Flex Markets Unlocked Programme

e-gate project

gridimp

›epexspot

Feasibility study
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Disclaimer

This is a final report for the Net Zero Innovation Portfolio: Flex Markets Unlocked Programme: Phase 1 Feasibility – egate project. This project has received funding from the government's £1 billion Net Zero Innovation Portfolio, which provides funding for low-carbon technologies and systems. Decreasing the costs of decarbonisation, the Portfolio will help enable the UK to end its contribution to climate change.

This report presents the outputs of a Phase 1 Project undertaken by EPEX SPOT and Gridimp and does not represent the views or policy of the Department for Energy Security and Net Zero.

The aim of the Flex Markets Unlocked Programme is to better enable distributed energy resources (DER) to participate in markets and provide system-wide flexibility in large volumes. The programme will support the design and development of innovative technical solutions that can facilitate system-wide coordination, standardisation, and revenue stacking across multiple flexibility markets (markets within which flexibility can be bought or sold), allowing a more diverse and competitive marketplace – unlocking flexibility.

Glossary of terms and definitions

Term	Definition
AAR	Automatic Asset Registration
API	Application Programming Interface
BRP	Balancing Responsible Party
CMZ	Congestion Management Zones
DER	Distributed Energy Resources
DFS	Demand Flexibility Service from ESO
DNO	Distribution Network Operator
DSO	Distribution System Operator (Evolution of DNO role)
ENA	Energy Networks Association
ESO	Electricity System Operator
FMU	DESNZ's Flex Markets Unlocked innovation programme
FSP	Flexibility Service Providers
IDC	Intraday Continuous
LEM	Local Energy Market
MPAN	Meter Point Administration Number
NGED	National Grid Electricity Distribution
SPEN	SP Energy Networks
UKPN	UK Power Networks

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1. e-gate, as a solution to facilitate market access for small-scale flexibility operators

To decarbonise the UK Energy system and maintain the security of supply, while saving billions of pounds in infrastructure expenditure, we must transition to a flexible system, where Distributed Energy Resources (DER), such as rooftop solar panels or battery storage, play a central role. DER owners should be able to create value by offering their energy flexibility to fulfil the needs of the electricity system operators at the distribution and transmission levels, the Distribution Network Operators (DNO) and Electricity System Operator (ESO) respectively.

These needs are met on three market categories' venues: at distribution level via the local flexibility markets, at national flexibility level and in the wholesale markets. However, the participation of DERs to these markets is limited today due to several factors including: operational complexity, difficulties of stacking revenues across uncoordinated markets and market entry barriers for smaller flexibility providers, i.e., some markets are only accessible for certain type of participants.

To address those difficulties, the Flex Markets Unlocked Innovation Programme explores solutions aimed at tackling the following problem statement: "The provision of distributed, small-scale flexibility is relatively untapped and there are challenges to realising its full system value; this value is fragmented across several markets that are not fully standardised, coordinated or fully accessible to this type of flexibility."[1]

This programme fits in a wider and evolving context, where progress has been made to foster the participation of DER within the wider energy market. The Energy Networks Association (ENA) continues to work to standardise flexibility products and accompanying contracts. There has been the development of local flexibility markets which have replaced the ad-hoc nature of the procurement procedures which reduces some of the administrative burden for both FSPs and Distribution System Operators (DSO). The Automatic Asset Registration (AAR) programme is tackling another difficulty linked to the visibility of those assets, from notification to registration in a consistent information landscape[2]. These initiatives, despite not being complete, are helping to make market access simpler, especially on both ends of the value chain: assets and markets.

Alongside those initiatives, private companies, such as aggregators and power exchanges, continue to work on facilitating the access to markets. For example, Gridimp provides services for assets that are too small to access the market or of which owners do not necessarily have the skills or time to navigate all markets. Whilst EPEX SPOT's short-term markets have been developed through improvements in product ranges, such as reducing the minimum amount of energy needing to transact, allowing the automation of trading processes and providing a variety of market access routes, to the point where intra-day trading is a viable revenue stream for Flexibility Service Providers (FSPs).

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[1] Flex Markets Unlocked Programme: Phase 1 Feasibility: competition guidance (publishing.service.gov.uk)

[2] https://www.gov.uk/government/publications/automatic-asset-registration-aar-programme ,
https://es.catapult.org.uk/project/automatic-asset-registration/

To address the problem statement identified within the FMU programme, EPEX SPOT and Gridimp propose the e-gate solution a simplified route to market for small-scale flexibility. In the context of this study, we consider small-scale flexibility to be any DER or demand which has the ability to shift its schedule - for example, via controlling its Heating Ventilation and Air Conditioning (HVAC). This route covers most of the value chain including aggregation and participation in various markets, enabling revenue stacking. Its aim is to minimise the barriers to entry into different and segmented markets. In its most complete form, small-scale flexibility assets will have a single interface to access markets, with limited to no change on the asset side when scaling up to additional markets. A high-level overview of this solution can be found in figure 1.
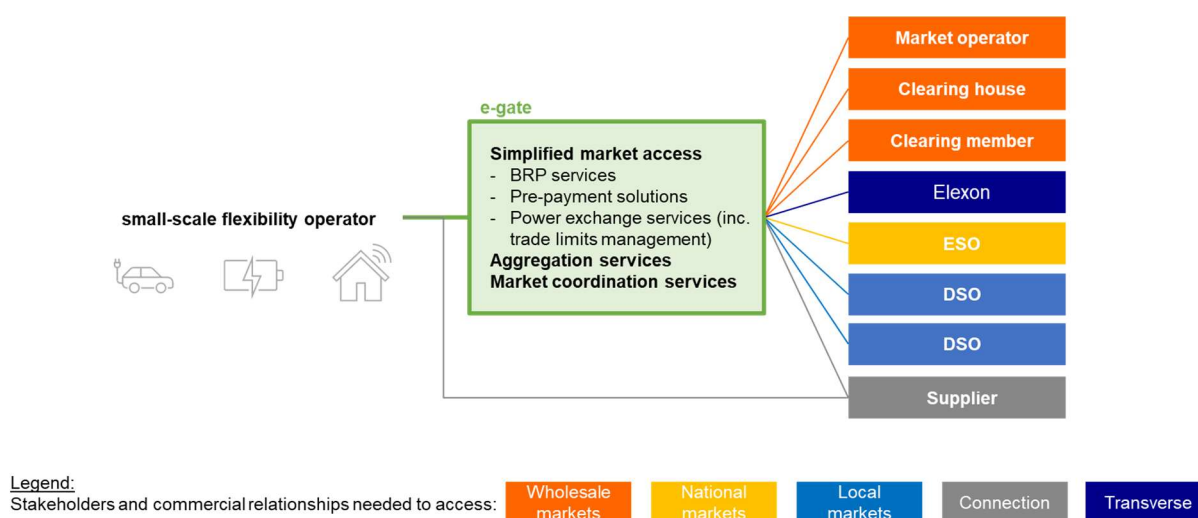

Figure 1: high-level overview of the e-gate solution: simplifying market access for small-scale flexibility operator

2. e-gate architecture

2.1. High-level architecture principles

In the scope of e-gate, we distinguish the role of aggregation and that of connecting and submitting offers on each market which largely builds upon existing systems. As such, the e-gate solution is not a centralised role with a single implementation. Any company wishing to trade flexibility may choose to implement part of the solution to address any selection of flexibility markets. For example, a firm could decide to create a system allowing asset owners or Flexibility Service Providers (FSP) to only access the wholesale market. This design is flexible depending on company need and decentralised. It does not rely on centralised infrastructure or the creation of a single entity.

Within e-gate, we describe a new market role called the "Market Orchestrator". This component is responsible for trading packets of aggregated flexibility into multiple markets. In this report we give the detailed design for one instance of a Market Orchestrator to address three markets where flexibility is traded. Namely: The Energy System Operator's Demand Flexibility Service (DFS), UK Power Networks' (UKPN) Local Flex and EPEX SPOT's Wholesale Intraday Continuous market. The solution is designed to extend to further energy flexibility markets including local flexibility markets from other DNOs, including National Grid Energy Distribution (NGED) and Scottish Power Energy Networks

(SPEN). This split of roles is depicted in figure 2, where a small-scale asset owner gains access to national, local and the Intraday Continuous (IDC) wholesale market:
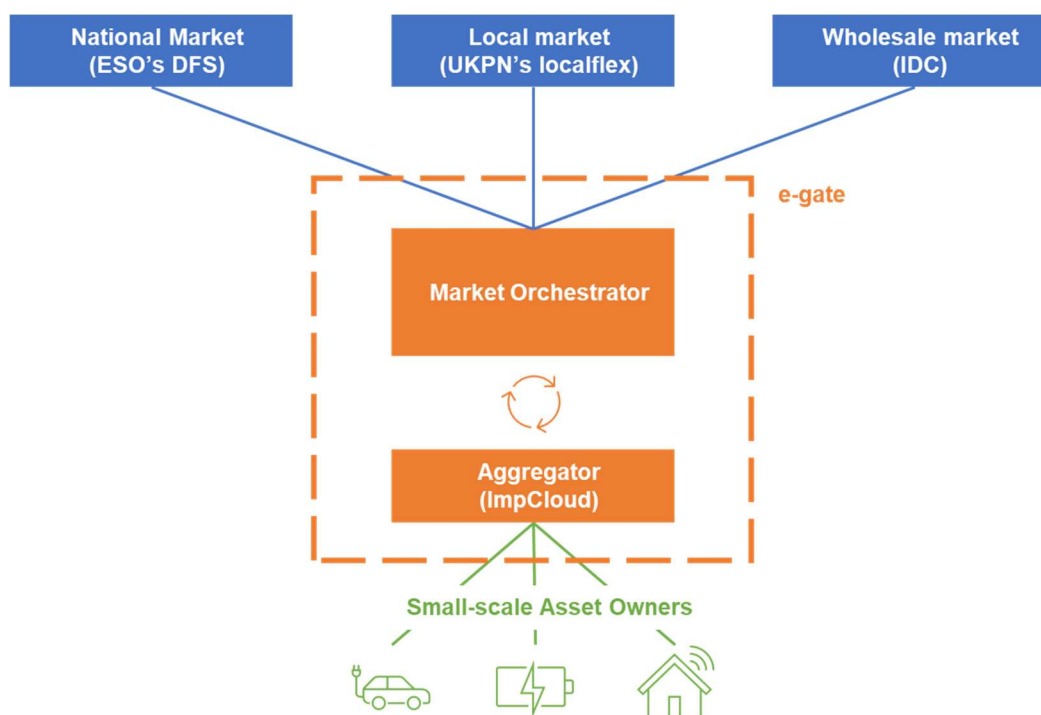

Figure 2 Functional blocks and roles as part of the e-gate solution are defined to be as modular as possible

In addition to tackling the technicalities of trading flexibility in multiple markets, we also propose simplified routes for onboarding into the wholesale market operated by EPEX SPOT. We are proposing to simplify the financial requirements and to remove the need for small-scale flexibility to become directly responsible for balancing their energy positions with Elexon. Without this simplified route, the FSP would need to onboard at Elexon and directly manage their expected energy positions.

e-gate provides a blueprint for other organisations to develop and compete against e-gate offering market access and market orchestration functionality.

2.2. Business Architecture

The business strategy of the e-gate project is to limit as much as possible the complexity small-scale flexibility providers face when accessing local, national, and wholesale markets.

In this section we describe the business architecture deriving from this strategy. This includes the commodity classes and markets that will be considered. Next, we describe the roles and entities involved in the business architecture. After describing the interaction use-cases required for flexibility trading we look at simplified market access business processes.

2.2.1. Commodity Classes and Markets

In this specification we define three broad commodity categories of flexibility, described in table 1.

Table 1 Commodity categories of flexibility

Name	Dispatch	Initiation Time	Duration
Energy-Flex	Signal	Minutes	15-120 minutes
Power-Flex	Signal	Seconds	5-60 minutes
Frequency-Flex	Frequency	Sub-Second	Minutes

The three Energy-Flex markets that we will focus on in this report are:

- Wholesale market: Intraday continuous.
- Local market: UKPN (UK Power Networks) & NGED (National Grid Energy Distribution)
- National market: ESO DFS (Electricity System Operator, Demand Flexibility Service)

The overall scheme described here is suitable to be extended to any additional Energy-Flex markets including local flexibility markets such as SPEN local flexibility and the ESO Reserve Suite.

2.2.2. Entities and Roles

This report considers the following roles:

ESO – Energy System Operator. Purchaser of flexibility from national aggregation or Bulk Supply Point (BSP) aggregation. Typical use case for flexibility is system balancing of supply and demand. Purchaser on Demand Flexibility Service (DFS), Reserve Suite and impacted by actions on the Wholesale market.

DSO – Distribution System Operator. Purchaser of flexibility from Constraint Management Zone (CMZ) aggregations. Typically use case for flexibility is managing constraints in the distribution network at different levels, often decomposed as High Voltage (HV) or Low Voltage (LV) levels, with zones defined according to the DSO internal definitions. Examples include, UK Power Networks (UKPN), National Grid Energy Distribution (NGED) and Scottish Power Energy Networks (SPEN).

Flex Provider – An individual provider of flexibility, this would be a domestic or commercial energy consumer, also known as the asset owner. These providers can use their plant, such as HVAC, Electric Vehicle (EV) chargers or Battery Energy Storage System (BESS) to provide flexible responses. This report focuses on small flexibility providers, this could be from an individual HVAC unit at 5kW, individual car charger 7kW and will typically be under 100kW.

Aggregator – The aggregator is a company that collects together responses from individual Flex Providers and offers them to the market, this role is also known as the Flexibility Service Provider (FSP). The aggregator is responsible for registering assets, making offers to the market, trigger responses from the assets and performing settlement. The Aggregator also holds the contractual relationship with the markets in which it participates.

Market Operator – A company that runs a flexibility market, typically on behalf of the ESO or DSO. The market operator records registered assets, collects offers of flex participation, collects needs of flexibility from System Operators (SO) also known as bids, and matches bids and offers. The Market Operator also records and informs FSP (Flexibility Service Providers) of trades for flexibility.

Market Orchestrator – A new role introduced in this specification; the Market Orchestrator forwards bids from Aggregators to multiple Market Operators.

Clearing House – The clearing house supports smooth operation of market system, by isolating individual trading participants from counter-party credit risk; put simply the clearing house ensures

that participants can trade safe in the knowledge they will be paid and don't need to worry about who specifically they are trading with.

The following entities will be referenced in this specification (table 2):

Table 2 Names and roles of entities

Name	Role
EPEX SPOT	Market Operator for UKPN Flex Market
EPEX SPOT	Market Operator for Wholesale Market
EPEX SPOT	Market Orchestrator for Gate 2
Gridimp	Aggregator
Gridimp	Market Orchestrator for Gate 1
National Grid ESO	ESO
UKPN	DSO
NGED	DSO

The EPEX SPOT Market Orchestrator targets Aggregators and larger FSPs at gate 2. Whilst the Gridimp Market Orchestration targets small scale flexibility providers at gate 1.

In addition, the specification will reference:

Elexon – Responsible for recording and administering the national metering settlement program and overseeing the implementation of the Balancing and Settlement Code (BSC). Notifications of wholesale market actions are sent to Elexon, which will include deviation volume trades under P415.

2.2.3. Key business processes of the Trading Phases within e-gate project

From a business architecture perspective, flexibility trading proceeds with the following distinct phases:

Contracting: Here contracts are established between the entities. The flexibility provider (asset owner) contracts with the flexibility service provider (aggregator) to market their flexibility. The aggregator contracts with the different markets. Where flexibility will be offered dynamically on day ahead and intraday markets, the contract here needs to take the form of a framework agreement, such that the individual assets, delivery times and volumes are left open for later phases of the business process.

Registration: Assets to be traded need to be registered, it is the role of the Aggregator to gather the details from the asset owner and forward these details to the relevant markets. The Energy Networks Association (ENA) provides a standard list of required questions for asset registration and the DSOs are adopting this list. Whereas the National, Wholesale and ESO DFS markets are based on Meter System ID (MSID) pairs, which are pairs of import-export Meter Point Administration Number (MPANs). MPANs are standard part of the national billing process, administered by Elexon, and it is possible to find the MPANs used for a given customer site from their Energy Supplier energy bill.

Bidding: In the bidding phase offers are made to the flexibility markets, including prices (e.g. £/kW/h for availability contracts) and volumes (e.g. kW for availability contract) for each aggregate zone. There are two types of payment made for flexibility, availability payments and utilization payments, for near-real time markets, such as day-ahead and intraday markets the remuneration will be exclusively utilization. For national market the aggregate zones will be either national or divided into BSP. For

DSO markets the aggregate zones will be divided into CMZ defined by the DSO. Each market runs its matching algorithm and comes back to the participant with accepted offers, which become trades for flexibility. It is during this phase that the new Market Orchestrator is most heavily involved in simplifying the bidding process.

Dispatch: In the dispatch the signals arrive from the markets to trigger the delivery of flexibility. These signals come from the SO or DSO and are forwarded to the flexibility provider by the aggregator. The dispatch signal means that plan and equipment must be changed, for the most common type of response, where active power is reduced this will involve turning off or down energy demands, increasing generation output or releasing stored energy from batteries. Note that since we are delivering flexibility, it is not necessary to export energy, but rather to change the power at the metered delivery point.

Settlement: After delivery it is necessary to calculate the volume of delivery. This volume is the difference between the expected baseline position and the metered position during the period of the dispatch. It is the role of the aggregator to calculate the settlement volume and distribute payments to the individual flexibility providers.

Interaction between those phases, especially for the bidding and trading phase itself, is represented in figure 3 hereunder:
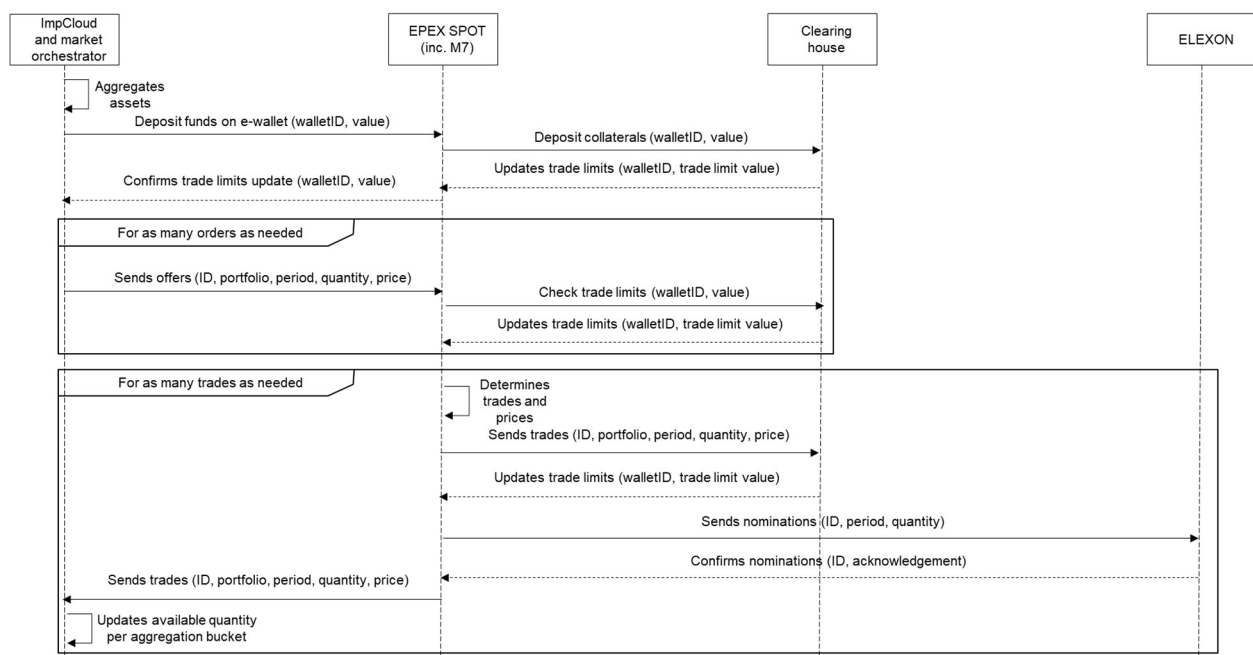

Figure 3 Bidding and trading phases indirectly involve the small-scale asset owner to facilitate this process as much as possible

As an initial proof of viability of this concept, EPEX SPOT and Gridimp worked a simplified integration use-case, involving EPEX SPOT's Local Energy Market (LEM) system and Gridimp's Impcloud: using Automated Programming Interfaces (API), the systems were connected to run register an asset into a local market and submit a bit linked to this asset.

2.2.4. Key business processes of the Simplified Market Access proposed by e-gate

From a business architecture perspective, the simplified market access to wholesale markets proceeds with the following distinct phases:

Contracting: the flexibility owner contracts with the aggregator to value its flexibility (this phase is unchanged compared to the existing set-up). As an additional stage, the aggregator will contract with the power exchange using the simplified market access route to participate to the wholesale market. This contract arrangement details pre-payment and Balancing Responsible Party (BRP) arrangements. A unique BRP, using the Virtual Trading Party (VTP) role, will be established for all parties subscribing to the simplified market access. This way, the process to access market will be streamlined as no additional BRP will need to be created for each new market participant. When a market participant is added, additional meter IDs will be added to the perimeter of this BRP and Credit Cover will be updated. It's possible for an aggregator to only subscribe to the pre-payment solution and not the BRP solution, depending on its preference.

Pre-payment – wholesale market side: a connection is made between the e-wallet solution and existing systems of the clearing house. The aggregator will deposit funds into its dedicated account. The total amount deposited in the account will be used to determine the trade limit (in £) of the aggregator on the wholesale market. Each order deposited on wholesale market by the aggregator will be used to compute an exposure, that can't exceed the trade limit. Settlement of trades will be done directly by the clearing house using the account (for deposit or withdrawal of funds).

Pre-payment – Elexon: The trade limit computed for the wholesale market includes a risk margin to cover for invoices sent by Elexon after a settlement run. After Elexon's Funds Administration Agent sends out invoices to the central BRP, individual imbalances are recomputed for each party subscribing to the BRP solution of the simplified market access, and funds will be transferred to Elexon through a dedicated Settlement Account.

The following graph (figure 4) summarizes the key business processes of the simplified market access (outside of the trading phase):
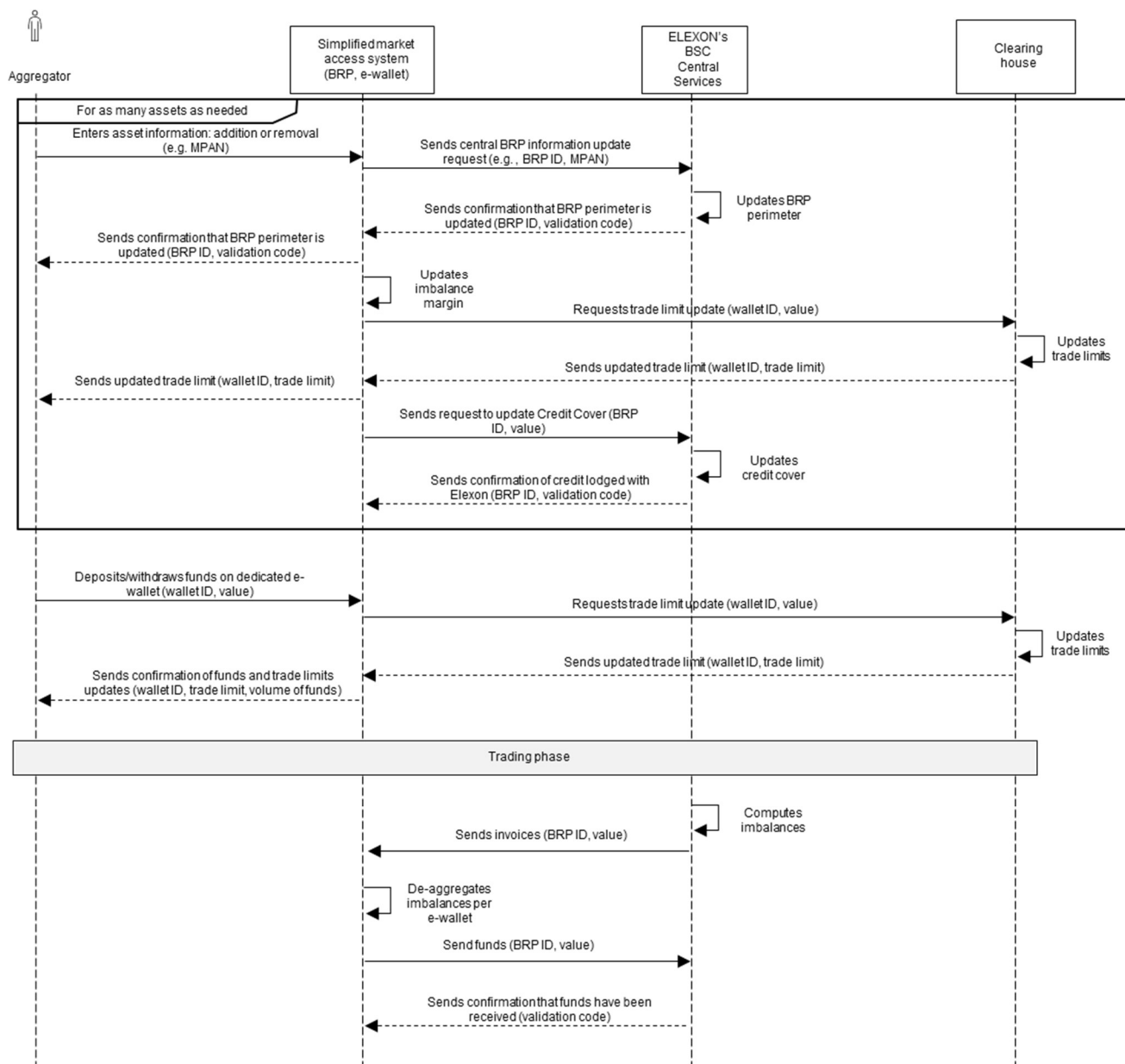
Figure 4 Interaction of aggregator with the simplified market access (trading phase excluded)

3. Conclusions

During this feasibility study, we demonstrated how the e-gate project and its concepts could remove barriers to entry to a fragmented marketplace for small-scale flexibility resources. Those resources can be aggregated and benefit from a simplified financial approach and Balancing Responsible Party access to wholesale markets, and a scalable and coordinated connection to national, local and wholesale markets to stack revenues.

e-gate innovates by interfacing existing services and systems across the value chain of flexibility markets, and by creating new roles and underlying systems: Simplified Market Access and the Market Orchestrator. The Simplified Market Access route removes barriers to access wholesale markets, by providing a central and neutral Balancing Responsible Party and pre-payment solution. The pre-

payment solution is linked to the clearing house and is used to define trade limits, avoiding the deposit of a high volume of collateral. Two barriers for small-scale flexibility to access wholesale markets are explicitly removed: complexity and cost. The Market Orchestrator links Flexibility Service Providers and the different markets, providing both a technical access point and a simplified trading strategy where capacity is forwarded from one market to another.

To deliver these services, e-gate's high-level architecture is based on the following principles: integration (not re-implementation), modularity, decentralisation and scalability. It allows different connection points along the value chain, depending on the market participant profile and their level of awareness of the different markets and processes. Development of API standards to access the different services facilitates this interoperability of the different modules of e-gate with modules provided or used by other parties. As such, e-gate delivers a blueprint that can be used by other companies in the industry to implement similar services, partly or totally. A decentralised, competitive landscape will ultimately deliver innovation and drive down costs across the value chain.

The value delivered by the project will be received by all key participants in the flexibility trading stack: small asset owners will derive an additional income stream; aggregators can trade flexibility on markets more easily; and market operators get increased trading on their platform. The overall trading community in the wholesale market get additional liquidity and trading opportunities and System Operators can more easily and cheaply access the flexibility they need for operational requirements and to accelerate the net zero transition. Distributed Network Operators and System Operators benefit from more visible and price-efficient flexibility.

e-gate will benefit from parallel developments in the industry, such as the Digital Spine Feasibility Study, the Automatic Asset Registration programme and Ofgem's System Use Case exercise for a centralised asset register. These programmes will facilitate e-gate's process, especially asset registration and qualification to participate in markets. Elexon's P415 is also key in unlocking wholesale markets for flexibility. Evolution of the DFS exclusivity clause, called for by the industry (and for which the project received support letters from DSOs), will also foster revenue staking and unlock the flexibility markets.

The extensive use of existing technologies, agreements, markets and stakeholders make the existing governance applicable. Rules to engage existing and well-functioning markets are not altered, fostering trust and clear governance. This solution is scalable and does not necessitate an additional layer of coordination or a central component to be managed – which could be difficult in a complex environment where many stakeholders evolve.

As a next step, a proof of concept will be developed, and scalability of the solution illustrated by the connection to more flexibility markets.