



A specialist energy consultancy

# Innovation Solutions

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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.

## Innovation Solutions

Electricity systems are undergoing a period of rapid and significant change to enable a Net Zero future. This is being accelerated through the 3 Ds: Decarbonisation, Decentralisation and Digitalisation. A radical shift is taking place in electricity network planning and operational philosophy, thus creating a range of new challenges and opportunities. More broadly, the power sector is transitioning to a “whole system” approach, requiring more innovative regulation and governance. This requires the development of innovative technical, commercial and operational approaches. Many of these will be novel and risky and some may not turn out to be feasible but this can only be established through the process of innovation.

TNEI is a leader in the development and delivery of innovative electricity network solutions, enabling the transition to a low carbon future. We transform concepts into solutions. Our expertise provides clients with bespoke modelling and software analysis solutions that are focused on generating value for our clients.

TNEI has an extensive track record in electricity systems innovation and are involved in world leading innovation projects that are changing future network design, operation, markets and regulation. We are technical experts in the design and operation of power systems and this is complemented by a strong understanding of the regulatory and commercial environment. We also provide predictive and prescriptive data-driven analytics solutions based on emerging statistical techniques such as machine learning and the field of Bayesian statistics.

TNEI has a proprietary power system software IPSA2 which we build upon to develop custom software models and tools that can provide insights into evolving electricity network behavior.

Our understanding of the changing needs of the electricity system allows us to offer innovative and useful tools and enabling solutions to facilitate the energy transition.

## Your innovation partner

As an innovation partner, TNEI can provide clients with any and all of the following services:

### Concept and Feasibility

- Identification and development of innovative propositions
- Technical and commercial feasibility assessment
- Business case development
- Market assessments and technology road-mapping
- A track record of successful funding bids.



### Development and Demonstration

- Specialist power systems analysis e.g. dynamic, transient, protection, harmonics
- Bespoke advanced modelling and software development
- Application of novel statistical methods for trial design and analysis
- Data analytics to extract patterns and learning from large data sets.



### Adoption into Business as usual

- Business ready modelling and software solutions
- Collaborative delivery to facilitate wider business adoption
- Recommendations on policy and process change
- Capacity building and knowledge dissemination, successful funding bids.

## Case studies

### Distributed ReStart

#### The brief

Distributed ReStart aims to resolve how to bring together the organisational coordination, the commercial and regulatory frameworks, and the power engineering solutions to achieve Black Start from Distributed Energy Resources (DER). Case studies on the SP Distribution (SPD) and SP Manweb (SPM) networks will be used to explore options and then design and test solutions through a combination of detailed off-line analysis, stakeholder engagement and industry consultation desktop exercises, and real-life trials of the re-energisation process.

#### The process

TNEI's innovative concept was selected from 37 innovation pitches to be taken into the 2018 Network Innovation Competition by NGEESO. We supported throughout the bidding process and built and defended the business case. TNEI is providing our extensive expertise in specialist power system studies and knowledge of distribution and transmission network planning and operation, grid code and generation technology. We provided contributions to the recent "Viability of restoration from DERs" report on network case study criteria and selection, DER and network capability, functional and testing requirements and rollout across GB.

#### Benefits delivered

This project will deliver both financial benefits to the GB consumer through reduced charges and support the decarbonisation process. It is a ground breaking approach that would be the first of its kind in the world, creating the blueprint for international adoption.

### NPG Smarter Network Design Methodologies

#### The brief

Smart metering can provide a much better understanding of the impact of changing customer behaviour and new low carbon technologies such as EVs, particularly at LV network level. Northern Powergrid secured Network Innovation Allowance funding, and contracted TNEI to collaboratively develop smarter design methodologies to incorporate smart meter data and overcome some of the uncertainties in LV and HV network planning and design.

#### The process

TNEI worked with Northern PowerGrid to conceptualise, develop and implement novel modelling techniques and algorithms that utilise smart meter data to statistically categorise customer demand. Our power system experts modelled representative networks and characterised the network response to demand parametrically, and then combined it with the statistically analysed smart meter data to produce a risk-based model of thermal and voltage capacity on the LV networks. The modelling techniques were articulated as a set of user requirements to inform a functional

specification for new power system software. TNEI also developed a Multi-Voltage Level methodology to enable a more holistic assessment of the impact of a wide range of network loads/states on power flow and voltages, leading to improved recommendations on voltage control and management.

#### Benefits delivered

- Solutions for smart metering challenges which will significantly improve the design and planning assumptions especially at LV
- Methodologies which allow the modelling of more innovative solutions due to the improved knowledge and visibility of the holistic operation of the combined networks
- Improved forecasting of network reinforcement investment requirements due to use of smart metering data.

## Key contact

Gordon McFadzean  
Principal Consultant



Gordon leads the delivery of projects relating to electricity strategy and regulation. He has a good technical overview of the network planning and system operation challenges facing the energy industry, particularly in GB and Ireland, and regularly advises generation clients on strategies for getting connected to the grid. He has a strong technical background in power systems analysis and power systems modelling and a good understanding of wholesale energy markets, ancillary service markets and network regulation, with a particular focus on use of system charging.

## 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 innovation services, please contact Gordon.  
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## Data Science and Probabilistic Modelling

TNEI's multi-disciplinary team provides predictive and prescriptive data-driven solutions to emerging energy sector challenges. How can data science and machine learning help?

Do you know how to quantify the value of flexibility services?

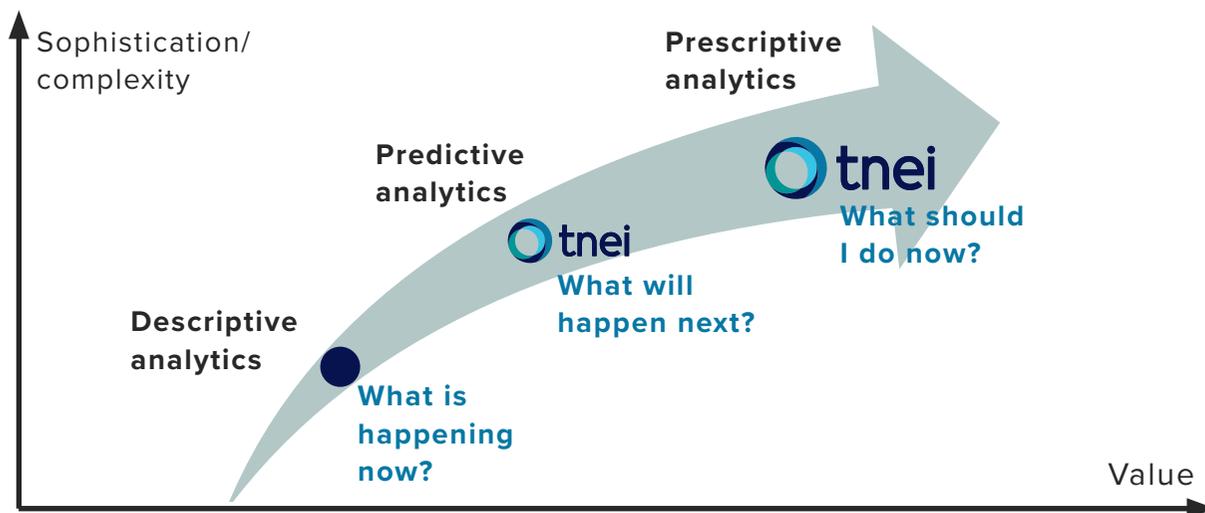
How will you plan for electric vehicles on your LV network?

Are demand and generation forecasts telling you what you need?

TNEI can help you maximise value from energy system data through our:

- Comprehensive expertise in probabilistic modelling
- Track record in automation, scripting and product development
- Domain expertise as energy systems engineers and analysts.

Our academic-level yet practical experts in data science, machine learning and statistical modelling and simulation can help.



## Case Study

### Quantifying the Reliable Output of Variable Renewable Generation

#### The brief

It is often assumed that renewable generation like wind power cannot be relied upon to provide any level of system security, because of its variable power output. We suspected that this was excessively pessimistic, and were interested in modelling the level of output that wind farm portfolios can guarantee to deliver or exceed over extended periods. If we accept that such guarantees inevitably come with some small, specified level of risk that it will be unable to deliver this power output at some point during the specified period, we can investigate how such guaranteed levels vary with the risk of failure and recent wind conditions. This work was conducted as part of our Distributed ReStart project with NGENSO, quantifying the extent to which a group of wind farms in Scotland could contribute to restoration.

#### The process

TNEI developed and utilised a cutting-edge statistical time series model ("SARIMA-GARCH") to simulate wind power output trajectories, conditioned

on recent conditions. This allowed the prediction of the MW level of reliable power output that could be delivered by different combinations of these wind farms, at any point in time, and with any chosen risk of failure.

#### Benefits delivered

Using this model, we were able to represent how the amount of output that wind could contribute during restoration depended on the level of risk that was considered acceptable, the duration of the period for which the output was required, and the nature of wind conditions immediately before the period starts.

We also revealed the degree to which some wind farm combinations are able to make a much more significant contribution to restoration than other others.

## Key contact

Gruffudd Edwards  
Senior Consultant



Gruffudd joined TNEI in 2018 as a technical consultant, making a transition from academia to the private sector. He is a data scientist with considerable experience in mining, analysing, interpreting, predicting and visualising data. His academic background spans statistics, electrical engineering and physics, and his research has often bridged these disciplines. This includes a PhD on the development of advanced time series models to reproduce the dynamics of wind resource availability on multiple spatial and temporal scales. He has strong expertise in stochastic power system modelling and the application of operational research methods to power system problems. Prior to his career in academic research, he held a variety of communications-related positions in the public sector.

## 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 data science and probabilistic modelling services, please contact Gruffudd. Email: [gruffudd.edwards@tneigroup.com](mailto:gruffudd.edwards@tneigroup.com) or call: +44(0)141 428 3145.



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For more information about who we are and what we do, please contact: [info@tneigroup.com](mailto:info@tneigroup.com)

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