Technology-neutral or Technology-specific? Designing Support Schemes for Renewable Energies Cost-effectively

By Paul Lehmann and Patrik Söderholm*

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, or the location of the plant (or a combination of these). Technology-specific approaches have however 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 to RES-E support have been praised for their cost-effectiveness as they promote the deployment of the cheapest technologies first.

Assumptions Underlying Pleas for Technology-Neutral Support

This critique notwithstanding, it has also been argued that technology-specific RES support schemes may decrease final consumer prices despite increasing overall generation costs, basically because price discrimination across technologies with dfferent costs may help to reap producer rents (see, e.g., Del Rio and Cerdá, 2014; Held et al., 2014; Resch et al., 2014). This argument is inspired by distributional concerns (distribution of rents across power producers and consumers), rather than by strict cost-effectiveness considerations.

However, under certain conditions, there may also be benefits from technology differentiation in terms of reducing long-run generation costs of, for instance, reaching climate policy targets. Here it is important to acknowledge that the economic critique of technology-specific support rests on at least two important assumptions: (1) The market failures associated with the development and deployment of RES-E technologies are absent, or properly addressed by other policies, and (2) the costs of renewables deployment beyond the private generation costs – e.g., system integration and environmental costs – are absent, or properly internalized by other policies. Consequently, RES-E technologies are assumed to compete among each other efficiently on the basis of their generation costs. Yet, we argue that rationales for technology-specific RES-E support may emerge once these assumptions are relaxed.

Technology Market Failures Impairing Technological Change

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: increased RES-E generation today may help to bring down generation costs in the future due to learning-by-doing (i.e., tacit knowledge acquired through manufacturing) and/or learning-by-using (i.e., improvements in the technology as a result of feedback from user experiences). However, RES-E investors may only partly be able to appropriate these learning benefits as part of the knowledge gained through learning will spill over to other competitors – e.g., by reverse engineering or personnel movements between firms. To avoid undervestment in RES-E deployment in this case, investors should receive a deployment subsidy. This subsidy (e.g., price premium) needs to be technology-specific as long as the degree of learning and the importance of spillovers effects varies across RES-E technologies. This variation exists in reality as the maturity differs across the various RES-E technologies (IEA, 2010), and due to differences in the complexity of the relevant actor networks as well as the role of users in the technology development process (see, e.g., Huenteler et al. (2012) comparing wind power and solar PV).

Capital Market Failures Resulting in Improper Treatment of Investment Uncertainties

Future benefits and costs, and thus the economic profitability of technology learning today, are by definition uncertain. Uncertainties are related inter alia to the degree of learning rates, resource costs and the political framework (Purkus et al., 2015). In theory, private investors could hedge against the resulting risks. However, they may be unable to do so efficiently if capital and insurance markets fail, e.g. because of moral hazard or significant transactions costs. This market failure may materialize through private investors discounting uncertain future income streams more strongly than public investors (Arrow and Lind, 1970). As a consequence, private investors will under-invest in more risky RES-E technologies, such as those characterized by capital intensity and technologi-

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cal complexity (e.g., second-generation biofuels). The RES-E subsidy to correct for this shortcoming has to be technology-specific if these learning effects and risks vary across RES-E technologies. Certainly, such a subsidy would only be a second-best policy instrument compared to measures strengthening capital and insurance markets in the first place.

Negative Externalities Produced by Renewables Deployment

While RES-E generation is meant to substitute fossil generation producing carbon dioxide emissions, it may also generate significant external costs next to the private generation costs. First, RES-E deployment may produce environmental costs. These costs can be site-specific (e.g., habitat losses) and/or distance-related, i.e. dependent on the distance to human settlements (e.g., noise emissions or aesthetical changes to landscapes). Second, RES-E generation produces system integration costs. Following Hirth et al. (2015), these costs include profile costs, grid-related costs and balancing costs. Both environmental and system integration costs may vary significantly across different RES-E technologies. At the same time, neither environmental nor system integration costs are typically fully borne by the RES-E generators. This distortion may be corrected by RES-E support schemes that differentiate subsidies on the basis of the externalities produced by them. Again, of course, such an approach would only be a second-best means to address RES-E externalities. Regarding system integration costs, for example, optimal technology choices and operation can be spurred 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 in spot, future and balance markets. In practice, however, these requirements are not met in many cases because of the use of fixed feed-in tariffs, or because power markets fail in turn due to, e.g., the absence of locational price signals, regulatory uncertainty and/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 a system-friendly RES-E portfolio and reduce integration costs.

The economic significance of the above market failures is likely aggravated by the fact that technology choices in the power sector are strongly path-dependent (Acemoglu et al., 2012). As a consequence, the benefits of having technology-specific RES-E schemes may even be higher compared to a setting in which investment decisions were continuously modifiable and reversible.

Caveats to Technology-Specific Renewables Support

Obviously, designing technology-specific RES-E support schemes cost-effectively taking into account also the future development of the technologies may be quite challenging in practice. Addressing the technological variations in learning and spillover effects, risks and externalities properly is quite demanding for the regulator in terms of the information required. Nevertheless, these transaction costs do not necessarily question technology-specific RES-E support as a whole but rather the depth of the differentiation. Moreover, technology-specific schemes may be more prone to interventions by political interest groups trying to maximize their individual rents. Some argue that in this respect there may be a "premium of simplicity" (Helm, 2010), in turn tending to speak in favour of technology-neutral schemes. However, also technology-neutral policy instruments may be eroded in part due to lobbying efforts (e.g., the EU Emissions Trading Scheme). Finally, technology-specific support schemes may be blamed for picking winners and creating path dependencies politically. However, technology-neutral schemes will also pick technologies, namely those that have the lowest cost in the present time, such as onshore wind power. Given the diverse market failures discussed above, the path dependencies created by technology-neutral schemes may by no means be better than those generated under technology-specific policies.

Conclusion

Overall, technology-specific support schemes may thus produce economic benefits, particularly if technology markets work imperfectly and in second-best settings with additional uncorrected market failures. This is not to say that technology-specific support schemes are by definition welfare-increasing. In fact, there may be practical impediments to getting technology-specific subsidies right. Nevertheless, it becomes clear that technology-neutral schemes are neither by definition superior. In the end this boils down to the notion that a RES-E target cannot be a desirable goal in itself; it must be logically derivable by analysis of more basic motives and of the relevant costs and constraints. Our point is that almost regardless of which these motives are, there is generally a stronger case to be made for technology differentiation compared to technology neutrality.

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