



A specialist energy consultancy

Energy storage
services

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TNEI is an independent specialist energy consultancy providing technical, strategic, environmental and consenting advice to organisations operating within the conventional and renewable energy sectors.

Energy storage services

The energy storage sector is growing rapidly in response to increasing renewable generation, rising demand for a range of grid ancillary services and falling costs of storage devices. Storage can be used to support grid frequency and voltage, grid operating reserve, and shift local peaks in load and generation to defer reinforcement. There are an increasing number of revenue streams available to energy storage developers.

TNEI has developed an in-house financial feasibility tool that can model a standalone or co-located battery. The tool simulates battery behaviour over each half hour of a typical year when targeting a range of revenue streams, and can be used to inform battery sizing for a chosen site. TNEI offers expert consultancy services for a range of projects, including large-scale storage, providing grid ancillary services, storage co-located with renewables, and developers at an early stage seeking to understand the storage market. We have a unique skill set which combines power systems design and engineering, commercial, regulatory, and planning and environmental expertise.

Our energy storage services include:

- Site finding, combining the expert knowledge of our planning, environmental and grid connection consultants to identify the best sites
- Grid connection applications and expert support in negotiating with Transmission and Distribution Network Operators
- Independent analysis of the business case for an energy storage plant based on potential revenue streams and capital and operational costs, including consideration of regulatory sensitivities and use of system charges
- Review and advice on technical and functional specifications
- Relationship building with relevant planning authorities, statutory consultees and the local community, robust EIA reporting and management of consenting, licensing and permitting risks through project stages
- Advice on and review of electrical, mechanical and civil design of storage projects, utilising a risk and cost based approach
- Studying and resolving harmonics and power quality issues, bringing experience from projects of varying technologies, across all network operators
- Grid compliance studies, required for storage to connect to the network.

TNEI has a strong track record in energy storage projects, with previous experience including molten salt, compressed air and flow batteries, second-life car batteries, and pumped storage. More recent work includes considering connection and control options, concept design and optimisation, as well as providing support to new entrants to the market providing ancillary services.

Case studies

Service: National Grid EFR Bids Support
Client: Multiple clients

TNEI assisted several clients with the development of large battery storage projects for provision of Enhanced Frequency Response (EFR) services to National Grid. Project layouts were developed and advice given on technical matters, as well as assisting clients with commercial discussions. Technical specifications and employer's requirements documentation were produced by TNEI, together with additional tender documents. TNEI also managed the tender process and assisted clients with identifying preferred bidders for construction of projects.

Service: Grid connection feasibility assessment
Client: Renewable energy developer

TNEI was commissioned by a renewable energy developer to assess the grid connection options for a large compressed air energy storage facility in the North West of England. Four viable grid connection options (including both transmission connections to National Grid and distribution connections to Scottish Power) were identified and investigated in great detail. For each option, the assessment included estimates of potential capacity, fault level, required infrastructure, capital costs, operating costs and securities and liabilities. The report also included a detailed discussion of wider network considerations which could affect connection and operation and an overview of possible planning risks and constraints. As an additional deliverable, TNEI provided a highly detailed overview of the UK grid connection process for both transmission and distribution connection options.

Service: Wind farm portfolio review for co-located storage
Client: Wind farm developer

Supporting a wind farm developer in optimising the value in their portfolio, TNEI developed a bespoke portfolio review methodology which considers the options and merits of integrating other generation technologies and energy storage options within existing and proposed wind farm developments. The two stage review process first identified potential options at each site, taking into account the characteristics of the grid connection and local grid network, land use, environmental constraints and consenting risks. Shortlisted sites were then subject to more detailed review using in-house modelling to interrogate the viability of incorporating additional technologies.

Service: Technical and economic modelling
Client: 2020 Energy

The aim of this study was to provide evidence to determine the impact of storage for integrating wind generation on Northern Ireland Electricity (NIE)'s network. The study was focused on the connection of small wind generation on LV networks.

The key constraint limiting the connection of wind generation to the LV network was voltage rise where small scale wind sources connected to LV grids could risk increasing the voltage beyond statutory limits. In order to determine the ability of storage technologies to manage voltage profile on low voltage grids in the presence of small scale wind generation, TNEI carried out power flow studies in IPSA and spreadsheets were used to

calculate electricity values with increasing penetration of small scale wind generation.

Service: Technical Advice for Large-Scale Battery Developer
Client: Confidential

TNEI acted in a technical advisory role for a large scale energy storage developer, helping the client to develop a transmission connection strategy and understand the locational benefit of specific ancillary services. TNEI supported the project from a very early feasibility stage to more detailed design. TNEI supported the technical specification for the storage equipment, including the functional (technical and commercial) requirements for the provision of Frequency Response, Reactive Power and Black Start commercial services. TNEI has an up to date understanding of the provision of ancillary services in the GB market, including the technical requirements and potential barriers to novel technologies.

Service: Design Support for Enhanced Frequency Response Battery Developer
Client: Confidential

TNEI assisted their client with development of a large battery storage project for provision of Enhanced Frequency Response (EFR) services to National Grid. TNEI acted as the Principal Designer, developed the project layout and typical construction drawings, advised on technical matters, and produced the Invitation To Tender (ITT) for the construction of the works including material specifications, employer's requirements, programme, interface schedule, Pre-Construction Information (PCI), Bill of Materials, payment schedule and form of tender. TNEI managed the tender process, including issue of the ITT, fielding technical queries, holding tender interviews and assisting the client with identifying preferred bidders and conducting commercial discussions.

Service: Support for Department of Energy & Climate Change (DECC's) Energy Storage Competition
Client: DECC

TNEI with Atkins supported the UK Government's Department for Energy and Climate Change (DECC) in assessing its energy storage competition. The aim of DECC's storage competition is to increase the Technology Readiness Levels of storage technologies to a near-commercial level. This involved assessing the technical feasibility, advantages and disadvantages, costs (prototype, demonstration and commercial), innovation, deliverability etc. of a wide range of technologies including batteries, liquid air, flywheels and many others. This has culminated in four winners for demonstration projects, including a liquid air demonstrator, a vanadium-redox battery integrated with wind turbines and a project for integrating second life batteries from Electric Vehicles.

Service: Site Search for Energy Storage
Client: Various Clients

TNEI have undertaken site searches for various battery storage developers. Based on specified client requirements, TNEI have searched large geographic areas to identify the most suitable sites, based on calculating the grid import and export capacity, analysing fault level data, GIS sieving and analysis of environmental and consenting factors.

Service: Battery Co-location Business Case Feasibility Study
Client: Confidential

TNEI used an in-house model for a client's Scottish wind farm site to assess the business case for co-locating a battery. The model, which is used to investigate the business case for battery storage co-located with an intermittent generation, considers the time-varying output from the generator and models the interaction with the battery. A number of costs and revenue streams are explicitly modelled, including the capital cost of the generator and the battery. Revenue streams considered include energy sales, capture of spilled intermittent energy, price arbitrage, triads, and super-red Distribution Use of System (DUoS) credits. An extension to this model which adds provision of frequency response is currently being completed.

Service: Flexibility, Network Charging and Storage
Client: Ofgem

TNEI, in collaboration with Cambridge Economic Policy Associates (CEPA), advised the UK regulator Ofgem (www.ofgem.gov.uk) on network charging and flexibility (i.e. storage, demand side management (DSM) and flexible generation). There are two main elements to this work. The first is to consider whether any current network charging arrangements are acting as a barrier to the provision of flexibility. The second is to consider how the use of distribution networks is changing and how the structure of distribution charging methodologies may have to change to account for this. The work has included an in-depth analysis of how network charges at both transmission and distribution will impact electricity storage providers, including comparison of whether electricity storage faces equivalent charges to other network users offering the same services, and a comparison of how stand-alone storage is treated versus co-located storage.

TNEI has developed an in-house business case feasibility tool that can model a standalone or co-located battery. The tool simulates battery behaviour over each half hour of a typical year when targeting a range of revenue streams, and can be used to inform battery sizing for a chosen site.

Key contacts

James Hollender
Principal Civil Consultant



James is a Chartered Civil Engineer with over 18 years' experience as a designer and project manager. For the last 13 years he has worked in the renewable energy and conventional power sectors. In 2016 James discharged the duties of Principal Designer (in accordance with the CDM Regulations) on an 11MW Sodium Sulphur Battery Energy Storage Scheme (BESS). He produced the civil specifications for the project and helped develop the site layout design in conjunction with electrical engineer colleagues. James also produced the ITT

documents for the civil and electrical balance of plant works, managed the tender process and helped the Client identify suitable contractors for inclusion in their bid to NGET for provision of Enhanced Frequency Response (EFR) services. James has also provided civil engineering and construction design input to a number of proposed battery storage projects, helping Clients develop their projects and obtain planning consent. Projects have included BESS co-located with generation assets, as well as standalone systems. As well as design input, James has been involved in due diligence reviews, acting as technical advisor and managing input from other disciplines on behalf of clients looking to invest in, or purchase, BESS delivering EFR and Firm Frequency Response (FFR) services as well as bidding in to the capacity market.

Jason McGray
Principal Consultant



Jason leads TNEI's EIA service, including management and coordination of EIAs and planning submissions for renewable energy and storage developments. His experience includes site finding and feasibility assessment, environmental input into FEED projects, and socio-economic impact assessment. With a background in financial services; Jason has an understanding of financial modelling and development valuation process and undertakes financial modelling for a range

of energy developments. He is an IEMA accredited, registered EIA Practitioner and Associate IEMA Member

Craig McGlone
Senior Consultant



Craig is a Senior Consultant at TNEI with experience in earthing design and assessment, power system studies (P28, G5/4 studies), grid code compliance and grid connections. He has extensive knowledge in the areas of wind and solar energy and their integration in the grid along with power system stability and modelling. Craig also has experience in tendering and has conducted research into using advanced control methods to better utilise the reactive power capabilities of wind turbines. He has worked on and project managed for a range of projects including solar and nuclear as well as assisting and producing tender documentation.

Get in touch

We are a specialist, independent company. That's why we can offer a flexible, personal service and help our clients quickly and efficiently, without all the big corporate distractions.

But most of all, we love to solve problems.

For more information about our energy storage services, please contact Jason Mcgray email: jason.mcgray@tneigroup.com or call: +44(0)191 211 1430





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tneigroup.com



Manchester
2nd Floor Bainbridge House
86 - 90 London Road
Manchester
M1 2PW
+44 (0)161 233 4800

Newcastle
7th Floor West One
Forth Banks
Newcastle Upon Tyne
NE1 3PA
+44 (0)191 211 1400

Glasgow
Queens House
19 St. Vincent Place
Glasgow
G1 2DT
+44 (0)141 428 3180

Cape Town
1st floor
Willowbridge Centre
39 Carl Cronje Drive
Cape Town 7530
+27 (0)21 974 6181

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