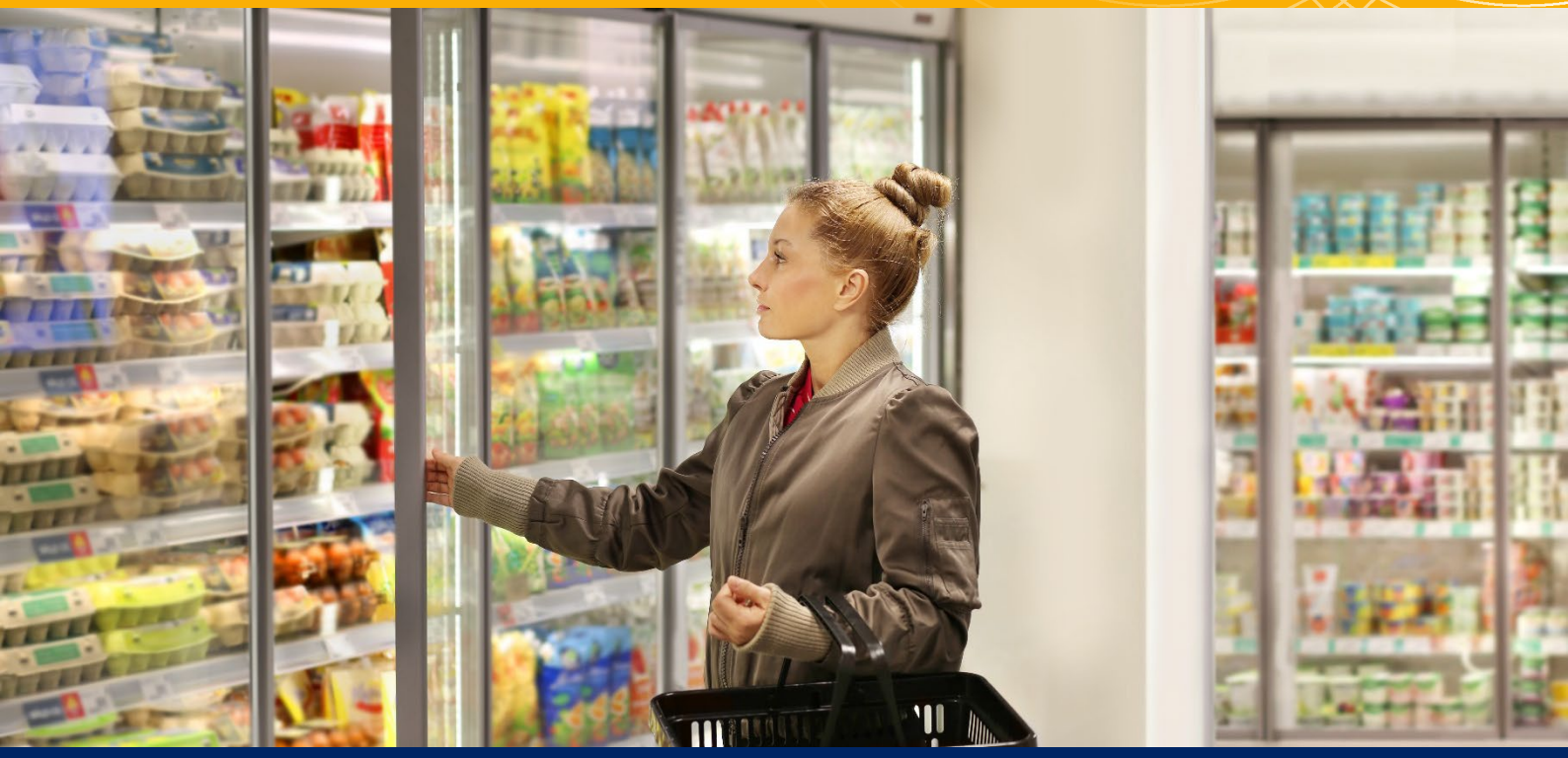
The Department of Climate Change, Energy, the Environment and Water

Measurement and verification demonstration project



Supermarket: Appendix C

Measurement and verification (M&V) plan

August 2024

NSW GOVERNMENT

Acknowledgment of Country The Department of Climate Change, Energy, the Environment and Water acknowledges that it stands on Aboriginal land. We acknowledge the Traditional Custodians of the land and we show our respect for Elders past, present and emerging through thoughtful and collaborative approaches to our work, seeking to demonstrate our ongoing commitment to providing places in which Aboriginal people are included socially, culturally and economically.

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Contents

Appendix C: M&V Plan

This measurement and verification (M&V) plan was prepared by the M&V practitioner prior the Implementation of the energy efficiency measures (EEMs), and it details the methods, procedures, analyses, and reporting that will be conducted throughout the measurement periods to determine, verify, and report energy savings for the energy efficiency upgrades that took place at a supermarket.

This document was prepared while ensuring that the requirements of EVO 10000 – 1:2022, IPMVP Core Concepts 2022, chapter 13, are met.

1. M&V plan authorisation

Site name	Alex Supermarket
Site address	Alex St, Sydney, NSW
Date of this plan	15 June 2019[1]
International Performance Measurement and Verification Protocol (IPMVP®) version being followed	IPMVP Core Concepts 2022[2]

The signatures below indicate acceptance and adoption of this plan.

Organisation that prepared the M&V plan (M&V practitioner)

Person responsible	Able Smith
Title	M&V Officer
Organisation	Acme Energy Savings Verification Pty Ltd
Signature of approval and acceptance	Able Smith
Date	15 June 2019

Third party quality assurance

Person responsible	Sarah Cando
Title	M&V Quality Officer
Organisation	Quality Assessors Pty Ltd
Signature of approval and acceptance	Sarah Cando
Date	16 June 2019

[1] While the data reflects an earlier period, the current version (as of the date of publication of this example M&V plan) of the ESS and VEU legislation has been applied (where these schemes are referenced).
[2] INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL (IPMVP®), *CORE CONCEPTS*, MARCH 2022, EVO 10000 – 1:2022

Energy user

Person responsible	Tesfaye Gebra Mariam
Title	Manager
Organisation	Alex Supermarket
Signature of approval and acceptance	Tesfaye Gebra Mariam
Date	16 June 2019

2. Facility and project overview

Site Name	Alex Supermarket
Site address	Alex St, Sydney, NSW
Brief description of the site operation	Suburban supermarket operating 7 days a week
Energy Efficiency Measures	1. A voltage optimisation (VO) unit installed on the power supply to the entire site 2. Variable speed drives (VSDs) fitted to the lead compressors of the refrigeration units
Energy audit report / other analysis used to develop the project	An energy audit was undertaken by Earnest ESCO but is not available. The two EEMs were identified by that energy audit.

3. Intent of the energy efficiency measures

EEM	Voltage optimisation	VSDs on refrigeration lead compressors
Description of measure	Installation of a VO unit on the electricity supply to the whole site. The VO unit will be set to deliver a steady 230 V supply.	Installation of VSDs on the lead compressors of the centralised refrigeration system supplying frozen and chilled cabinets in the supermarket.
How the measure will save energy, demand, or other resources	Existing electrical equipment on site is designed for 230 V. In practice, however, voltage is typically around 10 to 15 volts higher. For inductive loads such as direct drive motors, lowering the voltage reduces power draw without compromising equipment lifetime, reliability or service delivery.	The existing refrigeration lead compressors only cycle between on and off states and are somewhat oversized. Fitting VSDs enables continuous operation with a reduced pressure rise across the compressors. This process saves energy by bringing the evaporator and condenser temperatures closer together, and improving the refrigeration cycle coefficient of performance.

EEM	Voltage optimisation	VSDs on refrigeration lead compressors
Measure's impact on operational factors, such as temperature set points, hours of operation, etc, and if the measure will correct operational deficiencies	None expected. Whilst existing voltage levels are above the standard level, this is not causing any operational deficiencies.	May improve system reliability by reducing the likelihood of compressor fan belt failure upon system start up (there is less stress on the belts with VSDs, as they enable a "soft start"). On the other hand, the upgrade needs to verify that there is sufficient oil return to the compressors when operating at low speed, otherwise there may be early compressor failure.

EEM	Voltage optimisation	VSDs on refrigeration lead compressors
Affected equipment inventory	All electrical equipment on site	Refrigeration compressors and all equipment in the refrigeration circuit including evaporators, evaporator fans, condensers and condenser fans
Form of energy saved	Electricity	Electricity
Expected annual energy savings	75,000 kWh	58,000 kWh
Expected annual energy cost savings	$15,000	$11,600
Expected annual non-energy cost savings	None	None (ignore any potential savings from improved reliability)

EEM	Voltage optimisation	VSDs on refrigeration lead compressors
Expected total annual cost savings	$15,000	$11,600
Expected annual GHG savings (t CO2-e)	65	50

Total reduction in site electricity consumption is expected to be 133,000 kWh/year, which represents a 14% decrease in the total annual site electricity consumption. These savings estimates were provided by Earnest ESCO, the energy service provider who conducted the energy audit.

4. Selected IPMVP option and measurement boundary

Parameter	Description
IPMVP Option	IPMVP Option C, whole of site
Measurement boundary	The entire electrical system of the site, as supplied by the utility electricity meter.
Interactive effects and their calculated impact on savings.	There are no interactive effects – i.e., changes to site electricity consumption are not expected to impact the amount of gas consumed by the supermarket.

5. Baseline measurement period, electricity consumption and conditions

Identification of baseline measurement period	
Start date	1 June 2018
End date	31 May 2019
Measurement frequency	Daily
Total number of measurements	365

Baseline energy use and demand data
Baseline energy use data was collected from the site electricity interval data supplied by the electricity retailer. It is included in Appendix C3, along with data for the selected independent variables.

Independent variable data / Energy influencing variable data	
Independent variables selected	• Temperature data from the nearest Bureau of Meteorology (BOM) weather station (station ABC12356) • Whether or not the day of the weak is a Sunday, as a binary indicator • Whether or not the site is closed, as a binary indicator. (The site is only closed on Christmas Day, Good Friday, and Easter Sunday)
Independent variables rejected	Rejected independent variables include the other days of the week as binary indicators. These were rejected due to poor t-statistics.
Independent variable data	This is shown in Appendix C3
Visual plots	To demonstrate the relationship between independent variables and energy usage. Shown in Figure 1 below.

Potential static factor	Included in this M&V plan?	Value
Floor area (m^2)	Yes	610 m^2
Equipment nameplate data, to identify changes to existing electrical equipment, excluding plug-loads.	Yes	Refer to Appendix 2
Opening hours	Yes	Monday to Friday: 7am to 10pm Saturday and Sunday: 8am to 10pm
Occupancy	No. Data unavailable, there are no people counters. Proxys for occupancy, (e.g., data on the number of transactions or sales per day) were not supplied as the energy user was unwilling to disclose it due to confidentiality reasons.	N/A
Equipment run times	Yes	Refrigeration equipment operates 24/7. The HVAC system operates from 5:30 am to 9:30 pm Monday to Saturday, and from 6:00 am to 9:00 pm on Sundays

Operating conditions, such as set points, lighting levels, ventilation rates for each operating mode and season	Should be included, but data wasn't collected, as the advice was that HVAC and refrigeration set points never change.[3]	N/A

Potential static factor	Included in this M&V plan?	Value
Problems/ outages that occurred during the baseline measurement period	No, none occurred.	N/A
Planned changes	None are likely to occur during the reporting period.	N/A

Figure 1 Electricity use (kwh) and average temperature during the baseline

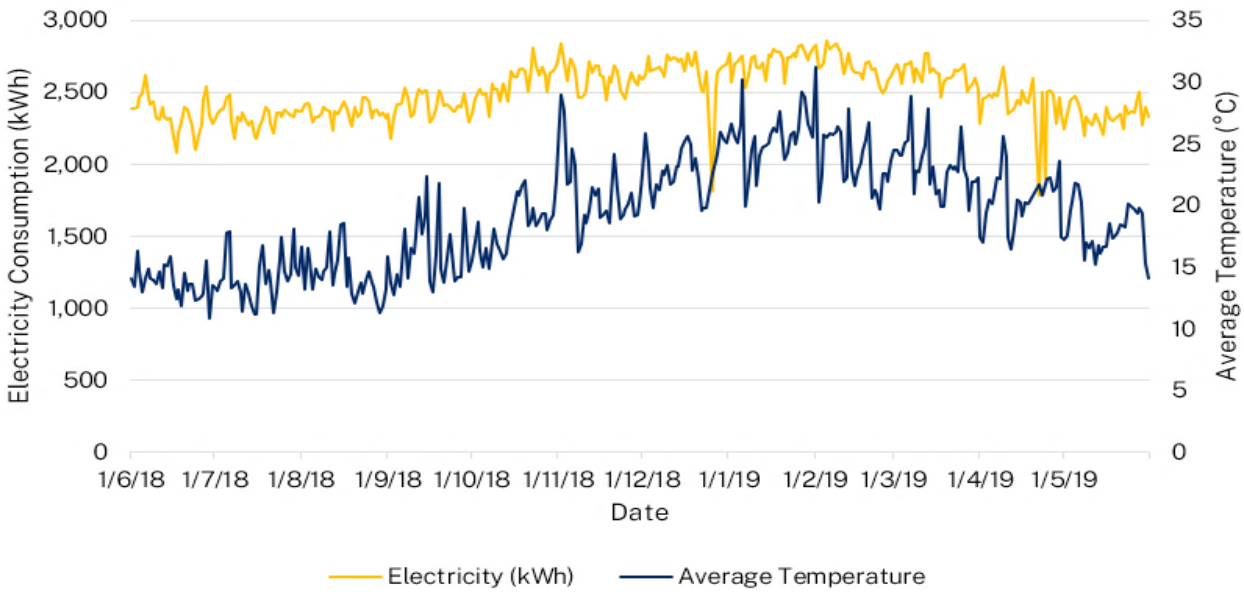
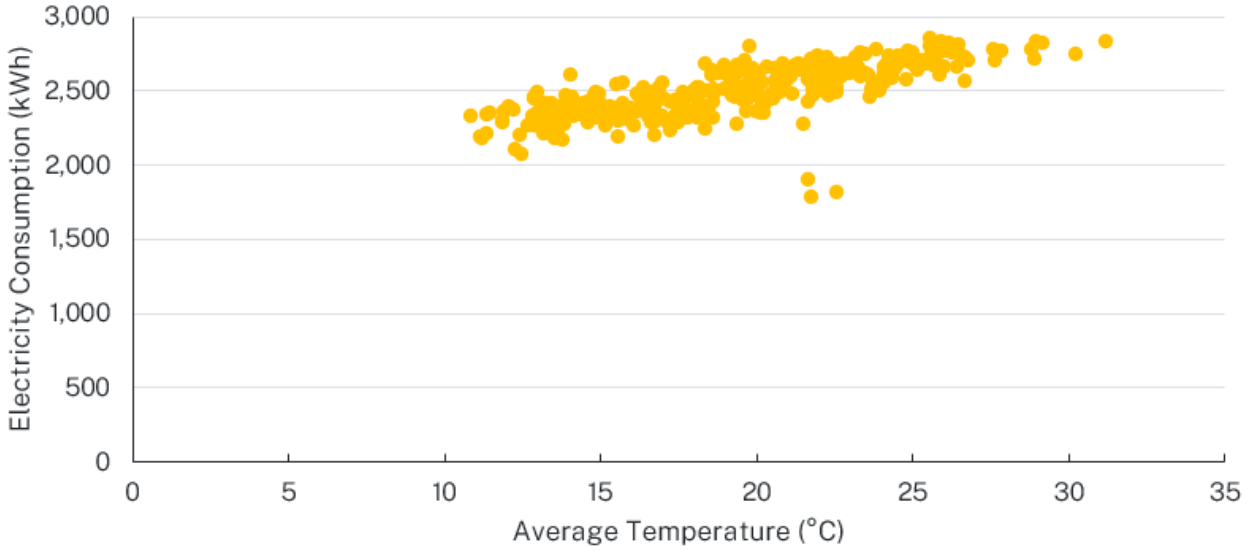


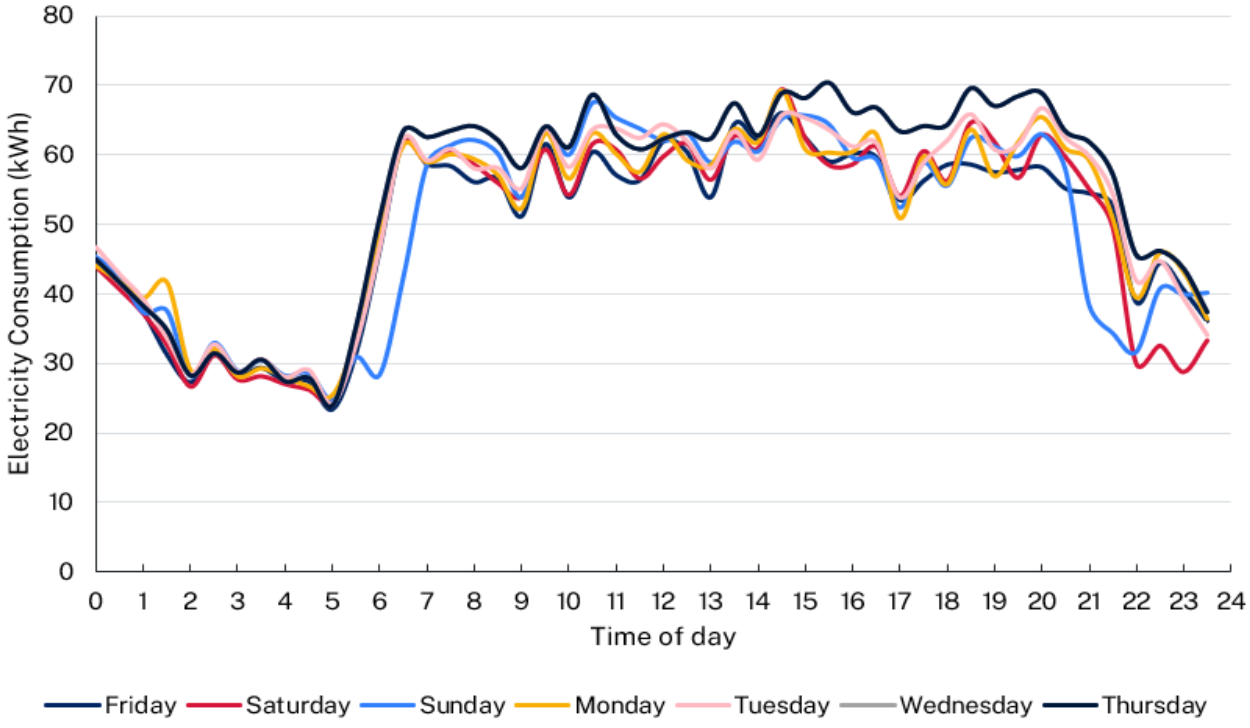
Figure 2 Baseline electricity use (kWh) versus average temperature (°C)

[3] This is a deficiency in the approach to M&V. By not recording it, it makes it impossible to account for potential future control point changes. For example, while refrigeration set points are unlikely to change, a future EEM could be to set seasonally based HVAC set points.



As shown in Figure 2, there is a clear relationship between energy consumption and average temperature. The three outliers represent days when the site was closed.

Figure 1 Hourly electricity consumption in kWh during weekdays, Saturday, and Sunday in the baseline period.



As shown in Figure 3, on Sundays, energy use is slightly lower than the remaining weekdays. And energy use is clearly lower when the site is closed.

6. Operational verification requirements

Operational verification activities to be undertaken include verifying that:

- The voltage of power leaving the VO equipment to supply the site is at 230 V, and also confirming that this voltage is lower that the incoming voltage into the VO unit. This is done using instrumentation installed on the voltage optimisation equipment.
- The compressors are mostly operating at below 50 Hz. This is done by monitoring the Building Management System (BMS) data and inspection of the VSDs fitted to the lead refrigeration compressors.
- The average difference between evaporator and condenser pressure (temperature) is lower following the upgrade than it was before the upgrade. This is done by inspecting the BMS trend logs.

Able Smith, the M&V Officer from Acme Energy Savings Verification Pty Ltd, will be responsible for verification activities.

Additionally, one month after commissioning the EEMs, the Able Smith will determine avoided energy use over a month to verify if the savings are approximately 14% as expected.

Every 3 months, Able Smith will also contact the store manager to discuss if there are any changes to static factors. However, prior to this quarterly call with the store manager, Able will determine the avoided energy use in the preceding 3 months. If there are any unexpected trends this will be discussed with the store manager, and if needed, additional verification visits may be undertaken. Each M&V report will report on any verification activities undertaken.

There are no plans to undertake additional site verification inspections. However, where there are significant unexpected and unexplained variations in savings, Able will conduct a site inspection to verify proper operation of the EEMs.

7. Reporting period(s)

Parameter	Value
Length of reporting period	12 months
Number of reports	8
Frequency of reports	Every 12 months

Parameter	Value
Date first report will be provided	Within one month after the end of the first 12-month reporting period. It is expected that the EEMs will be implemented by the end of June 2019, with the reporting period expected to start on 1 July 2019. The first report should be issued in July or August of 2020.

8. Basis for adjustment

Adjustment	Description
Basis for adjustment	Savings will be reported as normalised electricity savings. The normal year will be taken as the 2019 calendar year.
Static factor adjustments	Where changes in static factors occur, they will be addressed either: (a) In accordance with IPMVP guidelines an engineering calculation will be developed to estimate by how much the baseline energy should be increased/decreased to account for the change in static factors, and the baseline model then changed to take this into account (non-routine adjustment); or (b) Using the IPMVP Non-Routine Adjustments Guide[4], applied when changes in static factors are temporary to make baseline adjustments. *Note: The NSW Energy Savings Scheme (ESS) and Victorian Energy Upgrades (VEU) legislation have different requirements, as shown in the box below.*
Baseline adjustments due to issues in the baseline period	There are no baseline equipment problems or code compliance issues that have occurred in the baseline period that need to be addressed.

[4] IPMVP APPLICATION GUIDE ON NON-ROUTINE EVENTS & ADJUSTMENTS, INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL®, October 2020, EVO 10400 – 1:2020

Box 1 Static factor adjustments according to the ESS and VEU

ESS	VEU
The PIAM&V method application requirements for non-routine events and adjustments describes how to account for events that affect energy consumption and are not modelled by any of the Independent Variables or the Site Constants	Only changes whose root sources is COVID can be treated as non-routine events and must be undertaken in accordance with the document Accounting for COVID-19 under Victorian Energy Upgrades Measurement & Verification Projects.

9. Calculation method and analysis procedure

9.1 Baseline energy use

The baseline energy model is established via regression analysis using the Excel® function 'LINEST':

> Daily electricity consumption (kWh) = 1919.8 + 31.2 x {Average temperature} – 86.6 x {if a Sunday} – 744.53 x {if the site is closed}.

Equation 1 Baseline regression model

The model statistics, including the range of the independent variables, t-statistics, CV_{RMSE}, and R^2 are shown in Table 1 and Table 2.

Table 1 Baseline model statistical test results

Statistical test	Value	IPMVP Recommendation	Acceptable?
Expected Values error	0.000%	< 0.005%	Yes
Adjusted R^2	0.78	> 0.75	Yes
CV_{RMSE}	0.033	< 0.2	Yes

Table 2 Baseline model coefficient. t stats, and range of independent variables

Parameter	Intercept	Average Temperature	Sunday	Site closed
Coefficient	1919.7	31.2	-86.6	-744.53
t-statistic	99	32	-6.9	-15
t-statistic acceptable? (> |2|)	N/A	Yes	Yes	Yes
Minimum value	N/A	10.85	0	0
Maximum value	N/A	31.2	1	1

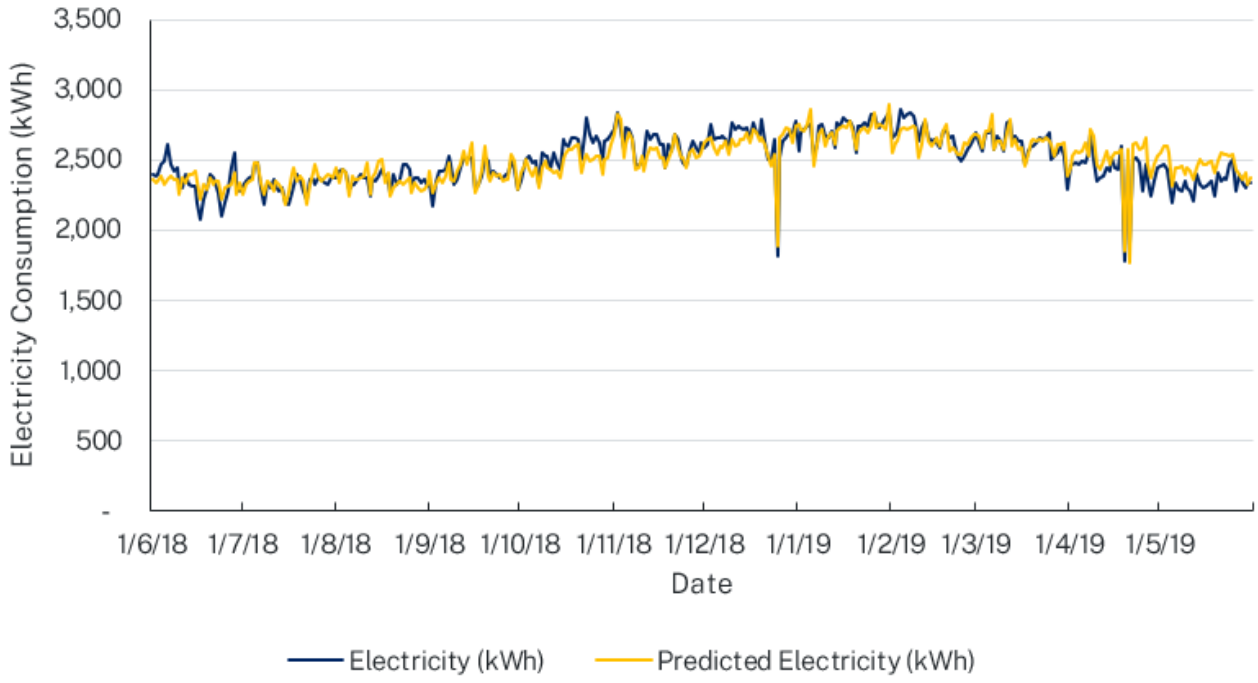
Box 2 explains the minimum statistical requirements under the ESS and VEU.

Box 2 Minimum statistical requirements according to the ESS and VEU

ESS	VEU
Table A22 of Schedule A in the ESS Rule stipulates the statistical requirements: • t-statistics must be > |2| • CVRMSE must be less than 0.25 if R2 is > 0.5, and < 0.1 when R2 is < 0.5	The VEU has no legislated statistical requirements.

Figure 4 below shows the actual electricity use in the baseline period along with that predicted by the baseline energy model. It can be visually seen that the model is a relatively good predictor of energy use.

Figure 2 baseline actual and predicted electricity consumption



9.2 Calculation of Savings

Using the baseline energy model, the adjusted baseline will be determined by applying the independent variables in the normal year to determine the adjusted baseline.

Using the reporting period energy model (to be developed for each reporting period), the adjusted reporting period savings will also be determined by applying the independent variables in the normal year to determine the adjusted reporting period.

Normalised savings for any reporting period will be determined by subtracting the adjusted reporting period energy from the adjusted baseline period energy. As mentioned earlier, the 2019 calendar year will be used as the normal year.

9.3 Uncertainty determination

Uncertainty will be determined by combining the sources of uncertainty as outlined in Uncertainty Assessment for IPMVP.[5]

The sources of uncertainty are the baseline model uncertainty and the reporting period model uncertainty. There is no metering uncertainty (utility meters are assumed to have no error) and no sampling uncertainty. The values of the uncertainty parameters for the baseline energy model are shown in the Table 3 below.

Table 3 Baseline model uncertainty

Uncertainty Parameter	Value
SEy, Regression model standard error (kWh)	177.72
N, Number of observations in the normal year	365
SE_{allobs}, Standard error over all observations = SEy x √N (kWh)	3,395

[5] UNCERTAINTY ASSESSMENT FOR IPMVP, INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL®, July 2019, EVO 10100 – 1:2019

10. Savings

10.1 Expected savings summary

The expected energy, cost and GHG savings are shown in Table 4 below.

Table 4 Expected savings

Savings	Value
Electricity savings (kWh)	133,000
Cost savings ($)	26,600
GHG savings (t CO_2-e)	116

10.2 Energy cost savings

Electricity is supplied at an average rate of $0.20/kWh. It has been agreed that an average rate will be used for determining savings, rather than differentiated time-of-use tariffs or with differentiated demand charges. This is to simplify the delivery of M&V and valuing of savings.

In the reporting periods, savings will be valued at the current flat tariff rate of $0.20 with no escalation. The monetary value of savings will be determined by multiplying the normalised savings, in kWh, by the tariff.

10.3 Non-energy cost savings

There are no expected non-energy cost savings.

10.4 Greenhouse gas emissions factors

The baseline greenhouse gas (GHG) emissions factor is based on the 2018/2019 financial year emissions factors published in the National Greenhouse Accounts Factors, August 2021.

It includes scope 2 and scope 3 emissions (covering transmission and distribution losses), with an overall full fuel cycle emissions factor of 0.87 kg CO_2-e/kWh.

In savings reports, the most recent published emissions factor, from the National Greenhouse Accounts, for the financial year in which most of the savings occur, will apply. The emissions factor is to include both scope 2 and scope 3 emissions.

The valuing of savings is treated differently in the ESS and VEU, as explained in box 3 below.

Box 3 Valuing savings according to the ESS and VEU

ESS	VEU
Financial savings: The ESS has no requirements for savings to be assigned a monetary value. The number of ESCs created is based on the amount of energy saved, applying various factors in accordance with the scheme legislation and as calculated in the case study off which this M&V plan is based. Greenhouse gas savings: The ESS has no requirements for savings to be assigned a GHG savings value.	**Financial savings:** The VEU has no requirements for savings to be assigned a monetary value. The number of VEECs created is based on the amount of energy saved, applying various factors in accordance with the M&V Specifications and as calculated in the case study, off which this M&V plan is based. **Greenhouse gas savings:** The VEU M&V Specifications base the number of VEECs created on the GHG savings, which are determined by applying an emissions factor stipulated in the legislation to the amount of energy saved.

11. Metering Details

Site utility electricity meter will be used to determine savings. Data will be collected directly from the web portal provided by the electricity distribution company serving the site (Table 5).

Table 5 Energy meters

Form of energy	Energy retailer	Billing units	Unique meter identifier number	Meter serial number
Electricity	Reliable Electricity Corp	kWh	NMI AE1F20591	N/A
Gas	N/A			

There are no calibration requirements for utility meters.

There are no non-utility energy meters involved in this M&V process.

The independent variable average temperature data is based on the average of daily minimum and daily maximum temperature data taken from the nearest BOM weather station to the site; station ABC12356. This temperature data will be collected directly from the BOM website.

Where either the daily maximum or minimum temperature reading is missing (which occurs occasionally, not often, with BOM data), that day shall be excluded from the regression model.

The VEU requirements are different to this as explained in the following text:

VEU requirements for missing data

Section 4.16 of the M&V Method Activity Guide details how to deal with missing data:

Missing data - Data loss and how it will be measured must be established in the M&V plan. The M&V plan must identify a method for dealing with missing or erroneous data in the measurement periods. There are different options when dealing with missing data for dependent and independent variables. The impact report should clearly identify all instances of missing data along with how these were dealt with, giving reasons for the option chosen as well as any relevant evidence to support this.

Where **dependent variable data** is missing, you should deal with this in the following order:

1. Consider moving the measurement period

2. Use site constants to remove ineligible time intervals (i.e. when site constant is not at its normal value)

3. Remove the time interval giving clear reasons for omission. Independent variable data

Where independent variable data is missing, you should deal with this in the following order:

1. Use a value from an equivalent time period to replace that data, where appropriate (e.g. the same interval in a comparable year).

2. Move the measurement period to avoid having missing data.

3. Propose another option to us, justifying why options one and two are not appropriate for your project.

Application to this Supermarket M&V Plan

Weather data from exactly a year before could be used to substitute any missing weather data.

12. Monitoring and reporting responsibilities

12.1 Responsibility Matrix

Table 6 shows the different parties responsible for undertaking the various tasks as part of the M&V process.

Table 6 Responsibility matrix

Task	Collect	Analyse	Review	Archive	Report
Energy Data	M&V provider	M&V provider	M&V provider	M&V provider	M&V provider
Independent Variables	M&V provider	M&V provider	M&V provider	M&V provider	M&V provider
Management of measurement equipment and specifications	N/A	N/A	N/A	N/A	N/A
Static factors / changes to static factors	Energy user	M&V provider	M&V provider	M&V provider	Energy user
Operational verification and periodic verification inspections	M&V provider	M&V provider	M&V provider	M&V provider	M&V provider
Preparation of M&V reports	M&V provider	M&V provider	M&V provider	M&V provider	M&V provider

12.2 Names of the individuals responsible

M&V provider: Able Smith

Energy user: Sarah Cando

13. Expected accuracy

Sources of uncertainty	
Modelling uncertainty	As shown above in Table 3, the baseline modelling uncertainty is 3,395 kWh (over the 365 days of the baseline period), accounting for autocorrelation.
Measurement uncertainty	As the utility meter is used, there is no measurement uncertainty.
Sampling uncertainty	As no sampling is undertaken, there is no sampling uncertainty.
Estimation errors	No estimates are undertaken, so there is no estimation uncertainty.

Uncertainty calculation	
Expected accuracy of the reported energy savings	Assuming that the reporting model has the same error as the baseline model, the expected normalised savings are expected to have a standard uncertainty of 4,801 kWh. This is calculated as follows: The only source of error in the baseline period is modelling error, with this error equal to 3,395 kWh (taking into account autocorrelation). Assuming the reporting model has the same error as the baseline model, the expected normalised savings are expected to have a standard uncertainty of plus/minus √2 x baseline error = √2 x 3,395 kWh (taking into account autocorrelation) = 4,801 kWh.

Uncertainty calculation	
Uncertainty in relation to savings	The expected savings are 133,000 kWh. The expected standard uncertainty as a percent of expected energy savings = 4,801/133,000 = 3.6%. The IPMVP recommendation that savings be at least twice the standard error is highly likely to be achieved.

Uncertainty calculation

Uncertainty in the savings report(s)

Uncertainty in the savings reports will be based by combining the baseline model error (as was shown in Table 4) with the reporting model error. These two errors are combined in quadrature, as shown below.

$$Savings\ standard\ uncertainty = \sqrt{\mathbf{SE(BL)^2} + \mathbf{SE(Reporting)^2}}$$

Equation 2 Formula for calculating savings standard uncertainty

Where SE(BL) is the Standard Error of baseline energy model, and SE(Reporting) is the Standard Error of reporting period energy model.

The savings uncertainty at the desired confidence level will be determined by multiplying the savings standard uncertainty resulting from equation XX by the t value.

To determine the t value for the 12 months period, the Degrees of Freedom (DoF) must be calculated as follows:

DoF = N (number of observations) – 1 – Number of Independent Variables = 365 – 1 – 3 = 361 (assuming that there are no observations excluded due to missing data). This produces a t-value of 1.649 based on Table 1 of Uncertainty Assessment for IPMVP.

Therefore, the savings uncertainty at the 90% confidence level, using the t value is 1.649 can be calculated following equation 2 below. (Assuming that there are no observations excluded due to missing data).

$$Savings\ uncertainty\ at\ the\ 90\%\ CL = 1.649. \sqrt{\mathbf{SE(BL)^2} + \mathbf{SE(Reporting)^2}}$$

Equation 3 Formula for determining savings uncertainty at the 90% confidence level

14. M&V Budget

14.1 M&V Establishment budget

The M&V establishment budget is $3,000.

14.2 M&V Reporting budget

Table 7 M&V Reporting budget

Parameter	Value
Cost of each M&V report	$2,000
Number of reports	8
Subtotal M&V reporting cost (8 years)	$16,000
Annual verification costs	$1,000
Number of years of verification	1 (during first year only)
Subtotal verification costs	$1,000
Total M&V Reporting and Verification Costs	$17,000
Annual reporting and verification cost as a percentage of the estimated annual savings	First year: $\frac{\$3,000}{\$26,600}$ = 11% Second and subsequent years: $\frac{\$2,000}{\$26,600}$ = 8%

Note: These costs do not include the costs of independent quality assurance.

15. M&V report format

The M&V report will be prepared using the template in Appendix C1.

M&V reports will be prepared annually. They will be supplied directly to the energy user.

There is no planned independent review of M&V reports.

16. Quality assurance

The following procedure will be used to ensure the quality of the energy saving calculations and all other related activities in determining the savings.

Verification inspections to ensure the EEM continues to operate as intended

- There will be one verification inspection to verify that the EEMs are operating as designed following deployment of the EEMs.
- No other verification activities are scheduled, however, should quarterly analysis of avoided energy usage identify any loss of inspected savings, additional verification activities may be undertaken. These are not included in the annual reporting budget.

Lost and missing data

- Where there is missing electricity consumption or weather data, any day in which observations are missing will be excluded from any of the energy models.

Review requirements

- This M&V plan will be verified by a third-party reviewer.
- There is no plan for independent review of savings reports.

17. References

- UNCERTAINTY ASSESSMENT FOR IPMVP, INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL®, July 2019, EVO 10100 – 1:2019 (Uncertainty Assessment for IPMVP)
- INTERNATIONAL PERFORMANCE MEASUREMENT AND VERIFICATION PROTOCOL (IPMVP®), *CORE CONCEPTS*, MARCH 2022, EVO 10000 – 1:2022 (IPMVP Core Concepts)

18. List of appendices

Appendix C1 M&V report template

Appendix C2 Equipment nameplate data

Appendix C3 Baseline energy and independent variable data

Appendix C4 Energy audit – not provided due to commercial confidentiality

19. Appendix C1 – M&V report template

19.1 Overview of the M&V report

19.1.1 M&V report authorisation

Site name	
Date of this M&V report	
Name and date of the authorised M&V plan being followed	
IPMVP version being followed	IPMVP Core Concepts 2022

The signatures below indicate acceptance and adoption of this report.

19.1.2 Organisation that prepared the report

Person responsible	
Title	
Organisation	
Signature of approval and acceptance	
Date	

19.1.3 Third party quality assurance

Person responsible	
Title	
Organisation	
Signature of approval and acceptance	
Date	

19.1.4 Energy User

Person responsible	
Title	
Organisation	
Signature of approval and acceptance	

Date	

19.1.5 M&V report distribution

[List who the report is being distributed to]

19.2 Project background

M&V option	
EEM description	
Reporting period start date	
Reporting period end date	
Frequency of M&V reports	

19.3 M&V data collection activities

Reporting period start time	
Reporting period end time	
Energy and key parameter data	
Independent variable data	
Static factor data	
Description of inspection/operational verification activities conducted and findings	

19.4 Savings calculation and methodology

19.4.1 Method overview

[Give an overview of the savings calculation method]

19.4.2 Method details

[Describe how the savings are calculated, including calculation details, include the following:

- Reporting period data
- Reporting regression model
- Tests of regression model
- Identification of the normal year
- Values of independent variables in the normal year

- Assessment of the range of independent variables in the baseline and the reporting period models as compared to their range in the normal year.]

19.4.3 Assumptions used in calculations

[List any assumptions made]

19.4.4 Non-routine adjustments

[Describe the baseline adjustments]

19.5 Verified savings

19.5.1 Verified savings calculations

[Insert from calculation spreadsheet the tables of calculations. Show energy, cost and GHG savings. Graph the adjusted baseline and adjusted reporting energy in the normal year]

19.5.2 Uncertainty

[Sources of uncertainty]

[State calculated uncertainty, including any calculations]

19.5.3 Utility costs used to calculate the reported savings

[Table the utility costs used in the savings calculation]

19.5.4 Greenhouse gas emissions factors used to report savings

[Table the emissions factors used in the savings calculation]

19.6 Verified energy and cost savings compared with those estimated in the M&V plan

[Table showing verified energy, cost and GHG savings compared with those estimated from the M&V plan]

20. Appendix C2 – Equipment nameplate data

- Lighting
  - Internal: 150 x 40w LED troffer lighting
  - External: 6 x 100w LED flood lights
- Toilet exhaust fans: 2 x Fantech MV254
- Packaged air conditioning unit 1: Hitachi RUA 30HS
- Packaged air conditioning unit 2: Hitachi RUA 40HS
- Packaged air conditioning unit 3: Hitachi RUA 10HS
- Cool room evaporators
  - Unit 1: Buffalo Trident PS1M095 Evaporator
  - Unit 2: Buffalo Trident PS1M095 Evaporator
- Freezer room evaporators:
  - Unit 1: Buffalo Trident PS1M095 Evaporator
  - Unit 2: Buffalo Trident PS1M095 Evaporator
- Refrigeration compressors: 10 x Bitzer 4DES-5Y
- Air cooled condensers: 6 x Carrier Tenor Alto
- Freezer cabinets: 10 x Bonnet Neve Skylight
- Refrigeration cabinets: 12 x Bonnet Neve FC16

21. Appendix C3 – Baseline data

Table 8 Baseline energy and independent variables data

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
1/06/2018	2,390.51	14.05	0	0
2/06/2018	2,387.77	13.45	0	0
3/06/2018	2,401.65	16.35	1	0
4/06/2018	2,468.47	14.8	0	0
5/06/2018	2,497.01	12.95	0	0
6/06/2018	2,613.36	14.05	0	0
7/06/2018	2,464.82	14.85	0	0
8/06/2018	2,418.95	14.1	0	0
9/06/2018	2,439.95	14	0	0
10/06/2018	2,324.74	13.65	1	0
11/06/2018	2,306.90	14.6	0	0
12/06/2018	2,392.31	13.35	0	0
13/06/2018	2,327.18	15.2	0	0
14/06/2018	2,313.17	15.15	0	0
15/06/2018	2,316.05	15.85	0	0
16/06/2018	2,194.11	13.55	0	0
17/06/2018	2,076.85	12.45	1	0
18/06/2018	2,216.01	13.15	0	0
19/06/2018	2,291.01	11.85	0	0
20/06/2018	2,400.12	14.55	0	0
21/06/2018	2,377.01	13.1	0	0
22/06/2018	2,339.77	13.7	0	0
23/06/2018	2,262.52	13.65	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
24/06/2018	2,103.02	12.25	1	0
25/06/2018	2,200.17	12.4	0	0
26/06/2018	2,273.05	12.65	0	0
27/06/2018	2,444.84	12.85	0	0
28/06/2018	2,545.33	15.5	0	0
29/06/2018	2,335.12	10.85	0	0
30/06/2018	2,280.46	13.5	0	0
1/07/2018	2,318.11	13.35	1	0
2/07/2018	2,345.35	13.1	0	0
3/07/2018	2,372.97	13.9	0	0
4/07/2018	2,385.81	14.1	0	0
5/07/2018	2,464.43	17.8	0	0
6/07/2018	2,485.13	17.95	0	0
7/07/2018	2,305.00	13.35	0	0
8/07/2018	2,179.68	13.5	1	0
9/07/2018	2,331.68	13.85	0	0
10/07/2018	2,304.15	12.95	0	0
11/07/2018	2,355.33	11.45	0	0
12/07/2018	2,315.36	13.6	0	0
13/07/2018	2,271.55	12.9	0	0
14/07/2018	2,297.77	11.85	0	0
15/07/2018	2,190.76	11.15	1	0
16/07/2018	2,179.64	11.2	0	0
17/07/2018	2,266.64	15.15	0	0
18/07/2018	2,314.16	16.75	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
19/07/2018	2,399.42	13.7	0	0
20/07/2018	2,364.11	14.75	0	0
21/07/2018	2,281.08	13.85	0	0
22/07/2018	2,218.67	11.35	1	0
23/07/2018	2,355.78	12.95	0	0
24/07/2018	2,355.74	15.5	0	0
25/07/2018	2,329.04	17.4	0	0
26/07/2018	2,374.72	14.7	0	0
27/07/2018	2,361.15	13.9	0	0
28/07/2018	2,342.32	14.45	0	0
29/07/2018	2,325.66	18.1	1	0
30/07/2018	2,377.98	14.95	0	0
31/07/2018	2,367.27	14.35	0	0
1/08/2018	2,371.23	16.65	0	0
2/08/2018	2,420.60	13.2	0	0
3/08/2018	2,427.54	16.5	0	0
4/08/2018	2,405.10	15.7	0	0
5/08/2018	2,288.71	13.2	1	0
6/08/2018	2,325.76	14.85	0	0
7/08/2018	2,327.85	14.15	0	0
8/08/2018	2,361.10	14	0	0
9/08/2018	2,392.42	14.6	0	0
10/08/2018	2,378.23	14.95	0	0
11/08/2018	2,368.46	17.9	0	0
12/08/2018	2,237.42	13.5	1	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
13/08/2018	2,363.98	14.4	0	0
14/08/2018	2,353.52	15.55	0	0
15/08/2018	2,384.35	18.45	0	0
16/08/2018	2,431.10	18.6	0	0
17/08/2018	2,385.28	13.4	0	0
18/08/2018	2,345.90	15.8	0	0
19/08/2018	2,266.96	12.9	1	0
20/08/2018	2,394.98	12.05	0	0
21/08/2018	2,327.72	12.95	0	0
22/08/2018	2,357.19	13.75	0	0
23/08/2018	2,464.18	12.85	0	0
24/08/2018	2,466.30	13.9	0	0
25/08/2018	2,431.22	14.6	0	0
26/08/2018	2,322.13	13.8	1	0
27/08/2018	2,372.89	13.4	0	0
28/08/2018	2,377.21	12.2	0	0
29/08/2018	2,341.43	11.35	0	0
30/08/2018	2,361.08	11.9	0	0
31/08/2018	2,317.66	13.15	0	0
1/09/2018	2,348.98	15.85	0	0
2/09/2018	2,175.81	13.75	1	0
3/09/2018	2,331.42	12.8	0	0
4/09/2018	2,417.94	14.45	0	0
5/09/2018	2,416.46	13.4	0	0
6/09/2018	2,426.64	14.95	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
7/09/2018	2,529.29	18.1	0	0
8/09/2018	2,465.45	14.1	0	0
9/09/2018	2,330.44	16.5	1	0
10/09/2018	2,363.25	16.15	0	0
11/09/2018	2,440.81	17.4	0	0
12/09/2018	2,519.25	20.65	0	0
13/09/2018	2,489.26	17.65	0	0
14/09/2018	2,515.84	19.1	0	0
15/09/2018	2,515.66	22.4	0	0
16/09/2018	2,287.89	13.85	1	0
17/09/2018	2,322.73	13	0	0
18/09/2018	2,388.73	15.95	0	0
19/09/2018	2,510.63	21.8	0	0
20/09/2018	2,488.61	14.85	0	0
21/09/2018	2,402.04	13.8	0	0
22/09/2018	2,419.52	15.7	0	0
23/09/2018	2,394.05	17.65	1	0
24/09/2018	2,368.95	15.15	0	0
25/09/2018	2,371.27	13.9	0	0
26/09/2018	2,402.12	14.25	0	0
27/09/2018	2,398.39	14.25	0	0
28/09/2018	2,489.36	19.85	0	0
29/09/2018	2,429.41	18.15	0	0
30/09/2018	2,288.47	14.6	1	0
1/10/2018	2,344.70	15.5	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
2/10/2018	2,454.96	17	0	0
3/10/2018	2,497.65	18.65	0	0
4/10/2018	2,521.81	16.35	0	0
5/10/2018	2,484.59	14.95	0	0
6/10/2018	2,494.67	16.6	0	0
7/10/2018	2,330.45	14.85	1	0
8/10/2018	2,556.48	16.95	0	0
9/10/2018	2,522.02	18.15	0	0
10/10/2018	2,524.82	16.85	0	0
11/10/2018	2,434.69	16.35	0	0
12/10/2018	2,555.93	15.7	0	0
13/10/2018	2,484.11	16.15	0	0
14/10/2018	2,431.78	17.25	1	0
15/10/2018	2,644.93	18.55	0	0
16/10/2018	2,606.08	19.75	0	0
17/10/2018	2,603.59	21.1	0	0
18/10/2018	2,653.39	20.85	0	0
19/10/2018	2,662.86	21.6	0	0
20/10/2018	2,646.90	22.05	0	0
21/10/2018	2,501.54	18.35	1	0
22/10/2018	2,679.05	18.95	0	0
23/10/2018	2,805.80	19.75	0	0
24/10/2018	2,680.99	18.35	0	0
25/10/2018	2,619.26	18.75	0	0
26/10/2018	2,672.62	19.35	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
27/10/2018	2,620.90	19.35	0	0
28/10/2018	2,505.45	18	1	0
29/10/2018	2,632.64	18.75	0	0
30/10/2018	2,645.40	19.2	0	0
31/10/2018	2,680.15	22.05	0	0
1/11/2018	2,722.70	24.5	0	0
2/11/2018	2,840.41	28.95	0	0
3/11/2018	2,711.89	27.65	0	0
4/11/2018	2,575.32	21.65	1	0
5/11/2018	2,732.41	21.95	0	0
6/11/2018	2,716.64	24.65	0	0
7/11/2018	2,657.03	23.25	0	0
8/11/2018	2,464.10	16.25	0	0
9/11/2018	2,459.28	16.85	0	0
10/11/2018	2,485.93	19.25	0	0
11/11/2018	2,510.17	18.6	1	0
12/11/2018	2,710.80	19.6	0	0
13/11/2018	2,641.10	21.5	0	0
14/11/2018	2,681.84	20.85	0	0
15/11/2018	2,682.48	21.35	0	0
16/11/2018	2,613.73	19.05	0	0
17/11/2018	2,609.24	19.2	0	0
18/11/2018	2,443.11	19.55	1	0
19/11/2018	2,607.31	18.55	0	0
20/11/2018	2,566.21	20.55	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
21/11/2018	2,683.90	24.2	0	0
22/11/2018	2,648.07	21.4	0	0
23/11/2018	2,510.67	18.95	0	0
24/11/2018	2,475.24	19.2	0	0
25/11/2018	2,452.42	19.7	1	0
26/11/2018	2,560.25	20.15	0	0
27/11/2018	2,637.29	21	0	0
28/11/2018	2,581.61	19.15	0	0
29/11/2018	2,553.11	19.25	0	0
30/11/2018	2,621.97	20.05	0	0
1/12/2018	2,589.63	22.45	0	0
2/12/2018	2,614.29	25.85	1	0
3/12/2018	2,747.32	23.45	0	0
4/12/2018	2,645.74	21.45	0	0
5/12/2018	2,655.74	19.75	0	0
6/12/2018	2,663.53	21.65	0	0
7/12/2018	2,675.43	21.25	0	0
8/12/2018	2,641.21	22.8	0	0
9/12/2018	2,603.16	22.5	1	0
10/12/2018	2,763.11	23.3	0	0
11/12/2018	2,721.87	21.75	0	0
12/12/2018	2,740.45	21.95	0	0
13/12/2018	2,730.80	23.15	0	0
14/12/2018	2,714.97	23.15	0	0
15/12/2018	2,729.96	24.65	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
16/12/2018	2,646.62	25.15	1	0
17/12/2018	2,766.22	25.65	0	0
18/12/2018	2,698.05	24.9	0	0
19/12/2018	2,680.93	22.8	0	0
20/12/2018	2,784.74	23.8	0	0
21/12/2018	2,628.49	22.2	0	0
22/12/2018	2,507.75	19.55	0	0
23/12/2018	2,499.42	19.85	1	0
24/12/2018	2,650.35	19.85	0	0
25/12/2018	1,816.06	22.55	0	1
26/12/2018	2,510.18	23.65	0	0
27/12/2018	2,633.70	24.2	0	0
28/12/2018	2,661.26	26	0	0
29/12/2018	2,688.91	25.4	0	0
30/12/2018	2,691.88	25.1	1	0
31/12/2018	2,772.79	26.1	0	0
1/01/2019	2,567.98	26.65	0	0
2/01/2019	2,695.95	25.6	0	0
3/01/2019	2,717.80	25.1	0	0
4/01/2019	2,739.91	26.55	0	0
5/01/2019	2,753.73	30.2	0	0
6/01/2019	2,528.39	19.95	1	0
7/01/2019	2,614.89	21.95	0	0
8/01/2019	2,739.16	24.55	0	0
9/01/2019	2,756.31	25.6	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
10/01/2019	2,672.58	21.6	0	0
11/01/2019	2,662.51	24.1	0	0
12/01/2019	2,704.05	24.75	0	0
13/01/2019	2,581.70	24.8	1	0
14/01/2019	2,764.65	25	0	0
15/01/2019	2,743.33	25.75	0	0
16/01/2019	2,796.17	26.25	0	0
17/01/2019	2,779.20	25.9	0	0
18/01/2019	2,780.31	27.6	0	0
19/01/2019	2,728.19	24.95	0	0
20/01/2019	2,555.88	23.7	1	0
21/01/2019	2,743.73	24.25	0	0
22/01/2019	2,739.29	25.7	0	0
23/01/2019	2,766.84	26	0	0
24/01/2019	2,737.98	24.95	0	0
25/01/2019	2,822.28	26.15	0	0
26/01/2019	2,828.93	29.15	0	0
27/01/2019	2,779.01	28.8	1	0
28/01/2019	2,723.18	26.65	0	0
29/01/2019	2,761.50	26.25	0	0
30/01/2019	2,801.57	25.55	0	0
31/01/2019	2,832.23	31.2	0	0
1/02/2019	2,662.63	20.3	0	0
2/02/2019	2,682.90	22.5	0	0
3/02/2019	2,705.67	25.7	1	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
4/02/2019	2,856.21	25.55	0	0
5/02/2019	2,798.91	25.85	0	0
6/02/2019	2,822.21	25.7	0	0
7/02/2019	2,834.89	25.9	0	0
8/02/2019	2,817.78	26.45	0	0
9/02/2019	2,766.32	25.9	0	0
10/02/2019	2,628.73	21.95	1	0
11/02/2019	2,725.48	22.25	0	0
12/02/2019	2,774.78	27.85	0	0
13/02/2019	2,661.51	22.9	0	0
14/02/2019	2,635.17	21.6	0	0
15/02/2019	2,641.29	22.8	0	0
16/02/2019	2,622.52	23.45	0	0
17/02/2019	2,586.11	24.35	1	0
18/02/2019	2,703.90	25.3	0	0
19/02/2019	2,709.15	26.75	0	0
20/02/2019	2,658.39	20.55	0	0
21/02/2019	2,665.98	21.2	0	0
22/02/2019	2,616.09	20.9	0	0
23/02/2019	2,532.19	19.7	0	0
24/02/2019	2,494.01	22.55	1	0
25/02/2019	2,529.95	22.55	0	0
26/02/2019	2,577.63	21.95	0	0
27/02/2019	2,606.47	23.55	0	0
28/02/2019	2,655.95	24.45	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
1/03/2019	2,690.36	24.55	0	0
2/03/2019	2,622.32	24.05	0	0
3/03/2019	2,561.64	24.1	1	0
4/03/2019	2,690.03	25	0	0
5/03/2019	2,692.01	25.25	0	0
6/03/2019	2,716.30	28.9	0	0
7/03/2019	2,571.94	20.95	0	0
8/03/2019	2,667.02	22.8	0	0
9/03/2019	2,630.65	22.75	0	0
10/03/2019	2,567.10	23.9	1	0
11/03/2019	2,767.32	24.85	0	0
12/03/2019	2,774.56	27.8	0	0
13/03/2019	2,640.83	21.7	0	0
14/03/2019	2,668.60	23.2	0	0
15/03/2019	2,634.31	20.95	0	0
16/03/2019	2,629.55	21.2	0	0
17/03/2019	2,468.21	19.9	1	0
18/03/2019	2,566.78	19.9	0	0
19/03/2019	2,599.78	22.7	0	0
20/03/2019	2,599.29	23.3	0	0
21/03/2019	2,621.89	22.95	0	0
22/03/2019	2,653.36	23.15	0	0
23/03/2019	2,649.50	22.7	0	0
24/03/2019	2,662.94	26.4	1	0
25/03/2019	2,689.54	22.9	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
26/03/2019	2,503.77	22.2	0	0
27/03/2019	2,530.31	19.6	0	0
28/03/2019	2,549.81	21.95	0	0
29/03/2019	2,602.77	21.95	0	0
30/03/2019	2,524.41	22.3	0	0
31/03/2019	2,286.05	17.5	1	0
1/04/2019	2,454.07	16.95	0	0
2/04/2019	2,465.86	19.3	0	0
3/04/2019	2,483.38	20.45	0	0
4/04/2019	2,464.86	20.1	0	0
5/04/2019	2,493.94	20.75	0	0
6/04/2019	2,476.20	22.3	0	0
7/04/2019	2,555.16	22.1	1	0
8/04/2019	2,677.49	25.65	0	0
9/04/2019	2,506.44	23.9	0	0
10/04/2019	2,346.02	17.45	0	0
11/04/2019	2,371.11	16.4	0	0
12/04/2019	2,384.92	18.15	0	0
13/04/2019	2,446.30	20.5	0	0
14/04/2019	2,417.37	20.25	1	0
15/04/2019	2,509.40	19.1	0	0
16/04/2019	2,441.14	20.2	0	0
17/04/2019	2,430.28	20.15	0	0
18/04/2019	2,595.32	20.85	0	0
19/04/2019	1,782.05	21.75	0	1

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
20/04/2019	2,504.01	20.8	0	0
21/04/2019	1,901.06	21.65	1	1
22/04/2019	2,499.73	22.1	0	0
23/04/2019	2,510.80	22.3	0	0
24/04/2019	2,485.10	21.15	0	0
25/04/2019	2,279.43	21.5	0	0
26/04/2019	2,462.91	23.6	0	0
27/04/2019	2,363.32	17.5	0	0
28/04/2019	2,240.95	17.25	1	0
29/04/2019	2,347.31	17.6	0	0
30/04/2019	2,442.25	19.6	0	0
1/05/2019	2,454.72	20.2	0	0
2/05/2019	2,469.55	21.8	0	0
3/05/2019	2,427.13	21.65	0	0
4/05/2019	2,350.58	20.2	0	0
5/05/2019	2,192.43	15.55	1	0
6/05/2019	2,333.54	16.95	0	0
7/05/2019	2,293.10	16.6	0	0
8/05/2019	2,275.24	17.15	0	0
9/05/2019	2,349.10	15.2	0	0
10/05/2019	2,301.82	16.75	0	0
11/05/2019	2,272.01	16.05	0	0
12/05/2019	2,208.80	16.7	1	0
13/05/2019	2,397.91	16.7	0	0
14/05/2019	2,322.91	18.6	0	0

Date	kWh	Average temperature (°C)	Is the day of week a Sunday?	Is the site closed?
15/05/2019	2,302.88	17.35	0	0
16/05/2019	2,312.95	17.5	0	0
17/05/2019	2,325.15	17.8	0	0
18/05/2019	2,346.09	18.4	0	0
19/05/2019	2,243.23	18.35	1	0
20/05/2019	2,406.56	18.2	0	0
21/05/2019	2,352.24	20.1	0	0
22/05/2019	2,367.43	19.95	0	0
23/05/2019	2,363.03	19.65	0	0
24/05/2019	2,461.75	19.35	0	0
25/05/2019	2,498.56	19.8	0	0
26/05/2019	2,276.91	19.35	1	0
27/05/2019	2,401.66	15.3	0	0
28/05/2019	2,333.13	14.05	0	0
29/05/2019	2,299.42	15.55	0	0
30/05/2019	2,332.03	13.05	0	0
31/05/2019	2,338.66	14.4	0	0

22. Appendix C4 - Energy audit

- Not provided due to commercial confidentiality

NSW GOVERNMENT

For more information on the Energy Security Safeguard

Visit: www.energy.nsw.gov.au

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