Solar Analytics: Monitoring for Better Energy Outcomes (ARP010)

FINAL LESSONS LEARNT REPORT

Project Details

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EXECUTIVE SUMMARY

Over the four years of this ARENA backed project, Solar Analytics has delivered our rooftop solar monitoring service to 40,000 customers across Australia. Throughout this period Solar Analytics have been at the forefront of increasing the value solar owners receive from their solar system by providing increasing insights and information to help them better manage their solar and increase their financial return.

The key learnings from this project are:

1. Active performance monitoring increased solar generation by 14% (or an average of $132 pa for residential customers) due to faster fault detection and rectification.
2. By monitoring both solar generation and electricity consumption, residential customers also save up to $350 pa by shifting their loads to times of high solar generation.
3. Time of use electricity tariff structures can generate savings of $200 pa for solar customers
4. Buying solar is confusing, with consumers struggling to compare between solar offers and often deciding on price alone. This makes presenting the value of solar monitoring challenging at the point of sale due the amount of new information being presented.
5. High quality near real-time data from solar system monitoring provides electricity networks with critical information to better manage our electricity networks.

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KEY LEARNINGS

Lesson learnt No.1: Performance monitoring of rooftop solar saves customers $132 pa

Category: Technical/Commercial

Objective: Analysis of the cost-benefit of solar monitoring

Detail:

Overall this project has enabled Solar Analytics to deliver 37 GWh of distributed rooftop solar electricity per year, with an energy production valued at $9.1 million per year.

The key benefits of active solar monitoring are detailed below.

1) Increased solar generation
    a. Use of monitoring allows for early identification of solar system issues in the first 6 months leading to an increase in solar production of 4.8% for small systems and 7.6% for large systems.
    b. A further increase of 3% for small systems and 11.9% for large systems can be attributed to the detection of zero generation faults.
    c. Together, this increase in solar generation leads to annual savings of $132 per site.[1]

2) Better management of energy consumption. Solar owners were able to increase their savings through shifting the energy load of major load appliances such as hot water, air-conditioning, pool pumps and electric vehicles. This active management of load patterns saved customers up to $350 pa, however it was highly variable across customer segments based on their ability and inclination to shift these energy appliances. Refer to Lesson #2 for additional detail.

The costs of Active Monitoring are paid for by the system owner. The costs are around $800 for standard residential and $1500 for commercial solar systems across 10 years. This includes the monitoring device, installation of the device, and ten years of active monitoring.

In addition to saving business and households thousands of dollars in electricity costs, increasing our total renewable energy generation and helping us meet our climate change commitments, rooftop solar has been demonstrated to provide savings for all energy consumers through:

a) reduced severity and length of peak demand periods, and
b) reduced wholesale electricity costs[2] - saving $2.2-3.3 billion for NSW electricity customers alone in 2016/17[3], and
c) increased grid resilience through autonomous DER response[4].

Implications for future projects:
Future projects should focus on how to deliver the benefit of active solar monitoring to more customers. This could include lower upfront cost for the consumer, improved messaging at point of sale, or integration with other products and services so that the benefit is inherently included. This will increase the total amount of rooftop solar electricity generated and provide these benefits to more solar owners.

[1] M6_D_SolA_Performance_Report_Feb_2020
[2] Electricity prices falling across the whole supply chain for first time, AEMC Jan 2020
[3] Impact of small solar PV on the NSW wholesale electricity market, Oct 2017, Energy Synapse
[4] Technical Integration of Distributed Energy Resources, Apr 2019, AEMO

Lesson learnt No.2: Monitoring solar generation and electricity consumption saves up to $350pa

Category: Social/Commercial

Objective: Analysis of consumer engagement in residential energy management

Detail:
The key for a consumer to be able to better manage their electricity costs is visibility and readily actionable information of what actions they can take. Empowering the solar owners to better manage their solar and energy profile includes the following.

a. Savings can be made from increasing self-consumption and lowering the amount of energy imported from the grid. For example, by changing large energy using appliances such as hot-water heaters and pool pumps to be operating during daytime hours rather than at night. Detailed savings expected in each state can be seen in a Solar Analytics blog post on energy shifting[5].
b. Active monitoring with additional measurement of these large energy appliances allows for identification of an appliance fault that otherwise would have gone detected. An example is given in a recent Solar Analytics blog post in which leakage from a hot water was identified early and rectified[6].
c. Active monitoring gives the customer a better overview of their energy usage, making it easier to choose the best electricity tariff to match their consumption. Once the customer can see how much energy they are using in shoulder and peak times, and how much of the this is a shiftable load, they can pick a tariff to maximise their savings.
d. A further benefit of this visibility is the provision of an accurate assessment of what the ideal battery size would be for the customers specific energy profile. Once the optimal battery size is determined, the cost and savings (in both energy and $) can be presented, enabling the customer to make an informed choice of if and when to add battery storage to their solar system.
e. The ability to see live and historical energy production and consumption in a clear and easily understandable format, also enables customers to become for energy knowledgeable. For example, live energy data allows a customer to see exactly which appliances draw greater amounts of electricity.

Implications for future projects:
Consumer education remains a key barrier to better electricity outcomes and lower costs for both solar and non-solar owners. Future projects could build on this work by refining how the message is delivered to the customer, with specific focus on providing readily actionable insights with estimated financial benefit.

[5] https://www.solaranalytics.com/au/blog/energy-load-shifting-made-easy

[6] https://www.solaranalytics.com/au/blog/how-checking-in-on-your-energy-usage-from-time-to-time-can-save-you-money

Lesson learnt No.3: Time of use (TOU) electricity tariffs can generate savings of $200 pa

Category: Commercial

Objective: Determining the cost/benefit of residential PV monitoring for a market participants

Detail:

There are two main types of electricity tariff – flat and Time of Use (TOU). A flat tariff has the same price of electricity throughout the day. A TOU tariff will vary the price of electricity depending on the time of day, ie more expensive during the period of high national electricity usage (typically 3pm – 10pm), and cheaper during periods of low electricity usage (typically 10pm-6am).

A further complication is that the time of use charges vary depending on the location, and may be different for the energy purchased from the grid (energy retailer tariff), and the energy sold back to the grid (Feed-in tariff).

By analysing the fleet of solar systems monitored throughout this project, it was shown that the orientation of a solar system (ie the direction the solar panels on the roof are facing) can determine which electricity tariff will generate the most savings for the customer.

With flat feed-in-tariffs, the profits from solar energy being sold back to the grid is directly in proportion to the amount of solar energy exported.

However, when the feed-in-tariffs are time-of use, the orientation of the solar system has a significant impact on the energy savings. The below tables show the typical tariffs available from energy retailers, and a comparison of the savings achievable for three common tariff types.

Table 1: Typical retailer tariff and feed in tariffs

	Retailer tariff	Feed-in Tariff
Flat	$0.29/kWh	$0.11/kWh
TOU	Peak: $0.37/kWh Shoulder: $0.25/kWh Off peak: $0.15/kWh	Peak: 29c/kWh Shoulder:10.3c/kWh Off peak:7.2c/kWh

Table 2: Comparison of different tariff structures (all systems)

	Scenario 1	**Scenario 2**	**Scenario 3**
Retailer Tariff	Flat	Flat	TOU
Feed in Tariff	Flat	TOU	TOU
Costs from energy import	$1,266	$1,266	$1,141

Savings from energy export	$408	$488	$488
Total costs	**$858**	**$778**	**$653**

Table 3 shows how a time-of-use tariff can save a typical solar home owner $205pa, however for West facing systems this increases to $240pa, and for East facing system reduces to $143pa.

Table 3: Comparison of different tariff structures for different solar system orientations

Orientation	North	West	South	East	All sites
Scenario 1 - Flat	$867	$844	$730	$791	**$858**
Scenario 2 - Flat/TOU	$739	$719	$651	$690	**$733**
Scenario 3 - TOU	$663	$604	$536	$648	**$653**
TOU savings vs Flat	**$204**	**$240**	**$194**	**$143**	**$205**

Note that the actual savings achieved from TOU tariff will vary between households, and is heavily dependent on the following factors:

- The specific electricity tariffs available
- The proportion of electricity generated that is consumed by the household, ie % self consumption (the average is 42% of solar being consumed on site)
- The energy usage patterns of the household, ie how much energy is consumed during peak periods
- The ability of the household to shift loads away from peak periods

Implications for future projects:
Studies of consumer behaviour in Victoria and elsewhere have repeatedly shown that consumers are far less favourable towards TOU tariffs, and much prefer a flat tariff. Further exploration could be done on ways to offer TOU retail tariffs combined with solar and/or the ability to shift major loads.

Lesson learnt No.4: Buying solar is confusing

Category: Social

Objective: Analysis of consumer engagement in residential solar monitoring

Detail:

At the start of this project only about 25% of new solar systems were provided with any form of monitoring, and that was mostly solar generation only with little value offered to the solar owner (Figure 1). Over the past 5 years that has increased to almost 85%, with over 40% also getting the essential energy consumption that enables the value of solar monitoring to be realised.

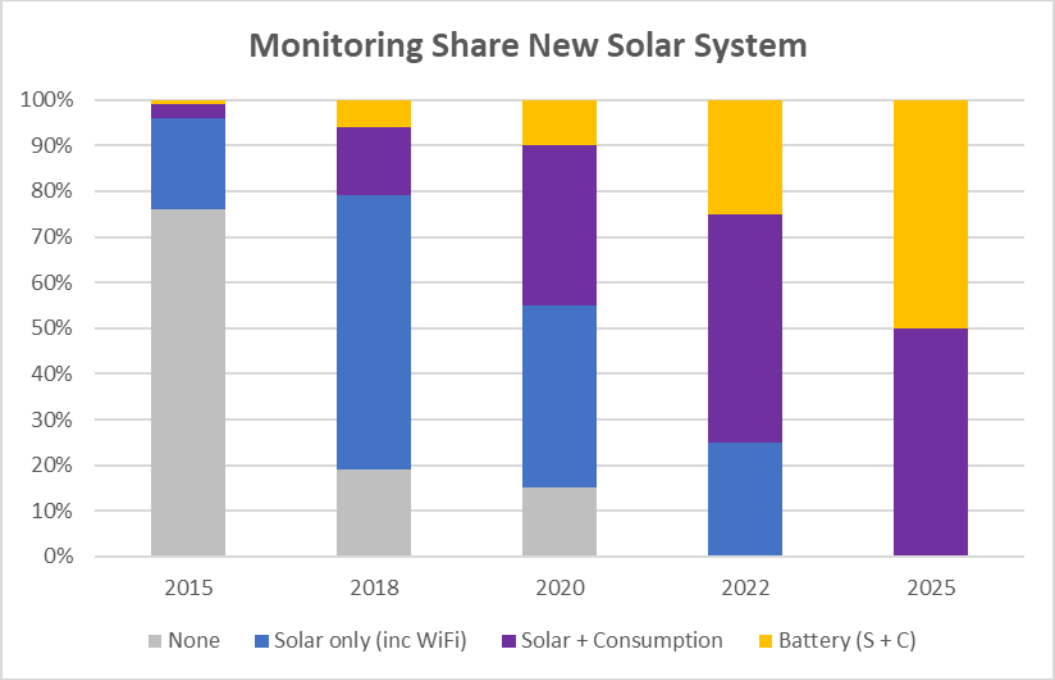

Figure 1: Growth in types of monitoring for new rooftop solar systems. Source - Global PV Monitoring 2017-2021, GTM and internal estimates.

Over this period the level of monitoring provided by Solar Analytics, other third party providers such as Reposit, and the native solar inverter monitoring have all continued to improve and add increased value and functionality.

Solar Analytics has established a committed customer base, with a high level of engagement where 70% of customers check their solar dashboard at least once a month. However, the value of this service and the financial rewards are not as apparat to the solar buyer, to whom rooftop solar is typically a first-time purchase and rife with conflicting statements from solar retailers.

With over 25% of homes nationally now having rooftop solar, most people have friends or family who have installed solar, hence increasing the level of consumer education and awareness. This has been aided by many highly informative and fact based publications to assist solar buyers, eg Clean Energy Councils buying solar guide, and SolarQuotes Good Solar Guide,

However, recent consumer surveys of solar buyers have shown that there remains a high degree of confusion among solar byers. Common areas of concern and uncertainty include:

- Am I being offered good quality equipment?
- Is this a reasonable price to pay? Prices for a similar system can vary by over 60%
- Is this solar retailer trustworthy? While rooftop solar is one of the most stringently audited and regulated consumer trades, there are still many cowboys who will rip off consumers
- What is solar monitoring and do I need it?
- Will this system suit my family's electricity needs?
- Should I get a battery?

With all of this new information and uncertainty for a solar buyer, it is still difficult for them to be confident in their solar buying decision.

As the electricity grid continues its rapid transformation to a two way market where rooftop solar is one of the largest generators nationally, we are now seeing an increased uptake in residential storage (batteries), community batteries, and the Virtual Power Plant (VPP). All of these new offers and opportunities are making the electricity sector even more confusing for new and existing solar owners.

Implications for future projects:
Further work into simplifying the consumer purchasing experience would benefit both consumers and the solar industry.

Lesson learnt No.5: Real-time data enables better management of our electricity networks

Category: Technical

Objective: Delivering aggregated, anonymised performance data for the use network distributors, industry and researchers

Detail:

On 11 Oct 2020 rooftop solar provided over 75% of the electricity for the South Australia electricity grid. The network organisations that have the responsibility of managing the electricity grid currently have little visibility of how their network is operating. With the increasing amounts of rooftop solar, network operators now urgently require this visibility to effectively and safely mange the grid.

On example of the need for visibility is the operating voltage of the network. The preferred and outer limits of the safe operating range is shown in Figure 2. As shown in this figure, analysis from Solar Analytics through this project found that many parts of the grid were operating in the upper operating zone.

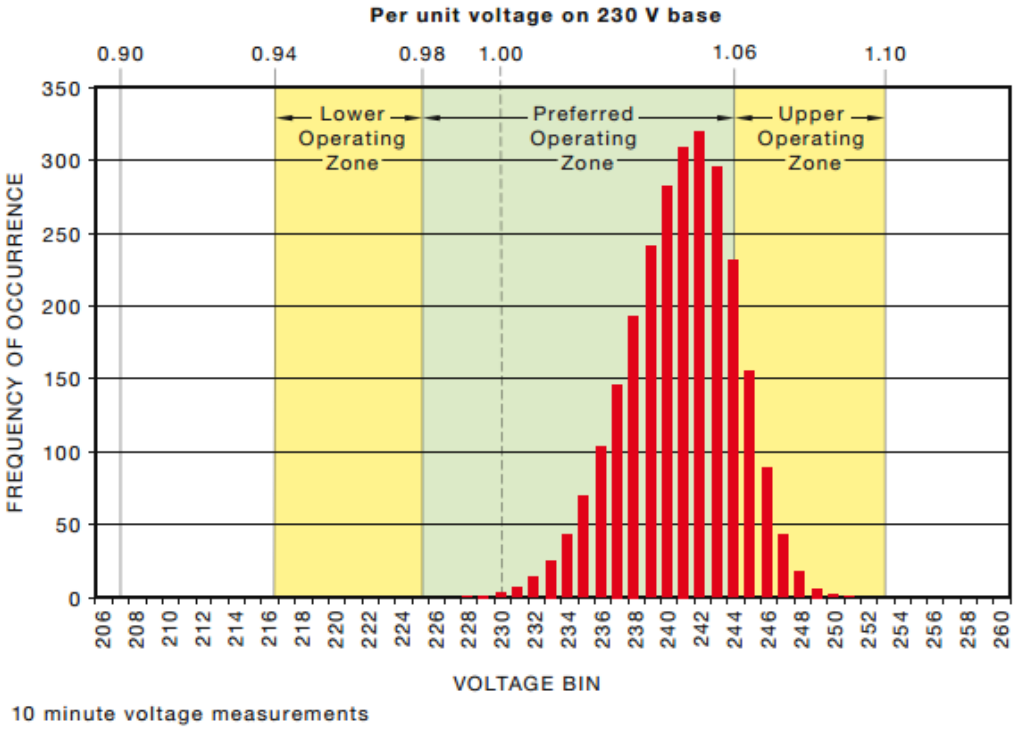

Figure 2: Analysis of network voltages data courtesy of CEEM UNSW and AusNet

The types of data that were provided to network operators by Solar Analytics to assist with grid management include:

- Solar system capacity
- Power factor at the point of grid connection
- Total solar generated
- Frequency
- Solar system responses under real world grid disturbance events
- Load consumption profiles

Based on the benefits and increased visibility over the network enjoyed by network operators through monitoring, general energy consumers (both solar owners and non-solar owners) across Australia also benefit. Monitoring potentially enables:

1) equitable access to solar savings for people who have not yet installed rooftop solar (including renters).
2) Reduced electricity costs from reduced network constraints (peak demand periods, wholesale electricity costs).
3) Reduced electricity costs from minimising network upgrade costs due to the enhanced NSP network visibility improving their network modelling and O&M programs.

Implications for future projects:

The key challenge for the network operators is sourcing sufficient quantities of real time network data to enable hem to effectively and safely operate the grid. Further work could expand the use of disparate data sources, or provide a pathway to establishing a common network visibility requirement that would enable this data to be provided to the network operators.