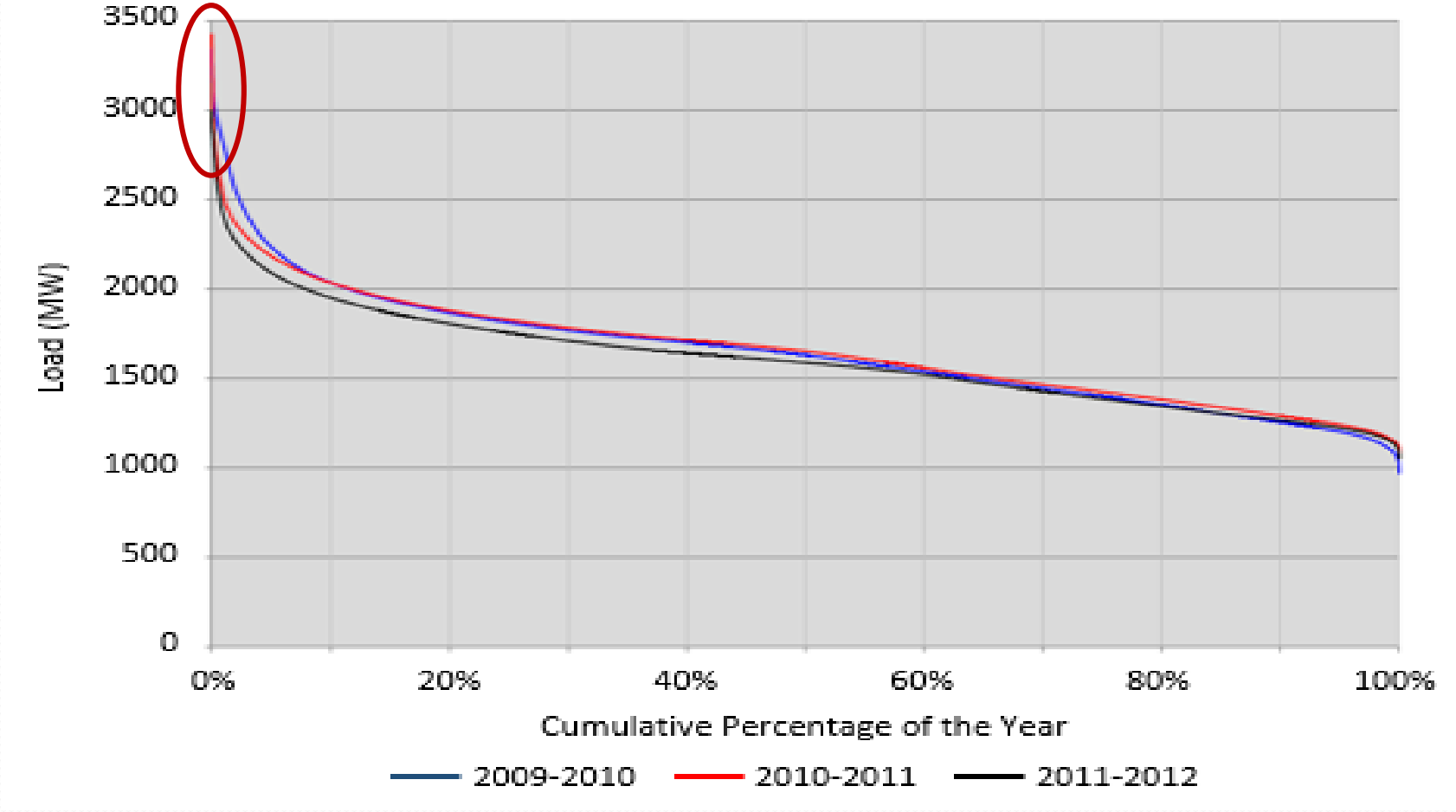
Control Strategies of Domestic Electrical Storage for Reducing Electricity Peak Demand and Cost

June 2017

Sleiman Farah, David Whaley, Wasim Saman

School of Engineering
University of South Australia
sleiman.farah@mymail.unisa.edu.au

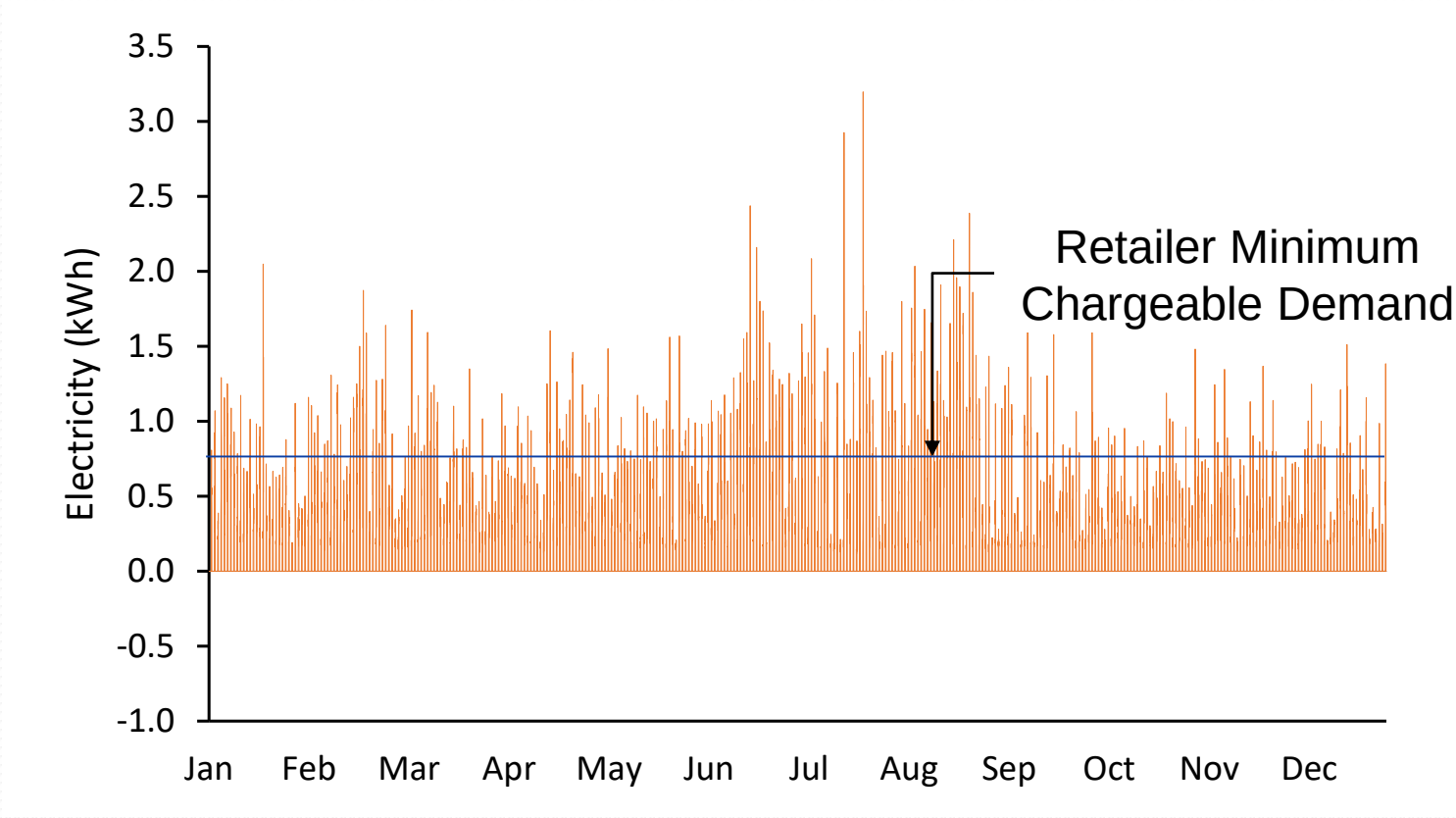
Electrical Load Duration in South Australia



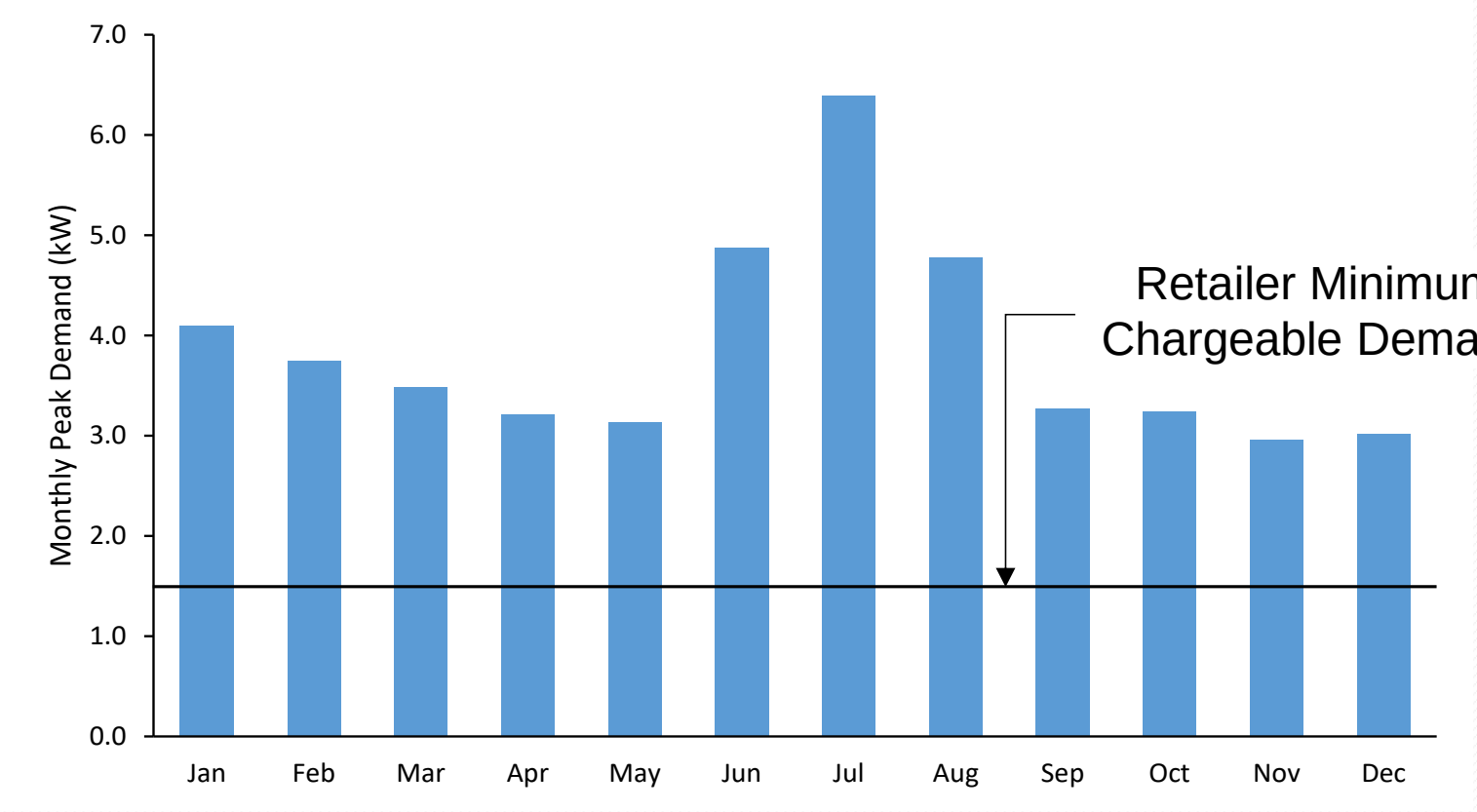
Standard Retail Contract Rates

Peak consumption	c/kWh	26.345
Supply Charge	c/day	40.392
Demand		
Summer Demand Peak	c/kW/day	54.197
Winter Demand Peak	c/kW/day	26.950
Demand Off-Peak	c/kW/day	0.000

Peak Electricity Consumption of a House at Lochiel Park



Monthly Peak Demand



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

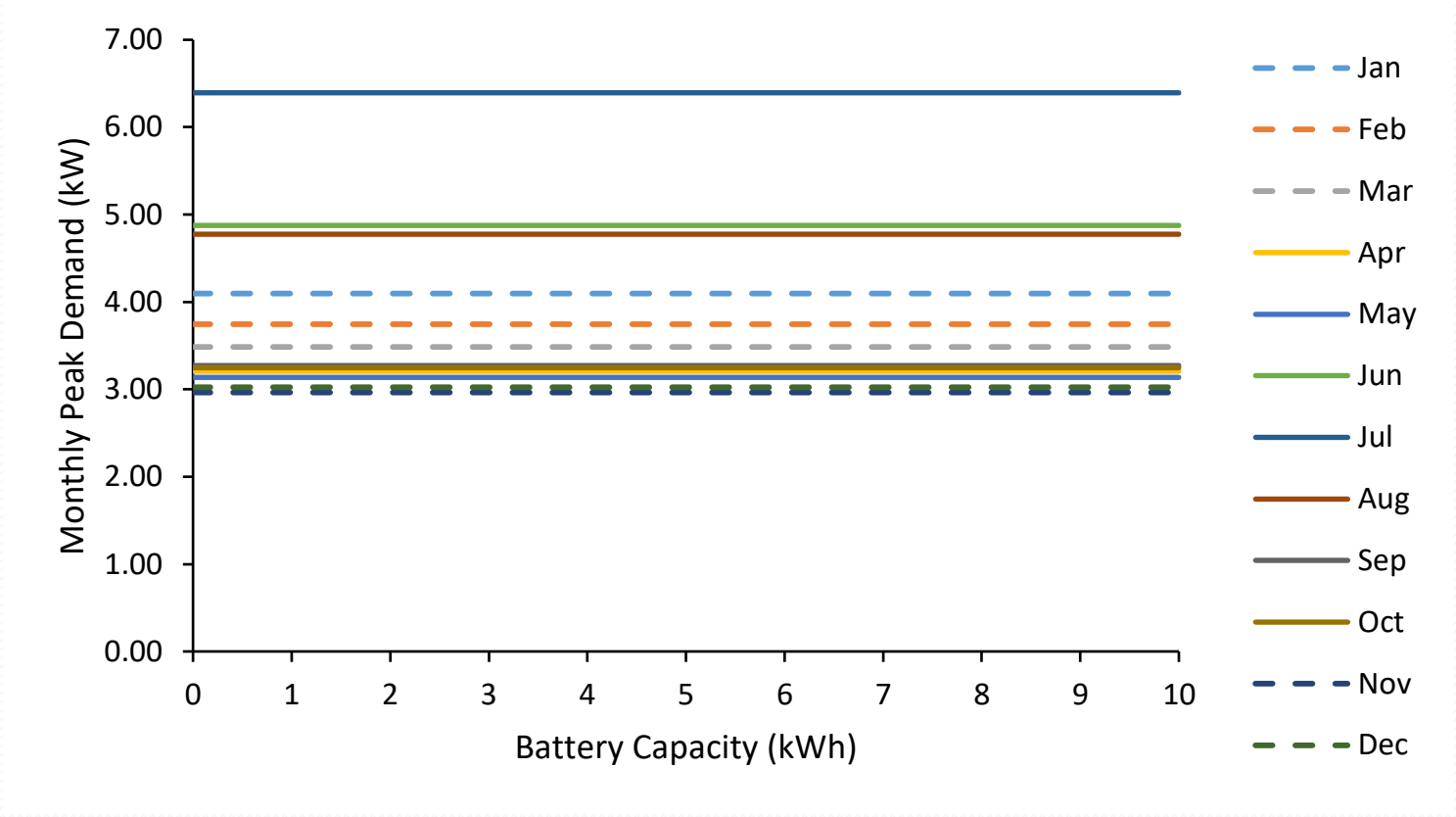
Charge

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

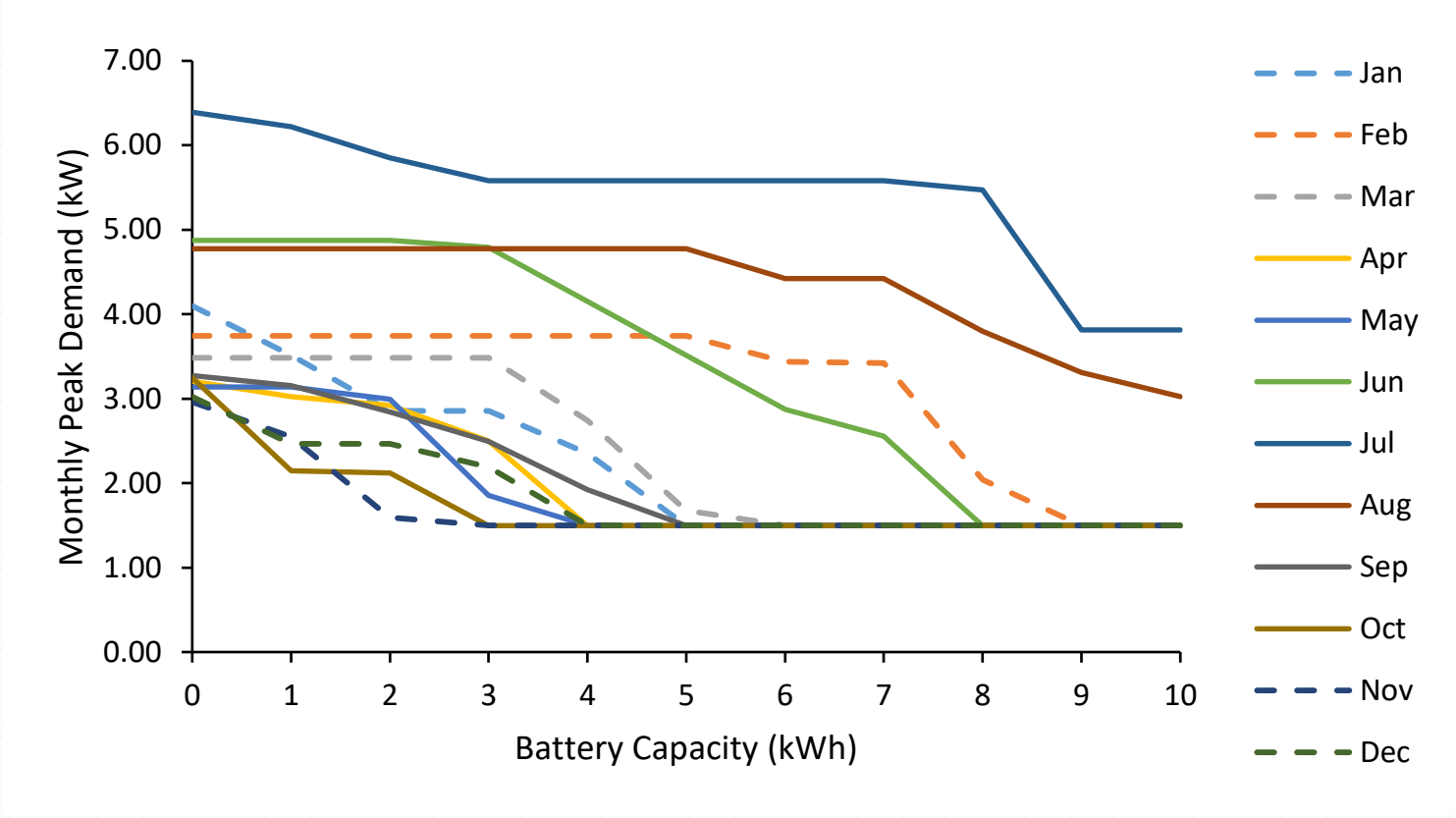
Discharge

- Discharge battery during peak period only
- Discharge battery to limit electricity demand to higher values (> 1.5 kW)

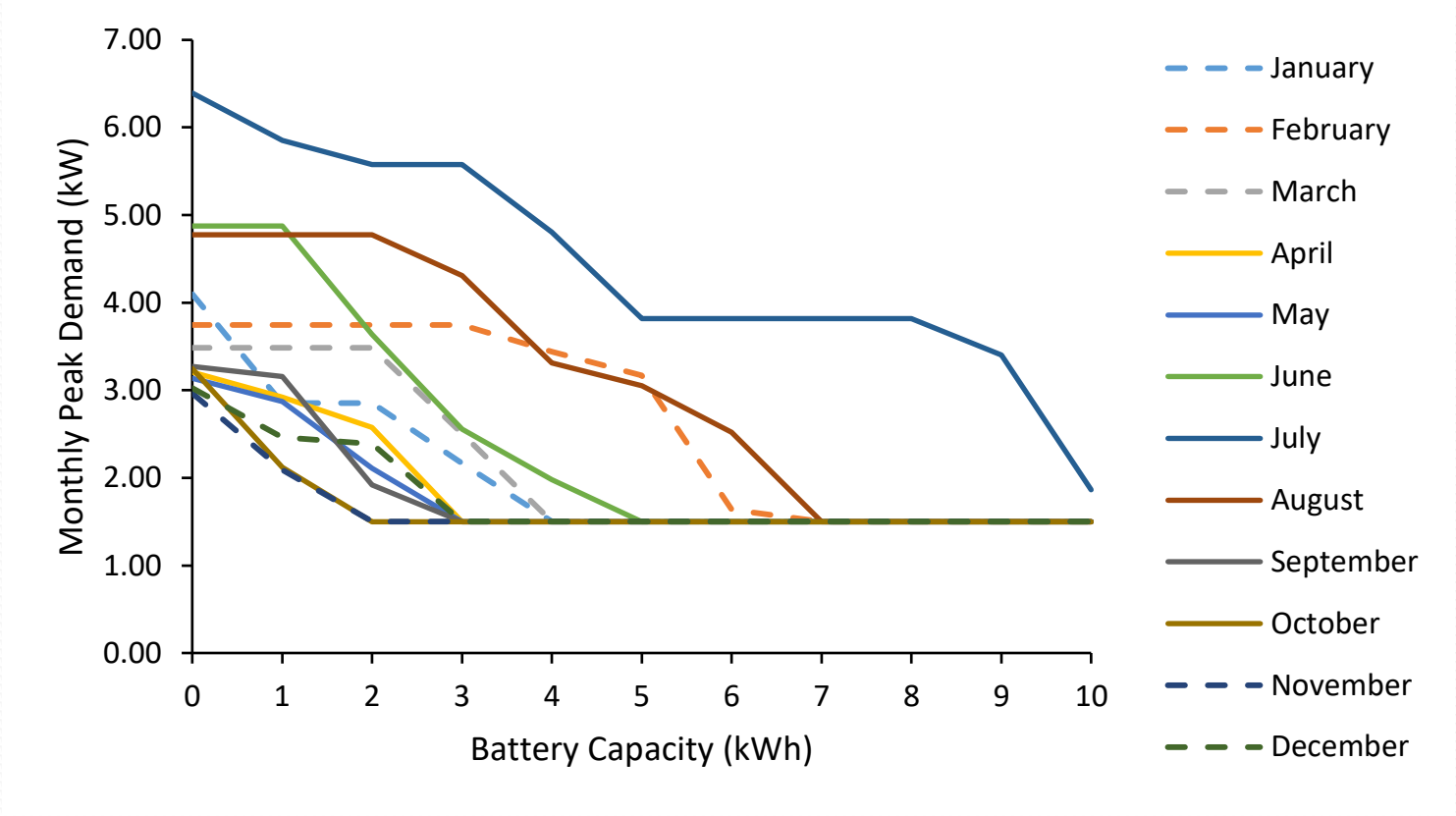
Monthly Peak Demand Using CS1 without PV



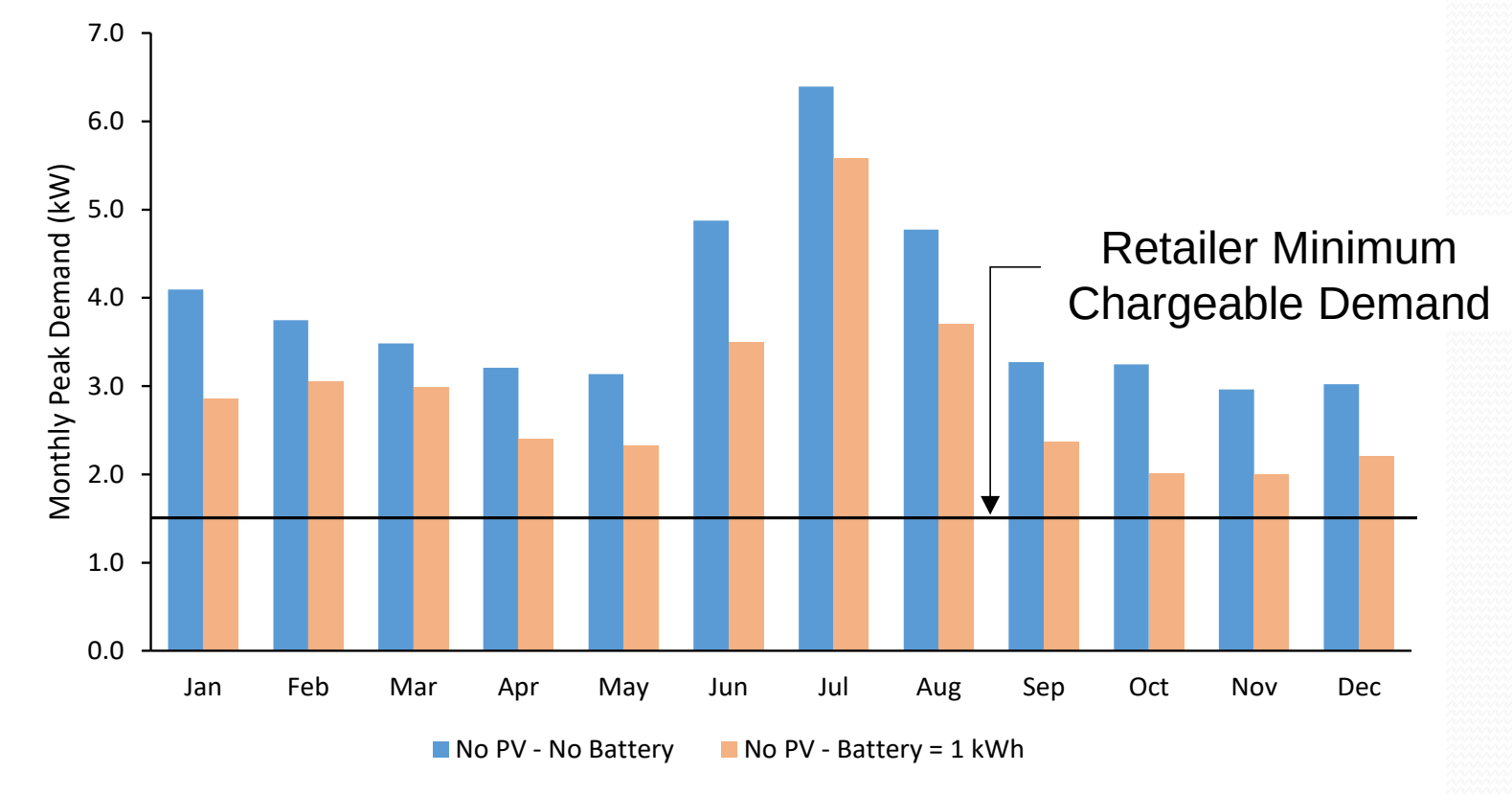
Monthly Peak Demand Using CS2 without PV



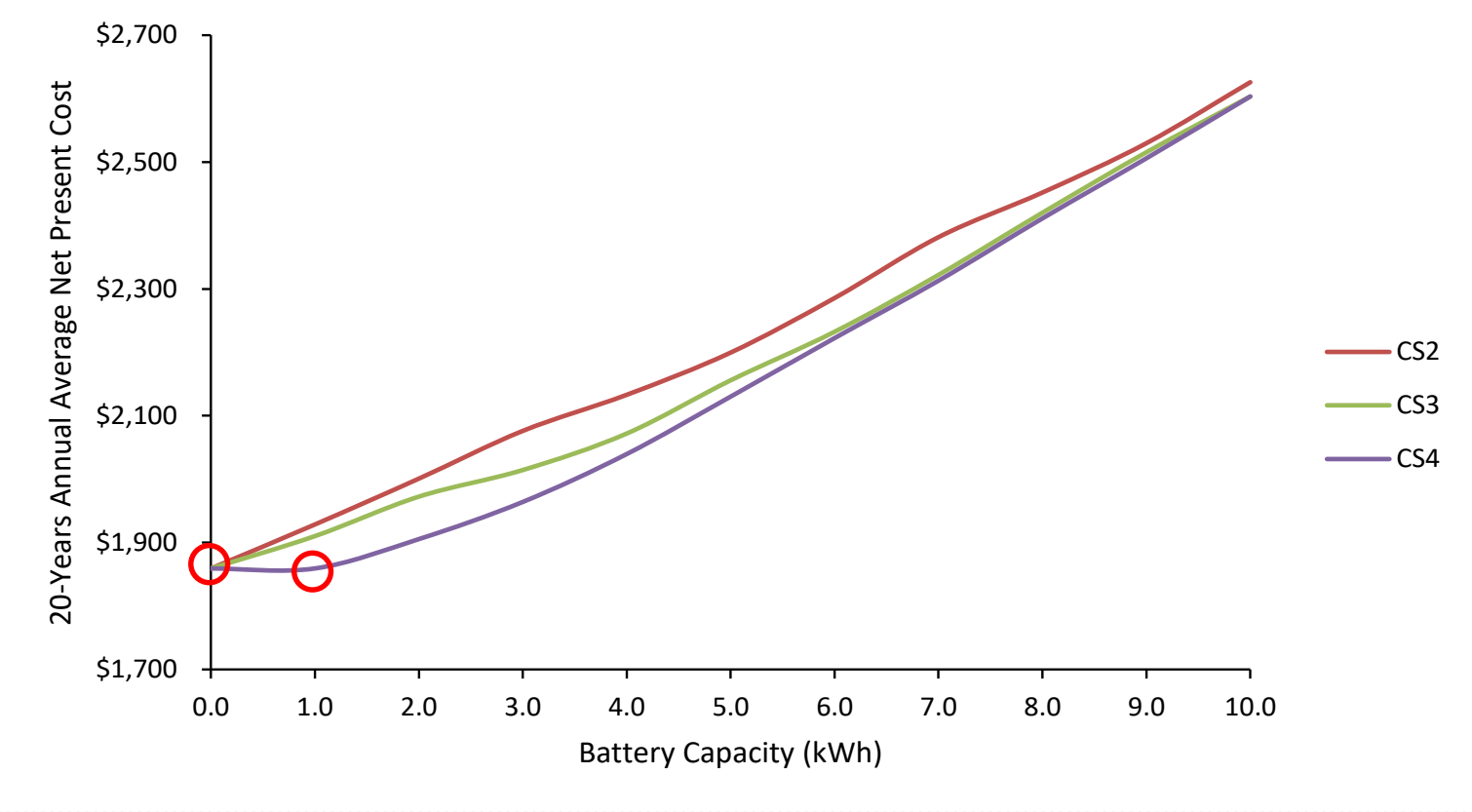
Monthly Peak Demand Using CS3 without PV



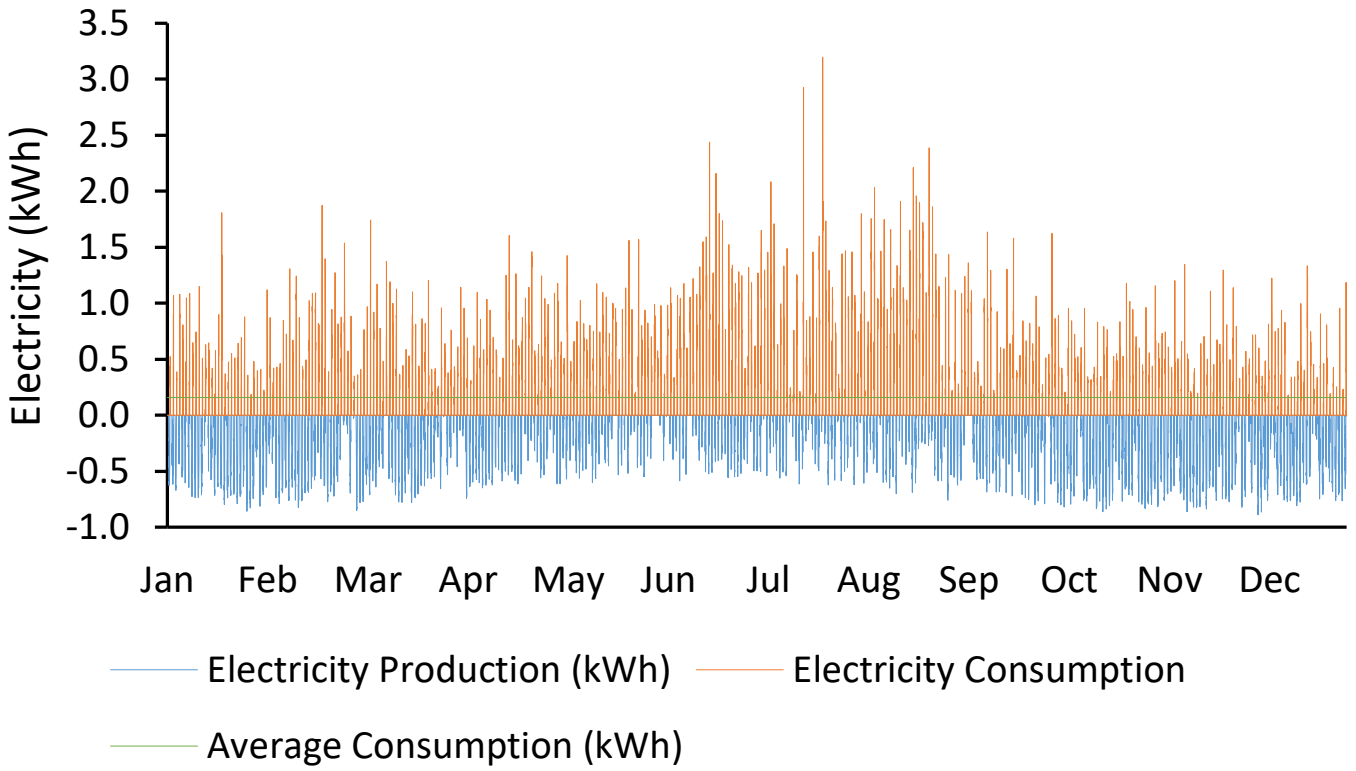
Comparison of Monthly Peak Demand based on CS4



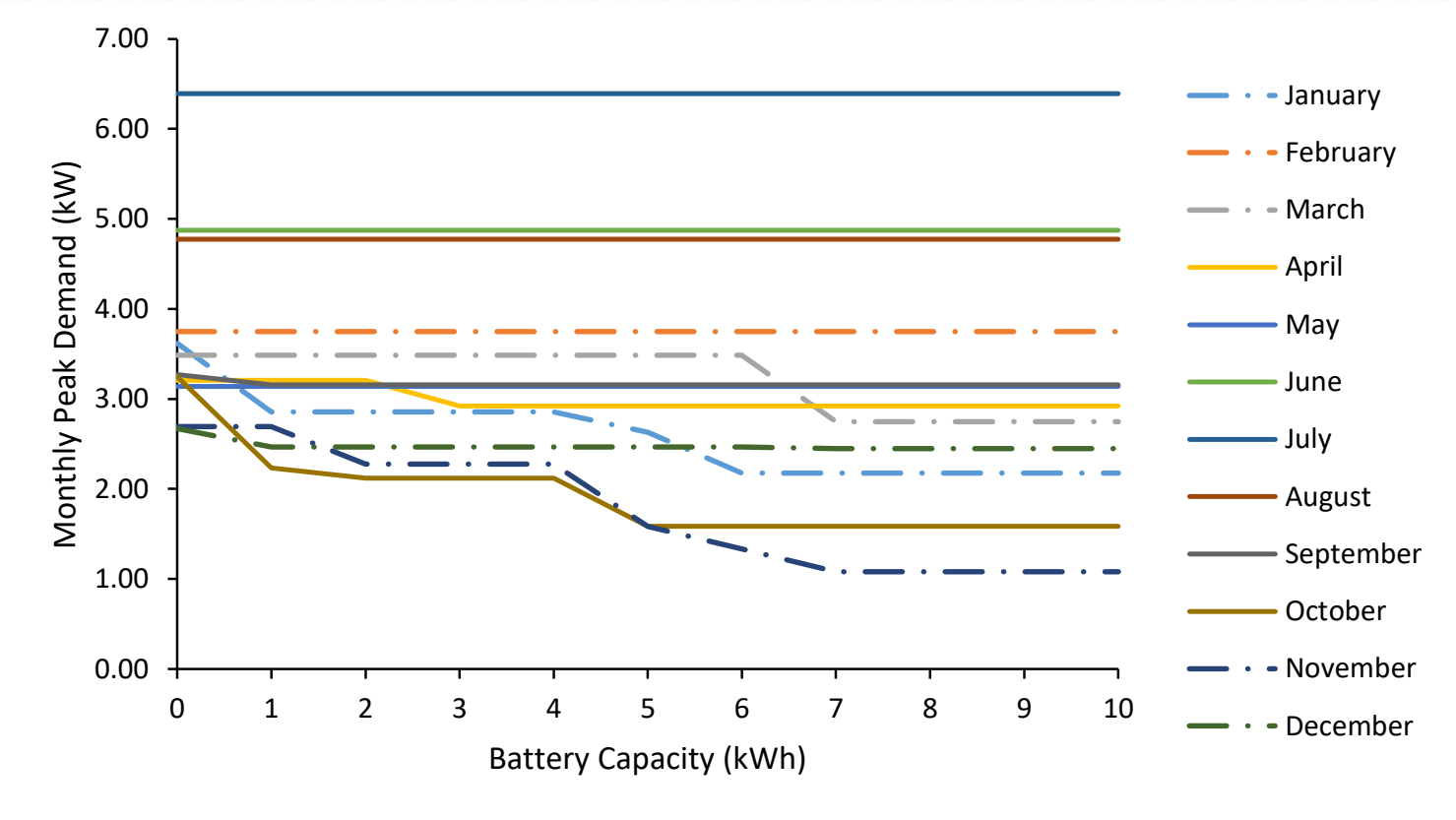
Annual Average Cost of Electricity without PV



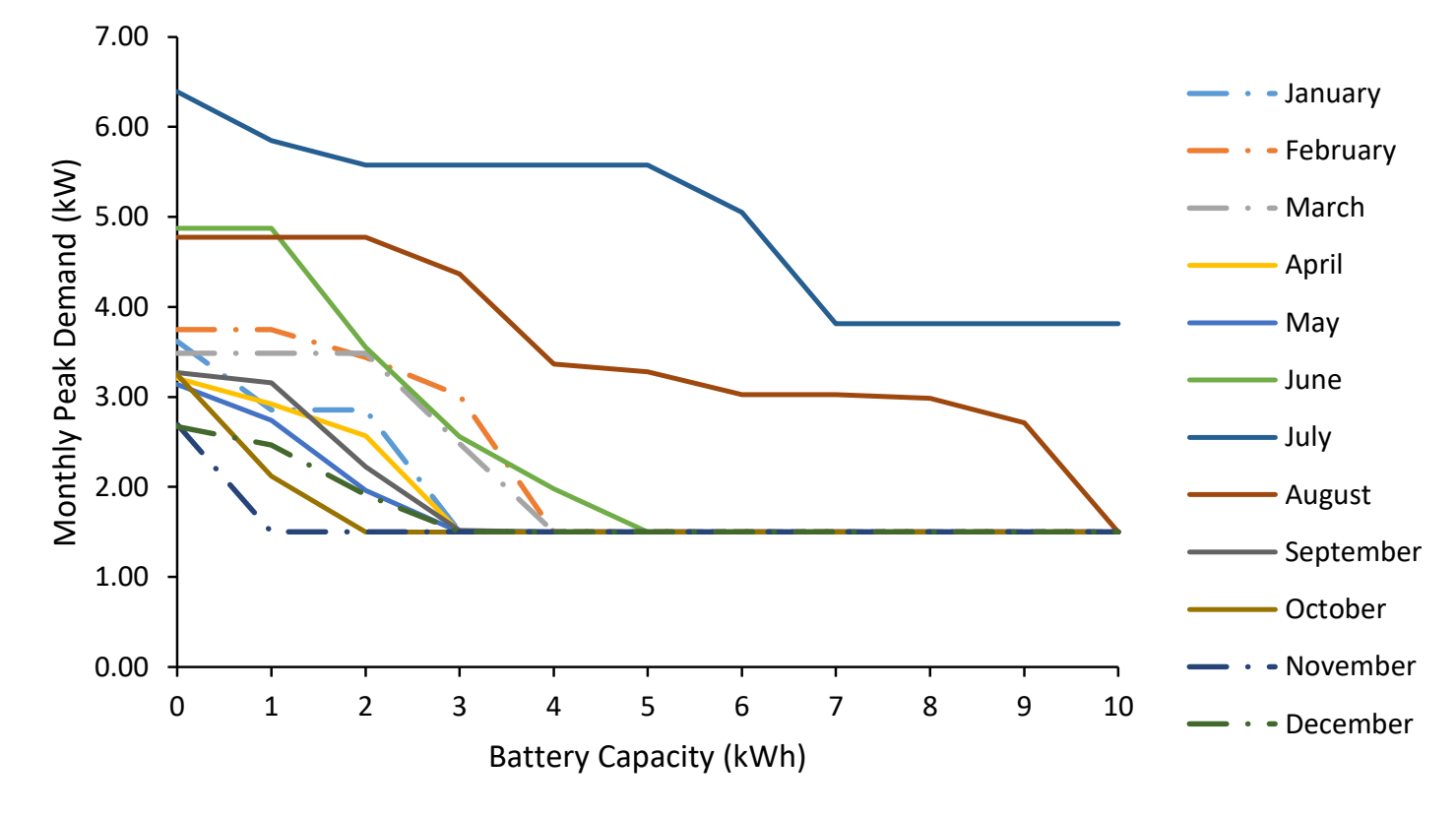
PV Generation + Peak Electricity Consumption of a House at Lochiel Park



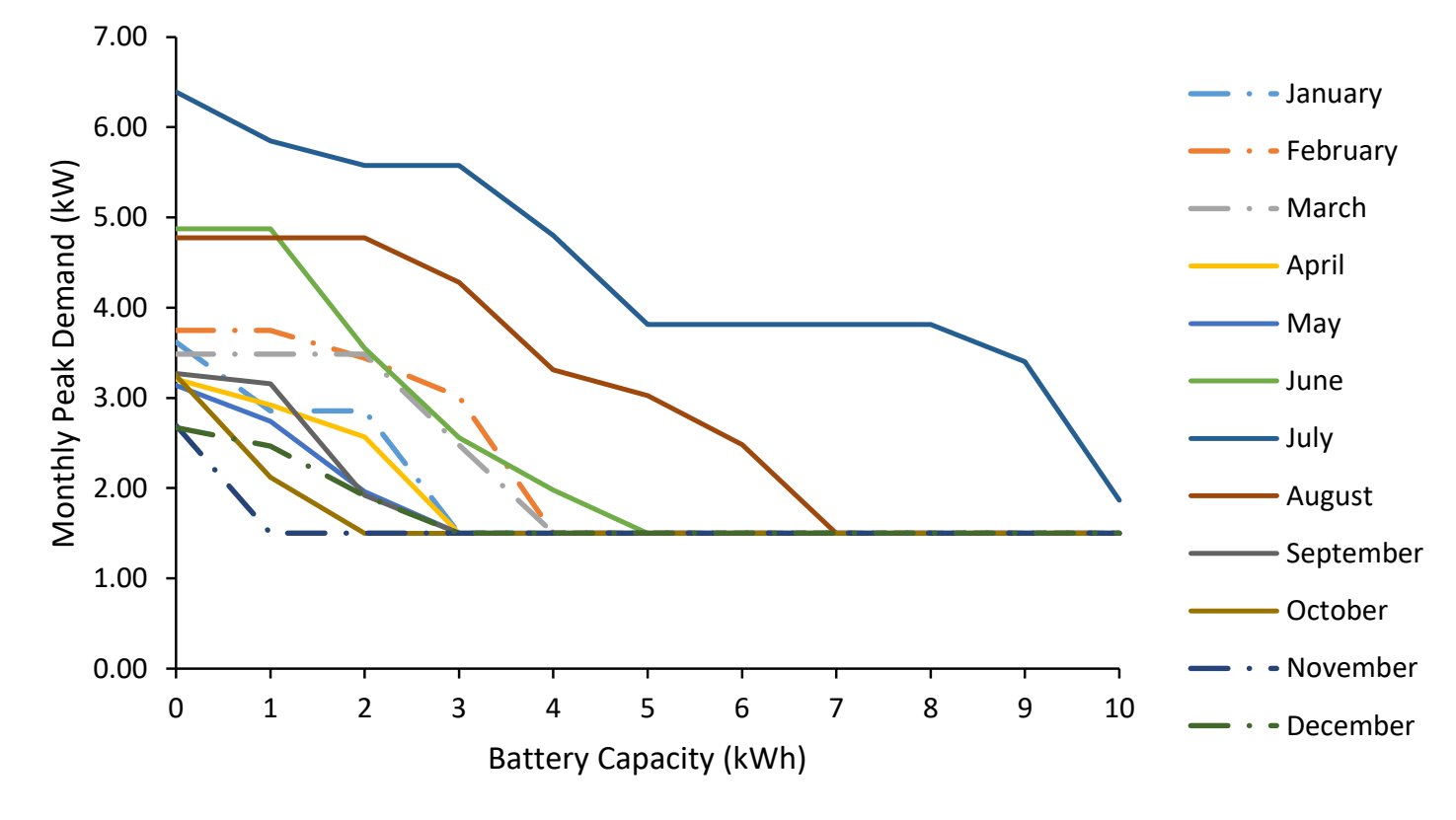
Monthly Peak Demand Using CS1 (PV = 2.5 kW_p)



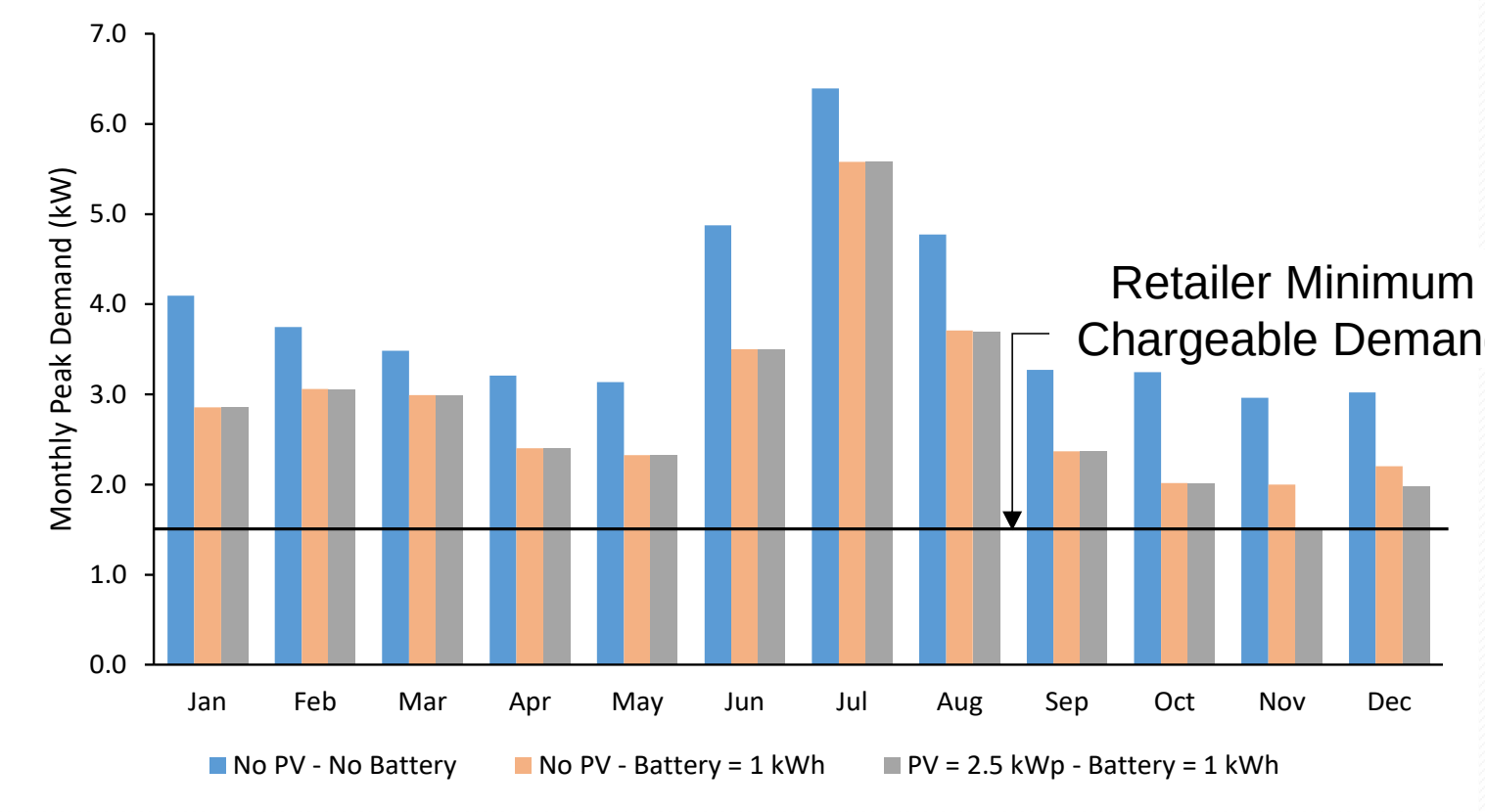
Monthly Peak Demand based on CS2 (PV = 2.5 kW_p)



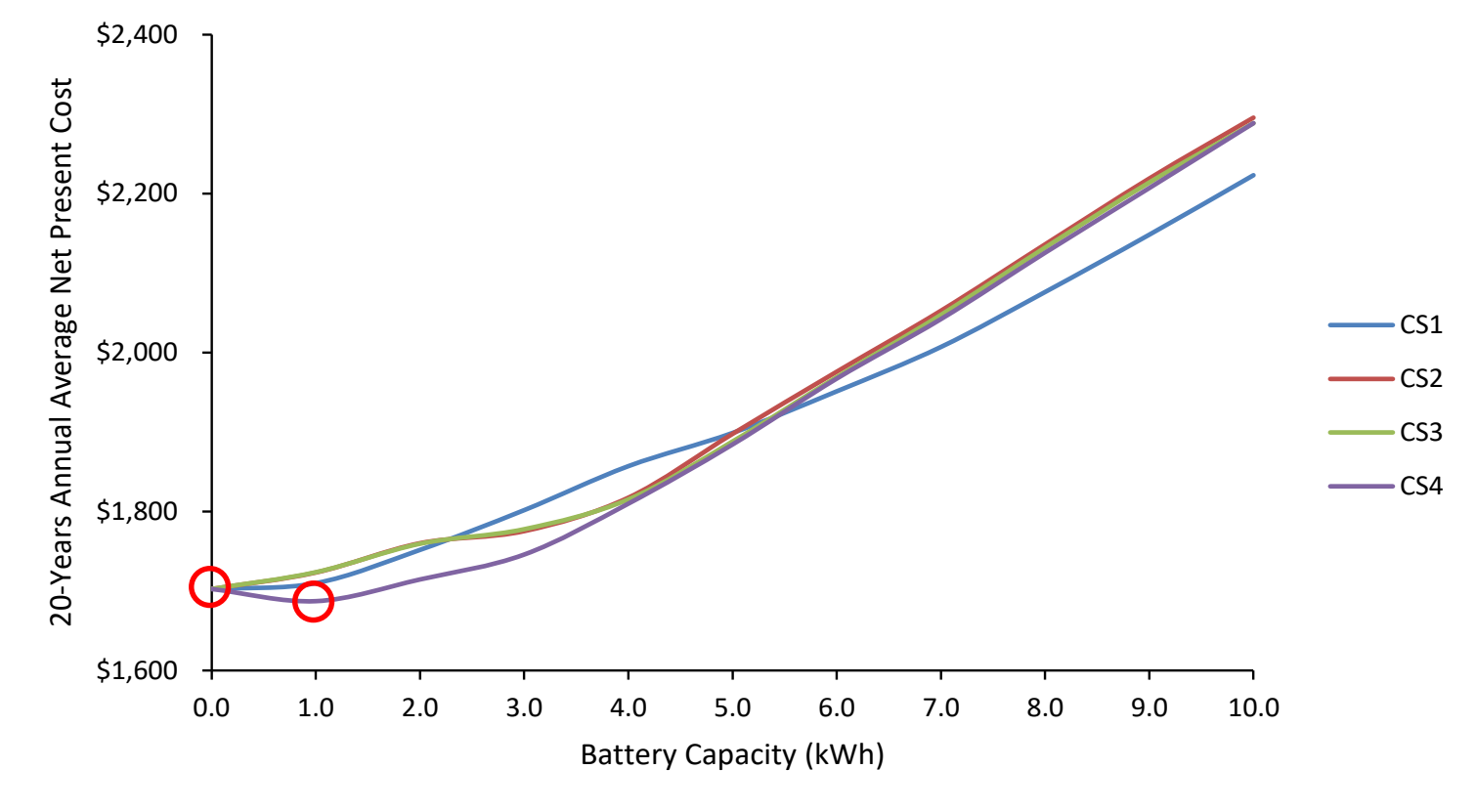
Monthly Peak Demand based on CS3 (PV = 2.5 kW_p)



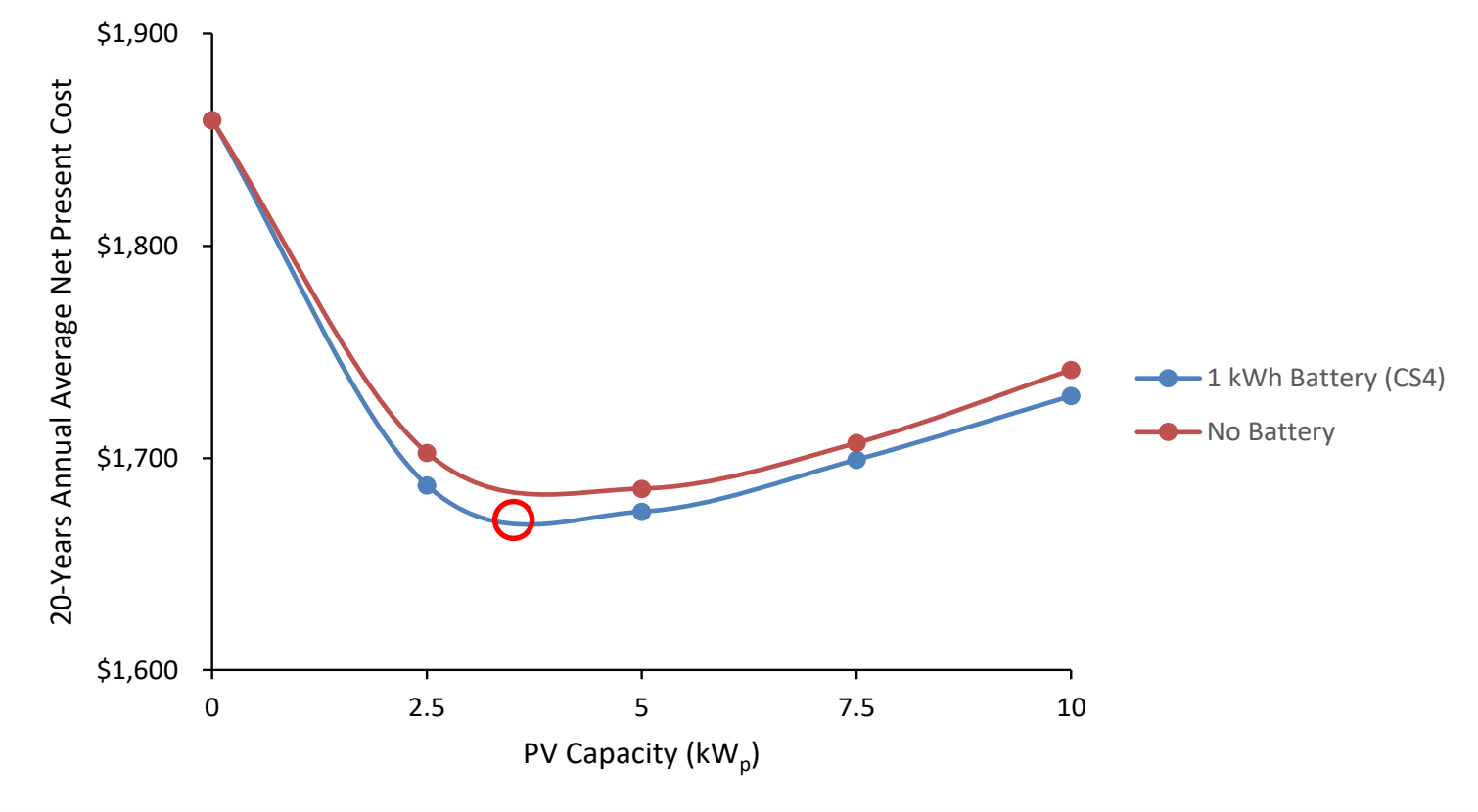
Comparison of Monthly Peak Demand based on CS4



Annual Average Cost of Electricity with PV (2.5 kW)



Comparison of Monthly Peak Demand based on CS4



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

sleiman.farah@mymail.unisa.edu.au