PV generation in the UK residential sector: opportunities and threats

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Overview

The power sector is undergoing a paradigm shift; the growth of distributed generation (DG) technologies promote the transition away from traditional centralized and top-down electricity supply toward more decentralized arrangements (Pérez-Arriaga et al., 2013). DG − mostly small-scale distributed solar PV systems − threats the utility business model, as their revenues are mostly volumetric-based (US$ per kWh supplied). The rise of "prosumers" triggers the vicious cycle, known as "death spiral", that results from lower energy sales and the need for utilities to increase their tariffs to recover their fix costs, further incentivizing DG penetration, as energy from the grid becomes more expensive than energy from the PV system (Sioshansi, 2014; Costello, 2015). This paper contributes to the understanding of the dynamics of solar PV diffusion in the residential sector, i.e., death spiral, considering the effects of these dynamics on utilities and solar companies within a reduction process of FIT. The UK was chosen for a case study as this country has made progress on FIT policy, but its impact has not yet been sufficiently assessed in terms of: first, the extent of the consequences of the adoption of household solar PV systems, with battery support; and, second, the possible market split between utilities and solar companies. Furthermore, as utilities may experience electricity sales losses due to the PV diffusion in the residential sector, this paper turns into identifying opportunities for utilities in new business models.

Methodology

A model-based approach has been used here for assessing policy effects on the diffusion of PVs in the residential sector in the UK. This section describes the simulation model that has been built for this purpose. The paper presents: first, the approach that has been used; second, the dynamic hypothesis and the stocks and flows map; and, finally, the main assumptions and data that has been incorporated in the model.

An SD modelling approach was chosen over other alternatives as this approach may capture feedbacks, delays, long-term effects and nonlinearities present in dynamics power markets (Dyner & Larsen, 2001). This explicitly makes SD modelling suitable as a tool to investigate the long-term effects of PV adoption on electricity utilities and solar companies. This section describes this simulation model that has been built to analyse the implications of PV adoption on energy industry in post-grid parity world.

Results

Results help assessing the: a) impact of FIT policy on adoption of household solar PV systems, with battery support, b) impact of FIT policy on electricity sales by utility companies and on solar companies, and c) development of new business models to make up for the loss of electricity sales by the traditional utility companies.

Conclusions

The greater the implementation of PVs in a country's energy matrix, the more **successful** this market/technology would be in social welfare terms. For decades electricity utilities in the industrialised world observed increases in their returns through increases in energy consumption. This is not being the case in a good number of countries as populations are stagnated or even decreasing and also because of the gains in efficient electricity consumption at all levels (Karunathilake et al., 2017).

Though a meaningful portion of the population may adopt solar PV systems, reducing the long-term revenues of utilities, the penetration of electric vehicles may increase electricity demand from the grid. Therefore, a traditional utility will not necessarily be harmed because of the power transformation.

Without subsidies, the solar PV industry will not reach high levels of development. A battery may improve the benefits for PV customers. Furthermore, if FIT rates decrease, then the adoption of batteries from PV household's increases.

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