Renewable energy, efficient energy networks and sector-specific market power regulation

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The recent developments regarding increasingly generation of renewable energy lead to a challenge of electricity transmission and distribution networks. Starting point are the recent laws and regulations regarding electricity transmission in Germany prohibiting charges for injection of electricity at generation nodes and only allowing charges at customer nodes. In addition according to the renewable energy law there exist obligations to guarantee prioritized access to renewable energy irrespective of the capacity constraints and scarcities of the transmission network. Moreover network carriers may be obliged to extent their infrastructure capacities, irrespective whether economic incentives are available.

The aim of the paper is to develop an analytical framework to localize the true opportunity cost of electricity injection into transmission networks from a disaggregated point of view. In contrast to aggregated end-to-end optimization of electricity generation and electricity transmission, a disaggregated nodal pricing approach is developed. Whereas the network owner has the competency to simultaneously determining access charges and network capacities, the generators of electricity in a decentralized manner are taking their production decisions. Access charges are based on opportunity costs of capacity usage for the whole network (system externalities) not only result at customer nodes, but also at generation nodes. The decision relevant cost for electricity injection is therefore not only the marginal cost of generation, but also the opportunity costs of network usage at the generation node. The relevant merit order is therefore depending on the sum of generation and opportunity costs of capacity usage. This

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may result into a reverse of the generation merit order, which only takes into account marginal generation cost.

Although the marginal costs of regenerative energy generation are typically rather low the opportunity cost of injection of a specific regenerative energy (e.g. wind energy) may be (depending on the specific time point) very high. Without efficient congestion management this may even lead to the necessity for inefficient injection of energy at other nodes in order to avoid the breakdown of electricity transmission. As a consequence, network carriers should have the flexibility to take into account the reverse merit order and inject energy according to the generation and opportunity costs of capacity usage.

Subsidies for regenerative energy generation depending on the amount of injected regenerative energy leads to inefficient incentives to inject large amounts of energy irrespectively of the opportunity costs of network usage. In contrast, lump sum subsidies of investment for regenerative energy generation do not create such inefficient generation incentives.

In contrast to electricity generators, the providers of electricity networks are characterized by network specific market power (monopolistic bottlenecks), where neither active nor potential competition can work. The focus of regulation should be the access to transmission and distribution networks. Regulatory instruments should not disturb entrepreneurial search for pricing structures of electricity transmission and investments in electricity networks. Instead, price cap regulation should be applied.

Keywords:
efficient electricity networks, disaggregated nodal pricing, renewable energy, access regulation.