

Project Code/Version Number:
SSEEN05 / V2.0

1. Project Summary

1.1. Project Title	TRANSITION
1.2. Project Explanation	The Government's 'Smart Systems and Flexibility Plan' ⁽¹⁾ demonstrates a clear requirement to transition to a Distribution System Operator (DSO) model. TRANSITION will help progress this change by developing and demonstrating a Neutral Market Facilitator (NMF) Platform to test the operation of the market models being produced by the ENA Open Networks Project. If successful, TRANSITION has the potential to deliver benefits of up to £292m to network customers by 2050.
1.3. Funding licensee:	Southern Electric Power Distribution (SEPD)
1.4. Project description:	<p>1.4.1. The Problem(s) it is exploring</p> <p>The GB network continues to evolve, and there is a clear need for networks to become more flexible. In addition, the energy trilemma and the voice of our stakeholders point to the need to adapt and enhance network operations to allow new market models such as peer-to-peer trading to emerge. The 'fit-and-forget' approach of traditional network operation relied on predictable energy use and production that matched that use; this paradigm is no longer relevant. The transition to a DSO has the potential to bring significant benefits to customers; it also brings a range of new complex challenges, unintended consequences and risks for market participants, new entrants and the network licensees.</p> <p>1.4.2. The Method(s) that it will use to solve the Problem(s)</p> <p>The ENA Open Networks Project (Open Networks) is focussed on defining the DNO transition to a DSO model, and has been endorsed by the UK Government's Smart Systems and Flexibility Plan. Based on the intermediate outputs of Open Networks, in particular Workstream 3, TRANSITION will inform the design requirements for the Platform, develop the roles and responsibilities within the marketplace, develop the market rules required for the trials, and implement and test the concept of the Platform.</p> <p>1.4.3. The Solution(s) it is looking to reach by applying the Method(s)</p> <p>This project will develop and deploy key elements of a NMF Platform that enables the transition to DSO.</p> <p>1.4.4. The Benefit(s) of the project</p> <p>TRANSITION is focussed on implementing the outputs from Open Networks. The NMF has the potential to deliver benefits of up to £292m for network customers by 2050.</p>

1.5. Funding			
1.5.1 NIC Funding Request (£k)	13,082	1.5.2 Network Licensee Compulsory Contribution (£k)	1,469
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)	14,691		
1.6. List of Project Partners, External Funders and Project Supporters (and value of contribution)	Project Partners: Electricity North West Limited External Funders: Project Supporters: DNO - Northern Powergrid Industry - Atkins, CGI, Origami Energy Ltd. Others – British Gas, ELEXON		
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	Frank Clifton, Development Manager	1.8.2. Email & Telephone Number	fnp.pmo@sse.com 01738 456414
1.8.3. Contact Address	Scottish and Southern Electricity Networks, Inveralmond House, 200 Dunkeld Road, Perth, PH1 3AQ		
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.	The project would not proceed without the support from the NIC		
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

2.1.1 *The Problem*

The world of electricity is changing and there are a number of significant challenges to the traditional method of distributing energy. These challenges include:

1. A change in the source of energy is altering the timing and direction of energy flows;
2. An increasing dissatisfaction with existing market models and the inability of existing systems to allow new disruptive market models like peer-to-peer trading to emerge;
3. Forecasts of significant load growth as a result of new low carbon technologies;
4. Increasing conflicts between the technical needs of different elements of the electrical system;
5. Increasing need to consider the wider system and other energy vectors in operating and developing the electrical network; and
6. Addressing all the above while meeting the challenges of the energy trilemma.

Extensive trials have been funded nationally and internationally to understand the efficacy of a range of solutions (technical, commercial, regulatory and behavioural) and we now know that we have the key elements to meet these challenges.

However, the key barrier to deploying these solutions at scale is the absence of the markets and platforms necessary to integrate these components into a system - a system in economic, technical, societal and commercial terms. The shift from the traditional DNO model to a DSO model will be crucial to this change.

Open Networks (see Appendix 11 for details) has been endorsed in the UK Government's recent "Smart Systems and Flexibility Plan"⁽¹⁾. Open Networks has already defined a DSO and the key functions and competencies that a DSO will require.

TRANSITION will explore several models with reference to "price flexibility (occurring when any party varies its demand or generation in response to the price of energy, and network use at a particular time and/or location)", and "contracted flexibility (where parties trade and directly contract with one another to procure flexibility)" as defined in the "Smart Systems and Flexibility Plan". There are different actions to achieve prices which reflect the value of the service to the wider system ('system value pricing') for different types of flexibility.

One of the key outputs from Open Networks will be a Smart Grid Architectural Model of the key elements of a DSO; this will include the NMF Platform. This Platform will be market agnostic but will provide the information and visibility necessary for a range of markets to operate. To use a very simplistic analogy, the relationship between the DSO and other Market Participants can be considered similar to that between the postal service and online retailers such as Ebay or Amazon.

Figure 2.1 depicts a 'peer-to-peer' market where the Post Office provides visibility of the services available and the charges; these can be used by market users when buying and selling products.

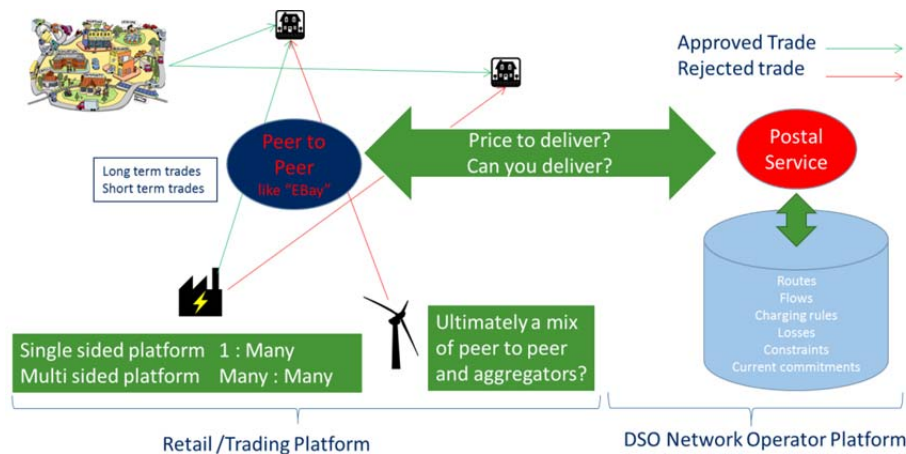


Figure 2.1 Peer-to-peer market model depiction

The principal problem is that the NMF Platform is a complex function, with strong and multiple interactions between system components such as markets, customer experience, business models, the network infrastructure, network losses and reliability. Robust trials are going to be critical in understanding, resolving and mitigating the practicalities and unintended consequences of developing and operating such a model. Without the confidence of robust demonstration and strong evidential basis, it is unlikely that any business will make the investments necessary to make the benefits of smart systems and flexibility a reality.

2.1.2 Industry Context

The need for a more flexible power system that uses the flexibility of connected assets to deliver services that support network management has been widely recognised by network stakeholders, including policy makers, users, customers and licensees. There is a growing body of evidence to support this change from BEIS and Ofgem⁽²⁾, Carbon Trust⁽³⁾ and the National Infrastructure Commission⁽⁴⁾. This culminated in the publication of the UK Government’s “Smart Systems and Flexibility Plan”.

Customers are increasingly seeking opportunities to actively manage their energy needs and costs and to monetise their flexibility through the provision of services to support the management of the network. The intelligent system of the future will require a marketplace where all flexibility providers can transact a wide range of innovative products and services that help to meet the needs of all Market Participants (MPs), especially the network licensees in managing local, regional, and national requirements. Enabling the use of existing and new flexibility to deliver services will support network development and requirements, avoids the significant investment that would otherwise be required, and resolves the trilemma. The marketplace will include new tariffs and services, peer-to-peer services, and trading and will disrupt established industry models with new market entrants using new innovative and non-traditional business models.

This transition toward a new flexible energy system, enabled by DSO, promises significant benefits for customers, but presents all licensees with new challenges, costs and risks. The DSO will need to become actively involved in the management and control of energy flows in a local area, rather than the traditional “arms-length” or “fit and forget” operating model. Further, the DSO will participate in new markets that reflect the needs and requirements of all MPs and are facilitated to ensure they are fair, competitive and they develop and evolve.

Open Networks⁽⁶⁾ was established to drive this change; this is a major cross-industry initiative that is redefining how our energy networks will operate in the future. The

changes it will make will give UK households, businesses and communities the ability to access a new range of energy technologies and services to take control of their energy and lower their costs, including renewable generation, storage and electric vehicles.

TRANSITION is strongly aligned with the outputs from Open Networks. Scottish and Southern Electricity Networks (SSEN) is partnering with Electricity North West Limited (ENWL) for this project, and will also benefit from senior-level engagement with Northern Powergrid (NPG) and National Grid System Operator.

During development of TRANSITION, further work has been undertaken with Scottish Power Energy Networks (SPEN) and Western Power Distribution (WPD) who are also preparing submissions looking at different aspects of the change to DSO. This recognises the need for convergence and consistency in the development of the interface that new MPs will have with DSOs across GB. Whilst each of the projects is looking at different aspects of the transition to DSO, it is recognised that there may be benefits in collaborating on certain activities. To ensure that there is no unnecessary duplication between the projects, a joint report from the funded DNOs will be provided to Ofgem within six months of the funding award to identify any areas of duplication and potential changes in the scope and budget of each project. This is described in more detail in Section 4.

2.1.3 DSO Functions

Open Networks Workstream 3 (see Appendix 11) has identified nine functional groupings to represent the activities of an effective DSO. Each functional group is represented by a combination of 12 competencies, with a minimum competence level identified for each of the four timescales: Current, Short Term (ST to end 2018), Medium Term (MT to end ED1), and Long Term (LT the duration of ED2).

The functions identified by Open Networks are summarised in Figure 2.2 with the competency levels identified from '1' (some competence based on traditional DNO methods) through to '5' (full competence in operating future active systems and managing those participants).

Functional Groupings	Current	ST (to end 2018)	MT (start 2019 to end ED1)
Balancing	1	2 2 2 2 2 2 2 2 2	4 3 3 3 3 3 3 3 3
Network Operation	1 3 2 3 2 2	3 4 2 3 3 2 2 4 3 3	5 4 4 4 5 4 4 5 5 4
Investment Planning	3 3 1 1 3 2 2 2	4 4 3 3 4 3 3 3	4 4 4 4 4 4 4 4
Connections & Connection Rights	3 1 3 2 2 2 2 2	4 2 3 4 3 3 3 3 3	4 3 4 4 4 4 4 4 4
System Defence & Restoration	2 1 1 2 2	3 2 2 3 2 2 2 3 3 2	4 4 4 4 4 4 4 4 4 4
Service/Market Facilitation	1 1 1 1 1	2 2 2 2 2 2 2 2 2 2	4 3 3 3 3 3 3 3 3 3
Service Provision	1 1 1 1 1	2 2 3 3 3 3 2 2 2 3 2	3 3 4 4 4 4 3 3 3 4 3
Last Resort Asset Owner	1	2 2 2 2 2 2 2	3 3 3 3 3 3 3
Charging	competency level not yet defined	competency level not yet defined	competency level not yet defined
Competencies	Forecasting	Forecasting	Forecasting
	Regulation Codes & Frameworks	Regulation Codes & Frameworks	Regulation Codes & Frameworks
	Commercial & Whole System Frameworks	Commercial & Whole System Frameworks	Commercial & Whole System Frameworks
	Whole System Co-ordination	Whole System Co-ordination	Whole System Co-ordination
	Power System Analysis	Power System Analysis	Power System Analysis
	Contractual Arrangements	Contractual Arrangements	Contractual Arrangements
	Dispatch	Dispatch	Dispatch
	Pricing	Pricing	Pricing
	Outage Planning	Outage Planning	Outage Planning
	Data Management	Data Management	Data Management
	Settlement	Settlement	Settlement
	Contract & Service Compliance	Contract & Service Compliance	Contract & Service Compliance

Figure 2.2 – Functions and Competencies for Current, ST and MT

TRANSITION intends to help develop a number of these requirements and competencies by implementing a NMF Platform

2.1.4 The method being trialled

TRANSITION will design, develop, demonstrate and assess the common tools, data and system architecture required to implement the proposed models produced by Open Networks Workstream 3. This will include:

- develop roles and responsibilities for MPs, and market rules to allow MPs to transact services;
- clarify the requirements and implement a NMF Platform for trials;
- engage and consult with stakeholders;
- identify up to three network locations on which to trial Use Cases;
- provide feedback on the learnings from the above; and
- provide direct validation and incremental development of the Open Networks market models.

The marketplace in a DSO world will be very different from today. The roles and responsibilities for MPs and the NMF will need to be defined to provide clarity and certainty, and they will be subject to stakeholder review. Market rules will be developed to ensure a fair, competitive, and transparent marketplace. The starting point for the development of the market rules will be the existing industry codes and working practices so as to minimise the overall costs of industry change. They will also enable MPs to transact for services under various market models. Areas to be addressed in the market rules include:

- the allocation of the NMF role;
- defining the range of services that may be required;
- prioritising access for the SO and DSO;
- conflicts between MPs when there is limited availability of a service;
- transactions that have the potential to adversely affect the network; and
- the technical definition of NMF interfaces in the form of protocols and standards.

The Platform, described in more detail in Appendix 8, will allow MPs to buy or sell services. MPs can be a buyer and a seller of a service at different times. The term 'Market Participant' covers a range of parties including organisations with one or more Distributed Energy Resources (DERs), aggregators with a portfolio of DERs, a DSO, the SO, or a trader with no 'physical' resource.

The role of the DSO will be to provide visibility and clarity of capacity, constraints and charging and to enable parties to use flexibility to provide services for the benefit of the whole system.

Stakeholder engagement is central to TRANSITION and will be crucial to its success. Extensive stakeholder engagement will map a wide range of viewpoints including customers, suppliers, aggregators, other potential MPs and Energy UK. This will ensure the solution is fit for purpose from a whole system perspective and provide a wider range of feedback to Open Networks.

Open Networks will define a number of Use Cases to test on the Platform which represent services or scenarios that could be required on a DSO network (see Appendix 7 for description of potential market models). The Use Cases will be subject to stakeholder consultation and will be applied to a variety of network types under a variety of market models. ENWL has agreed to be a partner in TRANSITION to ensure that a wide range of network conditions, issues and challenges are explored.

All of the above will enable TRANSITION to provide meaningful feedback to Open Networks on the market roles and responsibilities, market rules, the Platform, and market models under a variety of Use Cases.

2.1.5 Project structure and risk

As described earlier, at the time of submission Open Networks has not yet defined the market models for a DSO, and as such there is still some uncertainty on the outcome of that modelling. It is however, reasonable at this stage to draw conclusions on the probable outcomes. These interim conclusions are the basis on which TRANSITION has

been developed. We believe this approach will accelerate the transition to DSO, and the launch of a NMF Platform increasing the readiness for wider scale deployment in RIIO ED2.

To manage the risk of dramatic change in the outputs of Open Networks and protect customers' funds, we have proposed a Stage Gate approach to this project, described below.

The Project will be undertaken in two discrete phases with a Stage Gate after Phase 1 and prior to Phase 2. Phase 1 will focus on the definition of requirements, stakeholder engagement and consultation, IT architecture and integration requirements, trial site identification and specification of proposed trials. Following the Stage Gate, Phase 2 will see the deployment and trial of the NMF across a number of network configurations.

The Stage Gate at the end of Phase 1 will consider a number of key issues, including continued alignment with the Open Networks objectives and any other wider policy issues, the cost of trial deployments and evidence gathering, and a full review of the business case against the prevailing political and regulatory outlook. Importantly, by the end of Stage 1 we will have consulted with a wide range of stakeholders to review and test the project's objectives. Furthermore, we will have reviewed the deployment requirements with other funded projects to identify any areas of duplication during the deployment phase of each of the projects. The Stage Gate also allows the opportunity to ensure that the project is going to deliver the evidential base required to allow preparation for ED2,

The final decision on whether to proceed beyond the Stage Gate will be made by the Project Steering Board. The project will not proceed without a broad consensus from our stakeholders, industry and regulators that it will achieve its objectives.

2.1.6 The development being undertaken

The Platform will be developed and demonstrated using a combination of market models on up to three network areas. The Project will consider the requirements of all MPs to ensure a 'whole-system' approach, which will involve identifying roles and responsibilities. This will require a new approach to forecasting, system planning and operation to ensure that the transition to DSO yields the anticipated benefits for customers without compromising network security and integrity.

TRANSITION will be the first time that two DNOs have worked together as partners on a NIC project. SSEN and ENWL will jointly manage the deliverables and undertake extensive stakeholder engagement to ensure the project outputs are suitable for all GB DNOs. Additionally, Northern Powergrid (NPG) will provide expert resource to participate in progress workshops and the Project Steering Board). NPG are currently developing a project which will be complementary to TRANSITION and will focus on a 'demonstration through modelling' approach to DSO (See letter of support in Appendix 12).

TRANSITION will undertake development in three key areas:

- Data capture and modelling
 - Identify the future data requirements for and of each MP, and any timing requirements;
 - Conduct a gap analysis of data requirements and timing, data flows, and technology solutions to ensure the correct data is captured, stored, and can be retrieved; and
 - Identify the monitoring solutions and modelling requirements to provide required network data to support the Platform and trials.
- DNO interaction

- Identify the requirements for forecasting and power system analysis;
 - Conduct a gap analysis of the forecasting and power system analysis requirements and identify solutions to support the Platform and trials; and
 - Determine the visualisation requirements for trial areas, and develop a solution that meets operational requirements.
- Market interaction
 - Identify the roles of MPs and the NMF Platform;
 - Develop rules for the marketplace and additions for market models (as required);
 - Develop an integrated Platform and conduct end-to-end testing;
 - Conduct trials on physical networks with Use Cases; and
 - Conduct additional modelling as required.

2.1.7 Alignment with other industry work

The transition to DSO represents a potentially disruptive change to the established DNO operating model. Therefore, it is appropriate that there is a robust and well-documented evidence base to inform the shape of the future network. TRANSITION will help inform, and be informed by Open Networks, and will build on other LCNF, NIC, and NIA projects including Low Carbon London⁽⁶⁾, CLASS⁽⁷⁾, New Thames Valley Vision⁽⁸⁾ and ENTIRE⁽⁹⁾.

As stated above, ENWL is partnering with SSEN in this project, and there has been engagement with other parties including Open Networks to minimise potential crossovers, improve cross-project benefits, and ensure TRANSITION is a robust project that delivers meaningful and unique outputs. This includes:

- NPG regarding complementary scope of innovation projects and further engagement throughout TRANSITION;
- National Grid System Operator have been involved in the project development and are committed to continued support in its delivery, this also includes sharing learning from the ongoing Power Potential⁽¹⁰⁾ project;
- SPEN and WPD regarding their 2017 NIC project submissions (FUSION and Electricity Flexibility and Forecasting System respectively). As described earlier, all three projects are committed to producing a formal collaboration agreement within six months of the Ofgem Funding decision;
- Centrica regarding the Cornwall Local Energy Market⁽¹¹⁾; and
- The Energy System Catapult and Future Power Systems Analysis (FPSA) project members.

DSO transition is a major issue for the industry and we anticipate that Ofgem and BEIS would welcome a project that focusses on coordination and collaboration. This is described in more detail in Section 4(e).

2.1.8 The solutions enabled by solving the Problem

TRANSITION aims to:

- accelerate and de-risk the transition from DNO to DSO, reducing uncertainty for customers and industry;
- provide a clear signal to the market that a new platform (or platforms) for market development will be in place and enable the growth of new potentially disruptive market models, products and services;
- inform the appropriateness of competency assumptions for different DSO functions over various timescales;

- develop and demonstrate a NMF Platform including enabling infrastructure, data exchanges and commercial arrangements;
- demonstrate and test potential solutions to inform further development of Open Networks market model options;
- identify cost, risk, and benefits of the market models proposed; and
- consult with a range of stakeholders to ensure the analysis is undertaken from a whole-system perspective.

TRANSITION will deliver:

- requirements for changes to industry data needs, exchanges and structures;
- an outline process for real-time monitoring and visibility of the network;
- learnings from the operation of the NMF Platform as a commercial tool and the consequences of interactions between MPs;
- an outline requirement specification for a Platform that is scalable and technology neutral;
- a comparison of market models under different network configurations; and
- recommendations on required changes to existing market rules and codes (such as OC6 of the grid code and the BSC).

2.2. Technical description of Project

Open Networks will define a number of possible market models, associated roles and responsibilities, market rules, and services for MPs. TRANSITION will test the market models through the implementation of appropriate Use Cases and these will be used to inform the development of Open Networks. The TRANSITION team has used its expertise to develop three potential market models, described in Appendix 7. These have been used to help frame the scope of TRANSITION. These will be refined and updated as Open Networks progresses and we engage with other stakeholders. TRANSITION will also help inform the requirements of the role of the DSO and how that can be most effectively fulfilled in the GB electricity market.

2.2.1 Data Requirements

TRANSITION will look at the data and information requirements to be exchanged between MPs for the transaction of services. The Project will work with partners spanning the range of roles and will identify the data requirements and needs of each party in order to determine and deploy flexibility. TRANSITION will identify the barriers (technical, commercial and regulatory) to the sharing of data and propose solutions. The objective is to identify the minimum dataset that needs to be shared for MPs to have the confidence to transact for services, and the associated governance. As part of this exercise, the rights of access to data by the various MPs will be established. The approach will enable the risks associated with data items not being available to be identified, and the associated impacts in the operation of the energy system to be assessed. Once identified, this will enable prioritisation and approaches to making necessary data items available. As identified in Section 6 and as Project Deliverable 2, this will form a key output from WP2.

2.2.2 System architecture

TRANSITION will leverage the learning outputs from Low Carbon London on the generic systems architecture and develop it to expand the requirement for the use of flexibility services and the role of the DSO. Specifically, we will develop the detailed requirements for the market interface and management of commercial arrangements for the trading of flexibility service by multiple participants.

For the purposes of TRANSITION, we will employ a generic architecture that delivers the capabilities required for trial participants from different market roles to have access to the functionality they require, and develop their requirements to operate in a market that embraces the use of flexibility services.

Again, the detail of this will be aligned with the outputs from Open Networks. Key principles will be adopted:

- Mature commercial-off-the-shelf products will be employed wherever possible. This will:
 - reduce the delivery risk as existing solutions are being employed, the innovation coming from their application to these requirements;
 - provide confidence in the budget, as mature products will be used wherever possible;
 - provide confidence that there is a mature supply chain for the provision of the required solutions;
 - enable competitive procurement by MPs; and
 - deliver value for money for the consumer, both in terms of the delivery of TRANSITION and ultimately in the delivery of the market.
- Minimise costs of change and risk of cost stranding. The TRANSITION system architecture will provide functions on behalf of trial participants where they do not currently have them and there is uncertainty as to whether their role will ultimately require certain capabilities.

Additionally, we aim to use TRANSITION to evaluate the appropriateness of Distributed Ledger Technologies (DLTs) such as Blockchain. The objective is to provide an evidential base of experience of the use of DLTs for this application and inform a comparison of DLTs with alternative, more mature technologies and approaches to inter-market participant interaction.

2.3. Description of design of trials

2.3.1 Market Models

The purpose of TRANSITION is to establish the merits of different market structures relative to each other, as informed by the outputs of Open Networks and other relevant initiatives such as Ofgem's "Charging Futures Forum". These include the potential to support stacking of value and to allow identification and management of potential conflicts in value between market participants, the impacts on market participants of operating in such market structures and the identification of other barriers. In doing so, TRANSITION will help to quantify the relative benefits of more monopsonistic market models versus nearer perfect market models in terms of the costs and benefits to the consumer.

The structure of TRANSITION (operating across a number of discrete, topologically bounded networks) enables the value of flexibility to be evaluated within both a local energy market (within the topological boundaries of the individual networks) and nationally (by enabling flexibility to be traded outside the topological boundaries of the trial networks).

The approach to design of the three proposed trials is based on defined Use Cases that are designed to test the emerging scenarios from Open Networks and Ofgem, as well as TRANSITION's engagement work. Each Use Case will have clearly defined learning objectives, which will include both quantitative measures around data and system requirements and assessing value and risks for different participants, as well as qualitative measures based around trial participant feedback. The Use Cases will

articulate the processes for inter-party interaction, services, the data exchange and what data is to be captured to fulfil the learning objectives.

Open Networks market models have not yet been published. As such, the TRANSITION final submission team (which includes market experts) has used its market knowledge to develop and introduce our view of three possible market models and associated roles and responsibilities of MPs. This approach has been adopted to enable this submission to be developed in a way that provides confidence that the approach, capabilities and budget are appropriate to be adapted to trial the models yet to be defined by Open Networks. The new market models should deliver improved outcomes for customers, provide easy and efficient access, and should reflect the direction of travel outlined in the Smart Systems and Flexibility Plan⁽¹⁾ which identifies a requirement for both 'Contracted' and 'Process' Flexibility.

The evidential base delivered by TRANSITION will help to inform the decisions on market design, how the market can be neutrally facilitated and which market participant role is best placed to have the obligation for neutral market facilitation. The market models developed for this bid are explained in more detail in Appendix 7, and are summarised below. Note these will be updated prior to implementation to reflect outputs from Open Networks, and further stakeholder engagement.

- *Local Market* – multiple local marketplaces, each based around a specific geographical area, the boundaries for which are based on the network topology. These are likely to be licenced/regulated franchises
- *Central Market* – a single GB-wide marketplace managed by a single NMF. This will be a licenced/regulated special purpose vehicle.
- *Commercial Market* – multiple discrete but differentiated markets that operate concurrently, each with their own NMF. These NMFs are not bounded by geography or network topology and have developed commercially rather than as licenced/regulated franchises.

2.3.2 Network trial locations

Network locations will be identified as representative of the GB electricity distribution network so the benefits of each market model tested can be extrapolated. The selected networks will need to have an existing mixture of decentralised generation and demand flexibility providers, as well as a potentially constrained area to most closely match the trial Use Cases. Further detail is contained in Appendix 9.

Part of the selection criteria will be networks that already have flexibility available, in order to minimise any additional investment in the deployment of assets. Other factors which will be taken into account will include types of network:

- Rural – typically with low population density, predominantly overhead network typified by long HV feeders with high HV losses, lower average transformer ratings and short LV feeders, but with a good power factor;
- Rural and urban mix – this represents the majority of the GB distribution network with average population density and a mixture of overhead lines and cables, higher average transformer ratings, good power factor with localised issues;
- Urban – typically high population density, predominantly cable network typified by short HV feeders, high transformer ratings and utilisation, longer LV feeders, high voltage issues at low demand, power factor predominantly leading due to capacitive nature.

A mixture of network issues which could be addressed through a DSO's use of flexibility e.g. kW, kWh, kVA, kVAR, kVARh, and harmonics will be required in each of the trial zones. This will also be informed by the recent National Grid "System Needs and Product

Strategy” consultation ⁽¹²⁾. The trial zones selected should also present potential conflicts in the use of embedded flexibility between the DSO and other market actors. These would include the SO and other DSOs who may look to call on flexibility to alleviate a boundary constraint. The selection of trial locations will also be informed following collaboration with any other funded projects. This will help to ensure that any areas of potential duplication during the deployment phase are avoided.

2.3.3 Trial Use Cases

The test of each market model will be developed but potentially could include changing the level of demand and/or generation for a flexibility provider that can/cannot take physical delivery in four Use Cases (see Appendix 8).

	Reduce Demand or Increase Generation	Increase Demand or Reduce Generation
Physical Provider (can take delivery)	<p>Use Case 1</p> <p>The DSO has insufficient capacity to allow additional renewable generation to export to a local network and a reduction in demand is required to manage the shortfall in network capacity. The DSO requests a reduction in demand to balance the network/ keep the network within operational limits.</p>	<p>Use Case 2</p> <p>The DSO has insufficient capacity to allow additional renewable generation to export to a local network and an increase in demand is required to manage a reverse power flow restriction. The DSO requests a reduction in demand to balance the network/keep the network within operational limits.</p>
Non-Physical Provider (cannot take delivery)	<p>Use Case 3</p> <p>An energy supplier or energy trader wants to transact for a service to optimise their wholesale portfolio. The energy supplier/energy trader requests a service to effectively reduce the import (or increase the export) at an MPAN to help balance or lengthen their portfolio</p>	<p>Use Case 4</p> <p>An energy supplier or energy trader wants to transact for a service to optimise their wholesale portfolio. The energy supplier/energy trader requests a service to effectively increase the import (or reduce the export) at an MPAN to help balance or shorten their portfolio</p>

2.3.4 Modelling and verification

The involvement of an academic partner or partners to undertake simulation and modelling of the trials and commercial structure will both validate the results, and simulate scenarios that cannot be physically trialled as part of this project. TRANSITION will seek to coordinate this work where possible with other projects, and have already had discussions with NPg to consider a joint approach which would maximise the value of this work for customers.

2.4 Changes since Initial Screening Process (ISP)

Further work carried out during the submission preparation stage has allowed SSEN to define the scope and programme in much more detail. The funding request has changed from £13.05m to £13.08m.

Section 3: Project business case

The Department for Business, Energy & Industrial Strategy (BEIS) and Ofgem have put forward a strong business case that the electricity sector needs to move to a smart, flexible energy system⁽¹⁾. The distribution network is fundamental to allowing participants to offer flexibility, take advantage of opportunities to generate income, and contribute to an overall reduction in the costs of electricity. This will deliver benefits for all customers.

TRANSITION is an enabler for this smart, flexible energy system, by providing transparent and neutral access to a market for flexibility services. It will help to realise the savings identified in previous innovation projects which trialled flexibility, whether from residential customers, industrial and commercial customers or DERs.

SSEN engaged Mott MacDonald to evaluate the business case for TRANSITION by evaluating the benefits achieved from putting this enabler in place, and the likely benefits which the energy system would achieve without this enabler in place. Mott MacDonald's report in Appendix 10 draws on the extensive literature on the value of flexibility to the GB energy system and explains the benefits tables in Appendix 1.

3.1 Introduction

A transparent, neutral market for flexibility services will allow GB to fully utilise flexibility whilst realising the physical, locational, and economic constraints of the networks on which these services will be transacted. It will support the move towards half-hourly tariffs, by providing attractive opportunities for customers of all scales to respond to requests for flexibility, and thereby avoid new or replacement power plants to serve peak demand. It will also allow existing and new renewables to be fully utilised.

Many participants in the electricity value chain can benefit from flexibility. Energy suppliers and generators can use flexibility to manage imbalance between their contracted volumes and metered volumes, for which they are penalised at the "cash-out" price when their imbalance is in the same direction as the overall system imbalance. The GBSO is making increasing use of flexibility services to avoid holding power plants in reserve.

Finally, flexibility services contribute to addressing network challenges and deferring network upgrades. GB DNOs spent approximately £400m in regulatory year 2015/16 upgrading the distribution networks to create additional capacity. To date, no significant network upgrades have been needed to meet the uptake of Electric Vehicles (EVs), but this is likely to change. Studies of EV charging demonstrated that if no interventions by the DNO are introduced, uncontrolled charging may add load equivalent to an entire household's existing demand during the evening peak per vehicle⁽¹³⁾.

We believe that, if GB is to achieve the full value of flexibility a transparent, visible market platform is required. Our business case makes prudent assumptions about the uptake of flexibility, and we compare these with forecasts from BEIS and the Committee on Climate Change in Appendix 10.

3.2 Deriving the business case

This section describes the approach used to ensure the TRANSITION business case is robust. Appendix 9 describes how the Project is designed to be statistically sound.

Our analysis has drawn on the extensive literature on the value of flexibility. Whilst the majority of the literature calculates the overall gross benefit of flexibility compared to conventional reinforcement and conventional means of balancing supply and generation, a report by Frontier Economics⁽¹⁵⁾ represents a comprehensive attempt to explicitly model the incremental or net benefit of a market platform for flexibility. It compares the platform with other, less optimal, allocations of flexibility resources using conventional industry processes. The report was commissioned by ELEXON in 2014 and was presented and discussed at the Smart Grid Forum (Workstream 6). There have been no structural changes to the electricity market since 2014 which materially affect their modelling.

Frontier Economics developed a model which estimates the value of flexibility to the key stakeholders: the suppliers, DNOs and the GBSO. The value of flexibility is projected in 2023 and 2030 by using a market model and with an assumed allocation of flexible resource between the stakeholders. The Frontier Economics model was able to model the effects of suppliers contracting with one another for flexibility, rather than relying on their own portfolio only to resolve their imbalance; the DNOs and GBSO cooperating on their flexibility requirements; and all parties openly trading with one another.

3.3 Establishing the counterfactual

It is helpful to start from a “base case” defined by Frontier Economics:

The market as it stands today

Any Flexibility Provider can contract to provide Flexibility Services to a DNO, the GBSO or a supplier, but not more than one.

GB DNOs are increasingly active in flexibility services and in general have shown commitment to making progress with the System Operator on joint working and topics such as sharing of Flexibility Services⁽¹⁶⁾⁽¹⁷⁾. As such, our counterfactual assumes that, if TRANSITION does not go ahead, the industry will continue to make efforts to develop processes for procurement of shared services. Therefore, our counterfactual does not represent today’s market, but a future market with fewer conflicts:

The counterfactual

The counterfactual is the ‘next smartest’ option for flexibility, whereby energy suppliers bilaterally trade flexibility between themselves and with flexibility providers, rather than through a trading platform. DNOs and the GBSO co-operate to reduce conflicts as they procure flexibility services. Prices across the industry are opaque.

TRANSITION will deliver a step change in terms of visibility and access for flexibility providers by providing a NMF Platform. The table below demonstrates how this counterfactual relates to the Frontier Economics’ prior work:

	TRANSITION cost-benefit analysis	Frontier Economics report commissioned by ELEXON
Counterfactual or "Base Case"	The counterfactual is the 'next smartest' option for flexibility, whereby energy suppliers bilaterally trade flexibility between themselves and with flexibility providers, rather than through a trading platform. DNOs and the GBSO cooperate to reduce conflicts as they procure flexibility services. Prices across the industry are opaque.	Suppliers trade with one another bilaterally rather than through a trading platform. There is no sharing of these resources with the DNOs or System Operator. DNO and SO flexibility is shared, and DNO and SO compensate one another for any costs they impose on one another.
Proposition or the "Method Case"	A market platform - the NMF - with transparent prices, allowing DNOs to identify best value flexibility options, and allowing Flexibility Providers to contract with multiple buyers ("sharing") to get the most value out of their services.	A centralised market platform exists in which all flexibility resources are pooled, and if necessary, parties can pay flexibility providers not to dispatch.

A series of adjustments were made to Frontier Economics' results to reflect:

- The growth in flexibility services post 2030;
- How close the NMF Platform comes to the "ideal" modelled by Frontier Economics;
- The speed at which stakeholders adopt the Platform and achieve benefit;
- The degree to which energy suppliers participate in the Platform;
- The volume of flexibility which is likely to be available; and
- The ability of flexibility services to be used on different types of network faults.

3.4. Applicability and timeliness of TRANSITION

The use of flexibility services is in its early stages of being rolled out by the GB DNOs. It exhibits several characteristics typical of early markets:

- **Different pricing models are being explored** Most flexibility contracts are designed on the basis of a payment for "standing ready" or availability, and a payment upon delivery if the service is required and load needs to be reduced. SSEN has designed prices capped by the cost of conventional reinforcement within the current price control period. Other DNOs trialled pricing based on a multiple of the price paid by the SO for Short-Term Operating Reserve (STOR) and trialled zero availability payments.
- **Pricing is not fully visible** Current procurement activities are being carried out in accordance with the Utilities Contracts Regulations (2016). As conventional procurements however, they only provide pricing feedback to qualified participants who submitted a tender. By contrast, the GBSO is required to publish detailed, public domain market reports. Suppliers' own internal flexibility activities, such as DONG Energy's incentives for its demand customers to offset imbalance in its wind portfolio, are not visible ⁽¹⁸⁾.
- **Different business models are being explored** At least one DNO has explored a long-term relationship with a flexibility provider. Other DNOs have worked with

flexibility providers at arms-length, and require the provider to manage any conflicts within contracts they sign for their portfolio of assets.

- **Convergence of the DNO and GBSO markets has not taken place** Initial work has taken place within the ENA Shared Services group, attended by representatives from all DNOs and GBSO. Currently, a flexibility provider is not able to act as reserve for the GBSO and also provide flexibility services to the DNO within the same STOR season ⁽¹⁹⁾.

3.5 Roll-out costs

The roll-out costs originally assumed in the Frontier Economics work were replaced with revised assumptions. We assume the set-up cost of the Platform is £20m in 2023, with running costs of £2m pa. This is similar to costs incurred in 2015 establishing a market platform known as MOSL to support the non-domestic water market⁽²⁰⁾. Sensitivities to higher costs have been tested and are discussed in Appendix 10.

3.6 Benefits for customers

Figure 3.1 below show the gross benefits for distribution customers, the system operator and electricity suppliers in the Method Case and the Base Case.

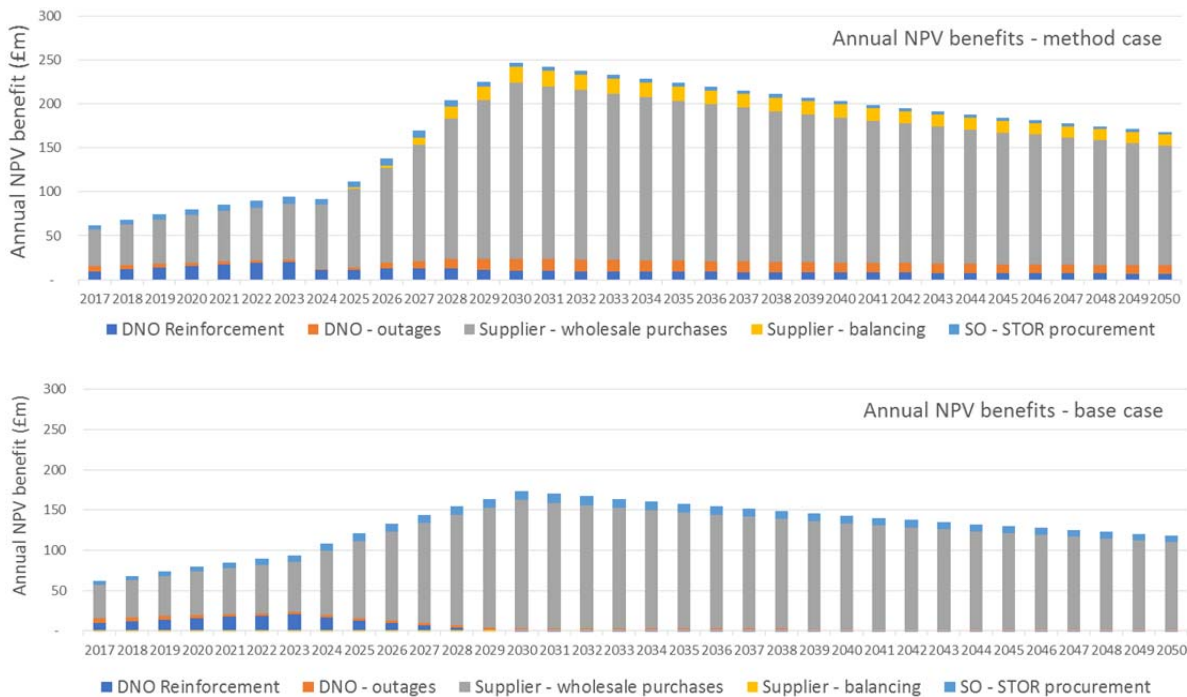


Figure 3.1 Gross benefits for distribution customers: method case and base case

“DNO Reinforcement” represents the value the DNO obtains from contracting DSR in lieu of a planned construction programme to upgrade capacity. “DNO – outages” represents the valued of flexibility contracted at short notice as part of the restoration for an unexpected fault on the distribution network. “Supplier – wholesale purchases” and “Supplier – balancing” represent the supplier’s interaction with the market. “SO – STOR procurement” relates to the GBSO’s use of flexibility as part of the STOR portfolio.

Figure 3.2 below illustrates how the net benefit to all system participants grows over time. We have assumed a growth rate for flexibility which is in fact slightly less than Ofgem’s discount rate. As such, the annual benefit declines gradually between 2030 and 2050.

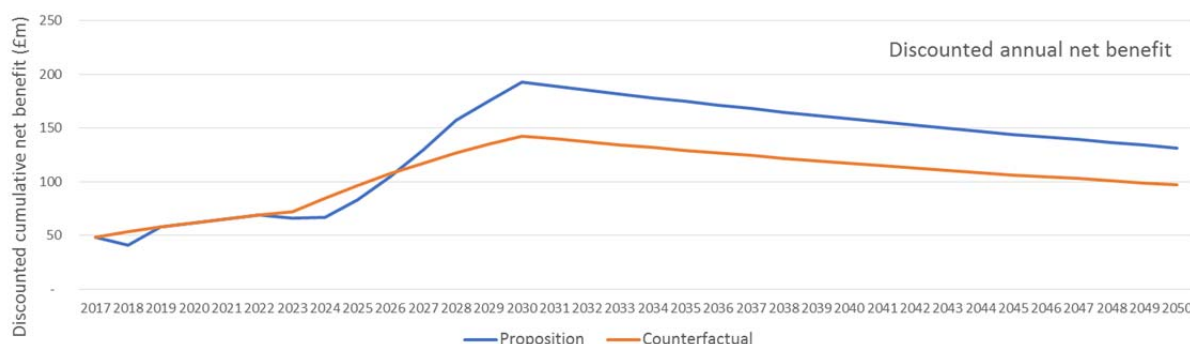


Figure 3.2 Net benefit to all system participants

3.7 Break-even analysis

Table 3.1 below demonstrates the break-even year and Net Present Value (NPV) exclusively for electricity distribution customers under several scenarios. The allocation of benefits to electricity distribution customers was based on Frontier Economics’ apportionment of value streams between the suppliers, the DNOs and the GBSO. Allocations to the licence area scale were based upon the number of customers in each licence area.

Scenario	Break-even	Cumulative NPV to DNO customers at 2050
Net benefit of the Method Case assuming 4GW of flexibility	2029	£292m
Overall uptake of flexibility in the GB reaches 11GW by 2030	2028	£899m
The NMF Platform comes 10% closer to matching a “perfect” allocation of resources for location-specific services	2029	£372m
Market takes an additional 5 years to establish	2032	£244m

Table 3.1 Break-even year and NPV for various scenarios

Appendix 10 summarises the benefits to the wider electricity system, which ranged from £905m to £2,586m in the case where 4GW and 11GW respectively of flexibility were available.

Section 4: Benefits, timeliness, and partners

(a) Accelerates 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

What aspects of the Carbon Plan (or its successor) the Solution facilitates;

TRANSITION complements The Carbon Plan’s strategy to reduce carbon emissions in several ways.

TRANSITION helps to fulfil the need for a stronger, more flexible grid to manage increased customer demand from the electrification of heat and transport and the ongoing increase in low carbon generation. The Carbon Plan⁽²¹⁾ advises that “Beyond 2030, as transport, heating and industry electrification occurs; low carbon capacity will need to rise significantly. We are likely to need 100 gigawatts (GW) or more of new, low carbon generation capacity in 2050.” (2.153, page 72) The transition to DSO being supported by TRANSITION will help ensure that the country has an energy network fit for this low carbon future.

The Carbon Plan recognises that average electricity demand may rise by between 30% and 60% and advises that “the grid will need to be larger, stronger and smarter to reflect the quantity, geography and intermittency of power generation.” (4.4, page 9). The learning from TRANSITION will help to create the strong, interconnected network required to meet the increase in customer demand in an economical way.

TRANSITION supports The Carbon Plan’s aim of creating energy security with a view to minimising costs: Page 14 of The Carbon Plan states that the Government is determined to tackle climate change and maintain energy security while maximising benefits and minimising costs to customers. The learning from TRANSITION will help to provide the network capability needed to ensure a secure, reliable network. As identified by the GB Government in the “Smart System and Flexibility Plan” a more flexible energy system is essential to allow the country to meet its move to a low carbon economy in a cost effective way. According to UK Government figures this could produce benefits of up to £40bn for GB consumers by 2050. If successful TRANSITION will help ensure that the future electricity network will enable these benefits to be realised. Meanwhile, based on our initial prudent assessment it is anticipated that TRANSITION will produce benefits of up to £292m by 2050, meeting The Carbon Plan’s desire to reduce costs to customers⁽²¹⁾.

How the roll-out of the proposed Method across GB will deliver the Solution more quickly than the current most efficient Method.

The Government has published its Smart Systems and Flexibility Plan⁽¹⁾ for the energy sector. The Plan recognises the Open Networks project as “a key initiative to drive progress” and “best placed” to leverage the wealth of thinking around smart systems to date. TRANSITION will play a vital role in helping Open Networks to achieve its objective by providing a mechanism for developing detailed requirements, demonstrating and validating potential solutions. This will ensure that the outputs from Open Networks are robust and more readily implemented across the industry which will help ensure that the anticipated benefits are realised. Without the coordinated approach from Open Networks, informed by learning from TRANSITION, it is likely that change will be piecemeal and

uncoordinated which may not achieve the best whole system outcome. A piecemeal approach to market development is also likely to take longer and be less efficient than the structured approach of a NMF Platform. It is also likely that change will take longer, delaying benefits for customers and increasing costs.

How the proposed Project could deliver environmental benefits to customers; and the expected financial benefits the Project could deliver to customers.

Environmental benefits- the primary environmental benefits from TRANSITION will come about through having a network which facilitates further connection of low carbon generation and facilitates the adoption of Low Carbon Technologies (LCTs) such as electric vehicles. Enabling a more flexible market place will allow new products and services to be implemented, which will allow the use of renewable energy to be optimised and further reduce reliance on conventional generation. If successful, the transition to DSO will see the emergence of new market models such as “peer-to-peer” energy trading, which allow consumers to become more active in the market. This will allow them to fully exploit the benefits from distributed generation such as domestic PV panels. Having a NMF Platform will help inform the development of these markets and accelerate their implementation.

One of the key drivers for having a more flexible system is to recognise the inherent intermittency of new renewable sources of energy such as wind and solar. A more flexible network will enable greater use of demand side services and energy storage to optimise the use of renewable energy.

To calculate the capacity released by TRANSITION, we have considered the volume of flexible assets that are anticipated to be connected to the network in future. Various figures are available from literature, and we elected to use the lowest of the range calculated by Imperial College London and Carbon Trust who estimate 4-15GW DSR available by 2030. Based on learning from previous innovation projects such as the NINES project, this flexibility can enable connection of an equivalent volume of renewable generation. Therefore, we estimate the gross capacity released by 2030 is 4GW. Post 2030 we assume the ratio between value and demand side response (DSR) capacity remains constant, so in 2040 we estimate capacity released to be approximately 4.7GW, and 5.4GW in 2050.

For the carbon calculation, we assume that 50% of capacity released is for variable renewable resources, with a 70:30 split of wind to solar. Gross avoided carbon emissions, cumulative for 2050 are estimated to be up to 5,818ktCO₂e.

Financial benefits – as indicated earlier, there is a growing body of evidence that a more flexible energy system could produce significant benefits for consumers, with a figure of £40bn being identified in the Smart Systems and Flexibility Plan. TRANSITION will help to inform the implementation of the changes to the electricity network required to access these benefits for consumers. In developing the business case for TRANSITION, the benefits were estimated by comparing the implementation of a coordinated and efficient Platform compared with an unorganised market of bilateral agreements. From the analysis undertaken by Mott MacDonald it has been identified that approach proposed by TRANSITION could produce benefits for network customers of up to £292m by 2050.

(b) Provides value for money to electricity Customers

i. How the Project has a potential Direct Impact on the Network Licensee's network or on the operations of the GB System Operator;

TRANSITION will trial a number of market models and provide feedback to Open Networks. This will inform the development of the DSO and improve the effectiveness of the process, the availability of flexibility services, and the deferral or avoidance of investment.

The Direct Impact of TRANSITION is the acceleration of the operational and functional changes necessary to ensure that local electricity network operators move from simply delivering electricity from centralised power plants, to being a smarter, more capable platform that enables new energy technologies, products and services to connect to the grid more quickly and more affordably than is currently the case. TRANSITION will achieve this by developing and demonstrating the infrastructure required and testing the market models proposed.

ii. Justification that the scale/cost of the Project is appropriate in relation to the learning that is expected to be captured;

SSEN believes that the scale and cost of TRANSITION delivers good value in comparison with the anticipated knowledge and learning that the project will produce. The knowledge and learning plan is described in Section 5, will ensure that the project outputs are disseminated effectively across a wide range of industry stakeholders. Key to this will be informing Open Networks. In Sections 2 and 3 the need for change and the benefits from flexibility are described, with the Government studies suggesting benefits of up to £40bn being possible from a smarter energy system. The work undertaken by Mott MacDonald to assess the benefits from TRANSITION indicates that the project could bring net benefits of up to £905m to the energy sector by 2050. Benefits for network customers will be up to £292m by 2050.

However, the transition to DSO represents a significant change from the established and well proven industry structure and brings new challenges, additional costs and risks with the potential for unintended consequences. TRANSITION offers an opportunity to identify and mitigate many of these issues, which will give a greater degree of confidence in the outputs from Open Networks and will help accelerate their implementation.

iii. The processes that have been employed to ensure that the Project is delivered at a competitive cost;

TRANSITION will be delivered within the SSEN Large Capital Projects governance processes and where appropriate suitable competitive processes will be used to secure equipment and services. In addition, SSEN have existing arrangements with a variety of framework providers, which have been secured via a competitive process.

It is worthwhile noting that a 'Call for Innovation' was released by SSEN on the OJEU and through the Energy Innovation Centre (EIC) to identify partners for the project. This call for innovation, whilst not forming part of a regulated procurement event, does evidence the fact that SSEN has approached the broadest possible supply base, spanning both the regulated (OJEU through TEDs) and the unregulated (through the EIC) supply chains. Appropriate commercial arrangements have been put in place with these partners for the bid development stage; these will be further developed if the project is successfully funded.

iv. What expected proportion of the potential benefits will accrue to the electricity network as opposed to other parts of the energy supply chain, and what assumptions have been used to derive the proportion of expected benefits;

As identified previously, TRANSITION has the potential to provide benefits for the electricity network and for the wider supply chain. This is described in more detail in Section 3 and Appendix 10.

v. How Project Partners have been identified and selected, including details of the process that has been followed and the rationale for selecting Project Participants and ideas for the Projects;

The outputs and learning from many of our earlier innovation projects and the learning from other DNO projects have been helping shape our approach to the preparation for DSO. This is shown in Appendix 13. TRANSITION represents the next phase in this development and is a natural progression from our earlier work.

In December 2016 SSEN issued an industry wide call for partners and ideas which could help enable the transition to DSO and increase network flexibility. The challenge received over 50 responses. Following an initial assessment, a number of organisations were invited for interview, before a number were selected to help shape the scope of TRANSITION. This is described in more detail in Section 4(e)

vi. The costs associated with protection from reliability or availability incentives and the proportion of these costs compared to the proposed benefits of the Project.

There are no costs associated with protection from reliability or availability incentives.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

i. The level of incremental learning expected to be provided by the Project;

TRANSITION will produce significant incremental learning, to help progress Open Networks. In particular, the project will seek to produce learning in the following areas;

1. Data requirements and data exchange, building on Open Networks DSO functions and mapped against current capabilities;
2. Requirements to create a sustainable market that can facilitate competition based on energy system needs;
3. Build on learning from NTVV, Low Carbon London, and future outputs from Power Potential and other funded DSO projects to understand the monitoring and modelling requirements to provide network data, connectivity and constraint data in sufficient detail to let the market operate in different network types.
4. Establish system processing and visualisation requirements, including data protection and information security.

ii. The applicability of the new learning related to the planning development and operation of an efficient Transmission System and/or of an efficient Distribution System to the other Network Licensees;

TRANSITION will be used to validate the market models and outputs from the industry wide Open Network project. Open Networks will deliver the operational and functional changes necessary to ensure that local electricity network operators move from simply

delivering electricity from centralised power plants, to being a smarter, more capable platform that enables new energy technologies, products and services to connect to the grid more quickly and more affordably. This change will fundamentally alter the methods of operating the network to produce the best whole system outcome; therefore, the learning from TRANSITION will be relevant to the full range of network licensees.

iii. The plans to disseminate learning from the Project, both to Network Licensees and to other interested parties, with credit being given to innovative plans, tools and techniques which enable learning to be shared openly and easily with other Network Licensees;

Our detailed plans for dissemination are included in Section 5. This includes a wide range of options to ensure that as wide a range of stakeholders can be included as possible. The critical dissemination activity will be to inform Open Networks, all DNOs and interested parties. Where practical TRANSITION outputs will be developed in a fashion which facilitates this, for example the project will produce Use Cases using the SGAM modelling technique. This is an area where SSEN and ENWL have already identified the potential for sharing or coordinating dissemination activities with WPD and SPEN's NIC projects. This will help ensure that stakeholders are presented with information in as coordinated a fashion as possible.

iv. The robustness of the methodology to capture the results from the Project and disseminate the learning to other Network Licensees;

SSEN has established methodologies for knowledge capture which have been developed in our extensive portfolio of innovation projects. This is further outlined in Section 5.

v. The treatment of Intellectual Property Rights (IPR):

It is our intention that the work undertaken using NIC funding will adhere to the NIC default IPR arrangements.

(d) 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

DNOs have historically owned and maintained a load focused electricity distribution system. Throughout the past decade, a move away from centralised transmission connected generation and an ongoing increase in LCTs has led to a change in the way the electricity system is operated.

Through innovation to date, new processes and technologies have been trialled to facilitate this transition. As we continue to decarbonise and increase the level of localised generation, distribution systems and their interfaces with the SO are becoming constrained, prohibiting further transition or triggering costly reinforcement. Thus, to enable further progress, greater flexibility within the energy system is required. One way to encourage cost effective development is to develop a more flexible energy system.

Open Networks brings together the GB DNOs, TOs, SO, Ofgem, Government departments and respected academics and consultants to develop DSO architecture. While Open Networks will provide direction, design core functions and map out business

change, the detailed design and physical trial of flexibility is outwith its scope. TRANSITION proposes to undertake these demonstrations to build on strong foundations to accelerate and de-risk the introduction of a DSO. Given the need for a GB-wide coordinated approach, it would be very onerous for a single DNO to undertake this as a business as usual activity.

Phase 1 – Design and Develop

TRANSITION will initially design and develop the common tools, data and system architecture required to implement the proposed models arising from Open Networks. If these models were simply to progress straight into BAU, each DNO could develop their own approach and follow alternative deployment programmes. This has the potential to see different practises being put in place across the country. SSEN and ENWL realise that this is not an efficient use of customer funds by adding costs and potentially alienating key stakeholders. While it is recognised that there will need to be regional variations in some aspects of DSO to reflect differing network types and customer needs, there are clear benefits in having a common and consistent approach to DSO across GB. TRANSITION aims to provide this consistent approach by building test Use Cases and consulting with core stakeholders to inform BAU deployment. Presently, the market models are undefined but will be produced by Open Networks towards the end of 2017. Implementing any new market arrangements without a strong evidential base relevant to the GB market with its level of unbundling represents a significant risk to customers and network licensees. Thus, there is justification for coordinated development of DSO outputs through innovation funding to provide reasoned and consistent DNO-wide direction to unlock the best overall value to the GB consumers.

Phase 2 – Physical Trials

Demonstration of the proposed neutral market provides validation of simulated results and tests its implementation. The full cost and carbon savings for GB consumers can best be realised through effective, efficient creation of the DSOs, hence well-defined physical trials are key in directing the transition to a DSO and determining the function types offering best value. Geographical variations and constraint type may impact vendor interaction and the effective value of flexibility, potentially highlighting the most economic arrangements for DSO. Only through demonstrating the market in representative network groups can quantitative and qualitative assumptions be tested, and firm conclusions drawn.

Detail of possible trial locations is contained in Appendix 9; this articulates some of the new challenges facing locations across GB that warrant innovative intervention.

The need for innovation funding

The development of a functional and competitive DSO has the potential to bring about significant cost and carbon benefits for consumers. However, as discussed above, there are many elements to explore within Open Networks, many of these require testing and validation in order to give industry wide confidence to ensure that the change to DSO will happen. Innovation funding for TRANSITION will accelerate the implementation of the DSOs, reducing the risk and cost of the GB wide rollout and expediting a common neutral market place on which the industry can build BAU deployment. There is a strong rationale for many aspects of DSO to be developed on a collaborative and consistent manner. This will not only drive efficiency but will help to engage stakeholders and

encourage new MPs to become involved in this new market. The industry has already shown a strong commitment to this change by committing significant time, resource and expertise to Open Networks. Funding for TRANSITION will allow the outputs from Open Networks to be robustly demonstrated to ensure that the change to DSO can progress without undue risk to customers.

4 (e) Involvement of other partners and external funding

Industry Engagement

As identified previously, SSEN and ENWL are collaborating to deliver TRANSITION. This collaboration arose from early work in establishing Open Networks, as each organisation recognised the significance and scale of the challenge in the move to DSO. There is currently an MoU in place between SSEN and ENWL for the project development. A formal partnering agreement will be implemented when the project receives funding. NPg will provide expert resource to participate in progress workshops and the Project Steering Board. NPg are currently developing a project which will be complementary to TRANSITION, and will focus on a 'demonstration through modelling' approach that could be combined with the practical learning from TRANSITION to provide insight into a wider set of scenarios.

The ENA Open Networks Project is at the heart of this and has been recognised as a key initiative to drive progress in this area. The underlying objective of TRANSITION is to develop, demonstrate and assess the tools required to implement the outputs from Open Networks. TRANSITION will not only be informed by the progress of Open Networks, but will provide vital learning to inform its progress. Therefore, TRANSITION will need to work closely with the ENA to ensure that it remains aligned with Open Networks. During the development of TRANSITION, SSEN shared the projects objectives with the Open Networks Steering Board and the ENA R&D Managers Forum.

We have also worked closely with WPD and SPEN who have submitted EFFE and FUSION for this year's NIC. This is to ensure that there is no unnecessary duplication and importantly to ensure that where appropriate the projects can cooperate. This will ensure that the projects share learning at key stages, particularly around the scoping and timing of trials, stakeholder consultation and dissemination. Whilst each of the projects is unique and individually produces valuable learning, the impact of the learning can be increased if the activities are coordinated and the learning shared effectively. Similarly, we have engaged with National Grid System Operator regarding their ongoing work with the Power Potential project funded via a previous NIC. We have worked closely with NGSO in the development of the project and through Open Networks, and they have committed to ongoing involvement. See letter of support in Appendix 12

It was recognised that Open Networks was the best mechanism to achieve a coordinated effort on an ongoing basis. A letter of support from the ENA is included in Appendix 12. This includes a proposed structure for coordination and crucially for engaging with key stakeholders, as described in more detail in Appendix 11.

TRANSITION has also had early discussions with other industry participants such as ELEXON and Centrica who have provided letters of support for the project (see Appendix 12).

Project and Partner Identification

The SSEN Innovation portfolio covers a wide spectrum of innovation areas. This recognises potential challenges that the industry may face in the future, including the uptake of EVs, energy storage, government policy on renewables, and the transition to a Distribution System Operator (DSO). TRANSITION represents the next phase in this development and is a natural progression from our earlier work.

In December 2016, SSEN issued an industry wide call for innovation ideas which could help enable the transition to DSO and increase network flexibility, whilst delivering benefits for GB customers. This challenge received over 50 responses.

From the call, we identified key project participants who have been involved in the development of TRANSITION. They bring a wide range of skills and expertise (described in more detail in Appendix 11) which will ensure the project meets its objectives.

1. Atkins – consultancy support for project development, systems modelling and technology implementation. In particular, this has included evaluation of potential technology solutions such as Blockchain.
2. CGI – market development and IT strategy development. CGI have been involved in developing similar “platform” type solutions in other sectors, most recently in the water sector⁽²⁰⁾.
3. Origami Energy Limited – current provider of flexibility services. Having input from a potential user of the NMF Platform is vital to ensure that the Platform is developed to include the requirements from across the energy supply chain.

In addition, SSEN commissioned Mott MacDonald to help inform the business case for the project and to provide support in estimating the benefits.

External Funding

Both SSEN and ENWL are making financial contributions to TRANSITION; additionally both organisations have committed significant time, effort and resource to the successful delivery of Open Networks. During the development phase of the project, SSEN investigated a number of potential external funding opportunities from both Scottish and UK Governments but none were appropriate to the scope of TRANSITION, therefore these were not pursued.

(f) Relevance and timing

i. Why the Problem the Network Licensee is looking to investigate or solve is relevant and warrants funding in the context of the current low carbon or environmental challenges the electricity sector faces;

With the establishment of Open Networks and the Government publication of “Upgrading Our Energy System: Smart Systems and Flexibility Plan”⁽¹⁾ it is clear that DNOs and the wider industry are already on the way to a DSO model. Open Networks is key to this and has been recognised in the Smart System and Flexibility Plan as being a **“key initiative to drive progress and develop proposals in this area”**. The scope for Work Stream 3 of Open Networks is outlined below:

Workstream 3: DNO to DSO Transition Scope



1. DSO Transition Roadmap - a roadmap to deliver transition to DSO in the short, medium and long term
2. DSO Functional Requirements
3. Model for DSO - model for DSO with some options set out for governance models which will allocate DSO functions to system roles and responsibilities
4. DSO Market Model Options Comparison & Evaluation - an assessment of the risks/benefits for power system users, customers and industry participants
5. Trials to Support DSO Definition – if necessary definition and initiation of trials to test different market models and/or any gaps in the existing evidence base to support decisions to define market models (across different regions and Network Operators)

The underlying intention of TRANSITION is to develop the outputs from Open Networks, to identify and put in place the enabling infrastructure to allow the trials of DSO to be delivered. The work to identify Functional Requirements is well underway and the initial outputs have been used to develop TRANSITION, the work to identify the Market Model Options has commenced and initial outputs are expected by the end of 2017.

If successful, TRANSITION will develop these models and then demonstrate them to assess their suitability. Therefore, it is essential that TRANSITION can commence in 2018 to ensure that the existing momentum can be continued, the trials completed and Open Networks can maintain its progress and the milestones on the Roadmap achieved. The project also needs to commence at the earliest opportunity to ensure that DNOs have available a robust evidential base to support the development of their RIIO-ED2 business plans.

ii How, if the Method proves successful, it would form part of the Network Licensee's future business planning and how it would impact on its business plan submissions in future price control reviews or future offshore transmission tender rounds.

The move from DNO to DSO is a fundamental change in the established operating model, with increasing requirements to open up the market to allow new flexible solutions such as storage and DSR to compete directly with conventional solutions. Similarly, there will be new levels of coordination between transmission and distribution to achieve the best whole system outcome for consumers. The Open Networks Roadmap for DSO shows this becoming a core business capability in ED2. Therefore, DSO will be a key element of future business plans and price control reviews.

Section 5: Knowledge dissemination

TRANSITION will deliver tools to ready the industry for the adoption of DSO. It has already been widely accepted by the industry that a move to a more flexible DSO is going to take place. TRANSITION will deliver learning around the functions and competencies that a DSO will require. Addressing the gap in industry knowledge now and reducing future risks.

TRANSITION will employ the Smart Grid Architecture Model (SGAM) to communicate solutions in a consistent manner, allowing for assessment, comparison and adoption by other parties. SGAM is being used by Open Networks to develop the market model options and high-level functional requirements for DSO.

As well as adopting SGAM to describe the elements and architecture of the project, a range of material together will be developed for dissemination as part of the project.

5.1. Learning generated

Efficient and effective knowledge capture and dissemination is critical to the success of innovation projects and the impact they have on the industry. SSEN adopts clear learning objectives, supported by established knowledge management principles and procedures. Eight initial learning objectives have been defined for TRANSITION, which will be supported by detailed knowledge and learning plans throughout the project.

1. Identify the data requirements and data exchanges informed by Open Networks for DSO functions, map this against current technology (service provider) capabilities, and develop requirements for future technologies.
2. Using the outputs from Open Networks, test and validate the market model options being proposed. Understand the requirements to create a sustainable market that can facilitate competition based on whole system needs.
3. Build on learning from NTVV, Low Carbon London, and the ongoing Power Potential project. This will help develop understanding of a range of areas where a collaborative approach will be beneficial, including monitoring and modelling requirements to provide network data, connectivity and constraint data in sufficient detail to let the market operate in different network types.
4. Establish system processing and visualisation requirements, including data protection and information security. This will ensure that cyber security risks are effectively identified and managed.
5. Develop and test DSO Use Cases that will be tested within the project on different network configurations as well as the market/trading rules and timeframes to allow a neutral market to develop. This will remove barriers to new technology and markets allowing the increased use of market based solutions as alternatives to reinforcement.
6. Evaluate stakeholder experience of DSO trials. Comprehensive stakeholder consultation will include discussion with licensees, aggregators, statutory authorities, consumer groups, community energy groups and engagement with the supply chain.
7. Understand and communicate the requirements of a NMF Platform and the commercial mechanisms that will be required for market participation to trial ways in which energy markets can evolve.

8. Present the commercial interactions required for a DNO to transition to a DSO, develop and demonstrate NMF Platform tested on different network configurations that will accelerate the transition from DNO to DSO. This will demonstrate the true value or flexibility from a whole system perspective. Maximising access to existing markets alongside new markets and being able to stack revenue across them.

All GB DNOs, TOs and the SO have been invited to engage and comment on TRANSITION via Open Networks in order to coordinate the innovation work and learning outcomes taking place in this area. This engagement will be continued during the life of the project.

5.2. Learning dissemination

TRANSITION aims to coordinate our dissemination activities through Open Networks, to include the knowledge and learning gained from other projects involving the transition to DSO.

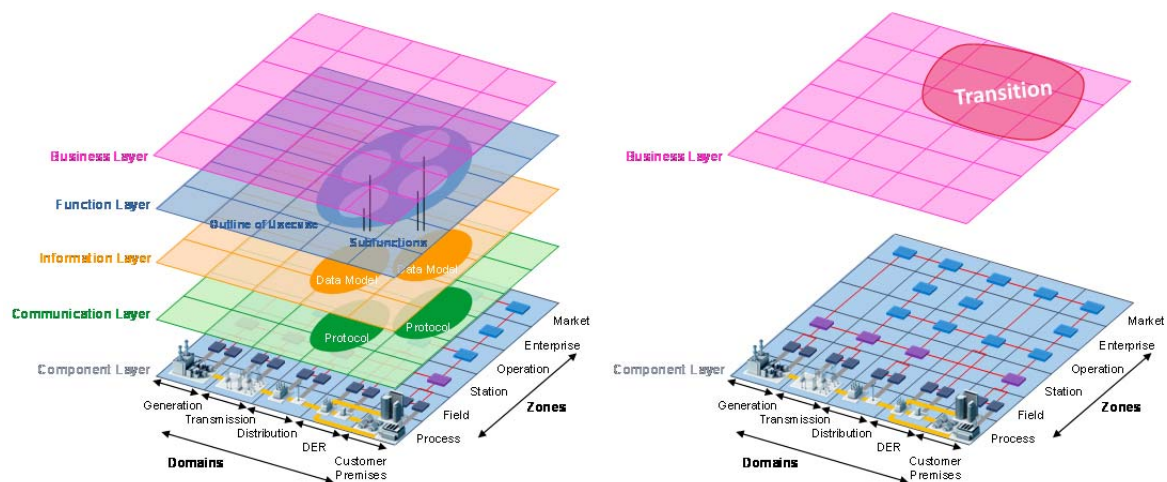
The TRANSITION knowledge and dissemination plan aims to facilitate and accelerate the adoption of DSO but also reduce the risk of the move to DSO. The learning outcomes from the project will inform standard business practices for licensees. The knowledge and learning will also be accessible to other interested parties such as aggregators and MPs. As well as employing SGAM to describe the elements and architecture of the project, a range of material will be developed for dissemination as part of the project.

The education of all stakeholders is essential to the successful adoption of DSO. Materials for different audiences will be developed which provide an insight into some of the challenges which TRANSITION seeks to address, the conditions and functions required for a successful DSO, and the barriers that currently exist to DSO. TRANSITION will seek to bring together outputs from other industry projects in order to deliver learning that represents the whole of the industry. This will provide learning associated with DSO across the industry and for all MPs including supply chain, licensees, statutory bodies, policy makers and academics.

The materials which will be used to disseminate learning outcomes include:

- A dedicated website to engage all stakeholders;
- Written reports (including progress and completion reports) available on the website, the ENA learning portal, and at key industry conferences;
- SGAM representations of TRANSITION technical and commercial approach;
- Annual events and webinars delivered at key milestones to present learning, encourage feedback, and answer questions;
- Newsletter/website articles, conference stands, handouts and press releases;
- Dedicated licensee workshops facilitated by key technical and commercial members of the project;
- Social media posts to raise the profile of TRANSITION and increase the range of project stakeholders;

TRANSITION will have a diverse range of stakeholders. Project information and learning will be accessible to various groups to ensure diverse interests are catered for. TRANSITION will employ Smart Grid Architecture Model (SGAM) to ensure that a common understanding is being used to make the learning from the project accessible to all UK DNOs and interested parties. Within SGAM, TRANSITION focuses on the business layer that is enabled by the information layer that is enabled by the information layer.



The key benefits from employing SGAM include providing a common and clear framework for efficiently communicating and comparing solutions in a consistent manner amongst all stakeholders. The consistent structure, language and visualization provide a common approach for all stakeholders. SGAM represents complete solutions: electrical infrastructure, ICT, information flows and market aspects. This allows clear and consistent comparison of different options. In previous work undertaken, Smart Grid Forum Workstream 9 took a decision to recommend the use of SGAM as being appropriate for the national GB market, rather than the use of other non-SGAM based frameworks. Open Networks is using the SGAM framework to develop DSO models, as it was judged to be well suited to the highly disaggregated nature of the GB energy system.

5.3. IPR

Currently we do not envisage the creation of any IPR during the TRANSITION project. However, if it turns out not to be the case then it is our intention to comply with the default IPR arrangements detailed in the Governance document.

Section 6: Project Readiness

6.1 Evidence of why the Project can start in a timely manner

A number of key activities have been initiated during the preparation of the full submission, which ensures that the project is ready to fully start at the beginning of January 2018. TRANSITION will be delivered within the SSEN Large Capital Projects governance processes. This is a well established process and has been used to successfully deliver a number of LCNF and NIC projects including NTVV and My Electric Avenue.

To develop this proposal SSEN has actively engaged with the supply chain. Initially a 'call for ideas' was published, which received over 50 responses. Following evaluation and interviews, attended by both ENWL and SPEN at our invitation, SSEN entered into formal dialogue with three parties. This consortium has developed the scope of TRANSITION in a collaborative manner. Additionally SSEN have engaged other stakeholders as detailed in Appendix 11. The supply chain engagement included specialist IT providers, SMEs and consultancy firms.

This early supplier engagement has provided a high degree of confidence that the skills to deliver this programme of works are readily available.

The project delivery process will be divided into two distinct phases, with the first phase comprising requirements capture, concept development and specification, followed by a phase of delivery, deployment and trialling of the solution.

The purpose of Phase 1 is to define the specifications of the delivery stage taking into account product readiness. TRANSITION will need to work closely with Open Networks to understand the direction of travel to ensure that the requirements being developed are suitable. Similarly, TRANSITION will provide knowledge and learning to support the progress of Open Networks. It is not expected that a completely new solution or platform would be developed. Phase 1 would look at the possibility of using established and mature market products to deliver a proof of concept test for Phase 2, hence avoiding issues associated with the development of new IT systems. The overall principles will be to:

- use Mature commercial off-the-shelf products wherever possible;
- reduce the delivery risk by employing existing solutions, the innovation coming from their application to these requirements;
- increase confidence in the budget and review the business case at the end of Phase 1,
- engage extensively with stakeholders and supply chain to develop robust, procurable requirements;
- provide confidence that there is a mature supply chain for the provision of the required solutions;
- enable competitive procurement by MPs, and
- deliver value for money for the consumer, both in terms of the delivery of TRANSITION and ultimately in the delivery of the market.

Alignment of this project with Stakeholders' expectations will be maintained by ensuring that the market models and Use Cases developed during Phase 1 are aligned with the

findings from Open Networks, with additional stakeholder engagement during development of key deliverables of TRANSITION. This will also include engaging with other innovation projects which are looking at the transition to DSO.

6.2 Evidence of the measures a Network Licensee will employ to minimise the possibility of cost overruns or shortfalls in Direct Benefits

A number of key activities will be initiated at project start up to ensure measures are in place to minimise cost overruns.

6.2.1 Project planning, governance and quality assurance

An initial detailed Project Plan outlining the activities, milestones and dependencies has been produced. This is attached in Appendix 5. This plan will be continually reviewed and refined during the stages of TRANSITION to ensure that it is maintained as a fully comprehensive, accurate and up-to-date plan for project delivery.

The project plan is largely defined in two broad phases with Phase 1 comprising of requirements capture, concept development and specification, followed by a phase of delivery and deployment of the solution. Phase 1 is defined by work packages 2-6 which are further described in Table 6.1:

Work package	Scope
WP2 Requirements, design, development	<ul style="list-style-type: none"> • Learning capture from previous or current projects; • Develop connectivity model for functional relationships between MPs; • Map Data exchange requirements; • Review of existing market rules and industry codes; • Review and update data governance processes; and • Specify system visualisation requirements
WP3 Forecasting & DSO data	Specification of forecasting data requirements for each DSO function
WP4 Market Models	Definition of at least two market models which can be trialled, including which data flows and forecasts are required and any derogations required
WP5 IT Framework	Technical specification including security standards, redundancy, resilience, and business continuity planning for the market platform
WP6 Trial specification	<ul style="list-style-type: none"> • Shortlist of trial locations • Programme of trials • Available flexibility in locations • Network adaptation requirements (incl. communication, protection, additional monitoring or additional flexibility assets)

Table 6.1 Work Packages 2 - 6

Phase 1 work packages have been assigned 11 key project milestones. Performance against these milestones will highlight risks and potential cost overruns and/or any change requirements to the project steering group (functions of which are described in further detail in this section).

Delivery of Phase 1 will be undertaken by the partner DNOs with expert support from the partner organisations; all outputs from Phase 1 will be informed by focussed stakeholder engagement and Open Networks outputs. The outputs will use common language and SGAM models, and will be widely disseminated to ensure supply-chain awareness and buy-in.

The outputs from Phase 1 and work packages 2-6 will inform a stage gate review. This review will include stakeholder review and feedback, industry impact assessment, feedback to Open Networks, specific compliance and regulation as well as derogations requirements, a full economic modelling and risk analysis, independent advisory and peer review, and a full business case review.

We also expect to run an RFP procurement exercise to refine the budget and inform the economic modelling and business case. A key milestone will be the approval of the consolidated business case by the project steering board, which includes Senior Management of SSEN, ENWL, and NPg. Once the business case is approved, a fully compliant procurement exercise following OJEU rules will be carried to ensure delivery partners for the deployment phase are selected representing the best value for money for customers.

As part of Phase 2, further procurement will be required within work package 7 to ensure best value for money in terms of the site equipment requirements and service contracts with flexibility suppliers. Phase 2 is defined by work packages 7-9 which are described in Table 6.2 below. These work packages align with Milestones 12-21 as described in the project plan.

Work package	Scope
WP7 Deployment	<ul style="list-style-type: none"> • Procurement of site equipment and service contracts with flexibility suppliers • Network adaptation at trial sites • Deployment of platform including establishment of 'sandbox' control room and all necessary processes
WP8 – Trials stage	<ul style="list-style-type: none"> • Trials conducted at appropriate times for each site – eg covering summer minimum and winter peak • Additional trials to be developed to address specific requirements e.g. further deployment of flexibility suppliers for winter peak etc.
WP9 - Dissemination	Learning dissemination will occur throughout the project with topic-specific webinars and presentations, and dedicated large dissemination events in conjunction with Open Networks and other innovation projects at key stages including the end of Phase 1 and the end of the first year of trials. This will help ensure that learning is made available in a timely manner to help inform the development of DNO business plans for ED2.

Table 6.2 Work Packages 7 - 9

6.2.2 Project governance and quality assurance

A project organisation chart has been developed which details the governance and management arrangements. This is attached in Appendix 4. Once suppliers and

resources have been selected, the organisation chart and responsibilities will be assigned to the appropriate resources. The initial organisation chart is shown in Appendix 4; note this is not an exhaustive list, and we would welcome representatives from Ofgem and BEIS on the Project Steering Board.

Roles and responsibilities are described below:

- A Project Steering Board comprising the key stakeholders and decision makers within SSEN, ENWL, and NPg will be established. This group is ultimately responsible for the project and will make decisions that have an overall impact on the benefits and outputs that the project will deliver. They will assess major change requests, review the impact on the project business case, and identify and review risks or issues associated with major change requests. It is also envisaged that an appropriate stakeholder representative will be invited to join the Project Steering Board to ensure that customers' views are considered.
- A competent project manager has been identified and will be responsible for managing key project tasks and activities. The project delivery team will be supported by a financial controller and a project management officer.
- Monthly reporting to the Project Steering Board by the project manager will allow full financial and project control.
- A Project Board, comprising the project manager and work package managers will meet monthly. The Project Board is responsible for the operational management of the project, focused on reviewing progress against the plan, and resolving any risks or issues. They will also approve change requests within a defined tolerance and prepare change requests for submission to the Project Steering Group for major changes. This will ensure a robust change management procedure will be set up as to ensure that change request impacts are fully analysed at the appropriate level of authority depending on the scale of the change;
- For each work package, a work package delivery team will be set up for the day-to-day undertaking of tasks within the work packages reporting directly to the work package manager. Interdependencies between work packages will be highlighted in the fully developed project plan and work package managers will be responsible for maintaining coordination between work packages;
- The project manager will undertake a regular risk review with results reported to the Project Steering Board. The project manager will prepare an active risk register, with mitigation and contingency plans in place. This will be continually reviewed and refined to ensure that it is maintained as a fully comprehensive, accurate and up-to-date reflection of project risks and mitigations in place for project delivery
- An independent design authority will be appointed to review and approve all key project deliverables, with ultimate responsibility for the overall solutions being delivered by the project.
- Quarterly project partner/supplier reviews will track and discuss progress and risks to project delivery;
- Technical design Risk Assessment and risk assessment workshops will be rigorously conducted for all stages. Reviews will be in the format of workshops

with the output captured within the Risk Register. The register issues, actions and ownership records will be readily communicated amongst the team. The workshops will identify risks and significant risks to project steering committee.

We believe that the two-phase process with a stage gate review following Phase 1 and robust project governance around specific milestones will limit the potential for cost overruns, materialised risks and risks for consumers. Additionally our proposed procurement exercise for the project delivery partners for Phase 2, and procurement of flexibility suppliers and trial site equipment will ensure best value for money for customers. Our approach is that Phase 1 is crucial in providing a robust business case and direction for Phase 2 and therefore scrutiny will be placed on the outcomes of Phase 1 to enable a robust delivery plan for Phase 2.

6.2.3 Senior management commitment

The project has been developed in conjunction with SSEN and ENWL senior management who have demonstrated management commitment and ensured the availability of input and support from in-house specialists. Management commitment has been achieved through regular presentations at executive management team meetings and also at senior management team meetings within relevant directorates.

We have engaged with SSEN, ENWL and ENA senior management, each of whom have provided inputs on the project scope, delivery phases and success criteria. The experiences and guidance in their areas of expertise has enabled a robust project to be prepared. A letter of support from the ENA is attached in Appendix 12 to demonstrate this commitment.

The project steering group will include senior management representation from both companies and project partners/suppliers.

6.3 A verification of all information included in the proposal (the processes a Network Licensee has in place to ensure the accuracy of information can be detailed in the appendices)

The project costs estimates are further detailed in Appendix 3 and have been based upon:

- Inputs from sector specialists and advisers external to SSEN;
- Inputs from SSEN specialists;
- Quotations received from the partners and suppliers, benchmarking where possible and utilising procurement expertise in specific areas to challenge costs and leverage existing commercial arrangements with suppliers; and,
- External and internal expert knowledge of the typical cost requirements from ICT projects.

SSEN has endeavoured to ensure all of the information included within this full submission is accurate. Information included within the proposal has been gathered from within SSEN, ENWL, the project partners, suppliers and other subject matter experts. All of this information has been reviewed to confirm and refine understanding, whilst evaluating the validity and integrity of the information.

A bid team has worked with partners to prepare and review the bid. Project partners have also ensured information provided by them has been through a thorough internal review and approval process before being provided to SSEN.

Benefits and business case

The carbon and financial benefits case outlined in Section 3 and supported by Appendix 10 has been developed by Mott MacDonald with input from SSEN, ENWL, and the project partners. At all stages, the case has been critically examined to ensure a prudent and defensible approach has been taken; this is explained in more detail in Appendix 10.

6.4 How the Project plan would still deliver learning in the event that the take up of low carbon technologies and renewable energy in the Trial area is lower than anticipated in the Full Submission

This project will demonstrate the potential market models, rules, data systems and market products required for the development of a market models proposed by Open Networks. While the benefits of this market will be to potentially provide more products for using the flexibility offered by low carbon technologies and renewable energy, there are other applications which could benefit from such a market. These include ANM using DSR, triad management, reactive power management at distribution level, and access and visibility for the SO and DSO of currently existing services at distribution level. All of which can be beneficial to both network customers and the wider industry.

As detailed in the business case, we have adopted a pragmatic view of future uptake of low carbon technologies to ensure that the benefits presented are not overly optimistic.

Our project plan includes a trial stage which will be scheduled to cover the appropriate time of constraint for that network –eg summer minimum and/or winter peak demand. Early learning from these first trials will be disseminated through dedicated events and publications. A second focused trial stage will take the lessons learnt from stage 1 and focus particularly on areas where the stage 1 trials have been inconclusive or unsuccessful due to for example lack of availability of flexibility suppliers, insufficient delivery of service contracts etc. Stage 2 trials will look at solutions to resolve these issues and perform further trials to determine whether the proposed solutions are sufficient. Additionally, we will explore the capability to simulate additional trial scenarios which we are unable to trial physically, possibly through collaboration with NPg.

Trial areas are to be selected based on the existing capabilities and will consider rural demand, urban demand and mixed demand as well as the underlying service suppliers such as aggregators, individual renewable/non-renewable generation suppliers within the trial areas. This will provide clarity on the potential for renewable generation at the DSO level, as well as provide visibility and clarity to the DSO and SO on how the network can be managed using such generation. The learning outcomes of the project will be delivered without a dependence on the speed of take up of low carbon technologies or distributed generation in the trial areas but will help inform the MPs for the future uptake or development of renewable generation as well as current MPs.

Throughout the project, details of lessons learned will be maintained by the Project Manager supporting the ongoing capture and transfer of knowledge to partners and internal/external stakeholders. This is expected to include equipment procurement,

control systems installation and overall system operations. A separate work package (WP9) has been planned for learning dissemination. Learning dissemination is covered across the project phases so that each phase of the project and each completed work package has the potential to deliver learning to the market. Two large learning dissemination events are planned at the end of trials stage 1 and 2 respectively to maximise the learning outcomes from the trials. Learning dissemination is covered in greater detail in Section 5.

6.5 The processes in place to identify circumstances where the most appropriate course of action will be to suspend the Project, pending permission from Ofgem that it can be halted.

As part of project governance there are number of processes in place to identify, assess and manage any issues that may affect the project. These processes are described in greater detail in the preceding subsections, and help to maintain the smooth running of the project, whilst also helping to identify the most appropriate course of action at any point.

The project governance will include several layers of approval and control such as a Project Steering Board. The control processes described above include risk assessment, technical assurance and risk workshops.

A phased project delivery and stage gate approval process will serve to review the project business case prior to deployment. This review will include stakeholder review and feedback, industry impact assessment, feedback to Open Networks, specific compliance and regulation as well as derogations requirements, a full economic modelling and risk analysis, independent advisory and peer review and a full business case review. An RFP procurement exercise on the fully developed trial programme, trial locations and IT specifications to refine the budget and inform the economic modelling and business case will be run. This consolidated business case will require approval from the project steering committee and the Senior Management of SSEN and ENWL. Progress through the stage gate will be approved by the project steering committee based on a KPI model, which will be developed at project initiation and is expected to include cost efficiency, benefits of project, and risks as well as performance against each milestone within Phase 1. The stage gate process will effectively identify and quantify whether the appropriate course of action is to suspend the project or carry on to Phase 2.

Section 7: Regulatory issues

7.1 Physical Market Participants

Physical MPs deliver or receive services at an MPAN and this will vary the import or export reading. Services are provided using the operational flexibility of assets that form a part of normal site activities, including embedded wind and solar. As assets are installed behind the MPAN for a site, they should comply with all relevant regulations and the site has a duty to avoid their use exceeding the authorised supply capacity or authorised export capacity and complying with the requirements of their connection agreement. No additional accreditation will be required for sites as part of this project, over and above the appropriate generator certification eg G59. Therefore, no derogation is required for the transaction of services by a physical MP.

7.2 Non-Physical Market Participants

Non-physical MPs do not have a MPAN but can be a party to a service transaction. It is possible that a non-physical MP is unable to negate a previous transaction for a service and this would either create an electricity imbalance or create an operational issue for the DSO. Such issues should be considered in the market rules and commercial arrangements but no derogation is required for the transaction of services by a non-physical MP.

7.3 Phase 2 – Trials

As discussed in Appendix 8, TRANSITION will trial a set of market rules and market models with defined Use Cases to determine the consequences and outcomes when delivering services on a typical network area.

At this stage it is envisaged that the trials in Phase 2 will be designed to comply with all relevant industry rules and standards. These include security standards (P2/6) and quality standards (SQSS, ESQCR, ER G5/4, and ER P28).

The work in Phase 1 of TRANSITION will inform the need for any derogations during Phase 2.

Should it become apparent that derogations are required for Phase 2, engagement with Ofgem will be carried out in a timely manner to discuss the requirements and find appropriate solutions e.g. use of standby generation, additional capacity service contracts to be placed etc.

Section 8: Customer Impact

TRANSITION will test a number of market models through the development of market rules and the implementation of appropriate Use Cases. This will expand on Open Networks and the roles and responsibilities of MPs. At this stage, there are no plans to engage directly with domestic customers or undertake trials within their premises. If the models produced by Open Networks require that domestic customers are directly involved then appropriate measures will be put in place to ensure compliance with the NIC Governance arrangements prior to commencing this work. Additionally, it may be appropriate to include domestic customers in stakeholder engagement forums; this engagement is discussed in Appendix 11 and will follow industry best practise. Both SSEN and ENWL have previous experience in delivering projects with significant customer engagement, such as Solent Achieving Value from Efficiency (SAVE) and feel confident that all relevant measures can be implemented. Any commercial customers required for the trial will be engaged on a voluntary basis using mutually acceptable commercial arrangements.

The project does not require any planned interruptions to supply and there is no need to consider alternative ways to implement the project or require protection from incentive penalties. There may be a requirement for monitoring equipment installation at trial participant or DNO sites. However, our previous LCNF Tier 1 LV Network Monitoring project (SSET1002) developed a range of network monitoring equipment that can be safely connected without interruption to customers' supplies.

Where risks are identified, appropriate contingency measures such as temporary generation and additional network protection assets will be deployed during trials to avoid any risk of loss of service to customers.

The impact of TRANSITION on individual MPs is summarised in Table 8.1.

Market Participant	Local Market	Central Market	Commercial Market
SO	Buy	Buy	Buy
DSO	Buy / Sell	Buy / Sell	Buy / Sell
Electricity Suppliers	Buy / Sell	Buy / Sell	Buy / Sell
Traders	Modelled	Buy / Sell	Modelled
Directly-Connected Generation	Buy / Sell	Buy / Sell	Buy / Sell
Consumers (Domestic)	Modelled	Modelled	Modelled
Consumers (Non-Domestic)	Buy / Sell	Buy / Sell	Buy / Sell
Aggregators	Buy / Sell	Buy / Sell	Buy / Sell
Community Energy Schemes	Modelled	Modelled	Modelled
Directly-Connected Storage	Modelled	Modelled	Modelled

Table 8.1 Impact of TRANSITION on Individual MPs (subject to contract)

During the trial network selection, a key consideration will be the impact on customers and the mix of customers in a particular network. This will include an assessment of any potentially sensitive customers such as hospitals or care homes, and will identify the number of vulnerable customers connected to the network. If necessary, appropriate contingency measures will be deployed to ensure that there are no adverse impacts on customers, for example:

- Standby generation – deployed in advance;
- Additional deployment of field staff and where required additional coordination with other surrounding/impacted DNOs both at control room and field staff deployment level;
- Deployment of additional customer services call handlers;
- Special provisions for identified vulnerable customers such as fast response with standby generation, heaters etc;
- Deployment of additional control room operatives;
- Reconfiguration of network e.g. moving open points to minimise risk.

Section 9: Project Deliverables

Table 1: Project Deliverables

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (% , must add to 100%)
1	WP6 Trial specification Produce and apply the site selection methodology and select the Trial networks.	June 2018	<ol style="list-style-type: none"> 1. Publish on the TRANSITION website a report detailing the site selection methodology, and a map of Trial areas. 2. Selection of networks to install monitoring (if required). 	6%
2	WP2 Requirements design development Data exchange requirements and updated data governance processes specified.	August 2018	<ol style="list-style-type: none"> 1. Publish report detailing learning from relevant international DSO experience relating to trial objectives. 2. Functional specification for connectivity model, data exchange and governance requirements. 	8%
3	Stakeholder feedback event (Stage Gate)	April 2019	<ol style="list-style-type: none"> 1. Stakeholder feedback event to disseminate and gather feedback on outputs from WP 2-6. 	7%
4	WP7 Deployment Develop appropriate commercial arrangements and contract templates for flexibility services. Network adaptation for trial deployment.	August 2019	<ol style="list-style-type: none"> 1. Publish contract templates for flexibility services and commercial arrangements learning 2. Publish equipment specifications and installation reports 	35%
5	WP7 Deployment Platform Full Acceptance Testing completed	August 2020	<ol style="list-style-type: none"> 1. Publish interface and configuration specifications and commissioning reports. 	17%

Reference	Project Deliverable	Deadline	Evidence	NIC funding request (% , must add to 100%)
6	WP8 Trials stage 1 Completion of one stage of trials	March 2021	<ol style="list-style-type: none"> 1. Publish monitoring and analysis results for Trials on TRANSITION website. 2. Stakeholder dissemination event showcasing learnings. 	17%
7	WP8 Trials stage 2 Completion of second stage of trials	December 2021	<ol style="list-style-type: none"> 1. Publish monitoring and analysis results for Trials on TRANSITION website 2. Stakeholder dissemination event showcasing learnings. 	10%
8	Comply with knowledge transfer requirements of the Governance Document.	End of project	<ol style="list-style-type: none"> 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. 	0%

List of Appendices

Appendix	Title	Content
1	Benefits tables	Financial benefits, capacity released and carbon benefits.
2	Full submission spreadsheet	Screenshot of front page (full spreadsheet attached separately).
3	Funding commentary	Description of main funding items.
4	Project organogram	Overview of project structure and reporting.
5	Project programme	Screenshot of high-level programme (full programme attached separately).
6	Risk register	Screenshot of highest-scoring risks (full register attached separately).
7	Market models	Description of commercial models and Use Cases to be developed during project.
8	Trial methods, technology and physical architecture	Description of the methods to develop and implement the trials software, equipment etc.
9	Trial network types	Description of network types with examples of potential locations to be explored further in project.
10	Business case supporting information	Further detail on Section 3; a standalone report produced by Mott MacDonald.
11	Stakeholder and other engagement	Additional details of engagement undertaken during project development, and proposed collaborative engagement during project.
12	Letters of support	
13	DSO Innovation model	Development of innovation portfolio building on previous learning.
	References	
	Glossary	

Electricity NIC – financial benefits

Scale (£m)	Method	Method Cost	Base Case Cost	Notes			Cross-references	
				2030	2040	2050		
DNO benefits - pilot	Method 1	n/a	n/a	n/a	n/a	n/a	Due to the nature of the method, the cost-benefit analysis (CBA) only makes sense at scale, where the market can fully function, and so benefits of the pilot scale are not applicable.	n/a
	Method 2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Method 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a
DNO benefits - licensee	Method 1	20	0	-27	-24	-20	Note that the Base Case cost is zero since the counterfactual is an assumed path taken by DNOs without the market platform and for which they are already funded.	See Section 3 and Appendix 10 for further details
	Method 2	n/a	n/a	n/a	n/a	n/a	The net benefits are considered to be a prudent case with greater potential for upside than downside.	
	Method 3	n/a	n/a	n/a	n/a	n/a	Upside: Greater market efficiency, more flexible capacity, higher growth post 2030 Downside: Market inefficiency (low number of flexibility providers and sellers leading to market distortion), limited participation, higher cost of platform.	
DNO benefits - GB wide	Method 1	20	0	21	168	292	265,000 sites engaging with the NMF by 2030, of which 26,000 are engaging with the DNOs. This assumes an average of 15kW of flexibility per site (which is the mean capacity per site based on Origami expected portfolio of flexibility providers from domestic to large sites). For all parties, value of method in 2030, 2040 and 2050 is £81m, £531m, and £905m.	See Section 3 and Appendix 10 for further details
	Method 2	n/a	n/a	n/a	n/a	n/a		
	Method 3	n/a	n/a	n/a	n/a	n/a		

Electricity NIC – capacity released [if applicable]

Scale (GW)	Method	Method Cost	Base Case Cost	Notes			Cross-references	
				2030	2040	2050		
DNO benefits - pilot	Method 1	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Method 2	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Method 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a
DNO benefits - licensee	Method 1	20	0	0.04	0.05	0.05	Note that base cost is zero the counterfactual is an assumed path taken by DNOs without the market platform. We take a conservative figure of 4GW of flexibility(from which we derive capacity released) , by 2030. Work from Imperial College London indicates flexible capacity could be up to 15GW.	See Section 3 and Appendix 10 for further details
	Method 2	n/a	n/a	n/a	n/a	n/a		
	Method 3	n/a	n/a	n/a	n/a	n/a		
DNO benefits - GB wide	Method 1	20	0	0.4	0.4	0.5	265,000 sites engaging with the NMF by 2030, of which 26,000 are engaging with the DNOs. This assumes an average of 15kW of flexibility per site (which is the mean capacity per site based on Origami expected portfolio of flexibility providers from domestic to large sites). For DNOs, capacity released by the Method in 2030, 2040 and 2050 is 386MW, 448MW, and 520MW. For all parties, capacity released by the Method in 2030, 2040 and 2050 is 4GW, 4.7GW, and 5.4GW.	See Section 3 and Appendix 10 for further details
	Method 2	n/a	n/a	n/a	n/a	n/a		
	Method 3	n/a	n/a	n/a	n/a	n/a		

Electricity NIC – carbon and/or environmental benefits

Scale (ktCO2e)	Method	Method Cost	Base Case Cost	Notes			Cross-references		
				2030	2040	2050			
DNO benefits - pilot	Method 1	n/a	n/a	n/a	n/a	n/a	Due to the nature of the method, the CBA only makes sense at scale, and so benefits of the pilot scale are not applicable	n/a	
	Method 2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
	Method 3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
DNO benefits - licensee	Method 1	20	0	51	70	80	Note that base cost is zero the counterfactual is an assumed path taken by DNOs without the market platform. We take a conservative figure of 4GW of flexibility(from which we derive carbon savings) , by 2030. Work from Imperial College London indicates flexible capacity could be up to 15GW. See discussion in Mott MacDonald Appendix.	See Section 3 and Appendix 10 for further details	
	Method 2	n/a	n/a	n/a	n/a	n/a			
	Method 3	n/a	n/a	n/a	n/a	n/a			
DNO benefits - GB wide	Method 1	20	0	498	689	785	265,000 sites engaging with the NMF by 2030, of which 26,000 are engaging with the DNOs. This assumes an average of 15kW of flexibility per site (which is the mean capacity per site based on Origami expected portfolio of flexibility providers from domestic to large sites). For all parties, capacity released in method in 2030, 2040 and 2050 is 2,834 ktCO2e; 4,816 ktCO2e and 5,818 ktCO2e.	See Section 3 and Appendix 10 for further details	
	Method 2	n/a	n/a	n/a	n/a	n/a			
	Method 3	n/a	n/a	n/a	n/a	n/a			
<i>If applicable, indicate any environmental benefits which cannot be expressed as tCO2e.</i>									

Appendix 2 Full Submission Spreadsheet

See full spreadsheet attached, and additional explanation in Appendix 3 Funding Commentary.

NIC Funding Request

	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	Total
Total Project Cost	<i>From Project Cost Summary sheet</i>						
Labour	179,185	1,110,845	2,117,992	680,259	672,027	227,930	4,988,238
Equipment	-	331,467	1,130,991	48,220	6,779	6,989	1,524,446
Contractors	132,000	838,203	1,774,082	417,543	65,533	34,947	3,262,308
IT	16,250	39,178	1,405,319	1,105,878	1,128,504	11,067	3,706,196
IPR Costs	-	-	-	-	-	-	-
Travel & Expenses	13,000	144,856	137,653	104,660	110,164	57,133	567,466
Payments to users & Contingency	-	-	-	246,580	288,121	34,947	569,649
Decommissioning	-	-	-	-	-	72,551	72,551
Other	-	-	-	-	-	-	-
Total	340,435	2,464,548	6,566,038	2,603,140	2,271,129	445,565	14,690,854

Initial Net Funding Required	<i>calculated from the tables above</i>						
Labour	179,185	1,110,845	2,117,992	680,259	672,027	227,930	4,988,238
Equipment	-	331,467	1,130,991	48,220	6,779	6,989	1,524,446
Contractors	132,000	838,203	1,774,082	417,543	65,533	34,947	3,262,308
IT	16,250	39,178	1,405,319	1,105,878	1,128,504	11,067	3,706,196
IPR Costs	-	-	-	-	-	-	-
Travel & Expenses	13,000	144,856	137,653	104,660	110,164	57,133	567,466
Payments to users & Contingency	-	-	-	246,580	288,121	34,947	569,649
Decommissioning	-	-	-	-	-	72,551	72,551
Other	-	-	-	-	-	-	-
Total	340,435	2,464,548	6,566,038	2,603,140	2,271,129	445,565	14,690,854

Licensee Compulsory Contribution / Direct Ben	<i>from Project Cost Summary sheet</i>						
Labour	17,918	111,084	211,799	68,026	67,203	22,793	498,824
Equipment	-	33,147	113,099	4,822	678	699	152,445
Contractors	13,200	83,820	177,408	41,754	6,553	3,495	326,231
IT	1,625	3,918	140,532	110,588	112,850	1,107	370,620
IPR Costs	-	-	-	-	-	-	-
Travel & Expenses	1,300	14,486	13,765	10,466	11,016	5,713	56,747
Payments to users & Contingency	-	-	-	24,658	28,812	3,495	56,965
Decommissioning	-	-	-	-	-	7,255	7,255
Other	-	-	-	-	-	-	-
Total	34,043	246,455	656,604	260,314	227,113	44,557	1,469,085

Outstanding Funding required	<i>calculated from the tables above</i>						
Labour	161,266	999,760	1,906,193	612,233	604,824	205,137	4,489,415
Equipment	-	298,320	1,017,891	43,398	6,101	6,291	1,372,001
Contractors	118,800	754,383	1,596,674	375,788	58,980	31,453	2,936,078
IT	14,625	35,260	1,264,788	995,290	1,015,654	9,960	3,335,577
IPR Costs	-	-	-	-	-	-	-
Travel & Expenses	11,700	130,370	123,888	94,194	99,148	51,420	510,719
Payments to users & Contingency	-	-	-	221,922	259,309	31,453	512,684
Decommissioning	-	-	-	-	-	65,296	65,296
Other	-	-	-	-	-	-	-
Total	306,391	2,218,093	5,909,434	2,342,826	2,044,016	401,009	13,221,769

NIC FUNDING REQUEST £

13,081,705

Appendix 3 Funding commentary

A3.1 Licensee funding contributions

Both SSEN and ENWL are contributing towards the compulsory contribution for TRANSITION. ENWL will contribute £[REDACTED] towards project management and network trial costs. For simplicity this is shown as two payments in Appendix 2, and is not separately referenced in the Full Submission Spreadsheet.

A3.2 Overall cost assumptions

Note costs outlined below do not include inflation.

- All internal resource costs are based on a rate of £[REDACTED] per day, which includes an allocation of all overheads.
- All external resource costs are based on an average rate of £[REDACTED] per day (based on the assumption that this is expert professional resource).
- All estimated costs have been inflated within the Full Submission Spreadsheet by the annual inflation rates provided by Ofgem.
- Travel and expenses includes provision for hire of event space in London or other major city for the main stakeholder engagement events.

WP1 Project management

- £[REDACTED] internal labour costs for
 - FTE Project manager + specialist engineering support + ICT engineer
 - 15 days/year PMO support
 - 26 days/year knowledge management support
 - 0.5 FTE commercial support + stakeholder engagement manager
- £[REDACTED] costs for project-specific IT hardware and software

WP2 Requirements design development

- £[REDACTED] academic best practise review
- £[REDACTED] consultant fees for network visibility and connectivity

WP3 Forecasting and DSO data

- £[REDACTED] consultant fees for forecasting and regional FES development

WP4 Market models

- £[REDACTED] internal labour
- £[REDACTED] consultant fees including SGAM modelling

WP5 IT framework

- £[REDACTED] consultant fees for platform requirements and development

WP6 Trial specification

- £[REDACTED] internal labour for trial location shortlist
- £[REDACTED] equipment **per site** for monitoring equipment
- £[REDACTED] internal labour **per site** for detailed planning and installation of monitoring

Stage gate

- £[REDACTED] internal labour and £[REDACTED] consultant fees for detailed review and assessment of project outputs, stakeholder feedback, and business case.

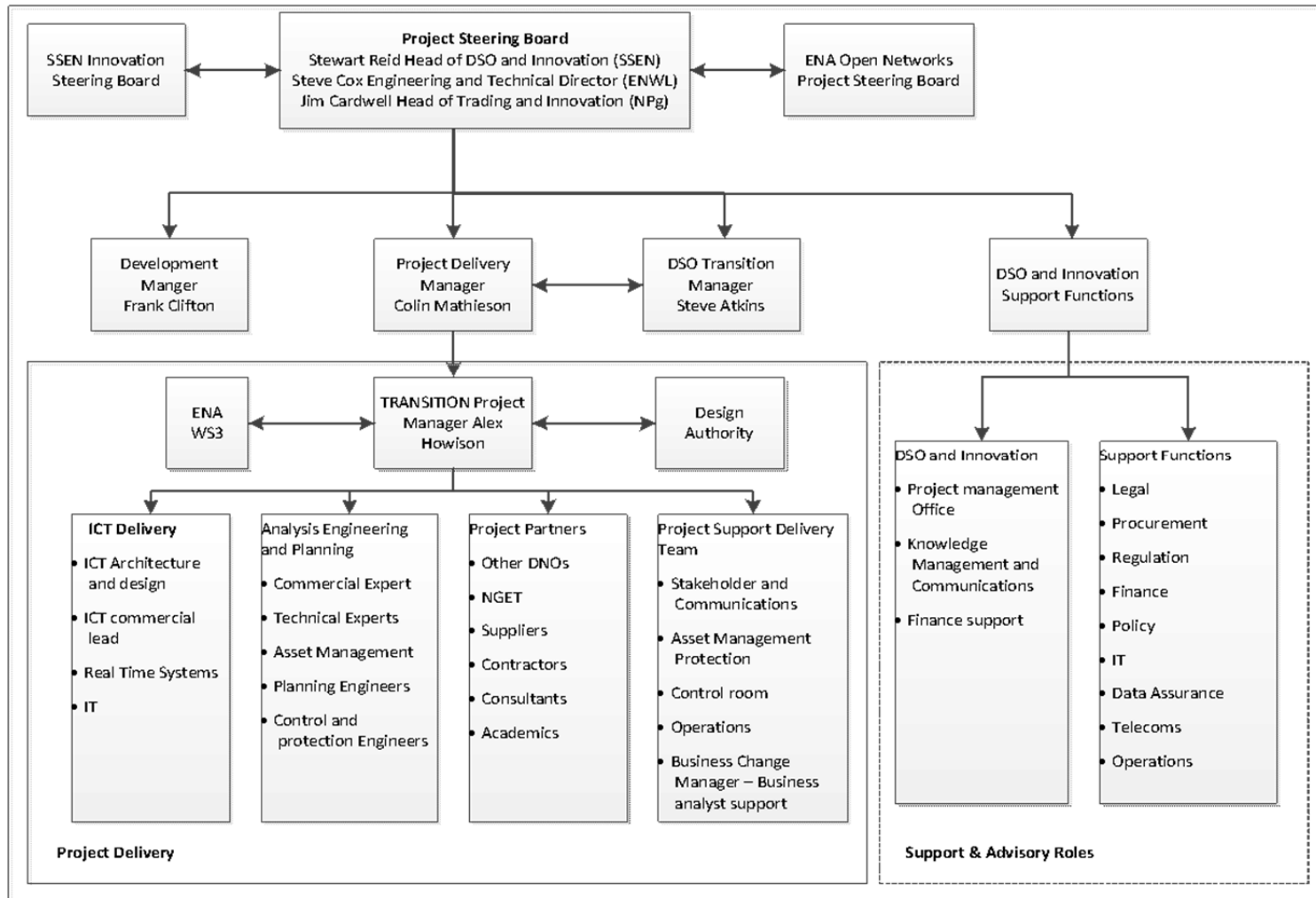
WP7 Deployment

- Trials IT architecture, including servers, FTP, RTS and Comms
 - £ [REDACTED] internal labour
 - £ [REDACTED] equipment
 - £ [REDACTED] contractors
 - £ [REDACTED] IT
- Licensing
 - £ [REDACTED] including shadow environment install of PowerOn Fusion and PI
- Specialist procurement
 - £ [REDACTED] internal labour for IT platform additional procurement resource
 - £ [REDACTED] internal labour **per site** for drafting and completion of market participants contracts
 - £ [REDACTED] **per site** payments to users for involvement in trials
- Network adaptation
 - £ [REDACTED] internal labour **per site** for network adaptation and automation
 - £ [REDACTED] equipment **per site** for protection, monitoring, and contingency equipment
- Software
 - £ [REDACTED] internal labour for specialist support regarding existing DNO systems
 - £ [REDACTED] contractor fees for trial platform development including data exchange, FAT, penetration testing, user training, and updates/changes following first round of trials.
 - £ [REDACTED] IT costs to purchase forecast software

WP8 Dissemination

- £ [REDACTED] internal labour to deliver dissemination events and support reporting
- £ [REDACTED] equipment for displays and pop-up banners at exhibitions and events
- £ [REDACTED] contractor and IT fees for development of displays for dissemination events, design of reports, and website development.

Appendix 4 Project organogram



Appendix 5 Project programme

Full programme is attached separately.

ID	Task Mod	Task Name	Duration	Start
1		Project TRANSITION	0 days	Mon 19/06/17
2		Milestones		
24		Project Mobilisation Stage		Mon 20/11/17
27		WP1 Project Management	1170 days	Mon 08/01/18
38		Requirements and Design Stage		
39		WP2 Requirements, design, development	189 days	Fri 19/01/18
40		Best practise review	30 days	Fri 19/01/18
41		Network visibility and connectivity	60 days	Fri 19/01/18
42		Data Model work package	139 days	Fri 19/01/18
43		Data requirement for each DSO function	60 days	Fri 19/01/18
44		Market participants data requirements	60 days	Fri 19/01/18
48		Review existing data availability	20 days	Fri 13/04/18
49		Data exchange requirements (to, from, frequency)	30 days	Thu 10/05/18
50		Stakeholder engagement for data Xchange reqs	20 days	Thu 21/06/18
51		Data protection review	10 days	Thu 21/06/18
52		System visualisation requirements	60 days	Thu 19/07/18
53		Loss of connectivity impacts	10 days	Thu 19/07/18
54		Data architecture and data governance	60 days	Thu 10/05/18
55		WP3 Forecasting & DSO data		
56		Forecasting	154 days	Mon 26/02/18
57		Review existing DNO systems	60 days	Mon 26/02/18
58		Forecasting requirements	60 days	Fri 13/04/18
59		Specification of forecasting systems	60 days	Fri 06/07/18
60		Business processes and rules	10 days	Fri 07/09/18
61		WP4 Market Models	151 days	Wed 10/01/18
62		Market Models	151 days	Wed 10/01/18
63		Use case definition	30 days	Wed 10/01/18
64		Identify trial participant groups to engage	20 days	Wed 10/01/18
65		Stakeholder engagement/market consultation	5 days	Wed 07/02/18
66		Establish market rules and incentives	60 days	Wed 21/02/18
67		Define services and providers	60 days	Wed 21/02/18
68		Define trading timeframes	30 days	Wed 21/02/18

ID	Task Mod	Task Name	Duration	Start
69		Margins and protections	60 days	Wed 21/02/18
70		Identify regulatory barriers	30 days	Wed 21/02/18
71		Market modelling	60 days	Wed 16/05/18
72		Feedback to ENA Open Networks Project	1 day	Wed 08/08/18
73		WP5 IT Framework	180 days	Thu 21/06/18
74		Technical specification	50 days	Thu 21/06/18
78		Platform development	130 days	Thu 30/08/18
82		WP6 Trial specification	173 days	Sat 10/02/18
83		Location shortlist	20 days	Wed 14/02/18
84		Network characteristics of shortlist	30 days	Wed 14/03/18
85		Available flexibility	20 days	Wed 14/03/18
86		Installation of monitoring equipment	20 days	Wed 25/04/18
87		Baseline data collection*	100 days	Wed 23/05/18
88		Network planning/power systems analysis	30 days	Wed 25/04/18
89		Local stakeholder and TSO engagement	30 days	Wed 11/04/18
90		Protection and contingency requirements	30 days	Wed 06/06/18
91		Network simulation	60 days	Wed 18/07/18
92		Define trial test programme	30 days	Wed 06/06/18
93		Stage Gate entry criteria	60 days	Mon 07/01/19
103		Design Stage - Gate Review	0 days	Fri 12/04/19
104		WP7 Deployment	345 days	Mon 15/04/19
105		Procurement	60 days	Mon 15/04/19
109		Network adaptation	180 days	Mon 15/04/19
115		Software	285 days	Mon 08/07/19
124		WP8 - Trials Stage	600 days	Fri 06/03/20
125		Run trials Stage 1	140 days	Mon 10/08/20
129		Run trials Stage 2	125 days	Mon 22/02/21
131		Run trials stage 3	250 days	Mon 16/08/21
132		WP9 Dissemination	535 days	Mon 01/01/18

Appendix 6 Risk register

The below table shows a snapshot of the highest five risks currently identified by the TRANSITION team.

Risk No	Phase	Category	Risk Description	Impact/ Likelihood						Risk Owner	Risk Review Date	Risk Control Actions	Status/actions
				People	Reputation	Operation/ Delay	Financial	Likelihood	Score				
1	R&D	Strategic	Changes to the ENA Open Networks project		3	2	3	2	16	Project Director	01.11.17	1. Engagement with senior ON members and regular meetings. 2. Stage Gates in TRANSITION programme	Engagement underway with ON project.
2	R&D	Strategic	Lack of SO engagement		2	3	2	2	14	Project Manager	01.11.17	1. SO has confirmed commitment to ON Project. 2. Engagement with SO at the bid stage. 3. Regular SO engagement. 4. Review at Stage Gate	Engagement carried out with SO and feedback gained on project.
3	R&D	Resource	Recruitment of market participants under-recruitment/lack of interest from DERs		2	2	3	2	14	Project Manager	01.11.17	1. Early and continuous engagement. 2. Customer feedback from the engagement sessions helping shape the commercial and technical designs. 3. Learning from other projects such as NTVV, CLASS, Cornwall etc.	Studying learning gained from previous projects NTVV, CLASS etc..
4	R&D	Regulatory	First time DNO collaboration fails due to competing priorities of partner DNOs		3	2	2	1	7	Project Manager	01.11.17	1. Signed memorandum of understanding by senior management at all DNOs 2. One DNO identified as lead 3. Partner DNOs on project steering board.	Signed memorandum of understanding.
5	R&D	Operations	Prohibitive costs of integrating final system into BAU.		3	2	2	1	7	Project Manager	01.11.17	1. Develop optimum design to keep costs low. Tendering process to be competitive to ensure value for money	Review at Stage gate

Appendix 7 Market models

The ENA-led Open Networks project (Open Networks) will define a number of possible market models and associated roles and responsibilities for Market Participants (MPs). TRANSITION will test these market models through the development of market rules and requirements and through the implementation of appropriate Use Cases. This work will inform the development of Open Networks.

At the time of writing the TRANSITION NIC submission, the Open Networks market models to support the articulation of the TRANSITION project activities had not been published. As such, the TRANSITION submission team has used its market knowledge and systems expertise to develop and introduce our view of three possible market models and associated roles and responsibilities of MPs. This approach enables this Project to be developed to provide confidence that the approach, capabilities and budget are appropriate to trial the models yet to be defined by Open Networks. A staged approach has been proposed in the TRANSITION project plan to maintain alignment with the Open Networks models.

A7.1 Market Participant Roles and Interactions

Role of the Neutral Market Facilitator (NMF)

We believe the role of the NMF should be transparent and non-discriminatory as it has a key role in establishing markets and the ability to improve coordination across the markets. The number of potential NMFs varies from one NMF (Central Market model with a GB focus), through a number of separate, geographical NMFs (where the boundaries are defined by network topology, such as one per DNO group or licenced DNO area, Local Market model), to many NMFs developed on a commercial basis and operating across geographic network boundaries (these could support local markets or a distributed market with a differentiated focus, Commercial Market model).

The NMF is a new role within the energy market and TRANSITION will consider;

- The role of the NMF and provide an evidential base that can be used to inform the decision as to who could fulfil this role.
- The extent to which the NMF should be independent of MPs and any consequences if the NMF can also transact for services.
- If all MPs should have unrestricted access to all NMFs under every market model and whether this affects the level of flexibility available or the delivery of services.
- How the role and scope of the DSO varies under each market model. TRANSITION will provide valuable insight to inform the development of both the NMF and DSO.
- The level and type of interaction between the DSO and the SO and whether the DSO is the route to market for all other MPs and, if so, whether such a step should be temporary or permanent.

Market Participants

The success of the NMF relies on operating a fair market that provides easy and non-discriminatory access for all MPs and this was highlighted recently by BEIS and Ofgem in the Smart Systems and Flexibility Plan⁽¹⁾. This will result in minimal influence of any one MP, increased service transactions, and the establishment of a more liquid and competitive market. All of this will result in better value for customers.

In Table A7.1 below we identify some of the MPs and classify them by their ability to accept physical delivery and the timescales in which they can operate.

MP	Type of MP		Operational Timescale ³			
	Non-Physical	Physical	LT	MT	ST	Real-Time
SO	-	X	X ¹	X ¹	X ¹	X
DSO	-	X	X	X	X	X
Electricity Suppliers	X ²	X	X	X	X	X
Traders	X ²	-	X	X	X	X
Directly-Connected Generation	X ²	X	X	X	X	X
Consumers (Domestic)	-	X	-	-	X	X
Consumers (Non-Domestic)	X ²	X	-	X	X	X
Aggregators	-	X	X	X	X	X
Community Energy Schemes	-	X	X	X	X	X
Directly-Connected Storage	X ²	X	X	X	X	X

Table A7.1 – Overview of MPs

Notes;

1. The SO is moving towards real-time requirements so the need for LT transactions may reduce.
2. These MPs may opt to unwind transactions to avoid physical delivery or could take physical delivery if the conditions were right (even if not established to do so).
3. LT-Long Term, MT-Medium Term, ST-Short Term

Interaction Between MPs

In the future, service opportunities will come from the DSO, from peer to peer transactions, and the potential for non-physical transactions for services. This will significantly increase the opportunities for flexibility providers and the requirements for services and increase competition within the market. This will also facilitate new potentially disruptive services to be developed offering a greater range of choice for consumers. TRANSITION will explore the impact of this on the willingness of MPs to make flexibility available and establish the value of services to the DSO, SO and other MPs accruing from the use of services at different times and under different market models. This evaluation will be undertaken from a “whole system” perspective.

A7.2 Market Models

TRANSITION considers the existing market model and three possible future market models, each of which becomes increasingly more interconnected. The new market models are generally consistent with the recent BEIS and Ofgem Plan and should;

- Provide effective and competitive markets that provide easy and efficient access for all MPs and flexibility (particularly unused, underutilised, or new flexibility) that enables the optimising of revenue streams from different markets to provide the best whole system outcomes;
- Enable transactions between all MPs, even if the DSO and/or SO is not a counterparty, such as peer to peer transactions; and
- Deliver improved outcomes for customers.

We also expect these market models to provide the SO and DSOs with the visibility they require of the actions by other MPs using their infrastructure, in order to maintain system integrity and deliver best value for customers. In summary, the market models proposed are:

- **Current Market** – the existing monopsonistic market;
- **Local Market** – multiple local marketplaces, each based around a specific geographical area, the boundaries for which are based on the network topology. These are likely to be licenced/regulated franchises or subsets thereof;
- **Central Market** – a single GB-wide marketplace managed by a single NMF. This is likely to be a licenced/regulated special purpose vehicle (or similar); and
- **Commercial Market** – multiple discrete but differentiated markets that operate concurrently, each with their own NMF. These NMFs are not bounded by geography or network topology and have developed commercially rather than as licenced/regulated franchises.

Requirements for all Market Models

There are a number of common features that could apply to all market models and these include;

- Standard service contracts across every market to provide maximum opportunity for service provision and to increase market liquidity;
- MPs should be able to provide a portfolio of services from their flexibility (whether from an individual asset or a group of assets acting in unison);
- The role of buyers and sellers of services is interchangeable as they may need to unwind a transaction nearer delivery due to changing requirements e.g. a DSO may need to unwind instructions as an outage may be cancelled or warmer weather reduces an expected capacity issue;
- All MPs need to have appropriate levels of market visibility, although the level of visibility may be different for different MPs; and
- Rules are required for conflict resolution, e.g. priority of access within a market and across the marketplace, provide for out of merit order service utilisation, and compensation arrangements if the services an MP has transacted for is negated.

Current Market

The Current Market is a single GB-wide homogenised market providing Balancing Services that is monopsonistic in nature with the SO fulfilling two roles (NMF and sole buyer). DNOs do not have a formal role in the process of procurement, co-ordination, or delivery of Balancing Services and some of their actions can negate those of the SO. The SO is the sole buyer of services, mainly from large, geographic BMUs. The SO contracts for a minority of Balancing Services from non-BMU MPs through one of three mechanisms where it is a counterparty;

- Bilateral Contracts - on negotiated terms with little or no price discovery;
- Standard Contracts - allow flexibility providers to enter the market and increase the service capacity with transparent pricing; and
- Auctions - using standard contracts that encourage smaller participants to enter the market with clearing prices reported after each auction.

In addition to the above, Open Networks is considering how the Current Market model could be evolved to facilitate the DSO role.

In parallel to Balancing Services summarised above, there are Bilateral Agreements between MPs. These Bilateral Agreements usually involve an aggregator (to access flexibility to provide Balancing Services), an electricity supplier (e.g. electricity supply contracts, contracts to access flexibility and PPAs), or a non-physical MP (e.g. financial instruments such as contracts for differences or insurance-type products). Bilateral Agreements need to be considered in any future energy market as the levels of decentralised generation, storage and flexibility increase. This will improve the visibility of actions on the DSO networks and provide opportunities for value optimisation.

The range and type of services available under the Current Market model is changing;

- The SO is streamlining and simplifying the range of services through their System Needs and Product Strategy⁽¹²⁾;
- Existing MPs are increasing the range of Balancing Services they offer;
- DNOs are introducing constraint management services; and
- New peer-to-peer services are being developed and some will be trialled through the Ofgem Innovation Link, Regulatory Sandbox competition.

The future of Bilateral Contracts under any market model is uncertain and they may remain for certain services. TRANSITION is not seeking to influence that decision, although the outcomes may assist.

Local Market

This model has a multitude of Local Markets, each with their own NMF, that operate within a defined geographical area based on network topology, e.g. primary sub-station, grid sub-station, or a DNO licenced area. Local Markets could operate as separate competitive entities on the same platform, each with their own rules, or could operate on their own physically separate platform.

The DSO and SO can transact across multiple Local Markets to access the required level of any service. The DSO and SO have greater visibility of local networks and the flows across the DSO network used to provide services, although the distributed nature of this marketplace may affect overall visibility as there is no single market authority. Whilst the SO is restricted to service transactions related to its needs, the DSO can buy or sell services for other Local Markets and higher voltage markets within its area. The sufficiency of service availability and the reliability of service delivery can inform DSO decisions regarding infrastructure and/or asset investment. The lack of a single authority across GB or the ability to adopt a whole system view may be sub-optimal.

The Local Market encourages the use of flexibility to deliver services between all MPs in the local area to resolve local issues and provides limited opportunities for the stacking of services, although there may be service innovation to meet local requirements. MPs need separate contracts with different NMFs to use flexibility to deliver services across Local Markets. This may create barriers to access the full value of the services available within a Local Market. Further, MPs may have limited opportunities for peer to peer service transactions which could result in the development of competing parallel markets.

Providers of flexibility sell via a single NMF and flexibility users access that flexibility via the NMFs and aggregate flexibility across NMFs as necessary (the SO and non-physical MPs are more likely to do this). Where there is a need for services within the specific

network topology, this can only be met by flexibility from within the local market servicing that topology.

The Local Market model is illustrated in Figure A7.1.

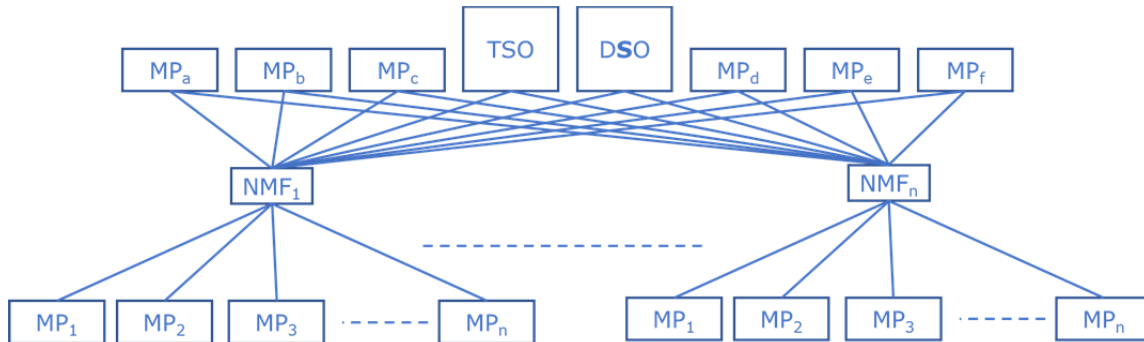


Figure A7.1 Local Market arrangements

Central Market

This model is an enhancement of the Local Market. It provides a single GB-wide competitive market for all MPs, operated by a single NMF with standardisation of services to provide clarity for all MPs. The Central Market increases the use of and opportunities for flexibility to deliver services and provides greater market visibility for all MPs beyond that available in the Local Market. The complexity of interactions may present an opportunity to evaluate the suitability of some form of distributed ledger technology to verify the local delivery of locational services.

A single GB-wide market provides a single authority that can provide market visibility and network flows to the SO and DSO. Transacting for services on a local, regional, and national basis is easier than the Local Market with only one market in which to participate although the GB-wide nature of the market may affect the availability of cost-effective services to address local issues. The sufficiency of service availability and the reliability of service delivery can inform DSO decisions regarding infrastructure investment.

The single GB-wide market based on standardised services should increase the need for services and provide increased scope for value stacking. It is uncertain whether the Central Market will reduce the barriers to entry as a larger market will provide a greater requirement for services but it may increase the minimum service requirement and standardised services may reduce the scope for innovation. MPs can transact services with other MPs across all geographies to deliver local, regional, or national access to services (provided there are no constraints that prevent access), although there may be a potential for conflict in value between MPs. There may be limited opportunities for MPs to interact through the provision of peer to peer services which could result in competing parallel markets. Depending on how the market is structured, there may be an erosion of value for aggregators in the Central Market model if end customers can participate in the Central Market on a standalone basis. The Central Market model is illustrated in Figure A7.2

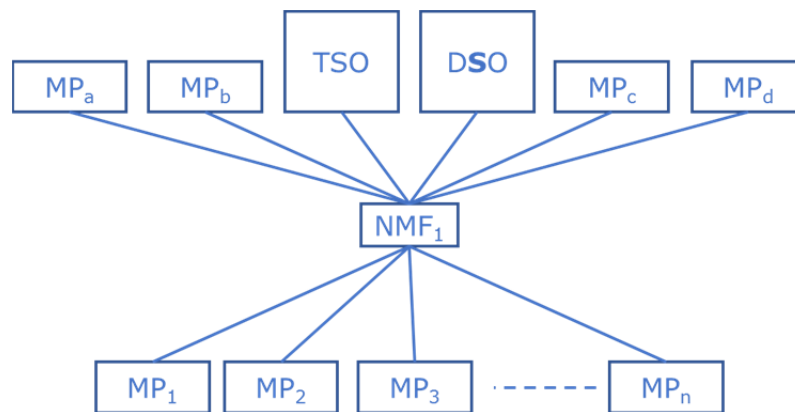


Figure A7.2 Central Market model

Commercial Market

This model is a GB-wide competitive and fully interactive marketplace with multiple markets, each operating on a commercial basis with its own NMF. The Commercial Market consists of multiple NMFs that have developed on a commercial basis rather than a regulated basis. Individual markets could be generalist or may be differentiated around specialisms, e.g. non-physical, service type, flexibility type, or geography (from Local Market to a DNO area to a GB-wide market). The larger number of individual markets may be unsustainable and some market NMFs could collapse or consolidate.

To operate effectively, the commercial market requires every NMF to use and every MP to transact on standard services and to adopt the same protocol for the transaction of services and the exchange of value for services. This approach may not suit each market and there may be a reduction in the scope for innovation. However, standardisation should increase participation in the marketplace and may increase the likelihood of local flexibility being used to deliver local services. Service delivery may involve MPs buying and/or selling the same service (or part of a service) multiple times which can increase the effective market size and increase market liquidity. The complexity of interactions between MPs may present an opportunity to evaluate the suitability of some form of distributed ledger technology to verify the local delivery of locational services. The marketplace will require an appropriate level of regulation and a lack of an overall market authority could affect visibility of activity. However, the increased competition in this market model should benefit the customer.

The higher level of participation in the marketplace provides an increased opportunity for the SO and DSO to secure services, although it is uncertain if this will increase availability of cost-effective services to address local issues. The SO and DSO have to provide signals for services across multiple markets which will increase their operational complexity. They will also have to compete for services which may increase the value of services or reduce the availability of services. The SO and DSO have a common need to understand the net effect of service transactions on energy flows and to then manage the network using this information, e.g. constraint management or prioritising service provision to maintain security standards. The distributed nature of this marketplace may affect overall visibility as there is no single market authority. The sufficiency of service availability and the reliability of service delivery can inform SO and DSO decisions regarding the repair, refurbishment, or replacement of infrastructure and/or assets or to invest in new infrastructure and/or assets.

The Commercial Market model operates in a similar manner to the Local Market model for MPs buying services. However, it enables MPs selling services to transact with buyers via multiple NMFs or allows MPs selling services to choose the NMF offering the best commercial deal for the services. MPs contract with multiple NMFs to participate in multiple markets and can participate in different markets concurrently. As the marketplace comprises multiple smaller markets, this may drive an increase in the minimum service size which may increase the barriers to entry. This increases the opportunity for peer to peer transactions (which could occur across different NMFs for peers within the same geographic area or network topology), allows MPs to maximise the value of their portfolio, and increases the value from service stacking. All of this increases the market efficiency. However, the increase in opportunity has an associated increase in complexity and may result in some barriers to full value realisation.

The Commercial Market model is illustrated in Figure A7.3.

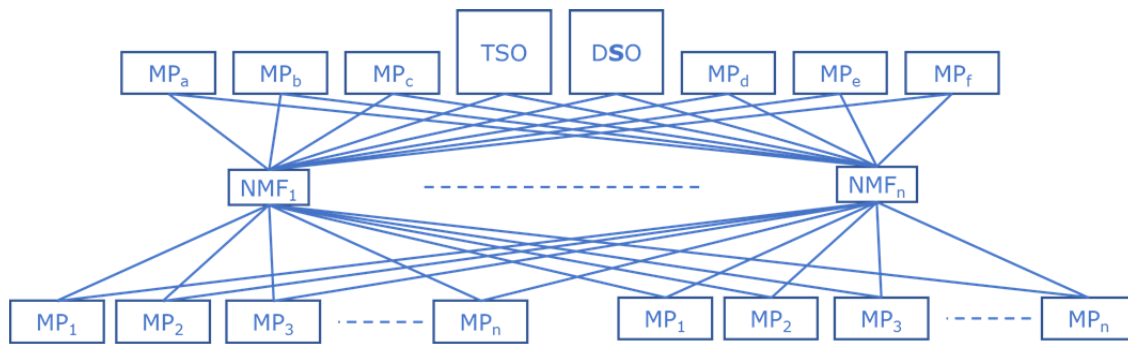


Figure A7.3 Commercial Market model

Evaluation of Market Models

Each market model defined by Open Networks will be evaluated through the application of a standardised methodology and participant feedback to determine the suitability of Use Cases (defined in section 2.3 and expanded below). This will allow an analysis of the benefits of and issues with each market model from a financial, services, MP, and network basis. This will ensure the greatest value can be derived from the Project.

Use Cases for Physical MPs (Use Cases 1 and 2)

Use Case 1	Use Case 2
<p>The DSO has insufficient capacity to allow additional renewable generation to export to a local network. A reduction in demand is required to manage the shortfall in capacity. The DSO requests a reduction in demand to balance the network/keep the network within operational limits.</p> <p>This creates economic value for the consumer through an increase in the level of renewable generation exported to the network, reduces the carbon footprint, and the DSO defers or avoids network reinforcement.</p>	<p>The DSO has insufficient capacity to allow additional renewable generation to export to a local network. An increase in demand is required to manage a reverse power flow restriction. The DSO requests an increase in demand to balance the network/keep within operational limits.</p> <p>This creates economic value for the consumer through an increase in the level of renewable generation exported to the network, reduces the carbon footprint, and the DSO defers or avoids network reinforcement.</p>

Potential Conflicts Arising from Use Cases 1 and 2

- the DSO request may counteract or override a previous request from another MP to use an increase in demand to deliver a service to a third party and this may adversely impact the value of that transaction.
- if the DSO request is made after Gate Closure, this could impact the Final Physical Notification of the supplier and expose them to imbalance charges.

Use Cases for Non-Physical MPs (Use Cases 3 and 4)

Use Case 3	Use Case 4
<p>An energy supplier or energy trader wants to transact for a service to optimise their wholesale portfolio. The energy supplier/energy trader requests a service to effectively reduce the import (or increase the export) at an MPAN to help balance or lengthen their portfolio.</p> <p>Value is created by reducing the MPAN import reading (or increasing the MPAN export reading) to either;</p> <ul style="list-style-type: none"> • reduce exposure to a high wholesale market price when the MP wholesale portfolio is 'short' or • lengthen the wholesale portfolio when the wholesale price is high to provide capacity to trade and take profit. 	<p>An energy supplier or energy trader wants to transact for a service to optimise their wholesale portfolio. The energy supplier/energy trader requests a service to effectively increase the import (or reduce the export) at an MPAN to help balance or shorten their portfolio.</p> <p>Value is created by increasing the MPAN import reading (or reduce the export reading) to either;</p> <ul style="list-style-type: none"> • take advantage of low wholesale market prices when their MP wholesale portfolio is 'long' or • shorten the wholesale portfolio when the wholesale price is low to provide capacity against which to purchase and take profit.

Potential Conflicts Arising from Use Cases 3 and 4

- Changing the MPAN reading can create network issues, e.g. reducing demand on lightly loaded networks, reverse power flows on networks with embedded generation, or increasing demand above an authorised supply capacity or constraint level.
- The DSO must have the final decision on the transaction of services by other MPs to maintain supply reliability and, as such, adversely impact their value.
- If the DSO call is made after Gate Closure, this could impact the Final Physical Notification of the supplier and expose them to imbalance charges.

Methodology for Applying all Use Cases

- Modelling and simulation to establish the impact of different forms of contracting and the associated value.
- Conduct a field trial to establish participant behaviour and the information requirements.
- Understand the outcomes of different levels of visibility for MPs and market models and quantify the impacts of conflicts.

Appendix 8 Trial methods, technology and physical architecture

A8.1 Trial methods

This section provides an outline of how the trials approach will deliver the learning outcomes.

Use Cases and Market Models

TRANSITION will be Use Case driven. The four core Use Cases have been outlined in Section 2 and Appendix 7. These Use Cases will be tested under the different market scenarios to provide an evidential base that will inform both the costs and risks as well as the ease with which value can be accessed to the ultimate benefit of consumers under each market model.

The Market Models are described in detail in Appendix 7. There are essentially two market structures that lead to three distinct market models. Market structures are based on either a single national Neutral Market Facilitator (NMF) (the Central Market model) or multiple NMFs (the Local Market model and the Commercial Market model).

The Central Market model is based on a single GB-wide market with a single NMF and would be a licenced or regulated special commercial vehicle.

The Local Market model is based on the market being geographically bounded; for the purposes of TRANSITION these boundaries will be based on network topology. Providers of flexibility sell via a single NMF and flexibility users access that flexibility via the NMFs and aggregate flexibility across NMFs as necessary (the SO and non-physical MPs are more likely to do this). Where there is a need for services within the specific network topology, this can only be met by flexibility from within the local market servicing that topology.

The Commercial Market model operates in a similar manner to the Local market model for MPs buying services. However, it enables MPs selling services to transact with buyers via multiple NMFs or allows MPs selling services to choose the NMF offering the best commercial deal for the services. In this model it is likely that the NMFs have developed on a commercial basis rather than a regulated basis. It is possible that NMFs in this market model specialise in types of MPs, types of flexibility or services provided. Peer-to-peer service transactions could occur across different NMFs for peers within the same geographic area or network topology.

TRANSITION's approach of operating across number of trial areas bounded by the network topology enables all three market models to be trialled based on the access rights that are assigned to different market participants. These access rights will be configured in the Trials Architecture and can be configured appropriately for the different Use Cases. TRANSITION's approach is distinct from other projects in that it will establish the relative benefits of local energy markets versus the national market, by involving a number of local energy markets. TRANSITION establishes the requirements of flexibility buyers operating across a number of local energy markets. TRANSITION therefore will establish the incremental value as well as the costs and risks associated with making flexibility available beyond the local energy market.

The four potential Use Cases outlined for the purposes of this submission will be informed and refined by the ongoing work of Open Networks Work Stream 3.

Market Model	Use Case 1	Use Case 2	Use Case 3	Use Case 4
	Network Constraint Management: Demand Turn Down	Network Constraint Management: Demand Turn Up	Wholesale Portfolio Optimisation Demand Turn Down	Wholesale Portfolio Optimisation Demand Turn Up
Central	✓	✓	✓	✓
Local	✓	✓	✓	✓
Commercial	✓	✓	✓	✓

At present it is intended that all of the Use Cases can be evaluated for all market models; this will be confirmed following receipt of the models from Open Networks. For example, the relative merits of all three market models can be evaluated for a DSO needing to manage a constraint on one of their networks. The Local Market model and the Central Market model provide a single point of access to all flexibility within a particular network topology, whereas the Competitive Market model would require a view across all NMFs with access to flexibility within that network topology. Similarly, the Local Market model and the Central Market model provide the DSO with a single point of visibility of what other MPs are doing within a particular network topology under Use Cases 3 and 4. This will enable the DSO to actively operate their networks as a system.

The data requirements and data model developed as part of work packages 2 (Requirements Design and Development) and 3 (Forecasting and DSO Data) will establish the minimum data set to which each market participant requires access in order to make informed decisions about the actions available to them.

Trial Methods: Use Cases 1 & 2

Use Cases 1 & 2 explore the opportunity for DSOs to access and make use of flexibility within their networks in order to manage network constraints. Use Case 1 looks at the use of demand turn down to manage a network constraint. Use Case 2 looks at how demand turn up can be used to manage an excess of supply from embedded generation.

The DSO will be using their existing forecasting capabilities to forecast demand over the medium to long term. The TRANSITION trial architecture will provide the participating DSOs with short-term and near real-time forecasting capabilities that will enable them to understand the likely demands on their networks. This will include factoring in the impact of meteorological data to forecast supply from non-dispatchable embedded generation, as well as demand.

OUTCOME: refined forecasting requirements and methods for operating as a DSO.

The forecasts will be fed into the near real-time Power System Analysis component of the trials architecture. The DSO will assess the impact on their networks and establish the control actions open to them to operate their system effectively. They will be able to assess whether conventional network management approaches are sufficient or whether the use of flexibility is required.

The DSO will be provided with access to the flexibility available to them from the NMF via a secure web browser and assess whether the flexibility available has the required

characteristics. They will also be able to request flexibility be made available and providers of flexibility with suitable characteristics will be able to bid to supply the DSOs need.

OUTCOME: Understanding of the value of flexibility and its accessibility under different market models.

If insufficient suitable flexibility is available, then the engineer will have to revert to conventional control approaches. This will provide learning around the factors affecting the availability of sufficient levels of suitable flexibility.

TRANSITION's approach is to use an engineer to make these decisions. This will enable the experience of the engineer to be captured and leveraged in designing the approach to automation. It will also avoid unnecessary costs and risks in integrating the trials architecture with the existing DNO systems.

Once a DSO has secured sufficient suitable flexibility, the flexibility provider will receive the instruction to dispatch the flexibility and will be responsible for its dispatch.

The Analytics solution within the trials architecture will capture all the actions. From a TRANSITION perspective, it will be used to provide the quantitative basis of the learning. In the enduring DSO systems architecture, analytics capabilities will provide the DNO with the ability to:

- Demonstrate regulatory compliance (Open Networks WS3 Competence 2).
- Inform the pricing approach to deliver a cost effective and economic distribution system (Open Networks WS3 Competence 8).
- Effectively manage the information and data exchanges they require to effectively plan and operate as a DSO (Open Networks WS3 Competence 10).
- Provide an audit trail that services have been delivered as contracted and when instructed (Open Networks WS3 Competence 12).

The Commercial Contract Database will store the commercial information required inform economic decisions about what actions the DSO should take. This database will provide the participating TRANSITION DSOs with the means to fulfil Open Networks WS3 Competences 3, 6 and 11.

Trial Methods: Use Cases 3 & 4

Use Cases 3 & 4 explore the opportunity for other Market Participants (MPs) to access and make use of flexibility within the DSOs' networks in order to create value by optimising their wholesale electricity portfolios. Use Case 3 looks at the use of demand turn down in response to high wholesale prices or a lack of supply. Use Case 4 looks at how demand turn up can be used to take advantage of low wholesale prices or manage the impacts of an excess of supply (either from embedded generation or from transmission connected sources).

Non-DSO MPs in TRANSITION will be selected based on them having the necessary system capabilities to participate in the project. They will be able to access available flexibility from the Neutral Market Facilitator via a secure web browser and assess whether the flexibility available has the suitable characteristics for their purposes. They

will also be able to request flexibility be made available and providers of flexibility with suitable characteristics will be able to bid to supply the MPs needs.

OUTCOME: Understanding of the incremental value of flexibility from stacking, where value may conflict between MPs and its accessibility under different market models.

An important outcome of TRANSITION will be the understanding of the opportunities for value stacking between MPs and when there are value conflicts. It will help to inform the development of the market arrangements around how to deal with value conflicts between MPs, how value accruing to one, or a number of, MP(s) at the expense of another MP should be settled and the associated implications for investment decisions.

Via the Neutral Market Facilitator secure web browser, the DSOs will have visibility of the actions of other MPs on the DSOs' networks. This will be factored into their short term and near-real-time forecasting and assessed via the Power Systems Analysis component (as per Use Cases 1 & 2).

OUTCOME: Understanding of whole system value from the use of flexibility by multiple parties. Quantitative insight on which to inform market and regulatory design.

Use Case 01: Network Constraint Management Demand Turn Down			
Description	<p>This Use Case enables a DSO to access flexibility services in order to manage a network constraint. In this Use Case, the type of constraint being managed is an upper capacity constraint, where the ability to turn down demand or to increase generation enables the DSO to create economic value for the customer through the deferral or avoidance of network reinforcement.</p> <p>The DSO calls on demand side flexibility to reduce demand or increase generation to balance their networks/keep within operational limits.</p> <p>Conflicts:</p> <ul style="list-style-type: none"> • The DSO's call to use flexibility services may supersede a call by other Market Participants, and as such adversely impact their value • The DSO's call is for a period after gate closure and impacts the suppliers' positions, leading to imbalance charges <p>Methods:</p> <ul style="list-style-type: none"> • Modelling and simulation to establish impacts of different forms of contracting and associated value; • Trial to establish participant behaviour and information requirements; • Understand outcomes of different levels of visibility for market frameworks and quantify impacts of conflicts. 		
Actors	<p>Buyer: DSO Sellers: Existing flexibility provider (aggregator (supplier or aggregator), end customer (large))</p>		
Triggers	DNO Network Monitoring		
Info In	Network data Seller data (offers) Buyer data (bid)	Info Out	Bid/offer acceptance Flexibility action Network performance data
Pre-Conditions (optional)			
Post-Conditions (optional)			
Business Rules	DSO has precedence over rights of use of flexibility to assure reliability of supply		

Use Case 02: Network Constraints Management | Demand Turn Up

Description	<p>This Use Case enables a DSO to access flexibility services in order to manage a network constraint. In this Use Case, the type of constraint being managed is a reverse power flow constraint, where the ability to increase demand or reduce generation enables the DSO to create economic value for the customer through the deferral or avoidance of conventional approaches to network reinforcement.</p> <p>The DSO calls on demand side flexibility to increase demand or o reduce generation to balance their networks/keep within operational limits.</p> <p>Conflicts:</p> <ul style="list-style-type: none"> • The DSO's call to use flexibility services may supersede a call by other Market Participants, and as such adversely impact their value • The DSO's call is for a period after gate closure and impacts the suppliers' positions, leading to imbalance charges <p>Methods:</p> <ul style="list-style-type: none"> • Modelling and simulation to establish impacts of different forms of contracting and associated value • Trial to establish participant behaviour and information requirements • Understand outcomes of different levels of visibility for market frameworks and quantify impacts of conflicts 		
Actors	<p>Buyer: DSO Sellers: Existing flexibility provider, end consumer (large)</p>		
Triggers	DNO Network Monitoring		
Info In	Network data Seller data (offers) Buyer data (bid)	Info Out	Bid/offer acceptance Flexibility action Network performance data
Pre-Conditions			
Post-Conditions			
Business Rules	DSO has precedence over rights of use of flexibility to assure reliability of supply		

Use Case 03: Wholesale Portfolio Optimisation | Demand Turn Down

Description	<p>This Use Case enables an Energy Retailer or Trader to access flexibility services in order to optimise their wholesale portfolio. In this Use Case, value is created by reducing demand or increasing generation to reduce exposure to a high wholesale market price when their wholesale portfolio is 'short', or to lengthen the wholesale portfolio when the wholesale price is high in order to provide capacity to trade and take profit.</p> <p>Energy Retailer/Trader calls on demand side flexibility to reduce demand or increase generation to balance their balance/lengthen their portfolio.</p> <p>Conflicts:</p> <ul style="list-style-type: none"> • Demand reduction or generation increase has the potential to create network constraints, such as reverse power flows on networks with embedded generation • DSO must have the final call on use of flexibility services by other MPs to assure reliability of supply, and as such adversely impact their value • DSO's call is for a period after gate closure and impacts the suppliers' positions, leading to imbalance charges <p>Methods:</p> <ul style="list-style-type: none"> • Modelling and simulation to establish impacts of different forms of contracting and associated value • Trial to establish participant behaviour and information requirements • Understand outcomes of different levels of visibility for market frameworks and quantify impacts of conflicts 		
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Actors	Buyer: Energy Retailer/Trader Sellers: Existing flexibility provider (aggregator (supplier or aggregator), end consumer (large))		
Triggers	Wholesale market price DNO Network Monitoring		
Info In	Network data Seller data (offers) Buyer data (bid)	Info Out	Bid/offer acceptance Flexibility action Network performance data
Pre-Conditions			
Post-Conditions			
Business Rules	DSO has precedence over rights of use of flexibility to assure reliability of supply		
Use Case 04: Wholesale Portfolio Optimisation Demand Turn Up			
Description	<p>This Use Case enables an Energy Retailer or Trader to access flexibility services in order to optimise their wholesale portfolio. In this Use Case, value is created by increasing demand or reducing generation to take advantage of low wholesale market prices when their wholesale portfolio is 'long', or to shorten the wholesale portfolio when the wholesale price is low in order to provide capacity against which to purchase and take profit.</p> <p>The Energy Retailer/Trader calls on demand side flexibility to increase demand or reduce generation to balance their balance/shorten their portfolio.</p> <p>Conflicts:</p> <ul style="list-style-type: none"> • Demand increase or generation reduction has the potential to create network constraints. • The DSO must have the final call on the use of flexibility services by other Market Participants to assure reliability of supply, and as such adversely impact their value • The DSO's call is for a period after gate closure and impacts the suppliers' positions, leading to imbalance charges <p>Methods:</p> <ul style="list-style-type: none"> • Modelling and simulation to establish impacts of different forms of contracting and associated value • Trial to establish participant behaviour and information requirements • Understand outcomes of different levels of visibility for market frameworks and quantify impacts of conflicts 		
Actors	Buyer: Energy Retailer/Trader Sellers: Existing flexibility provider (aggregator (supplier or aggregator), end consumer (large))		
Triggers	Wholesale market price DNO Network Monitoring		
Info In	Network data Seller data (offers) Buyer data (bid)	Info Out	Bid/offer acceptance Flexibility action Network performance data
Pre-Conditions			
Post-Conditions			
Business Rules	DSO has precedence over rights of use of flexibility to assure reliability of supply		

A8.2 Technology and Trials IT architecture

Delivering the Supporting Trial Architecture

TRANSITION will leverage the learning outputs from Low Carbon London and New Thames Valley Vision on the generic systems architecture and develop it to expand the requirement for the use of flexibility services and the role of the DSO. Specifically, we will develop the detailed requirements for the market interface and management of commercial arrangements for the transaction of flexibility services by multiple participants.

The obligations that will be placed on a DNO as they transition to become a DSO have not yet been finalised. In order to enable DNOs and other MPs taking part in TRANSITION to access the functionality required without potentially stranding systems investment, TRANSITION will replicate the systems required in the trials architecture. The trials architecture will facilitate the testing of the NMF functions with minimum impact on the systems of the DSO and other MPs.

TRANSITION will employ an innovative approach to the creation of the NMF functionality required going forward and develop a generic architecture that delivers the capabilities required for trial participants from different market roles. This approach will enable TRANSITION participants to have access to the functionality they require, and develop their requirements to operate in a market that embraces the use of flexibility services.

The following principles will govern our approach:

- Mature commercial-off-the-shelf products will be employed wherever possible. This will:
 - reduce delivery risk, the innovation coming from their application to these requirements;
 - provide confidence in the budget;
 - provide confidence that there is a mature supply chain for the provision of the required solutions;
 - enable competitive procurement by MPs; and
 - deliver value for money for the consumer, both in terms of the delivery of TRANSITION and ultimately in the delivery of the market.
- Minimise costs of change and risk of cost stranding. The TRANSITION system architecture will provide functions on behalf of trial participants where they do not currently have the required capabilities for participation in the project or where there is uncertainty as to whether their role will ultimately require certain capabilities.

During the early stages of the project we will explore a breadth of technology solutions to deliver an efficient solution. To keep costs and risk low, the project will aim to use existing, proven technology where this can deliver the requirements. However, we will also consider new technologies which can deliver a more efficient solution today, or reduce the barriers for new technologies in future (such as Internet-of-things devices or peer-to-peer trading).

The following section describes the component parts of the DSO Trials architecture and links these with the DSO Open Networks competencies.

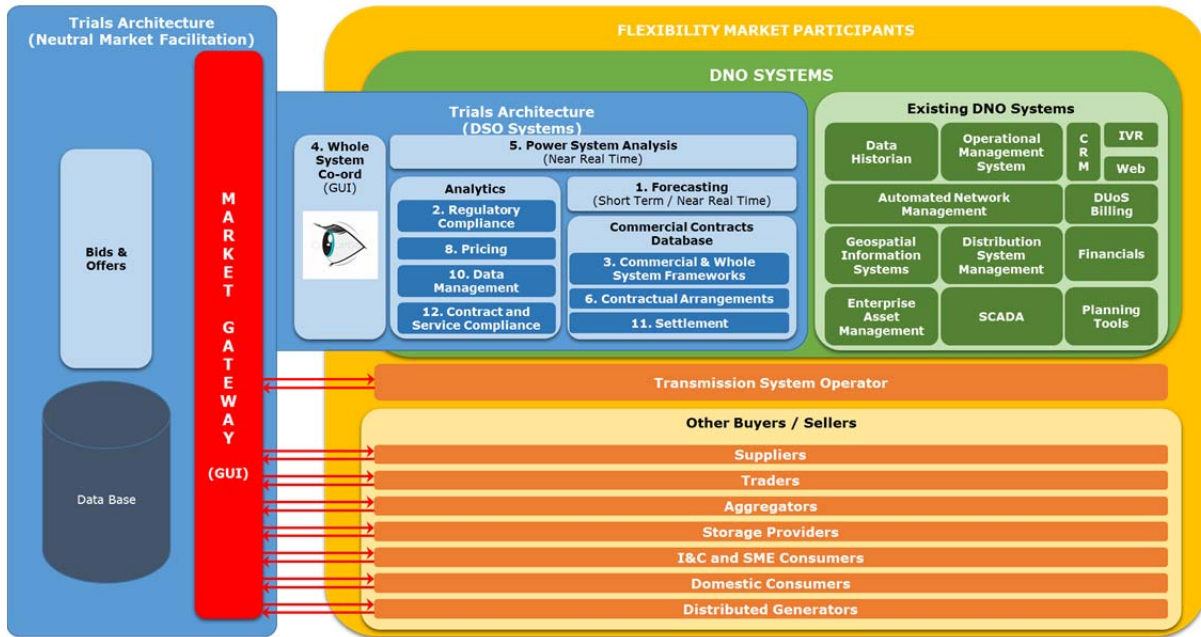


Figure A8.1 Overview of the TRANSITION Trials Architecture

The technical components of the TRANSITION project are described below.

Forecasting

A short term/near real time forecasting solution will be implemented. It will provide MPs that do not currently have this capability with the supply and demand forecasts they require to inform decisions about the levels of demand, supply and flexibility likely to be available and/or required.

It will enable MPs to establish consistent, repeatable and auditable methodologies in operational timescales for forecasting demand, generation, network power flows and the requirements and availability of services. It will not replicate existing capabilities for forecasting requirements across investment timescales as this capability already exists within the DNO. However, it will need to consider a “whole system” view to fulfil all of the requirements.

There is a mature supply chain for operational forecasting solutions. TRANSITION will fulfil this requirement from the existing supply chain.

Analytics

An analytics capability will be delivered within the trials architecture. The supply chain for analytics solutions is mature, so an off the shelf analytics programme will be implemented.

This component will deliver the following Open Networks Competencies:

- 2: Regulatory Codes & Frameworks: The DSO and other MPs will ultimately need to demonstrate compliance with their legal and regulatory obligations, as well as with the various industry codes.

For the purpose of TRANSITION, the analytics solution will also deliver the capability to evaluate the impacts on existing licenses, industry codes and policies to facilitate effective DSO operations.

- 8: Pricing: The analytics capability implemented within the TRANSITION trials architecture will provide MPs with the capability to evaluate and properly assess operational and investment decisions. It will enable DSOs to demonstrate how they can deliver economic networks as their need to support greater volumes of low carbon technologies and demand grows.
- 10: Data Management: The analytics capability will provide TRANSITION participants with the capability to manage the data items and their integrity during the trials period. This will help trial participants to establish the operational data practices required to buy and sell services.
- 11: Settlements: The analytics capability will provide input to the settlement process for services.
- 12: Contract & Service Compliance: The analytics capability will enable TRANSITION participants to confirm service delivery as per contract or instruction (where contracted in near real time/'spot' market).

Commercial Contracts Database

For the purposes of TRANSITION, the administration and management of the contractual arrangements associated to the interactions between MPs will be delivered via a standard database programme and undertaken manually.

This component will deliver the following Open Networks Competencies:

- 3: Commercial & Whole System Frameworks: the database will provide the source of the contractual relationships between the TRANSITION trial participants
- 6: Contractual Arrangements: the database will provide the basis for the administration and management of the contractual arrangements associated to the interactions between MPs
- 11: Settlements: the database will provide the source for the commercial settlement of transactions between MPs.

Near Real Time Network Planning Tools

In a the world where low carbon technologies have been installed on DSO networks on both sides of the MPAN, it will be necessary to evaluate in near real time the impact of actions of MPs on the operation of the DSOs' networks and assess the effectiveness of the options open to the DSO to ensure the continued effective operation of their system.

This will require the capability to evaluate the operational network impacts in near real time. TRANSITION will implement a commercial-off-the-shelf near-real-time network planning solution within the trials architecture that will enable operators to undertake network powerflow analysis in operational timescales to inform network security.

This component will deliver the following Open Networks Competency:

- 5: Power System Analysis: the network planning tools will allow the DSO to understand the net effect of service transactions on the network in near real time.

Market Gateway

The Market Gateway will enable MPs to buy or sell services under different market models as part of TRANSITION. It provides the mechanism for a NMF to operate the market.

It will support the TRANSITION Use Case trials and evaluation of the different market models by enabling services to be offered outside the local area and aggregated for higher level system balancing or for wholesale portfolio balancing.

It will also enable participants in local energy markets to have a view of the services available to them from a range of MPs. Additionally, it will provide the local DSO with visibility of the actions of MPs on the network, enabling the host DSO to make informed decisions about how to most effectively operate the local network.

The Market Gateway will be delivered via a secure graphical user interface (GUI) and backed by a platform that enables the transaction of services. Accepted bids and offers will be recorded for service compliance tracking and settlement. Acceptance will also act as a trigger for the MP to dispatch and/or receive the services in the contracted timeframe.

This component will deliver the following Open Networks Competency

- 7. Dispatch: The market gateway will enable the transaction of services between MPs and provide information to support delivery and settlement.

Whole Systems Co-ordinator Market GUI

For the purposes of TRANSITION, access to the various data sources (including the near real time network planning tool) will be delivered via a web-based graphical user interface (GUI). This will enable operators to understand the options available to them and make informed, real time decisions about how they should operate the distribution system.

The use of experienced control room personnel will enable the decision making processes and their experiences to be captured when evaluating what level of automation can be practically achieved in any target systems architecture for a DSO.

This GUI will provide visibility to an operator who will make decisions based on available data.

This component will deliver the following Open Networks Competency

- 4: Whole System Coordination: Whole System Co-ordination will ensure the SO and DSO have access to services to address their needs and visibility of the net effect of transactions between MPs.

Trials Database

The trials database contains data items required by different MPs. This will be mirrored for the trials networks and associated flexible resources from the relevant market participant systems.

Access to the data will be based on the needs of the different MP roles; identity and access control will be applied through the Market Gateway.

This component will deliver the following Open Networks Competency

- 10. Data Management - Having suitable systems to facilitate the information and data exchanges required to plan and operate as a DSO.

Data Security and Identity & Access Control

TRANSITION participants will be responsible for the security of and access to trial data they hold within their systems in accordance with the relevant legislative and regulatory requirements, and with the guidance current at any point in the trial period.

Identity and access control to data held within the trials architecture will be delivered as part of the trials architecture requirements.

This component will deliver the following Open Networks Competency

- 10. Data Management - Having suitable systems to facilitate the information and data exchanges required to plan and operate as a DSO.

A8.3 Future Proofing Technical Delivery

We will use the opportunity that TRANSITION presents to explore technology options to understand the best solution today and in future; this could include distributed ledger technology such as Blockchain. Significant investment has already been made in developing distributed ledger technology in other sectors, particularly in Financial Services. Given this investment and recent publicity about Blockchain, we are including a summary below of how we could leverage existing infrastructure and the potential benefits; TRANSITION will robustly explore if this is the best solution during the first Phase.

Leveraging Knowledge and Expertise from elsewhere

It is important to understand that we do not need to build our own blockchain to test this technology – in fact the blockchain infrastructure layer is being developed for us. It will be open source and available to everyone to implement and use.

There are a number of consortiums that are developing a blockchain infrastructure that will be open source and non-proprietary.

The application layer is where the proprietary, for profit applications or platforms will be built, or in our Use Case, a possible energy market place.

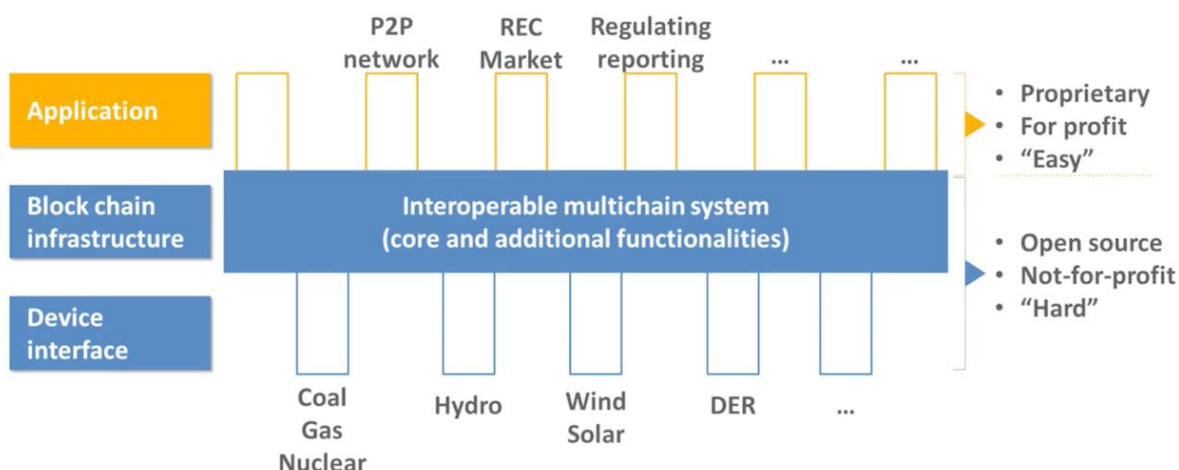


Figure A8.2 – Blockchain Infrastructure vs Applications

Source: Energy Web Foundation - 2017

Blockchain application to DSO Transition – beginning with the problem, not solution

The TRANSITION project will seek to provide the UK energy industry with an informed view on whether, if we have an energy market platform, is there a significant benefit to building this market place on a decentralised infrastructure like blockchain?

We believe that blockchain infrastructure has the following benefits which justify further exploration:

- A blockchain infrastructure would provide decentralised storage of all transaction data. This would provide transparency and prevent any one party from attaining a monopoly position, thus it has the potential to provide a central component of the neutral facilitator role.
- Payment for energy products could be built into the protocol via the use of tokens. Tokenisation is an important concept, which blockchain introduces. A token is a tool to facilitate the exchange of value digitally, without a central party. The concept is both simple and radical. Prior to blockchain technology, it was not possible to exchange ownership of assets without a central party.
- Blockchain introduces an authentication mechanism built-in within the infrastructure. This would be especially important in a society where our machines conduct commercial transactions between themselves without a central party to manage.
- The ability to control devices and manage transactions through smart contracts.
- Blockchain is potentially a more secure architecture for connected devices.

A8.4 Physical Trials OT Architecture

Network monitoring

The correct level and location of network monitoring will be identified through the installation of appropriate monitoring across the trial distribution network. The data provided will be analysed and categorised to determine the locations where there is a beneficial outcome and those where no further value can be identified.

We will monitor the network by installing equipment at LV feeders at distribution substations (aggregated to give each overall substation loading, and 11kV feeder loading information) and all HV customer network exit point supplied from the Primary (33/11kV) substation.

This level of network monitoring is necessary to understand the interaction between the network and the individual customers, utilising buddying and forecasting techniques developed during the New Thames Valley Vision Project (and associated LCNF Tier 1 projects).

Managing high volumes of data in a DNO environment

Data volumes will increase dramatically as monitoring on LV networks become more the norm. Data must be properly managed in the DNO environment, and presented in a way that empowers the DNO to make informed decisions.

Data architecture and principles will need to govern aspects such as appointing authoritative data, processes for pruning/cleaning/verification and data modelling. All of this will be presented as tradeable information annotated as a universal modelling language to facilitate sharing the learning with Ofgem other DNOs.

We will describe data ownership principles for a DNO managing new sources of data. Ownership of data implies responsibility for, control of and management of data. We will describe the required data integration points which will include internal IT systems data, real time systems (RTS) and SCADA data and third party information stores, such as data contained in modelling tools.

We will provide a description of Data Security Principles and establish policies for privacy, integrity, accessibility at the outset and maintain them throughout the Project. Where appropriate this will build on the experience gained in our earlier innovation projects, particularly SAVE and NINES.

Trials environment

TRANSITION will develop and implement a shadow control environment for each trial network, which will be situated in the Control Centre of SSEN/ENWL for the purpose of providing a secure, isolated and current set of advanced applications to deliver the trials. This method was successfully used in the New Thames Valley Vision Project.

TRANSITION will use SSEN's existing distribution management system (DMS) to provide the advanced online distribution power flow (DPF) analysis to support network management. Similar, arrangements will be put in place in ENWL's area.

The use of a virtual control room environment will enable the simulation of scenarios relevant to a live network deployment. This will allow a more complete understanding of the operational implications of these scenarios, de-risking live deployments.

Appendix 9 Trial network types

A9.1 Introduction

This appendix describes the proposed methodology for the selection of network groups to be included within the three proposed TRANSITION physical trials. The proposed methodology has been developed to allow the selection of representative samples covering different network environments, constraint drivers and provider capabilities. The aim is to ensure that the trial groups will be representative of the majority of GB distribution system, maximising the replicability of trialled market model results.

Section 2.3 outlines the fundamental approach to the trial selection process. Once the prime constrained networks have been identified the level of embedded flexibility must be measured to ensure there is an adequate intervention capacity to make measurable changes at the constrained assets.

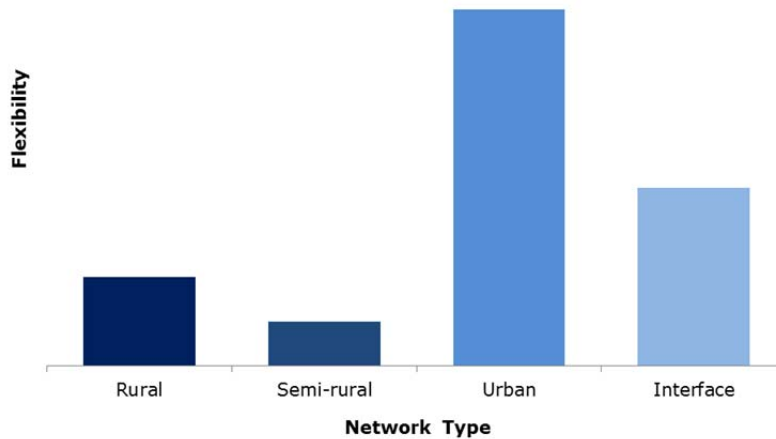


Figure A9.1 TRANSITION physical trial selection chart

The chart depicts indicative available flexibility in each network type for a single constraint issue. This procedure shall be repeated for each constraint issue (demand, generation, fault level, etc.) and the dimensions overlaid to identify the trial locations that would offer the most replicable and cost effective demonstrations.

A9.2 Potential Network Locations

Detailed analysis will be required to decide on a shortlist of viable locations for the TRANSITION trials. However, applying the aforementioned criteria to today’s networks we have identified a number of potential trial locations which are representative of network types across GB, and are used below to indicate the possible *type* of networks which could be used.

Trial 1: Urban, Demand Constrained Network

Traditional demand growth combined with new LCT along with new connections for energy storage schemes can lead to predominately thermal constraints on the High and Low Voltage networks. Areas identified include the south of England in SSEN’s network and ████████ in ENWL’s.

████████████████████

Demand in the ██████████ region continues to grow with significant ongoing development. Areas where demand is projected to continue to grow include around ██████████ and ██████████ which, depending upon the location and timing of load growth has the potential to cause constraints at various locations across the 11kV, 33kV and 132kV networks. Where, how and when these constraints manifest themselves will depend upon the rate at which demand grows in specific areas, which gives rise to a number of different scenarios for traditional network reinforcement options. The use of more flexible solutions may offer additional options for the DNO, making this a strong area to consider as a trial location.

████████████████████

████████████████████, England which sits within ENWL's licence area is an alternative provisionally scoped option. During the global financial crisis, development in ██████████ fell away and with it any requirement to increase capacity. However, in the past 6 months new investment has touched ██████████ and there are once again plans to develop new build apartments and office spaces, all of which require new demand capacity. Currently ENWL are moving forward the extension of one primary substation and construction of up to three new customer driven primary substations. Some of the accepted offers have triggered reinforcement of upstream assets and as additional interest has been voiced further reinforcement of the local network is likely. Through the introduction of flexibility, some of these constraints may be reduced and adequately managed, avoiding or deferring costly traditional reinforcement.

Constraints arising in ██████████ are visible from LV through to the 33/132kV Grid Transformers (GT). Therefore, ██████████ has a number of avenues which could be explored, acting as a good test bed to trial various functions on a range of vendors connected at different voltage levels. However, much of the identified reinforcement would have to be in the construction stage by the time of the trial if projects were to progress as planned, thus the option must be revisited during the trial design phase of the project to qualify its viability and compare against any alternative including the aforementioned ██████████ network.

While slightly different in their nature, both ██████████ and ██████████ would provide replicable learning which could be applied to most other cities and large towns throughout Great Britain.

Trial 2: Rural, Generation Constrained Network

A move away from the reliance on centralised generation, a drive to reduce carbon and a change in load has resulted in increased distributed generation. Site selection is often based on land rates, planning permission and fuel availability which typically results in rural or semi-urban locations. Rural networks and those on the urban fringes have not been designed to accommodate significant generation, so to accommodate new generation a more expensive connection may be necessary, or reinforcement may be triggered. The constraints are predominately thermal or fault level in the cases of high synchronous machine penetration.

There are many areas across the North of Scotland that are experiencing constraints as a result of massive increases in the volume of renewable generation which has been connected. Despite changes in UK government policy in this area there are still significant volumes of renewable generators looking for connections. See extract from SSEN generation availability map ⁽²²⁾.



Figure A9.2 SSEN generation availability map

SSEN pioneered the use of flexible connections with the introduction of ANM schemes in Orkney, Shetland and the Western Isles. Whilst these installations have proven to be very successful, they rely on managing a relatively small number of generators across in small geographic areas. To fully exploit the potential benefits it will need to be developed to operate across a wider geographic area, consider demand as well as generation and also look to interface with the Transmission system.

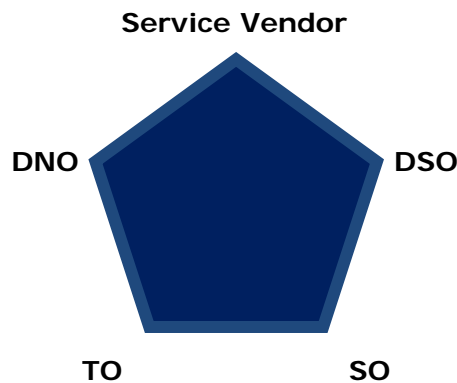
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██████████ may offer a potential alternative network which covers a large geographical area and incorporates a number of diverse grid and primary substations. All of these are connected upstream to the 132kV network which runs in a loop between ██████████ GSP and ██████████ GSP. There is a consistent flow of new interest from distributed generation and energy storage system developers in an area which is seeing both thermal and fault level constraints for new connections. Importantly the constraints are both import and export, thus any new connection at HV through to 132kV is presently likely to trigger traditional reinforcement. Additionally National Grid have communicated through the Statement of Works process that a Modification Application is required. The predicted requirement is the replacement of at least two super grid transformers and implementation of an ANM scheme. Hence, even if some of the new contracted connections were not to progress, there would still be a limitation at the interface with National Grid.

A trial of flexibility models on the ██████████ ring (at 11kV and/or 33kV) could therefore be a good neutral test bed which could deliver core learning outputs transferable to all other rural electricity networks in GB while unlocking further economic development in the northern patch of ENWL's network.

Trial 3: Rural & Urban, Interface Constrained Network

The ENA working groups steering and supporting the SO to DSO transition have primarily focused on the interface between five core stakeholders. To date much work has gone into looking at the interface between the physical assets of the Service Vendor, DNO and TO, however the boundary between DNOs is largely unexplored.



In the transition to a DSO the traditional connection agreement between DNOs does not fit into the new architecture. To enable DNOs to protect their own assets, the use of flexibility on either side of the interface may be a cost effective alternative to reinforcement.

ENWL Interfaces: The ENWL licence area borders with a number of other networks including Northern Powergrid, Western Power Distribution, Scottish Power Energy Networks and both onshore and offshore transmission networks. There is more than one interface with each DNO, with voltage at the point of connection ranging from 11kV through to 132kV, facilitating a range of test options. The load flow at each interface varies and is largely based on historical arrangements, but as we move away from the traditional load profile and see more localised generation connecting the flows are becoming more dynamic. While DNOs are working closely to best utilise the network at these locations, there is a risk that these could become 'pinch points' if not fully investigated ahead of implementing a new distributed flexibility market.

This possible trial is very open to variation as it is not particularly location dependant and lends itself to being more definitively defined during the trial scoping stage. The trial would test both technical and commercial challenges with the aim of developing a best practice for DNO interfaces, including boundaries between licences within the same parent company, which all can adopt and apply to their networks.

Appendix 10 Business case supporting information

A10.1 Summary

This report by Mott MacDonald supports SSEN’s submission to Ofgem for the Network Innovation Competition fund. While the analysis supports the submission, we have undertaken a Cost Benefit Analysis (CBA) of the proposition as an independent consultant. This analysis, and the judgements contained herein, are the authors own.

The aim of the CBA is to estimate the comparative value of the proposition against a counterfactual, and to estimate the breakeven for the proposition. The proposition is of a Neutral Market Facilitator (NMF). The counterfactual is the ‘next smartest’ option for flexibility, whereby energy suppliers bilaterally trade flexibility with each other and flexibility providers, and DNOs and the SO cooperate to reduce conflicts¹. Our approach has been to undertake a critical analysis of the extensive modelling work already in the literature (by Frontier Economics (FE)², Poyry³, Imperial College London⁴, and Carbon Trust⁵). Based on our critical analysis, we make a series of adjustments to estimate the annual value of the proposition and counterfactual. We also estimate the gross capacity released and gross avoided carbon emission from additional flexibility over the period.

The power system is in the middle of an unprecedented transition, and there is a general expectation of a step change in demand (through electrification of heat and transport), supply (uptake of variable renewable electricity) and the relationship between stakeholders (consumers becoming prosumers, large suppliers and generators at risk, new business models emerging). With this in mind, there is significant uncertainty. We present two cases – the prudent case, in which flexible capacity reaches 4GW by 2030, and an upside case in which flexible capacity reaches 11GW by 2030 (see Table 2).

Table 2: Key results of prudent case and upside case

		Prudent case	Upside case
Breakeven year	All parties	2029	2028
	DNO customers	2029	2028
Annual gross benefit ⁶ by 2030 (£mn)	All parties	314	865
	DNO customers	30	83
Cumulative gross benefit by 2050 (£mn)	All parties	4,485	12,430
	DNO customers	464	1,374
Cumulative net benefit ⁷ of market platform by 2050 (£m)	All parties	905	2,586
	DNO customers	292	899

¹ A ‘do nothing’ scenario on the other hand would not include the benefits arising from bilateral supplier to supplier trading of flexibility or cooperation between the SO and DNOs.

² Frontier Economics, *Cross-party impacts of DSR actions*, 2014

³ Poyry and Imperial College London, *Roadmap for Flexibility Services To 2030*, 2017

⁴ Carbon Trust and Imperial College, *An analysis of electricity system flexibility for GB*, 2016

⁵ See above

⁶ Gross benefit is the total benefit of flexibility in that scenario.

⁷ Net benefit is the benefit of flexibility in the proposition (method) case, less the benefit of flexibility in the counterfactual (base) case. This represents the benefit of the Neutral Market

Notes: Our prudent case assumes a conservative 4GW of flexibility by 2030. The upside case assumes 11GW by 2030.

In both the prudent case and the upside, we estimate the breakeven year of the proposition (in comparison to the counterfactual) and 2028 for all parties⁸. The breakeven takes place one year sooner for distribution customers in the Upside case (2028) than the Prudent case (2029). In the prudent case, total annual value by 2030 of the proposition is estimated to be £314mn pa, for the prudent case (all parties), and £865mn pa in the upside case (all parties). This compares to projected annual value of flexibility by 2030 of around £1.2bn pa estimated by FE, or £1.4bn to £2.4bn pa estimated by Imperial College London. Therefore, we would still consider our upside case to have further upside potential, while our prudent case is significantly below literature estimates.

This appendix sets out the methodology, and presents the impact of some of the uncertainty, as follows:

1. Establishing the baseline
2. Critical assessment
3. Carbon and capacity released

A10.2 Establishing the baseline

In this step, we establish a baseline from the literature for both the proposition and the counterfactual.

Defining the proposition and counterfactual

The proposition, detailed in this report, can be summarised as:

A central market platform with transparent prices, allowing Distribution Network Operators (DNOs) to identify best value Flexibility Service options, and allowing Flexibility Providers to contract with multiple buyers ("sharing") to get the most value out of their services⁹.

To conduct the CBA, we compare the proposition with the next smartest option, what we consider would arise in the absence of a market platform. We summarise the counterfactual as:

An unorganised market of bilateral agreements, dominated by incumbent electricity suppliers. Suppliers trade flexibility bilaterally, and DNOs cooperate with the SO to reduce conflicts. Prices are opaque, and sharing of Flexibility Services is limited.

Facilitator platform. The net benefit also includes the cost of the NIC award and the cost of setting up and running the platform.

⁸ Both cases have the same breakeven year as the assumption on the flexible capacity available is the same in both the proposition and the counterfactual for each of the base and upside case. This means that while the gross and net values may change, the payback period of the cost of the market platform stays the same. If the set-up cost of the platform rises from £20mn to £100mn, the breakeven year for the base case (all parties) is 2029, while for the upside case (all parties) it stays at 2029.

⁹ We have carried out the cost benefit analysis by only considering one of the market arrangements being considered by the TRANSITION project, the "central market facilitator" and therefore, consistent with that model, have costed a single centralised £20m platform.

Using the Frontier Economics analysis from 2014

As discussed above, our analysis draws from the extensive literature on the value of flexibility. Compared to other reports we reference and commissioned by CCC or Ofgem/BEIS, and which look at gross benefits of flexibility, the Frontier report is distinct by diving into the net benefit of a market platform¹⁰. We use the FE report as a key source text, updating where necessary using more recent modelling work from Imperial College London & Carbon Trust, and Poyry¹¹.

Overview of Frontier Economics modelling

The FE report uses a market model to estimate the value of flexibility to three distinct parties: Suppliers, the SO and the DNO. FE model the value of flexibility in a BAU base case. The value of flexibility is projected in 2023 and 2030 by using a market model and with an assumed allocation of flexible resource. FE then model the impact of three interventions:

1. Supplier to supplier bilateral trading;
2. DNO-SO cooperation; and,
3. Market platform.

FE assume the interventions result in perfect allocation, i.e. that the trading, cooperation, and market platform are 100% efficient. We compute from the FE report that the volume of flexible resource reaches 11GW by 2030¹². FE presents the value and cost of flexibility for the base case and each of the three interventions for the years 2015, 2023 and 2030.

Specification of the baseline

We specify our baseline figures from the FE modelling results for both the proposition and counterfactual. The baseline is then adjusted (down) through a sequence of steps based on our critical analysis.

The baseline for the proposition is specified by adding FE's base case to intervention 3 (the market platform) values. The cumulative Net Present Value (NPV)¹³ to 2030¹⁴ of the baseline for the proposition is £5,435mn.

The baseline for the counterfactual is specified by adding FE's base case to intervention 1 (the supplier to supplier bilateral trading) and intervention 2 (the DNO-SO sharing) values. The cumulative Net Present Value (NPV) to 2030 of the baseline for the counterfactual is £3,455mn. Therefore, the cumulative net benefit of the market platform (above the counterfactual) by 2030 is approximately £2bn.

Adjustment to GB-wide DNO customers only values and licensee customers

To estimate the value to GB-wide DNO customers, we strip out the value to the non-DNO parties. To estimate the value to the licensee customers, we pro rata the GB-wide DNO customer value on the basis of the relative customer numbers for the licensee.

¹⁰ The copy of the report can be acquired by requesting it directly from ELEXON, who commissioned the report.

¹¹ As referenced in the summary to this appendix.

¹² Note that Imperial College estimate a range of around 4GW to 15GW for DSR capacity by 2030.

¹³ We used the Ofgem specific discount rate of 3.5% to 2030, and 3.0% beyond 2030.

¹⁴ We linearly interpolate between 2015 and 2023 and between 2023 and 2030.

Critical assessment

In this step, we make a series of adjustments to the baseline values to ensure a prudent and conservative approach due to the uncertainty caused by the expected step change in the power system.

Our critical assessment makes the following adjustments:

1. Growth post 2030;
2. Market platform efficiency;
3. Market implementation;
4. Energy supplier involvement;
5. Flexibility capacity & DNO outage adjustment;
6. Cost of platform; and,
7. Counterfactual.

Growth post 2030

The FE report models up to 2030 only, so it is necessary to estimate the growth in the value of flexibility up to 2050. A significant value for the driver in the value of flexibility is the introduction of variable renewable energy in the power system. Therefore, we take the average percentage growth rate of variable renewables (wind, solar and marine) between 2030 and 2050 from the Slow Progression Future Energy Scenario (FES), which is 1.5%¹⁵.

Market platform efficiency

FE estimate the added value of the market platform assuming perfect allocation of resources. A real market won't achieve 100% efficient allocation due to structural issues (number and size of players, locational requirements) and design choices (transaction costs, barriers to entry, transparency of prices). Therefore, we make a downward adjustment on the value of the market platform to account for inefficiency. Where we discuss market efficiency, the percentages referred to here are the percentage of the added value attributed to the market platform, modelled by FE.

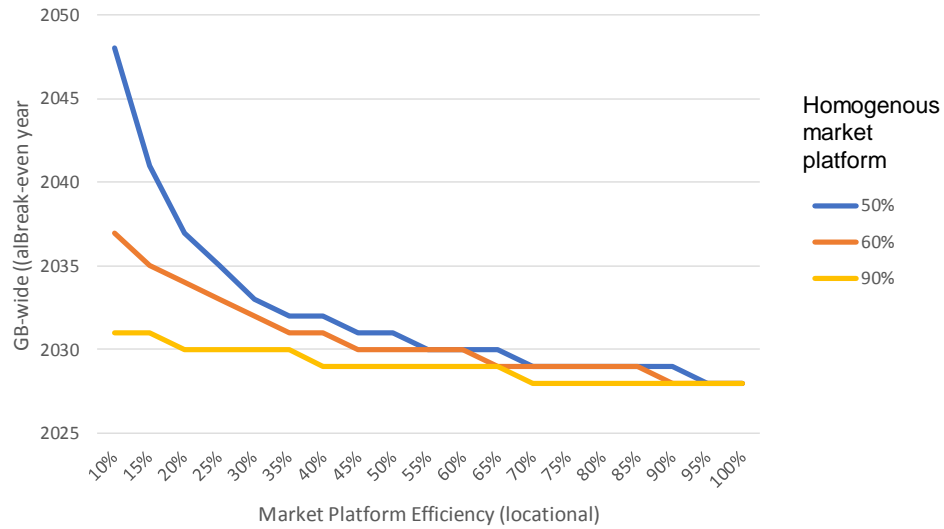
We split this into two distinct markets: a homogenous product (including supplier and SO value) and locational product (including the DNO value). We would expect the former market to achieve a higher level of efficiency due to the homogeneity of the product, and the large number of potential buyers and sellers. The market design elements of the proposition lead to a judgement of taking 90% as a base case for the supplier and SO value for flexibility in the FE baseline.

For the locational specific, the structural elements (different specifications of products and limited numbers of buyers and sellers) lead to a weaker market. For our base case, we take 60% (rising to 70% in 2026 as the market becomes more established and there are greater numbers of flexibility providers) of the flexibility value for DNOs estimated by FE in the market platform scenario.

¹⁵ Growth in flexibility value post 2030 only has an impact on break-even year in downside scenarios, in the prudent case, there is no impact. National Grid Future Energy Scenario generally expect the significant changes in low carbon technology to occur before 2030, for example, growth in storage capacity for the consumer power scenario post 2030 is just 0.9%. If growth in the value of flexibility post 2030 rose to 3%, cumulative NPV by 2050 for the proposition case would be around £5bn, as opposed to around £4.5bn with growth rate of 1.5%.

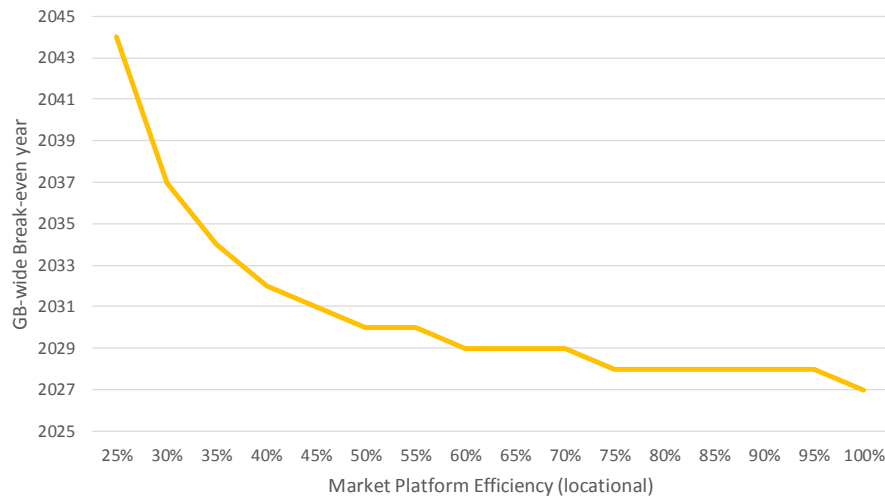
The break-even year is sensitive to changes in the market efficiency of both the homogenous and locational markets (see Figure 1 and Figure 2). Particularly, as efficiency of the locational market platform falls below 50%, break-even for DNO customers increases past 2030. As noted above, efficiency depends upon both the market design (including regulatory arrangements) and structural elements. The sensitivity highlights the importance of ensuring that both components are adequate.

Figure 1: Sensitivity of break-even year (for all parties) to the efficiency of the market platform



Source: Mott MacDonald

Figure 2: Sensitivity of break-even year for DNO customers to the efficiency of the market platform



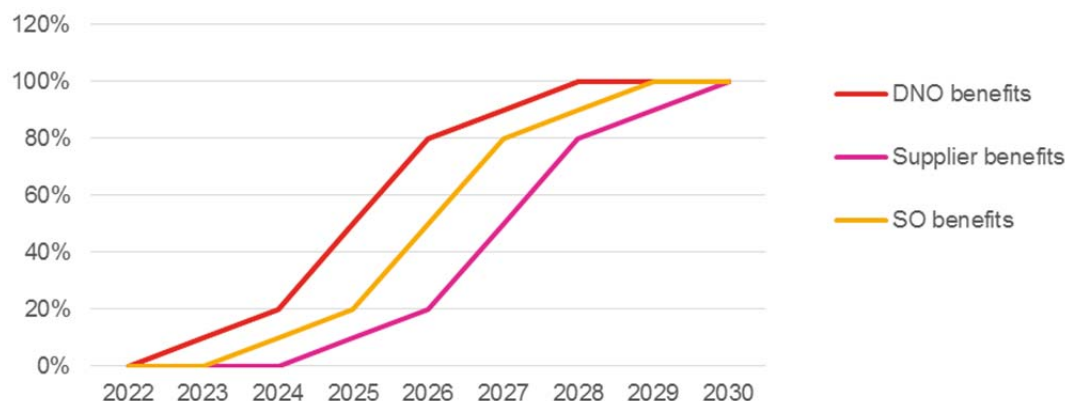
Source: Mott MacDonald

Market implementation

We expect that the market platform would take several years to move from trial, to roll-out, to full implementation. Based on our understanding of the proposed plan for rolling out the market, use S-curves to ramp up the value for each of the value streams estimate by FE. The flexibility resource cost is inferred as a weighted average of the

ramp up for each of the value streams. The ramp up percentages are applied to the value stream in each year as specified (see Figure 3).

Figure 3: Market implementation for different parties



Source: Mott MacDonald

Energy supplier involvement

Even when the market platform is full established, we expect that not all trades for flexibility will be made through the platform. We use the current energy market as an example, where 85%¹⁶ of total trades take place bilaterally, with the remaining 15% on an exchange. Ofgem analysis shows that, of the bilateral trades, 52% are made between “Big 6 to other”¹⁷, “Financial to other”, and “Other to other”, with the remaining between Big 6 and Financial parties¹⁸. Given the market platform should offer a meeting place for aggregators, small suppliers and flexibility providers to trade with larger players, we assume that all these trades could happen on the market platform. Therefore, we take as a base case 59.2%¹⁹ (=52% x 85% + 15%).

Flexible capacity & DNO outage adjustment

As noted above, we have inferred from the report that FE assume 11GW of available flexibility by 2030. The FE report was published in 2014, and so we have been able to update this estimate to take into account more recent work. Imperial College London and Carbon Trust estimate modelled 12 scenarios and estimated the capacity of DSR available by 2030 concluding there would be a range of 4GW to 15GW. As a prudent and

¹⁶ See: https://www.ofgem.gov.uk/system/files/docs/2016/08/wholesale_energy_markets_in_2016.pdf

¹⁷ Where Other in this context is a non-Big 6, non-financial energy supplier

¹⁸ See: https://www.ofgem.gov.uk/system/files/docs/2016/08/wholesale_power_market_liquidity_annual_report_2016.pdf

¹⁹ I more optimistic view of 90% would lead to a cumulative NPV by 2050 of around £5bn, compared to around £4.5bn at 59.2%, or £3.9bn at 30%.

conservative approach, we take 4 GW as our base case. We *pro rata* the value of flexibility in each year as a ratio of 4:11²⁰.

For the FE estimate of the value of flexibility to avoid DNO outage, FE assume that 1% of the network will be experiencing an outage at any one time. However, on 11kV on the distribution network, flexible resource will not resolve a fault due to the radial nature of the distribution grid. According to Ofgem 28% of faults occur on this level²¹, therefore we reduce the value of flexibility to resolve DNO outages by this percentage.

Cost of platform and flexible resource cost

We assume the set-up cost of the platform is £20mn²² in 2023, with running costs of £2mn pa. This is similar to costs incurred in 2015 establishing a market platform known as MOSL to support the non-domestic water market²³. The original cost incurred in 2002 in setting up ELEXON was £70mn²⁴. NIC funding assumed to be £13.05mn in 2018.

FE model the flexible resource cost (i.e. opportunity costs and cost of installing of smart technology to enable flexibility) for each of the three modelled cases. While we do not make any adjustment to the flexible resource costs, the costs are adjusted to account for different assumptions on capacity, as described in Section 2.5.

A10.3 Counterfactual

For the counterfactual, we make two adjustments. The first is to apply the same level of market efficiency adjustment for the homogenous product (i.e. 90%) to the bilateral supplier-supplier trading value. Secondly, we also apply the capacity adjustment factor as described in 2.5.

Getting to the base case

We show (see Figure 3) the impact of each adjustment as described to get from the baseline figure to our base case value. The values are presented as GB-wide, as cumulative NPV up to 2050.

²⁰ Using our approach, the assumption of capacity of flexibility reached by 2030 has a limited impact on break-even year; the value added from the market platform generally outweighs the set-up cost, even at lower end of expectations. However, the implication of reduced flexibility capacity is better capture in the impact on supplier involvement in the market, and crucially on the structural component influencing the efficiency of the locational market for flexibility.

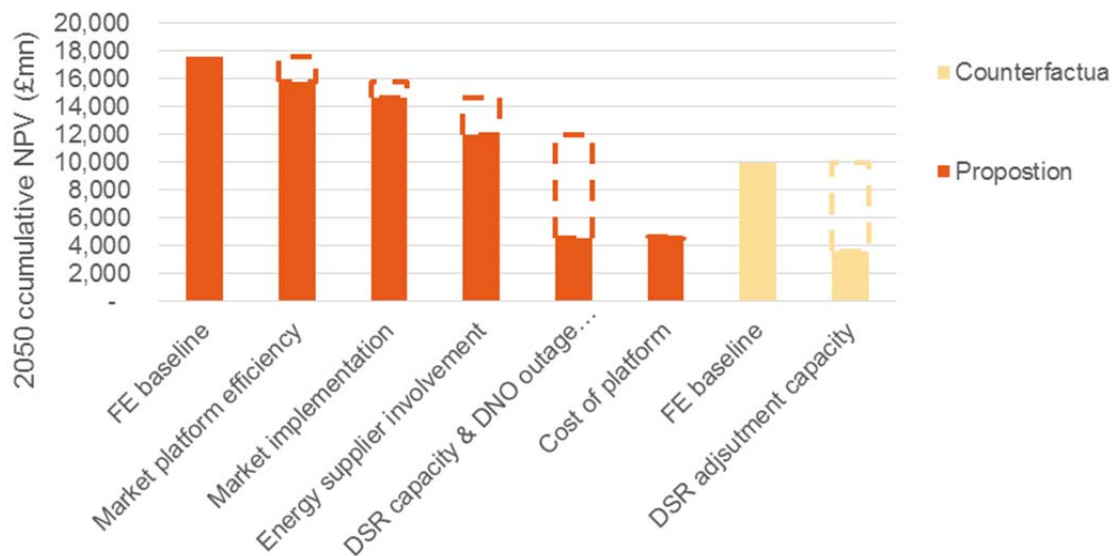
²¹ See: Ofgem Electricity Distribution Annual Report for 2010-11, customer interruption at low voltage network is 28% of the total.

²² If the set-up cost of the platform rises from £20mn to £100mn, the breakeven year for the base case (all parties) is 2030, while for the upside case (all parties) it is 2029.

²³ See: <https://www.cgi-group.co.uk/news/market-operator-services-limited-selects-cgi-central-market-system>

²⁴ Figure provided in stakeholder interview with CGI

Figure 3: Getting to the base case



Source: Mott MacDonald. Note: dotted lines show the impact on cumulative value of the adjustment factor

A10.4 Capacity and carbon

Capacity released

SSEN have run recent trials to establish the ratio between the capacity on new DSR and additional generation capacity released on the network. The ratio observed is for each MW of DSR implemented, and additional 2MW of renewable generation capacity can be connected²⁵. We take a conservative approach using a ratio of 1:1. Therefore, we estimate the gross capacity released by 2030 to be 4GW. Post 2030 we assume the ratio between value and flexibility capacity remains constant, so we estimate capacity released to be 4.7 GW and 5.4 GW in 2040 and 2050 respectively.

Carbon

For the carbon calculation, we assume that 50% of capacity released is for variable renewable resources. We assume a 70:30 split of wind to solar, with load factors of 29% and 11% respectively. We take the carbon intensity of the grid from the FES scenario Slow Progression. Gross avoided carbon emissions, cumulative for 2030, 2040 and 2050 are estimated to be 2,834 ktCO₂e; 4,816 ktCO₂e and 5,818 ktCO₂e respectively.

²⁵ For example in the NINES project in Shetland

Appendix 11 Stakeholder and other engagement

TRANSITION's key objective is to build upon the collaboration that is already underway within the industry as we move toward DSO. Industry wide collaboration, informed by a robust series of trials will be essential if the transition to DSO is to become a reality and deliver benefits for customers. Open Networks has been identified by Government as a key initiative to drive change in this area. SSEN and ENWL have engaged closely with Open Networks and will need to deepen this relationship when the project commences.

In addition, TRANSITION has engaged with other industry bodies, network licensees, suppliers and OEMS. Importantly, SSEN and ENWL have engaged with both SPEN and WPD regarding their DSO based applications for this year's NIC.

A11.1 The Open Networks Project

The Open Networks Project is a major cross-industry initiative led by the Electricity Networks Association that is re-defining how our energy networks will operate in the future. The changes it will make will give the UK's households, businesses and communities the ability to take advantage of a new range of energy technologies and services to take control of their energy and lower their costs, including renewable generation, battery storage and electric vehicles.

Open Networks - Objectives, scope and governance

The objectives of Open Networks for the first phase of work in 2017 are to:

1. Develop improved T-D processes around connections, planning, shared SO/DSO services and operation;
2. Assess the gaps between the experience our customers currently receive and what they would like, and identify any further changes to close the gaps within the context of a 'level playing field' and common T & D approach;
3. Develop a more detailed view of the required transition from DNO to DSO including the impacts on existing organisation capability; and
4. Consider the charging requirements of enduring electricity transmission/distribution systems.

As a result of these objectives, ENA and its members have created four workstreams under the project; T-D Process, Customer Experience, DSO Transition and Charging. Each of these workstreams will have a range of outputs to produce that will be undertaken by Subject Matter Experts. Given the pace of change and increasing requirement to solve system challenges on a whole system basis, increased transparency and co-ordination between DNOs, IDNOs, TOs, SO and the wider energy community is required. Thus all members have committed to provide significant resource to each workstream of the project.

The five workstreams will be overseen by an overarching Steering Group. The overall governance structure of the project can be seen in figure A11.1 below.

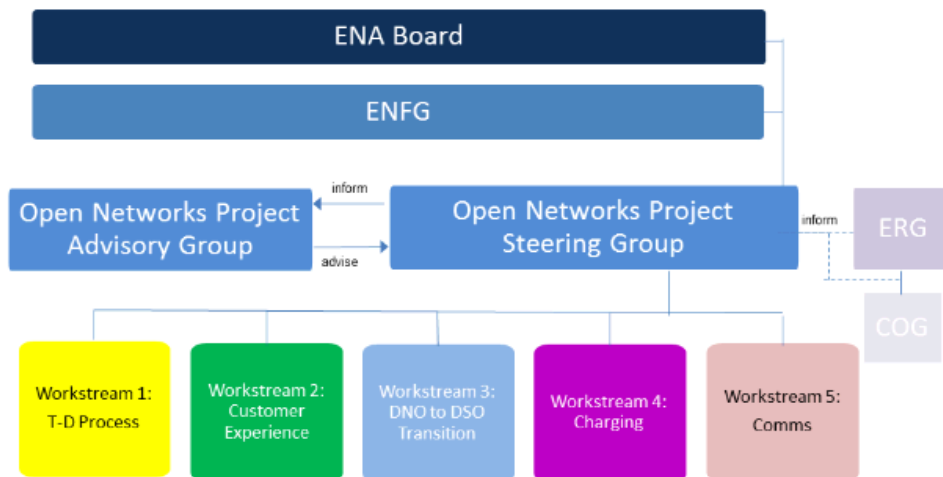
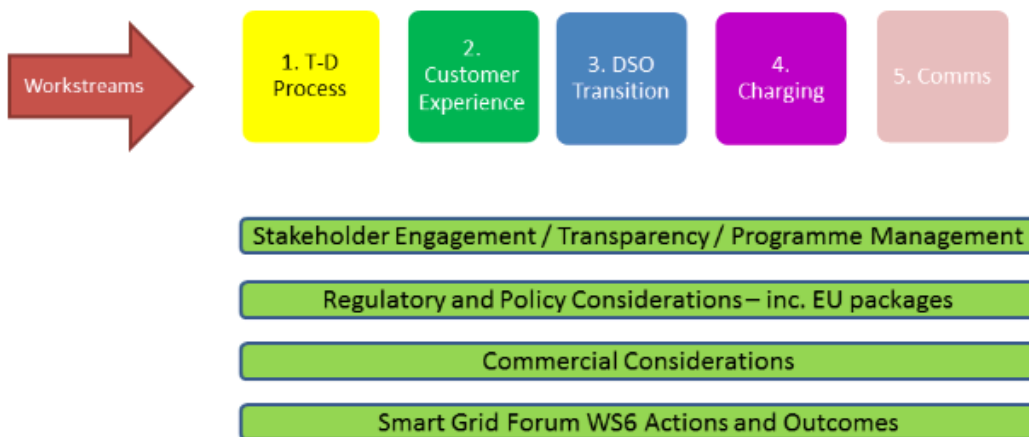


Figure A11.1 ENA Open Networks Project governance structure

It is important to note that the workstreams are all inter-dependent, and it will be the responsibility of the Steering Group and workstream leads to ensure that there is cross pollination of information between workstreams on development and specific outputs.



Apart from the inter-dependencies between workstreams, as can be seen in the figure above, there are a number of major cross-cutting issues that will need to be addressed within each of the workstreams and subsequent outputs. Each of the workstreams has a series of deliverables, which include a definition of DSO and DSO Roadmap. The published definition of a DSO is outlined below.

DSO Definition

A Distribution System Operator (DSO) securely operates and develops an active distribution system comprising networks, demand, generation and other flexible distributed energy resources (DER). As a neutral facilitator of an open and accessible market it will enable competitive access to markets and the optimal use of DER on distribution networks to deliver security, sustainability and affordability in the support of whole system optimisation. A DSO enables customers to be both producers and consumers; enabling customer access to networks and markets, customer choice and great customer service.

A11.2 TRANSITION and Open Networks Collaboration.

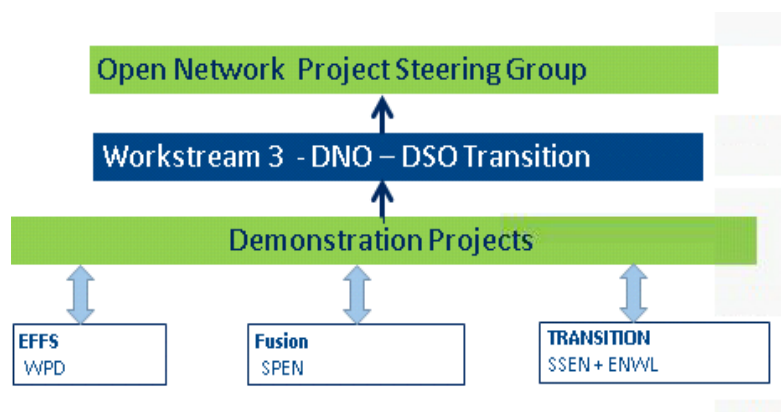
The initial deliverables from WS3 of Open Networks are detailed below:

1. DSO Transition Roadmap - a roadmap to deliver transition to DSO in the short, medium and long term;
2. DSO Functional Requirements;
3. Model for DSO - model for DSO with some options set out for governance models which will allocate DSO functions to system roles and responsibilities;
4. DSO Market Model Options Comparison & Evaluation - an assessment of the risks/benefits for power system users, customers and industry participants; and
5. Trials to Support DSO Definition – if necessary definition and initiation of trials to test different market models and/or any gaps in the existing evidence base to support decisions to define market models (across different regions and Network Operators)

TRANSITION will directly contribute towards these objectives and will provide a vehicle to allow the testing of the different market models proposed by Open Networks. The scope and intention of TRANSITION has been shared with the Open Networks Steering Board and we propose to maintain this close engagement throughout the project. In particular, TRANSITION will help inform the progress of Open Networks Workstream 3, and it is proposed that WS3 provides a focal point for this work.

During the development of TRANSITION, we have worked closely with both WPD and SPEN with regards to the EFFS and Fusion projects respectively. Where appropriate, we have agreed to work collaboratively and to coordinate certain aspects of the project delivery. Although each of our respective projects are unique, they are seeking to contribute to the overall development of the DSO role within the UK. It should also be recognised that there are areas which will benefit from a coordinated approach, and a degree of cooperation will be beneficial to all of the projects. We intend to review progress, share learning and peer review our work with both SPEN and WPD to ensure there is no unnecessary duplication and the projects are executed efficiently.

The most appropriate vehicle for this is Open Networks. Specific activities which have already been identified for collaboration include knowledge dissemination, stakeholder consultation, learning workshops and peer review of learning outcomes.



A11.3 TRANSITION Project Partners

In December 2016, SSEN issued an industry wide call for partners and ideas which could help enable the transition to DSO and increase network flexibility, whilst delivering benefits for GB customers. This challenge received over 50 responses. Following an initial assessment, a number of organisations were identified for interview, before a number were selected to help shape the scope of the Project. ENWL have been involved in the process for partner selection, including participation in the interview process.

From this, we identified key project participants who have been involved in the development of TRANSITION. They bring a wide range of skills and expertise to ensure the project meets its objectives.

Atkins, Member of the SNC-Lavalin Group

Atkins is one of the world's most respected design, engineering and project management consultancies. We build long-term trusted partnerships to create a world where lives are enriched through the implementation of our ideas.

Atkins specialises in the design of infrastructure projects across the world covering the building environment, transport and energy sectors, amongst others. Iconic projects include the London Olympics, Dubai Metro and the Johannesburg Gautrain. Atkins works with clients throughout the project lifecycle, from early concept definition through to detailed design and engineering support during installation and commissioning.

The original company WS Atkins and Partners was established in 1938 by Sir William Atkins in London. In its early years, the company specialised in civil and structural engineering design and has evolved into a multidiscipline business. The company was floated on the London Stock Exchange in 1996 and on 3rd July 2017, WS Atkins plc was acquired by SNC-Lavalin Group, headquartered in Montreal, Canada. Our networks team responsible for input to this project specialises in:

- Network planning and development;
- Power system modelling and studies, protection grading studies and fault level analysis;
- New generation and demand connection applications and scheme design;
- High voltage and LV substation FEED and detailed design- onshore and offshore;
- Utility regulation;
- Vendor and buyer due diligence services;
- Automated controls for substation and process industries (PLC/DCS/SCADA).
- Protection and automated control design;
- Power distribution and protection design;
- Construction management and commissioning.

CGI

CGI was founded in 1976 in Québec City by Serge Godin and André Imbeau. At the time, “CGI” stood for “Conseillers en gestion et informatique,” which translates to “Consultants in management and information technology.” As we grew into a global company, we became known as simply CGI.

Following a number of acquisitions, supported by organic growth, in 2012 CGI made its largest acquisition to date, acquiring the Anglo-Dutch business and technology services company Logica. The acquisition increased the size of our staff from 31,000 to 68,000 professionals and offered greater presence, service capabilities and expertise for our clients across the Americas, Europe and Asia. With this acquisition, CGI became the world's fifth largest independent IT and business process services company.

Today, with a presence in hundreds of locations worldwide, strong industry expertise, and end-to-end IT services, CGI is able to meet our clients' business needs anywhere, anytime, with 70,000 staff working across the globe. Together, CGI's professionals have built one of the leading IT and business process services companies in the world with a long track record of service excellence, innovative services and solutions, and sustainable profitable growth.

We continue to strive to be recognized by clients, members and shareholders as a world class IT and business process services (BPS) leader. While remaining true to our Constitution, CGI continues to adapt to best respond to changes in the IT market, the local and global business climate of clients, and to our professionals' and shareholders' expectations.

Origami Energy

Origami Energy Limited is an innovative technology company established in 2013 with the vision to build a real-time marketplace for the distributed energy world. This will enable a proactive approach to the use of flexibility from all energy assets (generation, flexible demand, and storage, whether in front of the meter or behind the meter) and avoids significant investment in distribution networks.

Origami has over 60 people across technical, operations, commercial, and storage. We are developing the underlying functional capabilities and commercial innovation required to deliver the real-time energy flexibility marketplace. This involves actively balancing the cost and performance of service delivery through the intelligent optimisation of flexibility to deliver a basket of services to multiple beneficiaries from a portfolio of assets involving multiple flexible providers. A key proof point is delivering balancing services to the SO and Origami is already contracted to deliver three services to the SO with over 45 MW of flexibility under contract. In addition to this, Origami is delivering private client services (ANM on a client site and the development and optimisation of storage).

The Origami team has experience across the energy market, including;

- DNO – new systems of supply, maintenance, refurbishment, and innovation.
- System Operation (pre-BETTA) – water management for hydro generation, management of teleswitching demand to reduce off peak demand, and balancing electricity supply and demand in real-time.
- Trading – development of energy projects from gas engines through CHP to small-scale CCGT through bilateral contracts and PPAs.
- Supplier – solution and direct sales through customer engagement.
- Energy Efficiency – evaluation and installation of energy reduction equipment.
- Storage – development and implementation of storage solutions, including the Smarter Network Storage system.

A11.4 Partner inputs and Responsibilities

High-level partner responsibilities for Phase 1:

	SSEN/ENWL	Atkins	CGI	Origami	Comments
<p>WP1- Project management</p> <ul style="list-style-type: none"> MS1 – Project commencement MS2 – Project Mobilisation complete 					<p>SSEN and ENWL lead</p> <p>SSEN and ENWL input required on all work packages for oversight and provision of network operations and data</p>
<p>WP2 – Requirements, Design, Development</p> <ul style="list-style-type: none"> MS3 - Best practise review report MS4 - Connectivity model, data exchange and governance requirements MS5 - System Visualisation requirements 					<p>Overall lead by CGI</p> <p>MS3 – all three partners</p> <p>MS4 – Origami and CGI</p> <p>MS5 – all three partners:</p> <ul style="list-style-type: none"> Atkins to provide DSO system operation perspective (control room visualisation requirements). Origami to provide MP perspective. CGI to provide data requirements.
<p>WP3- Forecasting and DSO data</p> <ul style="list-style-type: none"> MS6 - Specifications for Forecasting data requirements 					<p>Overall lead by CGI</p> <ul style="list-style-type: none"> Atkins providing DSO system operation forecasting requirements. Origami Energy providing MPs forecasting data requirements.
<p>WP4- Market Models</p> <ul style="list-style-type: none"> MS7 – Output definition of Market models 					<p>Overall lead by Origami</p> <ul style="list-style-type: none"> CGI and Origami developing the market models. Atkins input into system operation requirements of the market models.
<p>WP5- IT framework</p> <ul style="list-style-type: none"> MS8 - Technical specification of IT framework MS9 - Prototype platform 					<p>Overall lead by CGI</p> <ul style="list-style-type: none"> Origami and CGI to develop the IT infrastructure. Input from Atkins on Blockchain.
<p>WP6 Trial specification</p> <ul style="list-style-type: none"> MS10 - Shortlist and programme of trial locations 					<p>Overall lead by Atkins</p> <ul style="list-style-type: none"> Atkins for identification of site locations, network requirements, power systems modelling etc. Origami to input on quantifying available flexibility.

A11.5 Open Networks Project Factsheet



The Voice of the Networks

- o Renewable energy generates electricity at different times of day and under different weather conditions. These changes will mean we will be able to store and use more electricity locally in batteries. It will also mean that network companies can connect new technologies more cheaply, by avoiding having to pay to reinforce the grid for example.
- o Electric vehicles will not just be re-charged from the network but they will feed electricity back into it. New technology will make it easier for people to buy and sell electricity to and from the grid and businesses will have the chance to take advantage of new services that will help them use energy more intelligently too.
- o Our local electricity networks will become a platform that enables the development of a whole new market providing new products, technologies and services that will enable households and businesses greater control over their electricity use by working with service providers to allow that to happen.
- o Their relationship with the national transmission network will change, as the lines and responsibilities between local and national networks become more blurred. This Project is about defining that interaction and those responsibilities.

The wider economic impact

- The outcomes of the Project will help underpin economic growth, attract investment and deliver long-term economic benefits to the UK.
 - o Ensuring that the UK economy has access to some of most affordable energy in the world is at the heart of the UK's Industrial Strategy. The Open Networks Project is about ensuring that the UK's energy networks facilitate new services and invest in their networks in the most efficient way possible, to keep our lights on in the most cost effective way – all whilst acting as a platform for new technology and services that give businesses the tools to keep their own costs down.
 - o The development of new smart infrastructure by itself will deliver economic benefits across the UK, with an estimated potential of £13 billion of Gross Value Added, £5 billion of potential exports to 2050 and 8,000 – 9,000 jobs over the 2020s and 2030s associated with creating smart grids (DECC).
 - o Our approach towards innovation and funding support through the regulatory framework has enabled network companies to trial smart network projects and transfer innovative solutions into business as usual to help address these challenges. This has provided a level of technical understanding that puts the UK in a strong position to develop our energy future, as well as delivering a forecast of nearly £1 billion of savings between 2015 and 2023 a local electricity network level.

For further information contact:

Lizzie Lunn
 Energy Networks Association
 Policy and Public Affairs Officer
elizabeth.lunn@energynetworks.org
 T: 02077065115 M: 07843 516293



The Voice of the Networks

ENA Open Networks Project

Energy Networks Association

- Energy Networks Association (ENA) is the voice of the UK's energy networks, representing the 15 companies responsible for operating and maintaining the 'wires and pipes' that deliver electricity and gas to households, businesses and communities in UK & Ireland.

- ENA members serve over 30 million customers, whilst managing £62bn of assets that employ 30,000 people in communities across the country.

A pan-industry initiative: ENA Open Networks Project

- Launched in January 2017, the Open Networks Project will lay the foundations of a smart energy grid in the UK.

- The Project brings together the leading minds in the UK energy industry to transform the way our networks work - all 8 of the UK's electricity network operators (including National Grid as the System Operator), the Department for Business, Energy & Industrial Strategy and the energy regulator Ofgem, as well as leading academics, trade associations and NGOs.

- The Project will enable the UK's energy networks to move from their traditional role of delivering electricity in one direction from centralised power plants to our homes and communities, to one where they act as a smart platform that enables a whole range of new energy technologies that generate, consume and manage electricity. Local networks in particular will become more active managers of supply, and demand within their area, which will require new services and interactions with the wider network.

- Many of the issues which the gas and electricity networks face are common and decisions that the government and regulator take in one area of energy policy affect others. Benefits can include more efficient processes and projects, cheaper costs for customers, better safety, simpler policy and avoiding bad practice. The Project ensures a whole system approach is achieved by consulting with a wide range of stakeholders, including the gas networks, through the Advisory Group.

- These technologies and services, when part of a smarter grid, have huge potential to not only make our electricity grid cleaner but also to:

- o Provide greater control of our energy and ability to lower costs
- o Promote greater competition in energy markets and,
- o Ensure that the operations and maintenance the energy networks is done as intelligently and efficiently as possible.

- The first phase of work will take place over the course of 2017. It will undertake a complete assessment of the parts of the electricity grid that need to change, providing options for delivering that change at the end of the year. After a period of assessment in 2018, regulations will be drafted and introduced to put them into effect.

Delivering smart energy technologies

- The change that the Project will deliver will enable the much anticipated widespread adoption of new smart energy technologies, which will benefit both consumers and network managers
- They not only mean we will all be using and generating more electricity but that we will be using it differently.

Appendix 12 Letters of support

National Grid House
Warwick Technology Park
Gallows Hill
Warwick CV34 6DA
www.nationalgrid.com

nationalgrid

Friday 13th October 2017

Dear Sir/Madam,

Support for Scottish & Southern Electricity Networks "TRANSITION" proposal for 2017 Network Innovation Competition

I am pleased to confirm that National Grid System Operator ("NGSO") is supportive of the "TRANSITION" project proposal being put forward in response to Ofgem's 2017 call for projects under the Network Innovation Competition.

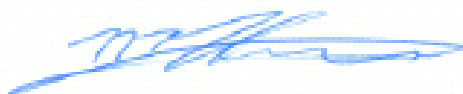
National Grid is the Transmission System Operator for the Great Britain electricity system. It is responsible for ensuring that generation of and demand for electricity are balanced at all times while ensuring the safety and security of the electricity system.

In this capacity NGSO is supportive of the TRANSITION bid as it is consistent with ongoing work through the Open Networks project and other initiatives.

The relevant teams within NGSO are aware of the TRANSITION bid and have been engaged during the development of the proposal. We expect to engage with the project through existing challenges such as the Open Networks project and other dissemination avenues, e.g. for projects such as Power Potential.

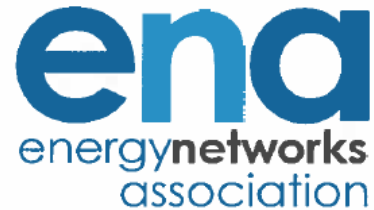
We hope that you consider this proposal favourably and look forward to working with Scottish & Southern Energy Networks on the TRANSITION project should it be awarded funding.

Yours faithfully,



Mark Herring
Acting Head of Innovation Strategy
National Grid System Operator

The Voice of the Networks



3 August 2017

Ofgem
9 Millbank
London
SW1P 3GE

Dear Ofgem

The Open Networks Project is a major cross-industry initiative that is re-defining how our energy networks will operate in the future. The changes it will make will give the UK's households, businesses and communities the ability to take advantage of a new range of energy technologies and services to take control of their energy and lower their costs, including renewable generation, battery storage and electric vehicles.

Open Networks will deliver the operational and functional changes necessary to ensure that local electricity network operators move from simply delivering electricity from centralised power plants, to being a smarter, more capable platform that enables new energy technologies, products and services to connect to the grid more quickly and more affordably than is currently the case.

ENA's members are undertaking various initiatives that will provide valuable learning for Open Networks and will help de-risk and accelerate these changes in the industry. For example, these initiatives will help to demonstrate and validate potential market models, which will be invaluable to the success of the Open Networks Project. Member's initiatives are being undertaken across a range of formats including internal DSO strategies, the Electricity Networks Innovation Strategy, NIA funding and the Network Innovation Competition (NIC), specifically the 2017 DSO-related NIC bids, which have been shared with the Open Networks Project. Collaboration between Members will be especially critical in progressing the outputs of the Open Networks Project and maintaining joint-thinking going forward. The learning from all of these initiatives will help ensure that the Open Networks Project can progress successfully and deliver the necessary changes to the industry.

ENA fully recognise the contribution that these projects will make to the successful delivery of the Open Networks Project and look forward to being closely involved in their delivery.

Yours sincerely



David Smith
Chief Executive



98 Aketon Road
Castleford
West Yorkshire
WF10 5DS

jim.cardwell@northernpowergrid.com

Frank Clifton
Project Development Manager
Scottish and Southern Electricity Networks (SSEN)
Inveralmond House
200 Dunkeld Road
Perth
PH1 3AQ

3 August 2017

Dear Frank,

Support for the Transition project

Northern Powergrid is the distribution network operator (DNO) for Yorkshire and the Northeast of England, serving a population of over 8 million with 3.9 million connections to our local electricity grid. As the industry transitions to a smarter, more flexible energy system electricity networks will play an increasingly important role. As such we recognise the importance to our customers of projects such as Transition and we are keen to record our support as well as offer our assistance to maximise value and minimise cost.

As a DNO we recognise the challenges involved in the transition from the current DNO role to that of Distribution System Operator (DSO) to ensure that customers are supported in the increasing use of renewables, with high level of system reliability; and all at least cost. Like SSEN we are working on a growing number of innovations that are associated with DSO. It is important that we share knowledge to maximise the value from all the industry projects for all customers (wherever they are connected in Great Britain). Also, we need to ensure that we are not unnecessarily duplicating our efforts. Therefore, effective collaboration is vital.

Our collaboration on the transition to DSO is being channelled and co-ordinated through the Energy Networks Association (ENA) Open Networks project. We welcome the learning that that could result from the Transition project which is aiming to design, develop, demonstrate and assess the common tools, data and system architecture required to implement the proposed models produced by the Open Networks project.

We are developing our own project that would be complementary to Transition. Our own thinking is centred on a 'demonstration through modelling' approach that could be combined with the practical learning from Transition to provide insight into a wider set of scenarios i.e. combining the real-world learning with simulations that are only possible in the laboratory setting. As our own project ideas take shape then we wish to ensure alignment with Transition to meet the twin objectives of maximising value and minimising cost for customers.

NORTHERN POWERGRID

is the trading name of Northern Powergrid (Northeast) Ltd (Registered No: 2906593) and Northern Powergrid (Yorkshire) plc (Registered No: 4112320)

Registered Office: Lloyds Court, 78 Grey Street, Newcastle upon Tyne NE1 6AF. Registered in England and Wales.

If you would like an audio copy of this letter, a copy in large type, Braille or another language, please call 0800 169 7602.

We are in a position now to commit to provide expert resource to participate in progress workshops and steering groups. Also, we would like to participate in shared dissemination events that explore the learning from all projects that are active in the DSO area. As our own project develops then we will be seeking to collaborate more.

We look forward to supporting you with the project.

Yours sincerely



Jim Cardwell
Head of Trading and Innovation

Sorcha Schnittger
DSO and Innovation
SSEN
One Waterloo Street
Glasgow G2 6AY

3 August 2017

Dear Sorcha

TRANSITION NIC bid

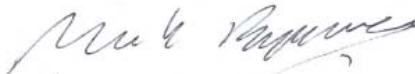
We note that the Open Networks Project is a major cross-industry initiative that is re-defining how energy networks will operate in the future. Open Networks is intended to deliver the operational and functional changes necessary to ensure DNOs can become smarter, and capable of enabling new energy technologies, products and services to connect to the grid efficiently.

We see the potential for the TRANSITION NIC project to provide valuable learning for Open Networks that can help de-risk and accelerate the proposed changes. TRANSITION will demonstrate and validate potential market models, develop specifications for the ICT infrastructure required to enable neutral DSO functions, including any changes to data exchange requirements. The TRANSITION trials will provide real-world data and learning from DSO operation under various Use Cases.

We know that SSEN and ENWL have already engaged with Open Networks in order to help shape the scope of TRANSITION. They have also committed to maintain this engagement throughout the life of the TRANSITION project.

ELEXON recognises the importance of Open Networks in delivering the industry change, and of TRANSITION in accelerating and informing that change; we look forward to engaging with the TRANSITION project, both through Open Networks and further discussions with the project delivery team to support a successful outcome for the project.

Yours sincerely,



Mark Bygraves
CEO

3rd August 2017

Centrica plc
Millstream East
Maidenhead Road
Windsor
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Telephone 01753 494000
Facsimile 01753 431010
Website: www.centrica.com

Sorcha Schnittger
DSO and Innovation,
Scottish and Southern Electricity Networks
One Waterloo Street,
Glasgow
G2 6AY

Dear Sorcha,

Re: TRANSITION NIC bid

Centrica Distributed Energy and Power offers its qualified support for SSEN's NIC bid submission for this year. This support is based on the fact that as we understand the TRANSITION project it offers opportunities for collaborative working and in particular based on some learning opportunities from our Cornwall Local Energy Market project.

We anticipate that Centrica will be able to share our learning about engaging with end users with the TRANSITION project team with a view to enabling them to gain as much as possible from their trials.

In addition, Cornwall LEM will share its high level market design with all stakeholders and this could well help the TRANSITION Project.

The Cornwall LEM will also produce a number of other key learning opportunities around managing distribution networks in the context of a Local Energy Market which could also be leveraged.

The Cornwall LEM project is an important project to Centrica Group and we welcome all opportunities for sharing the knowledge and experience that we will have gained from it with our industry stakeholders.

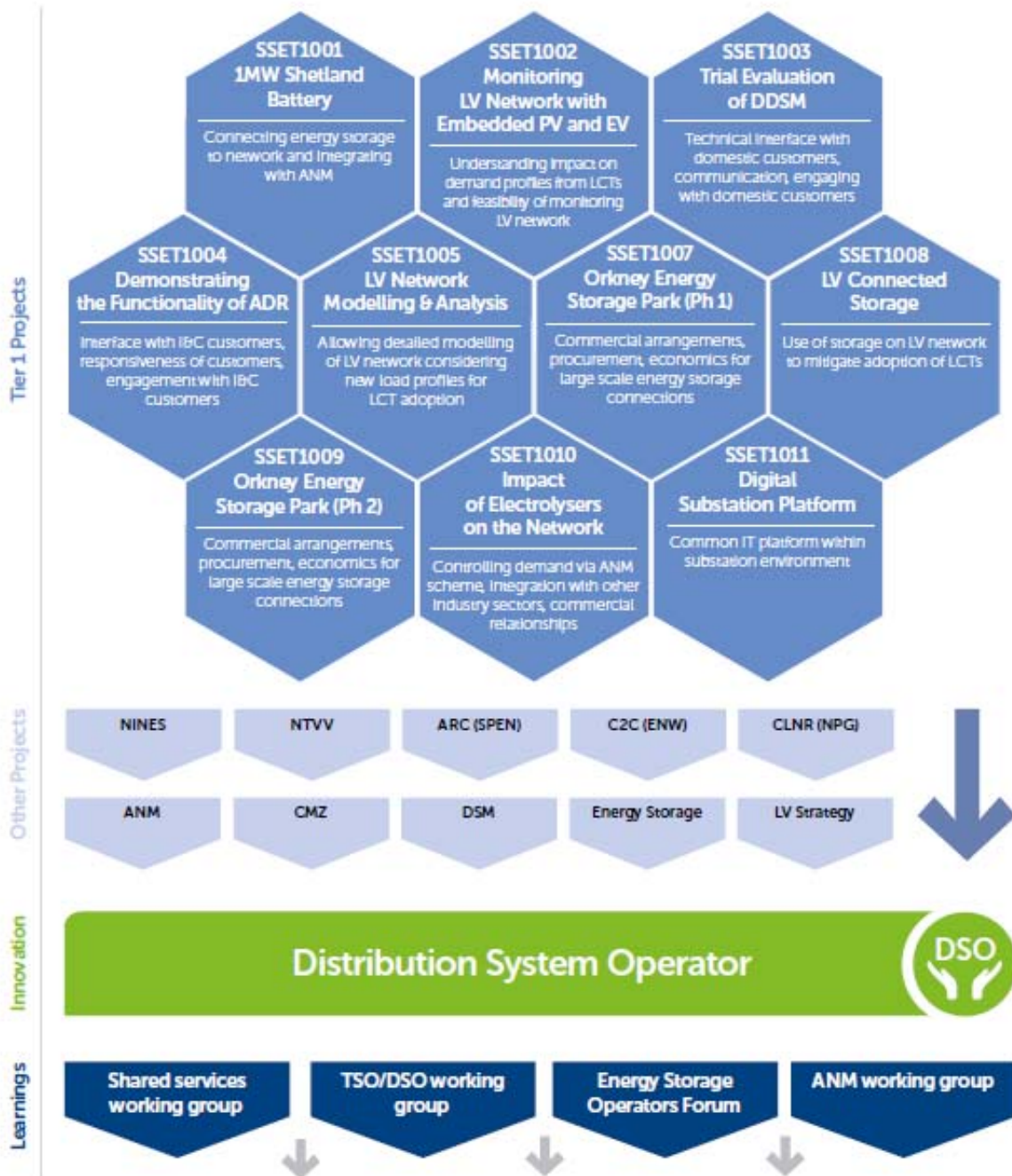
Should you wish to discuss this further please do not hesitate to contact me.

Yours sincerely,



Stuart Fowler
DNO Commercial Manager
Centrica Distributed Energy and Power

Appendix 13 DSO Innovation Model



References

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Glossary

BAU	Business as Usual
DER	Distributed Energy Resource
DLT	Distributed Ledger Technology <i>A technology solution that can securely record financial, physical or electronic assets for sharing across a network through entirely transparent updates of information.</i>
DMS	Distribution Management System
DPS	Distribution Power Flow
DSO	Distribution System Operator
EIC	Energy Innovation Centre
ENA	Energy Networks Association
EV	Electric Vehicle
ICT	Information Communications & Technology
LCNF	Low Carbon Networks Fund
LCT	Low Carbon Technology
LT	Long Term <i>When referring to</i> <ul style="list-style-type: none"> <i>Open Networks, is the duration of ED2.</i> <i>Forecasting, is more than four years ahead of delivery.</i>
MP	Market Participant <i>Any organisation that could buy or sell flexibility services via an NMF</i>
MT	Medium term <i>When referring to</i> <ul style="list-style-type: none"> <i>Open Networks, is the start 2019 to the end of ED1.</i> <i>Forecasting, is from four years to one year ahead of delivery.</i>
NINES	Northern Isles New Energy Solution

NMF	Neutral Market Facilitator <i>An organisation responsible for operating a fair, transparent and non-discriminatory market that provides access to all buyers and sellers of flexibility services, including peer to peer transactions.</i>
NTVV	New Thames Valley Vision <i>An SSEN LCNF Tier 2 project.</i>
Non-physical	Refers to MPs who do not have MPANs for the delivery or receipt of services.
NTVV	New Thames Valley Vision
OJEU	Official Journal of the European Union
Open Networks	The ENA Open Networks project.
Physical	Refers to MPs who have an MPAN for the delivery or receipt of services.
RIIO ED2	Price control period running from 2024 - 2030
RT	Real time <i>The period up to 24 hours ahead of delivery.</i>
RTS	Real time systems
SAVE	Solent Achieving Value from Efficiency <i>An SSEN LCNF Tier 2 Project.</i>
SGAM	Smart Grid Architectural Model
ST	Short term <i>When referring to</i> <ul style="list-style-type: none"> <i>Open Networks, is to the end of 2018.</i> <i>Forecasting, is one year ahead of delivery to one day ahead of delivery.</i>
STOR	Short Term Operating Reserve
TED	Tenders Electronic Daily