

# WHAT IS THE PAYBACK TIME OF RESIDENTIAL SOLAR SYSTEM?

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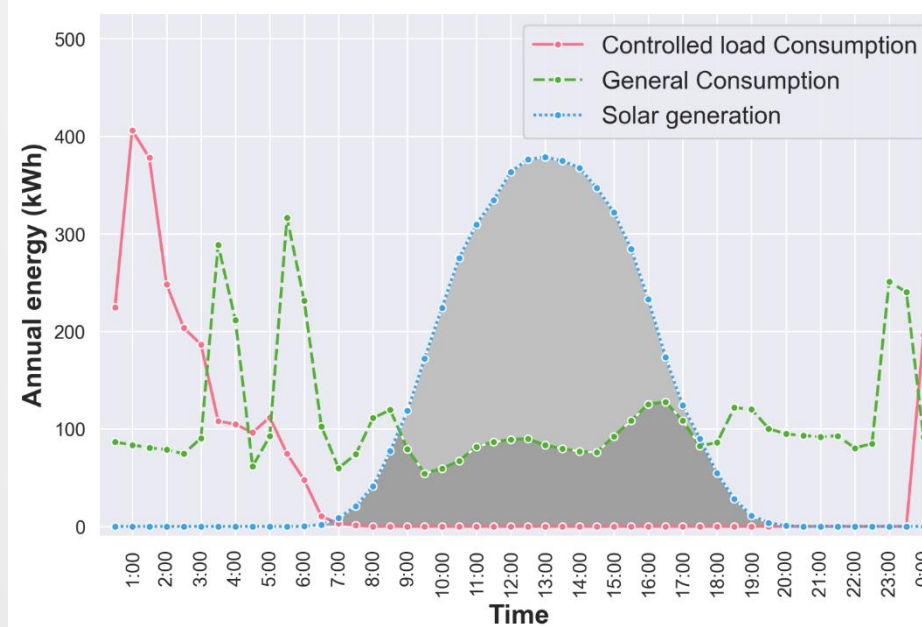
# SUMMARY

## Dataset:

solar generation & energy consumption



## EDA: Annual energy analysis

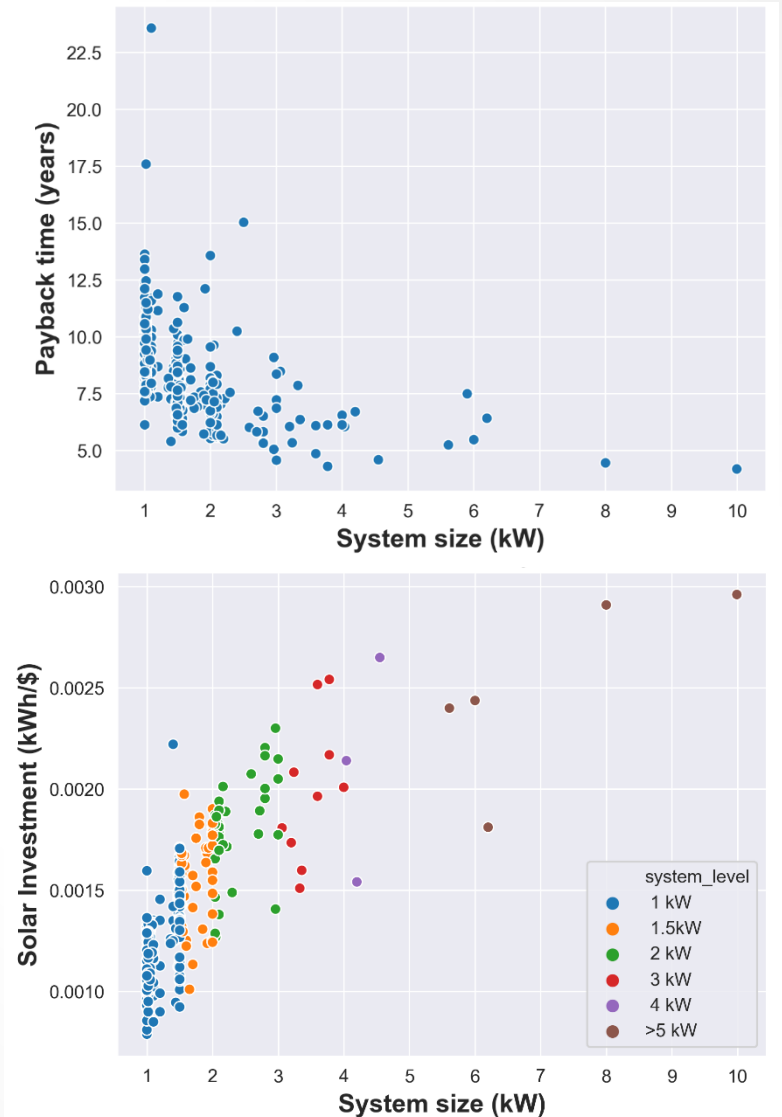


## Cost model:

Panel cost  
Feed-in tariff  
Electricity rate



## Solar payback time & investment



# DATASET

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## Source :

- <https://www.ausgrid.com.au/Industry/Our-Research/Data-to-share/Solar-home-electricity-data>
- One-year energy data (0.5hr interval) of 300 residential PV systems (2012-2013)
  - Solar generation
  - Household energy consumption

## Statistics -

- Rows: 268557
- Columns: 54

```
Index(['customer', 'generator_capacity', 'postcode', 'consumption_category', 'date',  
      '0:30', '1:00', '1:30', '2:00', '2:30', '3:00', '3:30', '4:00', '4:30', '5:00', '5:30', '6:00',  
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      '22:00', '22:30', '23:00', '23:30', '0:00', 'row_quality'], dtype='object')
```

# ASSUMPTION

## Cost:

Costs of solar panels and government rebates for different sized panels.<sup>#</sup>

System Size (kW)	Cost (A\$)	Government rebate (A\$)
1	4156	700
1.5	4774	1050
2	5712	1400
3	7503	2100
4	9529	2800
5	11487	3500

<sup>#</sup> These values are based on 2015 condition/rule.

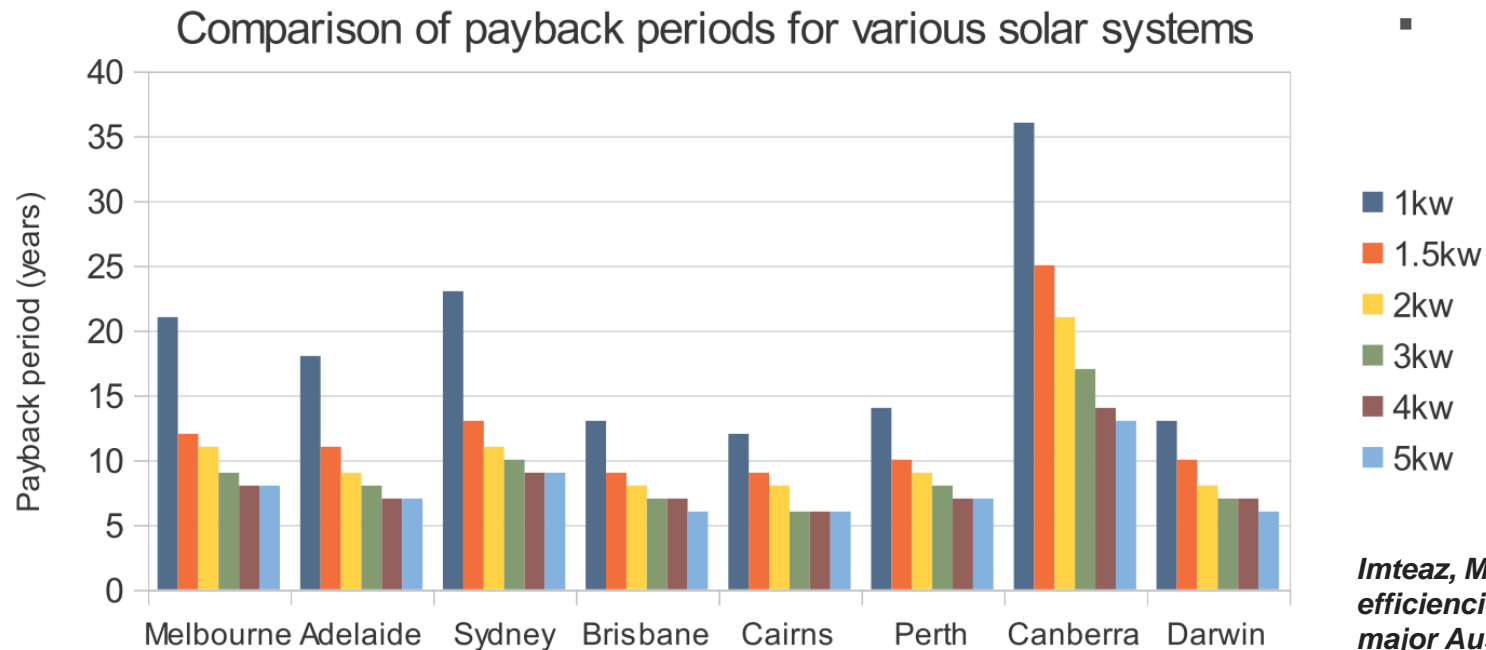
## Electricity rate (All time):

- All time - \$ 28c
- SmartHome: \$ 52c (peak)
- \$ 22c (shoulder)

## Feed-in tariff:

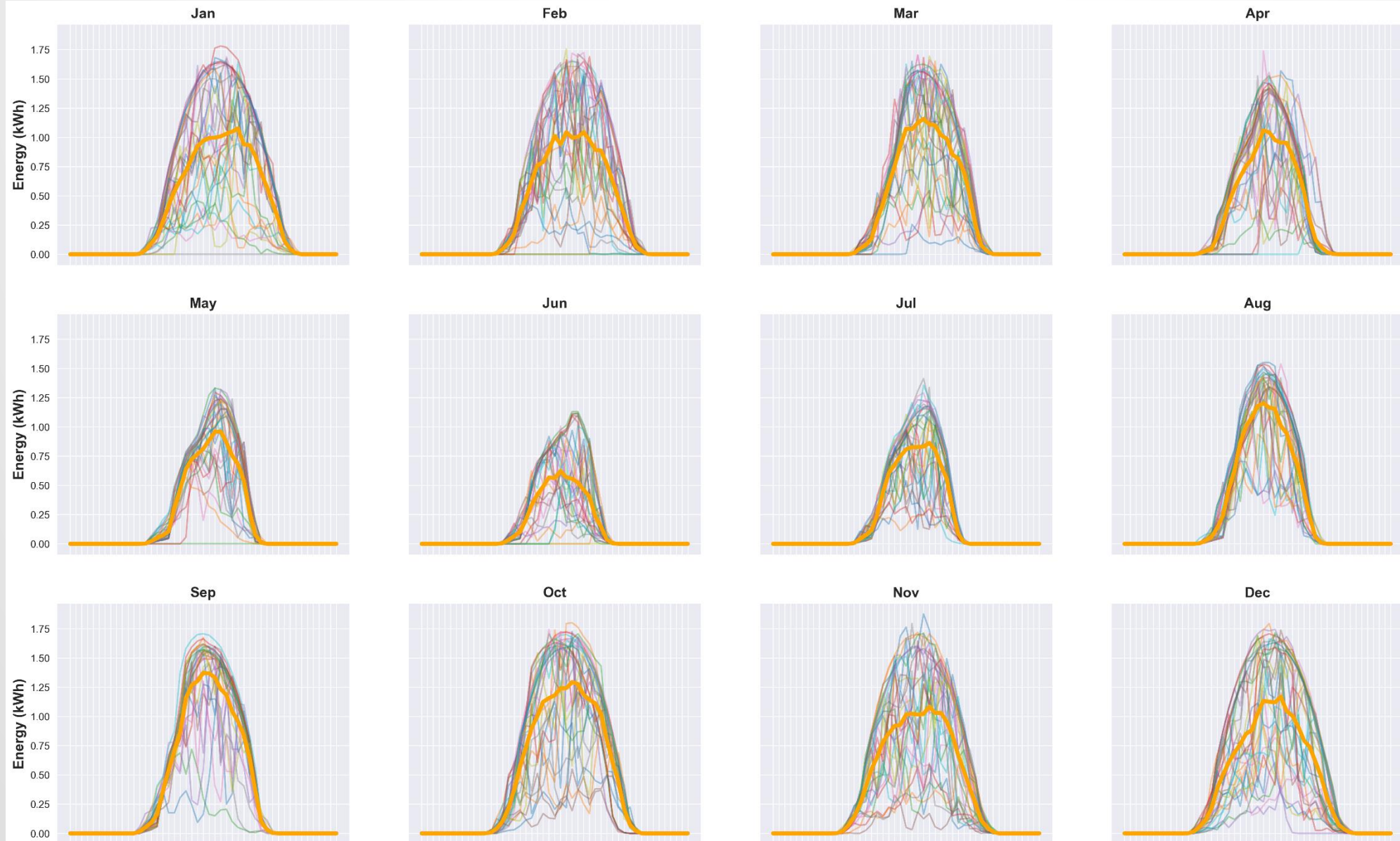
- \$20c – before 31 Dec, 2016
- \$10c – after 1 Jan, 2017

## Payback time:

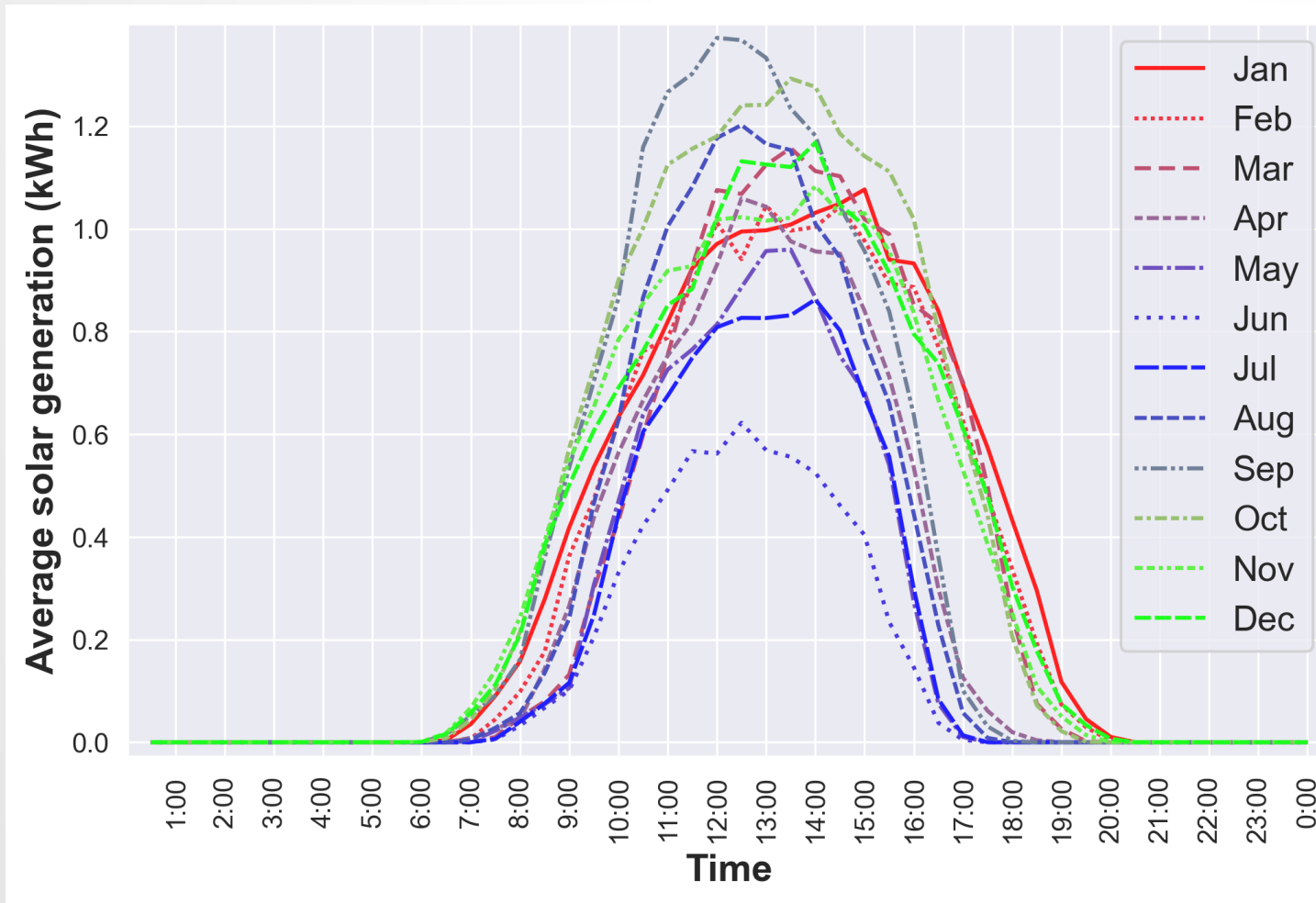


*Imteaz, Monzur Alam, and Amimul Ahsan. "Solar panels: Real efficiencies, potential productions and payback periods for major Australian cities." Sustainable Energy Technologies and Assessments 25 (2018): 119-125.*

# MONTHLY SOLAR GENERATION PROFILE



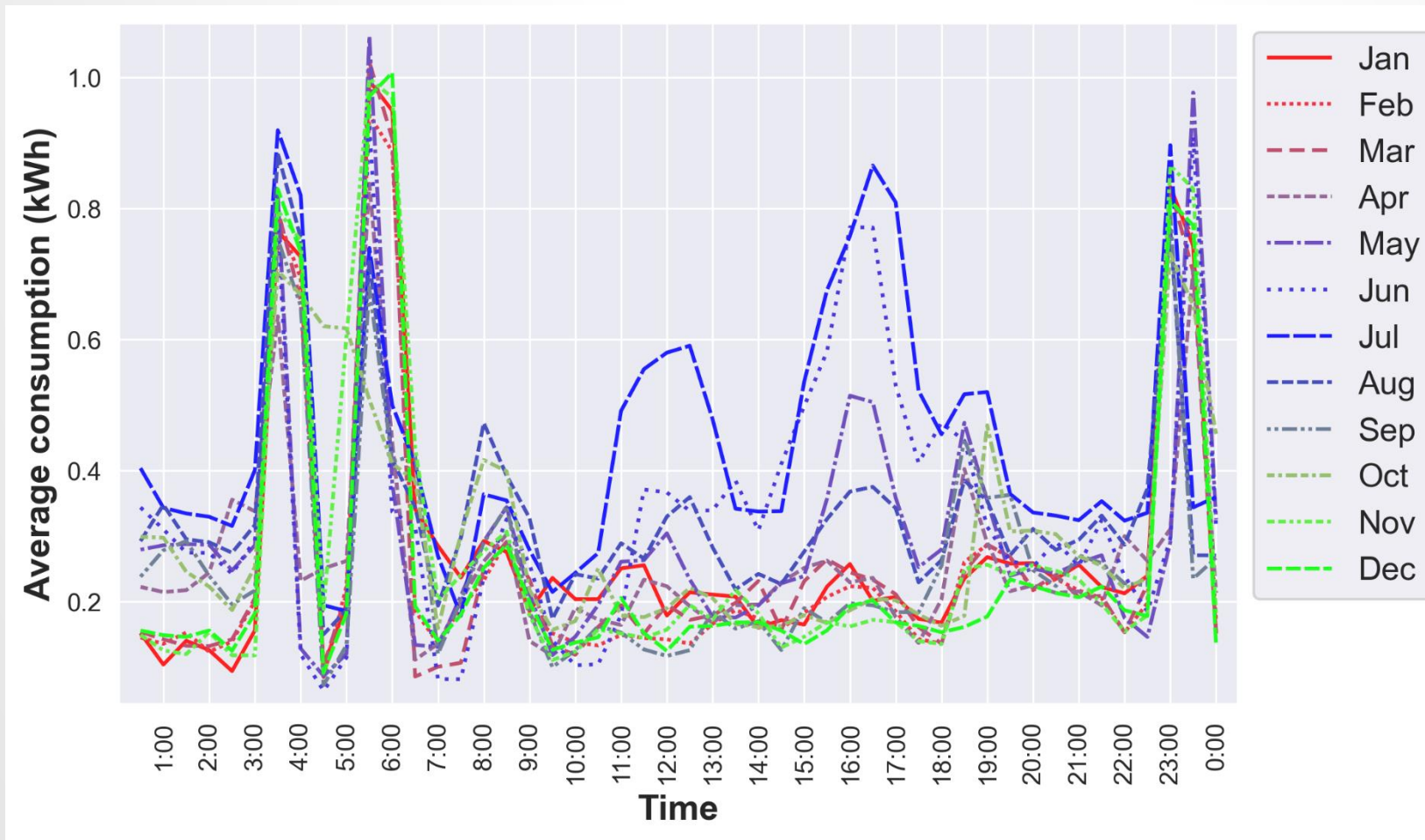
# AVERAGE MONTHLY GENERATION



- **Minimum in Jun**
- **Maximum in Oct** - Less cloudy/rainy days

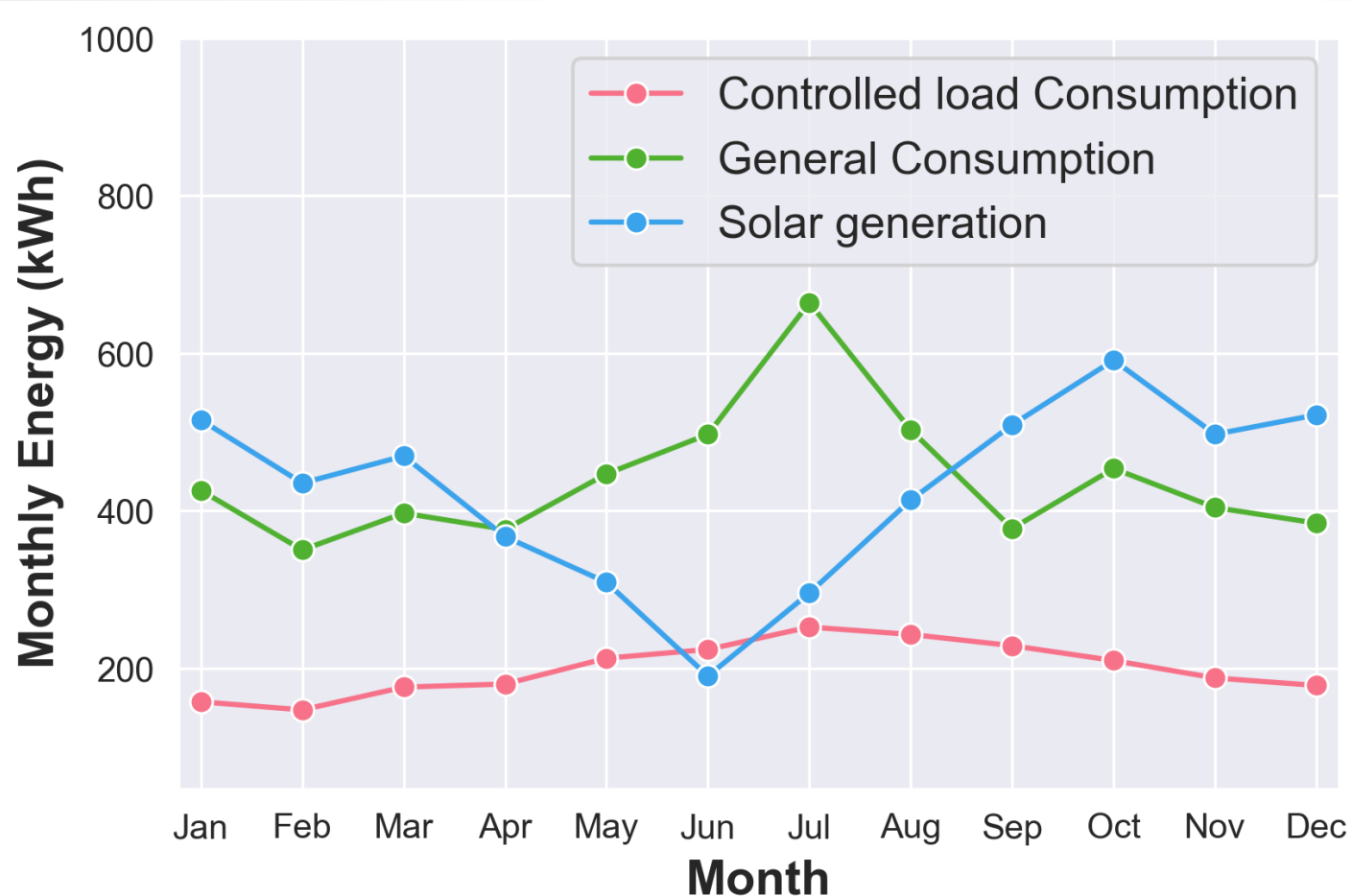


# AVERAGE MONTHLY CONSUMPTION



- Peak usage in early morning
- More afternoon consumption in winter

# ANNUAL ENERGY - MONTHLY

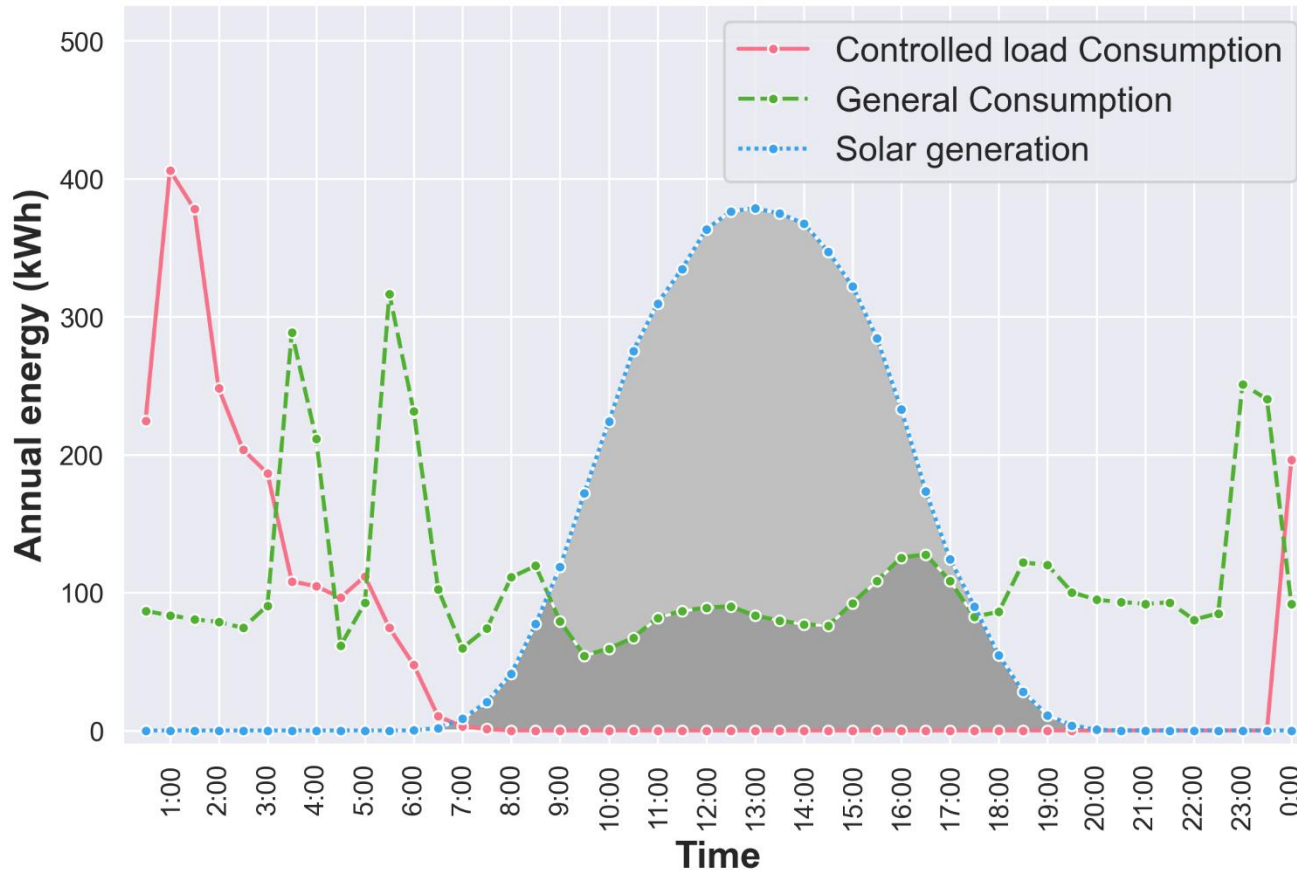


- Peak solar generation in Oct
- Peak energy consumption in Jul

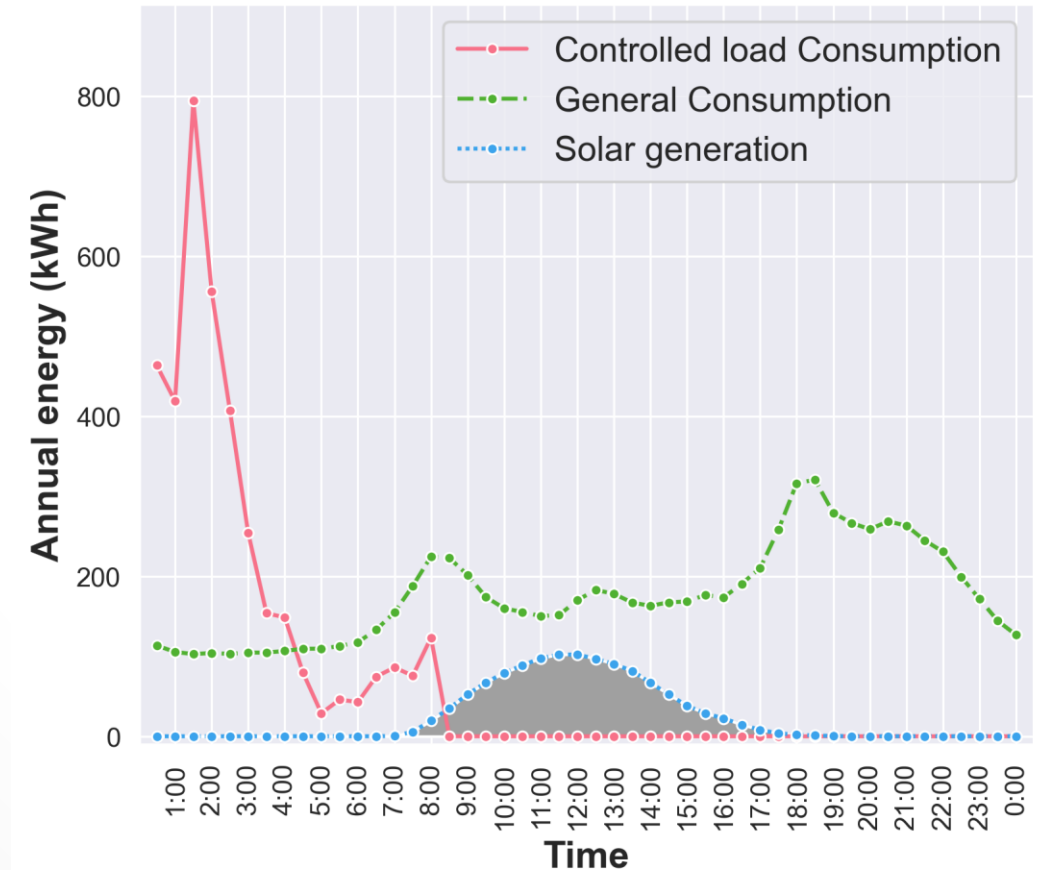


# ANNUAL ENERGY - DAILY

Customer #1



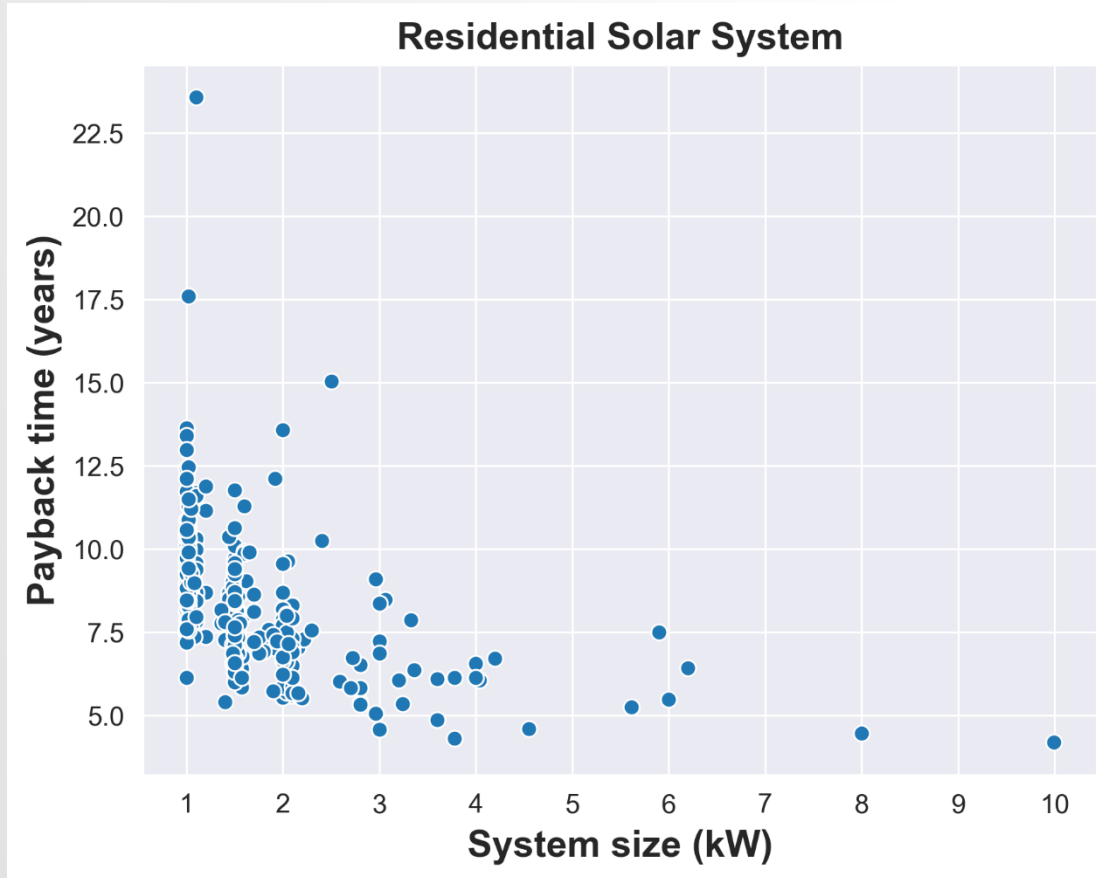
Customer #6



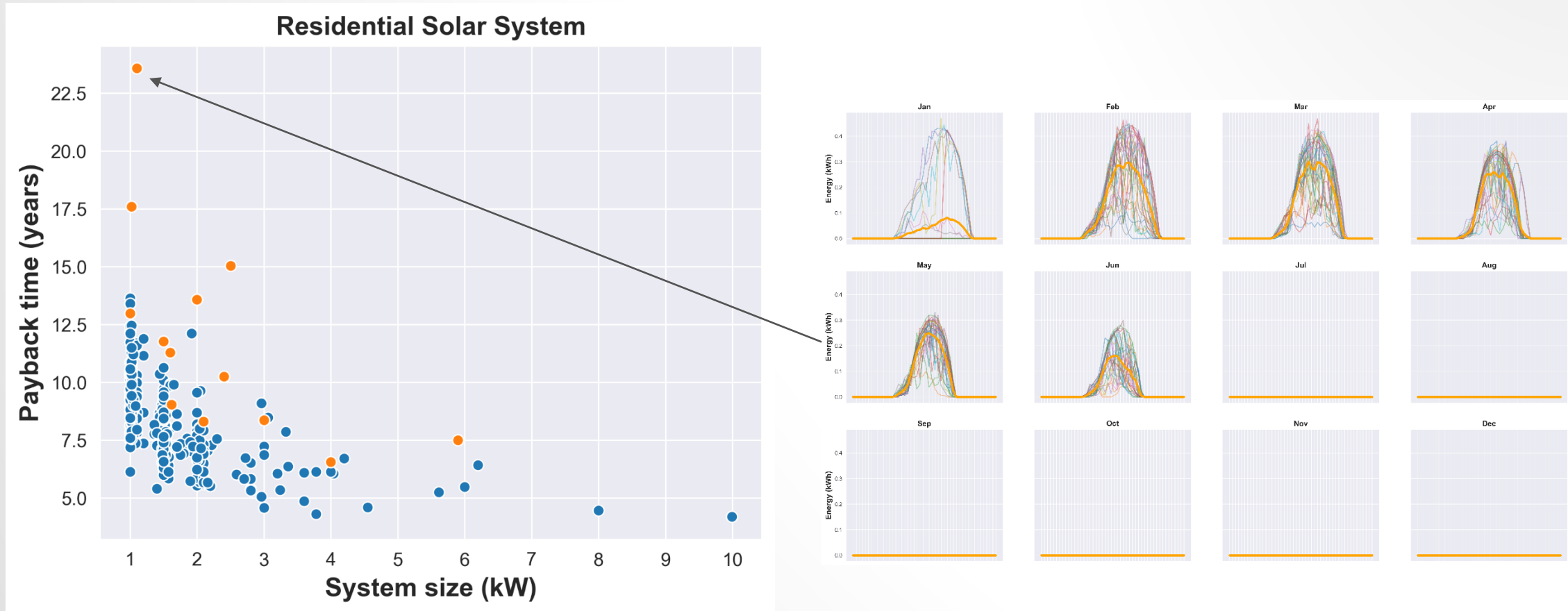
- Below consumption - savings @ electricity rate
- Above consumption - savings @ feed-in tariff

# PAYBACK TIME – ALL CUSTOMERS

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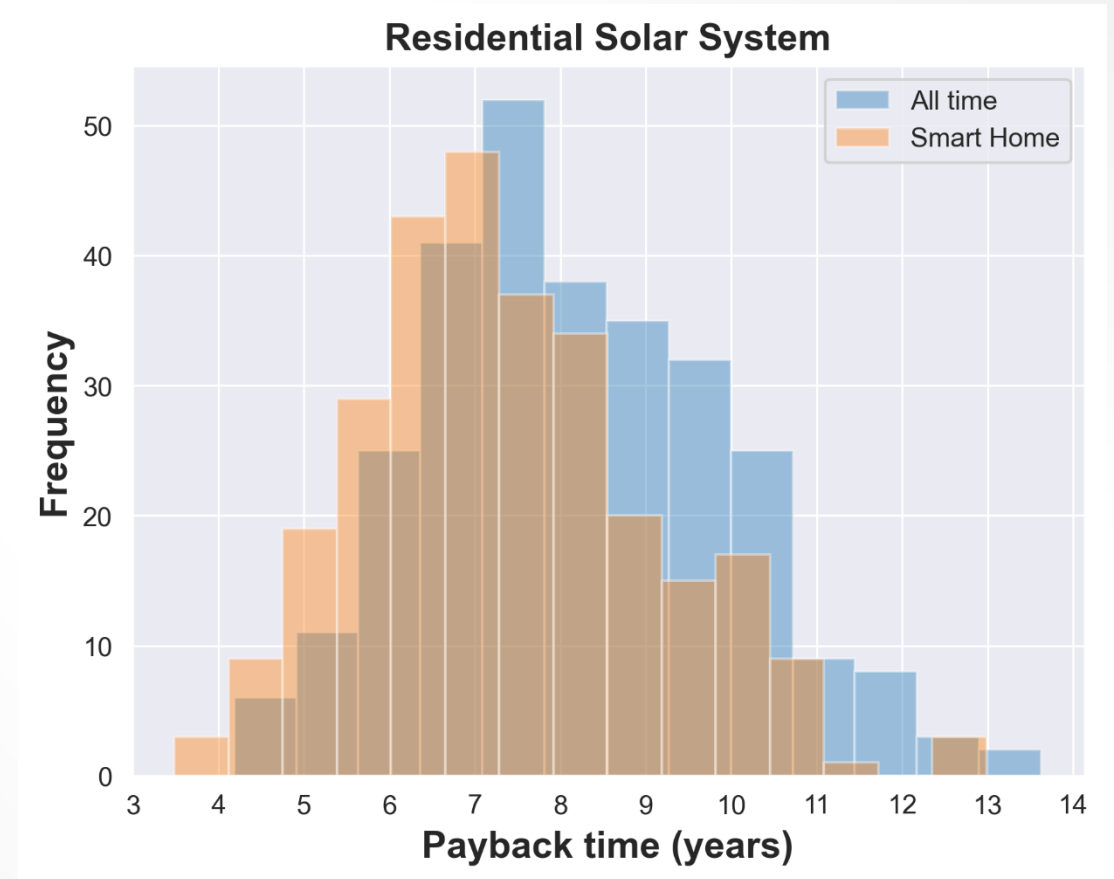
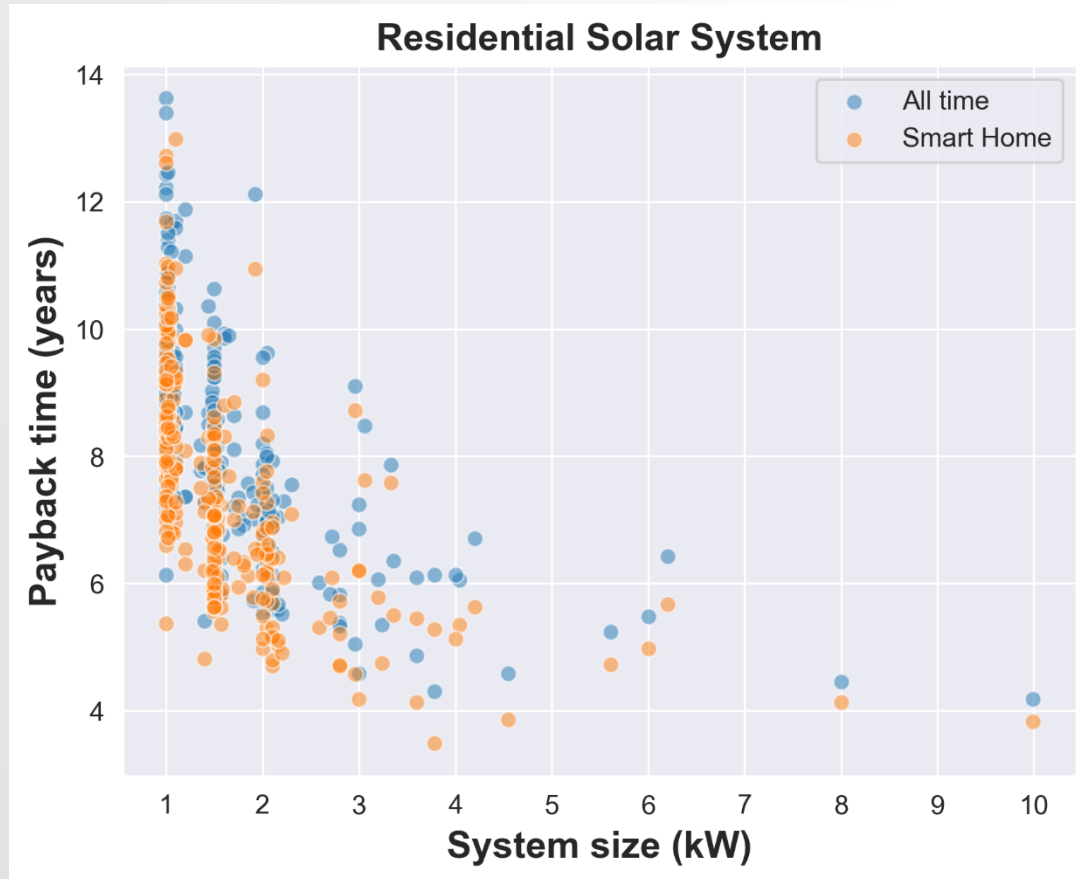


# PAYBACK TIME – ERRONEOUS DATA



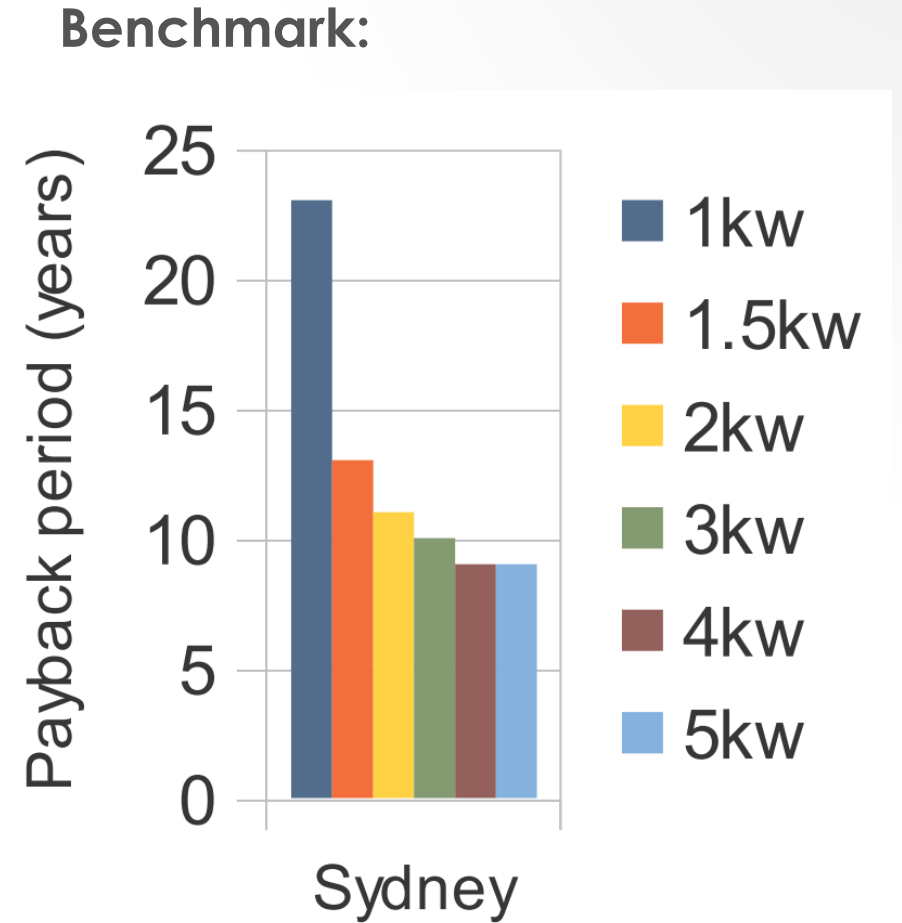
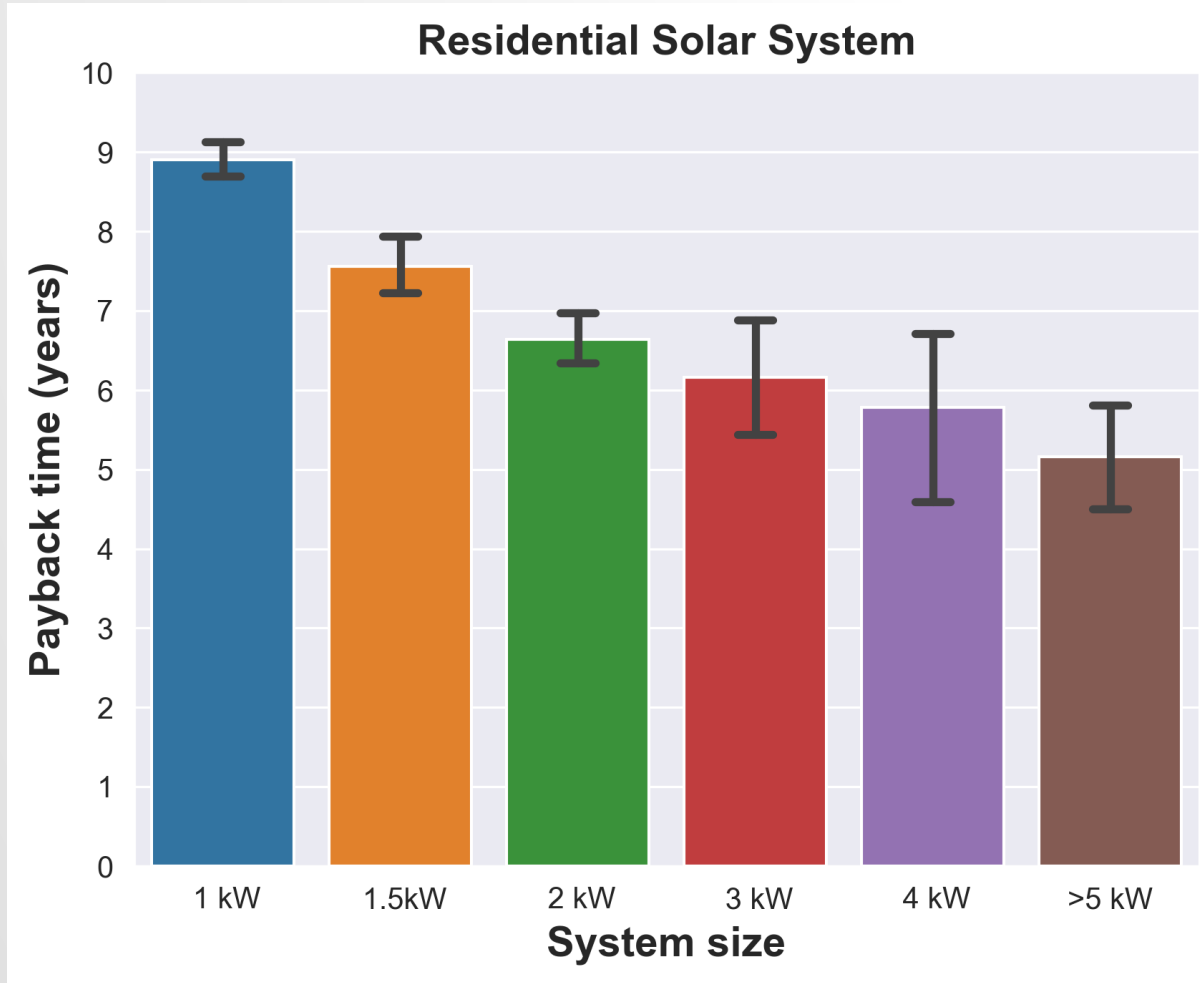
- 12 customers – missing solar generation data
- 1 customer – missing 81 days of data

# PAYBACK TIME – ENERGY PLAN



- Slightly lower payback time with Smart Home plan

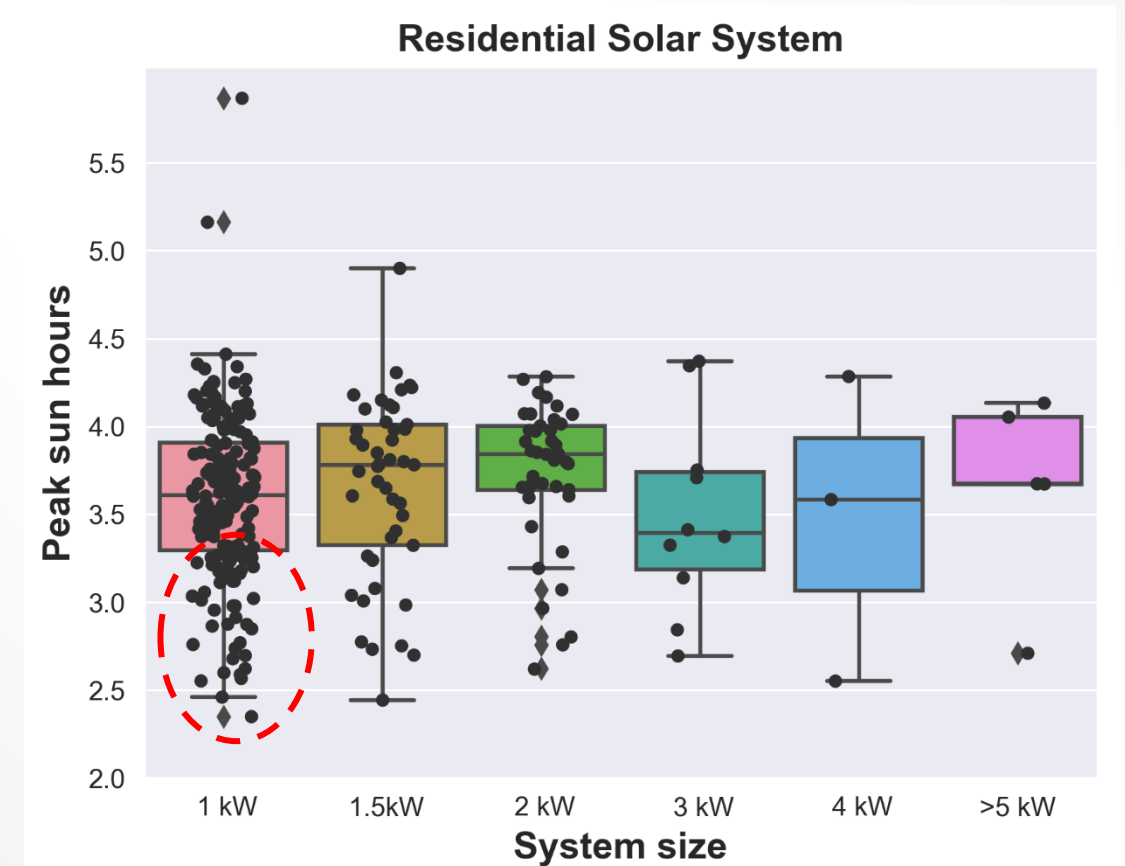
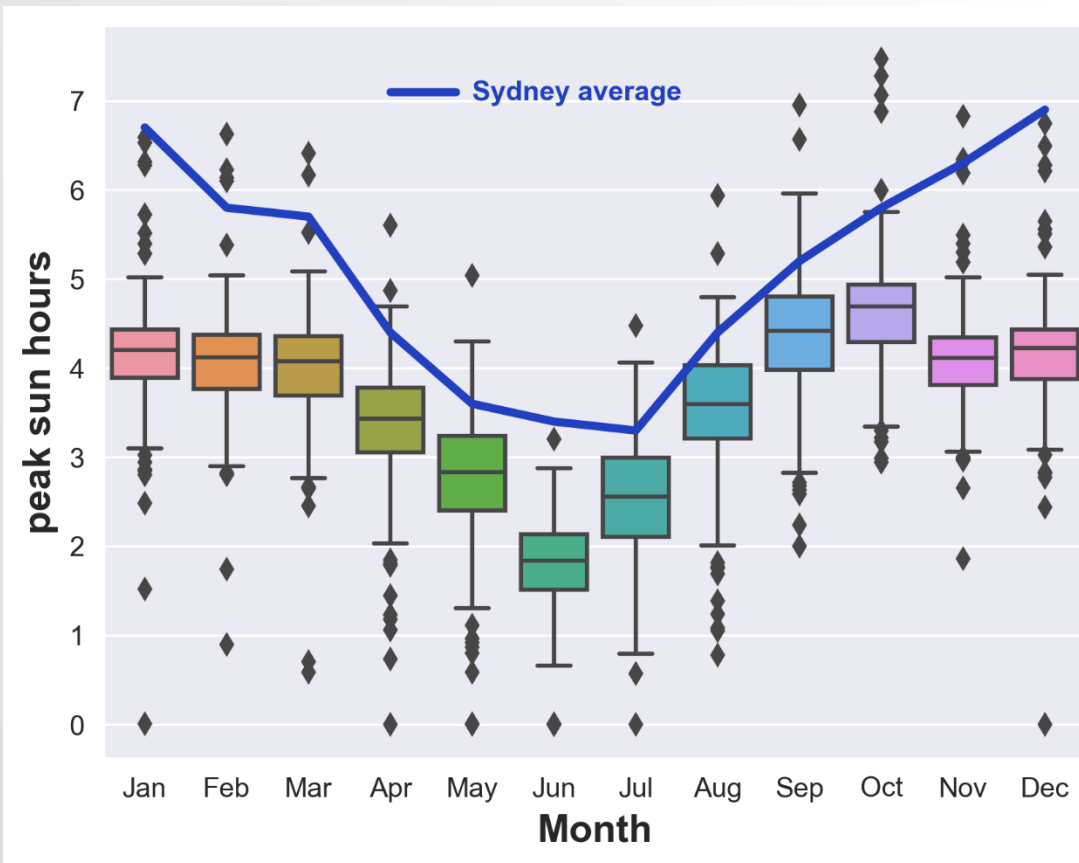
# PAYBACK TIME – SYSTEM SIZE



- Customers in the dataset have lower payback time than the benchmark

# PEAK SUN HOURS (PSH)

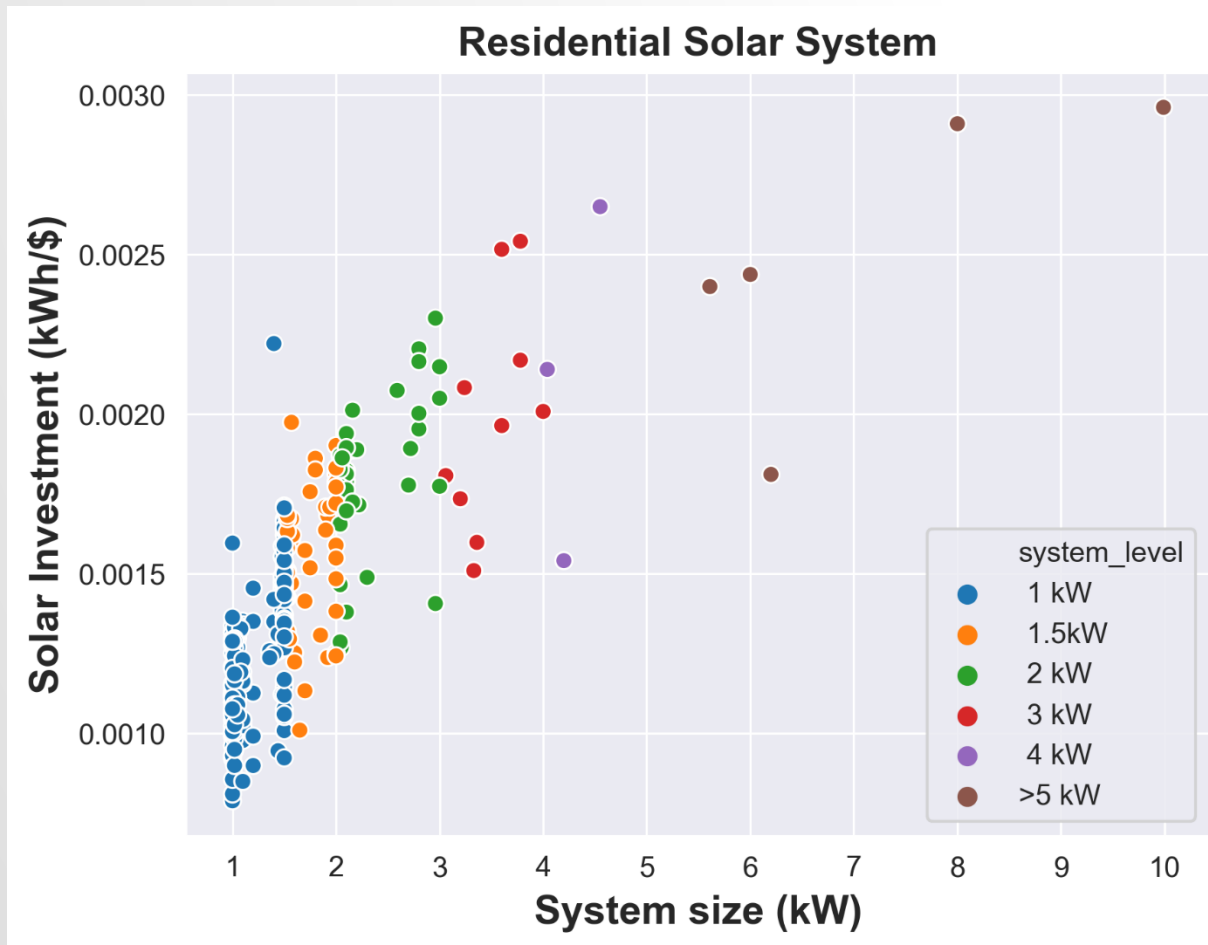
- The solar irradiance on the solar panels varies with time, day, month & location, orientation, tilt angle
- Peak sun hours is the equivalent hours that the solar panels operate at the rated power.





# SOLAR INVESTMENT

$$\text{Solar investment} = \frac{\text{peak sun hours}}{\text{system cost per kW}} \left( \frac{\text{kWh}}{\$} \right)$$



**Solar investment increases with the system size**

# SUMMARY

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- The average payback time is 9.2 and 8.5 years when the energy plans is all time and smart home, respectively.
- The payback time is inversely correlated to the system size.
- Solar systems performed comparably in terms of peak sun hours.
- Go for large system when the rooftop space is permitted.
- Good system design is crucially important.