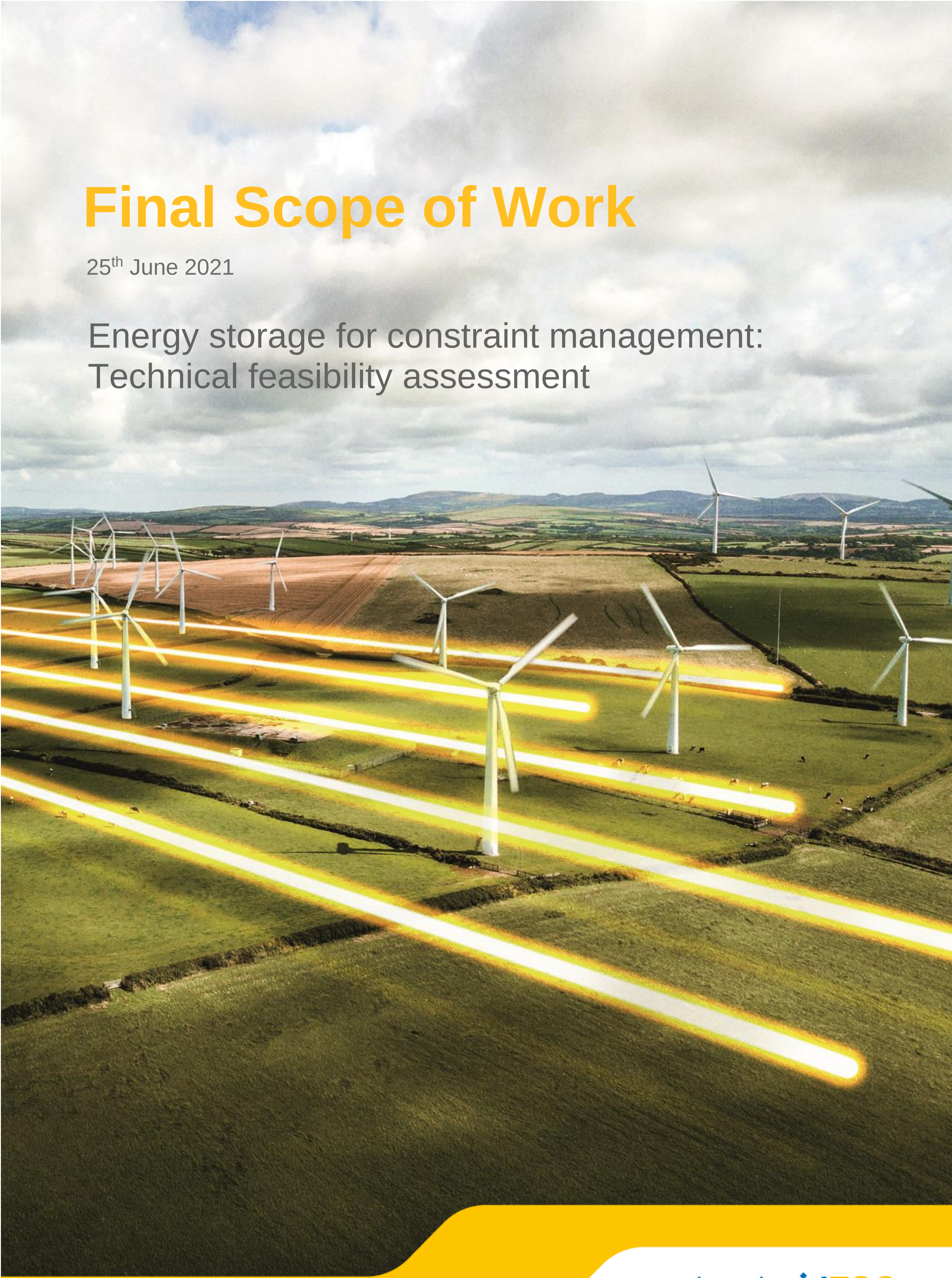
Final Scope of Work

25th June 2021

Energy storage for constraint management: Technical feasibility assessment



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Purpose of document

Provide details of the Final Scope of Work for the ESO Energy Storage for Constraints Management Technical Feasibility Assessment. This document builds upon the Draft Scope of Work published on 10th May 2021 and comments received from the industry.

The ESO has issued this Final Scope of Work to several consultancies shortlisted following the Request for Information tender phase (deadline of 10th June 2021). The ESO is undertaking a tender with invited consultancies who will bid to perform the project scope outlined below. The ESO will share findings from the project upon its completion (expected December 2021).

About National Grid Electricity System Operator (ESO)

Electricity is a modern-day necessity and the ESO exists because everyone deserves access to a safe, reliable and affordable supply. We all take for granted that we can make a cup of tea, cook dinner, travel to work, and stay connected to our loved ones on demand – but it only happens because the ESO keeps the power on 24/7. As the Electricity System Operator for Great Britain we are in a privileged position. We sit at the heart of the energy system, balancing electricity supply and demand second by second. We keep the lights on and the electricity flowing directly to where it's needed. We make sure British people, wherever they live, have the electricity they need at the flick of a switch because without it, society wouldn't function. We bring energy to life.

Providing reliable and affordable electricity is not enough. The energy we all consume needs to get cleaner, quickly. We are passionate about making a difference and delivering that change. We are here to help Great Britain and other countries reduce their carbon emissions so that our planet is safe for future generations to enjoy.

As well as day to day operation of the GB electricity system, we play a central role within the energy industry, looking at what the future may bring and how the market needs to adapt to deliver a greener future. We are facilitating the journey to net-zero by collaborating with others, sharing insights and analysis and running world-first innovation projects.

We know the energy transition must be affordable and that competition is vital for encouraging innovation and keeping prices as low as possible. We play a central role in developing electricity markets and the way they operate. We are helping to remove barriers to entry and improve access to electricity markets so that lots of different businesses, small and large, can participate and compete.

These actions will help us to keep the country supplied with the electricity it needs at lowest cost to the consumer. We continue to work collaboratively with industry and government to keep the lights on and protect consumers.

National Grid ESO at https://www.nationalgrideso.com/

Background

National Grid Electricity System Operator (ESO) undertakes the role of system operator for the GB electricity system. One of our roles as residual balancer is to ensure that the physical flows on the system stay within the capability of the transmission network. Flows on the network are initially determined by energy markets. When more electricity wishes to flow over a circuit than is permitted this is known as a constraint.

The ESO manages these constraints by taking locational actions - by paying generators (or demand) in different locations to change their output (or consumption), thus changing the flow on the network. The amount the ESO has to pay network users to manage constraints in this way is known as the constraint cost.

As the electricity system decarbonises these constraint costs are expected to rise significantly, particularly between now and 2030, as renewable generation connects faster than new transmission capacity can be built. After 2030 planned increases in transmission network capacity are expected to significantly reduce the level of constraints.

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On 25/02/21 the ESO launched a Constraint Management 5-Point Plan of measures to mitigate the expected increase in constraint costs. As part of this plan, the ESO wants to explore the technical feasibility of energy storage having a significant role in reducing network constraint costs between now and 2030.

What is in scope for this project

The ESO is running a tender process for a 'Technical Feasibility Assessment' to model flows and constraints on the electricity transmission network; the possible role of energy storage to reduce these constraints and the impact of this on system costs, the impact of this on system costs and whether it would be feasible under current market arrangements. It proposes that the successful bidder undertakes four work-packages that build upon one another, to investigate this question.

Work-package 1: Technical analysis of suitable energy storage for constraint management

Details	Analysis will not include
Undertake modelling analysis of specific constrained locations of the UK electricity transmission network and how energy storage could mitigate these constraints. This work-package will: • analyse the volume and timing of constrained power (consultant to propose the granularity of power and time to use and explain why this is appropriate) • determine suitable parameters for defining generic energy storage technology archetypes (e.g. charging power, discharging power, energy capacity) • develop a suitable set of energy storage technology archetypes to represent current and plausible storage options • model how each of the energy storage options, responding to the constraints, would charge and discharge • for each year and constraint location determine which storage archetype in the set best relieves the constraint, taking into account the design, location and operation of the storage and analyse the impact of this storage on network flows • provide a technical solution that optimises for minimum constrained energy (MWh) • calculate how much of the constraint problem energy storage could theoretically alleviate	• Constraint costs • Storage costs, performance and lifetime • Price signals • Market arrangements

Work-package 2: Value to the system / consumer of energy storage for constraint management

Details	Analysis will not include
Second work-package will build upon the first and will: • calculate how much constraint costs will be without energy storage • and how much constraint costs could be reduced by adding energy storage as defined in work-package 1 • for each year and constraint location, determine which storage archetype, from the set defined in work-package 1, best reduces the cost of the constraint, taking into account the design, location and operation of the storage	• Storage costs, performance and lifetime • Price signals • Market arrangements

- provide an economic solution optimising for the minimum of constraint cost plus storage cost (£)

Work-package 3: Business case analysis

Details	Analysis will not include
Third work-package will build upon the findings of the first two work-packages and will: • match the energy storage defined in work-package 1 to real-world energy storage technologies • (if necessary) adjust the analysis in work-package 1 to account for limitations in how real-world energy storage devices operate • use benchmark costs of energy storage technologies (capital, operating, financing and connection costs) to calculate approximate costs for the energy storage defined in work-package 1 • compare the cost of the storage with the value it delivers through reduced constraint costs (as calculated in work-package 2) • conclude whether it is theoretically possible for energy storage operating as constraint management to both have a business case and save the consumer money	• Price signals • Market arrangements

Work-package 4: Market arrangements

Details	Analysis will not include
The fourth and final work-package will: • summarise the current market arrangements and the revenue streams available to energy storage providing constraint management services • calculate the revenue that the energy storage defined in work-packages 1 and 2 could earn from current available revenue streams • compare this revenue with the energy storage costs calculated in work-package 3 and conclude whether this energy storage would have a business case under current market arrangements • outline at a high level the main barriers that current market arrangements cause for energy storage providing constraint management services	• N/A

Clarifications

- This study is part of a programme of work aimed at mitigating constraint costs in the period from now to 2030. As such, the analysis should only consider the impact of storage on constraints in the period 2022-30. Where limiting the time period of the analysis is likely to cause distortions, e.g. when considering the business case for technologies with longer lifetimes than this, simplifying assumptions should be used to remove the distortion without significantly increasing the work.

- In work-package 1, when identifying the most suitable energy storage solutions, the solutions analysed should be limited to those that are reasonably close to known technologies, to avoid unnecessary analysis of the performance of theoretical technologies that are unlikely to be available in the time period being considered.
- In work-package 1, when considering the impact that energy storage could have on constraints, it is expected that the main impact will be by absorbing and releasing active power. However, some energy storage technologies can also affect constraints caused by voltage, short circuit level and stability. The scale of these other impacts on constraints should be roughly estimated early in the project and where they are found to be significant, they should be included in the analysis.
- The ESO will provide the successful bidder with a set of 6 of the most highly constrained network boundaries to be studied as part of the analysis for work-packages 1 & 2, with the outputs of this analysis carried through to work-packages 3 &4.
- The scope of work proposes that two separate optimisations are delivered (a technical solution and an economic solution). When designing the analysis, consultants should consider the interaction between these different optimisations. We are open to recommendations on alternative optimisation approaches that achieve the same outcome.
- We expect most of the inputs for the network modelling to be publicly available (e.g. network topologies, scenarios of demand and supply from the Future Energy Scenarios) or provided by the consultant if necessary (e.g. more granular scenarios of renewable generation). We expect bidders to clarify what data sources will be used and any additional information that would be needed from the Electricity System Operator. It should be noted that the network information we would provide to the successful consultant would be in a format similar to PowerFactory models of the GB transmission network. The regional supply and demand data would be in a format similar to the publicly available regional FES data.
- We expect the detailed modelling and quantitative analysis to be heavily weighted towards the first and second work-packages.
- The scope of analysis will only cover the use of energy storage for network constraint management. Energy storage can provide other valuable services to the system, but they are out of scope for this study. In work-package 3, where the business case for storage providing constraint management services is analysed, it is sufficient to note that the storage may have additional revenue streams that would improve the business case.
- All storage technologies that absorb electricity from the network and later release it back into the network at the same location are within scope. This includes hydrogen technologies if they are designed to operate in this way. Alternative uses of hydrogen (e.g. power to gas, transport) are not in scope as they result in a net transfer of energy from the electricity system into other systems.
- The analysis of business cases in work-package 3 only requires approximate calculations using typical costs and performance for technology archetypes rather than detailed analysis of specific technologies and projects.
- The benchmark costs of energy storage solutions used in work-package 3 should reflect the maturity expected for the technology in the time period being modelled

What is out of scope for this project

This technical feasibility assessment will not cover:

- the use of energy storage options for anything other than constraint management (e.g. energy balancing, inertia, black-start capability)
- the impact of energy storage after 2030
- detailed examination of the barriers for energy storage
- the options for changing market arrangements