NP1001

CONTROL STRATEGIES OF DOMESTIC ELECTRICAL STORAGE FOR REDUCING ELECTRICITY PEAK DEMAND AND LIFE CYCLE COST

Research Question

Can the integration and smart control of batteries and PV systems reduce electricity peak demand and life cycle cost under demand tariffs?

Methodology

Using real-time monitored data as input, four control strategies (CS1–4) of domestic electrical storage, with and without PV, have been simulated using MATLAB.

Table 1: Main characteristics of the control strategies

CS1	**Charge from surplus PV only**
	Discharge **whenever** electricity is required
CS2	Charge from surplus PV plus **limited charging from the grid** during off-peak period
	Discharge during peak-period to reduce and limit power demand to the minimum demand charged by retailers, i.e. 1.5 kW
CS3	Charge from surplus PV plus charging from the grid during off-peak (**Fully Charged**)
	Discharge during peak period to maintain demand to 1.5 kW
CS4	Charge from surplus PV plus charging from the grid during off-peak (Full Charge)
	Discharge during peak period to **maintain demand to variable values**

Results

System without PV

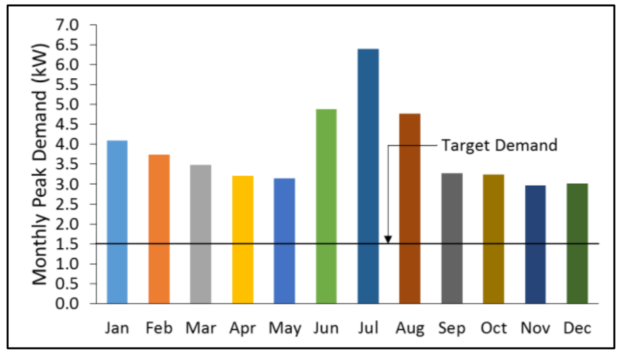

Figure 1: Monthly Peak Demands without PV and Battery.

System with 2.5 kW$_p$ PV

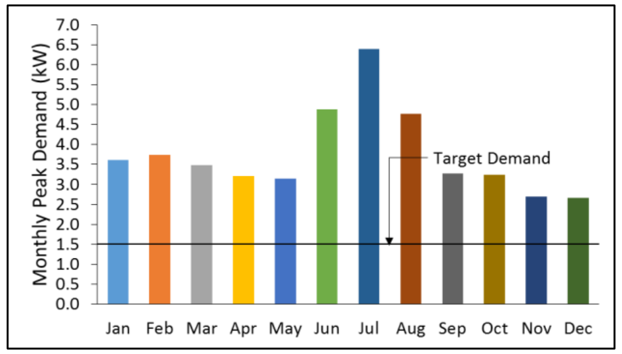

Figure 2: Monthly Peak Demands with 2.5 kW$_p$ PV and without Battery.

PV without electrical storage is inefficient in reducing monthly peak demands

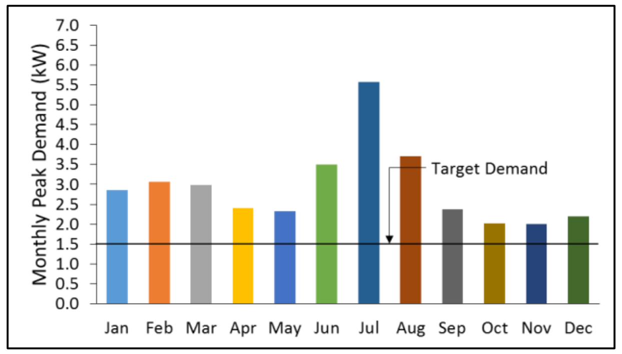

Figure 3: Monthly Peak Demand Using CS4 without PV and with 1 kWh battery.

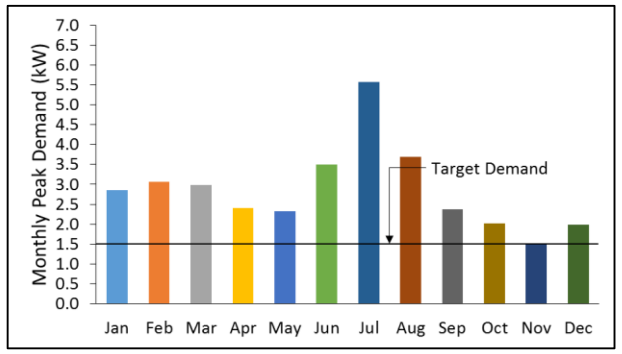

Figure 4: Monthly Peak Demands Using CS4 with 2.5 kW$_p$ PV and 1 kWh Battery.

With or without PV, electrical storage can reduce monthly peak demands

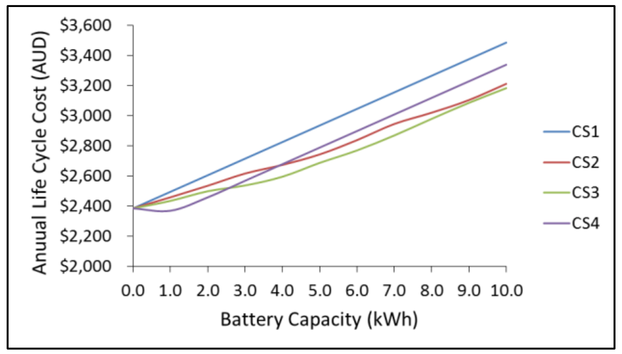

Figure 5: Life Cycle Cost of Electricity without PV.

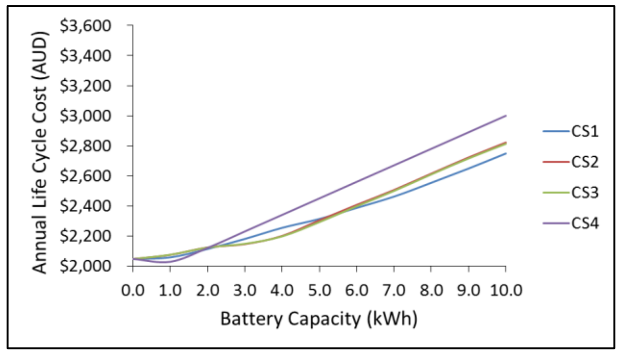

Figure 6: Life Cycle Cost of Electricity with 2.5 kW$_p$ PV.

PV plus electrical storage can reduce the life cycle cost of electricity

Conclusions

Although electrical storage can reduce monthly peak demands, the capital cost of electrical storage limits the economic benefits. On the other hand, PV alone has small potential in reducing monthly peak demands, nevertheless, the use of PV and small electrical storage system provides 14% cost savings.

Anticipated impacts

Rooftop PV combined with proper control of residential electrical storage can reduce the life cycle cost of electricity consumption. With reduced storage cost and proper control more uptake of electrical storage is anticipated.

Further information

This research is part of the Adelaide Research Node for Low Carbon Living. Additional information can be found on the CRC website: http://www.lowcarbonlivingcrc.com.au

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