European Environmental Regulations Concerning CO_2 and Another Power Industry Caused Air Pollutions

Krzysztof Badyda

***Abstract*—** This paper describes the current situation and future prospects for electricity and heat generation sector in Europe and in Poland as an example for european conditions. Current structure of energy sources and predictions for the upcoming years are presented. Selected aspects of the EU pollution reduction policy are described, primarily those affecting power industry installations. The paper points out difficulties in adapting the Polish power industry to the requirements stipulated by obligations, including the European Parliament's and Council's Directive on the industrial emissions and the climate change package. It also presents approximate balance of the emissions typical for the power industry (SOx, NOx, PM, CO_2). Impact of the future conditions on the national power and heat industry was evaluated.

***Keywords*—**About four key words or phrases in alphabetical order, separated by commas.

I. Introduction

THE international obligations undertaken by Poland result with limitations concerning the emission of harmful substances into the atmosphere. Current limits of the SO_2, NOx and particle matter (PM) emissions are defined by the Order of the Minister of Environment written according to the LCP Directive [1] and the Treaty of Accession to the European Union (ToA). Additionally the Treaty determined the national limits for emission of those substances from the sources referred to by the LCP Directive.

The hard coal and lignite are currently the primary sources of energy for the power and heat generation in Poland [2]. According to the declarations of consecutive political leaderships it will remain so in the future – for no less than next 20 years. The key question for the Polish energy policy is however whether such a plan is feasible, bearing in mind current regulations related primarily to the energy policy of the European Union, aimed mainly at significant reduction of the carbon dioxide emission as well as coal availability in Poland. The EU environmental policy affects not only the CO_2 emission question.

The limitations concerning the CO_2 emission result from the Kyoto Protocol and the European Trading Scheme for greenhouse gases. The new regulations, among them the so-called energy and climate change package, might result with a significant restrictions emission allowances. The Poland's obligations to the European Union state, that the 7.5 % of electricity generated in 2010 should be produced with renewable technologies. The climate change package of June 2009 proposed that in 2020 15 % of the primary energy consumed in Poland should come from renewable sources (with the EU average of 20 %). Both those objectives raise doubts about their feasibility and possibly involved costs.

The package mentioned above includes the following key components:

- directive [4] introducing new rules for the European Trading Scheme for greenhouse gas emission allowances;
- decision [5] intended to restrict the emissions from the sources not included in the European Trading Scheme;
- directive [6] concerning the geological storage of carbon dioxide;
- directive [7] promoting usage of the renewable energy.

The new directive concerning industrial emissions, supersede the IPPC Directive [1]. New regulations make it virtually impossible to combust coal in boilers not equipped with the desulphurization, denitrification and very effective dedusting systems. Their introduction as early as 2016 would mean that practically every coal-combusting boiler would have to be exchanged or deeply modernized.

The national energy policy [2] assumes to "use coal and lignite as primary fuel for the power generation industry in order to guarantee appropriate level of national energy security". It is a key question whether following this plan is still feasible bearing in mind the current situation, particularly the European Union's energy policy and its main objective of cutting down the carbon dioxide emissions. The results of selected analysis based on studies in which the author participated – like [2] or [8] – are presented below.

II. Energy Demand and Generation

Electricity consumption will grow worldwide faster than any other form of energy consumption. The increase might be decelerated by the current worldwide economic crisis but not stopped. It is expected that today's electricity consumption of 18,921 billion kWh will almost double to roughly 33,265 billion kWh by 2030 (Fig. 1). One-fifth of the electricity

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generated globally – roughly 3,354 billion kWh – is required in the European Union (EU). A 25 % rise in demand is alone expected there by 2030 (Fig. 2) [9].

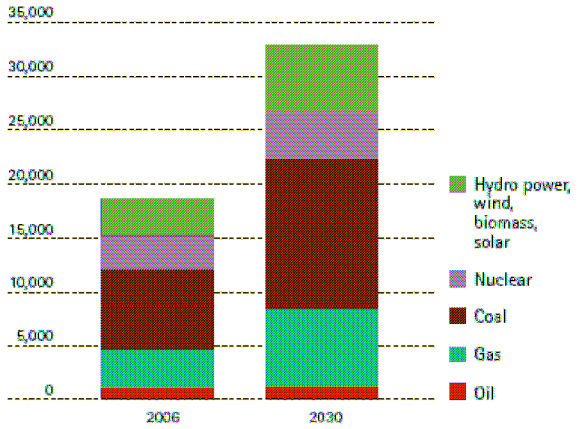

Fig. 1. Expected increase in electricity generation [TWh] worldwide [9]

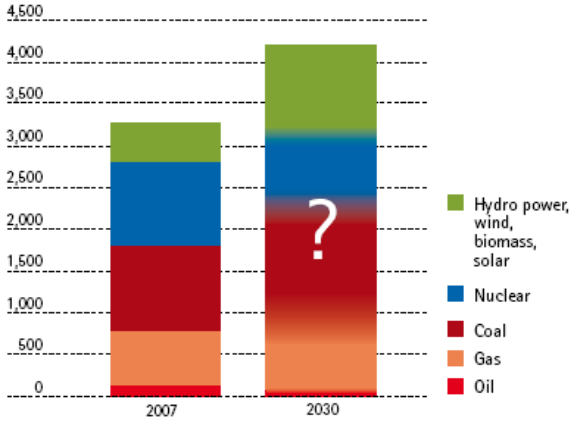

Fig. 2. Expected increase in electricity generation [TWh] in the European Union [9]

European power generation industry structure (depending installed capacity and energy sources) is shown in the Fig. 3. For 922 TW gross over 20% (190 GW) are installed in hydro power plants (including 40 GW pump storage), 23% in coal and lignite plants, near 22% in gas plants and 15.5% in nuclear power plants.

The EU enlargement (2004 and 2007) to Central and Eastern Europe can be characterised as “more of the same”: more gas import dependence, more reduction in coal-fired power generation, introduction of competition in electricity and gas markets and mixed signals about nuclear.

Overall, the share of imported energy will increase from approx. 50 % today to roughly 70 % by 2030 [9]. Hard coal and lignite are most important energy resources for Poland. They are world's fifth-largest proven reserves of hard and brown coal.

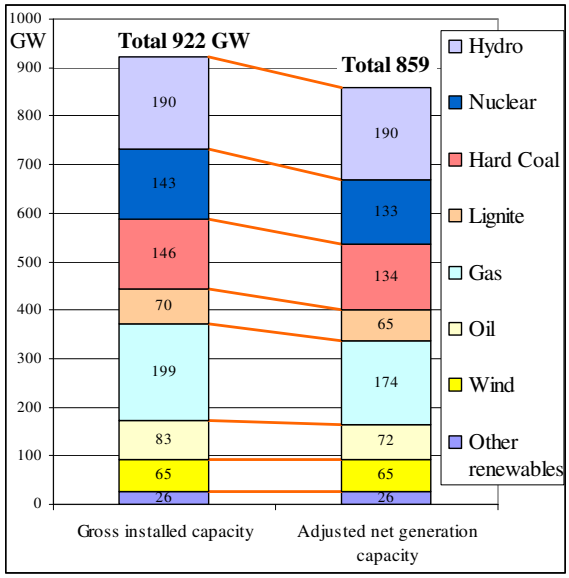

Fig. 3. Total generation capacity and structure in Europe (EU-27)2008 – source of data [10] - net capacity calculated as 93% of gross capacity for conventional power plants

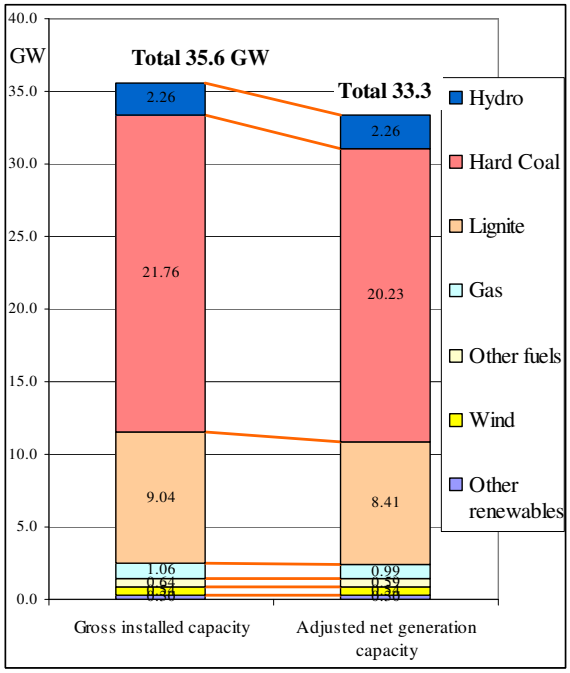

Fig. 4. Total generation capacity and structure in Poland 2008 - net capacity calculated similar to Fig. 3. (as 93% of gross capacity for conventional power plants)

Structure of polish power generation industry in similar form to Fig. 3 shows Fig. 4. Main power plants in Polansd are fueled with hard coal and lignite (over 86% of the capacity).

Capacity of hydro is marginal (2.26% - 2263 MW including 1330 pump storage), similar other fuels. Hard coal remains the foundation of Polish industry. Thanks to coal, Poland's total energy consumption and production have generally been in balance, with imports of oil offset by coal exports.

As a result of the transformation of the Polish economy after 1989 the national energy consumption dropped significantly. After 2003 both the production and demand were rising, with the exported volume of some 10-11 TWh. The increase of the national demand in this last period, except for the year 2005, was approximately 3 % per year. In 2007 the production stayed at the level of 2006, however the export dropped to 5 TWh. In 2008 the generation decreased, but the national demand slightly increased while the export was practically eliminated (Fig. 5).

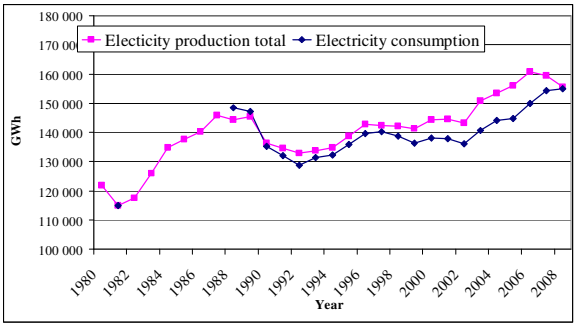

Fig. 5. Electricity production and consumption in Poland 1980-2009 (according to PSE Operator data)

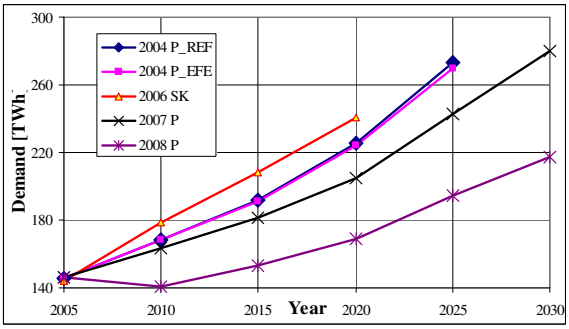

Fig. 6. Predicted electricity demand, comparison of the [2] to the previous variants (effectiveness 2004 P_EFE, reference 2004 P_REF [3] 2006 SK [8], 2007 P – previous forecast for the policy)

In late 2007 the forecast for the increase of primary energy demand – prepared for the sake of the national energy policy – said that it would increase by 32 % by 2030 with virtually constant use of coal fuel. The newer forecast included in [2] prepared in February 2009 was based on the assumption that the primary energy demand would only increase by 21 % and the consumption of hard coal and lignite would considerably drop (by 24 % and 16 % respectively).

Further forecasts concerning the electricity demand increase also prove divergent – the newer analysis predict slower growth (Fig. 6). It should be emphasized that all those studies were prepared by the same institution (Agencja Rynku Energii – The Energy Market Agency). Therefore all the differences result from the changed assumptions.

The decrease in share of coal in fuels used for electricity generation should be accomplished thanks to the increase of renewable generation, to some extent also natural gas, and – after 2020 – commissioning of nuclear power plants (Table 1). The increase of the renewable electricity will be mainly based on using biomass (in 2030 over 6 times more than in 2006), wind farms (70 times more) and biogas (33 times more).

TABLE 1
STRUCTURE OF FUELS USED FOR NET ELECTRICITY GENERATION FORECASTED BY [2] AGAINST THE REFERENCE STRUCTURE OF 2006

Year	2006	2010	2015	2020	2025	2030
Hard coal	58.31	52.95	44.90	40.17	32.37	35.58
Lignite	33.79	34.70	36.47	25.62	26.83	20.96
Natural gas	3.12	3.42	3.57	5.38	6.32	6.64
Oil derivates	1.08	1.48	1.78	1.79	1.61	1.49
Nuclear fuel	0.00	0.00	0.00	6.73	11.70	15.66
Renewables	2.64	6.21	12.13	19.28	20.23	18.83
Pumped storage	0.66	0.78	0.71	0.64	0.55	0.50
Waste treatment	0.41	0.47	0.43	0.38	0.39	0.35

Nuclear power plants, whose development pace is limited for organisational and technical reasons, are expected to be included in the optimum structure of electricity sources in terms of costs. It has been assumed that the first nuclear power unit would be ready in 2020. By 2030, three nuclear power units would operate at total net capacity amounting to 4,500 MW (4,800 MW gross).

The decrease of the heat demand in the recent years has been mostly stopped and it can be assumed that in the following years it will remain stable. However it is necessary to undertake actions intended to significantly increase the share of cogeneration of electricity and heat. Development of low-emission power technologies and CHP plants are among the priorities of the national energy policy.

III. CHANGES CONCERNING EMISSION STANDARDS

Restrictions of the sulphur and nitrogen oxides and particle matter emissions result from the international obligations of Poland mentioned in the introduction. Those obligations are reflected in the emission standards imposed by the national regulations and the national caps for the individual polluting agents. The Table 2 shows the results of the forecast of the harmful substance emissions included in [2]. Main source of those emissions is the power industry. However this forecast does not take into account proposals of the new industrial installations directive (also known as the "New IPPC Directive").

A significant drop of the SO_2 emissions is forecasted for the next decade – more than 50 % in reference to the year 2006. According to the accepted assumptions the national emission should decrease from 1216 thousand tonnes in 2006 to ca. 480 thousand tonnes in 2020 and 450 thousand tonnes in 2030. The emission cap resulting from the II Sulphur Protocol (cutting down the national emission of sulphur oxides below 1398 thousand tonnes by 2010) is considered easily achievable. The SO_2 emission level for large combustions

plants (LCPs) accepted as a result of negotiations on the ToA according to the "old" LCP Directive [2] (bringing the sulphur dioxide emissions below 454 thousand tonnes in 2008, 426 thousand tonnes in 2010 and 358 thousand tonnes in 2012) was slightly exceeded in 2008.

TABLE 2
ANNUAL EMISSIONS OF SOX, NOX, PARTICLE MATTER AND CO_2 FORECASTED BY [2] UP TO 2030 (IN THOUSANDS MG). THE NEW DIRECTIVE [11]) NOT TAKEN INTO ACCOUNT

Year	2006	2010	2015	2020	2025	2030
National emission						
SO_2	1216.4	733.1	588.6	477.8	451.3	447.5
NOx	857.4	786.7	725.6	651.6	636.5	628.6
PM	279.5	246.1	218.2	196.7	187.7	182.8
CO_2	331 900	299 100	295 700	280 300	294 700	303 900
Power generation installations						
SO_2	866.2	460.4	357.4	268.2	252.4	253.2
NOx	316.8	266.8	240.9	197.6	203.5	203
PM	56.7	46.7	39.8	35	31.5	29.7
CO_2	188 500	170 300	167 700	148 700	154 100	157 200
Commercial power plants						
SO_2	717	337.7	267.9	193.4	182	180.7
NOx	252.7	207.1	176.9	124.8	121.5	117.2
PM	56.7	46.7	39.8	35	31.5	29.7
CO_2	151 000	131 700	130 100	110 600	114 200	115 700

The cap for the nitrogen oxides emission resulting from the II Nitrogen Protocol (cutting down the national emission below 880 thousand tonnes by 2010) according to the assumptions made in [2] should be achieved. Keeping the NOx emissions below the limits described for LCPs in the ToA (254 thousand tonnes in 2008, 251 thousand tonnes in 2010 and 239 thousand tonnes in 2012) might prove more difficult to accomplish, although in 2008 the emission proved lower than respective cap. In 2010-2012 keeping below the caps might be achieved thanks to the decreased energy demand resulting from the predicted economical slowdown.

The particle matter emission should be systematically decreased. The factors positively influencing the reduction of sulphur oxides emission also help to cut down the PM emission.

The national standards are imposed by the Orders of the Minister of Environment. In Poland versions of the emission Order were announced in 1990, 1998, 2001, 2003, 2005 and recently in 2008. The standards defined in two last editions of the order for the LCPs were primarily based on recommendations of the LCP Directive [2].

Throughout many years the European Union was developing guidelines for the Best Available Techniques (BAT) basing on the "old" IPPC Directive 96/61/EC concerning integrated pollution prevention and control. Those works had been started long before Poland joined the EU and were finalized in 2006. The results were presented as an elaborate document [12], which includes emission standard proposals for the BAT-compliant power installations. It should be emphasized that the BAT requirements are particularly restrictive for the coal technologies. The proposals are significantly stricter than those included in the LCP Directive [2]. Those two documents were created only 5 years apart. The works on the BREF for the power industry had already continued for several years when the Directive was published and were practically accomplished in 2004.

Emission standards are particularly striking for the smaller installations. The new IPPC Directive [11] practically copy-pastes the BAT requirements (proposed in [12]) into emission standards.

TABLE 3
SO_2 EMISSION STANDARDS FOR THE LIGNITE/HARD COAL [MG/M³] CONVERTED FOR NORMAL CONDITIONS, 6% OF O_2 IN THE DRY FLUE GAS – "EXISTING" INSTALLATIONS, COMPARISON WITH REQUIREMENTS OF THE DIRECTIVE 80 AND BAT. WHERE ONLY ONE VALUE IS STATED IT IS COMMON FOR BOTH FUELS

Capacity [MW_{th}]	(98/01) until 2006	(98/01) until 2011	80/EC	2003/05**	BAT
50-100	2500/2000	2000/1500	2000	1500	150-400
100- 300	2500/2350	2000/1500	2000-400	1500-400#	100-250
300-500	2500/2350	2000/1200	2000-400	1500-400#	20-200
> 500	2500/2350	2000/1200	400	400	20-200

The BAT requirements are diverse, depending on the fuel/technology – extreme values provided.

Line change between 100 and 500 MWth (# 225 – 500 MWth).

** - values mandatory started in 2008.

TABLE 4
NO_X EMISSION STANDARDS FOR THE LIGNITE/HARD COAL [MG/M³] CONVERTED FOR NORMAL CONDITIONS AT 6% O2 IN THE DRY FLUE GAS – "EXISTING" INSTALLATIONS, COMPARISON WITH THE REQUIREMENTS OF THE DIRECTIVE 80 AND BAT. WHERE ONLY ONE VALUE IS STATED IT IS COMMON FOR BOTH FUELS

Capacity [MWth]	(98/01) do 2006	(98/01) do 2011	80/WE	2003/05 **	BAT
50-100	450/540	450/540	600	500/600	200-450 / 90-300
100- 300	450/540	450/540	600	500/600	100-200 / 90-200
300-500	450/540	450/540	600	500/600	50-200
> 500	450/540	450/540	500(200)	500(200)	50-200

** - values mandatory starting in 2008 (value from 2015 on in the brackets).

TABLE 5
DUST EMISSION STANDARDS FOR THE LIGNITE/HARD COAL [MG/M³] CONVERTED FOR NORMAL CONDITIONS AT 6% O_2 IN THE DRY FLUE GAS – "EXISTING" INSTALLATIONS, COMPARISON WITH THE REQUIREMENTS OF THE DIRECTIVE 80 AND BAT. WHERE ONLY ONE VALUE IS STATED IT IS COMMON FOR BOTH FUELS

Capacity [MWth]	(98/01) till 2006	(98/01) till 2011	80/WE	2003/05**	BAT
50-150	**225/350**	225/200	100	100	5-30
150- 300	**225/350**	225/200	100	100	5-25
300-500	**225/350**	225/200	100	100	5-20
> 500	**225/350**	100	50	50	5-20

The ministerial order of 2003 extended validity of these standards till 2008.

** values mandatory since 2008, in the discussed output range the requirements are identical before and after 2015, it is different for the smaller installations.

The requirements for the ageing boiler units working in the "existing" or "old" plants, qualified as constructed after 1990, are becoming stricter. The Tables 3, 4 and 5 present dynamics of changes of emission standards introduced in Poland for coal-combusting sources. They were imposed by the consecutive orders of the Minister of Environment. These were published respectively in 1990 (not shown), 1998, 2001, 2003

and the last one in 2005. Comaparision of [2] and [11] emission reguirements for SO_2, NOx and dust are shown respectively in Fig. 7, Fig. 8 and Fig. 9.

The Polish regulations of 2003 and 2005 are generally compliant with the requirements of the Directive 80. The national regulations have been formulated for a full spectrum of power outputs. The Directive sets conditions for the installations of over 50 MW of power in the fuel energy stream. The tables only show requirements for the plants compliant with this condition. The BAT requirements have been drawn in detail for various fuels and technologies; only the extreme requirements are shown in the tables to make them simple. Thus in fact they are in some cases even tougher. The BAT recommendations were copied into the new IPPC Directive. Upper values in last columns of the tables 3, 4 and 5 are therefore compliant with this directive, which is intended to be in force since 2016.

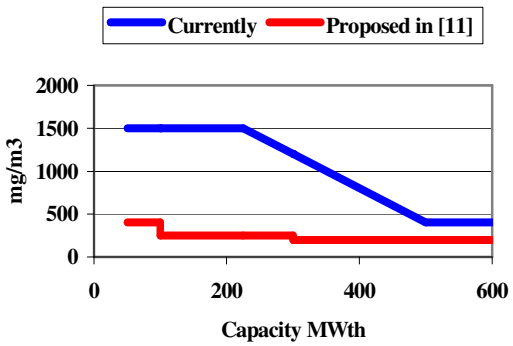

Fig. 7. SO_2 emission reguirements comaprison for the coal units [mg/m^3] converted for normal conditions, 6% of O_2 in the dry flue gas – "existing" installations – [2] and [11]

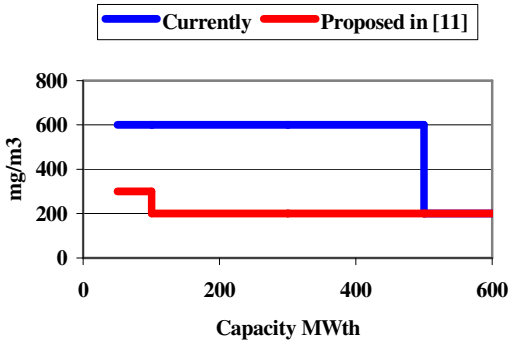

Fig. 8. NOx emission reguirements comaprison for the hard coal units [mg/m^3] converted for normal conditions, 6% of O_2 in the dry flue gas – "existing" installations – [2] and [11]

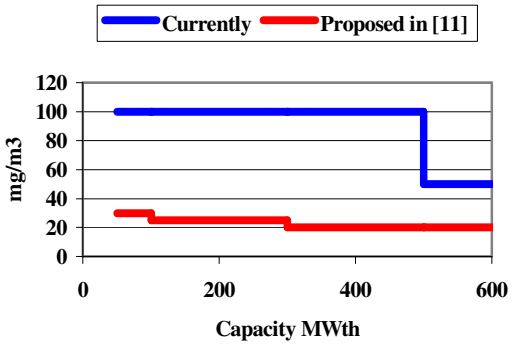

Fig. 9. Dust emission reguirements comaprison for the coal units [mg/m^3] converted for normal conditions, 6% of O_2 in the dry flue gas – "existing" installations – [2] and [11]

There is also a long lasting argument between Poland and the European Commission concerning the interpretation of the regulations. The controversial issue is the definition of "emission source" – should it be understood as a boiler or exhaust stack. The Polish regulations state that boiler is a source of emission, while the EU regulations do not resolve this issue clearly, though the interpretations seem to indicate the stack as the source. If this version will be forced through (and it is included in the Directive [11]) it will have a number of obvious results:

- change of the source output as a result of adding up outputs of boilers venting their flue gas through a common stack;
- shifting the emission standards towards the tougher values because of the mentioned change of outputs (now even many times higher);
- including many installations, previously considered unaffected by the IPPC Directive in range of the installations over 50 MW (this affecting many district heating objects).

IV. CO_2 Emission Reduction

From the perspective of both the investment costs and technological possibilities it can be most difficult to force the reduction of the carbon dioxide emission from the coal-fired power stations. Because of the fact, that their elementary CO_2 emission is higher than in case of other fossil fuels, the emission trading scheme decreases competitiveness of the coal-fired plants. The decisive factors here are emission caps and allowance prices. The Polish economy operates in conditions of the coal monoculture, both in the field of shares of electricity generation (Table 1, Fig. 4) and total consumption of the primary energy and with assumption of constant supply of the coal fuels. In 2020 still more than 65% of electricity is expected to be produced from hard coal and lignite. In this year those fuels will total about 44% of the primary energy used in Poland.

Particularly radical changes in the European Trading Scheme (EU ETS – Directive [4]) are: abolishing national emission allocation plans, and introduction of one general EU

emission cap for all member states. In consecutive years it will decrease linearly (by 1.74% a year), starting in 2013. The target is 21% reduction in 2020 in reference to the emissions reported for 2002. Initial value is the level of middle of 20082012 period (2010?).

In 2013 the European Commission plans to introduce a system where the emission allowances necessary to generate electricity will be sold on auctions only. It is difficult to predict price level of emission allowances in the auction system, but if we assume that the Commission will endeavour to keep those prices on similar level as extra cost caused by using Carbon Capture and Storage System (CCS), it is possible to estimate that it will be some 30÷60 EUR/tonne. This would practically double in Poland the cost of generating electricity from coal.

In case of "electricity generating sector and CO_2 capture and storage" it is assumed to switch to the 100% auction system already in 2013 (reasoning is that it is easy to transfer the cost to the end user and absence of international competition). In other sectors, including heat generation, there will be a transfer from free-of-charge distribution of 80% of emission allowances as the initial point to no-free-allowances situation in 2020 – this transition will be linear. In case of power generating systems which also co-generate heat it is proposed to maintain the rule of free-of-charge allocation of emission allowances related to the heat generation (within high-efficiency cogeneration, as per Directive 2004/8/EC).

It shall be reminded, that the electricity generation in Poland is greatly based on combustion of coal (Table 1, Fig. 4), which makes the power industry particularly sensitive to the common auction system. Estimated specific emission for electricity generation in Poland is somewhere around a tonne of CO_2 per megawatt-hour. For the sake of comparison in France corresponding value is close to 70 kg/MWh, and in Germany between 300 and 400 kg/MWh. The impact of the auction scheme on electricity production cost in Poland will be more than ten times stronger than in France and more than two times stronger than in Germany. Already today electricity prices in Poland and in France are comparable.

The threat was spotted not only by Poland, so a block of "coal countries" started negotiations about easing the rules of the auction scheme. In a result of the session of the Council of Europe in December 2008 it was decided to award derogations for the power industry in area of obligatory purchases of the emission allowances on auctions. Initially in 2013 only 30 % of allowances will have to be purchased and each year this share will be increased by further 10 % - i.e. to the 100 % in 2020. Derogations are only awarded to the plants operating prior to 31 December 2008 and those of the new plants where the investment process had been "physically started" by that date.

Power industry is a very capital-intensive branch of economy. Change of used fuel is practically impossible without replacing all generation facilities. Regardless of the costs involved, the time needed to construct a power plant from the initial concept to the start of commercial operation is at least several long years. In case of a nuclear plant it would be more than ten. Therefore no actions, even most radical, undertaken today cannot bring any significant result by 2013.

Directive [6] has been written in the context of intended global 50% reduction of CO_2 emissions planned until 2050. In opinion of its authors in this context it will be necessary to reduce emissions of developed countries by 30% until 2020 and then by 60-80% until 2050. In the document [6] this plan was acknowledged as technically possible, and the benefits are said to be much greater than the costs involved. The conclusion mainly affects regulations for CO_2 storage (CCS) and removal of currently existing legal obstacles for development of this technology. So far the relevant regulations are contained in several documents (earlier directives).

The most important change for the power sector included in [6] obliges all the combustion plants (with installed electrical capacity over 300 MW), which will have received a building permit or (if no such procedure is required) operational permit after the Directive comes into effect, to evaluate availability of appropriate CO_2 storage sites, and to carry out a feasibility study (in both technical and financial terms) of a CCS extension for the plant (modification of the process part and transport systems). It will be also necessary to reserve sufficient space for the future CCS extension on the site – the plants must be built "CCS-ready".

The primary assumption in [6] is that the stored and captured CO_2 will be considered not emitted within the EU ETS. In case of emissions caused by leaks however it will be necessary to present allowances for settlement. This means that the risk of potential technical failures remains on the side of plant's operator.

The Directive [7] determines the rules according to which the member states should assure at least 20% share of renewable energy sources for the entire European Union. This is to be done by achieving country-specific targets. Renewable energy will be developed in three sectors: power-generation industry, heating industry and transport. It is assumed that the member states will be able to decide shares of those branches in achieving national target at their own discretion. It is recommended however, that each member state should reach at least 10% share of renewable energy (primarily biofuels) in transport sector until 2020.

The target values of renewable energy share for individual member states were defined in [7] according to a five-stage procedure, taking into account: initial situation (i.e. share of renewable energy in 2005), various fuel availability in member states, and weighed target level (20% share of renewable energy). Result of works was summarized by determining targets for renewable energy share for individual EU member states (Fig. 10).

The Decision [5] proposed rules for determining contribution of member states to the community commitement to reduce greenhouse gas emissions from sources not included in the Directive 2003/87/EC during 2013-2020. Presented text

however also refers to the total national emissions of greenhouse gases. The document uses the same definitions ad the Directive 2003/87/EC.

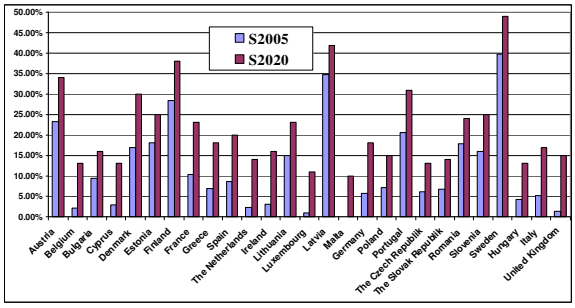

Fig. 10. Total national targets for renewable energy share in final energy consumption in 2020 (EU-27, RES Directive [7])

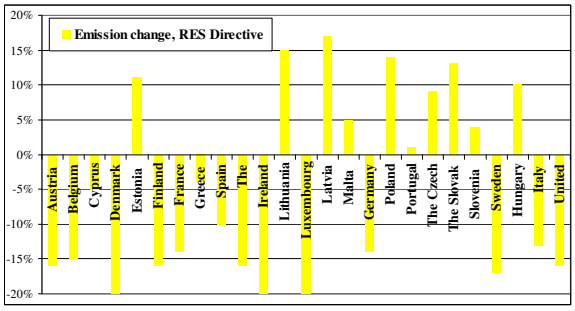

Fig. 11. Percentage change of greenhouse gas emissions in reference to the year 2005, from sources not included in EU ETS

According to the document [5] contribution of member states to the independent community commitment should be equal. It is proposed that no state should be forced to reduce greenhouse gas emission by more than 20% in reference to the emission level of 2005 by the year 2020. Simultaneously however no state should be allowed to increase greenhouse gas emissions by 2020 by more than 20% in reference to 2005. The same document, just like the other ones, includes the declaration that the effort of member states should be based on solidarity principles and concept of sustainable economical development of the Community , with regard to the GDP per capita of each member state. In case of Poland analysing rules included in the document [5] shows that the country has a right to increase emissions from sources not included in the EU ETS by 14% in reference to the level of 2005 (Fig. 11). Bulgaria and Romania, not shown in this figure, have a right to increase emissions by 20 and 19% respectively.

The current CO_2 cap allowed for Poland by the decision of the European Commission is 208 million (metric) tonnes a year instead of 289 million tonnes requested. The earlier works on the 2nd National Allocation Plan (NAP II – for years 2008÷2012) resulted in a proposal of the Ministry of Environment (distribution of totally 259 million tonnes – together with a reserve for the new installations and auctions proposed by the Ministry). After a long period of dismay caused by so huge reduction and indecisiveness about the further fate of the allocation plan for the CO_2 emission allowances, the Ministry decided to publish in December 2007 a new allocation proposal for consultations.

The proposal of December 2007 was particularly unfavourable for the power plant sector or rather in general – for covering the emission needs for electricity generation (in many cases the allowances would only suffice for 60÷70 % of needs). Another version, slightly corrected in favour of the power generators, was published in February, and yet another in May 2008. The evolution of the proposed emission allowances allocation in Poland can be reviewed in the Fig. 12. As it can be seen in this figure the E1 sector (Fuel Combustion) as the dominating one – more than 85 % of total volume – was virtually the only place when the cuts could be made.

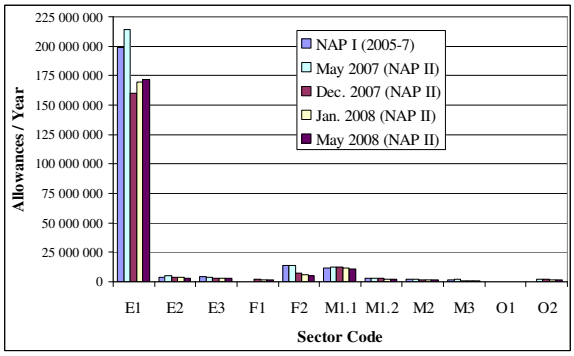

Fig. 12. Allocation of the emission allowances between the sectors in the 1st National Allocation Plan (I KPRU – 2005-2007) and in various proposals for 2008-2012. The Sector Codes are: E1 – Fuel Combustion, E2 – Refineries, E3 – Coke ovens, F1 – Metal ore roasting or sintering, F2 – Production of pig iron or steel, M1.1 – Production of cement clinker, M1.2 – Production of lime, M2 – Manufacture of glass, M3 – Manufacturing of ceramic products, O1 and O2 – Production of paper

Currently it is difficult to say whether the allocation process has finished there, as Poland attempts to increase the emission cap over the limit proposed by the European Commission on the juridical path.

One way or another the further restrictions – first of all those introduced after 2012 – remain an open question. We have to take into account the objective of the EU Energy Policy (3 x 20 – including 20 % decrease on CO_2 emissions).

V. Conclusions

The power and heat generation sector in Poland faces a number of challenges related to compliance with the obligations to cut down the harmful emissions to the atmosphere, which result from the international agreements mentioned above.

In the upcoming years these are primarily:

- continuation of the intensive investments in environment protection installations. The largest enterprise – after completing the construction of desulphurization units

supposed to make the branch compliant with the recently changed standards and allow to keep within the national cap – will be the investments in cutting down the nitrogen oxides emission. If the definition of the emission source currently used in Poland will be changed the industrial self-generation plants and heating plants will have to carry out significant investments;

- change of the fuel structure carried out through the increase of the share of renewable sources and introduction of the nuclear power after 2020. Those changes – included in the national policy [2] are smaller than expected, however even implementation of those plans will need considerable investment effort;
- adapting to the new situation resulting from changes in the European Trading Scheme for the greenhouse gas emissions. Of all the European countries Poland, due to the specific fuel structure, is the most sensitive to the increase of the electricity generation cost caused by those changes;
- possible adaptation to further restrictions in emission levels resulting from implementation of the new industrial emission directive [11];
- replacement of the decapitalized production facilities – the investments are needed to keep the capacity.

Total estimated level of Poland's emission allowances in 2020 resulting from [4] and [5] will be almost 400 million tonnes (some 216 million according to [4] plus some 177 million tonnes according to [5]). If distribution of those obligations for Poland was different, there should be no difficulties to meet them. The distribution method included in the Package however will result with significant effort needed to meet the first cap and probably some free margin in case of the second one. With more flexible approach to implementation of the main targets of the Package (3 × 20) Poland should have no difficulties to meet them.

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