DNV·GL

Project FUSION - GB Reference Implementation of USEF

SP Energy Networks

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3. This document forms part of the deliverables set out in the Project FUSION Directions - A plan for USEF implementation in Project FUSION.

4. This document can be cross-referenced with the publications USEF Due Diligence Report and USEF Consultation Report on the SP Energy Networks Project FUSION Webpage.

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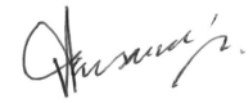

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EXECUTIVE SUMMARY

This document sets an implementation plan for the Universal Smart Energy Framework (USEF) in the GB energy market, confirming clear steps for the implementation in GB of several components of USEF, based on the outcomes of the Project FUSION Due Diligence and Public Consultation, and further informed through engagements with key stakeholders. This report is prepared by DNV GL as one of the industry partners in Project FUSION and founding partner of the USEF foundation, and further informed by DNV GL's professional experience as a leading energy sector advisory firm.

Modifications to USEF

In developing this report, DNV GL met with the USEF Foundation to discuss potential modifications to USEF. This workshop raised the following future actions to enhance and update USEF so that it aligns with GB arrangements:

1. The USEF Flexibility Value Chain (FVC) will be extended to include GB post-fault constraint management products;
2. The USEF Flexibility Value Chain (FVC) will be extended to include GB pre-fault constraint management and restoration support products;
3. The USEF roles will accommodate additional roles or responsibilities which are found in GB arrangements;
4. USEF will only consider adding a separate ESO role if this aligns with the Harmonised Electricity Market Role Model and with ongoing ebIX discussions (This is not, however, an issue from the perspective of USEF-compliance); and
5. The development of the Common Reference and the CRO role will use insights from the FUSION trial and other GB initiatives to ensure compliance with GDPR requirements.

Finally, we have identified GDPR compliance and penalty mechanisms in flexibility transactions as two elements that could lead to a non-compliant implementation of USEF in GB. To ensure USEF-compliancy, the USEF Foundation has agreed to consider GB GDPR requirements in the next framework update, and the FUSION trial will explore the mechanics of penalty mechanisms, to lay the basis for wider industry consideration at a later stage.

Recommended changes to GB arrangements

Application of USEF innovative elements in GB

The implementation plan considers the following innovative elements from USEF that can be comparatively easy to implement in GB energy market arrangements:

1. **Congestion point repository (or Common Reference)**: The application of the Congestion Point Repository in GB is within reach since USEF provides clear guidance on its structure, and its operation. In addition, GB initiatives such as the System Wide Resource Register (SWRR) indicate that the industry is already implementing similar structures, which can align with and be informed by USEF's Congestion Point Repository. The role of the Common Reference Operator (CRO) and the GDPR requirements are the main elements that need further clarification and discussions with the wider industry. Outcomes of the FUSION trial will provide clarity on this implementation.
2. **D-programmes:** The application of D-programmes is a USEF element that has not yet been introduced in any other GB initiative and will require the submission of aggregators' forecasts of planned activations of flexibility (day-ahead and intraday). The DSOs will use the D-programmes to perform their grid safety analysis. In addition, the D-programme is the baseline for flexibility settlement between the Aggregator and the DSO. The implementation of D-programmes in GB will require that DSOs integrate D-programme processes in their BAU operations. The FUSION trial will test the use of D-programmes and can facilitate the implementation process at a national level through experience and discussions with stakeholders.

3. **Free bids:** This plan recommends the inclusion of free bids in the design of constraint management services as per USEF recommendations. USEF describes clear steps on how free bids can participate in flexibility markets. However, the industry should have further discussions to define the merit order mechanism which will facilitate flexibility procurement and will ensure that the DSO can buy the economically optimal flexibility service.

4. **Sub-metering arrangements:** DNV GL acknowledges that the use of sub-metering in DSO congestion management products is within reach in GB and its implementation should only focus on practical elements, which are subject to the product design. These elements are: the level of granularity of measurements, the level of accuracy of measurements, the validation of the sub-meter data and the technical requirements of the sub-metering equipment.

5. **Baselining methodology for DSO products:** USEF defines the D-program as the standardised baseline for the congestion management product and recommends that the flexibility request part is responsible for defining the baseline methodology. The DSOs will need to align their baseline methodologies and include them in the product design. The ENA Open Networks Project (ONP) has been facilitating standardisation of DSO flexibility products, and therefore DNV GL recommends that ENA ONP is one of the platforms to lead discussions on standardisation and embed USEF's principles in product design.

Roadmap for GB modifications

The GB reference implementation plan of USEF has also developed a roadmap to explore the implementation of USEF recommendations that either require more complex changes in GB and/or further industry discussions:

1. Access to wholesale markets for independent aggregation;
2. Development of a Central Data hub;
3. Formalisation of the Constraint Management Service Provider (CMSP) role;
4. Development of operating regimes to govern the (un)restricted trade in flexibility services;
5. Development of standardised flexibility platforms;
6. Implementation of the USEF market coordination mechanisms (MCM); and
7. Facilitating dynamic pooling of flexible resources.

Although the individual roadmap of each innovative element involves unique steps, milestones and mechanisms tailored to each recommendation, some common themes arise in every roadmap:

- Most initiatives will require **leadership from Ofgem and BEIS** to support the initiative and provide clarity on the relevant policy and regulatory context.
- Further industry discussions will facilitate decision-making processes and will lead the way towards a USEF GB implementation which is fit for purpose. Therefore, the implementation plan has concluded that USEF recommendations will require the establishment of **cross-industry working groups** that will coordinate and lead the associated work and discussions.
- USEF innovative elements are highly relevant to other GB initiatives or industry discussions, when implementing flexibility mechanisms in the GB market and regulatory framework (e.g. central data hub, flexibility platforms, independent aggregation in wholesale markets). Therefore, the roadmaps recommend that USEF implementation aligns with and informs **GB initiatives and processes**. USEF recommendations and principles can be considered as part of concurrent development and initiatives (e.g. work undertaken by the ENA ONP or the EDTF) in the area of flexibility markets and should not progress in isolation from them.

- It is highly likely that some of the complex changes to GB arrangements will require **Code modifications**. DNV GL recommends that the impact on GB Codes be considered during the implementation of innovative elements and if appropriate, implemented to facilitate USEF implementation in GB. Ofgem is currently reforming the (governance of the) industry codes jointly with BEIS, to make sure they deliver more efficiently for a smarter energy system.[1] This reformation could consider changes associated with GB implementation of USEF, where deemed necessary.

Assessment of USEF options in GB environment

This report has highlighted that there are innovative elements that involve several possible options but that require further discussion to determine the preferred option:

1. **Aggregator Implementation Models:** The Uncorrected, the Contractual and Integrated Aggregator Implementation Models (AIM) can be applied in GB across all DSO flexibility products at the early stages of the development of the DSO flexibility services. In the long-term, the AIM for DSO congestion management products should consider whether re-dispatch and Transfer of Energy is required. DNV GL recommends that the AIM for DSO congestion management aligns with arrangements that are applied in other GB products such as Replacement Reserve products (STOR, TERRE platform). The AIMs, as presented by USEF, can still be adjusted to country arrangements provided that they comply with the corresponding country's policy and regulation. The industry should further explore the feasibility of the AIMs for congestion management products. The outcomes of the FUSION trial could provide useful insights into this topic.
2. **Re-dispatch mechanisms:** Assessment of the feasibility of each option would be required to get an in-depth understanding of risks, ease of implementation as well as costs and benefits involved in each option. The industry should also review re-dispatch mechanisms that have already been implemented in Europe and align re-dispatch implementation with the development of the Aggregator Implementation Model.
3. **DSO-Aggregator information exchange:** The information exchange between the DSO and the Aggregator, as described in the MCM processes, is implemented in the USEF Flex Transfer Protocol (UFTP). Standardised processes, and a standardised interaction between DSO, AGR and other roles, are crucial to USEF. Using this protocol ensures interoperability between DSOs and Aggregators, Constraint Management Service Providers and Flexibility Platforms, not only in GB but in every energy market that adopts the UFTP. DNV GL recommends that further discussion with stakeholders would be beneficial to determine whether UFTP fits in the current GB message exchange architecture, from a technical point of view. The outcomes of the FUSION trial could provide useful insights on this topic.

Future use of this report

This report should be used by GB energy market stakeholders as a blueprint for the GB implementation of USEF and more generally for development of flexibility mechanisms in GB. The ultimate goal of this document is to provide a roadmap for the GB energy industry to use learning and experience gathered in the USEF community and implement innovations that are beneficial to the GB market. DNV GL considers that this is a "live document," which should be read in conjunction with all the relevant USEF documentation, as well as ongoing and future GB initiatives exploring the same or similar subject matter. This plan will also be further informed by the forthcoming FUSION trial, which will provide practical insights into the implementation of USEF in the GB energy market.

1 https://www.ofgem.gov.uk/publications-and-updates/consultation-reforming-energy-industry-codes

1 ABOUT PROJECT FUSION

1.1 Introduction

Project FUSION is funded under Ofgem's 2017 Network Innovation Competition (NIC), to be delivered by SP Energy Networks in partnership with seven project partners: DNV GL, Origami Energy, PassivSystems, Imperial College London (academic partner), SAC Consulting, The University of St. Andrews, and Fife Council.

Project FUSION represents a key element of SP Energy Network's transition to becoming a Distribution System Operator (DSO), taking a step towards a **clean, smart and efficient energy system**. As the electricity system changes from a centralised to decentralised model, it enables a smarter and more flexible network to function. Project FUSION is trialling the use of commoditised local demand-side flexibility through a structured and competitive market, based on a **universal, standardised market-based framework; the Universal Smart Energy Framework (USEF)**. USEF provides a standardised framework that defines products, market roles, processes and agreements, as well as specifying data exchange, interfaces and control features. The purpose of USEF is to accelerate the transition to a smart, flexible energy system to maximise benefits for current and future customers. Appendix B provides a high-level introduction to USEF.

Project FUSION will also inform wider policy development around flexibility markets and the DNO-DSO transition through the development and testing of standardised industry specifications, processes, and requirements for transparent information exchange between market participants accessing market-based flexibility services. Ultimately, Project FUSION will contribute to Distribution Network Operators and all market actors unlocking the potential and value of local network flexibility in a competitive and transparent manner. In doing so, Project FUSION aims to contribute to addressing the energy trilemma by making the energy system more secure, more affordable and more sustainable.

1.2 Objectives

Project FUSION aims to achieve the following specific objectives:

- Explore the potential for localised demand-side flexibility utilisation to accelerate new connections to the network that otherwise would require traditional reinforcement;
- Investigate a range of commercial mechanisms to encourage flexibility from energy consumers' use of electrical applications in satisfying overall energy use; and
- Evaluate the feasibility, costs and benefits of implementing a common flexibility market framework based on the open USEF model to manage local distribution network constraints and support wider national network balancing requirements.

In addition, through a live trial in East Fife, Project FUSION will:

- Gain an understanding of the potential use and value of flexibility within geographically local regions to further enhance efficient DNO network management; and
- Demonstrate the proof of concept, and evidence the business case, of commoditised flexibility (locally and for GB) through a USEF-based flexibility market.

1.3 Project Structure

Figure 1 shows the high-level structure and timeline for Project FUSION.

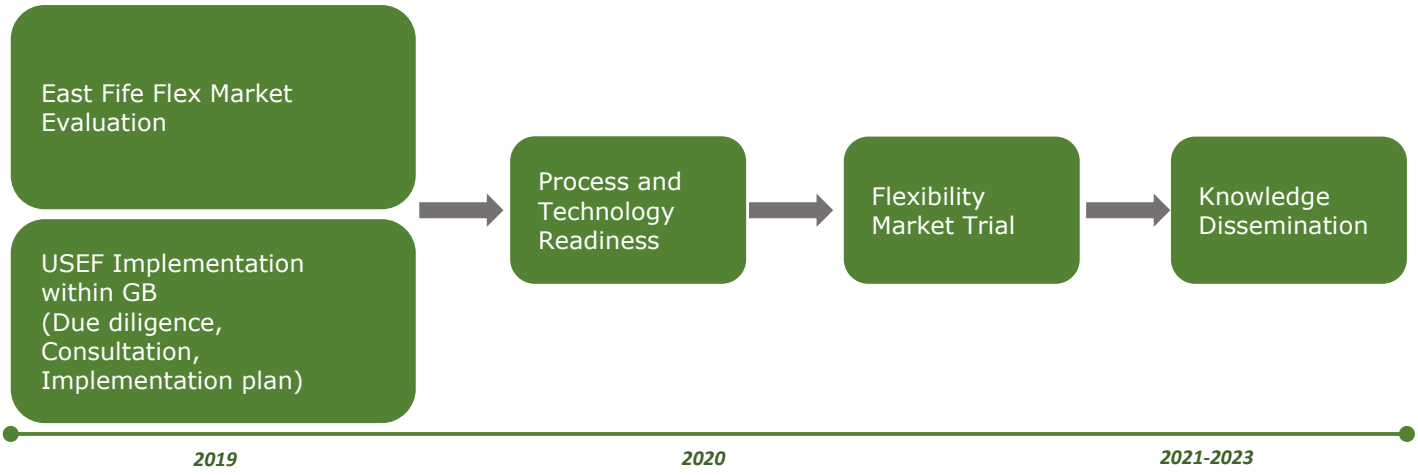

Figure 1: Project FUSION structure

The first two project stages were carried out in parallel during 2019:

- The **flexibility market evaluation** involves a comprehensive assessment of the available flexibility in East Fife, including customers connected at all voltage levels, to map the potential flexibility and determine the specific trial locations.
- The **USEF Implementation within GB** stage involves a due diligence of USEF against current and (likely) future GB energy market arrangements, a public consultation process and culminates in the development of a reference implementation plan for USEF in the GB energy market.

These initial two stages will inform stage 3, **Process and Technology Readiness**, to be delivered during 2020. This stage will implement the requisite processes and network flexibility planning tools that integrate with SP Distribution's existing network management tools to identify short-term and long-term flexibility requirements. This also includes implementation of USEF processes with market participants looking to participate in the trial. Moreover, Project FUSION will develop and implement a cloud-based procurement platform through which SP Distribution engages with participating aggregators and flexibility providers.

The **Flexibility Market Trial** in stage 4 will involve an open tender for the procurement of flexibility contracts with aggregators and other providers of flexibility in East Fife. Operational interaction with aggregators will be implemented using the cloud-based platform, which will facilitate the procurement, dispatch and remuneration of demand response and local generation. At the end of the trial, the trial results will be fully evaluated, and learnings will be made available to stakeholders through a range of appropriate dissemination methods.

2 INTRODUCTION TO THE GB REFERENCE IMPLEMENTATION OF USEF

This document forms part of the third Work Package (WP3) of Project FUSION which explores the implementation of USEF in the GB context and seeks to inform policy development around flexibility markets and the DNO-DSO transition.

2.1 Background

In January 2019, work package 3 (WP3) of Project FUSION commenced with a due diligence of USEF against legal, regulatory and market arrangements governing the GB energy sector. The due diligence was carried out by DNV GL and assessed the fit of USEF with the direction of reform of GB energy policy and regulation, as well as forward-looking industry initiatives like the Energy Networks Association's Open Networks (ENA ON) project, to inform the transition to a smart, flexible energy system.

The due diligence results showed that across a number of topics there is a close fit between USEF and both the current market design and the likely direction of future market design in GB. The results showed that there are several relevant and valuable innovative elements within USEF that could enrich current discussions and views on future energy market design, both broadening and deepening these views. Project FUSION subsequently sought the feedback of GB energy industry stakeholders on the merits and possible implementation of these innovative elements. The outcomes of this consultation are summarised in the FUSION USEF Consultation report of 15 November 2019.

In addition to innovative concepts, the due diligence also uncovered a small number of conflicts, which may require changes in either USEF or GB arrangements, as well as areas where GB arrangements could add to USEF. However, the due diligence did not indicate any areas that could prevent USEF from being implemented in GB, and Project FUSION's expectations are that only few modifications will be needed on USEF's side, and a limited set of recommendations to adjust current or (proposed) future arrangements in the GB energy system.

This implementation plan refers to work undertaken as part of the Due Diligence and Consultation reports developed under Project FUSION. Both documents are available on the Reports & Publication section of the Project FUSION website. In addition, appendices B and C to this report provide a high-level introduction to USEF and a Glossary, for further reference.

2.2 Objectives

This document provides an implementation plan for USEF in the GB energy market. Based on the outcomes of the Project FUSION Due Diligence and Public Consultation and further informed through stakeholder engagement it sets out clear steps for the implementation of several components of USEF in GB. The document:

- Provides context for the deployment of USEF in GB energy market arrangements;
- Sets out a roadmap to explore the implementation of USEF recommendations that either require complex changes in GB or require further industry discussions; and
- Summarises changes that are required in USEF to fit with GB arrangements.

This report should be used by GB energy market stakeholders as a blueprint for the GB implementation of USEF and more generally for development of flexibility mechanisms in GB. DNV GL considers that this is a "live document," which should be read in conjunction with all the relevant USEF documentation as well as ongoing and future GB initiatives exploring the same or similar subject matter. This implementation plan will also be further informed by the forthcoming FUSION flexibility market trial, which will provide practical insights into the implementation of USEF in the GB energy market.

2.3 Report Structure

A USEF implementation in GB will largely follow the USEF specifications itself, therefore this document will start by referencing the current version of USEF (section 3). This is not limited to the framework itself but also includes several documents that have been published afterwards.

To better understand the framework and facilitate discussions in GB context, section 4 provides a terminology mapping which translates some of the USEF terminology to GB terminology. Section 4 also maps USEF roles to GB actors, to align with current discussions on GB market design which tend to focus on actors, rather than roles. Finally, section 4 also maps USEF's flexibility products and services against GB products and services for explicit demand-side flexibility.

The remainder of the document focuses on aspects that may require modifications either to USEF or GB arrangements:

- Section 5 describes modifications to USEF. The due diligence exercise that DNV GL conducted under Project FUSION's WP3 identified areas where USEF might need to be updated. As a next step, DNV GL discussed the recommended changes with the USEF Foundation, which accepted the changes and recommended next steps forward for USEF's forthcoming update.
- Section 6 describes modifications to the GB market design. These modifications are grouped into three categories:
    - The main innovative elements that we propose to include in GB arrangements to make them USEF-compliant. Stakeholders generally supported these innovative elements and USEF provides clear steps for their implementation (section 6.1).
    - Innovative elements that are crucial to USEF, are conceptually supported by the majority of stakeholders, yet require further discussion on the exact implementation (section6.2).
    - Innovative elements that provide several options but need further discussion to agree on the preferred option (section 6.3).
- Section 7 covers elements that could lead to a non-compliant implementation of USEF in GB and recommended mitigation measures.

2.4 DNV GL's Role

DNV GL is one of the industry partners in Project FUSION and has led work undertaken under Project FUSION's WP3, which explores the implementation of USEF in the GB context. DNV GL is a founding partner of the USEF foundation and leads the USEF design team responsible for designing and maintaining the USEF specifications, describing, among others: the market coordination mechanism (MCM), the DSO – TSO coordination mechanism, the DSO interface with flexibility market participants, the wider design of flexibility markets and services, flexibility market platforms, as well as the validation and settlement procedures that underpin flexibility market transactions.

In spring 2019, DNV GL completed a due diligence analysis of USEF against legal, regulatory and market arrangements governing the GB energy sector. DNV GL subsequently used the findings of the due diligence to develop and deliver a public consultation on innovative elements from USEF of added value to future GB market arrangements. DNV GL then analysed the consultation responses to determine how USEF recommendations could be implemented in the GB energy market, as well as how the Project FUSION trial can test some of the proposed innovations. The roadmaps and recommendations set out in this report are based on this analysis, as well as DNV GL's professional experience as a leading energy sector advisory firm.

3 USEF DOCUMENTATION

USEF documentation provides details on key aspects and principles of USEF, as well as describing all the relevant components that are required to understand and implement a USEF-compliant market for flexibility.

We summarise below a list with the key framework design documents which are also freely available on the USEF Website:

- *USEF: The framework explained.* This document outlines the vision of the USEF Foundation and USEF's approach to the flexibility market design, with a high-level description of the structure, market roles, tools and rules.
- *USEF: The framework specifications.* This document sets out detailed technical guidelines for implementation of an optimised market-based energy system.
- *USEF: The privacy and security guideline.* This is a policy document which focuses on the topic of privacy and security. The security principles listed in this document need to be adhered to when implementing and operating the framework to ensure full USEF compliancy.
- *USEF implemented.* USEF's reference implementation offers sample coding to make building a USEF compliant IT system easier. It is available on GitHub under the Apache 2.0 license. The source code can be found here.
- *USEF Flexibility Trading Protocol (UFTP*) provides an update of the information exchange protocol between DSO and Aggregator (CMSP) role, incorporating lessons learned from USEF-based trials (outside the UK) which have tested this protocol.

The USEF Foundation has also published reports and whitepapers that provide useful insights into the flexibility markets in Europe and the USEF, and are listed below:

- *Flexibility Platforms.* This document provides a detailed introduction to various existing and emerging platforms as well as some USEF recommendations on the architecture of flexibility platforms for explicit demand-side flexibility and their standardisation.
- *Flexibility Value Chain (FVC) – update 2018.* This paper provides an in-depth insight into the FVC and presents an overview of services that can be delivered using demand-side flexibility according to USEF.
- *Flexibility Value Stacking.* This document describes USEF-recommended processes, rules and interactions to enable value stacking for portfolios of flexible demand-side resources.
- *DSO Workstream - Market-based congestion management models.* This document provides an assessment of 11 models that operated in 2017.
- *Workstream on Aggregator implementation models.* This document outlines recommended practices and key considerations for a regulatory framework and market design on explicit demand-side flexibility and sets out possible arrangements on the aggregator's relation to the supplier and the balance responsible party (BRP) in organising balance responsibility, transfer of energy and information exchange.
- *Energy & Flexibility Services for Citizens Energy Communities.* This document describes the main value drivers for citizens' energy communities, and how they can participate in flexibility markets and products.

USEF: The framework explained is expected to be updated in 2020, incorporating all relevant elements from these white papers. For further information on USEF, as well as the publications listed above, please visit the USEF website.

4 MAPPING USEF TO GB ARRANGEMENTS

To enable readers to place USEF in the context of GB energy market arrangements, this section

- provides terminology mapping, which translates key USEF terminology to GB terminology;
- maps USEF roles on GB functions and actors; and
- maps USEF's flexibility products and services against GB products and services on explicit demand-side flexibility.

4.1 Terminology

Table 1 maps USEF terminology to GB terminology and provides clarifications, where necessary. The table does not include roles; section 4.2 focuses on mapping of roles and actors.

Table 1: USEF and GB terminology

	USEF terminology	**GB terminology**
Active Demand & Supply (ADS)	Energy consuming or producing devices that can be actively controlled.	USEF only term
Aggregator Implementation Model (AIM)	USEF term that describes the relation of the aggregator with the supplier and the Balance Responsible Party (BRP). It covers relevant aspects of aggregation implementation, such as contractual arrangements, balance responsibility and Transfer of Energy (ToE).	USEF only term
Congestion Management	The avoidance of the thermal overload of system components by reducing peak loads. The conventional solution to thermal overload is grid reinforcement (e.g. cables, transformers). Congestion management may defer or even avoid the necessity of grid investments.	In GB the term is not widely used. Constraint management services at Transmission and Distribution networks is a more common term.
Constraint Management Services	Constraint management services support grid operators in active system management, operating the grid in a more efficient manner whilst respecting all physical constraints. Constraint management services in USEF include voltage control, grid capacity management, congestion management and controlled islanding.	Constraint management services in GB include services at transmission network which are not open to explicit demand-side flexibility and upcoming services in the distribution network which are under development.
Demand-Side Flexibility (DSF)	According to USEF, DSF is flexibility at the customer side, which includes flexible load, generation and on-site storage. DSF is provided "behind-the meter" or "behind the connection".	National Grid uses the term demand side flexibility (DSF) to encompass five categories of flexible response: 1. Demand Side Response (DSR) by flexible load shifting (e.g. heating, appliances, industrial operations, 2. DSR by onsite generation, 3. DSR by onsite energy storage, 4. distributed generation for export, 5. distributed energy storage for export.
Demand-Side Response (DSR)	USEF considers the term "DSR" the same as "Demand-side flexibility". USEF uses "DSF" instead of "DSR."	The change in electricity demand in response to a signal, through load shifting, on-site generation and/or use of storage.
Distributed Energy Resources (DER)	GB only term	Small scale power generation technologies (typically in the range of up to 10MW and including electric energy storage facilities) and larger end-use electricity consumers (e.g. industrial and commercial) with the ability to flex their demand (i.e. demand-side response) that are directly connected to the electricity distribution network. (ENA definition)

	USEF terminology	GB terminology
Flexibility Service Provider (FSP)	Market participant offering services using flexible resources. In USEF this is either a Balancing Service Provider (BSP), Balance Responsible Party (BRP), Constraint Management Service Provider (CMSP) or any combination of these roles.	The term is also used in GB. "Service provider" or "flexibility provider" are also common GB terms.
Flexibility Value Chain (FVC)	The potential of demand-side flexibility to create value to multiple participants through several markets and in the form of different products and services.	USEF only term
Flexilibility Requesting Party (FRP)	Market participant who buys flexibility from a flexibility service provider either directly or through exchange / market platform.	The term exists but is not widely used in GB.
Imbalance Settlement Period (ISP)	The time unit for which imbalance of the balance responsible parties is calculated. Each ISP normally lasts 15, 30 or 60 minutes.	In GB, the term Settlement Period is used and lasts 30 minutes.
Implicit Demand-Side Flexibility	Situation where consumers/generators react to pricing signals by increasing or decreasing demand/generation in response to pricing signals. Customers can choose to be exposed to time varying electricity prices or time varying network grid tariffs that reflect the value and cost of electricity and/or transportation in different time periods.	Same as USEF
Independent aggregation	Situation where a customer has an agreement with an Aggregator to dispatch and market (parts of) its flexibility, whereas this aggregator operates without the consent from or a contract with the electricity Supplier of the customer.	The term exists in GB, but it is not widely used.
Independent aggregator	A market party who performs the role of Aggregator and is not affiliated to a Supplier or any other market participant.	As per Ofgem's definition: Independent aggregators are defined as parties who bundle changes in consumer's loads or distributed generation output for sale in organised markets and who do not simultaneously supply the customer with energy.
Transfer of Energy (ToE)	USEF term for a wholesale electricity transaction between the Supplier and the Aggregator, triggered by a Demand Response activation by the Aggregator on the retail side, restoring the energy balance of both the Aggregator and the Supplier (and their BRPs).	USEF term only
Virtual Lead Party (VLP)	GB only term	Balancing and Settlement Code (BSC) party that only participates in settlement by offering balancing energy. The VLPs are aggregators of Supplier Volume Allocation (SVA) registered units for the sole purpose of participating in the provision of balancing services and are not subject to the same charges and obligations as existing BSC Parties.

The analysis indicates that although there is a large overlap between USEF and GB arrangements, there are still definitions which are different or unique in each framework. Ofgem's paper on flexibility platform has also highlighted a level of uncertainty or a lack of clarity around the terminology being used when discussing flexibility and recommends that "a clear set of definitions could assist innovation and engagement as well as set a basis for principles, standards and regulatory structures."[2] The USEF standardised terminology, which aligns with European definitions and the Harmonised Electricity Market Role Model, could be the basis for this effort and for the USEF implementation in GB. [3]

2 https://www.ofgem.gov.uk/system/files/docs/2019/09/ofgem_fi_flexibility_platforms_in_electricity_markets.pdf

3 https://www.ebix.org/artikel/role_model

4.2 Roles and Actors

DNV GL has classified roles and actors in three categories and summarised them in Table 2:

1. Roles/actors that can be found in all arrangements and have slightly different responsibilities and names.
2. Roles that are the same in all arrangements;
3. Roles that are exclusive to USEF or GB arrangements.

Table 2: Mapping of GB, Future Worlds and USEF roles

Legend:

Role exists in all the arrangements but with slightly different responsibilities or names
Exact match
Exclusive only to these arrangements

USEF	GB	ENA ONP Future Worlds
Aggregator: A service provider that contracts, monitors, aggregates, dispatches and remunerates flexible assets at the customer side. Aggregators buy flexibility from Prosumers and sell it to Flexibility Service Providers; i.e. market participants that provide services to the Transmission System Operator (TSO) and Distribution System Operator (DSO).	**Aggregator:** The role of the aggregator exists in GB as a market participant that aggregates a range of energy resources to create a single flexibility asset and provides flexibility services in several markets and through a range of products. Aggregators can be independent organisations or market actors combining roles such as prosumers, suppliers or generators. **Virtual Lead Party**: Balancing and Settlement Code (BSC) party that only participates in settlement by offering balancing energy. The VLPs are aggregators of Supplier Volume Allocation (SVA) registered units for the sole purpose of participating in the provision of balancing services and are not subject to the same charges and obligations as existing BSC Parties. **Clarification:** Where an aggregator (as defined by the ENA ONP) provides flexibility services to the ESO then the aggregator actor combines the USEF roles of Aggregator (i.e. aggregating flexibility at customer side) and Balancing Service Provider (i.e. providing a balancing service to the ESO). Additional differences between the USEF role and the ENA ON actor lie in the responsibilities of the Aggregators, in how broadly they can aggregate and sell flexibility as well as in the interactions with the prosumers and system operators.	
Allocation Responsible Party (ARP): A party that establishes and communicates the actual electricity volumes which are consumed and produced per Settlement Period within a certain metering area.	In GB the role is taken on by, ELEXON, for wholesale energy and the Balancing Mechanism. National Grid ESO is responsible for the settlement of non-BM balancing services and manages the payments of those.	**Settlement Agent:** The ENA ON project has introduced the actor of the Settlement Agent who manages the settlement of payments to and from flexibility service providers.
	Clarification: The "Future Worlds" role of the Settlement Agent is similar to the USEF ARP role in flexibility transactions. The main difference is that USEF assigns part of the responsibilities of the Settlement Agent to the Meter Data Company, such as the collection of meter data as well as the setup and maintenance of systems that securely collect, store and transmit the data required for the settlement process.	
Balance Responsible Party (BRP): A market participant or its chosen representative who is responsible for balancing electricity supply and demand of its portfolio in each settlement period.	Although the BRP role is not defined in a licence or code in GB, it is a term widely used in GB and indicates a market party who is responsible for actively managing the balance demand and supply. The balance responsibility in GB typically lies with the energy suppliers, who are responsible for matching supply and demand in their portfolio.	Not explicitly defined

Balancing Services Provider (BSP): A market participant who provides energy volumes to the TSO for the purposes of balancing the total system. In USEF the BSP is the trading counterparty through which the Aggregator provides Balancing Services to the TSO.	The term is used in GB. This role is usually undertaken by aggregators, suppliers or customers directly connected to the transmission network.	Not explicitly defined
Capacity Services Provider (CSP): A market participant in USEF that provides adequacy services to either the TSO or the BRP.	This term and its role are not formulated in GB although there are market parties that provide adequacy services in the Capacity Market.	Not explicitly defined
Common Reference Operator (CRO): In USEF, the CRO is responsible for operating the Common Reference. USEF defines the Common Reference as a repository which contains detailed information on network congestion points, their associated connections and active aggregators in the electricity network.	This role is only defined in USEF.	This role is only defined in USEF.
Constraint Management Services Provider (CMSP): A provider of constraints management services to a DSO or the ESO.	This role is only defined in USEF.	This role is only defined in USEF.
Distribution System Operator (DSO)	Distribution System Operator (DSO)	
Energy Services Company (ESCo): A company that offers auxiliary energy-related services to Prosumers.	Energy Services Company (ESCo)	Not explicitly defined
Meter Data Company (MDC): A USEF role designating a company responsible for the acquisition and validation of meter data and to facilitate the flexibility and balancing settlement processes by making accurate and valid data available to market agents.	**Data & Communications Company (DCC):** The current role of the DCC differs from USEF's definition. In GB, several entities are involved in data acquisition, sharing and management. For example, the DCC manages smart meter data and provides the communication infrastructure for suppliers and DNOs to acquire the data, however it does not communicate and share data with the ESO, nor does it validate data.	**Data & Communications Company (DCC):** Open Networks expect that the DCC role will evolve in the future setting up communications between platform developers and operators, service providers and their commercial agents, system operators.
	Clarification: In GB, there are several entities that are involved in data acquisition, sharing and management. For example, the DCC manages smart meter data and communication infrastructure, focusing on the domestic users of smart meters, however it does not communicate and share data with the ESO, nor does it validate data. The Data aggregator, Data collector and DSR administrator all have a role to play in the data validation, information exchange and settlement processes, which are carried out by ELEXON. USEF introduces a single entity that performs the meter data company role and interacts with all the market participants, which facilitates standardisation and transparency, and overall more efficient solution. This approach aligns with the Open Networks project's view on the future responsibilities of the DCC.	
Producer	Generator	
Prosumer	Prosumer & Consumer	
Supplier	Supplier	
Trader	Trader	Not explicitly defined

Transmission System Operator: A physical or legal entity responsible for operating, ensuring the maintenance and development of the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity.	**Electricity System Operator:** In GB, the party responsible for the system balance and operability is the Electricity System Operator (ESO), National Grid ESO. Separate parties, the electricity Transmission Owners (TOs), are responsible for investing, building and maintaining their electricity transmission network. **Transmission Owner (TO):** Separate parties from the ESO; responsible for investing, building and maintaining their electricity transmission network.	
Active Demand & Supply (ADS): Energy consuming or producing devices that can be actively controlled.	Flexibility Resources	Flexibility Resources
This actor was introduced by the ENA ONP.	This actor was introduced by the ENA ONP.	**Local Energy Systems:** utilise peer-to-peer trading/local energy market to the benefit of their participants (e.g. communities, companies, individuals).
This actor was introduced by the ENA ONP.	This actor was introduced by the ENA ONP.	**Local Market Operator:** third-party actor responsible for building and operating flexibility platforms at the request of a System Operator or Flexibility Coordinator

The mapping of roles and actors shows a large overlap between USEF and GB arrangements.

DNV GL has considered roles which are exclusive to USEF arrangements (i.e. Common Reference Operator and Constraint Management Services Provider) and has developed a roadmap for introducing these roles in GB in section 6. DNV GL has also flagged to the USEF Foundation actor/ roles that are unique to GB arrangements (current and/or future). Section 6.1 discusses potential modifications to USEF.

The reference implementation plan has not considered roles which are similar (but not an exact match), since there is no risk of a non-compliant USEF implementation.

4.3 Flexibility Value Chain

Figure 2 maps USEF and GB flexibility services based on purpose.

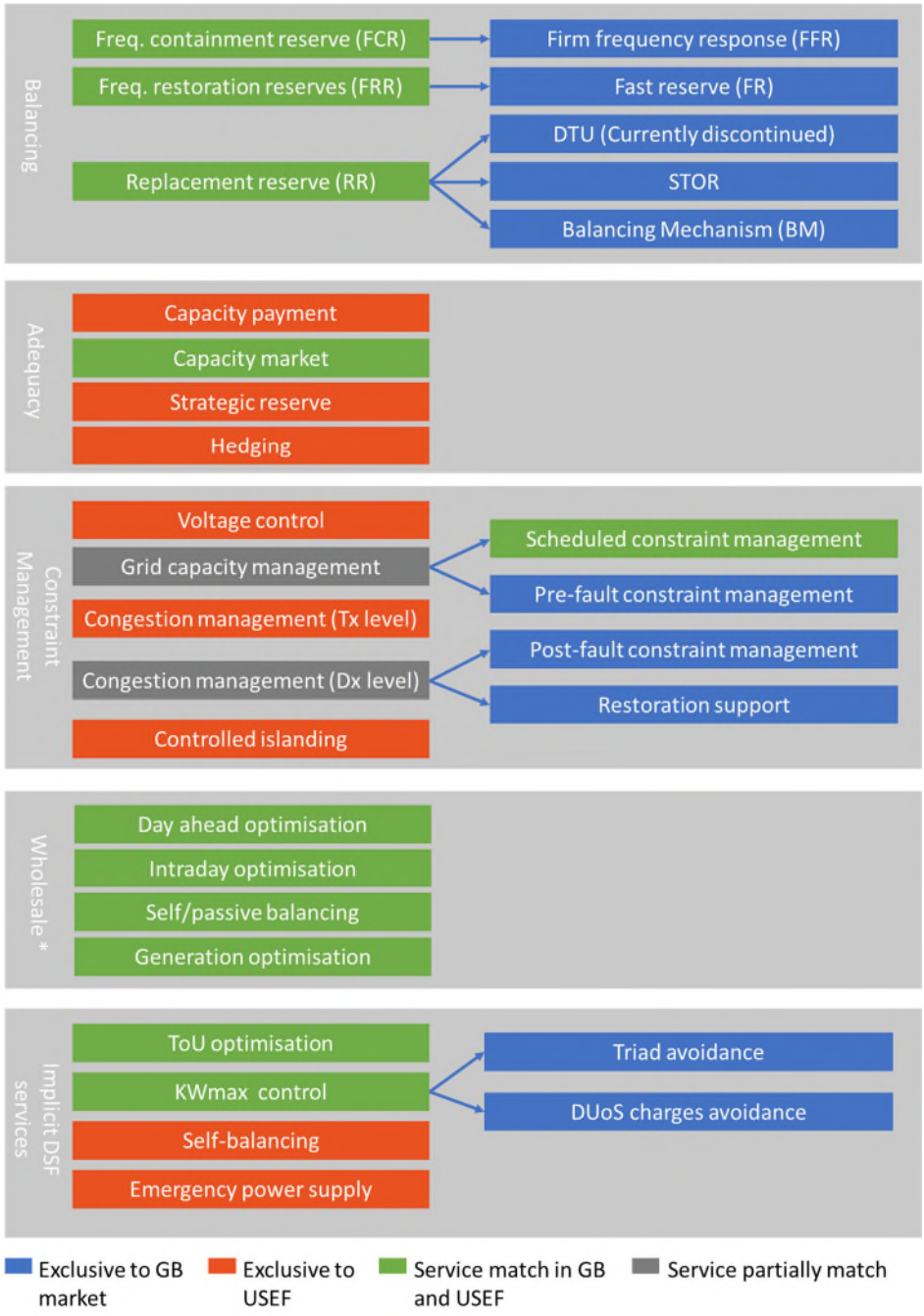

Figure 2: Mapping of GB and USEF DSR services

** Wholesale market services exist in GB but are not open for independent aggregation.*

Figure 2 shows that, although there is alignment on some key services, USEF describes a greater range of services than those that currently exist in the GB energy system. We consider this to be reflective of the nascent state of flexibility services in GB, and the FUSION consultation under project FUSION explored the potential future realisation of the additional services that USEF proposes. The analysis has also identified that GB DNOs are considering restoration support services, pre-fault and post-fault constraint management services at distribution level, which USEF has not yet considered concretely, and which could be incorporated in USEF to enhance the USEF flexibility value chain (see section 5).

5 MODIFICATIONS TO USEF

The due diligence exercise, which DNV GL undertook as part of Project FUSION earlier this year, identified areas where USEF could be updated to align with GB energy market arrangements. In developing this report, DNV GL engaged with the USEF Foundation to discuss potential modifications to USEF. The workshop between DNV GL and the USEF Foundation raised the following future actions to enhance and update USEF so that it aligns with GB arrangements:

1) The USEF Flexibility Value Chain (FVC) will be extended to include GB post-fault constraint management products;
2) The USEF Flexibility Value Chain (FVC) will be extended to include GB pre-fault constraint management and restoration support products;
3) The USEF roles will accommodate additional roles or responsibilities which are found in GB arrangements;
4) USEF will only consider adding a separate ESO role if this aligns with the Harmonised Electricity Market Role Model and with ongoing ebIX discussions (This is not, however, an issue from the perspective of USEF-compliance); and
5) The development of the Common Reference and the CRO role will use insights from the FUSION trial and other GB initiatives to ensure compliance with GDPR requirements.

The following section describes the outcomes of this discussion for each topic and sets out the way forward agreed with the USEF Foundation.

5.1 Post-fault products

GB post–fault products are not currently represented in the USEF Flexibility Value Chain (FVC). The USEF Foundation and DNV GL agreed that the distinction between pre- and post-fault products is relevant for the procurement and deployment of flexibility by future DSOs. As such, the USEF Foundation plans to explicitly recognise post-fault products in the next edition of the "USEF Framework Explained."

5.2 USEF Flexibility Value Chain

Figure 2 above shows that in the GB market there are two more products in the category of constraint management products at distribution level and are not currently represented in the USEF FVC:

- Pre-fault constraint management; and
- Restoration support.

The USEF Foundation plans to explicitly recognise pre-fault products in the next edition of the "USEF Framework Explained." The USEF will also formally recognise restoration support products in the FVC, given that demand-side flexibility can provide restoration support services to future DSOs.

More generally, the USEF Foundation is currently considering the standardisation of DSO products including identification of a set of parameters that are required to define and characterise a product. The USEF Foundation will draw on outcomes from international as well as GB initiatives, including UK Network Innovation Competition (NIC) projects (such as Project FUSION and TRANSITION) as well as ongoing work in the ENA ON project.

5.3 Roles & Interactions

Table 2 also shows that two energy market actors identified by the ENA could not be mapped to the USEF role model: Local Energy Systems (LES) and the Local Market Operator (LMO).

LES relate to energy exchange and/or peer-to-peer trading within a defined area. The USEF paper "Energy & Flexibility Services for Citizens Energy Communities" refers to concepts such as peer-to-peer trading. These concepts, however, are out of scope of the role model of USEF.[4] Therefore, the USEF Foundation considers that the Local Energy System (LES) actor is out of USEF's scope, unless it takes on responsibilities related to flexibility market transactions.

LMOs are developers and/or operators of flexibility platforms. The USEF Foundation will take into consideration specific responsibilities that could be assigned to the LMO as a market facilitator in USEF.

The USEF Foundation agreed that in the future if there is a relevant role/responsibility that is not covered by the USEF role model, it would be worthwhile exploring the possibility of including new roles.

5.4 System Operator

Table 2 above shows that USEF does not differentiate between the network operator and the system operator role. The distinction between the two roles is not fundamentally relevant to USEF, although USEF acknowledges that the two GB roles have different responsibilities.

Modifications to USEF's roles will be considered in conjunction with the Harmonised Electricity Market Role Model, with which USEF is aligned.[5] This model has been developed to identify and define all roles associated with the electricity market, and is used and maintained by the European Network of Transmission System Operators for Electricity (ENTSOe), the European Federation of Energy Traders (EFET) and the European forum for energy Business Information eXchange (ebIX). USEF will only consider adding a separate ESO role if this aligns with the Harmonised Electricity Market Role Model and with ongoing ebIX discussions. The existence of a separate ESO role in the GB market does not constitute non-compliance with USEF, but simply reflects an area where the GB market differs from European arrangements.

Irrespective of creating an additional role, USEF can recognise that the role of the System Operator (SO) can be split in the roles of the network operator and the system operator, for both transmission and distribution networks.

5.5 Privacy and Cyber Security requirements for congestion point publication

The USEF Foundation is developing changes for the Common Reference (CR) under the forthcoming USEF Flexibility Trading Protocol (UFTP).[6] the foundation expects that the Common Reference will include more information than what is currently documented. For instance, the USEF foundation would like to include historic data on congestion point publication as well as more details on the type of flexible asset. However, USEF will take into consideration findings on privacy-related limitations from the FUSION trial and from work undertaken by the ENA ON and EDTF, to inform potential CR modifications to accommodate GDPR requirements.

4 https://www.nweurope.eu/media/6768/usef-white-paper-energy-and-flexibility-services-for-citizens-energy-communities-final-cm.pdf

5 https://www.ebix.org/artikel/role_model

6 The UFTP document has not been published yet and therefore there is no available reference.

6 RECOMMENDED CHANGES TO GB ARRANGEMENTS

This section is split into three themes:

1. The first theme (section 6.1) will explore USEF innovative elements with easy implementation and which could be applied to the GB arrangements to make them compliant with USEF. It will provide basic USEF requirements that must be met as well as key changes to GB arrangements for the recommendations to be implemented.
2. The second theme (section 0) will provide a roadmap for implementation of USEF recommendations which either require complex changes to the GB regulatory framework or require further industry discussion to explore the merit of the USEF recommendation as well as the potential route for implementation.
3. The third theme (section 6.3) will look into USEF innovative elements which provide several options but need further industry discussion to identify a preferred option. It will consider feasible options and provide an overview of the way forward in GB.

6.1 Application of USEF innovative elements in GB

6.1.1 Congestion point repository

USEF proposes the development of a **congestion point repository** (or **Common Reference** in USEF terminology), which is a repository containing detailed information on network congestion points, their associated connections and active aggregators in the electricity network. The Common Reference can enhance informed decision making for flexibility buyers and sellers, as well as create a level playing field for all market participants by ensuring the availability of transparent and consistent information on congestion points and connected (potential) flexibility.

The GB implementation of the Common Reference involves the following steps:

1) Design the steps for the **structure and operation of the Common Reference** as described by USEF:
   - From a practical point of view, it is logical to include all congestion points of a DSO in a single Common Reference. The common reference must at a minimum include all connections related to individual congestion points.
   - The use of the Common Reference for flexibility services starts in the Plan phase of USEF's Market Coordination Mechanism (MCM – see Appendix B), when the DSO declares its congestion points. The DSO defines which grid points are congestion points. USEF recommends that DSOs declare congestion points at the lowest possible level in the grid to provide detailed insight into local network congestion, facilitating effective aggregation of flexible assets, which in turn enhances the reliability of the grid safety analysis.
   - In the MCM Plan phase, the Aggregator publishes a list of the connections (of contracted Prosumers) that are active at congestion points in the Common Reference. This list is stored and, subject to access controls, made available to other market participants by the Common Reference Operator.
   - In the MCM Validate phase, the DSO retrieves all DSO-registered Congestion Points with the list of Aggregators representing Prosumers at each Congestion Point, including the number of connections represented by each Aggregator from the Common Reference. The Aggregator its connections registered to congested points retrieves from the Common Reference. The Aggregator then submits to the DSO the D-programme providing its forecast of planned activations of flexibility for those connections.
   - Both the DSO and Aggregators update the Common Reference to reflect changes in congested network areas (DSO) or in activity at relevant connections (Aggregator).

2) Establish the **Common Reference Operator (CRO):** This role does not currently exist in GB current arrangements. Responses to the FUSION USEF consultation supported the development of a Common Reference, but were mixed as to whether a regulated entity should operate the Common Reference. The consultation did not solicit suggestions for specific organisations to take the CRO role, which will have to be further explored. In GB the role of the CRO could be performed by a new or existing entity (including ENA ON actors), which could be a single, centralised entity for the whole of the GB market, or individual DSOs acting as CRO for their network area under a common standard.

3) **Agree data requirements**: The Common Reference must contain a list of connection identifiers for each congestion point declared by the DSO. The type of the connection identifiers and the level of information is a sensitive topic in light of GDPR requirements. Engagement with the industry has highlighted that the use of Metering Point Administration Number (MPANs) is compliant with GDPR requirements, while individual customer names cannot be published under current regulations. The deployment of the Common Reference should take account of updates from industry on this topic (see below **initiatives in Great Britain**).

   USEF recommends that data submissions from the DSO and the Aggregators into the Common Reference employ a standardised format.

4) **Accessibility of the data** in the Common Reference is limited to contractual requirements between the DSO, and the other parties who use the Common Reference: DSOs may only obtain Aggregator identities and combined connection counts for Congestion Points they have registered themselves. Similarly, Aggregators may only obtain DSO identities, Congestion Point identifiers and Connection identifiers for connections that they have registered themselves.

5) Align efforts with relevant **initiatives in Great Britain.** The following is a non-exclusive list of current initiatives considering similar objectives and functionality as the Common Reference, which could be consolidated to deliver a single outcome for the GB energy industry:

   - The ENA ON project is currently developing the **System Wide Resource Register.**[7] The project is considering several options for the information that the DNOs will capture in the resource registers. It also considers alignment and coordination with the development of a **Digital System Map** that has been recommended by the Energy Data Taskforce.[8] The SWRR and Digital System Map share functionality and objective with the Common Reference, and DNV GL therefore recommends that the ENA ON considers the structure and principles recommended by USEF in the development of the SWRR.

   - **Data Catalogue – Energy Data Taskforce (EDTF):** The EDTF has recommended the creation of a data catalogue which requires organisations holding Energy System Data to contribute data about their assets. The Common Reference aligns with this EDTF recommendation as well as the direction of travel in GB on access to energy system data, and we consider there is scope for alignment or even integration. For example, the Common Reference could be one of the Energy System Datasets that is accessed via the Data Catalogue. In case of alignment with the EDTF data catalogue, the format of the Common Reference should be adjusted to Data Catalogue's format, so that information is manageable and useable.

   - **RecorDER project**: The RecorDER project has been proposed as a potential solution for the System Wide Resource Register. The development of the Common Reference could be further informed by insights from RecorDER. For instance, the ENA ON project is seeking further legal advice on GDPR and confidentiality requirements via this project, which would be relevant to the implementation of the Common Reference.

7 System Wide Resource Register Feasibility Report, ENA http://www.energynetworks.org/assets/files/2018%2029th%20Nov%20ON-PRJ-WS1%20Product%208%20Report%20V2.pdf

8 https://es.catapult.org.uk/wp-content/uploads/2019/06/EDTF-Report-Appendix-4-Digital-System-Map.pdf

- **'Data Best Practice' guidance – Ofgem:** Ofgem is considering the development of Data Best Practice guidance that would govern how data is handled as well as ease data exchange between parties. The guidance will be created on a broad and inclusive range of views and will be continually improved. The Common Reference could both inform Ofgem's initiative as well as evolve with the development of this guidance in the future.
- **Distribution Connection and Use of System Agreement (DCUSA) modification proposal** "DCP 350 - Creation of Embedded Capacity Registers".[9] This proposal requires DNOs to publish and maintain a register of all generation, storage and DSR assets (starting with those above 1MW) connected to and using their networks. DCP 350 closely aligns with data requirements proposed for the Common Reference and its implementation could remove barriers associated with data confidentiality.

6) **Use insights from the FUSION trial**, which will implement the Common Reference and will test the DSO performing the CRO role. The trial will test the Common Reference interactions in practice, will demonstrate how DSOs and aggregators can incorporate the Common Reference into normal operations, and will implement a GDPR-compliant solution.

Following the approach set out above, the operation and structure of USEF's Common Reference can inform the GB development of a Congestion Point Repository, including compliance with relevant regulations and alignment with other relevant GB initiatives, as well as draw on practical insights from the FUSION trial.

6.1.2 D-programmes

USEF introduces the concept of **D-programmes** to inform a DSO's forecast of the state of the distribution network and to determine whether there is a need for flexibility. Application of D-programmes in the GB market involves the following steps and processes:

- In the MCM Validate phase, Aggregators active in congested DSO areas are obliged to submit D-programmes to the relevant DSOs, informing them of planned activations of flexibility (day-ahead and intraday). The D-programme only includes the forecasted load of those Prosumers served by the Aggregator and that have a connection related to a congestion point. The D-Programme contains one full calendar day for the day ahead process and all remaining settlement periods of the calendar day for the intraday process.
- The DSO then combines the D-programmes with the profiles of the connections that are not served by Aggregators into a D-plan, which informs a grid safety analysis through which the DSO determines the status of the grid.
- As a minimum requirement, USEF specifies that the D-programme should show planned flexibility activations in every settlement period.
- USEF recommends that the Aggregator sends D-programmes to the DSO day-ahead, at least two hours before the day-ahead gate closure. Aggregators can update D-programmes up to one hour before intraday gate closure. Updates can be triggered by, for example, a change in forecast flexibility activation.
- The D-programme serves as the baseline for the settlement of flexibility transactions between the Aggregator and the DSO.
- The implementation of D-programmes in GB requires that DSOs integrate D-programme processes in their day-to-day operations.

9 https://www.dcusa.co.uk/change/creation-of-embedded-capacity-registers/

- In addition, the implementation of D-programmes should reflect existing requirements for generators and consumers regarding the submission of load forecasts. The European KORRR Guideline[10] describes the responsibility of large end-users to provide scheduled data (typically day ahead) to the TSO or (if connected to the distribution grid) the DSO. The exact implementation could differ at national level. Therefore, as part of next steps for the GB implementation of USEF D-programmes, the industry should clarify if the European KORRR Guideline is followed in GB and by each DSO:
    - To what extent are load forecasts currently in operation, either with end-users and/or with DNOs? Are these prognoses already used for grid safety analysis?
    - What are the exact information obligations (e.g. frequency and timing) in GB?
    - What are the minimum capacity levels for which this obligation for transport prognoses holds in GB, both at aggregated level and on individual level?

USEF describes clear steps for the application of the D-programmes, which are also applicable in GB. The FUSION trial will test the use of D-programmes and will inform the implementation process at a national level.

6.1.3 "Free bids" – DSO flexibility procurement

USEF recommends that alongside long-term flexibility contracts the market enables short-term flexibility procurement through "free bids." Short-term procurement involves contracts that are signed between the Aggregator and the DSO closer to real-time. Flexibility trading for congestion management, which typically occurs Day-Ahead, Intra-Day and sometimes in Real-time, is classified as short-term.

Facilitating "free bids" aligns with Ofgem's vision to "ensure they (*network companies)* explore both long and short-term flexibility tenders as part of their business as usual network management."[11] USEF describes the following steps for short-term flexibility procurement:

- The Aggregator places a **bid on the market** on a day-to-day basis, without a contractual obligation to do so.
- The Aggregator is free to offer flexibility at any price (in a competitive market, the price will potentially reflect marginal cost of this flexibility). The availability is not guaranteed for the DSO, until the bid is made.
- "Free bids" can compete with contracted flexibility in a **merit order mechanism.** The merit order mechanism may assess the price, as well as other qualitative characteristics such as connectivity, reliability, and the period to which the load is shifted. The merit order itself ensures that the DSO can buy the economically optimal flexibility service, while the availability contracts guarantee availability of flexibility (i.e. sufficient depth of the merit order).

  In the FUSION USEF consultation, some stakeholders raised concerns about the reliability of flexibility services procured short-term, as well as the risk of undermining long-term contracted flexibility services. USEF does not provide a detailed specification for the basis of the merit order, proposing only that the DSO accepts the flexibility offers that will solve the congestion issue, but not necessarily prioritising the lowest price offers. A DSO's selection process may assess the flexibility price against quality of the flexibility offered in both long-term contracts and short term offers, however a DSO must be transparent in its selection process.

10 KORRR, (All TSOs' proposal for the Key Organisational Requirements, Roles and Responsibilities relating to Data Exchange in accordance with Article 40(6) of Commission Regulation (EU) 2017/1485 of 2 August 2017 establishing a Guideline on Electricity Transmission System Operation), article 16 (scheduled data provided by Significant Grid Users)

11 https://www.ofgem.gov.uk/system/files/docs/2019/08/position_paper_on_distribution_system_operation.pdf

The **process** of requesting free bids takes place during the MCM Validate phase, triggered by congestion issues highlighted in the DSO grid safety analysis. The market participants take the following steps to solve the expected congestion:

1. The DSO, during the MCM Validate period (day-ahead and intra-day), requests from all the Aggregators who are active at the congestion point to provide flexibility. In this request, the DSO indicates the magnitude (amount of excess power) and timing (settlement period) of the expected congestion, and how much capacity is available in the settlement period;
2. Aggregators receive the flexibility request from the DSO;
3. Aggregators submit their offers for the flexibility (free bids). Offers can be submitted before day-ahead gate closure (for day-ahead requests) or intra-day gate closure (for intra-day requests) as set by the DSO;
4. The DSO receives the flexibility offers;
5. The DSO procures flexibility to resolve the congestion issues in two ways: either the DSO places an order for flexibility offered by Aggregators through free bids on the day, or the DSO activates flexibility from existing long-term contracts with an Aggregator;
6. The DSO determines whether the expected congestion will be resolved using the requested flexibility;
7. The Aggregators receive the flexibility orders and activate the requested flexibility.

The FUSION trial will further inform the potential GB implementation of the "free bids" processes, such as the merit order of flexibility procurement. For example, Project FUSION will consider developing a decision tree to facilitate the choice of flexibility offers and inform how free bids can compete with bids under long-term contracts.

6.1.4 Sub-metering arrangements

USEF considers sub-metering essential to enable independent aggregation in all flexibility products and to quantify flexibility when more than one Supplier or Aggregator is active at the same connection point. USEF recommends that all products allow for sub-metering unless the flexible load accounts for most of the total load, or sub-metering leads to unreasonable costs.

Sub-metering arrangements should consider the following elements:

- **Level of granularity of measurements:** Flexibility products have different requirements regarding the level of granularity of flexibility measurements. USEF specifies that time resolution down to a settlement period is sufficient for processes underpinning wholesale products, such as settlement, billing and forecasting. Other products, such as DSO constraint management, may require higher granularity. These requirements should be part of the product design and reflect the needs of flexibility markets. For example, the ENA ON flexibility products require minute-by-minute metering for DSO congestion management products. In the trial, Project FUSION will test a sufficient level of granularity for DSO flexibility products and the cost-effectiveness of sub-metering, to inform the future use of sub-metering in the GB market.
- **Level of accuracy of measurement:** the requirements on the accuracy level vary with the type of products and the type of Prosumer. Sub-meters which are used in the residential segment may have lower levels of accuracy compared to industrial & commercial (I&C) customers. The accuracy and the technical specifications of the sub-metering equipment should also ensure the feasibility of the sub-metering installation. For example, expensive and high-tech sub-metering equipment for domestic customers could lead to high installation costs and barriers to further implementation by domestic Prosumers. USEF recommends that high levels of accuracy should be ensured at aggregated level rather than at asset level.
- **Validation of sub-meter data:** USEF specifies that the Meter Data Company (MDC) should perform this process for data used as input for the Transfer of Energy (ToE). There is currently no equivalent for the MDC

role in the GB energy market, and therefore the industry should further consider which party would be suitable to perform this role. USEF's proposals for the role of the MDC aligns with the view of the ENA ON project on the future responsibilities of the Data Communication Company (DCC).

The quantification of the delivered flexibility for DSO products is performed by the DSO and validated with the CMSP.

- **Technical compliance considerations**: All sub-metering equipment should comply with the technical requirements of the flexibility request party (or the Allocation Responsible Party in the case of wholesale transactions). USEF itself does not provide recommendations on such technical requirements.

The use of sub-metering in DSO congestion management products is within reach in GB and its implementation should only focus on some practical elements, which are subject to flexibility product design. These elements are: the level of granularity of measurements, the level of accuracy of measurements, the validation of the sub-meter data and the technical requirements of the sub-metering equipment.

6.1.5 Baselining methodology for DSO products

USEF recommends a standardised baseline for all flexibility products to ensure transparency and standardisation of flexibility processes. The FUSION Due Diligence highlighted that there are differences between USEF recommendations and GB baseline methodologies for balancing and congestion management products. This difference is bigger in congestion management products, due to the lack of standardisation in the GB market.

Development of baseline methodologies according to USEF should consider the following elements:

1. **Baseline for DSO products**: USEF defines the D-programme as the standardised baseline for the congestion management product.[12] The D-programme (section 6.1.2) contains the most updated demand forecast at each connection point in the congested area.

2. **Development of baseline methodology:** USEF recommends that the flexibility request party is responsible for defining the baseline methodology, i.e. the TSO for balancing services, the DSO for DSO congestion management services. The same recommendation applies for the quantification of flexibility: the DSO should validate the baseline against real data, once the DSO has received the measurements from the Meter Data Company.

- **Standardisation of baseline**: USEF recommends that the baseline should be consistent and standardised across all DSOs.

- **Actions for DSOs:** Across the GB energy market, a range of baseline methodologies is currently in use for congestion management products. For example, UKPN uses an average consumption of the unit during representative historic peak periods; WPD uses the average demand from the previous month; and ENW uses a "Meter-Before/Meter-After" approach. This is indicative of a lack of standardisation, which may form a barrier for Aggregators entering the market, in the form of cost and effort to manage different baselining methodologies.

  DSOs will need to align their baseline methodologies and include them in the product design. The ENA ON project has been facilitating standardisation of DSO flexibility products, and therefore DNV GL recommends that ENA is one of the parties to lead discussions on standardisation and embed USEF's principles in flexibility product design.

Project FUSION will trial USEF's recommendations on the baseline for congestion management products. The trial will inform the effectiveness of the methodology as well as its practical implementation in the GB market.

12 This recommendation applies only for the congestion management product defined in the USEF Flexibility Value Chain. Other constraint management products discussed in GB, such as post-fault, may need a different baseline methodology.

6.2 Roadmaps for GB implementation

This section sets out implementation roadmaps for innovative elements that are fundamental to USEF, that are conceptually supported by the majority of stakeholders responding to the Project FUSION public consultation, but for which the exact implementation in the GB energy industry requires further consideration by energy industry stakeholders. DNV GL has proposed a bespoke roadmap for each USEF element considered, although some general observations can be made:

- DNV GL has identified the **key stakeholders** that should be actively involved in the implementation process.
- Almost all proposed innovations, particularly those where there may not be a (single) natural industry organisation to lead the development, will require proactive support and **leadership form Ofgem and/or BEIS** to drive further exploration.
- In the absence of clear industry owners to explore the implementation of USEF innovations, several routes for implementation of each USEF innovation may be feasible. For instance, the ENA Open Networks project will use insights from (among others) Project FUSION to inform further actions for network operators and other energy industry stakeholders. As such, the ENA could explore and drive implementation through the Open Networks project or take the initiative to set up industry working groups. Alternatively, Ofgem and/or BEIS could explore implementation directly as part of new or existing workstreams, or set up industry working groups. The roadmaps proposed in this report focus on the steps/actions required to implement USEF innovations, and proposes, on a non-exclusive basis, key stakeholders to take an active role in this process.
- **Industry code modifications** are likely to be required to enable some innovations. This report has identified where code modifications are likely to be required, and in such instances typically the relevant code administrator would have a role (e.g. ELEXON for the BSC). However, this report does not comment on the underlying code modification process, including any design activities in code modification workgroups.

6.2.1 Independent aggregation in wholesale markets

Facilitating the access of independent aggregation to wholesale markets will require new arrangements in the GB energy market. In particular, specific arrangements for the Transfer of Energy (ToE) and balance responsibility between Suppliers and Aggregators will need to be put in place. USEF has developed Aggregator Implementation Models (AIMs – see Appendix A) that could form the basis for these arrangements.

In addition to new arrangements, there are further changes in relation to wholesale settlement, the allocation of activated flexibility as well as to the energy balance and financial balance of the key stakeholders.

The **key stakeholders** that should be actively involved in the process are:

- Ofgem and BEIS;
- ELEXON;
- Balancing and Settlement Code (BSC) parties which will be impacted: aggregators, licensed DSOs, suppliers, National Grid ESO, Balance Responsible Parties (BRPs);
- Companies that are involved in the settlement processes, such as market parties that perform the roles of the Energy Contract Volume Notification Agent (ECVNA), HH & NNHH Data aggregator (HHDA & NHHDA), HH & NNHH Data Collector (HHDC & NHHD), and the Data Transfer Service Administrator;
- Nominated Electricity Market Operators (NEMOs); and
- The Data Communications Company (DCC).

In order to successfully facilitate access to wholesale markets for independent aggregation, stakeholders should participate via the following mechanisms and achieve the following milestones:

- **Leadership from BEIS and Ofgem**: BEIS and Ofgem should recognise the need for independent aggregation to access wholesale markets and provide clarity on the relevant policy and regulatory context to enable it.
- **Assess feasibility of independent aggregation in wholesale markets**: The industry should perform a Cost Benefit Analysis (CBA) to confirm costs and benefits which will occur due to the access of independent aggregation to wholesale markets. BEIS and/or Ofgem could commission or facilitate such a CBA.
- **Code modifications:** This recommendation may require a BSC modification, or alternatively it could be added to existing BSC modifications such as P344, P375, P376 and P379.[13] DNV GL recommends that the impacts on the Grid Code, on the Transmission Licence and on other relevant Codes are considered as part of exploring independent aggregation to access wholesale markets. This could be part of Ofgem's and BEIS's current work in investigating reform of industry codes and governance to enable a smarter energy system.[14]
- **Public consultation:** A BSC modification will require a public consultation developed by BSC signatories/working group or ELEXON, which will seek industry inputs on the recommendation and the changes that should be implemented.
- DNV GL recommends that stakeholders (acting under a future working group) discuss and seek agreement on the following:

    1. **Balance Responsibility:** The industry should define arrangements associated with the balance responsibility of independent aggregators. USEF proposes that independent aggregators are balance responsible of the activated flexibility when participating in wholesale energy markets (see section 6.3.1).
    2. **Transfer of Energy (ToE):** USEF provides recommendations on the energy settlement between the Aggregator and the Supplier in wholesale energy markets (i.e. ToE). USEF recommends that the ToE can be organised through two different ways (central settlement AIM or corrected AIM, see Appendix A). These arrangements will correct the open supply position of the suppliers. Stakeholders should consider these arrangements; USEF can inform this discussion and facilitate the design of the ToE arrangements.
    3. **Metering arrangements:** Smart meter installation at the Prosumer's site will be required, with 30-minute resolution of measurements. Provision of flexibility will alter the flows over the Boundary Meter and therefore sub-metering arrangements should be available to allocate the activated flexibility to the independent aggregator for the purposes of the Transfer of Energy (ToE). The use of sub-metering may have an impact on the feasibility of associated business models and should be further examined (see also section 6.1.4).
    4. **Baselining arrangements:** In wholesale markets, there is a need to quantify the ToE. There is no need to quantify the delivered flexibility, which is implicit in the portfolio of the BRPs. USEF therefore recommends a baseline methodology to quantify the ToE. Based on responses received in the FUSION consultation, DNV GL recommends that Ofgem should initiate the development of the baseline methodology for ToE, which can then be delivered through the BSC processes.

        Considering this topic as part of BSC processes provides the opportunity for a robust workgroup process to gather views and best practice from across the industry, whilst the outcome can be approved by Ofgem. For example, BSC Modification P376 is already considering introducing a Baseline methodology for the provision of Final Physical Notifications for Aggregators. According to ELEXON, this could be expanded and used for other products and services. DNV GL recommends

13 https://www.elexon.co.uk/mod-proposal/p344/

14 https://www.ofgem.gov.uk/publications-and-updates/consultation-reforming-energy-industry-codes

that the working group on independent aggregation engages further engagement with ELEXON to align with updates on BSC Modification and explore ELEXON's potential role in baselining and settlement processes under the new arrangements.

Figure 3 outlines the roadmap that the GB industry would follow to implement independent aggregation access to wholesale markets.

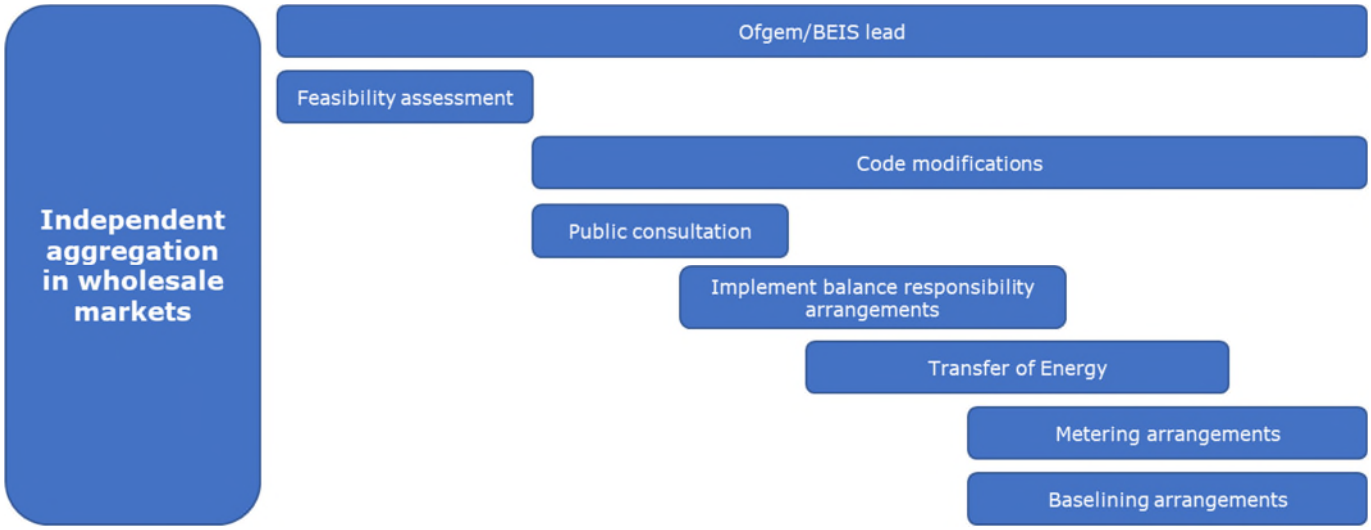

Figure 3: Roadmap for independent aggregation access to wholesale markets

6.2.2 Central data hub

USEF recommends the establishment of a central data hub, where data for flexibility processes, such as the coordination of flexibility deployment, measurement, validation and settlement of flexibility services, is recorded. This data hub will provide a more transparent market, facilitating the standardisation of flexibility settlement processes as well as the participation of flexibility service providers in various flexibility services.

The development of a central data hub will require various changes to GB market arrangements, such as changes in the data processes, change of an industry code, or changes in the role of some GB actors. The process would benefit from active involvement of at least the following **key stakeholders**:

- Ofgem and BEIS, possibly through the Energy Data Taskforce initiative;
- DNOs, possibly through the Energy Networks Association (ENA);
- National Grid ESO, possibly through the Energy Networks Association (ENA);
- Aggregators;
- ELEXON;
- Organisations that are engaged with the administration, management and operation of data - e.g. Ordnance Survey, Open Data Institute, ElectraLink;
- Organisations involved in the Energy Data Taskforce initiative.

The development of the central data hub requires the following mechanisms and should achieve the following milestones:

- **Align processes with other GB initiatives and current processes**:
    - **Data Catalogue – Energy Data Taskforce (EDTF):** The EDTF has recommended the creation of a data catalogue which requires organisations holding Energy System Data to provide data about their assets. The central data hub aligns with EDTF recommendation and the direction of travel on data access. The central data hub could be one of the Energy System Datasets that is accessed via the Data Catalogue. In case of integration with the EDTF data catalogue, the format of the central data hub can be adjusted to Data Catalogue's format, so that information is manageable and useable.
    - **Existing processes:** The ESO has developed a number of processes for sharing information with the industry related to its balancing services. For example, the ESO publishes a market information report after each STOR tender round that provides existing and potential STOR participants an overview of the bids received. It provides data on the tendered utilisation and availability prices, the forward contracted position and details on the type and dynamics of each tender unit. At the end of each month, the ESO also publishes a service-by-service summary of the cost of balancing services in the monthly balancing services summary (MBSS). DNV GL recommends that the implementation of the central data hub considers the applicability of these processes and the risk of overlapping data.
- **Define data requirements of the central data hub:** The industry will need to decide which data will be recorded in the central data hub. USEF proposes that the main function of the hub is to collate standardised datasets relating to flexibility transactions to be made available to relevant market parties.

  One option is that aggregators submit their data at Prosumer's boundary level or per flexible unit and record information on each flexibility transaction, the flexibility deployment in MW, measurement and validation as well as information on the settlement of flexibility for each transaction (e.g. utilisation price, capacity price, total remuneration for the activated flexibility). Another option is that aggregators provide information for their portfolio at aggregated level (e.g. substation level or Grid Supply Point level).

  DSOs should also provide data on flexibility transactions at congestion point level.

  The format of the dataset should be standardised across the industry.
- **Define ownership and operation of the central data hub:** The FUSION USEF consultation indicated that there is no obvious industry organisation which could operate the central data hub. DNV GL recommends that the central hub should be developed and managed by a trusted party with a strong track record in data management. This recommendation reflects the EDTF recommendation on the operation of the Data Catalogue, which has recommended the Office for National Statistics (ONS) as a possible operator. Based on EDTF recommendations for similar functions, other possibilities might be ElectraLink or Ordnance Survey.

  The central data hub can be either a regulated or unregulated function. This could be a decision for Ofgem and BEIS informed by industry feedback.
- **Access to the central data hub:** The principle of the central data hub is that all data should be as open as possible. Industry stakeholder should jointly determine whether each system operator has access to the data of other system operators and whether aggregators have visibility of all flexibility transactions. USEF does not have provide specific recommendations on this point.
- **Code modifications:** DNV GL recommends that code modifications be considered and if appropriate, implemented to increase the number and range of actors required to participate with the central data hub. For example, the EDTF recommendation for the creation of a Data Catalogue has indicated that the Code Administration Code of Practice, licence modifications, the Significant Code Review and the Energy Code

Review could be options for embedding requirements related to the Data Catalogue. This is a recommendation that the industry should also consider for the implementation of the central data hub.

Figure 4 outlines the roadmap for the implementation of the central data hub.

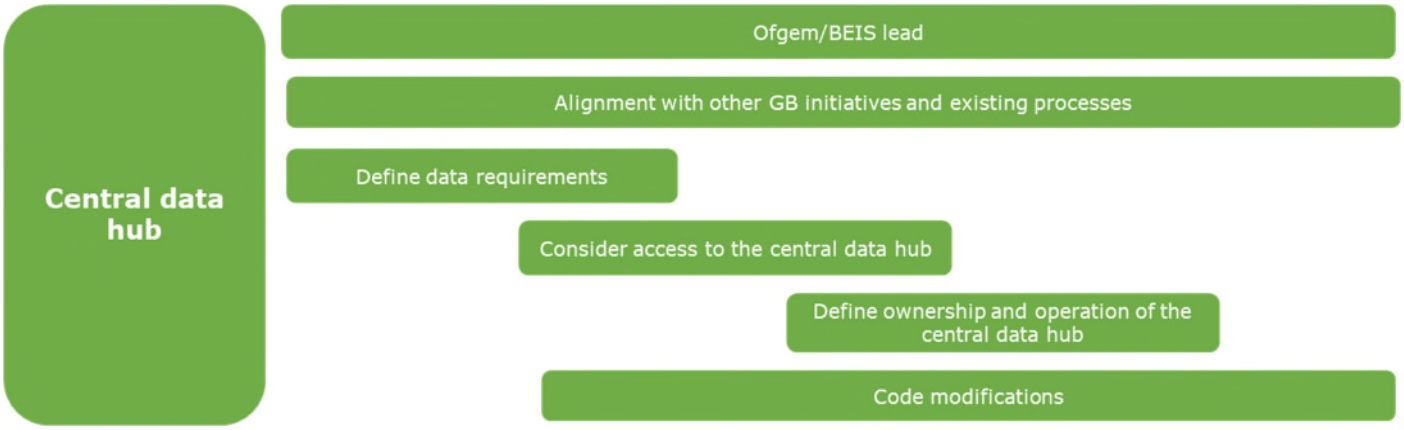

Figure 4: Roadmap for the implementation of the central data hub

6.2.3 Constraint Management Service Provider

Current GB market arrangements do not explicitly categorise market participants into the roles as defined in European Regulations (such as Balancing Service Provider, BSP). According to ELEXON, roles in GB are defined by business functions (e.g. Supplier, Generator, and Virtual Lead Party). The ability to act as, for example, a BSP is conferred onto market parties qualified for this role.

The FUSION USEF Consultation highlighted a need for further industry discussion to determine the need to formalise the role and responsibilities of parties providing constraint management services to future DSOs (referred to as Constraint Management Service Provider (CMSP)). Various **stakeholders** should be involved in this discussion and form a working group that will drive the CMSP implementation:

- ELEXON;
- Ofgem and BEIS;
- DNOs, possibly through the Energy Networks Association (ENA);
- Market participants that provide constraint management services to DSOs, or may provide such services in the future, such as aggregators, large industrial and commercial customers and distributed energy sources;
- Industry groups, such as Energy UK and the Association of Decentralised Energy (ADE).

DNV GL recommends that the process to formalise the CMSP role and responsibilities should include the following **steps:**

- A further **consultation** across the industry (principally among the stakeholders listed above) on the need of this formalisation would provide guidance and clarity on this topic. The consultation should focus on the role and the responsibilities of the CMSP, on the PROs and CONs of a formal CMSP role for DSOs and Aggregators, as well as considering alignment with European energy market arrangements. This consultation could be linked of a potential BSC modification process, as set out below.
- Depending on the outcome of the consultation the industry should further develop the **responsibilities of the CMSP**. USEF has identified the following responsibilities for the CMSP that are associated with the provision of constraint management services to the DSOs:
    - Set up flexibility service contract with the DSO;

- Set up contractual arrangements with the aggregator (if the roles of the aggregator and the CMSP are not combined);
- Meet obligations of the constraint management product that the CMSP serves, such as pre-qualification requirements, installation of appropriate measurement equipment, delivery of the agreed flexibility;
- When a DSO declares a Congestion Point, the CMSP active at this Congestion Point can decide to become active on the associated local market by offering flexibility to the DSO;
- Settle offered flexibility with the aggregator; and
- Settle offered flexibility with the DSO.

- **Define requirements** to be qualified as a CMSP. USEF does not describe requirements to become a CMSP since these will be developed in conjunction with the development of constraint management products.
- **Codes' modification**: In GB, the Balancing and Settlement Code (BSC), the Grid Code (especially the "Balancing Code" sections), the relevant sections of the Connection and Use of System Code (CUSC) and the Standard Contract Terms (SCTs) already contain provisions related to balancing that are applicable to BSPs and BRPs. Recently Ofgem asked the ESO to develop a proposal regarding the Terms & Conditions for balancing service providers (BSP).[15] The industry and Ofgem jointly will need to decide whether similar processes should be established for the CMSP.

DNV GL has mapped USEF roles against GB arrangements (see section 4.2) and has identified existing GB **functions and ENA ON actors** that can perform the role:

- Aggregators (as defined in GB);
- Suppliers that are active in flexibility markets, providing services through their customers;
- Operators of distributed energy sources (e.g. wind farm, solar farm, Combined Heat and Power generation, storage sites) or Distributed Energy Resources (DER – ENA ON actor);
- Prosumers (or Active Customers as per the ENA ON project) that choose to provide flexibility services directly to the DSO; and
- Local Energy Systems (ENA ON actor).

Figure 5 outlines the roadmap for the formalisation of the role of the CMSP in GB.

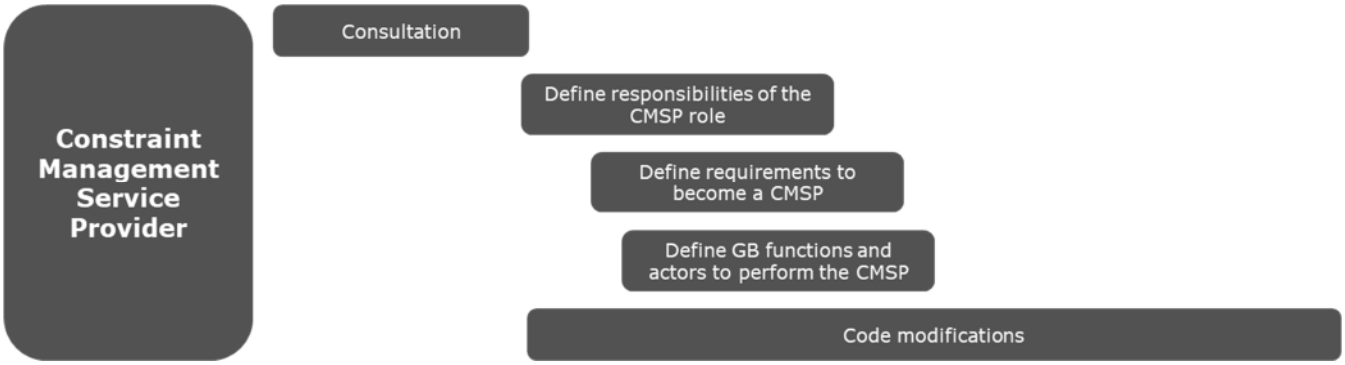

Figure 5: Roadmap for the formalisation of the role of the CMSP in GB

15 https://www.ofgem.gov.uk/ofgem-publications/156893

6.2.4 Operating regimes

USEF introduces the concept of operating regimes, which function as a traffic light mechanism reflecting the status of constraints and congestion in the energy system, and which govern the (un)restricted trade and dispatch of flexibility. The USEF market design of operating regimes aims to ensure well-functioning short-term electricity markets, where flexibility is dispatched based on market signals to where it is most essential and valuable.

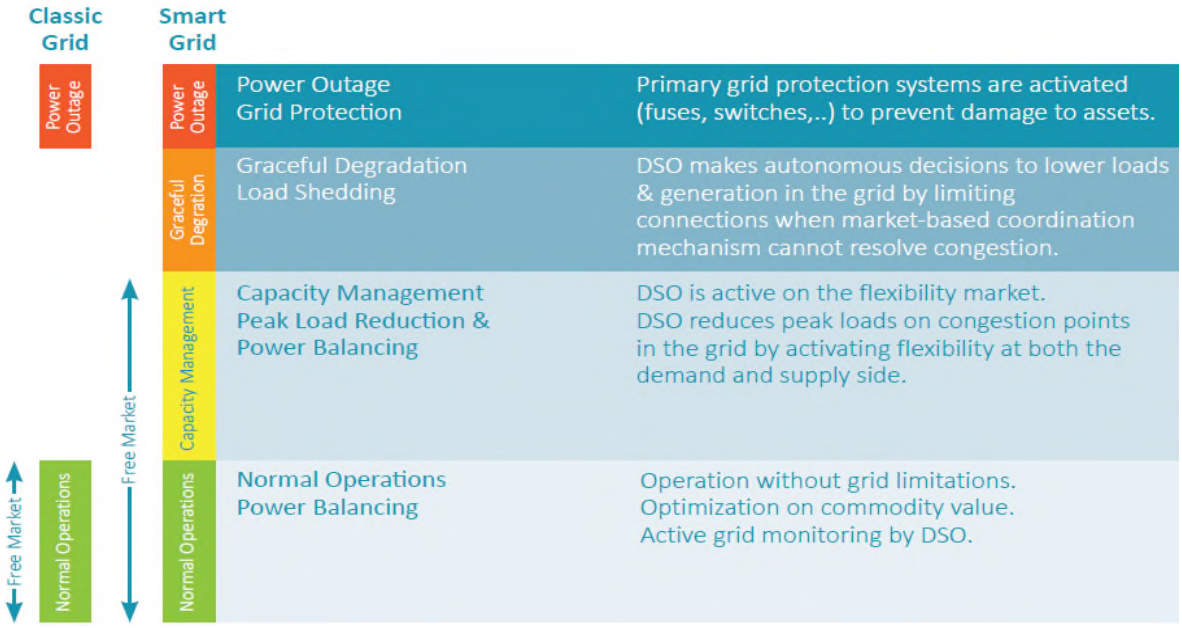

Figure 6: USEF Operating Regimes

The industry should have discussions on the scope and practicality of applying USEF operating regimes in GB flexibility markets and **key stakeholders** should be involved:

- Ofgem and BEIS;
- DNOs;
- the ESO; and
- aggregators.

In order to deploy USEF's operating regimes, stakeholders can participate via the following mechanisms and achieve the following milestones:

- **Leadership from BEIS and Ofgem**: BEIS and Ofgem should recognise the need to govern the (un)restricted trade and dispatch of flexibility, balancing free market operations with the need to safeguard the grid, and actively support the development of operating regimes for GB flexibility markets.
- **Establishment of a working group** that will lead this work.
- **Align with and review existing processes and ESO arrangements:** The deployment of USEF's operating regimes should consider existing processes and ESO arrangements. DSO flexibility processes are under development by the DSOs individually and by the ENA ON project collectively. The ESO already has processes in place at transmission level that provide solutions to managing network limitations in flexibility markets. Therefore, DNV GL recommends further discussions among key stakeholders to share best practices on this topic and explore ways to embed USEF's recommendation in GB flexibility markets.
- **Set network capacities of each operating regime:** Each DSO should define the safety margins of its network. USEF does not provide guidance on the network capacities, the voltage limits and the level of the

grid overload that will force the system to move from the Green Regime to the Yellow and to the Orange regime (see Figure 6 above). Each DSO should define its limits, which are subject to network's physical characteristics and parameters. An ENA working group is currently reviewing the Engineering Recommendation (ER) P2, which addresses topics related to the system planning and security of supply on Distribution Networks.[16] DNV GL recommends that DSOs consider the network capacities of operating regimes in conjunction with this working group.

USEF guidance on the operating regimes states that when energy flows are expected to remain within the safety margins of the network, there is no need to procure flexibility and the grid will be operated in the Green Regime.

In areas where there is possible grid overload for certain settlement periods, the DSO will procure flexible power options to keep the power flows and voltage levels within acceptable limits; the system moves from the Green Regime to the Yellow Regime.

In exceptional situations where the market is no longer able to maintain the network load within acceptable limits due to insufficient available flexibility, the process of graceful degradation starts; the system moves from the Yellow Regime to the Orange. In this regime, the DSO temporary overrules the market and limits the overloaded part of the grid. Implementation of this operating regime acts as a backstop for the Yellow regime and leads to a higher overall availability of the grid. The service level will be limited for certain customers in this regime. Clear public criteria are essential to legitimise this way of operation and maintain its public acceptance.

- **Align operating regimes with the capabilities of the flexibility service providers:** DNV GL recommends that DSOs should provide clear guidance on the flexibility service providers on the operational limits in each regime, on the timescales associated with moving from one regime to the other and on the conditions that market participants will need to operate their assets. This will allow aggregators to adjust their forecasting, their operations and the deployment of flexibility based on their capability to respond to the DSOs who operate in the Yellow Regime. USEF does not provide specific guidance on this topic as it is driven by regional requirements and characteristics.

- **Consider merit order of flexibility activation:** The industry should discuss and decide on the merit order of flexibility activation and Active Network Management (ANM), to meet Ofgem's expectations for "sound decision making on the best value solution to address network and system needs in the interests of consumer".[17] DNV GL considers there are two options for further evaluation when considering the development of operating regimes:

    1. The ANM is activated before the system moves to the Yellow Regime.
    2. The DSO prioritises market-based solutions. In case of congestion, the DSO moves from the Green Regime to the Yellow Regime where flexibility is dispatched based on market signals to where it is most essential and valuable. ANM is part of the Orange Regime.

  DSOs should be transparent about their approach in choosing between alternative solutions which will in turn improve market confidence.

- **Code modifications:** It is highly likely that implementation of operating regimes will require changes in the Grid Code, the Distribution Code, the relevant sections of the Connection and Use of System Code (CUSC) and the existing planning policy and practices for the DSOs.

16 http://www.dcode.org.uk/dcrp-er-p2-working-group.html

17 https://www.ofgem.gov.uk/system/files/docs/2019/08/position_paper_on_distribution_system_operation.pdf

Figure 7 outlines a high-level roadmap for the implementation of USEF's operating regimes in GB.

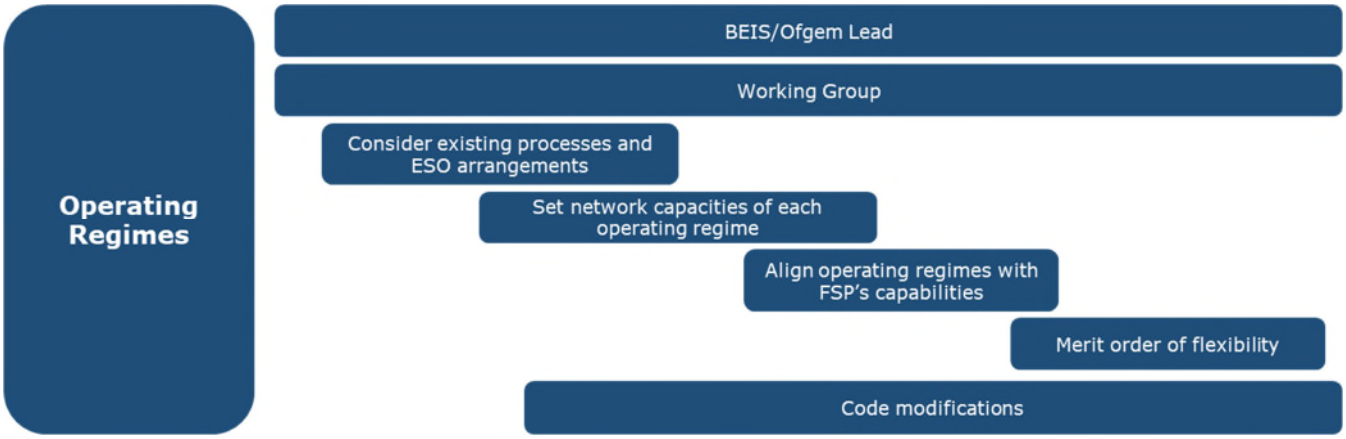

Figure 7: Roadmap for implementation of USEF's operating regimes in GB

6.2.5 USEF-compliant and standardised flexibility platforms

USEF proposes the standardisation of interactions between flexibility service providers and flexibility platforms as well as the standardisation of the interface between TSO/DSO platforms and third-party commercial platforms. DNV GL considers that standardisation will occur in steps as the market evolves and it is a long-term objective.

The industry should continue discussions on flexibility platforms in GB flexibility markets and **key stakeholders** should be involved:

- Ofgem and BEIS;
- DNOs;
- the ESO;
- aggregators;
- prosumers;
- operators of Distributed Energy Resources (DER)
- market/platform operators; and
- smart appliances and equipment manufacturers.

A high-level roadmap to develop USEF-compliant and standardised platforms includes the following milestones and mechanisms, which also reflect some recommendations from Ofgem's recent paper on flexibility platforms. [18]

- **Ofgem's leadership** to further develop this topic: Ofgem has already published a paper on the role of flexibility platforms in electricity markets, highlighting that flexibility platforms are part of a complex wider electricity ecosystem and that they could play a central role in the future. Ofgem should recognise standardisation of flexibility platforms as a key market facilitator and actively support initiatives to expedite this, such as a public consultation and the establishment of industry working groups (see below).
- **Cross-industry development and agreement on** the way forward and whether standardisation of flexibility platforms is a feasible solution for GB flexibility markets. For the standardisation of flexibility platforms, further work will be required to assess and communicate the benefits that standardised flexibility platforms can deliver both in short-term and long-term.

18 https://www.ofgem.gov.uk/system/files/docs/2019/09/ofgem_fi_flexibility_platforms_in_electricity_markets.pdf

- A further **public consultation** focused on platforms and their role could provide an indication of stakeholders' view on this topic.
- If the standardisation of flexibility platforms goes forward, DNV GL recommends the **establishment of an industry working group** that will facilitate discussions, decision-making, implementation and will lead this initiative. The working group should build its work on USEF's standards and existing work such as that of the ENA ON and the Energy Data Task Force.
- **Develop a common understanding and definition** of flexibility services processes and flexibility product characteristics and assets that will facilitate interoperability. USEF's definitions and principles would provide the basis for this exercise, although the ENA Open Networks have already initiated this activity under the Workstream 1A Flexibility Services.
- **Define the scope of standardisation.** Standardisation of flexibility platforms may cover several elements, including, among others, standardisation of market rules, contractual relationships, and flexibility transactions. Ofgem's paper on flexibility platforms has also identified the potential need to develop a common protocol for sharing data on flexibility platform transactions, as well as a common format and contents of flexibility bids and offers.

  USEF particularly focuses on the standardisation of the interaction between the market platforms and grid management services and focuses on the interface between the DSO and aggregator.
- **Implement standardisation:** The relevant parts of USEF can be the starting point for implementing standardised flexibility platforms, especially parts that cover the interface and information exchange between the DSO (grid platform) and the commercial platform. The current USEF version provides a solid basis for the corresponding process descriptions which can easily be mapped to the platforms' tasks and interactions.

  USEF describes a protocol for the interface and information exchange between the DSO and the commercial platform (referred to as the USEF Flex Trading Protocol or UFTP). Further work would be required to assess that the UFTP is fit for purpose in GB market, which will be informed by the FUSION trial. [19]

  Finally, a USEF market implementation will typically consist of multiple information systems interacting together based on the USEF interaction standards, in order to run the market processes.

Figure 8 shows a high-level roadmap to develop USEF-compliant and standardised flexibility platforms.

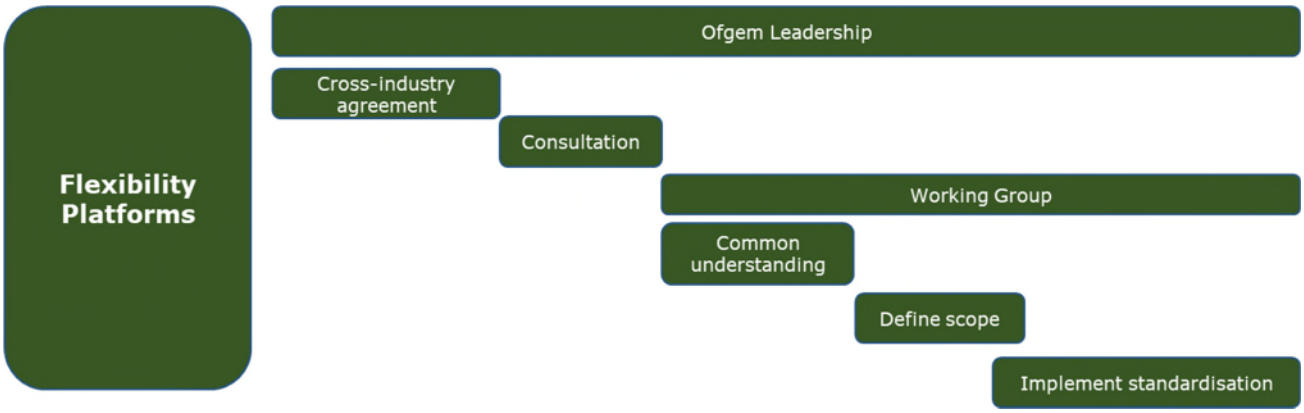

Figure 8: High-level roadmap for standardisation of platforms

[19] http://www.usef.energy/download-the-framework/?_sm_au_=iVVDsWMNWMRtfWFFctQQFK3qWK4TJ#

6.2.6 The USEF Market Coordination Mechanism

USEF introduces the Market Coordination Mechanism (MCM) which coordinates the use of flexibility and includes all the steps of the flexibility trading process from contractual arrangements to the settlement of flexibility. USEF splits the flexibility trading process in to five phases and describes the interactions and information exchange between all market participants: DSOs, the ESO, BRPs, aggregators, Prosumers.

Figure 9: USEF MCM Phases

The MCM connects with current work undertaken on TSO-DSO coordination on flexibility services, including by the ENA ON project, reflecting the understanding that market parties (that operate flexibility) play a vital role in the effective coordination of flexibility deployment.

DNV GL considers that inputs from the wider energy industry will greatly benefit the implementation of the MCM in GB and have identified the following key **stakeholders** in this process:

- DSOs, possibly through the Energy Networks Association (ENA);
- ESO, possibly through the Energy Networks Association (ENA);
- ELEXON;
- Aggregators;
- Suppliers;
- Balance Responsible Parties (BRPs);
- Industry groups, such as Energy UK and the Association of Decentralised Energy (ADE);
- Consumer Groups; and
- Data and Communications Company (DCC).

The roadmap to apply the USEF Market Coordination Mechanism in GB involves the following actions:

- **Establish a working group** that will lead the activities for the MCM implementation. The working group will be responsible for the full development and deployment of the MCM and for engaging with the wider industry (e.g. publish consultations, organise workshops) as well as the USEF Foundation where required.
- **Review current processes:** The industry should review current activation and dispatch processes, develop good practices from existing coordination between market participants, and identify what capabilities are required to support these processes. Regional Development Programmes and other innovation trials are delivering learning around conflict resolution and synergy identification.
- **Align with current GB initiatives,** particularly with the "Future Worlds" of the Open Networks ENA project. This ENA Workstream considers the procurement and deployment of flexibility from the perspective of network operators and does not fully explore the potential roles for other actors in future flexibility markets, such as Balance Responsible Parties (BRPs), generators, suppliers, aggregators and customers, all of which are considered in USEF.

The USEF MCM could enhance the "Future Worlds" by providing a more comprehensive view on the processes and interactions that all flexibility market participants should follow in executing flexibility transactions. USEF already provides details and the standards of a market mechanism that will maximise the benefits of flexibility for all stakeholders in the GB energy system and that can be used to inform flexibility market coordination in GB (see detailed documentation in section 3). DNV GL recommends that the ENA Working Group of this Workstream embed USEF's MCM principles and collaborate with the MCM working group (or the USEF Foundation).

- **Define flexibility market principles** as USEF recommends and in alignment with other GB initiatives, such as the ENA ON project.
- **Design MCM Phases:** USEF MCM provides clear guidance on the coordination of use of flexibility processes between the DSOs, the ESO, the aggregators and other market participants. USEF also describes the processes which will allow the Aggregator to perform flexibility stacking takes place. According to USEF, the development of the flexibility processes should focus on the following interactions between the stakeholders: (1) contract and offer of flexibility, (2) activation of flexibility, (3) information exchange on product delivery for imbalance settlement and/or Transfer of Energy, and (4) product settlement (based on flexibility quantification by the Flexibility Request Party).

  The recent paper from Ofgem on the role of the DSO and regulatory priorities has identified a range of DSO functions and processes to manage the system and network. Some of these functions are related to markets and settlement as well as to real-time processes and planning. The development of the MCM in GB could further inform the evolving DSO functions and consider concurrent developments in this area.[20]
- **Develop the Common Reference.** The Common Reference is a key element of the Plan phase of the MCM for a USEF implementation in GB.
- **Establish the role of the Meter Data Company (MDC):** USEF defines the role of the MDC designating a company responsible for the acquisition and validation of meter data and to facilitate the flexibility and balancing settlement processes by making accurate and valid data available to market agents. This role will ensure that all data used on settlement is trustworthy. The industry should decide who should perform this role. Mapping of USEF roles against GB functions and actors indicates that this role is slightly different from the DCC role, as such the industry should decide whether to enhance DCC responsibilities (as per ENA ON Future Worlds) or whether to combine existing functions in GB arrangements that collectively could perform the responsibilities of the MDC.

20 https://www.ofgem.gov.uk/system/files/docs/2019/08/position_paper_on_distribution_system_operation.pdf

Figure 10 outlines a high-level roadmap for the deployment of the MCM in GB arrangements.

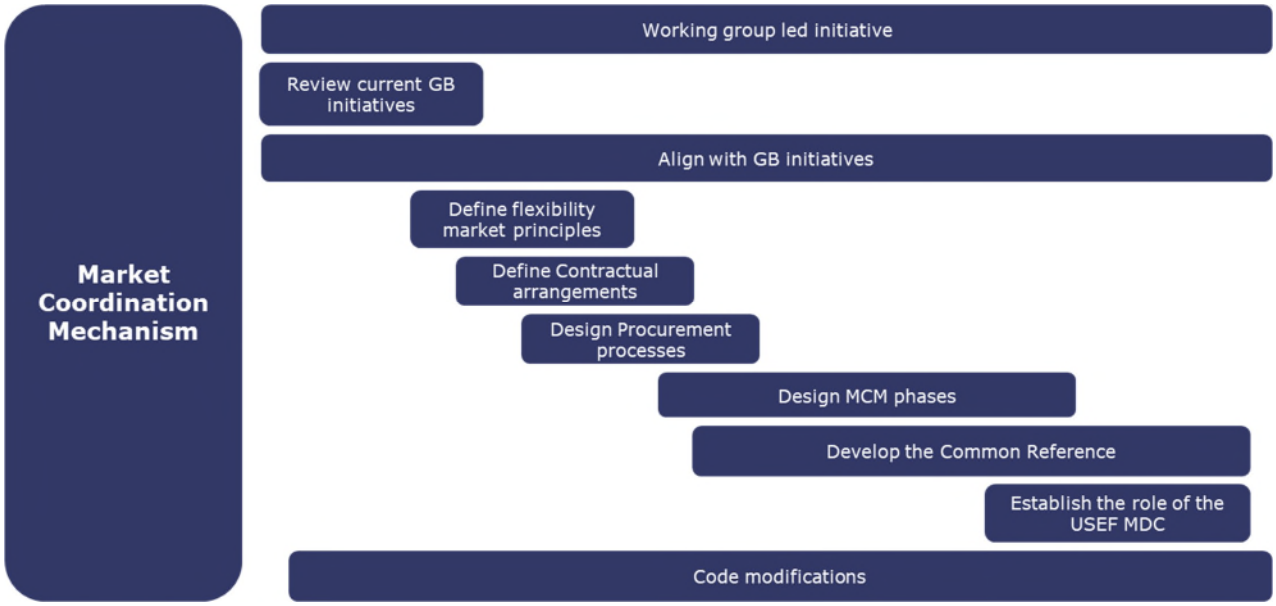

Figure 10: Roadmap for the deployment of USEF's MCM

6.2.7 Dynamic pooling

USEF recommends that flexibility processes, such as measurement, validation and remuneration should change to allow for dynamic pooling where this is feasible. Stakeholders' responses to the USEF consultation demonstrated support for this recommendation, and industry stakeholders should now determine which products are suitable for dynamic pooling and explore the need for further coordination between DSOs and the ESO.

DNV GL has summarised the **key stakeholders** that should be involved in the discussions on dynamic pooling**:**

- DSOs, possibly through the Energy Networks Association (ENA);
- ESO, possibly through the Energy Networks Association (ENA);
- ELEXON;
- Aggregators;
- Suppliers;
- Balance Responsible Parties (BRPs);
- Association of the Decentralised Energy (ADE);
- Consumer Groups; and
- Data and Communications Company (DCC).

The roadmap for the deployment of dynamic pooling in GB should involve the **following steps:**

- **Establish a working group** with key stakeholders which will lead discussions and provide guidance on the implementation of dynamic pooling in GB. DNV GL recommends that the ESO and DSOs are in any case represented in this working group.
- **Explore feasibility of dynamic pooling for flexibility products**. Stakeholders' responses to the USEF consultation indicated that dynamic pooling might not be feasible for all flexibility products and technologies. The working group could perform a feasibility assessment to justify the associated costs and benefits which

will occur due to dynamic pooling. In addition, the industry will need to consider whether there should be a limit on minimum and maximum flexibility volumes that could participate in dynamic pooling. USEF does not provide recommendations on these aspects, but proposes that they should be considered as part of future work on flexibility product definition and design.

- **Consider risk of conflicts of interest and unintended consequences:** This exercise should capture and mitigate the risk of conflicts of interest and unintended consequences that could arise and undermine the level playing field in future flexibility markets. Key to this exercise is the coordination between the ESO and DSOs, particularly for products that allow dynamic pooling. USEF's MCM and Flexibility Value Stacking principles can form the basis of this exercise.
- **Design flexibility processes to account for dynamic pooling.** USEF's processes for trading, validation and settlement of flexibility could inform this step, since they provide a solution for arrangements of flexibility value stacking (see detailed documentation in section 3). A USEF-compliant implementation of dynamic pooling would also require standardisation of interactions between the different participants to allow value stacking in practice. The key interactions described in USEF can provide a solid basis for this standardisation.
- **Define measurement arrangements** that allow the quantification of flexibility that is used in dynamic pooling. USEF recommends sub-metering at the flexible asset level to quantify flexibility of this asset. In addition, USEF recommends that baselines for dynamic pooling will need to be provided at unit-level and that additional administration and information exchange is likely required to avoid double counting of the activated flexibility.
- **Code modifications:** Additional measurements and baselining arrangements may lead to the modification of BSC Codes and/or other industry codes. DNV GL recommends that ELEXON, as the BSC Administrator, be included in the discussions on the settlement and remuneration of flexibility services that participate in dynamic pooling.

Figure 11 outlines a high-level roadmap for the deployment of the MCM in GB arrangements.

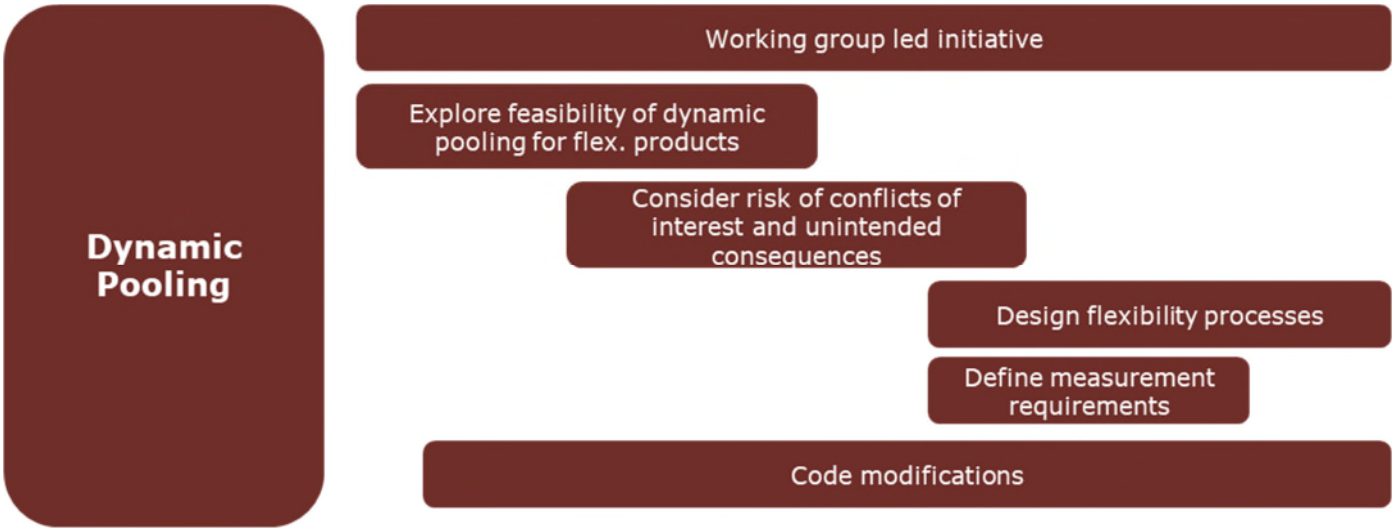

Figure 11: Roadmap for dynamic pooling

6.3 Assessment of USEF options in GB environment

6.3.1 Aggregator Implementation Models (AIMs)

USEF has developed seven models (Aggregator Implementation Models (AIMs)) that describe existing or potential future arrangements between the aggregator and other market participants. USEF has developed the AIMs to answer questions around balance responsibility, open supply positions and contractual arrangements between Aggregators and Suppliers.

Appendix A provides details on the interactions between key flexibility market participants in each AIM, the required contractual arrangements and their responsibilities.

Table 3 summarises the applicability of each AIM in GB and the changes to GB arrangements that each model will require.

Table 3: AIMs applicability in GB and requirements for changes to GB arrangements

	Applicability in GB	Required Changes
Integrated Model	Currently applied in GB. This model is always applicable when a market participant performs both the role of the Aggregator and the Supplier. Independent aggregation is not facilitated in this model.	No changes are required in GB arrangements since this model is already applicable when a market participant combines the role of the Aggregator and the Supplier.
Broker Model	Not currently used in GB. The model does not facilitate independent aggregation because it requires affiliation between the Supplier and the Aggregator.	No changes are required in GB arrangements, balance responsibility stays with the Supplier.
Contractual Model	Currently applied in GB when there is a bilateral agreement between the Aggregator and the Supplier. The model does not facilitate independent aggregation and is not in line with the current direction for GB future arrangements: plans of future GB arrangements do not currently involve bilateral contracts between the Aggregator and the Supplier about the ToE.	No changes are required in GB arrangements, as bilateral agreements are in place.
Uncorrected Model	Currently applied in GB. The model facilitates independent aggregation, but it does not account for open supply and imbalance of the supplier (or its BRP). This model will not be applicable in the future, since Ofgem and BEIS are considering changes in regulation so that open supply and imbalance costs are allocated to the market participants that occur these costs. In addition, the uncorrected model does not ensure compliance with the Electricity Regulation of Clean Energy Package which recommends aggregators are balance responsible.[21]	No changes are required; "by default" model applied in GB.

21 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN

Corrected Model	Not currently applied in GB. The model facilitates independent aggregation. This model describes a correction of the meter reading of the connection from the Meter Data Company (MDC) which would not be a feasible option for GB. This model includes a correction of supplier's perimeter, which aligns with GB arrangements under TERRE product implementation (i.e. also considering adjustment and correction of the supplier's perimeter). This model involves interactions with the Prosumer for the ToE, which is not currently considered in GB and may not be feasible for residential customers, due to extra complexity.	DNV GL acknowledges that changes associated with each of these AIMs are similar to the changes that the TERRE implementation identified and the BSC Modification P344 has highlighted: changes to the Grid Code, changes to the Code Subsidiary Documents, changes to the Transmission Licence and changes to the Data Transfer Catalogue (DTC).
Central Settlement Model	Not currently applied in GB. The model facilitates independent aggregation. This model describes a central perimeter correction from the Allocation Responsible Party (ARP). This function is similar with the foreseen arrangements for the TERRE product implementation and VLP's access to the Balancing Mechanism. ELEXON will perform the role of the ARP. Unlike the Central Settlement model, the foreseen GB arrangement does not charge the VLP for sourcing the energy from the supplier.	
Net Benefit Model	Not currently applied in GB. The model facilitates independent aggregation. This model is similar to the Central Settlement Model, yet the cost of compensating the Supplier is not born by the Aggregator but partly or entirely socialized.	

The implementation of an AIM should consider the requirements of various flexibility products. Each product could require different arrangements between the Aggregator, the Supplier and the BRP, which means that several AIMs could be feasible. This reference implementation plan focuses on the DSO congestion management products and recommends the following:

1. The Uncorrected, the Contractual and the Integrated AIMs can be applied in GB across all DSO flexibility products at the early stages of the development of the DSO flexibility services. Arrangements for these models are already in place in GB and facilitate aggregators' participation in the market without additional complexity and barriers. In addition, USEF suggests that the Uncorrected model is suitable for products that aim to solve local problems (i.e. DSO congestion management products) if the energy volumes are negligible.
2. In the long-term, the Uncorrected model may not be a feasible solution since it does not ensure compliance with the Electricity Regulation of Clean Energy Package, which requires that aggregators are balance responsible. In addition, it will not be suitable if the DSO products require re-dispatch mechanism to compensate the effect of the local flexibility activation. Therefore, the industry should consider alternative models that facilitate both independent aggregation and ToE.

3. In the long-term, the AIM for the DSO congestion management products should consider whether re-dispatch and Transfer of Energy is required. Where re-dispatch mechanisms are in place, the Contractual, the Corrected and the Central Settlement models are suitable. However, the Corrected AIM might not be feasible for residential customers, since it would create extra complexity.

4. DNV GL recommends that the AIM for DSO congestion management aligns with arrangements that are applied in other GB products such as Replacement Reserve products (STOR, TERRE platform). The AIMs, as presented by USEF, cover a wide range of scenarios on potential arrangements between the Aggregator, the Supplier and the BRP. However, they can still be adjusted to country arrangements provided that they comply with the corresponding country's policy and regulation. The industry should further explore the feasibility of the AIMs for congestion management products. The outcomes of the FUSION trial could provide useful insights on this topic.

5. The development of AIMs should also consider updates on the Future Energy Retail Market Review from Ofgem, which is considering "how the regulatory framework could better enable a wider range of new business models, products and services to come to market, while also ensuring appropriate safeguards are in place for all consumers."[22]

6.3.2 Re-dispatch responsibility

When a DSO or the ESO requests a flexibility activation in the form of a congestion management product, that activation affects overall system balance. This impact can be neutralised by activating the same amount of flexibility in the opposite "direction" outside the congested area. This mechanism is often referred to as a **"re-dispatch"** and raises the question of which market party should be responsible for the re-dispatch.

In theory, five models are possible with regard to re-dispatch responsibility in a DSO congestion management product. Table 4 summarises the re-dispatch mechanisms, their applicability in GB and the applicable AIMs, as well as considerations for implementation and industry support as per the FUSION USEF consultation.

Table 4: Summary of re-dispatch options for DSO congestion management

	Applicability in GB	AIM	Implementation	Industry support[23]
DSO; re-dispatch and flexibility activation at the same time	Not applicable in GB. This option requires DSOs to buy energy for the re-dispatch. GB DSOs are not allowed to buy energy.	All AIMs are applicable to this option, since it is the Aggregator that buys energy.	This option would require changes to the Electricity Distribution License to allow DSOs buying energy.	Low
DSO; no time restrictions on re-dispatch buy	Not applicable in GB. This option requires DSOs to buy energy for the re-dispatch. GB DSOs are not allowed to buy energy.	All AIMs are applicable to this option, since it is the Aggregator that buys energy.	This option would require changes to the Electricity Distribution License to allow DSOs buying energy.	Low
ESO	Applicable.	All AIMs are applicable to this option, since it is the ESO that performs the re-dispatch. This option does not involve interaction between Aggregators and Suppliers.	High ease of implementation due to current ESO's role to maintain system's balance.	Very high
Aggregator (or CMSP)	Applicable. The DSO buys a service, rather than energy. ToE is required.	Corrected, Central Settlement, Contractual, Net Benefit	A ToE needs to be organised. Open supply position should also be considered. Market-based option.	High

22 https://www.gov.uk/government/consultations/flexible-and-responsive-energy-retail-markets

23 Based on the FUSION USEF consultation.

Supplier	Applicable. The DSO buys a service, rather than energy.	All AIMs are applicable to this option, since it is the supplier that performs the re-dispatch and there is no need for further interaction between the Supplier and the Aggregator.	This option will require contractual relationships between the supplier and the DSO.	Very Low

The roadmap to implement re-dispatch options that are more suitable for GB arrangements should be developed in parallel with and consider the roadmap for independent aggregation in wholesale markets, given the relation between these topics, particularly when considering an aggregator's balance responsibility and the supply position.

The **key stakeholders** that should be involved in the deployment of re-dispatch options are:

- Ofgem and BEIS;
- ELEXON;
- Balancing and Settlement Code (BSC) parties which will be impacted: aggregators, licensed DSOs, suppliers, National Grid ESO, Balance Responsible Parties (BRPs), suppliers);
- Companies that are involved in the settlement processes, such as market parties that perform the roles of the Energy Contract Volume Notification Agent (ECVNA), HH & NNHH Data aggregator (HHDA & NHHDA), HH & NNHH Data Collector (HHDC & NHHD), Data Transfer Service Administrator;
- Nominated Electricity Market Operators (NEMOs); and
- The Data Communications Company (DCC).

The deployment of feasible re-dispatch options requires **leadership from Ofgem and BEIS** to highlight the importance of this topic, particularly as flexibility markets become more mature and traded volumes of flexibility will increase.

Milestones and actions associated with the deployment of re-dispatch options include:

- **Assessment of the feasibility** of each option to get an in-depth understanding of risks, ease of implementation as well as costs and benefits involved in each option. The most feasible option should be the one that minimises the overall system costs whilst ensuring system's stability.
- **Review practices from continental Europe.** Re-dispatch mechanisms have been already implemented in Europe. For example, in Germany several re-dispatch mechanisms are available which recently led to high costs for the system and in turn for the consumers.
- **Align with the development of the Aggregator Implementation Model**, since the applicability of a re-dispatch option depends on the AIM.
- **Design the coordination** of involved parties when re-dispatch is activated.

6.3.3 DSO-Aggregator information exchange protocol

The information exchange between the DSO and the Aggregator, as described in the MCM processes, is implemented in the USEF Flex Transfer Protocol (UFTP). Standardised processes, and a standardised interaction between DSO, AGR and other roles, are crucial to USEF. Using this protocol ensures interoperability between DSOs and Aggregators, Constraint Management Service Providers and Flexibility Platforms, not only in GB but in every energy market that adopts the UFTP.

Adopting the UFTP is not a prerequisite for USEF-compliancy, as long as there is alignment on the underlying process. An initial high-level assessment indicates that UFTP seems fit for the GB market: UFTP does not prescribe any specific technologies like HTTPS, web services, or SFTP for the lower layers of the communication. In addition, both UFTP and GB arrangements use XML for messaging in the upper layers of the communication, although USEF also allows alternatives like JSON.

DNV GL considers that further discussion with key stakeholders would be beneficial to determine whether UFTP fits in the current GB message exchange architecture, from a technical point of view. The outputs and the processes of the FUSION trial could inform this discussion, as parts of the UFTP will be implemented.

7 NON-COMPLIANCE CONSIDERATIONS

Two elements could lead to a non-compliant implementation of USEF in GB:

1) The FUSION due diligence and public consultation raised a potential issue associated with the role of the Common Reference and its compliance with the GDPR requirements. If the publication of congestion points leads to compliance issues with the GDPR in GB, the USEF foundation will develop a new GDPR-compliant option in the next framework update.

2) The FUSION due diligence identified a potential conflicting item between the GB arrangements and USEF on the use of penalties in flexibility transactions. USEF recommends the use of penalties for under/over delivery of flexibility, whereas existing GB DSO flexibility products currently do not include penalties.

   Stakeholder opinion on the use of penalties is divided. Some stakeholders consider penalties as a barrier for aggregators to enter flexibility markets, especially during the early stages of the development of flexibility markets. Other stakeholders are more supportive of the use of penalties to discourage arbitrage options and create trust in flexibility services as markets mature. The USEF foundation considers that the absence of penalties reflects the nascent state of flexibility markets in which stakeholders are looking to minimise barriers to participate. The USEF foundation recommends that the functionality of penalty mechanisms can be explored in first instance in the FUSION trial, to lay the basis for wider industry consideration at a later stage, as follows:

   a) include the process of applying penalties in case of under/over delivery;

   b) carry out the calculation of the under/over delivery volume; but

   c) set the penalty price to zero, to prevent inclusion of penalties in the settlement process.

8 CONCLUSIONS AND NEXT STEPS

This document has set out an implementation plan for USEF in the GB energy market, setting out clear steps for the implementation in GB of several components of USEF, based on the outcomes of the Project FUSION Due Diligence and Public Consultation, and further informed through stakeholder engagement.

The plan has considered required changes to USEF as well as recommended changes to GB arrangements to maintain compliance.

Modifications to USEF

The implementation plan has considered compliance with USEF. In developing this report, DNV GL met with the USEF Foundation to discuss potential modifications to USEF. This workshop raised the following future actions to enhance and update USEF so that it aligns with GB arrangements:

1) The USEF Flexibility Value Chain (FVC) will be extended to include GB post-fault constraint management products;
2) The USEF Flexibility Value Chain (FVC) will be extended to include GB pre-fault constraint management and restoration support products;
3) The USEF roles will accommodate additional roles or responsibilities which are found in GB arrangements;
4) USEF will only consider adding a separate ESO role if this aligns with the Harmonised Electricity Market Role Model and with ongoing ebIX discussions (This is not, however, an issue from the perspective of USEF-compliance); and
5) The development of the Common Reference and the CRO role will use insights from the FUSION trial and other GB initiatives to ensure compliance with GDPR requirements.

Recommended changes to GB arrangements

- We have identified five innovative elements from USEF that can be comparatively easily implemented in GB energy market arrangements. These elements involve the development and GB implementation of:
    1) A congestion point repository ("Common Reference") containing detailed information on network congestion points, their associated connections and active aggregators in the electricity network;
    2) Aggregator D-programmes to inform a DSO's forecast of the state of the distribution network and to determine whether there is a need for flexibility;
    3) Short-term flexibility procurement through "free bids" alongside long-term flexibility contracts;
    4) Sub-metering essential to enable independent aggregation in all flexibility products; and
    5) Development of a standardised baseline for all flexibility products to ensure transparency and standardisation of flexibility processes.

  All of the above can be implemented in the GB market by observing basic USEF requirements and comparatively straightforward changes to GB arrangements.
- For a further seven innovative elements requiring more complex changes to GB arrangements and/or require further industry discussion, the plan provides individual roadmaps for implementation. These involve:
    1) Access to wholesale markets for independents aggregation;
    2) Development of a Central Data hub;
    3) Formalisation of the Constraint Management Service Provider (CMSP) role;

4) Development of operating regimes to govern the (un)restricted trade in flexibility services;

5) Development of standardised flexibility platforms;

6) Implementation of the USEF market coordination mechanisms (MCM); and

7) Facilitating dynamic pooling of flexible resources.

The individual roadmap for each of these elements features unique steps, milestones and mechanisms. However, recurring themes in each roadmap involve Ofgem and BEIS to provide clarity on the relevant policy and regulatory context, establishment of cross-industry working groups to enable wider discussions, alignment with relevant ongoing GB initiatives, and potential modifications to key industry codes.

- For three other USEF elements, several options for GB implementation are possible and further industry discussion is required to identify the preferred option:

  1) Development of Aggregator Implementation Models (AIMs) to manage balance responsibility, open supply positions and contractual arrangements between Aggregators and Suppliers.

  2) Re-dispatch options for DSO congestion management.

  3) Options for the information exchange protocol between the DSO and the Aggregator.

  For these elements the plan describes feasible options to inform the way forward in GB arrangements.

Non-compliance considerations

We have identified GDPR compliance and penalty mechanisms in flexibility transactions as two elements that could lead to a non-compliant implementation of USEF in GB. To manage these issues, the USEF Foundation has agreed to consider GB GDPR requirements in the next framework update, and the FUSION trial will explore the mechanics of penalty mechanisms, to lay the basis for wider industry consideration at a later stage.

Future use of this report

This report should be used by GB energy market stakeholders as a blueprint for the GB implementation of USEF and more generally for development of flexibility mechanisms in GB. DNV GL considers that this is a "live document", which should be read in conjunction with all the relevant USEF documentation, as well as ongoing and future GB initiatives exploring the same or similar subject matter. This plan will also be further informed by the FUSION trial, which will provide practical insights into the implementation of USEF in the GB energy market.

APPENDIX A: AGGREGATOR IMPLEMENTATION MODELS (AIMS)

Integrated Model		
Summary	In the integrated model the roles of Supplier and Aggregator are combined in one market party. Compensation for imbalances and the open supply position are not necessary.	
Main Elements	Aggregator needs to assign its own BRP?	Not applicable
	Aggregator needs contract with Supplier?	Not applicable
	Energy transfer method?	Not applicable
Contractual Relationships	The Supplier/Aggregator combination has a contract with the Prosumer, selling energy and buying flexibility against a reward, the form of which is dependent on the proposition. The supplier can organize "aggregation" on its own or use a third-party as a service.	
Balance responsibility	Balance responsibility for the connection is with BRPsup	
Perimeter correction[24]	No perimeter correction by the Allocation Responsible Party (ARP) needed	
Transfer of Energy	Not applicable	
Applicability in GB	Currently applied in GB. No independent aggregation is facilitated. This model is always applicable when a market participant performs both the role of the Aggregator and the Supplier.	
Required changes	No changes are required in GB arrangements since this model is already applicable when a market participant combines the role of the Aggregator and the Supplier.	

Broker Model		
Summary	In the broker model, the Aggregator transfers the balance responsibility to the Suppler (or the BRP of the supplier). Compensation for the open supply position and the caused imbalance is settled bilaterally based on contractual arrangements.	
Main Elements	Aggregator needs to assign its own BRP?	No
	Aggregator needs contract with Supplier?	Yes
	Energy transfer method?	None
Contractual Relationships	The Aggregator has a bilateral contract with the Supplier (or BRPsup). The Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the ESO. The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.	
Balance responsibility	The Aggregator transfers its balancing responsibility for the flexibility it operates to the BRP of the Supplier, therefore full balance responsibility of the connection lies with BRPsup.	

24 Perimeter correction: Adjustment of the imbalance volume of the corresponding BRP. Normally performed by the Allocation Responsible Party role to avoid that flexibility activation would result in an imbalance due to the changed energy volume.

Perimeter correction	No perimeter correction by ARP needed
Transfer of Energy	Not applicable - but the model allows a settlement between supplier (or the BRP of the supplier) and the Aggregator.
Applicability in GB	Not currently applied in GB. The model does not facilitate independent aggregation because it requires affiliation between the Supplier and the Aggregator.
Required changes	No changes are required in GB arrangements, balance responsibility stays with the Supplier (or BRP of the Supplier)

Contractual Model		
Summary	In the contractual model, the Aggregator associates with his own BRP. Balancing parameters are corrected through a hub-deal (ex-post)[25] between BRPagr and BRPsup, transfer prices are based on contractual arrangements.	
Main Elements	Aggregator needs to assign its own BRP?	Yes
	Aggregator needs contract with Supplier?	Yes
	Energy transfer method?	Bilateral
Contractual Relationships	Aggregator has a contract with BRPagr for entering energy markets and to cover imbalance. Aggregator has a bilateral contract with Supplier about the Transfer of Energy. Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the TSO. The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.	
Balance responsibility	BRPsup holds full balance responsibility. During activation periods, the DR impact is neutralised with BRPsup through the hub-deal. BRPagr holds (implicit) balance responsibility for the flexibility during activation periods, as it needs to balance the sold energy with the energy sourced through the hub-deal.	
Perimeter correction	No perimeter correction by ARP needed	
Transfer of Energy	Aggregator will source the energy ex-post from BRPsup through a hub-deal. Sourcing volume equals the difference between measurement and baseline. A price formula needs to be agreed upon, preferably using a standardized method.	
Applicability in GB	Not currently applied in GB. The model does not facilitate independent aggregation. This model is not in the same direction as GB future arrangements; Plans of future GB arrangements do not involve bilateral contracts between the Aggregator and the Supplier about the ToE.	
Required changes	GB arrangements should change to accommodate the ToE with potential changes in the BSC modifications. A ToE price methodology and baselining methodology should be developed.	

25 "Afterwards", "after the event". Based on knowledge of the past. Measure of past performance.

Uncorrected Model		
Summary	In the uncorrected model, no perimeter correction is performed, and no volume transfers occur between the Aggregator and the Supplier. The activated volume is settled through the regular balancing mechanism.	
Main Elements	Aggregator needs to assign its own BRP?	No
	Aggregator needs contract with Supplier?	No
	Energy transfer method?	No
Contractual Relationships	Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the TSO. The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.	
Balance responsibility	BRPsup holds full balance responsibility.	
Perimeter correction	The perimeter is not corrected by the ARP (therefore named uncorrected)	
Transfer of Energy	Energy is not transferred. In general, DR activation will result in imbalance for the BRPsup. BRPsup is remunerated through the regular balancing mechanism, if passively contributing to balance restoration is incentivised by the balancing mechanism. If the Aggregator is active on balancing or adequacy services, the remuneration takes place against (in general favourable) balancing prices.	
Applicability in GB	Currently applied in GB. The model facilitates independent aggregation, but it does not account for open supply and imbalance of the supplier (or its BRP). This model will not be applicable in the future since, since Ofgem and BEIS are considering changes in regulation so that open supply and imbalance costs are allocated to the market participants that occur these costs. In addition, the uncorrected model does not ensure compliance with the Electricity Regulation of Clean Energy Package to ensure aggregators are balance responsible.[26]	
Required changes	No changes are required; "by fault" model applied in GB.	

Corrected Model		
Summary	In the corrected model, the Prosumer's consumption profile is modified, based on the amount of flexibility that has been activated by the Aggregator. In general, this is done by directly modifying the meter reading. The remuneration for energy takes place through the prosumer, based on retail prices. The Aggregator associates with his own BRP.	
Main Elements	Aggregator needs to assign its own BRP?	Yes
	Aggregator needs contract with Supplier?	No
	Energy transfer method?	Via the Prosumer

26 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0943&from=EN

Contractual Relationships	Aggregator has a contract with BRPagr for entering energy markets and to cover imbalance. Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the TSO. The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.
Balance responsibility	BRPsup holds full responsibility for the connection, where the allocation is based on the measurements, i.e. during activation periods on the corrected measurements (baseline). During activation periods, BRPagr holds balance responsibility for the difference between the actual consumption (non-corrected measurements) and the baseline.
Perimeter correction	The Meter Data Company (MDC) will correct the meter readings of the connection with the increased or decreased amount of energy triggered by the Aggregator. The MDC will inform the TSO both about the corrected values, as well as of the amount of increased/decreased energy, per settlement period. The ARP needs to correct the perimeters of the BRPsup and BRPagr with the activated energy.
Transfer of Energy	No financial remuneration needed, since the Supplier can bill the same energy volume as if no activation has occurred. Since energy is transferred through the Prosumer, the Aggregator will (in general) compensate the Prosumer for the energy that has been billed, but not consumed (or vice versa in case of load enhancement), depending on contract conditions.
Applicability in GB	Not currently applied in GB. The model facilitates independent aggregation. This model describes a correction of the meter reading of the connection from the MDC which would not be a feasible option for GB. This model includes a correction of supplier's perimeter, which aligns with GB arrangements under TERRE product implementation (i.e. also considering adjustment and correction of the supplier's perimeter). This model involves interactions with the Prosumer for the ToE, which is not considered in GB.
Required changes	DNV GL acknowledges that changes associated with this AIM are similar to the changes that the TERRE implementation identified and the BSC Modification P344 has highlighted: changes to the Grid Code, changes to the Code Subsidiary Documents, changes to the Transmission Licence and changes to the Data Transfer Catalogue (DTC).

Central Settlement Model		
Summary	In this model, a central entity (the ARP) corrects the perimeters of both the BRP of the supplier and the BRP of the aggregator by transferring energy from one to each other. This results in no imbalance positions for the BRPs caused by the activation of flexibility and there is no direct Transfer of Energy between the Aggregator and the Supplier. The central entity also settles compensation for the open supply position, where the Aggregator pays the supplier for energy that the Supplier sources but never used.	
Main Elements	Aggregator needs to assign its own BRP?	Yes

	Aggregator needs contract with Supplier?	No
	Energy transfer method?	central
Contractual Relationships	Aggregator has a contract with BRPagr for entering energy markets and to cover imbalance. Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the TSO. The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.	
Balance responsibility	Balance responsibility for the flexibility is with BRPagr. BRPsup holds full responsibility outside activation periods, during activation periods the allocation of the flexibility resource is set equal to the corresponding baseline. During activation periods, BRPagr holds balance responsibility for the difference between the actual consumption and the baseline.	
Perimeter correction	ARP corrects perimeters of both BRPsup and BRPagr	
Transfer of Energy	Rules are required to enable the ARP to transfer the energy between BRPsup and BRPagr. In addition, a price formula is needed that is applied for the transferred energy and paid by the party into which perimeter the energy is transferred into.	
Applicability in GB	Not currently applied in GB. The model facilitates independent aggregation. This model describes a central perimeter correction from the ARP. This function is similar with the foreseen arrangements for the TERRE product implementation and VLP's access to the Balancing Mechanism. ELEXON will perform the role of the ARP under GB arrangements. Unlike the Central Settlement model, the foreseen GB arrangement does not charge the VLP for sourcing the energy from the supplier.	
Required changes	DNV GL acknowledges that changes associated with this AIM are similar to the changes that the TERRE implementation identified and the BSC Modification P344 has highlighted: changes to the Grid Code, changes to the Code Subsidiary Documents, changes to the Transmission Licence and changes to the Data Transfer Catalogue (DTC).	

Net Benefit Model		
Summary	Similar to the central settlement model, in the net benefit model the ARP corrects balancing perimeters and settles the compensation for the open supply model. The cost of this compensation is socialised if certain conditions are met. For example, in the US, a net-benefit test determines the price level from which the cost gets socialised. The Aggregator compensates the Supplier for price levels below price level which was determined by the net-benefit test.	
Main Elements	Aggregator needs to assign its own BRP?	Yes
	Aggregator needs contract with Supplier?	No
	Energy transfer method?	Central/socialised
Contractual Relationships	Aggregator has a contract with BRPagr for entering energy markets and to cover imbalance. Aggregator has a flexibility service contract with a BSP, who is offering the flexibility to the TSO.	

	The Aggregator has a flexibility service contract with a CMSP, who is offering the flexibility to the DSO.
Balance responsibility	Balance responsibility for the flexibility is with BRPagr. BRPsup holds full responsibility outside activation periods, during activation periods the allocation of the flexibility resource is set equal to the corresponding baseline.
Perimeter correction	ARP corrects perimeters of both BRPsup and BRPagr
Transfer of Energy	The impacted supplier is compensated for the sourced but not delivered energy based on a regulated price formula. The cost of this compensation is socialized if certain conditions are met. Those preconditions ensure that DR is only dispatched according to this socialization principle when the added value for the system is higher than the cost of the compensation. In the US, a net-benefit test determines the price level from which the cost gets socialized. Under that price it is paid by the Aggregator.
Applicability in GB	Not currently applied in GB. The model facilitates independent aggregation. This model describes a central perimeter correction from the ARP. This function is similar with the foreseen arrangements for the TERRE product implementation and VLP's access to the Balancing Mechanism. ELEXON will perform the role of the ARP under GB arrangements. Unlike the Central Settlement model, the foreseen GB arrangement does not charge the VLP for sourcing the energy from the supplier.
Required changes	DNV GL acknowledges that changes associated with this AIM are similar to the changes that the TERRE implementation identified and the BSC Modification P344 has highlighted: changes to the Grid Code, changes to the Code Subsidiary Documents, changes to the Transmission Licence and changes to the Data Transfer Catalogue (DTC).

APPENDIX B: INTRODUCTION TO USEF

The Universal Smart Energy Framework (USEF) provides guidelines to build an integrated smart energy future. Its purpose is to accelerate the establishment of an integrated smart energy system which benefits all stakeholders, from energy companies to consumers. Through its work, USEF aspires to contribute to the harmonisation of these flexibility mechanisms throughout Europe. USEF's ongoing development is managed by the USEF Foundation, a dedicated core team tasked with coordinating expertise, projects and partners while safeguarding the integrity and objectives of USEF. A brief video introduction to USEF is available online via this link.

Overview

USEF aims to facilitate effective coordination across all the different actors involved in the electricity market by providing a common standardised roles model and market design while describing communication requirements and interactions between market roles. USEF turns flexible energy use into a tradeable commodity available for all energy market participants, separated from (but in coordination with) the traditional electricity supply chain, to optimise the use of resources. USEF focuses on explicit demand-side flexibility, in which prosumers are contracted by the aggregator to provide specific flexibility services using Active Demand and Supply (ADS) assets. USEF acknowledges, but does not provide detailed considerations for implicit demand-side flexibility or peer-to-peer energy trading.

To facilitate the transition towards a cost-effective and scalable model, the framework provides the essential tools and mechanisms which redefine existing energy market roles, add new roles and specify interactions and communications between them. In addition, the USEF standard ensures that all technologies and projects will be compatible and connectable to the energy system, facilitating project interconnection, hence fostering innovation and accelerating the smart energy transition. By delivering a common standard to build on, USEF connects people, technologies, projects and energy markets in a cost-effective manner. Its market-based mechanism defines the rules required to optimise the whole system, ensuring that energy is produced, delivered and managed at lowest cost for the whole system and effectively for the end-user.

USEF provides:

- a **standardised common framework** designed to be implemented on top of current energy markets such as wholesale, retail and capacity markets.
- a description of the **flexibility value chain** (FVC) involving new and existing market players and giving a central role to the aggregator in facilitating flexibility transactions.
- a **roles model** and an **interaction model** to enable the implementation of different business models and interactions between actors.
- a market design described by the **Market Coordination Mechanism (MCM)** which sets out the phases and interaction requirements for flexibility transactions. The MCM provides all stakeholders with equal access to a smart energy system. To this end, it facilitates the delivery of value propositions (i.e. marketable services) to various market parties without imposing limitations on the diversity and customisation of those propositions.
- detailed **communication and market access requirements** taking into consideration privacy and cybersecurity issues.

USEF's basic principles underpin its arrangements, roles and interactions and are summarised below:

- USEF facilitates one overall energy system instead of one single flexibility customer;
- USEF enables a market-based approach to unlock the value of flexibility;
- Freedom of choice to participate in flexibility products must be guaranteed; and
- USEF describes a model of interoperable roles, centred around the Aggregator role.

In USEF, aggregators have a central role in maximising the value and use of demand-side flexibility. Aggregators are responsible for acquiring and accumulating flexibility from prosumers and offering that flexibility to market participants (e.g. DSO, TSO, Balance Responsible Parties - BRPs) via trading counter parties (e.g. Balancing Service Provider – BSP) in commercial transactions as illustrated in the figure below. The reward that aggregators receive in return for providing flexibility to market participants is shared with the prosumers.

USEF, as a roles model positions the Aggregator role on the retail side. For example, where an aggregator business provides balancing services, it combines the USEF roles of Aggregator and Balancing Service Provider (BSP). According to USEF, all market parties (or actors) that aggregate flexibility undertake the role of the Aggregator.

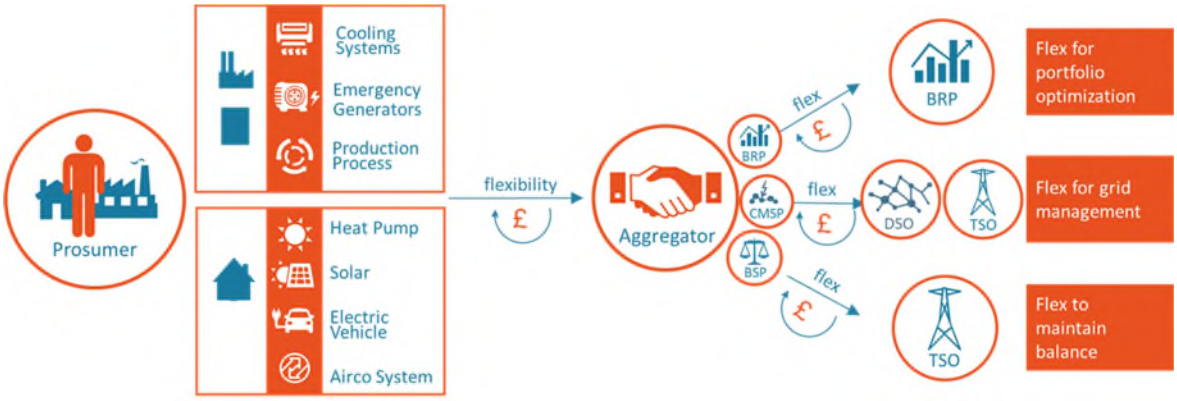

Figure 12: USEF Flexibility Value Chain

USEF Market Design

The USEF market design aims to create well-functioning electricity markets, where flexibility is dispatched based on market signals to where it is most essential and valuable. The flexibility market, as proposed by USEF, runs from the day before the delivery of the electricity to the moment of consumption, enabling full access to flexible technologies. The USEF market design provides USEF operating regimes and a common Market Coordination Mechanism (MCM).

The USEF MCM allows optimisation of the value of flexibility across all roles in the system and provides all stakeholders with equal access to the system, whilst ensuring that all physical constraints (frequency and thermal limits of network components) are met. The USEF MCM respects the freedom of connection, transaction and dispatch of flexibility, to the extent possible and builds on top of existing European market arrangements. It consists of five phases, as illustrated in the figure below. These phases are iterative and occur concurrently for different time periods under consideration (i.e. while network operation is underway for the current time period, settlement is being undertaken for a past period, and planning is underway for the future). When examining the market process for a single time period, the five market phases can be categorised as occurring sequentially from years and months ahead of time, through real-time network operation, to post-settlement.

Figure 13: USEF MCM Phases

APPENDIX C: GLOSSARY

Aggregator	A service provider that contracts, monitors, aggregates, dispatches and remunerates flexible assets at the customer side. (USEF terminology)
Aggregator Implementation Model (AIM)	USEF term that describes the relation of the aggregator with the supplier and the Balance Responsible Party (BRP). It covers relevant aspects of aggregation implementation, such as contractual arrangements, imbalance responsibility and transfer of energy.
Balance Responsible Party (BRP)	A market participant or its chosen representative who is responsible for balancing electricity supply and demand of its portfolio in each settlement period.
Balancing Service Provider (BSP)	A market participant who provides energy volumes to the TSO for the purposes of balancing the total system. In GB, this role is usually undertaken by aggregators, suppliers or customers directly connected to the transmission network.
Balancing Settlement Code (BSC)	The Balancing and Settlement Code (BSC) is a legal document which defines the rules and governance for the balancing mechanism and imbalance settlement processes of electricity in Great Britain. The BSC is administered by ELEXON, the Balancing and Settlement Code Company.
Central data hub	The central data hub is a repository where data for flexibility processes, such as the coordination of flexibility deployment, measurement, validation and settlement of flexibility services, is recorded.
Common Reference (or congestion point repository)	USEF defines the Common Reference as a repository which contains information about connections and congestions points in the network.
Common Reference Operator (CRO)	In USEF, the CRO is responsible for operating the Common Reference. The CRO's role is to ensure the publication of both the DSO flexibility requirements and the associated flexibility assets in each congested point as well as the standardisation of this publication for all distribution areas.
Congestion Management	The avoidance of the thermal overload of system components by reducing peak loads. The conventional solution to thermal overload is grid reinforcement (e.g. cables, transformers). Congestion management may defer or even avoid the necessity of grid investments.
Constraint Management Service Provider (CMSP)	A provider of constraint management services to a DSO or the TSO. This is a USEF role and is not currently used in GB. This role takes on specific responsibilities in communicating and coordinating flexibility transactions with the ESO and DSOs, to ensure effective deployment of flexibility as well as effective management of network constraints. Responsibilities also involve ensuring efficient dispatch of flexibility to maintain the safety and reliability of the networks.
D-prognosis	Aggregator forecast of the amount of energy to be consumed or produced at a given congestion point.
D-programmes	Aggregator forecasts of planned activations of flexibility (day-ahead and intraday) to be shared with DSOs in congested distribution network areas.
Distributed Energy Resources (DER)	Small scale power generation technologies (typically in the range of up to 10MW and including electric energy storage facilities) and larger end-use electricity consumers (e.g. industrial and commercial) with the ability to flex their demand (i.e. demand-side response) that are directly connected to the electricity distribution network.
Distribution Network Operator (DNO)	Company licensed to distribute electricity in GB.
Distribution System Operator (DSO)	As defined in DIRECTIVE 2009/72/EC: A natural or legal entity responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity.
Distribution Use of System (DUoS) Charges	Charges levied by distribution network operators on users to recover the cost of operating and maintaining the distribution network.

Energy Networks Association (ENA)	The industry association for operators of gas and electricity transmission and distribution networks in the UK and Ireland.
Flexibility Value Chain (FVC)	The potential of demand-side flexibility to create value to multiple participants through several markets and in the form of different products and services.
Flexibility Value Stacking	This is a concept where the Aggregator can provide multiple services from the same portfolio, or even from the same flexible asset(s), potentially to multiple parties to maximise the value of flexibility.
Flexibility	Ability of an asset or a site to purposely deviate from a planned or normal generation or consumption pattern.
Independent aggregation	Situation where a customer has an agreement with an aggregator to dispatch and market (parts of) its flexibility, whereas this aggregator operates without the consent from or a contract with the electricity supplier of the customer.
Independent Aggregator	A market party who performs the role of Aggregator and is not affiliated to a supplier or any other market participant.
Market Coordination Mechanism (MCM)	The Market Coordination Mechanism in USEF includes all the steps of the flexibility trading process, from contractual arrangements to the settlement of flexibility. USEF splits the flexibility trading process in five phases and describes the interactions between market participants and information exchange requirements in each phase of the MCM.
Operating Regimes	A USEF concept for a traffic light mechanism to govern the (un)restricted trade and dispatch of flexibility. The USEF market design of operating regimes aims to ensure well-functioning short-term electricity markets, where flexibility is dispatched based on market signals to where it is most essential and valuable.
Prosumer	This role refers to end-users who only consume energy, end-users who both consume and produce energy, as well as end-users that only generate (including on-site storage). (USEF terminology)
Post-fault products	Flexibility products under which the DSO procures, ahead of time, the ability of a Service Provider to deliver an agreed change in output following a network fault.
Re-dispatch	This is a mechanism that neutralises the impact of the activated flexibility on the overall system balance, by activating the same amount of flexibility in the opposite "direction" outside the congested area.
Restoration Support Services	Flexibility services provided following a loss of supply; the DSO instructs a provider to either remain off supply, or to reconnect with lower load, to support increased and faster load restoration under depleted network conditions.
Supplier	The role of the Supplier is to source and supply energy to end-users, to manage (hedge) delivery and imbalance risks, and to invoice its customers for energy.
Transfer of Energy (ToE)	USEF term for a wholesale electricity transaction between the Supplier and the Aggregator, triggered by a Demand Response activation by the Aggregator on the retail side, restoring the energy balance of both the Aggregator and the Supplier (and their BRPs).
Transmission System Operator (TSO)	A physical or legal entity responsible for operating, ensuring the maintenance of and, if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity. In GB, the party responsible for the system balance and operability is the Electricity System Operator (ESO), National Grid ESO. Separate parties, the electricity Transmission Owners (TOs), are responsible for investing, building and maintaining their electricity transmission network.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our professionals are dedicated to helping our customers make the world safer, smarter and greener.