COAL PHASE-OUT IN GERMANY: ANALYSING THE POLICY INTERPLAY WITH OTHER EU MEMBERS

Sebastian Osorio, PIK, +49 331 288 2436, sebastian.osorio@pik-potsdam.de
Robert Pietzcker, PIK, +49 331 288 2404, pietzcker@pik-potsdam.de
Michael Pahle, PIK, +49-331-288 2465, michael.pahle@pik-potsdam.de

Overview

The implementation of the objectives agreed in the Paris Climate Agreement requires a rapid and radical reduction of greenhouse gas emissions. As a result, the debate about coal phase-out is intensifying. Many countries in the EU, e.g., UK, Denmark, Finland or Austria, are designing or have even implemented policies to shut down their coal-fired plants by 2030. The debate exists also in Germany as the country adopted ambitious targets for reducing its emissions (40% by 2020, 55% by 2030, 70% by 2040 and between 80 and 95% by 2050), but is unlikely to reach them. The importance of the coal phase-out debate was also highlighted in the recent German coalition negotiations, where the question of whether to shut down 5 or 8 GW of coal power plants in 2020 proved one of the stumbling blocks for coalition formation. To inform this debate, in this paper we intend to evaluate how the interactions of potential German and EU climate policies would affect the feasibility and effects of a German coal phase-out.

Coal plays an important role in Germany's power mix. Lignite and hard coal-fired power plants produce 40% of total generation and account for approx. 80% of the total CO_2 emissions of the German electricity sector. Despite substantial increase of RES share over the last decade, the reduction of coal-based generation has been very limited. This, as in other European countries, has been due to, among others, the lower relative coal to gas prices and the low carbon prices (evidence shows that coal- was more profitable than gas-fired generation over most of the period between 2008 and 2012 in Germany (Castagneto-Gissey, 2014)). On top of the system's reliability issues, a particular concern for a phase out of coal on Germany is potential leakage.

Previous work addressing the coal phase-out in Germany mostly focused on national analysis of explicit phase-out schedules. Some analyses determine an exogenous phase-out schedule based on different allocation rules, e.g., Klaus et al. (2012), while others use some of these phase-out paths to analyse the impacts on the system costs at a country level, e.g., Heinrichs et al. (2017) analyse the emissions in the overall energy sector under three possible shutdown schedules. Most work so far is grey literature, in which coal phase-out results from environmental and technical constraints. The overall conclusion from these studies is that the fulfilment of German targets heavily depends on carrying out the coal phase-out.

In contrast, our study focuses on different climate policies (implement via carbon pricing and emission budgets) and the interaction between Germany and other countries under different implementation of such policies in Germany, in parts of the EU or the whole EU. The current EU ETS design limits the impact of a German coal phase-out, as there might be a water-bed effect. At the same time potential coalitions might trigger an overall emission reduction. The interplay between Germany and the rest of EU members is thus of paramount importance. We use the Long-term Investment Model for the Electricity Sector of Europe (LIMES) to analyse how different factors affect the coal phase-out and investments needed to support the transition, and to elaborate on the interaction between national and EU-level policies.

Methods

LIMES is a partial equilibrium model that computes electricity dispatch and calculates generation and transmission capacity expansion on 5-year steps from 2010 to 2050 for each country in Europe. It considers technical constraints, e.g., minimum load and ramping, as well as EU-wide and selected national (Germany) climate and energy policies, aiming to facilitate long-term assessment of the European power system on aggregate and national level[1]. It captures intra-day demand and supply variability in a computationally efficient way by implementing a cluster algorithm to compute representative days (Nahmmacher et al., 2016). This allows

---

[1] A more detailed description of the model can be found in https://www.pik-potsdam.de/research/sustainable-solutions/models/limes

analysing how short-term variability affects long-term investment decisions. For this study we run 4 scenarios of fixed CO_2 being implemented by a different set of countries.

Results

First we compare two scenarios: *S1*) all countries see weak CO_2 prices ("*path 1*" increasing from 8€/tCO_2 in 2020 to 25€/tCO_2 in 2050); *S2*) Germany follows the example of UK and implements higher CO_2 prices for the power sector ("*path 2*": increasing linearly from 30€/tCO_2 in 2020 to 120€/tCO_2 in 2050). Our preliminary results show that the resulting emissions at an EU-level are 33.8 GtCO_2 in *S1* and 29.2 GtCO_2 in *S2* between 2015 and 2050. While emission reduction in Germany equals 7.5 GtCO_2, the total reductions in EU are 4.6 GtCO_2, highlighting carbon leakage from Germany to the rest of EU countries.

Since several other European countries have also shown a strong commitment to the Paris agreement, and overall to any stringent environmental policy, we run an additional scenario (*S3*) in which we assume a coalition of countries implementing the "*path 2*" of CO_2 prices and the rest of countries implementing the "*path 1*" of CO_2 prices. This leads to cumulated emissions of 3.7 GtCO_2 in the coalition and 19.0 GtCO_2 in the rest of countries, which are 16.2 GtCO_2 lower and 5.1 GtCO_2 higher, respectively, than in *S1*. This implies a rebound effect of about 35%. In the most comprehensive scenario *S4*, where all EU countries implement the "*path 2*" of CO_2 prices, the emissions are reduced to 7.2 GtCO_2 over the same period. In all scenarios in which Germany implements high CO_2 prices the coal phase-out is achieved, but at an EU-level it just occurs when all countries implement them. Overall, the higher the price, the more investments in renewables and the need for transmission and storage capacity. Transmission capacity by 2050 in *S4* is more than double that of *S1*.

Conclusion

Germany has formulated climate targets for 2020 and 2030 that are difficult to reach with the current amount of coal power generation. It is thus contemplating national instruments to decrease power sector emissions. However, due to the waterbed effect of the EU-ETS, national climate polices can potentially result in increased emissions in other countries. Given that some countries are strongly opposed to near-term increase of climate policy ambition, some claim that one way to potentially reduce the waterbed effect and to increase the effectiveness of national climate policies would be to form a coalition of Member states that are willing to implement coordinated, more stringent climate policies.

We contribute to this debate by analysing the interactions between different formulations of German and other EU countries' climate policies and their effect on coal power generation and power sector emissions in Germany and the EU as a whole. Although there is carbon leakage when Germany or a coalition of countries implement CO_2 prices, the overall reduction is positive. This shows that unilateral actions achieve a significant reduction of CO_2 emission, but unless very stringent policy is implemented by all countries, the EU-targets cannot be achieved (we estimate 8-14Gt CO2 of cumulate power sector emissions to be in line with the Paris Climate targets). Despite the need to improve market-based mechanisms to phase-out coal, the idea of a planned and consented coal phase-out should remain in the agenda, as it could reduce uncertainty in electricity markets and social and economic impacts. Our research will be extended to other type of policies such as emission budgets and minimum CO_2 prices, and the complementarity among them.

References

Castagneto-Gissey, G., 2014. How competitive are EU electricity markets? An assessment of ETS Phase II. Energy Policy 73, 278–297. https://doi.org/10.1016/j.enpol.2014.06.015

Heinrichs, H.U., Schumann, D., Vögele, S., Biß, K.H., Shamon, H., Markewitz, P., Többen, J., Gillessen, B., Gotzens, F., Ernst, A., 2017. Integrated assessment of a phase-out of coal-fired power plants in Germany. Energy 126, 285–305. https://doi.org/10.1016/j.energy.2017.03.017

Klaus, S., Beyer, C., Jaworski, P., 2012. Kohleausstiegsgesetz. Ecofys.

Nahmmacher, P., Schmid, E., Hirth, L., Knopf, B., 2016. Carpe diem: A novel approach to select representative days for long-term power system modeling. Energy 112, 430–442. https://doi.org/10.1016/j.energy.2016.06.081