SP ENERGY NETWORKS

RIIO NIC NETWORK INNOVATION COMPETITION

FUSION

Network Innovation Competition 2017

DNV·GL passivSYSTEMS origamienergy Imperial College London SAC CONSULTING University of St Andrews FOUNDED 1413 INVEST IN FIFE Bright Green Hydrogen

Project Code/Version Number:
SPD/EN/05

1. Project Summary

1.1. Project Title	FUSION
1.2. Project Explanation	Demonstration of commoditised local demand-side flexibility through a structured market-based framework to address local and national electrical network congestion: ✓ inform innovative commercial tools to meet evolving customer needs associated with LCT uptake and new connections; ✓ enable efficiencies from deferred network reinforcement and accelerated customer connections.
1.3. Funding licensee:	SP Distribution Plc
1.4. Project description:	The UK faces high load growth from increasing LCT uptake and strategic regional developments. Conventional reinforcement can no longer provide the only efficient means to meet evolving customer needs. Geographically local demand-side flexibility is a valid alternative, however, its application is currently immature and has been tested only in bilateral agreements. In response to current policy developments, FUSION seeks to implement a **local competitive, open and structured flexibility market** in East Fife, Scotland, as a network management tool to mitigate local network constraints and complement national balancing requirements within the existing regulatory framework. FUSION will **develop, implement, and trial the application of the Universal Smart Energy Framework (USEF)**, and will inform wider policy development around flexibility markets and transition to DSOs through the development of standardised industry specifications, processes, and requirements for transparent information exchange between market participants accessing market-based demand-side flexibility. FUSION presents a positive and realistic business case. It could save customers over £236m, in addition to 3.6m tCO_2 by 2050.

1.5. Funding

1.5.1 NIC Funding Request (£k)	£5103.9	1.5.2 Network Licensee Compulsory Contribution (£k)	£567.1
1.5.3 Network Licensee Extra Contribution (£k)	£0	1.5.4 External Funding – excluding from NICs (£k):	£0
1.5.5. Total Project Costs (£k)	£5671.0		

1.6. List of Project Partners, External Funders and Project Supporters (and value of contribution)	Fife Council; University of St Andrews; Bright Green Hydrogen Ltd; SAC Consulting Ltd; Imperial College London; Origami Energy Ltd; Passiv Systems Ltd; DNV GL Ltd

1.7 Timescale

1.7.1. Project Start Date	January 2018	1.7.2. Project End Date	December 2022

1.8. Project Manager Contact Details

1.8.1. Contact Name & Job Title	Michael Green, Senior Innovation Analyst	1.8.2. Email & Telephone Number	mgreen@scottishpower.com 07731 325 965
1.8.3. Contact Address	SP Distribution, Ochil House, 10 Technology Avenue, Blantyre, G72 0HT		

1.9: Cross Sector Projects (only complete this section if your project is a Cross Sector Project, ie involves both the Gas and Electricity NICs).

1.9.1. Funding requested the from the [Gas/Electricity] NIC (£k, please state which other competition)	N/A
1.9.2. Please confirm whether or not this [Gas/Electricity] NIC Project could proceed in the absence of funding being awarded for the other Project.	

1.10 Technology Readiness Level (TRL)

1.10.1. TRL at Project Start Date	6	1.10.2. TRL at Project End Date	8

Section 2: Project Description

2.1. Aims and objectives

FUSION will demonstrate the feasibility of geographically local commoditised flexibility, accessible through a universal, standardised market-based framework – The Universal Smart Energy Framework (USEF), to address distribution network congestion issues, and complement national balancing requirements within the existing regulatory framework.

FUSION aims to achieve the following objectives:

- 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.
- Investigate a range of commercial mechanisms to encourage flexibility from energy consumers' use of multi-vector electrical applications in satisfying overall energy use.
- Explore the potential for localised demand-side flexibility utilisation to accelerate new demand connections to the network that otherwise would require traditional reinforcement.

Through a live trial in East Fife, FUSION will:

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

Electricity markets need to evolve and be accessible to all market participants to accurately reflect the value to the electricity network that flexible assets can provide, and create a level playing field to ensure that the best solutions are adopted. Development of existing market frameworks is needed to encourage more participants to supply services that cut across multiple and independently regulated markets. To overcome the present challenges, it is necessary to develop and trial novel solutions for delivering flexibility at distribution voltages that can complement national balancing requirements.

2.1.1 The problems which need to be resolved

Three principal challenges need to be met by DNOs to be able to adapt to the rapidly changing nature of the distribution networks:

1. Consistent high **load growth** from existing and future customers
2. Inability to access a **coordinated** flexibility market
3. Lack of certainty over **efficient network reinforcement** investments

1. **Load growth** from existing and future customers

Load growth through the connection of **Low Carbon Technologies** (LCTs), and regional regeneration and **new customers** presents challenges to the distribution network. Load growth forecasts have been revised to account for high LCT growth, resulting in the potential requirement for asset reinforcement prior to normal end of life expectations. [redacted] shows the increasing load relative to the TRANSFORM model, demonstrating the need for a greater penetration of network flexibility products and services.

[redacted]

Moreover, due to increased levels of load growth and a lack of network management tools within the control of the DNO, customers seeking new or larger connections to the distribution system can wait for reinforcements to be in place.

2. Inability to access a **coordinated** flexibility market

Consumers are becoming active and empowered agents at the heart of the current energy system. Business and residential consumers are seeking to maximise the efficiency, and lower the cost of their energy use, and demand-side flexibility is principal to this objective. Energy flexibility will have an increasing economic value and will become a commodity supporting wider economic growth.

A key challenge to realising the value of flexibility and implementing such a market, is how to make flexibility **accessible** for all market participants, across the spectrum of GB energy consumers, users and technologies, and commercial and regulatory requirements. **Standardisation** of flexibility products and services to serve both local and national network balancing will accelerate the realisation of benefits, and in the short and longer term will lower the overall cost of energy across GB.

Although flexibility services at the distribution-level have recently been introduced into the GB energy market, the scope of these services is limited in participants, technologies, and routes to market. Currently, no open accessible transparent market exists for all market participants. In its 2016 Call for Evidence, Ofgem highlighted the importance of changes to system and regulatory arrangements to optimise "*system-wide*

use of connected resources and network management approaches"[1] and create DSO/SO procurement mechanisms, referring, among others, to the USEF framework.

3. Lack of certainty over **efficient network reinforcement** investments

DNOs exist to maintain secure and reliable electricity supply. Under changing demand profiles, this task entails increasing pressure on timely and considered investments to ensure the most efficient deployment of network reinforcement. In an environment of forecast load and generation growth, the current energy landscape is more uncertain over the most **efficient allocation and deployment of network reinforcement**. Effective deployment of flexibility will give DNOs a valuable alternative option to defer investment in network reinforcement and ensure the scale and timing of any investment is optimised, thereby ensuring that the network is developed at the most efficient cost whilst maintaining a secure and reliable electricity supply.

2.1.2 The method being trialled to solve the problem

FUSION will develop and implement an open, competitive flexibility market at the distribution level. FUSION will do this in three broad phases:

1. Flexibility market **quantification** (WP 2)
2. Commercial and regulatory **establishment** of a flexibility market (WPs 3 & 4)
3. Technical and commercial **implementation** of a flexibility market in East Fife (WP 5)

The flexibility market will be **quantified** to give a full and thorough understanding of flexibility volume, availability, needs and potential value to end-users and aggregators. Quantification by aggregators is an essential method to ensure the liquidity and reliability of the commoditised flexibility market.

The principal focus of the geographically local flexibility market will be the establishment of a **neutral market facilitator,** allowing the greater penetration of new flexibility market participants. The flexibility market will complement existing ancillary services and will become part of a wider economic optimisation exercise for the provision of balancing services. This will be undertaken on a competitive basis, but linked to specific network constraint management zones (CMZs).

USEF, an established and trialled framework for such a market, will provide an international common standardised framework by (1) defining products, market roles, processes and agreements; and (2) specifying data exchange, interfaces and control features. The framework turns flexibility into a tradable commodity for all market participants, and makes available a range of services to stakeholders requiring demand-side flexibility, as shown in Figure 2.

[1] Ofgem/BEIS (2016), *A smart, flexible energy system - A call for evidence*, p79, November 2016.

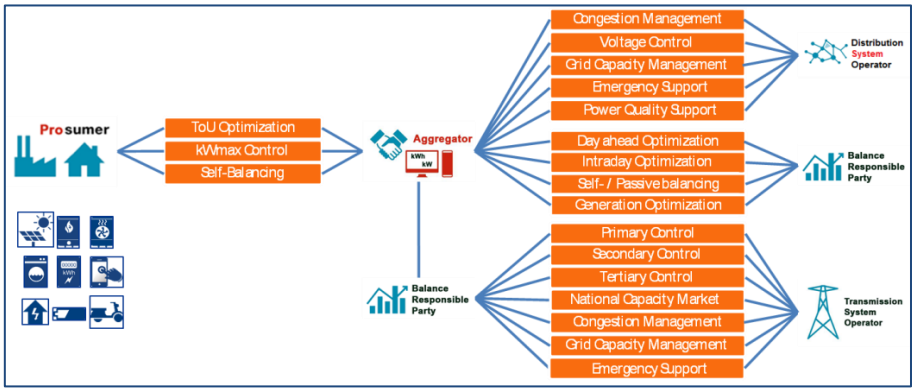

Figure 2: USEF: Unlocking the value of flexibility by creating a tradable commodity accessible for all stakeholders

Competition in the provision and use of flexibility **ensures the optimal allocation of flexibility**. On the provider-side of the market, flexibility providers compete to deliver flexibility to those entities that require it to meet their own needs (DNOs, TSOs, and GBSO), creating competition and optimised pricing. On the buy-side, the fact that there are alternatives to purchasing local flexibility means flexibility prices cannot rise to uneconomic levels and the efficient trade of flexibility develops. For example, National Grid in its role as GBSO is not bound geographically to procuring flexibility for system stability, while a DNO can always choose the traditional solution of investing in grid capacity if this is more efficient than procuring local flexibility to solve a congestion problem.

To ensure flexibility is a real alternative to traditional capacity investments, USEF provides a 'traffic light' system that allows the DNO to directly instruct flexibility in critical situations to avoid power failure. More information on USEF and the operational hierarchies within it is provided in appendices L, M and N.

Implementation of the proposed USEF solution across East Fife would use the inherent flexibility that exists within the local distribution network of East Fife to provide SP Distribution with an alternative means of mitigating against the risk of thermal overload within the distribution network in the event of intact, planned or unplanned N-1 events.

[redacted]

Implementation requires process and management integration by stakeholders as shown in Figure 3, and will be developed in FUSION. This includes localised flexibility management tools and processes that integrate with existing distribution management systems that can be called upon by operation engineers.

Figure 3: FUSION - Principle Architecture of the East Fife pilot

2.1.3 The development or demonstration being undertaken

FUSION follows a logical progression of assessment, preparation, implementation and validation, as outlined in Figure 4 and described below:

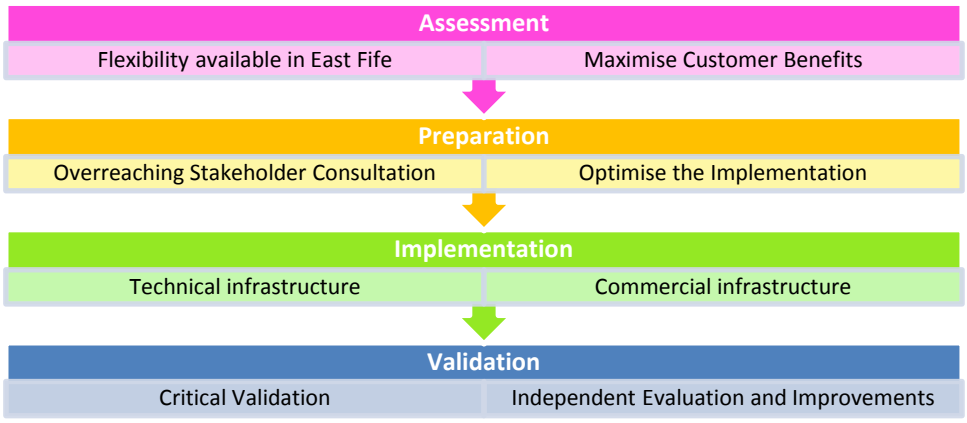

Figure 4: Development and Demonstration undertaken within FUSION

- **Assessment**

FUSION has undertaken a preliminary assessment of flexibility available in East Fife; this will be developed further and expanded by both I&C and domestic aggregators to ascertain a comprehensive evaluation of flexibility in the trial area. FUSION considers four key case studies for investigation, [redacted]

a) Insufficient Capacity within the 33kV Over Head Line Network
b) Insufficient Capacity at the 33/11kV Local Primary Substation
c) Insufficient Capacity during 11kV Alternative Running Arrangements
d) Insufficient Capacity at the Local Secondary Substation

Details of each case study can be found within appendix C.

For each case study, flexibility will be assessed and quantified, and flexibility product definitions developed. Concurrently, the preliminary assessment of USEF to the GB market will be greatly expanded in scope and depth to assess the fit and changes required for a commoditised flexibility market for distribution networks.

- **Preparation**

FUSION will undertake a structured public consultation on the development of a flexibility market at the distribution network level. This will include a broad base of stakeholders. Based on responses, implementation plans will be evaluated and refined.

- **Implementation**

Technical infrastructure will be constructed and implemented informed by both the assessment and preparation phases, ensuring that the flexibility market is appropriate to the context. Commercial arrangements will be enabled to facilitate FUSION and the flexibility market. The live trial will be developed and undertaken by relevant market actors.

- **Validation**

Critical assessment and evaluation of trial procedures and outcomes will be undertaken on an ongoing basis. This process will inform further project refinement, adjustments to technical and commercial aspects, and GB roll-out implementation plans for FUSION.

2.1.4 The solution which will be enabled by solving the problem

FUSION will deliver the following innovative solutions:

a) Creation of a **blueprint local flexibility market** to allow DNOs to procure flexibility from customers to help manage network congestion resulting from load growth.

b) Development of accepted **industry standard procurement procedures** for flexibility by the DNO within the existing GB regulatory and market framework.

2.2. Technical description of the project

The scope of FUSION can be divided into the following broad elements:

- A focused due diligence and public consultation about the participation of DNOs in the evolving flexibility market through the application of USEF (highlighted in green in Figure 5);
- A thorough and detailed analysis of flexibility available in the East Fife area across a range of market participants;
- A demonstration of this market in East Fife (highlighted in yellow in Figure 5), including the procurement of flexibility by SP Distribution on an open flexibility market [redacted]

To deliver the scope, FUSION is organised into the 6 work packages shown in Figure 5:

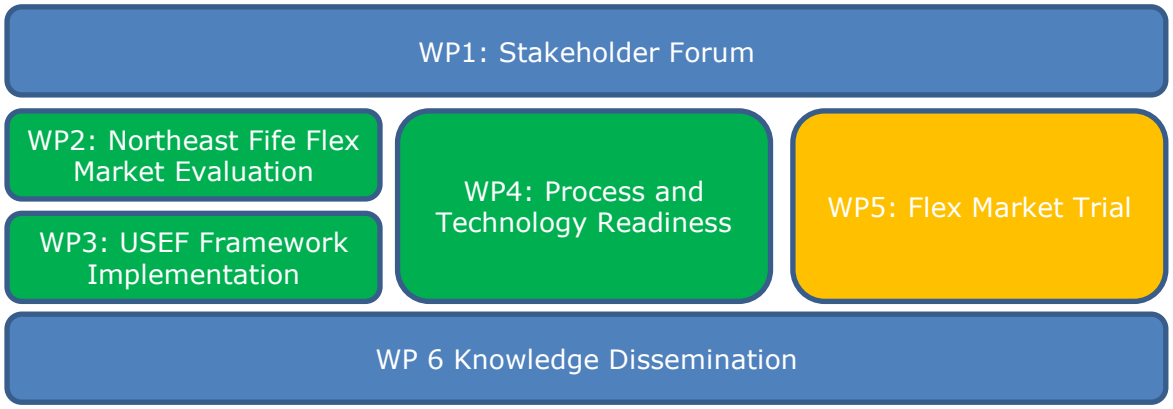

Figure 5: FUSION work packages

2.2.1 Work Package 1: Stakeholder Forum

The stakeholder forum will connect and communicate with multiple groups across the industry and form the basis of continual feedback and information exchange as the project progresses across local, national and international levels:

- **Local (East Fife) context:** These stakeholders will either actively participate in or passively monitor the demonstration of the flexibility market in East Fife. This group

will include local government and institutional stakeholders, end-users, aggregators, other network owners (primarily gas and electricity transmission) and energy suppliers. Trial participants will gain hands on experience in the pilot, inform the evolution of the trials, as well as providing valuable input into future GB flexibility market implementation and the further development of the USEF framework.

- **GB context:** This group does not have a direct local interest, but an interest from the perspective of the overall GB energy market. This includes Ofgem, DNOs, TOs, GBSO, gas network owners, aggregators, energy suppliers and end-users. This stakeholder group will play an active role in the market consultation and inform the adjustments and application of USEF to the GB market.
- **International context:** International stakeholders that have an interest in USEF and the development of flexibility markets. This group includes international utilities, network operators, regulators, ENTSO-E, USEF members, developers of flexibility pilot projects, and others. This group can provide valuable knowledge and information that can benefit FUSION, as well as FUSION providing valuable input to the further development of USEF and its implementations.

2.2.2 Work Package 2: East Fife Flexibility Market Evaluation

In this work package a comprehensive assessment of the available flexibility will be made in the East Fife area. This assessment will include customers connected at all voltage levels. Customers, as potential flexibility providers, will be invited to complete an Expression of Interest (EoI) and have their sites assessed to determine the potential flexibility that could be provided. This audit requires highly specific competencies and accordingly will be performed by one of the aggregator project partners in FUSION (Origami Energy or PassivSystems, with stakeholder support from SAC Consulting), or if requested, by other consultants appointed by the customer.

Site assessment will firstly involve an initial desktop study, as well as (depending on site potential) detailed site-studies, to determine a site's energy requirements across multiple energy vectors, including electricity, heat and automotive transport.

Following site-specific assessments of the flexibility potential, the full flexibility potential in East Fife will be mapped, which will determine the specific trial location(s). Finally, customers in the relevant trial area will be invited to take part in the trial.

2.2.3 Work Package 3: USEF Framework Implementation within GB

This work package contains all activities concerning USEF implementation in GB. This includes a due diligence of USEF against the GB legal, regulatory and market frameworks, including current and future settlement arrangements. During the preparation for FUSION, a preliminary, high-level assessment was commissioned to explore the fit of USEF to the GB market framework. This assessment revealed no regulatory or commercial barriers regarding the adoption of USEF to the GB market. market (see appendix M for details).

The due diligence process will also consider hoe FUSION can contribute to wider UK industry developments. Further, FUSION will define flexibility products, including: congestion management (n-1 compliance support); voltage control; and LV network constraint management, to be aligned with existing ancillary services markets and supplier portfolio optimisation.

The due diligence will be the basis of a public consultation, culminating in a reference implementation plan for USEF in the GB market. This plan will both inform the trial within FUSION, as well as forming a blueprint for the GB energy industry, to be refined over the course of the project and informed by the trial outcomes.

2.2.4 Work Package 4: Process & Technology Readiness

Work package 4 contains all preparation activities for the project demonstration in East Fife. The main input for this work package will be the results of the public consultation, which will inform any adjustments to the USEF framework, as well as finalisation of product specifications suitable for the GB market.

This work package 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, including load forecasting, load flow simulations and risk assessments, as well as develop the processes for establishing flexibility products linked to specific network constraints outlined in appendix C. Further, this will include flexibility procurement e.g. bid evaluation and selection, performance evaluation, settlement and payment. Similarly, we will implement USEF processes with market participants looking to participate in the trials. FUSION will develop and implement a cloud-based procurement platform through which SP Distribution engages participating aggregators and flexibility providers. The platform will be based on the USEF reference implementation and will enable SP Distribution to specify a flexibility requirement as a product with a set of standardised characteristics, to be delivered by the most economic aggregator bid. Appendix N provides a detailed description of the IT architecture of the procurement platform which will be developed for FUSION.

2.2.5 Work Package 5: Deployment and Demonstration of USEF in East Fife

This work package consists of the actual trial, informed by the outcome of previous work packages. [redacted] The trial will involve the following activities:

- an open tender for the procurement of flexibility contracts with aggregators;
- the implementation of the operational interaction with aggregators using a cloud-based platform; and
- the actual procurement, dispatch and remuneration of demand response and local generation.

During the trial, there will be a process of continual evaluation to identify opportunities for optimising processes. Where appropriate, these will be implemented during the trial. At the end of the trial a full evaluation will be undertaken. This will accumulate all experiences from the trial and evaluate the overall business cases for the DNO, aggregators and end-users.

2.2.6 Work Package 6: Knowledge dissemination

Throughout FUSION, tangible and valuable learning will be generated, captured and disseminated. FUSION will maintain ongoing evaluation and reporting, and will make learning available to all stakeholders through a range of appropriate dissemination methods. Integration and coordination with ENA workstream 3, DSO transition, will be principal to the knowledge dissemination strategy, further outlined in section 5.

2.3. Description of design of trials

FUSION follows a logical progression in project design, as outlined in Figure **6**: Pre-trial, FUSION will be informed by the assessment of local flexibility (WP2) as well as the due diligence and consultation process (WP3); During the trial, FUSION will demonstrate and test the workings of a local flexibility market in East Fife; Post-trial, the learnings from this trial will be incorporated in the evaluation of the GB wide business case and reference implementation plan of USEF in GB.

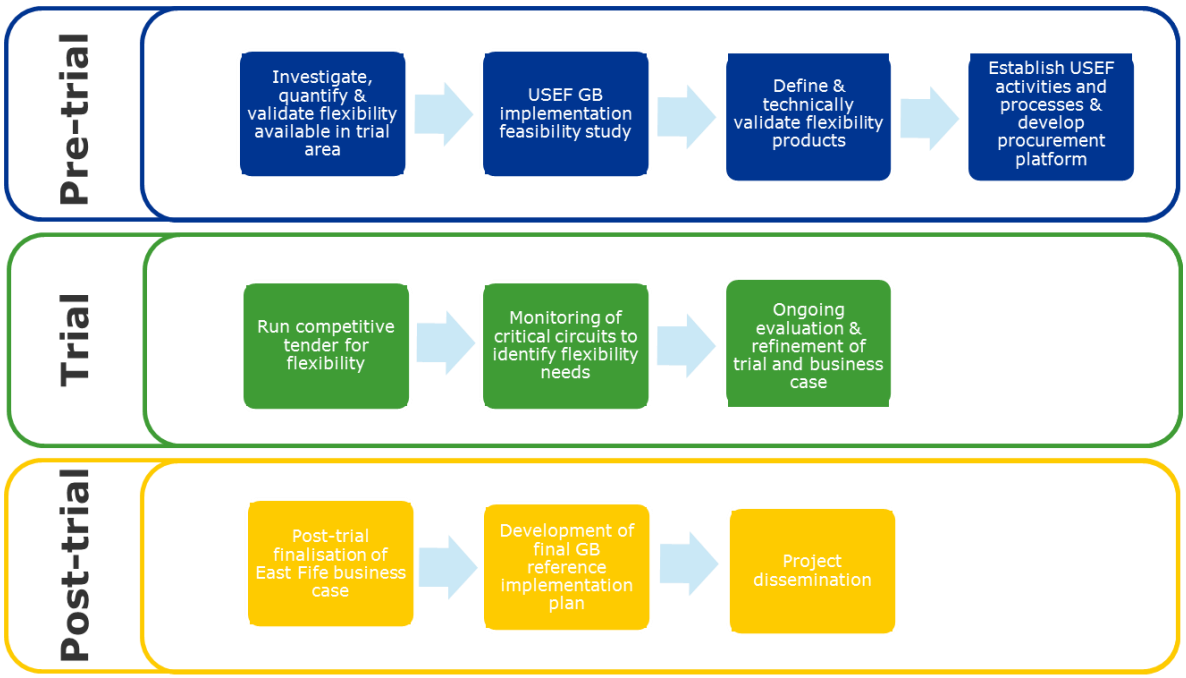

Figure 6: FUSION trial development and design

2.4. Changes since Initial Screening Process (ISP)

FUSION has amended its total budget from £7.74m to £5.97m, a decrease of 23%. This reflects the increased emphasis on the core USEF-based flexibility market deliverables, ensuring that a GB specific USEF implementation plan is developed at best possible value to GB consumers. Accordingly, elements of work have been de-scaled, and efficiency savings have been found. Specifically, cost reductions have been found in the following areas:

IT development: [redacted] Further, internal resources can be harnessed reducing implementation costs.

Academic modelling: Modelling scope has been reduced in line with existing research in the areas of flexibility, and specifically with reference to dialogue with Northern Power Grid's (NPG) Customer Led Distribution System, which incorporates significant academic work around flexibility management. NPG have liaised directly with FUSION project management, and have agreed that in order to reduce overlap, academic modelling should focus on flexibility frameworks.

[redacted]

Further, costs that can be saved through collaboration with other NIC 2017 projects have been reduced accordingly. This is specifically in reference to areas listed in section 4.4.3:

- Stakeholder forum management
- Public consultation activities
- Development of DSO foundation specifications
- Model design authority and trial validation
- Knowledge dissemination

FUSION anticipates cost savings in these areas, and has presented a preliminary cost saving associated with these activities. On formal collaboration post-NIC awarding phase, further and detailed budget changes can be confirmed, and will be presented to Ofgem in the second quarter of 2018.

In recognition of the comments from Ofgem following submission of the ISP, the project has removed the specific work package relating to the implementation of hybrid heat pump, thereby avoiding duplication with project FREEDOM. Accordingly, Energy Systems Catapult elected to withdraw from the project. In doing so, we have widened the scope of our overall project by partnering with a number of alternative partners to better understand the true potential for localised flexibility providers across multi-vector energy systems which will be delivered through a market-based approach to flexibility.

As noted in the ISP, stakeholder engagement is vital to the project, and places the customer at the centre of FUSION. Additional project partners have strengthened the FUSION submission; this creates a well-rounded consortium able to provide real input to ensure the appropriate delivery of a flexibility market capable of meeting multiple requirements, and to readily enable GB roll-out post-FUSION.

Following initial ISP feedback from Ofgem, FUSION has outlined the innovative qualities of a universal market for commoditised flexibility. Further, it has outlined that liaison with other DNOs undertaking relevant DSO projects will play a vital role in the project, with tangible contributions to the ENA workstream 3, Open Networks, and wider industry forums. SP Distribution have further engaged DNOs, including on-site visits to WPD's Entire project harnessing learning on the integration of flexibility management tools, as reflected in our overall bid submission. Further, dialogue with SSEN and WPD has continued to align where there is potential to collaborate in delivering the outputs of their respective NIC 2017 projects should they be successful.

Section 3: Project business case

The distribution network is evolving with the emergence of prosumers to meet the customer needs requiring evolution and adaption from the DNO.

FUSION provides the case that:

1. A flexibility market can be established at a local level and developing such a market in the proposed area represents a saving of £19m by 2050 for the licensee area, compared with conventional methods of reinforcement.
2. There are strong business cases for stakeholders engaged in this market;

Table 1: Business Case for Stakeholders

Stakeholders	Role and Function	Benefits
DNO/TO	Electricity Network Capacity Requirement	Defer/avoid reinforcement
Aggregators	Capacity Providers	Additional Income
Asset owners/flexibility providers	Infrastructure Owners	Additional Income or Energy Bills saving
Suppliers	Utilise customer base to provide balancing services	Balancing supply portfolio, opening up new revenue streams for themselves and customer base
GBSO	National balancing	Increased access to market participants

3. The identification of the trial area and timing are appropriate and the efforts are proportional to the innovation risks to warrant the designed trial;
4. The learnings of the local trial can be further rolled out and provide net present value (NPV) benefits over £236m and unlock up to £3.5billion per annum by 2050 for electricity consumers at the GB level[2].
5. A flexible market will aid in reaching the legally binding 80% reduction for all UK greenhouse gas (GHG) emissions, compared to 1990 levels, by 2050 set out by the Climate Change Act (2008)[3], and will support the potential pathways to an intermediate target reduction of 32% by 2020 set out by the Low Carbon Transition Plan[4].

3.1 Aligned to DNO innovation strategies

FUSION draws on innovation strategies within SP Distribution, in GB, and abroad. In doing so, the project addresses a range of issues outlined in innovation strategies, and develops outcomes to advance the provision and use of flexibility to resolve constraint issues in the distribution network.

[2] https://www.theccc.org.uk/wp-content/uploads/2015/10/CCC_Externalities_report_Imperial_Final_21Oct20151.pdf
[3] *Climate Change Act*, c. 27, 2008, available at: http://www.legislation.gov.uk/ukpga/2008/27/contents
[4] DECC, *The UK Low Carbon Transition Plan: National Strategy for Climate Change*, 2009. Available at: https://www.gov.uk/government/publications/the-uk-low-carbon-transition-plan-national-strategy-for-climate-and-energy

3.1.1. SP Energy Network's innovation strategy

SP Energy Networks Innovation Strategy[5] highlights demand-side response as an innovation development focus, over the period 2020-2023. It also notes the desire to build on commercial innovation and introduce new participants to the energy market. FUSION will facilitate these developments.

SP Distribution led the way for the DSO transition by publishing its DSO Vision[6] in 2016. The document highlighted the harnessing of demand-side response for deferring traditional reinforcement. Market facilitation and settlement services discussed in the DSO vision are developed by FUSION, demonstrating its strategic alignment with our corporate strategy in the short, medium and long-term.

3.1.2 National innovation strategies

The Energy Networks Association (ENA) Workstream 3, Open Networks, forms a vital strategic body for FUSION, which will act as a demonstrator project of demand-side response in an open market, and offers to feed in to the transitional roadmap, alongside developing shared knowledge and learning for the wider development of DNOs.

FUSION provides a viable alternative to bilateral flexibility trading, addressing concerns raised in the ENA discussion paper on Smart Demand response[7]. Further, a market framework addresses the need to standard practices and the thus far limited utilisation of flexibility in the distribution, concerns raised in Ofgem's July 2017 Smart Systems and Flexibility Plan[8]. The development of aggregators in the flexibility market supports open competition, a key strategic necessity outlined in Ofgem's report, Aggregators – Barriers and External Impacts[9]. Furthermore, the introduction of a new and innovative market for commoditised distribution-level flexibility develops businesses and new business models through trading optimisation, reduced transactional costs thereby supporting the wider UK Industrial strategy; These are all key targets highlighted as suitable for innovation funding in BEIS & Ofgem's Call for Evidence on A Smart, Flexible Energy System[10].

FUSION brings together both a range of industrial and commercial (I&C) customers across diverse business areas, and domestic customers due to the varied geographies of East Fife. It therefore addresses strategic issues around customer flexibility compatibility and availability raised in Ofgem's Analysis of I&C demand-side response[11], in the ENA Smart Grid Forum report[12], and the DECC report on Demand Side Response in the domestic sector[13]. Through work package two, FUSION will undertake comprehensive

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[5] SP Energy Networks, *Innovation Strategy*, 2014, available at: https://www.spenergynetworks.co.uk/userfiles/file/201403_SPEN_InnovationStrategy_MH.pdf
[6] SP Distribution, *DSO Vision*, 2016, available at: https://www.spenergynetworks.co.uk/userfiles/file/SPEN%20DSO%20Vision%20210116.pdf
[7] Energy Networks Association. *Smart Demand Response: A Discussion Paper,* 2012
[8] Ofgem, Upgrading Our Energy System: Smart Systems and Flexibility Plan, 2017, available at: https://www.ofgem.gov.uk/publications-and-updates/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[9] Ofgem, *Aggregators – Barriers and External Impacts*, 2016
[10] Department for Business, Energy & Industrial Strategy and Ofgem. *A Smart, Flexible Energy System: A Call for Evidence*, 2016
[11] Ofgem, *Industrial & Commercial demand-side response in GB: barriers and potential*, 2016
[12] Energy Networks Association, *Assessing the Impact of Low Carbon Technologies on Great Britain's Power Distribution Networks*, 2012
[13] Department for Energy and Climate Change, *Demand Side Response in the domestic sector – a literature review of major trials*, 2012

flexibility assessments of where flexibility can and cannot be implemented. Such a customer-centric approach is further impressed upon in Ofgem's Position Statement on Flexibility[14], and has been observed and adhered to in the proposal for FUSION.

3.1.3 International innovation strategies

FUSION aligns with the European Commission's Winter Package report (Clean Energy for all Europeans)[15] that develops the requirement for consistent distribution network coordination across Europe.

3.2. Context of Flexibility Development

3.2.1. Role and value of flexibility in future UK electricity system

The current UK electricity system, greater variability in supply due to increased renewable generation is expected to result in reduced utilisation of conventional generation, transmission and distribution, which in turn leads to higher total system costs. Recent studies[16] show that flexibility is absolutely vital to enable the cost-effective integration of low-carbon technologies. In the recently published study by the National Infrastructure Commission, deployment of flexible options in the future UK power system could deliver savings to customers of up to **£8bn annually in 2030[17].** At the same time, the BEIS study "An analysis of electricity system flexibility for Great Britain" reported that widely available sources of flexibility can reduce the NPV of total system cost of the UK electricity system to **2050 by up to £40bn,** enabling the UK to meet its carbon targets at lower cost whilst contributing to maintain a robust and stable electricity system[18].

3.3 Counterfactual

FUSION uses existing bilateral flexibility trading arrangement as the counterfactual in its business case, this is based on the anticipated developments in this sector. The business case demonstrates the additional value of a structured, accessible and transparent USEF-based flexibility market to address flexibility management.

Owing to load growth issues, SP Distribution has identified four case studies that present evidence of imminent reinforcement needs. [redacted] The case studies form the evidence base of FUSION, and are extensively detailed in appendix C.

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[14] Ofgem, *Position Paper: Making the electricity system more flexible and delivering the benefits for consumers*, 2015
[15] European Commission. *Clean Energy For All Europeans.* 2017
[16] These include studies carried out by Imperial College London for various public bodies in the UK, including:
- "An analysis of electricity system flexibility for Great Britain" (for BEIS)
- "Value of Flexibility in a Decarbonised Grid and System Externalities of Low-Carbon Generation Technologies" (for the Committee on Climate Change)
- "Can storage help reduce the cost of a future UK electricity system?" (for Carbon Trust)
- "Smart power: A National Infrastructure Commission Report"

[17] National Infrastructure Commission, Smart Power, 2016, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf
[18] BEIS, An analysis of electricity system flexibility for Great Britain, 2016, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

3.4 FUSION and complementary balancing mechanisms

3.4.1 Stakeholder and energy balancing interactions

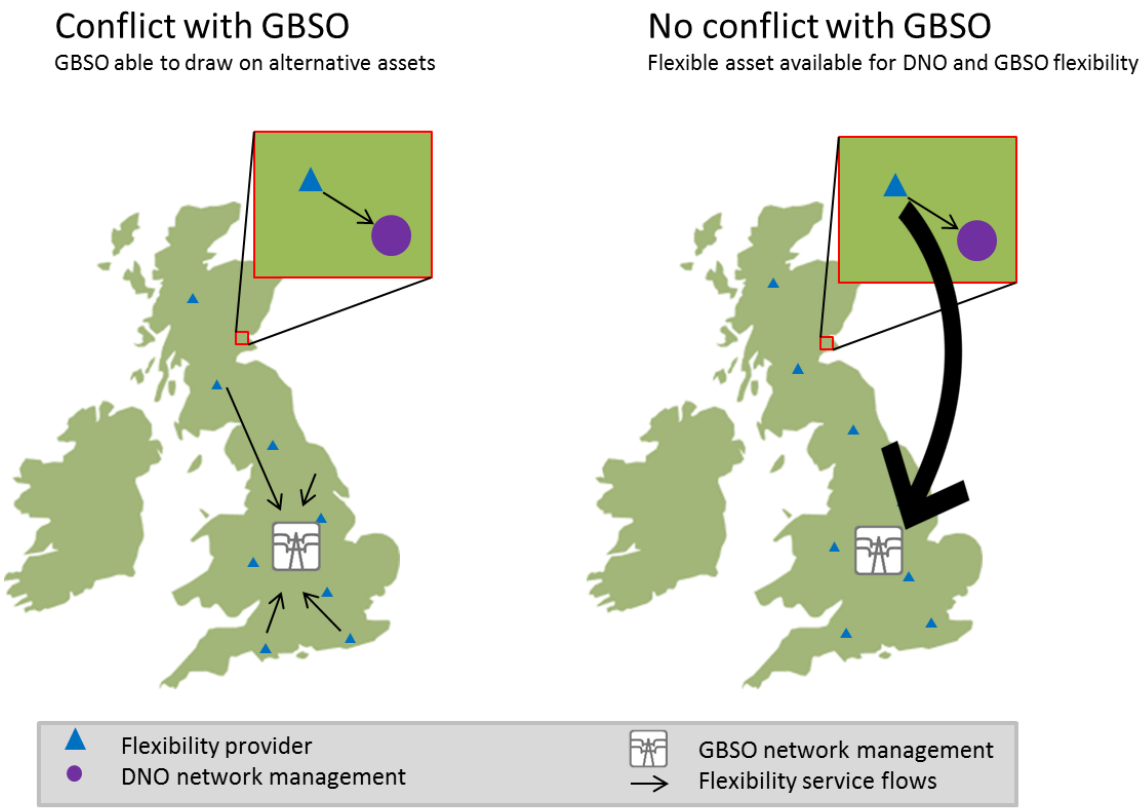
A principal mechanism for allocating a scarce resource (like flexibility) among competing stakeholders is through negotiating on a structured open market place. Under the right conditions, a market mechanism will ensure the optimal unbiased allocation, while preserving freedom of choice for the participating stakeholders.

In general, commodity markets operate on the premise that sellers can realise a higher value for their offering when there is high demand but low availability. The current energy market in respect of balancing services relies upon a relatively small number of participants to service a limited number of requirements. However as the GBSO operates across GB they can realise best value by not being geographically bound for sourcing flexibility providers.

The DNO however can only harness and maximise flexibility to overcome geographically specific constraints by having direct access to a targeted suite of flexibility providers linked to an identified distribution network location and assets as shown in Figure 7.

Demand response is therefore not zero sum where the value is shifted from one stakeholder to another. Instead, flexibility adds value to the system by driving investments and costs down. It is a matter of how to distribute this value among all relevant stakeholders (DSO, TO, end users, suppliers/BRPs). This is what USEF does.

Under different circumstances, stakeholder interactions are as follows:



Credits: 'Right curved arrow' by Star and anchor designs from www.thenounproject.com; 'GB map' from Clear Selection, available at: http://www.clearselection.co.uk/images/gb-map.gif

Figure 7: Diagram of stakeholder interaction

3.4.2 Pricing of flexibility for the DNO

National balancing payments and DNO flexibility are unlikely to be correlated. Therefore, the **local** price of flexibility lies between this (known) GBSO national balancing price and (the depreciation of) the grid reinforcement. The actual price is a matter of competition and negotiation. The GBSO price is unlikely to be affected as it can draw on a wide array of resources.

Where products can be stacked and fit multiple procuring parties, the price for the DNO may be lower, as for the aggregator this will just an extra bonus to existing operations.

Figure 8 shows the potential interactions of pricing based on conflict and non-conflict with GBSO.

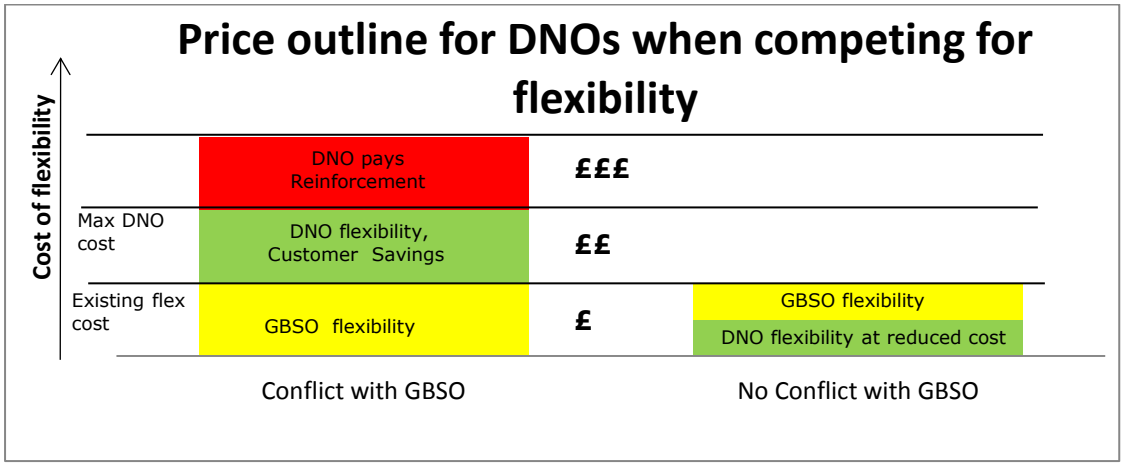


Figure 8: Price signals for flexibility for DNOs

Flexibility can only be procured once from a single flexibility provider for a given instance. Therefore, an important aspect of the project is to look for synergies between ancillary services for GBSO and local flexibility services that will be developed for the DNO, so the same flexibility can be used for multiple purposes. The n-1 compliancy support that will be demonstrated in East Fife.

3.5 Benefits from FUSION

3.5.1 Benefits

The main benefit of establishing a localised flexibility market will be avoided or deferred network reinforcement against the background of growing electricity demand. Given that the future demand increases driven by load growth and projected uptake of LCTs in heat and transport sectors is expected to occur across the SP Distribution licence area, the benefits for the DNO of locally procured flexible services can be replicated throughout the DNO area and beyond.

Analysis carried out for the specific case study within the trial area, identifies that contracting with flexible providers can defer network reinforcement beyond the point in time when demand starts to exceed conventional equipment rating. The deferral period that can be economically achieved using local flexible resources will be a function of the demand growth rate (lower growth rates will allow for longer deferrals and vice versa). The assessment of DNO area benefits presented in this section uses a conservative assumption of 7 years as the achievable deferral period through the deployment of

flexibility, beyond which the cost of paying for availability and utilisation of flexible providers is assumed to exceed the benefits of postponed reinforcement.

The business case studies demonstrate in excess of **£236m net financial benefits for GB electricity customers by 2050**. The significant carbon savings in the form of losses reduction and renewable energy replacement are forecast at over 3.6m tCO_2 by 2050.

3.5.2 Industrial customer benefits

The flexibility market trial for FUSION will be open to Industrial and Commercial (I&C) connected customers, who will have the option to provide flexibility directly into the market, or indirectly as part of an aggregator's portfolio.

In the FUSION trial environment, participating I&C customers can earn a benefit in the form of a commercial return on the flexibility sold in the market. Post-trial, they can continue to earn this commercial return, as well as the anticipated benefits of a lower cost (ultimately in the form of lower DUoS charges) and more reliable distribution service. In addition, effective deployment of flexibility by DNOs facilitates a managed approach to network connections, which can accelerate the delivery of new network connections and help avoid connection delays that may have a commercial impact for I&C customers. Moreover, I&C customers will also be able to de-risk the potential costs for new or enhanced connections, as flexibility effectively provides them (as it does the DNO) the option to wait until there is certainty that the investment is required.

Non-participating customers will forego the potential commercial return to be realised in the flexibility market, but will ultimately still benefit from a cheaper and more reliable distribution service, as well as accelerated connection times, without any detrimental side-effects to the standard of service they currently enjoy.

Section 4: Benefits, timeliness, and partners

4.1 Accelerating the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing Customers

FUSION proposal is consistent with the national carbon reduction targets within the Carbon Plan and aims to facilitate a low carbon distribution network by making better use of existing assets in an innovative commercial environment. The modelled carbon savings of 3.6m tCO_2 are achieved from both accelerating network access for low carbon technology and deferring/avoiding conventional reinforcements.

As detailed below, FUSION will deliver genuine potential to achieve net financial benefits:

- ✓ The feasibility study shows the net benefits of £1.2m for the trial itself;
- ✓ Useful learning and guidance to roll out at the GB level to unlock the £236m benefits for future customers.

4.1.1 Environmental benefits

FUSION will contribute to an overall enhancement of flexibility at a local and national system level. As demonstrated in the recent CCC study[19], a large-scale rollout of flexible solutions such as DSR and energy storage could significantly reduce the integration cost of variable renewables, by creating a more competitive market and increasing the numbers of market participants and have the ability to provide flexible services. This reduction in integration cost results from the impact of flexibility on reducing backup capacity cost, operating cost (including reserve and frequency regulation) and network reinforcement cost. As a consequence, the cost-efficient low-carbon portfolio in the presence of flexibility will feature high volumes of wind and PV. At low levels of flexibility (broadly consistent with the current situation) the key technologies to deliver decarbonisation would be nuclear and CCS given the high integration cost of variable renewables; the cost of this approach, however, would be high. With enhanced use of flexibility, however, renewable technologies become the preferred option, with more than 90 GW being deployed to achieve the 100 or 50 g/kWh carbon intensity targets, and overall system cost significantly reduced.

Further benefits for the low-carbon sector may arise from the adoption of solutions trialled in the project due to the fact that utilisation of local flexibility resources may release distribution and transmission network capacity in places where the network operates close to its limits, and hence allow for the *connection of additional renewable generation* such as wind and PV. This would in turn increase the portfolio of renewable projects able to deploy and allow for national objectives associated with decarbonisation and renewable energy to be achieved earlier or at a lower cost.

On the demand side, deployment of large numbers of electric vehicles and heat pumps as the result of the electrification and *decarbonisation of heat and transport sectors* will cause a significant increase in peak demand, potentially requiring additional investments

[19] Imperial College London, *Value of Flexibility in a Decarbonised Grid and System Externalities of Low-Carbon Generation Technologies*, a study for the CCC, October 2015.

to reinforce the distribution network and consequently increasing the cost of accommodating low-carbon technologies in heat and transport sectors. With additional flexibility released through the deployment of FUSION-type solutions, the need to reinforce the network to cope with demand increase will be more economically managed, supporting the cost-efficient development of low-carbon heat and transport sectors.

As part of the FSP development, where the Cost-Benefit Analysis (CBA) was carried out by using an accepted NIC CBA template, a number of sensitivity studies were run in additional and independently including using Imperial's whole-electricity system model (WeSIM) with the primary objective of establishing the economic benefits of flexibility, but at the same time also providing its benefits in terms of reduced system carbon emissions.

Table 2: Accumulative carbon benefits table ($mtCO_2$)

	2030	2040	2050
Licensee	0.02	0.1	0.3
GB	0.2	1.4	3.6

4.1.2 Potential to deliver net financial benefits

The avoided/deferred cost for the DNO can be represented in the form of the better utilisation of existing capacity, and avoided societal costs associated with providing additional capacity by alternative means. As such, the FUSION solution is considered to be viable from the point of view of potential long term financial benefits.

Table 3: DNO Oriented Financial Benefits for local Flexibility (NPV, £million)

	2030	2040	2050
Licensee	1	7	19
GB	10	81	236

The avoided societal cost for the DNO resulting from the expected release of 16MW of capacity in the same size as the trial (i.e. the post trial case) has been calculated using a typical value of £5.7m per reinforcement for distribution reinforcements.

Additionally, the release of 16MW of capacity corresponds to a maximum of 384MWh of additional energy that can be exported from renewable generation every day.

4.2 Value for money to electricity distribution customers

FUSION has been designed to be delivered in an economically efficient manner and to maximise the potential benefits, without inflicting unnecessary costs on SP Distribution or GB electricity customers. FUSION is economic in that:

- **FUSION is leveraging the efforts and learning** from past/existing innovation projects
    - project partners have already undertaken a preliminary assessment of the feasibility of implementing USEF in the GB market (see appendix M), in addition USEF market principles have already been established and applied within a trial environment in the Netherlands (see appendix H).
- **FUSION goes beyond other innovation projects** looking at accessing flexibility, which we note are underway in various places across GB. FUSION goes much further

to trial an open, inclusive and competitive flexibility market and create a blueprint for its application across GB (see appendix H).

[redacted]

- it is striking the balance of risk and potential returns of innovation so that the scale of trial is appropriate and the funding requested is proportionate;
- The successful trial of FUSION will unlock potential benefits of £236m for existing and future customers

In addition, it should be stressed that FUSION will not pay for any enabling equipment at a customer premises and this will be a commercial decision for the relevant entity contracting or seeking to provide flexibility services, however for the purposes for delivering the trail provisions have been made within the project budget to interface with the USEF platform and protocols.

4.2.1 Potential direct impact on the network

The project solution provides direct impact on the network as outlined in the following:

Impact on East Fife network:

- The release of capacity in the East Fife network is expected to **maximise the existing network capacity** and accommodate unplanned demand/generation increment

The commercial mechanism designed will investigate the connection of distributed generation and new demand in a shorter timescale.

4.2.2 Justification of the scale of the project

Following key criteria were considered when decisions were made for the scale of the project:

[redacted]

Learning Objectives

The key learning objective of this project is to demonstrate how to establish and sustain a local flexibility market within the existing regulatory framework as an alternative solution for the future reinforcement. In particular, this application would be more viable when there are uncertainties on future development.

Balance between Innovation and Risks

The trial of any unproven technology is associated with a various technical and commercial risks. We will demonstrate the FUSION solution in a real-life system and not in a laboratory environment. In addition to regular stakeholder engagement and

dissemination processes, the project has planned a full public consultation process at an early stage, to ensure effective design and delivery of the local flexibility market trial.

4.2.3 Provide the most economical solution

Through robust governance process FUSION will ensure that the project cost represents the best value for the customer by considering the following elements:

- **Optimal design of the market –**The design and operation of the USEF-based flexibility market will be informed by valuable insight and intellectual capital from project partners across the energy sector. By drawing on a broad range of expertise and perspectives, FUSION ensures optimal market design for all market actors.

- **Robust procurement process -** SP Distribution uses an established procurement process to ensure that the best value for money is achieved for the equipment and engineering services required in FUSION. In addition to the work undertaken in FSP development phase, SP Distribution will continue to carry out extensive market research and due diligence to identify capable suppliers and project partners. These activities will form the foundation in the first year of the project during Work Package 1 (Detailed design). Any associated equipment and services will be purchased through a competitive tendering process to realise best value for money.

4.2.4 The proportion of benefits that accrue to the electricity network

The principal benefits that arise from a local flexibility market accrue to SP Distribution and will ultimately flow through to consumers. These benefits are the network capacity release and the capital costs associated with deferred/avoided conventional reinforcement. Low carbon generation technology is likely to be accommodated as a result of this proposed project, but will be charged for connection in line with conventional reinforcement costs.

4.2.5 Project costs summary

FUSION has undertaken a thorough budgeting process to develop the most cost-effective and best value costings to efficiently undertake the project. During FSP development, comprehensive budgets have been developed through a rigorous and challenging process. Accordingly, internal and partner budgets have been presented, qualified and justified. A summary of cost breakdowns can be found in Table 4.

The project costs have reduced from £7.74m to £5.97m. This is reflective of the increased emphasis on the USEF development and trial for GB, and the delivery of core outcomes at the best value to GB consumers. As outlined in section 2.4, specific cost reductions come from:

IT development: [redacted] Further savings from harnessing internal resources has been agreed.

Academic modelling: Modelling scope has been reduced with reference to dialogue with Northern Power Grid's (NPG) Customer Led Distribution System, which incorporates significant academic work around flexibility management. Through discussion with NPG, project management has agreed that academic learning generated will focus coordinated flexibility frameworks.

Table 4: Summary of FUSION delivery budget

[redacted]

[redacted]

Labour costs reflect the significant intellectual and management capital required to effectively develop the neutral market, and provide the framework development needed to both undertake assessments and trials in East Fife, and to prepare well-developed GB roll-out implementation plans.

Work package cost breakdowns reflect the requirement to develop processes and flexibility management tools in order to interface with exitsing DNO distribution management systems for localised flexibility arrangements. In addition the project will require GIS analytical support to further develop network connectivity with future flexibility providers. The project will also consider requirements for flexibility providers to interface with the USEF platform and open protocols. This will enable the ability to undertake a practical live demonstration but also inform the industry standards for future neutral market facilitators, hence why funding is sought as part of FUSION for this activity.

A small amount of capital of expenditure has been allocated again to undertake these trails and will form the bases of payments to users.

The project will also undertake a significant degree of stakeholder engagement throughout its duration, therefore appropriate budget has been allocated to undertake this activity.

4.3 FUSION is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness.

FUSION is innovative in that it will seek to implement a neutral market facilitator for localised distribution network flexibility, a feature currently non-existent. This is not without commercial risk, since SP Distribution will have to rely on 3rd parties (aggregators) to deliver a reliable service (flexibility), that must be more cost-effective than the traditional solution (reinforcement), but sufficiently attractive as a commercial proposition (to aggregators).

In addition, for a DNO to procure and deploy flexibility requires several policy and process changes, as well as automated tools that complement and interface with existing distribution management systems.

FUSION introduces the application of the **innovative USEF framework** within a GB energy system context, and will seek to inform policy and process development in respect to standardised protocols and specifications across GB,complementary to existing flexibility arrangements.

4.4 Response to (e) Involvement of other partners and external funding

4.4.1 FUSION third party call

In response to Ofgem feedback, SP Distribution's NIC submissions 2017 have been informed by third party proposals. 35 submissions from third parties were received by SP Distribution in early 2017. Proposals relating to demand-side response were reviewed

alongside SSEN and WPD, and upon completion of this exercise, the concept for FUSION was taken forwards based on a hybrid of several project proposals. Criteria for deciding on which proposals to progress with were:Concept quality; Relevance to SP Distribution business needs; Relevance to SP Distribution Innovation Strategy; Potential for implementation to business as usual for all DNOs; Low project risks; Value for money for consumers.

On the basis of these criteria, FUSION was taken forward and further developed by SP Distribution. Well-established, rigorous internal procedures including data assurance and governance were followed prior to ISP submission and subsequent approval.

4.4.2 FUSION project partner consortium

FUSION is a **customer-centred project**, and will inform industry decisions on the use of distribution network flexibility. To make well-informed project decisions, a wide ranging and **well-rounded consortium of project partners** both local to the trial area and partners working across the GB energy market has been assembled to form a detailed project.

Partners include aggregators within the consortium; these partners provide the commercial guidance and knowledge required throughout to develop a tangible, realisable, and enduring flexibility market solution suitable for commercial enterprises to participate in and readily integrate with existing structures. FUSION project partners are:

Partner	Info	Role	Support & Funding
DNV GL Ltd	Founding partner in the USEF Foundation	Due diligence and consultation on the implementation of USEF in GB, design the flexibility market structure, designing market and flexibility tendering processes, monitor and validate the flexibility chain, draw technical requirements for flex products and support on business case validation.	Contribute to FUSION on a project contractor basis
Imperial College London	Academic partner. Member of HubNet Consortium	academic modelling, independent benefits analysis and reporting; knowledge dissemination activities	Contribute to FUSION by leveraging Hub Net expertise/resources
Origami Energy Ltd	I&C aggregator	Flexibility market assessments for I&C customers; Consult on aggregator USEF adoption	Contribute to FUSION on a project consultancy basis.
Passiv Systems Ltd	SME R&D organisation specialising in domestic DSR	Flexibility market assessments for domestic customers; Consult on aggregator USEF adoption	Contribute to FUSION on a project consultancy basis
SAC Consulting Ltd	Commercial department of Scotland's Rural Agricultural College (SRUC)	Provide analysis of flexibility across the agricultural enterprise and producer sectors; and aid in the assessment and quantification of flexibility	Contribute to FUSION on a project consultancy basis
University of St Andrews	Prospective prosumer; aspirations to become a large-scale adopter of LCTs.	Flexibility provider; facilitate flexibility assessments on their estate; partake in live trial.	A registered charity; No associated budget
Fife Council	Local Authority with ambitious LCT plans.	Provide access to relevant stakeholders; Estate may engage in live trial.	Local Authority; No associated budget
Bright Green Hydrogen Ltd	Hydrogen microgrid developer; prosumer with generation obligations.	Flexibility provider; facilitate flexibility assessments on their estate; may partake in live trial.	Not-for-profit, funded through Scottish Enterprise; No associated budget

Table 5: FUSION project partners

Further details on project partners can be found in appendix J.

4.4.3 Wider industry collaboration

There has been extensive dialogue with other DNOs, TOs and GBSO, both to develop FUSION in a considered and efficient manner, and to prepare engagement in a stakeholder engagement forum.

Under NIC 2017, SSEN are taking forward project TRANSITION, and WPD are taking forward the Electricity Flexibility and Forecasting System (EFFS) project. SP Distribution see the clear value and benefit in collaboration, and have actively requested formal partnerships with projects TRANSITION and EFFS. This would have made a significant industry commitment to working in partnerships in the best interests of energy consumers, whilst maintaining a pluralistic approach to innovative DSO solutions. SP Distribution have proposed collaboration plans, developed governance structures, and have re-examined budgets accordingly.

SSEN and WPD have preferred to abstain from formalising commitments prior to NIC 2017 projects being awarded funding, after which collaboration can be formalised. Arrangements will be reported on within the first six months of project commencement. Notwithstanding, SP Distribution have led engagement to define where activities can be coordinated, and have accordingly reduced the project budget. Coordinated activities are expected to include: Stakeholder forum management; Public consultation activities; Development of DSO foundation specifications; Model design authority and trial validation; Knowledge dissemination

System Operator

FUSION has positive and constructive dialogue and engagement with GBSO, who are supportive of FUSION, and regard the changing nature of DNOs to produce ongoing opportunities for positive change. Through the due diligence process in work package 3, the GBSO and all DNOs will feed in to the development of flexibility products that are compatible and acceptable across user groups. This will work to limit any flexibility conflicts, as well as to avoid opportunity costs and inefficiencies from unnecessary duplication of work, and facilitate the potential for (revenue) stacking of flexibility services. FUSION will **demonstrate flexibility conflict management**, showing how the GBSO, DNOs, and aggregators will interact under a USEF-based flexibility market.

Within the trial, FUSION will seek opportunities to offer the N-1 compliance product not only to the DSO (SP Energy Networks), but also to GBSO by actively participating in tenders for Short-term Operating Reserve (STOR) during the trial period. FUSION will also actively share data and information regarding flexibility deployment with GBSO, to further inform compatibility of flexibility services, as well as to enable GBSO to anticipate and manage any impacts of flex deployment on the transmission network.

The GBSO have agreed that Ian Pashley, Markets and Balancing Development Manager, and Cian McLeavey-Reville, Innovation Strategy Manager, will sit on the project steering board and stakeholder forum respectively. These mechanisms will facilitate dialogue between the GBSO and FUSION, allowing measurable and meaningful input to the project development.

ENA Open Networks

SP Energy Networks is central to the ENA Open Networks project, and sits on the board of each of the four workstreams. FUSION will work with the ENA to engage industry, to highlight learning, and to respond proactively to learning developed though the ENA. FUSION will accelerate learning on DSO models, and has engaged the ENA and associated consultants through the Full Submission development, and has received

positive support for the project. In addition, DNV GL has responded to the recent ENA consultation to provide a USEF perspective on the proposed commercial models.

Other industry collaboration activities

Furthermore, the Association of Decentralised Energy (ADE), representing GB aggregators, has also expressed its support for Project FUSION as well as their willingness to participate in the stakeholder forum.

4.5 Response to (f) Relevance and timing

In July 2017, Ofgem published its Smart Systems and Flexibility Plan: Upgrading Our Energy System[20]. The paper highlights that:

> "...*the regulated monopolies will need to plan ahead, engage with new businesses, and explore fully the use of markets to solve issues.*" (p.17)

> "...*there appear to be a lack of established markets in local flexibility services to manage local network constraints.*" (p. 18)

> *"There is also the case for further trials in this area to inform the development of policy and regulation across a number of areas. For example, there is currently no market for local flexibility trading. A local flexibility market could deliver whole system benefits."* (p.19)

Moreover, Ofgem has formulated an action around the efficient management of the energy system on a holistic basis, commissioning a report by the ENA to inform:

> *"opening up the delivery of network requirements to the market so new solutions such as storage or demand-side response can compete directly with more traditional network solutions, including as an alternative to reinforcement."* (p.29)

These considerations are all key objectives explored and developed through FUSION, demonstrating the topical alignment with GB policy direction and ability to address a clearly identified need.

Also in July 2017, Ofgem published it working paper on Future Arrangements for the Electricity System Operator[21]. The paper made specific reference to the SO engaging with competitive market-based procurement for services; FUSION develops product descriptions to enable and facilitate a common specification and dialogue for market-based interactions including the SO and the DNO.

In 2015, SP Distribution took forward the proposal to implement a local balancing market through the development of project Evolution. Whilst the project was unsuccessful in gaining NIC funding, there has, subsequently, been a significant shift in the direction of GB network operators to explore the opportunities for transitioning to Distribution System Operators. As part of our FSP development, we have referred to several projects that are in progress and exploring forms of distribution system

[20] Ofgem, *Upgrading Our Energy System: Smart Systems and Flexibility Plan*, 2017, available at: https://www.ofgem.gov.uk/publications-and-updates/upgrading-our-energy-system-smart-systems-and-flexibility-plan
[21] Ofgem, *Future Arrangements for the Electricity System Operator: Working Paper on the Future Regulatory Framework,* 2017, available at: https://www.ofgem.gov.uk/publications-and-updates/future-arrangements-electricity-system-operator-its-role-and-structure

operation. FUSION complements those projects and provides the opportunity for further learning to be developed.

The ENA, through its cross networks, Open Innovation programme provides a clear signal of intent that the GB energy market is going through a significant change and the development of Distribution System Operators will be critical to the continued ongoing operation of the GB energy system.

Local flexibility markets need to be established for distribution networks to accommodate the growth of distributed generation and adoption of low carbon technologies in a timely and economic manner. The current operation of the GB balancing market prioritises the needs of the national transmission system, limiting market development at distribution voltages. WPDs June 2017 consultation on their DSO Transition Strategy[22] highlights the importance of distribution connected assets contributing to DNO flexibility. FUSION develops on this approach, and designs and implements a market-based solution to DNO flexibility.

GB's historic reliance on large thermal power generation is in decline and local distribution market participants now hold the key to our future energy requirements. National Grid, as GB System Operator, also recognise that the current model for balancing services should be subject to fundamental review in its June 2017 consultation: System Needs and Product Strategy[23].

A key component of that consultation is the development of new balancing service products and recognition that most future services will be provided by participants connected to the distribution networks. However, the needs of the local distribution networks should also be addressed and system or market should not be created where local service providers are excluded from serving the needs of their local distribution network due to being exclusively contracted to provide national balancing services. FUSION will provide learning that ensures future DSOs can both manage local distribution networks and complement and further enhance the services available to National Grid in their role of System Operator of the national transmission system.

[22] Western Power Distribution, *DSO Transition Strategy*, 2017, available at: https://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Strategic-network-investment/DSO-Strategy/DSO-Transition-Strategy.aspx
[23] National Grid, *System Needs and Product Strategy*, 2017, available at: http://www2.nationalgrid.com/UK/Services/Balancing-services/Future-of-balancing-services/

Section 5: Knowledge dissemination

5.1. Learning generated

FUSION will demonstrate **the feasibility of commoditised flexibility in** addressing geographically local distribution network congestion issues and will generate learning as to how this flexibility can be operated and shared throughout the wider GB energy market. It will also inform on the **prioritisation of access to flexibility** and how this will be managed between network operators and other market participants on the rare occasions annually when both national and local constraint issues arise simultaneously.

The project will generate learning opportunities for SPD, the wider distributed network operator community, transmission network operators, National Grid in their role as GBSO, aggregators, renewable energy developers, national and international energy market stakeholders, academia, local authorities and other industry stakeholders such as the Energy Networks Association, Energy Retail Association, Department of Business, Enterprise and Regulatory Reform and Ofgem. To ensure that learning is captured and effectively disseminated throughout the project, reporting to the Project Manager, this function will form a key the role for a member of the project delivery team.

The project will generate the following learning through delivery of the various work packages;

- At a local geographical level, FUSION will provide an understanding of the **volume and willingness of customers** to operate within a local flexibility market through a form of neutral flexibility market facilitator USEF
- Provide learning on the viability of local electricity flexibility and its ability to mitigate or defer network reinforcement to ensure continued safe, secure and affordable electricity distribution
- Inform on the **commercial framework, technical solutions and support activities required** to implement, recruit, deploy and maintain a constructive relationship with local flexibility providers and define responsibilities, business processes and organisational changes as required
- Provide learning on the effectiveness of the commercial framework implemented through release of flexibility through a neutral market facilitator and how this flexibility can be shared between different market actors operating within the GB energy market
- Define the types of services and products that will be sought and offered through a local flexibility market and how future markets can be designed such that it can benefit all industry participants and be attractive to both new and existing flexibility providers

5.2. Learning dissemination

FUSION will focus on both internal and external learning and knowledge sharing activities from its inception through to conclusion. A key element of the project is ensuring that its progress and outputs feeds directly into and complements the activity being taken forward by industry as part of the ENA's Open Networks work programme.

The Open Networks programme has four distinct work streams and FUSION will focus on delivery learning associated with T-D Process and sharing of flexibility through a neutral market facilitator and DNO to DSO transition of which FUSION will focus on the requirement for the development of a locally geographical flexibility service that can be shared and/or complement as well as support the wider balancing services market.

A high level overview of the ENA's Open Networks project structure is provided below with information on how FUSION will complement this activity shown.

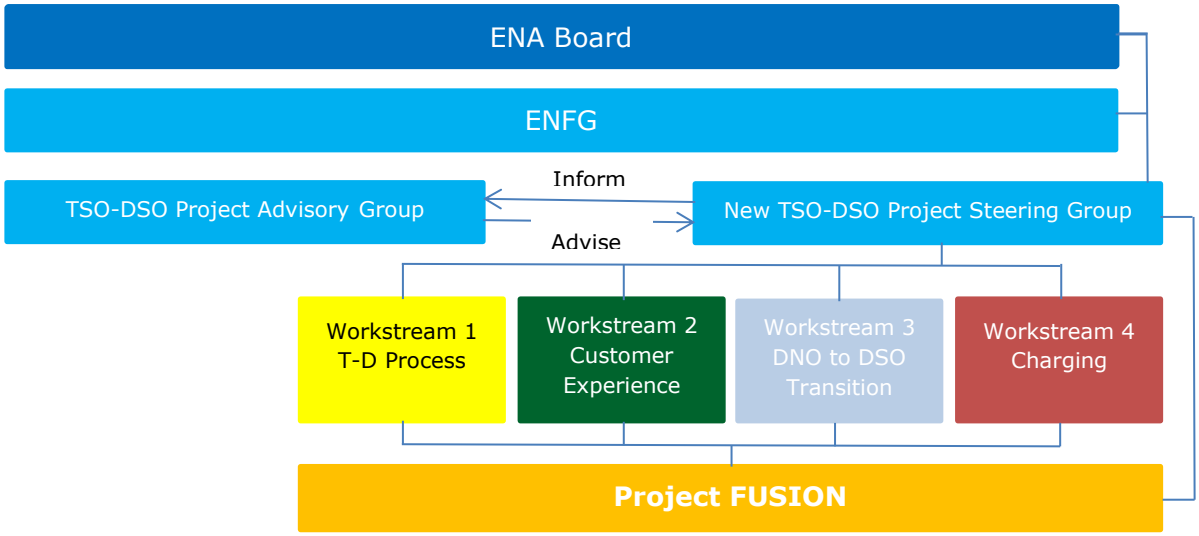


Figure 9: Project Coordination at National Level

In developing FUSION, we have worked closely with DNO colleagues from WPD and SSEN/ENW who are leading in taking forward Project EFFS and Transition respectively. FUSION have actively sought formal collaboration through partnership with these projects, and have proposed joint activities, cost sharing, and governance structures. This is in order to best realise the DSO transition whilst ensuring customer value and a pulralistic approach to innovation projects.

WPD and SSEN have proposed to abstain from formal collaboration prior to the NIC approval stage. SP Distribution, WPD and SSEN have confirmed that a formal collaboration structure will be reported to Ofgem within six months of project commencement. FUSION maintain that collaboration of specific activities will be beneficial to all projects, including: stakeholder forum management, public consultation activities, development of DSO foundation specifications, model design authority and trial validation, and knowledge dissemination.

5.2.1 Key Stakeholders

As part of the project development we have identified the following key stakeholders as being:

Energy Industry Market participants – Distribution and Transmission Network Operators, Energy Suppliers, Aggregators, GB System Operator, Generators and the emerging Prosumers of energy and ultimate providers of future energy flexibility across the UK. All of these energy industry participants will wish to form a greater understanding of FUSION and how the learning from the delivery of the project can be implemented on a wider GB scale, as outlined in Figure 10.

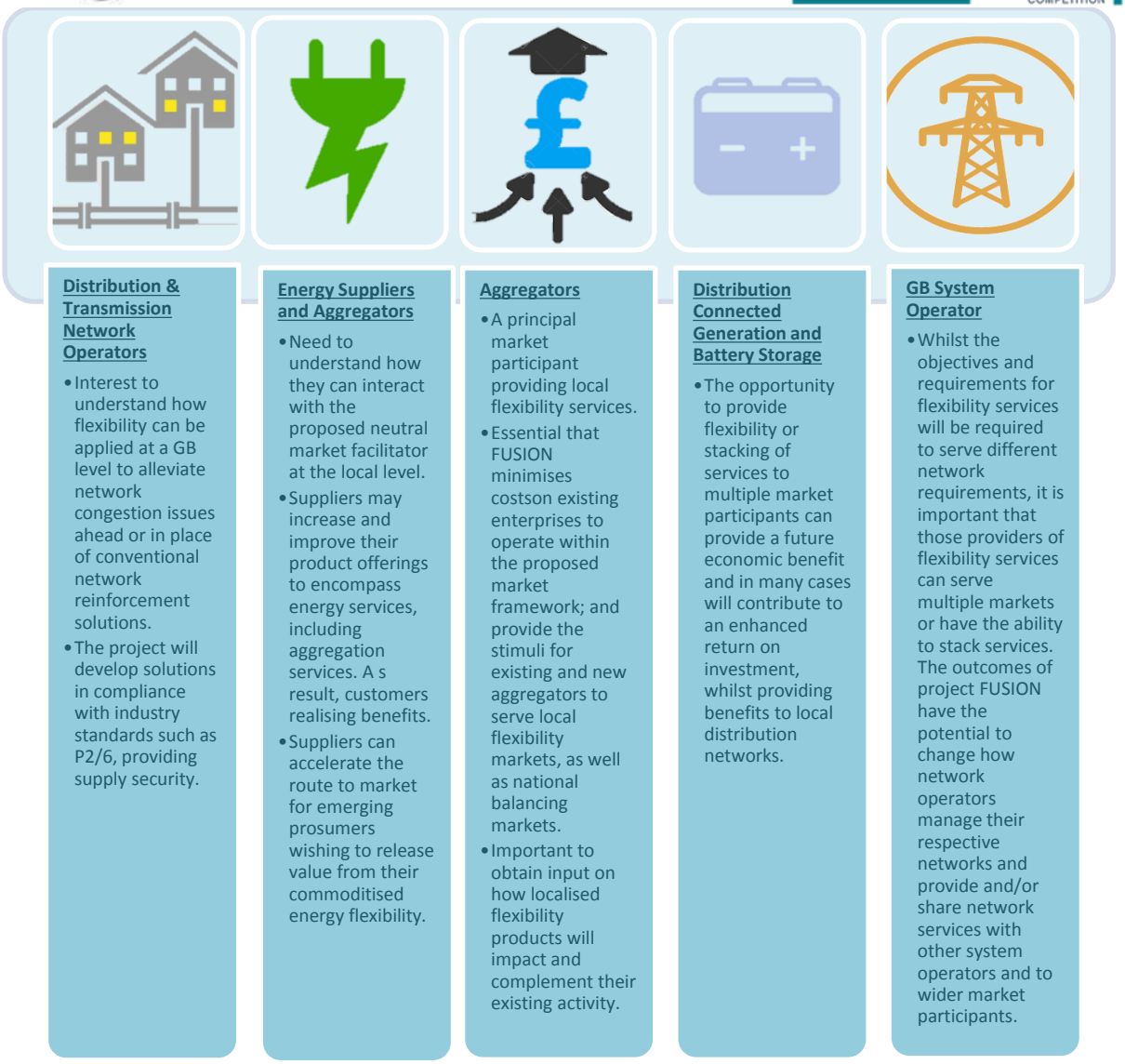


Figure 10: Key learning from FUSION, by stakeholder group.

As well as those stakeholders referenced above, FUSION will be of interest to a wider audience. As part of our project stakeholder engagement plan we aim to interact with a variety of interested stakeholders through various national and local workshops and forums. This will ensure that feedback on the development, aims, objectives and execution of the project receive the widest possible appraisal.

Such stakeholders will include National Government organisations, Scottish Government, local authorities, industry trade associations as well as individual customer groups and potential providers of flexibility services.

The aim of our dissemination and knowledge sharing activity will be to ensure market participants understand FUSION outcomes and any impact/opportunities for their respective organisations and which should form the foundation for future DNO/DSO and GB network design, operating models and industry regulation.

5.2.2 Method of dissemination and approach

Learning and knowledge dissemination derived from the project will be tailored to suit the interests, objectives and relevance of each stakeholder group identified. Our approach to learning and knowledge dissemination will draw upon experience and activity undertaken as part of our Accelerating Renewable Connections (ARC) project which was pragmatic, simple, regular and targeted and made use of a variety of mediums to engage and impart knowledge to a range of stakeholders.

Leaning and dissemination activity will also be two-way in that stakeholders will be continually informed and feedback sought on the direction and deliverables of the project. A continued review and feedback mechanism will allow FUSION to develop a local flexibility market for all interested market participants and ensure that FUSION is responsive to the environment that it is being taken forward within.

All of our dissemination activity will be managed through our Stakeholder and Knowledge Dissemination work packages respectively. The key role of those work packages is to ensure that the most appropriate information is provided to the most relevant stakeholder group that will be delivered through a range of communication channels detailed below. We envisage that the majority of the learning that will be derived from the project will be available towards the backend of the project timeframe. We will however disseminate learning as soon as appropriate analysis and/or trials have taken place and the learning generated has rigorously assessed.

We will use a range of mediums to engage with industry stakeholders, a summary of which are detailed below:

- Six Monthly Progress Reports: These reports will be submitted directly to Ofgem and will provide valuable information on the progress that the project has made in respect of each work package and delivery of SDRCs. Submitted Six Monthly Progress Reports will also be made available on the SP Distribution website as part of our innovation section.

- Participation at Industry Working Groups: Our main industry working group will be the ENA's Open Networks forum whereby we will provide regular updates on the FUSION project as well as seek feedback on key decision points and coordinate dissemination activity with SSEN/ENW and WPD respective projects where appropriate.

- Multimedia, Podcasts, Social Media: SP Distribution has developed a range of external media content that is available to customers to inform on a range of activity and initiatives. We shall build upon this activity as part of the dissemination and knowledge sharing mediums for FUSION. Where it aligns with internal business policy, we shall make use of appropriate social media platforms as a way of informing community groups and updating all interested stakeholders on the latest events and progress being made as the project develops.

- Internal Project Briefings & Updates: A key stakeholder in the execution of FUSION is our own internal staff and business departments. A range of communication mediums will be utilised such as internal briefings, updates on internal intranet, annual innovation learning events, Director road shows as well as our wider group magazines and internal communication channels.

- Conferences & Targeted Dissemination Workshops (National and Trial Area Specific): As part of our Stakeholder Engagement work package we will hold

regular workshops and stakeholder events. These events will take a variety of forms, some will be targeted at specific stakeholder groups or on specific topics whilst others will be held to dissemination knowledge and obtain feedback from a more market wide audience and stakeholder groups. This work package is critical to the success of the project and to ensure that all stakeholder views are considered when taking forward FUSION. The project team and wider partners will also engage and participate in a number of industry conferences and the LCN Fund annual conference during the life of the project.

- Press Releases: During the course of the project we will release a number of articles throughout the project highlighting FUSION, key events and outcomes. This will again be targeted at specific audiences and where appropriate will also publish articles in relevant publications relating to our project partner organisations.

- Closedown Report: A final Closedown report will be produced and submitted to Ofgem following completion of the project. This report will be drafted and shared with all interested stakeholder groups. The report will present the key findings as well as lessons learnt in undertaking FUSION.

5.3. IPR

FUSION develops a flexibility market based on the USEF framework.

USEF is a framework for a flexibility market, and is separate from a software based flexibility procurement platform. The USEF foundation has developed a reference implementation (RI), through which the concept and mechanism of the USEF framework can be tested and verified in field trials. The USEF RI is open-source and is available on GitHub under the Apache 2.0 licence; USEF does not impose/require any intellectual property rights. The flexibility procurement platform will be tendered for during the project, where every tendering party has the opportunity to base its solution on the open source RI. [redacted] Further, intellectual property developed through the course of the project will comply with all NIC governance IPR requirements.

FUSION will explore the options for a long-term market facilitator role to apply, manage and validate the USEF-based flexibility market post-FUSION trial. This is an industry wide subject; FUSION will be the basis of a USEF trial, with learning contributing to the industry consideration of the long-term use of USEF. This exploration will be a central element of the public consultation in work package 3, and will form the basis of stakeholder engagement events, and will be reported on in closedown reporting.

Section 6: Project Readiness

6.1 Evidence of why FUSION can start in a timely manner

A number of activities have been undertaken / initiated and/or completed during the preparation of the Full Submission designed to ensure that the project is able to commence in January 2018.

- Project governance and management arrangements as well as how the project will coordinate with wider industry working groups such as the Open Networks Project Work Stream 3, have already been identified and agreed, details of which are provided in Section 6.4.
- Detailed analysis of the project objectives and requirements has been undertaken by both SP Distribution in conjunction with each project partner resulting in the development of a well-defined scope and description for each of the six work packages that will form the basis of the deliverables of FUSION.
- A detailed project plan outlining activities, milestones and dependencies has been produced (appendix E). This plan will be continually reviewed and refined during the course of the submission evaluation period to ensure that it is accurate for project delivery commencing in January 2018.
- A detailed Risk Mitigation plan has been developed to identify issues that could potentially delay the commencement of the project or the ability to deliver key objectives and outputs during the project timeline (appendix F). The main activity that will require action to mitigate any potential to delay the commencement of the project following successful funding award, will be drafting of project partner collaboration contracts. Work on this activity will be addressed during the project submission evaluation period.
- A project organisational chart has been developed (appendix I) which details the governance and management arrangements that will be deployed throughout the duration of the project. Through the submission evaluation period key personnel from SP Distribution and its associated project partners will transition from the bid team to the enduring project team to ensure consistency and continuity. The enduring project team will be in place to commence the project at the beginning of January 2018.

FUSION is well prepared to ensure that it can start in a timely manner and that the chance of success is maximised. The project is divided into two major parts: A public consultation on the implementation of a flexibility market involving DNOs based on USEF; and a physical trial of this market involving aggregators in East Fife [redacted]

The public consultation is based on USEF. During the preparation of FUSION an assessment was made concerning the application of USEF to the GB market. No major issues were found during this assessment, paving the way for the public consultation (see appendix M).

The physical trial in East Fife will benefit from the already developed flexibility procurement platform architecture, which will ensure smooth operational communication between the DNO, SP Distribution, and participating aggregators (see appendix N).

Furthermore, an assessment has been undertaken of the potential flexibility provision in the trial area, categorised by demand and customer type (see appendix K). On the basis of this assessment, the project has a high degree of certainty that there will be sufficient liquidity to sustain a localised structured flexibility market. At the start of the trial, a

'tender' will be launched, inviting existing aggregators to participate (possibly using the flexibility of the local participating stakeholders). A budget is reserved for making their processes USEF compliant. The DNO flexibility products in FUSION will be designed in such a way that they can be 'stacked' on existing flexibility products from the TSO as well as fit the market as much as possible. This will ensure a low entry barrier for aggregators, several of whom have already shown interest.

6.2 Executive and Senior Management commitment to FUSION

FUSION has been developed in conjunction with SP Distribution Executive and Senior Management Teams. In addition, we have presented during the development of the Final Submission, to the Senior Management Teams of our identified project partners to ensure commitment to the objectives, deliverables and realising the benefits of the project. Senior Management commitment, review and challenge of assumptions identified in the Final Submission, has been achieved through regular dialogue, presentation and demonstration of coordination of the project objectives with wider industry and SPD business activity.

Support from in-house specialists has been achieved through regular project meetings with Senior Management and Heads of Departments. Development of the Final Submission has drawn on expertise from a number of areas including IT Systems, Data Management, Settlement and Billing, Regulation and Commercial and our District Network Design and Delivery teams who are responsible for the network within the identified trial area of East Fife. The guidance and input achieved from this range of internal expertise complemented by the expertise of our external partner organisations has enabled a robust project submission and plan to be prepared.

6.3 How the costs and benefits have been estimated

To develop and ensure a robust cost estimate, for each individual work package we have taken a bottom-up approach assessing each project work stream and deliverable on an individual basis. The project cost estimate has been based upon the following information:

- Inputs from internal SPD and wider project partners on labour requirements over the duration of the project, including provision of labour support for procurement, legal, analysts, IT support and dissemination activities. For SPD project management costs are included within the overall labour cost estimated identified to undertake and complete FUSION.
- Quotations have been received from project partners and we have drawn upon knowledge of existing equipment and services suppliers, and where possible utilising existing procurement expertise in specific areas to challenge costs and leverage existing commercial mechanisms with suppliers.
- Inputs from project partners, IT integration experts and wider system and balancing services experts has been sought to establish a robust and realistic cost estimate for IT system integration activity and equipment installation that will be required to undertake and execute the planned trials in work package 4 and 5 respectively.

Benefits have been determined for both the development of the project within the trial area and wider benefits identified for potential rollout across GB. Consideration has been given to the calculation of potential benefits of rolling out a neutral market facilitator such as USEF and development of local balancing services and which are based on:

- Professional engineering judgement and system design of conventional reinforcement solutions
- Verifiable and credible sources of unit costs using analysis already developed by DNV GL and which has been complemented by experience and work undertaken within the UK to date on various network innovation trials by Imperial College.
- Extensive modelling of the East Fife region and development of the four case studies.

In developing the benefits that will be derived from delivering the project, we have taken a conservative approach. More detailed information on the Cost Benefit Analysis (CBA) is provided in appendix D.

6.4 Measures employed to minimise the possibility of cost overruns or shortfalls in Direct Benefits

To support the delivery of a quality and meaningful project that will derive benefits for GB energy customers and contribute to and inform on the wider development of local balancing services across GB, project management will be based on existing and proven methodologies and established governance processes.

To deliver the objectives of FUSION we will require to procurement both services and equipment from external vendors to SP Distribution and respective partners. Where a delivery element of the project can be delivered by a range of vendors and out with the project direction agreed with Ofgem in respect of project partner deliverables, suitable suppliers will be identified through a competitive tender process in line with existing procurement governance arrangements.

Project delivery and governance controls will also be implemented throughout the project, which includes:

- A Project Steering Group, with a membership comprising of representatives from: SP Distribution Executive & Senior Management Team, including the overall project sponsor; customer representatives from industrial and commercial organisations (Chairman of the Fife Chamber of Commerce, Fife Council representative); customer representatives for residential energy consumers (Kingdom Housing Association representative, Kingdom Housing Association tenant, Citizens' Advice Bureau) . This group will be ultimately responsible for the achievement of the deliverables and overall governance of the project. The Steering Group will have the authority to make decisions, challenge and review key assumptions that have an overall impact on the benefits and outputs that the project will deliver. They will assess any requirement for a major change request, review the impact upon the overall business case of key project decisions and identify and review on a regular basis project risks and mitigation actions. The Project Steering Group will meet on a quarterly basis, or as required should key decision points be reached between scheduled meetings.
- The Project Manager will be responsible for providing a monthly project progress report to the Steering Group. This will facilitate a regular review point and allow full financial and project control whilst also ensuring that any issues that could compromise the overall delivery of the project are identified and escalated in a timely manner.
- A Project Board will be established that will be Chaired by the Project Manager, work stream team leaders, project programme co-ordinator and representatives from the various project partners and which will meet on a fortnightly basis. The principle responsibility of the Project Board will be the day to day deliverables of the project

and which will focus upon progress against plan as well as financial and risk management.

- The Project Manager will have overall responsibility for the management of project risks and adoption of mitigation actions and strategy. Regular review of risks will be undertaken and which will be reported to the Project Steering Group and Project Sponsor as part of the monthly reporting process.
- Management and delivery of each individual Work Package will be taken forward in line with milestone plans supported by detailed project plans and a set of clearly defined list of deliverables for each Work Package. These plans have been developed in conjunction with our project partners to ensure a strong foundation for clarity of scope, objectives, approach and deliverables.
- Should any change requests be required during the delivery period of the project, a robust change management procedure will be implemented overseen, coordinated and managed by the Project Steering Group, to ensure that any proposed change requests are fully analysed at an appropriate level of authority relevant to the scale and impact of the proposed change.
- Throughout the duration of the project, quarterly project partner/supplier reviews will take place to track project progress and manage any risks associated with the delivery of the project.

In addition to the internal governance arrangements, throughout the project we will ensure that wider industry stakeholders form a key part of the decision making process and are consulted regularly on the progress and direction of the project. The project team will regularly coordinate and consult on activity with the Open Networks Project to ensure not only that key stakeholders remain informed but also to ensure that the project is taking forward activity that supports the development of local flexibility markets across the UK.

6.5 Accuracy of the information provided and included within the Final Submission Pro-forma

SP Distribution and our project partners have endeavoured to ensure that all of the information relating to FUSION and provided within this Full Submission is accurate.

Information provided has been sourced and gathered from within SP Distribution, project partners as well as obtaining information and support from the wider DNO community. The information obtained has been reviewed and analysed to confirm and refine understanding as well as relate it to the specific subject and case studies identified within the project trial area.

The bid team, which has included 3 full time employees as well as full time support from wider project partners, has worked collaboratively with a number of organisations to prepare and review the bid. Project partners have also ensured information provided by them has been verified and completed their own internal review and approval process before being provided to SP Distribution and incorporated within this Final Submission.

In addition, prior to submission of the bid, SP Distribution has undertaken a full review and approval of the bid document with its own internal Research and Development Approvals Panel.

6.6 FUSION will deliver learning irrespective even if the take up of low carbon technologies and renewable energy within the trial area is lower than anticipated

FUSION will contribute to the development within the UK of establishing a recognised trading framework, policy and standards for the commoditisation of flexibility across local distribution electricity networks that will open and create new markets for a range of energy consumers and stakeholders that is currently unavailable.

The learning outcomes of the project will be delivered without dependence on the speed of up-take of low carbon technologies or distributed generation within the trial location as our case studies show, we have sufficient capability to undertake trials, once available flexibility is established, within the timeframe of the project.

We have a clear and comprehensive plan established for Stakeholder Engagement and Knowledge Dissemination throughout the project and details of lessons learned will be maintained by the Project Manager and wider project partners to support the continual capture and transfer of learning to industry stakeholders. This will not only include the range of flexibility available within a DNO network and how it can be commoditised to manage local network constraints, but also be focused upon installed equipment and technology, control systems, integration with flexibility market participants and providers and development and potential integration within the UK of the USEF concept itself.

[redacted]

6.7 Processes are in place to identify circumstances which could affect successful delivery of the project

As part of the project governance arrangements and work undertaken to establish the methods that will be trialled during the project, there are a number of processes that will be implemented to identify, assess and manage any potential circumstances that could compromise the overall successful delivery of the project. The governance arrangements will assist in the efficient management of the project throughout its duration whilst providing early warning indicators and identification of any issues that may arise.

SP Distribution's existing governance and approval processes will be followed at all times during the project and a risk management and contingency plan will be used to identify, analyse, control and review any potential risks. Relevant risks to the delivery of the project have already been identified with corresponding mitigating actions in place to ensure that success of FUSION. The Project Manager will be responsible for ensuring all risks and issues are effectively managed and where further mitigation action is required these will be escalated to the Project Steering Group. The Project Steering Group will have overall responsibility to determine whether the most appropriate course of action would be to suspend the project or affect an appropriate change request, but in considering this course of action guidance would be sought from Ofgem.

Section 7: Regulatory issues

We consider that FUSION does not require any derogation, licence consent or license exemption. However, the methods deployed and trialled in FUSION will fundamentally change how distribution networks will be operated and regulated in the future, and it will inform that change.

At the heart of FUSION lies the transition of DNOs becoming DSOs, through the procurement of local flexibility in an open market, to manage constraints on the distribution network, with a view of lowering the costs of the distribution business and accelerating customer connections. The deployment of flexibility in the context of FUSION, requiring a contracted temporary load reduction by end-users, effectively makes distribution networks part of the supply-demand equilibrium. This, we consider, aligns closely with Ofgem's (and BEIS') stated objective to make the electricity system more flexible, and to address any potential barriers that may prevent the system to benefit from the full value of flexibility, as the next sections explain.

7.1 Long-term regulatory considerations

We consider that in the near future a revision of the licence framework for electricity distribution will be warranted, to ensure the industry has access to the full potential value that flexibility can offer. We note that Ofgem has previously commented that it is mindful of potential regulatory barriers to the use of flexibility by DNOs. For instance, in its 2015 Position Paper on flexibility, Ofgem acknowledges the need to address potential regulatory barriers, including:[24]

- Future role of DNOs, including relationships with consumers and transition to a DSO role, needs to be clarified to better support the inclusion of flexibility in DNO business plans; and
- Regulation [is] to be kept under review to ensure licence obligations allow for efficient procurement of flexibility.

Elsewhere, the Position Paper (shown in Figure 11) highlights the importance of flexibility providers' access to revenues, highlighting DNOs (and, to a lesser extent, aggregators) as the most underdeveloped route to market for providers of flexibility. It is this issue, and the underlying cultural/regulatory/commercial/structural barriers, that FUSION (and the USEF framework in general) is seeking to address (see 7.2 below).

More recently, in the November 2016 Call for Evidence (CfE), Ofgem and BEIS, formulated their joint policy ambition regarding flexibility as follows:[25]

> *"The policy ambition is for flexibility providers to be able to access revenues which reflect the true value of their flexibility. In the current context, this means maximising access to the existing suite*

[24] Ofgem (2015), *Making the electricity system more flexible and delivering the benefits for consumers*, p36, 30 September 2015.
[25] Ofgem/BEIS (2016), *A smart, flexible energy system - A call for evidence*, p10, November 2016.

of markets (capacity, wholesale, balancing and ancillary services), alongside ***new markets (perhaps at a distribution network level****, or for new services) and being able to stack value across them wherever appropriate. In the future, it could mean* ***new market structures (such as flexibility trading platforms or DSO/SO procurement mechanism)*** *where these better support our aims."* [emphasis added]

Figure 11: Ofgem Position Paper[26]

		Capacity	Generation	Balancing				Networks		All
Users		Government	Generation	Suppliers	SO Frequency response	SO Reserve services	SO System security services	DNOs	TOs	Aggregators
Providers										
Generation	Distributed connected generation	✓	?	✓	✓	✓	✓	?	TO will co-ordinate with SO and make use of SO System Security Services to manage constraints and connections as efficiently as possible	x
	Flexible thermal generation	✓	✓	✓	✓	✓	✓	x		x
	Renewable generation	x	✓	✓	✓	✓	✓	x		x
Demand-side	Transmission connected demand	✓	?	✓	✓	✓	✓	x		✓
	Distributed connected demand	✓	?	✓	✓	✓	✓	?		✓
	Domestic demand	x	x	?	x	x	x	?		?
	Aggregators	✓	?	✓	✓	✓	✓	?		?
Storage	Pumped storage	✓	?	?	✓	✓	✓	x		x
	Battery storage	?	?	x	x	x	x	?		x

Moreover, the CfE goes on to acknowledge that the RIIO framework foresees in network operators' interaction with flexibility providers, and hence, implicitly, with electricity wholesale and retail markets:[27]

> *"RIIO is designed to ensure that network companies can procure and use services from storage providers (or other flexibility providers) to efficiently defer or avoid investments, support cheaper and timelier connections, or to better manage issues on their networks."*

As set out in section 4.5 above, in July 2017, Ofgem reaffirmed many of its considerations from the CfE in its Smart Systems and Flexibility Plan, noting the current absence, as well as the potential benefits, of local flexibility markets:

> *"There is also the case for further trials in this area to inform the development of policy and regulation across a number of areas. For example, there is currently no market for local flexibility trading. A local flexibility market could deliver whole system benefits."* (p.19)

FUSION aligns with GB policy direction and explores the key issues and considerations identified by Ofgem. In doing so, FUSION will contribute to the work already being

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[26] Ofgem (2015), *Making the electricity system more flexible and delivering the benefits for consumers*, p19, 30 September 2015.

[27] Ofgem/BEIS (2016), *A smart, flexible energy system - A call for evidence*, p33, November 2016.

undertaken in the ENA's Open Networks programme on (end-user involvement in) the future operation of the distribution network, and inform (changes in) the regulation of

- Load related capital expenditure;
- The network losses incentive;
- National Terms of Connection within Distribution Connection and Use of Systems Code;
- Distribution Grid Codes;
- Future DSO operational management; and
- Future opportunities to provide services into the national balancing services market for both new market participants and DNOs and the regulatory treatment of such network services.

7.2 USEF from a regulatory point of view

USEF aims to reconcile the regulatory governance of DNOs with the principles of competition that govern energy wholesale and retail markets. Its purpose is to optimise the allocation of flexibility across the industry, while allowing maximum freedom of choice for all industry participants.

To achieve this, flexibility must be negotiable between the industry participants, in a competitive market that enables sufficient liquidity in the supply and demand of flexibility. A liquid, competitive market lowers the price of flexibility (by lowering profit margins) and fosters quality and reliability in the provision of flexibility – as flex users have access to market-based (different suppliers) and non-market-based (e.g. network reinforcement) alternatives.

End-users can participate in providing flexibility to DNOs, as well as other parties, but cannot be forced to do so, and need not deviate from the current regulated arrangements for the collective distribution service. However, within the USEF framework, DNOs can give incentives (through aggregators) to deviate from this regulated service, where this lowers the overall costs of the distribution service.

Aggregators (which are likely to be suppliers as well) operate the demand response systems and translate the flexibility prices from the markets, the GBSO and the DNO into value propositions to entice end-users to offer flexibility. DNO incentives therefore may not necessarily end up at the end-user directly, but, in a competitive environment, aggregators themselves will be incentivised to maximise value propositions to end-users.

Section 8: Customer Impact

FUSION will not adversely affect the service that any distribution connected customer receives currently. A key output and demonstration of the project will be to ensure that DNOs continue to operate to P2/6 compliance through the use of inherent energy flexibility, at a lower cost to connected customers. The following sections describe the nature of the interaction with connected customers in FUSION, as well as how we plan to manage this interaction to ensure it is a positive experience.

8.1 Participation in the flexibility market trial

The flexibility market trial in FUSION does not seek to engage directly with customers or customer premises, and its implementation does not require any customer interruptions. Rather, SP Distribution will procure flexibility from the introduction of neutral market facilitator USEF through commercial principles. The flexibility that end-users can make available may involve a demand reduction or interruption, but on a voluntary basis, meaning that the end-user decides on participation based on the terms of their commercial contracts.

As part of the evaluation of the flexibility potential in the East Fife area (WP2), end-users with the potential to provide flexibility will be invited to make their load available to the local flexibility market, again on a voluntary and on commercially agreed terms. It is also possible that certain end-users decide to participate directly in the flexibility market, without an aggregator as an intermediary, however, this is considered less likely.

FUSION is designed to demonstrate how DNOs can procure flexibility in an economically efficient manner without disruption the existing energy market. The DNO competes with existing applications of flexibility and will thus pay a commercial price, ensuring that the flexibility will find its most optimal use in system perspective. This means that the price will be sufficient to compensate the aggregator and, by extension, the end-users in the aggregator's portfolio.

End-users participating in the flexibility market also benefit from the requirement for aggregators to compete for end-user flexibility, meaning end-users can select aggregators with the offer most attractive for them. In addition, and unlike the energy supply market, end-users have the option of not participating in the flexibility market, further ensuring the potential value end-users can extract from aggregators, in the form of lower energy bills, more innovative contracts and new services. While not being explicitly planned within FUSION, the project welcomes aggregators using the opportunity to experiment with such services.

End-users and aggregators that are not offering flexibility will not be affected in any way, except to benefit from the reduction in collective network tariffs, because of more efficient network operation.

8.2 Justification of the trial site

East Fife has been selected as the trial site for FUSION based on multiple criteria:

1. Developing learning relevant and representative for GB
2. Significant appetite for the project from stakeholder engagement
3. Development from prior innovation projects
4. Leveraging existing infrastructure

Labour markets and demographics have been examined, and are reflective of GB, therefore demonstrating the relevance of learning developed through FUSION.

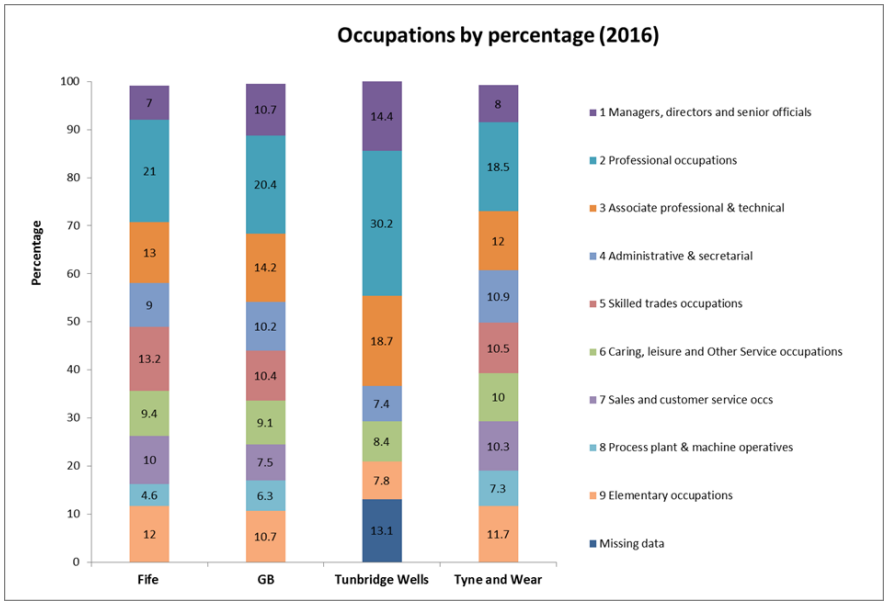

Figure 12. Population occupations in Fife, GB, Tunbridge Wells and Tyne and Wear, demonstrating the reflective nature of Fife's labour market and associated infrastructure. Tunbridge Well and Tyne and Wear are shown to add a rich context to the data.

Figure 12 shows 2016 occupation data from the UK Official Labour Market Statistics[28] demonstrating how Fife reflects GB; this acts both to inform the relevance of population demographics for the project, and to assess by proxy the premises that will be available to offer flexibility services to the market.

Through stakeholder engagement, including the survey undertaken as outlined in appendix O, FUSION has found resounding support for undertaking the flexibility market trial in East Fife. This includes support from Fife Council and the University of St Andrews, two of the largest energy consumers in the region. Further engagement has garnered significant support from industrial consumers [redacted] the agricultural community, as well as with residential consumers through Fife Council Social Housing and Kingdom Housing Association. We conclude that there is both significant appetite, and market liquidity to enable FUSION.

East Fife was the location of the FlexNet innovation project. Notwithstanding the continued load growth anticipated in the region, the network infrastructure is appropriate to FUSION, and will enable the project at a timely and affordable manner.

[redacted] SP Energy Networks Fife and

[28] UK Official Labour Market Statistics, available at: https://www.nomisweb.co.uk/

Central District Planning and Design Engineers are significant developers and supports of the project, and wish to see solutions developed deployed on the network, and transitioned to business-as-usual on successful implementation.

8.3 Stakeholder engagement

We recognise that the success of FUSION will only be realised by gaining support and engagement with our stakeholders and customers. It is therefore imperative that the customer experience of being part of the project is positive. We will therefore ensure, as part of Work Package 1, Stakeholder Engagement, that information is clear and easily understood, provide responses to any customer enquiry in a timely manner, provide targeted stakeholder workshops and forums to suit individual customer groups' needs.

Through our Stakeholder Engagement Work Package, FUSION will engage with customers via a number of communication channels and mediums (written, audio, visual, face-to-face) and work with relevant community and local groups and trade associations to engage with as many customers within the trial location as possible.

FUSION will leverage specialist internal resources within the Stakeholder Engagement and Communications team in SP Energy Networks. Resources will assist with the strategy, management and operations of engagement, and will deploy skills to reach a broad spectrum to stakeholder and customers, and to contact 'hard-to-reach' customers through the use of innovative communications techniques and strategies. Further, the use of [redacted] stakeholder and feedback monitoring software TRACKTIVITY® will enable professional and effective stakeholder and customer management.

Stakeholders that will attend the stakeholder forum are listed below in Figure 13:

Figure 13. Stakeholder forum attendees.

8.4 Customer engagement and education

FUSION has undertaken significant and meaningful customer engagement during the submission development, including direct engagement with multiple trial area flexibility providers: Fife Council – social housing and industrial & commercial, [redacted] Bright Green Hydrogen, the University of St Andrews, Kingdom Housing Association, the Agricultural community. Throughout, feedback has been resoundingly positive demonstrating an appetite to partake in a local energy flexibility market.

FUSION has undertaken an e-survey through the Fife Chambers of Commerce, reaching 1000 individuals in 300 businesses to gauge interest, again with positive feedback. A customer journey has established the benefits and customer choice developed within FUSION, showing the project from a customer perspective, further contributing to positive customer feedback, see appendix O.

All customers will have the opportunity to participate in the local flexibility market for provision of energy services by either engaging with the USEF platform directly or through aggregators or energy suppliers. In principle, there is no restriction on the types of service providers that can participate in FUSION. Participation will, however, be limited to the capability of a customer to provide a flexibility service and engage effectively with the neutral market facilitator both technically and commercially.

8.5 Engagement Plan

As part of the FSP development, a robust engagement plan, which identifies the outcomes that need to be achieved, and therefore the messages and methods that will be communicated to market participants has been developed. The engagement plan identifies through the various work packages, key engagement points with customers and wider market participants, from informing them of the project objectives, to provision of how involvement in the project will be achieved and learning disseminated. Further details of this plan are available in appendix G.

8.6 Recruitment process for establishing availability of flexibility

Prior to the trial, FUSION will assess the local flexibility potential as well as recruit customers to participate. This process will involve the following steps:

- We will invite interested customers to complete an expression of interest (EoI) to participate in the flexibility market trial.
- Upon receipt of the EoI, an energy audit will be carried out at each site to develop an understanding of the available flexibility. This audit will likely be performed by one of the project partners in FUSION, however customers will be free to engage their own consultants and provide their own energy audit.
    - Assessments of energy flexibility will include a sites requirement for electricity, heat and where applicable automotive transport and whether alternative automotive fuel is present on site, such as electric or hydrogen.
    - The assessment will initially involve a desktop study, which may (depending on site potential) lead to a more detailed site study to inform a full site report.
- Following the assessment of the flexibility potential, specific trial locations will be identified and customers will be invited to take part in the trial, indirectly through aggregators or energy suppliers, or directly.
- At this stage a wider tender will be issued to allow all market participants to submit their offers for the provision of flexibility services within the trial location.

8.7 Treatment of customer data

Any data published as part of the learning reports on the range of flexibility that can be provided by an individual customer and/or aggregator group, will be anonymised to protect the commercial interests of all parties participating in the trial unless prior agreement is provided by the customers that information can be made available.

Section 9: Project Deliverables – Consultations & Reports

Table 6 sets out the project deliverables for FUSION, to be made publicly available through the ENA Smarter Networks Portal, and wider knowledge dissemination processes.

Table 6: Designed Deliverables during Project Delivery

Reference	Project deliverable	WP	Deadline	Evidence	NIC funding request (%)
N/A	Ofgem full approval	N/A	30/07/18	Project Direction	0%
1	Report on flexibility quantification in E Fife	2	04/12/19	1. Report on quantification of the flexibility market value in E Fife, including robust assessments across voltage levels, market sector, industry type.	14%
2	Public consultation on USEF	3	29/11/19	1. Deliver the consultation document on the basis of workshops. 2. Hold an open consultation for a three month duration. 3. Report on consultation responses and analysis. 4. Report on associated changes to USEF implementation plan.	5%
3	USEF implementation plan	3	02/04/20	1. FUSION USEF implementation. 2. Report on GB specific reference implementation of USEF.	16%

4	USEF process implementation	4	02/06/20	1. Provide specification of communication and procurement platform. 2. Provide specification of communication protocols between market participants. 3. Provision of template flexibility contracts. 4. Quantify market participant costs for implementing USEF interface compatibility.	37%
5	Implement a minimum of two physical and live trials of commoditised flexibility based on the USEF framework	5	03/04/23	1. Identify two trial locations. 2. Identify the required flexibility services available from flexibility providers. 3. Contract for flexibility services. 4. Undertake live trials. 5. Report on the implementation and analysis of USEF trials.	19%
6	Modelling report on commoditised flexibility benefits for the UK (Imperial College London)	5&6	28/02/23	1. Academic modelling report on GB flexibility.	5%
7	Open Networks report in coordination with the ENA Open Networks Programme	6	28/02/23	1. Report on coordination and hierarchies of control for flexibility, in collaboration with the ENA Open Networks Programme	4%
Common Project Deliverable					
N/A	Comply with knowledge transfer requirements of the Governance Document.	N/A	02/11/23	1. Annual Project Progress Reports which comply with the requirements of the Governance Document. 2. Completed Close Down Report which complies with the requirements of the Governance Document. 3. Evidence of attendance and participation in the Annual Conference as described in the Governance Document.	N/A

Appendices

Appendices
1. List of changes to the Full submission document
A. Benefits tables
B. Full submission spreadsheet
C. Trial area overview
D. Cost-Benefits calculation methodologies
E. Project delivery programme
F. Risk register
G. Engagement plan
H. Development from other innovation projects
I. Project governance structure and key roles
J. Project partner information
K. Preliminary desktop potential flexibility assessment
L. Supplementary USEF information
M. Summary of Gap analysis USEF - GB
N. Flexibility Procurement Platform Architecture
O. Glossary of terms

List of changes to the Full Submission document

Pro-forma section and Topic	Expected amendment to submission	Reasons for amendment
Multiple	FUSION budget, project costs, NIC funding request and Full Submission Spreadsheet	Updated with budget reduction to focus on core project deliverables at best customer value
Multiple	Benefits (CBA)	CBA based on innovative solutions counterfactural using flexibility trading instead of conventional reinforcement
Section 1: Project Summary	Project Manager Contact Details	Staff change
Section 2.1.1: The problems which need to be resolved	Detail on outage and fault frequency – [redacted]	Greater detail on requirements for the project in East Fife, as requested by the Expert Panel
Section 2.2.5: Work Package 5: Deployment and Demonstration of USEF in East Fife	Detail on frequency of flexibility needs based on outage and fault frequency	Greater detail on the frequency of flexibility actions for the DNO, as requested by the Expert Panel
Section 4.4.3: Wider Industry Collaboration	Enhanced details on collaboration activities including 2017 NIC proposals, GBSO and ENA	Greater detail on collaboration activities to deliver project benefits and achieve value for money
Section 5.3 IPR	Enhanced details on long-term IPR arrangements	Reflect detail after requests in bilateral meetings
Section 6.4 Measures to minimise cost overruns benefit shortfalls	Greater detail on steering group	Address and confirm the questions from the Expert Panel
Section 8: Customer Impact	New sub-section: Justification of trial site	Provide further detail on the appropriateness of East Fife as a representative trial site.
Section 8.3 Stakeholder Impact	Greater detail on stakeholder engagement	Detail further stakeholder engagement and address the comments received from the Expert Panel
Section 9: Project Deliverables	Adjustment of allocated NIC funding with each deliverables	Ensure deliverables are appropriately budgeted
Appendix N	Added details on IT infrastructure	Provide further detail on IT arrangements, components, and cyber security
New Appendix	Added customer journey and the customer survey	Reflecting the enhanced customer engagement

Appendix A Benefits tables

Table 7: Financial benefits table

Scale	Method	Method Cost (£m)	Base Case Cost (£m)	Notes (£m)			Cross-references	
				2030	2040	2050	Sensitivities	Key Assumptions
Post-trial solution *(individual deployment)*	Method 1	[redacted]		1.2	1.2	1.2	1. the financial benefits were calculated based on difference between a competitive market and a bilateral market; 2. The freed capacity benefits was only calculated until 2030 for the trial area, with the prudent assumption that the flexibility market will only defer the reinforcement rather than replace the reinforcement 3. LV benefits may potentially double	1. both Method Cost and Base Case are NPV in 2017 2. for a market similar as the designed trial (two primary substations) 3. the start date of 2023 (upon completion of trial) and reinforcement was deferred for 7 years
Licensee scale (If applicable, indicate the number of relevant sites on the Licensees' network.)	Method 1	[redacted]		1	7	19	1. the capacity required does not take into account the local strategic development plan; 2. two local markets are assumed (one is within the trial, and the other is 2023)	1. both Method Cost and Base Case are CAPEX and OPEX combined by 2050. 2. the required capacity is calculated based on demand incremented by TRANSFORM model;
GB rollout scale (If applicable, indicate the number of relevant sites on the GB network.)	Method 1	[redacted]		10	81	236	1. 14 local markets (i.e. one per DNO license) 2. the whole GB roll out in 2030	1. the capacity required is proportional to the licenseed area; 2. the roll out rate is: 1 local market in 2023 and 1 more every 2 years from 2028.

Table 8: Capacity benefits table

Scale	Method	Method Cost (£m)	Base Case Cost (£m)	Capacity Freed (MW)			Cross-references	
				2030	2040	2050	Sensitivities	Key Assumptions
Post-trial solution *(individual deployment)*	Method 1	[redacted]		24	24	24	The freed capacity benefits was only calculated until 2030 for the trial area, with the prudent assumption that the flexibility market will only defer the reinforcement rather than replace the reinforcement	1. both Method Cost and Base Case are CAPEX 2. for a market similar as the designed trial (two primary substations) 3. the start date of 2023 (upon completion of trial) and reinforcement was deferred for 7 years
Licensee scale (If applicable, indicate the number of relevant sites on the Licensees' network.)	Method 1	[redacted]		72	186	395	1. the capacity required does not take into account the local strategic development plan; 2. two local markets are assumed (one is within the trial, and the other is 2023)	1. both Method Cost and Base Case are CAPEX; 2. the base case cost was calculated by using licenseed area average cable length (hence lower than the post-trial); 3. the required capacity is calculated based on demand incremented by TRANSFORM model
GB rollout scale (If applicable, indicate the number of relevant sites on the GB network.)	Method 1	[redacted]		1013	2605	5533	1. 14 local market (i.e. one per DNO license) 2. the whole GB roll out by 2030; 3. if the sensitivity of a slower progression and roll out by 2040, the 2030 value can be reduced, but 2050 figure stays the same	1. the capacity required is proportional to the licenseed area; 2. the roll out rate is: 1 local market in 2023 and 1 more every 2 years from 2028.

Table 9: Carbon benefits table

Scale	Method	Method Cost (£m)	Base Case Cost (£m)	tCO2			Cross-references	
				2030	2040	2050	Sensitivities	Key Assumptions
Post-trial solution *(individual deployment)*	Method 1	[redacted]		1,402	1,402	1,402	the carbon benefits was only calculated until 2030 for the trial area, with the prudent assumption that the flexibility market will only defer the reinforcement rather than replace the reinforcement	1. For I&C (industrial customers), we can treat them as part of the base case- we identified that St Andrews University about 1MW; 2. For SAC studies: accumulated individual users: 1MW, we treat them as the individual customers, there is currently no market; 3. For social households (i.e. Fife council); we make the assumption of 3.6kw per household*100=0.36MW, the rest is from industrial. The incremental carrbon benefits of FUSION: 1.36MW among 3MW (i.e. this is the part of conventional reinforcement, about 45.4%); The I&C customers 1.64MW (i.e. 1.64/3=54.6%) can be sourced from bilateral demand side response. we will maintain this ratio and scale up at SPD and GB level. In summary, the counterfactual base- case cost will be made up by two components: a) Bilateral DSR for the large I&C (about 54.6% of the total required flexibility requirement);
Licensee scale (If applicable, indicate the number of relevant sites on the Licensees' network.)	Method 1	[redacted]		24,722	105,380	291,680	1. the capacity required does not take into account the local strategic development plan; 2. two local markets are assumed (one is within the trial, and the other is 2023) for the Licensee area.	
GB rollout scale (If applicable, indicate the number of relevant sites on the GB network.)	Method 1	[redacted]		224,572	1,353,783	3,611,748	1. 14 local market (i.e. one per DNO license) 2. the whole GB roll out in 2030	
If applicable, indicate any environmental benefits which cannot be expressed as tCO2e.	It should be noted that the key benefit of a local flexibility market will include its agile set up to accommodate the uncertainties of demand increment /LCT uptake. The current assumption of 7 years deferral, rather than reinforcement avoidance is supposed to be very prudent. In the case of reinforcement avoidance, the environmental benefits should include the benefits of construction new primary subsations and cable burying.							

Appendix B Full Submission Spreadsheet

Table 10: FUSION Ofgem NIC spreadsheet

NIC Funding Request		2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Cost	*From Project Cost Summary sheet*							
	Labour	83.43	333.73	333.73	333.73	333.73	250.30	1,668.66
	Equipment	-	64.74	251.53	16.50	-	-	332.77
	Contractors	85.10	722.51	991.90	526.18	373.26	217.69	2,916.63
	IT	-	60.00	240.00	-	-	-	300.00
	IPR Costs	-	-	-	-	-	-	-
	Travel & Expenses	5.22	47.74	47.66	37.08	30.42	13.08	181.21
Payments to users & Contigency		-	9.82	3.21	3.21	128.53	127.00	271.78
	Decommissioning	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-
	Total	173.75	1,238.54	1,868.04	916.71	865.95	608.06	5,671.04
Initial Net Funding Required	*calculated from the tables above*							
	Labour	83.43	333.73	333.73	333.73	333.73	250.30	1,668.66
	Equipment	-	64.74	251.53	16.50	-	-	332.77
	Contractors	85.10	722.51	991.90	526.18	373.26	217.69	2,916.63
	IT	-	60.00	240.00	-	-	-	300.00
	IPR Costs	-	-	-	-	-	-	-
	Travel & Expenses	5.22	47.74	47.66	37.08	30.42	13.08	181.21
Payments to users & Contigency		-	9.82	3.21	3.21	128.53	127.00	271.78
	Decommissioning	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-
	Total	173.75	1,238.54	1,868.04	916.71	865.95	608.06	5,671.04
Direct Benefit	*from Direct Benefits sheet*							
	Total	-	-	-	-	-	-	-
Licensee Compulsory Contribution / Direct Benefits	*from Project Cost Summary sheet*							
	Labour	8.34	33.37	33.37	33.37	33.37	25.03	166.87
	Equipment	-	6.47	25.15	1.65	-	-	33.28
	Contractors	8.51	72.25	99.19	52.62	37.33	21.77	291.66
	IT	-	6.00	24.00	-	-	-	30.00
	IPR Costs	-	-	-	-	-	-	-
	Travel & Expenses	0.52	4.77	4.77	3.71	3.04	1.31	18.12
Payments to users & Contigency		-	0.98	0.32	0.32	12.85	12.70	27.18
	Decommissioning	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-
	Total	17.38	123.85	186.80	91.67	86.59	60.81	567.10
Outstanding Funding required	*calculated from the tables above*							
	Labour	75.09	300.36	300.36	300.36	300.36	225.27	1,501.79
	Equipment	-	58.26	226.37	14.85	-	-	299.49
	Contractors	76.59	650.25	892.71	473.56	335.94	195.92	2,624.97
	IT	-	54.00	216.00	-	-	-	270.00
	IPR Costs	-	-	-	-	-	-	-
	Travel & Expenses	4.70	42.97	42.90	33.38	27.38	11.77	163.09
Payments to users & Contigency		-	8.84	2.89	2.89	115.68	114.30	244.60
	Decommissioning	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-
	Total	156.38	1,114.68	1,681.23	825.04	779.35	547.26	5,103.94
balance		0.00	(1,271.06)	(2,957.06)	(3,797.95)	(4,602.64)	(5,181.40)	5,103.94
interest		0.00	(4.77)	(15.86)	(25.33)	(31.50)	(36.69)	(114.15)
								4,989.79
Bank of England interest rate			0.3%		**NIC FUNDING REQUEST £**			**5,103.94**
interest rate used in calculation			0.8%					

Fife Council has set out within its Local Development Plan (**FIFEplan**[29]) a number of key proposals for strategic regional development within the East Fife area. The plan includes proposals to develop land to the West of St Andrews and the regeneration of a former paper mill sited at Guardbridge Village to accommodate;

- 1,090 New Build Homes
- 10ha Science Park
- 8ha Employment Land
- 5ha Business Park
- Hotel and Care Home Accommodation
- 400 sq. m University Campus
- 3 Local retail 'Hubs'
- Sustainable Power and Research Campus (SPARC)

Following completion of '**Flexible Networks for a Low Carbon Future'** LCNF project, SP Distribution have implemented a number of key policy changes and operational practises to accommodate upto **20%** additional network capacity within the area. [redacted]

[redacted]

[redacted]

Examples of scenarios in which flexibility can provide a solution are detailed further within case studies 1 to 4 below;

Case Study 1 centres on a 33kV overhead line network (Figure 14) with insufficient capacity under n-1 conditions to service proposed new load connections under Primary Substation **A** and **B**.

[29] Fife Council, *FIFEplan: Fife Local Development Plan, Modified Proposed Plan,* February 2017. Available at: http://lpconsult.fife.gov.uk/portal/fife_ldp/fifeplan_-_adopted_plan_13/adopted_fifeplan?pointId=4395822

Network Problem:

Case Study 1: Insufficient Capacity within 33kV Overhead Line Network

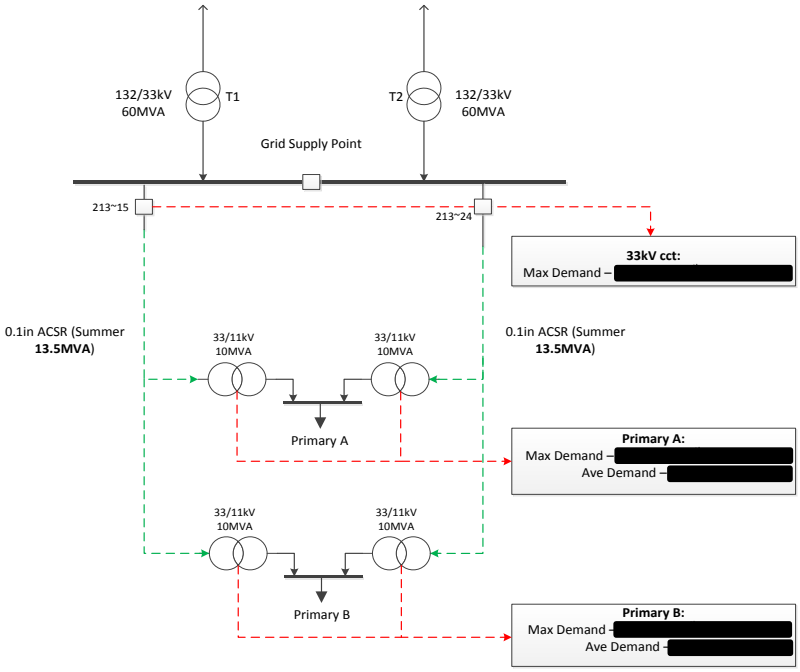

Figure 14: 33kV Overhead Line Network with Insufficient Firm Capacity

[redacted]

[redacted]

In the event of a network fault or planned outage on either 33kV circuit the remaining network infrastructure has insufficient network capacity to service the maximum demand once assessed against new projected load growth within Primary Substation **A** and **B**.

Traditional Solution:

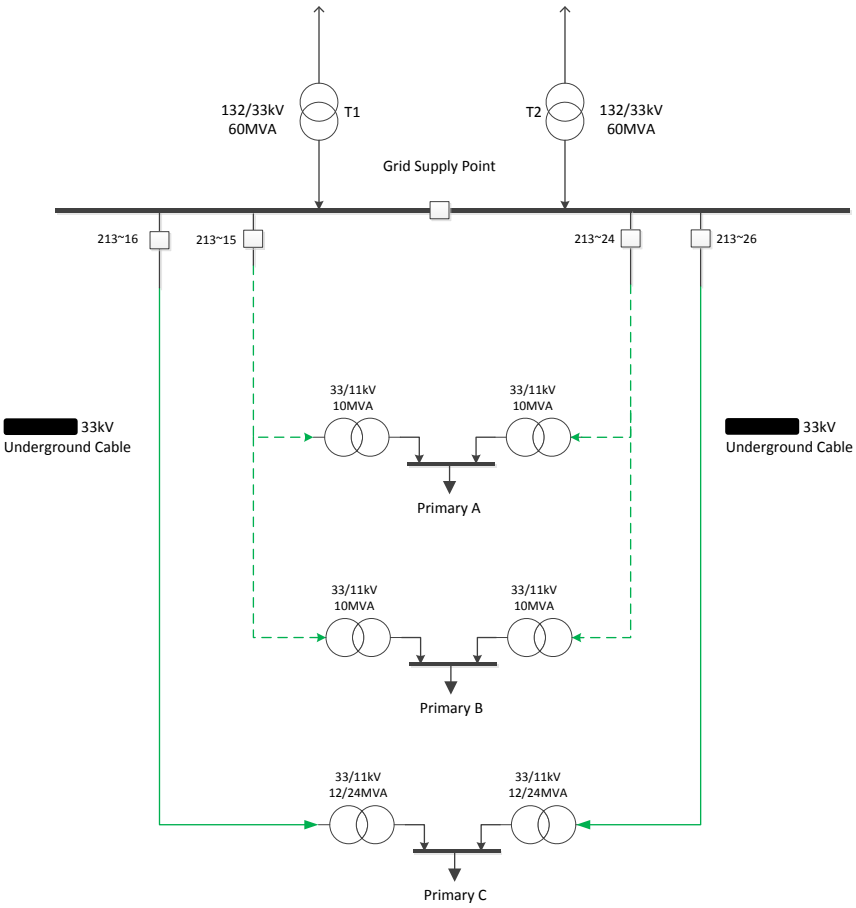

Figure 16: 33kV Reinforcement Scheme – New Primary Substation 'C'

To accommodate the new load at Site 'A', the traditional solution proposed is to install a new 33kV (12.25km) underground circuit from the Grid Supply Point to a new Primary Substation 'C', as shown in Figure 16. The total cost of these works is expected to be in the region of [redacted];

- 2 x [redacted] 33kV underground cable - [redacted]
- New 12/24MVA Primary Substation - [redacted]
- Primary Substation Civil Works - [redacted]

It is expected that these works will take approximately [redacted] with an estimated completion date of [redacted]

Solution to be Trialled under FUSION:

The proposed solution would utilise the inherent flexibility that exists within the local networks of Primary Substation **A** and **B** to mitigate the risk of thermal overload on either 33kV circuit in the event of a planned or unplanned N-1 event as network load increases, as shown in Figure 17. Sources of flexibility would consider both demand side response (DSR) and embedded generation turn up service, with flexibility sourced via the creation of local flexibility market (USEF).

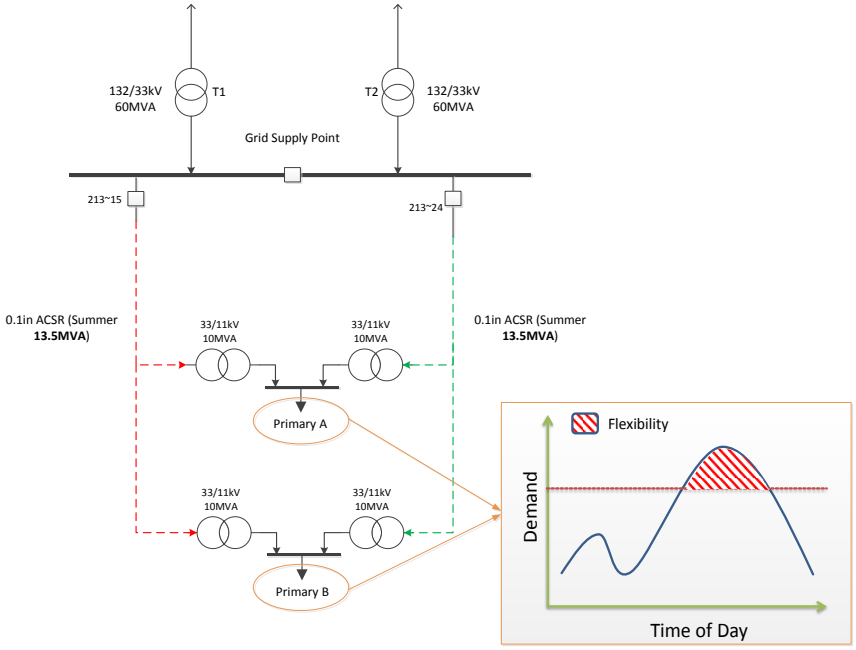

Figure 17: Demonstration of Flexibility to avoid N-1 Overload

Flexibility would be assessed on a site by site basis to establish the volume of reduction as well as obtaining the customers sustain time for flexibility activation. Given the locational nature of the constraint, only those customers connected under Primary Substation **A** and **B** would be available to participate.

Potential Learning:

Historically, 33kV distribution network infrastructure was designed to serve customer demand under both intact and N-1 conditions. This case study seeks to develop learning around alternative ways for the distribution network operator to design and operate a 33kV network through the use of inherent flexibility to provide network support arrangements during periods of high demand whilst the system is under fault or outage conditions.

It also provides an alternative method of providing customers with earlier access to constrained networks prior to long term reinforcement works being complete.

Procurement of flexibility shall be through a local flexibility market, allowing multiple providers of flexibility within the trial area to submit bids for provision of local network congestion management services. Tendering for congestion management via an open and transparent marketplace would deliver learning and inform the wider industry over what future synergies and/or conflicts that may exist between DNOs, SO and supplies when contracting for flexibility support.

[redacted]

Case Study 2: Insufficient Capacity at the 33/11kV Local Primary Substation

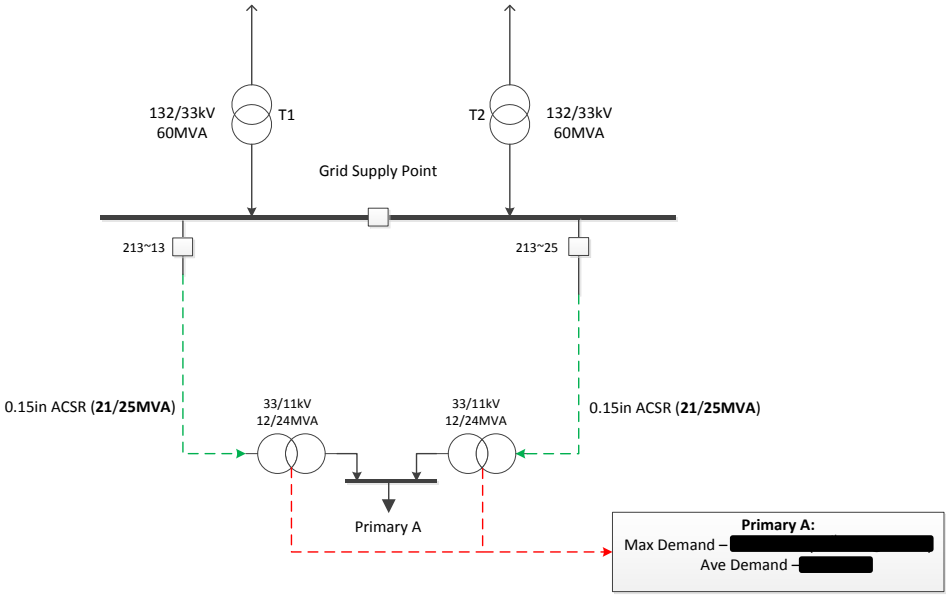

Figure 18: Insufficient Capacity at the 33/11kV Local Primary Substation

Case Study 2 centres on a 33kV Primary Substation (Figure 18) with insufficient capacity under N-1 conditions to service future LCT load growth predications and new connections under Primary Substation A.

Network Problem:

[redacted]

[redacted]

Work previously undertaken within the St Andrews area under '**Flexible Networks for a Low Carbon Future'** identified alternative innovative solutions to defer the reinforcement of a new St Andrews primary substation. Solutions implemented included the use of Real Time Thermal Rating (RTTR) of the existing primary transformers.

[redacted]

[redacted]

[redacted]

Traditional Solution:

To accommodate new load the traditional solution would be to install a new 33kV [redacted] underground circuit from the GSP to a new Primary Substation 'B'. The total cost of these works is expected to be in the region of [redacted];

- 2 x [redacted] 33kV underground cable - [redacted]
- New 12/24MVA Primary Substation - [redacted]
- Primary Substation Civil Works - [redacted]

However, these works are contingent upon the uptake in Low Carbon Technology within St Andrews town and the commencement of the St Andrews West development. Therefore the decision to commence with the reinforcement scheme is subject to many variables and difficult to predict.

An overview of the long term reinforcement scheme is detailed within Figure 20;

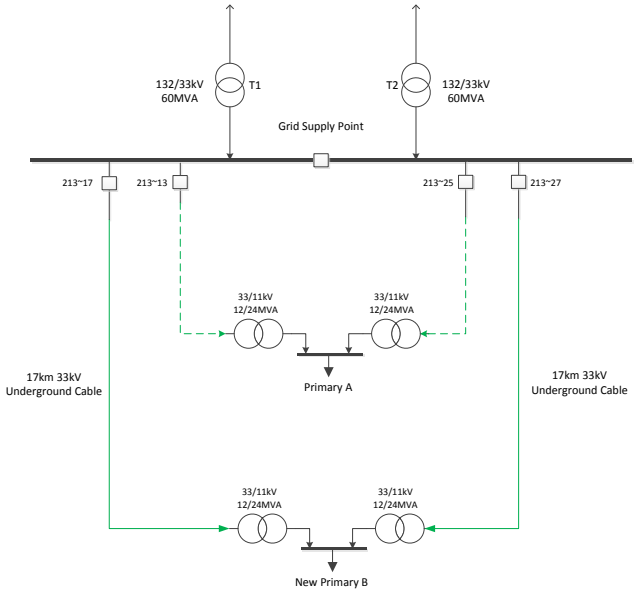

Figure 20: Reinforcement Scheme – Establishment of New Primary Substation 'B'

Solution to be Trialled under FUSION:

The proposed solution would utilise the inherent flexibility that exists within the local network of Primary Substation **A** to mitigate the risk of thermal overload on either 33kV circuit/transformer in the event of a planned or unplanned N-1 event, as shown in Figure 21. Sources of flexibility would consider both demand side response (DSR) and embedded generation turn up service.

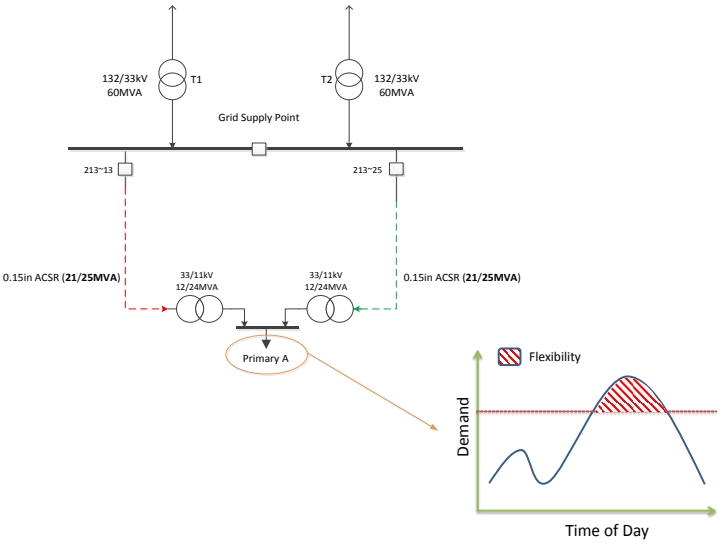

Figure 21: Demonstration of Flexibility to avoid N-1 Overload

Benefits:

The use of flexibility provides an alternative means of allowing SP Distribution to operate the local distribution network in compliance with P2/6 as load increases as a result of LCT uptake. It also provides the DNO with an enhanced means in which to determine the most appropriate time for reinforcement.

Case Study 3: Insufficient Capacity during 11kV Alternative Running Arrangements

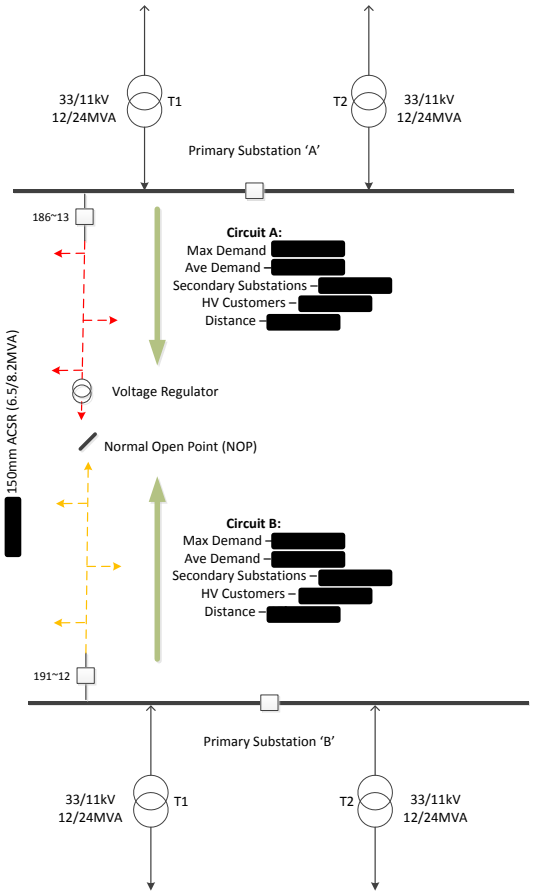

Figure 22: Insufficient Capacity during 11kV Alternative Running Arrangements

Case Study 3 centres on an 11kV Overhead Line Network (Figure 22) with insufficient capacity to service proposed new load connections under abnormal operating conditions.

Network Problem:

During its original construction the distribution network was built with the ability to transfer load between primary substations for operational contingency planning. In the event of planned outage or fault events, engineers could transfer customer load to alternative circuits/substations in order to reduce the burden on the remaining assets.

This operational practise still remains a critical function in operating today's network, however, as the network has evolved to accommodate new load growth, the ability to operate these critical interconnected circuits has become more complex due to load growth and embedded generation. In the event of a circuit fault within the first section out of Primary 'B', SP Distribution would experience a loss of supply to approximately [redacted]

secondary distribution substations and [redacted] HV customers. Restoration of supplies would typically be solved through use of the 11kV interconnector to Primary Substation 'A'.

Whilst engineers repair the fault, the 11kV interconnected circuit must be capable of supporting approximately [redacted] secondary distribution substations and 5 HV customers, with a potential maximum demand of [redacted](higher that the summer sessional circuit rating). Also under these circumstances, the circuit distance is now [redacted] and under high demand conditions network voltages at the remote end of the circuit are likely to be outside of statutory voltage limits (under voltage conditions).

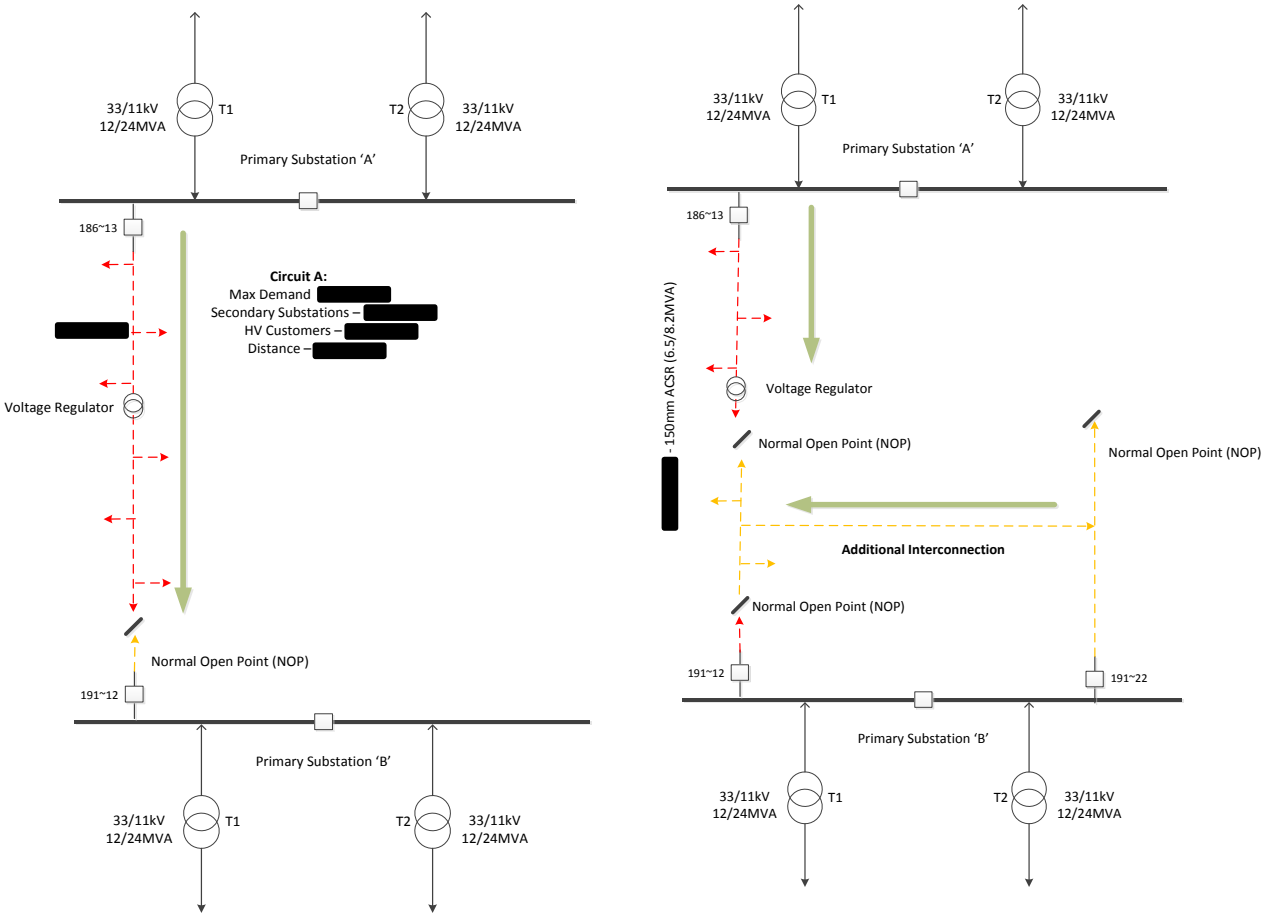

Figure 23: Circuit during alternative running arrangements and Conventional Option

Traditional Solution:
The traditional solution to resolve this operational problem would be the construction of additional interconnection between circuits and substations to ensure that in the event of a fault sufficient capacity remained to host the demand without impacting customer's quality of supply. A typical example is shown Figure 23.

Solution to be Trialled under FUSION:

The proposed solution would utilise the inherent flexibility that exists within the local 11kV and LV network along the feeder from Primary Substation A to mitigate the risk of thermal overload or voltage excursion along the 11kV circuit in the event of a planned or

unplanned N-1 event, as shown in Figure 24. Sources of flexibility would consider both demand side response (DSR) and embedded generation turn up service.

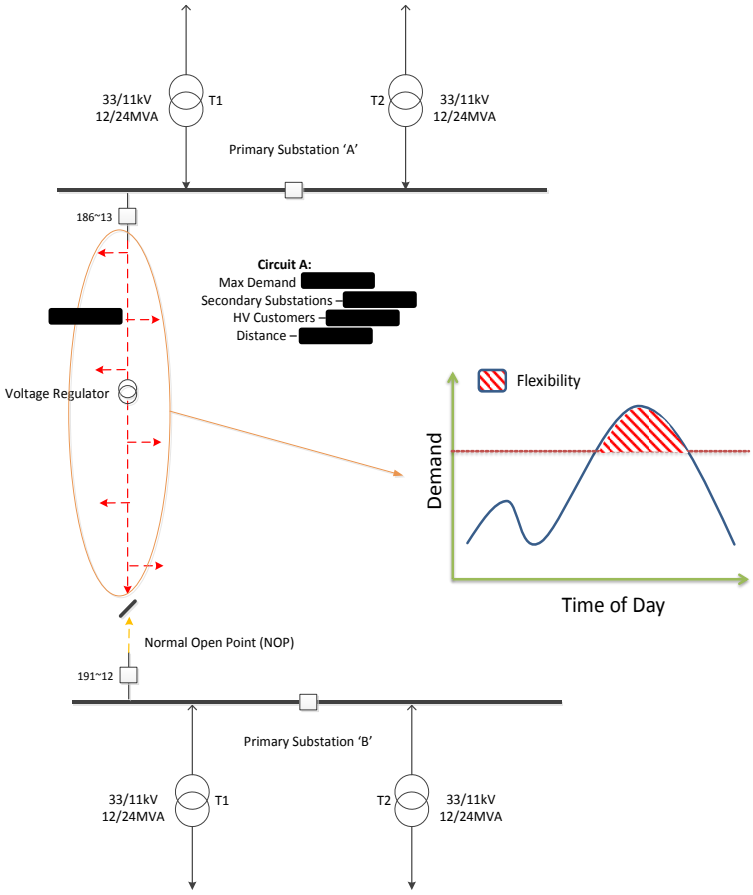

Figure 24: Demonstration of Flexibility to avoid 11kV Interconnector Congestion

Benefits:

Having the ability to call upon flexibility to resolve localised network congestion problems provides the control engineer with an additional means of managing the distribution network during abnormal running arrangements. At present the control engineer can implement a number of technical solutions such as reconfiguration of the network or adjustment to voltage levels, but they are historically limited in their ability to manage customer behaviour during such conditions which could resolve the congestion.

Case Study 4: Insufficient Capacity at the Secondary Substation

Case Study 4 centres on a thermal constraint associated with the low voltage network supplied from a traditional distribution secondary substation (Figure 25), with insufficient capacity to service proposed new LCT load growth under normal operating conditions.

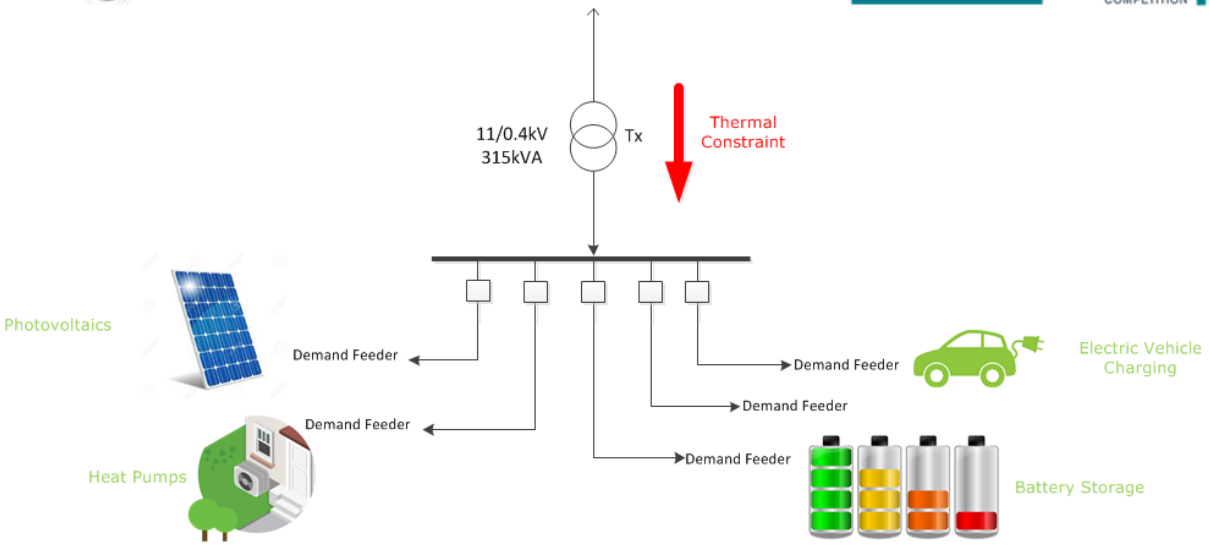

Figure 25: Secondary Substation Thermal Constraint (LCT)

Network Problem:

Thermal constraints on the Low Voltage distribution network are anticipated by DNOs as a result in electrification of heat and transport systems, mainly in the form of uptake in electric vehicles and domestic heat pumps.

Localised thermal issues are expected from local clustering of EV's and Heat Pumps and are currently difficult to predict.

Historically distribution networks were designed with an estimated customer load profile of between 1 to 2kVA ADMD per household for properties connected to the gas network. For properties without access to a gas network, a value of 5 to 5.5kVA ADMD per household was used to account for higher loading as a result of electric heating.

The challenge facing the DNO is how to prepare the existing LV distribution network for LCT uptake and ensure that existing networks are able to accommodate this additional capacity at the lowest possible cost whilst minimising disruption to customers.

Traditional Solution:

The traditional solution would be the reinforcement the low voltage distribution system to align the network with current design polices for off gas networks i.e. 5 to 5.5kVA ADMD per household. The scopes of these works are likely to include;

- Replacement of existing network secondary substation transformers to higher rated capacity to accommodate peak loads;
- Installation of new secondary substations to provide additional capacity for load sharing;
- Replacement of existing LV mains cabling to a higher rated capacity;
- Installation of new LV mains cabling to provide additional capacity for load sharing;

As an example, the typical cost associated with the installation of a new secondary substation, Figure 26, to provide additional network capacity as a result of LCT can be

estimated at approximately [redacted], based upon a new package substation and LV mains infrastructure.

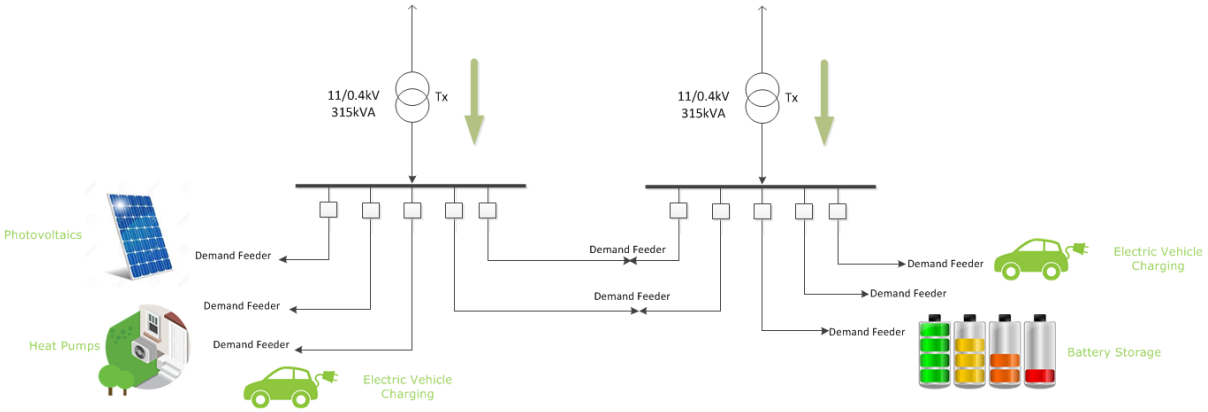

Figure 26: Typical LV Reinforcement to Accommodate High Levels of LCT

Solution to be Trialled under FUSION:

The proposed solution would utilise the inherent flexibility that exists within the local LV network to mitigate the risk of thermal overload of the local secondary substation, as shown in Figure 27. Sources of flexibility would be procured through the use a local market via domestic aggregation.

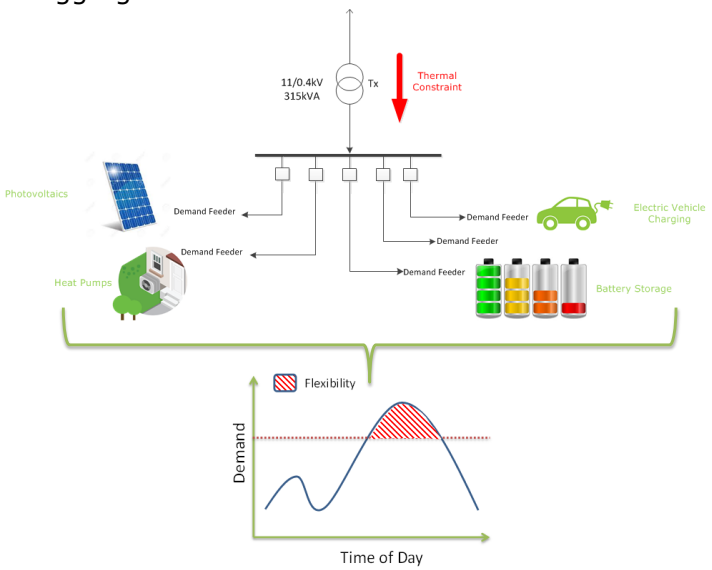

Figure 27: Domestic Flexibility to Manage LV Network Congestion

Benefits:

The uptake of LCT if left unmanaged will in future trigger the DNO to implement a number of mitigation measures to avoid thermal congestion of existing network assets. To date these measures include an array of traditional interventions such as network reinforcement and more innovative solutions such as enhanced network automation.

Through the use of new commercial mechanisms under FUSION, it is expected that enhanced network capacity could be released through the implementation of flexibility to solve network congestion problems. Project benefits include both the end user by avoiding intrusive reinforcements of the local LV network and creation of an additional income stream to customers for being flexible, and the DNO by providing a solution which helps address intermittent network congestion.

Appendix D Cost-benefit calculation methodologies

The purpose of Cost Benefits Analysis (CBA) is to provide a justified and realistic estimation on the potential benefits of innovation measures proposed under FUSION. The key assumptions of the CBA set out within this section are based on the understanding of low carbon technology (LCT) development pace and forecast of roll-out cost. While it has been accepted that there is no direct domestic flexibility market when this proposal is drafted, the potential and the pace of the bilateral flexibility market (i.e. industrial/commercial customers directly sign exclusive flexibility contract with either utilities or aggregators) should be sufficiently recognised. From that perspective, **the base case in this CBA exercise is the bilateral flexibility market**. This methodology is line with the NIC Guidance to take into account the latest innovation development.

A prudent scenario on demand growth has been further assumed for the licensee area, which only considered the annual increment rate from the industrial agreed TRANSFORM model and excluded scoping connection requirement at a local level. In the meantime, the cost deferred is based on the average cost.

Table 12: Key financial assumptions in FUSION CBA

	Base Case (Bilateral Contract)	Reference Case (USEF Based)	Justifications
Flexibility Availability MW per annum (£)	[redacted]	[redacted]	Based on the literature review on the published documents, such as Committee of Climate Change (CCC); the due diligence from other UK/EU DNOs on their public tendering of flexibility
Utilisation Cost Per MWh (£)	[redacted]	[redacted]	calculated based on the published STOR report, and verified by the trial from EU USEFprojects
Maintenance Costs (OPEX, £)	[redacted]	[redacted]	less FTE (full time equivalent employee) is expected for USEF*
One Off Set up Investment (CAPEX,£)	[redacted]	[redacted]	the main efficiency is from the hardware/software standardisation
Average Deferral Period	3 years	7 years	Breakeven point was calculated based on the same conventional reinforcement of £5.7m**

*: [redacted]

**:The conventional reinforcement costs within FUSION is based on two primary substations (each with a rating of 12MW), with this cost also containing a 33kV cable with an average length of [redacted] The cost information of Flexibility Contracting [redacted] and Utilisation [redacted] is based on the information published in 2016 on STOR market, and verified by trial projects in Netherlands[30]. From the CBA perspective, this figure will have limited material impact on the incremental benefits of USEF.*

Methodology of CBA

[30] http://www2.nationalgrid.com/UK/Services/Balancing-services/Reserve-services/Short-Term-Operating-Reserve/Short-Term-Operating-Reserve-Information/.
The average prices of STOR based on the tenders of 2016 (tender round 29-31) and the average prices of 2013-2015 are 4.84 £/MW/h for availability and 147.06 £/MWh for utilization. Within STOR, diesel generators take the larger share of the product. Hence, the n-1 congestion management product is more suitable for load participation, because of the lower activation frequency. In this respect, both the Belgian R3Flex and the Belgian ICH30 may be an even better benchmark. Therefore the R3flex is the main basis for the reference case. The cost is then normalized to be [redacted] for the USEF.

A Bottom-up approach was adapted in generating benefits for licensee area and the GB roll-out.

A post trial case was established based on confident knowledge on local specific cases. The licensee area benefits could be developed by scaling up costs and benefits proportional to the flexibility capacity required. For GB roll-out, a conservative adapting rate of the USEF local capacity market after 2023 is listed in Table 14. Only 14 local markets were assumed by 2030 (based on one local market for every DNO license). This number of local market was maintained until 2050.

Table 13: CBA scaling methodology

Elements	Trial Area 2 Primary Sub	SPD (Licensed Area)	GB
Peak Demand	12 MW	3.6 GW	61 GW
Benefits to DNO (CAPEX & OPEX)	Longer deferral time; lower flexibility cost	Scale up	Scale up
Carbon Saving (GHG)	Local Renewable & avoided civil & losses	Scale up	Scale up
Cost Development Bottom-up	From Developer	Scale up	Scale up

Table 14: number of USEF Local Market, GB Roll out estimation

2024	2025	2026	2027	2028	2029	2030
3	4	5	6	8	10	14

This section explains the basis for the business case for Project FUSION, which is based on the benefits of acquiring flexibility through a standardised, market-based approach, rather than through bilateral contracting with end-users.

Scenarios of N-1 at Distribution Network and Flexibility Benefits in General

A DNO needs to meet its P2/6 obligation throughout the year. This means that, when annual peak load is expected to exceed the nominal capacity of a transformer or feeder during a fault or outage condition, conventional reinforcement is traditionally required. As a consequence, the HV/MV grid is always operating at less than 50% of its capacity. Grid reinforcement is a high price to pay for mitigating the risk that a fault will occur precisely at the moment when the load is at its highest value throughout the year.

The alternative is to dynamically respond this requirement by reduce demand (or increase generation, based on the circumstance). This can be referred to as Demand Side Response (DSR). DSR can be a problem for distribution networks due to the diversity and size of individual customers. Some of the main obstacles are as follows:

- There is no visibility of the available flexibility within a specific region, nor if and how any commercial party is operating this flexibility.
- There is no (marked-based) mechanism available for the DNO to contract and activate flexibility
- A limited amount of demand side flexibility is currently controlled by Suppliers and Aggregators. This flexibility is often part of a firm capacity contact (e.g. STOR), which means that it cannot be applied in any other product, such as (n-1) congestion management. Or in more general terms, there is no agreement on the coordination of the use of flexibility between parties, esp. between TSO and DNO.
- Apart from trials, there is no existing (n-1) congestion management product operational, therefore there are little to no best-practices in product design.

When applying (n-1) congestion management, the main costs for the DNO relate to the contracting of available capacity to be deployed at times when (n-1) constraints may occur. The costs for activation are relatively small, since activation will be very rare, i.e. only if a fault occurs in specific (constraint) areas, during specific (constraint) times, and (possibly) during planned maintenance. Operational costs are limited as well, due to these four reasons:

- Processes can be automated to a large extent, requiring little workforce;
- Several processes that are crucial for (n-1) congestion management, are already part of a DNO's BaU activities, such as grid monitoring and forecasting;
- When the concept of (n-1) congestion management is applied on a large scale, the up-front costs can be spread over many congestion areas and over a longer period; and
- By applying a common reference model and architecture like USEF, further standardization is possible, further reducing the up-front and operational costs.

For most grid areas, a constant load growth is expected over time, based on future scenarios applied by the DNO in their long-term grid planning (based on both economic growth and LCT/electrification). Expectations are that the costs of applying (n-1) congestion management for each congested area will also increase over time, since the load growth will result in:

- A greater requirement for MW of availability during peak times;
- Longer required sustain times during the day; and
- Larger required availability windows, both during the day as well as during the year.

In addition, **the ability to defer investments also buys the DNO time, effectively offering a hedge against unforeseen load/generation changes** (e.g. large scale introduction of fuel cell EVs or autonomous driving), which may mean that:

- An (expected) reinforcement is either obsolete; or
- A different reinforcement (either larger or smaller) is required.

In the absence of a firm reference on the impact and timing of potential unforeseen load changes, the value of this option is extremely hard to quantify, and therefore, our assessment only focuses on the benefits of deferring reinforcements.

Incremental Benefits of USEF, compared with a Bilateral Flexibility Market

The inclusivity, inter-operability and transparency are the key features of a USEF compliant local flexibility market. The pilot schemes trialled in the Europe and the principles underpinned USEF warrant the expectation that a USEF compliant local market will be more efficient than a bilateral DSR (flexibility market).

While aggregators have been very active in GB to leverage the flexibility on ground, their primary flexibility providers are large industrial & commercial customers. FUSION will widen and facilitate the access to flexibility market for individual customers.[31]

During the FUSION proposal stage, a feasibility study and a gap analysis have been carried out. Using the example of trial area, the benefits of USEF local market can be summarised as the following

- ✓ Cheaper one off investment for hardware/software thanks to the standardisation of USEF
- ✓ Less maintenance from DNO perspective on commercial agreement management within such an open flexibility market. The flexibility utilisation is dynamic based on the real-time information and the commercial agreement is standardised;
- ✓ Shorter contracts for the available flexibility. The flexibility can currently be accessed by two-step contract: 1) availability contract; 2) utilisation contract. A USEF based market will effectively shorten the duration of availability contract
- ✓ Cheaper flexibility utilisation cost. USEF will provide a real time visibility of the flexibility available in the area and facilitate the competition. Based on the experience in similar innovation projects, such a competition will delivery financial benefits for the customer. We made the following assumption based on our stakeholder engagement with EU and GB DNOs:

Flexibility Availability Contract:	[redacted] per annum in a bilateral market; per annum in a USEF based market
Flexibility Utilisation Contract:	per MWh in a bilateral market per MWh in a USEF based market

In summary, the counterfactual base-case cost will be made up by two components:

a) Establishment of a bilateral DSR (demand side response flexibility) market;
b) Utilisation of Flexibility in such a market

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[31] In year 1, we require the flexibility of 3MW:
For I&C (industrial & Commercial customers), such as City Council office, office buildings and teaching buildings at St Andrews University: about [redacted];
From Scottish Agriculture College studies: individual farming demand [redacted], there is currently no access to flexibility market for them;
For individual households (i.e. Fife council social housing development); we make the assumption of 3.6kw per household*100=0.36MW
The incremental benefits of FUSION: providing access of 1.36MW among 3MW (i.e. those customers (about 45.4%) has no access to the flexibility market).

The incremental benefits of a USEF enabled local flexibility market are from the efficiency associated with standardisation, widen participation and competition.

Key flexibility capacity assumptions in FUSION CBA exercise

The existing peak demand was taken from the latest published Long Term Development Statement (LTDS). The annual load growth rate was taken from the TRANSFORM model, which takes into account a modest LCT development rate. This demand increment estimation has been applied to each of the 400 primary substations to generate the flexibility required. The annual total of flexibility required also responding to the capacity freed quoted in the main proposal.

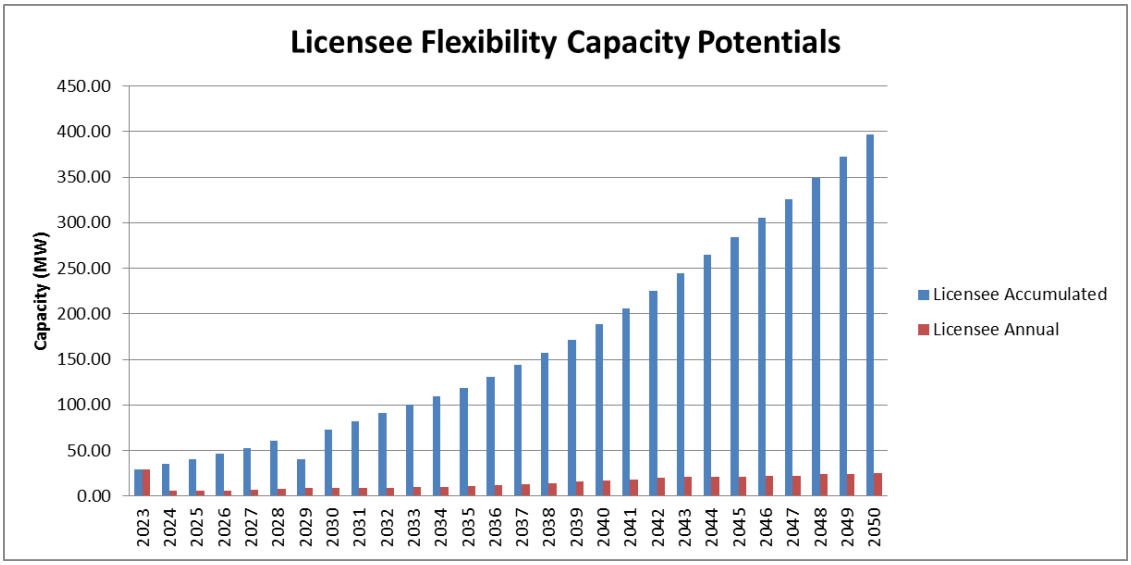


Figure 28: FUSION capacity benefits

Key Costs Assumptions and Their Justifications

We have based our estimate of the potential cost of flexibility on a survey of reference prices from relevant products, both in GB and in selected European markets, as well as from interviews with aggregators. It is important to find a product with comparable features; this is not straightforward, as the exact characteristics of the (n-1) grid management product are yet to be developed. Our main focus has been on products that allow for (or are only open for) demand side flexibility, have capacity remuneration, and have infrequent activation. Below are the main results of the market survey:

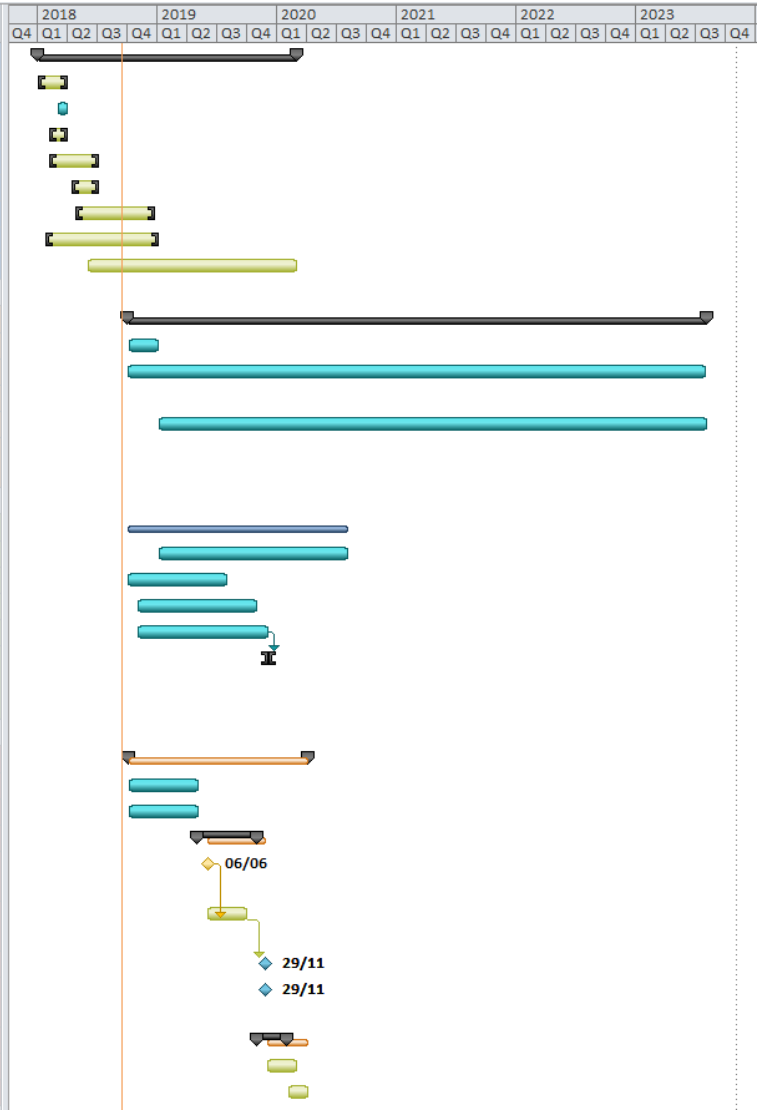
Table 15: Flexibility cost comparisons

Country	Product	Period	Availability	Energy	Trend
GB	STOR	2013-2016	4.83 £/MW/h	135.91 £/MWh	No clear trend
GB	Capacity market	2014-2017	23.23 £/kW/yr		Price increasing, till last auction capacity market
Germany	Minute Reserve (R3)	2010-2015	20 k€/MW/yr		Price decreasing over last 5 years
France	Reserve Rapide (mFRR)	2015-2017	24 – 36 k€/MW/yr		Price decreasing over last 3 years
France	Reserve Complémentaire (RR)	2015-2017	16 – 21 k€/MW/yr		Price decreasing over last 3 years
Belgium	R3Flex long term	2014-2016	3.20 €/MW/h		No clear trend
Belgium	R3Flex short term	2016-2017	3.47 €/MW/h		No clear trend
Belgium	ICH	2014-2017	1.6 €/MW/h		No clear trend
Belgium	Strategic reserve demand side	2015-2016	9.76 €/MW/h	736.73 €/MWh	No clear trend
Aggregator info	*Various, from interview*		5 – 50 k€/MW/yr	200 – 300 €/MWh	

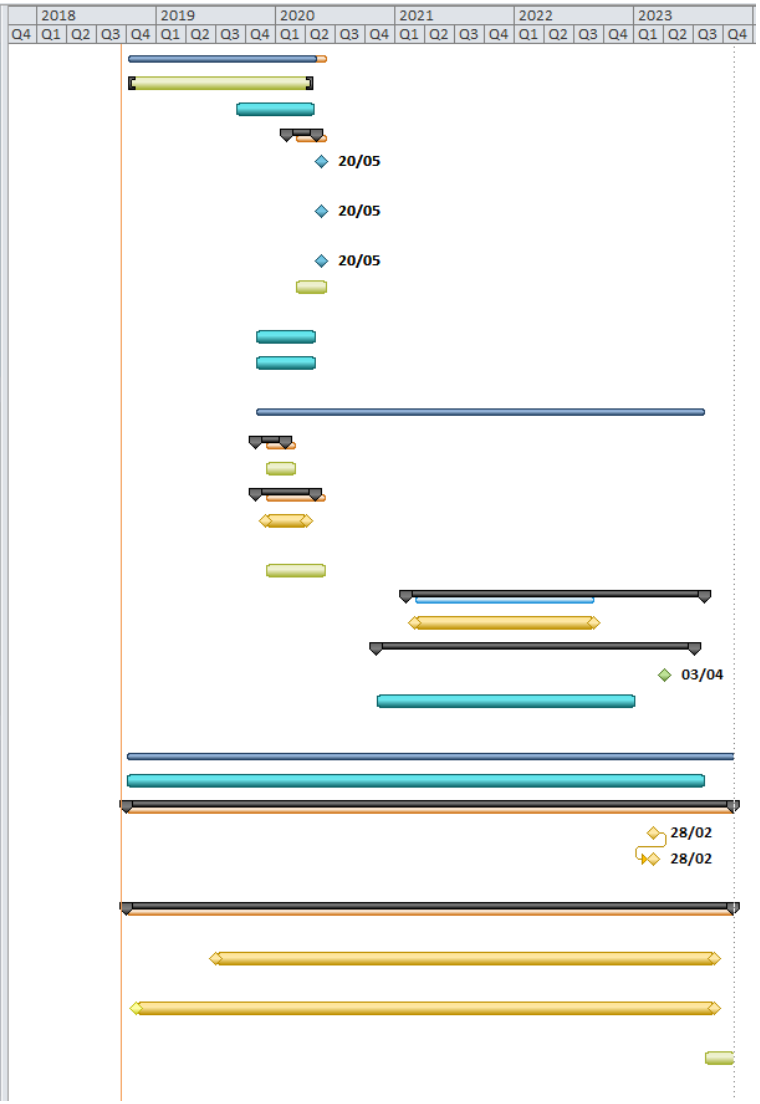
Based on the products and prices assessed in our survey, our business case calculation assumes a market price for flexibility utilisation: [redacted] **per MWh for the Bilateral Flexibility** and [redacted] per MWh to reflect the expected minimum benefits of competition.

Appendix E Project delivery programme

	Task Name	Duration	Start	Finish
1	**Project setup and initiation**	**565 days**	**Mon 01/01/18**	**Fri 28/02/20**
2	Ofgem conditions - DNO coordination	66 days	Mon 01/01/18	Mon 02/04/18
3	Formalise project delivery board (Steering Group & Technical Board)	23 days	Thu 01/03/18	Mon 02/04/18
4	Project Partner Contractual arrangements	40 days	Mon 05/02/18	Fri 30/03/18
5	DNO-DNO Collaboration Documentation	110 days	Mon 05/02/18	Fri 06/07/18
6	DNO-DNO Collaboration sign off / Submission to Ofgem	62 days	Thu 12/04/18	Fri 06/07/18
7	NIC Contracts in place with partners	176 days	Mon 23/04/18	Mon 24/12/18
8	FUSION Projetct USE case with Enterprise Service bus	247 days	Tue 23/01/18	Wed 02/01/19
9	***Deliverable: Common T.E.F. Stage Gate 18 months after project kick off***	***457 days***	***Fri 01/06/18***	***Sat 29/02/20***
10				
11	**WP1: Stakeholder Forum**	**1263 days**	**Mon 01/10/18**	**Wed 02/08/23**
12	Stakeholder mapping	65 days	Thu 04/10/18	Wed 02/01/19
13	National stakeholder events	1261 days	Mon 01/10/18	Mon 31/07/23
14	2 Events per year - collaboration with T.E.F. at selected events			
15	Trial location stakeholder events	1195 days	Thu 03/01/19	Wed 02/08/23
16	Multiple localised events, public consultation, trail engagement, trial support, knowledge dessimination			
17				
18	**WP2: Evaluate flexibility market in East Fife**	**481 days**	**Mon 01/10/18**	**Mon 03/08/20**
19	Customer mapping & network connectivity	413 days	Thu 03/01/19	Mon 03/08/20
20	Desktop flexibility quantification	218 days	Mon 01/10/18	Wed 31/07/19
21	Onsite customer surveys	261 days	Fri 02/11/18	Fri 01/11/19
22	Analysis and report on flexibiltiy	282 days	Fri 02/11/18	Mon 02/12/19
23	***Deliverable 1.1: Deliver report on quantification of flexibility market value in E Fife, including robust assessments across voltage levels, market sector, industry type***	***1 day***	***Wed 04/12/19***	***Wed 04/12/19***
24				
25	**WP3: USEF fit to the UK**	**369 days**	**Thu 04/10/18**	**Tue 03/03/20**
26	GB legal and regulatory framework	153 days	Thu 04/10/18	Mon 06/05/19
27	GB market structure & flexibility validation and pricing	153 days	Thu 04/10/18	Mon 06/05/19
28	Public consultation	131 days	Thu 02/05/19	Thu 31/10/19
29	***Deliverable 2.1: Deliver the consultation document on the basis of workshops***	***0 days***	***Thu 06/06/19***	***Thu 06/06/19***
30	***Deliverable 2.2: Hold an open public consultation for a three month duration***	***88 days***	***Mon 03/06/19***	***Wed 02/10/19***
31	***Deliverable 2.3: Report on consultation responses and analysis***	***0 days***	***Fri 29/11/19***	***Fri 29/11/19***
32	***Deliverable 2.4: Report on associated changes to USEF implementation plan***	***0 days***	***Fri 29/11/19***	***Fri 29/11/19***
33	USEF implementation plan for GB	66 days	Fri 01/11/19	Fri 31/01/20
34	***Deliverable 3.1: FUSION USEF implementation***	***66 days***	***Mon 02/12/19***	***Mon 02/03/20***
35	***Deliverable 3.2: Report on GB specific reference implementation of USEF***	***44 days***	***Mon 03/02/20***	***Thu 02/04/20***



	Task Name	Duration	Start	Finish
37	**WP4: Enabling technologies**	**413 days**	**Thu 04/10/18**	**Mon 04/05/20**
38	IT Integration	405 days	Thu 04/10/18	Wed 22/04/20
39	USEF redesign	172 days	Mon 02/09/19	Tue 28/04/20
40	DNO Process design & implementation	66 days	Mon 03/02/20	Mon 04/05/20
41	***Deliverable 4.1: Provide specification of communication and procurement platform***	***0 days***	***Wed 20/05/20***	***Wed 20/05/20***
42	***Deliverable 4.2: Provide specification of communication protocols between market participants***	***0 days***	***Wed 20/05/20***	***Wed 20/05/20***
43	***Deliverable 4.3: Provision of template flexibility contracts***	***0 days***	***Wed 20/05/20***	***Wed 20/05/20***
44	***Deliverable 4.4: Quantify market participant costs for implementing USEF interface compatibility***	***66 days***	***Tue 03/03/20***	***Tue 02/06/20***
45	Aggregator processes	131 days	Fri 01/11/19	Fri 01/05/20
46	NEW GB USEF roles	131 days	Fri 01/11/19	Fri 01/05/20
47				
48	**WP5: Trial**	**979 days**	**Fri 01/11/19**	**Wed 02/08/23**
49	Trial design	66 days	Fri 01/11/19	Fri 31/01/20
50	***Deliverble 5.1: Identify two trial locations***	***66 days***	***Mon 02/12/19***	***Mon 02/03/20***
51	Tender setup, delivery support and evaluation	131 days	Fri 01/11/19	Fri 01/05/20
52	***Deliverable 5.2: Identify the required flexibility services available from flexibility providers***	***89 days***	***Mon 02/12/19***	***Thu 02/04/20***
53	***Deliverable 5.3: Contract for flexibility services***	***131 days***	***Mon 02/12/19***	***Mon 01/06/20***
54	Trial delivery	653 days	Mon 01/02/21	Wed 02/08/23
55	***Deliverable 5.4: Undertake live trials***	***391 days***	***Mon 01/03/21***	***Mon 29/08/22***
56	Trial evaluation, analysis and reporting	697 days	Mon 02/11/20	Tue 04/07/23
57	***Deliverable 5.5: Report on the implementation and analysis of USEF trials***	***0 days***	***Mon 03/04/23***	***Mon 03/04/23***
58	Refine USEF GB implementation plan	566 days	Mon 02/11/20	Mon 02/01/23
59				
60	**WP6: Knowledge dissemination**	**1329 days**	**Mon 01/10/18**	**Thu 02/11/23**
61	Participation in workshops/events	1263 days	Mon 01/10/18	*Wed 02/08/23*
62	Dissemination reporting	1327 days	Mon 01/10/18	Tue 31/10/23
63	***Deliverable 6.1: Academic modelling report on GB flexibility***	***0 days***	***Tue 28/02/23***	***Tue 28/02/23***
64	***Deliverable 7.1: Report on coordination and hierarchies of control for flexibility, in collaboration with the ENA Open Networks Programme***	***0 days***	***Tue 28/02/23***	***Tue 28/02/23***
65	Comply with knowledge transfer requirements of the Governance Document	1327 days	Mon 01/10/18	Tue 31/10/23
66	***Deliverable OFGEM.1: Annual Project Progress Reports which comply with the requirements of the Governance Document***	***1088 days***	***Wed 03/07/19***	***Fri 01/09/23***
67	***Deliverable OFGEM.3: Evidence of attendance and participation in the Annual Conference as described in the Governance Document***	***1263 days***	***Thu 01/11/18***	***Mon 04/09/23***
68	***Deliverable OFGEM.2: Completed Close Down Report which complies with the requirements of the Governance Document***	***66 days***	***Thu 03/08/23***	***Thu 02/11/23***



Appendix F Risk register

The following rigorous risk register has been developed using well established SP Distribution methodologies, and demonstrates rational and effective risk management and appropriate risk mitigation measures to ensure the successful delivery of FUSION.

Probability of risk occurring	
Score	Probability
1	Very low
2	Low
3	Medium
4	High
5	Very high

Reputational impact	
Score	Impact
1	Minor: Department awareness
2	Medium: Company awareness
3	Major: National awareness

Financial impact	
Score	£k
1	<10
2	10-100
3	100-500
4	500-1000
5	>1000

Overall risk	
Score	Impact
0-9	Low risk
10-29	Medium risk
30-40	High risk

				Inherent Risk					Residual Risk			
Risk No.	Issue	Risk Description	Potential Impact	Probability (1-5)	Financial Impact (1-5)	Reputation Impact (1-3)	Overall Risk (2-40)	Control Measure(s)	Probability (1-5)	Financial Impact (1-5)	Reputation Impact (1-3)	Overall Risk (2-40)
1. Technical risks												
1.01	USEF compatibility to UK market	GAP analysis reveals that the USEF framework is poor fit for the UK regulated energy market	USEF implementation requires significant adaptation/halted	2	3	3	12	1. Ensure high TRL level of USEF framework. 2. Undertake preliminary GAP analysis. 3. Review lessons learned from early USEF trials in the Netherlands.	1	3	2	5
1.02	SP Distribution ICT systems compatibility	SP Distribution communications infrastructure is unable to readily adopt USEF framework and flexibility market.	USEF implementation delayed and requires significant DNO adaptation	3	4	3	21	1. Coordinate SP Distribution ICT infrastructure changes with ongoing GIS projects. 2. Sufficient support from specialist competent external GSI analyst and data scientist resources.	1	3	3	6

1.03	Market participants interoperability with USEF protocols	Market participants involved in the trial element of FUSION are unable to readily adopt USEF due to ICT infrastructure compatibility issues.	1. Few market participants come forwards for the project trial. 2. USEF trial delayed	3	3	2	15	1. Early stakeholder engagement with market participants to inform them of the USEF framework and trial. Use existing engagement mechanisms such as the UK branch of the Aggregators Association. 2. Work with market participants during the project to inform the project on aggregator needs. 3. Thorough public consultation to include aggregator community. 4. Anticipate costs associated with interoperability during the tendering phase of the trial.	1	2	2	4
	Summative Risk Scores			8	10	8	48		3	8	7	15
2. Procurement, manufacturing and installation risks												
2.01	Insufficient flexibility	Work package 2 results in limited load and generation flexibility available in the East Fife region.	1. Inability to develop a functioning commodified flexibility market to overcome SP Distribution constraints. 2. Halted trial implementation of USEF.	3	3	3	18	1. Continue already established engagement with key flexibility partners at the University of St Andrews, Levenmouth Community Energy Project, SAC Consulting, and Fife Council. 2. Refer to the preliminary load assessments undertaken during the FSP development stage to define and approach relevant potential flexibility providers. 3. Ensure appropriate promotion and explanation of the flexibility market concept to potential flexibility providers. 4. Cover sufficiently broad geographical area to encompass flexibility providers. 5. Where flexibility has already been contracted with other parties, develop revenue stacking capabilities to allow flexibility providers to harness multiple flexibility markets simultaneously.	1	2	3	5
2.02	Insufficient market participant interest	market participants do not regard the DNO constraint management market sufficiently profitable.	market participant do not engage and partake in FUSION trials. Trials are delayed/withdrawn.	3	4	3	21	1. Early engagement with market participant through the stakeholder engagement work package. 2. Ensure that contracted 'availability payments' are both relevant to DNO constraint management zones issues, and concurrently sufficient to maintain market participant interest. 3. Ensure that market participant have the ability to stack revenues based on multiple flexibility markets, therefore making incremental profits by participating in DNO level constraint management zone flexibility markets. 4. A range of flexibility providers have been identified as partner organisations in FUSION.	2	3	2	10

2.03	Limited support for USEF implementation	A broad range of stakeholders are not convinced that USEF is a suitable framework for a flexibility market.	USEF not supported in its initial form. USEF implementation must be significantly adapted prior to adoption.	4	4	2	24	1. An broad-based stakeholder forum (WP1) is developed early in the project, and maintained throughout course of the project. This allows objections to be reasonably dealt with in sufficient time. 2. A full public consultation is developed as part of WP3. This will allow stakeholder to raise contributions to USEFs implementation. 3. Sufficient time and resource is allocated to adjust USEF on the basis of the public consultation analysis.	2	2	1	6
2.04	Distribution management systems	Unable to interface and interact with existing distribution management systems due to non-supportable architecture	Unable to link sources of flexibility with distrbution assets.	4	4	2	24	1. Engagement with internal Real Time Systems and corporate IT has been undertaken during the full proposal development. 2. Delivery of a well-defined specification will be developed for interoperability of key functions. 3. Connectivity modelling identified and resourced during project delivery. 4. Suite of options identified to develop connectivity between distribution management systems and sources of flexibility for use during the trial phase.	2	2	1	6
	Summative Risk Scores			14	15	10	87		7	9	7	27
3. Operational risks												
3.01	Flexibility reliability	market participant in the flexibility marketplace cannot be depended on to supply demand-side flexibility for the DNO.	Commoditised flexibility is not used for DNO constraint management. Standard reinforcement is relied on to relieve distribution network constraints.	2	5	2	14	1. During the trial (WP5), flexibility providers are well-educated on the expectations placed on them. Customer education is highlighted in WP1, stakeholder engagement. 2. market participant are responsible for providing contracted flexibility are able to install secure and reliable demand control equipment in flexibility providers premises. 3. For roll-out, competitive aggregators are contracted to supply flexibility and carry the risk for reliability. Where they are unreliable, the market will reflect past performance.	1	3	2	5
3.02	Cyber security	The electricity flexibility marketplace is at risk of offensive cyber attacks.	1. Sensitive customer information is stolen. 2. Control of flexible demand is overridden by hostile agents.	2	5	3	16	1. Dialogue with internal cyber-security experts is opened early in the project and maintained throughout. 2. Precautionary measures and procedures are developed and diligently followed by the DNO, aggregators, and flexibility providers. 3. Standard resilience procedures are followed in the event of a cyber-attack.	1	3	3	6

3.03	Settlement procedures	Settlement procedures are not delivered to aggregators and customers in a professional manner.	1. Financial settlements are delayed in time. 2. USEF users are dissatisfied with the flexibility market framework and may request adjustments.	2	5	3	16	1. Settlement procedures are well developed based on USEF foundation findings and established protocols. 2. Settlement procedures are an element of the USEF public consultation in WP3. Stakeholder are given a chance to voice adjustments in a timely manner.	1	3	2	9
3.04	Cloud trading platform use	The Cloud procurement platform on which aggregators can bid for DNO flexibility contracts is not suitable.	1. Aggregators are unable easily navigate the platform making the bidding procedure difficult. 2. Future flexibility providers and customers are sceptical about the use of a cloud IT platform and do not join the flexibility market.	3	5	3	24	1. The cloud platform is developed as part of an open procurement tender process, where the most suitable and reliable provider is selected. The platform is open for discussion both at the stakeholder forum (WP1), and as part of the public consultation (WP3).	1	2	2	2
			Summative Risk Scores	9	20	11	70		4	11	9	22
4. Project Management risks												
4.01	Higher costs	Cost of scheme higher than anticipated	Exceedance of project budget; and risk of halting the demonstration project.	2	4	2	12	1. FIDIC contract terms should be used, such that the contractor takes on the risk; 2. Contingency funding deemed to be reasonable and sufficient.	1	3	1	4
4.02	Resources	Sufficient resources are not available in SP Distribution to deliver the project	Delay in delivery of the project and impact on quality of deliverables	2	4	3	14	1. Effective engagement with Director level in SP Distribution to provide clear understanding about project size and resource required 2. Use competent external resources where necessary	1	2	2	4
			Summative Risk Scores	4	8	5	26		2	5	3	8

Appendix G Engagement plan

1. Project Background

Throughout FUSION, SP Distribution will engage with the project partners, potential and existing customers, and stakeholders to provide clear explanation of the scope of the project and their role in the project; and to ensure that the flexibility market developed is acceptable and will be adopted by all parties. Therefore this plan will outline why, how and when SP Energy Networks will engage with the customers as part of FUSION.

2. Engagement Strategy

SP Energy Networks aims to engage with the participants of the project, by undertaking the following activities where appropriate, working with relevant project partners, and existing communities as required:

- Hold regular six monthly stakeholder events in respect of FUSION to provide information on the project, objectives, and how stakeholders can participate
- Engage in a targeted consultation with relevant stakeholder groups working with project partners SAC, Fife Council and the University of St Andrews
- Publish information on the types of energy services products requested and detail how customers and market participants can seek to serve those requirements
- Publish consultation on the principles of the USEF concept and how it could be developed for adoption across the GB energy market
- Publish report on the outcomes and analysis of the public consultation
- Publish a USEF implementation plan, taking in to account the outcomes of the public consultation

3. Key engagement points

Key points in the project will require engagement to enable informed and suitable decision to be made and implemented:

- Project setup
- Flexibility assessments and quantifications
- Public consultation
- Public consultation analysis and reporting
- Trial recruitment
- Trail operation
- Leaning dissemination

4. Providing and receiving information

General information

- FUSION will provide relevant information to market participants and industry stakeholders through forum meetings, written material, web-based material, and visual media.
- Information on the scope, progress and outcome of the project will be provided in these forums.
- Dialogue will be sought in all communication forms, allowing two-way engagement and the ability for stakeholders to influence and impact FUSION development and implementation.
- In conjunction with ENA workstream 3, FUSION will actively partake in industry engagement

5. Partnership Working

SP Energy Networks is undertaken with multiple project partners; this collaborative approach is designed to develop a well-rounded input into FUSION, and lead to be most equitable and adoptable flexibility market, thereby expediting GB roll-out suitability and readiness.

Project partners are:
DNV GL Ltd; PassivSystems Ltd; Origami Energy Ltd; Imperial College London; SAC Consulting Ltd; University of St Andrews; Fife Council; Bright Green Hydrogen Ltd

6. Facilities to Handle Enquiries

Enquiries

Customers can ask questions or raise queries related to FUSION through the means of the following platforms:

WEBSITE:

Information on the project will be available on a section of the SP Energy Networks website: https://www.spenergynetworks.co.uk/pages/innovation.aspx providing details of the project, FAQs, and contact details.

POST:

Customers can contact the Project team by post at the following address:
FUSION, Future Networks
SP Energy Networks
Ochil House, 10 Technology Avenue
Glasgow, G72 0HT

EMAIL: FUSION@spenergynetworks.com

7. Feedback & Review

Feedback can be given through filling out the form posted on the website. All feedback will be taken recorded, responded to, and taken into account.
The project board will work with the project partners to disseminate the learning points and seek feedback from interested parties.

Learning from other projects

FUSION builds on learning available from other network innovation project; this is a key process in the GB network innovation model adopted by Ofgem, and highlights the interaction of SP Distribution with other DNOs, and progressive nature of innovation within SP Distribution.

Key learning will be observed from a range of past and present projects. Table 16 below outlines the principal learning outcomes incorporated into FUSION, whilst simultaneously demonstrating the additionality of FUSION over and above the current state of the arts.

Table 16: Key learning incorporated into FUSION, and clear additionality of FUSION

Project name	Network lead	Category/tier	Completion date	Flexibility qunatification	DSR	Commercial contracts	Accelerated connections	Local consttaint management	Standards and practices	Neutral market facilitator
Low Carbon London	UKPN	2	June 2014	x	x	x		x		
C2C	ENW	2	Dec 2014	x	x	x		x		
CLASS	ENW	2	Sept 2015	x	x	x				
FALCON	WPD	2	Sept 2015		x	x	x			
GB Non-renewable Embedded Generation Forecasting	NGET	NIA	Jan 2018	x						
Optimisation of Energy Forecasting	NGET	NIA	Feb 2018	x						
TDI2.0	NGET & UKPN	2	Dec 2019	x	x	x				
Entire	WPD	NIA	June 2020	x	x	x		x		
FUSION	SPD	2	Dec 2022	x	x	x	x	x	x	x

Flexibility quantification

FUSION enables a local flexibility market to develop for distribution network management purposes whilst supporting wider network balancing purposes. To this end, a thorough quantification of the market potential is undertaken in WP2. Prior projects have similarly quantified flexibility and engaged with customers; however, the nature of prior engagement has been with assets and availability. Whilst this approach is valid and can inform FUSION, quantification with a market objective creates a different approach whereby flexibility is quantified relative to their probable market engagement and value. No other project has assessed the open market instruction of flexibility or quantified flexibility in the manner. This goes beyond simply the quantity and value of flexibility to the DNO, but assesses market interest, availability, market value based on alternative routes to market (STOR, system balancing etc.).

Projects 'GB Non-renewable Embedded Generation Forecasting', 'Optimisation of Energy Forecasting' and 'TDI2.0' all consider the flexibility offered by distribution level assets with the aim of resolving transmission level network management issues. This form of flexibility quantification again dismisses an open flexibility market, instead assuming operational control for the TO and SO. As suggested, FUSION goes beyond this to asses market value of quantified flexibility.

Notably, FUSION takes learning directly from the SP Distribution LCNF project 'Flexible Networks for a Low Carbon Future', and applies a 20% uplift to network infrastructure prior to instructing flexibility, based on the asset rating outcomes of the project.

DSR

DSR is central to multiple projects. The process and actions for calling upon DSR for DNO use will contribute significantly to FUSION, with projects C2C, Low Carbon London, and Entire informing this process.

FUSION looks to four specific case studies and outlines in the FSP; flexibility product descriptions are developed for all of these scenarios. Of these, two case studies of 33 kV reinforcement are taken forwards for trial to resolve constraint management issues. Above projects review DSR for specific issues. For example, CLASS reviews only voltage management issues. By developing four product descriptions, FUSION creates a well-rounded approach to DSR in a market environment.

Commercial contracts

Commercial contracts are integral to DSR; contracts are, however formed directly between flexibility provider and network operators in the above projects. Low Carbon London notes the difficulty of constructing contractual arrangements between customers and the DNO. They extend contractual arrangements to include commercial aggregators, however, these are similarly contracted with a DNO, rather than in an pen framework. C2C, CLASS, FALCON and Entire contract directly with customers; these provide useful reference frameworks and highlight valid issues and learning relevant to FUSION, however, they do not contract an open framework for commercial contract.

Accelerated connections

Flexibility can reduce constraints and thereby facilitate early connections that would otherwise require traditional reinforcement. These alternative connections are trialled by CLASS and FALCON, and demonstrate the value in this. For FUSION, important learning can be integrated on maintaining regulatory requirement and sector of supply to new demand customers through alternative connections.

Stakeholder engagement

Stakeholders are vital to DSR projects, holding the ability to block or unlock the potential flexibility in networks. FUSION will embrace the learning outcomes of prior stakeholder engagement effort, and develop on important communication and engagement frameworks that have been developed through other projects.

Local constraint management

FUSION develops case studies and trial based on a constraint management product. Importantly, constraints are geographically local in nature. Learning from distribution level constraints highlighted in Low Carbon London, C2C, FALCON and Entire will be absorbed in FUSION, and specifications and product definitions contracted on prior learning.

Additionality of FUSION from other projects

FUSION extends on prior innovation projects in two distinct areas; FUSION develops standard codes and adopted practices in DSR, and FUSION acts as a neutral market facilitator, effectively enabling a flexibility market to form without any initiation of direct contracting.

Standards and practices

In order to resolve complex and multifarious contracting arrangements highlighted in projects above, FUSION develops standard through a singular market framework to enable an effective market accessible by all relevant parties. USEF develops procedures and processes to ease the flexibility market, and to lower the cost of entry for all flexibility market actors. This innovative development clearly extends on the existing DSR models available for DNOs, and acts to coordinate multiple and otherwise costly and incompatible models.

Neutral market facilitator

FUSION does not align the DNO with any single flexibility actor; instead, it facilitates the construction of a competitive market driven solution to demand flexibility. This removes the potential for network market distortion, neutralises conflicts between market actors, and encourages value for money for customers through open competition and choice. These factors set FUSION beyond the contracting methodologies currently developed for distribution network DSR.

Coordination with concurrent projects

FUSION will act alongside other concurrent innovation projects. Natural synergies between projects will be capitalised on to produce best value for money for customers, and to inform the best route forwards towards distribution level flexibility.

- Transition (SSEN) is a NIC 2017 submission. This project will look at multiple DSO models. TRANSITION and FUSION have had open dialogue in the FSP preparation phase, and concluded to coordinate shared opportunities and learning through the ENA workstream 3 for the most effective project development.

- EFFS (WPD) is a NIC 2017 submission examining detailed load forecasting for constraint management, and flexibility services. WPD and SP Distribution have engaged in dialogue around project synergies, and have agreed to undertake projects both informing the ENA workstream 3. Commercial models in EFFS and FUSION will be evaluated in detail and both used to inform the development of flexibility for DNOs.

- Entire (WPD) is an ongoing NIA project. Dialogue has been developed during the course of the FSP development phase, including an on-site visit. Project synergies in IT specification development at both SP Distribution and WPD will coordinate for the benefit of both parties. Market structures and inclusion of aggregators in FUSION are notably different in nature to Entire; however, nuanced evaluation of processes will be undertaken to find and develop shared interest and developments.

USEF development project

USEF has been developed to its current technology readiness level through multiple project iterations. This process has led to the current full trial development stage proposed in FUSION. Previous projects demonstrate the strong basis for USEF, its innovative potential and the need for adoption for operational flexibility. FUSION builds rom these contributory projects and learnings, as outlined in Figure 29.

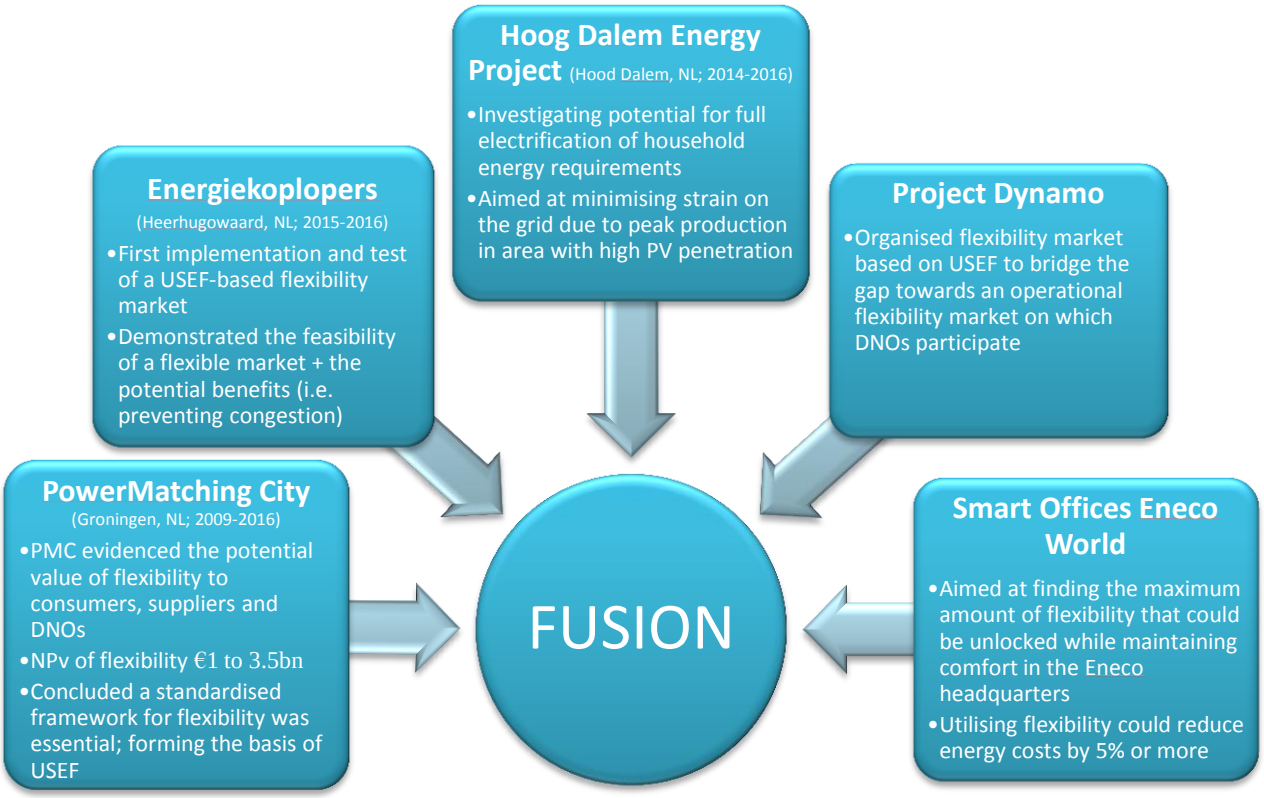


Figure 29: Overview of USEF related smart grid pilots in the Netherlands on which Fusion will build

Appendix I Project governance structure and key roles

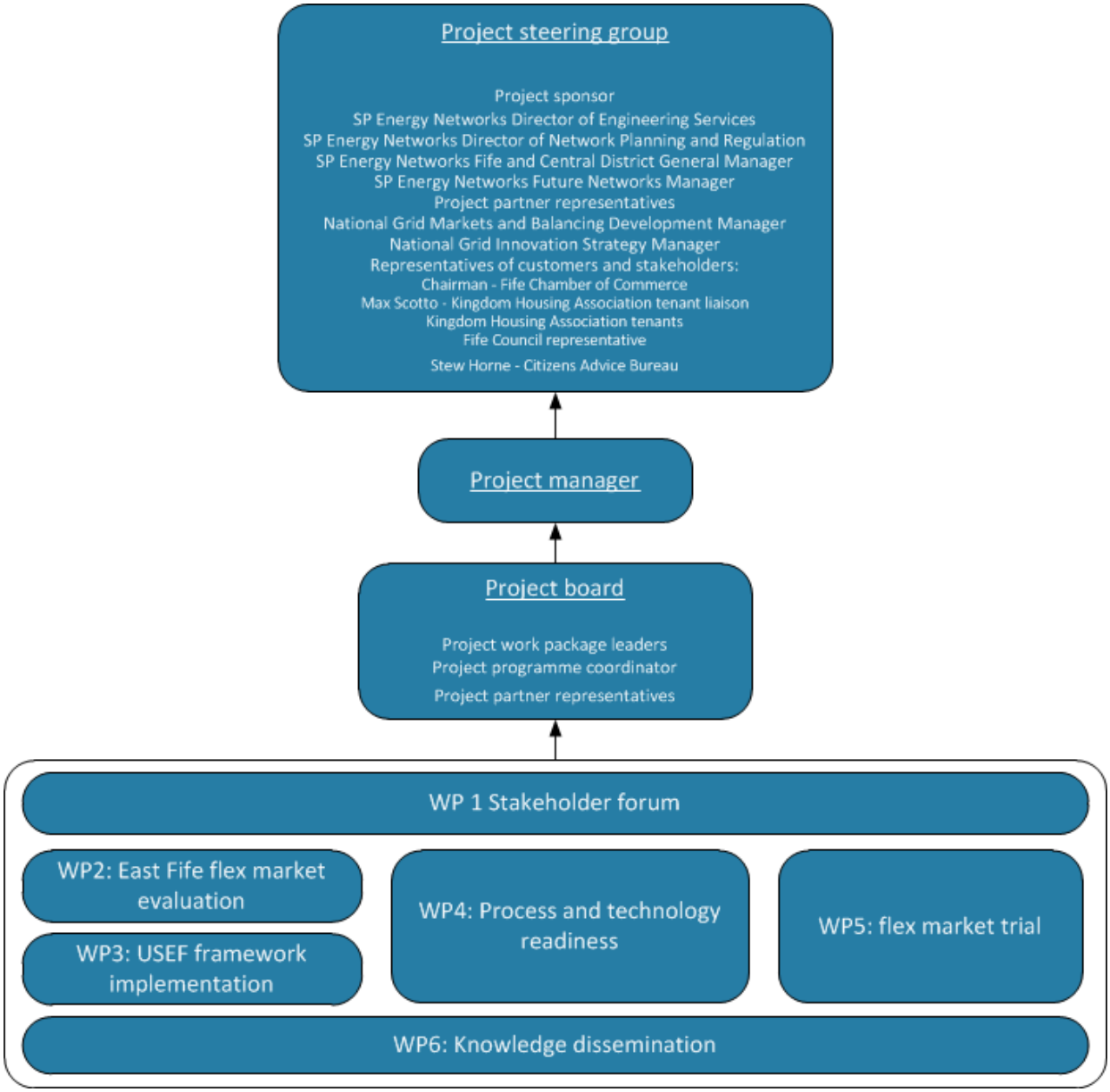


Figure 30: Project Governance

Project governance structure

The governance structure is outlined in Figure 30 and text in section 6.4.

Project board

The project delivery team are responsible for the timely and accurate progression of project FUSION. The core delivery team will consist of 3 FTE at SP Distribution, as outlined in the project budget, in addition to work package specific delivery resources from all project partners listed in appendix J.

Project steering group

The project steering board is responsible for the strategic direction and purpose of project FUSION, and comprises stakeholders and customers, technical experts, executive level directors within relevant organisations.

Key project roles

Specific roles within the project are responsible for project tasks and deliverables within work packages. Below are key roles that will be undertaken through FUSION; note that roles may be drawn upon from internal and external resources and do not equate to full time equivalents.

Table 17: Key project roles

Key Role	Delivered by	Description
Stakeholder engagement manager	SP Distribution resource	Responsible for developing and maintaining effective and meaningful dialogue with stakeholders, including flexibility providers, aggregators, DNOs, and wider industry partners. The role will be reporting principally within WP1.
Flexibility quantification specialists	Origami Energy Ltd; PassivSystems Ltd; SAC Consultants.	A specialist role that undertakes a thorough objective quantification of true flexibility within East Fife. Will be delivered for I&C, domestic, and agricultural customers, respectively.
USEF Public consultation manager	DNV GL	A managerial role with responsibility for ensuring a wide ranging and successful consultation on the implementation of USEF. The role will be within WP3.
USEF implementation developer	DNV GL	To guarantee the appropriate and informed implementation of USEF within the trial, as well as the wider GB market. This role will oversee implementation of USEF processes, market and product design, and evaluation – ensuring satisfactory standards for all stakeholders.
IT platform developer	This role will be tendered for through an open procurement process during project delivery.	The development of an IT platform for DNO flexibility will require significant technical specialist skills, and direct liaison with the USEF implementation developers and SP Distribution systems architecture and cyber security specialists.
DNO IT systems and architecture integration specialist	This role will be tendered for through an open procurement process during project delivery.	The IT specialists will develop a thorough and reliable integration with internal systems including PowerOn, SCADA and UMV, and will work under direction and supervision of internal SP Distribution specialists
Cyber security analyst	SP Distribution internal cyber security specialists	Advise on IT systems development, and undertake due diligence on new IT developments to ensure the integrity and security of all existing and new systems.
I&C aggregator trail participants	This role will be tendered for through an open procurement process during project delivery.	Aggregators will be invited to partake in the live monetised USEF trial. A competitive tender will inform the choices of multiple market participations.
Project academic modeller and analyst	Imperial College London	Undertake extensive modelling and analysis of the flexibility market created through project FUSION. This external role will offer great project scrutiny, and provide a significant knowledge dissemination route.
Knowledge manager	Internally resourced within SP Distribution	Responsible for capturing and disseminating appropriate project learnings through all relevant channels.

About 	DNV GL are a founding member of the USEF foundation, and have developed in depth knowledge on the development of demand-side flexibility and implementation of the USEF framework through trials in the Netherlands.
Role of Project Partner	DNV GL will leverage its involvement (and prior investment) in the USEF foundation, providing due diligence and consultation on the GB implementation of USEF, design the flexibility market structure, designing market processes and flexibility tendering processes, monitor and validate the flexibility chain, draw technical requirements for flex products and support on business case (cost-benefit analysis) validation.
Contractual Agreement	DNV GL will contribute to FUSION on a consultancy basis, providing knowledge and support for FUSION.

About 	PassivSystems are an SME with specific R & D capability in domestic energy aggregation and demand side flexibility.
Role of Project Partner	PassivSystems will undertake domestic level flexibility assessment and quantification to understand the availability and potential for a flexibility market. PassivSystems will also consult on the development of USEF and the preparations that an aggregator would be required to undertake for full adoption.
Contractual Agreement	PassivSystems will contribute to FUSION on a consultancy basis.

About 	Origami Energy are an I & C aggregator, currently operating in the transmission market. Origami Energy offer IT architecture specialist knowledge, and energy market development competencies.
Role of Project Partner	They will provide FUSION assessment and quantification of the DNO flexibility market potential for I & C customers. Origami Energy will also offer knowledge on the preparations an aggregator is required to undertake to become USEF compliant.
Contractual Agreement	Origami Energy will contribute to FUSION on a consultancy basis.

About	The Electrical Engineering Department at Imperial College London consists of world-renowned academics with specialist knowledge and research capacity in electricity flexibility and industry developments.

Imperial College London	Imperial College a a member of HubNet, an electricity research consortium.
Role of Project Partner	Imperial College London are the academic partner, offering research, analysis and modelling support to FUSION. Imperial College London will scrutinise and examine the viability of a DNO flexibility market, and undertake knowledge dissemination activities.
Contractual Agreement	Imperial College London will contribute to FUSION on an academic consultancy basis.

About SAC CONSULTING	SAC Consulting is a division of SRUC (Scotland's Rural College) and delivers consultancy services to agricultural and rural businesses across Scotland. Specialist staff in their renewables and agricultural sector business teams will undertake this project with support from the Cupar office.
Role of Project Partner	Develop existing relationships with the agricultural and rural sector within the trial area, and inform on the nature of operational flexibility available. SAC will support stakeholder engagement activity with the rural and agricultural sector, allowing them to access information on energy demand and local generation from the agriculture sector across the study area, from this information they can then quantify the level of flexibility that would be utilised within this sector. SAC can work with other partners to the project to develop case studies and is well placed to disseminate the knowledge obtained and demonstrate the potential benefits to the wider agricultural and rural community.
Contractual Agreement	SAC will work on a consultancy basis within FUSION.

About University of St Andrews	The St Andrews Area will be carrying out a number of developments over the next 20 years, such as the University building new accommodation for staff and students, as well as redeveloping an ex-paper mill into a new innovation accelerator to provide a place where industry and academia can collaborate together to commercialise ideas into reality. There will also be a state of the art Music Centre planned for the heart of St Andrews, and the Ministry of Defence is expanding its base in Leuchars. All of these developments will contribute to the demand growth in the area.

Role of Project Partner	The new Eden Campus will host innovative technologies, some of which will be available to integrate with FUSION in 2019 onwards and may include new additional on-site electricity, energy storage, carbon capture to re-use and smart management.
Contractual Agreement	St Andrews have agreed to provide access to their estate for both flexibility quantification, and as a live trial site location. This support is offered in kind.

About 	The Fife council delivers over 500 key services to the people of Fife, and the key challenge for the council is to meet the growing needs and demands being made on their services with an ever reducing budget. In order to meet this challenge, they have set out five aims: • Growing a vibrant economy • Increasing opportunities and reducing poverty and inequality • Improving quality of life in local communities • Promoting a sustainable society • Reforming Fife's public services
Role of Project Partner	To provide FUSION with an oversight into regional developments in the energy sector, and will also demonstrate the flexibility from the local Authority estate.
Contractual Agreement	Fife Council have agreed to provide access to regional stakeholders, and to provide access to their estate. This support is offered in kind.

About 	Bright Green Hydrogen (BGH) aims to demonstrate, educate and research the potential of renewable energy technologies, namely the use of hydrogen to tackle the intermittency of renewables and as a fuel source. The Levenmouth Community Energy Project (LCEP) showcases the practical potential of such philosophy towards the decarbonisation of both energy and transportation sectors. It is therefore in BGH's best interest to promote the flexibility of assets connected to the DNO, furthering the innovative and economic potential of the assets.
Role of Project Partner	BGH will acts as a flexibility provider, allowing quantification of their flexibility market potential. BGH are a multi-vector prosumer with specific contractual generation requirements, therefore providing a real world insight into potential flexibility market engagement from a prosumer.
Contractual Agreement	Bright Green Hydrogen have agreed to provide access to their estate for both flexibility quantification. This support is offered in kind.

Appendix K Preliminary desktop potential flexibility assessment

A preliminary desktop assessment of large half hourly customers within the FUSION trial area has identified the size of loads potentially available to participle in a local flexibility market to assist SP Distribution resolve localised network congestion problems.

The assessment was performed using data for those customer connected to the local distribution network on a half hour metering basis, and is shown in Figure 31. Average customer peak usage information (kVA) has been broken down into three distinct customer types;

1. Public Buildings (i.e. schools, hospitals, libraries)
2. Private Buildings (i.e. industrial, commercial, retail)
3. Agriculture (i.e. farming, production)

Each sector represents an opportunity for customers to provider flexibility services to realise an additional return making flexibility available to manage network constraints. FUSION will refine this further within WP 2 to quantify the true flexibility and value from this initial market assessment.

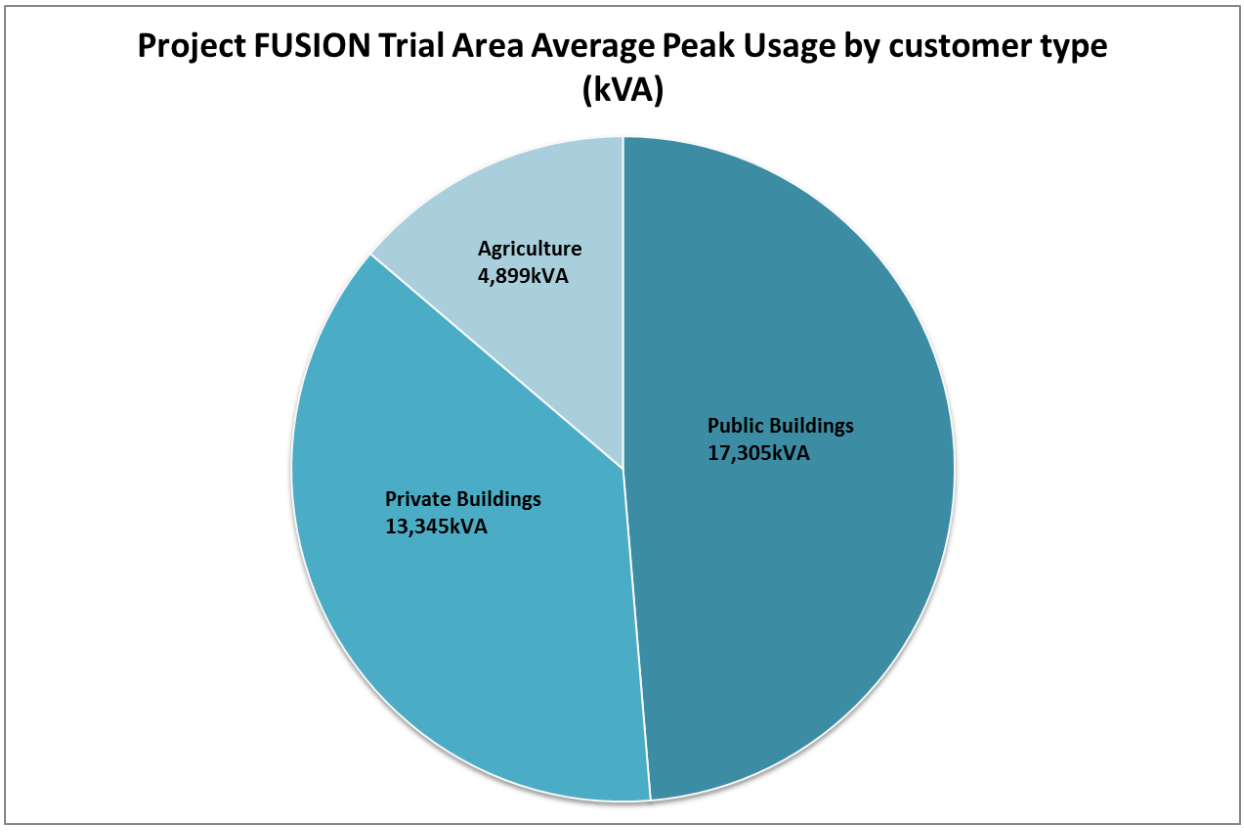


Figure 31: Pie chart of energy usage in East Fife by sector

USEF[32] is a market framework that aims to reconcile the regulatory governance of DNOs with the principles of competition that govern energy wholesale and retail markets, to optimise the allocation of flexibility across the industry, while allowing maximum freedom of choice for all industry participants. USEF is developed over more than 5 years by energy industry stakeholders, including grid operators, retailers and ICT companies and consists of a set of guidelines, roles, processes, protocols and reference implementations (see Appendix N) for the exchange of flexibility.

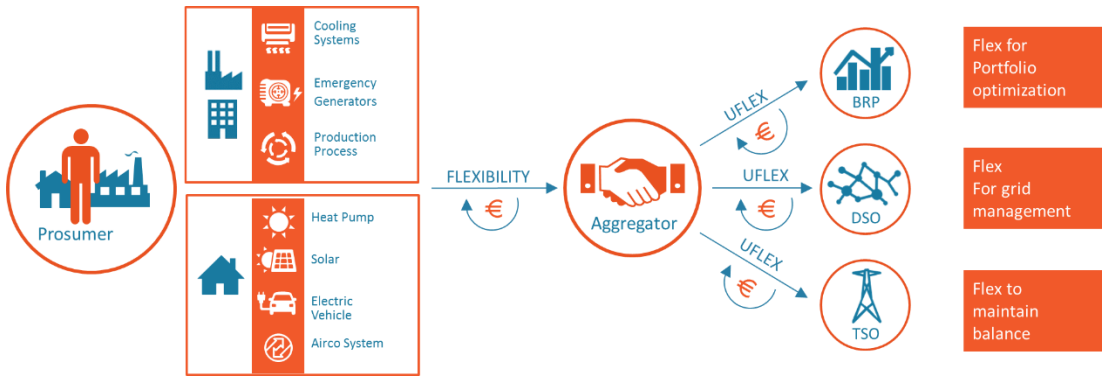


Figure 32: Overview of the exchange of flexibility for optimizing the power system

USEF fully recognises the importance of commercial signal and the role of flexibility providers. USEF describes in detail the interaction between the flexibility provider and the other energy stakeholders.

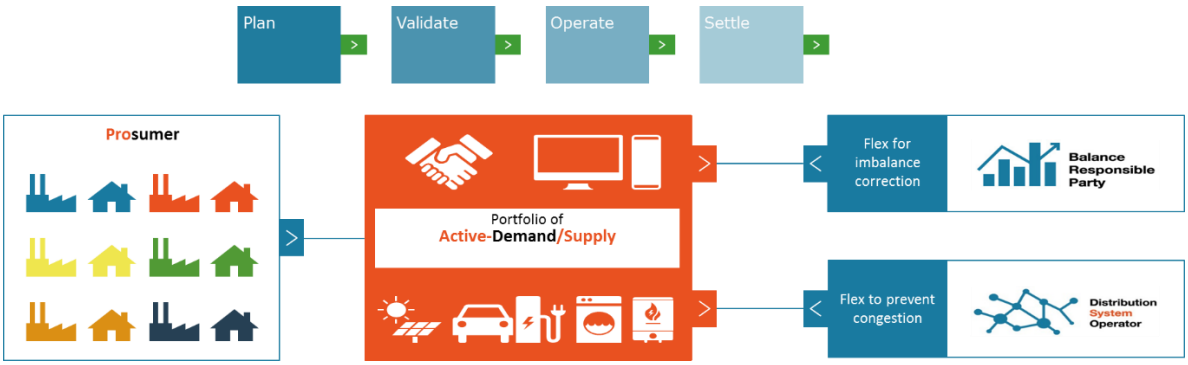


Figure 33: The role of the flexibility provider is to disclose (local) flexibility for the benefit of the power system.

By allowing DNOs access to the flexibility market, USEF creates the opportunity to optimise the use of flexibility and thus the efficiency of the energy system, as can be seen in Figure 34.

[32] More information on USEF can be found on https://www.USEF.energy

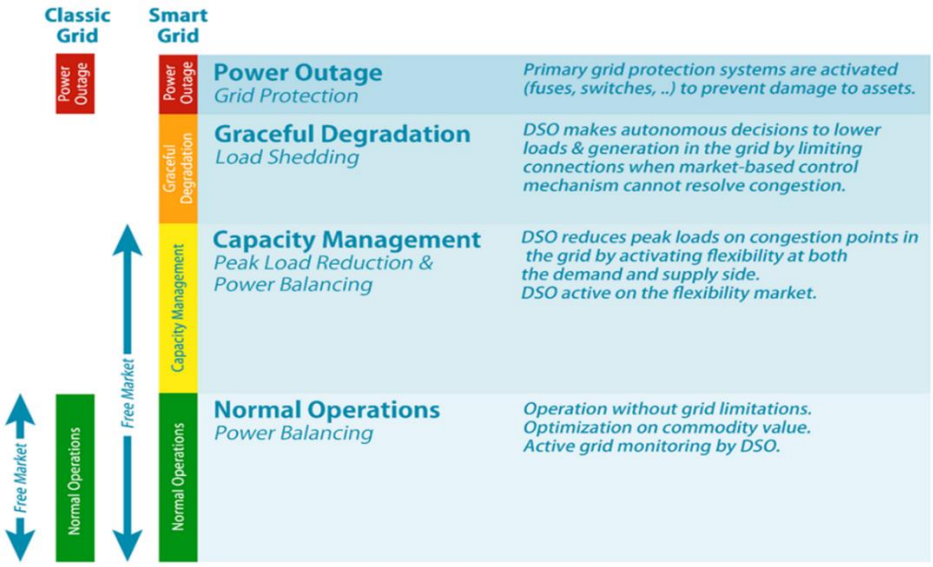


Figure 34: By creating more operating regimes USEF creates room to optimise the energy system, including the distribution and transmission system

By delivering a common standard for smart energy systems, USEF connects people, technologies, projects and energy markets. It is the basis for an integrated smart energy future that is both efficient and cost-effective. USEF helps market participants to access the following benefits:

1. Connecting smart energy products & projects
2. USEF's open ICT architecture provides the freedom to create unique and commercially competitive smart energy products and services, while delivering a common standard on which to build them. This ensures that all technologies and projects will be compatible and connectable to future smart energy systems.
3. Enabling new market opportunities
4. The smart energy market will see existing roles adapted and new roles created, some of which will be appealing to organisations outside the energy domain, from supermarkets to insurance companies. By defining the individual roles, responsibilities and interactions required, USEF enables interested parties to both understand and realise smart energy opportunities.
5. Accelerating the smart energy transition
6. Rapid transition to a smart energy future requires that the energy system is organised beyond existing roles, companies, regions and countries. We need to work together, based on a common standard, towards an integrated system that benefits everyone. USEF was founded on those principles and delivers the tools and rules to realise such a system.
7. Reducing costs

By delivering a common standard to build on, USEF reduces the cost to connect different technologies and projects to the energy system. Its market-based control mechanism then defines the rules required to optimise that whole system, ensuring that energy is produced, delivered and managed at lowest cost.

USEF uses an exhaustive list of roles. In practice, some of these roles will be combined by one party, and not all the roles are applicable in the GB market.

Table 18: Gap Analysis

USEF roles	Identified roles in GB
Prosumer	Yes
ADS (Active Supply and Demand)	Yes
Aggregator	Yes
Supplier	Yes
BRP (Balance Responsible Parties)	Yes (often Supplier)
DNO (Distribution System Operator)	Yes
TSO (Transmission System Operator)	Yes (National Grid)
Producer (Energy Suppliers)	Yes
ESCo (Energy Service Company)	Yes
CRO (Common Reference Operator)	No
MDC (Meter Data Company)	Yes
Allocation Responsible Party (ARP)	Yes (Elexon or DNO)

System operator

In the UK, the system operator role lies with National Grid for the transmission system. However, there is currently a transition ongoing to separate the system operator role further[33]. DNOs in the UK are seeking to extend their role to include system operations.

Ofgem stance on independent aggregator

According to the report 'Aggregators – Barriers and External Impacts', written by PA for Ofgem in May 2016, the lack of a decision on the independent aggregator is limiting the availability of flexibility in households.

The issue appears to be that the relationship between the aggregation of ancillary services and BRP is not well defined in the Balancing and Settlement Code. Therefore, flexibility providers have to register as a trading party of partner with a supplier. This creates difficulty when trying to close contracts with consumers for flexibility in wider markets.

Wholesale/Balancing Mechanism process fit with USEF

'USEF – The Framework Specifications' elaborates on the processes necessary for the four phases of the Market-based Coordination Mechanism: Plan, Validate, Operate and Settle. For the gap analysis, it is important that the existing processes recognized by USEF fit with the current UK market. This is based on the roles defined by ENTSO-E. No discrepancy has been found in the process fit.

Cyber Security

A short assessment of the cyber security context of USEF in the GB market is made, focusing on the messaging within the proposed system (USEF), rather than the system components themselves. Individual nations may have specific requirements for cryptography (e.g. particular algorithms which are, or are not, approved – but this is

[33] Ofgem. https://www.ofgem.gov.uk/publications-and-updates/greater-separation-national-grid-s-system-operator-role

likely to be for higher security solutions than are required here. Any solution will need to be aware of legislation (such as the coming EU General Data Protection Regulations) but this should not be overly onerous given that personal data should not be involved in this solution.

The USEF framework is at sufficiently a high level (principles rather than specifics) that there is nothing which would conflict with any legislation within the UK, irrespective of Brexit or the results of the general election.

Summary

In Table 19 below the main results of the short Gap analysis for the application of USEF in the GB market are given.

Table 19: USEF GAP analysis summary

Topic	Issue	Comment
Fit with ENTSO-E/USEF role model	No issue	
Existence of USEF defined roles	Minor issue	No CRO has been established.
Allocation and reconciliation	No issue	
System operator role (DSO/TSO)	No issue	
Market information exchange	No issue	
SP control in emergency situations	No issue	
Ofgem stance on independent aggregator	Minor issue	No final decision has been made on the independent aggregator, leading to an undefined relationship with the BRP and limited flex potential in households.
Wholesale/BM process fit with USEF	No issue	
Cyber Security specific to GB	No issue	

FUSION will use the USEF Reference Implementation (RI) as a baseline for its flexibility market tool. The reference implementation is publicly available in the form of open-source downloadable code[34]. It can easily be transferred, read, modified, and extended to suit the needs of the GB flexibility market and FUSION.

The reference implementation provides a starting point for third parties aiming to commercially exploit all or part of the USEF framework, or aiming to develop products and services built on top of the USEF framework. It is based on a three-layer architecture (pictured below). These layers enable users of the reference implementation to adopt the layers that are fit for purpose and re-implement the others, depending on their needs.

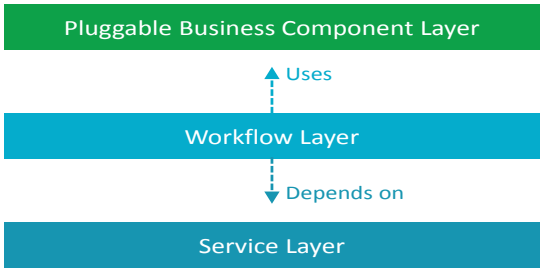


Figure 35: Architecture

Service layer
The service layer provides all the operational data stores required to realize the application components, a reliable set of communication capabilities, and logging and monitoring.

Workflow layer
The workflow layer provides, for each role in the USEF roles model, an implementation of the processes and business services specified by USEF.

Pluggable business component layer
Business decisions, such as the amount of offered flexibility or its price, are outside the scope of the USEF and should be made by the parties implementing USEF. The pluggable business component layer enables a third party to plug in custom business logic that drives its actions in a USEF workflow process step.

The reference implementation is accompanied by a set of sub-implementations of pluggable business components. These are simple implementations that contain no complex business logic. FUSION will replace these stubs with implementations that meet project-specific business requirements, either by re-implementing them or by linking into existing processes of the participating partners.

FUSION will use a complete implementation of USEF, in accordance with the USEF Flexibility Value Chain. SP Distribution (in its role as DNO) will setup a local flexibility

[34] USEF, Source code: https://github.com/USEF-Foundation/ri.usef.energy

market for n-1 congestion management on the distribution network. This market is open to multiple flexibility providers across voltage levels. Flexibility providers may unlock the flexibility present in assets and processes, and offer this via USEF's Market Coordination Mechanism to a BRP, ISO and/or DNO.

USEF assumes a contract relationship between flexibility providers and BRPs to ensure that activation of flexibility is well reflected in energy supply and balance position.

All USEF roles needed in FUSION will be hosted in a single instance of the USEF RI. However, any market participant (i.e. a market party taking a role) is free to decide to not use the USEF RI and implement the messaging towards other actors on their own.

Flexibility providers will need to establish a connection the Active Demand & Supply (ADS) technology at the source of flexibility. This is within the domain of the provider and outside the USEF RI. The provider can use a direct IP-based connection, or a connection via a home gateway, or, if present, use the existing connection provided by the device vendor. USEF's Device Interface (UDI) is an example interface on this level that could be implemented. UDI is supported by the reference implementation.

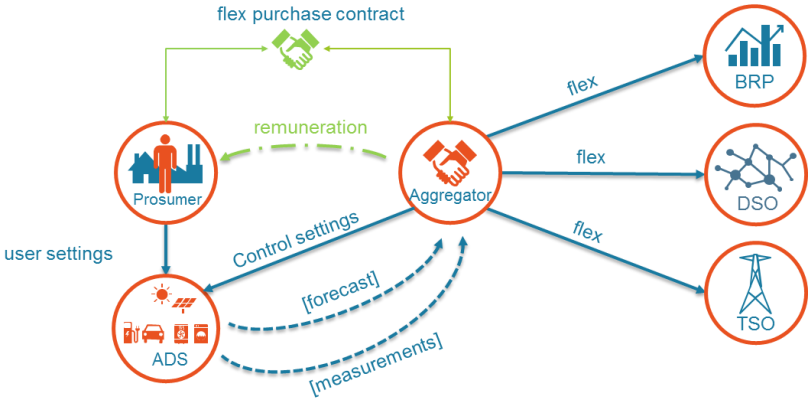
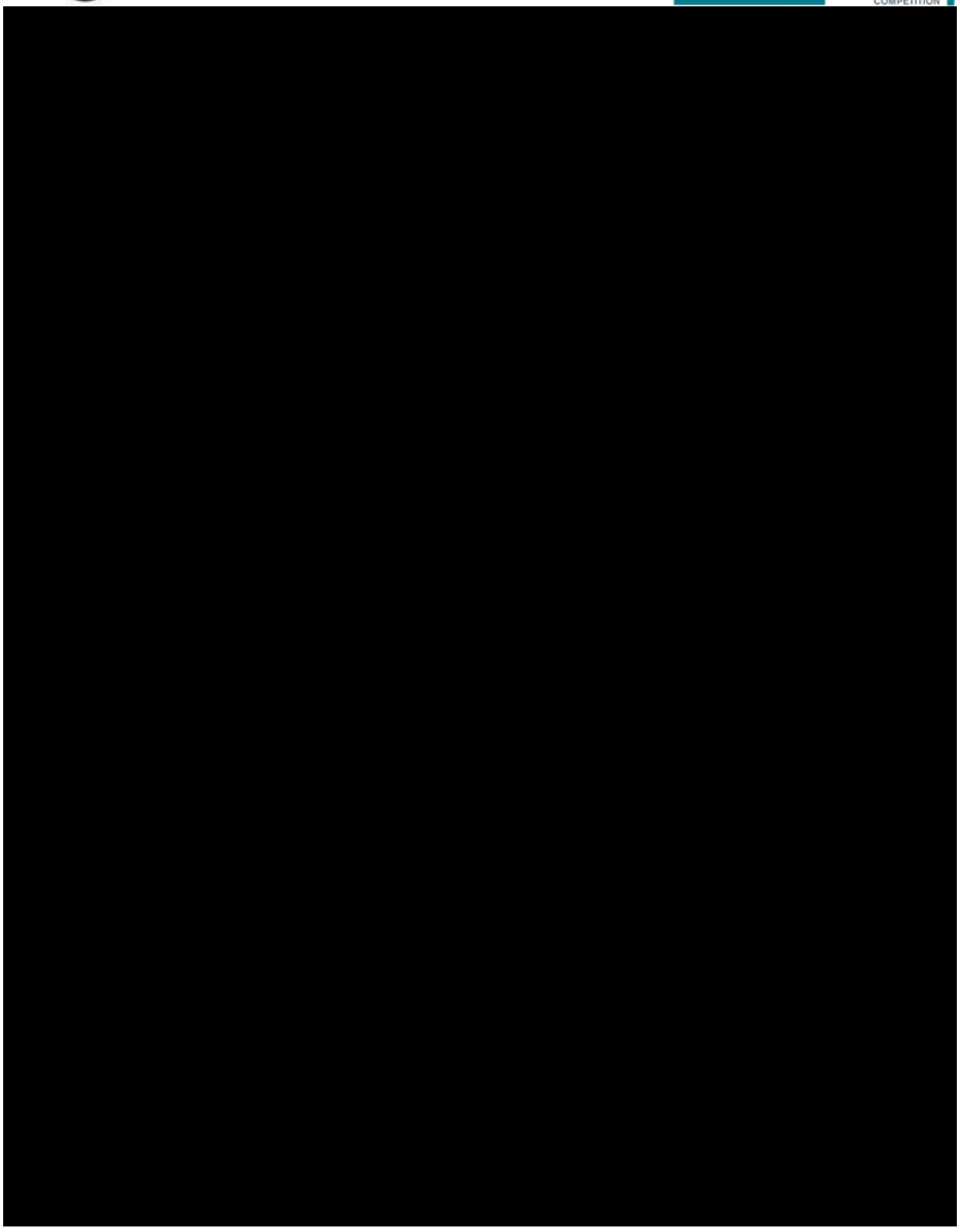


Figure 36: USEF Information Flow Chart

SP Distribution implementation and cybersecurity

SP Distribution will implement and trial USEF within FUSION. For the purposes of the trial, SP Distribution will maintain the cloud-based flexibility procurement platform. SP Distribution will integrate processes with existing architecture, as shown in Figure 37. This includes: network monitoring and load forecasting, real time systems (RTS) data management within PowerOn, cloud hosting of flexibility procurement platform in compliance with the SP Corporate Cloud Services Security Specifications[35] and the UK Government Security Classification.

[35] SP Corporate Cloud Services Security Specifications. SP Finance and Resources. March 2017.



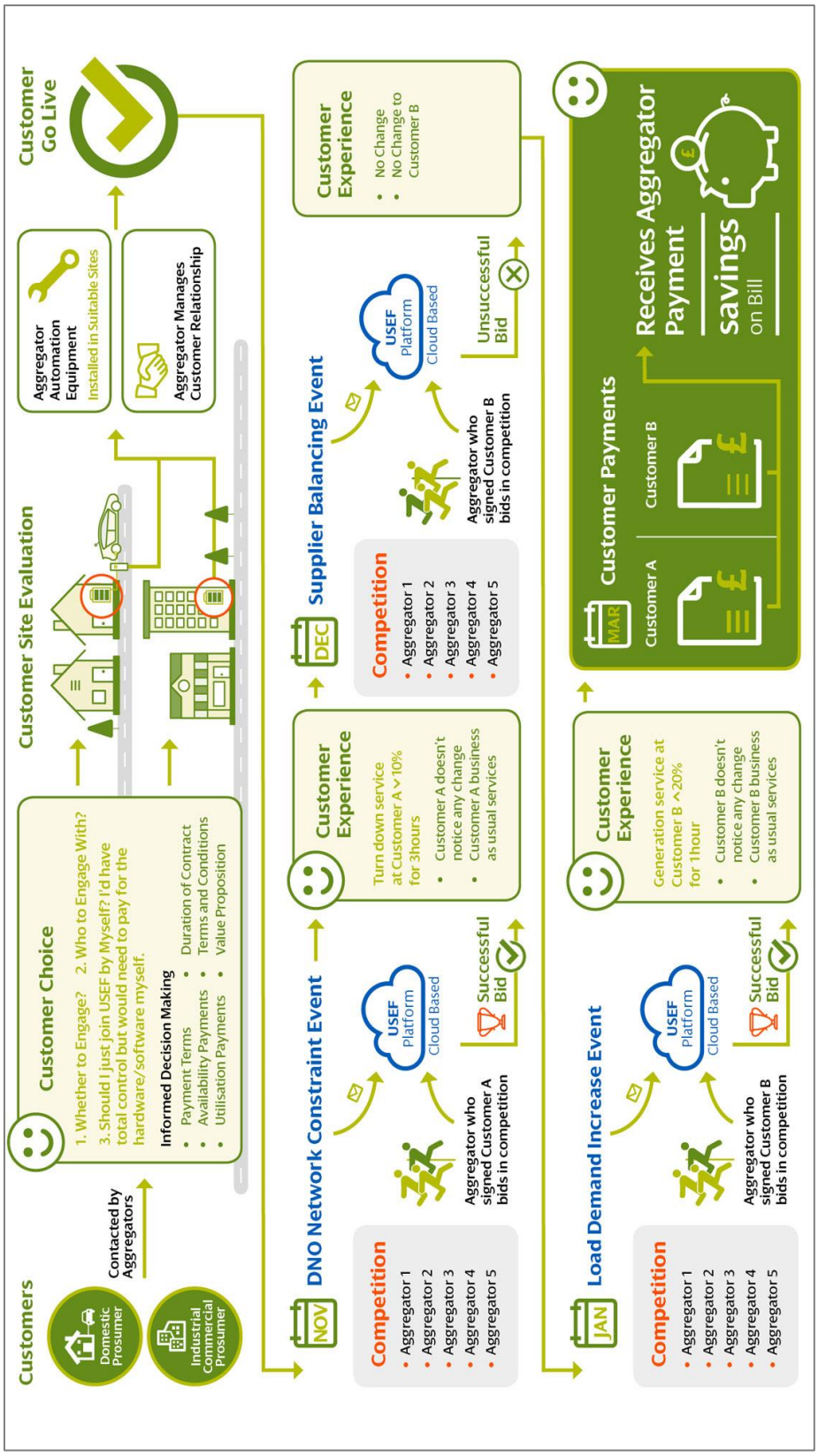


Figure 38. FUSION customer journey, showing how FUSION will look from a customer's perspective. The graphic details the stages and benefit of engagement with FUSION, and highlighted how different flexibility procurers can use the USEF-based flexibility market.

FUSION has further engaged customers in Fife with the publication of an e-survey, sent to 300 businesses through SP Distribution's relationship with the Fife Chamber of Commerce, as shown in Figure 39.

All returned responses noted interest in participation in the FUSION trials, whilst also demonstrating that many trial area flexibility providers are own generation capability that can contribute to the liquidity of a flexibility market.

Figure 39. E-survey sent to 300 businesses in Fife.

Appendix P Glossary of terms

Term	Definition
ADS	Active Demand and Supply
BEIS	Department for Business, Energy and Industrial Strategy
BRP	Balance Responsible Party
CfE	Call for Evidence
CHP	Combined Heat and Power
CMZs	Constraint Management Zones
CRO	Common Reference Operator
DECC	Department for Energy and Climate Change
DER	Distributed Energy Resources
DNO	Distribution Network Operator
DSO	Distribution System Operator
DSR	Demand-Side Response
DUoS	Distribution Use of System
ENA	Energy Networks Association
ENW	Electricity North West
ERDF	European Regional Development Fund
EV	Electric Vehicle
FSP	Full Screening Proposal
GB	Great Britain
GHG	Green House Gas
I&C	Industrial and Commercial
IoT	Internet of Things
IP	Internet Protocol
IPR	Intellectual Property Rights
ISO	Independent System Operator
ISP	Initial Screening Proposal
Km	Kilometres
kV	Kilo-Volts
LCNF	Low Carbon Network Fund
LCT	Low Carbon Technology
LV	Low Voltage
MCM	Market-based Coordination Mechanism
MDC	Meter Data Company
MW	Mega-Watts
NL	Netherlands
NPV	Net Present Value
Ofgem	Office of Gas and Electricity Markets
PV	Photovoltaic
RES	Renewable Energy Sources
RI	Reference Implementation
SMEs	Small and Medium-sized enterprises
SO (GBSO)	System Operator
SPARC	Sustainable Power and Research Campus
SPEN	SP Energy Networks
SPD	SP Distribution
STOR	Short Term Operating Reserve
SSEN	Scottish and Southern Energy Networks
TO	Transmission Owner
TRL	Technology Readiness Level
TSO	Transmission System Operator

UDI	User-Device Interface
USEF	Universal Smart Energy Framework
WP	Work Package
WPD	Western Power Distribution

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