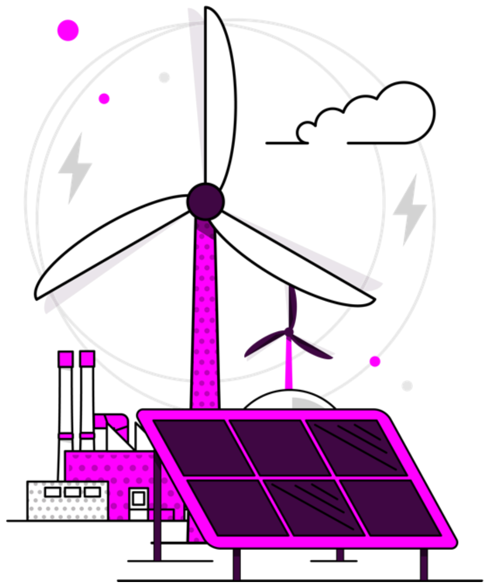
November 2025

Energy Forecasting Strategy

The future of energy forecasting: To 2030 and beyond (draft for consultation)

NESO
National Energy System Operator

Contents



1. Document Purpose

The electricity sector is going through a period of substantial change as our nation drives towards a net-zero future. This strategy has been created to identify and respond to the challenge of forecasting energy demand and generation from real-time to one-year ahead. NESO's operational forecasting capability, defined as predicting all quantities relevant to NESO's function as Electricity System Operator for Great Britain, and its role in facilitating the efficient operation of electricity markets.

This strategy has been developed by the NESO Energy Forecasting Team with input from a broad range of internal and external stakeholders. It identifies the forecasting capability NESO requires to operate the GB transmission system in 2030 and beyond, and to deliver customer value through more efficient system operation and publishing improved forecast information to the energy market. This strategy is not a detailed activity plan, but rather a basis from which all detailed activities on this topic will be aligned. NESO made a commitment to produce this strategy in BP3, and to publish a delivery plan in February 2026 following public consultation. Materials from engagement events are available on the Balancing Programme website.

This version of the Energy Forecasting Strategy is a draft for consultation. To respond to this consultation, email your comments to demand.forecasting@neso.energy by 19 December 2025.

Energy Forecasting at NESO

Energy forecasts predict the demand for, and generation of, energy ahead of time to enable the GB energy markets and networks to operate safely and efficiently. Forecasts of supply and demand from all types of generators and consumer are produced by NESO on a national and local level from real-time to years ahead. These forecasts may be used directly or as the basis for analysis of other variables such as power flows and voltage on the transmission network.

Energy consumption is largely influenced by weather, seasonal and calendar effects, and major national events. Other factors also influence human behaviour and thereby energy consumption; either through the impact of energy tariffs and other commercial drivers, or through mass engagement with live events, such as major sporting fixtures and popular television programs.

Demand forecasts are created to anticipate and plan the supply of the electricity; however, moving active power (the power available to do work, measured in MW) through the system requires reactive power (measured in MVAr). As a result, demand forecasts for reactive power are also created to facilitate network analysis functions.

Regional components of demand are measured and forecast at the interface between transmission and distribution networks at

Grid Supply Points (GSPs). Forecasting both active and reactive power is required at this level to inform voltage and power flow studies in network access planning and operational planning processes.

Electricity generation is influenced by a combination of commercial factors and the weather, depending on technology. Generation forecasts are created to anticipate which generators will be producing electricity and how that energy will be moved through the transmission network to where it is consumed. Generation forecasts are also used by NESO to anticipate and procure the Balancing Services required to maintain security of supply.

The provision of accurate and up-to-date forecasts must be maintained to ensure that:

- Energy security is maintained through effective planning and operation, as set out in the Security & Quality of Supply Standards (SQSS),
- GB energy markets have an insight into expected consumer behaviours and likely energy consumption and generation patterns,
- Electricity margins, the cushion of spare capacity on the electricity system, can be monitored and managed in a timely manner,
- Electricity is balanced around the transmission system in the most efficient way, ensuring it is supplied at the lowest cost to consumers.

The scope of this Forecasting Strategy is limited to forecasts up to one-year-ahead. The main sources of uncertainty and predictability in short-term forecasting are operational metering, weather forecasts, consumer behaviour, and generator and network availability. These forecasts inform real-time operations and operational planning. Beyond two weeks ahead, specific weather and behavioural information is less informative, and forecasts are driven by typical or pre-defined weather conditions for the time of year (e.g. Normal or Average Cold Spell, as defined in the Grid Code), asset availability, and changes to installed generation capacity and underlying demand. In some cases, such as the season-ahead forecasts produced for summer and winter outlook publications, specialist weather forecasts bring additional information.

Forecasting beyond one-year-ahead requires different approaches tailored to specific use cases and is not within the scope of this strategy, though areas where there is alignment between processes will be identified. Examples of these long-term forecasts produced by NESO include multi-year ahead forecasts and scenarios (scenarios in this context are forecasts with additional assumptions, such as policy decisions) are produced as part of the Future Energy Scenarios publications.

NESO's mission is to drive the transformation to a fully decarbonised electricity system by 2030, which is reliable and affordable, aligning to government targets. This ambition requires the ability to accurately forecast demand, wind, solar and other generation sources to manage network flows and maintain system frequency.

By 2030, there is expected to be a significant increase in wind and solar generation sources, with installed capacity estimated between 90GW and 120GW in Future Energy Scenarios 2025 (FES2025). The decline in fossil fuel generation and rapid increase in decentralised assets require us to think differently about how the system is balanced. This includes providing the forecast information required to plan and operate a system that is weather-driven and market-led, with demand becoming increasingly flexible and price-responsive.

As the energy system continues to transform beyond 2030, NESO's forecasting capability must continue to develop to meet future operational and planning needs, and to support the wider energy market.

November 2024

The Azure-based Platform for Energy Forecasting has been in production since November 2024 and continues to be expanded.

Forecasting Systems

Historically, NESO has opted to maintain its own energy forecasting capability and to procure weather data from a single supplier, rather than embrace energy forecasts from commercial vendors. However, this approach places the burden on forecast development and improvement entirely on NESO and exposes NESO to single source of data or model error.

NESO's current suite of forecasting tools includes several legacy systems, along with their intended replacement, the Platform for Energy Forecasting (PEF). Currently, forecasting processes are being transferred to PEF, with legacy systems being retired after a period of testing.

The creation of PEF represents a change in strategy from relying on external software vendors to develop and maintain systems to an in-house approach where NESO has full control over software development and maintenance. Building and retaining the internal capability for NESO to develop and maintain forecasting systems in-house is central to this strategy.

Forecast Performance

NESO's forecast performance is evaluated according to metrics agreed with Ofgem, specifically for day-ahead National Demand forecasting and day-ahead National Wind generation which are reported monthly and published on the NESO website. Both metrics are designed to incentivise continuous improvement in forecasting and compare recent performance to the average over the previous five years. As the energy system and NESO's forecasting practice evolve, these metrics will need to be continuously reviewed and adapted to ensure they provide appropriate incentives and reflect customer value.

NESO produces regular updates of forecasts within-day to take advantage of more recent weather and metering data. Within-day forecast performance impacts multiple metrics including Balancing Costs, Skip Rates, and Security of Supply, highlighting the importance of forecast improvement to NESO's broader objectives.

Benchmarking exercises comparing NESO forecasts with third-party forecasts are also carried out periodically. Although some third-party forecasts are currently available to NESO, they are used only for reference and none presently feed data into the Electricity National Control Centre (ENCC) systems or forecasts published by NESO. Recent performance and benchmarking exercises reflect the growing forecasting challenge as well as potential for improvement.

Looking to the future, the forecasting task is expected to become more difficult as demand becomes more complex, being influenced by embedded generation and consumers becoming more flexible and price responsive. At the same time, the installed capacity of large wind and solar generators is increasing rapidly. Given this context, it is anticipated that forecast uncertainty (and MW forecast errors) will increase from now to 2030 and beyond.

The aims of this strategy are to improve the accuracy and utility of NESO's forecasts by adopting new ways to forecast demand, wind, solar and storage, and to unlock the value of new forecast information through widening access to forecast data, updating operational and operational planning processes, and development of new decision-support systems. By publishing more forecast information we aim to improve transparency and support the wider energy market.

Summary

1. Energy forecasting will play an important role in providing cleaner, cheaper, and more reliable energy.
2. Forecasting requirements are changing as we move towards net-zero.
3. This strategy sets the direction for forecasting practice within NESO up to 2030 and beyond.

2. The Future of Forecasting at NESO

Pathways to net-zero all feature both demand growth and an increasing share of demand being met by wind, solar and storage. NESO will therefore increasingly rely on wind and solar power forecasts to anticipate energy consumption and supply. Similarly, increasing utilisation of storage and demand side flexibility represents a new forecasting challenge. This section outlines the three overarching goals of this strategy to support NESO's core purposes: to operate the electricity transmission network that supplies Great Britain with reliable, low-cost and low-carbon electricity, while facilitating electricity market operation.

FES2025 anticipates total GB electricity demand increasing by 12%-16% from 2024 to 2030, and by 20%-60% from 2024 to 2035, depending on scenario. In addition to demand growth, the changing nature of demand through electrification, behind the meter generation and storage, and price-sensitive demand-side flexibility represent a radical change and forecasting challenge.

This is accompanied by an anticipated doubling of installed wind and solar capacity by 2030. Based on historic trends, it is reasonable to expect the size of forecast errors (measured in MW) to increase roughly in proportion to installed capacity.

Against a background of demand and renewable capacity growth, NESO must seek continuous improvement in forecast performance but also recognise that the size of forecast errors and uncertainty will inevitably increase. Therefore, other approaches to improve decision-making under forecast uncertainty will be pursued. This aligns with other NESO strategies, notably the Operability Strategy Report (March 2025) and the Digitalisation Strategy & Action Plan (June 2025).

70-79 GW Wind Capacity

The Clean Power 2030 Action Plan envisages 70-79 GW of wind, 45-47 GW of solar and 23-27 GW of battery capacity in 2030.

This strategy articulates three goals underpinned by NESO's priorities to deliver 'Clean Power', 'Decarbonised Energy' and 'Consumer Value' by emphasising 'Customer Centricity', adopting a 'Digital Mindset' and investing in 'People Value'.

Goal 1: Produce and publish more accurate and informative forecasts

Producing the most accurate forecasts possible is critical to meet our obligations as NESO, and as the energy system becomes more complex, so does the nature of energy forecasting. Maintaining and improving generation and demand forecast performance against this backdrop will require NESO to adopt proven best practices, and to innovate where necessary. New digital infrastructure will enable improvements to forecasting processes such as combining multiple sources of weather forecast data, adopting state-of-the-art machine learning and AI methods, and leveraging more granular generation, demand and energy market data.

More informative forecasts will also be a key enabler of zero-carbon operation, and a driver of consumer value. The uncertainty associated with any given forecast can depend on many factors, and recognising when a forecast is confident or uncertain will enable new, more efficient ways to maintain system security at least cost. New forecast products, such as scenario forecasts, will unlock enhanced ENCC capabilities, the main mechanism by which they will deliver consumer value and bring wider benefited through data published to the market.

NESO will produce and, wherever possible, publish an expanded range of forecast information to support decision-making and appropriate down-stream calculations.

Primary forecasts, those of directly observed quantities such as GSP demand and wind power generation will be the immediate focus of forecast development as they impact existing processes and are necessary enablers of future capabilities.

Different forecast users require primary forecasts with different specifications:

- Spatial granularity, e.g. national vs GSP demand,
- Temporal granularity, e.g. second, minute, or settlement period resolution, updated within-day, daily, weekly, with forecast horizon from minutes-ahead to year-ahead,
- Uncertainty quantification, e.g. prediction intervals, or a set of scenarios,
- Raw data and APIs, or visualisations and dashboards.

Producing and harmonising all primary forecasts and forecast horizons on PEF is a strategic aim.

Secondary forecasts and those derived from one or multiple primary forecasts. Predictions of future reserve requirement and power flows are examples of secondary forecasts that are calculated from multiple primary forecasts, see example below. More accurate primary forecasts (demand and generation) will result in more accurate secondary forecasts, and uncertainty quantification will better inform risk-based decision-making. However, the efficacy of secondary forecasts depends on coherence between constituent primary forecasts. The ability to produce a suite of coherent primary and secondary forecasts is therefore an important design requirement for future forecasting systems.

Goal 2: Develop digital infrastructure that unlocks value

Making the latest forecast data available within NESO and to external stakeholders in appropriate formats is necessary to realise the value of forecasts. NESO has created PEF for this purpose, which will continue to be developed, maintained and expanded by NESO. Maintaining ownership of PEF represents a change in strategy regarding management of forecasting software that will allow NESO to continue improving its forecasting capability beyond 2030.

PEF will supply forecast data to the ENCC, other NESO systems, and the wider energy market, allowing down-stream users to add value and reap benefits of new capabilities and future forecast improvements.

PEF will also enable NESO to increase the volume and velocity of forecast processes, and to consume a much greater volume of input data, including additional weather and third-party forecasts. Similarly, PEF will make it easier for NESO to share forecast data externally via the NESO Data Portal and other services, reducing the time between new capability being developed and the wider industry benefiting.

Goal 3: Increase engagement with suppliers and consumers of forecast data

Weather and energy forecasting are rapidly evolving in a highly competitive global market. NESO aims to capitalise on the technological developments in this sector by procuring additional operational data feeds including multiple weather forecasts and third-party energy forecasts. NESO will play a leading role in driving innovation in weather forecasting for energy applications through transparent communication of forecasting needs and challenges and working proactively with innovators.

NESO has ongoing initiatives that aim to increase visibility of demand and its constituent parts by exchanging more data with Distribution Network Operators (DNOs) and Transmission Owners. Forecasting will be one of multiple benefits of programmes such as the Virtual Energy System Data Sharing Infrastructure, Transformation to Integrate Distributed Energy (TIDE) and connections reform. However, people resource must be available to implement new technologies and realise their potential. NESO will work with TOs and DNOs to share forecast data wherever benefits of doing so are identified, including reviewing requirements for restoration and other emergency scenarios.

NESO will also work with energy suppliers to exchange more information relevant to forecasting demand, embedded generation, and flexibility. This will similarly be enabled by the secure data sharing infrastructure being established by the Virtual Energy System programme.

Historically, NESO was unusual amongst international TSOs in opting to rely solely on its internal forecasting capability and a single supplier of weather forecast data. This placed the burden of model development and innovation entirely on NESO. Elsewhere it's common for TSOs to procure multiple forecasts from commercial vendors to compliment internal capability. Some TSOs even sub-contract out their entire forecasting function. While NESO procuring weather forecast from a single vendor minimised cost, it gave rise to a critical and single source of error. NESO has begun consuming additional sources of weather and energy forecast data and will adopt established best practice to combine multiple weather forecasts to maximise forecast performance.

NESO's new forecasting capability should be shared to benefit consumers and the wider market. To that end, new and improved forecast data will be published to the greatest extent possible without compromising market integrity or system security. Data will be published via the NESO Data Portal and by other channels as appropriate including the Elexon Insights and forthcoming Virtual Energy System Data Sharing Infrastructure.

Evaluation of Future Forecasting Capability

Forecasting is core competence that NESO must excel at to achieve its vision of a future where everyone has access to reliable, clean and affordable energy. Below, the Forecasting Strategy identifies specific actions that will remove barriers and unlock opportunities to help achieve the goals outlined above. As far as practical, existing (legacy) forecasting methodology will be maintained in parallel with new developments for a period to measure forecast improvement. NESO forecast performance will additionally be compared to that of third-party vendors to identify opportunities for further improvement or verify best-in-class performance. This strategy aims to improve quantitative measures of performance across all lead-times and quantities that NESO forecasts, which will be reflected in the day-ahead wind and demand forecast metrics set by Ofgem.

Ultimately, the value of forecast improvement will be improved outcomes, including more efficient balancing decisions and improved system reliability, as outlined in the Operability Strategy Report (March 2025), which have their own monitoring and incentive mechanisms. NESO will aim to quantify the value-add in these areas from improved forecasting and decision-support, including via Balancing Costs and Skip Rate metrics.

£2.5m per month

Estimated saving from adapting dynamic reserve setting methodology underpinned by probabilistic forecasts.

It can be difficult to separate the impact of forecast improvement from other factors, nevertheless, the impact of forecast improvement and new forecasting capabilities will be evaluated wherever possible, both quantitatively and qualitatively.

Example: Probabilistic forecasting unlocking value through dynamic reserve setting

Innovation project *ControlREACT* demonstrated how NESO's predominantly deterministic forecasting capability could be extended to produce probabilistic forecasts and identified reserve setting as a key use-cases that would benefit from such information. The subsequent project *Probabilistic Machine Learning Solution for Dynamic Reserve Setting* further developed a solution that is currently being operationalised.

Quantifying forecast uncertainty enables reserve to be procured to NESO's risk appetite for each settlement period based on current conditions rather than a fixed conservative heuristic. This has the potential to reduce average reserve holding by 400MW, with associate reduction in carbon emissions, while simultaneously reducing the occurrence of settlement periods requiring expensive actions to be taken as result of insufficient reserve procurement. The savings from this new approach are estimated to average £2.5m per month.

Summary

1. New types of forecast information, enabling infrastructure, and stakeholder engagement underpin this strategy.
2. Forecast improvement is broader than reducing the size of errors. Our goal is for forecasts to be more informative and lead to better decision-making and outcomes.
3. New forecasting capability will be evaluated quantitatively and qualitatively against benchmarks and customer benefits.

3. Forecasting Strategy

The following business strategy is organised into three sections. First, immediate objectives to be met over the next two years, including completion of ongoing and planned activity. Developments during this period lay the foundation for a substantial programme of work to create new forecasting capabilities in the period 2027-2030. Finally, potential requirements beyond 2030 are considered.

Key themes throughout include creating a state-of-the-art suite of forecast products that meet current and emerging user needs, developing infrastructure that enables forecast development, and engaging with external stakeholders to improve forecasting through data exchange across the industry.

Forecasting underpins operational and planning functions in NESO and must evolve to meet the demands of managing an increasingly complex and weather-sensitive energy system. This includes ensuring that forecasts are as accurate as possible by consuming the most informative data available combined with best-in-class modelling. Forecasts will never be perfect and must therefore also quantify uncertainty to enable decision-makers to manage risk cost-effectively. Given the large and increasing volume of forecast information produced by NESO, forecast must be provided to down-stream systems seamlessly and where appropriate be accompanied by decision-support tools. Users, internal and external, must be provided with the appropriate level of detail without being overwhelmed.

NESO's cloud-based forecasting infrastructure, PEF, hosts an increasing number of NESO's internal forecasting processes. It's continued development is central to this strategy, and retaining ownership and the technical capability to continue developing PEF represents a change in strategy compared to previous generations of forecasting software.

Forecasts produced by NESO are published to support stakeholders across the energy industry, and, to that end, it is an objective of this strategy to increase the range of forecast information published by NESO. Producing the best forecasts possible will also require NESO to consume new types of data, including third-party energy forecasts, and data related to Distributed Energy Resources (DER) and dispatch of demand flexibility. Development of NESO's people be essential to deliver this strategy given the increasing number and complexity of forecast capabilities required by NESO and the wider sector.

This strategy sits alongside other NESO business strategies that collectively aim to accelerate progress towards a sustainable future for everyone, with the goal of delivering Clean Power 2030.

Immediate: 2025-2027

This section describes the ongoing activities NESO is undertaking, and those that are planned to begin in the immediate future.

Deploying in-house operational wind and solar power forecasts on PEF is ongoing work that has already started to deliver with PEF supplying wind power forecast to wider NESO systems since November 2024, and solar power forecasts since May 2025. Both wind and solar forecasting systems are matching or exceeding the performance of their predecessors and are available within NESO via API. While initially developed to replicate the methodology used in the legacy Energy Forecasting System, PEF is readily extensible with access to richer weather data and modelling capability. Wind and solar power forecasts will be enhanced over the next year through use of gridded and ensemble weather data from multiple Numerical Weather Prediction (NWP) models and best-in-class machine learning algorithms.

Recently developed wind and solar forecasts are created using both Met Office MOGREPS-UK and ECMWF ENS ensemble NWP systems. Ensemble NWP quantifies the weather forecast uncertainty enabling users to act efficiently and confidently when forecast uncertainty is low, and to take appropriate actions to manage credible risks when uncertainty is high. Presently this is communicated to forecast users in NESO for situational awareness via dashboards showing prediction intervals for national and BMU (or GSP for embedded solar) forecasts. Widening understanding of, and access to, forecasts derived from ensemble NWP will enable further tools to be developed across NESO to improve situational awareness, provide decision support, and automate processes, where appropriate.

Developing new National and GSP demand forecasts on PEF is ongoing and will be an enabler of future capability, such as probabilistic power flow and constraint forecasting. New models must address the challenge of abrupt changes in behaviour caused by network switching and new connections, and the changing behaviour of reactive power introduced by embedded generation. It will be important to improve visibility of DER through new data provided via TIDE and Virtual Energy System programmes with DNOs, and through closer working with electricity suppliers. Switching from a fixed set of weather locations to gridded weather data in PEF allows embedded wind capacity to be aggregated flexibly, e.g. to GSP level. This will enable alignment with similar processes used for other DER and will bring immediate benefits, including more precise disaggregation of GSP net-demand into embedded generation and underlying demand. It is an objective to publish GSP demand forecasts on the NESO Data Portal.

In the next year, NESO will **complete a trial of at least one third-party forecast vendor to complement and benchmark in-house capability.** This trial serves to validate the quality of NESO's in-house forecasting capabilities and explore the potential benefits of consuming third-party energy forecasts. Comparing current forecast performance to historical performance is challenging due to the changing nature of the energy system and inter-annual weather variability, which results in variable predictability. Therefore, comparison against a competitive third-party provides a more meaningful assessment of performance. Furthermore, combining diverse data sources is best practice in forecasting in general, and combining third-party products with in-house forecasts is expected to improve forecast metrics and provide greater situational awareness, e.g. by providing forecasts derived from multiple NWP models.

NESO is also engaged in multiple innovation projects that are wholly focused on forecasting or include an element of forecast innovation. It is a strategic priority to **successfully deliver ongoing innovation projects, and plan implementation to business as usual (BAU) where value is demonstrated.** Current and recent examples include:

- Bringing into BAU the dynamic reserve setting capability, which as developed by NIA projects *ControlREACT* and *Probabilistic Machine Learning Solution for Dynamic Reserve Setting*.
- *Solar PV Nowcasting* NIA project with Open Climate Fix has developed substantially improved hours- to day-ahead solar power forecasts, including probabilistic forecasting, which are available operationally in PEF.
- The Volta programme incorporates multiple innovation projects related to with-day control room capabilities. This includes nowcasting of frequency-corrected demand and advanced dispatch optimisation tools based on probabilistic forecasts in the form of scenarios.
- The *Mass Mobility Data for Demand Modelling* NIA project explored how vehicle telematics data can improve the accuracy of electricity demand modelling.
- The *CrowFlex* SIF project is developing methods for forecasting and procuring domestic flexibility, including predicting separately the availability and expected delivery of flexibility.
- Projects are currently being scoped in areas including wind power nowcasting and scenario forecasting.

NESO recently signed a Memorandum of Understanding with the Met Office, building on the existing relationship between the two organisations. The Met Office's meteorological and climate knowledge and expertise will be leveraged to support the development and implementation of this strategy.

Operational forecasters presently use a multitude of tools to issue forecasts and provide contextual information to users within NESO. PEF will streamline these workflows by hosting forecasting processes in one place, releasing forecasters' time to provide greater support to forecast users. Operational forecasters play a crucial role in interpreting and communicating forecasts to the ENCC and others and their role will evolve alongside technical forecasting capability, for example, to contextualise probabilistic information and curate credible sets of scenarios to support operational planning functions (see example below).

Summary of objectives for 2025-2027	
1	Deploy and enhance operational wind and solar power forecasts on the Platform for Energy Forecasting
2	Develop new National Demand and GSP demand forecasting tools on the Platform for Energy Forecasting, including improved MVAr forecasts
3	Complete a trial of at least one third-party forecast vendor to complement and benchmark in-house capability
4	Successfully deliver ongoing innovation projects and implement outputs where sufficient value is demonstrated
5	Develop a user interface to the Platform for Energy Forecasting for operational forecasters

Short-term: 2027-2030

The first goal of this strategy is the ambition to produce more accurate and informative forecasts. Forecasting only adds value when it leads to improved decision-making and outcomes. The suite of forecasts produced by NESO will therefore be probabilistic, to quantify uncertainty, and coherent to enable these forecasts to be combined to calculate system-relevant secondary forecasts of quantities such as power flows and ramps. In this context, coherence means forecasts that reflect the spatial and temporal structure of the power system and energy markets.

Providing actionable uncertainty information to identify risks and optimise decision-making, such as balancing actions, is critical to operate the system securely and at least-cost. New forecasting capability will underpin control room tools providing situational awareness and decision-support. The Energy Forecasting Team and end-users will work collaboratively to develop these tools and maximise their utility. This will include both digital solutions and new roles for operational forecasters to contextualise and curate forecast information for the control room.

Developing NESO's cloud-based digital infrastructure, both PEF and connected systems, will allow data relevant to forecasting to be ingested and processed in greater volumes and at greater velocity than at present. Consuming a greater volume of high-quality weather forecast data will drive improvement from hours-to-weeks ahead, while access to observational data with low latency will improve within-day forecasts, which will be updated more frequently than at present. In general, NESO will be able to identify and integrate new sources of predictability with minimal friction. This infrastructure will also enable down-stream forecast users and systems to query forecast information to support processes and enable probabilistic decision-making and AI tools. Training and upskilling forecast users in new types of forecast information will be necessary to enable their adoption.

Harmonising forecasts across horizons is important to enable coherent decision-making and will require the suite of existing overlapping forecast products to be rationalised. Methods for communicating uncertainty in weeks to months ahead forecasts must be co-developed with end-users to ensure requirements are met. Improving forecasts of the installed capacity of embedded generation and demand-side flexibility will contribute to improvements in month- to year-ahead forecasting.

Future forecasting practice must **account for market effects** where relevant. For example, price-responsive demand obscures underlying demand and there are feedback loops between demand forecasts and prices. The growth of price-responsive demand from dynamic tariffs, embedded storage, electric vehicles and smart home devices represents an emerging challenge. Battery Energy Storage Systems (BESS) present a particular challenge and will require specific forecasting tools on a range of spatial and temporal scales.

Wind and solar generation are exposed to price signals that may trigger self-curtailment, which challenges historic assumptions that they will generate whenever the weather allows. This will require developing datasets that quantify historic commercial behaviour and activation of flexibility, and distinct forecasts with and without these effects. For example, producing a potential (unconstrained) wind power forecast and forecast that includes predicted commercial behaviour.

Addressing the growing complexity of demand is a theme throughout this strategy and requires NESO to improve visibility of demand and its constituent parts at national and regional levels. New forecasting and operational tools are required that account for demand flexibility including price-responsive demand, embedded generation and BESS. To meet this need, NESO will forecast underlying demand, embedded generation and the envelope of potential flexibility dispatch at GSP level. This will require observation or estimation of these components either directly or via submissions from market participants. Working with DNOs and electricity suppliers to improved visibility of demand flexibility is a priority and will enable robust bottom-up aggregation of forecasts, which is necessary for a range of use-cases within NESO. Initiatives such as the Virtual Energy System Data Sharing Infrastructure provide mechanisms for increased data exchange. Improving metering infrastructure and NESO's access to existing metering data will also play a role.

Forecast end-users, internal and external to NESO, have diverse needs and require forecast information appropriate to their situation. NESO is increasing the number of data points and study scenarios whilst developing new simulation tools and capabilities, which should be informed by the full range of possible weather, commercial and technical outcomes, and associated likelihood of occurrence. The wider energy sector similarly requires access to more detailed predictive information to operate as efficiently as possible. New NESO forecasting products will be published to the market to as great an extent as possible to that end. Forecast users will be empowered to develop processes and applications that ingest forecast information from PEF or NESO Data Portal with minimal friction.

Operating the transmission system require calculation of many **secondary forecasts**, such as power flows, that are derived from primary forecasts of supply and demand. Visibility of potential future flows is key to understanding the size of potential energy imbalances and is required to re-balance the system as efficiently as possible. Similarly, periods of high variability and ramps of weather dependent generation present an operability challenge, especially when generation and demand are ramp in opposite directions. To forecast the risk of high ramp rates, wind, solar and demand forecasts must be combined appropriately as common factors affect all three components, such as changes in weather or energy prices. Large ramps can potentially lead to frequency management and inertia challenges, and forecasts of ramps will enable NESO to procure response and reserve products efficiently to ensure there are sufficient options available to maintain system frequency and inertia levels at least cost to consumers. Forecasting systems must allow such forecasts to be calculated on the fly at the national or regional level, including constraint groups to provide up-to-date situational awareness and decision-support.

Other important secondary forecasts include market prices, interconnector flows, reserve requirements, system margin, inertia, constraints and constraint margins. Specialised forecasts may also be required to predict the availability and capability of different technologies to provide ancillary services such as frequency response.

Example: a curated set of scenarios

Forecast uncertainty may be quantified through an ensemble of credible scenarios, as illustrated in Figure 1, but it would be infeasible to perform detailed power systems studies and develop operational plans for them all individually. Therefore, a reduced set is required for further analysis. The example in Figure 1 shows a curated set of four national wind power scenarios spanning the range of operationally relevant potential outcomes: maximum and minimum peak generation, and the earliest and latest time that the forecast ramp-up exceeds 5GW.

Such scenarios must be coherent across variables, e.g. with corresponding unit-level wind and solar power forecasts and GSP demand forecasts to enable calculation of secondary forecasts and further analyses.

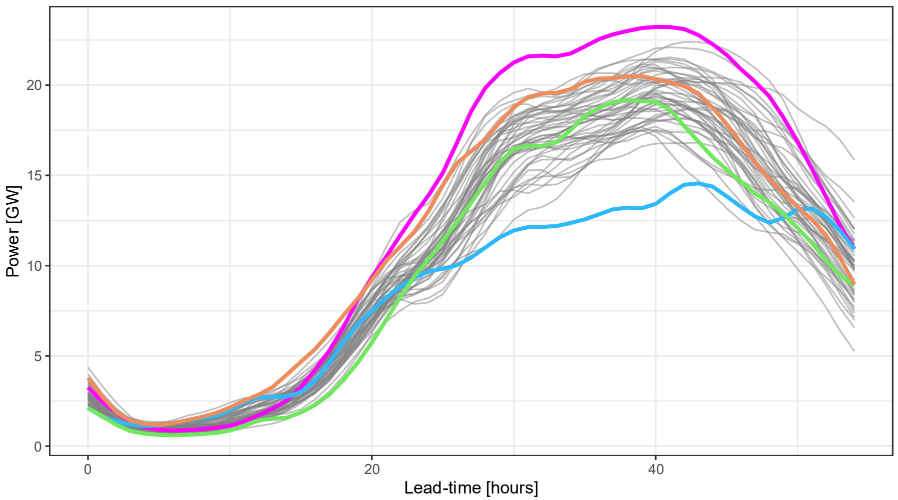


*Figure 1 : An ensemble national wind power forecast with a curated set of four operationally relevant scenarios highlighted: maximum wind power production (**pink**), minimum wind power production (**blue**), earliest ramp-up (**orange**), latest ramp-up (**green**).*

Within-day forecasting plays a crucial role in operating the transmission system. Real-time observations of supply, demand, weather and market activity will be leveraged to improve the accuracy of forecasts from seconds to hours ahead and quantify uncertainties to enable efficient risk management. Uncertainty will be communicated through prediction intervals and a set of curated scenarios reflecting the range of credible situations that the control room should prepare for. The curation of scenarios will require a combination of modelling and expert judgement by operational forecasts. Within-day forecast development will interact with the Open Balancing Programme, which is developing new tools to support control room operations, and the associated Volta innovation programme.

NESO will develop partnerships with multiple suppliers of energy and weather forecasts and innovation partners, including universities and international organisations. Weather forecasting technology has steadily improved over past decades, and NESO must be positioned to take advantage of future improvements and new capabilities, such as AI-based weather prediction, sub-seasonal-to-seasonal forecasting, and other weather and climate services. NESO will actively explore potential innovations that may improve forecast accuracy, reduce uncertainty, and more accurately quantify risk on all timescales, from within-day to seasons ahead. This includes innovations directly involving NESO as well as taking a leadership role in signalling to forecast vendors, meteorological organisations, and innovators where challenges exist.

Industry codes and frameworks should be updated in response to the changing energy landscape and increasing importance of wind and solar generation, interconnectors, batteries, and flexible demand.

It may benefit stakeholders if the data NESO publishes to the market is codified to formalise its definition and place a legal requirement on its production. Similarly, standardising forecast data formats across the sector would lower barriers to data sharing and support competition between vendors. Measures of NESO's forecast performance should be updated to reflect impact of forecasting on system operations and outcomes, and to encourage innovation that delivers consumer value. Changes in the average error of day-ahead wind and demand forecasts do not directly reflect impact on other measures of NESO's performance. Future performance evaluation should include benchmarking against commercial vendors and metrics that reflect operational impacts, including cost, reliability (and risk), and customer value.

A review of references to forecasting in Grid Code, Balancing and Settlement Code, and SQSS should be carried out. For example, Average Cold Spell and its role in peak demand forecasting has been identified as a topic that should be reviewed. Alternative methods for predicting peak demand that account for climate risk and new operational scenarios that may stress security of supply should be considered. Other elements of margin analysis may warrant similar review.

Beyond forecasting, it may be necessary to consider new definitions of National Demand and Transmission System Demand, for instance to account for battery charging.

Predictability of supply and demand is already a limiting factor in system operability with increasing levels of reserve required to account for forecast uncertainty. With the increasing deployment of weather dependent generation, forecast uncertainty (in terms of energy and power) will increase across all horizons. It is therefore necessary to quantify predictability to study the operability of the future power systems. Predictability will influence flexibility requirements, which need to be sized to manage both variability and short-term forecast uncertainty. This is an active area of development requiring innovation to create new methodologies for studying operability.

Summary of objectives for 2027-2030	
1	Develop cloud-based infrastructure to enable use of richer datasets and advanced modelling, and widen access to forecast data
2	Harmonise forecasting processes across horizons from short-term to 52 weeks ahead to improve coherence between lead-times and down-stream processes
3	Develop generation and demand forecasting capability that incorporates price-sensitive and flexible components
4	Identify and address emergent end-user needs, and support integration with end-user processes
5	Develop and deploy a suite of coherent secondary forecasts, including margin and constraint forecasts, meeting end-user needs

6	Update within-day forecasts as frequently as possible informed by real-time observations at the latest weather and market data
7	Develop partnerships with multiple commercial energy forecast and weather forecast suppliers, and innovative partners
8	Update industry codes and regulation to reflect modern forecasting requirements and practices
9	Support planning and operability functions with estimation and analysis of future system predictability

Beyond 2030

The deployment of onshore and offshore wind, solar, BESS and flexible demand will continue beyond 2030 placing ever more importance on forecasting. Maintaining a long-term view to identify emerging requirements across NESO's control room operations, operational planning, medium and long-term planning functions is part of that process. This strategy will be reviewed periodically to evaluate progress and update objectives considering new information and will require continued engagement with internal and external stakeholders.

NESO is acting now to ensure we can take advantage of future advances in forecasting science and support other NESO functions that require new types of forecast information. Advances in new technologies, including such as AI weather models, ground- and space-based remote sensing, and monitoring and control of distributed energy resources, which are expected to play a role in future forecast improvement beyond 2030.

NESO is already working to prepare for new energy technologies, such as smart consumer devices, electrolysers and Offshore Hybrid Assets that are not directly related to forecasting practice, but where engagement with forecasting will be critical to integrate them into the energy system.

Summary

1. Multiple initiatives are underway that provide a foundation for this strategy, such as development of the Platform for Energy Forecasting and numerous innovation projects.
2. An extensive list of new forecasting capabilities has been compiled with the potential to enhance operational planning and improve situational awareness with NESO and across the industry.
3. This strategy positions NESO to adopt and develop new forecasting technologies and continue improving forecasting capability beyond 2030.

Back Matter

Glossary

National Demand is the sum of metered generation, but excludes generation required to meet station load, pump storage pumping and interconnector exports. National Demand is calculated as a sum of generation based on National Grid ESO operational generation metering.

Underlying Demand is an estimate of the total electricity consumption in GB including demand met by embedded generation. This quantity is not possible to measure directly, but it is estimated by summing National Demand and estimates of embedded generation.

Acronym	Description
BAU	Business as Usual
BESS	Battery Energy Storage System
CER	Consumer Energy Resources. Consumer-owned assets, that are connected to the distribution network at the consumer premises.
DER	Distributed Energy Resources. Business-owned small-scale power generation, storage and demand devices connected to the distribution grid, located close to where energy is consumed.
DNO	Distribution Network Operator
ENCC	Electricity National Control Centre
FES2025	Future Energy Scenarios 2025
GSP	Grid Supply Point, the interface between Transmission and Distribution networks
MW	Mega Watt, unit of active power
MVAr	Mega Volt-Ampere Reactive, unit of reactive power
NIA	Network Innovation Allowance
NWP	Numerical Weather Prediction
PEF	Platform for Energy Forecasting, NESO's cloud-based forecasting system
SIF	Strategic Innovation Fund
TIDE	Transformation to Integrate Distributed Energy

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National Energy System Operator
Faraday House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

demand.forecasting@neso.energy

www.neso.energy