Challenges in designing technology-neutral auctions for renewable energy support

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Overview

The expansion of renewable energy (RE) sources is a cornerstone of the energy transition in order to achieve the global greenhouse gas emission reduction targets. However, the costs of electricity from RE sources has not yet achieved grid-parity with conventional energy sources and thus RE sources need support in order to achieve the expansion targets. The global trend regarding the promotion of RE sources is to determine the support payments through competitive bidding processes. Such auctions for RE support are, as of today, deployed in many countries around the globe in particular in Latin America and in Europe. Moreover, since 2017 the European Commission requires its member states to deploy auctions in order to promote RE (European Commission, 2014).

There is a large variety of auction designs in the different countries, yet, there is a general development to open up the auction formats. The most recent openings were so-called cross-border auctions, where participants from different countries could participate, e.g. in Denmark and Germany (Kitzing & Wendring, 2016), and technology-neutral auctions, where bidders participate with different technologies, examples include the Netherlands (Minister van Economische Zaken, 2015) and Mexico (IRENA, 2017). With a more open auction format and thus a larger variety in participating bidders, the complexity of designing an auction increases as well. We analyze the main challenges when designing a technology-neutral auction. We focus on the general differences between different RE technologies and the resulting implications for the bidders and the auctioneer.

Methods

We deploy a three-way approach in order to analyse the specific challenge to design a technology-neutral auction. First, we abstract the technological differences between different RE technologies, especially of wind on- and offshore and photovoltaics (PV). Those differences include construction and planning times, investment and operation costs and cost uncertainties. Second, we empirically analyse the design of already conducted or planned technology-neutral auctions for RE support, those include the Netherlands, Mexico, the UK, California, Spain and Germany. We focus on design elements that address the individual characteristics of the participating technologies and how they impacted the outcome. Moreover, we include the findings of previous studies on technology-neutral auctions (del Rio & Cerdá, 2014; de Mello Santana, 2016; Gawel, et al., 2017). Third, we apply auction-theoretic concepts on the present data. We deploy the concept of asymmetric auctions (Maskin & Riley, 2000) which corresponds to the different characteristics of the different technologies. Furthermore, the auction-theoretical analyses includes discriminatory auctions (McAfee & McMillan, 1989), integration costs (Joskow, 2011) and common values (Kagel & Levin, 1986).

Results

The results of our analyses show that actual technology-neutrality has never been achieved in the past and is in general hard to achieve. A further question is whether this should be achieved at all. First, there are arguments that speak against multi-technology auctions in general. Deploying technology-specific auctions reduces the uncertainty for both the auctioneer and the bidders. That has two main advantages. On the one hand, less uncertainty reduces the capital costs for investors and thus the costs for the economy. On the other hand, technological predictability helps the government to plan the grid infrastructure in line with the RE expansion and thus reduces integration costs (Hirth, 2013). Furthermore, technology-specific might be sensible with regard to dynamic efficiency (de Mello Santana, 2016), i.e., the technology development could change the costs differently for different technologies and thus their order with respect to the generation costs.

Those arguments are confronted with the biggest advantage of technology-neutral auctions, the (static) efficiency. That is, the bidders with the lowest generation costs are awarded and thus the welfare is maximized. However, due to the different characteristics of different technologies such an actual technology-neutral auction can hardly be achieved, e.g. the different number of full load hours, different upfront costs to achieve the permits and different lead times cannot be taken into account with full compensation. Upfront costs are auction-theoretically considers as sunk costs and influence the bidding behaviour depending on the amount (Levin & Smith, 1994). Additionally, different planning and construction times alter the possibilities to consider technology cost development, e.g. PV module or wind turbine prices, and thus also influence the bidding behaviour (Kreiss, et al., 2017a).

Finally, there is the question whether the auctioneer wants a technology-neutral auction. Even though such an auction theoretically results in the welfare optimum, this might not be the outcome with the lowest costs for the auctioneer. The different cost structures of different technologies lead to windfall profits which could be reduced through a discriminatory multi-technology auction (Kreiss, et al., 2017b).

Conclusions

The ongoing development of auctions for RE support leads towards open auction formats where bidders from either different countries or with different technologies can participate. However, this development increases complexity and is one of the key challenges for the upcoming years. Although there are reasons to maintain technology-specific auctions, the advantages of multi-technology auctions will prevail. Yet it is still questionable if such an auction will be designed technology-neutral. Firstly, it is really hard to design an actual technology-neutral auction. Secondly, depending on the auctioneer's goals a technology-neutral might not be the optimal solution. This debate proves once again that a good auction design starts with clear objectives and requires commitment to these goals.

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