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## **DECOMPOSING CARBON DIOXIDE EMISSIONS REDUCTION FOR COAL BASED ENERGY SYSTEM.**

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Poland is one of the coal based country, abundant domestic reserves and limited access to other fuels created energy system with more than 70% of primary energy and 94% power generation from hard coal and lignite. Reduction of greenhouse gases emissions in such a system is a challenge. The bottom-up model of power and heat generation system (Suwala et al., 2005) was used to analyze paths of technologies development required to comply with expected limits of carbon dioxide emissions. The model considered generation for various groups of consumers of flexible demand and limits on emissions for sulfur dioxide, nitrogen oxides, particulates and carbon dioxide. These limits were based on Polish EU accessions agreement and indications for EU climate policy.

The scenarios on various GHG emissions limits imposed on the Polish energy system gave directions of its development, mainly technologies applied. Decomposition method was used to identify effects of carbon sequestration, fuels structure, efficiency improvements and demand changes on emissions reduction. The effects evaluate effectiveness of policy instruments applied to foster carbon dioxide emissions reduction.

The technologies applied depend on the emissions limits. Coal and lignite based technologies would still constitute vital part of Polish generation system, only very low emission allowed, 35% of 2020 no limit level, reduces share of this fuels in power and heat generation below 40%. Carbon capture and sequestrations is not indispensable to lower emissions, nuclear and renewable energy, mainly biomass and geothermal heat plants would substitute coal (Fig. 1). Natural gas is not applied in stand alone technologies; it is used to lower emissions of clean coal or traditional technologies with gas turbine addition.

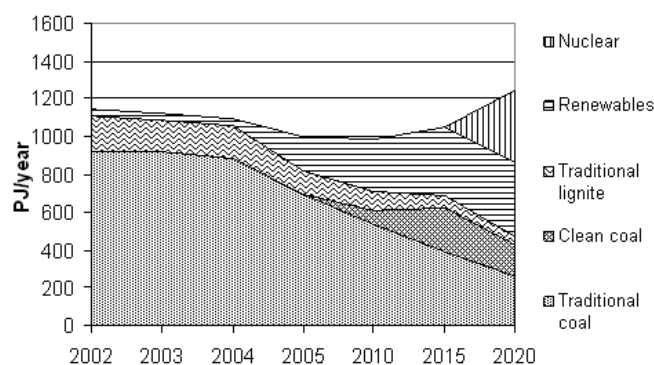
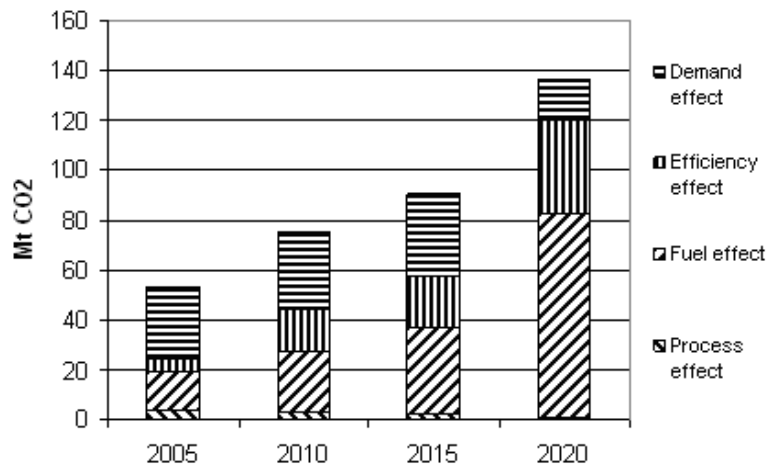


Fig. 1 - technologies mix for 70% emissions limit in 2020

Decomposition analysis with Shapley/Sun (Ang, 2004; Sun, 1998) algorithm shows that in the short term demand lowers due to higher costs of clean energy and with efficiency

improvements are major factors of emissions reduction. In medium or longer term efficiency is still the important factor, but fuels structure is becoming the second or even first measure of emissions reduction (see Fig. 2). This suggests that policy instruments supporting efficiency and fuels change would be most efficient in long term emissions reduction.



#### References

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