

## Faculty of Energy and Fuels

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### **Strategic approaches towards a low-carbon power sector in new member states based on the Polish example.**

#### **Introduction**

European Union plays a leading role in efforts to mitigate climate change. Its climate and energy package envisages in the perspective of 2020 to reduce the greenhouse gas emissions by 20% from 1990 levels and cut energy consumption by 20% of the projected 2020 levels. It also sets an ambitious target to reach 20% of total energy production from renewables in 2020. This gives a clear signal to the rest of the world that EU is ready to take actions towards keeping global temperature increase below 2°C compared to the pre-industrial levels.

This background paper briefly describes the situation of the centralized power and heat generation sectors under the new ETS regime after 2013 based on the Polish example. Possible ways of decarbonisation of those sectors are indicated.

#### **CO2 Emission Trading System – 3rd phase**

In order to improve the effectiveness of ETS, new rules were introduced for functioning of the EU Emissions Trading System in the third phase from 2013 to 2020. Emissions from power plants in 2020 are to be reduced by 21% below 2005 levels. Unlike in the previous two phases there will be one annual EU-wide cap for emission allowances instead of national allocation plans prepared by Member States. This annual cap will be decreased according to a linear trend line, which will be continued beyond the end of the third trading period. The most important difference is that full auctioning is introduced as a rule for electricity generators from 2013 onwards. However, under certain conditions derogation from this rule can be applied. This is the case of Poland, where in 2006 more than 90% of electricity was produced from coal, and its GDP per capita did not exceed 50% of the EU average. Consequently, Polish electricity generators will buy at auction only part of the allowances for the period 2013-2019. In 2013 it will be 30% in relation to their average annual emissions over 2005-2007, whereas from 2014 onwards the amount of free allowances will be gradually reduced.



As a way of curbing possible windfall profits, the Polish government plans set a rule that all power plants receiving free allowances will be required to use them to generate electricity, and must not sell them without actual production. In 2013 free allocation shall be given to district heating as well as to high efficiency cogeneration units related to their heat output. As they are treated as industrial sectors, they may obtain up to 80% of allowances for free in 2013. In each subsequent year, the total allocation to such installations shall be adjusted by the linear factor of 1.74%. The Commission shall adopt Community-wide and fully-harmonised implementing measures for the allocation of those free allowances.

### **An outline of the Polish power sector**

Decarbonisation of the power sector poses possibly the biggest challenge for low carbon strategies in the new Member States, often relying on coal as the major fuel, while being dependent to a very large extent on gas from a single source and limited possibility to transmit large amount of power from the neighbouring countries through the interconnected power grid (Suwała et al., 2008). The EU-15 average carbon intensity of electricity production is approx. 0.3 tCO<sub>2</sub>/MWh whereas EU-12 average is close to 0.6 reaching in some countries like Estonia and Poland more than 0.9 tCO<sub>2</sub>/MWh. In Poland it is due to the fact that ca. 95% of electricity is produced either from hard or brown coal. One should not forget, that the use of domestic coal makes Poland almost 100% self-sufficient as far as electricity is concerned, at the expense of being very carbon intensive. This is a big dilemma for Poland having also social and economic aspects deeply rooted in the Polish history. The hope in Poland is that the EU decision makers will understand this particular sensitivity of Poles towards energy independence, which was certainly aggravated by the recent gas crisis.

After a short stagnation of Polish economy in the last two years, the macroeconomic forecasts show that it will soon return to the path of steady strong economic growth. This expected growth involves a substantial rise in energy demand in spite of the current European plans to decouple economic growth from energy use. One should bear in mind that per capita electricity consumption in Poland is between 40 and 50 percent lower than the EU-15 average. The EU energy efficiency priorities will have an effect on the energy demand, but cannot curb completely the rise in demand, which is driven by increasing living standards.

A specific feature of the Polish centralized power sector is the large share of electricity produced in cogeneration, which is close to 20%. Quite exceptional

compared to other Member States is, that Poland district heating (DH) networks covers a large share of the thermal needs in the cities. Centralized heating systems cover on average 72% of their heat demand, so that about 12 millions Polish citizens are supplied by the centralised DH systems. The future evolution of heat demand will be affected by contradictory trends. In line with the increase in per capita GDP, Poles are likely increase the per capita living space which is now about half of the E-15 average. However, this rise should be staunch by better insulation standards. The latest studies show, that there still exists a significant potential for development of DH systems, in particular those based on high efficiency cogeneration.

At the same time, the power generation fleet is ageing and coming up for retrofit. New capacities added after mid 80s were small compared with the previous thirty years. Therefore, the existing power and CHP plants –which amount to about 34 GWe –will have to be completely replaced and developed in the next thirty years.

Bearing the above in mind, Poland is confronted with two crucial issues: (i) what technological choice should be adopted, (ii) how to reconcile the required investment with economical competitiveness and social cohesion? As the power plants lifetime ranges between 30 and 50 years in case of nuclear option, the current decisions will have a long time impact. The other dilemma is ensuring the security of supply while tackling the climate change concerns due to its coal based energy production.

### **Decarbonisation of Polish power sector**

The Polish energy sector is at crossroads. On one hand it has to meet the growing demand while most of the centralized heat and electricity production fleets have to be retrofitted. On the other hand, global and EU regulations to mitigate climate change have to be obeyed. This tremendous challenge creates a real opportunity to devise a new sustainable energy sector for the next generations. During the major retrofit, which is going to take place in the next 20 years, Poland should take advantage of its domestic resources, and make the right choices for the huge investments needed that will affect the national economy over the coming decades. While taking decisions more attention should be given i.a. on the carbon intensity of the available energy technologies. There certainly exists big potential to decarbonise the Polish power supply. For instance, two studies (Purta and Bogdan, 2010), (Jestin, 2008) show that the business-as-usual CO<sub>2</sub> emissions from power sector

forecasted for 2030 can be reduced respectively by 120 and 135 MtCO<sub>2</sub> in the most ambitious "low emission" or "carbon diet" scenarios set up in those studies.

Both of those ambitious CO<sub>2</sub> reduction scenarios combine several measures: (i) demand reduction through primary energy savings, (ii) development of renewable energy sources and (iii) CHP, (iv) development of nuclear and (v) clean coal technologies with carbon capture.

Improvement of energy efficiency remains the basic and best answer to the current environmental and social challenges. Renewable energy sources (in particular wind and biomass), could generate up to 40 TWhe by 2030 under the condition of an active policy and of a favourable legal framework. The existing green certificates support scheme together with the implementation of a new system to incentives the development of RES for heating and cooling, are likely to further stimulate the development of RES. In this regard Poland could take advantage of its big biomass resources with priority given to local space heating as advocated by (Gula et al., 2010).

The more urgent issue relates to mid-term horizon (from now to 2020), when a number of large supercritical and highly efficient coal plants may likely be developed. Nuclear power will not be introduced before 2020-2022 in the ideal scenario case. As the future coal plants should as well be CCS ready and as this technology are likely not to be operational and/or economically viable before 2020, it seems necessary not to excessively rely on the coal technologies which are not mature enough at present. Consequently, there are mainly two options available to fulfil the growing demand in the mid-term: CCGT and CHP. Gas penetration will increase, however, it is unlikely to cover significant share of fuel mix, as there are strong concerns about its price and fuel dependency. Thus, CHP seems to be a priority option to meet the increase in demand, while integrating the environmental, economical and geopolitical concerns. CHP seems to be the most relevant as it highly improves the efficiency of primary energy conversion and helps to reduce emissions of pollutants.

### **Challenges for the smooth transition towards low carbon power generation**

The necessity of investments in power transmission infrastructure and new capacities in Poland is obvious and inevitable. The question for Poland is how to make a smooth transition to less carbon intensive technologies, particularly for base-load generation.

As explained above, investments in large coal CCS equipped or nuclear units should realistically be considered after 2020. Consequently, until then the average Polish citizen who is not affluent will have to buy electricity generated, to the large extent, by the existing fleet. At the same time introduction of full auctioning in the 3rd phase of ETS could increase the electricity price in Poland much more than the forecasted EU average. Hopefully, this problem has been recognized at the EU level and the transition provisions for auctioning of EUAs have been introduced for Poland.

However, there are still some issues that need to be solved. Taking into account the peculiarity of the coal based Polish CHP sector, the benchmarks for free allocation of EUAs for the generation of heat in centralized systems and high-efficiency cogeneration units should be fuel specific.

The other important issue to be solved is free EUAs allocation for CHP units in respect to electricity generation under introduced transition provisions. Indeed, if CHPs will not be considered as electricity generators they won't benefit from free allowances granted under the derogation scheme. From the power generation point of view this will be serious distortion of competition.

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