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HOUSEHOLD INVESTMENTS INTO SOLAR PV AND BATTERY STORAGE: AN ANALYSIS OF PROFITABILITY AND IMPACT[1]

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INTRODUCTION

Many countries worldwide have adopted policies to support the expansion of renewable energy sources (RES) aimed at reducing greenhouse gas emissions and combating climate change. These support schemes have led to rapidly increased RES capacities. The installed solar photovoltaic (PV) capacity, for instance, has reached more than 300 GW globally at the beginning of 2017. This resulted in strong cost reductions for new PV systems and subsequently in reductions of the PV subsidies. At the same time, electricity retail prices increased in most countries depending on how the different governments decided to levy the RES subsidies. As a result, the consumption of self-generated electricity (the so-called self-consumption) from solar PV became more attractive than feeding the electricity into the grid and getting paid the subsidy. With strongly decreasing battery storage costs, more and more battery storages are deployed along with PV systems in several countries, further fostering self-consumption. In order to explore the main drivers of self-consumption and the resulting costs in different countries, we therefore compare and contrast two EU countries which differ strongly in terms of their solar energy policy as well as their geographical and meteorological conditions and solar PV potential: Germany and Ireland.

RENEWABLES POLICY BACKGROUND

Germany and Ireland both introduced a feed-in tariff (FIT) scheme and their overall targets for electricity generation from RES are similarly high. Nevertheless,

[1] This Bulletin summarises the findings from: Bertsch, V., Geldermann, J. & Lühn, T. "What drives the profitability of household PV investments, self-consumption and self-sufficiency?" *Applied Energy*, Vol. 204, 2017. Available online: https://doi.org/10.1016/j.apenergy.2017.06.055

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the legislation around RES expansion, particularly in terms of support for solar PV differs substantially.

Germany provided attractive investment conditions for PV with a FIT of more than 43 cent/kWh until 2009 for small plants, which was continuously reduced to 12.3 cent/kWh in 2016. The FIT payments are levied on a per unit (kWh) basis. The contribution from consumers increased from 1.33 cent/kWh in 2009 to 6.35 cent/kWh in 2016 leading, among other effects, to a residential electricity retail price increase which made self-consumption continuously more attractive altogether.

The Irish REFIT (Renewable Energy Feed-in Tariff) scheme does not provide support for solar energy to date. Moreover, REFIT is levied by the Public Service Obligation (PSO), i.e. it is paid for on a per household rather than on a per unit basis. As a result, residential electricity retail prices (per kWh) have not increased to a similar extent. Altogether, it is therefore obvious that the investment conditions for PV in Ireland have not been attractive.

RESULTS

Our simulation model identifies the most profitable sizes of PV and storage systems from a household perspective. The profitability of such systems depends on many factors, including technological, political and geographical aspects. Concerning the profitability of PV stand-alone systems, we find that the PV system costs and availability of a FIT are crucial drivers. Further, their profitability is driven by solar power availability and electricity retail prices. However, electricity retail prices become yet more important for combined PV-storage systems, i.e. for higher levels of self-consumption. Storage system costs are obviously also a major driver of the profitability of such systems.

Overall, we find that for current levels of costs, prices and FIT, household investments into solar PV are profitable in Germany. Even without FIT, battery storage costs decreasing to a level of around 500 €/kWh would render combined PV-storage systems profitable in Germany. For Ireland, we find that investments into solar PV or storage are not profitable under current market conditions and regulation. At today's costs of PV systems, a feed-in tariff of approx. 200% of the current REFIT level for wind would be required to achieve an internal rate of return of 5% for rooftop PV. With suitable economic conditions, which are potentially feasible in the next few years (e.g., decreasing PV and storage system costs or increasing electricity prices), however, PV systems may become sufficiently profitable. In this case, we find that self-sufficiency rates (the share of the demand that can be covered by self-generated electricity) of up to 75% and 65% can be achieved in Germany and Ireland respectively. Increasing the self-sufficiency rate beyond these levels will decrease the profitability of PV-storage systems significantly.

POLICY IMPLICATIONS

The achievable self-sufficiency rates imply that the corresponding households will only need to cover as little as 25-35% of their total electricity demand from the grid. When an increasing number of households only cover a small portion of their electricity demand from the grid in a system where the costs for maintaining the infrastructure are levied on a per unit basis, a decreasing number of households will need to pay continuously increasing per unit charges. This will create both challenges for electricity retail companies and distributional issues for policy makers.

Overall, these findings show that PV subsidies or changing economic conditions (e.g., PV and storage cost reductions) can lead to an increase in PV on the Irish system in the coming years. While there is nothing wrong with that, such high levels of PV can create significant challenges as outlined above. It is therefore important that policy makers are aware of the possible developments and that they have an open discussion with the public about their preferences and the related consequences.

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