



Solar
Victoria



Insights into consumer behaviour

Household electricity consumption after installation of solar and batteries

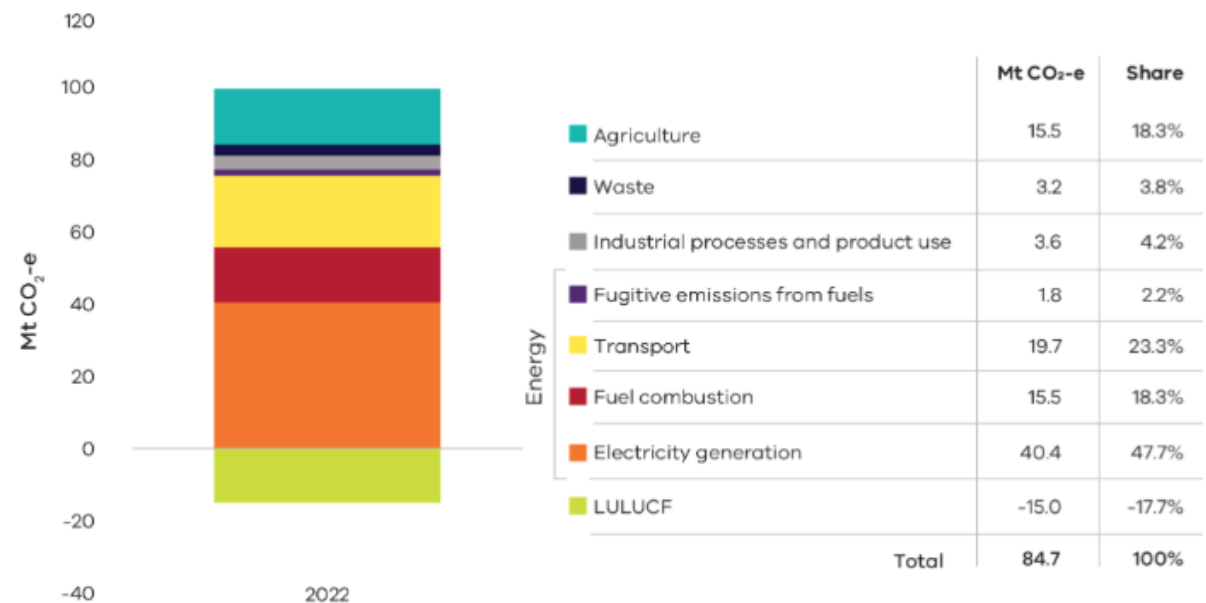
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Background

- The Victorian Government has committed to taking strong action to mitigate climate change which includes setting key legislative targets to achieve net zero emissions by 2045 with interim emissions targets of 45-50% by 2030 and 75-80% by 2035 on 2005 levels.
- More than 80% of Victoria's greenhouse gas emissions come from burning fossil fuel to make energy, with electricity account for 48% of fossil fuel emissions.
- Reducing the emissions intensity of the electricity grid is essential to achieving net zero by 2045.
- To scale up renewable energy investment, Victoria has committed to renewable energy generation targets of 65% by 2030 and 95% by 2035.
- A key part of the renewable mix is solar energy, and the Victorian Government is aiming to install an additional 6.3GW of rooftop solar by 2035.

Victoria's greenhouse gas emissions by sector in 2022



Source: Department of Energy, Environment and Climate Action, 2022, *Victorian Greenhouse Gas Emissions Report*, pp. 8.

Key incentive program to drive uptake of renewables by households

In 2018, the Victorian Government committed \$1.3 billion over 10 years to deliver the Solar Homes Program to provide rebates and loans to households to reduce the upfront costs of solar PV panels, batteries and energy efficient hot water systems.

Solar Victoria is the entity responsible for the design and delivery of the Solar Homes Program.

Long term program targets

1. Support installations on 770,000 homes in Victoria
2. 2.6GW of renewable energy capacity installed (equivalent to a coal-fired power station)
3. Savings households with solar PV ~\$1,000 – per year on their electricity bills



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Solar Homes Program incentives



10-year target: 700,000 solar PV applications approved

\$1,400 to install a rooftop solar system for eligible homeowners, including those building homes, and rental providers. A \$1,400 interest-free loan, repayable over four years, is also available.



Target: 60,000 solar and heat pump hot water rebates approved

Hot water rebates of up to \$1,400 are available for eligible heat pump and solar hot water products.



Target: 10,000 battery rebates and loans approved

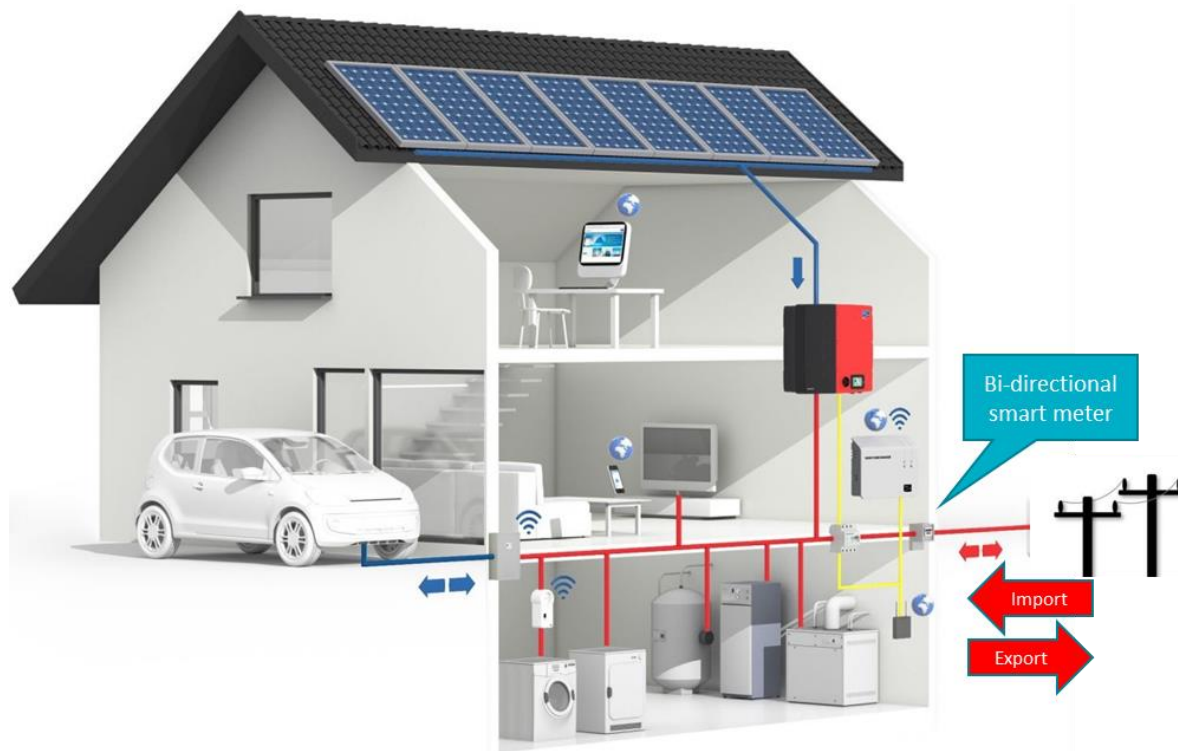
Up until May 2025, an interest free loan of up to \$8,800 was available to eligible households to install a battery with an existing solar PV system

The research need: What happens after a consumer installs a product?

- Solar Victoria wanted to know if and how consumer behaviour changed after installation of a solar PV, battery or hot water product
- We wanted to know:
 - What happened to their household electricity consumption after installation
 - How did this impact demand on Victoria's electricity grid
- This research will then assist in infrastructure planning for future electricity demand, as well as future design of government incentive programs.
- Solar Victoria commissioned the support of data scientists at the Centre for New Energy technology (C4NET) to help us conduct the analysis



Focus in on solar: How solar PV works



- Solar PV converts sunlight into electrical energy.
- Most houses with solar PV remain connected to the mains electricity distribution from the grid which supplements any shortfall between the site's solar generation and electricity demand.
- A house with solar PV installed uses the solar electricity generated first to power any device drawing electricity:
 - Import:** When solar is insufficient to meet the house's electricity needs the house draws electricity from the grid.
 - Export:** When the amount of solar generated exceeds the house's electricity needs, the excess electricity flows back to the grid.
- Each Victorian site has a bi-directional smart meter connected that records the sum of both the imports and exports at intervals of every 5 minutes, reported as 30-minute interval data for this analysis.

The study & methodology

- In 2022 a 3-year longitudinal study commenced with Solar Victoria and C4NET analysing electricity consumption before and after a Solar Victoria customer installed solar PV, battery, and hot water upgrades.
- This unique study is the first in Australia to link actual household and business electricity use and savings with solar program participation over multiple years.

Methodology

1. Customer consent gathered by SV during rebate application process for use of data for research
2. Anonymise site data
3. Extract each site's electricity data and match attributes – data provided at 30-minute increments
4. Filter data to remove outliers, anomalies and incomplete datasets
5. Analyse data 12 months before and 12 months after the installation (i.e. 30-minute increments for 365 days per year for two years)
6. Consolidation of insights and findings

The Solar PV customer sample

- Data from over 4,400 sites
- Sites selected to provide a good representation of all sites across solar system sizes and geographic areas across Victoria
- Provided a good spread of owner occupier and rental households

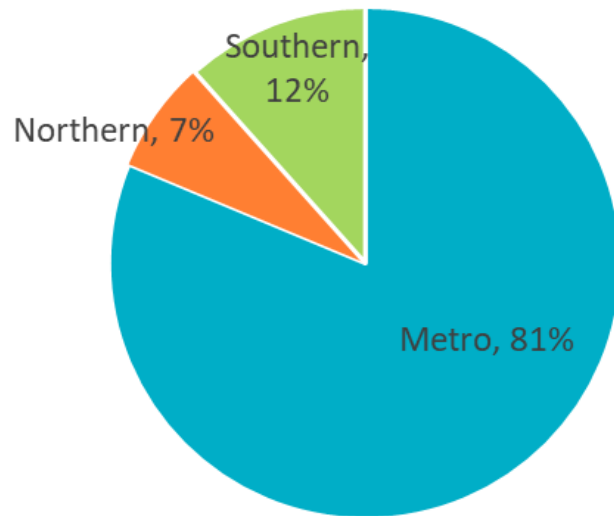


Figure 1. Split of residential solar PV recipient by region

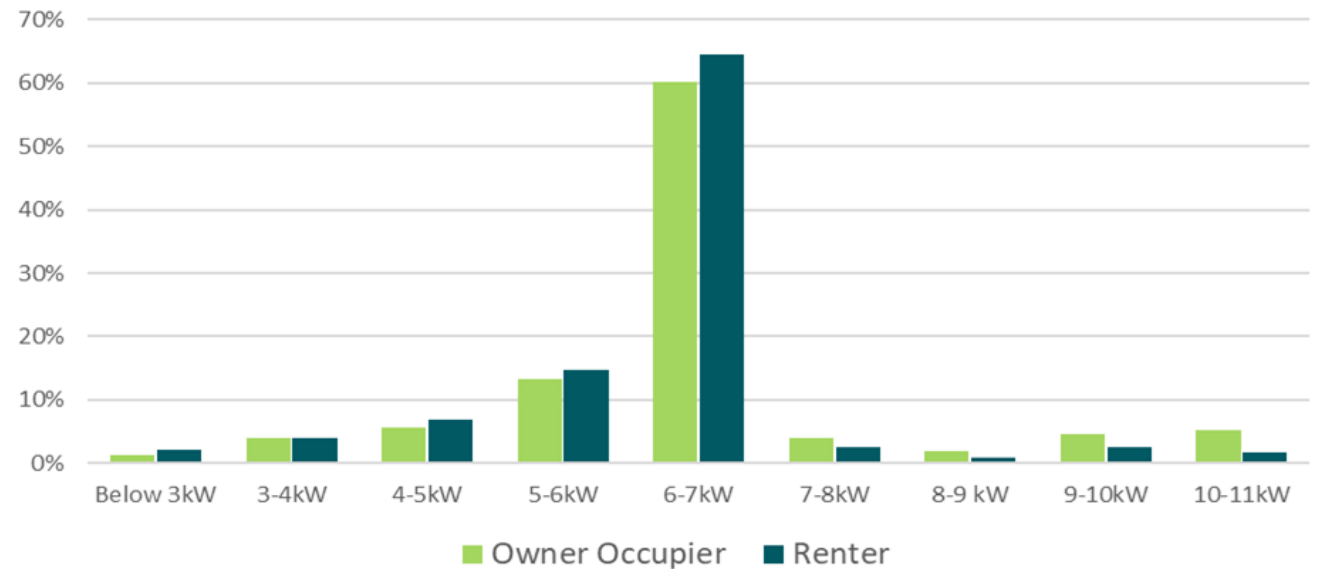
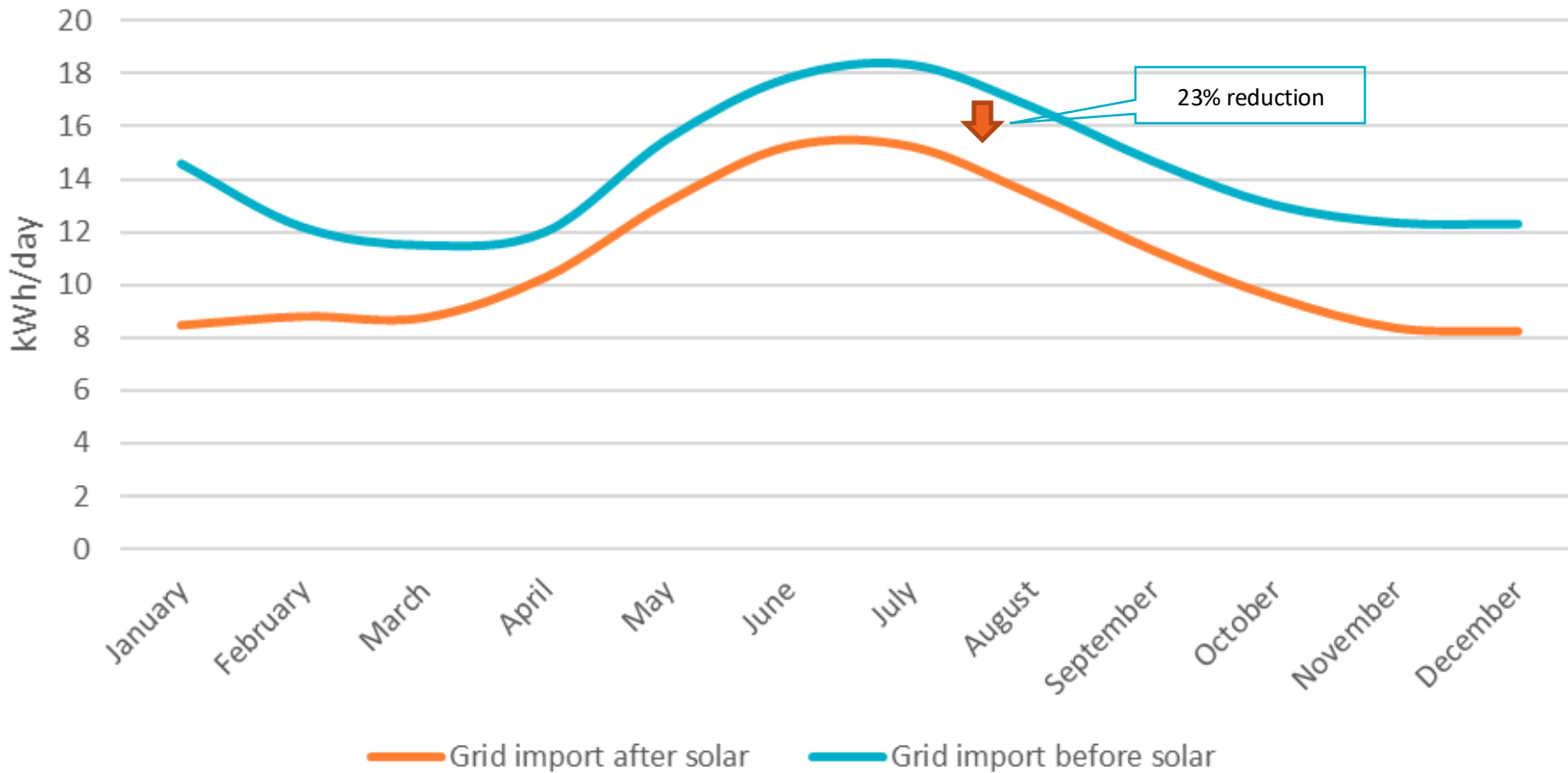


Figure 2. Solar PV system size between owner occupier and rental sites

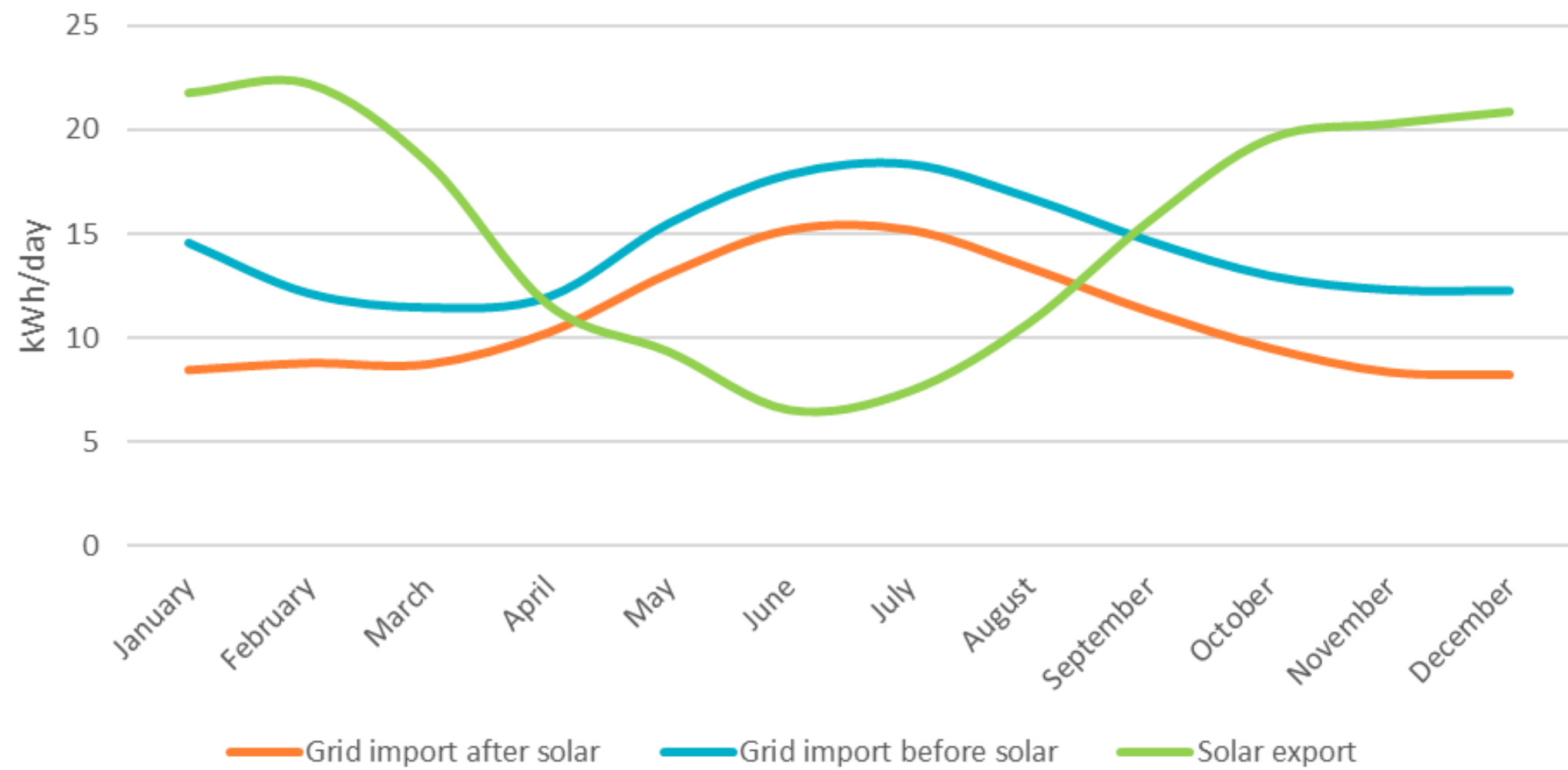
Our predictions

- Electricity imports would decrease with installation of a solar PV system
- Overall electricity use of the home would be stable, except where homes electrified (i.e. home owners swapped from gas powered appliances like hot water, heating and cooking, to electric alternatives)
- Self consumption rates (i.e. the proportion of solar power generated that is consumed onsite) would increase over time as households seek to maximise their savings from their solar generated power
- The addition of a battery to a solar PV system would increase self consumption and improve savings, while reducing draw down from the electricity grid during peak periods

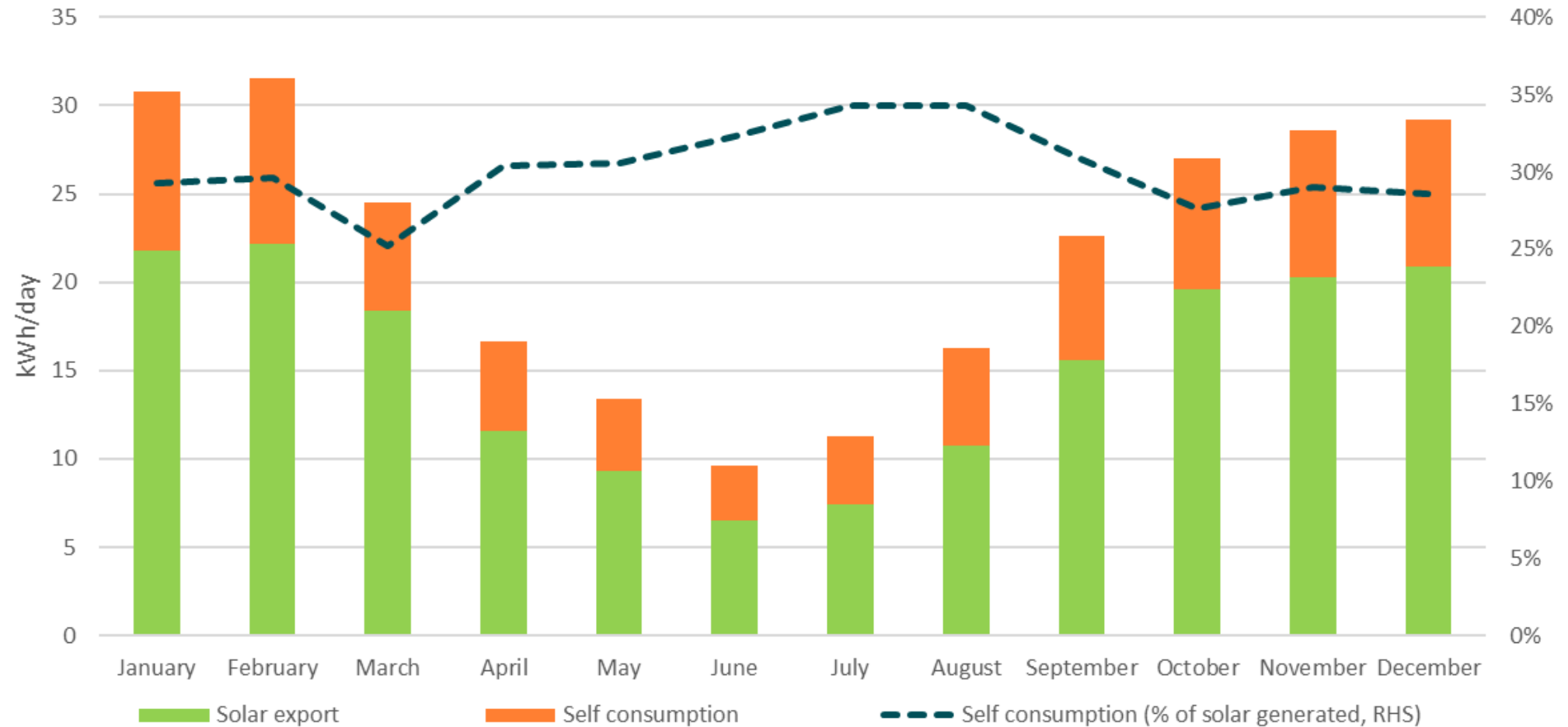
Observations: Electricity import after solar PV is installed



Observations: Solar export throughout the year

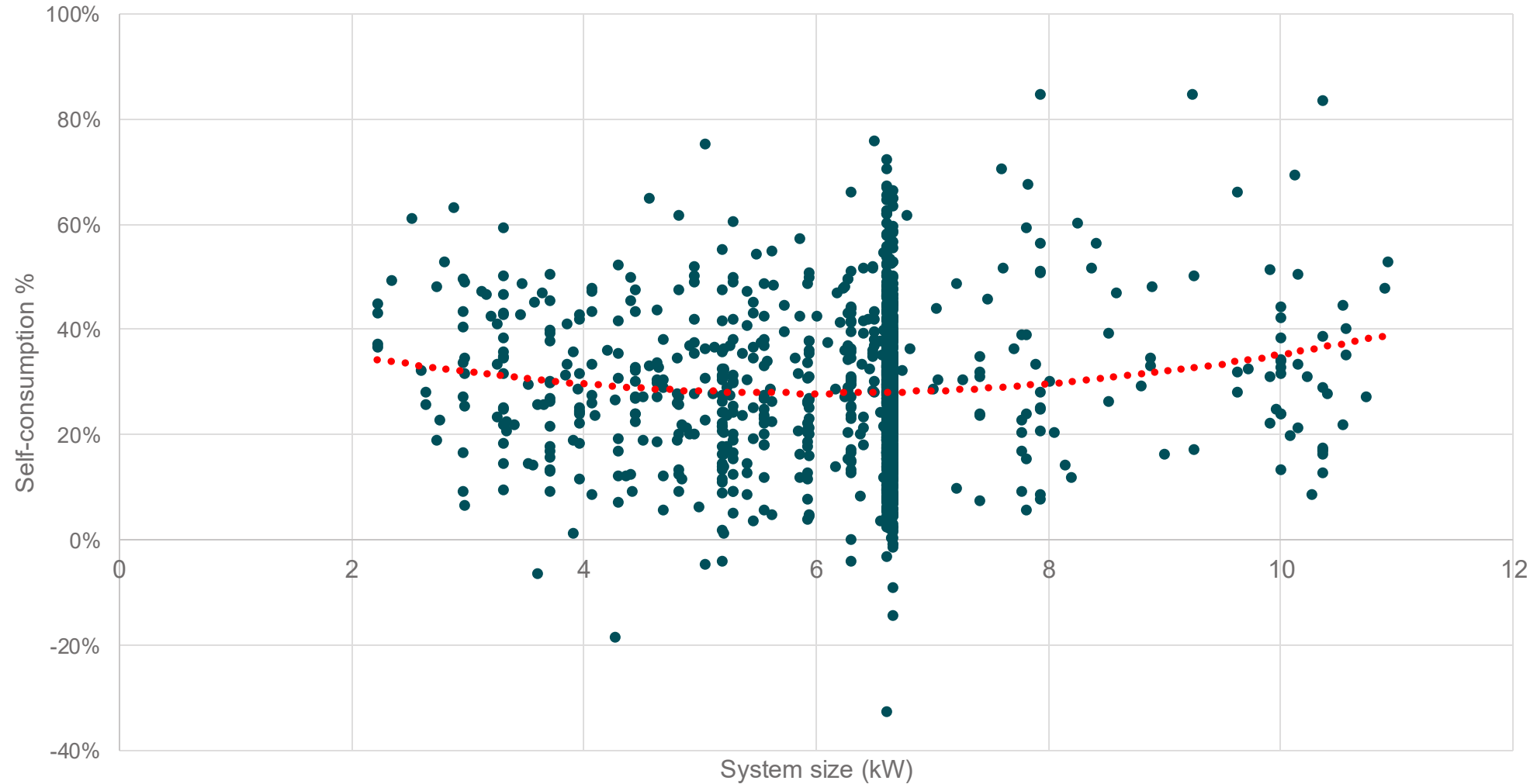


Average daily split: self consumption vs. solar export



Self consumption rates

There is no average customer

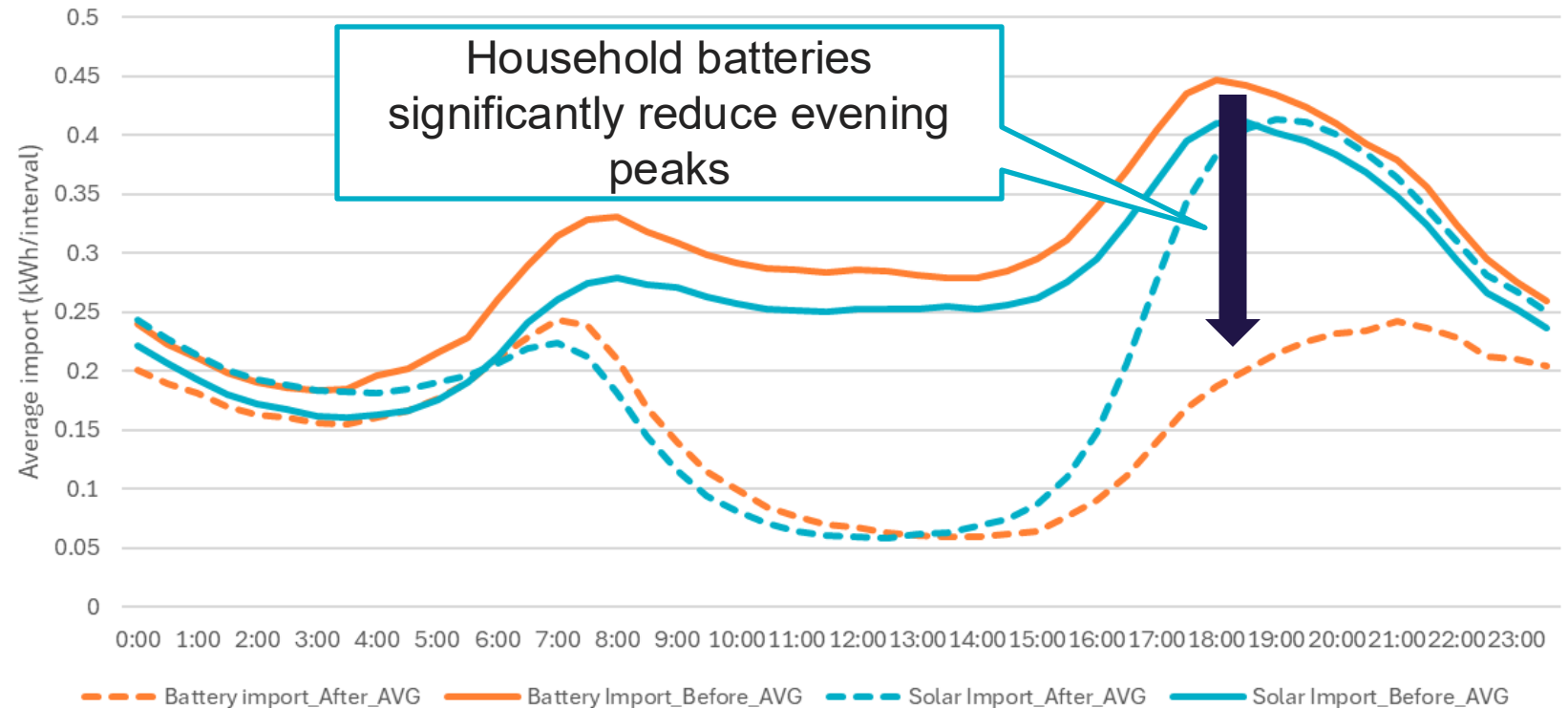


The impacts of adding batteries is clear



Battery customers:

- draw down 36% less electricity from the grid
- have very high rates of self consumption (~57% vs 29% for PV-only)
- significantly reduce their evening peak – particularly in summer
- save on average of 100% more per annum than solar PV-only customers



Other observations over 3 years: Solar systems are getting bigger

- Systems sizes are getting larger and this is forecasted to continue
- Back in 2018, when the Program began, forecasted system sizes were just 4kW, which grew by >50% in 6 years and is forecasted to continue
- Renewable energy generation forecasts underestimated what was actually been installed
- Has implications for how the electricity grid is managed and the utilisation of excess solar that is generated during the day

Year	System Size (kW)
2022	6.05
2023	6.39
2024	6.51

Stagnant rates of self-consumption

Adding a battery is a game changer

- Rates of self consumption, particularly for households, have been stagnant
- Adding a battery significantly increases this self consumptions, delivering greater savings for customers
- Batteries continue to be a significant financial outlay but there continues to be opportunity
- Additionally, heat pump hot water systems (that use the solar power generated during the day to heat water) act as a 'battery', increasing rates of self consumption and savings consumers money

	Year	Self- consumption rate
Solar PV only	2022	28%
	2023	28%
	2024	29%
Battery	2022	63%
	2023	54%
	2024	57%

Our predictions – were they right?

Our prediction	Was it right?
Electricity imports would decrease with installation of a solar PV system	Yes, but we got a better understand of how this changes throughout a calendar year which provides useful insights for grid infrastructure planning
Overall electricity use of the home would be stable, except where homes electrified (i.e. homeowners swapped from gas powered appliances like hot water, heating and cooking, to electric alternatives)	Yes, but the demand for electricity was higher than anticipated
Self consumption rates would increase over time as households seek to maximise their savings from their solar generated power	No – it was stagnant across the research period. Significant opportunity to support further behaviour change and make it easier to self consume at great rates (i.e. batteries)
The addition of battery would increase self consumption and improve savings, while reducing draw down from the electricity grid during peak periods	Yes – it really did

Thank you and questions