Evaluating the Benefits of Existing Storage Technologies with Rooftop PV systems

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Introduction

Rooftop Photovoltaic (PV) systems can produce a significant proportion of daily household needs, yet that relies on the careful design of the system and the time of energy use. With reducing Feed in Tariff values and Federal supports across Australia, it makes little sense to install larger photovoltaics systems on residential rooftops, where most of the electricity generated would be exported directly to the grid.

Aim

This research aims to:

- Study the benefits, both financial and technological, of adding storage to existing rooftop distributed PV systems on residential households in Sydney, Australia.
- Estimate the required amount of storage for a given PV system size for a typical household, to make more financial sense and make PV a major and more dispatchable electricity source.
- Analyses the impact of installing storage in customer households on evening peak electricity load.

Methodology

In this study, actual customer load data was obtained for a selection of Sydney households. A model was created to generate net customer load data by simulating the output of PV systems of different capacities on individual rooftops. A study of the financial benefits of PV systems under different regimes and the impact of the system on the total network load was modelled. Storage systems of different sizes were then added in to the systems to store the excessive PV power generated during the day, for use during the evening peak time. A study of the financial benefits and effective network load was again performed on the new system and was compared with the base case.

Network Load & PV Generation Profiles

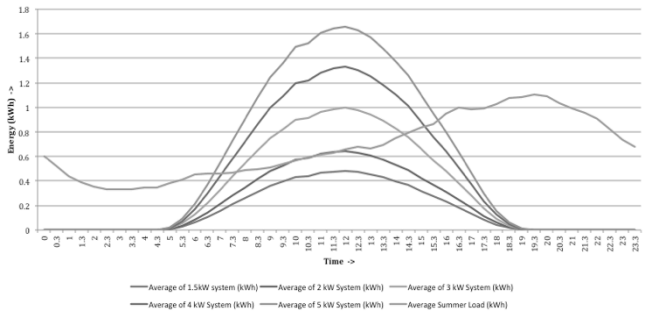

Figure 1: Average PV Generation and Load profile curve for Sydney summer

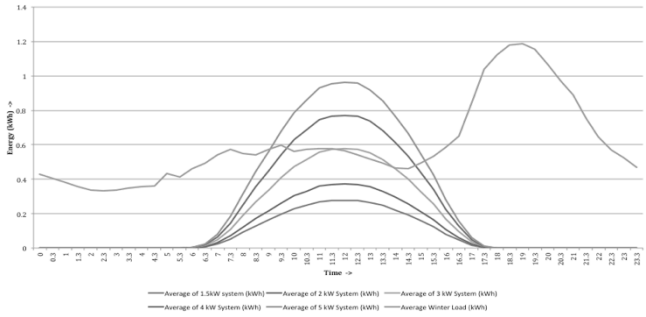

Figure 2: Average PV Generation and Load profile curve for Sydney winter

Payback Analysis Results

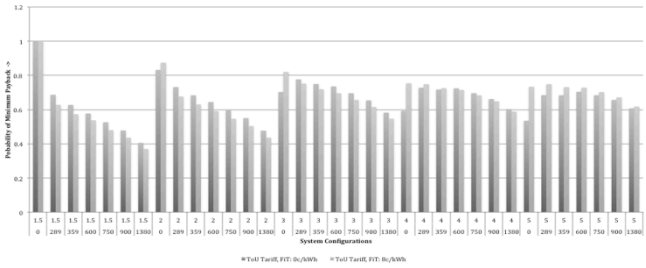

Figure 3: Payback analysis of systems for ToU tariff regime and FiT:0c/kWh & 8c/kWh

NPV Analysis Results

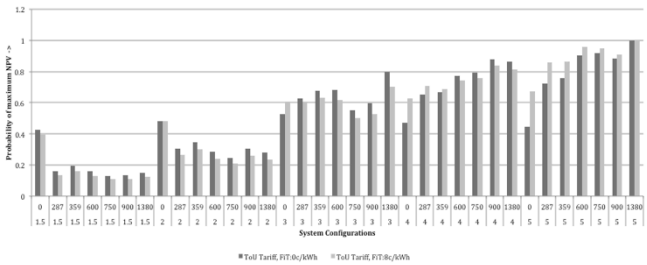

Figure 4: Net Present Value analysis for ToU tariff regime and FiT: 0c/kWh & 8c/kWh

Optimised System Configuration

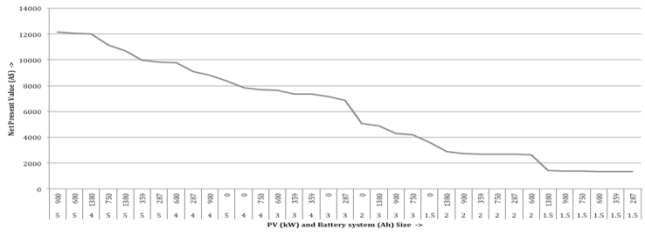

Figure 5: Optimised Results for Customer 3 with 5c/kWh FiT and ToU tariff structure

Network Peak Load Reduction

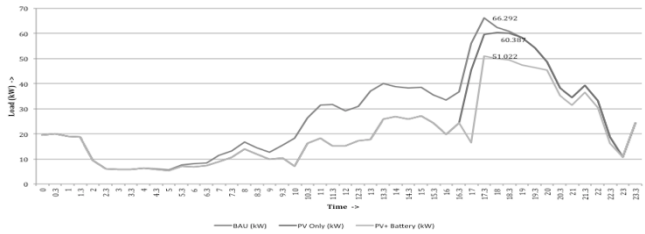

Figure 6: Effective Network load profile for 22nd November when network minimizes peak load

Conclusion

It was concluded that:

- Addition of storage could result in significant reduction in peak hour energy consumption; hence alleviating the need of expensive network upgrades.
- Increased financial returns, significant reductions in payback periods and increase in total lifecycle financial savings can be obtained from the renewable energy system, from an end user point of view.
- Optimised system configuration favours addition of batteries for most customers, for increased total lifecycle financial savings.