Modelling used

DESCRIPTION OF MODELS USED IN THE STUDY

In the PKEE study, a CGE-PL general equilibrium model is applied, along with a PROSK-E energy demand model and national energy system optimization model (EFOM-PL). Research capabilities of this set of models are similar to ones used in the Eurelectric study and European Commission forecasts (models used by National Technical University of Athens).

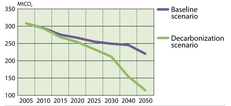
ANALYZED SCENARIOS

There were altogether twelve different demand and supply scenarios analyzed in the study. Two major scenarios correspond to the ones taken into account in the Eurelectric "Power Choices" study, i.e.:

- A Baseline scenario which assumes continuation of all existing policies
- A Decarbonization scenario which assumes realization of the 70-80% EU greenhouse gas emissions reduction target (base year 1990) by 2050

Emissions reduction paths in these two scenarios, are presented in the figure below.:

Fig.1 Annual levels of emissions up to 2050 in Baseline and Decarbonization scenarios (Mt CO_2) in the Polish economy



KEY MODELING MACROECONOMIC ASSUMPTIONS AS COMPARED TO THE EURELECTRIC STUDY

In order to objectively assess the impact of the decarbonization policy on the Polish economy, a majority of key modeling assumptions, including fuel and CO_2 prices are correlated with the ones adopted in the Power Choices study. The notable exceptions are GDP growth assumptions.

- **GDP growth assumptions**

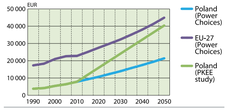
Key differences between macroeconomic assumptions in respective studies appear in this area. The PKEE study assumes a relatively short period of global recession mainly as a result of quick economic industrialization of China and India. These assumptions correspond to ones used by the IEA in the World Energy Outlook 2009.
It was assumed that Poland will be relatively immune to global recession due to its economic growth potential, low labor costs, EU structural funds absorption, as well as a high share of the domestic market in GDP creation.
It needs to be noted, that macroeconomic assumptions used in the PRIMES model which are based on the ECOFIN Ageing Report 2009 are very conservative, especially in the area of the labour market and growth of labour productivity in new Member States, and should not serve as the basis for assessing long-term macroeconomic trends. Initial GDP growth data for 2009 and 2010 already shows inaccuracy of Eurelectric assumptions.
Therefore, annual growth rate of Poland's GDP in the 2006-2050 period is assumed at 3.9%, as compared to 2.4% assumed in the Power Choices study.

This notion has an influence on primary energy demand, final energy demand and CO_2 emissions. Taking into CCS count the fact that Poland is, and will remain for decades to come, on the "catch up" trail to the EU average in terms of economic development, it is estimated by the IEA that primary energy demand will grow by 20% in Poland by 2030. Major differences in estimations between two studies in terms of primary energy demand, production, electricity demand, occur after 2020.

- **GDP/capita growth assumptions**

Also, the Power Choices study assumes a GDP/capita level of EUR 20.9 thousand by 2050 in the Baseline scenario, as compared to EUR 40.4 thousand in the PKEE study, while assuming at the same time similar levels of final electricity consumption/capita – 5.2 and 6.1 MWh/capita respectively. The GDP/capita level for Poland assumed in the Power Choices study in 2050 is very low, still below EU average in 2005, which is not in line with national forecasts.

Fig.2 GDP per Capita for Poland up to 2050 as compared to EU-27 (EUR)

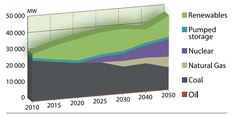


Key findings - impact of the decarbonization policy on the Polish power sector

ELECTRICITY GENERATION FUEL MIX

According to our study the generation fuel mix is considerably changing as a result of the decarbonization policy. Nuclear, gas and renewables appear in those scenarios, which assume implementation of the decarbonization policy. This means a major change in the fuel mix of Poland in the decades to come.

Fig.3 Fuel Mix Decarbonization scenario w/o CHPs (MW)



The following trends were noticed in the forecasts up to the year 2050.

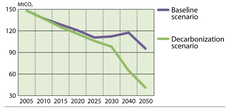
- The scale of coal power plants development varies between different supply scenarios and climate policy restrictions. However, even under the decarbonization scenario it remains on the level of 13-20 GW depending on the demand structure.
- Nuclear energy is competitive against coal plants, and under the decarbonization fully takes advantage of the restrictions imposed.
- Thorough analyses of RES development potential indicate that achieving a 15% share of renewable energy sources in final energy balance will require expansion of wind energy up to 10 GW in 2020, which would account for 25% of installed capacity.
- Under the decarbonization scenario, gas power plants are utilized mainly in a combined cycle as peak sources.

In the course of fuel mix analyses we observe that despite a significant growth of RES, **only the widespread deployment of CCS technology on all coal and gas power plants would make decarbonization goals possible.** This notion results in partial abandonment of coal-fired investments in Poland by some companies due to lack of economic viability of these projects. If sustained, this trend will constitute a direct threat for the national security of supply due to a lack of serious alternatives for such new generation sources in Poland up to 2020.

CARBON INTENSITY

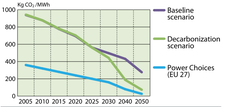
Achievement of the CO_2 emissions reduction targets depends on either bearing higher costs of implementation of low emission technologies, or on usage of more expensive fuels with lower emission coefficients. According to our study, and considering the optimal set of electricity production technologies in the power sector, the maximum potential for the reduction of CO_2 emissions under the decarbonization scenario amounts to 41 Mt/a which corresponds to the reduction of ca. 75% by 2050 in the Polish power sector.

Fig.4 Annual levels of emissions of the Polish power sector in two analyzed scenarios (Mt CO_2)



The technological burden of such deep reductions is well represented by a change of carbon intensity in the Polish power sector. Under the decarbonization scenario the sector cuts its emissions from 950 kgCO_2/MWh in 2005 to 40 kgCO_2/MWh in 2050 thus delivering a reduction of approximately 95%.

Fig.5 Carbon intensity of power generation in two analyzed scenarios (KgCO_2/MWh)

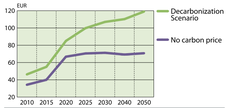


ELECTRICITY PRICES FOR CONSUMERS

One of the most significant effects that the EU decarbonization policy will have on the economy is the level of electricity price increases in Poland associated with necessary investments in new generation technologies, along with an obligation to purchase more EUAs at higher prices prior to achievement of significant electricity mix diversification. As a country strongly reliant on coal in electricity production, generators in Poland will be obliged to purchase a much higher share of allowances on the market than EU average before large scale technology switching may take place.

In the scenario without carbon price, at the assumed, quite high increase of coal prices, wholesale electricity prices will reach ca EUR 70/MWh after 2020 due to necessary modernization and replacement of power generation infrastructure, and will stabilize at this level afterwards.
On the other hand, implementation of the decarbonization policy will cause further growth of electricity prices, which will exceed a level of EUR 105-120/MWh in 2030 and afterwards. In short, the decarbonization policy will result in 3 – 4 times higher prices for electricity after 2020 compared with prices in 2005.

Fig.6 Marginal costs of electricity generation as the basis for setting electricity prices in Poland up to 2050 in different carbon policy scenarios (EUR/MWh)

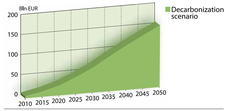


It is worth noting that electricity prices in Poland in 2009, as compared to 2008, have already increased most drastically in the entire EU according to Eurostat data – for households as well as for industry. Also, **prices for households in Poland in terms of purchasing power standards are now the second highest in the EU** (behind Hungary)[2].
Extreme increases of electricity prices in the decades to come will result in higher production costs of energy intensive industries in Poland, the result of which maybe, according to the PKEE analysis, **a 50-80% decrease of industry production in Poland by 2050.** Also, as analysis shows, due to implementation of decarbonization policy, one may expect significant increases in district heat prices in Poland. The study depicts that heat prices may increase twofold by 2050, from the level of EUR 12 /GJ in 2010 to EUR 25 /GJ in 2050.

INVESTMENT EXPENDITURE

The reduction of greenhouse gas emissions is connected with emergence of technologies with higher generation costs, which require higher investment expenditures. The implementation of the decarbonization policy results in the total investment expenditures in the 2006 – 2050 period accounting for **EUR108 – 160 billion**.

Fig.7 Total investment expenditures in the years 2006 – 2050

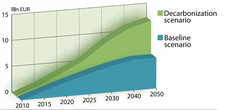


The values presented above do not include increases of expenditure resulting from implementation of the obligation to obtain 15% of energy from RES in final consumption by 2020.

ETS COMPLIANCE COSTS

The implementation of stringent greenhouse gas emissions reduction targets at EU level will require not only inclusion of large combustion plants in the EU Emission Trading Scheme (EU ETS), but also the non-ETS sectors – dispersed emissions from households, services, transport or industry. This may be achieved through the EU-wide carbon tax or by enforcing an obligation to buy the relevant number of allowances at the time of fuel purchase. The assumption of covering all emissions by the enhanced EU ETS was adopted in the Power Choices study.

Fig.8 Annual Costs of EUA purchase in Poland (billion EUR) assuming extension of ETS to non-ETS sectors.



The PKEE study indicates the following costs of EUA purchase in Poland:

- **EUR 2.50 – 6 billion** annually in years 2020 – 2050, assuming continuation of current climate change policy.
- **Up to EUR 14.25 billion** annually in years 2020 – 2050, assuming decarbonization of power generation in the EU.

These calculations assumed gradual implementation of obligation on large installations, in the period 2013 – 2027, as well as non-ETS installations in the 2020-2030 period, to purchase CO_2 allowances on auctions.

TECHNICAL GENERATION AND TOTAL COSTS OF DECARBONIZATION FOR THE POLISH POWER SECTOR

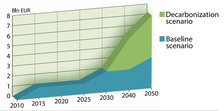
Technical generation costs of new technologies' implementation occur only after some time and depend greatly on the available technical solutions. In case of the continuation policy, the goal of reaching 15% of RES in 2020 results in growing technical costs of power generation already in 2010, whereas a 20% reduction in CO_2 emissions brings about costs only after 2020. The reason for this is that while there is space for the increase in RES generation, it is economically not viable to introduce low emission technologies till 2020. It means that at the present time we do not experience the costs of the already accepted policies as they will affect the sector mainly in the future years. The study shows that new climate policy objectives increase these costs two or even threefold.

According to the calculations, power generation costs increase reaches the following level in 2040-2050:

- ca **EUR 2.25 – 4.75 billion** annually – when compared to the current climate change policy,
- ca **EUR 3.25 – 6.25 billion** annually – when compared to policy without reduction of CO_2 emission.

The inclusion of costs related to the legally enforced development of electricity generation from renewable sources will increase costs of the decarbonization policy by ca. **EUR 0.75 – 1.5 billion annually** in the whole period and will reach in 2050 a level of **EUR 6.25 – 7.5 billion annually** (depending on scenario).

Fig.9 Annual increase in Technical costs of generation up to 2050 in two scenarios (Billion EUR)

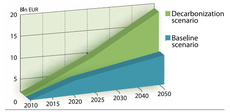


The so-called "delayed cost effect" is very dangerous for facilitating political acceptance of decisions and shifting their financial burden in time.

Total additional costs of the decarbonization scenario constitute of the financial outlays, which after 2030, can significantly exceed this year's budget deficit in Poland, estimated at ca. 50 billion PLN (ca EUR 13 billion), and recognized by the government as one at a conclusively alarming level.

When considering total additional costs of implementation of more expensive technologies and costs of EUA purchase, the decarbonization policy aimed at obtaining a 75% reduction of CO_2 emissions in the EU proves extremely expensive for Poland and amounts to:

Fig.10 Total annual costs of climate change policy's implementation in two analyzed scenarios (Billion EUR)



- EUR 3.3 – 3.8 billion /year- from 2020
- EUR 10.5 – 11 billion /year- from 2030
- EUR/14.1 – 16.2 billion /year- from 2040
- EUR 18.2 – 22.3 billion /year- from 2050

What if... The security of supply is not sufficiently addressed in the process of formulating political targets at the European level. It is crucial to safeguard the fuel supply but also to guarantee the electricity supply to all final customers. Security of supply of carbon-neutral power production at this moment cannot be guaranteed, as there is no experience in management of an EU-wide power system with more than 50% of capacities based on renewables (mostly intermittent wind generation). In particular, the widespread deployment of CCS technologies in fossil-fueled power generation is called into question. The long term security of natural gas supply for power production is also not confirmed.

What if... The introduction of new technologies is not based on their real commercial availability (e.g. CCS) and properly estimated dependability (e.g. RES). In case these technologies are not introduced or their deployment is delayed, it will cause a loss of competitiveness for the whole EU economy and the emissions targets will not be met. Feasibility of achieving a carbon-neutral power supply in Europe by 2050 is dependent on the ability to solve many technological problems concerning CCS technologies, CO_2 transport and particularly storage safety, as well as integration of large scale wind generation in the power system. Also, solving a problem of social acceptance for such elements of the strategy as increase of nuclear power production or CO_2 transport and storage, is a big issue.

What if... The creation of new jobs in the context of introduction of the climate energy policy is unevenly spread across EU Member States. It seems that the so-called "green jobs" will mainly be created in Members States with developed technologies, and the ones on the technological demand side may actually see a decline in employment because of energy mix diversification measures.

What if... Polish economic growth lags behind the EU average in the context of the climate-energy policy's implementation up to 2050. GDP levels in new EU countries assumed by the Power Choices study are unacceptably low, and preserve severe differences in GDP per capita levels in the EU. The PKEE study's outcomes show that as a result of such a scenario the national budget is drained and household disposable incomes decrease.

What if... Electricity prices increase drastically in carbon-intensive Member States and the cost of technology deployment will unevenly affect citizens across the EU. Also, what if complementary policy measures are not envisaged to avoid the risk of energy poverty in countries facing the most challenging objectives.

[2] Source: Eurostat data in focus 22/2010 - Electricity prices for second semester 2009.

Approach to coal in a global perspective

In the global context, one should keep in mind that Europe's emissions reduction targets ought to be complementary to global actions aimed at climate protection. The problem of CO_2 emissions is trans-boundary and even a significant reduction of emissions in the EU will not combat climate change, as Europe is responsible only for circa 13% of global emissions.

According to IEA estimations coal will still play a dominant role as a source of world's electricity and heat generation in decades to come. It is predicted that global deposits of coal are enough to cover global consumption of this source of energy for 200 years for hard coal, and 300 years for lignite. IEA predicts that by 2030 around 44% of electricity globally will be produced from coal. These figures show that the global trend is to intensify the use of coal and that a drastic change in the extent of global coal usage in the near future is impossible.

Therefore, development and implementation of clean coal technologies should become a priority. Only by promoting this approach and contributing appropriate funds to realize it, may we realistically propose solutions, which will ensure global CO_2 emissions reduction. A different approach to coal – aimed at diminishing its role in Europe's energy mix – will be ill advised leading not only to failure in emissions reduction on a global scale, but also to increased carbon leakage problem.

In this respect, it is highly important that we work together on commercialization of all clean coal technologies, including CCS. However, current assumptions that CCS will be commercialized in the near future is too farfetched as of today, particularly because of an extremely high cost and lack of social acceptance, which is becoming a growing problem. The notion of equipping all coal power plants (as well as gas-fired ones in the future) with CCS installations, endorsed by Eurelectric, was based on the assumption that the whole world will commit to use CCS as a result of implementation of the global system enforcing emissions reduction by at least 50% by 2050.

Failure of the Copenhagen Conference and lack of readiness to adopt this concept by the leading global players results in the fact that CCS technologies will probably not be used significantly outside the EU, due to their high costs and increased consumption of fuel caused by their operation. This means that their application in the EU will not cause a reduction of global emissions and expenditures suffered for development and construction of these technologies will be probably irretrievably lost.

Summary of outcomes

As seen in the outcomes of the PKEE study, current plans on part of the European Commission to introduce measures aimed at decarbonization of electricity generation in the EU by 2050, entail the following problems when looked at through the prism of Polish preconditions:

- Rapid increases of power generation and ETS compliance costs for generators in Poland, which will be passed through to consumers. However, due to a possible scale of price increases for consumers, a full pass-through of carbon costs will most likely not be possible because of government regulations, which may be implemented for socio-political reasons. This likely regulation will be detrimental to the competitiveness of the Polish power sector
- The resulting electricity and heat price increases will nevertheless drastically enhance energy poverty and jeopardize the competitiveness of energy intensive industry in Poland in the 2010-2050 timeframe. Another factor contributing to electricity price increases will result from the necessity to pass through investment expenditure of up to EUR 160 billion by 2050 onto the consumers. It must be underlined that Poland already today has one of the highest electricity prices in the EU when purchasing power standards are taken into account.
- Raising financing for these investments will be a particularly challenging task for Polish power generators, which are functioning on a relatively small scale as compared to the biggest EU players.
- Also, taking into account a high share of coal in the Polish electricity mix, very optimistic assumptions in terms of CCS and RES development may lead to unrealistic conclusions in terms of Poland's potential to decarbonize its power sector.

Policy recommendations

Therefore, prior to committing ourselves to further reductions targets, it would be advisable to:

- First commercialize clean coal technologies to the level of application indispensible for achievement of more ambitious targets.
- Ensure that our global partners are all on board – only such common global actions will deliver the desired results in terms of combating climate change.
- Only when the above-mentioned conditions are fulfilled, should the EU engage in discussions on climate protection taking into account:
  - security of power supply
  - solidary burden sharing among EU Member States
  - creation of "green jobs" in the entire EU
  - significant support measures for the most carbon-intensive and less economically developed Member States.

LISBON TREATY
ARTICLE 194

1. In the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment, Union policy on energy shall aim, **in a spirit of solidarity between Member States**, to:
(a) ensure the functioning of the energy market;
(b) ensure security of energy supply in the Union;
(c) promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
(d) promote the interconnection of energy networks.

Compliance with the EU climate change policy is a huge challenge for Poland and most of other new Member States today. This task is particularly difficult taking into account the electricity mix as well as relatively low levels of GDP/capita in Eastern Europe. Also, it needs to be underlined that diversification of the energy mix is a lengthy, gradual and time-consuming process. Investments in nuclear power generation and renewables which are planned in Poland will take years to become operational.

Because of the complexity of above-mentioned precondition in terms of development of new technologies and taking into account the current state of negotiations within the UNFCCC framework, **the EU should take into account different national circumstances of Member States and refrain from applying political pressure in the internal debate on further emissions reduction targets.** The strategy of going ahead with unilateral actions may be detrimental to possible binding political commitments on part of the EU's global partners such as United States, China and India. Potential costs of such unilateral actions for the EU economy may be too high taking into account current economic difficulties of some Member States, and they may worsen the EU's competiveness in the global context. Also, this additional burden will be unevenly spread among EU Member States, mostly affecting the carbon-intensive ones such as Poland. This uneven cost distribution would be against the principle of solidarity which is the basis for the Lisbon Treaty as well as the sheer existence of the European Union.

PKEE
Polish Electricity Association

The Polish Electricity Association (PKEE) – member of the EURELECTRIC – is an association of the power sector, whose activities focus on the issues related to the functioning of the industry in the modern market-based economy. We engage in actions and projects because of which the Polish power industry can better respond to the challenges related to: the EU integration, power supply security, functioning of the competitive energy market, environmental protection measures and development of state-of-the-art technologies.
We actively support the development of the Polish power sector by conducting opinion-making activities aimed at improvement of functioning conditions of the sector, including the regulatory framework in Poland as well as in the EU.
PKEE is a representative of the largest companies as well as leading organizations in the Polish power sector

Common Vision
- A Solidary Approach

Impact assessment of the EU decarbonization policy by 2050 on the Polish power sector

PKEE
Polish Electricity Association

Background of the study

We are aware that EU actions aimed at combating climate change are necessary and we have already joined them. Our recent study – "Impact assessment of the EU decarbonization policy by 2050 on the Polish power sector" (hereafter referred to as the "PKEE Study"[1]) – indicates however, that by fulfilling the presently debated targets, Poland would be forced to incur much higher investment outlays than other EU Member States. Also, the competitiveness of energy-intensive industries would deteriorate along with increased energy costs for households, as a result of unavoidable steep increases in electricity prices. While formulating long-term targets of climate change policy, we should not forget that energy sectors of particular Member States vary and that these differences are sometimes significant. In case of Poland this major difference is caused mainly by reliance on coal in electricity generation (more than 90% of electricity is generated from coal). It is worth noting that coal, being a domestic fuel source, has been the natural choice for the power sector at the time when most of the currently operating units were built (1960's to 1980's). It ensured stable and reliable power supply, significantly improving Poland's energy security. On the other hand, due to enormous financial efforts, Poland has been able to significantly reduce emissions of CO_2, SO_2, NOx, and dust. **Compared to the Kyoto Protocol reference year (1988), Poland has already reduced its CO_2 emissions by 30%.**

The EU climate-energy policy constitutes an immense challenge for Poland, creating both opportunities and risks. However, there is a real possibility that its costs may be too high for Poland in relation to benefits which other EU Members States may enjoy in terms of boosting economic growth and employment through technological transfers.

With our study, we would like to draw EU attention to the fact that the Polish energy system is extremely sensitive to any further deepening of emissions reduction targets. An EU-wide move to a more stringent reduction target must be accompanied by a thorough analysis of its impact not just on the EU as a whole but on all of the individual Member States. In the Polish case, the result of such a study would likely **demonstrate loss of competitiveness of the Polish economy as well as a growing number of households moving towards energy poverty.**

[1] PKEE abbreviation stands for The Polish Electricity Association – a representation of the power sector in Poland.