Prosumage of solar electricity: pros, cons, and the system perspective

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Executive summary

We examine the role of prosumage of solar electricity, i.e. PV self-generation combined with distributed storage, in the context of the low-carbon energy transformation. After briefly reviewing recent literature, we first devise a qualitative account of arguments in favor of and against prosumage. Arguments in favor of increased prosumage include consumer preferences for local renewable energy solutions or for energy autarky; increased participation and acceptance of the energy transformation; lower and less volatile electricity costs; an activation of private capital for PV and storage investments; additional system flexibility, for example by unlocking previously untapped residential demand-side management potentials, increased sector coupling, and energy efficiency improvements; distribution and transmission grid relief; increased competition in the electricity market; local economic benefits; and political economy and institutional economics arguments such as the opportunity for promoting renewable expansion without direct support schemes or increased innovation.

Arguments against prosumage include efficiency losses arising from not exploiting the benefits of large-scale geographical balancing, such as complementary time profiles of load and renewables as well as complementary generation and flexibility portfolios at different locations. Further, prosumage-oriented PV systems may be designed and operated in a sub-optimal way from a system perspective. Other arguments against prosumage include regressive distributional impacts between prosumers and other consumers; potential rebound effects; issues of policy coordination as well as technological and political path dependencies; and concerns about privacy and data protection.

Second, we give an overview of prosumage in Germany, where incentives for prosumage can be considered higher than in most other countries. On the one hand, this is driven by indirect support measures, such as volumetrically charged grid tariffs and other retail price components. While retail prices have increased in recent years, feed-in tariffs for small-scale PV installations have decreased substantially and were much lower than retail prices by 2016. On the other hand, prosumage is directly supported by a subsidy program for battery storage connected to small-scale PV systems. Indirect and direct incentives have triggered the deployment of around 48,000

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Executive summary of the article: Wolf-Peter Schill, Alexander Zerrahn and Friedrich Kunz, 2017. Economics of Energy & Environmental Policy, Vol. 6, No. 1. https://doi.org//10.5547/2160-5890.6.1.wsch

prosumage systems by 2016. Looking at PV capacity dropping out of the German renewable support scheme in coming years, we infer that prosumage will likely gain substantially larger momentum after 2020.

Third, we model possible system effects in a German 2035 scenario. To do so, we employ an extended version of the open source electricity system model DIETER and apply it to four cases with varying degrees of the interaction between the prosumage battery and the overall electricity market. We find that prosumage batteries allow for a notable substitution of other storage facilities only if fully available for market interactions. An analysis of storage patterns shows that the storage energy capacity is determined by self-consumption needs, and that the prosumage battery is filled with cheap market electricity in night hours in which it is not required to serve self-consumption. Self-generation requirements put additional restrictions on the model and, thus, lead to higher overall system costs, which are only to a minor extent offset by the additional flexibility of prosumage batteries. Whether the potential benefits of prosumage, which we discuss qualitatively, outweigh these costs cannot be assessed here. In any case, system-friendly operation of prosumage batteries would help limiting cost increases.

We conclude that additional quantitative evidence on many of the potential positive and negative impacts of increased prosumage would be desirable in order to derive robust policy recommendations. Yet in general, policymakers should not unnecessarily restrict the development of prosumage in order to realize its potentially beneficial effects in the context of the low-carbon energy transformation. At the same time, system and distributional aspects must be considered, and potentially detrimental technical or political path dependencies should be avoided. In particular, it appears to be beneficial to ensure system-oriented design and operation of prosumage installations, and to make their flexibility potential available for the power market to the largest extent possible. At the same time, consumers who can or do not want to switch to prosumage should not be unduly disadvantaged.

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