Operational visibility of DER

May 2022

nationalgridESO

1. Executive summary

As we transition to Net Zero, we are seeing a proliferation in the volume of generation technologies such as wind and solar connecting to distribution networks. New technologies such as battery storage and more active demand are driving an increase in the volume of Distributed Energy Resource (DER). Such volumes of DER are changing the way that distribution networks behave, making them increasingly complex and challenging to forecast. These increasing volumes of DER could provide both ESO and Distribution System Operators (DSOs) with flexibility services, reducing costs to the consumer. These changes provide new challenges and opportunities for the industry including:

- The opportunity to increase market liquidity through removing barriers to entry in our markets to incentivise broader aggregation of DER.
- The need to understand more about the volumes and behaviour of connected DER to better plan and operate networks.
- The importance of continued system resilience including greater co-ordination of ESO and DSO operational activities and services.

Greater operational visibility of DER will be critical to the future operation of the electricity system. It is a key enabler to overcoming the above challenges, facilitating the opportunities, and ensuring GB meets its Net Zero ambitions.

We already have a level of visibility of DER, but we recognise going forwards that this will need to increase to understand more about the volumes and behaviour of connected DER to better plan and operate the transmission system. Our initial work, complimentary to work ongoing in ENA Open Networks, has identified consumer benefits of up to potentially £150m per annum arising from greater operational visibility of DER to the ESO. We believe that these are only a proportion of the full benefits that can be realised and our proposed further work on DER visibility will explore these further.

Critical to this visibility is the need for operational metering at a standard that works for all parties. Operational metering provides the ESO with real-time visibility of asset behaviour. As a condition of participation in ESO balancing services markets, we require service providers to submit operational metering to the ESO close to real-time. These operational metering requirements have evolved for large traditional power stations and can present a barrier to smaller providers. Metering requirements can differ by service and there is a risk that a service provider may have to duplicate hardware to participate in different ESO services.

We have already opened the door to aggregator participation in the BM through more appropriate interpretation of the operational metering requirements for aggregated units. This should promote standardisation and proportional investment costs for all market participants. We welcome aggregators coming forwards to work with us to develop mechanisms and techniques that will facilitate appropriate real-time data to the ESO.

We will simplify participation for new (and existing) market participants. In this paper we provide guidance on our proposed operational metering specifications going forwards, and we value your responses to the questions we raise in this paper and our proposed position on operational metering requirements.

2. The case for change

The past decade has seen the emergence and growth of DER on the GB electricity system. This has created significant new opportunities for the industry in terms of new service provider opportunities, but also different operability challenges for the ESO.

Our Future Energy Scenarios (FES)[1] indicate that this trend is to accelerate, and it is critical that we have appropriate visibility to allow us to manage the electricity system of the future. The chart below indicates at least a doubling in connected distributed generation volumes by 2050. In addition to this we will see more active demand side parties providing services to both the ESO and DSOs. Greater DER visibility will be a key enabler in this future landscape, and we need to ensure that we are actively developing the capability to support this transition.

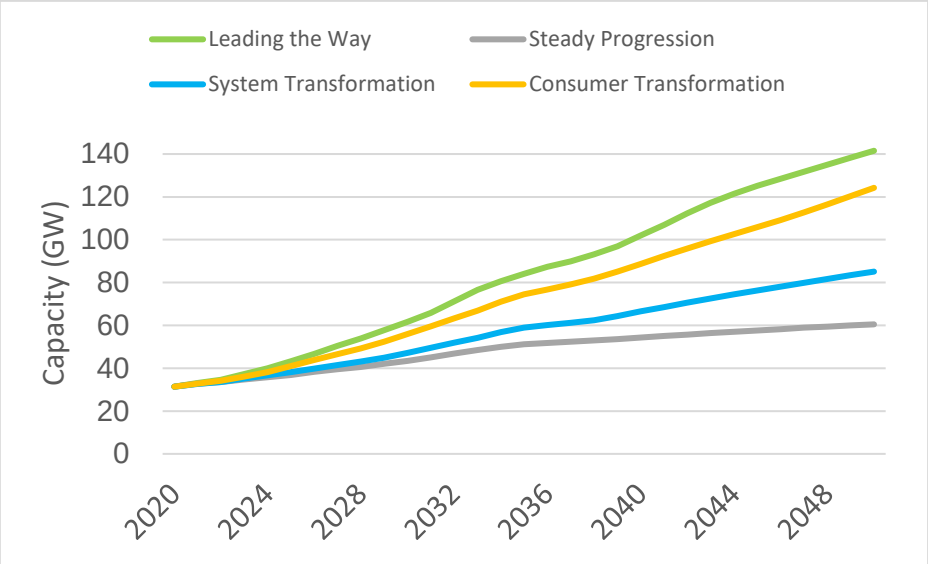

Figure 1 - Future distribution connected generation capacity (source 2021 FES data workbook - ES1: Electricity supply data table)

We define operational visibility as the ability to access real-time information on DER MW and MVAr positions to inform both operational and planning purposes. Whilst there is much industry focus on greater operational visibility of distributed generation, we believe that operational visibility of DER also needs to consider demand side parties.

The benefits of greater operational DER visibility

Greater operational visibility of DER provides significant benefits to industry stakeholders. For service providers it will facilitate market access for increasing volumes of DER and facilitate emerging business models such as third-party platforms.

There are also benefits to the ESO. As DER volumes grow, identification of DER assets and their potential system impacts are becoming more critical to our system operation. In the future greater operational visibility of DER will be essential to allow continued secure operation of the GB electricity system. The ESO 'Overview of aggregation at GSP[2]' paper published in January 2022, describes emerging operability challenges in greater detail, and provides further information on how we are managing aggregation models in the absence of real time DER visibility. In turn, this work has informed this paper and our proposed pathway to greater visibility which will facilitate broader aggregation models amongst other activities.

[1] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/fes-2021/documents
[2] https://www.nationalgrideso.com/document/234901/download

In addition to these operational challenges, we have worked as part of the ENA Open Networks programme to identify a series of high-level broader use cases for greater visibility of DER[3]. These include use cases for service providers, DSOs and the ESO. The list of use cases relevant to the ESO is shown below with example benefits.

Use case	Example benefits
Improved long term system development	Better understanding of future system backgrounds allowing for more informed options assessment.
Improved network access planning	Supports transition from conservative assumptions on available network capacity.
Whole system co-ordination of services	Ensures that ESO services are not counteracted by automated systems on the distribution network, such as Active Network Management. It also allows greater optimisation of ESO and DSO service needs across different time horizons.
Ancillary and balancing service provision	Facilitates market access for increasing volumes of DER particularly for locationally dependent requirements.
Capacity Mechanism (CM) planning	Better understanding of DER output trends ensures consumer value is maximised through the CM.
New market opportunities	Facilitates emerging business models (e.g., aggregation models, third party platforms).
Forecasting	Better understanding of underlying demand and generation will improve operational forecasts and adequacy margins.
Operational co-ordination	Improved real time assessment and situational awareness of network needs and associated contingency planning. Improved inputs to online modelling tools leading to increased accuracy of results and therefore increasing the efficiency of dispatch of services.
System restoration	Utilising distributed generation to restore power following an electricity system restoration event.
System resilience	Improved situational awareness of system issues and co-ordination of actions.

Table 1 – Use cases for operational visibility of DER

Through consideration of these use cases and potential opportunities we consider that the benefits of greater DER visibility can be derived from three main sources:

- Improved ability to forecast the output of DER and service provider behaviour.
- Increased market liquidity through facilitating entry for new service providers.
- Operational benefits associated with improved system resilience and service co-ordination.

We have undertaken an initial assessment of these three benefit sources seeking to quantify benefits where possible. This analysis, complementary to our work in the ENA Open Networks projects suggests potential benefits to consumers of up to **£150m/pa** although we believe that the actual benefits realised could be much higher. Further details of our benefits assessment can be found in Annex 1 of this paper.

Question

1. Do you have any views on our listed ESO benefits arising from greater DER visibility?

[3] https://www.energynetworks.org/industry-hub/resource-library/on21-ws1b-p6-operational-der-visibility-use-cases-and-volumes-(30-jul-2021).pdf

3. Roadmap to greater operational visibility

Operational visibility of DER is achieved through a combination of having the required operational metering of the DER, the appropriate communication links from the DER, and the systems within the ESO to view and utilise metering data. The ESO's operational visibility of DER is currently limited by all three of these components. We recognise that improving visibility in some areas will require the installation of new telecommunications and IT equipment. Additional funding requirements for the ESO would follow our business planning processes and be appropriately justified.

The following roadmap provides our proposed view of how we can improve in these areas over the coming years. We are however progressing actions already, and in section 4 we introduce our commitment to review operational metering standards as our priority. Our proposed roadmap is split into three-time periods:

1. **Short term (1-2 years)** – This is the period through to the end of 2023 where we believe that flexibility markets, particularly for smaller DER will be in a nascent state. It is assumed there is only limited real time visibility of DER. There is potentially a need during this period to put in place some short-term tactical solutions to mitigate industry and customer risks and make best use of the data we have today. We will do this with clear justification through discussion with stakeholders. Within this timeframe we would also seek to define future operational metering standards for both BM and non-BM reserve services providing assurance to parties who want to connect projects in future years.
2. **Medium term (3-5 years)** – This is the period through to end of 2026. During this period, we are anticipating significant growth in the volume of flexibility resource connected to distribution networks. We will need a corresponding roll out of greater visibility of existing distributed generation including potentially through the Ofgem led work being developed through ENA Open Networks. This period would also see the development of ESO systems to utilise visibility of both this distributed generation and other available DER metering including that from service providers. Understanding and resolving any further technical blockers to DSO participation in ESO markets will be critical during this time.
3. **Long term (6-13 years)** – This period is essential to the delivery of the Net Zero ambition and would see mature markets in existence that facilitate all forms of flexibility. To ensure continued operability the ESO would need greater visibility of DER down to residential levels. We believe this could link to Ofgem's review of industry wide half hourly settlement[4]. ESO systems would need to be developed to manage this volume of data.

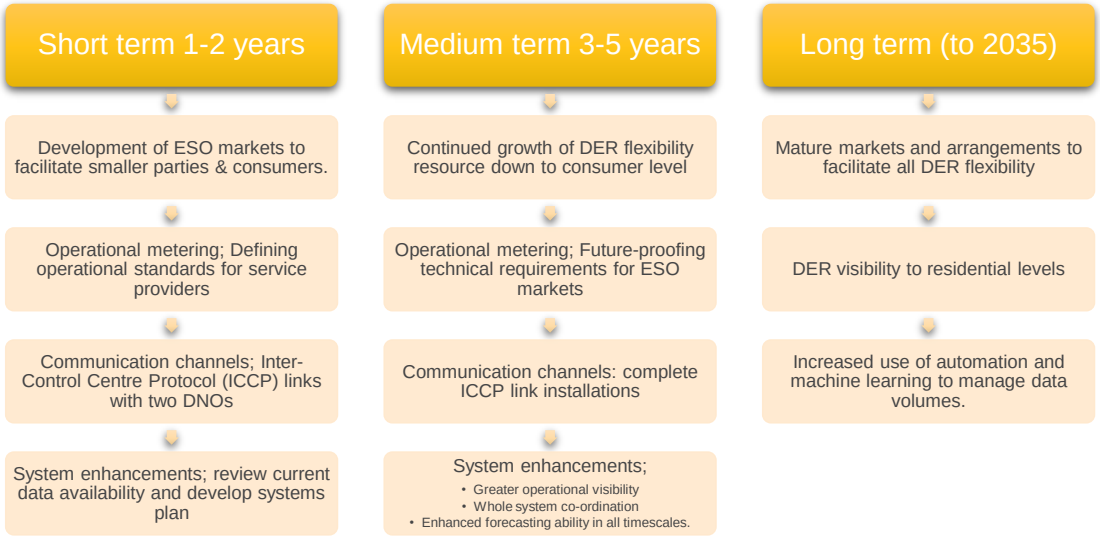

Figure 2 – Proposed roadmap to greater operational visibility

Question

2. Do you agree with our proposed roadmap including activities and timescales?

[4] https://www.elexon.co.uk/about/industry-wide-changes/mhhs-programme/

4. Operational metering standards going forwards

The ESO's visibility of generation and demand is currently constrained to assets which participate in commercial markets, such as the Balancing Mechanism and ancillary services. We acknowledge that there are growing volumes of DER which are eligible and interested to participate. As a condition of participation in ESO these markets, we require service providers to submit operational metering to the ESO close to real-time. This provides us with critical visibility of asset output in the control room and aids real-time system decision making as well as demand forecasting. However, our operational metering requirements have evolved for large traditional power stations and can present a barrier to smaller providers, particularly for aggregators when looking to pool domestic flexibility. Through this work, we are committed to revising our approach to operational metering, removing barriers to entry for markets and consequently improving our visibility of DER assets.

Given the increasing numbers of smaller providers in these markets, there is a risk that the cost on providers to install secondary meters for the purpose of meeting ESO operational metering requirements is a barrier to entry for new forms of flexibility. A core example being for sub-1MW assets, such as EV charge points, which already have metering devices embedded within the asset. We want to pre-empt the scenario where service providers may have to install multiple meters per asset to satisfy different requirements for accuracy and read frequency.

In March, at our Markets Forum, we launched a revised approach to operational metering standards. We want our operational metering standards to facilitate access to our markets for smaller DER and their commercial intermediaries. We are starting this approach for BM participation, with further considerations for non-BM applicability in the future. Our proposed roadmap for this work is shown below.

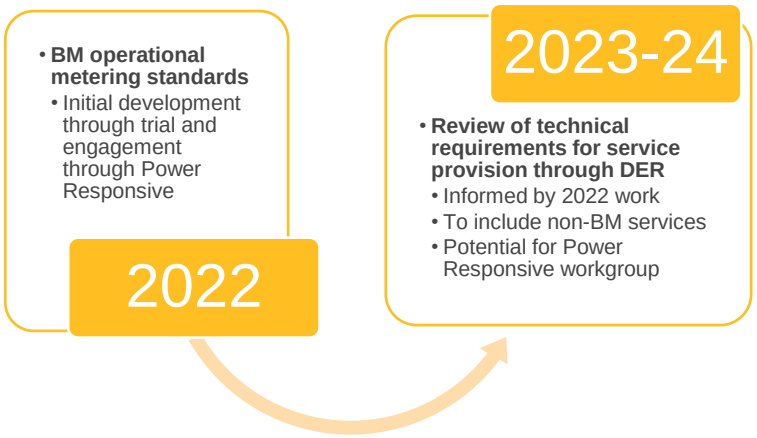

Figure 3 – Proposed roadmap for review of operational metering standards for smaller providers

Our proposals for BM operational metering

Our initial review focuses on unlocking BM participation for smaller flexibility providers, such as domestic assets, who would need to be aggregated to meet the existing 1MW entry threshold[5].

As our operational metering standards are currently written, each asset within an aggregated unit is obliged to provide data at the same frequency and latency as a discrete, standalone unit capable of meeting the minimum participation threshold. Considering the costly data burden on providers to handle and submit this data across potentially hundreds of sites, we agree with industry that there are alternative solutions which can provide the appropriate visibility, but at a more manageable cost. We are proposing that for these aggregated units, we would remove the need to enforce the same standard for operational metering at the asset level. Instead, our

[5] https://www.nationalgrideso.com/news/national-grid-eso-widens-balancing-market-access-smaller-providers

standards would be interpreted as operational communication standards applying between the aggregated unit and ESO. We would consider the overall accuracy of the aggregated unit, the frequency of data refresh from the aggregator and the latency associated with this step in the data transfer chain. Further details are shown in Table 4 below. We propose that accuracy monitoring would be via settlement metering and would be interested in views on this point.

Through taking this approach we believe that we would open the door to aggregators utilising existing metering capabilities giving them the latitude to meet the required aggregated standards based on their own systems and client base.

Aggregated unit size	Overall Accuracy of unit	Read Frequency	Latency
>10MW & <=100MW	+/-1.0%	Once per second	≤5 seconds
>1MW & <=10MW	+/-1.5%	Once per second	≤5 seconds

Table 4 – Proposed BM operational metering standards – aggregated units

Approach to implementation

We are proposing to trial this approach going forwards for the Balancing Mechanism (BM). Our initial trial period has already started and will run through to Autumn 2022. In parallel we will be establishing a dedicated working group under Power Responsive[6] that will bring in learnings from the trial as well as related innovation projects such as Powerloop and Crowdflex. We want this group's work to be enriched with feedback from the aggregator and supplier community. Ultimately this group will define our BM standards for aggregated units on an enduring basis which we would hope to be established in Autumn 2022.

This work will then feed into further work to review non-BM services, firstly looking at reserve requirements and then response. Our operational communications standards will need to consider the criticality of metering accuracy and speed for shorter term requirements whilst building on the BM work in 2022. It will also ensure that our standards develop in a consistent manner and are accessible to as wide a range of providers as possible.

Questions

3. Do you agree with our approach to BM operational metering requirements for aggregated units?
4. Do you agree with our proposed standards for operational communications with aggregated units?
5. What are your views on our proposed approach to implementation?
6. What are your views on our proposed roadmap to review operational metering standards for non-BM services?
7. What are your views on our proposed approach to accuracy monitoring?
8. How would you like to be engaged on this work going forwards?

[6] https://www.nationalgrideso.com/industry-information/balancing-services/power-responsive

5. Providing feedback and next steps

We welcome your views on this paper by 10th June, including feedback on our proposed timeline of activities and our proposal for standardising operational metering requirements.

Following review of stakeholder responses, we will confirm our forward-looking operational metering standards for new balancing services and a plan for implementation.

Summary of questions

1. Do you have any views on our listed ESO benefits arising from greater DER visibility?
2. Do you agree with our proposed roadmap including activities and timescales?
3. Do you agree with our approach to BM operational metering requirements for aggregated units?
4. Do you agree with our proposed standards for operational communications with aggregated units?
5. What are your views on our proposed approach to implementation?
6. What are your views on our proposed roadmap to review operational metering standards for non-BM services?
7. What are your views on our proposed approach to accuracy monitoring?
8. How would you like to be engaged on this work going forwards?

Responses can be sent to: box.WholeElectricitySystem@nationalgrideso.com

Annex 1 - Quantification of benefits for greater operational DER visibility

In section 2 of this paper, we support our case for change with a description of the benefits of greater operational DER visibility. This annex provides further information on our benefits assessment. This assessment focuses on benefits that are quantifiable at this time. There are other significant operational benefits of increased real time DER visibility which are described in section 2 and the associated 'Overview of aggregation at GSP' paper published in January 2022.

A1.1 Improved ability to forecast the output of DER and service provider behaviour

Real time DER and behaviour patterns can help inform ESO forecasts of future system demands in a range of timescales from real time operations through to long term system development. Currently around 25% of generation connected to the GB system is not readily visible to the ESO. Greater operability visibility would allow us to better forecast flows across the system, facilitating greater optimisation of system requirements and reducing the need to manage operational headroom on critical circuits and boundaries. Assessment of our NOA 2020/21 forward look at constraints indicates that a 10% improvement in distributed generation forecasting would reduce annual constraint costs by around **£10m-£60m** pa in peak years depending on the scenario[7]. This benefit would be facilitated by access to distributed standards (EREC G99) operational metering, meaning that much of this data exists but is not currently available in ESO systems.

Greater visibility will also allow us to better assess system margins, including improving visibility of smaller generators that have Capacity Mechanism contracts. In the longer term, with increasing volumes of demand side response we will also need to model forecast behaviour of demand parties in greater detail. Greater operational visibility will be key to developing our forecasting ability in such areas.

A1.2 Increased market liquidity through facilitating entry for new service providers.

Increased operational metering could facilitate greater participation in ESO markets. We have assessed this benefit in two areas:

1. **Greater participation in services that could be facilitated through distribution standards (EREC G99) operational metering**. We believe that for some services, including thermal constraint management, distribution standards (EREC G99) operational metering would be appropriate. Such metering is already being used in the provision of flexibility services for DSO needs through the Regional Development Programmes. We believe that through making these markets more accessible to smaller parties we will increase overall liquidity in thermal constraint management. Even a 1% reduction in unit costs would see a reduction in thermal constraint management costs of between **£4.4m-£23.0m** pa based on our NOA 2020/21 forward look at constraints. Other applications of this metering could include electricity system restoration services where the ESO's Distributed Restart project quoted a £115m NPV of service provision from DER by 2050[8]. Further access to thermal constraint management services from such parties could help reduce the need for some investment in transmission. This benefit is already being developed in certain locations through our Regional Development Programmes (RDPs). In our RIIO-2 business plan,[9] we quoted our RDP proposals would generate benefits of £6m-£34m pa, based on specific geographic locations and a wider rollout of RDPs with more locations could expect this to at least double to **£12m-£68m pa.**
2. **Greater participation in other ESO services**. Services, such as reserve and response, are used to ensure the system remains in overall balance and require a higher standard of operational metering than that provided by distribution standard metering. Standardising these requirements and making operational metering more accessible to smaller parties could increase market liquidity and reduce the unit costs of relevant services. Greater visibility could also unlock business models including broader aggregation of services. We would welcome stakeholder feedback on the value of this potential benefit.

[7] https://www.nationalgrideso.com/document/194436/download
[8] https://www.ofgem.gov.uk/publications/electricity-nic-2018-national-grid-electricity-system-operator-eso-black-start-distributed-energy-resources
[9] https://www.nationalgrideso.com/document/158061/download

A1.3 Operational benefits associated with improved system resilience and service co-ordination.

We have considered this benefit in two ways. Both benefits would be facilitated by access to EREC G99 operational metering, meaning that much of this data exists but is not currently available in ESO systems:

1. **Benefits from improvements in system resilience**. We believe that greater operational visibility of DER would increase the number of operational options available to the ESO reducing the probability of a need for demand control in the event of a major system event. The societal cost impact of such demand actions for such a one in 10-year event can be up to around £13m. With increasing demand for electricity this value will increase. We have estimated that, in the future, greater operational DER visibility could increase consumer value by around **£1m pa** in this area. In addition, greater operational visibility could improve the speed of post event restorative actions following both national and regional events.
2. **Benefits through improved operational co-ordination with DSO services**. Through improved co-ordination and visibility of each other's actions we would expect that there would be an overall optimisation of system needs, and the removal of any risks of service conflict.