

Boston Spa Energy Efficiency Trial (BEET) Frequently Asked Questions

What is BEET?

The Boston Spa Energy Efficiency Trial (BEET) is a Northern Powergrid innovation project to improve the energy efficiency of customers' household appliances. It will use smart meter data in (near) real time to adjust network voltage to increase efficiency and reduce energy consumption of our customers' appliances. This should save our customers money and reduce carbon emissions, without them needing to do anything differently.

This energy efficiency trial will take place in Boston Spa, West Yorkshire and the surrounding areas, including Wetherby, served by the following primary (i.e. large) substations:

- Audby Lane (which includes Boston Spa and Wetherby)
- Leeds Road (which includes Boston Spa, East Rigton) and;
- Warren Lane (which includes Boston Spa and Bramham).



You can find out whether your house or business is served by one of these substations by using our interactive [Network Availability Heat Map](#). To access the interactive map, click on the link, select Network Availability Heat Map (to the top left hand side of the screen), select 'Demand Primary', then scroll to the correct location on the map. Clicking on the desired area will display details of the applicable primary substation. For help navigating our heat maps contact the project team on BEET@northernpowergrid.com

When is the trial taking place?

Offline testing is now complete. The live trial will be taking place until September 2025.

What is voltage?

Voltage is electrical pressure measured in units known as volts (V). Northern Powergrid facilitates the delivery of electricity to domestic customers at 230 V 'nominal' – this means that voltage can be provided to you within a range around 230 V, from 216.2 V to 253.0 V. The voltage varies within that range through the day as customer demand on the system changes.

Why a range, and not simply always 230 V?

The voltage varies within the range of 216.2 V to 253 V through the day as customer demand on the system changes.

The UK network used to run at 240 V nominal, with the European network running at 220 V nominal. This meant appliances had to be designed separately for each market, creating a trade barrier. The European Commission resolved this in 1995 with voltage 'harmonisation', which standardised network voltage across the UK and Europe at 230 V (nominal). Because no infrastructure was updated, what this meant in practice was that both networks were to operate within a crossover range around the harmonised level. The BEET trial aims to understand the optimum operating point – 220 V, 230 V or 240 V? In its own £9m 'voltage optimisation' trials, electricity distribution network operator Electricity North West (ENW) found the 'sweet spot' was between 220 V and 230 V.

What is voltage optimisation?

Typically, because of how we operate the network, customers receive a voltage above 240 V. Optimising this voltage means simply turning it up or down, but the how and why we will do this is a combination of:

1. The relationship between voltage and energy efficiency.
2. How the voltage is managed on our network at present – i.e. voltage compliance.
3. How new innovative voltage optimisation techniques can provide benefit to our customers.

Let's explore these three areas in more detail...

1. The relationship between voltage and energy efficiency

Generally, the higher the voltage, the higher the energy consumption. Overall, the relationship between voltage and energy efficiency is that a one per cent reduction in voltage should result in a one per cent reduction in energy consumption.

There are several important pieces of evidence to support this relationship, which are detailed within our literature review undertaken as part of BEET¹. Of note is the learning from Smart Street. Smart Street was an innovation project undertaken by ENW, the distribution network operator (DNO) for the North West of England. Smart Street concluded from two years of trials that there is typically a one-to-one relationship between voltage and energy consumption. Other evidence in our literature review identified a higher benefit than this (typically 50 per cent higher), however, we have aligned our assumptions to ENW's Smart Street conclusions. We believe that this provides a conservative benefit, based on a robust trial undertaken that provided a similar level of voltage optimisation to that of BEET.

We will undertake a robust statistical analysis of the data created during BEET to better understand and quantify the relationship between voltage and energy efficiency.

2. How the voltage is managed on our network at present – i.e. voltage compliance:

The voltage on our network is actively controlled at 'primary' substations. A primary substation typically feeds thousands of customers via hundreds of kilometres of network. For example, in our trial area, the Audby Lane substation powers roughly 10,000 homes.

¹ See our literature review at: <https://www.northernpowergrid.com/asset/0/document/5985.pdf>.

The voltage received by each property is dependent on the route its electricity takes through the network and the amount of power flowing through that route. Generally, the voltage reduces as it moves away from the primary substation. It also reduces at a steeper rate as more power is flowing through the circuit. This means that the actual voltage received by each customer is slightly different, and it depends on what is happening in real time (i.e. how much power is flowing to meet customer demand).

Therefore, to ensure that we always provide a compliant and safe voltage to all customers, and cater for network outages, we typically provide customers with a voltage at the upper end of the range. This approach can be thought of as voltage compliance.

3. How innovative voltage optimisation techniques can provide benefit to our customers:

Traditionally, we have achieved voltage compliance by supplying customers with a voltage that is at the higher end of the allowed (compliance) range (216.2 V to 253.0 V). This is to cater for any potential network outages, but also because we have not previously had access to real-time data about the voltage our customers receive, or the ability to respond to this information.

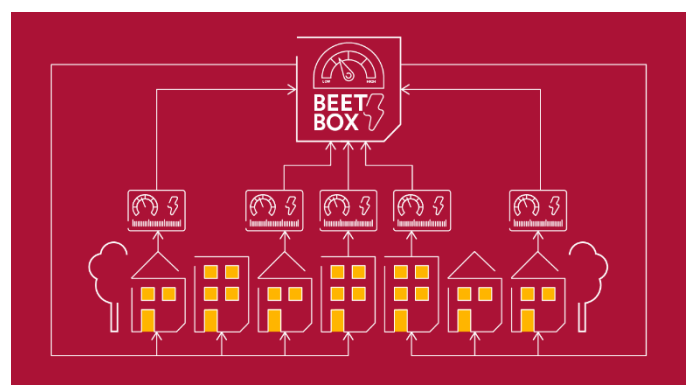
Smart grid investment and smart meters change that. Smart grids are technologies and capabilities that let us respond to network data in real time, enabling us to actively manage the network. Smart meters provide the essential data needed for us to provide voltage optimisation.

What will happen during the trial?

The trial will use a special platform developed by Northern Powergrid, known as the BEET-Box, which will analyse smart meter data to optimise the network voltage every half hour – in other words, to safely turn up or turn down the voltage to ensure appliances have a suitable voltage and to lower customer bills. The amount of voltage is to be optimised to maximise your energy efficiency. To maximise our learning and to ensure the proposed future roll-out is enhanced, we will monitor, adjust and improve the way in which the BEET-Box functions.

How does the BEET-Box work?

Smart meter voltage data feeds into the BEET-Box, which applies an optimisation algorithm, developed by Fundamentals Ltd in conjunction with Northern Powergrid, to smart meter data, to determine the level of voltage adjustment required, and sends this information to the network management system (NMS), which in turn adjusts the voltage to customers' homes and businesses.



Will BEET affect my power supply?

In short, no, there are statutory voltage limits under the Electricity Safety, Quality and Continuity Regulations (ESQCR) and the BEET-Box algorithm is designed to have close-to real-time knowledge of the network and calculate appropriate voltage targets so that these are adhered to. We will only begin the full trial once we are confident the BEET-Box will function as required. Customers shouldn't notice any discernible differences to their power supply.

Will I notice anything different?

No, it shouldn't significantly affect your everyday life apart from helping you save money and energy. If the average voltage optimisation achieved is four per cent, appliances with motors, such as fridges and washing machines, will continue to deliver the same levels of performance, but will be more energy efficient when they operate. Kettles may take fractionally longer to boil, for example, instead of taking 30 seconds they could take 32.5 seconds, but this should not increase costs.

How much is the BEET project costing Northern Powergrid?

The trial is a £1.3m investment, and we estimate a full roll-out across our region would be about £11m. This is part of our wider investment plan to create a greener energy system in the region, and help the UK decarbonise. Once BEET is rolled out at scale, the savings for customers are expected to significantly outweigh this investment: the annual saving for each could be between £15 and £70 – typically we expect it to be £28², with vulnerable customers and those who are fuel-poor likely to feel the most benefits.

What benefits will I see?

The benefit to you as a customer is estimated at £28 per household every year, because you should use less energy – and therefore pay for less. Using less energy will also lower your carbon footprint. And this happens without you having to do anything.

What will it cost me?

We do not seek any direct payment from households benefiting from the trial. This project is funded by Northern Powergrid, as part of our [2023-28 business plan](#) agreed with Ofgem.

Customers pay for the services we provide through network related charges, which appear as part of their bill from their chosen electricity supplier. For the average domestic customer, this is around 25p a day and it covers everything we do to manage, maintain, innovate and invest in the network that powers our customers' lives. Given the benefits, this project is vastly in favour of customers and, if successful, will later benefit most customers living in our area and potentially the whole country.

How can BEET reduce carbon emissions?

We know from research that voltage optimisation reduces energy use and that this in turn is directly linked to carbon emissions. A one per cent voltage reduction would deliver at least a one per cent energy consumption reduction, and therefore, in turn, a one per cent carbon reduction. On average, we believe voltage could be reduced by up to four per cent – saving 20 kg per household annually (the equivalent to driving 46 miles in an average car). Across the UK, this could potentially save up to 1.1 million tonnes of CO₂ annually – that's the equivalent of taking up to 200,000 cars off the road for a year.

² Calculations based on several factors, including our regulator Ofgem's definition of typical electricity usage, and assumed unit costs of £0.30 per unit.

Why optimise the voltage?

There is a broad industry consensus that a one per cent voltage reduction can produce a one per cent electricity consumption reduction – therefore reducing customer bills and carbon emissions. The potential benefits of voltage optimisation include:

- lowering customers' electricity bills;
- reducing carbon emissions (because less energy and infrastructure is needed);
- increasing capacity to connect to the network (to support low carbon technology uptake, such as installing solar panels or getting an electric vehicle); and
- providing Northern Powergrid with network voltage insight, enabling us to proactively resolve problems before they become complaints (thereby improving customer satisfaction).

How far can Northern Powergrid optimise the voltage?

There is the potential that, on average, our BEET team could safely reduce voltage by up to four per cent. We anticipate the average annual CO₂ saving to be 20 kg per household, the equivalent to driving 46 miles.

How can the same benefits be provided across the UK?

BEET is part of Northern Powergrid's overall goal to decarbonise regionally and nationally, and secure net zero. It is our aim to ensure that the technology is shared with all the UK DNOs so they can use it with minimal investment. Assuming the same benefit could be provided across the UK, this could provide annual national customer savings in the region of £770 million and up to 1.1 million tonnes of CO₂ emissions annually – the equivalent of taking up to 200,000 cars off the road each year.

What evidence does Northern Powergrid have that this will work?

The benefit to our customers of receiving an optimised voltage has been explored by several innovation projects within the industry, such as:

- Electricity North West's [Customer Load Active System Services](#) (CLASS) and [Smart Street](#) projects;
- Western Power Distribution's [LV Network Templates](#) and [Voltage Reduction Analysis](#);
- Scottish Power Electricity Networks – [Flexible Networks for a Low Carbon Future](#);
- National Grid's – DNO Investigation into Voltage Interaction and Dependency Expectation ([DIVIDE](#));
- Powerstar's [voltage optimisation technologies](#), and;
- Northern Powergrid's own ongoing 'level bar reduction' initiative, plus the research discussed in the [documents and resources](#) section of our project webpage, which was completed in December 2020.

Have you done anything similar before?

Yes, to date we have:

- Carried out a significant piece of analysis that resulted in us lowering the voltage at the majority of our substations by roughly two per cent. We are close to completing this action, and the benefits of this work were assessed statistically to identify significant energy efficiency benefit³. This action also created network capacity to connect more solar panels to the network.
- Applied intelligent techniques to optimise voltage in real time based on local measurements as part of our [Customer-Led Network Revolution \(CLNR\)](#) smart grid project. It's because of CLNR we started an £83m smart-grid enablers programme that is nearing completion. The learning and technical capability from this work has formed the building blocks for BEET.

Why hasn't voltage been optimised before?

It's only now that we have the learnings from the smart-grid enabler investments – together with recent work by Electricity North West's Smart Street project – that we know the tangible benefit voltage optimisation can provide to customers. And we need the tools to implement this knowledge – visibility of what's happening to voltage at our customers' locations. The smart meter roll-out is the final piece of the puzzle; smart meters measure the voltage across the network where it really matters – where our customers are located. They can provide regular voltage readings that can be used to optimise the voltage for all customers. As we move to an increasingly digitalised network, we're discovering exactly what data such as this can do, and exploring more possibilities to increase efficiency, save customers money, and reduce carbon emissions – over and above what our regulator Ofgem requires. Because once we know we can do something, and we have the tools to do so, it's the right thing to do.

Do I need to have a smart meter to have my voltage optimised?

No – the BEET-Box will read smart meter voltage data and feed it back to Northern Powergrid, who can then optimise the voltage for all customers. The sample readings across the network should provide enough information for the BEET-Box to ensure that the whole network is receiving the optimal voltage. The same voltage applies to thousands of customers, so it will never be entirely 'bespoke', which is why you don't have to have a smart meter to benefit from the trial – we're supplying the optimum voltage for your village or community overall, rather than for each individual customer. However, the more smart meters there are on the network, the more successful the project will be, because we will have more data and thus a 'bigger picture' of how the network is working in real time.



³ See Northern Powergrid's [HV Conservation Voltage Reduction Impacts Study](#).

I've read a lot about the energy system changing, and an increase in electricity use from things such as heat pumps and electric vehicles. How can you say we'll be making savings on our energy bills when we'll all be using more electricity in the future?

We are expecting to see more heat pumps and electric vehicles (EVs) as the UK progresses towards net zero, and it's true that these (likely) won't benefit from voltage optimisation. This is because devices such as EV charging points have 'power electronics', which are relatively immune to voltage fluctuations. The cost savings and reduced carbon emissions are based on existing use of the network, which is not expected to change over the next 10 years, despite people consuming more electricity each year if they buy an EV. We will be carrying out robust statistical analyses both during the BEET trial, and in future alongside any roll-out, to ensure the ongoing benefit is quantified.

Why is Northern Powergrid planning to pass on the cost savings to customers and not take it as profit?

Energy suppliers pay us network charges for using our equipment to transport electricity to their customers – rather like a delivery charge. Customers, as part of their bill from their chosen supplier, pay their supplier their share of the network-related charges and pay for the actual amount of electricity they use. This means that any cost savings on electricity use are yours – not ours. BEET does help us to 'deliver more for less' and offers wider social benefits, but its biggest impacts are carbon footprint reduction and financial benefits – which will be felt most by those in our region who are vulnerable or fuel-poor.

Then what's in it for Northern Powergrid?

We've made commitments to be an enabler of net zero – it's a key theme in our [2023-28 business plan](#). Innovation is one of the main drivers to reach this goal, and BEET is a prime example of how digitalisation and technology can provide energy and carbon savings with minimal investment. This is one such benefit to us, but others include:

- providing improved customer service (which benefits everyone);
- improved efficiency across the network;
- improved reputational excellence; and
- increased capacity to connect.

Why do I need to know about BEET if I won't notice it taking place?

The success of BEET depends on support from our communities and regions, because the project:

- is driven by community engagement;
- requires the use of community-located assets (smart meters – these belong to suppliers, but we need access to the voltage data they contain, at the point of supply in the community);
- ultimately benefits the community by reducing customers' consumption, thus saving the community money and reducing the carbon emissions associated with their electricity supply; and
- contributes to improvements in energy efficiency – a key factor in helping communities, regions and the UK reach net zero by 2050.

Who are the project partners?

BEET came from an idea by Boston Spa resident Keith Jackson and is a collaborative project led by Northern Powergrid with support from:

- Keith Jackson – project board member and Boston Spa community member.
- The communities in and around Boston Spa, where we will be trialling this innovative voltage optimisation technique.
- WSP – project managing the trial.
- Fundamentals – designing the BEET-Box and an algorithm to determine the most efficient voltage to supply on the network.
- Gutteridge Haskins & Davey (GHD) – system studies to support development of the BEET-Box.
- Siemens/Northern Powergrid smart metering team – creating the smart meter interface with the BEET-Box.
- GE Digital – providing a software platform that will provide the data to effectively and efficiently manage network operations to interface with the BEET-Box.

How will my smart meter data be kept safe?

We take your data privacy seriously. BEET will not use energy ‘consumption’ data which, under GDPR, is covered by our Data Privacy Plan, see northernpowergrid.com/privacy-policy. We’ll only use voltage readings, which don’t tell us about your personal energy consumption, and don’t give insight into your personal data. All the BEET-Box will see is the ‘big picture’ of voltage across the network.

Are there any other benefits?

Our principal driver behind BEET is to enable customers to reduce their energy consumption by improving the energy efficiency of their appliances, this in turn saves customers money and can lower carbon emissions. We do envisage some other benefits however, including:

- Lower electricity losses.
- Improved capacity to connect customers (including low carbon technologies), as voltage optimisation should improve the amount of new load or generation that can connect before a voltage compliance issue is encountered.

What do I need to do?

Nothing! Though we encourage you to consider a smart meter if you don’t already have one (and you can still benefit from BEET even if you don’t), as this will provide valuable data to enhance the project. We’d like you to get involved if you wish and provide us with your thoughts on this project.

How can I get a smart meter?

To find out more, visit smartenergygb.org. Contact your energy supplier to find out how to arrange a free smart meter installation. Your supplier is responsible for installation and making sure it works properly. They should explain the process, show you how to use it and give you a copy of the instructions. You can find out more about the national transition to smart meters, at northernpowergrid.com/smart-metering.

How do I share my ideas or ask a question?

We really encourage you to get in touch and give us your feedback. We want to develop BEET together with our stakeholders and customers.

- You can find out more about BEET on our website at northernpowergrid.com/beet.
- If you'd like to share an idea, ask a question or give feedback on BEET, you can arrange a conversation by emailing BEET@northernpowergrid.com or calling 0800 011 3332 and asking to speak to one of the project team.
- Alternatively, you can write to us at Stakeholder Relations, Northern Powergrid, 98 Aketon Road, Castleford, West Yorkshire WF10 5DS.

What happens if I already have a voltage optimiser?

Voltage optimisers are rare and you will almost certainly know if you have one, if you don't know if you have one, it's almost certain you don't. Someone with their own voltage optimiser that is already optimising the voltage to a lower level than we're supplying, could potentially find that it drops even further, potentially below statutory limits. In all likelihood, you wouldn't notice an effect on your appliances, and would only become aware of the issue by looking at your optimiser. There's no data available on how many 'personal' voltage optimisers there are on the network, but our research suggests that they are most likely to be used by industrial customers on the high voltage network.

If you have concerns about this, please email BEET@northernpowergrid.com or call 0800 011 3332 and ask to speak to one of the project team.