A economic assessment of the residential PV self-consumption support under cost-reflective grid tariffs

Olivier Rebenaque,
Grenoble Applied Economics Laboratory, Grenoble University,
Climate Economics Chair,
olivier.rebenaque@chaireeconomieduclimat.org
0768057539

Overview

By generating their own electricity, households are less dependant from the grid. PV self-consumption received a lot of attention due to its potential of decreasing the dependency on fossil fuels. However, because there is a mismatch between PV generation and consumption, the economic benefits from self-consumption rely on the economic compensation of the excess electricity fed into the grid *(Bertsch et al., 2017; Dietrich and Weber, 2018)*. The economic benefits may drop by the implementation of cost-reflective grid tariffs such as Time-of-Use tariffs or capacity tariffs. Indeed, a capacity-based tariff decreases the variable part of the retail rate as well as the economic benefit from self-consumption. With a dynamic tariff, the prices are higher during the night when PV generation does not occur. In France, Time-of-Use network tariffs will be extended in a few years for most electric customers. Thereby, the development of prosumers (producer and consumer) would probably decrease without an increase in self-consumption *(Kaschub et al., 2016)*. To do so, the storage of electricity could be necessary to store PV generation in excess, to consume it at another period when needed. Battery is a promising technology for reaching this goal. In fact, batteries can also provide grid benefits by decreasing the peak load during high demand and the peak generation during sunny days. In this paper, we investigate how public supports can trigger grid benefit by the development of PV self-consumption. First, we perform an economic assessment of the PV self-consumption with the current Frenc policy support. We show that it is profitable without any subsidies but only for a self-consumption ratio from 88%. Then we propose an alternative policy support which guaranteed an upfront purchase subsidy for battery investment and the excess generation is sold at the market price. Based on this alternative policy, we simulate economic benefits from various PV panels and battery capacities with a Time-of-Use network tariff. Finally, we compare the current support with the alternative one. The profitability of a PV-battery investment is not profitable even with the implementation of an upfront purchase subsidy which represents 77% of the battery costs. The pricing structure has a significant impact. The profitability increases with a peak / off-peak rate but decreases if there is a seasonal differentiation.

Methods

The investment profitability of PV coupled with batteries are analyzed by computing the Net Present Value (NPV) for two different households. A simulation of the electric flows between household appliances, PV, battery and the grid is performed to calculate the bill savings. We compare the NPV with three different pricing structures : 1) a flat rate; 2) a Peak/ Off-peak rate (TOU_2P); and a Peak/ Off-peak rate with a seasonal differentiation (TOU_4P).

We define the upfront purchase subsidy according to the Levelized Cost of Storage (LCOS) of the PV-Battery system under a flat rate. Then we assess the Net Present Value of the PV-Battery investments under the different rates. Finally, we compare the cost of this policy with the current one.

Results

PV self-consumption is currently profitable in France with the existing subsidies even with a low self-consumption rate (30%). However, it is already profitable without subsidy but households must self-consume at least 88% of the PV generation with the flat tariff. The installation of a battery is not profitable even with an upfront purchase subsidy. In some cases, PV-battery investments are more profitable than the PV investments alone. The benefits are increasing with TOU_2P because stored excess PV generation allows to decrease the consumption during the peak price. However, the NPV under the TOU_4P is lower than the other rates because the price is lower in summer while the self-consumption is higher. We have also pointed out that the sizing is an important driver of the profitability. If households decide to invest, they have to take into account the aging process related to the sizing of the two technologies. A relation from 3 kWh/kW to 4 kWh/kW maximizes the profitability of the two households. Finally, a grant for a battery cost more than the current policy.

Conclusions

In France, PV self-consumption needs policy support to be profitable as long as there isn't a perfect match between PV generation and consumption. This could be achieved by integrating a battery in the system. However, batteries is costly compared to the retail rate in France. In all pricing schemes, the profitability of a PV-battery investment is not profitable even with the implementation of an upfront purchase subsidy which represents 77% of the battery costs. The pricing scheme is important to take into account in the case of the alternative subsidy because the battery can increase the self-consumption during peak rates. So, the phase out of the current subsidies with the development of Time of Use Tariffs can highly affect PV self-consumption development.