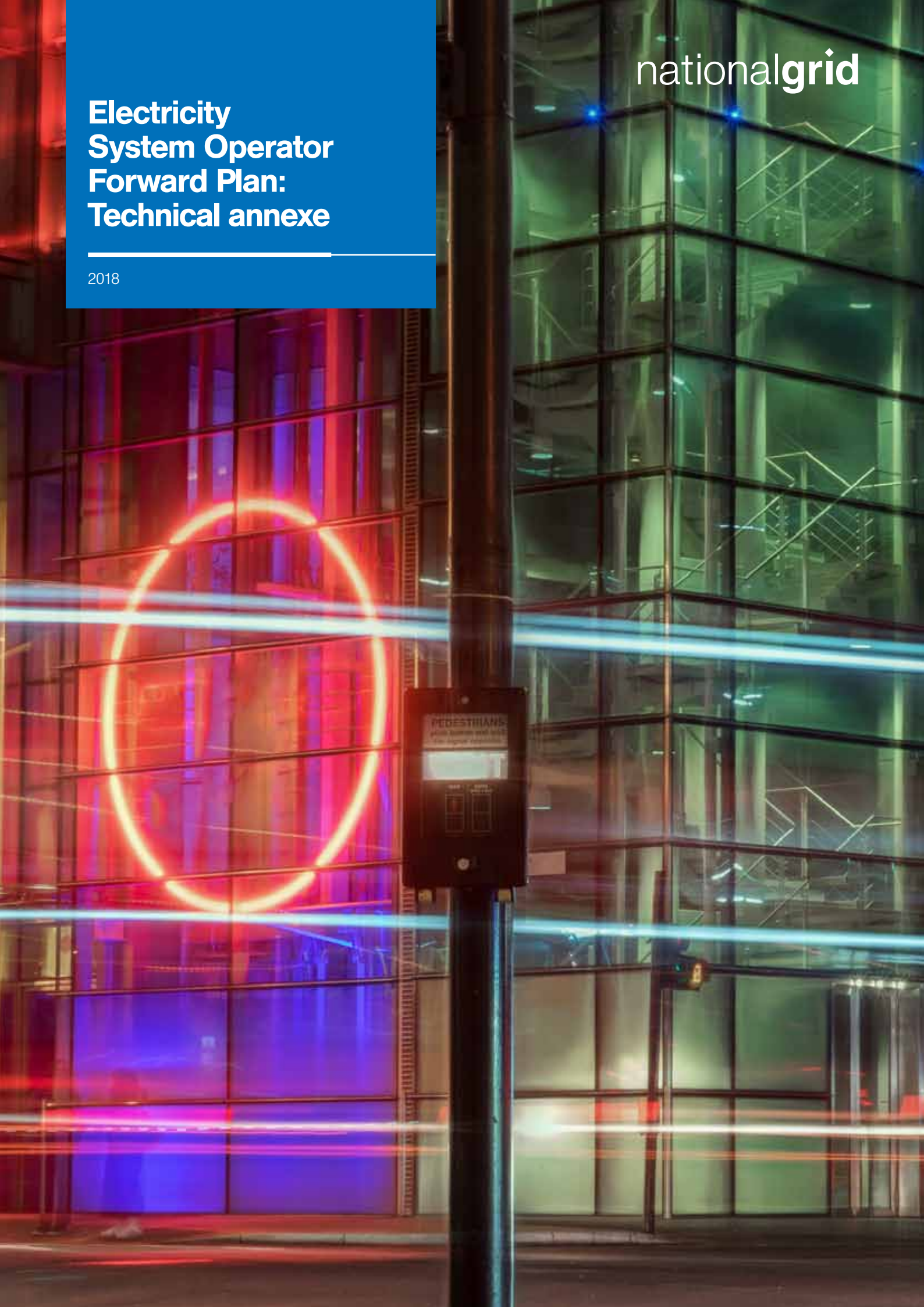
nationalgrid

Electricity System Operator Forward Plan: Technical annexe

2018



1. Forecasting accuracy

ESO role	Principle
Managing system balancing and operability	1. Support market participants to make informed decisions by providing user-friendly, comprehensive and accurate information.

Forecasting accuracy for day ahead transmission demand and day ahead BMU (Balancing Mechanism Unit) wind generation.

Description

Day Ahead (DA) Transmission demand forecast accuracy

One of the key objectives of publishing demand forecasts is to support the market to balance its position ahead of real time. DA is very important because this is where market liquidity is greatest. A good DA forecast allows parties to efficiently trade their residual positions prior to within day (WD). Therefore the ESO is investing in our DA forecasting of demand and believe this is where greatest value for the consumer can be gained and our performance should be measured. At 2DA stakeholders find there is less liquidity and still time for the demand forecasts and plant availability to change. Trading at 2DA, parties run the risk of having to unwind their trades when better information is gathered at DA stage.

DA forecasting improvements will be incorporated into the forecasts at different lead times. Enhancements to the forecasting process will drive overall benefit but these longer term forecasts are more at risk to external factors and so are not true measures of the ESO's performance.

The DA Demand forecast accuracy will be calculated daily for the following forecasting points1 to align to market electricity trading blocks:

- Overnight Minimum.
- Daytime Peak.
- Daytime Minimum.
- Evening Peak.

This will align ESO deliverables to what is relevant to the market and drive tangible value to consumers.

The accuracy of each forecasting point will be based on:

- Operational national outturns (in MW);
- Daily demand forecast points (in MW).

The performance of each forecasting point will be measured daily by comparing the daily forecast error (MW) to pre-defined targets (MW).

There will be 12 targets (MW) for each forecasting point. These targets are based on a 5% reduction of the average forecasting error (as highlighted above) over the last 3 financial years.

The table below shows the targets calculated using the methodology described above (period considered for the calculations: 1 April 2015 to 31 of December 2017).

Month	Overnight minimum (MW)	Daytime peak (MW)	Daytime minimum (MW)	Evening Peak (MW)
April-18	533	719	1110	746
May-18	443	624	896	649
June-18	359	592	715	588
July-18	358	623	718	549
August-18	342	663	798	639
September-18	405	534	687	580
October-18	408	611	877	643
November-18	530	675	767	514
December-18	590	674	927	722
January-19	675	725	831	613
February-19	527	779	1040	594
March-19	442	812	1102	488

[1] Appendix 1 - forecasting points definition

Evening peak performance over the Triad Period (period from November to February when Triad charges are incurred by market participants) will be based on the Triad Avoidance calculation methodology described in the attached document on Appendix 2.

During the past few years we have observed shifts in the morning and evening peak times primarily due to embedded PV generation. In order to continuously improve forecasting accuracy, the ESO reviews forecasting point definitions after every clock change. When a decision to change forecasting point definition (the time period within which forecasting points happens) is made by the ESO, the same would be promptly communicated to the market through subscription email, distribution list and on our website[2].

The ESO will publish Day Ahead demand forecasts every day by 9:15am, except exceptional circumstances outside of our control[3]. All forecasts published after the deadline will be excluded from performance calculations.

Day Ahead (DA) BMU Wind generation forecast accuracy

The DA BMU Wind forecast accuracy will be calculated for each settlement period (half hour) and will be based on:

- First Run settlement metering data (in MW);
- Half hour BMU wind forecasts (in MW) excluding BOAs (Bid Offer Acceptance).

The incentive performance will be measured half hourly by comparing percentage mean absolute error to pre-defined seasonal targets percentage.

BMU Wind will have seasonal targets. These targets are based on a 5% reduction of the average forecasting error (as defined above) over the last three financial years[4]. By following this methodology, these are the wind targets:

Season	Period	Target
Spring target	1 April 2018 - 31 May 2018 1 March 2019 - 31 March 2019	4.72%
Summer target	1 June 2018 - 31 August 2018	4.50%
Autumn target	1 Sept 2018 - 30 Nov 2018	4.71%
Winter target	1 Dec 2018 - 28 Feb 2019	5.45%

The ESO will publish Day Ahead wind generation forecasts every day by 9:15am, except exceptional circumstances outside our control[5]. All forecasts published after the deadline will be excluded from performance calculations.

Performance measure

The scoring methodology will follow three sequential steps.

Step 1

Daily forecasts will be produced for both wind and demand; errors will be calculated.

Step 2

Forecasting errors (daily for demand and HH for wind) will be compared to pre-set target values (these targets are a 5% reduction in error from the performance over the last three years.) For each forecast one of the three outcomes will be recorded:

Forecast error Demand (MW) Wind (%)	Pre-defined target Demand (MW) Wind (%)	Outcome
		Forecast error < target
		Forecast error = target
		Forecast error > target

[2] https://www.nationalgrid.com/uk/electricity/market-and-operational-data/data-explorer
[3] Forecasting system outages, extreme weather conditions: snow, flooding etc.
[4] From 1 April 2015 to 14 December 2017
[5] Forecasting system outages, extreme weather conditions: snow, flooding etc.

Step 3
The final score (for each forecast) will be measured by aggregating all monthly forecasts whose error was equal to or below a pre-defined target value (as defined in step 2) and assigned a rating highlighted in the tables below:

Demand		Below target	On target	Above target
Number of days in month	**Number of forecasts in month (n)**	**Count of within-target forecast errors**	**Count of within-target forecast errors**	**Count of within-target forecast errors**
28	112	0 - 51	52 - 60	61 - 112
30	120	0 - 55	56 - 64	65 - 120
31	124	0 - 57	58 - 65	66 - 124

Wind		Below target	On target	Above target
Number of days in month	**Number of forecasts in month (n)**	**Count of within-target forecast errors**	**Count of within-target forecast errors**	**Count of within-target forecast errors**
28	1344	0 - 656	657 - 687	688 - 1344
30	1440	0 - 704	705 - 735	736 - 1440
31	1488	0 - 727	728 - 760	761 - 1488

To calculate the three incentive target rating classes, we have assumed a binomial distribution to represent the distribution of within-target forecasting errors.

The numbers provided in the tables above are thus calculated using the Inverse Cumulative Binomial Distribution Function, where a forecasting error at or below the target value represents success.

As the target value is derived from an analysis of historic mean absolute errors, the probability, p, of the forecast error being at or below the target value is 0.5.

n represents the number of forecasts in a given month.

'Above Target' and **'Below Target',** correspond to probabilities of 20 percent that the number of within-target forecasting errors fall within these ranges. **'On Target'** corresponds to a probability of 60 percent that the number of within-target forecasting errors fall within this range.

Consumer benefit
The proposed metrics will drive the ESO to:
- Continuously improve the Demand and Wind annual forecasting errors against a backdrop of increasingly volatile/ weather dependent generation mix and consumption patterns;
- Deliver improved demand and wind forecasts to ENCC (Electricity National Control Centre) and market participants.

We plan to achieve the above goals by:
- Developing/improving forecasting processes.
- Developing/improving forecasting models.
- Sourcing new and more accurate/ frequent data.
- Adopting new flexible forecasting systems.
- Adopting new technologies (A.I., big data, and data analytics).

The Energy Forecasting Team long term objective is to:
- Improve forecasting accuracy.
- Build a forecasting system able to cope with future forecasting challenges.
- Deliver transparent, easily accessible and more accurate demand and wind forecasts to the market participants.

Producing accurate forecasts will allow market participants to better adjust their generation/consumption positions ahead of real time. This will result in fewer actions taken by ENCC – and therefore less consumers' money spent – to balance the electricity system. As a rule of thumb a sustained reduction in daily demand forecasting error by 10MW could result in a £20m reduction of the annual cost to balance the system.

In addition, an improved transparency of data and actions to improve market participants' understanding will lead to more efficient markets and lower costs to consumers. This is supported by the addition of a quarterly narrative explaining the ESO's performance.

2. BSUoS forecast provision

ESO role	Principle
Managing system balancing and operability	1. Support market participants to make informed decisions by providing user-friendly, comprehensive and accurate information.

Description

BSUoS forecast provision (half hourly forecast published at day ahead)
BSUoS forecast is currently broken down to monthly resolution. Stakeholders have told us that a granular forecast of BSUoS would help them to make better informed balancing decisions. This forecast will provide a best view of expected BSUoS costs to the market at a single point in time. This will ensure that all participants have the opportunity to benchmark and optimise their commercial positions against a consistent basis, and one that is reflective of the expected operational context of the next 24 hours.

This is a challenging piece of work as half-hourly BSUoS is impacted by many external factors e.g. weather conditions/ network and plant availability as well as complex interplay between this forecast and market behaviour. Once this forecast model is established and in production we will collate the data and identify the drivers of the change in BSUoS from publication. The accuracy of the forecast will likely be impacted as customers respond to the information provided and as such, a measure of forecast accuracy is not proposed.

Performance measure

The ESO will develop a new methodology for a half hourly total BSUoS cost forecast. The forecast will be published on the National Grid website. The measure will count the number of forecasts published during the agreed reporting period.

In addition, we will publish a document describing at high level the main methodology that the forecasting process uses.The measure is the daily delivery, Monday to Friday, of a day ahead half hourly BSUoS cost forecast by 08:00, and on Friday by 17:00 a half hourly forecast for the coming Sunday and Monday.

The following performance targets will be enacted from Q2 2018-19, following deployment and testing of the new BSUoS forecasting system in Q1 2018-19. As this is a new methodology and forecasting system that will be developed we believe that publishing these on time 85-95% is an appropriate target to reflect the development of a new methodology and processes to do this.

On target:
85-95% forecasts published on the National Grid website before 08:00 each publication day for Tuesday – Saturday forecasts, and by 17:00 on Fridays for Sunday – Monday forecasts (the agreed schedule).

Exceeding target:
Greater than 95% forecasts published on the National Grid website by agreed schedule.

Under performance:
Fewer than 85% forecasts published on the National Grid by agreed schedule.

The target will exclude all planned outage/downtime of the IT systems which have been scheduled.

Consumer benefit

This metric will focus the ESO to deliver BSUoS half hourly cost forecasts as requested by customers. At present, no such forecasts are published. Changing system background conditions make straightforward historical comparisons difficult. The ESO will use its understanding of these changing conditions to facilitate customers in understanding likely future costs close to real-time.

This forecast will provide customers with an increased understanding of likely future BSUoS costs, allowing them to manage their profitability within the BM. The main benefit will be a potential reduction in risk premia built into the BM bid/offer prices to compensate for uncertain BSUoS costs.

3. Commercial assessment transparency

ESO role	Principle
Managing system balancing and operability	1. Support market participants to make informed decisions by providing user-friendly, comprehensive and accurate information.

Publication of Ancillary Services/Balancing Services (AS/BS) tender assessment decisions to a published schedule. This is for products: Firm Frequency Response[6] (FFR), Short Term Operating Reserve[7] (STOR), and Fast Reserve[8] which we run monthly for FFR and Fast Reserve and three times a year for STOR. The three tenders are the ones that we run regularly all others are on an ad-hoc basis and we will continue to explore how to measure our performance in these areas.

Description

Ancillary service providers have told us that they value clarity and transparency on how we procure ancillary services. There are a number of factors in the way we determine the value of these services. Providers have highlighted that the better they understand how we assess value and make procurement decisions the better they can tailor their offers to meet our requirements. This should lead to greater confidence in the market and a clearer understanding of pricing.

This metric incentivises the ESO to publish on time, clear, useful market information and results and to ensure providers understand our procurement decisions. It also incentivises the ESO to establish a continuous feedback loop from our providers. We will run webinars to explain how we make our decisions and to receive feedback from our providers on what they need to enable them to make more effective offers into the market.

The tender process is as follows:

1. Structuring and Optimisation (S&O) receive tenders from Contracts and Settlements (C&S).
2. S&O run an assessment.
3. S&O determine the contracts to award, and get sanction for that.
4. S&O provide the results to C&S (whether a tender is accepted/rejected), and where possible a reason for rejection.
5. C&S use the information to publish the results to our website.

FFR and Fast Reserve have schedules published of when we will publish the results. Currently FFR and Fast Reserve results are published on a specific business day of the month (12th business day for FFR and 14th business day for Fast Reserve)1. STOR results publication is flexible based on operational requirements; however we will publish a schedule of publication dates. The schedule is published by the tender-lead within the C&S Team in advance of April 2018.

We are striving to meet customer needs which they have expressed as wanting the information as soon as is possible.

Performance measure

On Target:
Results published on time, right first time, 91% of the time (11 out of 12 months) for FFR and Fast Reserve and on time, right first time 100% of the time for STOR.

On-time is defined as published on the same calendar day as in the schedule.

Right first time is defined as no errors in the data (i.e. all tenders acceptances / rejections clearly stated).

We will be deemed to have failed to publish right-first-time if we have to re-publish any results due to errors identified by any party. The ESO will put in place back up arrangements to normal publication methods to act as contingency in the event of systems failures.

[6] https://www.nationalgrid.com/uk/electricity/market-operations-and-data/system-balancing-reports

[7] https://www.nationalgrid.com/uk/electricity/balancing-services/reserve-services/short-term-operating-reserve-stor?market-information

[8] https://www.nationalgrid.com/uk/electricity/balancing-services/reserve-services/fast-reserve?market-information

Ancillary Service providers are now tending to submit more complex bids, which has increased the workload, whilst at the same time we endeavour to make a step change in how we interact with parties and provide more timely and transparent market information. Increased numbers of providers need to be accommodated, as well as an increase in the numbers of units that can be tendered. The operating environment will increasingly pose challenge.

Exceeding expectation:
On target performance and conduct webinars for FFR, Fast Reserve and STOR to provide the results of the assessments and to engage with stakeholders. The ESO commits to trial results webinars for FFR and Fast Reserve for 6 months (1 per tender) and will collect formal feedback periodically (twice during 6 month period). The ESO commits to trial a results webinar for STOR for TR35 and TR36 and will collect formal feedback after each one. The webinars will be available to those companies with a signed Framework Agreement.

Stakeholder feedback will be reviewed and where possible, changes made to the content of the webinars or we will consult further with industry to implement suggested feasible value-add activity to enhance the customer/stakeholder experience.

Under performance:
Results published on time, right first time, less than 91% of the time (11 out of 12 months) for FFR and Fast Reserve and on time, right first time less than 100% of the time for STOR.

Late is defined as published later than the calendar day listed in the schedule.

Consumer benefit
This performance metric drives the ESO to be more transparent and punctual in data provision on all ancillary services and balancing services decisions. It also drives the ESO to be responsive to customer/stakeholder needs for transparent and punctual market information.

Having these results on time gives providers time to absorb what is happening in the market, reflect on this, and incorporate in their thinking into their bidding strategies for the next rounds. This should lead to greater confidence in the market and a clearer understanding of pricing, which will in turn lead to increased participation in these markets. The ESO wants to give focus to the tendering process, to avoid as much as is possible, procuring services in real-time/ Control Room timescales so that costs can be optimised.

4. Trades data transparency

ESO role	Principle
Managing system balancing and operability	1. Support market participants to make informed decisions by providing user-friendly, comprehensive and accurate information.

Description

Timely publication of information relating to trades undertaken by the ESO in managing system balance and operability. Stakeholders have told us that they want the information about trades enacted by the ESO to be published more quickly than via Elexon. Therefore the ESO has invested in a new platform to allow these to be published..

Performance measure

This metric supports a newly developed process using new software to greatly increase the frequency of publication of Trades data.

The ESO aims to carry out 7-day a week publication of trades within targeted frequency (1hour).

The target is to publish 80-90% of all trades data within 1 hour of capture. In the development of this new platform the ESO has been efficient in the specification and support. A system that is available 100% of the time and that it is fixed very quickly upon identification of an error comes with a very high price tag. An efficient choice has been made that balances stakeholder need and cost. Therefore we propose that on target performance would be 80-90% of all trades data published within 1 hour of capture.

The information will be published at https://trades.nationalgrid.co.uk

On target:
Publish 80-90% of all trades data within one hour of capture.

Exceeding expectations:
Publish > 90% of all trades data within one hour of capture.

Under performance:
Publish < 80% of all trades data within one hour of capture.

Consumer benefit

This measure drives the SO to be transparent and punctual in data provision.

The industry has explicity asked for greater frequency of Trades data publication at Operational forums, highlighting that the delay introduces increased risk in their decision making.

We are listening to our customer and stakeholders and delivering tangible outcomes in response to their feedback.

Increasing the frequency of National Grid reporting of trade data to the industry will improve market transparency resulting in more informed decision making by market participants. This should result in lower risk premia in the market, reducing costs to consumers.

5. Information provision innovation

ESO role	Principle
Managing system balancing and operability	1. Support market participants to make informed decisions by providing user-friendly, comprehensive and accurate information.

Determine the gCO_2/Kwh produced by GB generation and publish the data publicly as the de facto measure of progress being made towards targets set in the 2017 Clean Growth Plan which enables consumers to make informed consumption decisions.

Description
National Grid ESO in collaboration with stakeholders has delivered not only the de facto measurement of carbon intensity of electricity consumed in GB, but this also forecasts forward 48 hours. This allows consumers and industry to plan their use of electricity depending on the carbon intensity. Stakeholders including environmental groups and politicians wanted this information to be publicly available and approached the ESO to support with this. We have listened and are pursuing the expansion to regionalised forecast to support further decarbonisation.

The pilot scheme is currently a national GB metric, publicly available through carbonintensity.org.uk. In 2018 we plan to regionalise the information down to each DNO area, giving a more localised prediction of the cleanliness of the electricity being consumed.

We will measure how well we are responding to stakeholder, customer, and consumer needs and wants in this area through stakeholder satisfaction measurement and gathering of feedback through the following process:

Q1 18-19
Survey of customers and stakeholders to determine current and future needs, accessibility, ease of information gathering, transparency etc.

Q2 18-19
Production of Road Map with deliverables and milestones based on the survey and our current plans/proposals.

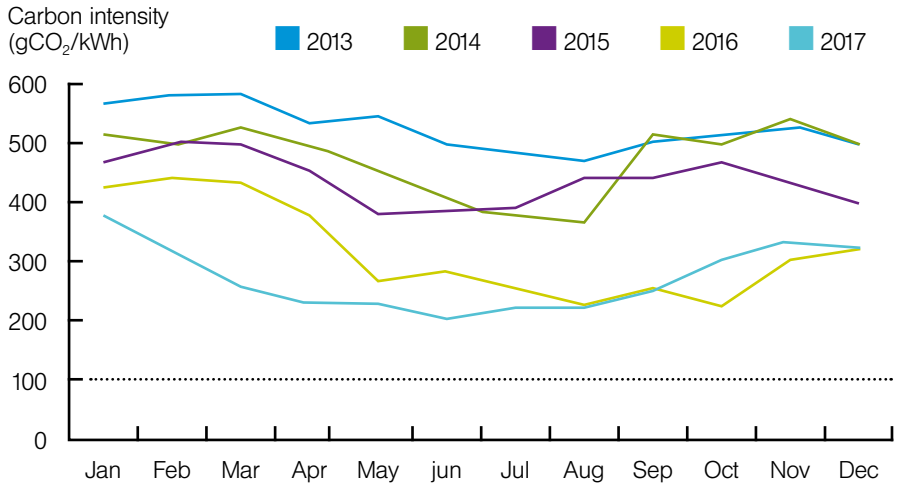
Q3 or Q4 18-19
Survey to measure improvements and publication of a delivery report.

In the final survey ask the question:
“Are you satisfied with accessibilty and transparency of the improvements to the carbon intensity forecast?”

1-10 scale ~ 1 poor, 10 outstanding.

Example of transparent reporting capability:
When plotting backwards, we can see the decarbonisation trend in GB (as illustrated in the chart below):

The decarbonisation of British electricity
2017 was the greatest year on record in Great Britain with the carbon intensity of electricity dropping to record lows.



49.7%

decrease from 2013 to 2017

2013.....529 (gCO_2/kWh)

2014.....477 (gCO_2/kWh)

2015.....443 (gCO_2/kWh)

2016.....330 (gCO_2/kWh)

2017.....266 (gCO_2/kWh)

Source: National Grid

The year on year progress here is primarily driven as a combination of the rise of wind & solar offset with a market driven significant reduction in coal generation. Since coal is typically at a minimum, we won't see a continuation in this trend without a significant market shift towards renewables and energy efficiency.

Seasonal quarterly reports may be used to determine:

- **Clean Energy Plan on-target:** the reduction continues at a rate that achieves the targets set in the clean growth plan.
- **Clean Energy Plan ahead of target:** the reduction continues at a rate that exceeds the targets set in the clean growth plan.
- **Clean Energy Plan behind target:** maintain current carbon intensity levels year-on-year.

Performance measure

On target:

- We deliver all actions for delivering regional carbon intensity information identified in the product roadmap in 18/19
- Stakeholder Feedback in range 5/10 through 7/10.

Exceeding expectations:

- In addition to on-target requirements, we deliver a wider multi-industry engagement with the carbon intensity information. Trials are delivered with other stakeholders.
- Stakeholder Feedback > 7/10.

Under performance:

- We don't deliver all actions for regional carbon intensity information identified in the product roadmap in 18/19.
- Stakeholder Feedback < 5/10.

Consumer benefit

We have responded to stakeholder feedback on the need for clear, transparent data to inform and facilitate market and consumer decision-making, and started to develop creative and innovative reporting not seen before.

The information will drive awareness that variable pricing linked to utilisation habits is an essential way to achieve the UK's 2030+ vision.

The apps developed using the data from this API gives consumers choice to change their usage to drive a more environmentally friendly usage of power.

On an industrial scale, this allows businesses to make ethical power choices. Once variable pricing takes hold, this can be linked to the cost of power usage.

As variable pricing becomes more widespread alongside the mass deployment of smart meter technologies on the consumer side, this service lays the groundwork for linking cleaner and cheaper generation to the consumers' end bill.

6. Balancing cost management

ESO role	Principle
Managing system balancing and operability	2. Drive overall efficiency and transparency in balancing, taking into account impacts of its actions across time horizons.

Description

A new, simple, transparent balancing cost metric, which gives the ESO a cost target for balancing spend (excluding Black Start), which the ESO should strive to outperform.

The pilot scheme is currently a national GB metric, publicly available through carbonintensity.org.uk. In 2018 we plan to regionalise the information down to each DNO area, giving a more localised prediction of the cleanliness of the electricity being consumed.

Performance measure

The metric is intended to provide a benchmark range against which the performance of the ESO, in managing balancing costs, can be assessed against historical outturns. It will incorporate a forward view of signifcant cost drivers, both positive and negative and in recognition that a single benchmark number cannot be accuarately forecast, the benchmark will include a range in which costs could be expected to outturn. This will ensure that the changes in system conditions and operational requirements are reflected in the performance measure as we transition to an increasingly renewable energy source (RES) led transmission system and reflect the inherent volatility of costs. When we publish the benchmark range, we will provide a supporting narrative and where possible some quantitative anaysis to provide additional contextual information. This would include where we expect to see signifcant change in system operability and where that may, if at all, impact on costs. In producing a benchmark with a range, we believe we can better help our customers manage their commercial positions.

The benchmark for expected balancing costs will be derived from the application of a linear trend through 5 year moving averages of historic balancing cost (excluding black start and SBR), beginning with the rolling mean for 2010/11-2014/15. We intend to use historical data to develop our baseline costs for two reasons. Firstly, some cost elements are comparatively stable over time and therefore history is a good indicator as to how they will evolve in the future. For those costs that are less stable year on year, by applying a historical dataset that intrinsically reflects a broad range of operational situations and we therein capture a sufficient number of observations that the ESO has encountered to establish a good baseline for costs. Using only one year as a data point, or indeed a shorter time horizon in the historical dataset, would not provide a robust benchmark e.g. If the operational context for the chosen year had an unusual component which then affected cost.

The purpose of using a moving average is to smooth out the volatility of year to year balancing costs and establish a baseline for future costs. By using a 5 year moving average, we are able to calculate a sufficient number of data points to produce a more stable trend that will be less affected by the inclusion of any particular year. This trend will be adjusted to account for the offset necessarily induced by the use of the backward-looking rolling mean. This correction will provide a fitted moving average to match average historic out-turns across the period. Therefore, there may still be under/overspend between outturn and benchmark in any single year. The forecast baseline balancing cost using this methodology for 2017/18 would be £960.2M. At this point we would expect the 2018/19 baseline benchmark to be £998.6M but this will be recalculated once we have full year outturns for 17/18.

In recognition that there are a number of foreseeable fundamental drivers that might impact balancing costs but which historical costs might not reflect, we will also include additional adjustments. These adjustments will be limited to no more than three, recognising that the intent of them would be to reflect only structural changes to the benchmark that could lead to higher or lower costs in the forecast year. These adjustment factors would be agreed on an ex-ante basis and informed by underlying analysis. For example, the expected change in frequency response requirements that will be necessary as the operating system state evolves, or the impact of new transmission assets such as the WLHVDC9 could be determined on an ex-ante basis. These adjustments will be supported by analysis that will be made available to the Authority or expert panel.

Currently, for 2018/19, we would expect the foreseeable cost drivers to be principally based around the following areas:

1. The full commissioning of the WLHVDC which should have a downward effect on costs.
2. Managing summer minimums demand periods and the associated costs in frequency response and management of system inertia during high penetration RES periods. This is likely to have an upward effect on costs.
3. Impact on balancing costs due to higher RES penetration and therein the impact on revenues of thermal or contestable plant. We would expect to see an increase in some elements of service pricing if revenues become increasingly constrained.

At this point in time we continue to undertake analysis to understand the magnitude of the benchmark range and we would intend to publish analysis prior to the commencement of 2018/2019 financial year.

The benchmark range will reflect the uncertainty that is intrinsic to a system with a high proportion of RES. We will produce a range based on an analysis of historic balancing cost elements that can be significantly affected by factors that are beyond the direct control of the ESO. This will be predominantly a price effect but might also include costs that can be significantly impacted by variable generation. The analysis that informs the derivation of the range will be made available to the Authority or expert panel.

In order to assist the in-scheme monitoring role that the Authority undertakes, a monthly shape will be applied to the annual projected cost. The principal aim of this will be to provide an understanding of how costs might typically be distributed across the year so providing a supporting indicator on whether costs are emerging in line with expectations and where there is deviation, that the ESO can provide contextual explanation. For the avoidance of doubt, this monthly shape will only be used for information and context. The performance of the ESO will be assessed against the annual cost benchmark.

The benchmark will therefore be;
BCt = Sum (Xn (5 years) ± Xa ± Xb ± Xc) ± Yt

Where
Xn = Linear trend through 5 year rolling means since 2010/11 – 2014/15, adjusted for the offset associated with use of the rolling mean:
Xa = Cost Driver 1
Xb = Cost Driver 2
Xc = Cost Driver 3
Yt = range derived from historical analysis

The outturn cost value used in this metric comprises of terms defined in National Grid Special License Condition 4C.110

Outturn cost = CSOBM + BSCC – OM

Defined as:
CSOBMt which represents the cost to the licensee of bids and offers in the Balancing Mechanism accepted by the licensee in Relevant Year t less the total non-delivery charge for that Relevant Year, is the sum across Relevant Year t of the values of CSOBMj (being the daily System Operator BM cashflow for each settlement period j as defined in Table X-2 of Section X of the BSC in force immediately prior to 1 April 2001);

BSCCt means the costs to the licensee of contracts for the availability or use of balancing services during the Relevant Year t, excluding costs within CSOBMt and BSCt but including charges made by the licensee for the provision of balancing services to itself in the Relevant Year t;

OMt means an amount representing the revenue from the provision of balancing services to others during the Relevant Year t, calculated in accordance with paragraph 4C.10;

Explanation of outturn vs target performance will be provided to Ofgem and stakeholders through Monthly Reporting. Evidence of non-BAU and innovative activities providing cost savings will be presented, along with explanation of the drivers of outturn costs. The information provided will be similar to the monthly reporting that was in place under the previous Balancing Services Incentives Scheme.

On target:
outturn spend within benchmark range

Exceeding expectations:
outturn spend < lower bound of benchmark range

Under performance:
outturn spend > upper bound of benchmark range

Consumer benefit

This metric continues to incentivise the ESO to keep a focus on reducing balancing costs. It ensures we use the most economic options for relevant timeframes and find innovative and new ways of doing business with providers to lower costs.

This metric also allows us to look across the spectrum of system operation to optimise the costs of running the system, in terms of both ‘energy’ and ‘system’ spending.

This metric will focus the ESO on delivering reduced BSUoS cost for users of the transmission system which should feed through to lower costs for consumers.

The narrative provided by the ESO on how value has been delivered and brings a new level of transparency on balancing costs to stakeholders.

7. Reform of balancing services markets

ESO role	Principle
Facilitating competitive markets	3. Ensure the rules and processes for procuring balancing services maximise competition where possible and are simple, fair and transparent.

A flexible network will make the most economic and efficient use of all available resources to meet the continuing needs of the electricity system, thus lowering costs for consumers whilst facilitating the transition to a low carbon future.

The ESO has highlighted the need to reform the balancing services markets in order to remove barriers to entry to enable the participation of new providers. This will increase both the volume and technical range of counterparties which will enable the ESO to increase the flexibility of the electricity system.

The activities that are required to achieve this objective are:
- Develop and implement a plan to reform balancing services.
- Move away from bilateral procurement activities to competitive market based procurement methods wherever possible.
- Faciliate the entry of non traditional providers into balancing service markets.

In order to measure the success of the ESO's actions in these areas, a suite of three metrics is being composed, which together hold the ESO accountable to delivering the reform of the electricity balancing service markets. These work together in the following manner:

Reform of balancing services markets	Tracking our progress in moving away from bilateral procurement towards market based mechanisms.
New provider on-boarding	Tracking our progress in facilitating the entry of new providers in offering balancing services.
Market diversity	A measure of success of our activities demonstrated through increased liquidity in relevant markets.

This metric will track the progress of the SO in achieving commitments made in the Future Balancing Services Roadmap[11].

Description

Part of the ESO's role is market facilitator and it will work with parties to develop markets so that they, ultimately, better serve consumers. The activity that is underway to develop balancing markets is on a scale far beyond that normally undertaken. It involves working with entirely new groups of stakeholders; private investors, equity investors, small scale developers etc., in order to understand their business and open up value propositions for them. We are working hand in hand with these stakeholders in an incredibly fast developing market, breaking down barriers to entry and tackling new issues daily. The issues we are tackling are complex and we need to find the right pace in order to keep up with this market but also continue to ensure the safe operation of the system. We have over 300 participants registered with us that we are actively managing and 1500 stakeholders on our power responsive distribution list.

Commitments are made, via the Future Balancing Services Roadmap, to changes that will be made to reform the balancing services markets. The roadmap outlines changes to the procurement of Response, Reserve, Black Start capability, Reactive Power and Constraint Management Services. This metric will track the progress of the SO in achieving those commitments. These commitments have been publicly made, and endorsed by industry and so are a priority for the SO to achieve.

[11] https://www.nationalgrid.com/uk/electricity/balancing-services/future-balancing-services

Performance measure

Commitments have been made, via the Future Balancing Services Roadmap, to changes that will be made to reform the balancing services markets in order to open the markets up to new providers. This will increase the provision of flexible balancing services, which is essential in enabling the SO to facilitate the transition to a low carbon network. The Future of Balancing Services roadmap is published in two parts; the December 2017 roadmap contains our actions for Reserve and Response. In Q4 2017-18, we will be publishing our proposals for Black Start, Reactive Power and Constraint management.

The roadmap is publicly available information to which the SO commits.

Measurement

Part one: progress against plan

We will publish quarterly our progress on delivering the commitments to reform balancing service markets . Progress against the plan will be reported, supported by a narrative explaining the current state of the programme, and where changes have been made, the rationale for the changes. Where deadlines have been missed or key milestones delivered early we will report the reasons for this.

Part two: Stakeholder satisfaction with information provided on progress

We will survey our stakeholders each quarter, asking them to review the quality of progress updates provided to industry via all the relevant forums e.g. progress updates on the website, forums, webinars etc. We will use the following questions:

"Are you satisfied with the overall level of information provided by the SO at this point in time on the progress of achievement of milestones in the Response/Reserve/ Reactive Power/Black Start/Constraint Management Service?"

1-10 scale ~ 1 poor, 10 outstanding.

Planning and Execution Performance

On target:

We deliver all rationalisation and simplification actions for response and reserve identified in the product roadmap in 18/19.

Exceeds expectations:

We deliver all rationalisation and simplification actions to the timeline laid out in the product roadmap and we deliver an auction trial for response in 2018/19

Under performance:

Failure to deliver all rationalisation and simplification actions for response and reserve identified in the product roadmap in 18/19

Stakeholder Feedback Measure:

On target:

5 through 7

Under performance:

<5

Exceeding expectation:

>7

Consumer benefit

This metric will drive the ESO to design solutions to meet future system operation challenges and facilitate markets to provide for those needs at least cost to the end consumer.

The increased competition through access to markets and revenue streams for participants delivers value for the end consumer as well as improving security of supply.

8. New provider on-boarding

ESO role	Principle
Facilitating competitive markets	3. Ensure the rules and processes for procuring balancing services maximise competition where possible and are simple, fair and transparent.

Description

Commitments have been made to changes that will be made to reform the balancing services markets in order to open the markets up to new providers. New providers must go through an 'on boarding' process before they can participate in balancing service markets. This metric is intended to measure the ESO's success in facilitating new providers (generally those that do not participate in the balancing mechanism – commonly referred to as non traditional providers) getting to the stage where they are able to offer services. Around 100 parties are being actively managed through the on-boarding process currently and around 40 of these have signed framework agreements. Two metrics are proposed in order to reflect the maturity of our action in this area.

Performance measure

Commitments have been made to changes that will be made to reform the balancing services markets in order to open the markets up to new providers. This will increase the provision of flexible balancing services, which is essential in enabling the SO to facilitate the transition to a low carbon network. New providers must go through an 'on boarding' process before they can participate in balancing service markets, which starts with introducing the provider to the range of balancing services and helping them to understand potential opportunities, through to the point where the provider signs a framework agreement and is thereafter able to participate in procurement activities. This metric is intended to measure the ESO's success in facilitating new providers' (generally those that do not participate in the balancing mechanism – commonly referred to as non traditional providers) progress through that process. Two metrics are proposed in order to reflect the maturity of our action in this area.

Metric One (2018/19 and onwards): Stakeholder satisfaction

Currently only counterparties that have a signed framework agreement (and are therefore already 'on-boarded') are included in the SSAT survey. We propose that we will widen the parties we survey to include the rest of the new providers that we work with (where the ESO Business Development Team spends a large proportion of its time) in order to understand whether those parties are satisfied with the support they are getting from the SO.

A password protected document contains details of key contacts for our existing providers, with a selection of 7 chosen at random each month to survey. The survey is carried out by an independent third party. The metric is updated every month to reflect the responses received. It is proposed that this process is retained and the master list widened to include all of the parties with which we are currently actively engaged with.

The parties that we will be surveying through this survey are new entrants into a very competitive market, who are often investing their own money (compared to the large organisations traditionally providing balancing services) and therefore more likely to have their opinion of the ESO adversely affected by external factors[12] that are out of our control. The target level should be set lower than the main survey to reflect these challenges.

On target:
5 through 7

Under performance:
<5

Exceeding expectation:
>7

[12] Examples of external factors:

- New emerging technologies – e.g. increasing competition or slow progression into market.
- Impact of Policy and Regulatory changes – e.g. impact of decarbonisation measures, specifically Medium Combustion Plant Directive, and the consequences for owners or aggregators of diesel generation assets delivering commercial services.
- Financial Climate – attractive proposition vs business as usual activities.
- Potential changes to Network Charging.
- DNO/Network connection restrictions (ANM schemes, Non-Firm connections etc – note this can also be at a Transmission level).
- Level playing field for market access – e.g. NBM access to BM, and access to all markets: SO, DNO/DSO, Suppliers (imbalance).
- No. of market players affecting competition and market liquidity.
- Changing system requirements.
- Existing experienced market players blocking entry to new parties.
- Certainty of revenue to get payback on investment needed to provide services.

Metric Two (October 2018 onwards): Progress through 'on-boarding' process
The ESO is working with Unipart Expert Practice (UEP - a consultancy helping us implement 'Lean' working practices) and the Customer Strategy Team to map out the 'journey' that potential counterparties go through from first showing an interest in the balancing services market, through to signing a framework agreement which will allow them to participate. We are working with UEP to understand this journey and then build a measurement framework as a result, that will track the success of the ESO in facilitating the progress through this journey. For example, the metric could be the percentage of potential service providers/market participants which sucessfully pass through each stage gate and the percentage of potential service providers/market participants that pass through each stage gate within defined timescales. It is proposed that this metric is developed during 2018/19 and implemented from October 2018.

As yet, we do not have sufficient understanding of the journey that counterparties go through from first contacting us (often through Power Responsive) to the point where they are able to sign a framework agreement which would enable them to tender in to provide ancillary services.

The Customer Strategy Team has been engaged to help us build and understand this journey and create the 'stage gates' against which we would measure performance. We need to be very clear in how much of this we can influence in order to set a sensible target.

Consumer benefit
This metric will drive the ESO to focus on providers and potential providers to reduce barriers to market entry, increasing liquidity in balancing services markets which will lower costs for consumers. Removing barriers to entry will increase liquidity of balancing services markets which will lower costs for consumers and facilitate transition to lower carbon network.

9. Market diversity

ESO role	Principle
Facilitating competitive markets	3. Ensure the rules and processes for procuring balancing services maximise competition where possible and are simple, fair and transparent.

Description

We have committed to make changes to the balancing services markets in order to open the markets up to new providers; this will facilitate the transition to a low carbon network as well as increasing market liquidity, reducing cost to consumers. The purpose of this metric is to measure the effectiveness of the programme of work that is being undertaken to remove barriers to entry to the balancing service markets.

Performance measure

Commitments have been made, via the Future Balancing Services Roadmap, to changes that will be made to reform the balancing services markets in order to open the markets up to new providers. This will increase the provision of flexible balancing services, which is essential in enabling the SO to facilitate the transition to a low carbon network. Increasing participation in these markets will also increase liquidity, which will lower costs for consumers. The ESO has publicly committed to moving away from bilateral procurement activities to competitive market based procurement methods wherever possible.

The purpose of this metric is to measure the success of the ESO in removing barriers to entry to a number of balancing service markets. This metric has been restricted to those balancing services where markets already exist and therefore focusses the ESO activity on increasing participation in those markets. It works hand in hand with the 'Reform of Balancing Services' metric, which is focussed on opening up bilateral procurement activities to market based methods. Once these markets have been opened up to competitve procurement activities, they should be included in this removal of barriers to entry metric, in order to test the effectiveness of the programme of work.

We have considered utilising an established liquidity measure, such as the Herfindahl Hirschman Index (HHI) for this metric but consider that this would not drive the correct behaviour. HHI makes an assessment of the market share of each participant in a market. This would not be appropriate in a market such as FFR, where there is a limited requirement and few large (MW volume) participants competing against many small (MW volume) participants. We therefore propose a simple measure of increase in the number of tenders/bids from individual units received (by number rather than MW volume) as a measure of the success in removing barriers to entry, and therefore would for each market based procurement method for Frequency Response and Reserve measure the number of tenders/bids received, with the objective of increasing the number received.

Target:

Continuation of existing trend in increase in participation. The reason for continuing the existing trend, rather than a higher trend is that there are a number of established aggregators operating in this market – who have caused the historical increase. Going forward, new entrants are more likely to be smaller independent parties who will find the barriers to entry much more difficult to navigate.

Consumer benefit

This metric will drive the ESO to encourage diversity in markets and develop market based solutions to its needs.

Increased competition through access to markets and revenue streams for participants,delivers value for the end consumer .

10. BSUoS billing

ESO role	Principle
Managing system balancing and operability	4. Promote competition in wholesale and capacity markets.

Description

Customers have told us that BSUoS bills are at the core of managing their profitability. Putting customers' needs at the heart of this process shows we are listening and understand the importance of this. We want to improve their experience. There are two aspects of BSUoS billing that are important to customers: good quality and timeliness. The prime focus of the Billing Team in the coming year is to improve the quality of the BSUoS bills. The measure of the quality of the billing process is response and resolution time of BSUoS billing queries. The aim is to improve on quality whilst holding steady on timeliness. The ESO has already invested effort in improving the timeliness of bills, measured by the percentage of billing runs delivered on time.

These metrics will give the opportunity for the ESO to progress a step change in the ability to acknowledge and close customer queries in a timely way. In recent years there has been a substantial increase in the number of BSUoS payers and bills so there is a requirement for the ESO to ensure that the quality of service is maintained despite the increasing workload. For example, the number of customers we invoice on a daily basis has increased by 65% between April 2014 and January 2018, and the number of BMUs registered has increased from just over 2000 in April 2014 to over 3250 in January 2018. In addition the new providers are often new to the industry and require more support to understand their bill. Maintaining the element of billing on schedule whilst improving the quality makes this a powerful metric.

Performance measure

The quality measure uses two indicators for quality of BSUoS billing process:

- Query response time: time to respond/ acknowledge customer BSUoS queries.
- Percentage queries acknowledged <1 business day following receipt.
- Query resolution time: time taken to resolve/close BSUoS queries.
- Percentage queries resolved in <2 weeks following receipt.

Targets:
Query response time:

Under performance:
<90% initial response within 1 business day of receipt.

On target:
90-95% initial response within 1 business day of receipt.

Exceeding expectations:
>95% initial response within 1 business day of receipt.

Query resolution time:

Under performance:
<60% queries resolved in <2 weeks following receipt.

On target: 60-70% queries resolved in <2 weeks following receipt.

Exceeding expectations: >70% queries resolved in <2 weeks following receipt.

Historic performance:
FY 2017/18: (to date at January 2018):

- Baseline performance across April to September 2017 – 53% closed in 2 weeks.
- Performance across YTD (to Jan 18) – 63% closed in 2 weeks.

The timeliness measure will take the total number of billing runs due to be delivered each day as per the BSUoS Payment Calendar and compare the actual number delivered against this to give a percentage figure. The billing runs are defined as follows:

- II (Interim Initial)
- SF (Initial Settlement)
- RF (Final Reconcillation)

On each billing day at least one of each of these runs is due to be billed.

The BSUoS Payment Calendar is published online by National Grid[13], the dates are set by the requirement for bills to be produced on the next working day following Elexon's publishing of the necessary data for billing. This is the baseline for what is defined as "on time" delivery, ie as per the dates in the BSUoS Payment Calendar.

The measure will exclude impacts of any movement by Elexon from their own calendar for sending data, though a report of any such instances will be included for information.

The metric will be based on a target percentage of runs delivered on time as an annual figure; a monthly percentage figure will be collected and reported by National Grid throughout the year to indicate performance.

Targets:
Under performance:
<90% billing runs on time.

On target:
90-95% billing runs on time.

Exceeding expectations:
>95% billing runs on time.

Historic performance:
- FY 2016/17 89% billing runs on time.
- FY YTD 2017/18 98% billing runs on time.

Consumer benefit
These metrics will drive the ESO to maintain a high level of reliability and predictability of BSUoS billing process for customers, minimising any deviation from the published billing calendar. It will drive us to steadily improve the quality of customer experience of the BSUoS billing process, with the measure of query closure rate giving a clear view of customers' experience with the team. As a result, existing and new providers can rely upon improved BSUoS billing. This provides more certainty to all on their settled financial position. In turn this frees bill payers to compete more freely in all market sectors.

In order to continually improve performance against this performance metric we will be driven to prioritise the experience of customers alongside delivering a timely billing process.

Direct impact on SO customers:
- Predictability of bills and when they will be produced by SO is valuable for BSUoS customers.
- Impacts their costs directly as it is a post-event daily invoicing process.

Indirect impact on end consumers:
- Uncertainty around bills may lead suppliers to build in risk premium to their prices, so driving SO performance on timeliness of billing runs will drive value for end consumers.

[13] https://www.nationalgrid.com/sites/default/files/documents/45780-BSUoS%20Payment%20Calender%202015-2017%20Web.xlsx

11. Code administrator – stakeholder satisfaction

ESO role	Principle
Facilitating competitive markets	4. Promote competition in wholesale and capacity markets.

Description
Customer Satisfaction Survey on Code Administrator Performance – CUSC, Grid Code and STC.

Performance measure
The ESO will use the results from the Ofgem CACoP[14] survey in Q4 2017-18 for its three codes; CUSC, STC and Grid Code as the baseline for its performance. Following the results of this survey a code administrator improvement plan will be developed. During Q2 2018 this improvement plan will be published including a consultation with industry. Throughout the remaining 2018-19 the improvement actions will be implemented. In Q4 2018-19 the CACoP survey will be rerun to demonstrate the effectiveness of this improvement plan. It is anticipated that the CACoP survey will be run early in the year and will be repeated annually for the next 3 years.

The most recent comprehensive customer satisfaction survey in this area was the Ofgem run CACoP survey which was reported to industry in early 2017 and which shows underperformance for the ESO. Our ambition is to increase performance for 2018/19 against the new baseline by 3-7 percentage points per code. This target shows our desire to improve customer and stakeholder service in this area.

Below target:
Less than 3 percentage point improvement in overall satisfaction per code.

On target:
Between 3 and 7 percentage point improvement in overall satisfaction per code.

Above target:
Greater than 7 percentage point improvement in overall satisfaction.

Consumer benefit
This metric drives delivery of improvement actions based on customer feedback including inter alia efficiency, transparency, accessibility and customer service.

The benefit to our customers of this performance metric is that delivering actions based on a customer satisfaction survey will improve the efficiency of the code change processes and increase engagement with the codes, especially for smaller customers. The removal of barriers to effective code change could also improve the timeliness and quality of industry change in the interests of consumers.

[14] https://www.ofgem.gov.uk/licences-codes-and-standards/codes/industry-codes-work/code-administration-code-practice-cacop

12. Charging futures

ESO role	Principle
Facilitating competitive markets	4. Promote competition in wholesale and capacity markets.

Description
Overall coordination and facilitation of Charging Futures in our role as Lead Secretariat.

Charging Futures has been set up to respond to industry's call for better coordination of access and charging reforms, where network users and end consumers can contribute to change no matter their size or how they use the network. The aim of Charging Futures is to help network users and end consumers plan and prioritise their involvement. Our role is to create one place where they can learn, collaborate and contribute to change.

Performance measure
Our role as Lead Secretariat for Charging Futures is a new area of accountability for ourselves and allows us to exhibit our proactive stance in facilitating the market, and enabling the industry to engage with charging reform. We have begun collecting data to benchmark our performance and have focussed on collecting feedback from the first Charging Futures Forum, but also on the utilisation of the supporting web portal (www.chargingfutures.com) and the supporting mail drops.

Our performance should be judged on how well we can facilitate the industry change process and how engaged the industry is with this process. One potential benchmark to judge ourselves against is an industry engagement score. For example, we will use the following question:

'Considering everything, how would you rate your overall satisfaction with National Grid at the present time, in the role of Lead Secretariat for charging futures?'

We currently do not have a benchmark for this but could ask this question to the Charging Futures Membership list to set a level (Currently around 150 members). This could be judged as a Stakeholder Satisfaction score (e.g. an average of all scores) or we could look to create a net promoter score NPS, assuming that the data set is statistically significant (e.g. 30 + respondents).

Our proposal would be that our Primary performance metric should be judged against our ability to maintain the overall engagement score for Charging Futures throughout the year. Our proposal is that we measure the engagement score at the start of the process in March and then repeat the process on a quarterly basis. These scores would then be averaged, and then judged against the baseline score.

Key to the success of our role is building a framework which can be accessed by all. To prove that this is the case we can collect metrics that could be shared with Ofgem to quantify our progression in this area. The diagram below shows what quantifiable metrics we could gather, and how these would support the overall narrative as to how well we are delivering within our role as Lead Secretariat.

Overall engagement with process question

Survey the full Charging Futures distribution list to baseline and engagement score.

Diversity index

Evidence of breadth of offering organisations participating in changing futures.

Gross participation

Evidence of increased participation – measured by numbers on mailing list and website traffic.

NPS on CFF

Evidence of continuing enhancement of event. Current score of 7.3.

Internal measures that can be used to provide flavour to our commentary on performance.

Consumer benefit

Drives the SO to deliver innovative solutions for Transmission and Distribution connected customers. Enablement of a clear route for industry to engage with Access and Charging reform.

Customer Benefit

The overall benefit for customers will come from a reduction in barriers to:

- Access the market.
- Participate in Change process.

This will be achieved through the following:

- Improved transparency and understanding of developing charging policy.
- Ease of route to engage.
- Changes to reduce market access barriers identified and made in a timely manner.
- Reduced cost for stakeholders to engage.
- Plain English approach.
- Access to charging expertise.
- Provision of a voice to engage.

Benefit for end Consumer

End consumers will benefit through Charging Futures facilitating an expanding market and reducing barriers to new entrants. This will have the impact of stimulating competition for the benefit of the end consumer, defined by:

- Increased choice.
- Enhanced service provision.
- Reduced costs.

13. Whole system – optionality

ESO role	Principle
Facilitating competitive markets	5. Coordinate across system boundaries to deliver efficient network planning and development.

Following identification of regional tranmsmission system challenges, the metric captures the number of non-transmission solutions to transmission issues put forward as part of an Extended NOA[15]/Regional Development Plan (RDP) process by non-transmission parties.

Description
The purpose of this metric is to drive the ESO to facilitate an increase in the number of proposed non-transmission solutions to transmission issues.

The aim of this metric is to act as a measure of how effective the ESO is in encouraging non-transmission parties to suggest solutions to transmission system needs. These can be assessed against what might be thought of as more traditional transmission-based solutions.

The ESO is running three Regional Development Plans with DNOs so the target is reflective of achieving one non-transmission solution per collaboration.

Performance measure
Our role as Lead Secretariat for Charging This is a transformational piece of work that has not previously been undertaken by the ESO:

On target:
Up to three new solutions.

Above target:
More than three new solutions.

Consumer benefit
We are seeking credible options from DNOs to tackle regional transmission system issues. The behaviour we are trying to drive in the ESO includes a clear articulation of those issues, derived through credible and robust network modelling, so that DNOs can respond with potential solutions to those problems. These can then be assessed in a transparent way in accordance with an agreed methodology.

Consumer benefit will be derived by assessing a wider pool of solutions to transmission problems via a detailed cost/benefit assessment, with a recommendation regarding which of the assessed options should be pursued. Successful solutions should drive lower costs in terms of network costs, balancing costs, or both.

[15] https://www.nationalgrid.com/uk/publications/network-options-assessment-noa

14. Whole system – unlocking cross-boundary solutions

ESO role	Principle
Facilitating competitive markets	5. Coordinate across system boundaries to deliver efficient network planning and development.

Description

The metric is an assessment of the effectiveness of the ESO's delivered whole system actions, measured in terms of their consequences. The specific measurables will depend on the projects progressed (see previous metric), however as an example of a measurable performance indicator, the remainder of this section considers the following:

- MW capacity of DER (Distributed Energy Resource) connections as a result of the 2017 UKPN/NGESO RDP collaboration on the South-East Coast (i.e. from 1st June 2017)- this would be a measure of the contracted MW.

Performance measure

Assessment of the performance will be on an ex-post basis based on what level of MW are contracted and the narrative of what we have achieved if connections in this area are requested and contracts signed.

The baseline position is that no further DER connections were possible pre-June 2017 when the arrangements developed between NGESO and UKPN were formally publicised to the developer community. Following the work carried out during 2017-18, DER developers are now able to apply to connect in the South East coast distribution network area. There will still need to be new processes and types of contracts developed by the ESO to enable connections due to the number of transmission and distribution constraints in this area.

The metric is designed as a measure of the effectiveness of contracts and processes we implement, as measured by new capacity contracted at distribution level.

Consumer benefit

This metric will drive effective collaboration and timely development of innovative Balancing Services contracts; informing the development of new industry roles and responsibilities.

DER developers will regain access to connections in the South-East coast distribution network. In addition, the ESO gains access to a wider range of constraint management tools, which supports the ongoing efficient management of network issues, supporting system security and potentially driving down balancing costs.

Consumer benefit will be derived by assessing a wider pool of solutions to transmission problems via a detailed cost/benefit assessment, with a recommendation regarding which of the assessed options should be pursued. Successful solutions should drive lower costs in terms of network costs, balancing costs, or both.

15. Connections agreement management

ESO role	Principle
Facilitating whole system outcomes	6. Coordinate effectively to ensure efficient whole system operation and optimal use of resources.

Efficient and effective management of existing connections contracts.

Description
The GB transmission system is constantly under change as the three Transmission Owners (TOs) build new assets. All generation that needs to be connected to the transmission system requires a contract with the ESO. After changes are made to the transmission system by the TOs the ESO is informed of these changes and would need to ensure that the relevant contracts for the affected generators are then updated to reflect this change. Some agreements permit the ESO to curtail generation under certain circumstances at no cost. If an agreement is not up to date and the generation requires curtailment without a current connection agreement, the ESO may need to instruct this through a Bid Offer Acceptance (BOA).

Performance measure
This metric will measure from the point of notification how long it takes for these agreements to be updated. Updating connection agreements requires collaboration between the ESO and the relevant TO and then the updated agreement needs to be signed by the customer, for which 3 months is permitted. The ESO cannot control all aspects of the performance as it requires interaction between the ESO, TO and the customer, therefore reflective targets are set.

On target:
60- 70% of agreements to be updated within 9months of notification.

Below target:
<60% of agreements to be updated within 9months of notification.

Above target:
>70% of agreements to be updated within 9months of notification.

Current performance:
= 22%.

Consumer benefit
This metric drives the ESO to have connection agreements ready for when the network topology changes and have customers agreements up-to-date. This would provide clarity around what circuits are being restricited according to the conditions of each customers connection agreement.

This metric drives the ESO to work strongly with the relevant TOs to ensure that it can enact the contracts that it has in place and not have to fall-back to BOA instructions. This will reduce balancing spend and save BSUoS money.

16. System access management

ESO role	Principle
Facilitating whole system outcomes	6. Coordinate effectively to ensure efficient whole system operation and optimal use of resources.

Number of planned system access requests cancelled in the control phase by the ESO due to process failure.

Description
System Access requests are formally submitted to the ESO from the TOs. The ESO performs due diligence on these requests and, if secure and economic, they are accepted into the master outage plan in the TOGA database prior to 15:30 on D-1. These outages are then reassessed in the control phase prior to switch-out to ensure adherence to policy (GBSQSS- GB Security and Quality of Supply Standard).

This metric looks to drive down the number of planned outages that are cancelled by ESO in the control phase (within day) due to process failure, investigating the reason for cancellations and putting in place mitigating actions to prevent any repeat.

Performance measure
The ESO is required by its licence to coordinate the flow of electricity over the network in an efficent, economic and co-ordinated manner. For this reason sometimes the ESO should cancel system access requests that have been accepted into the plan. However this number should be as low as practical to avoid costs for external stakeholders and costs for the ESO in re-planning these requests. The tension between these two aspects is dynamic and so the ESO will work to reduce the number of system access requests cancelled per 1000 during the control phase.

ESO current performance:
11.5 cancellations within day per 1000 outages accpeted into the master outage plan.

On target:
10.9 -10.4 per 1000 outages (5-10% reduction).

Exceeding expectations:
Less than 10.4 per 1000 (more than 10% reduction).

Below target:
More than 10.9 per 1000 (less than 5% reduction).

Consumer benefit
The purpose of this metric is to drive the ESO to improve planning process and performance. This will result in reduced system risk caused by errors in the outage plan, and fewer outages being cancelled on the day for TOs/DNOs. This should reduce avoided costs through re-planning outages at short-notice which will in turn save money for the consumer.

(The estimated delay costs to the TOs are at between £5k and £15k per day).

17. Future GB electricity system security

ESO role	Principle
Facilitating whole system outcomes	6. Coordinate effectively to ensure efficient whole system operation and optimal use of resources.

Description

This area is to focus the ESO on identifying emergent and interacting system operability challenges in all timescales, putting a plan in place to address the issues, and executing the plan to time and quality.

We will publish a Six Monthly Operability Report detailing:

- Current view on operability gap analysis for each security area.
- Review of previous six month's performance.
- Work already underway to reduce operability gaps.
- Plan for future work to eliminate remaining operability gaps and which seeks feedback from stakeholders.
- This will give a more transparent and coordinated view of the operability challenges facing the system to industry. It will engage them with the solution development phase and seek feedback on proposed actions.

Performance measure

System Operability has been split into five key areas that we need to focus on to deliver secure and economic balancing now and into the future:

- Voltage management.
- Frequency management.
- Restoration capability.
- Stability of the system.
- Thermal capacity.

We will use existing and new modelling coupled with power system analysis to identify our current capability in these areas, and in the period up to 2030.

We will also use these models and engineering approaches to identify what the system needs are expected to be in these areas, as demand, generation and system design change, in order to remain secure. This will include emergent operability challenges and a focus on the interaction between the five operability areas. We will be ensuring that the impacts of solutions in one operability area on the remaining areas are understood and taken into consideration in our technical analysis and cost benefit analysis.

We will then be identifying the differences between our current capability and future system needs to understand the operability gaps which will need to be addressed. We will look at all options for solutions to problems, eg. New market-based approaches; system asset changes (distribution and transmission); and updates to industry codes, and develop a plan for future work to eliminate these gaps.

We will measure our delivery of the Six Monthly Operability Reports, stakeholder's engagement with them and their view of our delivery against plan.

Through the Operability Reports, the operability delivery plan will be supported by a narrative explaining the current state of the programme, and where changes have been made, the rationale for the changes. Where deadlines have been missed or key milestones delivered early we will report our reasoning for this.

Six Monthly Operability Reporting Performance:
Delivery of Six Monthly Operability Reports on time - This is a transformational piece of work that has not previously been undertaken by the ESO.

Stakeholder feedback on Six Monthly Operability Reports
We will survey our stakeholders at each report, asking them to review the quality of progress updates provided to industry via the Six Monthly Operability Reports.

We will use the following questions:
"Are you satisfied with the level of information provided on the progress of achievement of milestones in the Operate Programme by the latest Six Monthly Operability Report."

Below target:
<5.

On target:
between 5 and 7.

Above target:
>7.

"Are you satisfied with the overall level of information provided by the SO at this point in time on the progress of achievement of milestones in the Operate Programme by the latest Six Monthly Operability Report?"

Below target:
<5.

On target:
between 5 and 7.

Above target:
>7.

Consumer benefit

This metric will drive the ESO to determine and ensure implementation of a coordinated, optimised programme delivering system operability from 2019 to 2030, where operability is defined as: a technically secure system with quantified and agreed risk achieved through market acceptable cost and procurement methods.

This will be developed through building upon current horizon scanning and industry engagement activity such as the Future Energy Scenarios[16], System Operability Framework[17] and System Needs and Product Strategy[18] work. Using this information an ongoing Operability Gap Analysis will be produced and where operability gaps are highlighted plans will be developed to ensure they are closed in appropriate time.

This will be reported to industry in a Six Monthly Operability Report which highlights:

- Current view on operability gap analysis for each security area.
- Review of previous six month's performance.
- Work already underway to reduce operability gaps.
- Plan for future work to eliminate remaining operability gaps and which seeks feedback from stakeholders.

We will deliver a technically secure system with quantified and agreed risk achieved through market acceptable cost and procurement methods from 2019 to 2030 with a background of fundamental change in the energy industry. Benefits to consumer will vary within each area and within each delivered solution to the operability gaps but would include:

- Reduced system operability risk and therefore increased system security.
- Reduction in cost where accepting increased risk in areas is the appropriate step to take.
- More efficient delivery of system operability through longer term planning and enhanced operability modelling capability.

[16] http://fes.nationalgrid.com/
[17] https://www.nationalgrid.com/uk/publications/system-operability-framework-sof
[18] https://www.nationalgrid.com/uk/electricity/balancing-services/future-balancing-services

18. NOA consumer benefit

ESO role	Principle
Supporting competition in networks	7. Facilitate timely, efficient and competitive network investments.

Description

Consumer benefit expected from alterative NOA options. The ESO will report calculated incremental benefit of alternate solutions compared to asset based solutions.
Currently four parties can submit options to the NOA process; the three TOs and the ESO. This metric will measure how many non-transmission build options that have been submitted to the NOA process appear in the optimal path and where this is the case, what is their consumer value. In any given year, there are not always non-transmission build options that can be included within the NOA and the consumer value of these options is not in the control of the ESO

Performance measure

This metric should be a mix of value-add options appearing in optimal paths and consumer value. The number of options is expressed as a percentage of actual/target.

Consumer value will be based on £/kW saving for alternative options against traditional build options or as a percentage of actual/target.

Exceed expectations:
Larger number of value-add options than target and/or consumer benefit >=10% in excess of target.

On target:
Number of value-add alternative options meets target and/or consumer benefit within 10% of target.

Under performance:
Number of value-add alternative options below target and consumer benefit below 10% of target.

These targets are based on the average number of options and consumer benefit in 14/15, 15/16 and 16/17 options.

NOA	Number of options	Consumer value
14/15	1	£0.00
15/16	7.	£320.87m
16/17	5	£158.63m
Average	4	£159.83m

This is as follows:
- Target number of value add options: 4
- Target consumer value: £160m

Consumer benefit is calculated as the difference in £/kW of alternative options compared to:
- For NGET – UCA (Unit Cost Allowance) for named boundaries as defined in RIIO-T1. For boundaries not listed an average of the UCA.
- For SP Transmission plc and Scottish Hydro Electric Transmission plc - compared against the average £/kW of transmission build solutions submitted for that year's assessment (or an average of the UCA for NGET).

Consumer benefit

This metric will drive the ESO to consider the variety of options available, not just transmission build, which will maximise benefit for the consumer.

The aim of this metric is to minimise consumer spend on network reinforcement through use of alternative options to traditional asset build. This results in a lower cost for delivering increased capability.

19. NOA engagement

ESO role	Principle
Supporting competition in networks	7. Facilitate timely, efficient and competitive network investments.

Description

Delivery and publication of NOA roadmap to show direction of travel to allow more parties to engage in NOA process.

The ESO is engaging with stakeholders to expand the NOA process to more and different parties. The aim of this is to allow more alternatives to transmission build to be submitted and to drive competition. To do this the ESO is engaging with stakeholders and from this, will develop and publish a NOA roadmap. If this is successful the ESO will expect an increased engagament in the future participation in the NOA.

This metric is a measure of effectiveness of engagament with NOA process – are we increasing awareness of the NOA process and it's move to being relevant for a wider range of people.

Performance measure

Measuring effectiveness of the ESO's engagement on the development of the NOA.

Number of responses to consultations - Historic Data:

	TOs	Industry	Environment	Other
NOA1 report	3	2	1	0
NOA2 methodology	3	0	3	0
NOA2 report	3	1	0	1
NOA3 methodology	3	0	1	0

Above target:
On time publication of the NOA roadmap and measurable increase in responses to formal consultations and publications (more than 6 responses to consultations).

On target:
On time publication of the NOA roadmap and sustained number of responses to formal consultations and publications (5-6 responses to consultations).

Below target:
Late publication of the NOA roadmap and measurable reduction in the number of responses to formal consultations and publications (fewer than 5 responses to consultations).

Consumer benefit

This metric will drive the ESO to raise awareness and involvement of potential participants in the NOA process to help shape its development.

Increasing the level of participation in NOA will increase competition and deliver greater value to the consumer through meeting transmission system needs at lower cost.

20. Customer and stakeholder satisfaction

ESO role	Principle
This performance metrics spans all roles	This performance metric spans all principles

Description

We will survey ESO customers and stakeholders minimum of once a year. This will allow the ESO to measure and track customer satisfaction and demonstrate improvements over a three year period.

Performance measure

Contact list

We will survey the current (NGET) CSAT/ SSAT survey recipients that have ESO interactions. Customers will be contacted using the established process.

For 2018-19 we are under licence obligation to conduct the survey as NGET (i.e. SO and TO), but for this performance metric we will only report the score where a customer has an ESO interaction.

From 2019 onwards, where a customer receives a service from both the TO and the SO, it is our intention that each service and service provider will be clearly introduced and scored separately. The SO satisfaction score will be reported as this performance metric.

Proposed questions

- Satisfaction question:
  - Overall on a scale of 1 to 10, where 1 is very dissatisfied and 10 is very satisfied, taking all aspects of the service you have received into account, how satisfied are you with National Grid Electricity Transmission?
  - Why did you score this way? (Free text).
- Secondary questions (interaction specific).

We will baseline against the 2017-18 CSAT/ SSAT survey results for customers and stakeholders that have ESO interactions and will propose specific numbers when this is known.

Above target:
A significant increase in the 2017-18 result.

On target:
An increase in the 2017-18 result.

Below target:
Below 2017-18 result.

Consumer benefit

Serving our customers better means they can serve consumers better. Benefits to customers will be an ESO that listens to and acts on their needs, and improves the service it provides. participants in the NOA process to help shape its development.

Increasing the level of participation in NOA will increase competition and deliver greater value to the consumer through meeting transmission system needs at lower cost.

Appendix 1 – Forecasting points definition

Electricity demand changes during the day depending on how much energy people, businesses and industries are using at that moment in time. As the electricity demand goes up and down we see characteristic peaks and troughs appearing daily at similar times.

These peaks and troughs occur within four forecasting points as described below:

1. Overnight minimum (1B):
Early morning minimum usually between 04:30 and 07:30.

The time of day when the most number of people are in bed using no electricity, just before the surge in demand cause by people getting up.

The measure of this forecasting point for incentive purposes will be the minimum demand between the period defined above. Period time can change based on operational requirements.

2. Daytime peak (2F or 2A or 2B):

- **2F** – Early morning demand peak after the ramp up from overnight minimum usually happens 08:00-09:00am.

This point can be the morning peak depending on solar generation output/ time of year.

- **2A** – Mid-morning, usually between 09:30-10:30am, peak as by this time the majority of people have arrived at offices/school/places of work, after which demand starts to level off.

- **2B** – Morning/midday peak usually between 11:00-13:00hrs, caused by a lunchtime surge in demand as energy is used for food preparation.

The measure of this forecasting point for incentive purposes will be the maximum of the above cardinal points. Period time can change based on operational requirements.

3. Daytime minimum (3B):
Or afternoon trough usually happens between 13:30-16:30hrs, people still at work but no extra electricity demand is being used, primarily computers and lights which are already on.

All daytime peaks and troughs are largely affected by embedded solar generation.

The measure of this forecasting point for incentive purposes will be the minimum demand between period defined above. Period time can change based on operational requirements.

4. Evening peak:

- **BST Only – 3C** Afternoon peak as people get home and make dinner and turn on other appliances.

- **BST Only – 4B** Peak as the sun sets and people turn on lights.

- **GMT Only – DP (Darkness Peak)** peak of the day as people get home, make dinner, turn appliances on and turn lights on.(as the sun has already set).

The measure of this forecasting point for incentive purposes will be the maximum of the above cardinal points. Period time can change based on operational requirements.

Appendix 2 – Triad avoidance methodology

The three Triad demands are the three highest settlement period demands occurring between start of November and end of February, subject to the condition that the demands must be separated by at least ten days.

Demand customers try to avoid high charges that are determined by their usage over the three Triad settlement periods (SPs) by suppressing their transmission supplied demands on days which have a reasonable chance of being one of the Triad days. This is referred to as Triad avoidance. Because the peak of the day has a reduced value, the values of the demand in SPs on either side of the peak are also affected; otherwise they might become a new, higher, peak for that day. Typically, SP 33-37 are affected. We call this the Triad Interval.

No data is available to measure this triad avoidance accurately, and so it must be estimated by assessing what the outturn would have been had there been no triad avoidance. This note explains the methodology for performing this estimation.

Triad avoidance days have a distinctive demand shape. On normal days, Monday to Friday, during the Triad period November to February, half hourly demands increase steadily from settlement SP 31 to a daily maximum value during SP35, then decreasing for the rest of the day. Typically, on a Triad day, the rise stops at SP 33, and demands remain (roughly) level, or can even slightly decrease, until SP 37, when the normal pattern re-emerges. This behaviour is only observed on days with a reasonable chance of becoming one of the Triad days.

Estimating Triad avoidance

To estimate what would have happened had there been no Triad avoidance, a historical day from recent history on which there was no Triad avoidance (i.e. the distinctive Triad shape is not present) is considered.

This historical day is taken as a proxy for the counterfactual situation that no Triad avoidance occurred.

It is important that this day is from as recent history as can be found, as changing use of technologies and energy saving technologies has slowly changed the shape of the demand curve, including over the daily peak, over a period of years.

Other factors affecting the timing of the peak and the demand shape around it, are overall weather conditions and time of year.

Because of changing economic conditions, different years have different underlying customer demand levels. Even within a year these underlying demand levels shift as week progress. Therefore when a candidate historic day has been identified it is aligned as closely as possible to the observed day on either side of the Triad interval.

In assessing Triad Avoidance we identify customer behaviour in the demand trace. The National Demand trace is affected both by customer behaviour and by fluctuations in the weather-driven embedded generation (PV and wind). Therefore to assess the impact of Triad avoidance we use National Demand with non-metered PV and wind generation added on; this is referred to as Virtual Demand.

The proxy Virtual Demand curve chosen is the historic day that best fits the observed climb up towards the peak before Triad avoidance begins, and also fits the observed Virtual Demand fall after Triad avoidance ends, subject to the conditions that the day falls within two weeks of the calendar date of the observed day, occurs most recently, and fits the temperature profile over the peak most accurately.

Once the historic day has been chosen, it is aligned to fit the rise and fall before and after the Triad avoidance interval as well as possible.

The difference between the (adjusted) historic day peak half hourly Virtual Demand and the corresponding half hourly Virtual Demand on the observed day is measured. This is rounded to the nearest 100MW, as the methodology cannot be presumed to give any greater degree of accuracy.

The key to the procedure is choosing the historic day to represent what would have happened without Triad avoidance. The precise methodology for this is set out on the following page.

Historic day methodology

1. Determine the national average effective temperature (TE) over the Triad interval on the observed day.
2. Search the demand database for days with closely matching temperature profiles, according to a defined temperature tolerance, that occur within two weeks of the calendar day of year, that represent the observed day of the week appropriately, and that occur within the past 4 years. These are the candidate days.
3. Group these results by most recent year, then within each group arrange by goodness of fit of the temperature profile.
4. Starting with the current year group, test the candidate historic days for (adjusted) demand shape fit around the Triad interval, using a maximum metric.
5. Select the best candidate according to the metric. If the best candidate has maximum deviation from the observed day $<$ 100 MW, accept it as the proxy day. If not, move to the next most recent year group.
6. If no suitable proxy is found after all candidates have been tested, re-query the historic demand database relaxing the temperature profile tolerance.
7. Repeat the testing procedure.
8. If no suitable candidate is found after this second run, choose the historic day from the most recent two years with the minimum deviation from the observed demand.

Triad avoidance methodology

1. Align the proxy historic Virtual Demand curve with the observed Virtual Demand curve to obtain the minimum deviation.
2. Identify the peak in the Triad Interval settlement periods in the proxy historic day Virtual Demand.
3. Measure the Virtual Demand in the corresponding SP in the observed day.
4. Calculate the difference, and round to nearest 100MW.

nationalgrid

National Grid Electricity Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA
www.nationalgrid.com/innovation