Making a positive difference
for energy consumers

To network operators, generators
and other interested parties

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Next steps on visibility of distributed generation connected to the GB distribution networks

Dear colleagues,

In August 2020, we published a call for evidence on distributed generation (DG) visibility connected to the GB distribution network.[1] This document sets out our findings, and next steps to improve DG visibility.

As the share of intermittent renewable generation rises, and electricity demand from heat and transport grows, the electricity market will need to become more flexible, primarily to enable demand to adjust to the intermittency of supply. This is a key driver behind the establishment of our full chain flexibility programme which will update our assessment of the applications of flexibility and take a broad look at the range of approaches to unlocking the highest potential sources of flexibility.

Against this broader context and further decentralisation of the electricity system, DG visibility is hugely important for both system resilience and for the transition to a greener,

[1] https://www.ofgem.gov.uk/publications-and-updates/call-evidence-visibility-distributed-generation-connected-gb-distribution-networks

smarter and fairer energy system, making effective use of data and taking a whole system approach to delivering net zero at lowest cost .

Over 1300MW of DG was disconnected during a power outage on 9 August 2019. Limited visibility of this DG potentially hindered mitigation actions during the event and limited the subsequent investigation.

To develop appropriate policies we need more information on a number of aspects. These include exactly how enhanced DG visibility would contribute to assisting the Electricity System Operator (ESO) and Distribution Network Operators (DNOs) now and in the future; what data measurements enhanced visibility of DG should include; the costs and benefits of enabling such visibility; and how governance changes should be implemented.

Our 2020 call for evidence sought to find answers to these questions and provide industry the opportunity to inform our policy making.

Annex 1 sets out more details on the background and finding from the eighteen responses we received. In summary, respondents agreed that there is a significant problem in limited DG visibility, and that there may be impacts on system resilience and Distribution System Operation (DSO) function delivery. Respondents highlighted that the principal beneficiaries of this data are the ESO and DNOs. Some wider benefits were identified, such as improved efficiency of the Capacity Market and opportunities for informing flexibility service markets and associated supporting technology infrastructure. However, we found that, in general, industry did not have a clearly articulated set of use cases for DG data visibility; how this would inform decision-making; what data measurements and specifications would be required; the costs and benefits of enhancing DG visibility; or the required changes to existing governance. In general, respondents recognised these limitations, and sought further industry analysis to assess the costs and benefits of changes to DG visibility.

We agree that further industry analysis is required to inform policy decisions. Given the principle beneficiaries were identified as being the ESO and the DNOs, we have requested that the Energy Networks Association (ENA) Open Networks Project (ONP) work this year with relevant stakeholders to provide a clearer articulation of why and how DG visibility could be improved, and the costs and benefits of doing so. Timelines for the ENA's work this year, including interim outputs, are presented in section 4.4.

We will closely monitor this work and use the analysis, in coordination with our wider policy development and considerations on data and digitalisation reforms, full-chain flexibility, and energy system governance, to inform our policy development.

Yours faithfully,

Steve McMahon

Deputy Director, Electricity Distribution and Cross-Sector Policy

Annex 1 - The need for visibility of distributed generation connected for the GB distribution networks

9 August 2019 power outage

1.1. On Friday 9 August 2019, a power outage caused interruptions to over 1 million consumers' electricity supply. During this event, a large amount of DG tripped or de-loaded resulting in demand disconnection being triggered in order to protect the system and bring system frequency back under control.

1.2. Following this event, Ofgem opened an investigation into the power outage which resulted in nine specific and measurable actions.[2] Action eight states Ofgem should investigate and consider options to improve real time visibility of DG to DNOs and the ESO.

1.3. Under current arrangements, not only were the ESO and DNOs not able to measure the real time loss of available capacity from DG, but it was also difficult to determine the magnitude of lost DG after the event. Our lower bound for total estimated DG lost across the event is 1300MW, and the loss could be as high as 1500MW. There is a significant possibility that this volume is in excess of the transmission connected generation lost during the event (approx. 1378MW).

Distribution System Operation (DSO)

1.4. The potential for loss of generation connected at distribution to outweigh losses at transmission is a clear demonstration of changes in the energy system, and the need for accelerated delivery of DSO functions.

1.5. Distribution networks need to transition from passive to active systems, capable of managing dynamic patterns of electricity generation and demand and coordinating closely with the ESO. We have clearly set out our vision for DSO delivery, and the increasing role for DNOs in distribution network management.[3] We anticipate that DNOs will require enhanced visibility of DG to undertake this role. While there is

[2] https://www.ofgem.gov.uk/publications-and-updates/investigation-9-august-2019-power-outage
[3] https://www.ofgem.gov.uk/publications-and-updates/riio-ed2-sector-specific-methodology-decision

anecdotal information to support this expectation, we require evidence of how enhanced DG visibility will meet the needs of a changing energy system, the cost of enhancements, and the benefits that are likely to accrue, in order to inform evidence-based policy.

2. Developing an evidence base for changes to DG visibility

2.1. Based on action eight of our 9 August 2019 power outage investigation report, we undertook a review exercise including interviews, stakeholder engagement, and analysis. We found that current arrangements provide very limited visibility of DG to DNOs and the ESO.

2.2. We found that despite an appetite for greater data on DG from industry participants, there lacked a clear articulation or compelling evidence regarding which data should be captured, why, and how this would help with system resilience and DSO function delivery.

2.3. We therefore decided to issue a call for evidence to wider industry in order to establish a sufficient evidence base to develop effective and targeted policy. This was published in August 2020.[4]

2.4. We sought views on six key areas, including:

- Data on DG that would aid in the prevention, live management and recovery from loss of supply events.
- How additional data would assist in the planning and real time operation of GB transmission and distribution systems.
- How additional data would assist in the delivery of DSO functions.
- At what temporal granularity real time data would aid in the prevention, live management and recovery from loss of supply events.
- Investments needed to improve data management, which party or parties should be responsible for this, and whether this varied by DG size.

[4] https://www.ofgem.gov.uk/publications-and-updates/call-evidence-visibility-distributed-generation-connected-gb-distribution-networks

- What technical, regulatory, legal and cost barriers exist to DG visibility improvements.

2.5. We received eighteen responses, with all non-confidential responses published on our website. Annex 2 details the responses.

3. Findings from our call for evidence on visibility of distributed generation

3.1. The call for evidence produced some valuable findings. However, we note that in general, respondents focused on different aspects of DG visibility, which led to an overall lack of consistency in the responses.

Key findings

3.2. Based on the responses to the call for evidence, we found the following:

- **The ESO and DNOs are likely to be the principal data users and beneficiaries.** In their response, the ESO presented some preliminary use cases for greater DG visibility; these would need some further definition in order to provide a basis for full specifications to be created and implemented. DNOs are also likely to benefit where they manage DG connections and in any DSO functions that they deliver. We found limited evidence for third party network users to benefit significantly from access to DG data. This does not preclude the possibility of there being value in network users accessing DG data, but highlights that limited evidence was presented to this call for evidence.

- **Use cases for DG visibility data are poorly defined.** While the ESO and DNOs articulated a high-level benefits case for capturing DG data, the specific instances in which the data would be valuable and the decisions it would inform are still uncertain. Based on subsequent discussions, we understand that the use cases and frequency of occurrences, and number of generators affected are not well developed and further work is required in this area.

- **There is a very broad understanding of what constitutes real time DG data.** Many of the data characteristics identified may be collected under 'static' data within the Embedded Capacity Register, but this is not real time data.[5]

- **Monitoring equipment is only part of the challenge of improving DG visibility.** There are significant challenges to managing the communication

[5] https://www.ofgem.gov.uk/publications-and-updates/dcp350-creation-embedded-capacity-registers

infrastructure to collect and transfer data to the ESO and DNOs, and for subsequent secure storage and management of this data.

- **There are no standardised hardware or software solutions to improve DG visibility.** Without this information, it is challenging for industry or Ofgem to describe possible costs of improving DG visibility with any accuracy. Where costs were presented, these varied by several orders of magnitude.

- **No cost benefit analyses for improving DG visibility have been undertaken.** Based on the lack of use cases and volumes, benefits cannot be well defined; similarly, without clearly defined use cases and volumes, specifications cannot be developed, nor associated costs.

- **Establishing governance will be a challenge.** There were a range of responses that commented on the complexity of retrospective installations of visibility equipment at DG sites. Primarily, the responses commented that there is currently no clearly defined responsible party for this activity, and it is not easy to define a responsible party, since codes do not cover this activity, and generation assets with a capacity of less than 50MW are not required to have a generation licence.

3.3. Based on these findings and their limitations, we believe it is appropriate to request that the ESO and DNOs, as the likely principal data users and beneficiaries, undertake further detailed analysis to sufficiently inform any further policy development.

4. Next steps

Next steps in 2021

4.1. We have worked with the ENA's ONP to define a product that will review the needs cases, specifications and cost benefit analysis for enhanced DG visibility. The ONP is an industry-led initiative run by the ESO and DNOs to develop electricity systems and networks capable of meeting energy transition challenges.

4.2. Our call for evidence found that the benefits of enhanced DG visibility primarily accrue to the ESO and DNOs, and that further analysis and evidence is required before any policy is defined. Given that the scope of any improvements includes meeting energy transition challenges, we believe it is sensible to request that the ONP undertake the next stage of analysis.

4.3. Product 6 of Workstream 1B (DG Visibility) has a clearly structured scope of works for the ONP to deliver. The 2021 work is currently under consultation by the ENA, and we encourage readers to respond by the closing date of 1 March.[6]

4.4. Specifically, we have asked the ONP to prioritise:

- defining the use cases and frequency of occurrence, and number of generators affected thereof, for DG visibility and monitoring for the ESO and DNOs by May 2021;
- defining the functional specifications for these use cases by July 2021;
- use these to derive a cost-benefit analysis framework for DG visibility and monitoring against the use cases; and,
- undertake the cost-benefit analysis by December 2021.

[6] https://www.energynetworks.org/newsroom/ena-sets-out-ambitious-programme-of-work-for-open-networks

4.5. This will help to define the data required by the ESO and DNOs, including but not limited to the fields:

- The data parameters that must be captured (MW output etc);
- Resolution of data capture (seconds, milliseconds etc);
- The means by which data should be transferred to the ESO and DNOs; and,
- Associated latency (ICCP links, half hourly data transfer etc).

Next steps beyond 2021

4.6. On receipt of the ONP's analysis, we will be better informed to develop appropriate policy options if we are best placed to take this work forward, or to allocate this to the appropriate party to take forward, if this is not Ofgem. We will consider findings against the wider policy development objectives including our data and digitalisation reforms, management of energy system data architecture and energy sector data governance; the RIIO output deliverables for DSO including incentives and base line expectations; full chain flexibility goals; the energy codes review; and system operator governance and institutional review and reforms.

4.7. In particular, we expect further work to consider:

- The most appropriate DG visibility required against each use case;
- Whether DG visibility equipment should be installed on existing or newly connected DG; and,
- Policy options for the governance and cost of improving DG visibility.

4.8. We encourage stakeholder to participate in our policy development, and welcome feedback as we develop our policy options.

Annex 2 – summary of responses to the call for evidence

1. **DCUSA modification DCP350 will provide data on a number of characteristics for DG greater than 1MW. Are there additional characteristics for DG, such as real time MW/MVAr output, load factors and protection settings, which would aid in the prevention of, live management, and recovery from loss of supply events?**

- Real time MW/MVAr output and load factors were acknowledged by most respondents as significantly beneficial for the prevention and recovery of any loss of supply event, as well as live management of assets.
- Most respondents agreed that protection settings should be readily available, but not necessarily in real time, as they seldom change following commissioning and the additional cost implication may not be justified.
- Numerous additional characteristics which would aid in the prevention of, live management and recovery from loss of supply events were suggested. These are listed below:

    - Available capacity on the network
    - Network hierarchy
    - Customer to network mapping
    - Sensitivity factors
    - Data on Network Reinforcement
    - Data on services being provided by DER to DNOs
    - Status of Active Network Management (ANM) zone
    - Relevant substation running arrangement and circuit breaker status
    - DG effectiveness (relative ability of DG to meet a transmission system need)
    - Balancing service provider information
    - DG contact details
    - Small DG visibility (less than 1MW)
    - Power Available from wind parks
    - Operational metering requirements for participating in the Balancing Mechanism
    - Enhanced short term visibility of future operation or ancillary service contracts

- One network operator highlighted that load factor could be relatively easily calculated from half hourly Elexon settlement data.

2. **What value will these additional characteristics provide to improving the planning, security and real time operation of the GB transmission and distribution systems?**

- Most respondents suggested that with enhanced DG visibility, the ESO will have better visibility of the system and improve planning for operational contingencies, thereby ensuring security of supply at lowest cost to consumers.
- Some respondents identified real time data as increasingly important in reducing the risk of loss of supply events and ensuring the reliability of black start projects where DG may be used to support restoration.
- Several respondents suggested that there are opportunities for providing more accurate assessment of system operational risks and optimisation of costs to secure the system.
- A few respondents stated that DNOs could use the information to take appropriate actions on distribution networks when systems are under stress.
- Some respondents identified managing operational conflicts between ESO and DNO services as a use case to be investigated.
- A few respondents stated that more information will allow better system analysis, including analysis of fault level and voltages, as well as help coordinate system requirements.

3. **What value will the above characteristics provide to improving DSO function delivery by the DNOs or other stakeholders? DSO functions may include network management, flexibility procurement, and service conflict avoidance.**

- Most respondents agreed that the coordination and sharing of data regarding connected DGs would facilitate DSO by enabling closer to real time flexibility markets to operate, and providing more dynamic opportunities for flexibility services.
- A few respondents believed access to historical data would enhance DNOs ability to understand the performance of its network. This understanding would then lead to more effective decisions regarding network reinforcement solutions or flexibility service alternatives.

- Some respondents stated long term system design and investment planning would be improved.
- Some respondents believed additional information would help coordinate the availability of unused network capacity, avoid unnecessary investment, and identify where there is a need for network services to support efficient development and operation of the network.
- One respondent suggested DSOs could benefit from a wider spread of operational metering at distribution, and that this may enable them to form their own balancing mechanism in the future.
- Some respondents suggested more information on DG stations would help in the identification of resources that might support local smart energy or community energy initiatives.
- One respondent argued that improving the real time visibility of DG operational outputs are part of the critical path towards any DSO model.
- One respondent considered that greater DG visibility would result in improved efficiency of the capacity market and improved understanding of how wider policy initiatives are impacting the development and situating of DER.

4. **At what temporal resolution (instantaneous, seconds, minutes etc) would real time data on DG be valuable to improve the resilience of the GB electricity system in the prevention of, live management, and recovery from loss of supply events?**

- It was generally agreed that further assessment is required on the temporal resolution and latency of real time data required, as it is a function of how quickly action is needed and how quickly connected generation can respond.
- Most respondents stated that there is a positive relationship between real time data temporal resolution and the ability to better resolve or prevent loss of supply events.
- Several respondents expressed the view that the temporal resolution of real time data is best defined by ESO and DSO functions.
- Some respondents stated data resolution is subject to site by site assessment, but the cost-benefit analysis of the added value of very high temporal resolution data relative to the associated cost of data collection and management should be discussed further with wider industry in order to make progress.

- Some respondents identified time synchronisation as a valuable requirement for DG systems to ensure both DNO and DG data have the same time reference for post-event analysis.
- A few respondents suggested that data temporal resolution should be related to the capacity of generation.
- One respondent mentioned that 1 second resolution would be appropriate for real time DG data (MW and MVAr) and 10 second resolution for dynamic data, in line with existing mechanisms and systems.

5. **What investment would be required for monitoring, collecting, storing and disseminating real time operational data associated with DG? Which party should be responsible for these investments? How does this vary, based on the size of visible DG at 1MW or 50kW?**

- It was generally agreed that further assessment of cost is required, as it will depend on the granularity of data and requirements set by ESO and DSOs.
- It was generally agreed that a lower threshold of DG visibility (50kW) would imply more investment and greater costs primarily due to the increased volume of data associated with a 50kW threshold as compared to 1MW.
- Several areas for investments were identified by respondents, including: asset registration costs; costs of planning relevant upgrade; ENA digital system mapping; communication network upgrades; hardware installation for IT; and, control room resource for monitoring and management, among others.
- Several estimates for required cost of investment were provided which ranged from a few thousands to hundreds of thousands of pounds per site, subject to generator size, installation location and if the installation is prospective or retrospective.
- Some respondents believed investment should be considered on a site by site basis as they do not only depend on size of the asset, but also on existing technology, location, layout, and other factors.
- Some respondents suggested investment should be funded by DNOs through network price controls, while IDNOs could ensure recovery of any cost through relative price control mechanisms.
- A few respondents suggested that DNOs should be responsible for these investments while others believed that the ESO, DNOs and generators are all responsible parties.

- A few others believed that cost of shared infrastructure should be funded by the DNO via DUoS, while sole assets at the generator's site should be funded by the generators.
- One respondent suggested a separate fund to support the implementation on all export MPANs up to 10MW capacity would be beneficial.

6. **What are the credible technical, regulatory (industry codes, licences and governance) and legal barriers and costs associated with increasing the data collected, stored and shared regarding DG operations, and in obligating parties to do so?**

- Retrospective implementation of changes on existing generators, particularly where the generators would incur cost, was a commonly listed barrier by respondents.
- Most respondents highlighted data privacy regulations, data sharing and security concerns and barriers, especially for smaller generators, where there are risks that personal data may be collected.
- Many respondents mentioned the additional costs to consumers of enhancing DG visibility, and stated that there needs to be a cost-benefit analysis to ensure any changes are in the best interest of electricity consumers.
- Several respondents stated that there is currently a lack of relevant obligations on DNOs to provide or publish operational data.
- Some respondents identified a lack of clarity for DG, such as the ambiguity of G99, with regards to requirements to install SCADA at the point of connection.
- Some respondents identified additional costs to DG and DNOs and the need for appropriate funding of regulated entities.
- Some respondents believe enhanced DG visibility is likely to affect both distribution and grid codes, and will possibly require changes to engineering standards.
- One respondent stated that there are currently no regulatory or legal barriers that would stand in the way of improving the visibility of DG.