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Future Arrangements for System Services (FASS)

Proposals for enduring arrangements and transition

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Purpose and scope

In this paper, we present our proposals for the **enduring arrangements** for the procurement of System Services, following the High-Level Design (HLD) set out by SEM-C.

We concentrate on auctions of **reserve services**, which have the complication of interacting significantly with energy provision. Enduring arrangements relating to the procurement of other services, such as reactive power, will be discussed in a subsequent separate paper.

Product assumptions

For current purposes, we assume that the existing DS3 service definitions would continue in a similar form. However, the proposed approach is flexible and can accommodate revised or additional service definitions.

To simplify interaction with the energy market, we assume reserve services would be procured within **30-minute periods**, corresponding to the current Balancing Market (BM) periods. However, this assumption is not critical, and some services could be procured within some multiple of these periods with limited modifications.

Compatibility with the HLD

The recommendations conform with the HLD, with the exception that we see need for a **secondary trading platform** from the outset. The HLD considers that a centralised secondary trading platform might be introduced at a later stage, but would not be needed initially, leaving secondary trading to bilateral agreements that would need to be notified to the TSOs. However, we conclude that a secondary trading platform would be beneficial to maximise participation from the widest possible range of providers.

Long-term contracting

In addition, we have gone somewhat beyond the scope of the HLD in considering, in outline terms, potential new approaches to long-term procurement possible once daily markets are in place. In our view, the need for mechanisms to boost long-term investment in new provision of System Services will not be addressed by short-term markets alone.

Working assumptions

When developing these proposals, we assume that:

- the TSOs' overall System Services volume requirements remain largely the same as current requirements (though product definitions could change);

- System Service auctions would be based on a sealed bid process rather than a multiple round auction, as the benefits from price discovery can arise anyway from the daily repetition of auctions;
- suppliers' maximum capability for service provision will be set on registration, tested and monitored as at present;
- the Performance Scalar system can remain in place to provide good incentives for providers to deliver committed System Services volumes; and
- the BM and dispatch actions taken by the TSOs guarantee that a sufficient volume of System Services is available for the grid.

Timing of the day ahead auction

The HLD considered the following options for the timing of the **Day Ahead System Services Auction** (DASSA):

- after the DAM but before the first LTS; or
- after the LTS.

We favour the first, earlier option, as it is likely to lead to greater participation and competition.

The Day Ahead System Services Auction (DASSA)

DASSA bids would have a similar structure to DAM bids, with units being able to make bids by providing a number of price/quantity pairs that define a **supply function** (i.e. a schedule specifying the volume that could be supplied at a given unit price). Bids would be made independently for each service within each 30-minute period.

We see no strong need for package bidding across services or time periods within the DASSA. In bilateral meetings, stakeholders indicated that this was not necessary.

The DASSA would determine the **clearing price** for each System Service and assign volumes (which we call **DASSA Orders**) to winning bidders (**DASSA Order Holders**). Within the clearing process, each 30-minute period is cleared separately. However, within a period, there may be some limited interaction across different services within the clearing process due to:

- the TSOs' preference for a common provider of reserve services across consecutive time scales (currently incentivised through a scalar for **continuous provision**); and
- the possibility that, in the future, new services might be introduced that are substitutable at the margin depending on relative price (e.g. different qualities of FFR).

DASSA Orders would be **tradeable** up until a deadline shortly before BM opening for the relevant 30-minute period, ideally through a centralised secondary trading platform. This would permit participation by providers whose availability was only known closer to real time.

After DASSA clearing

A DASSA Order Holder would receive payment for supply of the specified volume if it provides an FPN that is **compatible with its DASSA Order** when entering the BM for the relevant time period.

On notification of a compatible FPN, a DASSA Order becomes a **Confirmed DASSA Order,** which is an operational commitment to provide that volume of System Services. A Confirmed DASSA Order requires its holder to be available to provide the required System Services, otherwise the holder will be subject to Availability Performance Scalar consequences. However, there will be no Performance Scalar consequences if subsequent BM or dispatch actions by the TSOs move the unit into an incompatible energy position, making it infeasible to supply the volume in its Confirmed DASSA Order through no fault of its own.

Conversely, where a DASSA Order Holder provides an FPN that is incompatible (or only partially compatible) with meeting the DASSA Order, the DASSA Order will (partially) **lapse**, and the holder will be liable to make a **compensation payment** to the TSOs for failing to be in a position to provide the entire volume specified in its DASSA Order. There are no Performance Scalar consequences for DASSA Order Holders from not providing a compatible FPN.

Actual supply of System Services

After running the DASSA, some of the volume procured through DASSA Orders may not be supplied, either due to the DASSA Order Holder failing to provide a compatible FPN, or due to BM or dispatch actions taken by the TSOs. However, in the latter case, the TSOs will have already ensured that their actions maintain system stability, bringing on alternative service suppliers of reserve services as needed through actions in the BM and/or at dispatch. The TSOs' actions determine the actual supply of System Services.

BM and dispatch actions are taken by the TSOs for various energy and non-energy reasons. These actions could lead to more providers being potentially able to provide reserve services than are necessary to meet the TSOs' requirement. Therefore, there is potential for oversupply of System Services.

The Final Assignment Mechanism (FAM)

Rather than seeking to classify the TSOs' actions after the DASSA into those that are energy-related and those that are system-service related (not least as in some cases both motives may be present), we propose a reconciliation mechanism, the **Final Assignment Mechanism (FAM)**, that notionally assigns required System Service volumes not supplied under Confirmed DASSA Orders to providers. This reconciliation mechanism determines payments to potential System Service providers, above what is paid out through Confirmed DASSA Orders.

The FAM will use a merit order[1] based approach to assign the total volume required to meet the shortfall not supplied through Confirmed DASSA Orders to those units that offered them at the lowest price (these are the **FAM Assignments**) and determine the corresponding clearing price (the **FAM clearing price**). To be considered within the FAM, units must have declared availability.

A supplier of System Services that has declared itself available and subsequently fails to deliver when triggered or called upon by the TSOs would face consequences under the Event Performance Scalar regime, regardless of whether it held a Confirmed DASSA Order.

The FAM provides additional revenue for System Service providers that supply services that benefit the TSOs without a DASSA Order. This provides an incentive for units to make themselves available even if they have not participated in the DASSA or hold a DASSA Order. The incentive is greater for those providers that can supply System Services at a lower cost, as they have greater chances of receiving a FAM Assignment.

FAM cost consequences of energy actions

Under these proposals, there are predictable cost consequences for the FAM from actions taken by the TSOs after the DASSA. Changes in energy positions can render Confirmed DASSA Orders infeasible, requiring additional volumes to be assigned in the FAM and corresponding payments made. Therefore, at some future time once System Services auctions are running, there is potential to phase in consideration of **FAM cost consequences** for System Services within BM and dispatch decision making. However, to avoid excessive implementation burden, we do not suggest this for initial implementation of System Services auctions.

Phasing

[1] Ordered by price, then whether the unit was called upon, and then at random.

We propose that the enduring arrangements are phased in by **initially not procuring the full volume requirement** through the DASSA, leaving the rest of the volume to be assigned in the FAM. A default price for supply without a corresponding DASSA bid would be initially set at the level of the regulated tariff. The volume procured through the DASSA would be progressively increased, until the full volume is run through the DASSA. In parallel, we expect that the default price would be decreased, to reach a suitable long-term value.

We do not propose phasing of the auctions by initially running them at **lower frequency**, as this creates challenges for bidders whose availability is not known far enough in advance (especially in the absence of a centralised secondary trading mechanism). Lower frequency auctions do not appear to meet the requirements of the EBGL.

Long-term contracts

A more significant question is whether these arrangements adequately provide incentives for long-term investment in new capability to provide System Services. The recent SEM-C consultation[2] on phased implementation of auctions for System Services, considers so-called “layered procurement” of services on contracts of less than one year. However, this does not address the question of providing incentives for investments in new assets to provide System Services whose lives would clearly much exceed one year.

The existence of daily auction prices from the DASSA enables new approaches to long-term procurement. For example, long-term contracts can offer delivery payments for System Services at the DASSA-determined prices (i.e. the contract holder is a DASSA price taker), along with an availability commitment offered in return for some fixed available fee. This approach avoids the problem of offering fixed delivery payments in the far future at a time where costs may fall due to entry of new service suppliers.

[2] SEM-23-043, June 2023.

1 Introduction

We have been commissioned by SONI and EirGrid to formulate proposals for the detailed design of a competitive process for the procurement of System Services, following the High-Level Design (HLD) set out by SEM-C.[3]

For the purposes of this initial paper**, we concentrate on reserve services**, where there is the greatest **interaction with energy markets**. We defer consideration of locational issues. A subsequent paper will address services where locational elements are likely to be important, such as reactive power.

1.1 HLD requirements

Matters largely resolved by SEM-C

The HLD set out certain relevant requirements:

- The competitive process will be based on **daily auctions**, which will be run after the Day Ahead Market (DAM). We call these the ***DASSA (Day-Ahead System Services Auction)***.
- The DASSA will be followed by a top-up 'physical' **reconciliation mechanism**, informed by the providers' positions following TSOs' dispatch instructions.
- The DASSA should set a **commitment** on winners to supply assigned volumes. However, the possibility of non-firm or contingent supply is not entirely closed off in the HLD.
- System Services products may be defined with **time-of-day differentiation**, though no further details are provided regarding the different time periods to be used.
- There can be **limited parallel medium-term procurement arrangements**, but any such contracts should be for at most one year ahead.[4]

[3] SEM-21-069, 26 August 2021, available at https://www.semcommittee.com/sites/semc/files/media-files/System%20Services%20Future%20Arrangements%20-%20High%20Level%20Design%20Consultation%20Paper.pdf

[4] The term "layered procurement" has been adopted, for example most recently in Section 5 of SEM-23-043, to describe forward procurement of System Services alongside daily auctions, but at timescales of less than a year.

- The competitive process should be designed to deal with **reserve products** in the first instance, followed by ramping, but should allow for the inclusion of **additional System Services** in the future (potentially all System Services, including possible future modifications to existing DS3 services).
- The auction should report a **summary price for each System Service** to guide investment decisions (although the reported price could be an algorithmic output from the clearing/settlement procedure).
- There should be **rolling registration** to support new entry.
- A platform for **secondary trading** is not envisaged as part of the initial design of future arrangements, but it should be possible to introduce this at a later stage (with a requirement for the TSOs to issue a consultation on this, following 18 months of operation of the new market arrangements).

We have been mindful of the HLD when proposing options. However, we have not simply excluded consideration of alternatives incompatible with the HLD.

Secondary trading

Our eventual conclusions coincide with the HLD requirements with the one exception: the potential use of a central platform for secondary trading.

We consider that secondary trading may need to be considered as an intrinsic part of the enduring arrangements. Together with running System Services auctions at sufficiently high frequency (such as daily), secondary trading is likely to be necessary to accommodate service suppliers whose availability is known only close to real time, a concern that was raised by several stakeholders during exploratory meetings.

It may be beneficial to develop a secondary trading platform from the outset, both to facilitate trading and to ensure that the TSOs have accurate information about who holds commitments to supply System Services when secondary trades occur. We note that even without centralised clearing of an order book, there would still be the need for a system to log who holds System Services supply commitments if there were bilateral trading.

Future-proofness

In principle, the design needs to work with at least all current System Services (with the possibility of a DS3 'big bang' closure by May 2026), even if only some of these services are initially included. Ideally, it should be possible to modify and add services without the need to make major adjustments to the procurement process.

1.2 EU requirements

Certain current EU requirements are relevant to System Services:

- the Directive on common rules for the internal market for electricity (EU) 2019/944;
- the Regulation on the internal market for electricity (EU) 2019/943; and
- the Regulation establishing a guideline on electricity balance (EU) 2017/2195 (the 'EBGL').

The EBGL requires a transparent, non-discriminatory, and market-based process.

Balancing Capacity is defined by Article 2 of the EBGL as a balancing service in which a provider has agreed to hold capacity in reserve to potentially provide balancing energy. Additional requirements arise for Balancing Capacity:

- procurement should be short-term, at most one month ahead and ideally daily; and
- long-term contracts should not be used unless needed for the secure operation of the system.

Derogation from these requirements is possible upon request to the Regulatory Authorities. In particular:

- non-market-based procurement for non-frequency ancillary services is possible if the Regulatory Authorities have assessed that the market-based procurement would not be economically efficient; and
- up to 70% of Balancing Capacity can be procured monthly, extendable to annual products at the request of the TSOs.

Given the definition of Balancing Capacity in the EBGL, these specific requirements only apply to reserve (frequency-response) products and potentially to ramping products. They do not apply to other System Services such as inertia and reactive power.[5]

[5] Our current understanding is that inertia is not considered a frequency response product and that these additional requirements for procurement do not apply. However, we also note that there is some ambiguity in the formal definition of Balancing Capacity within the EBGL.

Irrespective of which exact System Services fall under the definition of Balancing Capacity within the EBGL, the proposed design for System Services procurement set out here is fully compliant with these requirements because:

- it uses a transparent and competitive market-based procurement process; and
- the DASSA is run daily, the day before delivery.

Even where System Services do not fall under the definition of Balancing Capacity, an obligation remains to procure them using a transparent, non-discriminatory and market-based approach, but without specific timing requirements.

Table 1: Envisaged products and EU regulation

Products	Applicable EU definition	'Default' procurement according to EU regulation	Proposed approach
POR, SOR, TOR1, TOR2, RRS, RRD, FFR	Balancing Capacity	Transparent, non-discriminatory and market-based procedure Daily	Under proposed approach, procurement would be via the DASSA on a daily basis
RM1, RM3, RM8	Balancing Capacity	Transparent, non-discriminatory and market-based procedure Daily	DASSA approach applicable, but not proposed for initial deployment of DASSA
SIR, SSRP, DRR, FPFAPR	Ancillary Services	Transparent, non-discriminatory and market-based procedure No duration and timing limitations	The intention is for market-based procurement similar to the DASSA

1.3 Automated response services

This paper concentrates on **reserve services**, particularly frequency response services. The HLD envisages that payments will be made for the **availability** of the service – that is maintaining the potential to respond – rather than a payment being made for the response itself (if it occurs). This payment structure is appropriate as costs are primarily driven by providers maintaining their readiness to respond (including the opportunity cost of not being able to sell energy to maintain capacity for reserve), rather than by making the response itself. To the extent that there are costs of making a response, the provider needs to form an expectation of these and recover them through its payment for availability.

Payments for usage and availability

We are not considering here the possibility of any hypothetical future reserve services in which costs are primarily caused by response, rather than caused by readiness to respond. Such services would fall outside the current scope if their suppliers needed to be compensated not just through availability payments, but also some usage payments. This possibility is excluded by the HLD.

Automatic triggering

For services such as FFR, POR and SOR, responses are automatic, triggered by the system frequency falling below a trigger point for a sufficient time.[6] In particular, the TSOs do not identify service providers and explicitly call them. This means that price mechanisms can operate at the level of determining which providers should be paid for their availability, but the responders to a system event are determined by the playing out of automated triggering rules already in place. In Section 6, we will discuss the possibility of creating differentiated 'types' or 'qualities' of automated response services and paying different amounts for availability according to how readily providers respond.

1.4 DASSA timing options

DASSA timing options

The HLD considers two **options for timing** of the DASSA:

- ***Model A***: the auction would be run after the DAM but before the first LTS, allowing units to bid to provide System Services given their energy positions resulting from the DAM and any secondary trading.
- ***Model B***: the auction would be run after the LTS, taking into account final dispatch positions.

We believe Model A is a more attractive option than Model B for the reasons set out in Box 1 below. Model A is likely to lead to greater participation and competition in the DASSA as it

[6] This may also be the case for TOR1 and TOR2, which can be automatically triggered as well as being dispatchable services.

avoids potential disincentives for participation by innovative service suppliers that arise under Model B.

Box 1: DASSA timing options

Who can bid?

A key difference between the two timing models is that under the earlier Model A, there are subsequent opportunities to trade energy positions initially set by the DAM (within IDA1 covering the entire trading day, IDA2 and IDA3 which only cover part of the trading day, and then continuous intraday trading). Trading can be used to achieve an energy position compatible with obligations to supply System Services resulting from the outcome of the DASSA.

Therefore, Model A permits an approach in which winning bids in the DASSA create obligations on System Service providers to achieve compatible FPNs allowing those System Services to be supplied. Providers have opportunities to achieve such a compatible FPN and it is reasonable to require compensation to be paid to the TSOs if providers fail to do so (as this would make providers unable to meet System Services obligations arising from winning DASSA bids).

Under Model A, the DASSA should be more competitive, as it may attract bids from a wider range of units, rather than only those which are potentially able to supply System Services given the LTS outcome.

Impact of system constraints

Under Model B, energy positions will have been changed relative to the DAM outcome (and subsequent trading) due to the application of system constraints, such as the SNSP (system non-synchronous penetration) limit and minimum number of thermal units.

Some bidders who might have made DASSA bids under Model A (in the expectation of being able to trade to a compatible FPN to supply those System Services) may find they cannot bid under Model B, as the LTS has placed them into an incompatible energy position.

The SNSP limit leads to additional inertia on the system due to synchronised plants being constrained on, and possibly additional reserve if part-loaded plants are constrained on. As a result, system constraints might reduce the scope for innovative System Service providers to supply System Services. In turn, this reduces investment incentives in innovative System Services provision.

In contrast under Model A, the impact of system constraints is much more limited. Provided a DASSA winner achieves a compatible FPN allowing supply of those System Services, it will be paid for them, even if subsequently it gets moved into an incompatible position due to the application of system constraints.

1.5 Working assumptions

Largely uncontroversial matters

Our working assumptions when considering the detailed design of the processes are that:

- volume requirements are largely similar to those under the DS3 arrangements (though differentiation by location and time of day may need to be added for some System Services, such as reactive power, but these are not the focus of this document), even though product definitions and potential subdivisions may change[7];
- each daily auction would consist of a single bidding round (sealed bid) rather than a dynamic multi-round process. There would be no particular benefit in terms of increased price transparency from running a dynamic auction if the DASSA is run daily;
- suppliers' maximum service capability will be set on registration and needs to be backed by grid connection and any other prerequisites (we expect a similar approach to the current testing regime for validating and updating this data); and
- a similar Performance Scalar system can continue to be used to incentivise operational performance from providers, provided this can be integrated with the proposed arrangements (as discussed below).

1.6 Outline approach

Outline structure of the DASSA

Under our proposals, the DASSA will procure some required quantity of System Services by identifying winners who become holders of what we call **DASSA Orders**. These orders can subsequently be traded in a secondary market. A DASSA Order is an obligation to submit an FPN compatible with the supply of System Services required by the Order. On submitting a compatible FPN, this becomes a **Confirmed DASSA Order**, which is a commitment to provide the specified System

[7] For instance, some existing products could be split into sub-categories reflecting different quality parameters (e.g. response time or carbon emission levels). The proposed DASSA design allows for the possibility of setting some total volume requirements across multiple products and allowing the final mix of products to be determined when optimising, taking into account cost implications. This is discussed in Section 6, as an extension to the basic DASSA design, set out in Section 2.

Services. However, subsequent changes in energy positions may occur either through the BM or dispatch actions that make such supply of System Services partially or entirely infeasible. A key principle is that payments to System Service providers are not at risk from TSO actions that leave providers unable to meet their supply obligations through no fault of their own.

BM and dispatch actions

An important assumption throughout is that these various changes to energy positions made by the TSOs will not entail a risk that the volume of System Services being supplied fails to meet the TSOs' requirements. This is because actions taken by the TSOs through the BM and at dispatch must always ensure that the system can be operated securely. Therefore, real-time supply could differ from that set out in Confirmed DASSA Orders, but the BM and dispatch actions will *already* have ensured that there is sufficient overall supply.

The FAM

This potential difference between Confirmed DASSA Orders and real-time supply creates the need for some subsequent reconciliation of payments, through what we call the **Final Assignment Mechanism (FAM)**. For the avoidance of doubt, the FAM does not allocate *ex ante* orders for supply of System Services (unlike the DASSA) but rather makes payments *ex post* to units who supplied System Services required by the TSOs. These FAM payments incentivise units who may not hold Confirmed DASSA Orders to maintain availability to meet the TSOs' requirements for System Services that arise beyond those specified in Confirmed DASSA Orders.

Incentives to meet obligations

A holder of a DASSA Order has an incentive to submit a compatible FPN due to a requirement to make a compensation payment to the TSOs if they submit an FPN incompatible with the required System Service supply. Once confirmed, this becomes a commitment to supply these services. There is an **Availability Performance Scalar** to incentivise a unit to provide services specified in Confirmed DASSA Orders.

In addition, all units who are available – whether holding a Confirmed DASSA Order or receiving a FAM Assignment - will be subject to an **Event Performance Scalar** consequence, utilising existing performance monitoring methods. This evaluates a unit's response to frequency deviations or calls by the TSOs (as relevant depending on the particular service) when it has declared its availability to provide a service.

2 Proposed enduring arrangements

In this section, (Sections 3 and 4 following) we outline a basic design for procurement of System Services. Section 5 then gives some examples of how a provider might offer to supply System Services within this basic design.

The basic design provides a framework that should already allow for the implementation of the initial auctions for reserve products. We then extend the framework to include additional features in Sections 6 and 7.

2.1 Products

Supply of System Services

The interpretation of 'supply' may vary somewhat across different System Services. For reserve services (our focus here) and ramping, it is the maximum additional energy quantity that the TSOs *could* request from a unit within the relevant timeframes and notice period defined for that service. Therefore, we understand the supply of a reserve or ramping service to be maintaining the *availability* to respond when required, regardless of whether the unit is actually triggered or called upon to deliver. For services such as reactive power or inertia, the 'supply' is simply the quantity that the provider delivers.

Quality differentiation

For automated response services, triggering conditions are part of the definition of the System Service. For example, FFR requires a response within a certain time if the system frequency falls below some trigger level. In Section 6, we discuss the possibility of creating differentiated 'types' or 'qualities' of service, for example through setting different trigger conditions in responding to a Frequency Event.

Locational differentiation

For some products (for example reactive power, but also for reserve due to jurisdictional requirements or congestion in some areas), locational differentiation may be needed. This will be addressed separately as an extension of the basic design in a subsequent paper. However, we envisage that other quality parameters (such as activation/deactivation times) would be part of the product definition, rather than be left for bidders to specify in their bids. We discuss this issue of differentiated services in more detail in Section 6.

Time periods

We expect 30-minute time periods for System Services, so that these are aligned with those in the BM. This means that we have one DASSA outcome for each BM 30-minute trading period. These time periods are aligned with EU requirements (which need auctions daily at minimum) and with metering in Northern Ireland. Longer periods would also be feasible, covering several 30-minute periods with minor modifications of these proposals. There is no difficulty in some System Services being procured in a 30-minute period and others in some multiple of these periods (as we discuss subsequently).

2.2 General structure

Outline of our proposed process

The high-level features of our proposals are as follows:

1. Offers from units to supply System Services in 30-minute windows for the following day are made in the **DASSA**. This auction leads to the assignment of volumes through '**DASSA Orders**' and determines a clearing price for these. The DASSA is run after the DAM and before the first LTS.
2. A **DASSA Order** is a contractual commitment on a unit to submit an FPN that is compatible with the supply of the volume of the System Services specified in the DASSA Order. Therefore, payment for a DASSA Order requires a compatible FPN. Failure to achieve such an FPN would trigger a contractual obligation to make a compensation payment to the TSOs.
3. DASSA Orders can be traded (through **secondary trading**) up to a deadline set by the notification of FPNs prior to the relevant Balancing Market in energy for that 30-minute period. All trades should be between pre-approved peers (i.e. between potential suppliers that have already registered with the TSOs and are capable of supplying that service) and must be notified to the TSOs.[8]
4. After notification of FPNs, DASSA Orders held by units that submit an FPN that is compatible with supplying the volume of System Services covered by the Order will

[8] For this reason, it may be convenient to use a centralised secondary trading platform, which would only allow trade under certain conditions and would automatically update information for the TSOs, as we discuss below.

become **Confirmed DASSA Orders**.[9] Units that hold a Confirmed DASSA Order will be remunerated for supplying the volume covered by the Order, unless they fail to supply the service without this being a direct consequence of BM or dispatch action from the TSOs. DASSA Order Holders that submit an FPN that is not compatible with supplying the volume in their Order become liable to make a compensation payment to the TSOs. A unit may have an FPN that is compatible with supplying only part of the volume in its DASSA Order (subject to any minimum volume requirements), in which case the corresponding part of the DASSA Order would become Confirmed, and the unit would be liable for a compensation payment to the TSOs for the remaining volume in the Order.

5. The subsequent BM and dispatch processes determine the eventual energy positions of the different units and the eventual supply of System Services. It is possible that some units that had submitted an FPN compatible with their DASSA Order may become unavailable to supply this due to BM action or dispatch instructions; this would not trigger an Availability Performance Scalar consequence as it would be outside the unit's control. Conversely, in the event that a unit were unable to supply the volume in its Confirmed DASSA Order due to a fault of its own, then there would be Availability Performance Scalar consequences (discussed below in Section 2.3).
6. In addition, any units that declare themselves available to provide a reserve service, but who fail to deliver when triggered or called upon in a Frequency Event will be subject to Event Performance Scalar consequences (discussed below in Section 2.3).
7. Not all DASSA Orders may be feasible. This can happen if a DASSA Order Holder has not provided a compatible FPN or due to subsequent BM or dispatch actions by the TSOs. As a result, the total volume of System Services procured by the DASSA may turn out to be less than the TSOs' requirement. In addition, the TSOs' requirement may have changed since clearing the DASSA due to unforeseen events. Therefore, there may be a shortfall

[9] If a service was procured over multiple 30-minute periods, then it would be required to have a compatible FPN for each of those periods.

between the required volume and that eventually supplied under DASSA Orders (the '**shortfall volume**').[10]

8. It is also possible that the total supply of System Services given the eventual energy positions after the BM and dispatch instructions may exceed the required volume of System Services. This could occur if System Services come as a co-product of energy generation brought on in the BM or dispatch process for energy or non-energy reasons. In this case, the total volume of System Services available at real-time might exceed the shortfall in System Services volume.

9. The **Final Assignment Mechanism (FAM)** is an ex-post reconciliation process by which the TSOs remunerate service suppliers needed to provide the shortfall volume. However, any over-supply of System Services resulting from there being too many potential suppliers will not be remunerated. We envisage that it will be run at the end of each day.

10. The FAM uses what we call **Adjusted Supply Functions** based on DASSA bids and units' eventual energy position. Therefore, additional bids are not collected in the FAM, but rather DASSA bids are taken with appropriate re-interpretation to reflect current circumstances. It will use a merit order to assign the shortfall volume to those units that offered the most cost advantageous terms. These are the **FAM Assignments**.

2.3 Obligations and consequences

Incentives to meet obligations

It is important that there are incentives for DASSA Order Holders to submit compatible FPNs and more generally that any bidders declaring availability (whether as a Confirmed DASSA Order Holder or to seek a FAM Assignment) have incentives to maintain their availability and respond to Frequency Events or calls from the TSOs (as relevant depending on System Service).

[10] To some extent, it may be possible to anticipate needs for System Services that might arise after the DASSA and include these within the volume requirement procured in the DASSA. However, this also risks procuring System Services that are seldom used. Therefore, the ability for the TSOs to source additional System Services after clearance of the DASSA is important in managing risk and avoiding the need to procure excessive 'precautionary' volumes.

To ensure this, we envisage that the general approach used in the TSOs' current Performance Scalar methodology could be carried over. We do not make specific recommendations on detailed parameters at this time, but rather set out the general approach.

Performance Scalar regime

There would be two scalars:

- an Availability Performance Scalar, intended to incentivise Confirmed DASSA Order Holders to be available and supply the System Service as specified by the Order; and
- an Event Performance Scalar, to incentivise units declaring availability to respond to Frequency Events or calls from the TSOs (as relevant depending on System Service).

These scalars would reflect overall performance over some period (e.g. a month or several months) rather than just within the single 30-minute period in which the service is supplied for the purposes of the DASSA and FAM. Scalars would be applied to the relevant total revenue earned by the unit over that period.

Availability Performance Scalar

Where a Confirmed DASSA Order Holder is not available at all, it would be subject to Availability Performance Scalar consequences including:

- cancellation of the DASSA payment for supply of service during the 30-minute period of the Confirmed DASSA Order; and
- facing a potential reduction in DASSA revenues for additional 30-minute periods.

Therefore, there is a strict financial disincentive for a unit holding a Confirmed DASSA Order not to fulfil it.

Non-performance is a potentially a matter of degree and commitments might be partially, but not entirely met. For example, a Confirmed DASSA Order Holder might supply a System Service, but not the entire volume specified in its Order. In this case, the Availability Performance Scalar consequence would reflect the part of the Confirmed DASSA Order that was unmet.

Event Performance Scalar

The Event Performance Scalar is intended to ensure that where a unit declares availability, the service is provided. This scalar would apply both to Confirmed DASSA Order Holders declaring availability and to units not holding Confirmed DASSA Orders declaring availability to be considered for a subsequent FAM Assignment.

For reserve services that are triggered, an Event Performance Scalar consequence arises from failure to respond to a Frequency Event in line with the requirements set out in the service definition. For a System Service that is explicitly called by the TSOs, a consequence arises from failing to respond to such calls within the requirements of the service definition.

If a unit which has declared availability entirely fails to respond to a trigger or call (as relevant for the service) then:

- for a Confirmed DASSA Order Holder, no DASSA payment for the relevant 30-minute period is made, as the Event Performance Scalar would nullify the payment for the relevant 30-minute period;
- for a unit without a Confirmed DASSA Order, its supply going into the FAM may be adjusted accordingly and may not receive a FAM Assignment payment[11]; and
- there would be a further Event Performance Scalar consequence, that would potentially reduce revenues for the DASSA and FAM for that service in additional 30-minute periods.

It is possible that a unit could partially respond to a system event, but not entirely fulfil the requirements of its declared availability. In this case, it would be considered to have provided part of its volume,[12] There would be Event Performance Scalar consequences reflecting the shortfall of the response.

Scenarios for payments and scalar consequences

Table 2 below sets out the various situations in which units could find themselves and the consequences for:

- whether a payment is made for the supply of System Services;
- whether a compensation payment to the TSOs is triggered; and
- whether there are Performance Scalar consequences.

This table is not exhaustive and does not include all the various situations in which a unit is partially, but not entirely performant.

[11] Ideally, these units would be excluded from the FAM entirely, subject to Detailed Design considerations.

[12] We note that there are many possible dimensions to non-performance in a system event, such as delayed response or nor providing the whole volume declared. However, in order to determine a partial payment under a Confirmed DASSA Order or the eventual supply that can still be considered within the FAM, we need to identify a partially supplied volume for that 30-minute period.

For the avoidance of doubt, there is financial consequence from a DASSA Order Holder not submitting a compatible FPN, but this does not cause any Performance Scalar consequences. However, once a DASSA Order is confirmed by submission of a compatible FPN, there is a commitment to be available or otherwise face an Availability Performance Scalar consequence. Whenever a unit is available, and could receive a payment via a Confirmed DASSA Order or FAM Assignment, it must respond to Frequency Events otherwise it will be subject to Event Performance Scalar consequences.

Table 2: Payments and Performance Scalar consequences

Situation	***Payment to unit for SS supply***	***Compensation payment to TSOs***	***Availability Performance Scalar consequence***	***Event Performance Scalar consequence***
DASSA Order Holder submitted incompatible FPN (entirely incompatible so not allowing any volume)	×	✓	N/A	N/A
Confirmed DASSA Order Holder submitted compatible FPN, maintains availability and responds to any Frequency Events	✓	×	×	×
Confirmed DASSA Order Holder submitted partially compatible FPN, maintains availability and responds to any Frequency Events	✓ (For compatible part)	✓ (For incompatible part)	×	×
Confirmed DASSA Order Holder submitted compatible FPN but is subsequently not available due to TSO action in BM or at dispatch	✓	×	×	N/A
Confirmed DASSA Order Holder submitted compatible FPN and is subsequently not available, but this is not due to TSO action	✓*	×	✓	N/A
Confirmed DASSA Order Holder submits compatible FPN, declares availability but does not respond to Frequency Events	✓*	×	×	✓
Unit does not hold Confirmed DASSA Order but declares availability and responds to any Frequency Events	Possibly through FAM	N/A	N/A	×
Unit does not hold Confirmed DASSA Order but declares availability and fails to respond Frequency Events	Possibly through FAM*	N/A	N/A	✓

** Payment nullified by applicable Performance Scalar where the unit does not declare availability for any volume of their Confirmed DASSA Order or where the unit entirely fails to respond to a Frequency Event as applicable.*

2.4 Function of the DASSA

The Day Ahead System Services Auction (DASSA)

System Service suppliers will be able to bid price-quantity points (subject to minimum and maximum price levels set by the TSOs) into the DASSA to indicate their System Services supply function, in a similar manner to the DAM.[13] The DASSA will then assign System Services volume orders ('**DASSA Orders**') for periods during the following day and identify a clearing price for each System Service(s) during each period.

Compatibility with FPN

The DASSA does not directly procure supply of System Services, but rather creates a contractual requirement to submit a compatible FPN that allows a DASSA Order allocated by the auction to be met. Therefore, the TSOs must be able to check whether an FPN is compatible with a DASSA Order to determine whether this contractual commitment has indeed been met.

The TSOs already use knowledge of the operational characteristics of units to consider the system stability consequences of changing energy positions when accepting BM bids or taking dispatch actions. We envisage a similar situation in which, when units register to participate in the DASSA, they identify the relationship between their energy positions and the volume of a System Services that can be supplied. This relationship could be updated from time to time by notification to the TSOs if operational characteristics of the unit change, but we do not envisage dynamic updating. The TSOs then uses that **notified SS/FPN relationship** to determine whether a DASSA Order is compatible with a notified FPN for each period.

Payments

A DASSA Order becomes a **Confirmed DASSA Order** if its holder submits an FPN that is compatible with supplying the System Services volume in the Order. Confirmed DASSA Orders will be remunerated, unless the unit subsequently fails to supply without this being a consequence of BM or dispatch action.

[13] For this basic design we assume that other quality parameters would be part of a fixed service definition. We also assume that bids would be divisible (subject to any minimum service volumes specified by the TSOs). It may be possible to allow bidders to specify whether bids should be non-divisible bids if this were important for bidders. This would be considered when selecting winning bids, by solving first under the assumption that all bids are divisible, and then calculating alternative outcomes in the event that a non-divisible bid were accepted at the margin, in order to either accept or reject the bid entirely, depending on the associated cost of doing this. Location data would also be needed for some services (and has implications both for selecting winning bids and for secondary trading), but this is considered separately as an extension to the basic design.

Conversely, a DASSA Order lapses if its holder submits an FPN that is not compatible with supplying the System Services volume in the Order. These holders will be liable for a compensation payment to the TSOs.

Whether a DASSA Order is confirmed or lapses depends on its FPN, which is determined *before* any dispatch instruction and/or BM actions and is, therefore, within the holder's control. Equally, DASSA Order Holder payments are not affected by the BM or dispatch instructions by the TSOs that arise after notification of the FPN, which are outside the holder's control.

Secondary trading

DASSA Orders would be tradeable up to a deadline close to the BM for the corresponding time period (e.g., an hour before the BM opening, as is the case for the continuous IDM). This would provide an alternative route for System Service providers who only know their availability closer to running time.

Trades would only be allowed between approved parties (for instance by only allowing trade with pre-approved peers) to ensure that the TSOs can verify that the commitment can be met by the new DASSA Order Holder. Trades would need to be notified to the TSOs so that they have current information about DASSA commitments when entering the BM, and also to be able to make the necessary payments (i.e. compensation payments).

Rights and liabilities attached to DASSA Orders

To avoid creating impediments to secondary trade, it is important that both the right to payment and liability for compensation payments associated with a DASSA Order should be transferable and be the same regardless of who holds the Order. For this reason, we propose these payments are only defined in relation to the DASSA clearing price, and not to unit-specific factors (as would be the case with Performance Scalars, which has a different effect on units depending on their total output). Under this approach, the obligations and payments are unambiguously associated with a DASSA Order and can be transferred between trading parties.

Where a DASSA Order is transferred, the new holder takes on the obligation to have an FPN compatible with the System Services supply obligation in the DASSA Order, with compatibility assessed according to the notified SS/FPN relationship of the new holder (which is already known to the TSOs as the new holder will have previously registered to be a potential DASSA participant).

Therefore, secondary trading adds some practical complications, for example:

- any provider taking on a DASSA Order needs to have already registered a profile relating the compatibility of a System Services supply commitment against its FPN; and
- trades need to be notified to the TSOs to allow eventual settlement and DASSA and FAM payments.

In principle, this does not require any form of explicit trading venue (for example, secondary trades could be bilateral agreements rather than order book matching) provided that the two requirements for TSOs' notification above are met. However, given the potential difficulties for units wishing to identify trading counterparties (possibly at short notice) and the need for the TSOs both to approve a trade and keep track of trades, a central secondary trading platform might greatly facilitate and encourage secondary trading, improving participation opportunities with technologies with availability determined closer to real-time.

2.5 Function of the FAM

Deviations from the DASSA outcome

There are several reasons why the volume of System Services supplied under Confirmed DASSA Orders may be insufficient to meet system stability requirements:

- There could be some changes to volume requirements between the DASSA and the actual time of supply of System Services.
- Even with the possibility of secondary trading, some DASSA Orders may lapse due to the holders failing to provide a compatible FPN.
- Some Confirmed DASSA Orders may become unable to supply the System Services volume in the Order due to BM actions by the TSOs.[14]

BM and dispatch actions consider system stability

In response to any of these changes, the BM and dispatch actions will ensure that enough providers are able to supply the required volumes of System Services for secure operation of the system. This is an intrinsic feature of the scheduling and dispatch process, as it should only give rise to outcomes where system stability requirements are met. Therefore, the BM and dispatch process effectively source any additional System

[14] With respect to this situation, it would be possible for a unit to partially fulfil the volume in the Order. However, the volume must be supplied for the full time period.

Services volumes that are required but cannot be met by DASSA Orders.

However, there is still the question of what payment should apply for any additional volumes of System Services that are needed to meet system requirements, but which are not supplied under a Confirmed DASSA Order. This is the role of the **Final Assignment Mechanism (FAM)**.

The Final Assignment Mechanism (FAM)

The FAM will be run for every time period covered by DASSA Orders, to assign the volume requirement of System Services that was not covered by Confirmed DASSA Orders. The FAM will be run as an **ex-post reconciliation** to remunerate provision of additional System Services volumes that were necessary to meet system requirements. Units need to have declared availability to qualify for payments from the FAM.

FAM Assignments

To remunerate the provision of additional System Service volumes necessary to meet system requirements, the FAM will create what we call **Adjusted Supply Functions** for the units that eventually supplied those System Services during the corresponding time period, given their eventual availability. The Adjusted Supply Functions are based on the offers implied by the DASSA bids, but are corrected to reflect eventual supply and any volumes already supplied under Confirmed DASSA Orders. The Adjusted Supply Functions also add in any additional volumes supplied without a corresponding DASSA bid at a default price.

For the avoidance of doubt, there is no opportunity for service suppliers to make new bids for the FAM. In Section 7, we discuss a possible extension to allow providers to make DASSA bids that are only considered in the FAM, but not considered when clearing the DASSA. However, even in this extended model, we still envisage that bids are made a day ahead.

The individual Adjusted Supply Functions will be combined into an aggregated supply function, and the cheapest service suppliers will be assigned a total volume equal to the difference between the final total system requirement and the volume already supplied under Confirmed DASSA Orders. These are the **FAM Assignments**, which will be remunerated at the corresponding clearing price (subject to any Event Performance Scalars).

3 The DASSA

The DASSA procures a commitment for providers to enter the BM with an FPN that is compatible with the provision of System Services volumes assigned by a DASSA Order.

3.1 Structure of bids

Bids are made for individual System Services products, for a specific time period, which might most easily be the periods on which the BM operates (i.e., 30 minutes), though could be a multiple of this for some services.

Bids endure until real-time

Bids remain valid after the DASSA and until real-time. Therefore, the TSOs may subsequently take System Services on the terms specified in the bid (provided that this is compatible with the bidder's energy position), even if the bidder has not been successful in the DASSA. However, the bidder is not required to maintain an energy position that is compatible with supplying the volumes offered in its bids which do not win and which are not covered by a DASSA Order.

Structure of bids

Our current proposal is to use bids similar to the simple orders used for the DAM/IDA. Bids would be made by units, who would be able to provide a stepwise supply function indicating the quantity they would be willing to supply at prices within an interval set by the TSOs (i.e., within a minimum and maximum price). To do so bidders will specify one or more quantity/price pairs, subject to the requirement that quantities must be non-decreasing with price.[15]

Additional parameters may be required for some services (e.g., location for locationally differentiated System Services). However, this will be covered separately as an extension to the basic design set out here. Other quality parameters would be part of the fixed product definition, rather than specified by bidders in their bids (which we discussed in Section 6).

We envisage that, in the long run, bidders could be allowed to:

- indicate whether the volume offered is divisible or not;

[15] Unlike in the DAM, we propose to not require that bidders specify quantities for both the default and maximum price. This is important if we want to keep flexibility to adjust supply functions when going into the FAM at the prices set by bidders using the approach set out below.

- make ‘block’ bids covering several time periods, to express any complementarity across periods, or any technical constraints that affect the speed at which they can turn on/off supply; and
- make ‘complex orders’ as in the DAM.

However, we do not consider these to be a key issue at this stage, so these options are not considered for the basic design, but only as possible future extensions.

3.2 Clearing

For the basic design set out in this Section, we propose that different System Services are cleared independently of each other. More sophisticated approaches, such as clearing different services jointly are treated as an extension to the basic design.

Continuous provision

One such extension is that the TSOs may have a preference to procure reserve services at different timescales (FFR, POR, SOR and TOR1) from a common service supplier, provided this does not create too much additional cost. This has the potential to create limited interactions across services when clearing. We discuss this issue of continuous provision in Section 6. Nevertheless, the principle that each service is cleared in a separate auction and has a defined price is maintained.

Stacked supply

Bidder supply functions will be combined into an aggregated supply function. The DASSA clearing price for each service will then be that which is needed to procure the total DASSA volume requirement for that service.

The DASSA clearing price is the common price that will be paid for volumes in Confirmed DASSA Orders. It will also be the reference for calculating compensation payments, which we propose to be calculated using a proportion (potentially 100%) of the clearing price times the Order volume that the holder cannot supply.

3.3 DASSA Orders

The outcome of the DASSA leads to the award of DASSA Orders, which specify:

- the volume of System Services covered by the DASSA Order;

- the unit price that the DASSA Order Holder will be paid if it enters the BM with an FPN that is compatible with the supply of System Services volume in the order (which is the corresponding DASSA clearing price);
- the unit price for compensation payments that DASSA Order Holders who enter the BM with an FPN that is incompatible with the supply of System Services volume in the order will be required to pay to the TSOs; and
- the deadline for secondary trades in relation to the DASSA Order.

The information about all DASSA Orders and their initial holders will be publicly released. This should facilitate secondary trading.

3.4 Secondary trading of DASSA Orders

Trading conditions

Providers can trade DASSA Orders up to a deadline close to opening of BM. We assume that it would be reasonable for trading to close one hour before the BM for the relevant DASSA product.

Secondary trading provides a mechanism for providers who might only know availability to provide System Services close to real-time to supply. A secondary market would allow such providers to lay off obligations from DASSA Orders that they found they could not meet or to take over others' obligations closer to real-time if they could supply those more cheaply. These trades could occur bilaterally (subject to notification to the TSOs of changes to holders of DASSA Orders) but would be facilitated by a centralised matching mechanism.

Trading would be subject to eligibility criteria, to ensure that buyers of DASSA Orders have capability to be in a compatible FPN and to implement any other restrictions that may be necessary, for example if certain DASSA Orders are subject to special conditions (e.g. locational or technological).

Upon trading a DASSA Order, the change of holder would need to be notified to the TSOs.[16] Partial trade of the volume in an Order would be allowed (subject to any minimum volume

[16] Note that we envisage DASSA bids being made at the level of individual units. Therefore, a provider with a portfolio of units could sift a DASSA Order from one unit to another (subject to any locational or technical limitations than might apply), but this internalised trade would still need to be reported to the TSOs.

requirements that may apply), thus allowing providers to split Orders, and/or aggregate them if a provider obtains several Orders for the same System Services.[17]

Given the potential search costs for units wishing to trade and the need for the TSOs to keep track of trades and ensure these occur only between pre-approved parties, a central secondary trading platform might be crucial for enabling secondary trading.

Central trading platform

Both trading and monitoring of trades could be facilitated by channelling all trades through a central platform provided by the TSOs, similar to the Intra-Day Continuous Market. This would allow for rapid matching of offers to buy and sell Orders, checking of eligibility and an immediate update of relevant information. In the absence of a central trading platform, it would be essential to ensure at least that the TSOs are notified of trades.

We understand that the HLD does not envisage the development of a central trading platform as part of the initial design. Instead, the HLD requires that the competitive process should allow for its inclusion at a later stage (if it were considered appropriate following consultation 18 months after operation of the new market arrangements).

Whilst a central trading platform is not essential for the proposed approach to work, it may be the only way to ensure that trading can be done with the necessary reassurance that trades are properly notified to TSOs in a timely manner, as TSOs need to keep track of who holds obligations to supply System Services. We expect that this platform would be similar to the IDM. It would then be appropriate to require all DASSA Order trading to occur via the platform in order both to ensure the TSOs are notified of trades and to maximise liquidity.

If secondary trading were to occur without a central platform, it may be necessary to set an earlier deadline for secondary trades to ensure that there is sufficient time to make notifications and update records prior to the BM. This would reduce the efficacy of secondary trading, as one of the main reasons to implement it is to provide an entry route for units that cannot accurately forecast their availability too far in advance. Without a central trading platform it might also be necessary to require that units are only allowed to trade with pre-approved peers – units would

[17] TSOs may set some limits, if necessary, with respect to the minimum and maximum volume that can be held by an individual supplier.

need to establish partners ahead of any trade, which would need to be pre-approved by the TSOs (and any trades with peers which have not been pre-approved would be voided, and the Order seller would remain liable for compensation payments depending on its FPN when entering the BM).

There may be further complexities associated with secondary trading, which will be subject to further considerations when refining the design of enduring arrangements.

3.5 Confirmation of DASSA Orders

Confirmed DASSA Orders and lapsed Orders

The DASSA Order Holder's FPN when entering the BM applicable for the time period of the product covered by the Order determines whether the Order becomes a Confirmed DASSA Order or lapses. If the FPN is compatible with the holder supplying the volume of System Services in the Order, then the Order will become a **Confirmed DASSA Order**, and the holder will be remunerated for supply at the DASSA clearing price (subject to any applicable performance scalars as discussed in Section 2.3 above). Otherwise, the Order lapses, and the holder is liable for a **compensation payment** to the TSOs, which applies given that the obligation in the DASSA Order would not have been met, calculated using the unit compensation price specified in the Order.

There is the possibility that a DASSA Order may be partially fulfilled (subject to any applicable minimum volume requirements), if the holder's FPN is compatible with supplying part, but not all the volume in the order. In this case, the DASSA Order would be split, with the corresponding part becoming a Confirmed DASSA Order and the other lapsing. The holder would be remunerated for supply of the volume in the Confirmed Order and be liable for compensation payment in relation to the volume in the Order that lapsed.

However, we do not contemplate the possibility that an Order is partially fulfilled with respect to the time period for which a unit supplies System Services. This ensures that we have a common time period over which we can identify suppliers for any shortfall in volumes in the FAM by using DASSA bids, as DASSA bids are for the full period, not part of it. Therefore, if, when entering the BM, a unit had an FPN that is not compatible with supplying System Services for the full duration of the DASSA Order, then the full Order would lapse.

4 The FAM

The FAM identifies payments for any additional volume needed to make up the difference between the total System Services volume requirement and the volume supplied under Confirmed DASSA.

We envisage the FAM as a mechanism to reconcile the DASSA outcome with whatever subsequent BM and/or dispatch actions the TSOs take. We make no particular assumptions about BM and/or dispatch actions, other than that they always ensure system stability. In particular, if a supply of System Services from a DASSA Order Holder becomes infeasible given its changed energy position, then it will have been necessary to choose some other supplier of System Services as a replacement. This is what already happens in the BM and at dispatch.[18] Therefore, as System Services requirements are in practice met, the role of the FAM is not to ensure the supply of services, but only to identify payments amongst suppliers.

The FAM will:

- calculate what we call **Adjusted Supply Functions** using data from the DASSA and eventual availability; and
- determine **FAM Assignments** to ensure that the System Services volume requirement is met, at the same time setting a **FAM clearing price** for that System Service.

4.1 Input data

The FAM requires the following information:

[18] The total potential supply of System Services given the positions after the BM and dispatch is assumed to always be sufficient to meet the TSOs' requirements, as these requirements are considered when taking BM and dispatch actions. Therefore, the FAM is not needed to ensure that there is sufficient supply of System Services. However, in some cases, the total supply might exceed the total System Services volume actually required, as some units may be in a position to supply System Services not because they were needed for System Services, but simply as a collateral effect of the need for their supply of energy (e.g., part-load plant brought on by TSOs could provide reserve or ramping). In these cases, the FAM will identify some of the potential suppliers as those who will be remunerated for the volume of System Services they supply.

- the (potentially revised) total System Services volume requirement (in the event that the required volume is different from that in the DASSA);
- the bids made in the DASSA;
- the applicable default price for that System Service;
- the Confirmed DASSA Orders; and
- the eventual availability of units.

The corrective volume of System Services that we need to assign in the FAM is the difference between the (potentially revised) total System Services volume requirement and the total volume eventually supplied under Confirmed DASSA Orders.

4.2 Adjusted Supply Functions

The FAM will assign the corrective volume at the lowest possible cost (with winners being paid at a new clearing price) from a set of **Adjusted Supply Functions** derived from DASSA bids. These are adjusted to reflect any volumes already supplied under Confirmed DASSA Orders and the units' final supply (given by their eventual energy positions and availability, independently of whether the unit was triggered or called upon to deliver) in the corresponding time period.

The Adjusted Supply Functions are calculated as follows.

- We start from each unit's supply function offered through its DASSA bids. (A unit's supply function is taken to be zero volume if the unit did not make any DASSA bids).
- The maximum volume in the Adjusted Supply Function is the unit's actual supply given its eventual availability. Therefore, where the unit offered to supply higher volumes in the DASSA, the maximum volume in its supply function is constrained to its eventual availability. Conversely, where the unit supplied a larger volume than it offered in the DASSA, we need to add this volume to its supply function, at the lowest price at which it offered to supply its maximum volume in the

DASSA.[19] For units that did not make any DASSA bids, this additional volume is offered at the default price.

- We then need to take out any volume already supplied by the unit under Confirmed DASSA Orders,[20] so that the Adjusted Supply Function is for *additional* volumes.

[19] In order for this to work, we remove the requirement for bidders to make a bid at the maximum price (as is the case for DAM bids), which would remove the possibility for bidders to offer to expand supply at their highest bid. This does not penalise bidders, as they may still make their highest bid at the maximum if this is in their interest.

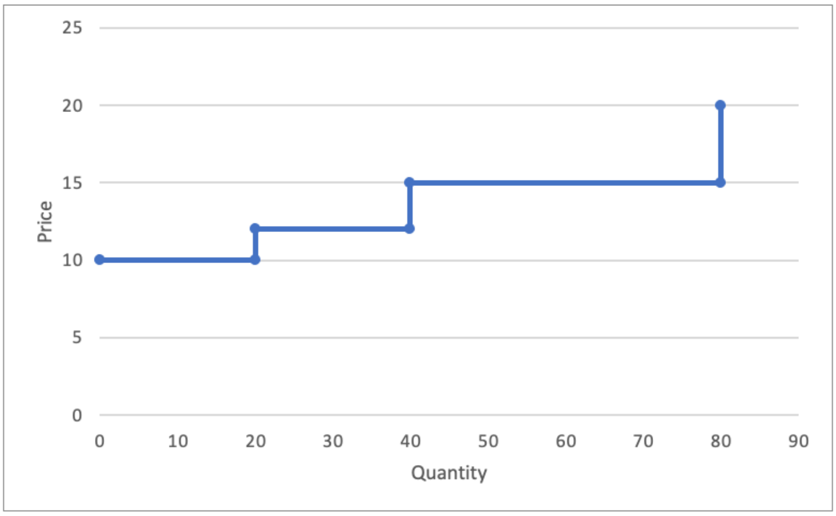
[20] Notice that the adjustment is made for Confirmed DASSA Order Holders, regardless of whether they won their order in the DASSA or acquired it through secondary trading after the DASSA. This means that a unit that had won in the DASSA, but has subsequently sold all of the volume in its DASSA Order in the secondary market, would not have any volume removed from its DASSA supply (though its maximum supply will be constrained by its eventual availability).

Example 1: Adjusted Supply Functions for the FAM

Unit A made a DASSA bid with the following (price, quantity) pairs:

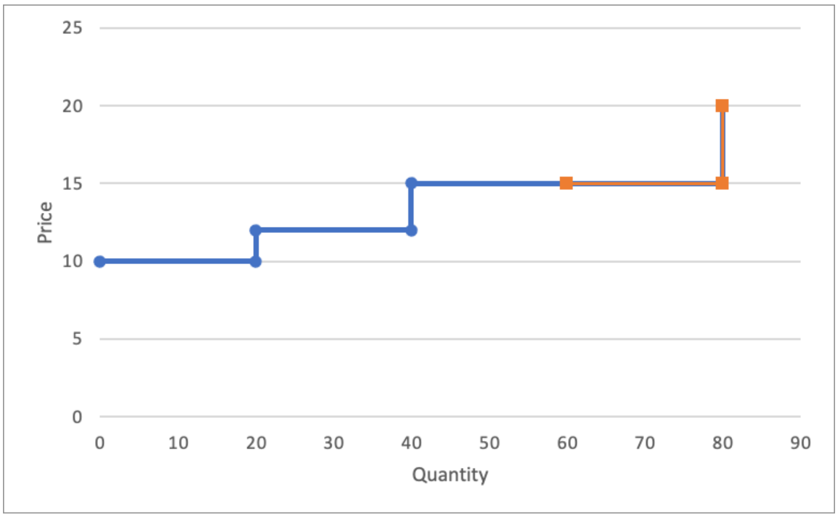
- (10, 20)
- (12, 40)
- (15, 80)
- (20, 80)

The DASSA supply function would be as follows:

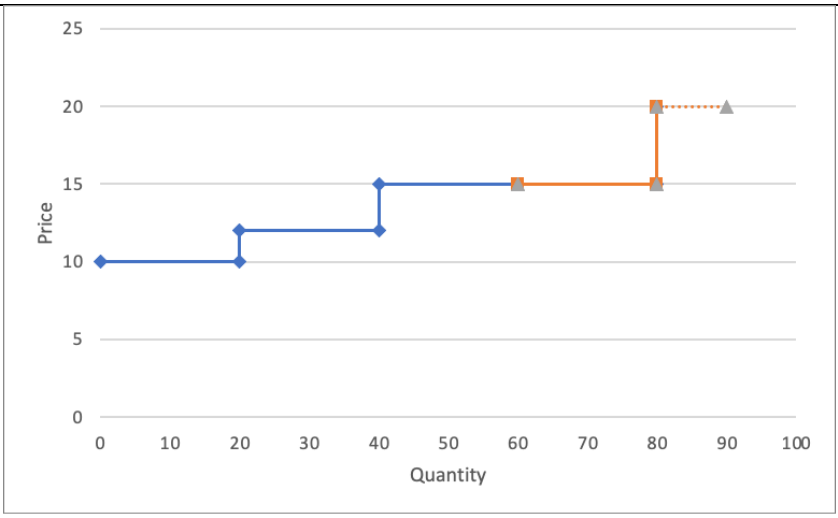


Case A

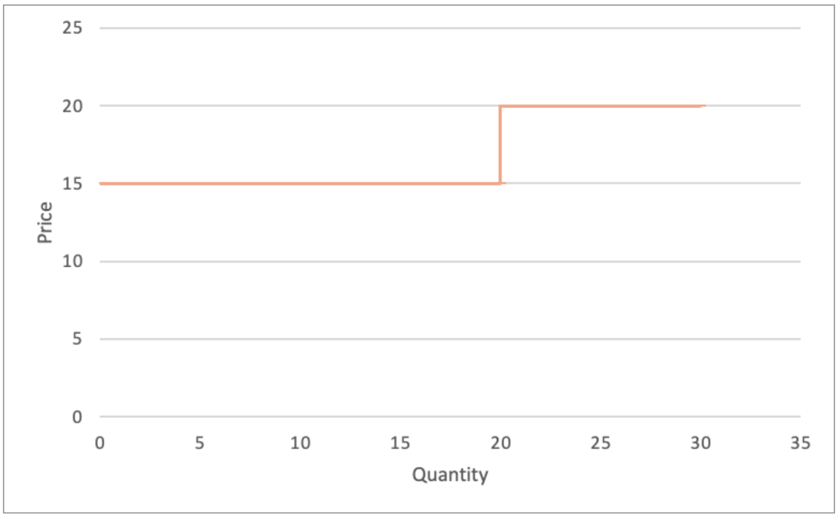
Suppose in the end, Unit A holds a Confirmed DASSA Order for a volume of 60 MW. As a result, the relevant part of the supply function is only that for volumes of 60 MW or more, shown in orange:



Given unit A's eventual availability, it supplied 90 MW. In this case, we need to *add* the additional supply – we do this at the lowest price at which Unit A offered its maximum quantity shown in the dotted orange line:

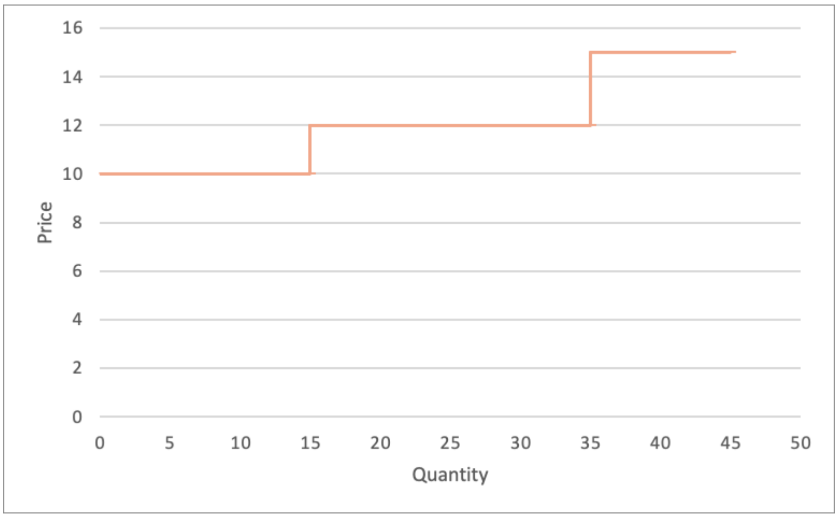


Finally, we subtract the volume already covered by the Confirmed DASSA Order:



Case B

Suppose, instead, that in the end, Unit A holds a Confirmed DASSA Order for a volume of 5 and given its eventual availability it supplied 50 MW. In this case, we need to *drop* the part of the supply function, which is infeasible given this energy position, and then subtract the volume in the DASSA Order:



4.3 FAM Assignments

The FAM is cleared using the same approach as in the DASSA, but now using the Adjusted Supply Functions. This yields a new **clearing price** and volumes for each supplier.

The clearing price in the FAM is not constrained by the clearing price in the DASSA, so it can be higher or lower.[21]

The clearing outcome leads to **FAM Assignments**, which specify:

- the volume of System Services covered by the Assignment; and
- the unit price that the Assignment holder will be paid.

We use the term 'Assignment' rather than 'Order' to emphasise that this is, in its basic form, an ex-post reconciliation process in

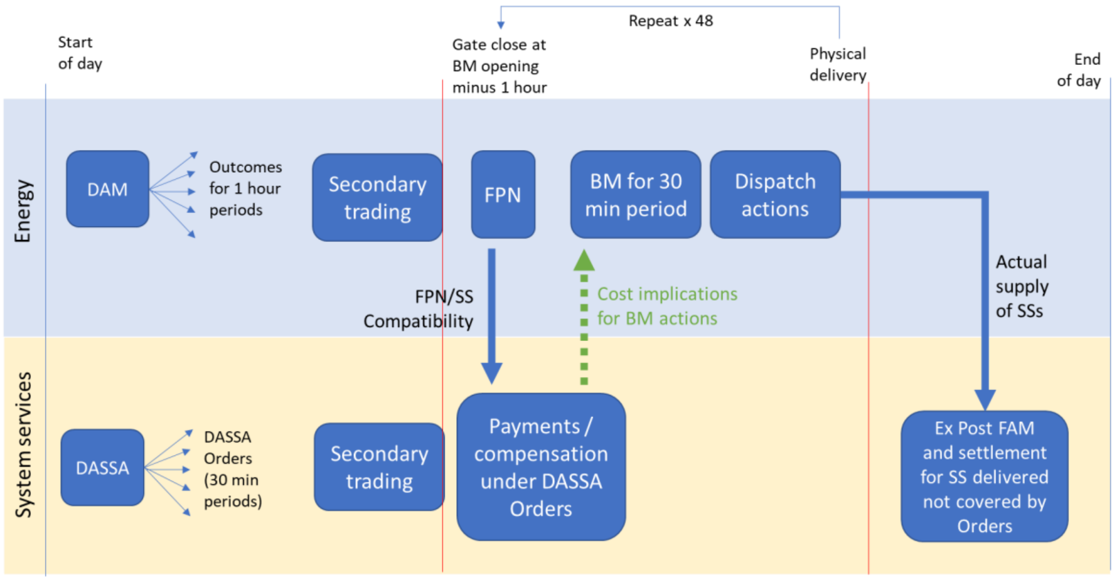
[21] If we need to procure System Services from suppliers that were unsuccessful in the DASSA due to being too expensive, then the FAM clearing price will be higher than the DASSA clearing price. Conversely, if we only procure System Services from suppliers that had been successful in the DASSA (who may have sold part or all of the volume in their DASSA Order) or from suppliers who did not offer the volume they are assigned in the DASSA (offered at the default price), then the FAM clearing price might be lower than the DASSA clearing price.

the light of eventual availability. In contrast, DASSA Orders imply contractual obligations.

4.4 Timing

The relationship between the DASSA and the FAM is illustrated below.

Figure 1: FAM timing and inputs



Under this simple approach, BM and dispatch actions are taken without direct consideration of their consequence for eventual payments for System Services that might need to be made through the FAM. However, it is possible for the TSOs to anticipate the FAM cost implications of BM and dispatch actions, as we explain below, and take these into account when taking those actions.

4.5 Cost consequences of energy actions

There is no opportunity for bids to be revised after submission in the DASSA. Therefore, it is in theory possible to identify the consequences for payments in the FAM of any post-DASSA changes in energy positions that result in DASSA Orders becoming incompatible and additional losing DASSA offers being taken instead.

As a very simple example, suppose that one DASSA winner is moved to an incompatible position. Because we already know all the DASSA bids, we can already determine what FAM payment would be triggered if no other changes were made to other DASSA winners' energy positions. If the TSOs had a choice between several DASSA winners, one of which might be moved to an incompatible energy position, we could calculate the System Services cost consequences for each option.

Note that DASSA payments are not affected by whether BM bids are accepted, as the DASSA payment would be made anyway to the affected DASSA winner if it achieves a compatible FPN regardless of whether it has any BM bids subsequently accepted. Therefore, the overall energy and System Services cost consequences of accepting BM bids and changing energy positions can simply be added together.

If the same situation arose subsequently, we could in principle simply run a similar process to determine the overall energy and System Services cost consequences of different energy actions. In effect, this is the same as simulating the FAM repeatedly each time energy positions change. Therefore, it is in principle possible for the FAM to have an ex-ante aspect, in the sense of being hypothetically run against various possible changes in energy positions to determine their consequences for additional payments that might need to be made through the FAM.

Given this, there is a possibility of including System Services cost consequences within the BM explicitly and also having information available on System Services cost consequences when taking dispatch actions. We do not develop this methodology in detail in this report, as our working assumption is that System Services auctions would need to be implemented and working well before such further changes to the BM or dispatch procedures could be contemplated. However, we note the potential to make such an extension.

5 A supplier perspective

The first potential entry point for a System Service supplier is the DASSA. Participating in the DASSA provides an opportunity to be assigned a DASSA Order at the DASSA clearing price. Even if a DASSA bid loses, there is still the possibility it might be considered within the FAM.

A DASSA bidder automatically participates in the FAM and is eligible to deliver System Services without a DASSA Order if it holds a compatible energy position. It also has the possibility of providing an energy position compatible with supplying a higher maximum volume of System Services than offered in its DASSA bid.

The different entry (i.e. offering potential supply of System Services) and exit (i.e. cancelling obligations or potential to supply) points are illustrated in Figure 2. Entry possibilities are shown in green boxes on top, and exit possibilities in red boxes at the bottom.

Figure 2: Entry and exit points for the short-run System Services market

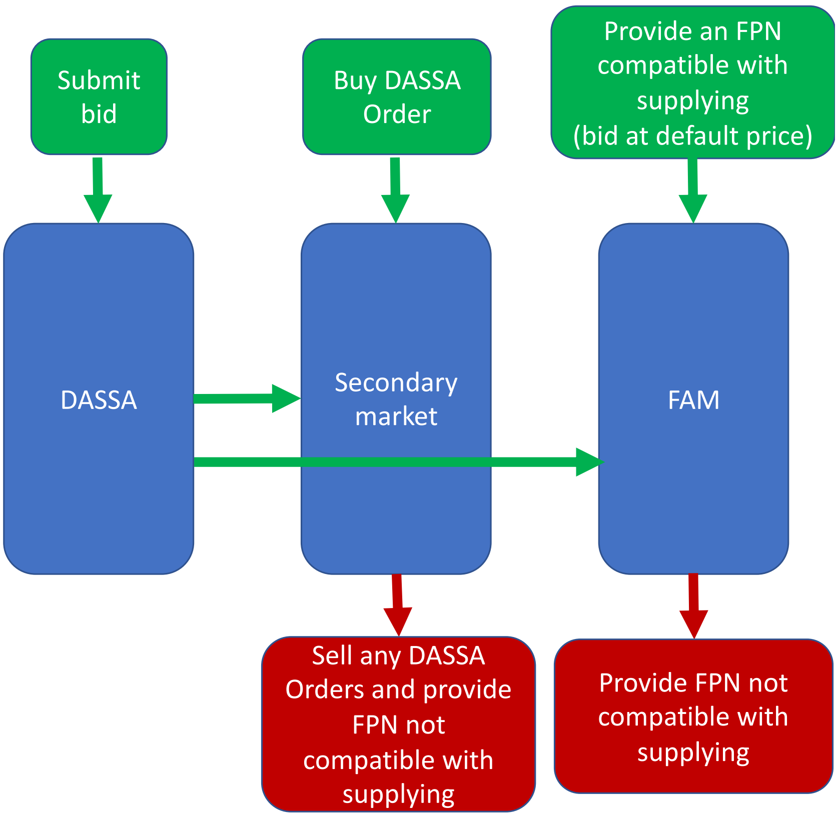


Figure 3 and Figure 4 provide an overview of the DASSA and FAM respectively, and the consequences of a unit's energy position and availability for determining payments (which were also summarised earlier in Table 2).

Figure 3: Overview of DASSA

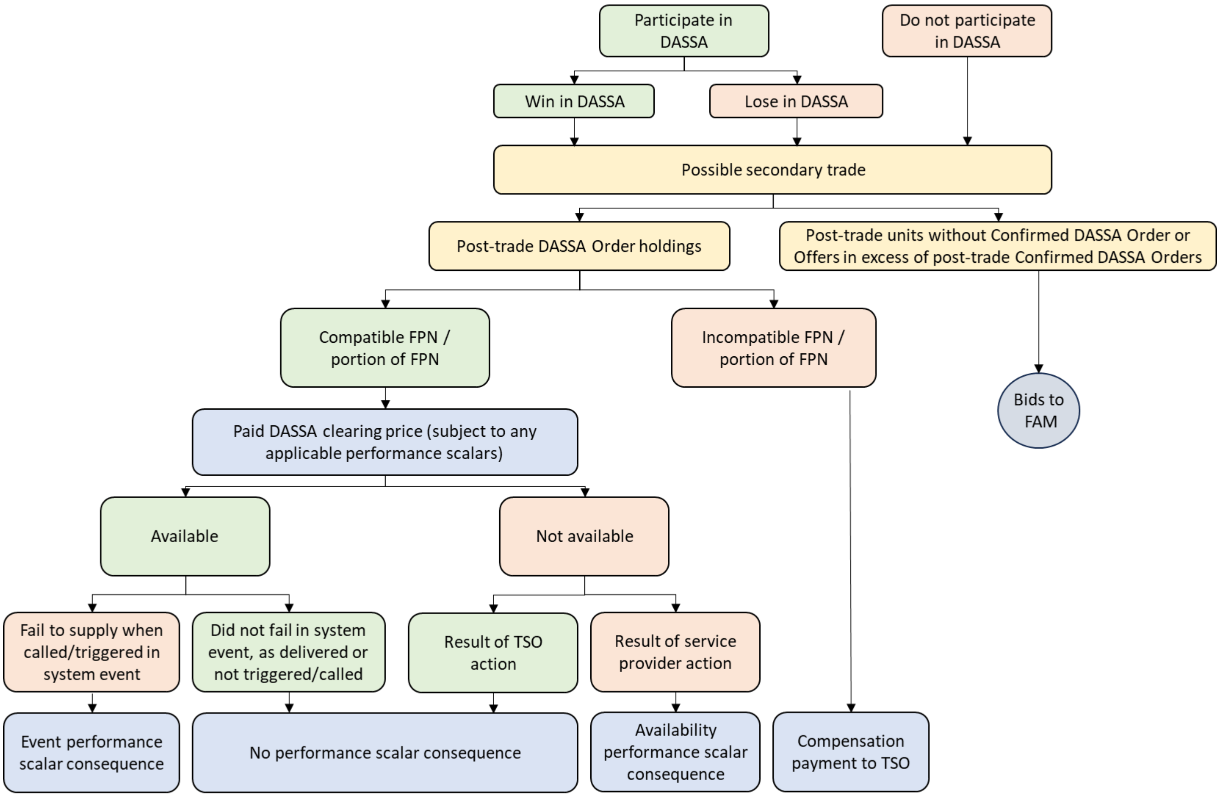
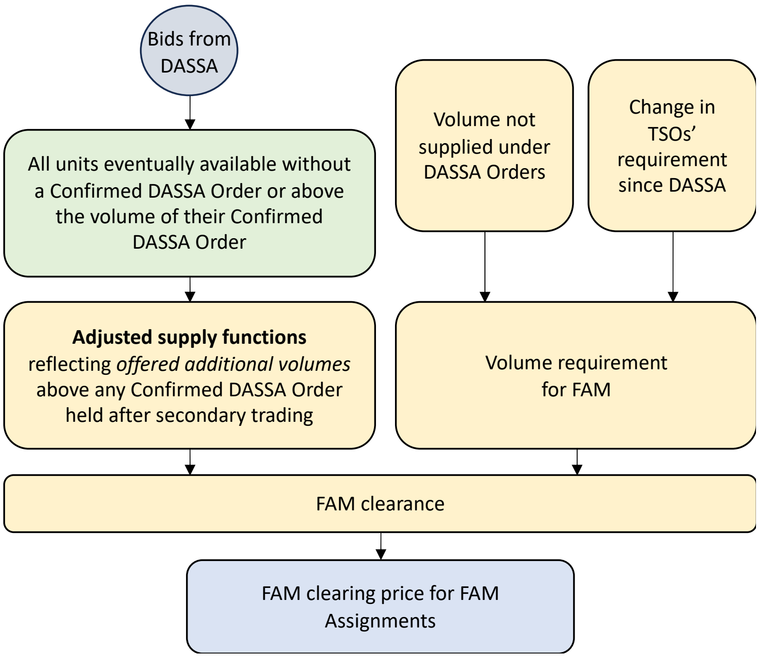


Figure 4: Overview of FAM



Below we provide examples of the mechanics used for adjusting supply functions and determining FAM Assignments.

Example 2: FAM Assignments

Suppose that for a given time period for a reserve product, the final volume supplied under Confirmed DASSA Orders is 40 MW lower than total volume requirement.

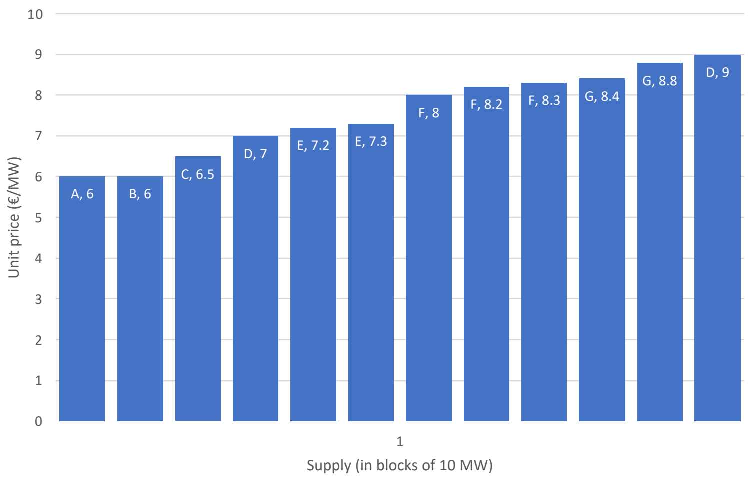
The first step in the FAM is to create a merit order to assign this volume to those units who supplied it at the lowest cost.

Suppose that we construct the Adjusted Supply Functions as follows:

- Units A and B did not make DASSA bids, but eventually supplied to 10 MW each. Assuming that the default price is €6/MW, the Adjusted Supply Function for each of these units is 10 MW at €6/MW.
- Unit C made a DASSA bid of 30 MW at €6.5/MW and had a Confirmed DASSA Order of 30 MW. In the event it supplied to 40 MW. Its Adjusted Supply Function is thus 10 MW at €6.5/MW.
- Unit D made a DASSA bid of 10 MW at €7/MW and 30 MW at €9/MW. It did not hold an Order but eventually supplied 20 MW. Therefore, its Adjusted Supply Function is 10 MW at €7/MW and 10 MW at €9/MW.
- Unit E made a DASSA bid of 10 MW at €7.2/MW and 20 MW at €7.3/MW. It did not hold an Order but eventually supplied to 20 MW. Therefore, its Adjusted Supply Function is 10 MW at €7.2/MW and 10 MW at €7.3/MW.

- Unit F made a DASSA bid of 10 MW at €8/MW, 20 MW at €8.2/MW and 30 MW at €8.3/MW. It did not hold an Order but eventually supplied 30 MW. Therefore, its Adjusted Supply Function is 10 MW at €8/MW, 20 MW at €8.2/MW.
- Unit G made a DASSA bid of 10 MW at €8.4/MW and 20 MW at €8.8/MW. It did not hold an Order but eventually supplied up to 20 MW. Therefore, its Adjusted Supply Function is 10 MW at €8.4/MW and 10 MW at €8.8/MW.

The aggregate supply function and merit order are illustrated as follows:

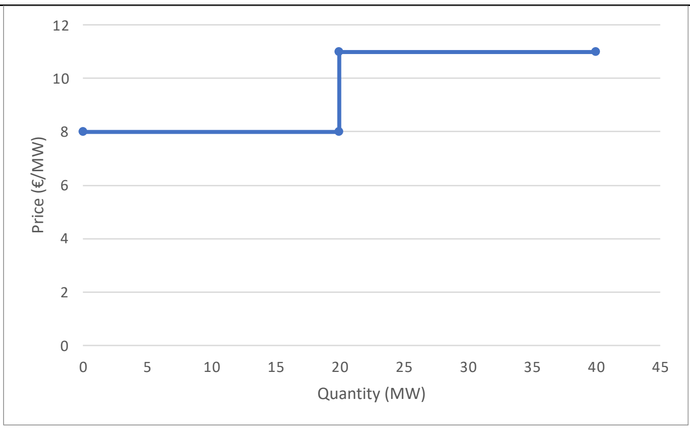


Each column represents a supply of 10 MW and is labelled indicating the unit that supplied that volume and the unit price in that unit's Adjusted Supply Function.

For the FAM Assignments we select the first 40 MW in the merit order. Therefore, units A, B, C and D each receive a FAM Assignment of 10 MW each, at the FAM clearing price of €7/MW.

Example 3: DASSA winner that does not trade in the secondary market

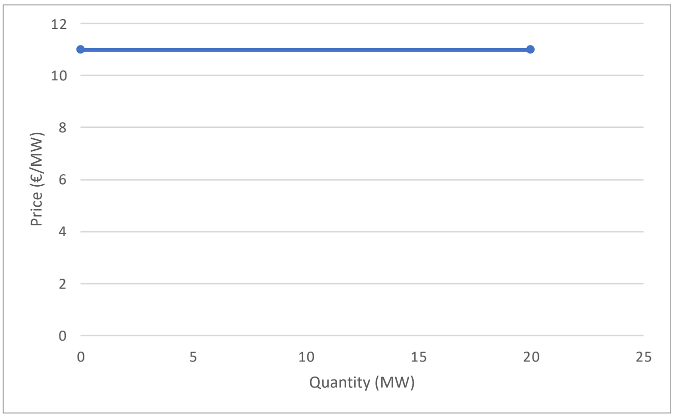
A unit makes a DASSA bid for a reserve product, offering up to 20 MW at a price of €8/MW and up to 40 MW at a price of €11/MW. It DASSA supply function is as follows:



The DASSA clears at a price of €10/MW. The unit is awarded a DASSA Order for 20 MW at €10/MW.

The unit does not trade in the secondary market, and its FPN is compatible with the unit supplying 40 MW. Its DASSA Order becomes Confirmed, and thus the unit will be remunerated €200 (the volume in its DASSA Order times the DASSA clearing price) in relation to this Order. However, the unit could still supply an additional 20 MW given its FPN.

Suppose that the TSOs do not change the unit's energy position through BM or dispatch action, so the unit eventually supplies a total of 40 MW. In this case, the unit's Adjusted Supply Function for the FAM is as follows:



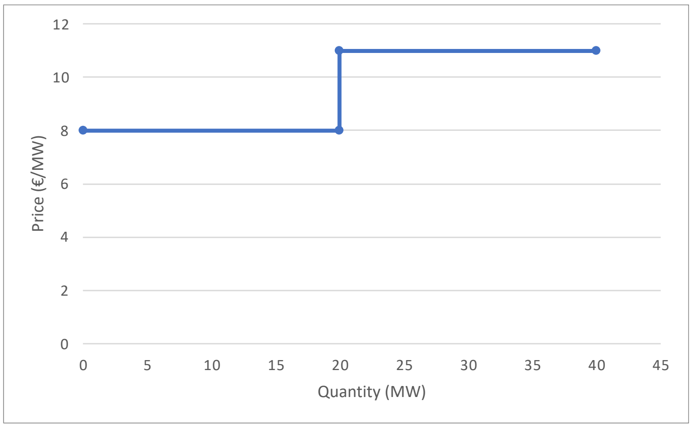
If the FAM clears at a price below €11/MW, then the unit does not get a FAM Assignment.

If the FAM clears at a price above €11/MW, then the unit will receive a FAM Assignment for the full 20 MW at the FAM clearing price.

If the FAM clears at a price of €11/MW, then the unit might be assigned a FAM Assignment or not, depending on whether the additional System Services volume needed to meet system requirements is already assigned to units that are ranked before it in the merit order.

Example 4: DASSA winner that trades in the secondary market

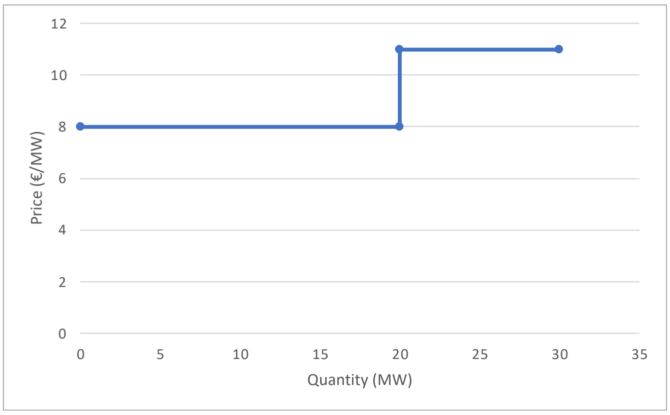
A unit makes a DASSA bid for a reserve product, offering up to 20 MW at a price of €8/MW and up to 40 MW at a price of €11/MW. It DASSA supply function is as follows:



The DASSA clears at a price of €10/MW. The unit is awarded a DASSA Order for 20 MW at €10/MW.

The unit sells its Order in the secondary market, and its FPN is compatible with the unit supplying 30 MW of the reserve service. The unit does not hold a DASSA Order (and will not be paid for this), but it could still supply up to 30 MW given its FPN.

Suppose that the TSOs do not subsequently change the unit's energy position through BM or dispatch action, so it eventually supplies 30 MW of the reserve service. In this case, the unit's Adjusted Supply Function for the FAM is as follows:



If the FAM clears at a price below €8/MW, then the unit does not get a FAM Assignment at the FAM clearing price.

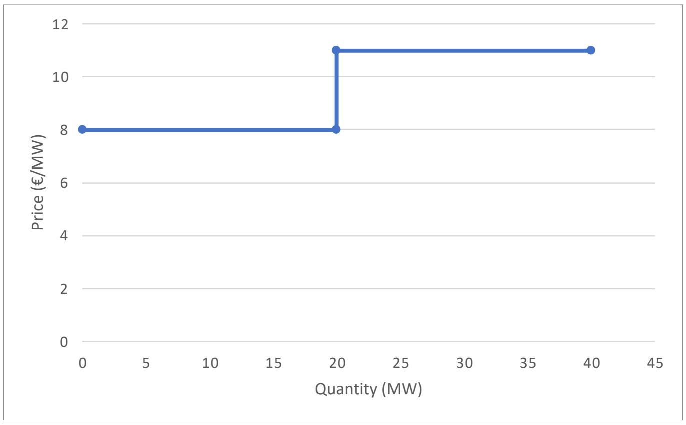
If the FAM clears at a price between 8 and €11/MW, then the unit will receive a FAM Assignment for 20 MW at the FAM clearing price.

If the FAM clears above €11/MW, then the unit will be assigned a FAM Assignment for the full 30 MW at the FAM clearing price.

As above, in the event that the FAM clears exactly at €8/MW or €11/MW, the volume that the unit might be assigned through a FAM Assignment depends on whether the additional System Services volume needed to meet system requirements is already assigned to units that are ranked before it in the merit order.

Example 5: DASSA winner that gets its final energy position affected by BM or dispatch action

A unit makes a DASSA bid for a reserve product, offering up to 20 MW at a price of €8/MW and up to 40 MW at a price of €11/MW. It DASSA supply function is as follows:

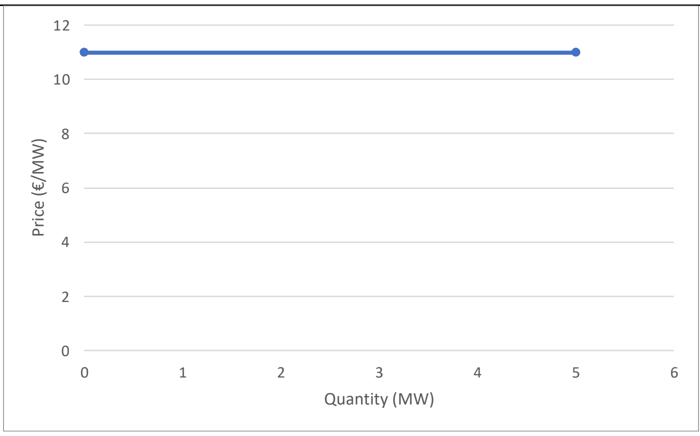


The DASSA clears at a price of €10/MW. The unit is awarded a DASSA Order for 20 MW at €10/MW.

The unit does not trade in the secondary market, and its FPN is compatible with the unit supplying 20 MW of the reserve service. Its DASSA Order becomes Confirmed, and thus the unit will be remunerated €200 (the volume in its DASSA Order times the DASSA clearing price) in relation to this Order.

Suppose that after the BM the unit is moved into an energy position in which it cannot supply any of the product. The unit still receives the payment of €200 in relation to its Confirmed DASSA Order.

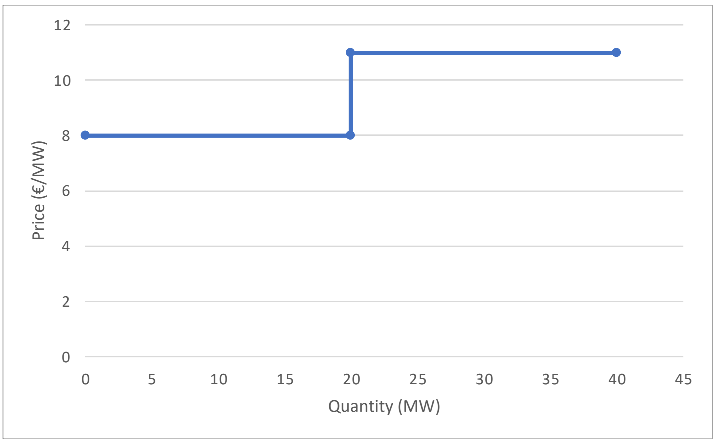
Further suppose that finally, after dispatch, the unit ends supplying 25 MW of the reserve service. In this case, the first 20 MW are covered by the unit's Confirmed DASSA Order, but the additional 5 MW could receive a FAM Assignment. Therefore, the unit's Adjusted Supply Function for the FAM is as follows:



12
10
8
6
4
2
0
Price (€/MW)
0
1
2
3
4
5
6
Quantity (MW)

Example 6: DASSA bidder in a position to supply above the volume of its bid

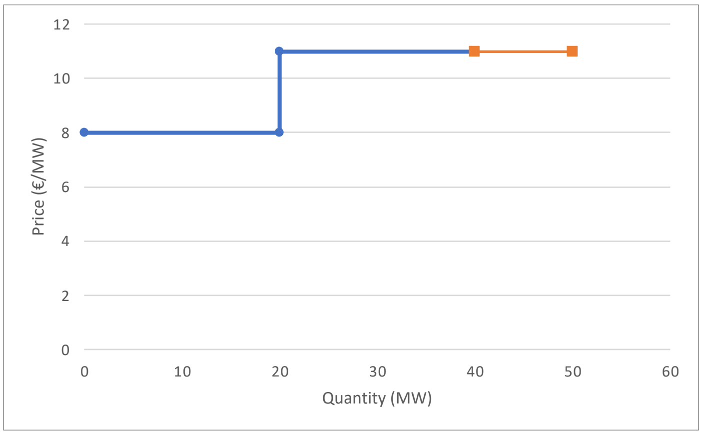
A unit makes a DASSA bid for a reserve product, offering up to 20 MW at a price of €8/MW and up to 40 MW at a price of €11/MW. It DASSA supply function is as follows:



The DASSA clears at a price of €7/MW. The unit is not awarded a DASSA Order.

The unit does not trade in the secondary market, and its FPN is compatible with the unit supplying 20 MW.

Suppose that subsequent BM or dispatch actions leave the unit supplying 50 MW of the service. In this case, the unit's Adjusted Supply Function for the FAM is as follows (blue indicates the volume covered by its DASSA bid, and orange the additional volume without a corresponding DASSA bid):



If the FAM clears at a price above €11/MW, then the unit will receive a FAM Assignment for a total volume of 50 MW at the FAM clearing price.

If the FAM clears at a price of exactly €11/MW, then the unit will receive a FAM Assignment for a total volume between 20 MW and 50 MW at the FAM clearing price.

If the FAM clears at a price between €8/MW and €11/MW, then the unit will receive a FAM Assignment for a total volume of 20 MW at the FAM clearing price.

If the FAM clears at a price of exactly €8/MW, then the unit will receive a FAM Assignment for a total volume between 0 MW and 20 MW at the FAM clearing price.

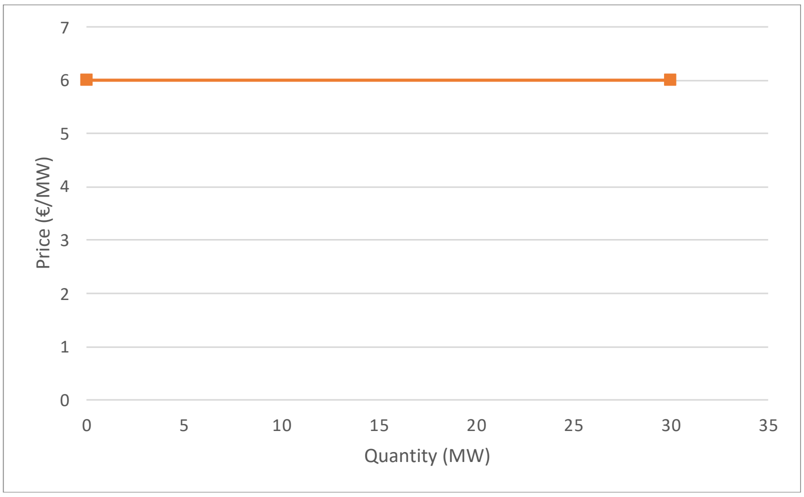
If the FAM clears at a price below €8/MW, then the unit does not receive a FAM Assignment at the FAM clearing price.

Example 7: DASSA non-participant in a position to supply

A unit that is qualified to supply does not make a DASSA bid for a reserve product.

The unit does not trade in the secondary market, and its FPN is compatible with the unit supplying 20 MW.

Suppose that due to subsequent BM or dispatch action, the unit eventually supplies 30 MW. Suppose also that the default price for this product is €6/MW. In this case, the unit's Adjusted Supply Function for the FAM is as follows:



If the FAM clears at a price above €6/MW (the default price), then the unit will receive a FAM Assignment for a total volume of 30 MW at the FAM clearing price.

If the FAM clears at a price of exactly €6/MW, then the unit will receive a FAM Assignment for a total volume between 0 MW and 30 MW at the FAM clearing price.

It is not possible for the FAM to clear at a lower price.

6 Extensions to the clearing process

In this section we consider three potential extensions to the auction process which includes:

- the possibility of a service having several **quality levels** (FFR being the leading example of this);
- procuring '**continuous provision**' of several reserve services from a common provider; and
- **complex bids** such as a minimum revenue requirement or a 'block' bid applying across time periods.

The first two potential extensions do not require any adjustments of the structure of bids. Bids are still made independently for each service in each time period. We still run individual auctions for each service that determine a separate price for each service. However, we add an additional step where the TSOs determine the mix of volumes to be procured across several auctions for interrelated services. We consider how this mechanism can be applied to quality levels first as this is somewhat simpler, then apply it to the related, but more complex, question of continuous provision.

In contrast, complex bids involve changes both to the bids made and also to the clearing process. This introduces interactions across time periods, unlike the first two extensions.

6.1 Quality aspects

'Types' of a service

We have assumed existing DS3 service definitions remain in place for the purposes of considering the design of the procurement process. However, it is important that the procurement process is future-proof and that modifications and additions to the set of services can be made.

SONI and EirGrid have identified a potential need for expansion of the FFR service into several 'types' varying by how fast frequency response can be provided, whether the service is provided in a dynamic or static manner and the frequency at which the reserve can be triggered (analogous to the current FFR characteristics for which incentives are provided in the regulated arrangements). More generally, the situation could arise in which services could have quality aspects that the TSOs might want to consider when procuring them. More generally, any automatically triggered reserve services might have variants with somewhat different trigger conditions.

We do not consider the merits of any particular scheme for differentiating a service into various quality types. Rather we note that there are plausible circumstances in which the TSOs might need such a procurement approach and the enduring auction design would benefit from having such a capability.

It is possible to include non-price elements as continuous parameters to be specified within bids and then to include these within a more complex multifactorial evaluation of which bids win. However, such methods typically involve assigning some weighting to price and non-price elements, leading to scoring processes that may be somewhat arbitrary and non-transparent.

Distinct service types

Therefore, our recommended approach is to introduce a small number of distinct 'types' of such services and then to clear each of these separately. The TSOs then have a choice of how much of each of these various types are procured, depending on the clearing prices that would be established. From a bidder's perspective this involves very little change relative to the DASSA/FAM structure already set out.

To be more concrete, suppose that a service has several distinct quality types, labelled $1,2, \ldots, n$. Each type has defined service requirements. Bidders then make bids within the DASSA to supply a service type within a certain time period, as already described. In effect, each type is no different to a separate service from the bidder's perspective.

Bidders can make bids for one or more types within the same time period, but there is no linkage across these bids. In particular, none, one or several of those bids might win and become a DASSA Order. Bidders would need to meet all of the obligations within their DASSA Orders in the usual way if bids for different types of the same service won in the DASSA. In practice we expect bidders' choice of service type to be driven by their technology.

Simple clearing

So far, we have assumed that the TSOs will have an identified quantity requirement for a particular service in a particular time period. Typically, this is a fixed quantity, which then determines the clearing price within the DASSA for that service. By stacking bids in ascending order of unit price for a service, we can create an aggregate supply curve $S(p)$, which is the total quantity offered by bids with a unit price below p. If the TSOs have a quantity requirement Q, then the clearing price $p^\star$ satisfies the clearing condition $S(p^\star) = Q$.[22]

Price-dependent requirements

It is simple to extend this to the case where the TSOs have a quantity requirement for a service that depends on its cost to them. If the quantity requirement is $Q(p)$, a decreasing function of price, then the clearing price satisfies $S(p^\star) = Q(p^\star)$. Whilst a price-dependent requirement is simple to implement for a service, this is not relevant for DS3 service definitions, as fixed quantities of each service will be required set in line with expectations of requirements for each time period.

Clearing with multiple types

Whilst individual 'types' of services are no different from individual services from the bidders' perspective, for the TSOs types represent alternative ways of meeting the service requirement.

The enhanced quality service is more effective in meeting the TSOs' system stability requirement than a standard service, as defined. Therefore, there will typically be some trade-off between procuring a smaller amount of a more effective enhanced service and a larger amount of less effective standard service. The terms of this trade-off might vary with the quantities taken of the various types of service.

The bids made for a type i imply an aggregate supply curve $S_i(p_i)$ for that type representing how much it costs to procure different quantities. Therefore, the TSOs can simply pick some mix of quantities across the various types given how much it costs to procure the various quantities of each type.

The picking of a quantity-mix across the various services could be represented by a rule, or more generally captured by expressing the TSOs' preferences through an objective function. Mathematically, these preferences over the mix of types can be generally represented by the optimisation problem:

$$\max_{p_1,\ldots,p_n} V\big(Q_1(p_1), Q_2(p_2), \ldots, Q_n(p_n)\big) - \sum_i p_i Q_i(p_i)$$

subject to the requirement that:

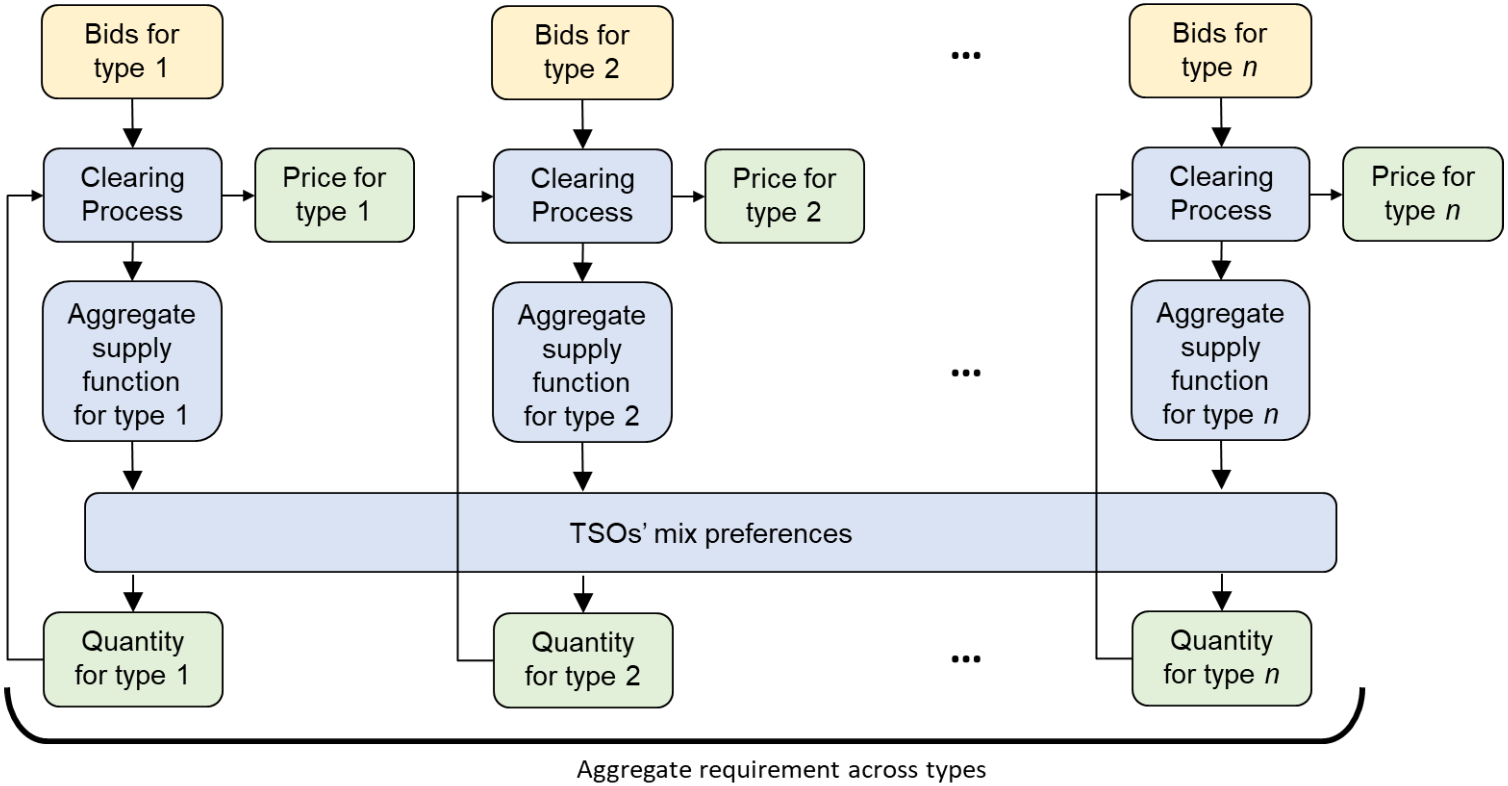
[22] More generally, $p^\star$ would be the lowest price for which $S(p^\star) \geq Q$ to allow for the lumpiness due to bids being for quantities that may be significant relative to the requirement. Therefore, we assuming for presentational simplicity in this section that bids are small in quantity terms relative to requirements.

$$\sum_i Q_i(p_i) = \bar{Q}$$

where $\bar{Q}$ is the total quantity requirement that must be met across all the various types of the service. The function V encodes preferences for the mix of types, in effect placing an implicit valuation on various mixes. This is not a complex optimisation, as we are simply choosing quantities along the various aggregate supply curves for the types.

The overall process is illustrated in Figure 5 below. Each clearing process is just a conventional ordering and stacking of offers to supply that service type. This establishes an aggregate supply curve for each service type. There is then an overarching determination of the quantity mix across the various types, setting the quantities required for each type. The individual auction for each type then sets its clearing price given the quantity procured.

Figure 5: Overall process for types of a service



To take a very simple example, suppose that we have three different services, say short, medium and long response times for FFR. Suppose that the short type is 20% more effective than the long type and the medium type is 10% more effective than the long type. Then the objective function V would be:

$$V = 1.2q_{short} + 1.1q_{med} + q_{long}$$

In this very simple example, the TSOs would be likely to procure only one type (assuming sufficient supply is available), because they only care about relative performance of the different types, not achieving some mix.[23] However, suppose that the short type were much more effective, say 50%, in limited amounts, but that diminishing returns set in if the overall mix is too heavy in the short type. In particular, if more than half of the total service requirement across all types comes from the short type then its additional effectiveness is only 20%. The objective function would become:

$$V = \begin{cases} 1.5q_{short} + 1.1q_{med} + q_{long} & \text{if } q_{short} \leq q_{med} + q_{long} \\ 1.2q_{short} + 1.1q_{med} + q_{long} & \text{otherwise} \end{cases}$$

As far as bidders are concerned, they do not need to know about what objective the TSOs will use to decide how to split the total service requirement volume across the various types of that service. Bidders simply bid independently for each type. Clearing (i.e., sorting and stacking offers) still establishes a separate price for each service.

Under this approach, we are excluding the possibility that bidders may wish to make more complex bids in which they bid in the same time period for a number of types of a service, with a restriction that they only win one type. If types are substitutes for providers and they can provide only one, they will need to anticipate the relative clearing prices of different types to decide which type to bid for in any particular time period. However, because the DASSA is repeated, information is readily available for bidders to make such decisions. In practice, we do not expect that bidders would switch between types in the short-run; the choice of type is more likely to be affected by long-run technology decisions.

[23] This is because the objective function is a simple linear function.

6.2 Continuous provision

Operational benefits of a single provider

At present the TSOs have a scalar for continuous provision of reserve on different time scales (FFR, POR, SOR and TOR1). When the same party provides all these services simultaneously, a premium is added to payments under the regulated DS3 tariffs. This is intended to encourage providers to have the capability to provide all these services together. This 'continuous provision' has an operational benefit for the TSOs, in that if shorter time scale reserve is called, but then longer reserve subsequently needed, swapping of the provider can be avoided.

In the context of an auction for these services, the TSOs prefer certain reserve services being procured from the same provider. We can accommodate the TSOs' preference for continuous provision into the auction clearing process, reusing some of the ideas discussed in the previous subsection. In particular, no modifications of bids are needed. The general approach is first to identify where 'continuously provided' offers have been made by a common provider and to create a hypothetical bundled service. This hypothetical service can be cleared conventionally (by ordering and stacking bids). Finally, we need to decide what volume of this bundled service the TSOs wish to procure, as opposed to taking various individual services from different service suppliers.

Clearing recipe

Reusing our earlier notation, suppose that we have several services labelled $1, \dots, n$. There is a preference for a common service supplier of all n different services. Bids are evaluated using the following recipe.

First, we introduce a *notional* 'bundled' service consisting of all of these n services. If a bidder has offered some quantity q of *every one* of these service at unit prices $p_1, \dots, p_n$ through its DASSA bids, then it is considered also to have made an offer to supply the bundle at a unit bundle price of $\sum_i p_i$.

We emphasise that we are not introducing package bidding here. Bids are still made separately for each service type in the DASSA. We are just collating these offers to see what possibilities there are for the TSOs to buy all services from a common 'continuous provider'.

Second, create an aggregate supply curve for the bundled service $Q_B(p_B)$. This is the sum of all the (notional) offers for bundles at unit bundle prices below p_B.

Third, suppose we hypothetically set a clearing price for these bundled bids to clear a quantity Q_B of bundled services from common service suppliers. We now consider the possibilities for accepting additional quantities of individual services, but not from a common service supplier. Some DASSA winners will not be supplying their DASSA quantities, in which case their bids for individual services remain as they were. Where a DASSA winner is supplying some bundled quantity of all services, we consider offers it has made *in excess of this common quantity* to supply the individual services. Taking these modified bids, we construct aggregate supply curves for the individual services in the usual manner (by ordered and stacking).

Now the aggregate supply curves for individual services depend on how much bundled quantity Q_B we have taken. We can write the aggregate supply for service i as a function $Q_i(p_i, Q_B)$ of its individual price and the quantity of 'continuous provided' bundled services Q_B we have accepted. As we accept more of the bundle, less quantity is available to be accepted as individual services.

Fourth, the TSOs pick the mix of 'continuously provided' bundled services required and individually provided services (where different services do not necessarily all have a common service supplier). The aggregate supply functions map out the possibilities for the TSOs to accept offers for bundled services (with different services supplied by the same service supplier) and individual services.

As in the previous subsection, we can generally represent the TSOs' preferences for the quantity mix by an optimisation problem:

$$\max_{p_b, p_1, \ldots, p_n} V\left(Q_B(p_b), Q_1\big(p_1, Q_B(p_b)\big), \ldots, Q_n\big(p_n, Q_B(p_b)\big)\right)$$
$$- p_B Q_B(p_b) - \sum_i p_i Q_i(p_i)$$

subject to the constraints:

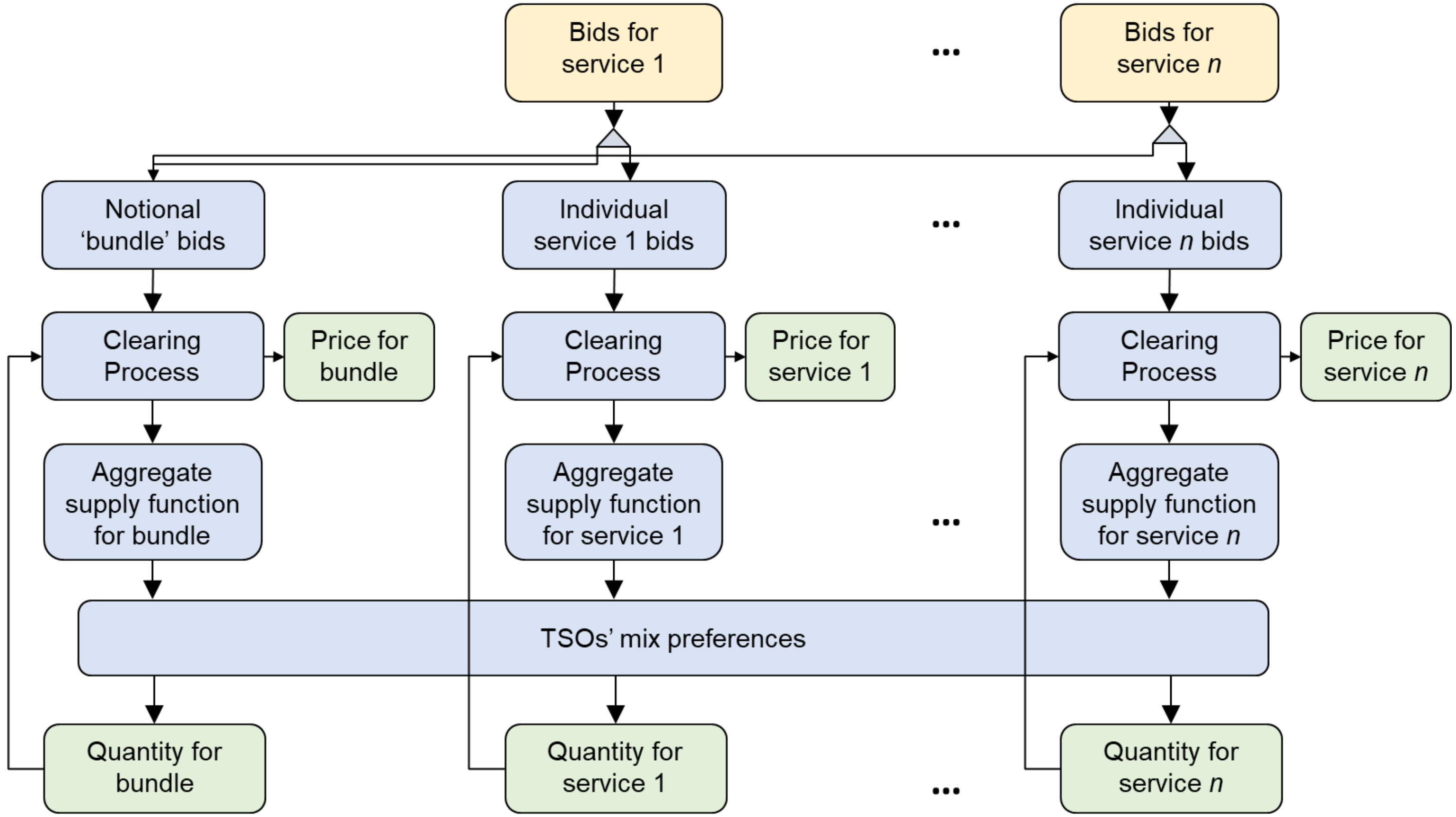
$$Q_i(p_i) + {Q_B}^i(p_B) \geq \bar{Q}_i \quad \forall i$$

$$p_B \geq \sum_i p_i$$

where $\bar{Q}_i$ is the quantity requirement for service i.

The overall process is summarised in the figure below.

Figure 6: Clearing processes with continuous provision preference



V represents the TSOs' preferences across how the service requirements are met from the bundled (continuous provided) services or the individual services. For example, if the TSOs considered that continuous provided services are 50% more effective than separately provided ones from distinct service suppliers, then:

$$V = 1.5Q_B + \sum Q$$

The TSOs' value function for bundled products would be pre-determined and fixed. It would not be changed in response to the specific bids received.

Bundled price vs individual prices

Those who supply the bundled service (i.e., the same quantity of each service) receive the bundle price, whereas individual service suppliers receive the individual prices. It is quite possible that a service supplier might get a DASSA Order for a bundle, with a common quantity across all services at the bundle price, and then some extra quantity of one or more services at the individual price.

We have imposed a constraint that the bundled price is at least as great as the sum of the individual prices. Because we are (notionally) clearing the continuous provided services separately from the individual services. If the accepted bid for bundled services were all from cheaper service suppliers, then without this constraint we could have the bundled price being less than the sum of individual service prices. This would undermine the incentive for continuous provision.

Often, we would expect to see a premium being paid for the bundled service, limited by the TSOs' willingness to switch to services that are not continuously provided by the same service suppliers. However, the premium is market determined and depends on relative supply and demand. If they are many continuous service suppliers, the premium can be eroded or even fall to zero.

6.3 Complex bids across time periods

We do not see any overwhelming need for complex bids across time periods as part of the initial deployment of the DASSA. However, we recognise that some bidders might consider that they could potentially benefit from such a facility.

Introducing complex bids involves creating interrelationships between time periods. The DAM includes such features as:

- block bids, where a bid in one time period is conditional on winning a bid in an adjacent time period; and
- minimum revenue requirements, where the bidder can set a minimum revenue needed across a number of bids, otherwise all of those bids fail.

These structures are potentially useful in energy supply where it is costly for a provider to start up and these costs need to be recovered across more than one of the settlement periods. This appears far less relevant for System Services.

It is typically not feasible to deal with such bids through clearing processes based on full optimisation of the winning bids. This is because we might have chains of interdependencies across many time periods. Rather, the typical approach is to:

- initially clear time periods within regard to complex bid constraints;
- consider whether any accepted bids fail to meet block bid or minimum revenue requirements;
- delete such bids; and
- make up any resulting quantity shortfall by accepting further bids.

This approach is not necessarily fully cost minimising and is most appropriate where only a small minority of bids express such constraints. Where most bids are complex bids, approximate optimisation techniques may be preferable.

7 Extensions to FAM bidding

In this section we consider further possible extensions to the basic design. These extensions might provide more flexibility for bidders who cannot commit to supply System Services the day ahead to be able to specify the price for their Adjusted Supply Function for the FAM in the event that they subsequently end up in a position to supply.

The basic design proposals for calculating Adjusted Supply Function in Section 6 use a simple approach by which we simply curtail or extend DASSA supply functions to reflect eventual supply. This approach should work reasonably well if we only expect small deviations relative to the supply offered in the DASSA. However, it has limitations in that it does not allow bidders to specify higher unit prices for volumes above the maximum offered in the DASSA.

The limitations of this approach may be problematic for units that do not know their availability until relatively late. They may be unwilling to offer volume in the DASSA but may still have the possibility of winning a FAM Assignment if their eventual energy position is compatible with supplying System Services. Under the current proposals the supply for these units is at the default price, under the assumption that these units would be happy to act as price-takers. However, it is possible that only such units receive FAM Assignments, in which case the clearing price would be the default price rather than competitively set by bids. If these units have costs that exceed the default price, then they might have poor incentives to offer System Services in the FAM by providing a compatible FPN and declaring availability.

In this section we consider two potential extensions to the proposals that provide more flexibility for providers to specify the price for their Adjusted Supply Function to be used in the FAM. This would be useful for potential service suppliers that only know their availability relatively late, but know their costs of supplying the service in advance. These potential extensions are only presented for consideration and we make no recommendation at this time whether they should be included in the design.

7.1 Zero-volume bids

Consider the case of a unit that bids in the DASSA, where the highest (price, quantity) pair offered by that unit is (p, x). For simplicity assume that the unit does not hold a Confirmed DASSA Order. If the unit's eventual energy position is compatible with supplying $y > x$, then its Adjusted Supply Function will be extended (according to the procedure already set out) so that its highest (price, quantity) pair is (p, y).

Notice that if the unit wished to specify a higher price for any volumes greater than x, it can do so by specifying an additional price point in its DASSA bid with a small volume increment. For example, it could submit (p, x) and $(p', x + \epsilon)$ where $p' > p$ and ϵ is small.[24] This means that if it ended up supplying $y > x + \epsilon$ then a marginal price p' would apply when extending its supply function.

This flexibility could also be provided to those units who are unable to commit volume in the DASSA, by simply allowing them to make a bid for zero volume at a price of their choice. In this case, this bid would not be relevant for clearing the DASSA, but would set the price for their Adjusted Supply Function in the event that their eventual energy position is compatible with supplying some volume needed in the FAM. Thus, if the unit bids $(p, 0)$ and is eventually able to supply y, then its Adjusted Supply Function would be (p, y), assuming again for simplicity that the unit does not hold any Confirmed DASSA Orders that it could have acquired through secondary trading.

This approach of allowing such zero-volume bids provides an option for units that cannot commit volume in the DASSA to specify a price that differs from the default price for their Adjusted Supply Function in the FAM. This may encourage units to offer System Services by simply providing an FPN that is compatible with supplying volume not covered by a DASSA Order in the long run, if they expect the FAM clearing price to be at or above their bid.

Providing such an enriched possibility to offer quantity in the FAM that is not offered for DASSA clearing is compatible with secondary trading. Through secondary trading, a provider can take on a DASSA Order, which entails a commitment to provide a compatible FPN. In contrast, allowing a zero-volume bid (as

[24] Alternatively, the bidder could submit *{p, x-e}* and *{p', x}I*, with similar effect that the final step in its supply offer is at a price of *p'*.

described) allows a provider to compete for any volume allocated in the FAM in the event that it has a compatible energy position and is available, but does not entail any requirement on it to achieve such an energy position.

7.2 Capping volume offered in the DASSA

The previous approach of zero-volume bids might be useful where the additional System Services volume available for potential service supply is small. However, it may still be limiting if additional volumes are potentially large and unit costs are increasing.

A more general approach would be to allow units to specify a wider range of price-quantities in their DASSA bids,[25] whilst limiting the volume they offer in the DASSA. Thus, a unit could specify a supply function up to a volume x, and then cap the volume offered in the DASSA at $y < x$. In this case, if the unit were eventually to supply $z > y$, then its Adjusted Supply Function for the FAM would be determined by any price points provided in the DASSA bid for volumes between y and z, rather than only by the price at which the bidder offered to supply y. The example below illustrates the approach.

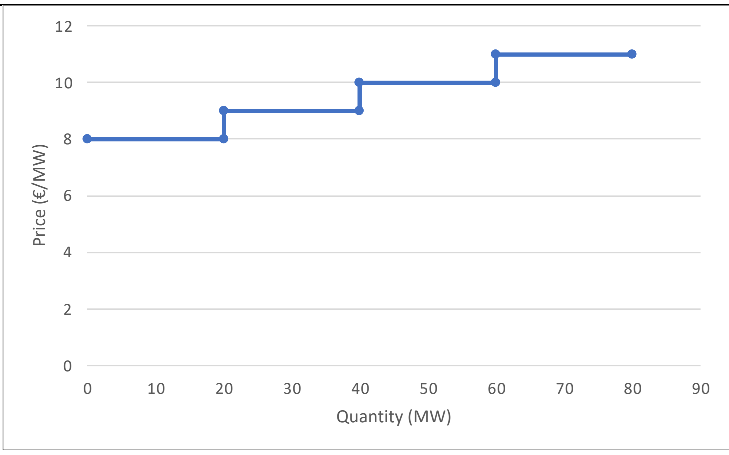
Example 8: Adjusted Supply Function when bidders are allowed to cap volume offered in the DASSA

Suppose that the bidder makes a DASSA bid for the following price points:

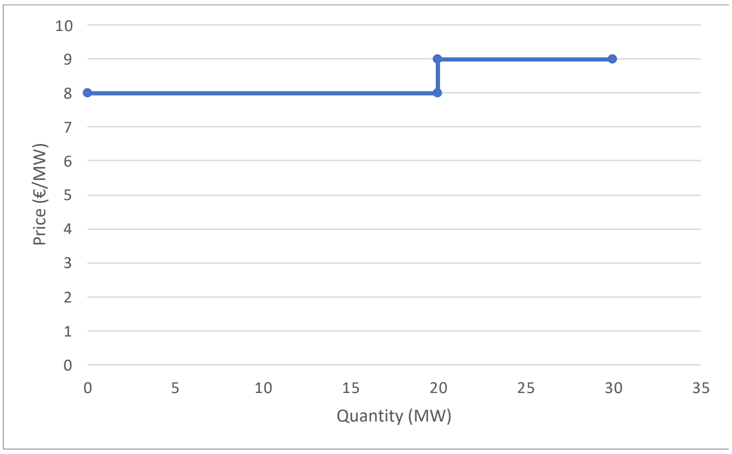
- 20 MW at a price of €8/MW
- 40 MW at a price of €9/MW
- 60 MW at a price of €10/MW
- 80 MW at a price of €11/MW

Its full supply function would be:

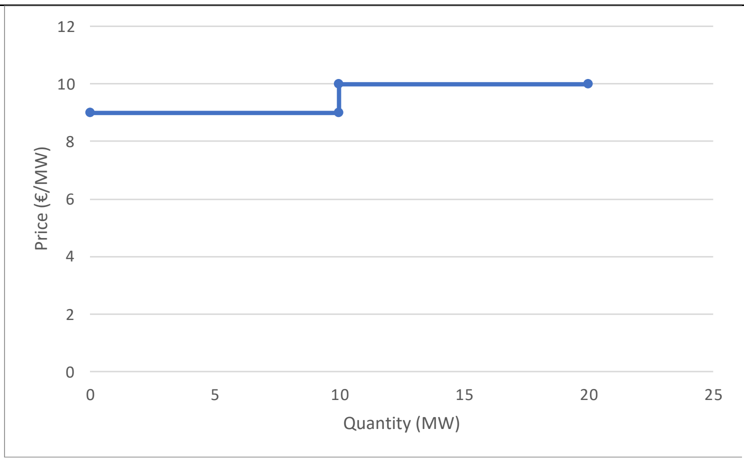
[25] As these would be DASSA bids, they would continue to be restricted to be for prices within the default and maximum prices set by the TSOs for the DASSA.



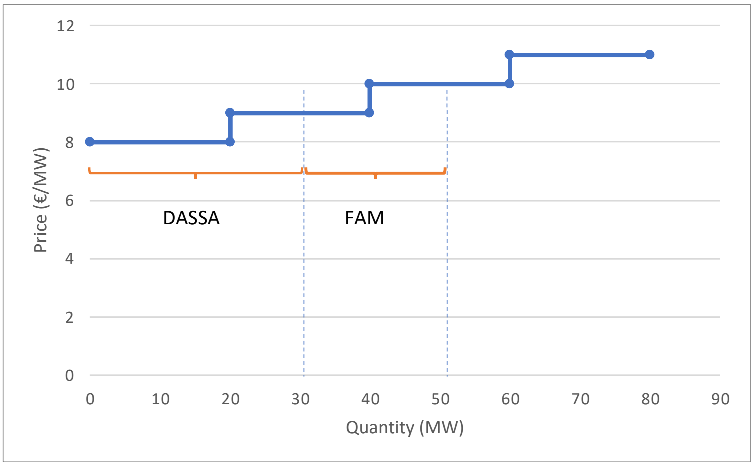
However, suppose that the bidder is not willing to commit more than 30 MW in the DASSA. In this case, the bidder could specify a cap of 30 MW for the DASSA, and its DASSA supply function would be:



Suppose now that the unit wins a DASSA Order for 30 MW, which it does not trade, and that when entering the BM, the unit is able to increase its supply up to a total of 50 MW. The unit can provide an FPN compatible with supplying up to 50 MW, in which case its DASSA Order for 30 MW will be confirmed. Assuming there are no changes to the unit's energy position through BM or dispatch action, the unit's eventual supply would be 50 MW, so an additional 20 MW relative to that covered by its Confirmed DASSA Order. Given the unit's total supply function between 30 MW and 50 MW, its Adjusted Supply Function for the FAM in this case would be:



Below we illustrate the different parts of the bidder's original supply function offered in the DASSA and the FAM:



8 Transition to new arrangements

Volume procured through the DASSA

We envisage that the transition from current DS3 regulated tariffs to these proposals for new arrangements would be phased through adjustment of the **proportion of System Services volume** being procured through the DASSA.

To create a smooth transition path, only part of the total System Services volume requirement would be initially procured in the DASSA. Volumes not procured in the DASSA will go through the FAM, with a **default price** for the supply of volumes not offered in DASSA bids, as we explain below.[26] Over time, the proportion of the overall volume requirement procured through the DASSA would be increased.

Progressively increasing the volume that goes through the DASSA would ensure that we do not have grid stability problems if participation in the DASSA is low initially. It would also allow providers to adjust to new arrangements.

Increasing the volume procured through the DASSA increases incentives for participation in the auction, as those who do not participate face an increased risk of not being selected to supply System Services in the FAM. However, if there were insufficient volumes being offered into the DASSA, it may be necessary to reduce the default price as part of the transition, as we discuss below.

Reduced frequency is a poor means of phasing

A conceivable alternative approach to phasing might be to run the DASSA at a lower frequency, procuring commitments to supply System Services for longer periods, and then increasing this frequency, eventually to daily. However, this is unlikely to be an effective means of transition. If the DASSA is run infrequently, with DASSA Orders entailing a sustained commitment to be available to supply System Services over the period between auctions, there is a risk of an unlevel playing field; it may be that only some providers can provide the necessary sustained availability over an extended period.

Therefore, we consider that better route for introduction of System Services auctions is to move directly to daily auctions. This meets the requirement of the Electricity Balancing Regulations for short-term, ideally daily, markets.

[26] Note that this formally means that DS3 regulated prices do not continue, rather than a parameter of the new regime – the default price in the FAM – is initialised at the DS3 regulated price.

8.1 Using the DASSA and FAM

The process for selecting volumes not procured in the DASSA at the default price could be done through the FAM. This would be achieved by entering additional volumes not offered as bids in the DASSA, but available for the TSOs to call upon, as adjusted supply at the default price. This default price could initially be set to the level of current regulated tariffs. Thus, the FAM would consider previously unsuccessful DASSA offers together with any other available volumes at the default price. Notice, that the FAM Assignments would only cover the volume requirement, rather than making payments to all service suppliers (as is the current situation with DS3 regulated tariffs). However, those receiving payments from the FAM would do so at a market-determined price.

As a result, we would expect the FAM to clear initially at the regulated tariff until there is a sufficient volume of System Services offered through unsuccessful DASSA bids, at which point it would be these bids that would set the clearing price.

As the FAM would only assign the necessary volumes, we would expect this to help in reducing the overall cost, even if clearing prices might be above the regulated tariff. This would be consistent with the rationale for reducing the expenditure cap under DS3.

8.2 Level of the default price

The incentive to make DASSA bids is greater if the default price (initially set at the level of the regulated tariff) is lower, as this makes non-participation in the DASSA less attractive. Therefore, in parallel to increasing the System Services volume procured in the DASSA, phasing may be assisted by lowering the default price gradually to assist the move from payment at regulated tariffs to competitive arrangements. This also means that transitioning can go beyond the end of the DS3 regime without any extension of the regulated prices, provided that the RAs can control the level of the default price as a parameter of the new regime.

However, decreasing default prices too rapidly before sufficient volume has been shifted to the DASSA risks undermining incentives for service suppliers to be available to be called upon to supply System Services in the FAM without a DASSA bid.

Therefore, we envisage a process in which volume requirements are progressively shifted to the DASSA and the default price is lowered taking into account the volume of offers in the DASSA.

This is primarily an issue for early in the transition process. Once a sufficient portion of volume requirements shifts to the DASSA, we expect there to be strong participation incentives regardless of the level of the default price, as the probability of receiving payments at the default price will fall as the volume assigned by this route falls. However, initially there may be incentives for providers to wait and see what prices the DASSA yields, which is when reduction in the default price may be helpful.

8.3 Phasing compensation payments

DASSA bids can be expected to reflect the potential cost of failing to provide an FPN compatible with DASSA Orders when entering the BM. Therefore, the higher the compensation payment for failing to honour a DASSA Order, the higher the expected DASSA clearing price.

However, the risk associated with having to pay the compensation payment may also decrease once units are familiar with the process and have better expectations about their possibilities for trading DASSA Orders. Therefore, it may be appropriate to start with relatively lenient compensation payments and increase them progressively as a greater proportion of the volume is run through the DASSA, to ensure they are proportionate to the costs incurred by TSOs. This needs to be balanced with the TSOs' requirement for having supply commitments that can be relied on, especially once significant volumes have shifted to the DASSA.

8.4 Frequency of auctions

Even though the SEM-C requirement is to have daily auctions (and this is a requirement under the EBGL), another potential parameter for the transition could be the frequency of auctions – starting with less frequent auctions and then increasing frequency until we reach daily auctions. However, we would advise against phasing in of auctions through starting with low frequency and then increasing this for the following reasons.

Holding less frequent auctions would add complexity to the process, as well as asymmetries across different technologies.

This is because a commitment to be available for a longer period, further into the future, is increasingly difficult for providers whose availability is known only closer to real time. As a result, some technologies might be unwilling to participate in such auctions, and simply rely on the possibility to be selected after the BM in the FAM. The DASSA would have limited participation, potentially excluding some technologies unable to commit availability over extended periods, and reduced competition, leading to higher prices. Furthermore, requiring that units commit to supply System Services will reduce their flexibility to supply energy, and thus may also lead to higher prices for energy.

Therefore, less frequent auctions are unlikely to be effective in determining market-based prices through a competitive process open to the widest range of bidders. They might even be considered discriminatory against technologies with relatively greater difficulty in committing to provide System Services for longer periods.

This all becomes much more problematic if regulated tariffs (which would be the alternative path to supplying System Services for those only able to determine availability close to real-time) are reduced, as without other changes this takes us further away from close-to-real-time System Services markets, limiting market access for providers with unpredictable availability. This is particularly problematic if the consequences from not being available are severe.

Therefore, we would recommend starting directly with daily auctions, and manage transition only with other parameters (volumes, regulated prices and compensation payments). This also has the practical advantage of allowing necessary systems and processes to be run in a similar way during a transition as they would be long-term.

9 Long-term contracts

In this section we discuss the new possibilities that existence of daily auctions of systems services would give for establishing long-term contracts to encourage new investment.

9.1 Need for long-term contracts

Long-term hedging is a key feature of European power markets with all power exchanges offering forward products. Such forward products are used extensively by electricity suppliers and generators to hedge volumes and prices. The role of long-term hedging and long-term contracts has also been highlighted in the recent EC market reform proposals with measures proposed to improve the PPA (Power Purchase Agreement) and forward markets.

Investment in System Services

System Service providers are no different; they need to have some certainty about future volumes and prices. This becomes even more important for technologies/providers which predominantly (if not entirely) rely on income from System Services and are making sunk, long-term investments. Where investments are sunk and there is no buyer for services other than the TSOs, investors cannot exit or seek alternative buyers if revenue streams decline. This puts the TSOs in a strong position to impose terms (in regard of price or quantity) after investments have been made. In turn, the anticipation of such risks may discourage such investment. Investors are also at risk of future regulatory actions that may occur after investment has occurred. By offering some degree of commitment on future price and/or quantities, the TSOs can reduce this ‘hold-up’ risk for investors unable to unwind their investments.

Prices and quantities

Boosting investment incentives means improving long-run predictability of both prices and volumes, especially from System Service specialists less supported by other revenue sources. This is more complex than simply offering a fixed price over a sufficiently long contract, as if the TSOs reduce quantities taken from that service supplier (say the price becomes uncompetitive given general cost trends) then its revenue reduces. Therefore, some predictability about both price and quantity is required, but this does not need to go as far as a revenue guarantee.

Benefits

We see significant benefits from improving the predictability of future revenue streams through appropriate long-term contracts:

- This lowers risk for new investment, resulting in a lower cost of capital and greater investment, especially for System Service specialists.
- New investment is encouraged. The TSOs (and consumers) benefit from greater resilience through having more options for sourcing System Services.
- Competition in daily System Services markets may be improved if new providers enter on foot of long-term contracts, but also offer additional volume into daily markets that would otherwise have been absent.
- There may be less exposure to price volatility for the TSOs (and by extension for consumers).

Drawbacks

However, there are also potential drawbacks from excessive use of long-term contracting because:

- contracted volumes may not participate in a meaningful way in the spot markets reducing liquidity and short-run efficiency;
- long-term contracting routes may be better suited to some technologies, but not others (such as demand-side response, RES and storage), raising the risk of distorting competition between technologies;
- there may be a loss of short-run cost efficiency where costs vary over time and long-term contracts do not represent the current cheapest providers; and
- there may be less innovation if routes for new entrants become limited once long-term contracts are awarded.

These drawbacks can be mitigated, whilst retaining the key benefits of long-term contracts:

- Volumes procured through long-term contracts can be limited to that need to boost investment (as new providers always have the option of selling additional volume through the daily market).
- Contracts can be structured in a way that facilitate daily market participation.
- A secondary market can allow providers to reallocate contracted positions and allow for more efficient provision to be revealed.

Our current thinking is that the physical volumes for System Services are primarily procured daily via the DASSA in accordance with the wider EU regulation. The envisaged long-term contracting of System Services is then solely aimed to supporting incremental investment that would otherwise not occur, rather than being driven by a need for the TSOs to procure System Services (or Balancing Capacity) over a long timeframe to ensure certainty.

9.2 Layered procurement

We note that the HLD provides for so-called 'layered procurement', which in practice means forward purchasing of System Services supply commitments up to a year ahead. Longer-term contracts are not permitted under this rubric.

Formally, such layered procurement is straightforward to include in the design set out in previous sections:

- Some part of the overall volume requirement is earmarked to be procured as a medium-term commitment and withdrawn from the relevant DASSAs.
- An auction essentially identical to the DASSA is run to allocate those forward volume commitments.
- Winners are required to hold FPNs over the whole of the forward period (possibly with some allowance to drop some periods for maintenance etc). Winners face making compensation payments if they fail to notify compatible FPN in each period. Where winners are subsequently moved to incompatible energy positions, they still receive payments.
- If a forward contract holder is moved to an incompatible position in a given period, this gives rise to needs to replace that provider and to make payments through the FAM in exactly the same manner as for DASSA winners.

However, using this approach reduces liquidity and competition in the daily processes. It is unclear to us what countervailing benefit the TSOs would obtain from locking in supply of System Services on this sub-one-year time frame. This period is not sufficient to provide much operational certainty. It is certainly insufficient to have any material impact on incentives for investment by new providers as economic lives for new assets would be much longer that one year.

9.3 What should long-term contracts do?

The key question when designing long-term contracts is their purpose:

- Where the TSOs enter into a long-term commitment to purchase services primarily with a view to attracting additional investment and entry of new technologies, then long-term contracts should be designed to mitigate the uncertainty that service suppliers may face about future revenue (and thus the possibility of recouping investment). In this case, it is reasonable to expect service suppliers to be willing to accept a lower price if this allows them to mitigate or eliminate uncertainty about future volumes to be supplied and the prices that will apply (both of which affect revenue).
- Conversely, where the TSOs' objective is to secure at least part of the required volume of System Services to guarantee system stability over an extended period, then long-term contracts should be designed to provide a guarantee about service suppliers' availability. In this case, it is reasonable to expect the TSOs to be willing to pay a premium in order to mitigate or eliminate uncertainty about future availability.

Therefore, in principle, there is a balance of supply (providers wanting future certainty) and demand (the TSOs wanting to lock in future availability) factors at work. Both are relevant, but we may be particularly concerned about the former in an environment where significant new investment may be required with extended pay-back periods.

In practice, a large volume of System Services is currently provided as a co-product of energy, but the volume of co-produced System Services is likely to wane as traditional generating technologies are replaced with low-carbon ones. As a result, the TSOs need to encourage investment to ensure adequate supply of System Services in the long run. Therefore, it may be reasonable in this situation for the TSOs to be willing to offer long-term contracts in order to encourage new entry and promote decarbonisation.

Long-term contracts

This need has to date been primarily met by contracts given under the Fixed Contracts' Framework established under SEM-17-094. These typically have a 6-year duration. To date there has been one competition under the framework for a bundle of reserves (Volume Capped), with a second tender in progress for Low Carbon Inertia Services (LCIS).

In principle, there is nothing to stop longer-term contracts co-existing with daily procurement of System Services. However, this reduces volume requirements in daily markets. In the context of new entry into System Services and potential innovation, there may also be concerns about locking in fixed prices for long periods within contracts, only to find that costs have fallen over time.

9.4 Options for long-term contracts

With well-functioning daily auctions for System Services, new options become available for using long-term contracts to incentivise new investment in System Services supply. In particular, rather than offering fixed prices, there are various options for providing long-term contracts that are written contingently on the prices established in the DASSA or which interact with the DASSA. This is attractive, as it avoids the risk of simple contracts offering to take System Services at pre-specified prices that may prove uncompetitive in the long-term if supply costs fall. Such schemes may be attractive alternatives to the existing Fixed Contracts Framework.

When considering options for long-term contracts, we adopt the following general principles:

- Primacy of the daily auction market – long-term contracts should not undermine the short-term market.
- Avoid absolute long-term commitments to take volume at fixed prices where costs may fall through the entry of new technologies, as this could lead to unnecessary and inefficient future expenditure. However, there is obviously a trade-off between short-run cost minimisation and long-run commitment to service suppliers to encourage investment.

Pricing taking model

A simple approach to mitigate uncertainty both about revenue and supply is to consider a "booking fee" arrangement:

- The long-term contract sets an obligation for the service supplier to have a certain volume of System Services available (by ensuring a compatible position when notifying its FPN prior to entering the BM), in exchange for a contract fee. The contract fee is *additional* to the price paid for System Services eventually procured.

However, in order to avoid giving market power to these service suppliers, we would require that long-term contract holders must be willing to accept the short-run clearing price established by the DASSA for any volumes linked to their long-term contract – effectively they commit to being price-takers within the DASSA.

- The assignment of long-term contracts can be done through a competitive process analogous to the DASSA, with bids consisting of offers to be available to provide a given volume throughout the period (i.e., a commitment to enter the BM with a position compatible with supplying this volume) and a price. The clearing price would be an 'availability price' (the highest accepted contract fee). It is possible that this could even be negative for some providers if they expect delivery costs to often be less than the DASSA clearing price.
- Failure to have a position compatible with supplying the volume committed to in the long-term contract when entering the BM should be subject to a compensation payment, as is the case in the DASSA.
- The volume procured through the long-term market would be deducted from the volume procured in the DASSA, but would remain part of the volume procured in the FAM.

This simple system is akin to a capacity market. Long-term contract holders receive a firm revenue provided that they are available, but need to forecast the short-run clearing price in order to form expectations about any additional revenue if they are chosen to supply. It avoids the TSOs making any long-term commitment on price, but there is some de-risking against future cost movements for service suppliers as the DASSA clearing price would apply for the volume taken.

Price taking with a price floor

This simple price-taking model does expose long-term contract holders to some risk of future low DASSA prices, as they have a firm obligation to supply regardless of how low the DASSA price might be. The TSOs could limit this risk by offering to pay for the committed quantity at the larger of the DASSA clearing price and some floor price. This is effectively a price-taking model, but with some limited price support (in effect a one-way CfD).[27] The difficulty here may be setting a meaningful floor price that encourages investment without also exposing the

[27] A further extension of this approach is to offer a price floor, so that the contract holder is paid at least this amount if the DASSA price drops below the floor, but to also apply a ceiling.

TSOs to the risk of committing quantities to a service supplier who may not the most efficient in the long run if costs fall over time. However, a greater floor price can be expected to reduce the contract price. Indeed, the contract price could even be negative, as competition for the contract leads bidders to offer some of the surplus they might expect from winning the contract.

Committed bid model

Other risk distribution models are possible. For example, we could ask potential contract holders to offer a maximum delivery price as well as a contract fee. A long-term contract holder is then treated as if it bids in the maximum delivery price (or a lower amount if it chooses) for a pre-committed quantity within the DASSA in each period it is required to be available. This leaves the service supplier at risk of falling costs and reducing prices in the DASSA over time, as it would need to reduce its bid to remain competitive and secure volumes. A more complex contract evaluation would then be required considering the trade-off between the benefit of a pre-committed offer at (no more than) the maximum delivery price and the contract fee when deciding which long-term contracts to accept. The benefit for the TSOs of this form of contract is that some supply of System Services is locked in, but without needing to commit to a long-term price that may become uncompetitive over time. Clearly the TSOs would expect to have to pay a positive contract price for such an arrangement.

Availability commitments

Long-term contracts have some availability requirements. These might be tailored to avoid excluding too many classes of technology, but it is inevitable that some technologies may find it more difficult to give availability commitments far out.

Nevertheless, it may be possible for some providers with uncertain future availability to form bidding consortia to share risks with other providers, even if the DASSA requires bids at a unit level. Long-term contract holders should also be allowed to procure services from other service suppliers through secondary trading to meet their commitments, subject to approval by the TSOs that any technical requirements continue to be met. However, there are clearly significant practical issues in notifying the allocation of supply obligations amongst such consortia to the TSOs.

Combinatorial procurement

We have ruled out combinatorial bidding across services in the DASSA. However, it is plausible that new investors in System Services may be able to offer a range of different System Services from a common investment (e.g. a battery could offer various reserve services). There could be strong cost synergies across those services.

In this case, it may be attractive to run a long-term contract procurement auction in which bidders offer bids, each of which consists of a package of quantities across several System Services at a single contract price. A bidder could offer multiple mutually exclusive bids (alternatives with potentially different sets of services included and different quantities at different contract prices). The contract evaluation would then be an optimisation to achieve target quantities of services with these long-term contracts at the lowest total contract cost. If a bid is successful, the bidder would be paid the contract price of its winning bid (phased over time) and would commit to supply the various quantities of System Services specified in that bid at whatever clearing prices set in the relevant DASSAs.

We have not made any specific recommendations about the most appropriate approach to long-term contracting, as it is clearly important to hear from potential investors about what their preferences are. However, the presence of well-established prices for each System Service from the DASSA gives a much richer set of possibilities where long-term contract holders can be incorporated into those daily markets, in the simplest case as price-takers (with committed volumes) but potentially through more elaborate schemes.

10 Next steps

We have set out preliminary recommendations on the structure of daily System Services auctions, with a focus on reserve services. We would appreciate feedback and comment from stakeholders. SONI and EirGrid will endeavour to organise bilateral engagement with stakeholders for comment and discussion.

We are particularly interested in feedback on:

- the need for secondary trading as an intrinsic feature of the enduring design for daily System Services auctions, and the need for a centralised secondary trading platform to facilitate this;
- the proposed approach to incorporating the current continuous provision scalar within an auction framework (discussed in Section 6);
- the potential for allowing offers to supply quantities of System Services only in the FAM, but not in the DASSA (discussed in Section 7); and
- the need for long-term contracts and investors' preferences around the various options for incorporating DASSA-determined prices into long-term contracts (see Section 9).

We anticipate issuing a further document with clarifications and refined recommendations in light of this feedback.

So far, we have not considered the question of how interconnectors – both to the EU and the UK, which operate under different regimes – would interact with daily System Services auctions. We will be considering this question shortly and expect to cover this issue in our subsequent response document. We would be happy to receive any input on this question from interested parties.

Further System Services such as reactive power, where locational issues are likely to be important, will be considered in a separate report.

11 Glossary

Acronym	Meaning
BM	Balancing Market
CfDs	Contract for Differences
DAM	Day Ahead Market
DASSA	Day Ahead System Services Auction
DRR	Dynamic Reactive Response
DS3	Delivering a Secure Sustainable Electricity System
DSU	Demand Side Unit
EBGL	Electricity Balancing Guideline
FAM	Final Assignment Mechanism
FASS	Future Arrangements for System Services
FFR	Fast Frequency Response
FPFAPR	Fast Post Fault Active Power Recovery
FPN	Final Physical Notification
HLD	High-Level Design
IDA (1,2,3)	Intraday Day Ahead
LCIS	Low Carbon Inertia Services
LTS	Long-Term Scheduling
MW	Megawatt
POR	Primary Operating Reserve
PPA	Power Purchase Agreement
RAs	Regulatory Authorities

RES	Renewable Energy Source
RM (1,3,8)	Ramping Margin
RRD	Replacement Reserve Desynchronised
RRS	Replacement Reserve Synchronised
SEM-C	Single Electricity Market Committee
SIR	Synchronous Inertial Response
SNSP	System Non-Synchronous Penetration
SOR	Secondary Operating Reserve
SSRP	Steady State Reactive Power
TOR (1,2)	Tertiary Operating Reserve
TSO	Transmission System Operator

Term	Definition
Adjusted Supply Function	Supply functions used in the FAM derived from DASSA bids. DASSA bids are adjusted to reflect any volumes already supplied under Confirmed DASSA Orders and the units' final supply (given by their eventual energy positions and availability, independently of whether the unit was triggered or called upon to deliver) in the corresponding time period.
Aggregated Supply Function	The combination of all units' individual supply functions.
Availability Performance Scalar	A Performance Scalar to incentivise a unit to maintain availability for the volume in its Confirmed DASSA Order. This Performance Scalar is applicable to Confirmed DASSA Order payments (i.e. not applicable to FAM Assignments) over some period. This Performance Scalar will not be applied where a unit cannot maintain availability to fulfil its Confirmed DASSA Order as a result of the TSOs' BM or dispatch actions.
Balancing Capacity	Defined by Article 2 of the EBGL as a balancing service in which a provider has agreed to hold capacity in reserve to potentially provide balancing energy.
Bundled Service	Where offers for FFR, POR, SOR and TOR1 have been made by a common provider for the same time period.
Central Trading Platform	A centralised trading platform to facilitate the secondary trading of

	DASSA Orders and the monitoring of these trades.
Clearing	Sorting and stacking of offers to determine the price to be paid to units awarded DASSA Orders. Results in a single clearing price to be paid uniformly (per unit of volume) for each winning offer.
Compensation Payment	A payment from a DASSA Order Holder to the TSOs for failing to be in a position to provide the volume in its DASSA Order i.e., their FPN is incompatible with meeting the DASSA Order.
Complex Bids/Orders	Bids that allow units to specify various conditions under which their bids may be selected as winning bids (e.g., once minimum revenue requirements are met).
Confirmed DASSA Order	An FPN-compatible DASSA Order that is remunerated. It is also an operational commitment to provide that volume of System Services.
Continuous Provision	The provision of reserve services across consecutive time scales (FFR, POR, SOR and TOR1) by a common provider.
Daily Auctions	In this paper, refers to the Day Ahead System Services Auction (DASSA), which will be run after the Day Ahead Market (DAM) and before the first LTS.
DASSA Clearing Price	The marginal price for each System Service that will be paid for volumes in Confirmed DASSA Orders. It will also be the reference used for calculating compensation payments.
DASSA Orders	The volume of System Services and clearing price that a winning bidder

	has been assigned. It is a contractual requirement to submit a compatible FPN that allows the DASSA Order to be met as opposed to the procurement of actual supply of System Services.
DASSA Order Holder	Providers that have been awarded volume in the DASSA or subsequently bought a DASSA Order through secondary trading.
Default Price	Where a unit has not made a DASSA bid but supplies volume, the price assigned to that volume in its Adjusted Supply Function for the FAM is the default price.
Delivery	Adjusting the units' energy production or consumption in response to being triggered or called upon by the TSOs in relation to a given System Service.
Enduring Arrangements	The procurement of System Services as per the SEM-C High-Level Design Decision (SEM-22-012).
Event Performance Scalar	A Performance Scalar to evaluate a unit's response to frequency deviations, utilising existing performance monitoring methods. This scalar is applicable to payments associated with Confirmed DASSA Orders and FAM Assignments.
Eventual Supply	The total volume of System Services available in real-time.
FAM Clearing Price	The marginal price for each System Service(s) that will be paid for volumes compensated via the FAM.
FAM Assignments	The total assigned volumes required to meet the shortfall not supplied through Confirmed DASSA Orders,

	assigned to those units who offer the most advantageous terms.
Final Assignment Mechanism (FAM)	An ex-post reconciliation mechanism to remunerate provision of additional System Services volumes that were necessary to meet system requirements, above what is supplied and paid for through Confirmed DASSA Orders.
Frequency Event	A Frequency Event is an event where the Transmission System Frequency falls below, or rises above, pre-defined frequency thresholds.
Layered Procurement	The competitive procurement of System Services in the medium timeframe (anytime, up to one year).
Long-Term Contracts	Multi-year agreements that offer delivery payments for System Services at the DASSA-determined prices, along with an availability commitment offered in return for a fixed available fee.
Long-Term Scheduling (LTS)	The TSOs' software used to provide indicative commitment decisions (i.e., which units should be on-line or off-line) up to the end of the Trading Day or the next Trading Day depending on the timing of the LTS run.
Merit Order	In this paper, the ranking of bids ordered by price, then at random.
Order Book	A centralised list of buy and sell orders organised by price levels.
Performance Scalar	Scalars are multiplying factors applied to unit's payments. Performance Scalars are applied to reward and incentivise high levels of performance and to ensure lower payments for a lower level of performance.

Pre-Approved Peers	Potential suppliers that have registered with the TSOs and are capable of supplying a System Service, pre-approved for secondary trading.
Sealed Bid	A once-off bid process in which offers are made without visibility of other offers. This contrasts with multiple round, dynamic auctions where bids can be updated in the light of feedback given to bidders.
Supply	Being available to deliver additional energy when if triggered or called upon by the TSOs.
Supply Function	A schedule specifying the volume that a unit would be willing to supply at a given unit price, defined by price/quantity pairs specified by the unit in its bid.
Trading Day	Means the period commencing at 23:00 each day and ending at 23:00.
TSOs Mix Preferences	A rule or objective function to express the TSOs' preferences when determining the volume mix of qualities/ bundled services.
Units	Includes Generator Units (as defined in the TSC), Generation Units (as defined in the Grid Codes), demand side units and System Service providers that form part of the scheduling and dispatch process.