

GREENHOUSE GAS EMISSIONS IN POLAND. CURRENT STATE AND REDUCTION STRATEGIES 2020-2050

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Abstract

Reduction of greenhouse gases is the key climate-related issue, both in Europe and worldwide. Therefore, the European Union imposed an obligation to achieve the targets specified in the climate and energy package on Member States, i.e. reduced the emission by 20% until 2020 when compared to 1990. These and very other reasons show an overriding need for ongoing efforts to improve the methods of reducing greenhouse gases. The objectives of this study are as follows: (1) to present the current quantitative and qualitative emission of greenhouse gases in Poland, (2) to show the strategies to reduce greenhouse gases in the years 2020-2050, (3) to identify the main barriers that prevent greenhouse gas emissions in Poland, (4) to choose the most probable scenario of reduction of the amounts of gases released to the air in Poland for the years 2020-2050. The analysis of the concepts available shows that implementation of the 'renewable' and 'nuclear' scenarios is less likely than the 'coal' scenario. This demonstrates that there are too many factors that hinder the implementation of the concepts to reduce greenhouse gas emissions in the power sector in Poland. What we definitely need is long-term changes (scenario for the next 25 years) to re-shape the mentality of the Poles and reduce economical barriers, which seem to be crucial for the process.

Keywords: *greenhouse gases, greenhouse gas emissions, barriers, strategies to reduce greenhouse gas emissions*

JEL classification: Q54, Q56, Q58

1 Introduction

Reduction of greenhouse gases is the key climatic issue, both in Europe and worldwide. Having noticed the increasing problem, the European Union imposed on Member States an obligation to achieve the targets specified in the climate and energy package (Miciuła, 2014; Kumar & Madlener, 2017; Su et. Al., 2016), aiming to reduce emissions and enforce strong reaction to consequences of climatic changes. The EU plans extend well beyond 2020 (Skwierz, 2016; Sówka & Bezyk, 2018). All this is done to prevent climate changes from reaching a dangerous level. The international community set a target of keeping global average temperatures from rising 2°C (compared to temperatures pre-industrial revolution).

As a result of the restrictions introduced, most of the EU-28 Member States have reduced annual emissions of greenhouse gases when compared to 1990^{69,70}. Among the positive aspects of the changes introduced is improvement of the quality of air and other elements of natural environment. Despite the considerable improvement of conditions, we must not forget the ongoing economic growth and dramatic consequences of previous activity of man.

In 2015 the overall amount of greenhouse gases emitted in Poland equalled 356997.90 kt CO₂ eq. National CO₂ emission to the atmosphere plays crucial role, as it constitutes 80% of all GHG produced in Poland. Methane and dinitrogen monoxide play smaller roles, i.e. 12% and 6% respectively, with fluorinated industrial gases taking the remaining 2% (KOBIZE, 2017). Even if in smaller amounts, dinitrogen monoxide and fluorinated industrial gases must not be underestimated when it comes to their impact on greenhouse effect, as they have significant heat absorption properties (Róžański et. al., 2016).

The key GHG emitter is power industry (81%). Other categories, i.e. industrial processes, land use and agriculture release 8% GHG each. Waste constitutes 3% of total emission of greenhouse gases in Poland. In this list, land use and land conversions are designated with negative values, meaning that they absorb carbon dioxide (KOBIZE, 2017). These gases do allow the Earth's absorption of solar radiation *but prevent* the thermal radiation from going out, wherefore temperatures grow.

These very examples show an overriding need for ongoing efforts to improve the methods of reducing greenhouse gases.

The objectives of this study are as follows:

- to present the current quantitative and qualitative emissions of greenhouse gases in Poland,

⁶⁹ https://ec.europa.eu/clima/policies/strategies/progress_en

⁷⁰ Energy Policies of IEA Countries - Poland 2016 Review. Retrieved from: www.iea.org

- to show the strategies to reduce greenhouse gases in the years 2020-2050,
- to identify the main barriers that prevent reduction of greenhouse gas emissions in Poland,
- to choose the most probable scenario of reduction of the amounts of gases released to the air in Poland for the years 2020-2050.

The present study contains an analysis of individual options and of relevance of introducing different strategies to reduce greenhouse gas emissions in the energy sector.

2 Data and Methods

Two research techniques were used to analyse the possible options of reducing greenhouse gas emission. It was a survey conducted in January 2018 among persons from different professional circles with theoretical and/or practical experience in the field; and analysis, as part of which individual properties and incidents were identified and their relationship with the whole were described. Plus, an overview of the available scientific literature was performed. 32 of the 100 surveys entitled: "Analysis of barriers for greenhouse gas emission reduction in Poland" were sent back. The respondents were selected from:

- state environmental authorities and authorities from the sector of energy,
- companies specialised in ecological counselling,
- research units.

Relying on experts' knowledge and the literature available (Szywała, 2016), 27 factors were distinguished with potential significance for the reduction of greenhouse gas emissions in Poland (Swora, 2011). The factors were divided into 5 groups (Table 1).

Another method used in the study was the scenario method (Nabielak et. al., 2018). The scenarios selected were supposed to facilitate expert assessment of the likelihood of application of individual reduction methods in the years 2020-2050. The scenarios were as follows (Kolasa-Wiecek, 2015):

- coal as the main pillar of the energy sector; reduction of greenhouse gas emissions through modernisation and improvement of performance of the existing systems,
- increasing the production of energy from renewable energy sources with gradual diminishing of the role of coal-based energy production,
- replacement of lignite combustion with nuclear power in the process of energy production.

Table 1 1st and 2nd order barriers which may potentially favour the freezing of wind power development in Poland

Parameter symbol	Barriers
L	Legal (legislative) barriers
T	Technical and technological barriers
E	Economic barriers
S	Social and cultural barriers
I	Infrastructural barriers

3 Results and Discussion

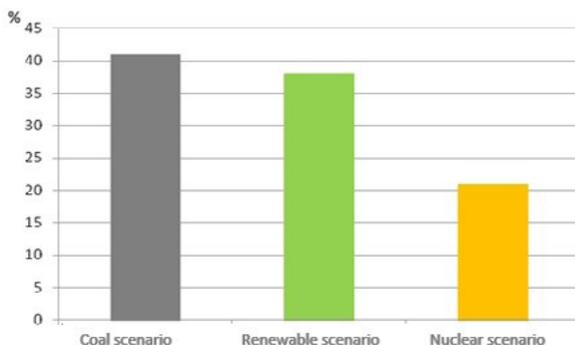
The respondents indicated the coal scenario as the most likely⁷¹. More of 40% of them are of the opinion that the future of the Polish economy shall be mainly based on coal (Szczerbowski, 2016; Molo, 2016; Greinert, 2014). The above confirms the governmental plans^{72,73}, which indicate own resources (meaning mainly coal) as the foundation of the Polish power sector. The least likely scenario indicated by the respondents is the nuclear one (only 21% of votes). Total generation costs in analyzed scenarios are similar (the difference in cost ca. 6%), but there is a large difference in the reduction of CO₂ emissions by 2050. Diversification of energy mix will improve energy security and independence of import in Poland³.

⁷¹ Polski sektor energetyczny 2050. 4 scenariusze. Forum Energii 2017

⁷² <https://www.salon24.pl/u/energetyka/823161,kongres-590-przyszlosc-energetyki-opartej-na-weglu-coraz-ciemniejsza> [accessed: 23.01.2018]

⁷³ <https://www.salon24.pl/u/energetyka/753466,polska-energia-z-wlasnych-zrodel-wegiel-przed-wszystkim> [accessed: 23.01.2018]

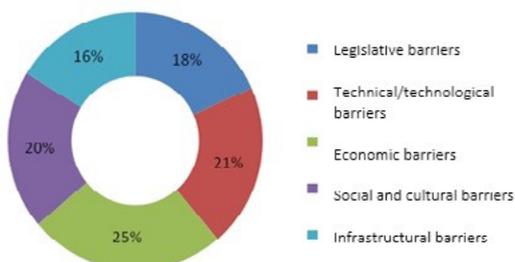
Figure 1 Likelihood of implementation of individual scenarios in the opinion of respondents



Source: Author's own work.

Nearly 1/4 of all respondents consider economic barriers to be the most important factor hindering the reduction of GHG emissions in Poland, while infrastructural and legislative barriers are thought to be the least significant.

Figure 2 Significance of 1st order barriers hindering greenhouse gas reduction in Poland



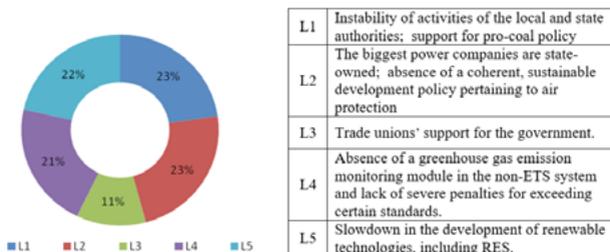
Source: Author's own work.

In part two of the survey, respondents were asked to distribute 100% among all 2nd degree factors.

In the opinion of respondents, all 2nd order barriers are comparably important. The most important were: support for pro-coal policy and absence of a coherent, sustainable development policy pertaining to air protection. The trade unions'

support for the government was, however, considered to be the least important barrier for greenhouse gas reduction.

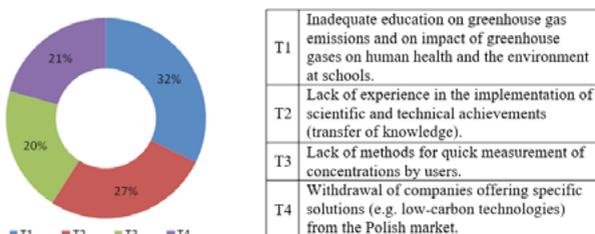
Figure 3 **Significance of individual 2nd order legislative barriers**



Source: Author's own work.

Respondents indicated inadequate school education on greenhouse gas emissions and impact of greenhouse gases on human health and the environment as the most significant 2nd order technical/technological barrier. In their opinion, factors such as lack of methods for quick measurement of concentrations by users and withdrawal of companies offering specific solutions from the Polish market are far less important when it comes to hindering greenhouse gas reduction.

Figure 4 **Significance of individual 2nd order technical and technological barriers**

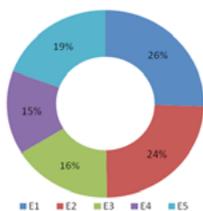


Source: Author's own work.

In the 'economic barriers' group, respondents chose high costs related to modernisation of the existing installations needed in order to shift towards a new energy carrier and high investment costs connected with new technologies as the most

significant. Other factors were considered to be on a slightly lower, comparable level.

Figure 5 **Significance of individual 2nd order economic barriers**

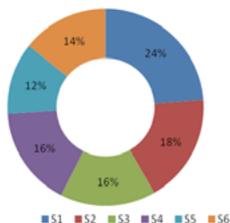


E1	High costs related to modernisation of the existing installations needed in order to shift towards a new energy carrier (e.g. coal replacement with gas or RES).
E2	High investment costs of implementation of new technologies (e.g. RES) that need to be incurred at the start.
E3	High costs of obtaining 'clean' energy, e.g. RES, alternative energy.
E4	Inadequate support for RES/alternative energy by the European Union.
E5	Unstable and insignificant state funds allocated towards improvement of efficiency of the technologies.

Source: Author's own work.

In the view of respondents, the biggest role in the 'social/cultural barriers' group is played by years-long habits of using heating systems based on coal or other energy-generating raw materials. Lack of social awareness and knowledge of the methods to measure greenhouse gas concentration was assessed as not half as important.

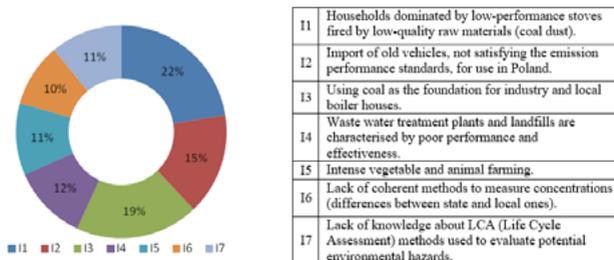
Figure 6 **Significance of individual 2nd order social/cultural barriers**



S1	Years-long habits of using heating systems based on coal or other energy-generating raw materials (including waste or rubbish).
S2	Limited awareness connected with waste burning, low-quality coal and other energy-generating raw materials.
S3	Miners lobbying further use of coal.
S4	Providing prices of power produced from fossil fuels net of external costs (costs of maintenance of unprofitable mines, double end-of-year bonuses for miners, environmental costs, healthcare costs etc.), aiming to keep the society convinced that coal energy is the cheapest choice.
S5	Lack of social awareness and knowledge of the methods to measure greenhouse gas concentration.
S6	Weak recycling and secondary raw material recovery culture.

Source: Author's own work.

Households dominated by low-performance stoves fired by low-quality raw materials and the use of coal as the foundation for industry and local boiler houses were considered the crucial 2nd order infrastructural barriers. In the opinion of respondents, lack of coherent methods to measure concentrations plays a negligible role in the reduction of greenhouse gas emissions in Poland.

Figure 7 Significance of individual 2nd order infrastructural barriers

Source: Author's own work.

4 Conclusion

The problem of greenhouse gas emissions to the atmosphere in Poland, which has been persistently growing in recent years, as well as the related intensification of the greenhouse effect, are noticeable and need a strong reaction. The necessity to meet strict requirements is not the only problem that Poland must face, as worse quality of air directly translates into human life and functioning. Immediate actions must be taken. Nevertheless, in order to make sure that the reforms will not have a negative impact on the Polish economy, they must be introduced successively over a lengthy period. It is impossible for Poland to abandon coal-based power within a few years only. Nevertheless, the capacities of coal-based power require gradual replacement with new technologies, including RES. The most reasonable system for implementing such changes assumes 20-25 years of transformations. Therefore, the scenario for the oncoming 25 years should be chosen as soon as practicable (Szczerbowski, 2015; Szczerbowski & Ceran, 2015).

The analysis of the concepts available shows that they are all feasibly, but their implementation may not be easy. For instance, construction of nuclear power plants oftentimes provokes objections of the local people, which in some cases makes the erection of new systems impossible (Olkuski et. al., 2017). The scenario based on renewables is burdened by limitations, too. Leaving aside the legal aspect, introduction of renewable sources of energy induces high capital expenditures on the purchase of expensive technologies. Additionally, high costs are also generated because of the necessity to install higher capacities in a system based on unstable sources, to ensure continues power supply.

The respondents are aware of these barriers. This is why most of them indicated that the 'renewable' and the 'nuclear' scenarios were less likely to be implemented

than the 'coal' scenario. This demonstrates that there are too many factors that prevent the possibility to implement the concepts to reduce greenhouse gas emissions in the power sector. What we definitely need is long-term changes to reshape the mentality of the Poles and reduce economic barriers, which seem to be crucial for the process. The following conclusions were drawn from the study:

1. Each of the concepts to reduce GHG emissions in Poland is feasible, but each has weak points, too:
 - the nuclear scenario oftentimes provokes objections of the local people, which in some cases delays the erection of new systems or makes it impossible at all,
 - the main weak point of the renewable scenario is the legal situation, high capital expenditures and high costs generated by the necessity to perform installations in a system that is based on unstable sources.
2. The respondents are aware of the barriers that hinder the implementation of the GHG reduction scenarios.
3. The majority of respondents indicated that the 'renewable' and the 'nuclear' scenarios were less likely to be implemented than the 'coal' scenario. This demonstrates that there are too many factors that hinder the implementation of the concepts to reduce greenhouse gas emissions in the power sector in Poland.

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