

A background image showing several wind turbines silhouetted against a sunset sky with orange and purple hues. The turbines are positioned at various angles, with some in the foreground and others further back.

Voltage Management for a Net Zero Electricity System

IET Task and Finish Group Stage 1 Report
A Briefing for the Voltage Matters Forum
16 October 2026



Introduction

An IET Voltage Management Task & Finish Group (TFG) has undertaken a study for Ofgem addressing emerging concerns over the adequacy of grid voltage management

An interim report has been presented to Ofgem setting out the TFG's analysis and signalling the direction of its developing conclusions ahead of the final report

This presentation provides a brief overview of the TFG's analysis to date

TFG Terms of Reference

- Define the scope of voltage management concerns
- Explain the risks and opportunities
- Explore the current policy context
- Explore the extent to which the British 50Hz synchronous system might become exposed to a failure mode similar to that which led to the Iberian Peninsula event on 28 April 2025
- Provide a roadmap of what is possible and realistic in the short and longer term



Desired Outcomes of Enhanced Active Voltage Management

- Addresses current and emerging system operational issues
- Reduces costs to customers through ensuring electrical appliances are operating within a supplied voltage range that enables efficient use of electrical energy
- Increases grid hosting capacity for low carbon technologies (LCTs) in support of Clean Power 2030 and longer-term energy decarbonisation objectives
- Improves overall grid efficiency in terms of effective voltage control, efficient asset utilisation, and economic management of system losses (hence indirectly reducing costs to customers)
- Increases overall system resilience to shocks arising from displacement of synchronous generation with weather-dependent inverter-based resources (primarily wind and solar generation)

Scope of Voltage Management Concerns – LV System

Voltages Above Statutory Limits

- Evidence that up to 5% of LV-connected customers experience sustained voltages above the current statutory voltage limit
- ‘Nuisance’ tripping of solar PV inverters and EV chargers

Appliance Efficiency

- Most domestic appliances are designed for 220-240V operation
- But evidence suggests average supplied voltage might be closer to 243V
- Leading to additional energy consumption by some domestic appliances
- Note that the proposed ENA voltage reduction trial (2% in year-2) might reduce average supplied voltage to 238V - still at the high end of appliance rating range

Scope of Voltage Management Concerns - Wider System

Grid Code OC6 Compliance

- Evidence from DNOs of primary substation transformers often operating close to bottom tap – possibly compromising ability to provide up to two stages of between 2% and 4% voltage reduction on instruction from NESO

High Summer Daytime / Overnight Transmission System Voltages

- Solar PV generation displacing transmission-connected synchronous generation
- Falling transmission demand and lower VAr consumption on distribution networks
- Increasing distribution-transmission VAr injection (due to cable shunt capacitance)
- Requiring more active VAr control by both TSOs and DSOs (including maintaining PF between 0.9 lead / 0.9 lag at T-D boundary as per Ofgem's ED3 SSMD)

System Stability

- Ongoing displacement of synchronous generation by inverter-based resources (IBRs) potentially leading to increased risk of voltage oscillations

Current Policy Context - Clean Power 2030 and Net Zero

Projected Growth in LCTs

- Current policies, inc. CP2030 and the UK Solar Roadmap, could lead to an installed solar PV capacity of 45GW - 47GW by 2030, potentially rising to 85GW by 2035
- Prospect of LV distribution networks exporting to higher voltage networks during high irradiance and/or low demand conditions
- Conversely, policies promoting heat pumps and home EV charging have the potential to significantly increase peak demand at times when solar PV output is negligible
- Hence LV network voltage levels likely to experience wider diurnal / seasonal variation
- On 26 May 2026, the electricity system saw its lowest ever transmission demand - dropping to 12.62GW due to low customer demand and very high solar PV output
- Prospect of periods of negative (net) transmission demand with the potential for reverse power flows through various voltage levels of distribution systems if the UK Solar Roadmap projections and CP2030 targets are realised



Current Policy Context - Regulation

Sector Specific Methodology Decision

Ofgem's SSMD introduces voltage management as a new responsibility for DSOs in RII0-ED3 - including publishing a Voltage Management Strategy - responsibilities to include:

- Improving monitoring – understanding voltage headroom and legroom on primary networks, and voltage issues at customer premises, using LV monitoring capability enhanced with smart meter data and data from third-party assets
- Improving ability to control voltage across primary and, where required, secondary networks to ensure voltage remains within statutory limits and to eliminate interruptions of LCTs and curtailment of DERs due to voltage issues
- Reducing reactive power injection onto the transmission network with the aim of keeping power factor within an envelope of 0.9 lead to 0.9 lag at the T-D boundary
- Providing Flexibility - for example using temporary voltage reduction to provide a flexibility service to NESO



Emerging risks

System Resilience to Shocks – lessons from the Iberian Peninsula event

The Iberian Peninsula event has highlighted a number of emerging risks - some of the more notable ones potentially having implications for the GB 50Hz system include:

- Rapid generation ramping coupled with relatively slow operation of transformer tap changers – hence response too slow to react to rapidly increasing voltage levels
- Inverter-based resource (IBR) instability combined with interaction with other IBR generators leading to forced oscillations posing a risk to the system of severe and rapid (within seconds) frequency and voltage fluctuations
- A high number of overvoltage trips of small PV units connected to LV networks (note: in GB there is evidence of rooftop solar PV inverters disconnecting at voltages well below G98 over-voltage ‘no trip’ test thresholds)
- Lack of visibility of DERs and CERs in terms of capacity, network connectivity, and behaviour under voltage stress conditions - undermining voltage recovery decisions



Opportunities – LV Network Voltage Control

Reducing the LV Lower Statutory Limit

- A wider statutory bandwidth would enable LV system voltage to be lowered - improving hosting capacity for rooftop solar PV and reducing risk of nuisance tripping whilst maintaining sufficient voltage margin for heat pumps and home EV chargers
- Energy conservation through appliances operating more consistently within their nominal 220V-240V rating
- Prudent for DSOs to adopt LV operational limits of 210V - 250V – i.e. a 3V margin to the proposed statutory limits (noting instances of nuisance tripping at 207V and 253V)

CER/DER Integration

- Ensure G98 & G99 compliance w.r.t 'no trip' voltage thresholds and over/under voltage interface protection – and w.r.t power factor capability (0.95 lag to 0.95 lead)
- Implement PQ control of rooftop solar PV inverters to contain voltage rise

Manual Adjustment of Distribution Transformer Winding Tap Positions

- As a 'one-time' exercise where LV voltage levels remain consistently high despite other measures (limited to one tap adjustment where DTFs are already operating at +2.5%)



Opportunities – Primary Network Voltage / VAr Control

CLASS

- Tap-staggering of primary transformers to absorb VArS
- Tripping one of a pair of parallel primary transformers to instantaneously lower voltage
- Lowering tap position to temporarily reduce voltage and hence demand

Primary Substation AVC Compounding

- Boosting or bucking voltage according to network loading - helping contain voltage rise on downstream networks when net demand is low due to high solar PV output

Monitoring and Smart Meter Data as an Input to Primary AVC Set Points

- Setting primary transformer tap position through an optimising algorithm based on LV monitoring and smart meter voltage data from the area served by the substation

D-STATCOMs

- Strategically located to enhance VAr control on primary networks (e.g. where BESS or other DER capacity is insufficient to provide reactive power services to DSO or NESO)



Opportunities - Enhanced System Visibility

Enhanced System Monitoring and Modelling Capability

Recommended actions arising from the Iberian Peninsula final report include:

- Improve and expand the use of PMUs, oscillographs, and power quality monitoring
- implement automatic detection and early-warning systems to identify oscillations, and their source to support prompt corrective action
- Improve visibility of DERs and especially CERs in terms of technology, capacity, network connectivity, and behaviour under system stress conditions

Digitalisation and AI

- Access to an increasingly wide range of digitalised real-time or time-series data, including data from LV monitoring and smart meters, will enable better contingency planning and faster, and better, optimised actions for voltage control
- Faster AI-enabled processing of data to identify abnormalities and inform corrective actions will reduce the risk of suboptimal decisions, whilst ML will help refine decisions based on the observed impact of decisions over time

Opportunities - Innovation Rollout

Innovation / Innovation Rollout Mechanism (IRM) Funded Trials

Examples of recent and current projects include:

SPEN LV Engine	SPEN D-Suite	NPg BEET
UKPN NExT	NGED VRA	UKPN / NPg Phase Switch System
NGED LV-ACT	SP ENW Smart Street	SSEN Voltmetric

Rolled out at scale over ED2 / ED3, these innovations have the potential to enhance LV network voltage management ...

- Maintaining voltage within statutory and operational limits
- Increasing LCT hosting capacity
- Conserving customer appliance energy usage
- Reducing network losses
- Improving overall LV distribution system efficiency

Implementation – Barriers and Enablers

Barriers

- Technology readiness level - particularly w.r.t innovation funded projects where hardware or software has yet to reach TRL 8 or 9
- The need for new standards, or amendments to existing standards, to enable specifications for equipment to be drawn up
- The possible need for further financial (e.g. venture capitalist) support to bring a product to market
- High initial costs pending economies of scale from future volume sales
- Supply chain constraints if initial demand exceeds current production capacity

Enablers

- Sufficient commercial backing / risk appetite by the supply chain to commit funding to production capacity and further product development
- Regulatory certainty regarding commitment to future investment funding
- Implementation risk management – including through a trial period to identify potential early functional failures (infant mortality)

Implementation – indicative timescales for adoption at scale

Note: it may be that localised tipping points trigger a need for earlier targeted implementation than indicated in the table

Application	Implementation
Lowering MV system voltage (via Primary Substation AVC set points)	<5 years
AVC compounding at Primary Substations	<5 years
Lowering DTF tap position (where LV volts are consistently high)	<5 years
Reducing LV lower statutory limit	<5 years
SIF / NIA / IRM funded projects (including smart distribution transformers)	5 - 10 years
CLASS – frequency response / VAr absorption / demand reduction	<5 years
PQ control of solar PV & V2G inverters	5 - 10 years
DSO procurement of reactive power from DERs	5 - 10 years
D-STATCOMs	5 - 10 years
Smart meter data to optimise Primary Substation AVC set points	5 - 10 years
Enhanced monitoring and EMT modelling	<5 years
Enhanced visibility of DERs and CERs	<5 years
Digitalisation and AI	5 - 10 years



Knowledge Gaps Requiring Further Work

- There remains limited understanding of the long-term implications of sustained operation at the lower end of the statutory voltage range
- There is a lack of visibility within both NESO and across DSOs regarding network connectivity of DERs and CERs
- There is no comprehensive set of publicly available data quantifying the scale or frequency of events resulting in widespread solar inverter disconnection
- Methodologies to coordinate real time or near real time control of distributed assets whilst ensuring stable and predictable system behaviour, remain underdeveloped
- Data from smart meters, EV chargers, and microgeneration is neither sufficiently visible nor consistently integrated into network operation
- Whilst there is strong evidence of the benefits of voltage optimisation, a comprehensive CBA at a whole system level is still required
- There is a need for flexibility and ancillary service markets that customers will engage with and maintain their commitment to whilst feeling adequately rewarded



Governance and Technical Coordination

- There is limited integration between the processes that define responsibilities, standards, and data exchange
- Effective voltage management is dependent on governance frameworks that enable coordination across organisations, provide access to relevant data, and define clear roles and accountabilities
- The absence of structured mechanisms for information exchange and coordinated decision making creates a gap between system level oversight and operational reality
- Existing governance arrangements have neither the agility to adapt sufficiently quickly to the technical challenges presented by the rapidly evolving characteristics of the electricity system, nor the scope to ensure adoption and compliance
- A more integrated governance framework will be essential to ensure that voltage management can be delivered efficiently, consistently, and at the scale required
- Without effective integration, there is a risk that governance reforms will not reflect operational constraints, and that potential technical solutions will not be supported



Questions?

We will be happy to address questions at the Voltage Matters forum on 16 October

Link to full report:

<https://www.theiet.org/impact-society/government-policy-and-submissions/submissions-archive/2026-submissions/iet-voltage-management-considerations>