Inland hard coal transportation costs in the European Union – A model based approach

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1. Motivations underlying the research

The European Union (EU) has committed itself to several climate and energy policy goals based on the Framework Convention on Climate Change and several self-imposed resolutions. Given these objectives, there is a trend away from lignite and hard coal towards renewable energies. However, despite these long-term goals, coal will remain a relevant energy carrier within the European electricity mix in the medium term.

The long-term goal of an energy system dominated by renewable energies requires businesses and politicians to make numerous decisions. Energy system models try to reflect and predict reality with its key relationships and thus provide a basis to support decision-making. Yet, energy system models have limitations due to necessary assumptions and simplifications. To assess the potential technical, economic, ecological and social impacts of policy measures, high accuracy and thus high-resolution input data is required. Depending on the problem, this also applies to geographical data. For fuel prices however, this is usually not the case. Many energy system models only differntiate fuel prices between countries, but not within a country. Location-specific costs, such as transport costs, are therefore not taken into account. For hard coal power plants, among the main cost drivers of fuel supply are the transport costs of steam coal from import harbors to the power plant sites. These costs consist either of freight rates of the barges, charges for transport by train, or a combination of both. In addition, transshipment costs during transport may arise.

Therefore, we aim at determining country-specific regional transport costs for hard coal to power plant sites in the European Union. Another goal of this work is to answer the question of whether the differences in transport costs for hard coal within a country are large enough to change the merit order and whether there are differences between countries in the European Union.

2. A short account of the research performed

For this purpose, a model for the EU has been developed which determines the country-specific regional transport costs for hard coal from the import harbors to the respective power plant sites. The geographical resolution of this work is at the municipal level of each country, in which each municipality is characterized by specific costs, depending on distance from import harbor and means of transport. In total, transport costs were modelled for 119,978 municipalities. The model results are presented and discussed for Germany, France, Italy and Spain. In addition, the effects of a low water scenario for Germany are examined, as it occurred in Central Europe in autumn 2018.

3. Main conclusions and policy implications of the work

The model results show a clear ranking of the most favorable locations in terms of transport costs for hard coal, starting with locations at the open sea. In this case, no onward transportation by inland waterway vessels or train is needed. As the costs of shipping coal from its producing countries to Europe also depend on the size of the ships used, an additional aspect is the question of which ship sizes can unload at the specific harbor. The second-best choice are all inland locations near riverbanks since inland

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waterway vessels can be unloaded directly at the power plant site too, but a ship-to-ship handling is needed in advance which increases costs. Furthermore, inland waterway vessels are more expensive than seagoing vessels due to their smaller load quantities. All other locations remote from both sea and river access are the most expensive sites because transport by train or truck are the only options to transport coal to the respective power plant sites. The latter is extremely expensive, which is why it is an exceptional case and not part of the model. In can be concluded that the geography of a country has a major impact on transport costs.

Although the impact of transport costs is small compared to fuel prices and CO_2 prices, they are large enough to change the merit order. Variable costs of hard coal-fired power plants are close, so that even small differences can change their position in the merit order. Transport costs thus mainly exert an influence on the competition between coal-fired generation units. A comparison between the standard and a low water scenario in Germany shows that median transport costs to existing power plant units increase about 29 percent if waterway vessels can only load half of their usual cargo. Not all power plants are affected equally because some have alternative supply options.

Our model results are particularly suitable as input for energy system models simulating European power plant dispatch. Further work can assess if an integration of transport costs results in a better reflection and prediction of reality.