarios (2)

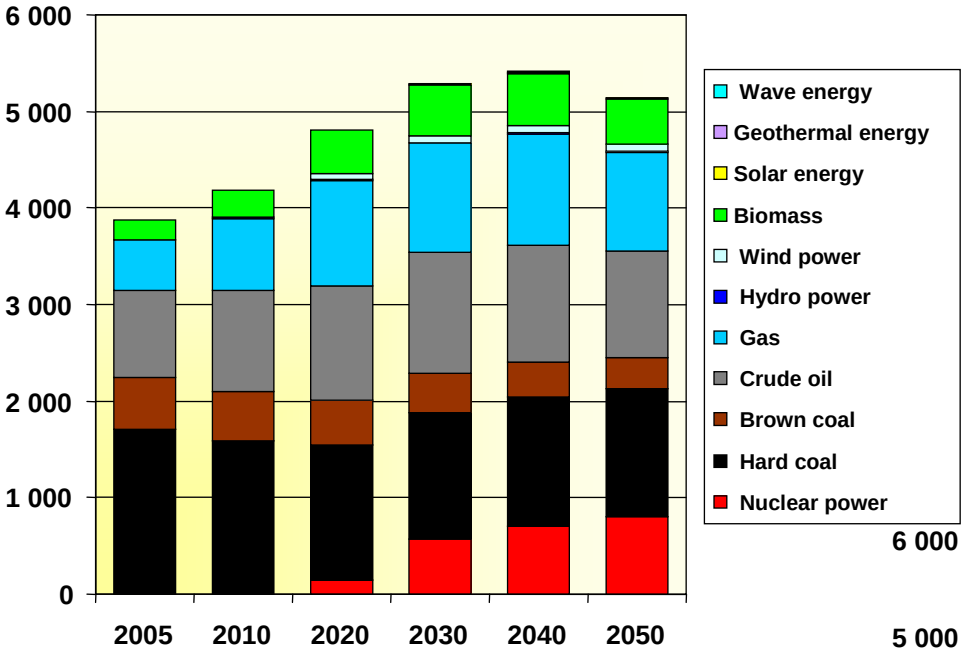
Fossil fuel prices according to draft *Poland's Energy Policy (PEP 2030) to 2030* and forecast taken in this presentation in USD – by 2050 (in fixed prices from 2005)





Unit investment cost for renewable electricity generation technologies, fixed prices in euros, 2005

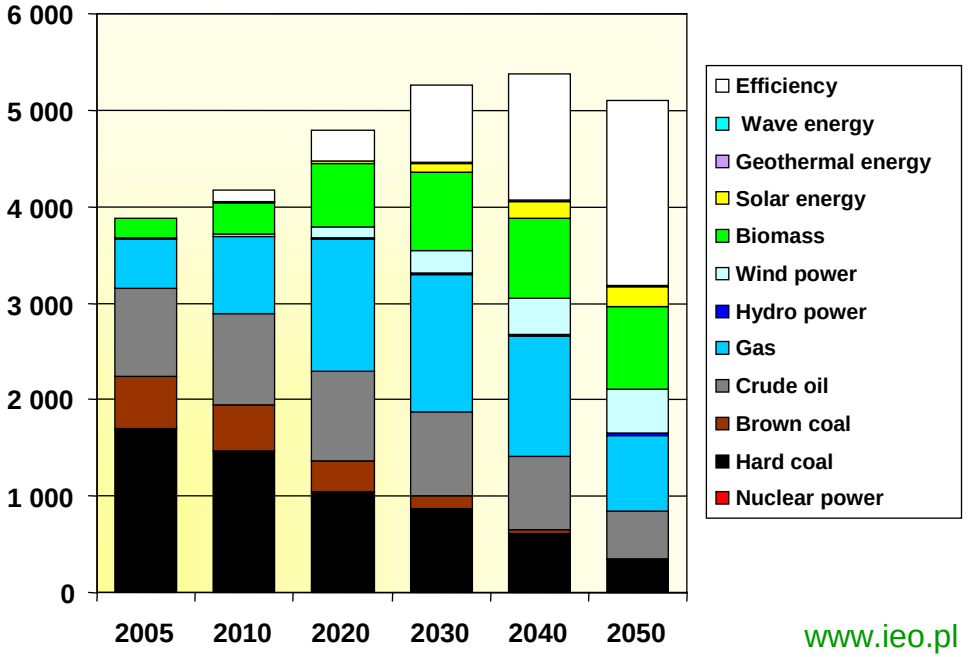
Primary Energy (PJ/year)
in both Scenarios



Reference scenario

Contribution of RES in 2020 = 18.4%

Alternative scenario

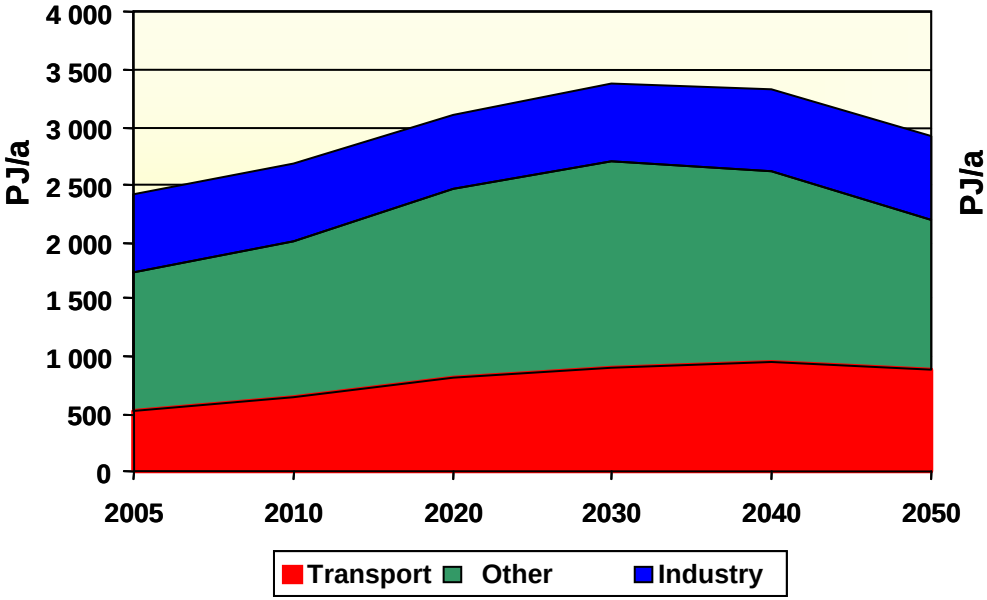


www.ieo.pl

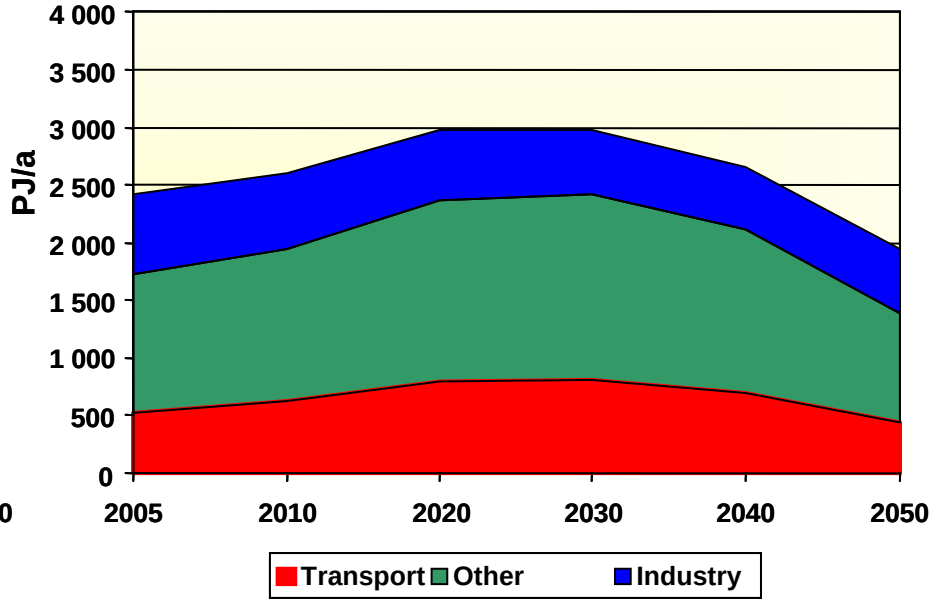
Primary Energy (PJ/year)
in both Scenarios

Contribution of RES in 2020 = 21.2%

Reference scenario

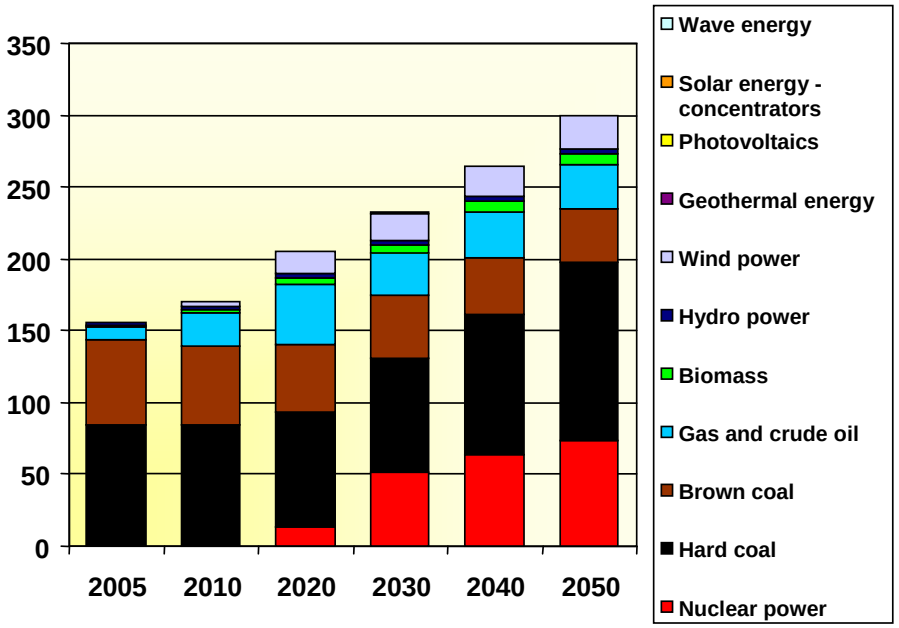


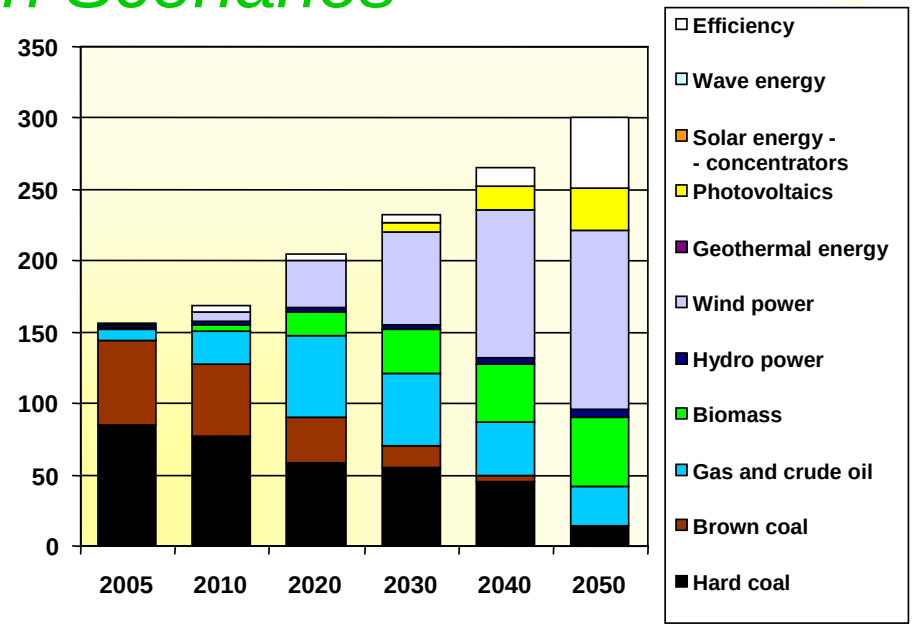
Alternative scenario

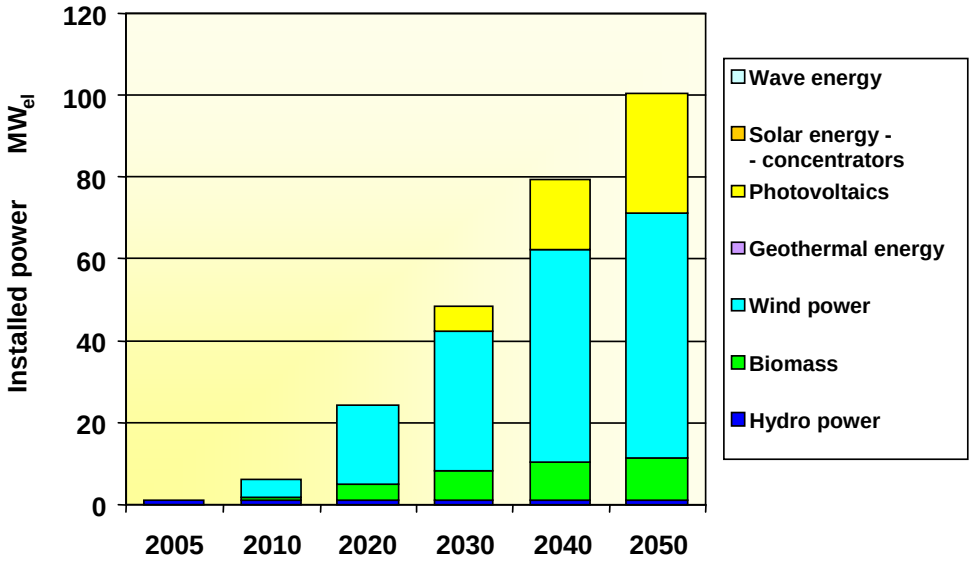


Electric Energy (TWh/year)
in both Scenarios

Reference scenario

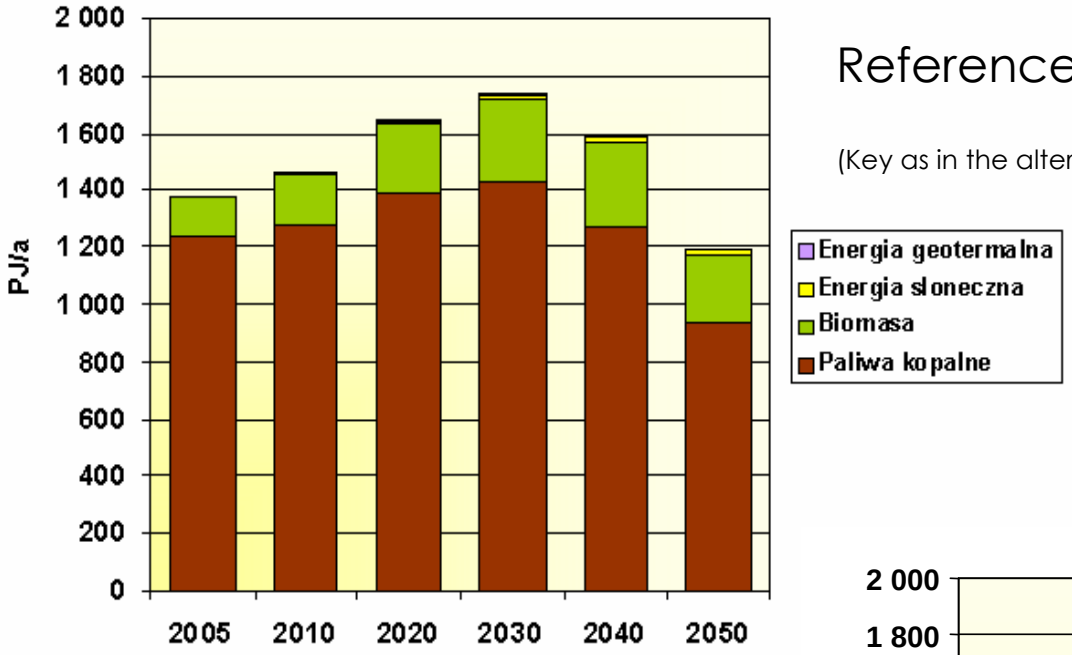






Contribution of RES in 2020 = 26.5%

Heat (PJ/year)
in both Scenarios

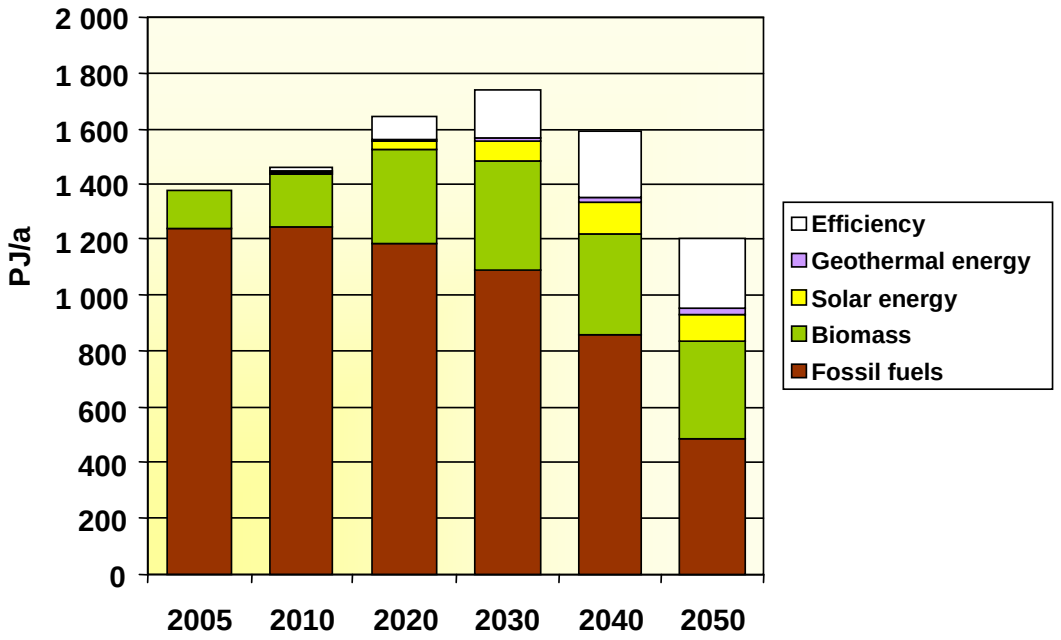


Reference scenario

(Key as in the alternative scenario below)

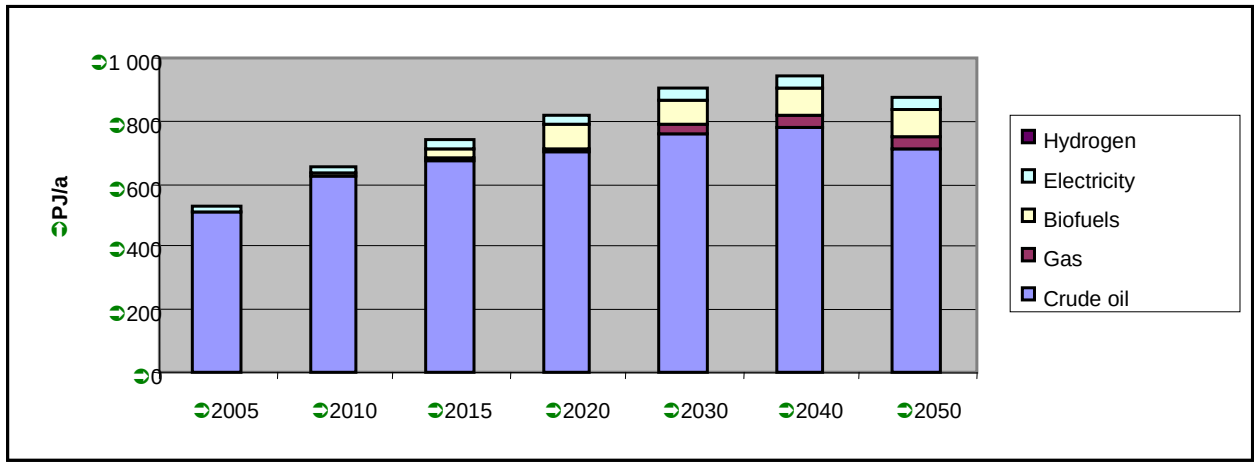
Contribution of RES in 2020 = 23.6%

Alternative scenario

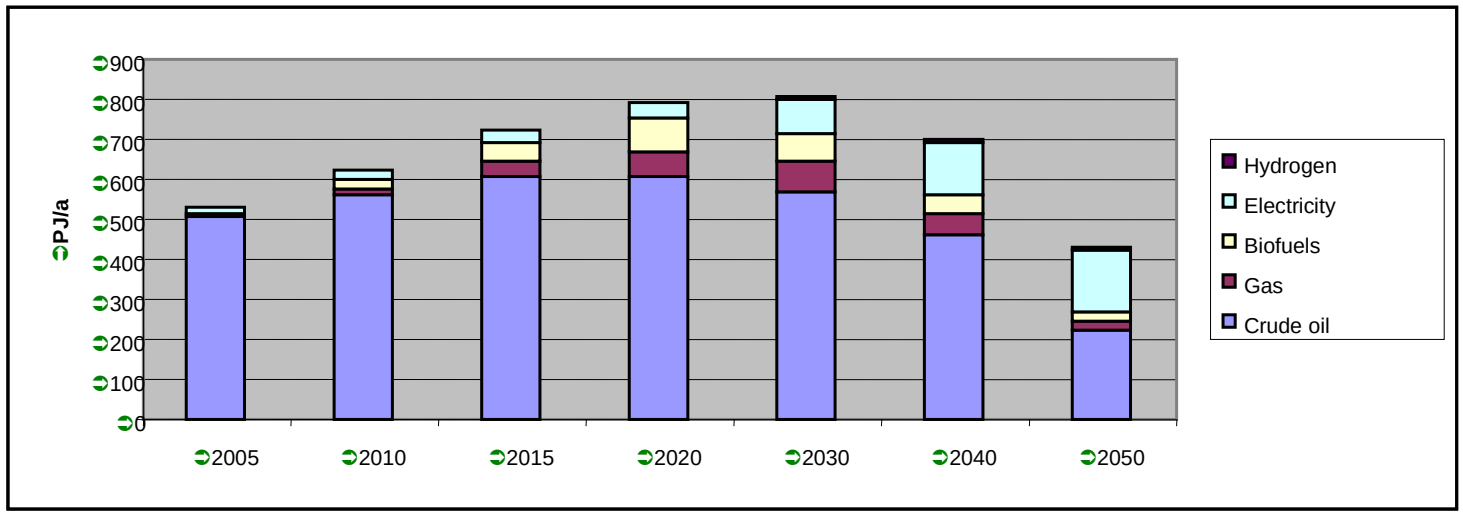


Energy in Transport (PJ/year)
in both Scenarios

Reference scenario

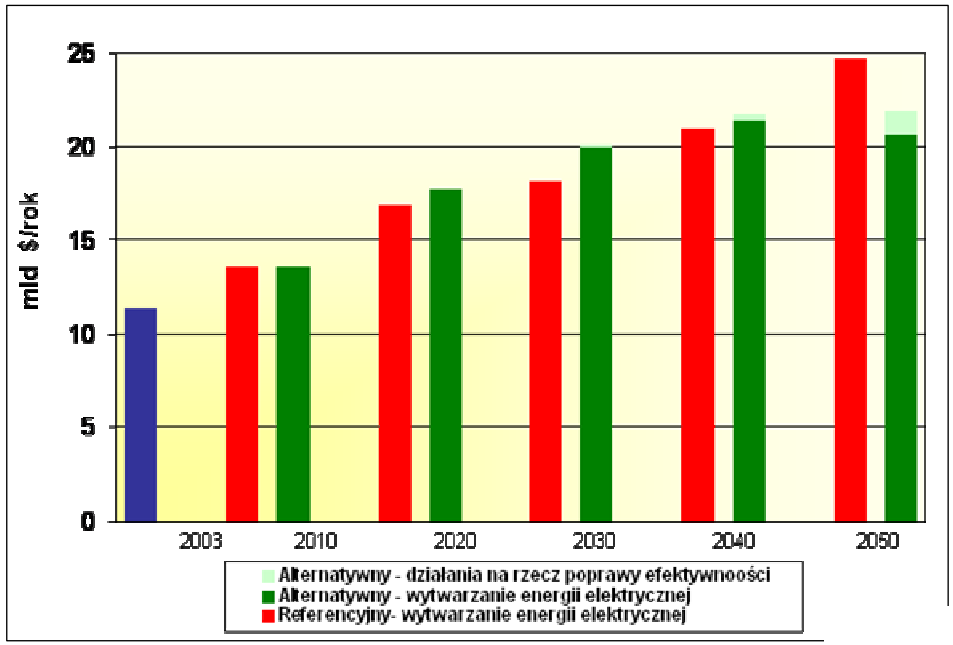


Alternative scenario



Contribution of RES in 2020 = 10.0%

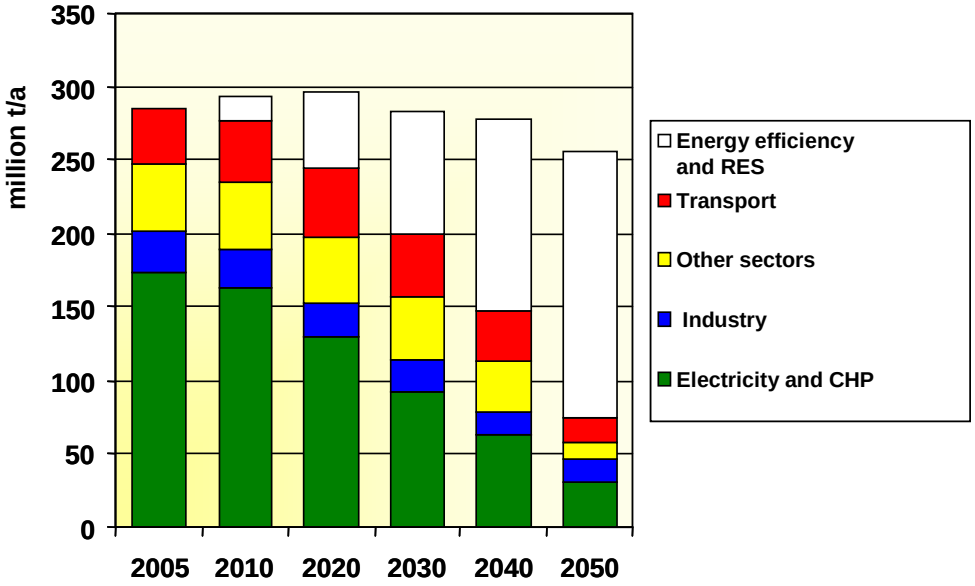
Costs and Benefits
(Electricity and CO_2)



Differences in the costs of supply of **electricity** in reference and alternative scenarios

(light green: alternative scenario - action to improve efficiency; dark green – alternative scenario – generation of electricity; red – reference scenario – generation of electricity)

Emissions of CO2 to atmosphere in particular sectors;
reference scenario with white bars, alternative scenario without.



***Other opinions*:**

PKEE "Raport '2030"

Costs of implementation of EU Climate Package will cause a drop of GDP by 15% (PLN 500 billion) in 2030

http://www.pkee.pl/public/content/48/PKEE_Raport_2030_Synteza_rekomendacje_2008_06_30.pdf

.pl

Summary

- The EU Climate Package of January 2008 is good for Poland; it is ambitious yet fully achievable; however, it requires departure from current energy policy preserving technical structures and building on them conservative organisational structures, which stifle innovation.
- The Polish national potential of renewable energy sources permits the contribution of renewable energy to the final energy consumption balance in Poland at the level exceeding 21 % in 2020 and nearly 60 % in 2050.
- The 15% contribution of renewable energy to energy consumption in Poland in 2020 means the need for new projects at the level of (maximum) 10 GW of electricity, 30 GW of heat and 50 PJ/year production capacity in biofuels.
  Problems: access to capital and limited supply of modern technology.
- The key issue for the contribution of renewable energy in 2020 is the use of the potential of wind power and energy crops, the sources which are most severely affected by environmental and spatial restrictions.
- Local (for heat and cold production) use of solar and geothermal energy and utilisation of dry and solid biomass waste is the least controversial. The related technologies will be developed in conjunction with action aiming at increased energy efficiency at end users'.
- Biogas production (first from waste, then from special crops) is an exceptionally advantageous option for cogeneration from the environmental and energy point of view.
- Based on the development of renewable technologies by 2020, achievable in the long-term perspective (2050) is an approximately 55 % contribution of RES to the primary energy balance and 80 % to electricity consumption as well as the reduction of CO_2 emissions from 10 t/ca to 2.5 t/ca.

Thank you for your attention.

Further information:

- gwisniewski@ieo.pl

Further documents and discussion:

- www.ieo.pl (news)
- www.odnawialny.blogspot.com
- www.renewables.pl (discussion on RES)