Network voltage report

Winter 2023

United Energy

October 2023

1. Introduction

This report outlines United Energy's customer voltage performance for the period 1 June 2023 to 31 August 2023, based on the performance indicators outlined in the Electricity Distribution Code of Practice (Code) and Compliance and Performance Reporting Guideline (Guideline).

Four key themes emerge from this report:

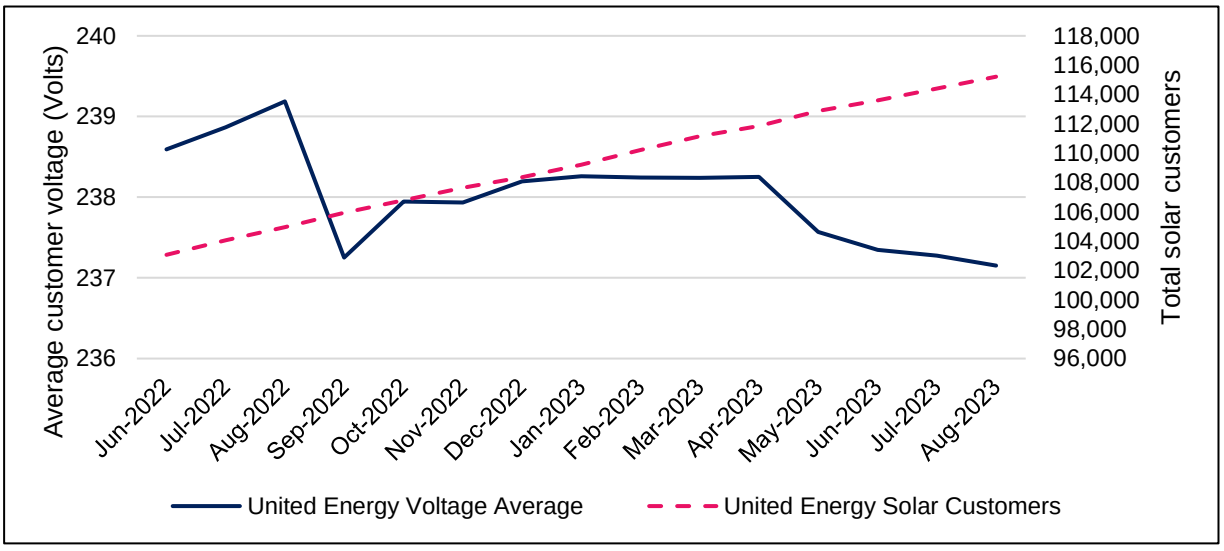
1. Average voltage levels are continuing to trend down for United Energy customers, remaining stable at approximately 237V throughout Winter 2023. This is 1.6V lower than in Winter 2022.
2. United Energy is reducing average voltage levels while continuing to connect rooftop solar and approve customers for export. Solar connections grew to 115,216 in Winter 2023, with more than 98.6% of customers export-approved.
3. While customer power quality complaints continue to trend down, United Energy has observed a 52% increase in undervoltage complaints as average voltage levels reduce. Providing undervoltage solutions for customers in energy-intensive industries has been a focus during this period, highlighting the need to manage voltage within both upper and lower limits.
4. The key drivers of voltage performance this quarter are the Dynamic Voltage Management System, operational on United Energy since 2022, along with an ongoing program to lift and sustain compliance with mandatory 'smart' settings for rooftop solar inverters.

Our data shows United Energy's voltage levels remained functionally compliant and above 95% for the upper and lower voltage limits set in the Electricity Distribution Code of Practice throughout the period.

2. Average network voltage

Average voltage levels on the network are continuing to decrease over time as illustrated in Figure 1. Within the latest reporting period, average voltages have been sustained at approximately 237V. Average voltage levels are 1.6V below the same period in the previous year.

Figure 1. Average customer voltages and solar connections, rolling 15-month average



Between June 2022 and August 2023, residential solar connections on United Energy increased by 2.1% to 115,216. The network was able to provide 5kW export approval for more than 97.7% of new

residential rooftop solar connections in this reporting period. Our export assessment includes consideration of localised variations in voltage.

The key drivers of voltage performance during this period have been the operation of our Dynamic Voltage Management System (DVMS) as well as our ongoing program to lift solar inverter compliance.

Inverter compliance

Technical compliance for rooftop solar inverters continues to be an urgent priority and key focus for our networks, particularly as undervoltage trends begin to present in the voltage data. The Australian Energy Market Operator has called for an industry-wide focus on addressing this challenge, targeting 90% compliance with AS/NZS4777.2:2020 for newly installed systems by the end of this year.

United Energy is engaging directly with rooftop solar inverter manufacturers and installers to lift compliance, building on changes introduced to our solar export pre-approvals process in October 2022 to provide evidence of compliance with the relevant standard AS/NZ4777.2:2020.

Advanced analytics undertaken using our Dynamic Voltage Management Systems has allowed us to track inverter compliance and pursue remote rectification in line with our Model Standing Offer. Our data indicates an 81% compliance rate for new rooftop solar connections in this reporting period, from as low as 10% in 2019.

Internet connectivity is proving to be the most important factor in determining whether networks and inverter manufacturers can remotely rectify non-compliant devices. In recent engagement with one manufacturer, poor connectivity made remote rectification impossible for close to a quarter of identified non-compliant devices.

Continued effort is therefore required to lift inverter compliance to a sustainable level, particularly to ensure customers can continue to enjoy high power quality, have the opportunity connect and export energy from their rooftop solar systems and participate in the new flexible export services our networks will be introducing in 2024.

Improved customer experience

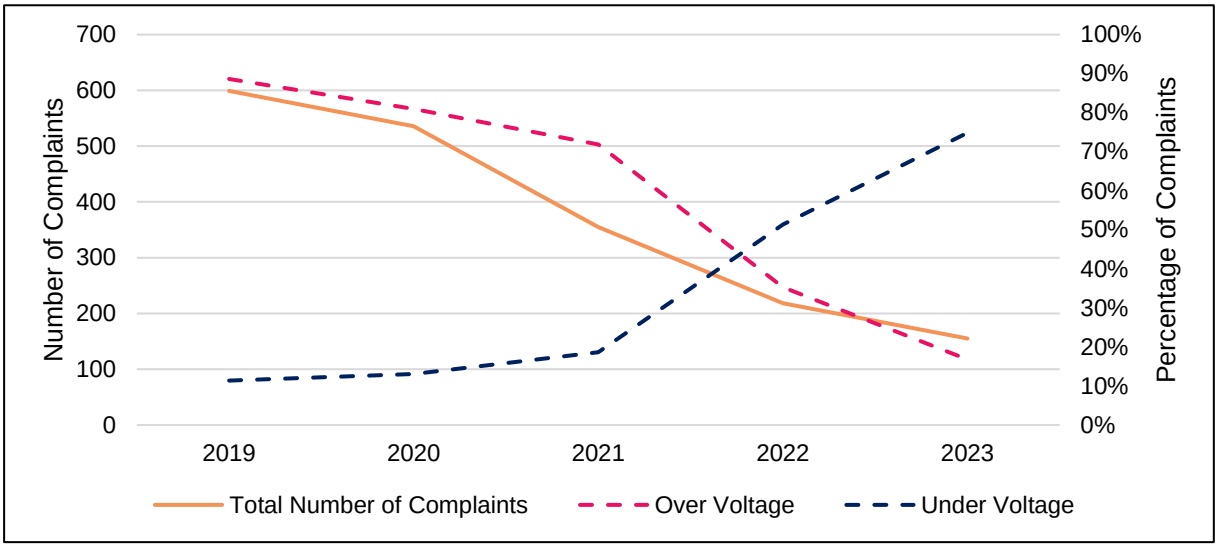
Customer complaints are trending down over the long term as United Energy continues to invest and deliver programs to sustain high levels of voltage performance and compliance.

During this reporting period, however, United Energy received a total of 57 power quality complaints, as 14% more than the same period in 2022. Overvoltage complaints have continued to trend down, from 12 in Winter 2022 to three in this reporting period, but undervoltage complaints have 33 to 50 complaints.

Undervoltage reduces electricity flows to customer devices and can lead to power quality issues such as flickering lights and malfunctioning motorised appliances. The increase in undervoltage complaints highlights the need to manage voltage within a range, especially as average voltage levels reduce across the network.

Undervoltage is also a key concern for commercial and industrial customers operating in energy-intensive industries. United Energy has implemented settings in heavy industrial regions to operate slightly higher than the rest of the network, while maintaining upper limit compliance and maintaining power quality for our broader customer base. This ensures we meet the needs of industrial customers operating heavy industrial machinery, which performs optimally in with a high voltage power supply.

Figure 2. Customer complaints trend including overvoltage and undervoltage split.



3. Voltage performance indicators

Measures against each of the performance indicators under the Compliance and Performance Reporting Guidelines reflect the continuous improvement of network voltages for our customers.

Data in Table 1 demonstrates that:

- less than 2.1% of customers exceeded upper or lower voltage limits more than 1% of the time.
- less than 0.5% of customers exceeded hard lower limits for two consecutive intervals.
- less than 0.04% of customers exceeded hard upper limits for two consecutive intervals.

We acknowledge comparatively higher undervoltage measures for the weeks starting 18/06/2023 and 16/07/2023. This reflects sustained high demand in consumption observed on the network during cool weather, which in turn leads to voltage drops. This result is consistent with the 2022-23 winter peak.

Table 1. Weekly voltage performance indicator summary, June 2023 to August 2023

Start date	End date	Below lower limit more than 1% of the time	Above upper limit more than 1% of the time	Below lower limit for two consecutive intervals	Above upper limit for two consecutive intervals
4/06/2023	10/06/2023	0.71	0.32	0.13	0.00
11/06/2023	17/06/2023	1.01	0.30	0.18	0.00
18/06/2023	24/06/2023	2.03	0.99	0.47	0.03
25/06/2023	1/07/2023	1.52	0.49	0.33	0.01
2/07/2023	8/07/2023	1.31	0.26	0.26	0.01
9/07/2023	15/07/2023	0.85	1.12	0.16	0.04
16/07/2023	22/07/2023	1.72	1.17	0.39	0.03
23/07/2023	29/07/2023	1.18	0.27	0.24	0.01

30/07/2023	5/08/2023	0.76	0.20	0.13	0.00
6/08/2023	12/08/2023	1.10	0.21	0.25	0.01
13/08/2023	19/08/2023	1.59	0.24	0.35	0.01
20/08/2023	26/08/2023	0.58	0.44	0.11	0.02
27/08/2023	2/09/2023	0.42	0.82	0.07	0.02

4. Upper and lower voltage limits over time

United Energy has maintained functional compliance under the Electricity Distribution Code of Practice throughout the reporting period, for both upper and lower limits (Figures 3 and 4, respectively).

DVMS optimisation has continued to drive high levels of upper voltage compliance for United Energy customers. As temperatures cooled over the winter period, the network experienced a decline in lower limit compliance levels which is consistent with historic seasonal trends.

Figure 3. Customer voltage levels against upper limit, rolling 15-month performance.

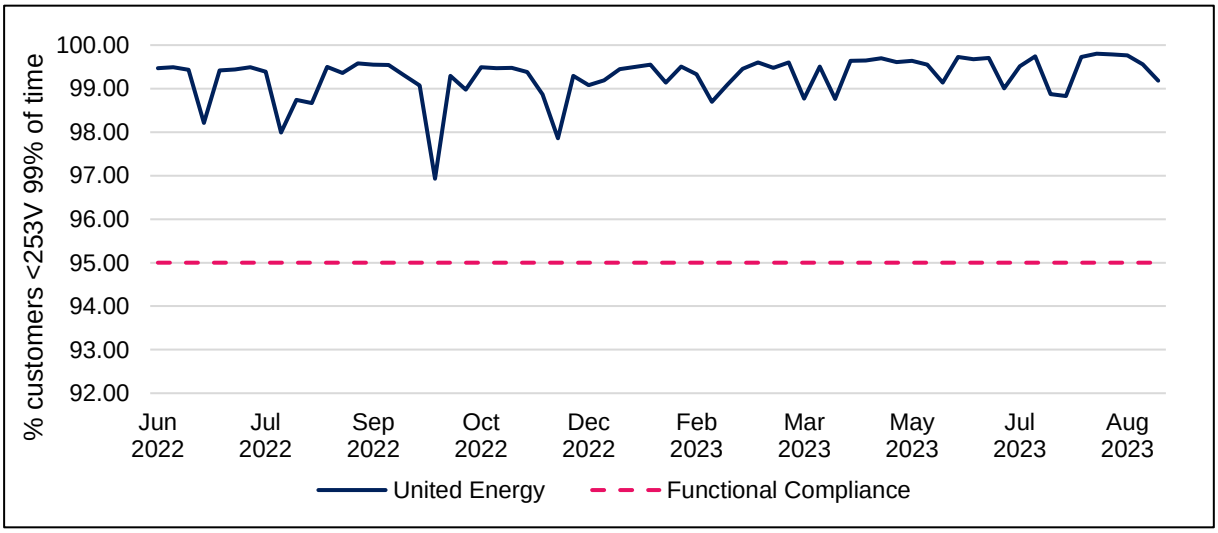
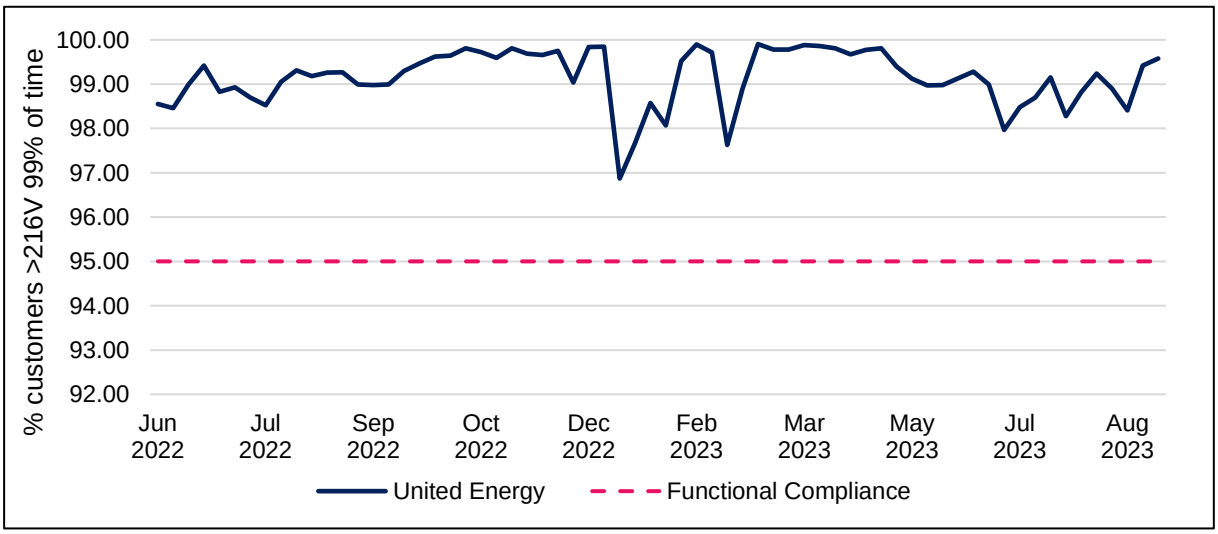


Figure 4. Customer voltage levels against lower limit, rolling 15-month performance.



Definitions

Functional compliance

Distribution businesses are required to supply electricity to customers at a standard nominal voltage of 230 volts. This is a requirement under Australian Standards AS60038 and AS61000.3.100. Because of a number of factors than can cause variations in voltage at a local level, the standard specifies an allowable range on voltage of 230V +10% and -6% under normal operation with direction on the preferred operating zones of the network and limits for customers.

Under the Electricity Distribution Code of Practice in Victoria, this requires networks to manage voltage within a narrow window of between 216V and 253V. 'Functional compliance' with the Code is therefore determined to be when voltages are below 253V (v99%) and above 216V (v1) for 98% of the time for 95% of customers.

Local variations in voltage

The range of factors that can cause local variations in voltage on networks are specific to the profile of communities serviced and can include:

- *the mix of customer types across residential, commercial or industrial, and their electricity consumption patterns.*
- *electrical load including variations for weekday or weekend demand.*
- *the capacity of the local network infrastructure to support two-way power flows.*
- *the length of power lines emanating from the zone substation or distribution substation*
- *the volume and voltage of solar exports within the community subject to inverter compliance*
- *the impact of voltage regulating devices at customer installations including commercial or industrial facilities*
- *localised weather patterns, in particular, the influence of high or low temperatures*
- *the voltage at an electricity transmission level when received at the transmission connection point (Terminal Station) where voltages are reduced from either 500,000V or 220,000V to a distribution level of 66,000V or 22,000V.*