MOTIVATIONS FOR AND IMPLICATIONS OF CAPACITY-CONSTRAINED ONSHORE RENEWABLE POWER GENERATION DEVELOPMENT

Valentin BERTSCH[1]

Background & Motivation

It is generally accepted that greenhouse gas emissions need to be reduced globally in order to combat the effects of climate change and that the decarbonisation of the energy system is an important prerequisite in this context. Internationally, many countries plan to achieve decarbonisation by increasing energy efficiency and expanding renewable energy sources (RES), though these actions will involve significant investments in energy infrastructures. For example, Slednev et al. [1] quantify the large investment requirements for a range of different renewable electricity generation scenarios out to 2050 for Ireland to meet its long-term decarbonisation targets. While people are generally found to express acceptance of these investments on a broader level, policy makers and planners are frequently met with resistance from local residents to specific energy infrastructure development proposals. Indeed, some politicians and renewable energy technology (RET) developers argue that this local resistance can be explained by 'NIMBYism' ([2], [3], [4]) which suggests that people support such developments in general but object to them for selfish reasons when the planned developments affect their direct vicinity. This so-called NIMBY ('not in my backyard') explanation is, however, widely acknowledged in the literature as far too simplistic or invalid ([5], [6]). Nevertheless, many studies identify the distance between the particular energy infrastructures and a person's home as one of the key factors affecting the local acceptance of different energy technologies (e.g., [7], [8], [9]). This so-called 'proximity hypothesis' implies that people are more likely to oppose the energy technology, the closer it is located to their residence [10]. Increasing the setback distance between (renewable) energy infrastructure and people's homes, however, will constrain the space available for and may ultimately increase the costs of renewable power generation development.

Methodological Approach

We use a combination of different methods to analyse the effects of such a capacity-constrained renewable development regime. On the one hand, we employ an appropriately designed optimisation model, accounting for network effects, which are largely neglected in previous studies [11]. We use this model to compute the techno-economic effects (e.g., costs, grid congestions) by performing a medium- and long-term generation expansion planning exercise considering different renewable development cases, in which renewable power expansion is spatially constrained to certain degrees, under a range of demand, (storage) cost and policy scenarios. On the other hand, in order to explore the socio-economic effects and to understand what actually drives people's preferences for spatial proximity to different energy infrastructure technologies, we conduct an unprecedented survey on nationally representative samples of the population and analyse the stated preferences in a cross-country econometric analysis.

Results & Discussion

In relation to the techno-economic effects of capacity-constrained renewable power development, we find that the unconstrained portfolio is only marginally cheaper than the constrained one. However, there are substantial differences in the final generation expansion portfolios. The network reinforcement requirements are also greater under the unconstrained approach. Lower storage costs only slightly mitigate the costs of capacity constraints but significantly alter the spatial distribution of generation investments. The differential in costs between the unconstrained and constrained cases increases non-linearly with renewable generation targets. This is an important finding as it suggests that achieving very

[1] Chair of Energy Systems and Energy Economics, Ruhr-Universität Bochum, Universitätsstr. 150, 44801 Bochum, Germany, Phone: +49-234-32-26357, valentin.bertsch@ee.rub.de, www.ee.rub.de

high renewable generation targets may be challenging, if not impossible, if setback distances are increased too much.

In relation to the socio-economic effects, we find that the survey respondents are indeed more accepting of (renewable) energy infrastructure developments as the setback distance increases. Moreover, based on the results it is evident that people’s preferences for spatial proximity between various energy technologies and their homes are driven by some very influential factors, such as their tradeoffs between national energy policy preferences, their technology specific perceptions and to a lesser extent their socio-demographic characteristics.

Thus, policy makers may choose to trade achieving RES-E targets off against arriving at the least-cost scenario. If a constrained roll-out of renewables overcomes public opposition to the high levels of RES installations required to meet higher renewable integration targets, the increase in total costs may be acceptable, from a policy-maker’s point of view. An appropriate assessment and monitoring of the expected cost (increase) is very important though given that increased energy prices for consumers may themselves prove a barrier to social acceptance.

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