Public

# Balancing Programme Forecasting Stakeholder Focus Group

**21 May 2025**
**1:30 - 3:30pm**

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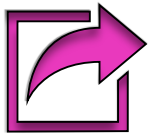
# Focus Group Agenda

| Time | Agenda Item | NESO Presenters | Details |
|---|---|---|---|
| 13:30 – 13:35 | Welcome & Introductions | John Walsh, Energy Forecasting Manager<br>Rich Sykes, Product Manager | • Role of the Forecasting Focus Group<br>• Aims of the session |
| 13:35 – 14:05 | The Current State of Energy Forecasting | John Walsh | • Role of the NESO Energy Forecasting Team<br>• Overview of the NESO forecasting models |
| 14:05 – 14:20 | PEF Roadmap | Rich Sykes | • Platform for Energy Forecasting (PEF) developments to date<br>• Planned PEF developments for FY25/26 |
| 14:20 – 14:25 | Innovation Projects | John Walsh | • Overview of innovation projects in the forecasting space |
| 14:25 – 14:55 | Future Energy Consumption Influences 2026 -2031 | John Walsh & Rich Sykes | • High-level overview of factors which are anticipated to impact the National Demand curve between 2026-2031.<br>• Mural Board breakout session exploring influencing factors in more detail i.e., what's missing / what factors will have the biggest impact etc. |
| 14:55 – 15:15 | Forecasting Strategy | John Walsh | • Proposed NESO forecasting goals for 2026 - 2031<br>• Mural Board breakout session exploring the goals in more detail i.e., agree/disagree, level of priority, what's missing? |
| 15:15 – 15:25 | Q&A | John Walsh & Rich Sykes | • Please place your questions in the chat or raise your hand |
| 15:25 – 15:30 | Next Steps | Rich Sykes | • Future engagement opportunities |
| **15:30 Meeting Close – Thank you for engaging with us** | | | |

# Audience Participation

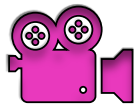
There is time allocated to Q&A towards the end of the session - we will take all questions during this part of the agenda to ensure we get through all pre-prepared content.

Please raise your hand & come off mute ensuring to state both your **name and organisation** - this will enable us to follow up with you after the webinar if necessary.



Out of scope questions will be forwarded on to the appropriate NESO team or expert for a direct response. We may ask you to contact us by email to ensure we have the correct contact details for the response.

If you have any further questions after the Focus Group, please get in contact with us at **box.balancingprogramme@neso.energy**

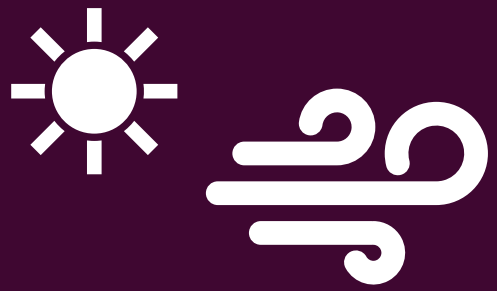


Today's Forecasting Focus Group will be **recorded and published online** after the session, along with the slide pack.

Public

# The Current State of Energy Forecasting

John Walsh



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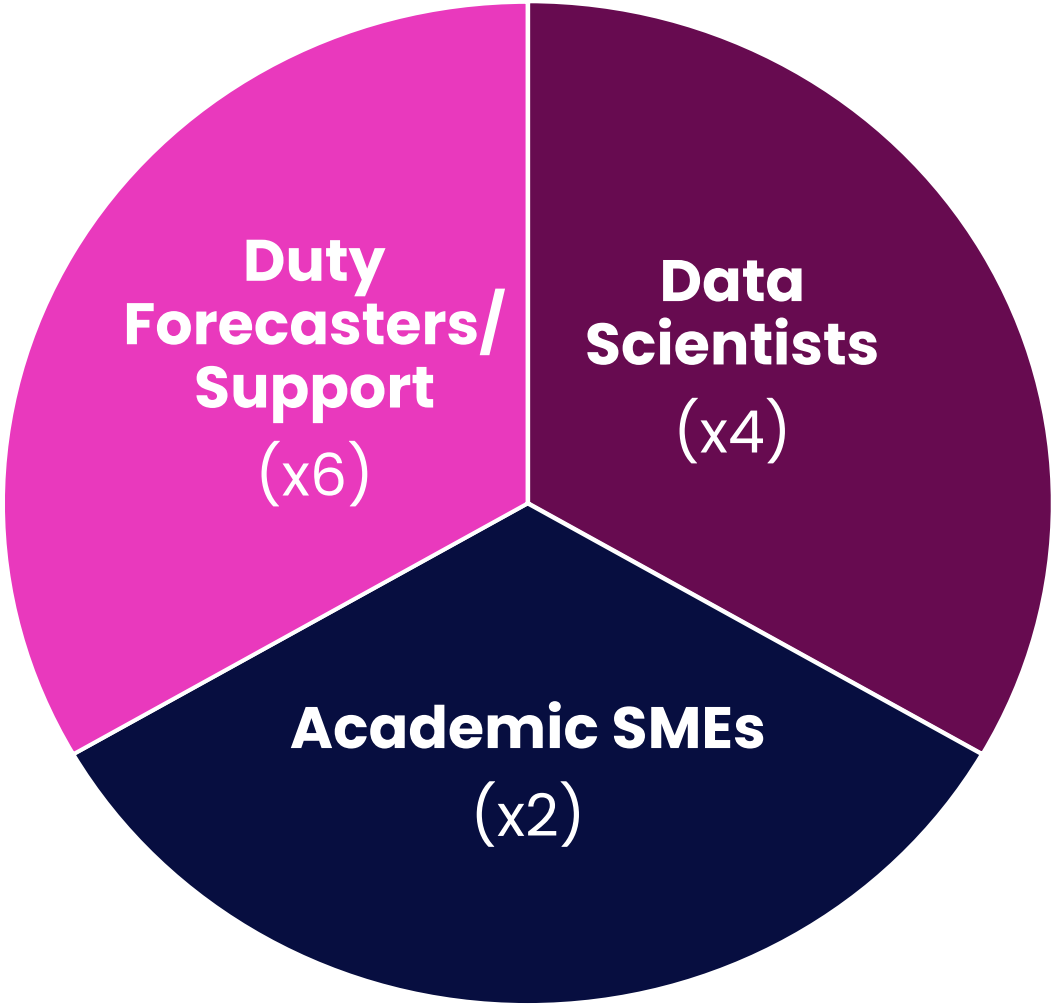
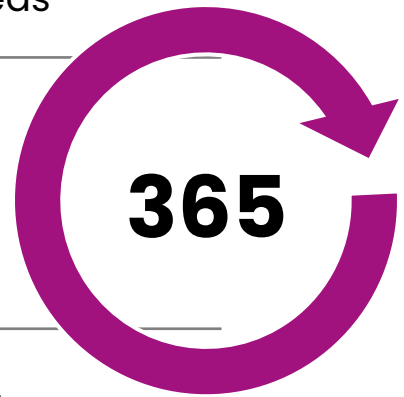
# The Energy Forecasting Team - 2025



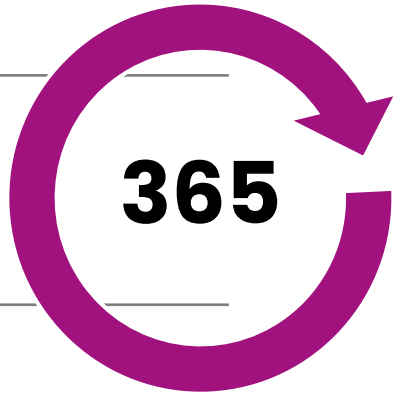
# Role of the NESO Forecast Team

| | Timescales | Frequency |
|---|---|---|
| **National Demand**<br>**(As per Grid Code definition)** | • Within day<br>• Day ahead<br>• 2DA & 7DA<br>• 13 Weeks ahead<br>• 2-52 Weeks ahead | • 3 x daily, 24 x daily, 48 daily<br>• 3 x daily, 24 x daily, 48 daily<br>• Daily<br>• Daily<br>• Monthly, or as per needs |
| **Wind Power**<br>**Metered & Non-metered** | • Within day – 14 days ahead | • 24 x daily |
| **Solar Power**<br>**Metered (new) & Non-metered** | • Within day – 14 days ahead | • 24 x daily |
| **GSP forecasts**<br>**(Demand, Wind & Solar)** | • Within day – 14 days ahead | • 6 x daily, plus 24 x daily |
| **Reactive power (MVAr)** | • Within day – 13 days ahead<br>• 2DA – 13 Weeks ahead | • Daily<br>• Daily |



# Role of the NESO Forecast Team

| | Timescales | Frequency |
|---|---|---|
| **Transmission Losses** | • Retrospective/On request | • Monthly<br>• Yearly |
| **TV Pick-ups**<br>(ENCC notification) | • Within day<br>• Day ahead | • Daily |
| **Special event forecasts**<br>(Demand forecasts, Demand profiles & TV Pick-ups) | • Within day<br>• Seasonal | • On request |
| **Customer Support**<br>(Publish new data and respond to queries from Data Portal, Extranet and BMRS) | • Data dependant | • Daily |
| **Innovation Projects** | • Project dependant | • Weekly |



# Demand Concept

## National Demand

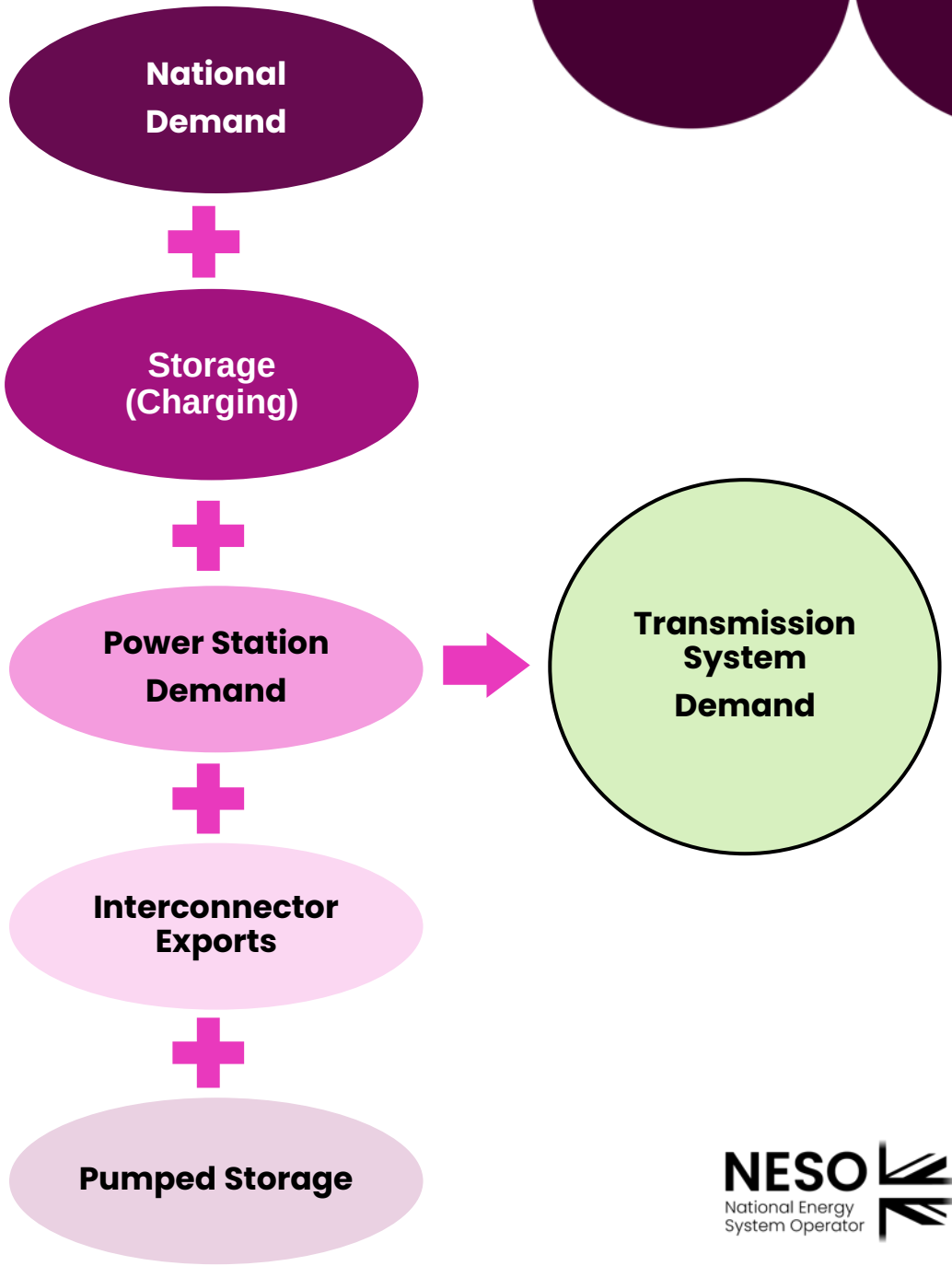
- ***Total GB generation requirement to supply the customer demand***

- Sum of metered generation, excludes station load, pump storage pumping, electricity storage consumption and interconnector exports

## National Electricity Transmission System Demand

- ***Total demand to be met by the GB transmission network***

- Meets the total GB customers demand plus the additional generation required to meet station load, pump storage pumping, electricity storage consumption and interconnector exports



# Demand Model - DFT

## Approach

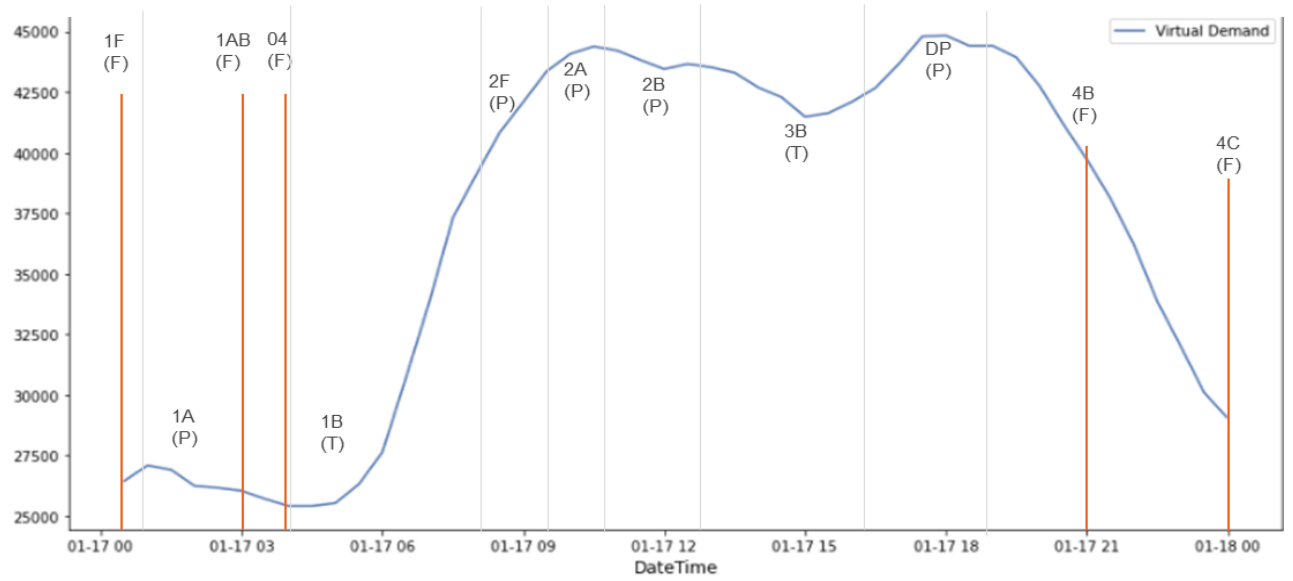
**Cardinal Points**
- Capture the demand pattern and characteristic behaviour

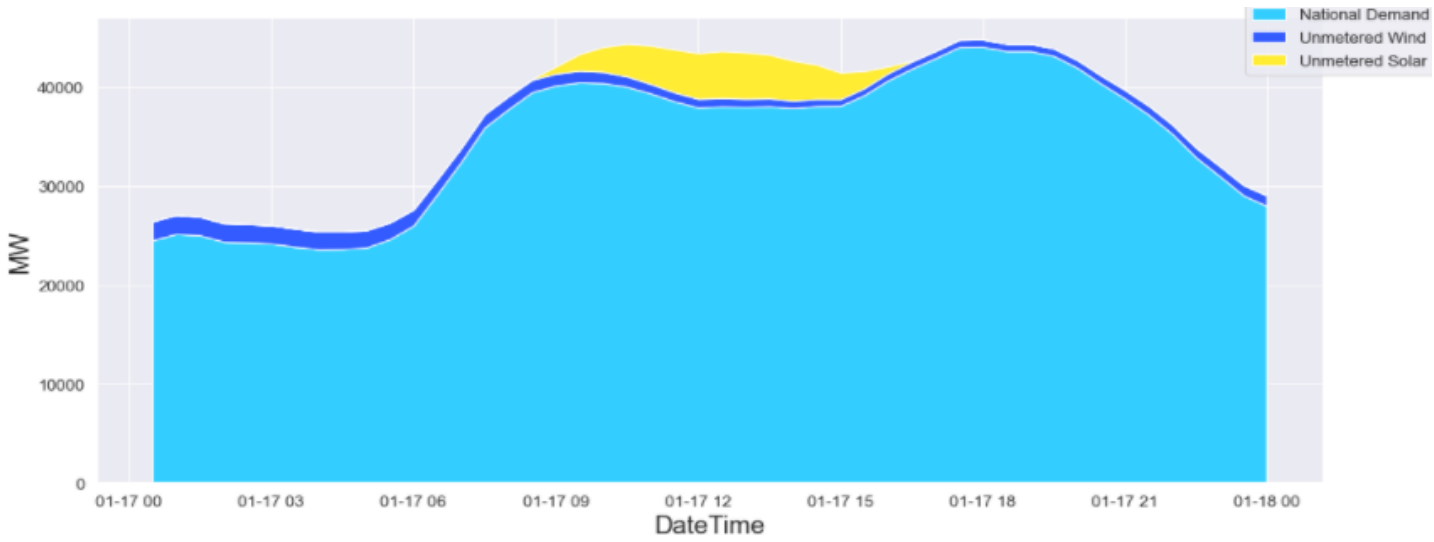
**Historical profile date**
- Similar daily profile

**Virtual demand – half-hourly**
- Interpolation between the CPs

**Embedded generation**
- Subtract Wind and solar

**National demand forecast**



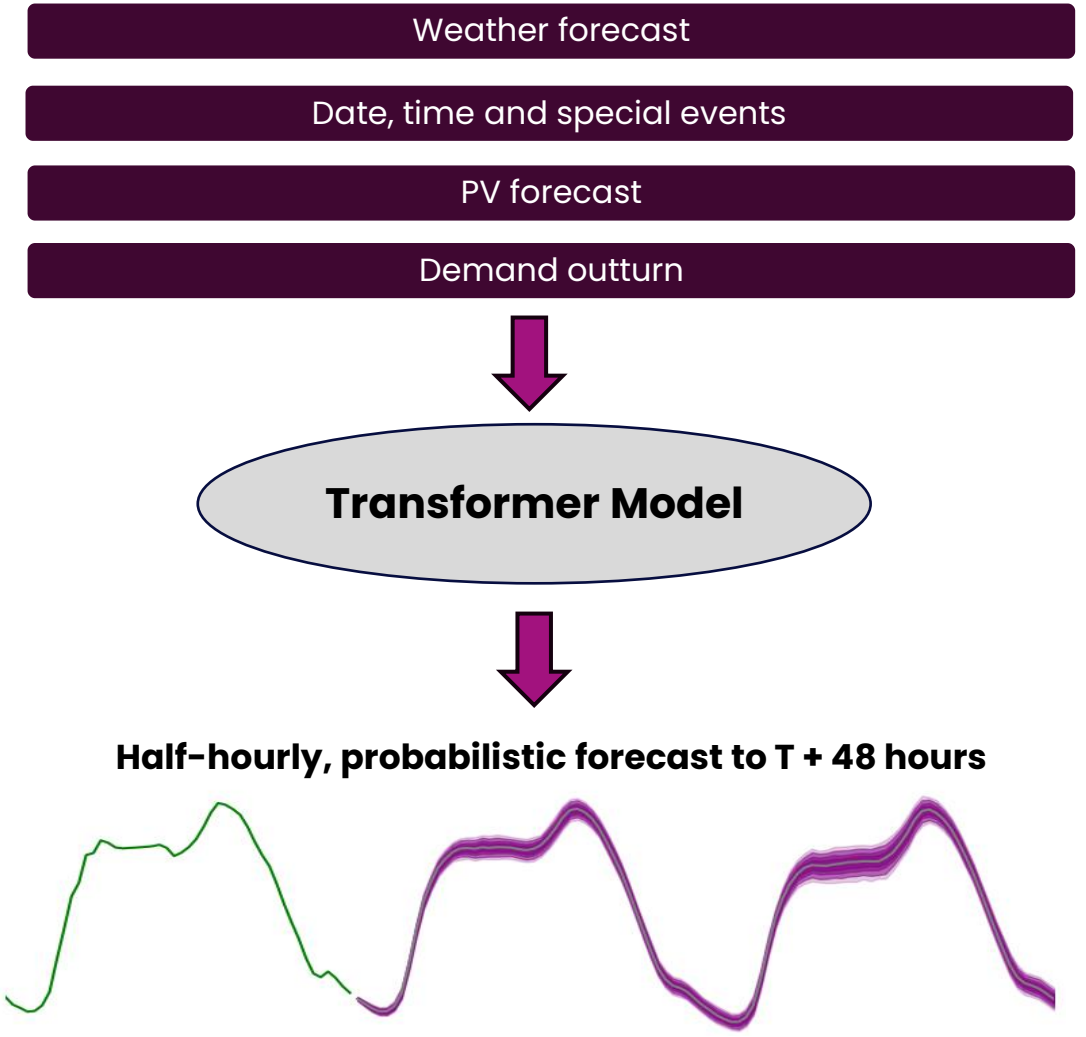




Note:
1. Demand Forecast Tool (DFT) – a custom-built legacy product, that focuses on the urban cities of GB.
2. DFT uses a custom weather-data file, suppled by the Met Office.

# Demand Model – Machine Learning (ML)

## Approach

- Deep learning (transformer) model for probabilistic time series forecasting
- Half-hourly resolution – no CP forecasts
- Updates every 30 minutes
- Trained on ~5 years of historical data
- Model inputs:
  - Regional demand outturn (last 7 days)
  - Regional weather outturn and forecast (-7 days to +2 days)
  - National PV forecast using satellite imagery (-7 days to +1 days)
  - Date, time and special events
- Model outputs:
  - National demand forecast (probabilistic)
  - No virtual demand

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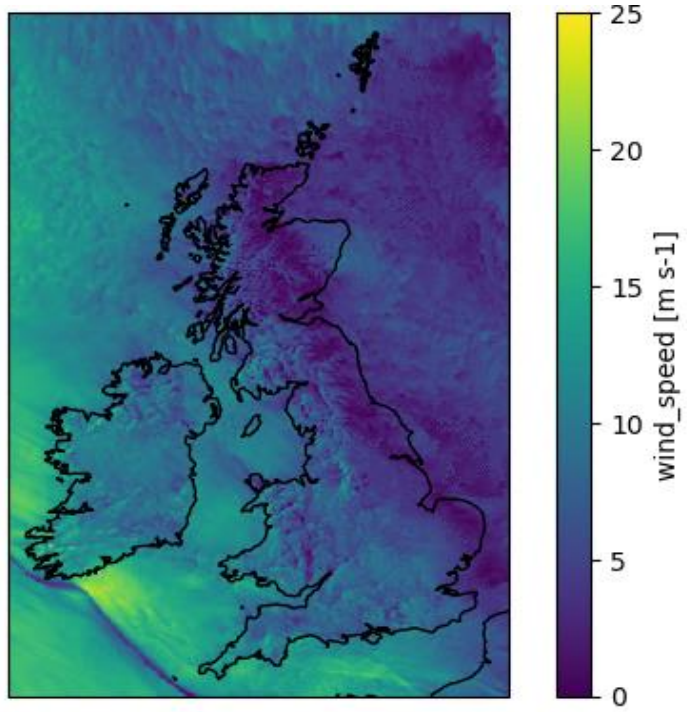
# Wind Model

## Approach

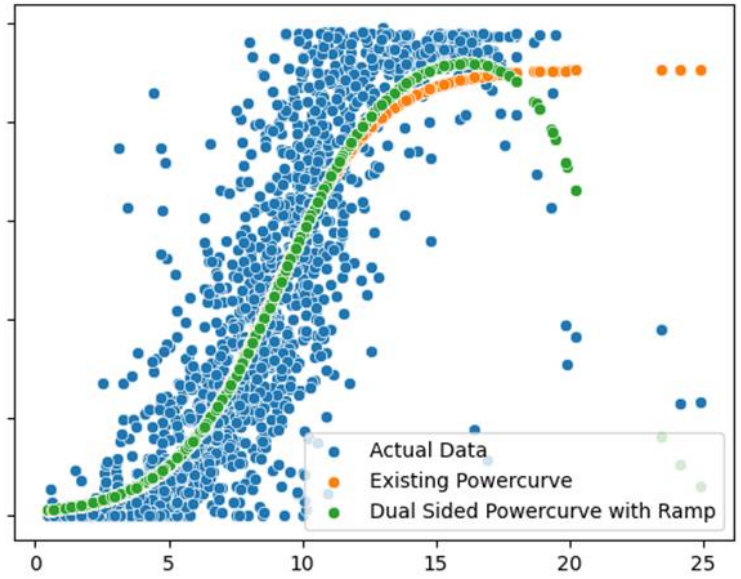
**Numerical Weather Prediction (NWP) model forecasts**

- NWP model forecasts from two leading weather centres (Met Office and ECMWF)
- This captures the detailed effects of weather systems on localised wind patterns, and updates every hour
- Up to 50 weather scenarios are considered, allowing us to quantify the probability of upcoming extreme events




**Conversion to power**

- Statistical or machine learning models are applied to convert the weather data to equivalent power output
- Trained against settlement and operational metering data
- Wind farms without metering use a reference model
- New model includes the expected drop off at high wind speeds (‘*high speed shutdown*’)
- Adjustments to capacity are made for declared wind farm outages
- National and unit-level forecasts for over 800 wind farms



# Solar Model – (Prototype)

## Approach

### NWP model forecasts

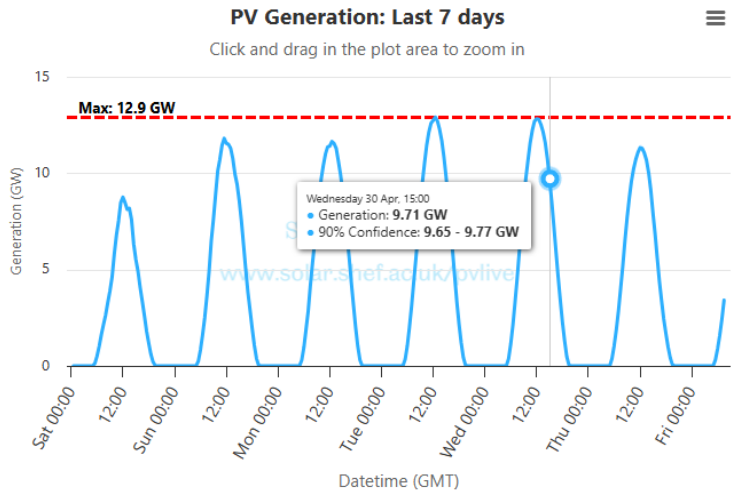
- *Numerical Weather Prediction* model forecasts from two leading weather centres (Met Office and ECMWF)

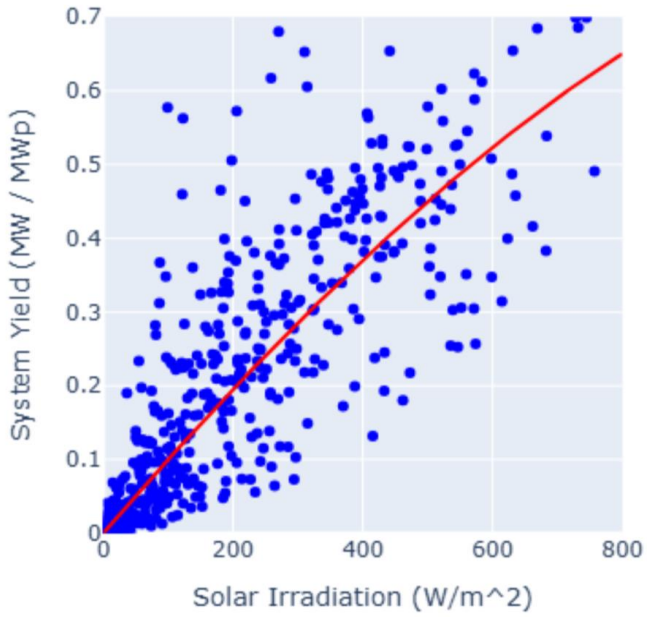
### PV Live generation estimates

- NESO does not have access to direct metering for the majority of solar PV capacity
- Independent estimates of PV generation are provided by the Sheffield Solar project (‘*PV Live*’)
- PV outturns are estimated using data from around 25,000 systems across GB

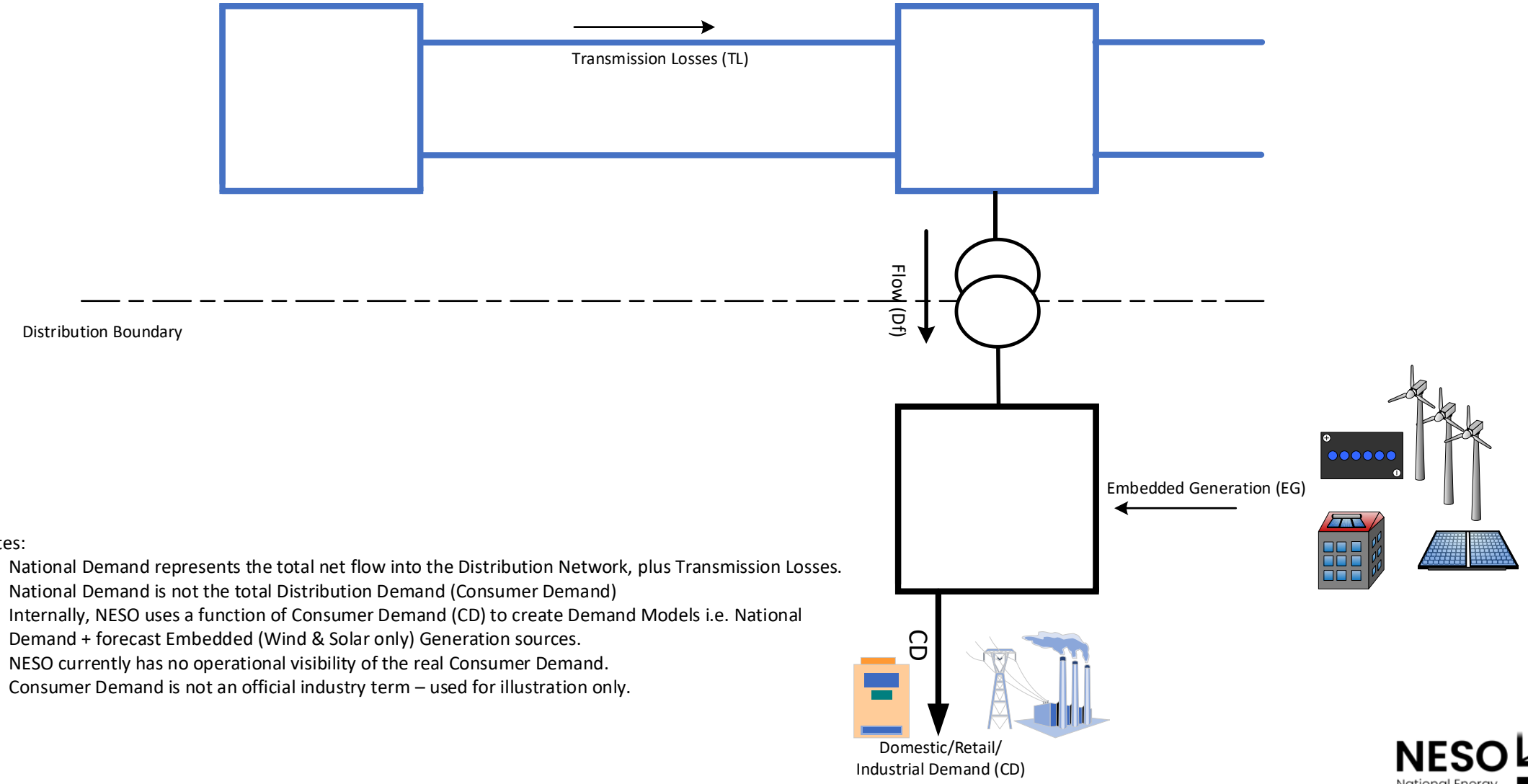
### Conversion to power

- Multivariate statistical or machine learning models are applied to convert the weather data to power output
- Trained using metering data where available (small number of metered solar farms have recently connected!)
- Models for individual units (BMUs and large embedded), Grid Supply Point (GSP) and national



# The Actual Demand we Forecast




Notes:

- National Demand represents the total net flow into the Distribution Network, plus Transmission Losses.
- National Demand is not the total Distribution Demand (Consumer Demand)
- Internally, NESO uses a function of Consumer Demand (CD) to create Demand Models i.e. National Demand + forecast Embedded (Wind & Solar only) Generation sources.
- NESO currently has no operational visibility of the real Consumer Demand.
- Consumer Demand is not an official industry term – used for illustration only.

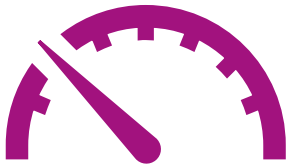
National Demand (ND) = Net Transmission to Distribution Flow (Df) + Transmission Losses (TL)

# How we Measure and Record Demand

- **Initial National Demand Outturn** (INDO) is defined in the Balancing & Settlement Code(BSC) as:

*The demand metered by the National Electricity Transmission System Operator (NETSO) taking into account transmission losses; but not including station transformer load, pumped storage demand or Interconnector demand.* (1)

- NESO are obligated to publish INDO, under the Balancing and Settlement Code.
- INDO is updated every 30 minutes and within 15 minutes of the end of the effective Settlement Period.
- INDO is simply an immediate post-event indicator for National Demand.



Note:
1. NESO are progressing an INDO definition change, to align more closer with the latest Grid Code definition of National Demand.



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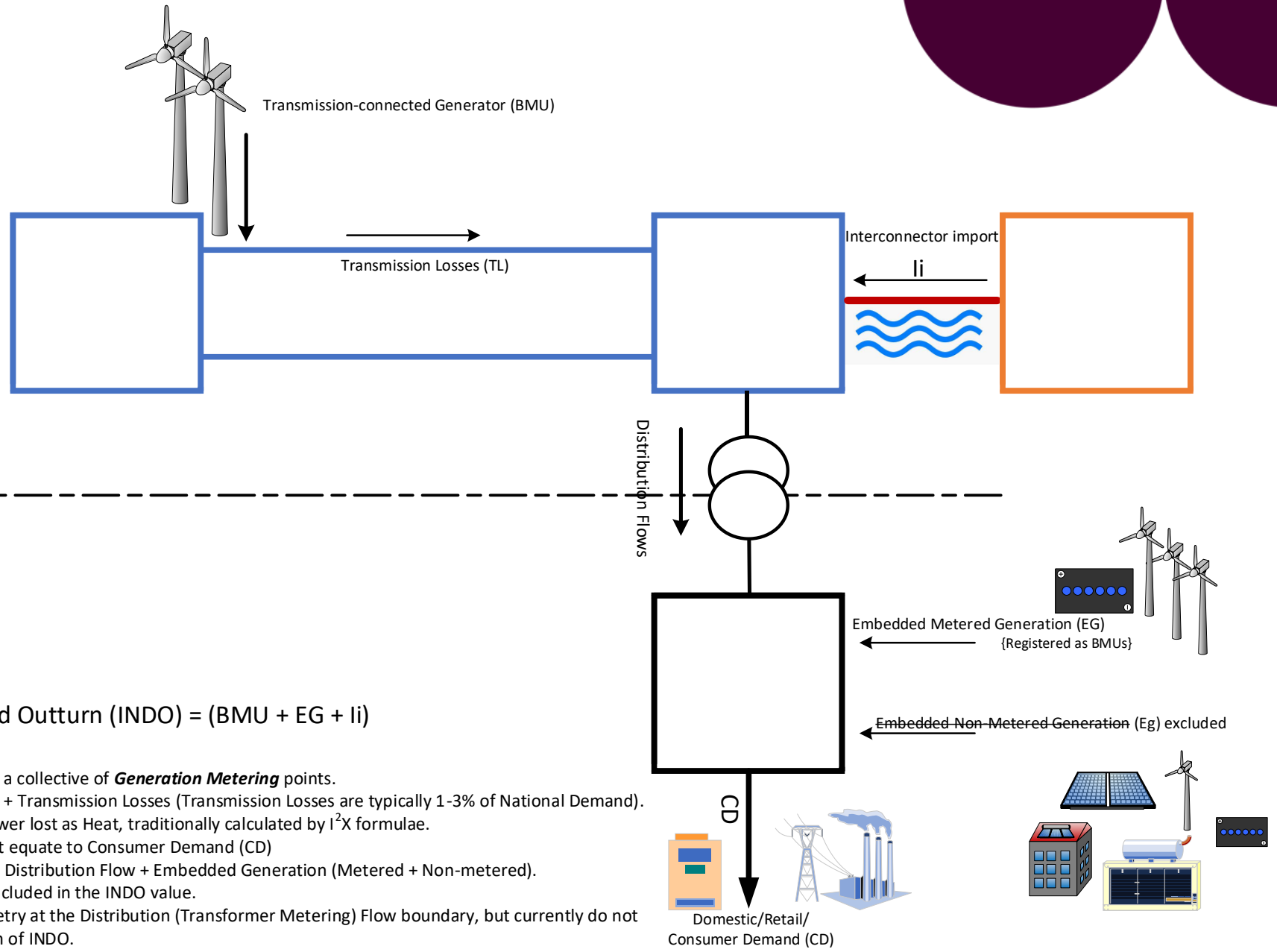
# Initial National Demand Outturn Methodology




Initial National Demand Outturn (INDO) = (BMU + EG + Ii)

Notes:

- INDO is compiled through a collective of ***Generation Metering*** points.
- INDO = Distribution Flows + Transmission Losses (Transmission Losses are typically 1-3% of National Demand).
- Transmission Losses is power lost as Heat, traditionally calculated by $I^2X$ formulae.
- Distribution Flow does not equate to Consumer Demand (CD)
- Consumer Demand (CD) = Distribution Flow + Embedded Generation (Metered + Non-metered).
- Batteries (Metered) are included in the INDO value.
- NESO also receives telemetry at the Distribution (Transformer Metering) Flow boundary, but currently do not use this in the compilation of INDO.
- Consumer Demand (CD) is not an official industry term – used for illustration only.

# Flaws and Myths of INDO

**Initial National Demand Outturn** (INDO) is not a complete representation of the total Distribution Network Owner demand :

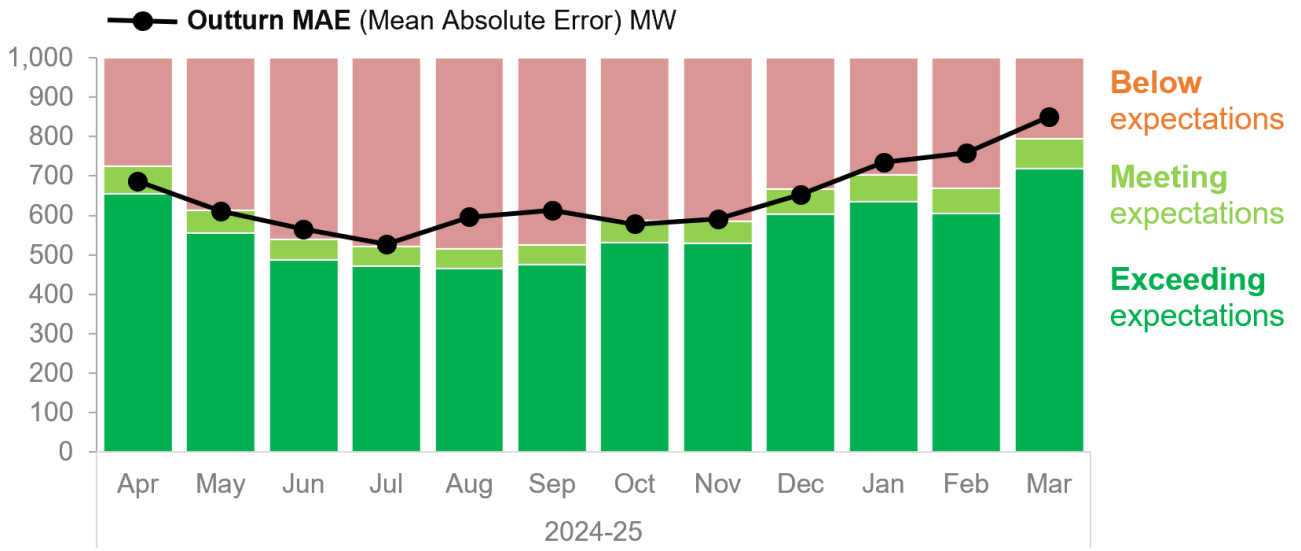
- INDO is compiled through a series of ***Generation*** measurements.
- INDO excludes Distribution Demand met by local embedded Non-metered (BTM) generation sources. i.e. Small DERs and almost all solar installations are excluded.
  - True Demand (effects of non-metered Wind and Solar excluded) is considerably higher.
  - Underlying Demand (effects of all embedded generation sources excluded) is higher still.
- INDO includes directly-connected (Transmission) consumer sources, such as rail network demand or large industrial sites.
- INDO includes the effects of Balancing Actions by the ENCC, that are enacted on non-BMU assets.
- INDO includes the effects of demand management and similar consumer activities.
- INDO methodology and reporting captures telemetry (generator) metering errors and faults, so is always flawed and distorted.  But it is only intended to be an indicative value.

Notes:
1. INDO is often used as a front-end data input, by third-party commercial forecasters.
2. BTM – Behind the Meter.
3. DER – Distributed Energy Resources

# Regulatory Incentives

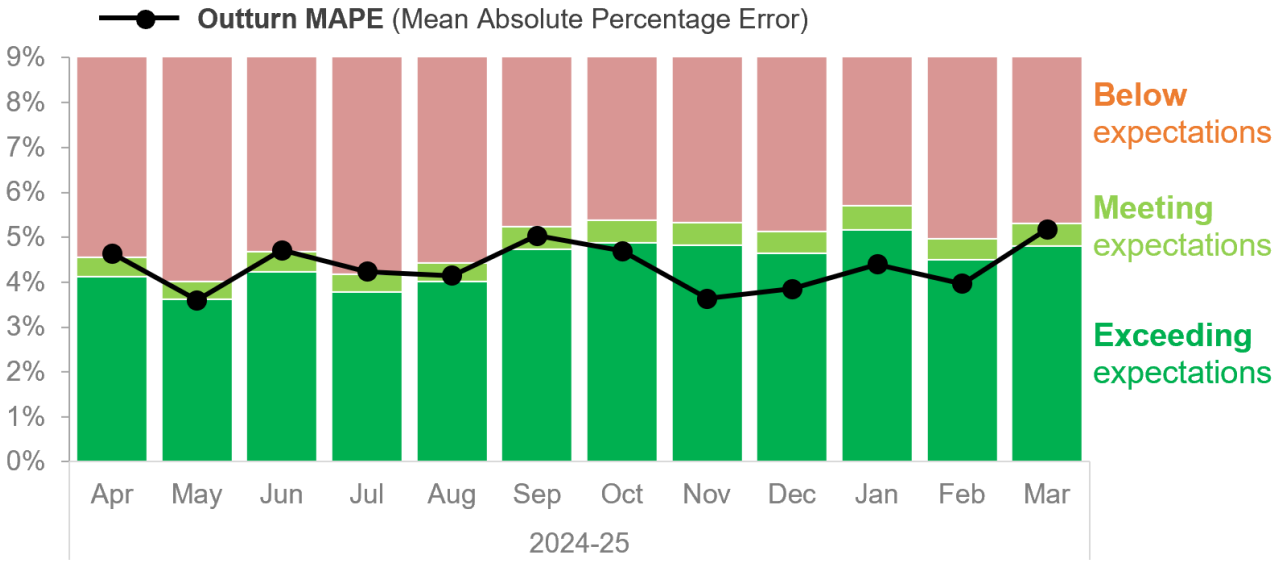
## Role1b. Day-ahead Demand forecast

This metric measures the average absolute percentage error (APE) between day-ahead (DA) national demand forecast and outturn demand for each half hour period.




## Role 1c. Day-ahead metered wind forecast

This metric measures Average absolute % error in day ahead metered wind forecast (as % of total capacity).



# Platform for Energy Forecasting (PEF)– Near Future

Rich Sykes

NESO
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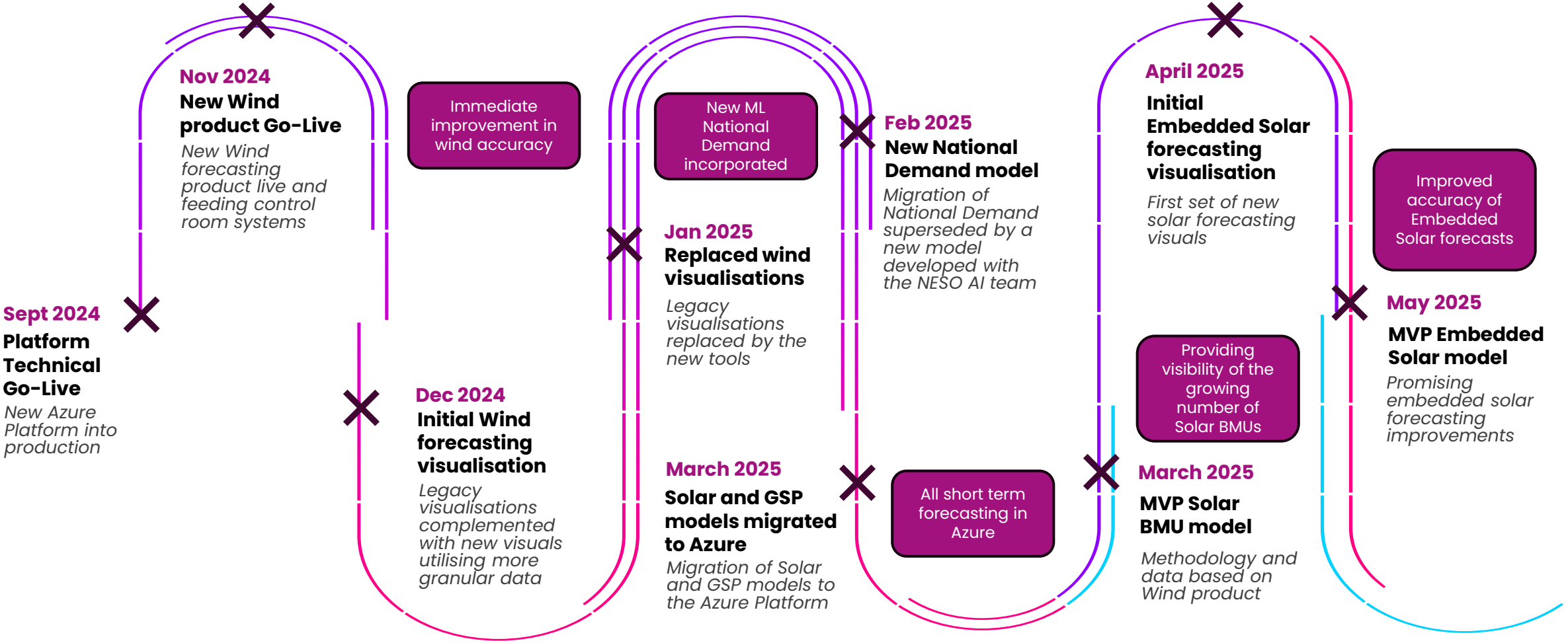
# A Recent History of the Platform for Energy Forecasting (PEF)



# Platform for Energy Forecasting (PEF) Roadmap

## Q1 FY 25/26 (Apr 25-Jun 25)

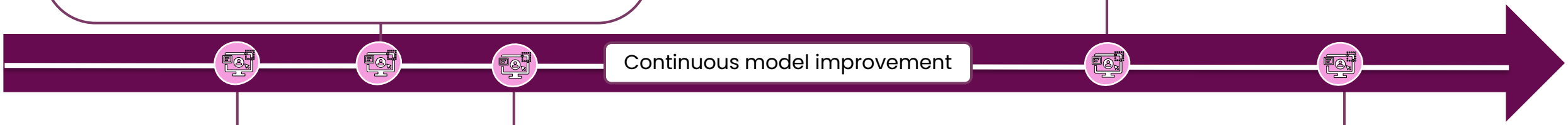
**Key Capabilities:**
- Visuals and tools for the control room [2]
- Solar BMU model and visualisations [1]
- Improved embedded Solar forecasts [1]
- Integrate Solar Nowcasting [1]
- **Renewable forecast control room situational awareness**

**Key Enablers:**
- Renewable generation forecasts decoupled from EFS [2]
- GSP model audit [1]
- **Offline Prototype Demand Forecasting capability**

## Q3 FY 25/26 (Oct 25-Dec 25)

**Key Capabilities:**
- Azure produces long term forecasts 13 & 52 week ahead, 5 year ahead (demand) [2]
- **Demand forecasting control room situational awareness**

**Key Enablers:**
- Integration with Network Access Planning tools for improved studies [2]
- **MVP Reactive Power Forecasts**




## Q4 FY 24/25 (Jan 25-Mar 25)

**Key Capabilities:**
- ✓ Migration of Solar and GSP [2] products onto the new platform
- ✓ Migration of an enhanced National Demand model onto the new platform. [2]

**Key Enablers:**
- ✓ MVP Solar BMU model [1]

## Q2 FY 25/26 (Jul 25-Sep 25)

**Key Capabilities:**
- Forecasting tools [2]
- Regional demand forecasts shared with Elexon as part of Electricity System Restoration Standards (ESRS)
- **MVP Demand Forecasting**

**Key Enablers:**
- PEF migrated to NESO azure tenancy

## Q4 FY 25/26 (Jan 26-March 26)

**Key Capabilities:**
- Advanced Analytics data integration [2]
- **Improved accuracy for Reactive power forecasting**
- **Redevelopment of Demand Forecasting Tools completed**
- **Replacement or removal of legacy End-User Developed applications (EUDAs) with Azure tools**
- **Enhanced control room situational awareness**
- **PowerBI and Azure reporting and analytic tools to support future improvements**
- **Incorporating additional datasets including market and consumer data**

**Key Enablers:**
- EFS system retirement strategy [2]



[1] Delivered under "Continuous model improvement", [2] Work enabling EFS retirement, **Bold** – New BP3

# Innovation Projects in the Forecasting Space

John Walsh

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# Innovation Projects

## Discovery

**Offshore Weather**

Spire

Access to high quality weather (wind speed) forecasts

## Scoping

**Grid Synth**

OCF

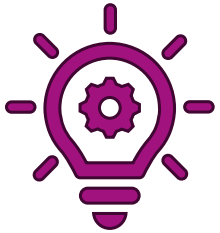
Scenario modelling for forward network planning

**> Nowcasting**

OCF

Horizon-extension of Nowcasting technology

Multiple active innovation projects, largely with a focus on within-day forecasting for ENCC applications



## Live

**Crowdflex**

ERM, AWS, Smith-Ins

Development of GSP models to analyse reliability of domestic customer behaviour

**Mass Mobility for Demand Forecasting**

The Floow

Using vehicle telematics (ICE, not EV) to support with demand forecasting patterns

**Volta: Impact and Feasibility Analysis**

Mesh AI

Feasibility analysis for the use of adaptive models in the control room

## BAU Integration

**Solar Nowcasting**

OCF

Satellite imagery and ML for improving solar generation forecasting



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# Future Energy Consumption Influences 2026 -2031

John Walsh & Rich Sykes

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# Future Energy Consumption Influences

There are a significant number of new drivers of uncertainty, which may influence energy consumption

- Weather changes (Global warming)
- Energy storage
- Consumer appetite
- Demand-side flexibility
- Regulation
- Workforce or consumer behaviour
- Increased volumes of Distributed Energy Resources
- Other Embedded Generation
- Growth in established technologies (Heat Pumps & EVs)
- Emerging technologies
- Retail incentives
- Active network management
- Time of Use (ToU) Tariffs
- Economic outlook / cost of living
- REMA



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# For Example ….. Demand side flexibility

- **Demand Side Flexibility Growth**: "Demand side flexibility will need to grow by four-to-five times in the next five years."
- **Smart Meters**: "Around 10 million more working smart meters in our homes."
- **Electric Vehicles (EVs)**: "Smart charging of EVs could make the largest contribution to demand flexibility through 2030."
- **Vehicle-to-Grid (V2G)**: "EVs could support the grid further by providing 1 GW of vehicle-to-grid (V2G) in 2030 at peak."
- **Demand Turn-Up**: "Demand turn-up… has strong potential, with 14.3 GW capacity in 2030."

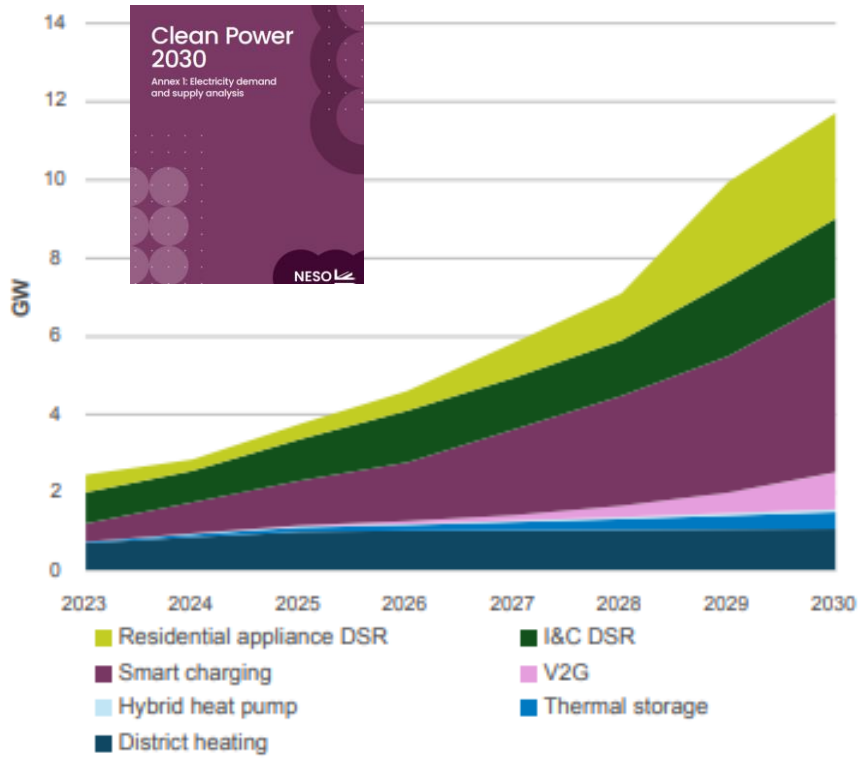


Figure 2: Demand side flexibility capacity at peak in our Further Flex and Renewables pathway

Source: CP30 Annex 1 - https://www.neso.energy/document/346791/download

# For Example ..... Energy Storage

- **LDES Capacity Increase**: "The installed capacity of LDES needs to increase from 3 GW today to between 5 – 8 GW through 2030."
- **Battery Energy Storage Future Capacity**: "Batteries are to grown from 5GW to 23 - 27 GW installed capacity by 2030."

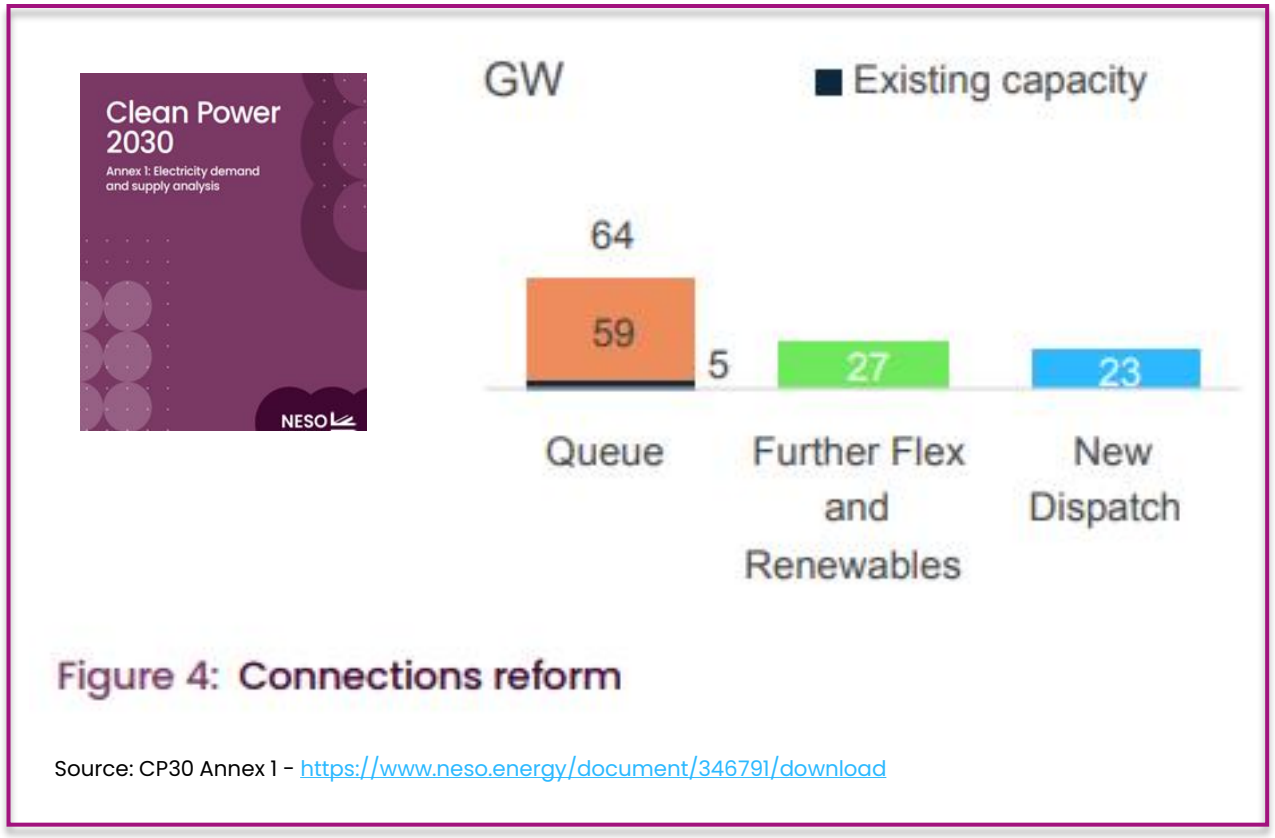


Figure 4: Connections reform

Source: CP30 Annex 1 - https://www.neso.energy/document/346791/download

# Interactive Mural Board

Over to you ....

- **Gaps:** Are there future energy consumption influencing factors you think are missing? How will these missing influencing factors impact demand?

- **Biggest Impact:** What influencing factors do you think will have the biggest impact & why?

- **Challenges:** What do you see as the biggest forecasting challenges between 2026-2031

# Forecasting Strategy

John Walsh

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# NESO Forecasting Strategy

**Context:**

- There are a significant number of **new drivers of uncertainty**, which may influence energy consumption & demand e.g., growth of embedded and flexible assets, retail incentives etc.
- **Growth of wind and solar capacity** - Accurate generation forecasting will be critical for markets and ENCC to operate as efficiently as possible.
- **Forecasting active and reactive power at GSP** and national level is required but complicated by largely unobserved activation of flexibility.

A coherent & co-created Forecasting Strategy is required to ensure we can optimise forecasting accuracy, whilst enabling clean power and consumer value

- **Commitment to produce a NESO Forecasting Strategy in BP3**; these focus groups (21 May & 05 June 2025) are the early engagement touch-points for Industry to input into the shaping & design of the strategy. A consultation will officially be launched on the strategy in Autumn 2025 – this group will be sent the consultation.
- **The strategy will help guide & inform deliverables** on the Platform For Energy Forecasting, and future innovation projects.

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# Forecasting Goals

1. **Produce more accurate and informative forecasts**
2. Establish digital infrastructures that unlock value
3. Increase engagement with suppliers and consumers of forecast data

- Adopting best practices, such as blending multiple sources of weather and forecast data
- Probabilistic forecasting to quantify uncertainty coherently across space, time and variables
- Enable NESO teams to develop bespoke solutions, e.g. to improve situational awareness, provide decision-support, automation



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# Forecasting Goals

1. Produce more accurate and informative forecasts
2. **Establish digital infrastructures that unlock value**
3. Increase engagement with suppliers and consumers of forecast data

- Develop more accurate and informative forecasts on PEF
- Expand interfaces between PEF and other systems to enable (1) and (3) in collaboration with OBP, DAP, Data Sharing Infrastructure etc…
- Build internal capability to maintain and develop PEF in-house as the enduring business model for forecasting at NESO



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# Forecasting Goals

1. Produce more accurate and informative forecasts
2. Establish digital infrastructures that unlock value
3. **Increase engagement with suppliers and consumers of forecast data**

- Consume best-in-class weather forecast data taking advantage of advances in weather forecasting
- Consume third-party energy forecasts to complement and benchmark internal capability
- Increase data exchange with distribution networks, suppliers, Virtual Lead Parties (VLPs) to increase visibility of demand and embedded assets



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# Interactive Mural Board

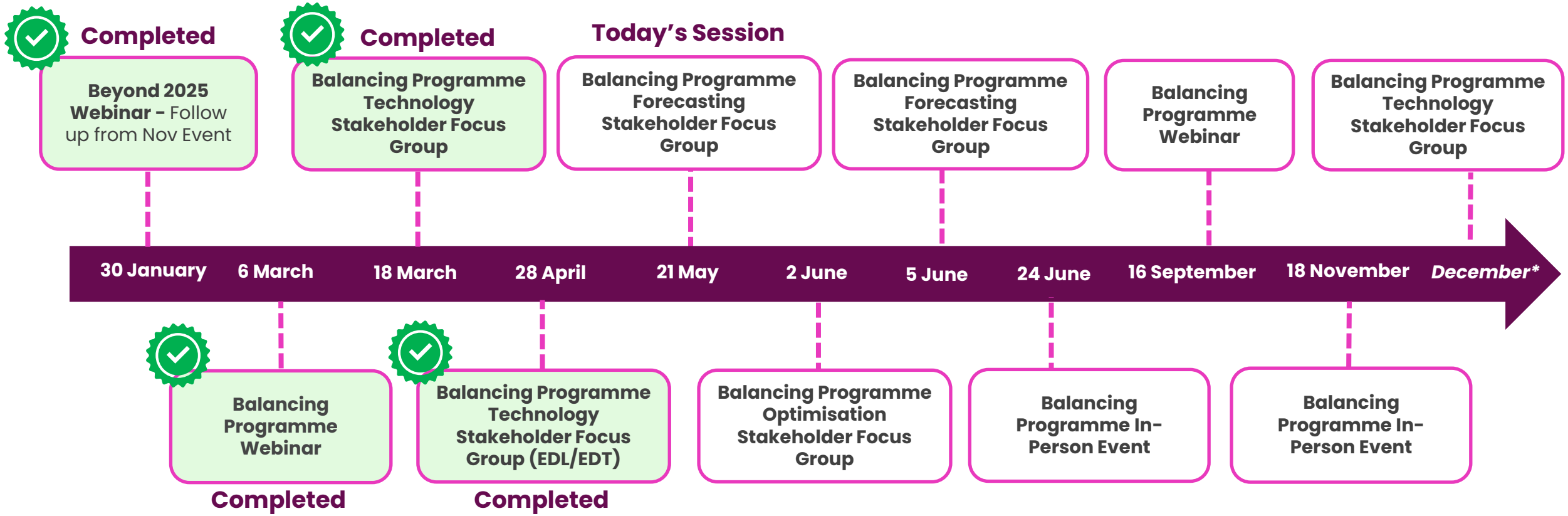
Over to you ....

- **Goals:** Do you agree on the goals outlined? Is there anything missing?
- **Priority:** What goal do you think should be prioritised & why?
- **Challenges:** What do you see as the biggest challenges in reaching the defined goals?

# Q&A

**Please raise your hand & come off mute**

# 2025 External Engagement Timeline




** Exact date TBC*

Balancing Programme **relationship management meetings** throughout 2025 & **external NESO newsletters 'Energising Progress'** with Balancing Programme content issued regularly, providing updates between online & in-person events. **Further Stakeholder Focus Group dates** to be added throughout 2025.

# Next Steps

**Upcoming Forecasting Focus Group:** On 5th June 11:30 - 13:30, we will explore the forecasting requirements needed to operate the electricity system between 2026-2031, consider what data NESO should publish in the future, and discuss how NESO could improve its forecasting abilities to support consumer value and a decarbonised power system.

We welcome your feedback & questions – please get in contact with us at **box.balancingprogramme@neso.energy**

Slides from today's session will be shared and published **on our website** where you can also view previous focus group content.

Subscribe to our new NESO newsletter **here** **-** please select **'Future of Balancing Services inc. Balancing Programme'** to keep up to date.

If you are interested in a regular meeting with a representative from the Programme and would like more information, please get in contact using the email address above.

NESO National Energy System Operator

Public

# Balancing Programme Forecasting Stakeholder Focus Group

**21 May 2025**
**1:30 - 3:30pm**

NESO
National Energy System Operator