TECHNOLOGY-SPECIFIC OR TECHNOLOGY-NEUTRAL? ON THE LONG-RUN OPTIMALITY OF RENEWABLE ENERGY POLICY

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Overview

Most support schemes for electricity generation from renewable energy sources (RES-E) in Europe grant technology-specific subsidies. That is, they differentiate subsidies to RES-E plants on the basis of the energy source used, the technology employed, the size of the plant, and/or the location of the plant. Technology-specific approaches have been criticized for making the attainment of climate and energy targets – be it a greenhouse gas reduction target or a RES-E deployment target – unnecessarily costly (see, e.g., Frontier Economics and r2b, 2013; Jägemann, 2014; Jägemann et al., 2013). In turn, technology-neutral approaches are praised for their cost-effectiveness as they promote the deployment of the cheapest RES-E technologies first. Yet, this reasoning rests on two important assumptions: (1) Market failures associated with the development and deployment of RES-E technologies are absent, or properly addressed by other policies, and (2) Costs of renewables deployment beyond mere generation costs – system integration and environmental costs – are absent, or properly internalized by other policies. Consequently, renewable generation technologies compete among each other efficiently on the basis of generation costs. This paper aims to explore to what extent a differentiated, technology-specific RES-E policy may be economically sensible once the above assumptions are relaxed. Our paper follows up on a series of studies showing that technology-specific RES support schemes may decrease final consumer costs despite increasing generation costs, basically because price discrimination may help to reap producer rents (see, e.g., Del Rio and Cerdá, 2014; Held et al., 2014; Resch et al., 2014). However, these studies primarily provide a rationale for technology-specific RES support on the basis on distributional concerns (distribution of rents across power producers and consumers). In contrast, we aim to explore whether and under what assumptions technology-specific RES schemes may also generate benefits in terms of cost-effective power generation in the long run.

Methods

For the purpose of the theoretical analysis, the paper employs an analytical partial equilibrium model of the power sector. The model encompasses two periods and distinguishes between two representative types of RES-E technologies which may be employed to attain a certain RES-E target. The technologies differ in generation costs but also in their technological change properties, integration costs and external environmental costs.

Results

The model analysis sheds light on three types of benefits which may be produced by technology-specific RES-E support schemes. First, the development of RES-E technologies may be impaired by technology market failures. A basic assumption in this respect is that RES-E technologies experience learning curves. These future reductions in generation costs may not be considered by investors properly due to knowledge spillovers, myopic decision making (represented by differences between private and social discount rates) and uncertainty about the actual extent of learning effects. The welfare losses from these market failures are aggravated by the fact that technology choices in the power sector are strongly path-dependent – which also makes theses choices significantly different from those in other technology-heavy sectors. If the severity of these market failures varies with RES-E technologies – e.g. due to heterogeneity in learning curves, spillovers or uncertainties – technology-specific RES-E subsidies may be a first-best response.

Second, RES-E generation produces system integration costs, next to generation costs. Following Hirth et al. (2015), integration costs include profile costs, grid-related costs and balancing costs. These costs call for a RES-E portfolio which is also optimized with respect to the variability, location and predictability of the technology mix. Compared to a scenario with pure generation-cost minization, this approach may call, for example, for a mix of RES-E technology with uncorrelated generation profiles, the use of system-friendly RES-E technologies, such as weak-wind turbines, or a location of RES-E plants closer to load centres. These costs are imposed on RES-E operators to provide for optimal technology choices and operation if (1) the RES-E remuneration reflects market prices, as under a premium tariff, and if (2) the market value of power is properly reflected spot, future and balance markets. In practice, however, these requirements are not met in many cases, (1) because of fixed feed-in tariffs, or

(2) because power markets fail, e.g. due to absence of locational price signals, regulatory uncertainty or market power. While the first-best response would be the reduction of these failures, this may not be feasible due to politico-economic constraints or administrative hurdles. In this case, technology-specific RES-E support may help promote system-fiendly RES-E portfolio and reduce integration costs.

Third, power generation with RES-E technologies also produce external environmental costs. These costs may be (1) site-specific (e.g. habitat losses) and (2) distance-related, i.e. dependent on the the distance to human settlements (e.g. noise emissions or aesthetical changes to landscapes). Moreover, these costs vary significantly across RES-E technologies. Again, there may be direct approaches to internalizing these externalities, e.g. by taxes or land use planning. If such approaches are deficient, however, - e.g. due to a lacking political will or because externalities are produced outside the scope of an administrative entity – technology-specific RES-E support may produce benefits.

Conclusions

The theoretical analysis thus reveals a variety of possible benefits of technology-specific RES-E schemes which need to be put in relation to the commonly discussed costs of technology differentiation. Due to market and policy failures, a cost-effective RES-E technology mix for power generation cannot be identified on the basis of generation costs. Notably, the impacts of market and policy failure are heterogeneous across RES-E technologies. This implies that a proper correction may call for the differentiation between energy sources (e.g. intermittent vs. non-intermittent), technologies (e.g. by type of photovoltaic module), size (e.g. height of wind turbine) and location (e.g. wind onshore and offshore) of a RES-E plant. Theoretically, technology differentiation can be implemented under any type of RES-E policy – under fixed feed-in tariffs as well as under more market based approaches, such as quotas or tenders. Presumably, however, transactions costs of technology differentiation are higher under market-based approaches. Moreover, these approaches lose a lot of their appeal (in terms of reducing RES-E support costs) when technology-specific constraints are incorporated. Thus, it may be argued that the more important technology differentiation is, the less appropriate are market-based approaches.

Obviously, this is not to say that technology differentiation of RES-E support schemes is by definition welfare-improving. To the contrary, existing technology-specific RES-E subsidies are usually the outcome of political negotiations and interference from affected stakeholders. This practical caveat notwithstanding, this paper illustrates that technology differentiation cannot be ruled out per se on the basis of cost-effectiveness concerns.

References

Del Rio, P., Cerdá, E., 2014. The policy implications of the different interpretations of the cost-effectiveness of renewable electricity support. Energy Policy 64, 364-372.

Frontier Economics, r2b, 2013. Effizientes Regime für den Ausbau der EE, Weiterentwicklung des Energy-Only-Marktes und Erhaltung des EU-ETS. Ein Bericht für die RWE AG. Frontier Economics Ltd., London.

Held, A., Ragwitz, M., Gephart, M., De Visser, E., Klessmann, C., 2014. Design features of support schemes for renewable electricity, Task 2 report. Ecofys, Brussels.

Hirth, L., Ueckerdt, F., Edenhofer, O., 2015. Integration Costs Revisited - An economic framework of wind and solar variability. Renewable Energy 74, 925-939.

Jägemann, C., 2014. A Note on the Inefficiency of Technology- and Region-Specific Renewable Energy Support: The German Case. Zeitschrift für Energiewirtschaft 38, 235-253.

Jägemann, C., Fürsch, M., Hagspiel, S., Nagl, S., 2013. Decarbonizing Europe's power sector by 2050 — Analyzing the economic implications of alternative decarbonization pathways. Energy Economics 40, 622-636.

Resch, G., Liebmann, L., Ortner, A., Busch, S., Panzer, C., Del Rio, P., Ragwitz, M., Steinhilber, S., Klobasa, M., Winkler, J., Gephart, M., Klessmann, C., de Lovinfosse, I., Papaefthymiou, G., Nysten, J.V., Fouquet, D., Johnston, A., van der Marel, E., Bañez, F., Batlle, C., Fernandes, C., Frías, P., Linares, P., Olmos, L., Rivier, M., Knapek, J., Kralik, T., Faber, T., Steinbaecker, S., Borasoy, B., Toro, F., Plascencia, L., 2014. Design and impact of a harmonised policy for renewable electricity in Europe - Final report of the beyond 2020 project - approaches for a harmonisation of RES(-E) support in Europe Energy Economics Group (EEG) et al., Vienna.