

# Sovereign Hills Battery Ring-fencing Annual Compliance Report

2025

## Table of Contents

1. Executive Summary	2
2. Purpose	2
3. Sovereign Hills Battery Operation	3
3.1 Background	3
3.2 Operating Model	3
3.3 Phases of Battery Operation	5
4. Network Support Services Provided in Calendar Year 2024 (“CY2024”)	6
4.1 Context	6
4.2 Network Reliability	6
4.2.1 Methodology	7
4.2.2 Results	8
4.3 Voltage Support	9
4.3.1 Methodology	9
4.3.2 Results	11
4.4 Thermal Mitigation (Demand Management)	11
4.5 Aggregated Network Use and Comparison with Forecast Network Use	12

## List of Figures

Figure 1: Sovereign Hills Battery Business Model	4
Figure 2: Value Stack of Network and Market Services Provided by the Battery	4
Figure 3: Staged Phases of Battery Operation	5
Figure 4: Battery Usage Methodology for Network Reliability Services	7
Figure 5: Battery Usage Methodology for Voltage Support Services – Volt-VAR	10
Figure 6: Battery Usage Methodology for Voltage Support Services – Volt-Watt	11

## List of Tables

Table 1: Summary of Network Support Services for Feeder	2
Table 2: Inputs and Assumptions	6
Table 3: Frequency and Volume for Feeder Reliability and 1MW Load Limit	8
Table 4: Frequency and Volume for Zone Substation Reliability and 1MW Load Limit	8
Table 5: V-P Droop Settings for Voltage Support	9
Table 6: V-Q Droop Settings for Voltage Support	9
Table 7: Frequency and Volume for Voltage Support – Volt-VAR	11
Table 8: Frequency and Volume for Voltage Support – Volt-Watt	11
Table 9: Aggregated Network Support Services for Feeder	12



# 1. Executive Summary

On 4 August 2022, the Australian Energy Regulator (AER) granted Essential Energy a 15-year ring-fencing waiver for the Sovereign Hills Battery, effective until 4 August 2037. A condition of this waiver is the establishment of specific reporting requirements, including an annual comparison of the battery's usage—detailing both the volume and frequency of its operation—to differentiate between Essential Energy's network usage and the spare capacity leased to the nominated third party, AGL. Additionally, Essential Energy must provide an explanation for any discrepancies between forecast and actual usage.

Testing and commissioning of the battery commenced on 1 February 2023 following the finalisation of an Orchestration Agreement between AGL and Essential Energy. During this phase several operational issues were identified and resolved which led to the battery not being fully operational until 31 July 2024.

Operational experience with the battery so far indicates that network support services (such as reliability, thermal, and voltage support) can be delivered alongside market services. However, charge and discharge limitations, reactive power supply and absorption, and restrictions on charging and discharging in response to network voltage levels affect the extent to which the battery can provide market services.

Table 1 presents a consolidated time duration for Network Services<sup>1</sup> (Reliability and Voltage Support), alongside a comparison with the forecasted network usage for CY2025 for the cost allocation.

**Table 1: Summary of Network Support Services for Feeder**

ITEM	UNITS	VALUE
Forecast network use in CY2025 (Time)	%	16.60%
Forecast market use in CY2025 (Time)	%	83.40%
Actual network use in CY2025 (Time)	%	81.90% <sup>2</sup>
Actual market use in CY2025 (Time)	%	100.00% <sup>3</sup>

As shown in Table 1, the battery provided combined network support services for 81.90% of the time in CY2025. The battery is funded 57% through Essential Energy's regulated asset base and 43% through unregulated funding. This allocation was determined using modelled estimates of the battery's network and market usage, along with the corresponding revenue. These revenues were discounted at the regulated and unregulated streams to the net present value, ensuring an appropriate proportional cost allocation.

The cost allocation of 57% to the regulated asset base was based on a forecasted network use time of 16.60% for CY2025. As the actual percentage of time for network use is greater than the time forecasted, the cost allocation is still appropriate.

## 2. Purpose

This report has been prepared in accordance with the Sovereign Hills Battery ring-fencing waiver conditions.

<sup>1</sup> As the battery does not currently provide direct Thermal Mitigation services, its role in Demand Management, including usage volume and frequency, will be evaluated in future reports following the implementation of Stage 3(c).

<sup>2</sup> Network support services and market services delivered concurrently.

<sup>3</sup> Network support services and market services delivered concurrently.

The waiver was granted on 4 August 2022 for 15 years, until 4 August 2037.

As part of the waiver, the Australian Energy Regulator (AER) outlined specific reporting requirements, which include:

- ▶ *Provide on an annual basis a comparison of the uses (volume and frequency) of the battery that confirms and differentiates between Essential Energy's network usage and spare capacity leased to the third party, and an explanation of any differences between forecast and actual usage.*
  - › *This includes the total period of time (to the nearest five-minute increment) that the battery is operating at the direction of Essential Energy and total period (to the nearest five-minute increment) of time that the battery is operating at the direction of the third party.*
  - › *The independent assessor, as part of the annual ring-fencing compliance assessment, is to confirm the comparison is accurate and the appropriate cost allocation was applied between the regulated and unregulated uses of the battery.*

## 3. Sovereign Hills Battery Operation

### 3.1 Background

Essential Energy has deployed its first network battery through a trial in the Sovereign Hills area of Port Macquarie. The primary purpose of the battery is to provide common distribution services (network services), that is, standard control services that will provide price, reliability and security benefits to consumers from deferred augmentation expenditure (augex) and improved network performance. The battery was specified and sized to 1MW/2MWh to provide network services and deliver these benefits to customers.

The battery also provides voltage support services as required (i.e., when they fall outside the limits set by Essential Energy), which increases the safety, reliability, and security of supply in the network.

To maximise the network investment in the battery, a non-affiliated third party is provided with access to the asset during periods of spare capacity when the battery is not needed for network services. AGL was selected as the preferred third party following a comprehensive testing of the market, which took the form of a competitive Request for Proposal (RFP) process.

AGL uses the spare capacity to provide arbitrage services and leases the spare storage capacity for these services - but only when it is not required for standard control services by Essential Energy.

Two important learning outcomes sought from this project:

- ▶ To refine forecasting and modelling approaches to understand how much of a battery could be used for network services and how much for other services over time, without compromising network services, to inform future cost allocation approaches.
- ▶ To develop an understanding of how to define the roles between Essential Energy and third parties in order to inform future contractual arrangements.

### 3.2 Operating Model

The purpose of the battery is to provide network services. However, to maximise the value of the asset, Essential Energy has partnered with AGL to provide it with access to the battery when it is not required for network purposes. AGL utilises the spare storage capacity for arbitrage services only when it is not required



for standard control services by Essential Energy. Accordingly, this creates an efficient utilisation of a network asset by facilitating customer and market value streams.

As shown in Figure 1, Essential Energy owns the battery and uses it to provide network services, including voltage support, and provide access to AGL for market services (arbitrage and ancillary services).

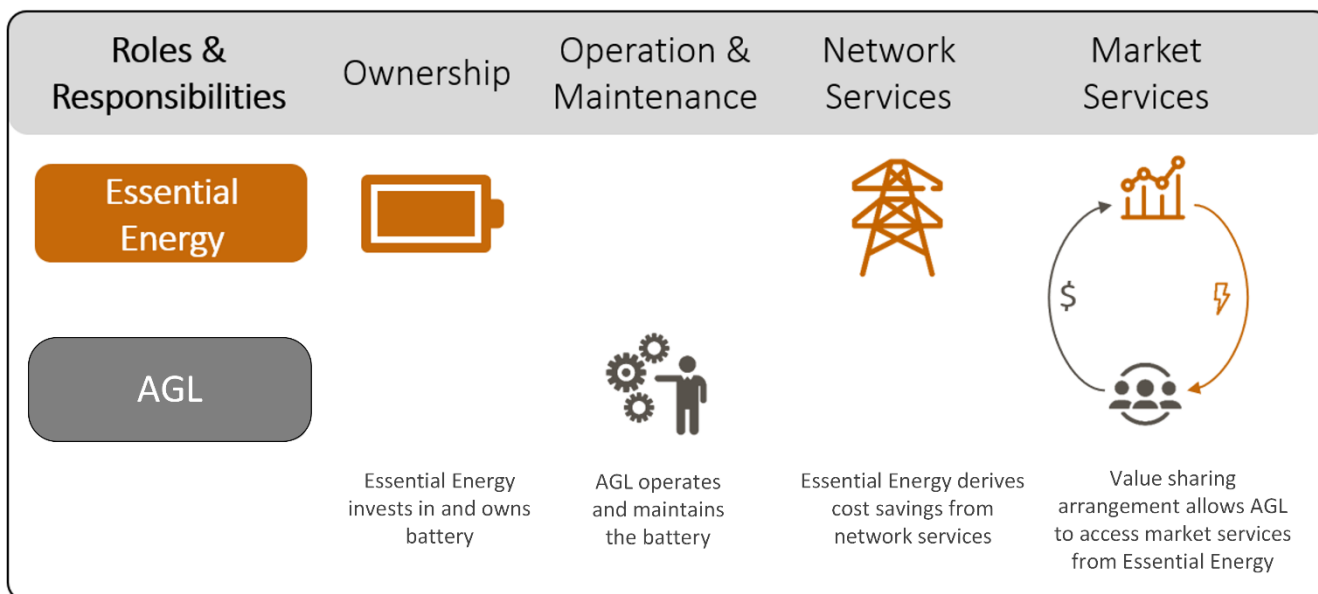


Figure 1: Sovereign Hills Battery Business Model

Figure 2 shows the value across market and network services that the network battery captures under the agreement with AGL.




AGL	 Energy services	Energy arbitrage	Trading in the electricity spot market
AGL	 Ancillary services	Frequency reserves	Maintaining system frequency
Essential Energy	 Network services	Congestion relief Reliability	Deferring network investments (generation or demand-driven) Reduced outages

Figure 2: Value Stack of Network and Market Services Provided by the Battery

AGL is responsible for the technical operation of the battery, i.e. charging and discharging commands and connecting with the Australian Energy Market Operator for market facing services. This effectively means the network battery agreement is for a single party ‘shared use’ contract for the asset – Essential Energy will use the battery for network services, and in periods where Essential Energy does not require the battery to provide network services, AGL has access to it to provide other services. The operating model does not comprise of an ‘open access’ retail battery-service offering.

To ensure appropriate protocols exist to avoid any potential discrimination concerns in the operation of the battery, Essential Energy implements a control scheme. This consists of the following hierarchy of control to take precedence in the operation of the system.

1. Do no harm to the network
2. Network Services
3. Ancillary services
4. Energy services

### 3.3 Phases of Battery Operation

The first three years of the battery’s operation are set as discovery phases to test optimal charging schedules. This staged plan for developing capabilities for the battery dispatch and commercial arrangements has enabled Essential Energy to progressively gain an understanding of the nature of the network services required from the battery and share new knowledge about battery operation and value stacking with AGL. The initially proposed staged approach is illustrated in Figure 3.

Note: Since commissioning began in February 2023, the Sovereign Hills Battery has encountered several operational issues. To address these issues, AGL implemented a revised control scheme on 31 July 2024, marking the battery’s full operational status. Consequently, the trial period was delayed, and 31 July 2024 should be considered the start of the trial phase.

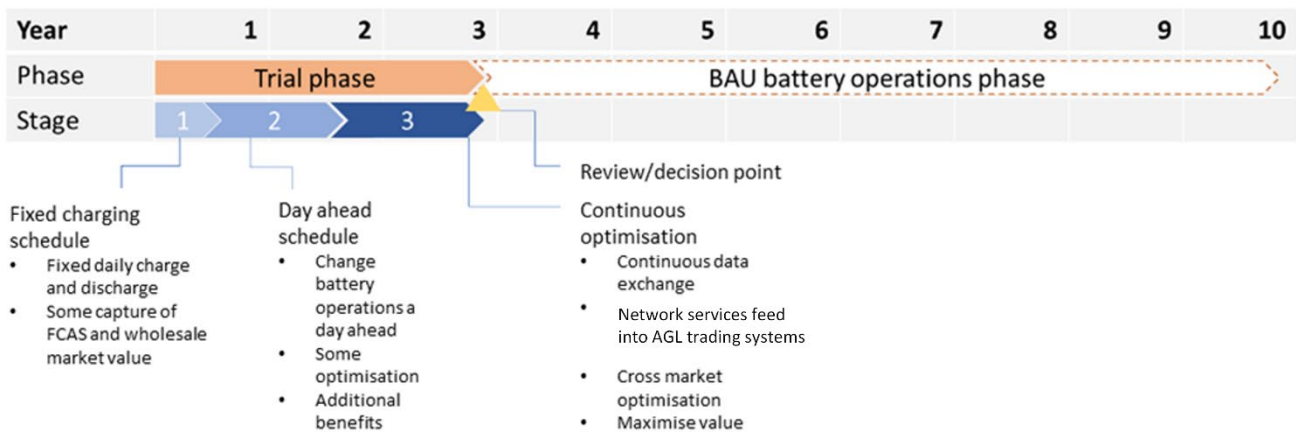


Figure 3: Staged Phases of Battery Operation

Through the course of the trial, this approach has been refined as below and will continue to be refined as both Essential Energy and AGL gain further learning and experience.

**Stage 1:** In the first stage, the battery’s charging capability was limited to 500kW, and automated real and reactive voltage response modes (Volt-Watt and Volt-VAR (Volt-Ampere Reactive) respectively) were implemented to provide network support.

**Stage 2:** In November 2024, AGL incorporated time varying charging and discharging limits (advised by Essential Energy) in their control algorithm.

**Stage 3:** Essential Energy has implemented a Supervisory Control and Data Acquisition (SCADA) solution for network support which will be implemented in three stages below. Volt-Watt and Volt-VAR response modes will continue to be used in these stages to provide voltage support services.

**Stage 3 (a) Automation of Pre-calculated Operating Envelopes:** The charge and discharge limits will be calculated similar to Stage 2 but implemented through an Essential Energy device directly connected to the battery instead of relying on AGL to incorporate limits in their control algorithms. This was implemented in November 2025 and has provided Essential Energy the flexibility to remotely update operating envelopes as often as required to achieve network support outcomes.

**Stage 3 (b) Automatically updated DOEs:** In Stage 3 (b), telemetry from the zone substation will be provided to the onsite Essential Energy control device to automatically calculate and update the DOEs. This has been trialled in February 2026 leveraging the automation achieved in Stage 3(a) and will be implemented in Spring and Autumn months of CY2026, commencing in April. Summer and Winter periods will still rely on methodologies established in Stage 2 until Stage 3(c) can be achieved. This is to manage risks concerning thermal constraints of the associated network during peak periods.

**Stage 3 (c) Thermal Mitigation Scheme:** In Stage 3 (c), telemetry from the zone substation will be used to automatically update DOEs, pre-charge the battery for demand management, and to charge or discharge the battery automatically when required to alleviate network constraints. The goal is for this to be implemented in 2027.

## 4. Network Support Services Provided in Calendar Year 2025 (CY2025)

### 4.1 Context

Essential Energy's operational experience with the battery to date demonstrate that network support services (reliability, thermal and voltage support) and market services can be delivered concurrently.

The battery remains capable of performing arbitrage services while being readily available to provide power quality network support. Voltage support can also be delivered concurrently with other market services including energy arbitrage using automated response modes and control mechanisms for managing over and under-voltage conditions.

Specifically, the Volt-VAR response mode provides reactive power to maintain voltage stability. Meanwhile, the Volt-Watt mode does not directly address thermal overloads or defer network augmentation. Instead, it operates under Essential Energy settings and intervenes only when voltage exceeds acceptable thresholds. This limits the battery's charge or discharge capacity, ensuring it functions primarily as a safeguard for grid stability, rather than as an unrestricted asset for market activities.

### 4.2 Network Reliability

The Sovereign Hills battery provides improved network reliability by supporting the area's backup feeder's (CPM3B7) load capacity constraints during unplanned outages.

While no direct unplanned outages occurred on the feeder during CY2025, the volume and frequency of battery backup support provided to the feeder and zone substation were calculated. The methodology used for this estimation is detailed below, with the inputs and assumptions summarised in Table 2.

**Table 2: Inputs and Assumptions**

ITEM	VALUE
Data start date	01/01/2025
Data end date	31/12/2025



ITEM	VALUE
Data increment time intervals	5 minutes
Average assumed outage duration	100 minutes
Number of intervals per outage	20 intervals (calculated based on 5-minute increments)

#### 4.2.1 METHODOLOGY

The methodology for estimating the frequency and volume of battery usage for network reliability follows a four-step process. This process evaluates the battery's ability to support the feeder load by considering both the absolute feeder load, feeder energy demand and the battery's state of charge (SoC) within a rolling 100-minute (20 intervals based on 5-minute increments) outage window. The steps involved in the methodology are as shown in Figure 4.



Figure 4: Battery Usage Methodology for Network Reliability Services

#### Step 1: Define the rolling outage window

Establish a 20-interval rolling window to represent the assumed outage period of 100 minutes as it could occur at any point in time.

#### Step 2: Assess feeder load and battery capacity

In this step, the following conditions are assessed within the defined 20-interval rolling window:

- ▶ Feeder Load (MW): Identify the number of intervals where the feeder load is  $\leq 1$  MW (i.e. rating of the battery).
- ▶ Feeder Energy Demand (MWh): Determine the corresponding energy demand during the intervals where feeder load is  $\leq 1$  MW.
- ▶ Battery Capacity: Evaluate whether the battery's State of Charge (in MWh) is sufficient to meet the full or partial identified feeder energy demand, where the feeder load is  $\leq 1$  MW.

This combined assessment enables determination of frequency and volume of battery usage to meet the energy demand while supporting feeder reliability.

#### Step 3: Calculate proportion of each interval

To prevent double counting within the rolling window, or overestimation of reliability services, the number of instances and the battery energy volume identified in Step 2 are divided by the total number of intervals in

the window (20 intervals). This calculation identifies the proportion of each interval that the battery provides reliability services for i.e. there is sufficient energy stored in the battery to support the feeder for this proportion of the potential outage interval.

#### Step 4: Aggregate weightings for battery usage frequency and volume

Sum the proportions calculated in Step 3 for all intervals to determine the total battery usage frequency and volume. This step provides an overall assessment of battery usage across the rolling window, accounting for both the frequency and the total energy volume.

Note: The same methodology has also been applied to assess network reliability at the zone substation level, instead of the feeder level. The battery usage frequency and volume have been calculated and reported separately for the zone substation in Table 4.

#### 4.2.2 RESULTS

The results of the analysis, based on the methodology outlined above, provide the frequency and volume of battery usage to maintain network reliability. The analysis specifically examines the potential usage of the battery, where frequency denotes the number of instances the battery was available to meet feeder and zone substation demands, and volume reflects the total energy it could supply. These findings underscore the battery's capability to enhance reliability and support feeder and zone substation operations during potential outage scenarios, mitigating the impact on customers, and deferring the need for network augmentation.

**Table 3: Frequency and Volume for Feeder Reliability and 1MW Load Limit**

ITEM	UNITS	VALUE
Frequency	Number of instances	83,367
Duration of Time	%	79.31%
Volume	kWh	1,209,186

**Table 4: Frequency and Volume for Zone Substation Reliability and 1MW Load Limit**

ITEM	UNITS	VALUE
Frequency	Number of instances	5,259
Duration of Time	%	5.00%
Volume	kWh	108,656

As shown in Table 3 and Table 4, the battery was available to support the feeder for reliability for 79.31% of the time in CY2025, providing a total of 1,209,186 kWh of network support. Similarly, for zone substation operations, the battery was available for 5.00% of the time in CY2025, supplying 108,656 kWh to ensure a reliable energy supply during potential outages.

Note: The Frequency and Duration of Time results are not mutually exclusive from those outlined in Section 4.3 for Voltage Support. Combined results are presented in Section 4.5.



## 4.3 Voltage Support

The Sovereign Hills Battery supports management of minimum and maximum demand periods and provides network voltage support, through Volt-VAR and Volt-Watt response modes thereby strengthening network security.

The methodology used for this estimation is outlined below, with the V-P (Volt-Watt) and V-Q (Volt-VAR) settings summarised in Table 5 and Table 6. These settings define how active power (real power, P or W) and reactive power (Q or VAR) is adjusted in response to voltage changes. The approach is based on 5-minute time interval increments and applies to CY2025, covering the period from 1 January 2025, through to 31 December 2025.

**Table 5: V-P Droop Settings for Voltage Support**

PHASE VOLTAGE (V)	LINE VOLTAGE (V)	PERCENTAGE (%)	ACTIVE POWER (KW)	COMMENT
250.0	433.0	0%	0	No Discharge
245.0	424.3	100%	-1,000	Droop Start
228.6	395.9	100%	500	Droop Start
226.2	391.8	0%	0	No Charge

**Table 6: V-Q Droop Settings for Voltage Support**

PHASE VOLTAGE (V)	LINE VOLTAGE (V)	PERCENTAGE (%)	REACTIVE POWER (KVAR)	COMMENT
256.0	443.0	100%	1,000	Absorb Reactive (Generator Inductive)
245.0	424.0	0%	0	Absorb Reactive (Generator Inductive)
225.0	389.7	0%	0	Supply Reactive (Generator Capacitive)
205.0	355.0	100%	-1,000	Supply Reactive (Generator Capacitive)

### 4.3.1 METHODOLOGY

#### 4.3.1.1 Volt-VAR

The methodology for estimating the frequency and volume of battery usage for network voltage support through Volt-VAR response mode is based on rolling 5-minute time intervals and follows a three-step process. This approach involves evaluating the average voltage across the three phases and when the



voltage threshold for V-Q droop settings is exceeded, determine the reactive power absorbed or supplied by the battery, and aggregating the response over the year. The steps are detailed in Figure 5.

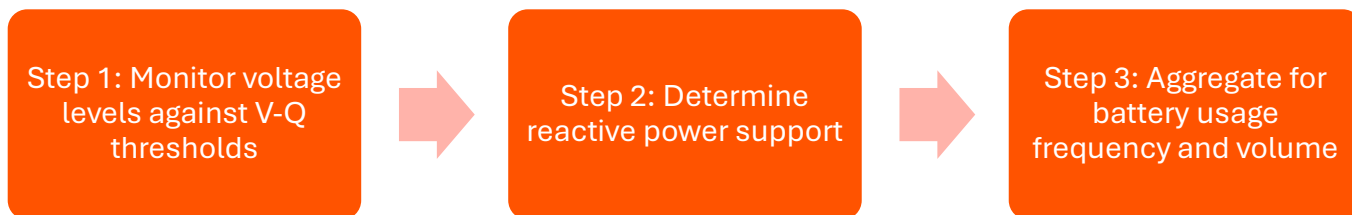


Figure 5: Battery Usage Methodology for Voltage Support Services – Volt-VAR

### Step 1: Monitor voltage levels against V-Q thresholds

Continuously assess the average voltage across all three phases to identify instances where the V-Q droop setting thresholds are exceeded.

### Step 2: Determine reactive power support

Measure and quantify the reactive power supplied or absorbed by the battery during each instance of threshold breach.

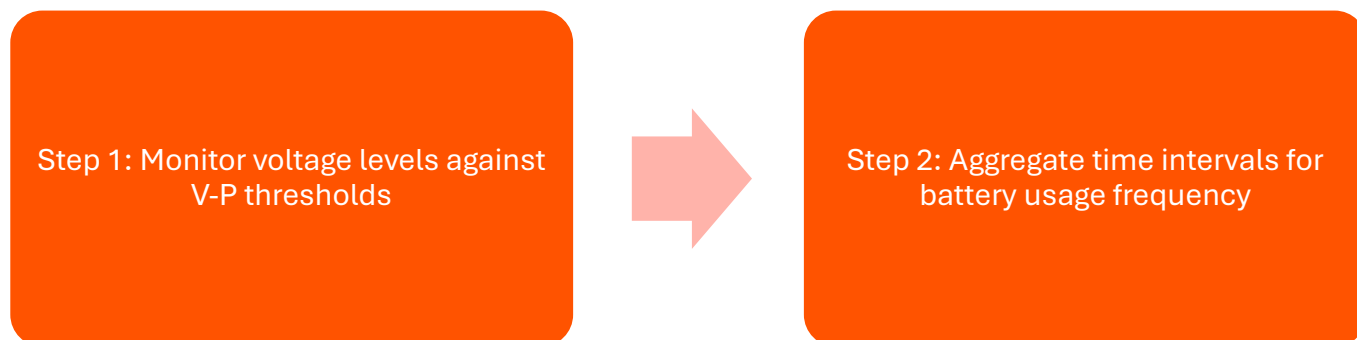
### Step 3: Aggregate for battery usage frequency and volume

Aggregate the data for all time intervals, including the total reactive energy supplied or absorbed, to evaluate the overall battery performance for voltage support.

#### 4.3.1.2 Volt-Watt

The Volt-Watt mode does not directly address thermal overloads or defer network augmentation through active power input. Instead, it operates under Essential Energy settings and intervenes only when Volt-Watt values exceed acceptable thresholds, thereby limiting battery's charge or discharge capacity, ensuring it functions primarily as a safeguard for grid stability, rather than as an unrestricted asset for market activities. While frequency-related calculations are relevant during these operations, energy-based volume calculations are not applicable, as these are limits to operation rather than directions to charge or discharge.

The methodology for estimating the frequency of battery usage for network voltage support through Volt-Watt response mode is based on rolling 5-minute time intervals and follows a simple two-step process. This approach involves determining and aggregating the time intervals for the battery average voltage across the



three phases and when the voltage threshold for V-P droop settings is exceeded aggregating the corresponding time intervals to determine the frequency usage of the battery.

**Figure 6: Battery Usage Methodology for Voltage Support Services – Volt-Watt**

### Step 1: Monitor voltage levels against V-P thresholds

Continuously assess the battery average voltage across all three phases to identify instances where the V-P droop setting thresholds are exceeded.

### Step 2: Aggregate time intervals for battery usage frequency

Aggregate all time intervals where V-P droop settings exceedance is observed to determine the frequency usage of the battery.

## 4.3.2 RESULTS

The results of the analysis, based on the methodology outlined above, provide the frequency and volume of battery usage for network voltage support. The analysis specifically examines the usage of the battery, where frequency denotes the number of instances the battery provided network voltage support to the feeder, and volume reflects the total reactive energy it supplied. These findings emphasise the battery's ability to enhance network voltage stability and strengthen overall system security.

**Table 7: Frequency and Volume for Voltage Support – Volt-VAR**

ITEM	UNITS	VALUE
Frequency	Number of instances	7,167
Duration of Time	%	6.82%
Volume	kVARh	42,439

**Table 8: Frequency and Volume for Voltage Support – Volt-Watt**

ITEM	UNITS	VALUE
Frequency	Number of instances	6,812
Duration of Time	%	6.48%
Volume	kWh	N/A

As shown in Table 7, the battery provided voltage support through Volt-VAR response for 7,167 instances amounting to 6.82% of the time in CY2025, providing a total of 42,439 kVARh of network support. Table 8 shows voltage support through Volt-Watt control for 6,812 instances amounting to 6.48% of the time in CY2025.

Note: The Frequency and Duration of Time results are not mutually exclusive from those outlined in Section 4.2 for Network Reliability. Combined results are presented in Section 4.5.

## 4.4 Thermal Mitigation (Demand Management)

As detailed in Section 3.3, in CY2025, the battery was not directly providing thermal mitigation services. Instead, battery operations were being indirectly influenced using charging and discharging limits (and to a lesser extent, through automated voltage response modes). Volume and frequency of direct use of the



battery for Demand Management will be calculated for subsequent reports once Stage 3 (c) has been implemented.

## 4.5 Aggregated Network Use and Comparison with Forecast Network Use

Essential Energy's operational experience with the battery to date demonstrates that network support services (reliability, thermal and voltage support) and market services can be delivered concurrently. Charge and discharge limitation imposed on the battery, and supply and absorption of reactive power and limitations of charging and discharging in response to voltage levels on the network, impact the extent to which the battery can deliver market services. The network support services results presented in sections 4.2 and 4.3 are not mutually exclusive. A consolidated time duration for Network Services<sup>4</sup> (Reliability and Voltage Support), along with a comparison with network use in CY2025 forecasted for the cost allocation methodology, is provided in Table 9.

**Table 9: Aggregated Network Support Services for Feeder**

ITEM	UNITS	VALUE
Forecast network use in CY2025 (Time)	%	16.60%
Forecast market use in CY2025 (Time)	%	83.40%
Actual network use in CY2025 (Time)	%	81.90% <sup>5</sup>
Actual market use in CY2025 (Time)	%	100.00% <sup>6</sup>

As shown in Table 9, the battery provided combined network support services for 81.90% of the time in CY2025. The battery is funded 57% through Essential Energy's regulated asset base and 43% through unregulated funding. This allocation was determined using modelled estimates of the battery's network and market usage, along with the corresponding revenue. These revenues were discounted at the regulated and unregulated streams to the net present value, ensuring an appropriate proportional cost allocation.

The allocation of 57% of the battery's costs to the regulated asset base was based on a forecasted network use time of 16.60% for CY2025. As the actual percentage of time for network use is greater than the time forecasted, the cost allocation is still appropriate.

<sup>4</sup> As the battery does not currently provide direct Thermal Mitigation services, its role in Demand Management, including usage volume and frequency, will be evaluated in future reports following the implementation of Stage 3(c).

<sup>5</sup> Network support services and market services delivered concurrently.

<sup>6</sup> Network support services and market services delivered concurrently.

