

Smarter Network Storage

Frequently asked questions (FAQs)



**UTILITY OF
THE YEAR**



Smarter Network Storage FAQ's

Why is there a need for electricity storage?

Firstly, as a result of the transition to a low-carbon future, electricity demand is expected to increase in the UK because of more low-carbon technologies, such as electric vehicles and heat-pumps. This leads to a growing requirement for investment and upgrading of the networks, which must be designed to meet peak capacity demands, even if this peak demand only ever occurs for a very short-period of time, if at all. This reinforcement is normally provided through the addition of new cable circuits, with higher capacity, and bigger transformers.

Secondly, increasing amounts of renewables on the system means that generation of electricity becomes more intermittent and unpredictable. This makes it more difficult to precisely balance the generation and consumption of electricity, which is currently completed every second by National Grid. It also means sudden losses of generating plant, such as an unexpected failure of a power station, are more difficult to compensate for without the use of reliable, reserve generating plant, which is often high-carbon and costly to run.

Energy storage, located across distribution networks can help with both these challenges. Storage can provide an alternative way to increase network capacity and improve asset utilisation by reducing the amount that needs to be supplied from higher up the National Grid. This reduces the peak demand that the cables and transformers need to supply, which is achieved by using the storage to absorb energy at low-demand times, and injecting it back at peak times. This in turn means that reinforcement of the network can be deferred, or potentially even avoided entirely.

As well as increasing the utilisation of the networks and reducing peak demands, storage can also help to provide reserve capacity, to help stabilise the energy system and allow more intermittent, renewable generation connect to the networks. Certain storage types such as batteries can also provide very quick response which can help to stabilise the frequency of the energy system in the event of major faults or generation failures.

Sufficient storage capacity in the UK could even make it possible to turn off nuclear, coal, gas or diesel power plants completely.

How can electricity storage help electricity networks?

Storage can aid electricity distribution networks in a number of ways including:

- Reducing peak demands on network assets; which can defer or avoid the need for reinforcement
- Increasing the utilisation of networks which allows for more efficient operation and overall reduces losses
- Providing backup, or reserve, capacity to support a more renewable, and intermittent generation mix
- Helping to stabilise the frequency of the networks in the event of generation losses

For more details, see

http://www.electricitystorage.org/technology/energy_storage_benefits/benefit_categories

Does storage support the use of renewable generation?

Absolutely - In addition to wind and solar-based power generation, energy storage is the third building block for a fossil-free energy supply. It ensures that wind and sun energy is available when it is needed.

The growth of wind power and other intermittent sources of energy generation that rely on natural resources are less predictable and controllable; this presents a less certain generation mix for the System Operator, National Grid, who

has the task of balancing supply and demand. The conventional way to overcome this issue is to utilise sources of backup generation, if more is needed, or curtail generation (disconnect generators) if less generation is needed. Alternatively, consumer demand can be stepped-down in times of peaks. Intermittent generation can however be effectively decoupled from the system using storage as a buffer.

The closer the storage asset is placed to the customer then typically the greater the positive effect it can have on the distribution system. However, there is a trade-off between the economies of scale present from large numbers of installations and the increase in complexity that exists as a result of a network of multiple smaller storage devices.

Why is the project called Smarter Network Storage?

'Network Storage' refers to the connection of energy storage technology to the distribution network. This enables a change from the traditional, one-directional flow of energy through the network; instead storage serves to act as a reservoir. This enables electricity to be either stored for later use (charging), or delivered to the network from a previous charging period (discharging).

Additionally, the project is described as 'Smarter' due to the innovative commercial frameworks in conjunction with the Smart Optimisation and Control System that will be developed.

By validating new business models for storage and identifying necessary market changes to aid the integration of storage into electricity distribution, it is hoped wider adoption of storage can be enabled. Further to this, by accommodating the higher levels of intermittency that will occur through the uptake of low carbon generation and technologies, a cost efficient and effective means to both benefit the distribution networks and ultimately the end customers will be achieved. Importantly, for wider system benefits, the storage does not need to be located near to the renewable generation plant; it can be located anywhere on the network providing there are no local network constraints.

How much funding has Smarter Network Storage received?

Smarter Network Storage was awarded funding of £13.2 million from the Low Carbon Networks Fund. This will be supplemented with £4 million of funding from UK Power Networks and £1 million from our Project Partners.

When will Ofgem see a return on the investment?

The purpose of the Low Carbon Network Fund is for distribution companies to find innovative ways of managing the increasing demands on electricity networks, whilst simultaneously managing the cost to the customer.

Ofgem will realise the benefits through the dissemination of the learning generated throughout the course of the project, in particular, the commercial learning. In conjunction with shared data around the application of storage across a range of services, commercial learning will help support DNOs and/or third parties in developing other business cases for the integrated use of storage. This will seek to support the growth of this industry in the UK and Europe. Through demonstrating means of improving the value and economics of storage, and validating future business models, the SNS project will help to encourage the wider adoption of energy storage into the electricity system.

In conjunction with value from supporting electricity system balancing, the project will facilitate savings in distribution and transmission investment. On wider roll out, the project is expected to provide over £0.6 billion of savings for customers.

It is estimated that once this is proven as an economic alternative solution to reinforcement, around 2GW of distribution-connected storage capacity could be integrated into the system across GB by 2040, providing significantly more benefits for customers.

What benefits will the customer get?

Customers will benefit from the project through reductions in overall system costs and more efficient network investments, which will pass through to reduced electricity bills.

The Smarter Network Storage project will defer the need for traditional reinforcement at the chosen site in Leighton Buzzard, but also serve to demonstrate the means in which the economic potential of storage can be maximised throughout its lifecycle. This will be achieved through harnessing the storage for other purposes that would otherwise involve additional system costs, including the provision of ancillary services to National Grid. These wider system efficiencies across transmission, generation and balancing all serve to benefit customers through improving the return on the investment in the storage device, which passes through to reduced costs for customers.

The learning from the project, in particular relating to the commercial arrangements and business models, will help to encourage the development of storage as a more economical alternative to traditional means of overcoming network challenges. This in turn will allow more optimal and efficient investment decisions to be made in distribution networks across Great Britain for the benefit of customers.

What is Smarter Network Storage trying to achieve?

There are a number of problems currently preventing the more widespread adoption of energy storage across distribution networks:

- Storage deployed for one application alone is inefficient and therefore uneconomic;
- Business models for maximising the value of energy storage are challenging to predict and implement;
- The regulatory frameworks make the long-term integration of storage and other forms of flexibility challenging;
- The supply chain is immature and evolving, therefore many companies are affected by issues elsewhere; e.g. the electric vehicle market in America;
- Large-scale storage is currently unproven on UK distribution networks

The solution:

To address these issues, the Smarter Network Storage project will trial innovative technical and commercial techniques that will provide the means for storage to be used to solve distribution network challenges, whilst ensuring the value of the flexibility is maximised for the benefit of the wider system and customers through:

- 1) Deployment of large-scale distribution-connected energy storage;
- 2) Implementation of a Smart Optimisation and Control system in order to manage and optimise the storage flexibility;
- 3) Innovative commercial arrangements to support the shared use of energy storage in providing wider system benefits, including standby reserve and managing frequency;
- 4) Assessment and validation of the full value that storage can provide to DNOs and the wider system to support future business models for storage;
- 5) Building upon learning from other LCNF projects;

- 6) Ensuring cost effective use of flexibility is fully explored.

The project will provide experience of real commercial innovations required to bridge the gap between pure technical demonstrations and the knowledge required to understand the commercial viability of storage and the means to deploy it in the most economical way.

Where is the project being trialled?

Leighton Buzzard 33 / 11 kV primary substation, adjacent to Woodman close, Leighton Buzzard, has been chosen as the trial site because it provides an ideal opportunity to demonstrate Smarter Network Storage (see section 4 for further details).

A 6MW / 10 MWh energy storage facility is being installed at the substation in order to mitigate the thermal constraints of the overhead lines feeding the site which currently limit the available capacity at time of very high peak demand. Network support provided by the storage will help accommodate current and future load increases, avoiding the immediate need for reinforcement. The storage deployed at the site will generate new knowledge and learning on the challenges of integrating large-scale storage, and provide an opportunity to trial its capabilities in providing load shaping, reactive power compensation and voltage support.



Indication of the area of Woodman Close that will contain the storage device.

How much energy can the battery hold?

The energy storage system is rated at 6MW (it's peak power output), and 10MWh (It's energy capacity);

This is enough to power about 6,000 homes for 1.5 hours **at PEAK times** (Based on typical domestic max demand of 1kW);

During average or low demand times, the storage is enough to power about 1,100 typical UK homes for a whole day; or over 27,000 homes for an hour (Based on average annual domestic consumption of 3,300kWh).

Smart Optimisation and Control Platform

What will the Optimisation Platform do?

The Smart Optimisation and Control Platform (SOCs) is the name given to a new software system being developed that will manage the wide range of potential services that could be carried out by the storage device.

It will help to optimise and maximise the value of the storage capacity and enable the storage device to provide wider system benefits, over and above those provided to the Distribution Network Operator.

The system will optimise the usage of the device depending on a number of inputs and predictions, attempting to maximise the value of the storage capacity within the constraints of the network.

Why is the Optimisation Platform new for SNS?

Network storage has not previously been installed in the UK with the intention to leverage multiple benefits outside of the reinforcement of the distribution network. For this reason, a system that can suggest the appropriate use of the device, ensure network constraints are not breached and guarantee the state of the battery is suitable for the next application is required. It is this system that will be the optimisation platform for Smarter Network Storage.

What storage technology is being used?

- The storage is using a battery cell technology, based on a Lithium-Ion chemistry;
- The exact cell chemistry is a Lithium-Manganese blend.

The type of storage technology that has been selected as the most appropriate for the installation is an advanced Li-ion (Lithium Ion) technology. Li-Ion was selected from a number of both traditional and new technologies. The deciding factors that have highlighted Li-Ion above competing technologies are:

- Safety, a key factor in deciding which technology to utilise has been safety. We have endeavoured to use a technology with a track record and is proven to be safe;
- Mitigation of potential impact to wildlife, some of the other technologies considered involved vast volumes of chemicals that needed to be moved in order to store energy i.e. flow batteries. Due to the proximity of Clipstone Brook; this was a deciding factor against such technology;
- Energy Density, a figure typically given in kWh/kg, with mitigation of the impact of the size of building required to house the storage device in mind, Li-Ion technology represents a good density of energy, thus reducing the overall physical dimensions of the individual batteries and racks;

- Cost per kWh, in order for the project to demonstrate that storage technology is a viable alternative to traditional reinforcement, the cost of the storage technology has to be competitive;
- Lifetime of device, in order for a viable alternative to traditional reinforcement to be proposed, in conjunction to initial outlay, the lifetime of the technology has also been a key factor to prevent premature replacement occurring.

What can the storage device do?

- 1) Peak shaving;
- 2) Reactive power support, which improves losses;
- 3) Stabilise the frequency of the national grid;
- 4) Defer reinforcement of the network;
- 5) Provide reserve to overcome the intermittency of renewable generation;
- 6) Wholesale market opportunities.

Smart Commercial Arrangements

What are the 'Smart Commercial' Arrangements?

The smart commercial arrangements address the issues required for operating the storage system with National Grid, the facilitator of both frequency response services and short term operating reserve to deal with imbalance on the electricity system. Historically, ancillary service providers have only been able to offer one service at a time, however, with the Smarter Network Storage project; we will explore provision of all of the services, storage can participate in, individually whilst simultaneously dealing with power flow constraints on the local network. Due to the nature of previous subscribers to the service, the contractual agreements do not allow the asset owner to commit to a National Grid service and simultaneously deliver other services to the distribution network. We will explore a more flexible arrangement, facilitating the ability for an asset owner to offer multiple services whilst delivering system stability support to National Grid. Hence, Smarter Network Storage will bring 'Smart commercial arrangements' and share the knowledge gained to potentially change the way National Grid procure Reserve and Response Services.

What is the problem?

The National Grid market for ancillary services has been designed with generators in mind, meaning it is challenging both for smaller providers to access the market, and to provide benefits across a range of services. The current arrangements are not well suited to storage, which can provide capabilities above and beyond those on offer from alternative providers e.g. faster response (seconds).

The solution:

The solution is to trial the use of storage to benefit the whole system, and explore with National Grid, the smart commercial arrangements that storage asset owners, and other flexible providers, can utilise.

Why are the commercial agreements so innovative?

The arrangements are innovative as electrical energy storage has not previously been part of the National Grid portfolio of balancing services. New commercial arrangements with National Grid, specifically for multi-purpose storage have not been explored in the UK. In doing so, opportunities for smaller multi-functional storage devices will be realised.