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The impact of PVs and EVs on Domestic Electricity Network Charges: a case study from Great Britain

EPRG Working Paper 1814

Cambridge Working Paper in Economics 1830

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This paper uses a case study from Great Britain which shows the impact of increasing penetration of photovoltaics (PVs) and electric vehicles (EVs) under existing electricity network charges. Its aim is to show the extent to which different types of customers will see their charges vary under different roll-out scenarios for PVs and EVs, regardless of the underlying cost increases in network costs that such roll-outs might impose. This is an area which is of active concern to electricity regulators, one of whose primary functions is to protect consumers facing monopoly distribution charges.

In this paper, our main motivation is to question fairness in distribution tariffs in Britain. **As the problem statement, we ask; what is the situation with the British electricity customers in terms of designing fair distribution tariffs among customers who own EVs and/or PVs and who do not own these?** To analyse this problem, firstly, we examine two DNOs; most and least expensive ones in Great Britain. Then we defined four customer types, which are:

- Customers who own PVs and EVs;
- Customers who own PVs but not EVs;
- Customers who own EVs but not PVs;
- And finally, customers who do not own **either**.

The recent increase in distributed, intermittent and difficult to control generation and loads has posed many different challenges for electricity regulators. There are bold forecasts for rapid increases in household solar energy and electric vehicle use in Britain that raise the question of whether the current distribution charging

mechanism is fair or not. In a two-part tariff design, with a fixed rate (£/day) and a volumetric rate (£/kWh), raising a fixed amount of revenue by varying the volumetric charge exacerbates inequalities in charging. This paper takes the most and least expensive British network operators: London Power Networks and Scottish Hydro Electric Power Distribution, **as case studies**.

Our findings can be summarised as:
According to the most aggressive scenarios, in Great Britain by 2030**, the overall EV penetration will be around 30% and the overall solar rooftop PV uptake will be around 20%.**

- For every 5% increase in EV uptake, the total distribution charge decreases almost by 3%.
- For every 5% increase in PV uptake, the total distribution charge increases almost by 1%.
- As EV penetration increases, the tariffs decrease for all customer groups regardless of whether one owns an EV or not.
- As PV penetration increases, the tariffs increase for all customer groups especially the ones without a PV.
- **If both overall EV and PV penetrations are at the same percentage, the total distribution tariff decreases for all customer groups.**

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Publication May 2018
Financial Support EPRG