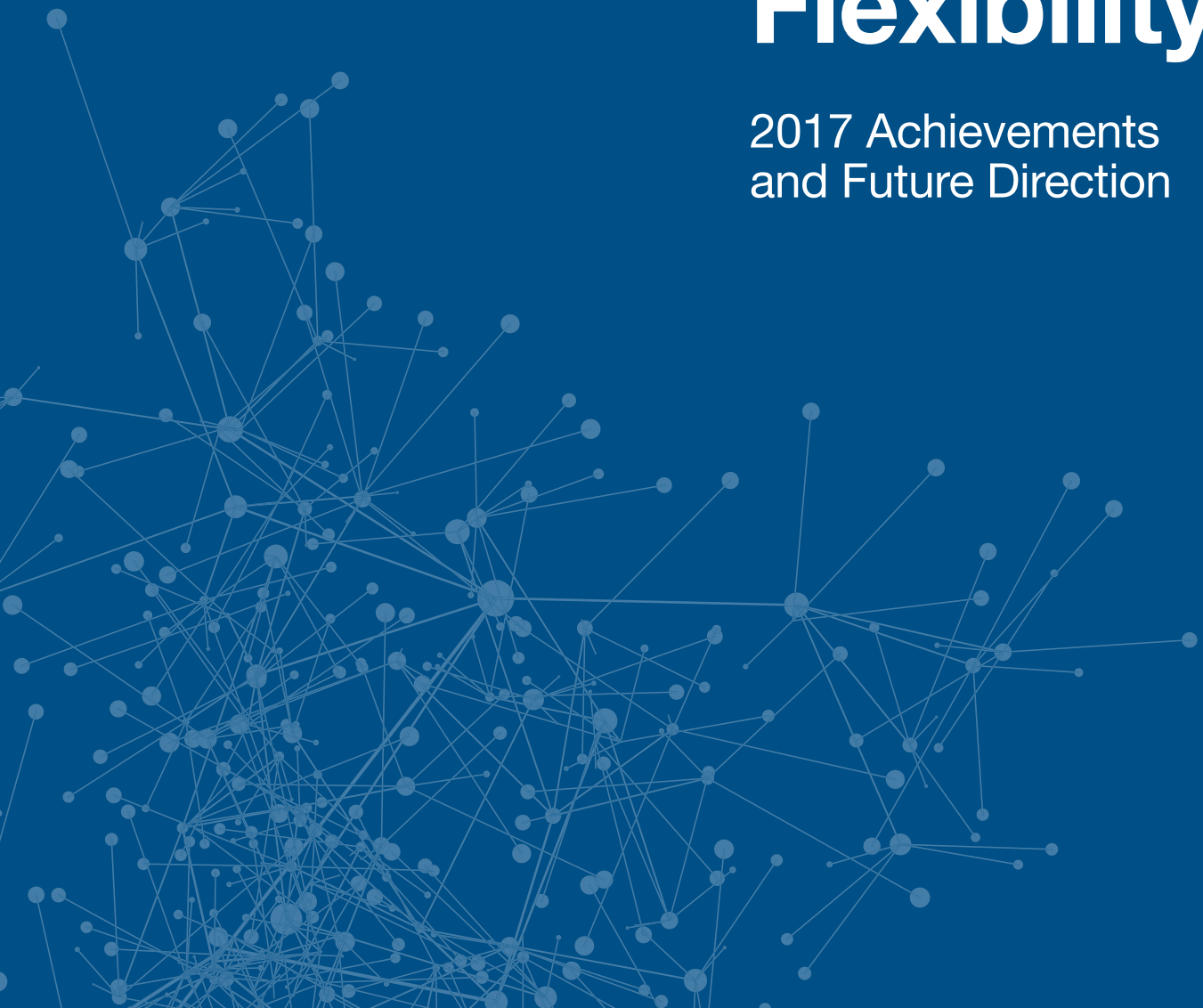
The Voice of the Networks

energynetworks association

Open Networks Project Opening Markets for Network Flexibility

2017 Achievements and Future Direction



Contents

Contributing Partners

The Open Networks Project brings together 10 of UK and Ireland's electricity network companies.

nationalgrid

NORTHERN POWERGRID

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

SP ENERGY NETWORKS

electricity north west
Bringing energy to your door

UK Power Networks
Delivering your electricity

Scottish & Southern Electricity Networks

BUUK infrastructure

ESB NETWORKS

Northern Ireland Electricity Networks

Structure of this Report

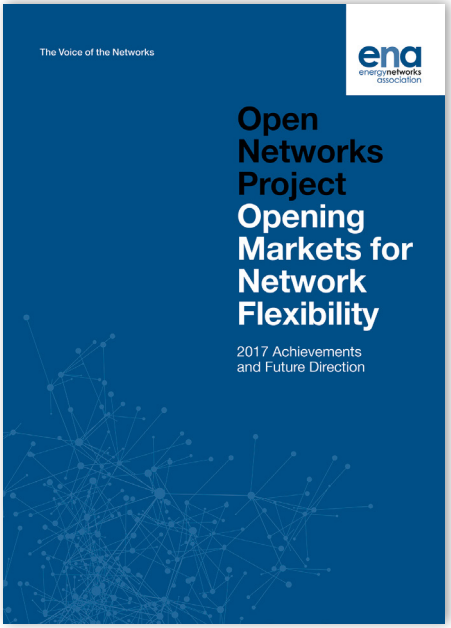
This report begins with an introduction to set the scene for the background and scope of what ENA's Open Networks project has delivered and will achieve.

It then sets out a key principle of our work, to take a whole system approach to development, as well as referencing the key policy driver of the Ofgem and BEIS Smart Systems and Flexibility Plan and our focus on stakeholder engagement.

This is followed by our work to date focused on the customer experience.

The next two sections demonstrate how we are delivering the objectives set out in the Ofgem and BEIS Smart Systems and Flexibility Plan:

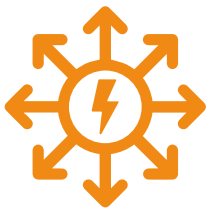
– Opening up the delivery of network requirements to the market so new solutions such as storage or demand-side response can compete directly with more traditional network solutions, including as an alternative to reinforcement.
– Mechanisms for transmission and distribution coordination which enable whole system network requirements to be identified and acted upon efficiently, in the best interests of the consumer.



The report then highlights the project's support to whole system network charging reforms.

The development work planned for 2018 is covered in each of the four sections above and the report concludes with a vision of the next steps for the project.

Foreword



The complete evolution to Distribution System Operator is a very large-scale business transformation which will require a substantial increase and change in capabilities in the networks over the next 10 years, and is already underway.

The Open Networks Project is a key initiative to deliver Government policy set out in the Ofgem and BEIS Smart Systems and Flexibility Plan, the Government's Industrial Strategy and the Clean Growth Plan. Our work is also progressing measures to address some of the principles highlighted in the Cost of Energy Review by investigating how networks can use competitive services to deliver best value for money to customers and consumers. The Open Networks project will also continue to drive the investigation of the options for roles and responsibilities for all parties in future market structures and a whole system approach, including the evolving transformation to Distribution System Operator. We expect our input will contribute to future Ofgem and Government considerations on future markets and remain committed to working with Ofgem, Government and wider stakeholders to ensure our work responds to policy direction.

We highlight in this report that there are different local challenges for different network operators and there are a number of potential strategies for different network operators to meet those challenges. **Within ENA's Open Networks Project, we are collaborating on good practice and looking at standardisation and simplification across Great Britain to make this simpler for customers.** We expect that the Open Networks Project output will be a key input to the network operator submissions for the next regulatory period.

The complete evolution to a whole system approach and Distribution System Operation is a very large-scale business transformation which will require a substantial increase and change in capabilities in the networks over the next 10 years and beyond. Network companies are already evolving in response to the network challenges resulting from the decentralisation of energy production and the future challenges posed by the transition to a low carbon economy.

A number of Distribution Network Operators have already gone to the market for competitive flexibility services as an alternative to traditional network investment, particularly in areas where networks are under stress, and the National Electricity Transmission System Operator is improving its balancing services products. The transformation has begun.

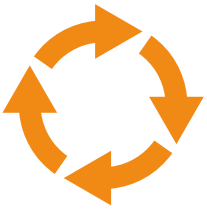
The Open Networks Project has begun what we believe is the most comprehensive modelling of future Distribution System Operator models in the world and this will provide us with a significant evidence base to trial, test and implement what may work for the UK network operators of the future. Taking a whole system approach to transmission and distribution (with consideration of gas, heat and other cross-vector industries) is essential to delivering the best outcomes for customers.

We will create new markets to enable flexibility services to compete alongside traditional investment options for all major network reinforcements or upgrades, and to make the most cost-effective investment decisions in the future. We expect a Distribution System Operator to be a neutral market facilitator for both existing and emerging providers of network flexibility (as we are seeing with early initiatives now). In this price control, we will continue to develop these services and rapidly increase the use of competitive markets to deliver:

- Lower carbon energy at the lowest overall cost for customers.
- Opportunities for customers to realise value from services and new technology.

But we are not waiting for that work to complete to **progress improvements in the Transmission and Distribution interfaces and making improvements for customers:**

- We have completed drafting of changes to the distribution network planning standard (P2/6) to include the use of flexible resources as an alternative to traditional network investment to deliver cost-effective planning.
- Following trials across GB, we have also released an improved Statement of Works process where the Transmission Network is impacted by Distribution connections and have published a GB-wide roll-out plan for customers prioritising the areas of most need. This will accelerate and simplify this process for customers.



Taking a whole system approach to transmission and distribution is essential to delivering the best outcomes for customers.

We are sharing good practice between network operators within the project which has resulted in changes to improve customer experience. Network Operators have started to use elements of improved whole system planning processes with plans in place to roll out more comprehensive changes over time, for example there are guidelines in place to ensure that network capacity is available for customers from connection applications that are not progressing.

Good customer experience is key and we have a specific customer experience workstream to ensure that we stay true to that vision.
Over 40 industry stakeholders have provided input to our development work through our project Advisory Group and we have publicly consulted on a set of potential commercial models for flexibility services. We are building our outreach to inform people of what we are developing and we plan to increase our stakeholder engagement activities through 2018, starting with a public consultation on our 2018 workplan in January so we can reflect stakeholder views on our priorities.

The scope of work is increasing into 2018 and we will continue to increase our commitment of resource to continue to make ENA's project a success in delivering the benefits set out.

Our current environment is changing and we expect that much more will change over the next few years, so we have set ourselves up to be adaptable to keep relevant as the world moves on. This work will align with the Joint Innovation Strategy that is also under development at ENA. The Open Networks Project is defining and delivering a fundamental transformation in the energy industry for now and the future with great potential to benefit the environment, economy and society.

We look forward to working with you all in delivering on our vision for the future, starting now.

David Smith
Chief Executive
Energy Networks Association

Peter Emery
Chief Executive Officer
Electricity North West

Phil Jones
Chief Executive Northern Powergrid

Clive Linsdell
Chief Executive Officer
BUUK Infrastructure

Frank Mitchell
Chief Executive Officer
ScottishPower Energy Networks

Colin Nicol
Managing Director Networks Scottish and Southern Electricity Networks

Marguerite Sayers
Managing Director ESB Networks

Basil Scarsella
Chief Executive Officer
UK Power Networks

Nicola Shaw
Executive Director National Grid

Robert Symons
Chief Executive Officer
Western Power Distribution

Nicholas Tarrant
Managing Director NIE Networks

Introduction & Background

The ENA Open Networks Project is a major energy industry initiative that will transform the way our energy networks work.

The Open Networks Project will help underpin business growth, attract investment and deliver economic benefits to the UK.

In December 2016, Energy Networks Association (ENA) members gave their commitment to the Open Networks Project, a major collaboration that will transform the way that both local Distribution Networks and national Transmission Networks will operate and work for customers.

Launched in January 2017, ENA's Open Networks Project has started to lay the foundations of a smart energy grid in the UK.

The Open Networks Project has introduced real momentum into the development work required to enable the UK's energy networks to:
- Facilitate our customers' transition to a low carbon future, including the electrification of heat and transport.
- Address the challenges rising from the continued uptake of local generation.
- Evolve to be market enablers for a whole range of new smart energy technologies.
- Reduce costs to customers by contracting for flexibility services alongside investment in traditional and innovative network solutions.
- Play a key role in delivering overall lowest energy system costs for customers.

Electricity is an essential service to our customers, and their reliance on it will grow, for example with the electrification of transport. Network operators must meet these challenges whilst:
- Continuing to deliver safe and secure operation of their Networks.
- Ensuring efficient and timely access to networks for customers.
- Continuing to provide value for money.
- Ensuring that our universal service continues to be available to all customers on a fair basis.

The ENA Open Networks Project is a major energy industry initiative that will transform the way our energy networks work, underpinning the delivery of the smart grid. It brings together Great Britain's network operators and DNOs from Northern Ireland and the Republic of Ireland and has included a broad range of stakeholders in its development work, including the energy regulator Ofgem, Government departments, independent Distribution Network Operators (iDNOs), customers, generators, suppliers, storage providers, respected academics, Citizens Advice Bureau and other NGOs amongst others.

The UK's energy networks face a number of challenges whilst maintaining secure networks, access to customers and value for money:
- The physical need to connect more Distributed Generation to the local networks.
- The increasing capacity interactions between Distribution and Transmission Networks.
- Increasing requirements of Distribution Networks to manage less predictable and more active energy flows, which are met by contracting 'system operator' services.
- Increasing availability and use of capacity and network support services at distribution level.

£1.7bn

LCNF projects could deliver £1.7bn worth of benefits

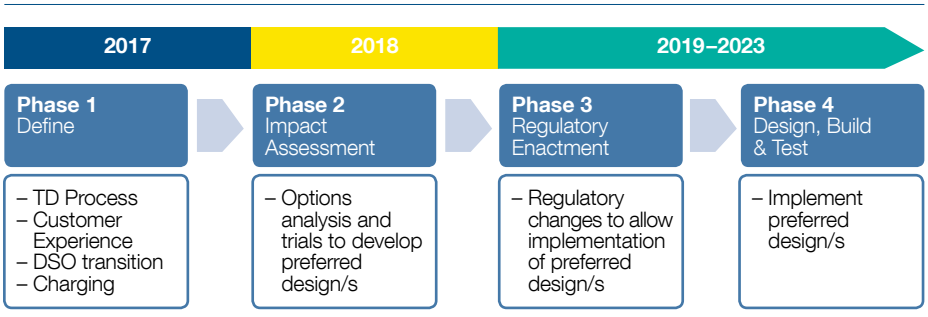
– New data requirements to manage the system efficiently and securely.
– The need to assess investment and operational decisions across the whole energy system rather than just one part of it.
– Reducing system inertia and increasing whole energy system reliance on Distributed Generation (DG) which largely uses renewable technologies.
– The evolution of traditional network operation to more active and empowered Distribution System Operators (DSOs) as they adapt to the evolving system to continue to meet their obligations to deliver in an economic, efficient and coordinated way.

These challenges will be met by the Open Networks Project which will help underpin business growth, attract investment and deliver economic benefits to the UK:
– Helping to create the market place for products and services to deliver cost-effective energy to British businesses, as part of the Government's Industrial Strategy.
– Ensuring existing electricity network assets are fully utilised with capacity made available to customers as soon as practicable.
– Existing Low Carbon Network Fund (LCNF) projects could deliver £1.7bn worth of benefits to 2031, clearly demonstrating the economic potential of smarter networks.

Delivering opportunities for customers to realise value from technology and services is key to the Open Networks Project. We have been using an Advisory Group of stakeholders for input to our materials and are publishing our outputs wherever possible. We will continue to need that input from stakeholders as we progress through the Open Networks Project and we would encourage you to get in touch if you would like to be informed on our progress.

We expect that the project development work will evolve over time and we will adapt – a broad timeline for development is set out below. This timeline is illustrative only as the project will also look to implement improvements where practical through the early phases of the project. Different initiatives will take different times to complete and there is the potential for staggered roll-out of some processes across different areas of the country, as Open Networks can't deliver a 'one-size-fits-all' solution for many of the challenges which can be geographic. Open Networks is collaborating on good practice and looking at standardisation and simplification across Great Britain to make it simpler for customers.

Different initiatives will be delivered over different timescales. Many of the challenges are geographic and a 'one-size-fits-all' solution is unlikely to be appropriate. This drives the need for a staggered roll-out approach.



Project Scope

The project has been organised into five workstreams that are:

1. **Developing improved processes between Transmission and Distribution, particularly around connections, planning, shared services and operation.**
2. **Improving customer experience and looking to improve information available to customers to enable their decisions for connection and services.**
3. **Developing a more detailed view of the required evolution from traditional network operation to new Distribution System Operator (DSO) functions. This includes definition of how this will work, the roadmap to implementation and how existing network operators can make the organisational transformation to support new markets and functions.**
4. **Considering the charging requirements of enduring electricity transmission/distribution systems; what barriers and anomalies might exist for customers; and how network operators deliver value for money to customers.**
5. **Effectively communicating our output to a wide range of stakeholders.**

In 2017, we have successfully:

– Agreed a definition of what we mean by Distribution System Operator and a set of core functionalities and competencies required for future network and system operation, regardless of the allocation of roles and responsibilities in any market model.
– Created a living roadmap for the evolution from traditional network operation to new DSO functions, including the steps network and system operators need to take in the short, medium and longer terms.
– Started mapping out a robust set of potential market models for DSO to understand the implications.
– Identified key issues in transmission-distribution processes; allocated action plans to enable whole system requirements in the short, medium and long term.
– Developed potential new models for whole system investment planning.
– Started the roll-out of new processes for customer distribution connections requiring transmission works with a new improved process and roll-out underway.
– Defined customer information improvements and shared best practice for management of applications and connections.
– Identified issues and variations with charging between transmission and distribution to feed into the Ofgem charging review work.

In 2018, we will:

– Continue to develop potential models for DSO across the whole system (including the facilitation of flexibility markets), gather evidence to support evaluation of models and undertake real trials on the network.
– Continue to facilitate markets for flexibility services for DSO to consider alongside traditional investment in deciding the most cost-effective planning solutions for customers.
– Develop potential new models for whole system investment and operational planning.
– Drive joint working and improvements to whole system transmission-distribution processes.
– Drive improvements to the treatment of flexibility services in the queue for applications and connections.
– Improve information provision to customers and processes for customers through the applications, connections and post-connection processes.
– Continue to support input to the Ofgem charging review through the Charging Futures Forum and associated Task Forces.
– Keep the customer at the forefront of our minds during development with a continuing customer workstream and increasing customer and stakeholder input to our work.

We have already taken input from stakeholders at the Advisory Group for priorities for 2018 and will be publicly consulting on our work plan in January.

We expect that there will be a wide range of ways in which change can be implemented and improvements made for customers:

– Network Operators will take the output from the project and implement improvements. We have seen this in 2017 with trials and changes to working practices – some examples and case studies are highlighted in this report.
– Good practice/guidelines may be published from ENA and/or formalised into industry codes where appropriate.
– Where more structural reform is required (e.g. DSO models), the industry and customers are likely to require regulatory change, which we will support.

We will continue to be adaptive in our development approach.

Alignment with the Ofgem & BEIS Smart Systems & Flexibility Plan

Our approach has been not to favour one type of flexibility over another, but to allow different forms of flexibility, including forms which will be developed in future, to compete against each other, and against more traditional solutions, within a market framework.

We have been working closely with both Ofgem and BEIS throughout the course of the project, at both the Steering Group and workstream level, to ensure that our work is aligned with policy direction.

In July, Ofgem and BEIS published their Smart Systems & Flexibility Plan and they placed an onus on ENA's Open Networks Project to "demonstrate how parties will deliver:

– opening up the delivery of network requirements to the market so new solutions such as storage or demand-side response can compete directly with more traditional network solutions, including as an alternative to reinforcement. These needs will also need to be signalled well in advance; and
– mechanisms for transmission and distribution coordination which enable whole system network requirements to be identified and acted upon efficiently, in the best interests of the consumer."

We have shaped this report with key sections on 'Opening Network Requirements to the Market' and 'Transforming Transmission and Distribution Processes' to show how the project outputs will make a difference for customers in these two key areas. We summarise below some of the key initiatives and reference projects over time. These initiatives are further discussed later in this report.

There are a number of general themes within the Smart Systems & Flexibility Plan that are consistent with the way that we have approached our work within the Open Networks Project:

– Improved coordination between Transmission and Distribution.
– Facilitating competition and ensuring effective markets.
– Maximising access to the existing range of markets alongside new markets or revenue streams (e.g. distribution services).
– Being able to stack value across them wherever appropriate.
– Improved visibility and transparency between buyers and sellers of flexibility.
– A focus on outcomes for customers.
– A deliberately adaptive approach.

Our approach has also been not to favour one type of flexibility over another, but to allow different forms of flexibility, including forms which will be developed in future, to compete against each other, and against more traditional solutions, within a market framework.

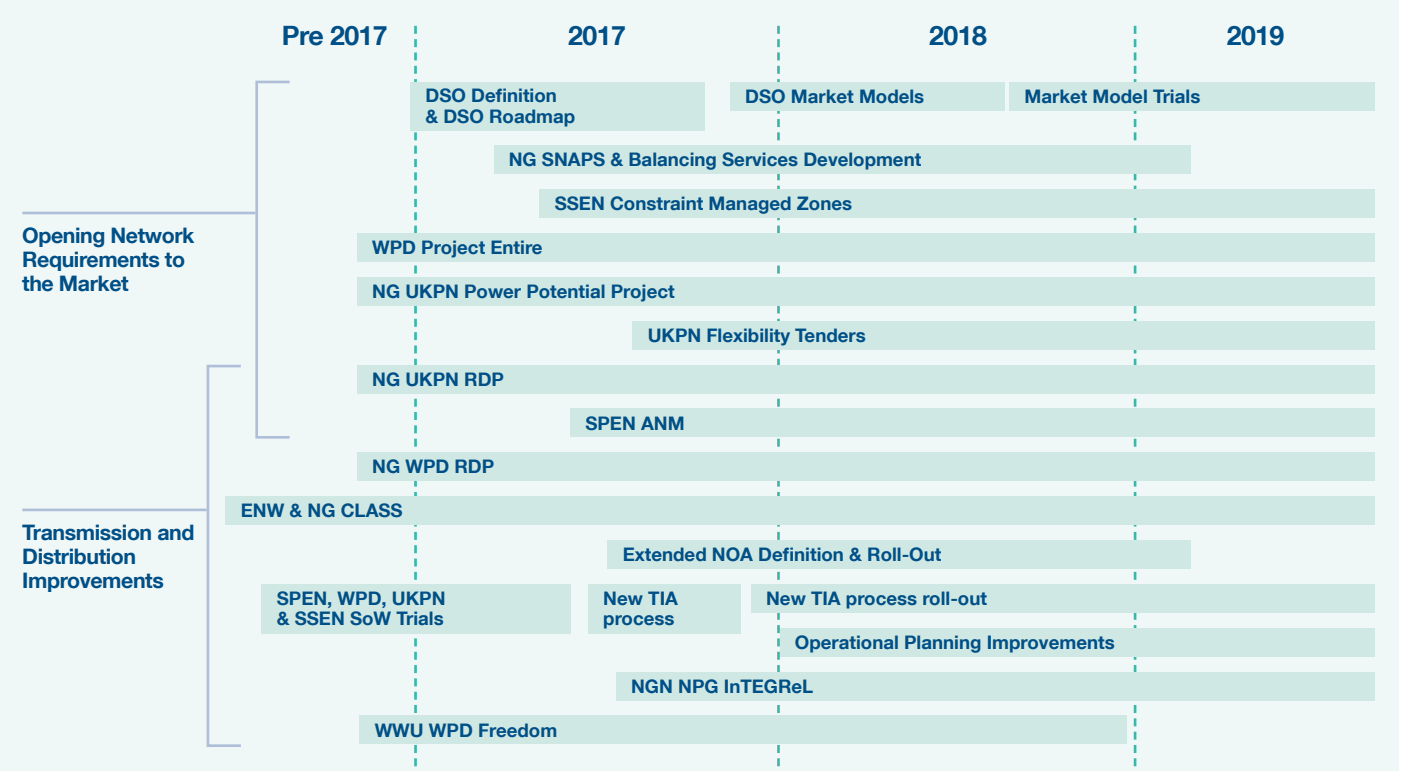
Flexibility Services
There is much discussion of flexibility services in this report and therefore we set out what we mean by flexibility services below[1].

Flexibility Services
Flexibility services are offered by customers connected to the Distribution or Transmission Networks to change their electricity use to allow the network operators to more cost effectively plan for or operate their networks. Examples of these services include an increase or curtailment in generation, increase or decrease in consumption (often referred to as Demand Side Response), the use of energy efficiency measures, the use of storage facilities or heat networks. Network Operators set out services that they need to plan and manage the networks and then procure these services.

The European Commission Smart Grid Task Force 3 define flexibility as: On an individual level, flexibility is the modification of generation injection and/or consumption patterns in reaction to an external signal (price signal or activation) in order to provide a service within the energy system. The parameters used to characterize flexibility in electricity include: the amount of power modulation, the duration, the rate of change, the response time, the location etc.

[1]https://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Final%20-%20January%202015.pdf

Figure 1:
Case Study Timelines



Whole System Approach

The Open Networks Project is taking a whole energy system approach to our development work and in designing solutions and we have defined our project view on the whole system approach below.

The Open Networks Project is focused on the entirety of the electricity networks, both Transmission and Distribution Networks, but in a whole system context.

Whole System Approach

The Open Networks Project is focused on the entirety of the electricity networks, both Transmission and Distribution Networks, but in a whole system context; this means that the project is looking at making optimal network investment and operational decisions for the whole electricity network, not just transmission or distribution networks in isolation. The project is also considering interactions with other energy networks and vectors (including gas networks, heat networks) so that wider options and value can be taken into account.

This work is supported by consideration of the connections, data links, interfaces, coordinated planning opportunities, potential impacts and mutually beneficial shared learnings across electricity Transmission and Distribution Networks and other energy vectors, both currently and in the future.

We have consulted with a wide range of stakeholders, including the gas networks, through the Advisory Group and considered common issues and resolution action.

A whole system approach is of value because:

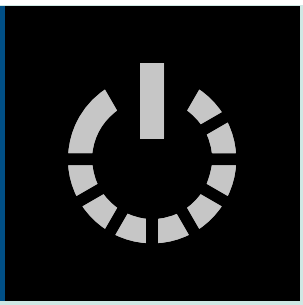
– Gas and electricity networks face many of the same issues, and could help solve issues across vectors, therefore we are working together with gas networks in our development work. We are considering how data can be shared between the networks and what improvements can be made to planning for both gas and electricity networks.
– Perceived successes and failures in one area of energy policy can inform the Government's or regulator's view of future energy policy and regulatory changes in another.
– There is potential for strong benefits from thinking across the whole energy system and from networks working closely together, speaking with a common voice and learning lessons from each other's experiences.
– Benefits can include more efficient processes and projects, cheaper costs for customers, better safety, simpler policy and avoidance of bad practice.

This work has involved strong collaboration between DNOs and the NETSO to assess the technical requirements of this capability, with a view to informing relevant work streams in the broader project on what would need to be done to enable such capability.

Case study

Whole System Black Start

Black Start is the ability of a power system to restart itself after a full system black out.



National Grid as National Electricity Transmission System Operator (NETSO) is responsible for maintaining Black Start capability and managing the process of system restoration if a black out occurs. Against a trend of reducing availability of traditional Black Start service providers (transmission-connected synchronous generators), the NETSO has explored alternative methods of Black Start from Distribution Networks that could be developed in the future, such as by using smaller generators than have been traditionally considered that may be connected at distribution level; and using them to establish small power islands of Distributed Generation and demand as a stepping-stone to wider restoration.

This work has involved strong collaboration between DNOs and the NETSO to assess the technical requirements of this capability, with a view to informing relevant work streams in the broader project on what would need to be done to enable such capability. Emerging results suggest that there are potential benefits to both alternative approaches to Black Start in terms of availability, resilience and restoration time, however significant investment in control infrastructure would be required, as well as work to understand the impact on existing Black Start roles, responsibilities and regulations to ensure reliability and safety during a Black Start situation.

Case study

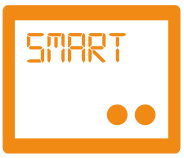
InTEGReL[2]

Is a collaboration between industry and academia

Breaking down traditional barriers between gas, electricity and transport sectors to use their assets in order to deliver a more secure, affordable, low carbon energy system.

InTEGReL stands for Integrated Transport Electricity and Gas Research Laboratory and is a fully integrated whole energy system development and demonstration facility, providing a space for industry, academia, SMEs and government to explore and test new energy technologies, strategies and processes which bring transport, electricity and gas into one place.

InTEGReL is led by Northern Gas Networks working with Northern Powergrid and Newcastle University, in partnership with the EPSRC Centre for Energy Systems Integration (CESI).



A UK first demonstrator of 75 hybrid heating systems with smart management technologies within on and off-gas properties in Bridgend, South Wales.

Case study

Wales & West Utilities and Western Power Distribution FREEDOM Project

Flexible, residential energy efficiency, demand optimisation and management[3]

A UK first demonstrator of 75 hybrid heating systems with smart management technologies within on and off-gas properties in Bridgend, south Wales. This project is currently testing the ability and benefits of smart heating systems that can switch fuel sources and heating appliances through a heat service under aggregated control, depending on energy system signals and user requirements. The project outcomes will be a major contributor that will show how far we can affordably decarbonise heat using hybrid solutions. Simulations of future scenarios include differing fuel price ratios, tariffs, live market prices, network constraints and hybrid hydrogen cities.

[2]https://www.northerngasnetworks.co.uk/ngn-you/the-future/integrel/
[3]http://www.smarternetworks.org/project/nia_wpd_023

Leveraging Other Thinking to Date

We have learnt from a number of current initiatives in industry in developing our work this year. That has included:

– Regional Development Programmes.
– LCNF trials.
– Statement of Works trials.
– Future Power System Architect (FPSA) Programme.[4]
– European and international developments, including use of relevant international experience in our Smart Grid Architecture Model (SGAM) modelling work and liaison with European committees.

ENA's Open Networks Project has published a report on key learnings from a number of relevant trial projects.

International Analysis

Our consultants have referenced and considered the following international projects in developing our DSO Market Models:

SmartNet	SmartNet Project (European Commission, Horizon 2020 framework) http://smartnet-project.eu
evolvDSO	evolvDSO Project (European Commission, FP7 framework http://www.evolvdso.eu/
EDSO for smart grids	'The Role of DSOs in Tomorrow Electricity Market', EDSO, May 2015
entsoe Reliable Sustainable Connected	'General Guidelines for Improving TSO-DSO Cooperation', entso-e, Nov. 2015 'TSO-DSO Data Management Report', entso-e, Jul. 2016
eurelectric / CEDEC / GEODE / EDSO	'Eurelectric Vision about the Role of DSOs', Eurelectric, Feb. 2016 'DSO Viewpoints on Flexibility', Eurelectric, Mar. 2017
CEER	'The Future Role of DSOs', CEER, Jul. 2015 'CEER Position Paper on the Future DSO and TSO Relationship', CEER, Sep. 2016
NEW YORK STATE OF OPPORTUNITY. Reforming the Energy Vision	The State of New York's Reforming the Energy Vision (REV)
ena energynetworks association	'TSO-DSO Active System Management Workshop', Nov 2016 Other ENA provided materials

We believe that we are consistent with international work to date, tailored to our UK requirements and extending the model to new actors, e.g. cross-vector considerations and whole system thinking.

Future Power System Architect (FPSA) Analysis

We have particularly analysed the overlap with the FPSA team to ensure that the Open Networks Project reflect the FPSA functions in our functional requirements and modelling for DSO models. The Open Networks Project will continue to deliver on the network elements of transformation in a complementary way to FPSA developments.

[4]www.theiet.org/sectors/energy/resources/fpsa/index.cfm?origin=reportdocs

Stakeholder Engagement

We have created a representative Advisory Group containing approximately 40 experts from across the energy industry.

We believe that stakeholder input to the Open Networks project is absolutely critical. We have worked to involve anyone who has any interaction with the networks in Great Britain, across the whole energy system.

There are two key elements to stakeholder engagement:

– Providing input and reviewing our key products and deliverables, mainly through a project Advisory Group established for this purpose.
– Ensuring that the wider stakeholder community are engaged with project developments and opportunities to engage.

Advisory Group

We have created a representative Advisory Group containing approximately 40 experts from across the GB energy industry including Suppliers, Aggregators, iDNOs, industry groups, academia, Generators, consumer groups, the gas industry, Government, Ofgem and other industry parties. ENA and its members have used the Advisory Group to inform stakeholders of project progress, but more importantly allow contribution and input to the workstream products at a very early stage. All of this input and feedback has heavily shaped the outcome of products, and we encourage stakeholders to continue with their feedback into 2018 and beyond.

Stakeholder Input to Deliverables

As the scope of the project increases in 2018, increased stakeholder engagement will be a key success factor. For workstream products requiring review and input, our approach includes:

– Targeted collaborative development with Advisory Group.
– Increased use of public consultation on key products, including webinars (e.g. Commercial Principles Paper this year).
– Breakfast briefings to provide opportunities for stakeholders to engage with the project face to face.
– Quarterly Programme Newsletter to keep a wide range of stakeholders informed on latest developments.

The project will also engage with wider industry including MPs, regulatory, Government departments, civil servants, press, gas networks, trade associations, think tanks, charities, Generators, Suppliers, technology suppliers, Aggregators, community groups, local authorities, regional development agencies, manufacturers (e.g. cars, batteries), flexibility service providers, consumers and with a focus on the customers of the networks.

Figure 2: Categorisation of Stakeholders to support Engagement Activities

Thus far, we have undertaken with the Advisory Group:

4
Advisory Group Meetings

3
Advisory Group Modelling Workshops

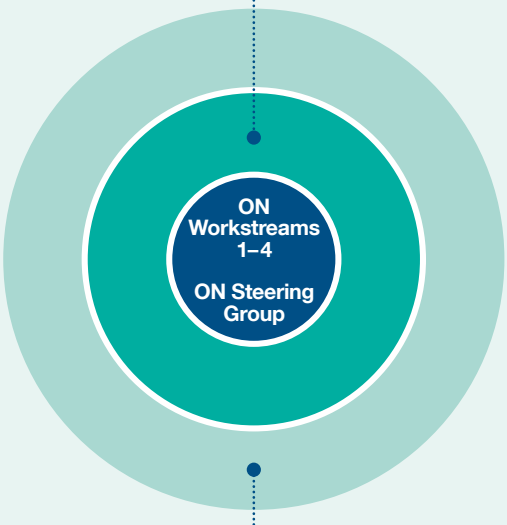
40
With over 40 different stakeholder attendees at these sessions

To the wider stakeholder community, we have:

Published a newsletter to 100s of stakeholder contacts.

Published our material on ENA website updates.

Conducted a stakeholder webinar with 45 attendees followed by 30 responses to commercial principle consultation.



Customer Experience

We have been running a customer experience workstream to ensure that there is a customer focus on our development work in collaboration with the Advisory Group. We have published a set of customer categories and customer journey maps for current processes, together with a set of current issues for resolution.

Customer Categories

We have defined a set of Customer Categories so that work being undertaken elsewhere in the project can test its output against different types of customer and check that customer requirements are being met for different types of customer (e.g. in considering process improvements, DSO market models and charging implications). These categories are set out below.

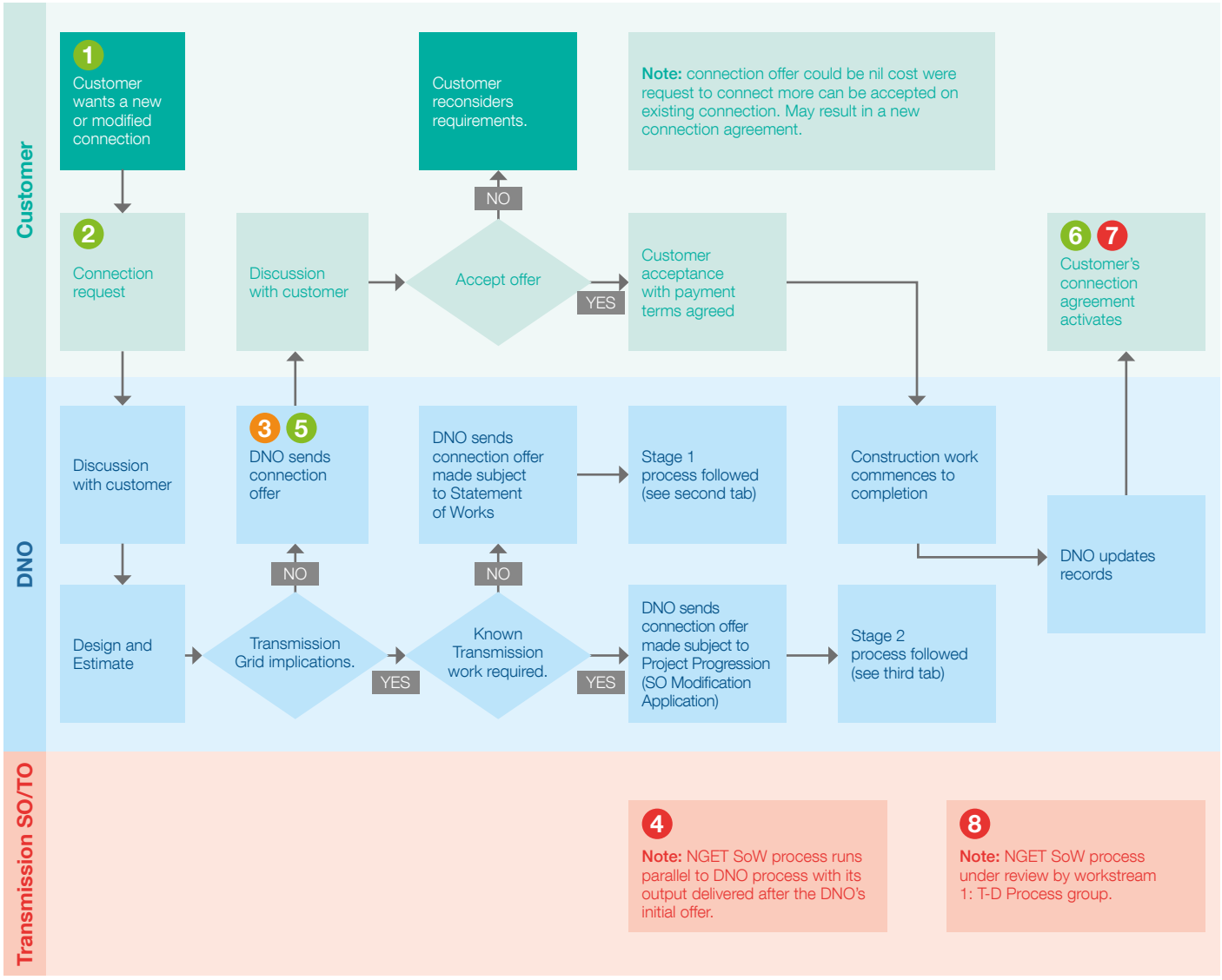
We have tested these within the DSO modelling work set out below and these customer categories are going to be separate actors in the model. The modelling work to date has demonstrated these to be appropriate categories.

Category		Characteristics	Customer Type Examples	Contract Examples
A	System Service Providers	Their core function (or a key element of their overall business portfolio) is to manage load, generation or storage to sell ancillary services **to TSOs and DSOs**.	– TSO **contracted** service provider, e.g. – Balancing Mechanism Units (BMUs) – Enhanced Frequency Response services – Ancillary Services – DSO service **contracted** flexibility service provider	– Bilateral agreements between the customer and the DSO / TSO – Could be DSO / DSO agreements for DNO-DNO interconnection
B	Active Participant	Have invested in generation, storage, demand side management and / or low carbon products. They will **actively participate in the energy market** to make money from generation, reduce operating costs and/or for low carbon social responsibility reasons. They do not have contracts for services to TSOs or DSOs. Could have automated controls to maximise savings / returns.	– Distribution connected generation, e.g. solar farm exporting – Behind the meter generation/storage, e.g. for peak lopping, triad avoidance – Demand side response e.g. for peak lopping, triad avoidance – Residential customers actively engaged e.g. timing of EV charging, use of heat pumps/solar/storage	– Power Purchase Agreements – Suppliers via Time of Use tariffs or products – Contracts with Aggregators – residential and industrial and commercial
C	Passive Participant	Energy conscious low carbon investor generally off-setting demand for benefits **(passive/fit and forget)**. Have invested in 'off the shelf' low carbon **products** such as solar panels, heat pumps, EV or smart appliances **to reduce energy bills**. May be exporting and importing and would be interested in reducing costs via Time of Use tariffs.	– Businesses or residential with installed products, e.g. solar panels, heat pumps, EV or smart appliances – Residential customers with customised Time of Use tariffs	– Suppliers via Time of Use tariffs or products
D	Passive Consumer	Normally demand customers. Little or no knowledge or interest in Time of Use tariffs. Normally on standard single rate tariff but could include customers on standard 2 rate tariffs and storage heaters.	– Business or Residential customers	– **Basic Supplier tariff contract**

Customer Journey Maps

We have set out a set of Customer Journey maps to help clarify current processes, identify issues and potential areas of improvement for network operators in their dealings with customers. An example of the customer journey is set out below together with identified issues:

Figure 3:
As is connections process for system service providers, including demand, storage and Non G83 DG. New and modified connections.



Key

1. DNOs publish heat maps to assist customer's own assessment.
2. Connection process for storage – Dedicated storage application form available.
3. DG and storage customers want more information on estimated curtailment on unfirm connections
4. NGET SoW process under review by workstream 1: T-D Process group.
5. DG connection offers contain milestones to enable DNO unlock unused capacity.
6. The connection agreement sets the operational 'envelope' for DG and storage to provide flexibility services
7. Customers want more information on constraints/curtailment and outages post connection.
8. Customers want DNOs to publish information on indemnities and liabilities when transmission work required.

Customer Information Requirements

We have developed and published customer information requirements with input from the Advisory Group and presented information for review to stakeholders through their trade associations at the Advisory Group. We are looking to extend the involvement of customers more widely in 2018.

Making Change for Customers

Distribution Network Operators are making improvements to their processes through their Incentivised Customer Engagement (ICE) plans and sharing of good practice in the Open Networks Project is facilitating these improvements.

The outputs from the customer-focused work above is an input to the development work and improvements elsewhere in the programme.

2018 Customer Experience Developments

In 2018, we are planning to continue to share good practice across all customer touch-points and develop further improvements in collaboration with the Advisory Group, customers and other stakeholders.

These will include recommending improvements for how connection capacity that is contracted but not being used is handled and publishing good practice for:

- How network operators support customers pre-application.
- How information should be provided to customers on DNO requirements for flexibility services.
- Managing issues impacting customers in the post-application phase including interactivity and queue management.
- Providing information on constraints and curtailment to customers.

2018

In 2018, we are planning to continue to share good practice across all customer touch-points

Opening Network Requirements to the Market

We set out at the beginning of the year to define:

1. **What we mean by a Distribution System Operator.**
2. **The functional requirements for DSO.**
3. **A roadmap for transition to DSO.**
4. **Potential commercial models for contracting flexibility.**
5. **End-to-end functional DSO models to facilitate evaluation of different market models.**

Our approach is to develop the functions and requirements for what a Distribution System Operator needs to do before we consider who performs those functions and where roles and responsibilities might lie. This allows us to be agnostic to what the final model might look like whilst ensuring that the future market models deliver the identified benefits to customers.

1

Distribution System Operator 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.

The **neutral market facilitator** role is **essential** to ensuring that all potential providers of flexibility services can **compete directly with more traditional network solutions, including as an alternative to reinforcement**.

DSO

A DSO enables customers to be both producers and consumers, enabling customer access to networks and markets, customer choice and great customer service.

2

DSO Functions

Eight DSO functions have been identified and described to cover a wide range of potential DSO activities going forward.

System Coordination	Operate local and regional areas and coordinate energy and power transfers with other networks and systems to enable whole system planning, operation and optimisation across different timescales. System Coordination could include local actions to support thermal, voltage and frequency management across networks including actions to minimise losses, manage constraints and provide capability.
Network Operation	Operate the electricity distribution network to maintain a safe and secure system. Ensure that network powerflows remain within limits and that the network operates within acceptable voltage limits. Ensure that the network remains secure against credible events such as circuit trips and generation loss. Identify and manage current and future risks. Coordinate and collaborate with National Electricity Transmission System Operator (NETSO) to manage potential conflicts to support whole system optimisation. Respond to customer needs.
Investment Planning	Identify capacity requirements on the distribution network and secure the most efficient means of capacity provision to customers. Coordinate with the NETSO and Transmission Owners to identify whole system options. These would include commercial DER options as well as distribution network investment.
Connections & Connection Rights	Provide fair and cost-effective distribution network access that includes a range of connection options that meet customer requirements and system needs efficiently.
System Defence and Restoration	Enhance whole system security through the provision of local and regional flexible services. Provide system resilience to very low probability but high consequence events using risk-based approaches. Provide the means to re-establish the wider synchronous area in the event of widespread disruption.
Service/Market Facilitation	Interface with the NETSO and other network operators to enable the development of distribution capacity products, the creation and operation of local network service markets and to enable DER access/participation in wider services for whole system optimisation. Facilitate local and national markets to access and settle services through auctions and other market arrangements for whole system efficiency. Ensure these arrangements are fair and transparent. Provide information and control system infrastructure to facilitate local and national markets and service provision.
Service Provision	Access services on behalf of others, or provide services to others, where doing so is necessary to maximise whole system efficiency, and protects competition. Use own services to manage other risks on the network and contribute to resilience.
Charging	Sets Distribution Use of System prices for local network. Determines Point of Connection. Determines connections charges and informs of Transmission reinforcement charges (if applicable). Consideration to Exit Charging (dependent on size, variations and apportionment).

Each DSO function includes a discrete set of activities that a future DSO may be required to carry out depending on how the electricity supply industry and markets develop over the next 5–10 years. It is likely that each function would be developed over different timescales. It is possible that specific functions (e.g. Service Provision) may not be developed at all. Each function has an associated set of activities to further define its scope.

These functions will not be static; we are learning all the time through development. We are evolving our requirements as we go.

3

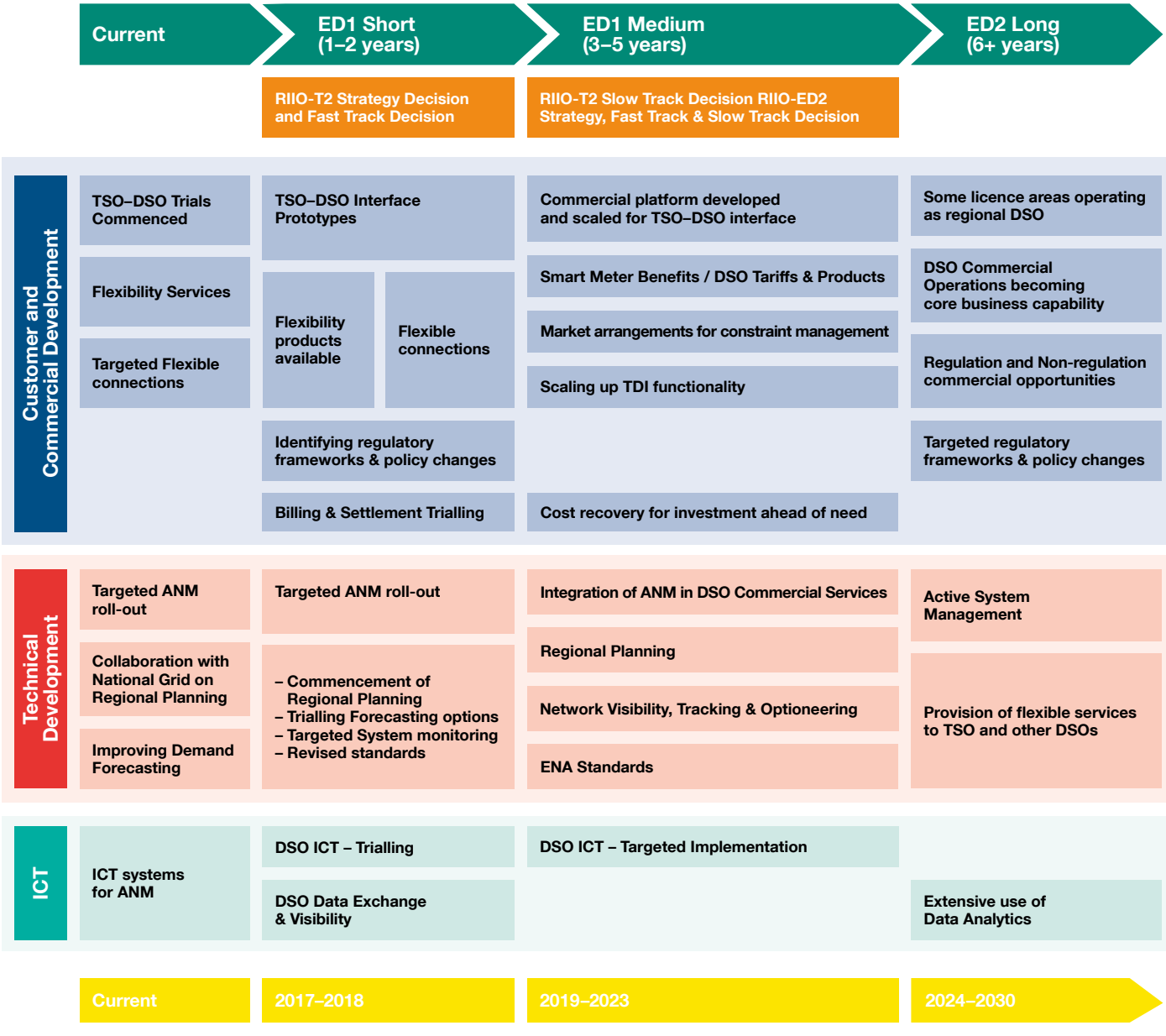
DSO Transition Roadmap

Whilst improvements are being made now, the evolution from traditional network operation to DSO is an ongoing initiative that requires major transformation and organisational change for all network companies and system operators.

We have analysed what this means in terms of the functions and capabilities needed and what activities and functions are expected to be needed to deliver the vision.

This roadmap will evolve over time, particularly as the market models are clarified, and we will update this roadmap to give customers the most up-to-date view so they can plan investments and market services accordingly.

Figure 4:
DSO Roadmap to 2030 (Tier 1)



We expect that the options for DSO developed in Open Networks will be an input into submissions to Ofgem to consider in their decision-making for ED2. This will evolve over time and be subject to discussion with Ofgem, BEIS and other stakeholders during development.

Transposing EU Code legislation into GB Codes will put in place much of the technical infrastructure to allow flexibility to flourish in the GB markets.

Different network operators will implement change in their own organisations to align with their specific challenges, but there are likely to be central or common facilitators in place across the market at different times. If we are working towards the roadmap, then this will ensure that network operators are moving at an appropriate pace for customers and opportunities are being made available to flexibility service providers.

There are activities happening now to allow customers to contract for flexibility services at DNOs.

CMZs are geographic regions served by existing networks where security of supply is met through the use of flexibility services, such as Demand Side Response, Energy Storage and stand-by generation.

Case study

SSEN Constraint Managed Zones

Scottish and Southern Electricity Networks (SSEN) is establishing agreements with suppliers for the provision of Constraint Managed Zone (CMZ) services.

CMZs are geographic regions served by existing networks where security of supply is met through the use of flexibility services, such as Demand Side Response, Energy Storage and stand-by generation. SSEN is considering CMZs in electrical network areas that are approaching network capacity.

After completing a number of successful innovation projects, SSEN is now introducing CMZs into its everyday network operations, taking the learning it, and other industry players, have gathered for a number of years. The network in Yeovil was identified as the first suitable zone for deployment of the CMZ services. The introduction of the CMZ in Yeovil is fully commercial in nature and not a demonstration or innovation project. SSEN believe that the CMZ approach could be more cost-effective and better in the long term than tradition network reinforcement. CMZ is allowing customer flexibility to gain value.

SSEN don't have a technique or technology preference in how the service is provided and won't restrict CMZ suppliers from participating in other markets. It is looking to establish a multi-year Preferred Supplier Agreement with a minimum term of four years. This will be subject to renewals of two years, up to a maximum duration of eight years. SSEN intend to continue to implement new CMZs until the equivalent flexibility markets are delivered by Open Networks.

WPD have been identifying existing generation, whether currently connected to the network or not, and engaging with their owners to explain the benefits of joining the DSR scheme.

Case study

Western Power Distribution Project ENTIRE

Project ENTIRE involves developing innovative new systems and contracts with commercial customers and aggregators to allow WPD to fulfil its requirements whilst also enabling customers to use flexibility for other Demand Side Response (DSR) schemes when they are not needed by the local grid. These further services could include balancing services procured by National Grid.

WPD and aggregators are identifying existing generation, whether currently connected to the network or not, and engaging with their owners to explain the benefits of joining DSR schemes.

As part of Project ENTIRE, WPD launched its Flexible Power[5] product looking to contract with approximately 100MW of demand turn down (or generation turn up) in the southern parts of its East Midlands area.

The requirements for Flexible Power are technology agnostic and so is open to any flexibility provider. The service will be used to manage constrained networks and will mix business cases of deferred reinforcement alongside enabling connections ahead of upgrades. As such, the timescales of the requirements range from several years to potentially enduring solutions. When not required by WPD, providers will be able to participate in alternative services to generate additional revenues. This can be done through a third party aggregator.

35.4MW

Building on this learning UK Power Networks issued the first public tender for flexibility services for up to 35.4MW of DSR services across ten locations.

Case study

UK Power Networks Flexibility Tenders

Using customer flexibility as an alternative to network upgrades – Flexibility Tenders

Distribution Network Operators (DNOs) traditionally have invested in upgrading their network assets to accommodate the peaks of demand to meet customer needs. The capability to reduce the peaks allows DNOs to delay the investment until it becomes clear that reinforcement is required, therefore driving cost-efficiencies in network investment.

Building on this learning UK Power Networks issued the first public tender for flexibility services for up to 35.4MW of DSR services across ten locations and the intention is to continue to contract for flexibility services until equivalent flexibility markets are delivered by Open Networks.

Open Networks is actively working on aligning TSO and DSO service requirements to improve the customer experience and enable further DSO level flexibility markets. Customer flexibility will be central to facilitating a smarter, flexible energy system.

[5]www.flexiblepower.co.uk

4

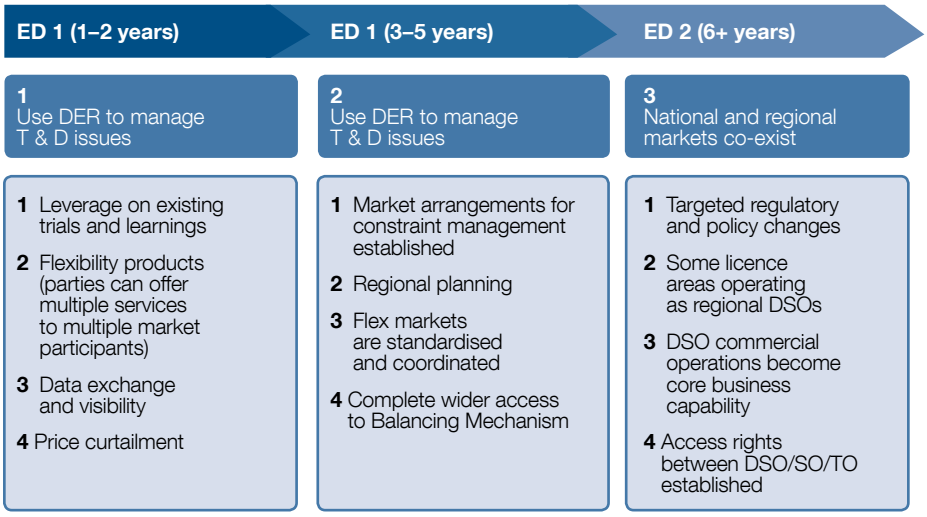
Commercial Principles and Market Options

In the autumn of 2017, we consulted on a range of issues associated with broadening the participation of distributed energy resources in the provision of services to network operators in the following paper 'Commercial Principles for Contracted Flexibility: Promoting Access to Markets for Distributed Energy Resources'. The 'Commercial Principles' consultation sought to inform both the development of these services to ensure Distributed Energy Resources (DER) can participate in their provision; allowing them to optimise participation across markets and supporting efficient procurement by multiple entities; and the evolution of relationships between the entities that are necessary to support that DER service provision.

Roadmap to optimising the use of DER

Figure 5 provides a potential roadmap to optimising the use of DER, including the activities which need to be undertaken. This is closely aligned and builds on the ENA DSO roadmap. There are a number of trials underway (Regional Development Programmes, Power Potential Project, Demand Turn Up, Project Entire) which are designing and trialling a set of new commercial models in the short-term. This will allow customers to realise the most value for their connected technology and energy resources.

Figure 5: Roadmap to optimising the use of DER[6]



[6]ED1 and ED2 refer to the regulatory period within which the DSOs are incentivised. The ED1 period lasts eight years from 2015 to 2023.

£400m

If the approach being trialled is introduced nationwide, it could save consumers more than £400m by 2050.

Case study

Developing and Testing DSO Models

Power Potential

In the Power Potential Project National Grid is working with UK Power Networks to improve Transmission and Distribution coordination to realise additional generation capacity in the highly utilised South East network.

The project will help make best use of existing and new Distributed Energy Resources (DER) on the network. It will support the growth of low carbon technologies, such as wind and solar power, and help manage the operational challenges that the intermittent generation of renewable energy presents.

By creating a real and reactive power market in the South East, the project aims to deliver over 3.7GW of additional generation capacity in the area by 2050 and reduce the need to build additional electricity infrastructure. If the approach being trialled is introduced nationwide, it could save consumers more than £400m by 2050.

The project will create new opportunities for customers and, through establishing a market that will help manage the whole electricity system, deliver the most cost-effective solution to the consumer.

The project is developing and testing in a real environment one of the key TSO–DSO interaction models developed under Open Networks: the 'joint DER procurement and dispatch' model.

Market Options

The 'Commercial Principles' consultation proposed a series of evolutionary market options that could enable this broader participation, and presented ENA's initial views on how they stacked up against a range of assessment criteria. We received thirty responses to the consultation, providing valuable insight into broader industry views on the characteristics of the models and on associated issues. The views expressed will inform ongoing work on services and DSO capabilities, as well as guiding the focus of our work plan for 2018. The roles and responsibilities of all industry parties (the NETSO, DNOs, TOs, Suppliers, Aggregators, Generators) are changing as Great Britain moves to a smarter energy future. All network operators are committed to enabling access to markets for both existing and new parties, technologies and business models. The smarter electricity system also brings opportunities to develop new markets.

The analysis and conclusions from this work is feeding into the modelling work being undertaken on DSO Market Models on pages 25–8.

5

Potential Market Models for DSO Services

We undertook a wide-ranging review of potential market models for ways in which third parties could provide flexibility services to the DSO, for the purposes of constraint management. This included a review of the models set out in our commercial principles paper above, models from Ofgem, industry, academia and other countries. We then selected a robust set of three potential market model options for DSO that can support the required functions of the DSO while delivering neutral market facilitation.

At this point, we are not recommending market models – we are going to develop these models so that they are well understood, adapt those models to reflect improved learning and then consider the costs and benefits of each of those models to inform an evaluation. We have chosen market models to test a range of different interfaces and processes. We will also define trialling to test that any potential models and allocation of roles and responsibilities will work in practice. All of this evidence will feed into future Ofgem and Government considerations on future market structures. It might be that future models assessed with Government and Ofgem will be hybrids of what is being modelled in this initial phase. There are some principles that we have Ofgem's guidance on policy that we will reflect in our models, for example that a DSO will not act as a commercial aggregator, it is a market enabler.

There is a link to the customer-focused development described earlier in this report, as the customer categories described there are being used in the modelling work to test that the models work for different types of customer. This ensures that we keep the customer in the forefront of our development work. At this stage, we are developing these models and providing the opportunity for stakeholders to input so that we have the best view on how these models may work and how they might support customers and flexibility providers.

Smart Grid Architecture Model (SGAM)

Within the Open Networks Project, we have chosen to use Smart Grid Architecture Model (SGAM) to capture the definition of our different market models for DSO.

SGAM was developed as an architectural framework designed for developing and enhancing standards for the smart grid by the European Smart Grid Coordination Group[7]. We can comprehensively describe the market models by capturing the interactions between different 'actors' from a high-level 'Business Layer' perspective down to the detail of what information is passed using what communications methods between equipment. This will enable us to test and trial how different models might work.

Current Market Models Under Analysis

The market models we are currently modelling are set out below in a latest summary form and these will change over time as we understand them better.

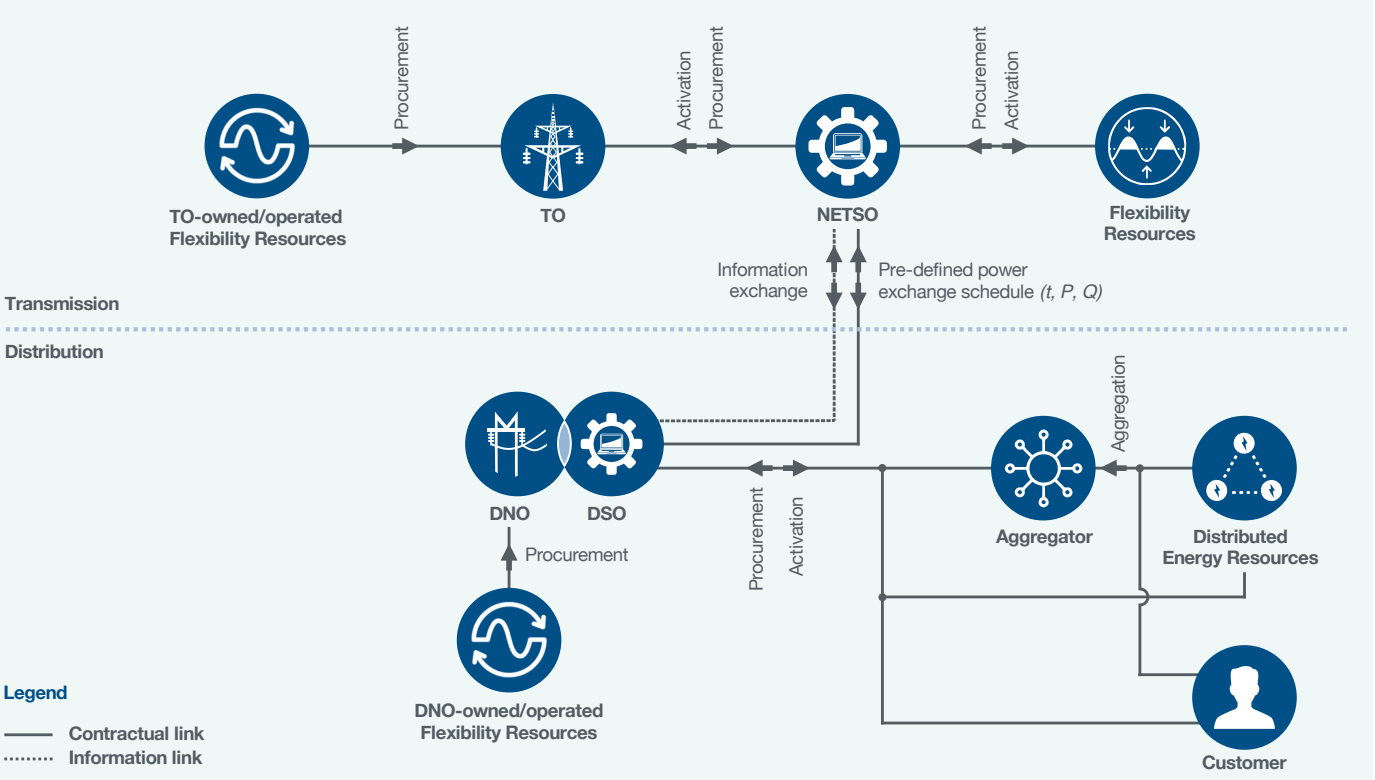
DSO Models

We are developing DSO Models to trial and inform roles and responsibilities for Government and Ofgem policy

[7]https://www.cencenelec.eu/standards/Sectors/SustainableEnergy/SmartGrids/Pages/default.aspx

In this model, DERs and aggregators of DER services interact directly with local DSOs to provide services for distribution and transmission constraint management and for electricity system balancing. DSOs schedule the required DER services to deliver NETSO and DSO requirements.

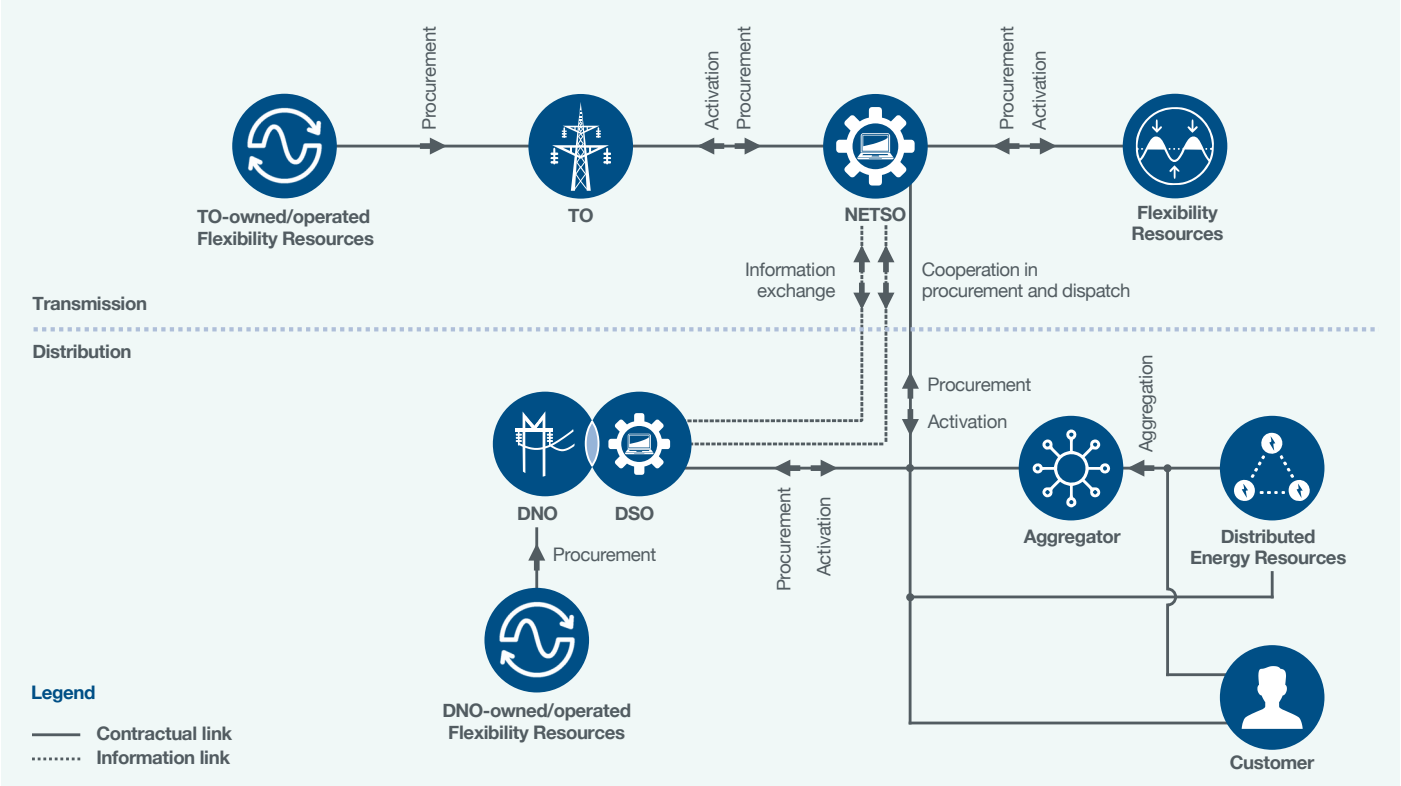
Figure 6:
Market Model A – DSO Coordinates



Key characteristics	
NETSO	– The NETSO procures and activates flexibility resources connected to the T-network for electricity system balancing and transmission network constraint management – The NETSO indirectly procures and activates flexibility resources connected to the D-network for electricity system balancing and transmission network constraint management via the DSO – The NETSO has a commercial relationship with the DSO for the procurement of distribution connected flexibility resources on its behalf
DSO	– The DSO develops and operates the D-network following an Active Distribution System Management approach – The DSO directly procures flexibility resources connected to the D-network for T- and D-networks, constraint management and for electricity system balancing – The DSO has a commercial relationship with the NETSO for the procurement of distribution connected flexibility resources on its behalf – The DSO has electricity system balancing responsibilities based on a pre-defined power exchange schedule agreed with the NETSO
DER	– DER provide flexibility services directly to the DSO or indirectly via an Aggregator of choice
Aggregator	– The Aggregator combines different flexibility resources connected at the D-network and offer their aggregated output as a flexibility service to the DSO
Customer	– Customers provide behind-the-meter flexibility resources that can be directly offered to the DSO or indirectly via an Aggregator of choice

In this model, DERs and aggregators of DER services interact either with the NETSO or with DSOs to provide services for distribution and transmission network constraint management and for electricity system balancing. The NETSO and DSO coordinate the secure scheduling of services.

Figure 7:
Market Model B – Joint Procurement and/or Dispatch



Key characteristics	
NETSO	– The NETSO procures and activates flexibility resources connected to the T-network for electricity system balancing and transmission network constraint management – The NETSO directly procures flexibility resources connected to the D-network in coordination with the DSO or indirectly via the DSO
DSO	– The DSO develops and operates the D-network following an Active Distribution System Management approach – The DSO directly procures distribution connected flexibility resources for D- and T-networks, constraint management and for electricity system balancing in coordination and collaboration with the NETSO – The DSO undertakes a coordinated procurement and activation processes of distribution connected flexibility resources with the NETSO to ensure the activation of flexibility resources meets concurrent T- and D-networks' requirements – The DSO offers flexibility services to the NETSO from its portfolio of DER and smart network solutions
DER	– DER provide flexibility services directly to the NETSO and the DSO and/or indirectly via an Aggregator of choice
Aggregator	– The Aggregator combines different flexibility resources connected at the D-network and offer their aggregated output as a flexibility service to the NETSO and the DSO
Customer	– Customers provide behind-the-meter flexibility resources that can be directly offered to the NETSO and the DSO or indirectly via an Aggregator of choice

Ofgem has published a working paper[8] related to access and forward-looking charging, which has a focus on signals for usage of the network and therefore is particularly relevant for the modelling development.

Market Model C – Price Driven Flexibility

Ofgem has published a working paper[8] related to access and forward-looking charging, which has a focus on signals for usage of the network and therefore is particularly relevant for the modelling development. The Open Networks Project is assessing this working paper with Ofgem and stakeholders to define a model driven by pricing and charging signals. This will be published and shared as soon as it is better defined.

Further Market Models

A number of respondents to the commercial principles consultation highlighted benefits associated with a 'NETSO Coordinates' market model and we will be investigating that as an option in 2018. We will also investigate an option which has market facilitation functions operated by an independent third party.

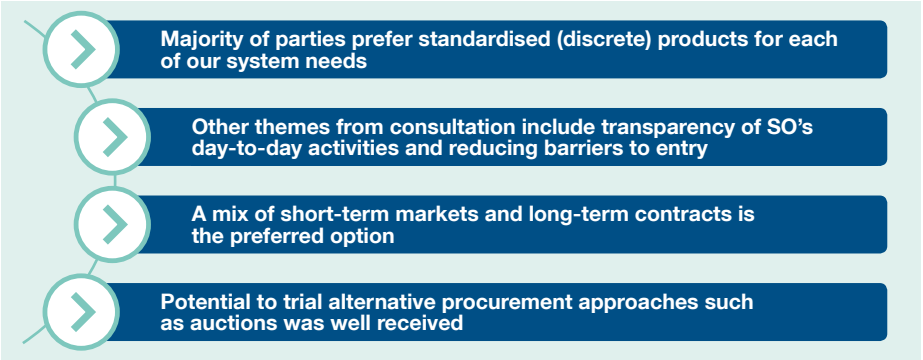
Future Products and Services

As part of the definition of DSO above, we have highlighted Service Provision as a core functional requirement. We expect that the DSO will go to market to procure services to help plan and operate networks securely and potential services will be developed during the Open Networks Project.

National Grid as the NETSO has published their own consultation for System Needs and Product Strategy (SNAPS)[9] to refine their current services to better meet their transmission system operator requirements and the Open Networks Project has provided input into this work.

We expect that the key learnings from SNAPS will feed into the Open Networks development work to define and facilitate key DSO services, for example one of key outcomes of the SNAPS consultation was to simplify services and we should consider that any future DSO models being trialled should reflect the principle of simplicity for customers and industry.

Figure 8: Summary of Key Insights in SNAPS Consultation



Developing Markets in 2018

In 2018, we are planning to:

- Continue to facilitate markets for flexibility services for DSO to consider alongside traditional investment in deciding the most cost-effective planning solutions for customers.
- Develop options for models for 'NETSO Coordinates' and the use of an independent third party for market facilitation.
- Complete ongoing SGAM modelling to establish recommended DSO model(s) to take into trials.
- Complete further work to validate the SGAM models (including considering the consultation responses from the commercial principles paper) and extend these to cover whole system investment planning.
- Provide a clear and detailed cost–benefit analysis to determine the wider consumer value of the DSO transition and to have this delivered or verified by an independent party.
- Identify and deliver key enablers to ensure progress.
- Establish a DSO implementation plan.

Liaison with Ofgem, BEIS and open engagement with stakeholders will continue to be essential in the development of future models and any regulatory changes that might be required.

[8]https://www.ofgem.gov.uk/publications-and-updates/reform-electricity-network-access-and-forward-looking-charges-working-paper
[9]http://www2.nationalgrid.com/UK/Services/Balancing-services/Future-of-balancing-services/

Transforming Transmission and Distribution Processes

The process that we have followed is: Analysis of current processes; Understanding gaps and issues; Deliver short-term improvements; and Develop and implement medium- and longer-term improvements.

We set out to deliver a wide set of improvements and development work in Transmission and Distribution processes and interfaces to improve customer experience and to reflect whole system thinking. We have agreed with Ofgem and BEIS to prioritise Investment Planning over Operational Planning. We have taken a structured approach to the analysis of issues so that we identify short-medium- and longer-term improvements.

The process that we have followed is:

- Analysis of the current processes and lessons learnt from existing trials: completed and published.
- Understanding of the gaps and issues and therefore a programme of work to deliver improvements: completed and published for Investment Planning and we anticipate the Operational Planning section being published by the end of the year.
- Deliver short-term improvements, including completed improvements to the Statement of Works process, joint working in Regional Development Programmes and innovation trials.
- Develop and deliver short-, medium- and longer-term improvements, in whole system Investment and Operational Planning processes. These are currently under development, with proposals for an improved Investment Planning process due this year.

The completed analysis has taken significant time and effort within the project and a structured approach has been essential. This approach ensures that we don't miss key issues for customers and to ensure that the right actions are prioritised and allocated to the right parties for implementation.

To understand how the processes work for customers, we have used the categorisation of customers highlighted in the Customer Focus section later in this document and will embody Customer Information Requirements into defined data and interfaces.

Current Improvement Programmes

There have been a number of short-term improvements underway with Network Operators delivering benefits for customers and we highlight a few case studies in this section.

Making Statement of Works Faster & Easier

Generators wishing to connect to the distribution system may have an impact on the transmission system. DNOs are required (under the Connection and Use of System Code) to make a request for a Statement of Works (SoW) to the Transmission Operators in relation to the potential impact of generation connections on the transmission system.

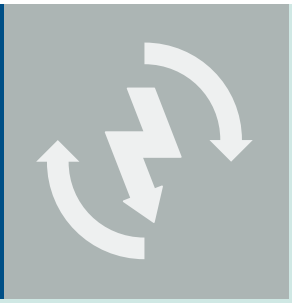
The existing process generally worked well for low volumes of Distributed Generation. However, in recent years there has been a significant rise in Distributed Generation, led in large part by the drive for renewable energy. This has resulted in relatively small volumes of Distributed Generation having a cumulative impact on the transmission system. This has stretched the current process, resulting in Distributed Generation projects having a significant period of uncertainty on the conditions of connection. This has adversely affected customers wishing to make timely connections to the distribution network.

There have been trials in England & Wales and Scotland looking at different options to make the SoW process faster and easier for customers.

A new process has now been agreed and is planned for roll-out across Great Britain. A Modification to the Connection and Use of System Code (CUSC) to support this new process is planned to be raised in January.

Case study

Statement of Works Trials



Trials in England & Wales: Appendix G process

Due to the significant impact of Distributed Generation in the South of England and Wales, National Grid worked initially with WPD, UKPN and SSEN to evaluate the impacts of Distributed Generation on their respective networks. Revised Bilateral Connection Agreements were issued for a number of Grid Supply Points (GSPs) which included a new schedule 'Appendix G'. This schedule included all contracted and connected Distributed Generation and was provided with a 'Materiality Limit'. This effectively constituted an 'Aggregated Developer Capacity' that could be used by the DNO to manage new connections and re-utilise capacity where schemes dropped away. An approved process for managing updates to the Appendix G was put in place, with no requirement for re-assessment by National Grid unless the 'Aggregated Developer Capacity' or other 'Technical Conditions' were to be breached. The advantages of this process were that in areas where there were lower levels of Distributed Generation activity or significant 'turnover' of capacity, the timescales to give customers certainty around their connection conditions were greatly reduced.

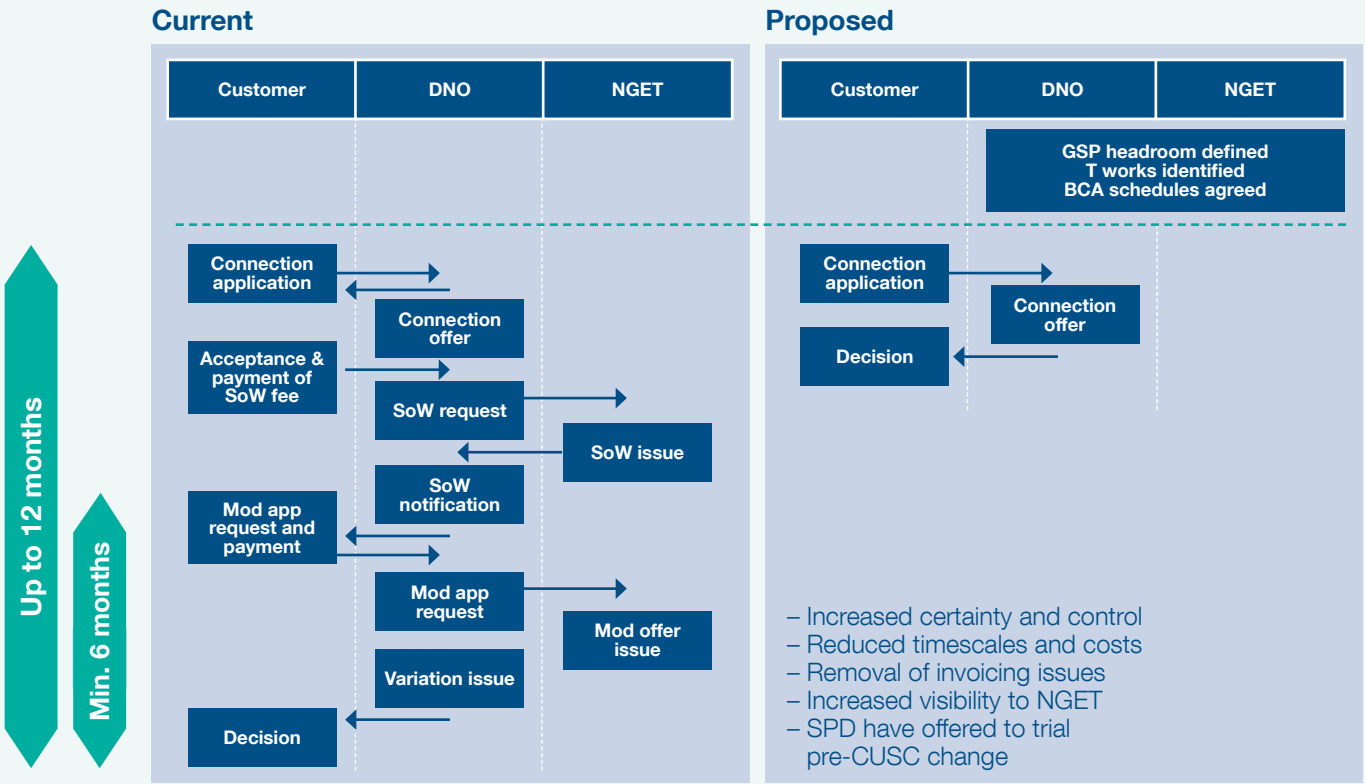
Trials in Scotland: Planning Limits

Due to the increased understanding of transmission constraints, Scottish Power Distribution (SPD) were able to trial 'Planning Limits' at four of their GSPs. Having visibility and understanding of planning limits and known transmission constraints has enabled SPD to provide a comprehensive offer detailing the transmission and distribution impacts, minimising the need for referral to the NETSO. Under the Scottish trial SPD were able to offer detail of any known transmission system works, associated charges/securities and timescales for completion of transmission system works, all within standard DNO offer timescales. This has meant that discussions around the transmission implications could be had considerably earlier in the process, providing customers with the ability to make decisions on investment far sooner. This has also led to reduced capacity reservation from accepted offers awaiting clarification of the transmission impact via the existing SoW Modification Application process.

Trials in England & Wales: Planning Limits

Initially, a GSP in UK Power Networks SPN region was identified as a suitable candidate and work was undertaken to establish a methodology to facilitate the provision of 'Planning Limits'. This work was then advanced further by the Regional Development Programme in the South East. Following improved data exchanges and the use of enhanced modelling, UK Power Networks now has sufficient visibility of the transmission system to be able to provide customers with all the necessary information within the DNO connection offer. This allows customers to make a decision on their investment in a timely fashion, following receipt of this offer. New processes and information exchanges have also been developed to ensure future customers can continue to receive the same level of service.

Figure 9:
Streamlining the Statement of Works Process



Following these trials, and through continue collaboration between the Open Networks members we have now published an improved process, the Transmission Impact Assessment (TIA) process which is shown above in comparison to the previous SoW process.

The objectives of this improved process are:

– To provide customers with an improved, more efficient, timely and cost-reflective process; and consistent across DNOs.
– To enable DNOs to provide customers with visibility of the known transmission impact within distribution offers made to their customers within licence/GS timescales. Where applicable, this will include detail of any operational restrictions and requirements, transmission works required, costs, security and liability and impact on timescales to connect.
– To provide customers with an offer which can be assessed fully in order to make the necessary investment decision.
– For DNOs to have greater visibility of the available capacity on the transmission network. i.e. through the provision of Planning Limits.
– Better Queue Management.

ENA has published:

– A Data Template setting out the information required by the NETSO/TOs from each DNO in order to undertake the necessary system studies which will determine planning limits at GSPs. A subset of this data will also form the basis of the data exchange between the DNOs, NETSO and TOs when managing DG contracted to connect under the new proposed process, the impact on the transmission system and the agreed planning limits.
– Customer journey maps to provide customers with certainty on what they can expect from the process.

Network Operators have now started to use this new process and the roll-out plan for the whole of GB on a Grid Supply Point (GSP) by GSP basis has been published by ENA.

QMEC (Quicker More Efficient Connections)
The ENA DNO-DG Steering Group launched a consultation on 'Fair and Effective Management of DNO Connection Queues: Treatment of Changes to Connection Applications', which was part of Ofgem's wider piece of work on Quicker More Efficient Connections (QMEC).

Regional Development Programmes (RDPs)
Over the last 12 months National Grid have been working with DNOs to establish whole system approaches to operability challenges in areas of the GB network. RDPs were established with both WPD (referenced in the Whole System Investment Planning section below) and UK Power Networks, with a number of initiatives being identified to resolve specific issues on the system.

3.6GW

The South East Coast electricity system is one of the most complex areas of network in Europe. Just in this area alone, there is over 1.8GW embedded generation and 3.6 GW of transmission connected generation.

Case study

Collaboration with the System Operator

To realise Additional Generation Capacity in the South East Coast network

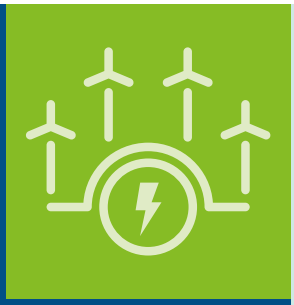
The South East Coast electricity system is one of the most complex areas of network in Europe, with several interconnections to continental Europe, a nuclear power station and a significant volume of renewable energy resources. Just in this area alone, there is over 1.8GW embedded generation and 3.6 GW of transmission connected generation (2GW of HVDC interconnector contracted and coming online in next 3–4 years). To continue to give access to new generation and storage wanting to come onto the system, required both National Grid and UK Power Networks to consider a whole system approach to manage and optimise network capacity.

Close collaboration between UK Power Networks and National Grid has co-developed improved network models and improved the level of granularity in data exchanges. This has delivered a better understanding of the technical limitations of this area of the network on a whole system basis, and has already revealed the potential for further DER connections within the South Coast region, subject to the visibility and controllability of those DER.

Over the coming months the programme will develop the use of Active Network Management technology and the commercial framework required to help manage the identified transmission constraints. It will also look to continue to develop different approaches to managing whole system challenges.

Case study

SP Energy Networks Active Network Management



SP Energy Networks (SPEN) is establishing wide scale Active Network Management (ANM) and flexible customer arrangements across the Dumfries and Galloway network area to manage Distributed Energy Resources (DER) impacted by transmission constraints.

SPEN has secured funding through the 2017 'Innovation Roll-out Mechanism' scheme to implement a wide-scale integrated ANM scheme across the distribution and transmission networks in Dumfries and Galloway. This project will establish new real-time customer relationships, simultaneously monitoring and matching network capacity with local generation output for DER of all sizes.

The electricity network in Dumfries and Galloway has amongst the highest proportion of renewable generation connected in the UK relative to local electricity demand. Transmission constraints have restricted existing capability as well as delayed new connections. This project will address this across 11 GSPs, reducing existing constraints, facilitating new connections in advance of required transmission upgrade works and contributing to carbon reduction targets.

This project will provide an ideal opportunity to develop whole system technical, operational and commercial solutions between the GB System Operator, Transmission Owners and Distribution Network Owners, consistent with the key objectives of the Open Networks Project.

Central Controller with no cap on MW capability

Scalable ANM solution across entire SPD network

Complex ANM managing generation across T and D boundary

Provides interface with SO management system

Case study

Customer Load Active System Services (CLASS)

The project was run by Electricity North West and National Grid to investigate and better understand the effects on electricity demand through changing network voltage.

The project demonstrated that through the deployment of voltage control equipment at DNO substations, grid transformers could be used to modify network voltage and demand and so provide frequency and voltage management services to National Grid.

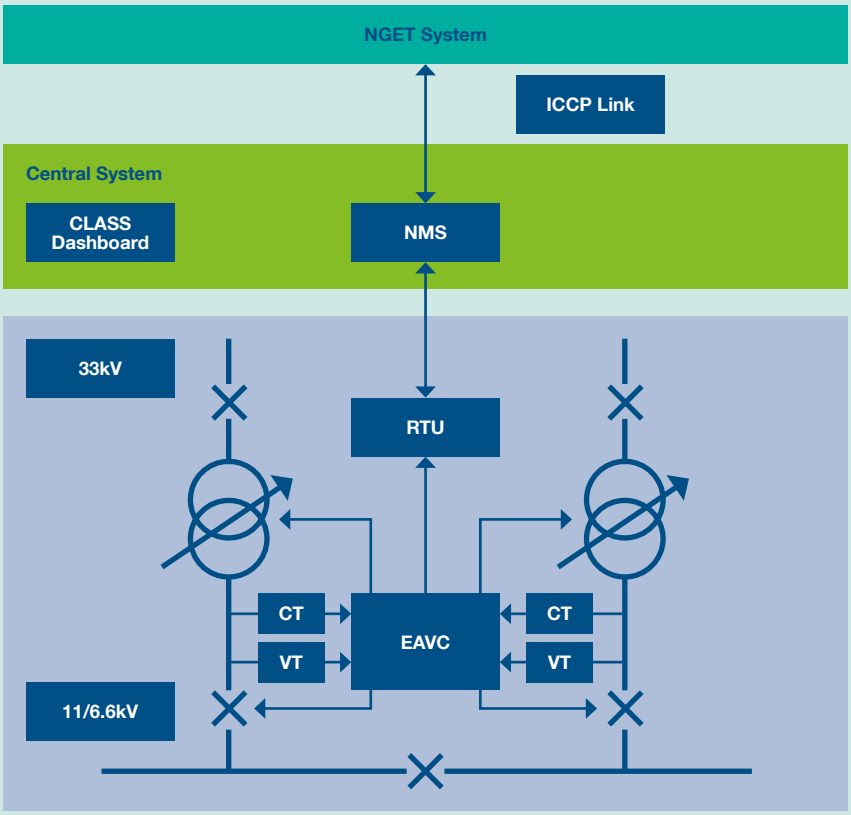
Importantly CLASS demonstrated that these services could be provided without compromising the customers' quality of supply.

The project identified that, if the voltage control techniques were applied widely, around 3GW of demand reduction or demand increase could be achieved to provide frequency services. Around 2GVAr of reactive demand could also be achieved to help manage transmission voltage. In addition to these wider system services, additional benefits might also include reinforcement deferrals and a considerable reduction in carbon emissions.

3.0GW

If voltage control techniques were applied widely, around 3GW of demand reduction or demand increase could be achieved to provide frequency services.

Figure 10:
CLASS Systems Overview



We have also begun to look at what models might need to be developed to support whole system thinking on investment planning processes.

Whole System Investment Planning

The industry has developed the existing P2 engineering standard to allow for the use of flexible resources in network investment planning. The code and licence changes for this critical development are complete and will be sent to Ofgem in January following final consultation.

We have also begun to look at what models might need to be developed to support whole system thinking on investment planning processes. We have looked at National Grid's existing Network Options Assessment (NOA) process and how this could be evolved to reflect a whole system approach. This considers a more regional approach, with increased DNO/DSO involvement and assessment of DNO/DSO and market-based solutions alongside transmission solutions when looking to resolve an identified issue or constraint on the transmission system. We have developed five potential new models that have increasing involvement of regional programmes, but at this stage, we are focusing on an 'Extended NOA' model to prioritise a process with a more regional based assessment.

Figure 11 shows how we might add regional issue and priority analysis into the existing Analysis stage of the NOA process and how we might apply Regional Governance over the latter stages. There is also a new flow of information and visibility of issues from NETSO to DSO within this proposed high level process.

Input Scenario based Demand and Generation forecasting. Emerging and operational issues.

Analysis of network requirements against forecasting scenarios and ad hoc emerging issues. The analysis of the transmission system will look to identify regional issues that can be addressed through distribution or transmission level interventions. The Distribution Network analysis will prepare for providing solutions to the identified transmission issues.

Options Optioneering exercise to provide a set of options for submission into the whole system cost–benefit analysis. This stage includes the analysis to develop the proposed solutions.

Assessment Cost–benefit analysis of options to produce a set of recommendations.

Output Decision/recommendation on best solutions.

Regional Issues and Priorities this outlines the process by which triggers or issues are communicated and discussed ahead of more detailed analysis. This process will derive where additional information and models are required to be able to fully understand the issue and begin to derive mitigation options.

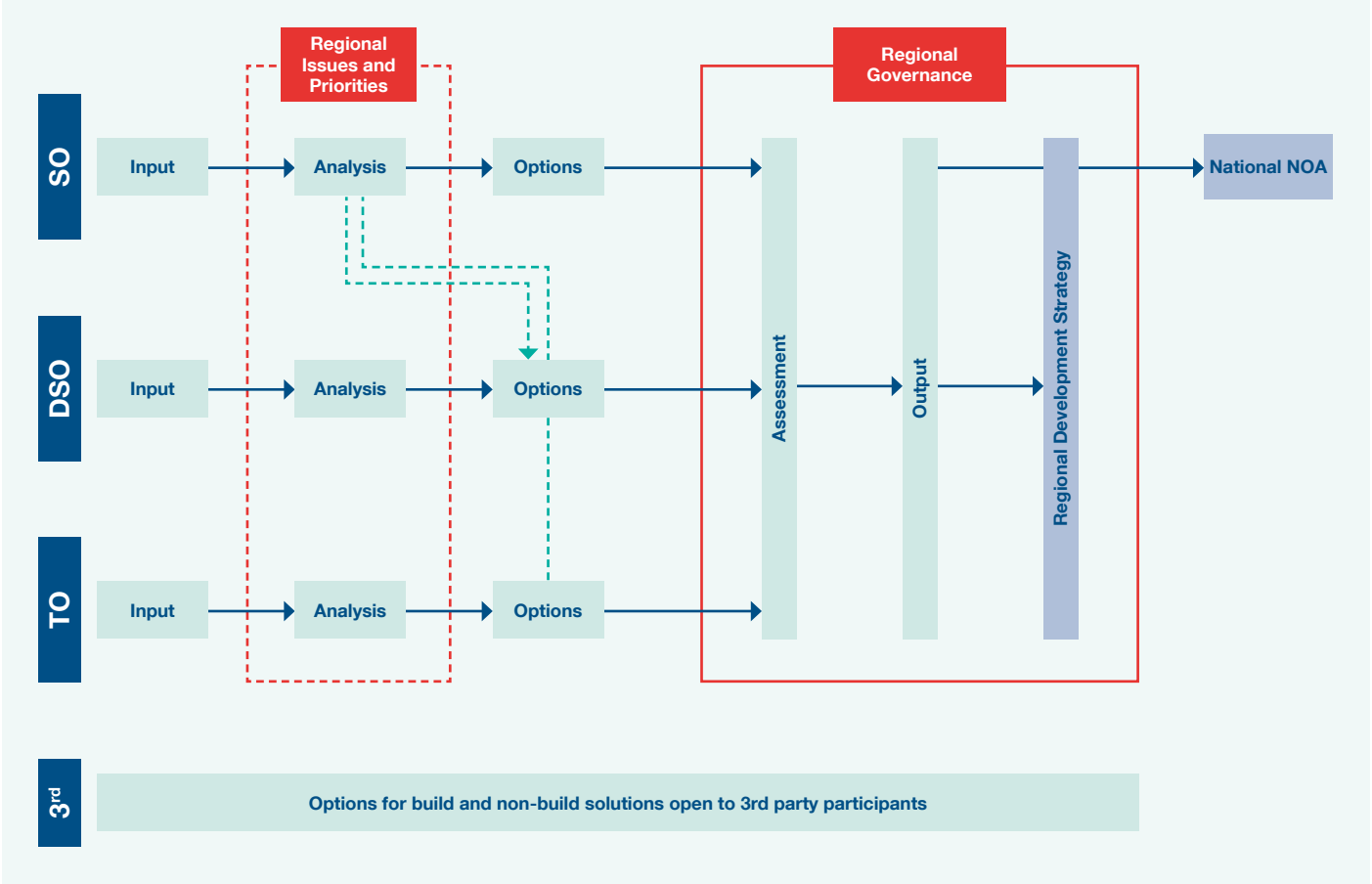
Regional Governance this is an area which will evolve over time. It is anticipated that in the first instance this will be more of an informal process (i.e. akin to RDP methodology), which will evolve into more of a formal framework and structure.

Regional Development Strategy this builds on the work that has been carried out under the two trial areas in UK Power Networks SPN region and WPD's South West region. The aim of this is to ensure that there is a facilitator for ensuring regional considerations can be met inside or outside of the national NOA process. RDS (Regional Development Strategy) will include the outcome for each option considered.

There is more work to be done within the project to develop this model into a practical process to execute. This will be an important step in developing the necessary learning and processes required to evolve to a more comprehensive whole system planning model. The Power Potential programme highlighted earlier in this report is also an important source of learning.

Whole System Investment Planning will open opportunities for customers to realise value for flexibility services and provide opportunities for network operators to reduce the cost of investment, reducing the end cost to consumers.

Figure 11:
Potential Extended NOA Process



Key

Input Scenario-based Demand and Generation forecasting. Emerging and operational issues.

Analysis Analysis of network requirements against forecasting scenarios and ad hoc emerging issues

Options Optioneering exercise to provide a set of options for submissions into [cost–benefit analysis]

Assessment Cost–benefit analysis of options to produce set of recommendations

Output Decision/recommendation on best solutions

SO National Electricity Transmission System Operator (NETSO)

DSO Distribution Network Owner or Distribution System Operator

TO Transmission Network Owner

3rd Third Parties (e.g. CATO, OFTO). This box does not include parties who are providing solutions as a response to services procured by T and/or D (e.g. ANM, STOR etc.)

Visibility of issues

Coordination

T-D Working Group or Independent Party

Case study

National Grid & WPD Regional Development Programme

This Regional Development Programme is focused on WPD's South West licence area. A whole system roadmap of Distributed Generation, low carbon technologies and demand growth scenarios has been created. Through a joined-up T-D approach to the development and operation of the local network, the programme is providing better use of local network capacity for Distributed Generation connection and reduced time for customers to connect.

The programme also establishes the costs and benefits for distribution customers providing flexibility and associated benefits to solve transmission issues and recommends least regret works to be completed to ensure customer requirements are met on time.

To achieve these outputs for customers, National Grid and WPD are sharing existing data and network models on a more granular basis than before. Different scenarios for DG growth are being considered (3GW in 2020, 4 GW in 2025 and 5 GW in 2030) to help assess future network requirements. A range of potential solutions to these network requirements are then being considered, using both conventional reinforcement and commercial non-build solutions. The programme requires whole system thermal, voltage and fault level studies to be carried out by National Grid and WPD with National Grid sharing the dynamic modelling techniques it uses for the transmission network. Detailed cost–benefit analysis is required to identify the most appropriate solutions to meet the identified network requirements.

We will also provide further information to customers by collating and publishing information for DER customers to support connections and service provision.

2018 Developments for Transmission & Distribution Processes

In 2018, we are planning to enhance whole system investment planning by:

– Developing and consulting on Whole System Investment Planning models, conducting case studies and learning lessons from the RDPs to include whole system option(s) thinking during the 2018/19 Network Options Assessment process (NOA4).
– Developing DNO capability and establishing improved data and models to support whole system investment and operation for priority areas.
– Establishing the framework to produce distribution level future energy scenarios for priority DNO licence areas and align these to the GB *Future Energy Scenarios* publication produced by the NETSO.

We are working to enable greater DER access to networks and services by:

– Further developing DER service procurement models and processes during 2018 so that preferred models are implemented during 2018.
– Putting in place mechanisms to identify and publish DSO service requirements for priority areas.
– Publishing and taking forward action plans to enable the timely connection of flexible resources where these can avoid investment and unlock connection capacity.

We will also provide further information to customers by collating and publishing information for DER customers to support connections and service provision. This would include service requirements, future scenarios as well as further information on connection costs, levels of curtailment and resource volumes. Finally, we will ensure continued network reliability for all customers by identifying and agreeing further transmission and distribution network and DER improvements.

Supporting Whole System Network Charging Reform

2017 Charging Development Work

The Open Networks Project undertook two key pieces of analysis which have been well received by Ofgem as key inputs into their wider charging Significant Code Review, which identified:

– whether differences in charging arrangements influence customers' economic decisions on where and how to connect to the electricity system – published in a Charging Scenarios paper

– options for progressing charging issues considered to be of particular relevance to the development of the GB DSO model – published in a Charging Issues paper

Charging Scenarios Key Conclusions

– Whilst Ofgem's recent decision on embedded benefits has reduced the difference between T&D charging arrangements there remains an incentive for DG to connect to distribution networks.
– Distribution connected licensable generation is liable for both T&D charges which may discourage such developments.
– Parties connecting at HV in Scotland only may face charges for relevant transmission reinforcements at 132kV.
– Parties wishing to connect at 132kV face lower charges when the network is a distribution network (as is the case onshore in E&W).
– Discounts available for smaller 132kV transmission connected generators help reduce differences but create discrepancies between parties with capacities above and below the 100MW threshold.
– There is less of a difference between T&D treatment of demand.
– Differences in the distribution charging methodologies (EDCM/CDCM) result in significant differences in charges or credits applied to DG connecting at EHV and HV/LV.

Key Charging Issues Identified

– Common charging methodology for costs associated with Active Network Management.
– Future compensation arrangements for distributed energy resource.
– Cost-reflective charging arrangements for 'behind the meter' connections.
– Cost-reflective charging arrangements for reactive power across T&D.
– Cost reflective charging arrangements for electricity storage providers.
– Rights to connect to and access networks between transmission and distribution.
– Network charges for Community Energy and parties with Local Generation and Supply.

We also published a paper setting out the status of all current charging reviews which was well received by stakeholders.

2018 Support to Charging Futures Forum & Task Forces

ENA is now providing secretariat and support to Task Forces on Access Rights and Forward Looking Charges for the Charging Futures Forum. This provides a key link in considering charging in other development work within the project (e.g. DSO Market Models). It is essential that our project development work is linked to and consistent with charging development.

Looking Forward for ENA's Open Networks Project

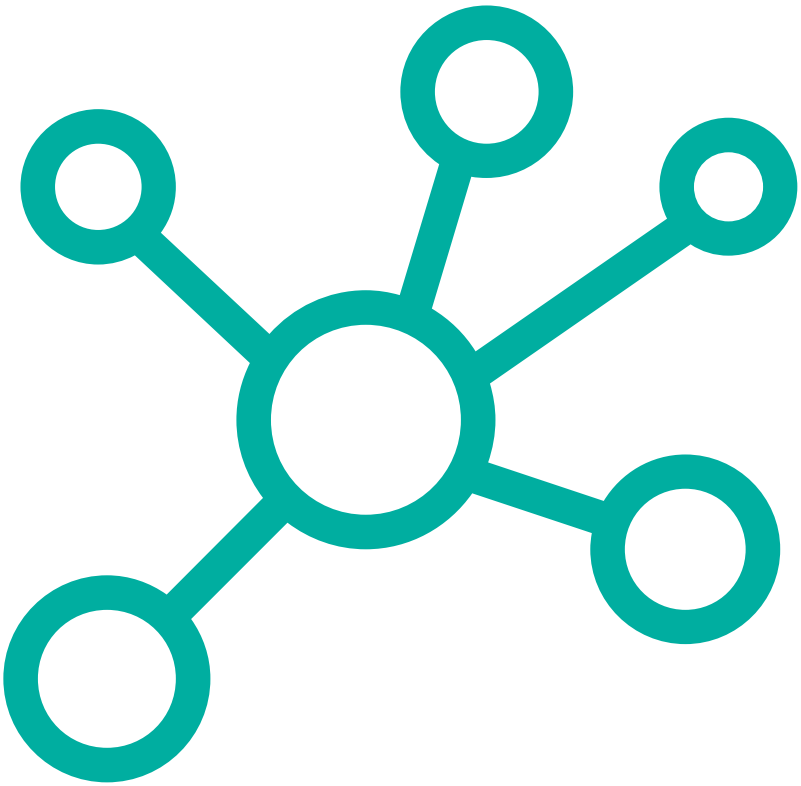
We look forward to maintaining the momentum of the project, delivering customer improvements and the Government policy set out in the Ofgem & BEIS Smart Systems and Flexibility Plan, the Government's Industrial Strategy and the Clean Growth Plan.

There are short-term improvements underway and the longer-term vision of the Distribution System Operator roadmap to work towards. We will continue to implement and develop improvements to Transmission and Distribution processes and the customer experience, alongside supporting industry charging reforms. The network operators are working together with industry stakeholders, Ofgem and Government to deliver against that vision in stages, including into the next regulatory cycle. All of this will be done against the backdrop of the Joint Innovation Strategies for networks.

We can be pretty sure that the vision will change as we understand and learn more about the best way to deliver the projected benefits to customers in a low carbon environment, so we will have to continue to be open and adaptable in our approach to delivery.

We can't do this alone and we look forward to continuing to engage with a wide group of stakeholders and work alongside Government and Ofgem to help us make a difference for customers now and into the future.

We will continue to develop and implement improvements to Transmission and Distribution processes, DSO transition, the customer experience and support to whole system charging reform.



Glossary of Terms & Further Information

All ENA Open Networks Project information can be found at the following link:

www.energynetworks.org/electricity/futures/open-networks-project/open-networks-project-overview/

With wider network innovation work described here:

http://www.energynetworks.org/electricity/futures/network-innovation/network-innovation.html

Term	Definition
Aggregator	An entity who acts as intermediator between electricity generators and users with Distributed Energy Resources and those power system participants who wish to use these services.
Customer	A person who is the owner or occupier of premises that are connected to the Distribution or Transmission Network.
Distributed Energy Resources (DER)	Electricity generators or users that are connected to Distribution Networks. These include electricity storage developments.
Distributed Generation (DG)	A Generator including a Customer with own generation whose generation sets are directly connected to the DNO's Distribution Network or to another authorised distributor connected to the DNO's Distribution Network.
Distribution Network	The network operated by a DNO and used for the distribution of electricity between Grid Supply Points or Generation Sets or other Entry Points to Customers and any electrical plant and meters and metering equipment owned or operated by the DNO in connection with the distribution of electricity.
Distribution Network Operator (DNO)	The person or legal entity named in Part 1 of the Distribution Licence and any permitted legal assigns or successors in title of the named party.
Distribution System Operator (DSO)	As defined in this report.
ED1; ED2	The 8-year period covered by an agreed set of regulatory arrangements for electricity DNOs. For example, ED1 covers the 8-year period from April 2015 to March 2023.
Generator	A person who generates electricity under licence or exemption under the Electricity Act 1989 (as amended by the Utilities Act 2000 and the Energy Act 2004).
Independent Distribution Network Operators	Independent Distribution Network Operators (iDNOs) develop, operate and maintain local electricity distribution networks. iDNO networks are directly connected to the Distribution Network Operator (DNO) networks or indirectly to the DNO via another iDNO. iDNO networks are mainly extensions to the DNO networks serving new housing and commercial developments.
Low Carbon Network Fund (LCNF)	As part of the electricity distribution price control that ran until 31 March 2015, Ofgem established the Low Carbon Network Fund. LCNF allowed up to £500m to support projects sponsored by the Distribution Network Operators (DNOs) to try out new technology, operating and commercial arrangements.
National Electricity Transmission System Operator (NETSO)	National Grid Electricity Transmission (NGET) in its capacity as operator of the National Transmission System.
Networks Options Assessment (NOA)	The NOA is a licence obligation under National Grid's NETSO role comprising a process and methodology to compare and select solutions to address transmission system capacity requirements.
RIIO 1; RIIO 2	RIIO (Revenue = Incentives + Innovation + Outputs) price controls – Ofgem's framework for determining the allowed expenditure and associated revenues, for the monopoly electricity and gas network companies. The 8-year period covered by an agreed set of regulatory arrangements for TOs. For example, RIIO 1 covers the 8-year period from April 2013 to March 2021.
Smart Grid Architecture Model (SGAM)	From CEN-CENELEC-ETSI Smart Grid Coordination Group, December 2014: The Smart Grid Architecture Model (SGAM) is a reference model to analyse and visualise smart grid use cases in respect to interoperability, domains and zones.
Statement of Works (SoW)	Statement of Works is submitted to National Grid for the purposed of assessing the impact of embedded generation upon the National Electricity Transmission System.
Supplier	Grid Code definition: (a) A person supplying electricity under an Electricity Supply Licence; or (b) A person supplying electricity under exemption under the Act; in each case acting in its capacity as a supplier of electricity to Customers in Great Britain.
Transmission Network	The network of high voltage lines and plant owned by the holder of a Transmission Licence and operated by the NETSO, which interconnects power stations and substations.
Transmission Operator (TO)	Transmission Operators (TOs) are licensed to develop, operate and maintain the high voltage system within their own distinct onshore transmission areas.

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