**SGF Workstream 6 DG & Storage Subgroup: Table of Potential Services from Network Connectees (DG and Storage) to Various Industry Players**

Note: Distributed generation services are tabled first; then storage services. The procurer of the service is in the left hand column (“customer”).

**Services: Distributed Generation**

| **Customer** | **Service** | **Feasibility of Service** | | **When needed[[1]](#footnote-1)** | **Rationale for Contract Design** | **Provider Issues[[2]](#footnote-2)** | **Upstream / Downstream Impact[[3]](#footnote-3)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Possible Y/N** | **Being done now?** |
| **Supplier** | Triads Management | Yes | Triad Management is being done through demand management and also DG | Now | No specific contract required if supplier owns the asset. If not the supplier can contract with a DG/Storage owner and send them signals to generate in the periods they forecast to be Triads. Obviously this may fall in the same periods that the DG/Storage provider have committed to be available for TSO services.  The payment for providing this service is very location specific. | The efficient provision of this service is highly dependent on capability to forecast Triad periods. Suppliers have a good ability to forecast but number of hours of generation required to hit the actual Triads remain uncertain and very much dependent on the load curve.  Triads usually happen between periods 34 through 39 on Mondays through Thursday in November through February. This means that with a relatively small exclusion the DG/Storage could also contract for TSO or DNO services. But by their very nature, the Triad periods are when the TSO is most likely to want to have their services.  In the future due to demand response actions the value of this service may reduce. | DG/Storage contracted for this service may find it difficult to contract for firm TSO or DNO services due to difficulty in predictability of Triad periods. |
| Supplier cost management | Yes | DG/Storage can be used for portfolio management | Now – possible but the value is highly dependent on wholesale market activities and prices | A minimum 10MW capacity required. Operationally it is more valuable if it is part of the supplier portfolio. If DG/Storage owner has contracts with TSO, DNO, then there is a risk attached to availability of the asset whenever called by the supplier, therefore resulting in lower value. | The decision to dispatch DG/Storage to manage supplier costs is based on whether the cost of generation is lower than the market price (or avoided SBP, which should be strongly linked to the market price). | DG/Storage contracted for this service may find it difficult to contract for firm TSO or DNO services. |
| Supplier imbalance management | Yes | DG/Storage can be used to reduce risk of exposure to high cash-out prices. | Now – The service may become more valuable in the event of single cash-out mechanism. In a single cash-out world, the service could be useful to a producer as well, as plant trips and short notice outages expose the generator to potentially high system buy prices. | Similar to above. | The requirement for this service is very much dependent on the position of the supplier at gate closure (long or short), market prices for balancing the position, and the imbalance price penalties. | DG/Storage contracted for this service may find it difficult to contract for firm TSO or DNO services. More specifically period of high cash-out price may be the periods of high requirement for reserve and response services. |
| **TSO** | Reserve services – STOR | Y | Y | Now.  Required volumes will increase as largest loss increases. | Aggregation model in place to allow service to be scale- and technology-neutral (assuming service parameters capable). However, 3MW minimum in place so service is practically usable from a contract and system perspective. Procured in advance on a firm basis to ensure system security. | Scale; generators below the size threshold (currently 3MW for STOR) must engage through aggregators.  Commercial/contract issue (1); National Grid requires certainty on the amount of available response. It is difficult for variable generation to accurately predict their availability far into the future. Shorter-term contracts could make it easier for variable generators to engage in this service. Traditional generators do not have this issue.  Commercial/contract issue (2); Exclusivity of TSO reserve service contract prevents provider from holding other contracts (eg with the DNO for constraint management). In general for reserve and response services: Predictability of availability becomes much higher for shorter time horizons and aggregated over many assets. The firmness of response from intermittent generation can be increased by either reducing contract length or aggregating over larger fleets. In the latter case firm output could still vary significantly. This risk could either be borne by aggregators or by adapting how services are procured, taken into account varying levels of firm capacity. | A provider contracting for this service would not currently be available to the DNO for constraint management.  A DNO may need to be informed when the TSO calls this service. |
| Reserve Services – Fast Reserve | Y | Y | Now. | Aggregation model in place to allow service to be scale- and technology-neutral (assuming service parameters capable). For practical purposes it must be possible to dispatch large volumes at a single point in time, therefore a 50MW minimum is in place. Procured in advance on a firm basis to ensure system security. | *As above apart from scale.*  Scale; generators below the size threshold (currently **50MW**) must engage through aggregators.  Commercial/contract issue (1); National Grid requires certainty on the amount of available response. It is difficult for variable generation to accurately predict their availability far into the future. Shorter-term contracts could make it easier for variable generators to engage in this service. Traditional generators do not have this issue.  Commercial/contract issue (2); Exclusivity of TSO reserve service contract prevents provider from holding other contracts (eg with the DNO for constraint management). | *As above.*  A provider contracting for this service would not currently be available to the DNO for constraint management.  A DNO may need to be informed when the TSO calls this service. |
| Frequency Response - FFR  (dynamic) | Y | Y | Now.  The need case is based on inertia and largest loss combined. In future, it is likely that greater volumes and faster response will be needed as largest loss and volumes of renewable generation increase.  These requirements are considered in terms of dynamic response; static is covered under FCDM. | 10MW minimum in place as this is equal to the smallest generator option. To have a credible alternative of economic value, 10MW is the minimum starting volume. Aggregation model is implemented. Procured in advance on a firm basis to ensure system security. | *As above apart from scale, plus further availability considerations.*  Scale; generators below the size threshold (currently **10MW**) must engage through aggregators.  Commercial/contract issue (1); National Grid requires certainty on the amount of available response. It is difficult for variable generation to accurately predict their availability far into the future. Shorter-term contracts could make it easier for variable generators to engage in this service. Traditional generators do not have this issue.  Commercial/contract issue (2); Exclusivity of TSO reserve service contract prevents provider from holding other contracts (eg with the DNO for constraint management).  Commercial/contract issue (3). Response energy payment needs to reflect cost of lost revenue for generation in receipt of financial support | *As above.*  A provider contracting for this service would not currently be available to the DNO for constraint management.  A DNO may need to be informed when the TSO calls this service. |
| Frequency Response – FCDM  (static) | Y | Y | Now.  Static can provide under FFR, however it is categorised under FCDM to simplify.  Static response, broadly speaking, is used for high and low frequency; however FCDM is only for low. | Designed for demand as opposed to most other services which are altered for demand. Very fast service delivery within 2 seconds therefore high technical bar for providers to achieve. Very flexible service provision terms to reflect the reduced certainty of volumes from the category of provider (this works in alignment with the other firm services).  3MW minimum, which can be achieved through aggregation. | To be developed for very flexible generation such as wind. | ??? |
| Reactive Power and Voltage Stabilisation | Y | N | Now, for a no regrets approach. If not in place by 2018/19, there are likely to be impacts for consumer bills. | Transmission level voltages needed. Distribution level impact is often very localised and therefore not utilised. However, generators are required to have the capability and could support TSO in certain areas, particularly where the DG is “high up” in the distribution network. | Commercial/contract issues  (1) It is difficult for variable generation to accurately predict their availability far into the future. Shorter-term contracts could make it easier for variable generators to engage in this service. Traditional generators do not have this issue. | A provider contracting for this service would need to agree both with the TSO and DNO, to ensure no disruption of the DNO network. |
| Intertrips and soft deloading | Y |  | Now, for a no regrets approach. If not in place by 2018/19, there are likely to be impacts for consumer bills. | Solutions from DG likely to lead to issues with visibility (as not enough known about distribution networks and impacts) and with scale/effectiveness (as distribution level solutions are unlikely to have an impact at transmission level). Typically don’t see aggregation in network services due to inability to aggregate required MW in particular geographic area. | DG can offer protection to the transmission system. |  |
| Inertia | Y |  | Now, for a no regrets approach. If not in place by 2018/19, there are likely to be impacts for consumer bills. | No contract terms for inertia at present. | Commercial/contract issues; Could inertia be procured from distribution connectees?, technical developments to emulate inertia with power electronics (few seconds); ie for wind measure change in frequency, and apply additional torque: slows down and releases additional energy (can result in higher demands on primary response) |  |
| Constraint management | Y | Y | Now, for a no regrets approach. If not in place by 2018/19, there are likely to be impacts for consumer bills. | Balancing Mechanism at the moment requires a minimum capacity but bilateral contracts are also possible. | Commercial/contract issues:  Solutions from DG likely to lead to issues with visibility (as not enough known about distribution networks and impacts)  Scale issue:  scale/effectiveness (as distribution level solutions are unlikely to have an impact at transmission level). Typically don’t see aggregation in network services due to inability to aggregate required MW in particular geographic area. |  |
| Footroom | Y | Y | Now | Currently no defined products and therefore nothing to include on contract terms/set characteristics. | Commercial/contractual:  By more DG signing up to the Balancing Mechanism, the System Operator could avail itself of additional footroom and avoid the need to constrain off renewable generation. | A provider contracting for this service would not currently be available to the DNO for constraint management.  A DNO may need to be informed when the TSO calls this service. |
| Headroom | Y | Y | Now | Currently no defined products and therefore nothing to include on contract terms/set characteristics. |  |  |
| **DNO/DSO** | Peak load management | Y | Y | Now | ANM contracts: Where ANM is available as a solution, generators are offered a “firm” connection (DNO’s statutory obligation), and also an ANM offer based on curtailment, meaning that the connection can be done quicker and cheaper, and it is for the generator to evaluate risks vs. benefits. In these cases, DNO can curtail off generations at times where generation exports cannot be managed by the network.  No payment is given under normal operation, as generator benefits at the outset from cheaper and quicker connection.  Another option is for a generator to contract with an aggregator and allow the aggregator to control the load. DNO would purchase the DSR service from the aggregator. No change to connection agreement would be needed. | Commercial/contractual:  (1) Need limits to uncompensated curtailment. |  |
| Post-fault recovery | Y | Y | Now | There are some bespoke arrangements in place currently. E.g. Flotta Refinery in Orkney provides some generation capacity if required. This isn’t paid for but rather allows the generator access to the network when they may otherwise be off. |  |  |
| Fault management | Y | Y | Now | Occasionally allow generators onto post fault weakened networks at reduced export capacity. This allows them to generate when they would otherwise be off and also helps boost supply in certain cases. This is unpaid. |  |  |
| Intertrips and soft-deloading | Y | Y | Now | DNOs do this at the moment. Conditions of their connection agreement, it allows them to connect quicker and cheaper | The SO needs to be able to cope with major tripping events on the DNO system and it may help for it to have notification of larger trips. |  |
| Constraint management | Y | Y | Now | As per peak-load management. | There is a need to manage the risk of unlimited constraint. There is a need for a signal for reinforcement. And arrangements need to drive the right behaviour by both generators and DNOs. There may be a need for greater SO visibility of constraint management activity. |  |
| Reactive Power and Voltage Stabilisation | Y | N | Now | Commercial/contract issues: Timescales for requirement will depend on the TSO who may be minded to enforce zero VaR export from GSPs in the future. This would be the DNO’s responsibility to comply. |  |  |
| **Storage** | Recharging | Y |  |  | Generators can sign contracts with storage. | A storage unit can contract with a single DG but would be dependent on this DG for providing services to other players. |  |

**Services: Electricity Storage**

| **Customer** | **Service** | **Feasibility of Service** | | **When Needed[[4]](#footnote-4)** | **Rationale for Contract Design** | **Provider Issues[[5]](#footnote-5)** | **Upstream / Downstream Impact[[6]](#footnote-6)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Possible Y/N** | **Being done now?** |
| **Supplier** | Triads Management | Y | ? | ? |  | Limited certainty of future value, but no contract necessary.  Contracts to facilitate stacking; visibility (commercial).  No external penalties.  May overlap with other services and cause penalties for non-delivery of those services | As more demand is reduced at triad, either date of triad changes or system charges increase (substantially?) for non-storage / or non-switchable customers  In order to gain full benefit, consumer may need to reduce demand on many days at peak times. Currently around 20-30 hr/yr |
| Supplier cost management | Y | ? | ? |  | Commercial issue:  Uncertain and variable income. Dependent on ownership of device by consumer or supplier. For consumer ownership, savings could be passed on. Possible option for stacking contracts; Consumer would need separate contracts for stacking.  Contract terms (varying by user / supplier) may also reduce capacity or demand charges.  No external penalties  visibility (commercial) |  |
| Supplier imbalance management | Y | ? | ? |  | Uncertain and variable income.  No external penalties  Contracts to facilitate stacking; visibility (commercial) |  |
| **TSO** | Reserve services (such as STOR) | Y | N | Over supply | Aggregation model in place to allow service to be scale- and technology-neutral (assuming service parameters capable). However, 3MW minimum in place so service is practically usable from a contract and system perspective. Procured in advance on a firm basis to ensure system security. | Commercial/contract issue  (1); Exclusivity of TSO reserve service contract prevents provider from holding other contracts (eg with the DNO for constraint management). [Creation of firm and non-firm markets could lead to more efficient service provisions?]  2) Other ancillary services contracts may be of higher value. (but there is potential to stack this service with other ancillary services such as FFR, providing that they are contracted for different time intervals)  3) Penalty terms act as disincentive (Four strikes and out)  4) Tender periods are not necessarily aligned with other services, making stacking complex  Technical issue: contract requirement is for up to 2 h discharge, but this may not necessarily be needed,  5) Small players dependant on aggregators to access market  6) Tender contracts often for short periods which is a barrier to new investments in capital intensive solutions (these might be more efficient in the long term but current tenders cannot take this into account)  7) Tenders assessed against criteria that reflect operational characteristics of legacy providers?  8) Limited foresight of potential size of the market under different future scenarios | A provider contracting for this service would not currently be available to the DNO for constraint management.  A DNO may need to be informed when the TSO calls this service. |
| Reserve services - Fast Reserve | Y | N |  | Aggregation model in place to allow service to be scale- and technology-neutral (assuming service parameters capable). For practical purposes it must be possible to dispatch large volumes at a single point in time, therefore a 50MW minimum is in place. Procured in advance on a firm basis to ensure system security. | Commercial issue, 1)contract terms require 50 MW, so precluding smaller participants (even with aggregation)  2) Limited potential for co-incident stacking.  3)May be stacked in different time intervals  4) Tender periods are not necessarily aligned with other services, making stacking complex  5. Strict penalties for non-performance  Inserts as above | Distribution connected Fast Reserve can have serious impact on DNO operation.  Commercial issue: increasing options for near event participation through more transparent grid information |
| Frequency Response - dynamic | Y | N | Now |  | Commercial issue  Difficult to predict costs and value of service due to uncertainty of use. Contract terms need to include both availability and utilisation  4) Tender periods are not necessarily aligned with other services, making stacking complex  Penalties  Contracts to facilitate stacking; visibility (commercial)  Inserts as above |  |
| Frequency response static |  |  |  |  | Commercial issue  Lack of information on utilisation increases commercial risk  Penalties – loss of contract  Tender periods are not necessarily aligned with other services, making stacking complex  Technical issue: number of calls influences choice of technology  May be aggregated.  May be both positive and negative |  |
| Reactive Power and Voltage Stabilisation | Y | N | Now | Transmission level voltages needed; distribution level is unlikely to have an impact as very localised. Typically don’t see aggregation in network services due to inability to aggregate required MW in particular geographic area. | Contracts to facilitate stacking; visibility (commercial) | Technical issue: Point of connection important for TSO / DNO |
| Inertia Services | Y | N |  | No contract terms for inertia at present. | New forms of contracts required. Contracts to facilitate stacking; visibility (commercial) | May partially replace other reserve services |
| Constraint management | Y | N | Now | Solutions from DG likely to lead to issues with visibility (as not enough known about distribution networks and impacts) and with scale/effectiveness (as distribution level solutions are unlikely to have an impact at transmission level). Typically don’t see aggregation in network services due to inability to aggregate required MW in particular geographic area. | Contracts to facilitate stacking; visibility (commercial)  Technical issue: energy and power rating important. Aggregation may be possible (although complex) | Commercial issue: Hierarchy of services |
| Footroom | Y | N | Now | Currently no defined products and therefore nothing to include on contract terms/set characteristics. | Contracts to facilitate stacking; visibility (commercial) |  |
| Headroom | Y | N |  | Currently no defined products and therefore nothing to include on contract terms/set characteristics. | Contracts to facilitate stacking; visibility (commercial) |  |
| **DNO/DSO** | Peak load management | Y | N |  | A service arrangement could be established to import at times of peak load. The payment would reflect the VALUE to the network, not the cost of the service. If the value to the network (deferred reinforcement on £/MW for a number of years) is lower than the cost of the service, it is not economical or optimal, for the system as a whole, to contract this service. | Regulatory and contract arrangements  Contractual issue: is the payment reflective of the costs, and will the service enable stacking?  Lack of local market for services = market access barriers. Effects storage in particular as storage may be more economic where it can provide multiple services to a portfolio of parties  Informational barriers: no current products --> lack of visibility and understanding of buyer requirements to allow stacking and business case development  Limited foresight of potential size of the market under different future scenarios for new entrants | Commercial issue: Hierarchy of services |
| Post-fault recovery | Y | N |  | Bespoke contract | Regulatory and contract arrangements  Contractual issue: As an “insurance” service payment needs to be made on an availability basis  Inserts as above |  |
| Fault management | Y | N |  | Bespoke contract | Regulatory and contract arrangements  Contractual issue: As an “insurance” service payment needs to be made on an availability basis |  |
| Constraint management | Y | N | Now | As per peak load | Regulatory and contract arrangements  Technical issue: energy and power rating important. Aggregation may be possible.  Commercial issue: Not necessarily stackable with other contracts.  Inserts as above | Commercial issue: hierarchy of need of services. |
| Reactive Power and Voltage Stabilisation | Y | N | Now | Bespoke contract, location specific | Technical issue: Control system.  Commercial issues Not necessarily stackable with other services  Regulatory and contract arrangements  Inserts as above |  |
| **DG** | Dispatch / constraint management | Y | N | Now |  | RoC and FiT arrangements dis-incentivise option  Inserts as above (lack of market for curtailments). A sole generator cannot currently invest in a viable storage facility but investment by multiple parties has not yet been viable. |  |

**SERVICE DEFINITIONS**

**Supplier Commissioned Services**

***Triads******Management*** (values vary by location; depends on supplier tariff) means reducing consumption or increasing generation, usually for a few hours, during the afternoon / early evening from November to February on occasions when the winter peak is expected to occur.

***Supplier******cost******management*** (medium and short term) – suppliers must match energy supply and demand within their own portfolio. Rather than purchasing electricity through bilateral trades or through the spot market, they could ask consumers to reduce their demand, therefore negating the need to purchase a quantity of electricity thus leaving them in the position to pass on this cost saving to their customers.

***Supplier******imbalance******management*** (short term pre- and post-gate closure) – suppliers are able to forecast where their electricity purchases are unlikely to match their consumer demand. By requesting consumers to increase or decrease demand accordingly, they can reduce their imbalance costs.

**TSO Commissioned Services**

***Short******Term******Operating******Service*** (STOR) is a reserve service which is used by National Grid to provide additional power in the event of sudden generation loss and/or demand increases and/or forecast errors during certain periods of the day. Providers typically respond within 20 minutes and must be able to deliver energy for up to two hours.

***Fast******Reserve*** is the rapid delivery of active power through the rapid increase in generation from power stations (or potentially) a reduction in consumption from demand sources following receipt of an electronic despatch instruction from National Grid. Providers must ramp to full output over two minutes and deliver for at least fifteen minutes.

***Frequency******Response*** is a market where power stations and demand side response providers can sell National Grid firm dynamic frequency response services – where active power generation or consumption is increased and decreased continuously to track the grid frequency – or static frequency response services where active power generation or consumption changes when the frequency reaches a predefined level . Providers must be able to start responding within two seconds and deliver within 10 seconds for Primary and High Frequency Response or 30 seconds for Secondary Frequency Response. Providers must be able to deliver energy for up to thirty minutes. Rapid Frequency Response is a new frequency response service being defined by National Grid to deal with increased rate of change of grid frequency. The service definition is currently expected to require frequency response which starts within 1 second and delivers within 5 seconds.

***Reactive******power***describes the background energy movement in an Alternating Current (AC) system arising from the production of electric and magnetic fields. Devices which store energy by virtue of a magnetic field produced by a flow of current are said to absorb reactive power; those which store energy by virtue of electric fields are said to generate reactive power. The flows of Reactive Power on the system will affect Voltage levels. Unlike system frequency, which is consistent across the network, voltages experienced at points across the system form a 'voltage profile', which is uniquely related to the prevailing real and reactive power supply and demand. National Grid must manage voltage levels on a local level to meet the varying needs of the system. Without the appropriate injections of reactive power at correct locations, the voltage profile of the transmission system will exceed statutory planning and operational limits. National Grid utilises the below services in order to manage voltage levels.

***Intertrip*** services are an automatic control arrangement where generation or demand may be reduced or disconnected following a system fault event to relieve localised network overloads, maintain system stability, manage system voltages and/or ensure quick restoration of the transmission system. *Soft de-loading* is a similar service provided by assets which cannot disconnect immediately but rather do so over slightly longer timescales.

*I****nertia***provides near instantaneous response, which is then held for seconds and minutes (possibly longer) until other plant is available. It can be considered to be similar to the sum of the first part of a dynamic response, static frequency response, fast reserve and STOR.

***Constraint Management*** is National Grid taking actions in the market to increase and decrease the amount of electricity at different locations on the network in the event that the system is unable to flow electricity in the way required. A constraint arises where the system is unable to transmit the power supplied to the location of demand due to congestion at one or more parts of the transmission network.

***Footroom*** is the requirement to reduce active power generated (or potentially increase active power consumed), particularly in situations of low demand. Footroom is the ability to reduce generation below a particular level to deal with uncertain demand forecasts.

***Headroom*** the requirement to increase active power (generation) in response to increasing demand (like STOR).

**DNO Commissioned Services**

***Peak load management*** is when a local branch of the distribution network is reaching its peak load or generation and consequently, its capacity limits (likely to be network winter peak). In this circumstance the DNO would seek to engage services to reduce demand.

***Post-fault recovery*** and ***Fault management*** is when there has been a fault on a certain part of a DNO network causing some customers to go off supply. The DNO might deploy DSR to allow some supplies to be returned while repairs or maintenance are carried out (could be at any time, although more likely at peak demand). This DSR could be either reduced demand or reduced generation output.

**Storage**

Storage could contract directly with a generator to purchase electricity for recharging.

**Distributed Generation**

Distributed generation could contract with storage to make variable generation dispatchable and to help manage constraints and power flows on the networks. Generated electricity could be stored or released on to the network.

**Other clarifications**

**Hierarchy of services**: Satisfactory and economic operation of the network requires a range of services. However under some conditions some are more important. A hierarchy of services can be listed by considering the value paid by the TSO (£ / MW of service supplied), but this may not actually represent the true value to the system. For example, the value of constraint management may be instantaneously higher, but the payment may be much lower than for other services.

**Contract terms**: penalties. Some contracts permit various levels of default. A default may be penalised by non-payment of the relevant fee, payment of a penalty fee or cancellation of the contract. If there is a hierarchy of services, penalty terms could be adjusted to reflect performance in one area at the expense of another. Not all penalty information has been included.

1. When needed as a mainstream service, rolled out across the country (including clusters) [↑](#footnote-ref-1)
2. Provider Issues: Technology specific constraints; Timescales of contracts; Penalty clauses; Exclusivity [↑](#footnote-ref-2)
3. Downstream implications are those for a DNO of a TSO-called service; upstream implications are the reverse. Issues flagged here have been communicated to the Visibility subgroup. [↑](#footnote-ref-3)
4. When needed as a mainstream service, rolled out across the country (including clusters) [↑](#footnote-ref-4)
5. Provider Issues: Technology specific constraints; Timescales of contracts; Penalty clauses; Exclusivity [↑](#footnote-ref-5)
6. Upstream Implications: Implications for TSO contracting of DNO services; Implications for DNO contracting of TSO services [↑](#footnote-ref-6)