Agent-based modelling of the effect of government policy on the adoption of domestic photovoltaic systems in Great Britain

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Motivation

Feed-in tariffs (FiTs) to support small-scale renewable energy generation have been available in Great Britain since 2010, with solar photovoltaics (PV) making up the vast majority of FiT-supported installations [1]. There is currently around 2.25 GW of small scale (up to 10 kW), domestically-owned solar PV installations registered under the FiT scheme [2], costing electricity suppliers over £500 million a year in generation and export tariffs [1].

Purpose of the work

In order to explore the effectiveness of UK FiT policy, this work introduces an agent-based model (ABM) which predicts the adoption of small-scale PV systems by individual households in Great Britain.

Scientific approach

The agents take several economic factors and their social network into account when making adoption decisions, including the economic effect of FiT policy. The model was calibrated to match the observed deployment of small-scale domestic PV systems supported by the FiT scheme (see Figure 1); thus alternative scenarios could be compared to actual policy in order to make recommendations.

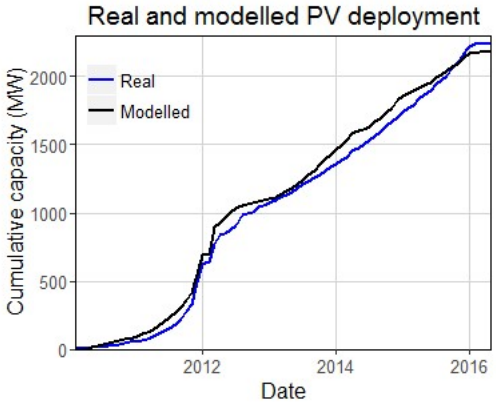

Figure 1: Real and modelled cumulative capacity of domestic PV installations with capacity less than 10 kW in Great Britain, after model calibration.

The experimental section is divided into two sections: experiments on the past (2010-2016), looking at alternative historical policy scenarios, and experiments on the future (2016-2023), considering four policy scenarios as well as three PV capital cost and three consumer electricity price scenarios.

Results and conclusions

The key conclusions arising from the model results were that while historical FiT policy has encouraged adoption, it did not do so in the most cost-effective way; initially, high FiTs led to cost escalation, while current FiTs are so low that the policy is completely ineffective in offering meaningful support to generators. Alternative historical policy scenarios, with reasonable FiT reduction strategies using either gradual pre-announced changes or deployment caps, gave significantly lower costs.

Optimal future policy is strongly dependent on how the cost of PV develops, with an additional, less prominent dependence on electricity prices. Current government policy should be reviewed by 2018 to make sure the correct strategy for the observed PV cost trends is chosen. If PV costs continue to fall rapidly, the current subsidy levels with deployment caps have a negligible effect and could be cut completely without reducing the level of deployment achieved by 2023, while if PV costs stay close to current levels an extension of current policy, or even a FiT increase, should be considered.

References

[1] Ofgem, "Feed-in tariff Annual Report 2014-2015," 2015. [Online]. Available: https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-fit-annual-report-2014-15.

[2] Ofgem, "Feed-in Tariff Installation Report 31 March 2016," 2016. [Online]. Available: https://www.ofgem.gov.uk/publications-and-updates/feed-tariff-installation-report-31-march-2016. [Accessed: 01-Jul-2016].