Consumer Behaviour & Engagement

- Workforce or consumer behaviour
- Retail incentives inc. Time of Use tariffs
- Demand-side flexibility
- Consumer behaviour clustering around half-hourly settlement boundaries
- Behind-the-meter demand aggregator challenges
- Growth/decline of certain industries e.g., data centre growth
- Appetite for self-generation & consumption
- Cost of living

Technological Developments

- Growth and evolution of established technologies (Energy, Storage, Heat Pumps & EVs, Smart appliances etc.) e.g., EV batteries increasing in size, reducing charging frequency - more variability in when and where charging occurs.

- Emerging technologies

- Increased volumes of Distributed Energy Resources

- Active network management

Regulatory, Economic, & Natural Environment

- Weather changes (Global warming)
- REMA (Review of Electricity Market Arrangements) – potential to influence how systems operate and how distributed generation is sized
- Incentives reshaping how demand is managed and responded to inc. demand-side incentives
- Economic outlook
- Cross-border complexity - Increasing difficulty in managing international energy flows & extra regional load from European consumption is affecting interconnectors.

Question 1:

What new forecasts are required and why (type / regularity / granularity)?

What problem will it solve?

- Neso view of forward surplus margin/negative prices; to encourage demand side load shift. Win-win
- Customer reaction to variable renewable generation output by switching times of Appliance use and EV Charge/Discharge renders the basis of current Top Down Forecasting methods useless. Need to rebuild from the bottom up through DNOs to Customer behind the meter systems with simple bartering.
- Publishing in an easily accessible format all data, methodology and assumption underpinning key forecasts (including regional versions) (1)
- Publication of all existing forecasts at the time resolution and timeframe that the control room uses, so we're all working to a mutually understood picture
- More consumer and SME friendly response automation from heat to white goods and computing (eg down to laptops): automation is more effective than price signals alone eg see todays NESTA report.
- Datacentres- likely demand and actual demand
- Is there a way to forecast EV charge demand profiles based on hisoric actuals and future growth in EV sales?
- All price-sensitive demand (e.g. VTPs and suppliers with agile tarrifs) should have to FPN or otherwise publish more reliable forecasts, given they're essentially dispatchable. They already model this internally anyway
- A lot of what I'm seeing here is talking about price-responsive processes. The very act of trying to forecast these and publishing a forecast will likely incentivise consumers to target different times; changing the forecast
- Freely available (down to consumer level) DNO end-point conjestion forecasts at ~1h/1d/1w grain. Better utilisation of DNO capacity for RE.
- Freely available (down to consumer level) grid carbon intensity national and regional forecasts at ~1h/1d/1w grain. Better timing of domestic demand.
- Freely available (down to consumer level) solar national and regional forecasts at ~1h/1d/1w grain. Better timing/ deployment of beind-the-meter storage.
- Forecasting for Peer to Peer Energy Trading
- Headroom/footroom available from demand-side flex, minutes to days ahead, national/regional. (1)

- Inertia needs and live recordings at key gsp around the country
- Anticipated constraint points on the grid from planned build out compared to current infrastructure
- Full Customer behind the meter auto bartering with infor via DSOs to NESO.
- Combine weather system tracking (Wind patterns) with NWP using AI to better predict wind conditions at each farm
- More consumer and SME friendly response automation from heat to white goods and computing (eg down to laptops): automation is more effective than price signals alone eg see todays NESTA report.
- Forecast around the emergence of mass V2G could be very useful. Timescales appear to be slipping?
- Comms route to premises and through meters. 850000 non domestic HHR meters (c. St Cats from 1994) with Phone lines (Meter System Advanced).
- Freely available (down to consumer level) DNO end-point conjestion forecasts at ~1h/1d/1w grain. Better utilisation of DNO capacity for RE.
- Consideration of what battery capacity degradation forecasting may be needed.
- Re comment below V2G is likely to be a when not if? Mass market consumer PV was a unicorn in 1980s!
- Publish Power Available for wind, to deal with FPN discrepancies
- Comms via SMETS meters Elective Services route (DCC asking for stakeholders) to behind the meter customer systems. Meter System Smart. MHHS project for Settlement.
- Datasets that include total electricity generation in demand, including where there is behind the meter generation and storage.
- Data centre dynamic response to help balance etc.
- Beware of becoming drawn into unicorn hunts! XYZ new tech sold as being the one thing that matters, but it never materialises. Suggested example: V2G.
- More automated collaborative control over major domestic loads such as space heat and DHW and even whitegoods (smart appliances) to help trim peaks and balance.

- Likely pan-european weather events, impacts on IC flows
- Full bartering within extended MArket system down to retail level. Automatic systems behind the meter.
- implement locational pricing ASAP and, make it accessible to customers
- Sharing of near-real-time (fully open) data down to consumer level BUT care to avoid security issues from eg herding my malicious actors (eg financial and state).
- Better integration with EU market/grid: maybe incorporate ENSTO-E related data into BMRS data views?
- accurate demand and generation forecast MW, and their locations, and half-hour prices, to encourage consumption MW in off-peak SP
- Avoiding of herding at artificial/ HH (eg price) boundries: maybe new incentives to reduce slew rate down to consumer level?
- Forecasts for frequency risk and control report, rather than just extrapolation from historic data

Question 2:

What additional data might be required over the next 6 years that will unlock improved forecasting, and where is it?

How could you support NESO?

- SEG forecasts - expected changing demand there impacting shaping (smart export guarantee - solar panels mainly meant here)
- Can help by holding show-and-tell sessions on how industry is using data (2) (1)
- Monitoring of load by GSP to reduce the dependence on inferring demand from generation levels. And to provide better locational information.
- An approach by NESO, DNOs and TOs to make information on scope internal data sets open automatically, to help industry formulate requests for publication. (1)
- Much more DNO-level monitoring and forecasting to enable more efficient use of infrastructure for eg RE injection.
- Peak time consumption/ demand. From mart meteres enabled with consents for near real-time metered consumption for use in better forecasting.
- Greater emphasis on operational metering accuracy and reliability to give a full data set.

- 5- and 30-minutely outturns of battery generation / consumption. As it currently stands, battery generation is published under fuel type OTHER which is never negative – makes it practically impossible to understand the demand placed on the transmission network by batteries.
- Live constraint information, and/or common constraint boundaries. This would help distributed generators (or demand reduction assets) structure groups into units that are not constrained off by crossing a constraint boundary. This would result in more generation/demand reduction available for NESO. (2)
- Battery availability forecasts from aggregators of EVs & domestic stationary batteries (1)
- System losses/theft
- Reporting on accuracy of outage plans and constraint forecasts (1)
- Real-time, granular (ideally minutely) operational metering of outturn. Settlement metering is already public, so no reason operational can't be (2)
- Live constraints
- Live flows from Transmission System into each GSP or GSP group. Must be individual, rather than aggregated so regional variation can be understood. (1)
- Propose open, long-running, competative forecasting challenges to encourage the forecasting community to develop better approaches (1)
- Much more DNO-level monitoring and forecasting to enable more efficient use of infrastructure for eg RE injection.

- NESO should consider consuming ensemble, gridded numerical weather predictions from >5 NWP providers. Perhaps from Dynamical.org
- Security/privacy vs cost/ carbon trade-offs publically assessed and improving.
- Data is supposed to be default open. But today, data has to be manually requested, and goes through a slow, unhelpful triage process. Instead, all new software should build in transparency at the design stage, without industry having to ask after the fact. (2)
- Default publishing of data sets used by the control room and forecasting at a granular level. Better labelling of datasets to help location of correct info, sometimes it takes weeks of interaction for data to be located and questions answered even with NESO analyst help (1)
- Forecast wind and solar by regional area (either side of common constraint boundaries). This would allow anticipation of which common constraint boundaries and the restructuring of distributed generation/ Demand reduction units to avoid expected constraints (resulting in more flexibility available to NESO) (1)
- Much more DNO-level monitoring and forecasting to enable more efficient use of infrastructure for eg RE injection.

Question 3:

What might an industry recognised “What does good look like” be?

What KPIs could we use to measure progress?

- Minimum publication latency (e.g. a few seconds, like at Elexon)
- Level of system imbalance?
- Percentage of data sets available to the control room, or underpinning data used by the control room, that is available live online
- Transparent benchmarking of forecasting against other equivalent organisations (1)
- Benchmarking against data availability in other grid internationally.
- Something about pro-active data cleaning, e.g time to notice missing data, or time to notice errors
- Minimising Balancing Costs (1)
- Empirical evidence that NESO's forecasts are state of the art (compared to other commercial forecasters & academia)
- Independent annual benchmarking of NESO performance against best practice and quantitative annual targets.
- Consultation with industry on what ambitious but achievable quantifiable (and independently verifiable) targets should be set annually
- % of all NESO data a) catalogued b) triaged c) published (3)
- Running the grid for many hours per week on 100% renewable generation + batteries
- More transparency around forecast errors- why they happen, how often, how significant as parties make decisions based on system data. Ofgem can hold them accountable for various actions, even if forecasts were incorrect or changed significantly
- Equivalent data available for BM and non -BM markets
- Could you provide a comments/suggestions section on the data sets provided so specific questions/issues could be directed at individual datasets? Perhaps a Q&A session would be useful for answered questions and visibility on % of questions responded to within 3 days (for example)
- Vast majority of grid (NESO --> DNO) data free and open and available to all participants down to consumers. Eg CC0 or CC4 licenced. To maximise participation of eg wider public and innovators.
- Percentage of data relating to new products that is available online
- KPI: stable, reliable and cheap electricity supply. In the last few years, electricity too expensive
- Reliability of data sets in % availability - often live data feeds go down which we use in market operation - this reduces the efficiency of market operation
- ready access to data on the accuracy of all forecasts and actions in place if any to improve each data set.
- Higher renewables injection at DNO level.
- Higher DNO (low voltage) connection utilisation for higher renewables injection (without overload)
- Reduction in margin held between MEL and SEL on fossil fuel types in BRMS. This zone of operation is (1) the least efficient mode for CCGTs and (2) an indication that forecast uncertainty was high enough that a unit had to be synchronised ahead of gate.

- Maximum co-operation between different levels of the electricity system to allow for a secure transition to a low carbon grid. (1)
- NESO capable of onboarding a new dataset (that could improve NESO's forecasts) within a month
- NESO capable of implementing new forecasting algorithms from the literature within a month.
- Public sandbox forecast algorithms, just NESO or with collaborators.
- Significant and expanding live automated collaborative interaction between domestic (and small commercial) major loads and grid state, eg heat for DR, but also loads such as home/business computing which largely have rpd software present too. "Hey Siri, please help the grid."
- KPI: Cost savings from integrated network planning. IE: money is saved by choosing the most effective place/way to reinforce the network
- NESO running hundreds of internal experiments per month to continuously improve forecasts. (Modern ML is an empirical science!)
- A vibrant community of forecasters constantly trying to push the state of the art, using GB grid data, in public long-running competative challenges. See Donoho 2023.
- << HH pricing and data granularity to minimise abrupt pricing/demand steps.
- Long term vision to move to a 1 minute market and settlement to allow the market address balancing issues. (2)
- NESO's DSI could fully to allow information to flow freely between DNOs and NESO, enabling better forecasting/ planning/modelling

- Higher (approaching 1.0 from just below, time averaged) utilisation of transmission and distribution assets.
- Vast majority of grid (NESO --> DNO) data free and open and available to all participants down to consumers. Eg CC0 or CC4 licenced. To maximise participation of eg wider public and innovators.
- Abundant affordable reliable electricity. (Not necessarily too cheap though!)
- Large energy users such as data centres required to public efficiency metrics?
- Higher renewables injection at DNO level.
- give consumer access of locational half-hour pricing, reduce cost!
- Lower balancing costs
- The obvious one: low or zero carbon grid!

Anything else you would like to feedback that isn't captured in the 3 questions?

- Consider the option for a hackathon or competition style approaches to improving forecasting.
- Future market redesign to deal with a vastly different energy landscape - how incentives need to change as the system changes. Not really forecasting?
- Make sure relevant forecasts on the need for post quantum crypto for NSCS are shared widely, to allow time of implementation
- Risks assessment of market manipulation of forecasts.
- Forecasting for periods when distributed generation meets close to 100% of demand.
- Can you produce a document that shows which data is sensitive and which isn't on a geolocational basis?
- Would you consider releasing problem statements framing the trickier problems you are dealing with into an open process similar to the ENA basecamp process? Possibly more helpful than a hackathon, given security considerations
- Where does forecast to help support disaster response fit in?