



Network voltage report Autumn 2023

Introduction

This report outlines CitiPower and Powercor’s customer voltage performance for the period 1 March 2023 to 31 May 2023, based on performance indicators outlined in the Electricity Distribution Code of Practice and (Code) Compliance and Performance Reporting Guideline.

Three key themes emerge from this report:

1. Our Dynamic Voltage Management System continues to drive positive voltage performance throughout this period. Overvoltage compliance continues to improve substantially for customers on the regional Powercor network, from 96.7 in March 2022 to 98.7% at the end of this period.
2. Lower voltage levels have significantly reduced customer enquiry volumes, with power quality complaints approximately 17% lower than in Autumn 2022. Overvoltage complaints are now at their lowest historical level, as undervoltage increases grows as a share of total customer inquiries.
3. The substantial program of work CitiPower and Power have implemented to improve inverter compliance is yielding a positive result, with compliance lifting to above 80% for connections in the current quarter (from less than 40% in 2020). Technical compliance for rooftop solar and other distributed energy resources continues to be one of the most urgent and fundamental barriers to continued export enablement, demand management and security in a highly distributed system.

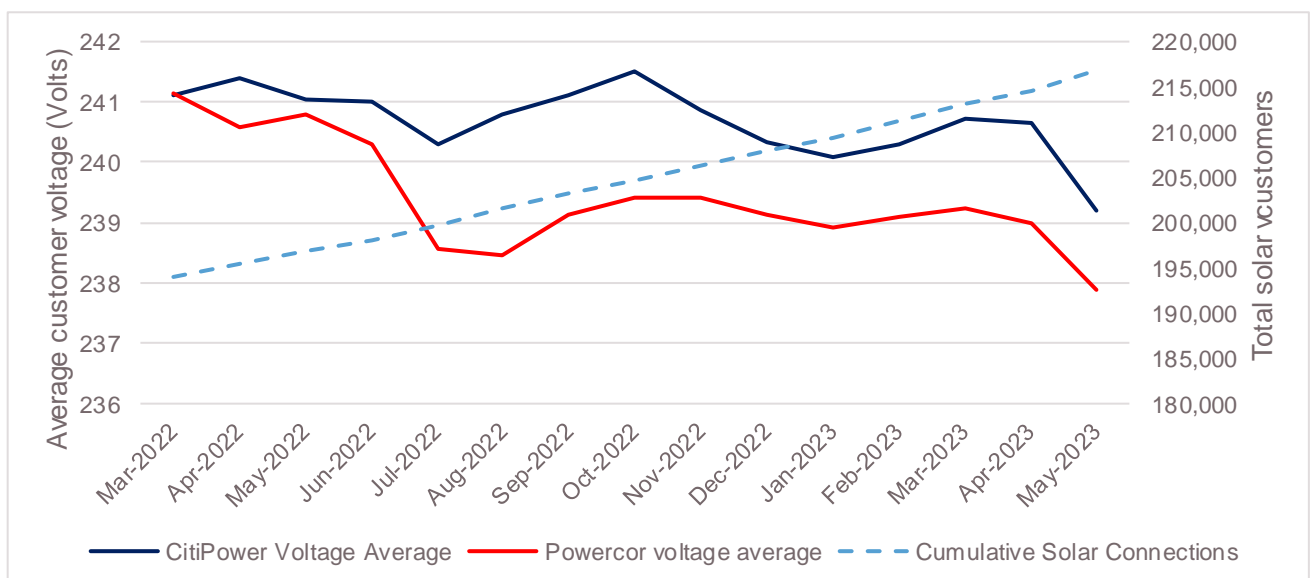
Our data shows CitiPower and Powercor’s voltage levels remained functionally compliant and above 95% for both the upper and lower voltage limits set in the Code throughout the period.

Average network voltage levels

Average voltage levels are stabilising on both networks, as long-term decreases achieved through our Future Networks Program become a permanent feature of the power quality profile for our customers.

Figure 1 shows that average voltage levels remained steady throughout the quarter at 239V on CitiPower and 238V for Powercor and are at least 1.5V lower than the same period in the previous year.

Figure 1. Average customer voltages (rolling 15-month average) and cumulative solar connections



Cumulative solar connections continue to grow on both networks, even as average voltage levels stabilise at an historical low. Residential solar connections grew to 216,836 as at 31 May 2023, an increase of 5,637 from 211,199 at the end of February 2023.

At the end of this quarter, more than 96% of customers on both networks were approved for exports up to the full capacity of their systems. Our export assessment includes consideration of localised variations in voltage.

Inverter compliance

Technical compliance for rooftop solar inverters continues to be an urgent priority and key focus for our networks, particularly as minimum demand and undervoltage trends begin to present in the voltage data.

The *Compliance of Distributed Energy Resources with Technical Settings* published by AEMO published in April 2023 describes the challenge thusly:

At this time, it is clear that whilst the impacts of non-compliance are complex and multifaceted, this issue is already causing serious power system security challenges.

Poor disturbance ride-through of DER is identified as the most serious and urgent barrier to achieving successful, secure and reliable operation of the NEM and WEM with high levels of DER.

On this basis, AEMO recommends that industry efforts focus on improving compliance urgently, targeting at least 90% compliance of new installations with AS/NZS4777.2:2020 by the end of 2023, complemented by ongoing governance frameworks to maintain and further improve that level of compliance.

Direct engagement with rooftop solar installers and manufacturers, coupled with advanced analytics to detect through our Dynamic Voltage Management Systems has allowed us to detect and pursue remote rectification in line with our Model Standing Offer. These actions have driven compliance above 80% for new connections in the quarter, a substantial improvement from less than 40% between December 2019 and July 2020.

These actions ensure CitiPower and Powercor can maintain voltage levels while continuing to connect and enable solar exports at greater than 96%, but further improvement is an imperative. Industry and government efforts must focus on improving technical compliance as more DER comes online.

Improved customer experience

We continue to see a significant reduction in the number of customers reporting voltage and power quality concerns. During the reporting period we received 189 complaints across the two networks, a 17% reduction on the 229 received during the same period last year.

While overall complaints have reduced substantially, there has been an increase in the proportion of customers reporting issues associated with lower voltage. Of the complaints received during the reporting period, 14% related to low voltage concerns, compared to 12% during the same period in 2022.

Undervoltage reduces electricity flows to customer devices and can lead to power quality issues such as flickering lights and malfunctioning motorised appliances. The increasing share of undervoltage complaints highlights the need to not only focus on reducing voltages, but to manage both minimum and maximum demand in an increasingly dynamic network, for which DERMS is a critical enabling technology.

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 for CitiPower is summarised in table 1 and demonstrates:

- less than 1.25% of customers exceed either upper or lower voltage limits for more than 1% of the time.
- no more than 0.19% of customers exceed upper or lower hard limits for two consecutive intervals.

Table 1. Weekly voltage performance indicator summary, CitiPower: March – May 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 hard limit for two consecutive intervals	Above upper hard limit for two consecutive intervals
5/03/2023	11/03/2023	0.03	0.65	0.00	0.00
12/03/2023	18/03/2023	0.03	0.65	0.01	0.00
19/03/2023	25/03/2023	0.01	0.91	0.01	0.01
26/03/2023	1/04/2023	0.02	0.76	0.01	0.06
2/04/2023	8/04/2023	0.02	0.47	0.01	0.01
9/04/2023	15/04/2023	0.05	0.48	0.01	0.00
16/04/2023	22/04/2023	0.03	0.68	0.01	0.01
23/04/2023	29/04/2023	0.02	1.00	0.01	0.02
30/04/2023	6/05/2023	0.25	0.86	0.06	0.01
7/05/2023	13/05/2023	0.62	0.62	0.14	0.01
14/05/2023	20/05/2023	0.94	0.91	0.19	0.01
21/05/2023	27/05/2023	1.02	1.25	0.23	0.01
28/05/2023	3/06/2023	0.79	1.04	0.15	0.01

Data for Powercor is summarised in table 2 and demonstrates:

- less than 2.0% of customers exceeded upper or lower voltage limits for more than 1% of the time.
- no more than 0.44% of customers exceeded upper or lower limits for consecutive periods.

Table 2. Weekly voltage performance indicator summary, Powercor: March - May 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 hard limit for two consecutive intervals	Above upper hard limit for two consecutive intervals
5/03/2023	11/03/2023	0.16	1.80	0.05	0.08
12/03/2023	18/03/2023	0.19	1.82	0.06	0.10
19/03/2023	25/03/2023	0.32	1.94	0.10	0.12
26/03/2023	1/04/2023	0.18	1.92	0.06	0.19
2/04/2023	8/04/2023	0.27	1.58	0.05	0.07
9/04/2023	15/04/2023	0.34	1.71	0.08	0.10
16/04/2023	22/04/2023	0.49	1.50	0.10	0.08
23/04/2023	29/04/2023	0.38	1.56	0.08	0.11
30/04/2023	6/05/2023	0.33	1.93	0.08	0.14
7/05/2023	13/05/2023	0.84	1.51	0.25	0.09
14/05/2023	20/05/2023	1.32	1.47	0.35	0.10
21/05/2023	27/05/2023	1.45	1.35	0.36	0.09
28/05/2023	3/06/2023	1.86	1.28	0.44	0.07

Voltage performance indicators over time

Customer voltage performance between March and May 2023 improved significantly compared to the same period in the previous year. Figures 2 and 3 illustrates that voltage levels remained well above the upper and lower limit for customers on both networks during the reporting period.

Our Dynamic Voltage Management System has been the key driver of voltage improvements over the previous 17-months. Of particular note, compliance with the upper voltage limit has lifted by approximately 4% since December 2021 for customers on the regional Powercor network.

Figure 2. Customer voltage levels against upper limit, rolling 17-month performance

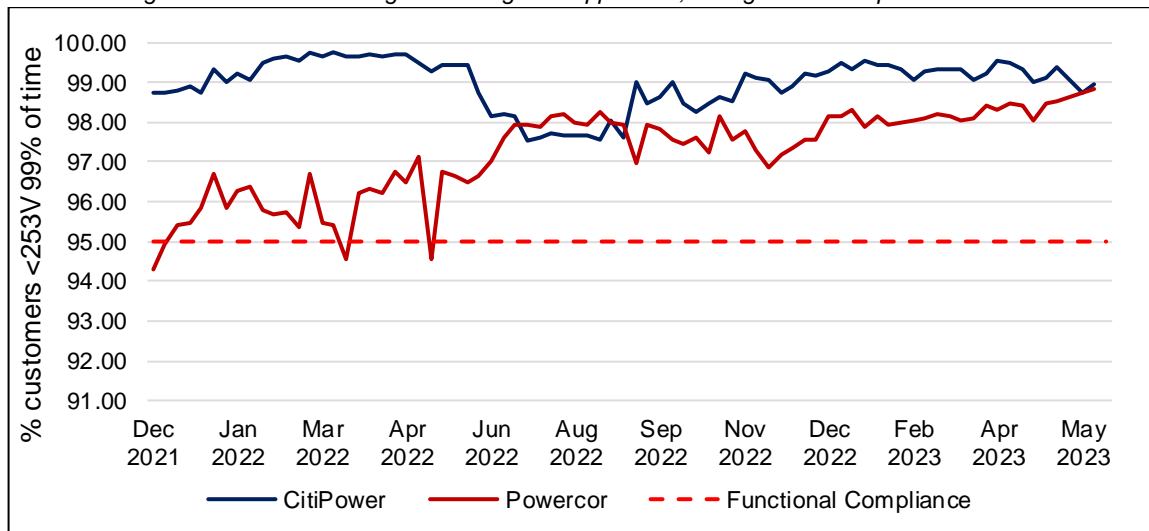
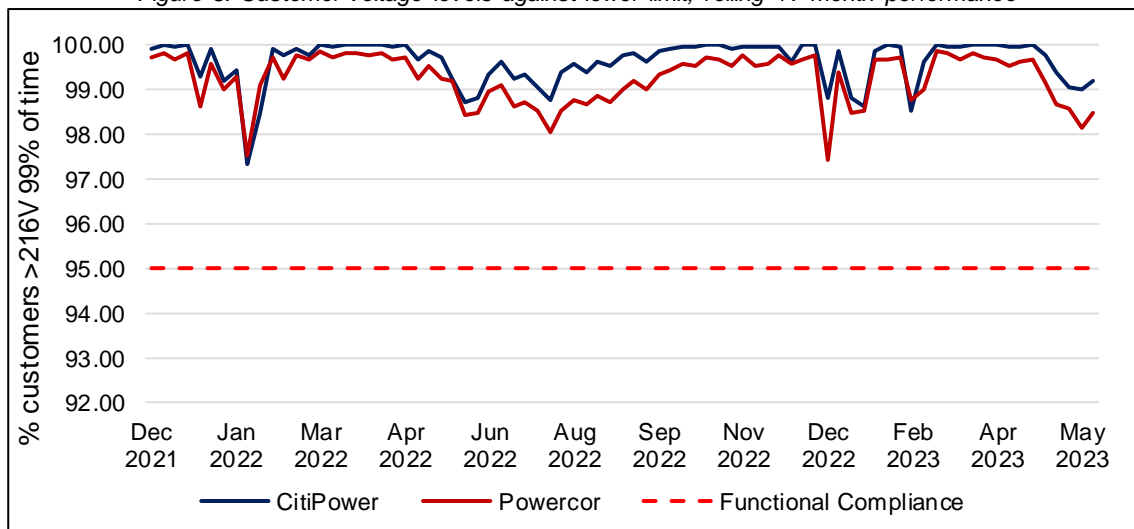


Figure 3 shows stable undervoltage performance on both networks, with a spike in December 2022 consistent with the seasonal trend for greater rooftop solar generation and lower demand during summer months.

As rooftop solar grows, our world-leading DER Management System is allowing our networks to manage demand while delivering new flexible services to customers, helping us maintain safe, reliable and affordable supplies for all consumers.

Figure 3. Customer voltage levels against lower limit, rolling 17-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 several factors that 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.*