THE OPPORTUNITY OF LOCAL NETWORK CREDITS FOR HOUSEHOLDS WITH PV SYSTEMS AND EFFICIENT AIR CONDITIONER EQUIPMENT

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Overview

A growing range of energy efficient consumer technologies combined with an extraordinary decline in photovoltaics system (PV) prices has seen household electricity demand fall at the same time as a growing proportion of the remaining load is provided by household self-generation. Australia is a particularly interesting example of these developments, with one in five households now possessing a PV system while per-capita household demand has also fallen markedly as more efficient air conditioner systems are installed (AEMO, 2016). However, existing retail electricity tariffs and regulatory arrangements can create mixed incentives for households contemplating both PV and efficient air conditioner equipment. This is certainly the case in Australia with net metering arrangements (NM) that value self-consumption of PV far more than PV exports to the grid. Thus, energy savings from air conditioner energy efficiency measures (AC-EE) could reduce considerably the household PV self-consumption and hence the value of the PV system. Recently proposed 'local network credits' (LNCs), which offer an improved time-varying feed-in tariff (FiT) for PV exports, can potentially significantly change the combined value of residential PV and AC-EE. In this paper we use real household load and PV data from Sydney households to assess the potential implications of the introduction of LNC arragements on the financial attractiveness of PV and AC-EE installed in combination. Our results highlight how inappropriate flat feed-in tariffs may well adversely impact on the value that a combination of PV and AC-EE offers to households, and how LNCs can be an opportunity to remove barriers to the further uptake of these key clean energy resources.

Methods

We have estimated hourly household revenue in Australian dollars from 5kW PV systems and a typical AC-EE measure under NM, with and without LNCs, for a whole year period. We use real life hourly PV generation and electricity consumption data obtained from ten households located in Sydney in order to show representative energy performance. We have averaged the results for these households to obtain annual values in $/house/year and have projected and discounted the annual PV revenues considering future increases of electricity prices and retail tariffs.

Net Metering

Under NM arrangements, customers with PV systems first self-consume their PV generation and any excess of generation is exported to the electricity network. In this way, customers with PV experience savings in their electricity bill, which is valued at the customer retail electricity rate. They also typically get paid a flat FiT for their PV exports. PV exports get charged the whole transmission and distribution network infrastructure. As such, in Australia, as in many other jurisdictions, the value of PV self-consumption is far greater than the value of PV exports as avoided retail rates are three to four times higher than the FiT rates (Oliva H et al., 2016).

Modelling the air conditioner energy efficiency measure

The fall in household electricity consumption caused by AC-EE energy savings under current NM arrangements can potentially significantly reduce the household revenue gained from the PV system. This is because less household consumption will reduce the PV generation that is self-consumed and will increase PV exports.

The AC-EE measure we explore in this work consists of upgrading a typical residential air conditioner system with a 5 stars rating for heating and cooling to a new one with a 10 stars rating. An hourly profile of AC-EE energy savings (ES_t) has been built for the whole year period using real hourly household AC usage data and considering a 40% reduction of the AC electricity consumption with the AC-EE measure. As such, the combined hourly revenue gained for households investing in PV and AC-EE has been modelled as in Eq. (1).

$$\textit{Combined revenue from PV and AC-EE}_{\,t} = R_t \; x \; (SC_t + ES_t) + FiT_t \; x \; Exp_t \qquad (1)$$

Where at hour t, R_t is the Time-of-Use electricity tariff rate, SC_t is the PV self-consumption, Exp_t is the PV export and FiT_t is the feed-in tariff paid for PV exports in $/kWh which can include LNCs.

The local network credits

Household PV exports are physically consumed just by nearby customers and therefore PV exports utilise only a very small segment of the distribution network. A reduction of the network charge for distributed generation proportionate to the level of utilization of the network has been proposed as a regulatory arrangement in Australia under the name of 'Local Network Credits' (LNCs). Not only are LNCs a fairer network charging methodology for distributed generation that can improve the PV business proposition, but they could also increase the value of PV exports and hence potentially remove competition between PV and AC-EE to capture the household bill savings.

ISF (2016) has estimated LNC rates in $/kWh using a method that spreads the annual long run marginal cost of the network levels above the generator connection point – that is, the cost of the assets that distributed generation does not use – into the 8,760 hours of the year. This method considers the probability of network load peaking within an hour. Network businesses participating in the ISF project have advised this probability for different network levels which ISF has used to build Time-of-Use LNC rates that include a peak, a shoulder and an off-peak period. In this work we have complemented the traditional low FiT payment with the ISF LNC rates associated to the Ausgrid distribution network, which is where our households are located.

Results

In this section we show the average result of applying Eq. (1) to our household sample data. The scenarios explored are: households with PV only and households with PV and AC-EE, for both NM with and without LNCs.

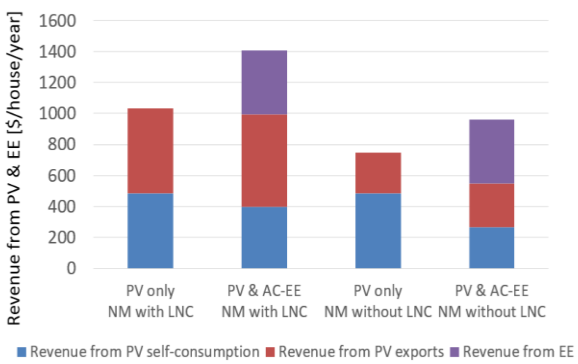

Fig. 1. Annual revenue from PV and EE with and without LNCs.

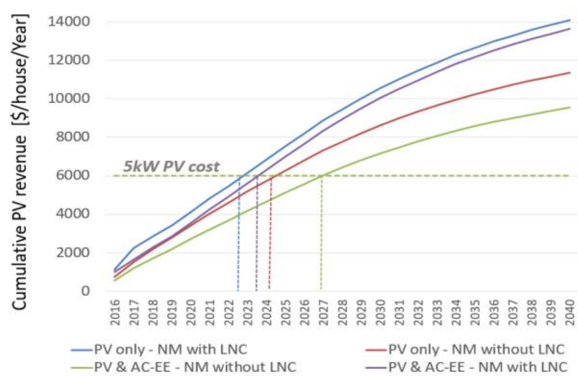

Fig. 2. Cumulative household PV revenue against PV costs.

Fig. 1 demonstrates that the AC-EE measure can take considerable revenue from the PV system under current NM arrangements in Australia. This is largely driven by AC-EE energy savings reducing considerably PV self-consumption at times of peak tariff rates. This is the result of a good energy match between AC usage and PV generation within a wide 2pm – 8pm peak tariff period, especially on hot summer afternoons. This dynamic can be seen as well as PV discouraging investments in AC-EE for household already possessing PV systems as Fig. 2 shows.

LNCs ameliorate considerably the negative impact of AC-EE on the PV value as it offers a much better value to the PV exports. Fig. 1 shows that by including LNCs about 70% more PV revenue is generated when AC-EE has been implemented. This shows that LNCs are not only a long term signal to incentivise distributed generation at peak times but also they can remove barriers to the combined uptake of residential PV and EE.

Conclusions

- We found that under current Australian NM arrangements installing efficient residential air conditioner equipment can increase considerably PV exports, reducing in this way the value of PV systems for households.
- LNCs can mitigate this unfortunate outcome of NM as they can credit a fairer and higher feed-in tariff value to PV exports, which is estimated considering the little network utilization of distributed generation.
- There is no regulatory obligations for electricity retailers and network businesses to facilitate the implementation of LNCs. This suggests that policy developments are needed in this area.

References

AEMO, 2016. National Electricity Forecasting Report. Australian Energy Market Operator, For the National Electricity Market. June.

ISF, 2016. Economic Impact Analysis of Local Generation Network Credits in NSW. Institute for Sustainable Futures, UTS. July

Oliva H, S., MacGill, I., Passey, R., 2016. Assessing the short-term revenue impacts of residential PV systems on electricity customers, retailers and network service providers. Renewable and Sustainable Energy Reviews 54, 1494-1505.