NP1003

HERE'S HOW TO *REALLY* SAVE $$ ON YOUR ELECTRICITY BILL…

Research Question

How can a community precinct use 100% renewable energy, in a manner which is affordable and technologically feasible? How will this specifically impact upon precincts of retirees?

A procedure for designing energy systems that allow for maximum use of renewable sources in community precincts will be developed.

Figure 1. Example of an intentional community development at Mt Barker, South Australia (http://www.millerscorner.org)

Methodology

As a first step of addressing the above research questions, we have evaluated potential electricity cost savings for a community within an embedded network using a complete 12 month data set of electricity usage in 2015, available for 29 households at Lochiel Park in South Australia.

Lochiel Park households are not within an embedded network, but we have used the half-hourly energy use data to calculate energy bills for each household for a standard energy tariff (traditionally used) and for a proposed bulk supply tariff that would be available for an embedded network. All houses generate some power from photovoltaics. The impact of storage is not included here, but will be investigated in the next study.

Results

Our results show that if the individual houses act as a community, they could share 15% of otherwise exported solar power. Using a traditional residential tariff this results in a 6% cost saving.

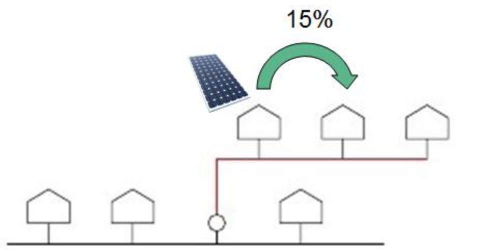

Figure 2. Schematic diagram of an embedded network. The top three houses are on an embedded network. The circle represents the common connection point to the public distribution network.

However, by far the biggest cost saving arose when the bulk supply tariff was applied to the data, resulting in a 45% cost saving off the community's traditional bill.

But how much of the community bill should be allocated to each household? We used concepts from cooperative game theory to help us formulate key requirements for an allocation scheme, based on ideas developed by delegates at the 2017 Mathematics in Industry Study Group workshop held in 2017. They are:

- There must be a unique allocation for any community bill.
- The allocation should be easy to calculate.
- The bill for each household should be no more than the household would receive from an external retailer.
- Households with identical energy use profiles must receive identical bills.
- The allocation should be understandable by householders.
- The allocation should encourage households to behave in a way that reduces the community bill.

All requirements can be met if we approximate each customer's contribution to the community bill by first calculating, as an interim step, an individual bill for each household based on the bulk supply tariff. We then scaled the community bill accordingly. Results are shown in figure three below.

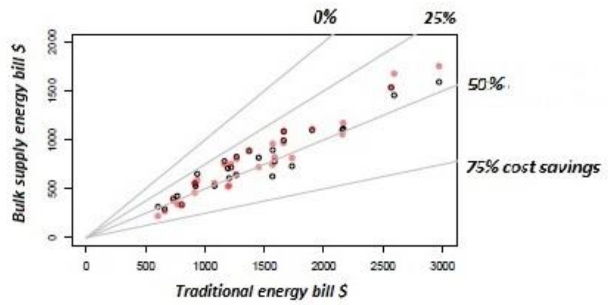

Figure 3. Individual energy bills vs bulk supply bills. The diagonal lines, from top to bottom, correspond to cost savings of 0%, 25%, 50% and 75%.

Conclusions

The analysis shows that while some cost savings arise because power flows between households within the community decrease the community's electricity bill, the main savings (a 45% decrease) come from the ability of a sufficiently-large community to negotiate a bulk supply contract. Fair allocation between households is achieved by calculating bills using the bulk supply tariff for individual households as an interim step. It is important to note that costs associated with operating and maintaining an embedded network are not included.

Embedded networks as prosumers are increasingly forming part of a clean energy electricity grid. This work assists in their successful integration as part of community precincts.

Further information contact:

Name: Kirrilie Rowe
Organisation: CRC for Low Carbon Living / UniSA, Barbara Hardy Institute
E: kirrilie.rowe@mymail.unisa.edu.au