Regional and Remote Communities Reliability Fund Microgrid

MyTown Microgrid

Milestone 4 Data Delivery Report

July 2022 Version 1.0

wattwatchers DIGITAL ENERGY

Federation University

public interest ADVOCACY CENTRE

LATROBE VALLEY AUTHORITY

RMIT UNIVERSITY

community power agency

HEYFIELD COMMUNITY RESOURCE CENTRE

UTS

AusNet services

Research Team

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Key support

Heyfield Community Resource Centre
Latrobe Valley Authority
University of Technology Sydney
Federation University Australia
RMIT University
Public Interest Advocacy Centre
Community Power Agency
AusNet Services

About the project

MyTown Microgrid is an innovative, multi-year, multi-stakeholder project that aims to undertake detailed data-led microgrid feasibility for the town of Heyfield (Victoria), built on a platform of deep community engagement and capacity building.

The project received funding under the Australian Government's Regional and Remote Communities Reliability Fund Microgrids stage 1 funding round. It also received funding from the Latrobe Valley Authority as part of the Gippsland Smart Specialisation Strategy.

Executive Summary

The Heyfield MyTown Microgrid project is undertaking a detailed, data-led microgrid and energy solutions feasibility assessment for the town of Heyfield (Victoria), built on a platform of deep community engagement and capacity building.

This document is the updated report on the summary of devices deployed by customer and location type (milestone 3.1) and a summary of the data collected so far (milestone 3.2) from the Heyfield community, which is being delivered as part of project milestone 4 under Work Package 2: Technology Deployment.

The data collection process for Heyfield MyTown Microgrid has undergone careful planning through the definition of a sampling design plan. This plan was based on a target of 75 residential, 12 commercial and 2 school sites with a range of consumption profiles, solar generation and other characteristics that have guided the installation of Wattwatchers devices.

The Wattwatchers Auditor 6M is a compact and cost-effective energy monitoring solution that is installed in the customer's electrical switchboard to monitor the key circuits - including grid imports and exports, solar generation and other major equipment - with revenue-grade metering accuracy and using integrated 4G/3G communications to provide access to near-real-time energy data.

Installations have been completed at 63 residential sites, 14 commercial and 2 school sites with a total of 98 Wattwatchers devices installed. The minimum number of data monitors required under the contract was 50 devices which has been achieved. There are 41 residential sites with solar generation, 31 sites with air conditioners being monitored, and 2 sites with battery energy storage systems. Of the residential sites being monitored, 63% are single phase, 33% are two phase and 3% have a three phase connection to the grid.

The aggregated load profiles from the monitored sites indicate there is excess solar generation between 8am and 5pm in summer and 9am and 4pm in winter that may be beneficial to a Microgrid or community energy solution. The summer peak load appears to be in the middle of the day, while the winter peak is at around 9am each day. The lowest daily load appears at 2am in winter and 4am in summer.

In this reporting period, the project has continued to endure through further impacts from COVID-19, limiting the availability of both participants and our installation team as community cases increased. However, the vast majority of sites have now been installed to meet the original project objectives.

The key lessons learned include being conservative and realistic about the number of devices and time required to install them while installing devices as early as possible considering community engagement and lead times. It was also identified that steps to validate and cross check survey data should be inserted in the data journey as early as possible and that a plan for sites that may require multiple devices where solar is installed on a separate building or structure. The requirements for the minimum data collection from the energy questionnaire have been updated based on the first rounds of analysis.

The success of the deployment and the data collected serves as an important anchor for "bottom-up" modelling of the community once a sufficient duration of quality data is available, by providing the specific sample of customers and energy use across the potential boundaries of the Microgrid or community energy solution.

Contents

Introduction

The Heyfield MyTown Microgrid project is undertaking a detailed data-led microgrid and energy solutions feasibility for the town of Heyfield (Victoria), built on a platform of deep community engagement and capacity building. Over the three-year duration, the project will also develop the knowledge and tools to make it faster, easier, and cheaper for other regional communities to understand microgrid and other energy solution propositions for their community. This project takes a novel approach to a community-based microgrid feasibility process by:

- Using multi-data source platforms to calculate demand, flexibility and supply.
- Undertaking deep community and stakeholder engagement
- Co-designing community-centric business models with enshrined benefits and consumer protections
- Wrapping technical, market, economic and regulatory analysis into fit-for-purpose decision support tools

This document is the updated report on the progress of the deployment of monitoring devices into the Heyfield community which is delivered as part of project milestone 4 under Work Package 2: Technology Deployment. This document provides a summary of devices deployed by customer and location type (milestone 3.1) and a summary of the data collected so far (milestone 3.2).

The data collection process for Heyfield MyTown Microgrid has undergone careful planning, involving the establishment of clear and concise goals, the development of a model process, and the definition of a sampling design plan.

The sampling design plan describes the number of monitoring units and targeted areas/customer types for deployment, including the process for opt-in confirmation. It also includes the goals for data collection and describes the data collection process.

The deployment has required extensive engagement with the Heyfield community and the methods and applications that were used to support participant recruitment are described in this report. Additional information on the broader community engagement activity is available in the separate Community Engagement Reports.

This document should also be reviewed alongside the previous milestone's community engagement and deployment reports and the other relevant project documents that describe the broader details of the project.

Data sampling design plan summary

Site selection

The Data Sampling Design Plan delivered as part of the Milestone 1 deliverables defined the number, type and characteristics of the sites that were being targeted as part of the program. Participants were planned to be recruited to take part in the program based on accepting the installation of a Wattwatchers device into their home or business and to provide additional information on their use of the property through an energy questionnaire.

Table 1 - Site selection breakdown

Type of participant	Total number in Heyfield	Targeted number for trial	Other targeted features
Residential	700	75	50% of non-solar 50% of solar Low energy users (<20kWh per day) Medium energy users (20kWh to 40kWh per day) High energy users (>40kWh per day)
Commercial	50	12	Australian Sustainable Hardwoods and Gippsland Canningvale Timbers Sales as special key sites
Schools	2	2	

The Site Selection Criteria list was defined as follows:

- Distribution of sites around the Heyfield township and the local electricity network segments.
- Different types of home and small business.
- Sites with and without Solar or Solar and Battery Systems.
- Key energy consumers in the region such as large businesses (e.g.: the sawmill sites).
- Number or capacity of measurable and controllable loads which may be beneficial for demand response (such as Hot Water, Battery Systems or Electric Vehicle Charging equipment)

Monitoring devices

Data is being collected using Wattwatchers Auditor energy monitoring devices to help characterise residential and business sites for the purposes of modelling the Heyfield residents and to understand the feasibility of a microgrid.

The Wattwatchers Auditor range of Energy IoT devices is a commercially-proven solution suite, with over 50,000 units installed in the field, deployed across residential, commercial, industrial and utility use cases.

The Wattwatchers Auditor 6M is a compact and cost effective energy monitoring solution - that is installed in the customer's electrical switchboard to monitor up to 6 circuits, with revenue-grade class 1.0 metering accuracy and cellular (4G/3G) communications - to provide access to near-real-time energy data through the Wattwatchers Mercury platform and API.

Figure 1 - Wattwatchers Auditor and current transformer product range

The Wattwatchers devices collect energy demand, consumption and power quality data in two types referred to as Long Energy and Short Energy.

Five-minute Long Energy data is captured for kWh, Voltage, Current and Reactive Energy, and is stored indefinitely (i.e. currently there are no time limits on availability via the API).

Thirty-second Short Energy data is captured for Voltage, Current, Reactive Energy and Frequency. This data is a “best effort” transmission and may have “gaps”. This data is stored in the platform for 31 days.

Monitoring circuit selection

Up to 6 current transformers were installed at each site based on the following priority of loads for monitoring to ensure the largest and most relevant loads for consideration in the microgrid are monitored first.

1. Grid Connection
2. Solar Generation
3. Battery Storage Systems
4. Electric Vehicle Charging
5. Air-Conditioning
6. Electric Hot Water
7. Pool or irrigation pumps
8. Oven
9. Kitchen Power Circuits
10. General Power Circuits
11. General Lighting Circuits

Due to a range of factors, such as sites with two-phase or three-phase incoming supply, only some of these loads are monitored at each site, and this varies from site to site. The grid connection is always monitored at every site.

The installation process using the Wattwatchers Onboarding application captures these circuit categories and a human-friendly label so that customers and the research team can identify the different circuit types and key appliance usage.

Summary of energy data captured

The following Long Energy data for each monitored circuit of each device is available in 5-minute resolution:

- Active Energy Total (kWh)
- Active Energy Imported (kWh)
- Active Energy Exported (kWh)
- Reactive Energy Total (kvarh)
- Reactive Energy Imported (kvarh)
- Reactive Energy Exported (kvarh)
- Voltage (Vrms) minimum and maximum
- Current (A) minimum and maximum
- Power Factor

This Long Energy data is available for all devices from when the device is first installed.

Additional short energy data is available in 30 second resolution for the following data:

- Frequency (Hz)
- Active Power Total (kW)
- Reactive Power Total (kvar)
- Voltage (Vrms)
- Current (A)
- Power Factor

Note that some values above require the use of the conversion features of the Wattwatchers API and the quantities above have been simplified into the most relevant units for this report.

Device installation and data outcomes

Device installation summary

The following installations were completed by the 30th of June 2022.

Table 2 - Installation summary

Participant Type	Target Sites	Sites Installed	Devices Installed
Residential	75	63 (84%)	71
Commercial	12	14 (117%)	23
Schools	2	2 (100%)	4
Total	**89**	**79 (89%)**	**98**

Figure 2 - Summary Map of Wattwatchers Device Anonymised Installation Locations (Google Maps via MyTown Microgrid Project Dashboard). Not all devices are shown due to visible map area.

Aggregated data insights

The following are some of the insights from the aggregated data in the Heyfield MyTown Microgrid Project Dashboard showing average daily consumption, generation and export to grid for the categories of All Sites (yellow), Residential (blue), Commercial (red) and School (green) sites.

Figure 3 – Project Dashboard Aggregated Data Insights (22 Jul 2022)

This aggregated data indicates the average residential daily winter consumption of 20.55 kWh for customers with solar compared to 15.16 kWh for customers without solar generation systems. The average residential daily solar generation in December 2021 was 17.77 kWh but was 7.59 kWh in July 2022. The commercial daily generation was 23.67 kWh in December 2021 compared to 58.26 kWh in July 2022 as more commercial sites with large solar systems were added in this period. Only one school has solar installed which generated 118.31 kWh in December 2021 and 62.87 kWh in July 2022 as the average daily solar generation result.

The aggregate data captured for all sites also indicates there is excess generation available between the hours of 8am and 5pm in summer, with the lowest average daily consumption between 4am and 5am with peak consumption at around 12pm.

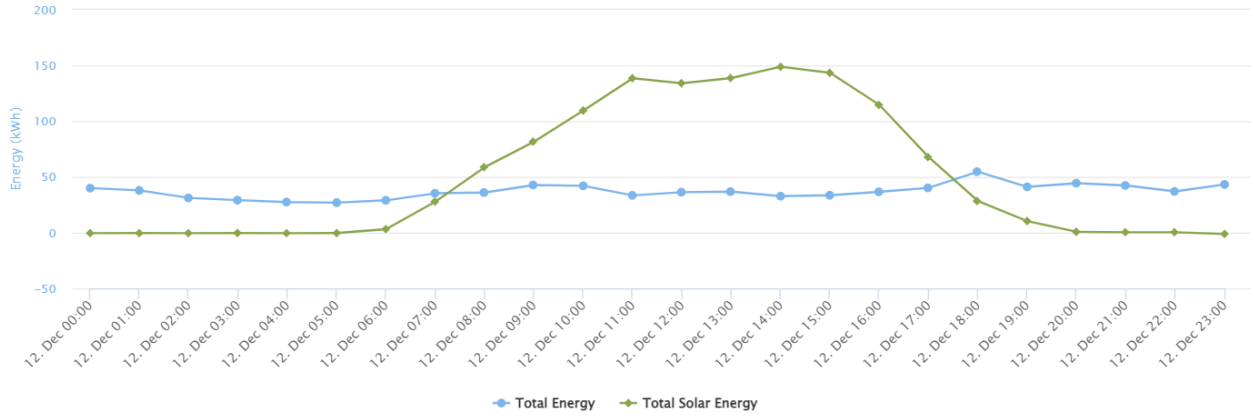

Figure 4 - Aggregated Consumption and Solar Generation Data for all sites 12 Dec 2021 (Summer Profile, 61 sites)

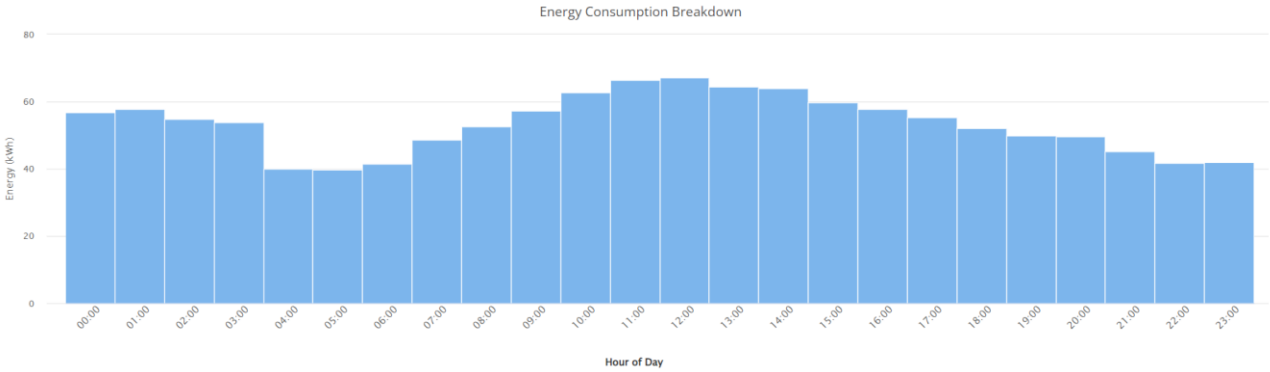

Figure 5 - Aggregated Consumption by hour for all sites December 2021 (Summer Profile, 61 sites)

For the winter seasonal data, there is a similar period of the day when excess solar is available between 9am and 4pm, with a lower overall magnitude compared to the summer period. This is also correlated with the lowest winter daily usage around 2am – 3am each day, with peak usage at 8am – 9am.

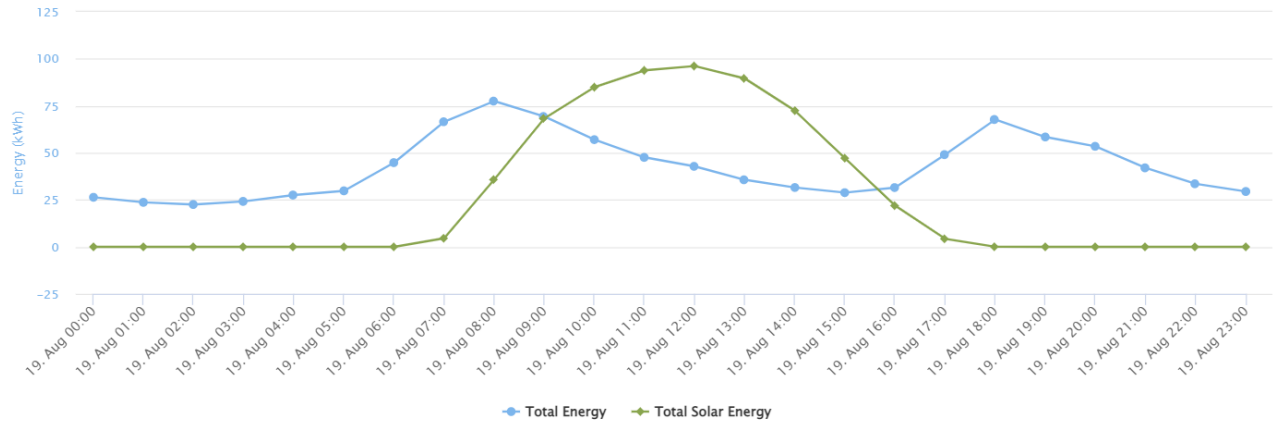

Figure 6 - Aggregated Consumption and Solar Generation Data for all sites 19 August 2021 (Winter Profile, 52 sites)

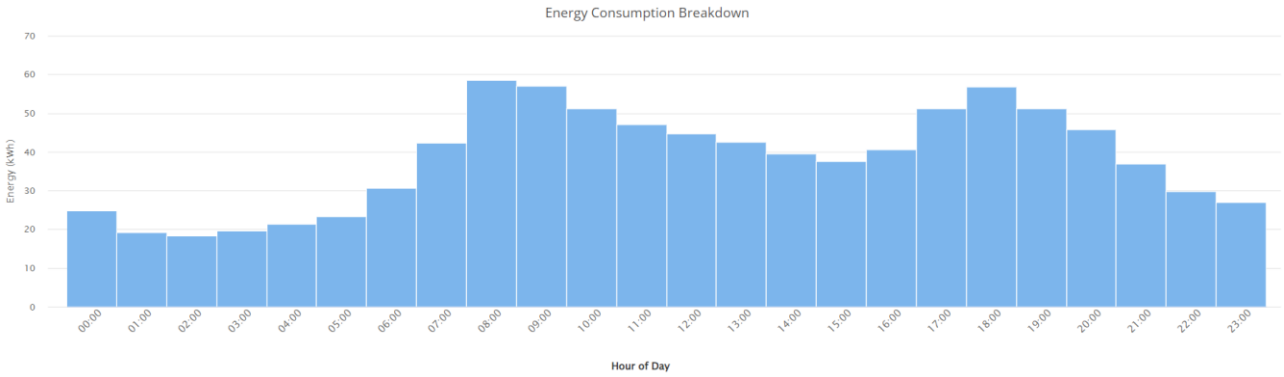

Figure 7 - Aggregated Consumption by hour for all sites August 2021 (Winter Profile, 52 sites)

Residential sites – location and type summary

Residential participants were recruited from all the target areas in Heyfield, Coongulla, Cowwarr, Denison, Glenmaggie, Seaton, Tinamba West and Winnindoo, based on the largest potential Microgrid boundary options from the previous stages of the project. This resulted in a wide range of types of sites from typical single-building domestic dwellings in the Heyfield town itself to larger rural properties with multiple buildings and sheds in the surrounding areas.

The current numbers of residential installation locations are detailed in the following table.

Table 3 - Residential Installation Locations

Residential Site Location	Number of Sites
Heyfield	50
Coongulla	1
Cowwarr	1
Denison	5
Glenmaggie	3
Seaton	3
Total	**63**

In a number of cases, properties had solar generation systems installed on a second building at the property, such as a garage or shed. This required a second Wattwatchers device to be installed to directly monitor the solar generation to make this data available to the research team and the participant.

The following is a summary of the key installation insights from the residential installations completed:

- The average installation cost was $350 per site including additional minor works.
- An average of 1.15 devices were installed per site (or approximately 7 devices for every 6 sites).
- The average installation rate was 5-6 sites installed per installer per day.

There also was a variety of single phase, two phase and three phase residential grid connection types that are being monitored by the installed devices.

Table 4 - Residential Connection Types

Residential Connection Type	Number of Sites
Single Phase	40 (63%)
Two Phase	21 (33%)
Three Phase	2 (3%)
Total	**63**

Two phase installations were much more prevalent than initially expected due to the regional location of Heyfield and a common grid connection pattern of connecting most house loads to one phase and the hot water to a second phase when originally connected.

Here are some further statistics on the types of sites being monitored:

- There are 41 residential sites with solar generation. This represents around 65% of the residential sites being monitored. By comparison, 30% of homes in Australia have solar PV systems, and only 20% of homes in Victoria[1].
- There are 31 sites with air conditioners being monitored, which represents around 49% of the residential sites in Heyfield compared with 74% of homes having air conditioning in Victoria[2]. There are additional sites with air-conditioners that are being monitored as part of the total site consumption that were not available on a dedicated circuit, but the exact number is unknown.
- There are 2 sites with battery energy storage systems. This represents around 3% of the residential sites being monitored compared with less than 1% of homes in Victoria having a battery energy storage system[3].

Residential sites – accompanying data

The Ecologic energy questionnaire was also used to collect data from participants about the location, number of occupants, property use, heating, cooling, hot water, building and insulation, and appliance usage.

Some high-level summary statistics from the residential participant responses include:

- 33% of respondents indicated they are using traditional electric storage hot water systems.
- 25% of respondents indicated they are using electric Heat Pump hot water systems.
- 30% of respondents indicated they are using solar hot water systems with either electric boost (56%) or gas boost (44%).
- 65% of respondents are using some form of gas (which is predominantly bottled gas) while 35% indicated they have no gas supply at their property.

[1] Solar Victoria, 2021
[2] ABS, 2012
[3] Solar Victoria, 2021

The energy questionnaire data is being used by the research team to cross-reference and validate some aspects of the Wattwatchers energy data, as well as to provide inputs for the community energy solution modelling.

Commercial sites - location and type summary

The commercial site participants include a mixture of the small and medium businesses in Heyfield that include cafes, a supermarket, other hospitality and retail stores, and the key Australian Sustainable Hardwoods (ASH) sites.

Table 5 - Commercial Site Installation Locations and solar installed

Location	Commercial sites with solar	Commercial sites without solar	Total commercial sites
Heyfield	10	3	13
Denison	1	0	1

As expected, the majority of the small and medium commercial sites are located within the Heyfield town with the one farming site located in Denison.

The ASH sites have not yet had devices installed but they have undergone the detailed site assessment for the potential installation of 7 devices for grid monitoring and an additional 20 devices would be required for sub-mains monitoring. The ASH gate (NMI) meters already have existing monitoring devices installed by the energy retailer which will provide data via an API, following an agreement that has been established between ASH, the energy retailer and the project team. The resultant data is available in the Project Data Dashboard for the Project Research team.

Commercial sites – accompanying data

The Ecologic energy questionnaire was also used to collect data from participants about the location, number of employees, business type, hours of operation, heating, cooling, hot water, insulation, and equipment usage.

Some high-level summary statistics from the commercial participant responses include:

- 15 responses were received from business participants.
- 66% of business responses are using electric storage hot water.
- 60% of responses indicate that electricity is the only fuel type used by the business, while the remaining 40% use electricity and gas (LPG).

The energy questionnaire data is being used by the research team to cross-reference and validate aspects of the Wattwatchers energy data, as well as to provide inputs for the community energy solution modelling.

School sites

Installations were completed at both schools in Heyfield as follows:

- **Heyfield Primary School** – with around 195 students with an existing 27kW solar system installed
- **St Michael's Primary School** – with around 80 students with no solar system installed

The installation of devices at the school sites was supported by Solar Schools[4], a Wattwatchers business partner that provides an additional education and support package to the schools that forms part of the community education and engagement of the MyTown Microgrid project.

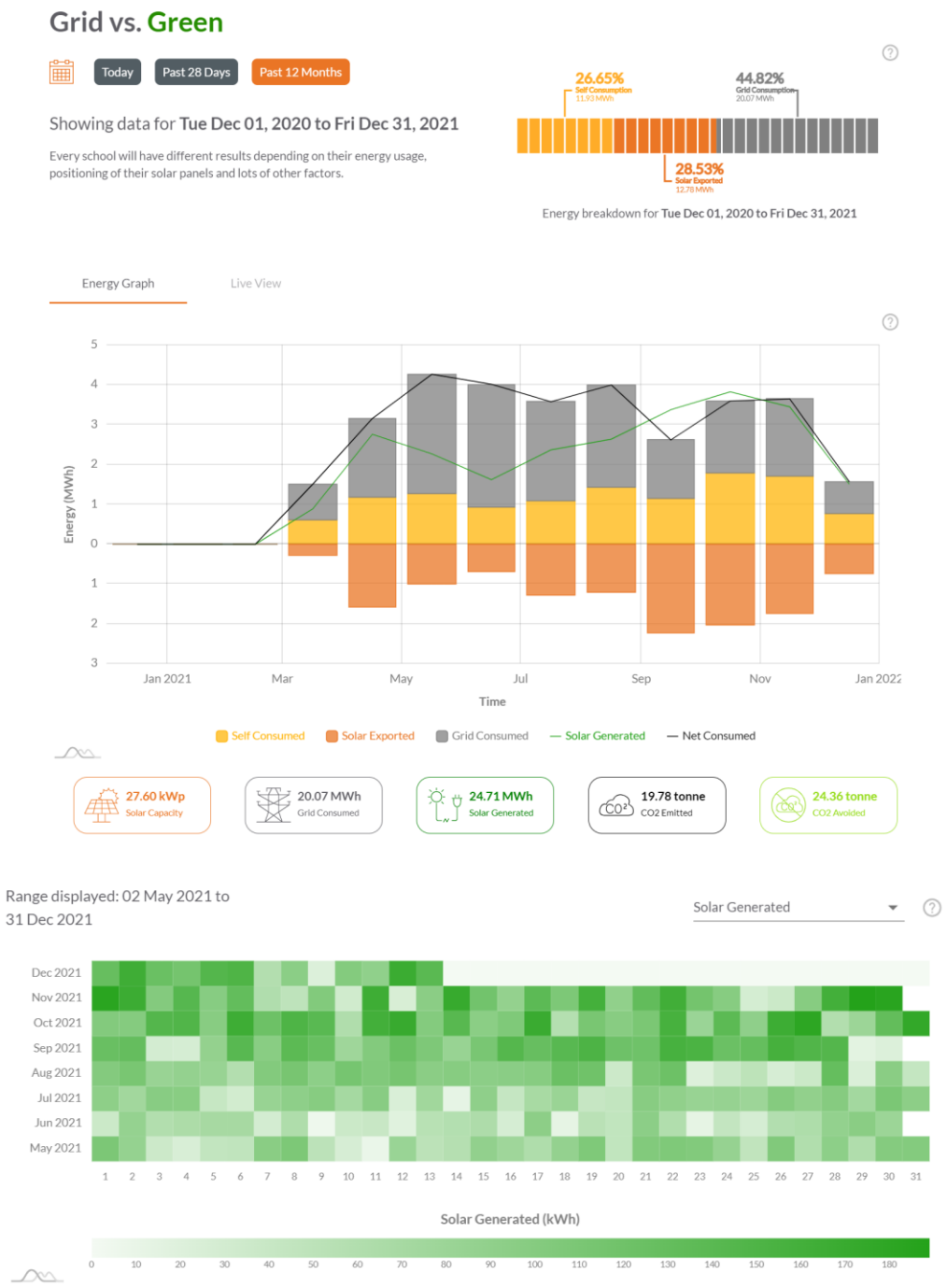

Figure 8 - Solar Schools Public Dashboard for Heyfield Primary School (December 2021)[5]

[4] https://www.solarschools.net/
[5] https://www.solarschools.net/schools/heyfield-primary-school

Impacts from COVID-19

The project has endured through several further interruptions that have required device installations to be delayed or rescheduled due to lockdowns, restrictions and other impacts from COVID-19.

This particularly impacted the project during the August to September 2021 Victorian lockdown period which prevented most installations from occurring due to restrictions on access to residential properties and deferred non-essential works for commercial properties. This also resulted in a substantial backlog of other work for our local electrician, who was required to attend to high priority works in the September to December 2021 period that further limited the rate of deployment of new devices.

There were further impacts to the availability of the participants and the installation teams during this milestone period due to community wide impacts from COVID-19 cases and isolation requirements.

As a further result of these impacts, some final installations will continue through to the end of 2022, but are within the original project budget plan.

Additional Data

Wattwatchers has also provided anonymised data from 45 additional devices installed in the Heyfield region prior to the formal commencement of the MyTown Microgrid project. These devices were installed in September 2020 to November 2020 and provide access to additional sites with over 12 months of historical data that was required for some of the preliminary analysis.

These participants have been invited to formally participate in the Heyfield MyTown Microgrid project to provide the additional consent and to complete the Ecologic questionnaire so that the linked data can be made available to the research team in the future.

Network data from AusNet Services was required for the techno-economic feasibility and high-level options analysis, but this is detailed in the other Analysis Reports as part of milestone 3.4 (techno-economic assessment of energy portfolio options).

Lessons learned

The following are the key lessons learned throughout this milestone period relating to the device deployment and use of data from the Wattwatchers energy monitoring devices.

Be conservative and realistic about the number of devices and time required to install devices

The project required a minimum of 50 devices to be installed with a stretch target of 75 residential, 12 commercial and 2 school sites. The extremely positive deployment results to date despite the complex impacts of COVID-19 have required the focus and dedication of an extremely experienced team to manage the community engagement and installation processes.

This was also supported by a highly-engaged community and community reference group, local installers with an understanding of the specific conditions in and around Heyfield, and the wider project team's extensive experience on other large-scale pilot residential projects that involve energy technology installations.

Devices need to be installed as early as possible in a feasibility study to support modelling and options analysis while considering community engagement lead time

While the installation of the devices in the Heyfield MyTown Microgrid is on-track, it has been recognised that the monitoring devices need to be installed as early as possible in order to record 12 months of data for meaningful analysis of the customer usage profiles.

Most of the Heyfield MyTown Microgrid devices now have 8-12 months of historical data available, but additional data was required from devices with more than 12 months of data available to support the high-level options analysis and preliminary modelling.

By installing devices as early as possible in a project, the research team can ensure there is sufficient data for modelling and analysis without delaying the overall project progress towards modelling the best potential Microgrid or energy solution outcome.

It is also very important to not rush this process and to aim to strike the right balance between doing the necessary preparation work with the community and the supply chains to ready them for device deployment phase, while ensuring you will have enough time to address data quality issues and have 12 months of data for your data analysis phase. Preparation before deployment should include proper training for Community Liaison Officers, the data sampling design plan, customer and data journey mapping, finding a good local installer, sending the necessary communications to the community and stakeholders and setting up support lines and FAQs.

Ensure steps to validate and cross-check survey data are inserted in the data journey as early as possible

Some discrepancies have been identified between the actual data being reported by the Wattwatchers energy monitoring devices and the responses to the Ecologic questionnaire. Examples of this included responses that indicate a heat pump hot water system is installed, but the actual data indicates a traditional electric storage hot water is being used.

This further indicates that additional up-front community education, training and engagement is required to help customers understand what type of appliances they have, as these are important answers for any energy consumption survey or questionnaire that will be used to model and understand local energy usage.

When monitoring hot water in a customer switchboard, the circuits are generally downstream of the revenue meter and the grid contribution needs to be validated with actual data. At some sites, the hot water was

required to be configured as a “grid” channel in the Wattwatchers software so that the contribution of off-peak hot water was more easily identifiable to the research team.

Some of the steps to ensure the data is validated and cross-checked as early as possible should include:

- additional training in energy auditing including easy self-validation checks
- data validation by electrician at time of installation
- early preliminary analysis of energy data to test process and identify common errors.
- off-peak hot water sites may require an extra validation step

Plan for sites that may require multiple devices where solar is installed on a separate building or structure

Around 16% of sites had solar generation systems installed on a secondary building at the property, such as a garage or shed. This required a second Wattwatchers device to be installed to directly monitor the solar generation in addition to a device installed on the main switchboard of the house to make the complete view of data available to the research team and the participant.

This leads to the requirement to clearly identify and link data from multiple devices that are installed at a single site in order to correctly determine Grid usage and Solar generation for a single property.

The requirements for the minimum data collection from the energy questionnaire have been updated based on the first rounds of analysis.

The minimum data required includes:

- Type of property - Residential/Commercial (if Commercial, what subtype; e.g. shop, manufacturing, bank, etc.)
- Total indoor (heated/cooled) area of building in m2; if there is any other relevant outdoor area for commercial
- Number of occupants or workers
- Type of Hot Water (Standard electrical, Electrical Heat Pump, Gas) and identification of Off peak operation.
- Type(s) of heating (Electric resistance, Wood, Gas, Heat pump AC)
- Type(s) of cooling (Fan, Heat pump AC, None)
- Solar system capacity in KW and orientation
- In case of industrial properties, the size of the industrial business (e.g. by output) or main equipment size (e.g. size of pump)

Additional questions for further energy efficiency:

- Type of lighting (if there are many types, specify approximate percentage of each)
- Infiltration level (Draft prone, moderately sealed, well-sealed)
- Insulation level (including Walls, Roof and Floor)
- Type of Window glazing (Single, double, triple)
- An additional question related to Vehicles can include Fuel type and total fuel consumption weekly (for the property) for consideration of potential EV requirements.

Next Steps

An additional 10-20 devices will be installed at residential and commercial sites in the Heyfield region through to December 2022 to complete the device deployments for the project.

This data serves as an important anchor for “bottom-up” modelling of the community by providing the specific sample of customers and energy use across the potential boundaries of the Microgrid or community energy solution.

The data will continue to be available for the research team throughout the project, and any data issues identified will be addressed as required as part of the normal operation and maintenance of the fleet of devices.