Control Strategies of Domestic Electrical Storage for Reducing Electricity Peak Demand and Cost

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Electrical Load Duration in South Australia
# Standard Retail Contract Rates

<table>
<thead>
<tr>
<th>Category</th>
<th>Unit</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak consumption</td>
<td>c/kWh</td>
<td>26.345</td>
</tr>
<tr>
<td>Supply Charge</td>
<td>c/day</td>
<td>40.392</td>
</tr>
<tr>
<td><strong>Demand</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer Demand Peak</td>
<td>c/kW/day</td>
<td>54.197</td>
</tr>
<tr>
<td>Winter Demand Peak</td>
<td>c/kW/day</td>
<td>26.950</td>
</tr>
<tr>
<td>Demand Off-Peak</td>
<td>c/kW/day</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Peak Electricity Consumption of a House at Lochiel Park
Monthly Peak Demand

![Bar chart showing monthly peak demand with peaks in July and August. The retailer minimum chargeable demand is indicated by a vertical line.]
Control Strategies

Control Strategy 1 (CS1) – PV only Charge

Charge
• Charge battery until full from PV only
• Export to grid

Discharge
• Discharge battery until maximum depth of discharge
• Import from grid
Control Strategies

Control Strategy 2 (CS2) – Partially Charged for Peak Use

Charge
- Charge battery from PV
- Charge battery from grid if state of charge < 75%, 1h before peak period
- Export to grid

Discharge
- Discharge battery during peak period only
- Discharge battery to limit electricity demand to 1.5 kW
Control Strategies

Control Strategy 3 (CS3) – Fully Charged for Peak Use

Charge
- Charge battery from PV
- Charge battery from grid (linear time-dependent charging)

Discharge
- Discharge battery during peak period only
- Discharge battery to limit electricity demand to 1.5 kW
Control Strategies

Control Strategy 4 (CS4) – Reduced Discharge

Charge
• Charge battery from PV
• Charge battery from grid (linear time-dependent charging)

Discharge
• Discharge battery during peak period only
• Discharge battery to limit electricity demand to higher values (> 1.5 kW)
Monthly Peak Demand Using CS1 without PV
Monthly Peak Demand Using CS2 without PV
Monthly Peak Demand Using CS3 without PV
Comparison of Monthly Peak Demand based on CS4

Monthly Peak Demand (kW)

No PV - No Battery
No PV - Battery = 1 kWh

Retailer Minimum Chargeable Demand

Legend:
- No PV - No Battery
- No PV - Battery = 1 kWh
Annual Average Cost of Electricity without PV

![Graph showing the annual average net present cost for battery capacities ranging from 0 to 10 kWh. The costs are labeled for CS2, CS3, and CS4, increasing with battery capacity.]
PV Generation + Peak Electricity Consumption of a House at Lochiel Park

Electricity (kWh)

Electricity Production (kWh)

Electricity Consumption

Average Consumption (kWh)
Monthly Peak Demand Using CS1 (PV = 2.5 kWₚ)
Monthly Peak Demand based on CS2 (PV = 2.5 kW_p)
Monthly Peak Demand based on CS3 (PV = 2.5 kW_p)
Comparison of Monthly Peak Demand based on CS4

Monthly Peak Demand (kW)

- No PV - No Battery
- No PV - Battery = 1 kWh
- PV = 2.5 kWp - Battery = 1 kWh

Retailer Minimum Chargeable Demand
Annual Average Cost of Electricity with PV (2.5 kW)
Comparison of Monthly Peak Demand based on CS4

- $1,600
- $1,700
- $1,800
- $1,900

PV Capacity (kWp)

20-Years Annual Average Net Present Cost

1 kWh Battery (CS4)
No Battery

- 1 kWh Battery (CS4)
- No Battery
Conclusions

- Conventional control strategy (CS1) is ineffective for reducing peak demand
- Proper control strategies of battery can reduce peak demand
- Compared with battery, PV is more effective in reducing electricity cost
Thank You
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