System Operability Framework

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Welcome to the Launch Event

Welcome to the Launch Event

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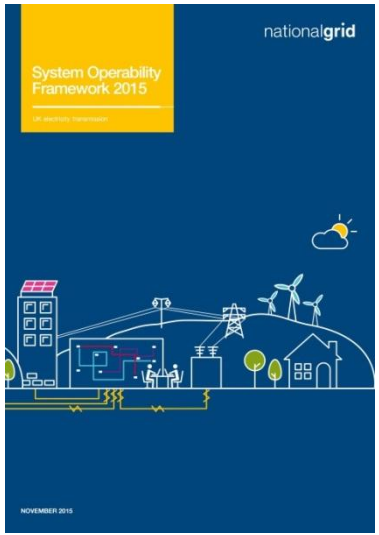

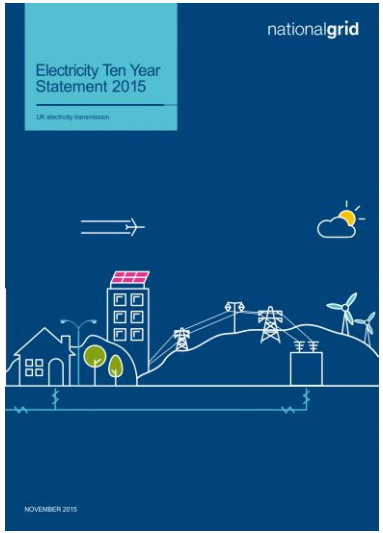

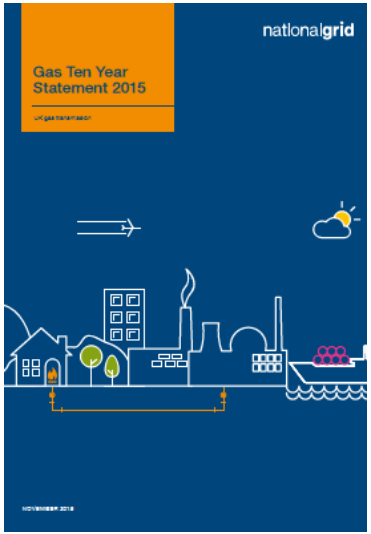

Vandad Hamidi

SMARTer System Performance Manager

Safety and Security

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- No planned fire alarm after 10am today
  - Leave through nearest exit - You will be directed by Fire Marshalls
  - The muster point is outside the building in the car park
- Facilities
- Tea and Coffee

Agenda - Morning Session

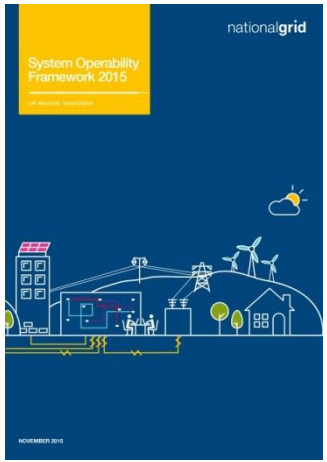
- **[10:00 - 10:05]** Welcome and Brief overview of the day
- **[10:05 - 10:15]** Introduction
- **[10:15 - 10:30]** Future Energy Scenarios (FES) 2015
- **[10:30 - 10:40]** Gas Ten Year Statement (GTYS) 2015 Update
- **[10:40 - 11:35]** System Operability Framework 2015
- **[11:35 - 11:45]** Coffee Break
- **[11:45 - 12:45]** Industry perspectives on key themes of SOF 2015

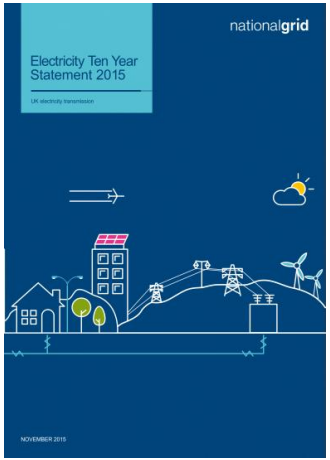
  External Perspective:, EirGrid, Renewable Energy Systems (RES), Energy System Catapult, and Ofgem

Agenda- Afternoon Session

- **[12:45 - 13:45] Break (business lunch) and general Q&A**
- **[13:45 - 14:10]** Electricity Ten Year Statement (ETYS) 2015 updates
- **[14:10 - 15:10]** Contracting for New Services Workshop
- **[15:10 - 15:30]** System Operator Innovation Strategy
- **[15:30 - 15:45]** Next steps and future engagement

SOF in the context of Electricity Network Capability





Richard Smith

Head of Electricity Network Capability

Future Energy Scenarios 2015

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UK Energy Strategy

30th November 2015 – Duncan Sluce

What are Future Energy Scenarios?

- Transparent, holistic paths of supply and demand of energy.
- Not forecasts - predictions of the future that seek to cover all likely possibilities
- Detailed analysis to 2035. High level analysis to 2050.
- Used for network analysis that enables us to identify potential gas and electricity network investment requirements in the future

The only constant is change

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Electricity Market Reform

power responsive

Contracts for Difference

The value of scenarios

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Development of transmission systems

Supply & demand for the year ahead

European developments

Security of supply & decarbonisation

Future Energy Scenarios 2015

- The 2015 scenarios are an evolution of those published in 2014
- Consumer Power replaces Low Carbon Life, reflecting stakeholder feedback

The 2015 key themes

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Gone Green is the only scenario to achieve all renewable and carbon targets on time.

GB remains a net importer of electricity in three out of our four scenarios.

Sufficient gas Supplies are available in all scenarios with significant uncertainty on the source.

The scenarios highlight the increasing operability challenges the electricity industry faces.

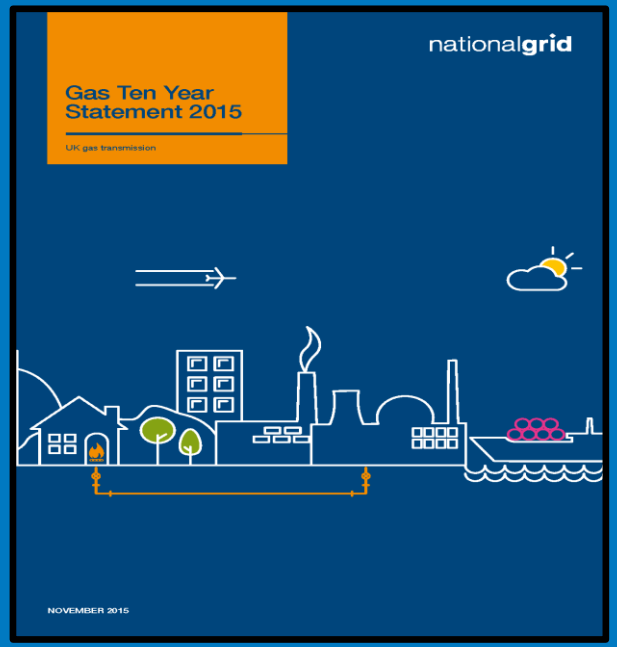
Margins, whilst narrow, continue to be manageable until 2018/19 when the capacity market delivers new sources of capacity and margin pressures ease.

Annual FES development cycle

- Feedback is fundamental to the development of our FES.
- Our stakeholders' views are at the heart of the scenario creation process, from developing the primary assumptions and model inputs, through to the scope and content of our FES

2015 Gas Ten Year Statement

Lauren Moody
Gas Network Strategy Manager



We must provide a safe and reliable network for you to use.

Our challenge is to make the most efficient investment decisions to make the most of our existing network before we build new assets.

The GTYS looks at our customer requirements and how we plan and operate our network for these requirements, over the next ten years.

Key Themes

- Changing customer requirements
- Evolving supply and demand patterns
- Legislative changes
- Asset health

For more information:

Download the GTYS: www.nationalgrid.com/gtys

Email us your queries or feedback: Box.SystemOperator.GTYS@nationalgrid.com

Customer Driven Content

- Entry and exit connections (A2O)
- Entry and exit capacity auctions
- Entry and exit capacity (PARCA)

For more information:

Download the GTYS: www.nationalgrid.com/gtys

Email us your queries or feedback: Box.SystemOperator.GTYS@nationalgrid.com

System Operability Framework 2015

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Patrick Cassels
Power System Engineer
Smarter System Performance

Ellen Webborn
Power System Engineer
Smarter System Performance

SOF Relationship to the Future of Energy

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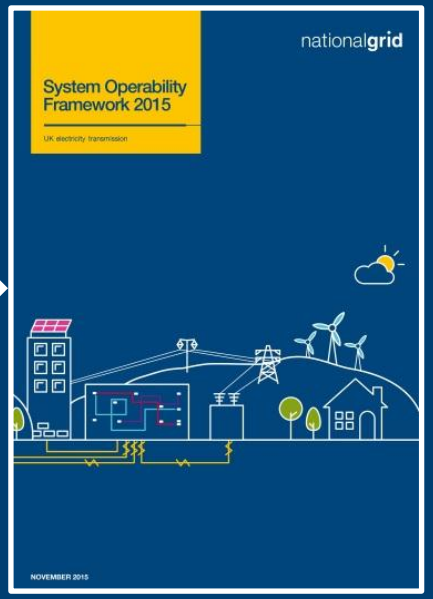
Future Energy Landscape



Performance Requirements

Operational Challenges

Solutions and Opportunities

Key Drivers for SOF 2015

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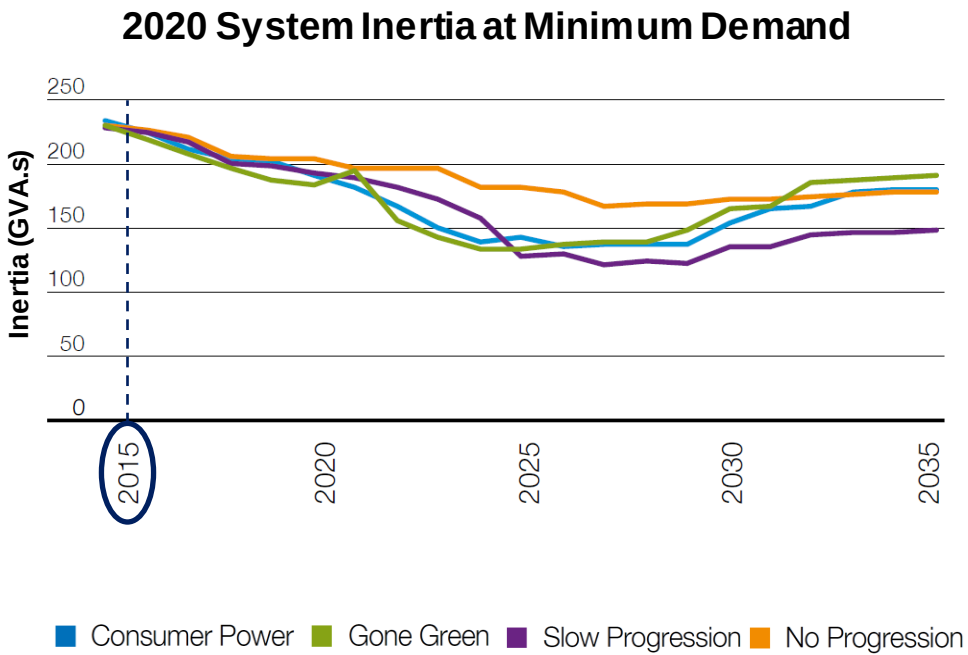
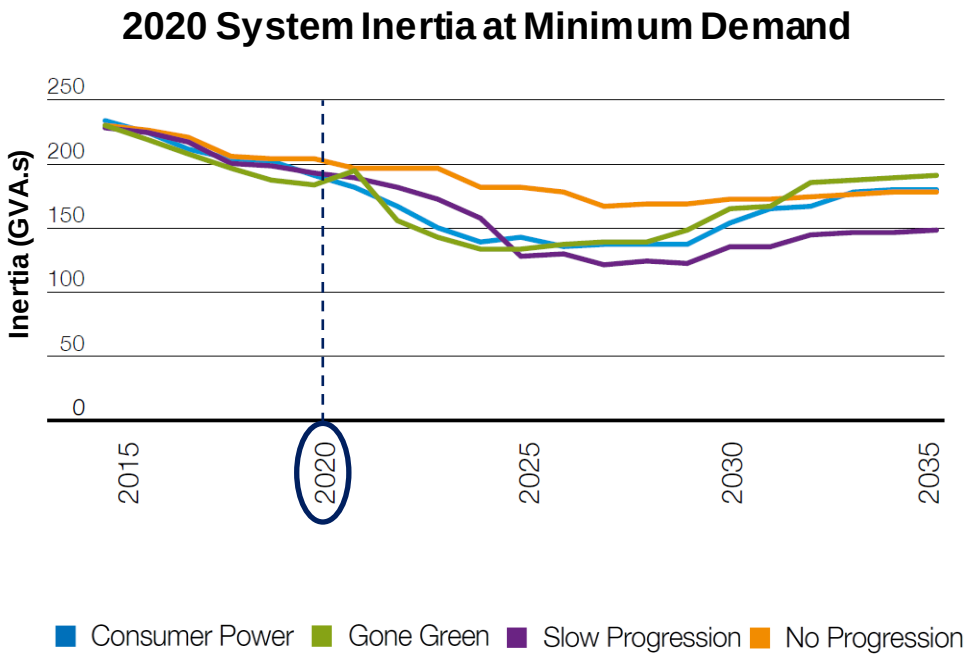
- Changing Generation Mix
- Different Technology Capabilities
- Increase in Embedded Generation
- Changing Demand Profile

System Inertia



System Inertia

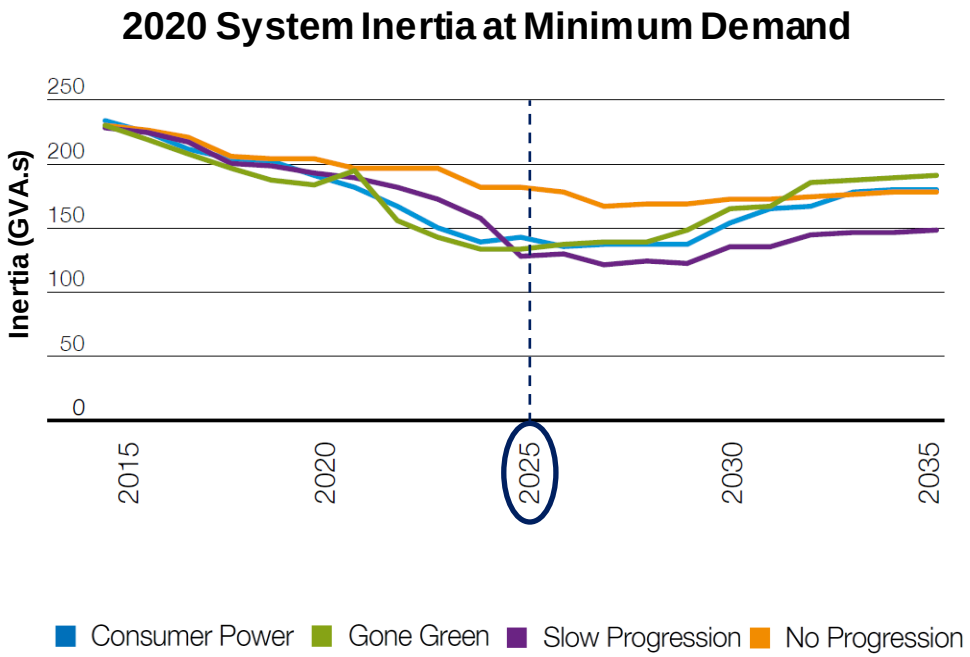


30% – 40% increase in frequency response needed for **all scenarios**

Service opportunities for enhanced frequency response

Plant flexibility has clear value for system inertia provision

System Inertia



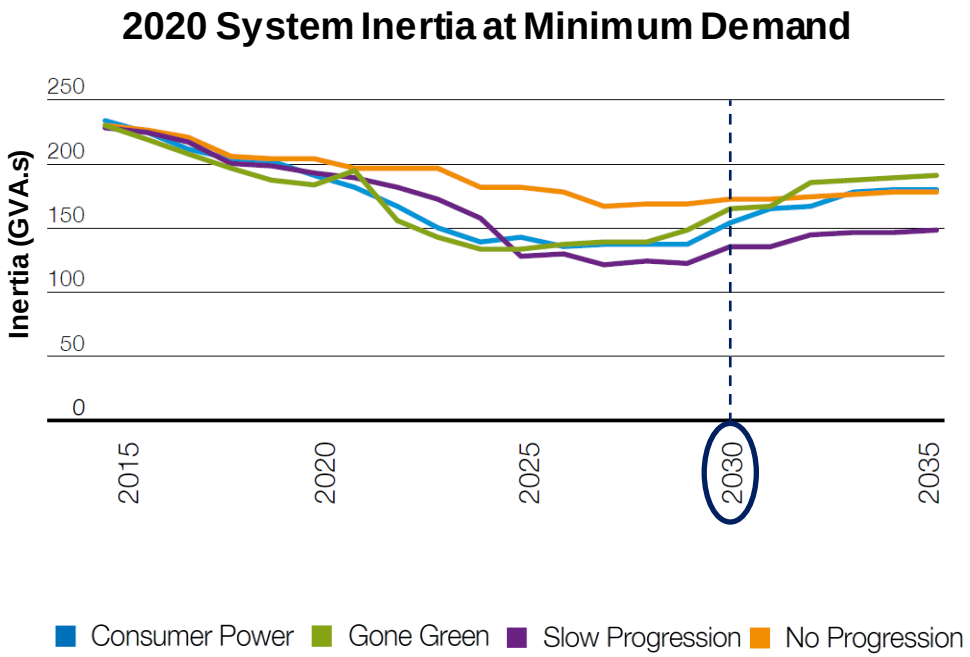
SP

Slow Progression becomes lowest inertia scenario

Service opportunities for enhanced frequency response

Plant flexibility has clear value for system inertia provision

System Inertia

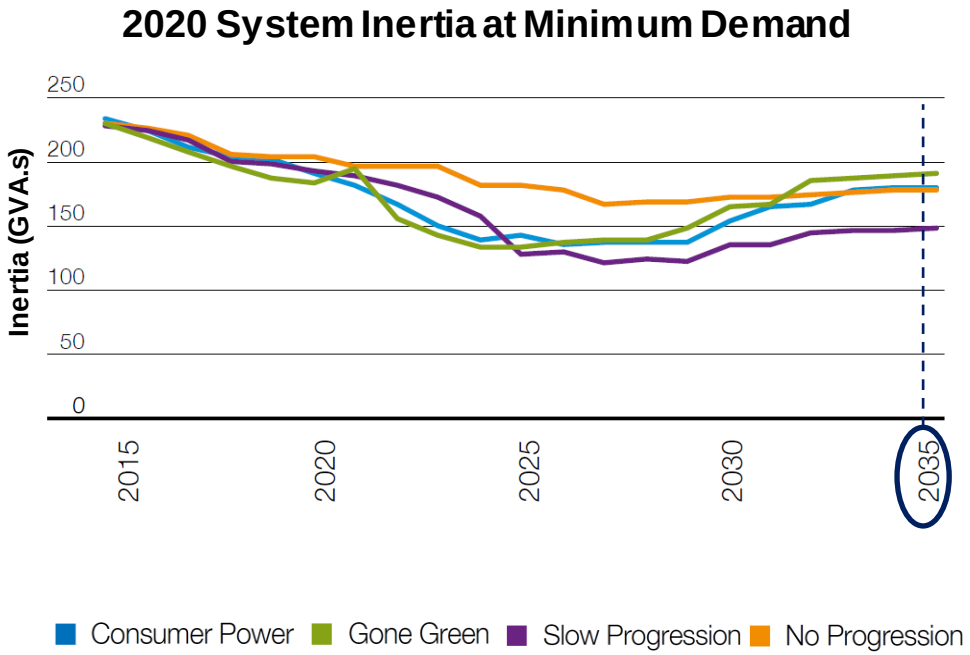


300% – 400% increase in frequency response needed for all scenarios and **new providers required**

Service opportunities for enhanced frequency response

Plant flexibility has clear value for system inertia provision

System Inertia



New synchronous plant provides partial system inertia recovery

Service opportunities for enhanced frequency response

Plant flexibility has clear value for system inertia provision

System Strength and Resilience

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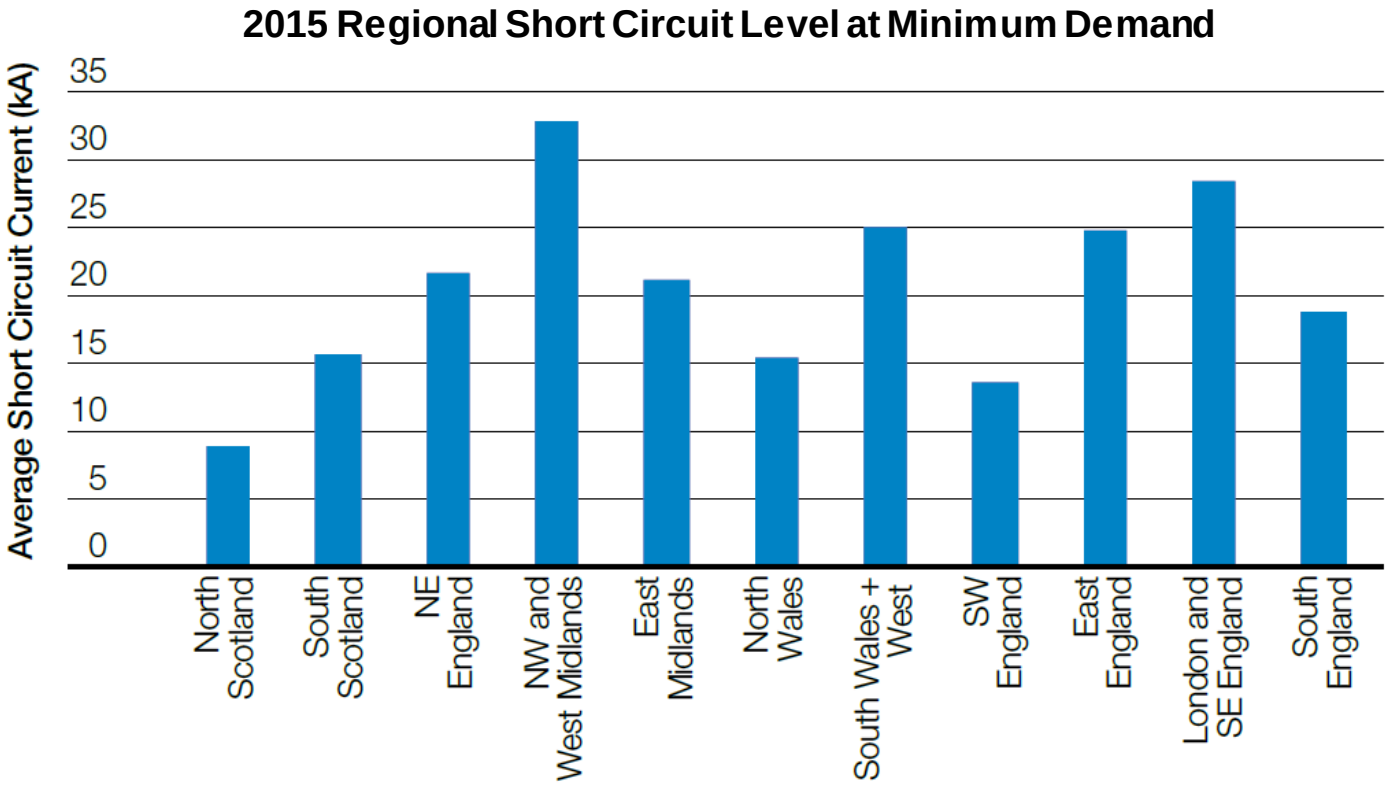

System Strength and Resilience

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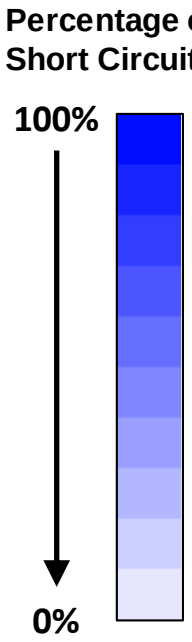
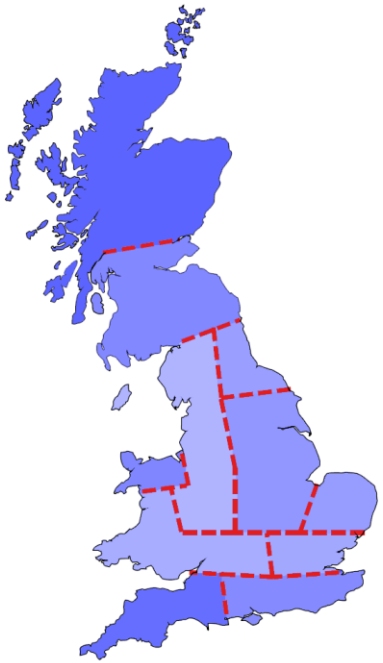


2025 Consumer Power



55% average decrease in regional short circuit level

6.6Gvar additional reactive support required

Across all scenarios short circuit level decreases, reactive support is required

Fault ride through capability from embedded generation is required

System Strength and Resilience

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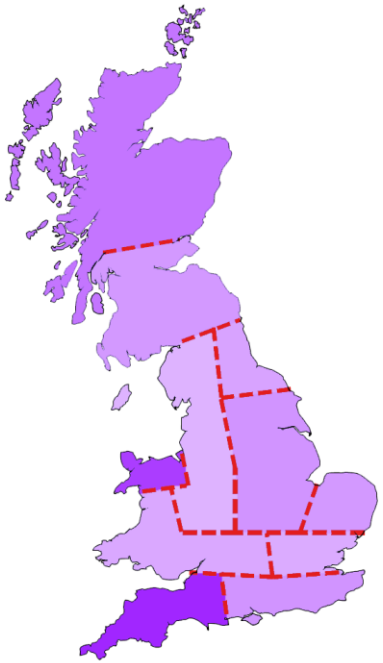
2035 Slow Progression

Percentage of 2015 Short Circuit Level

100%

0%



54% average decrease in regional short circuit level

14.1Gvar additional reactive support required

Across all scenarios short circuit level decreases, reactive support is required

Fault ride through capability from embedded generation is required

Embedded Generation

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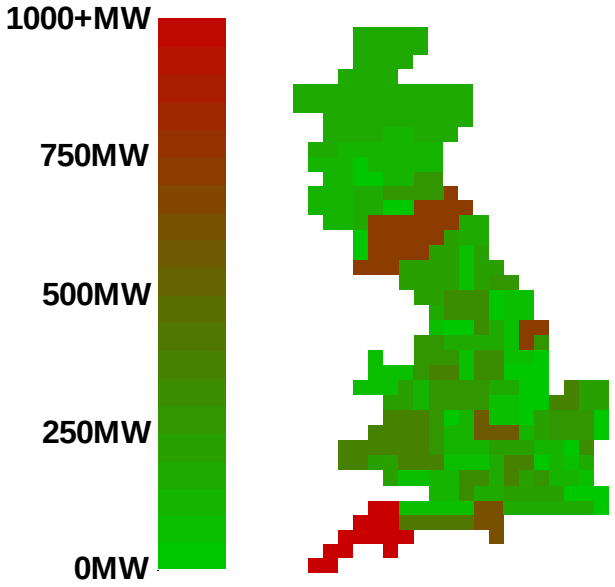
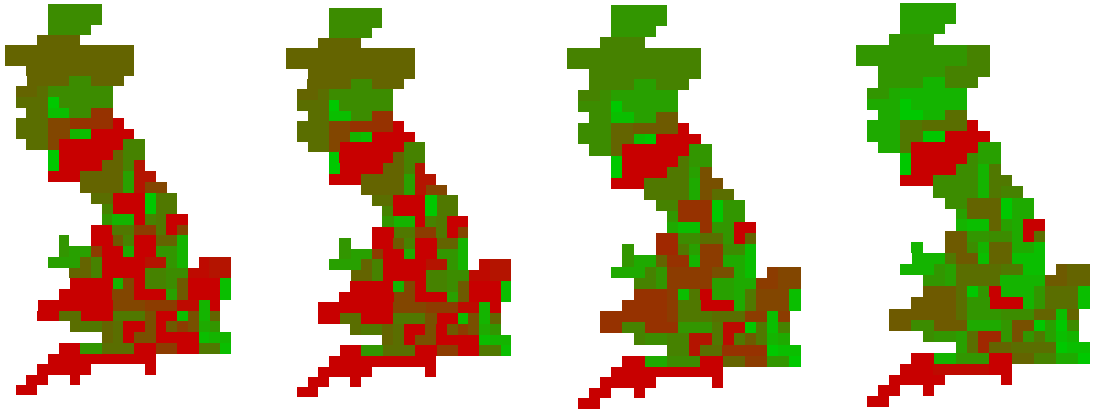
2015 Installed Capacity



2035 Installed Capacity



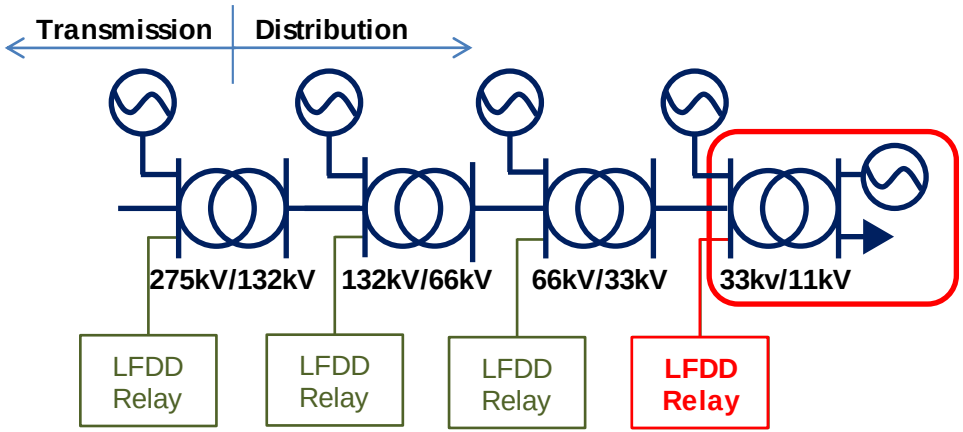
Consumer Power

Gone Green

Slow Progression

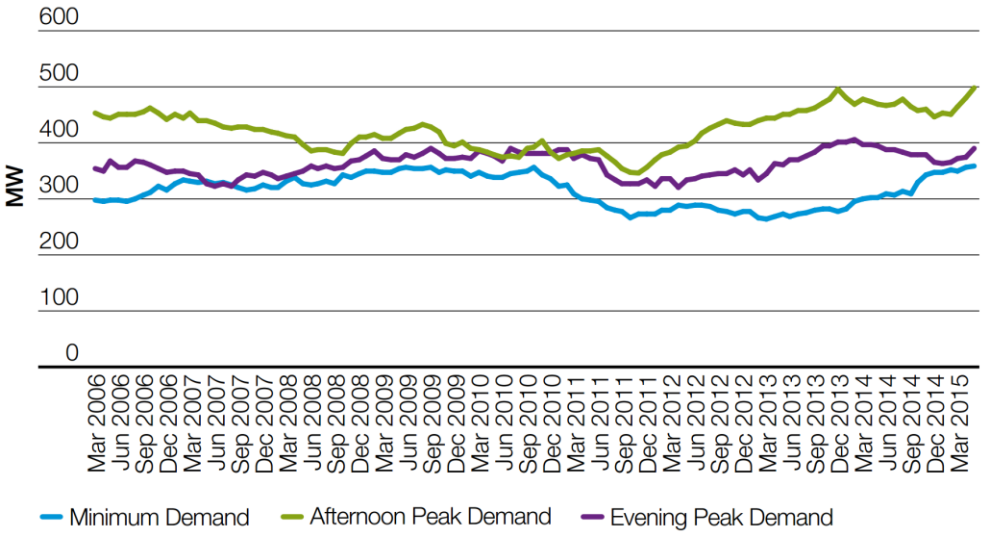
No Progression

Embedded Generation



Immediate review
of Low Frequency Demand Disconnection (LFDD) schemes

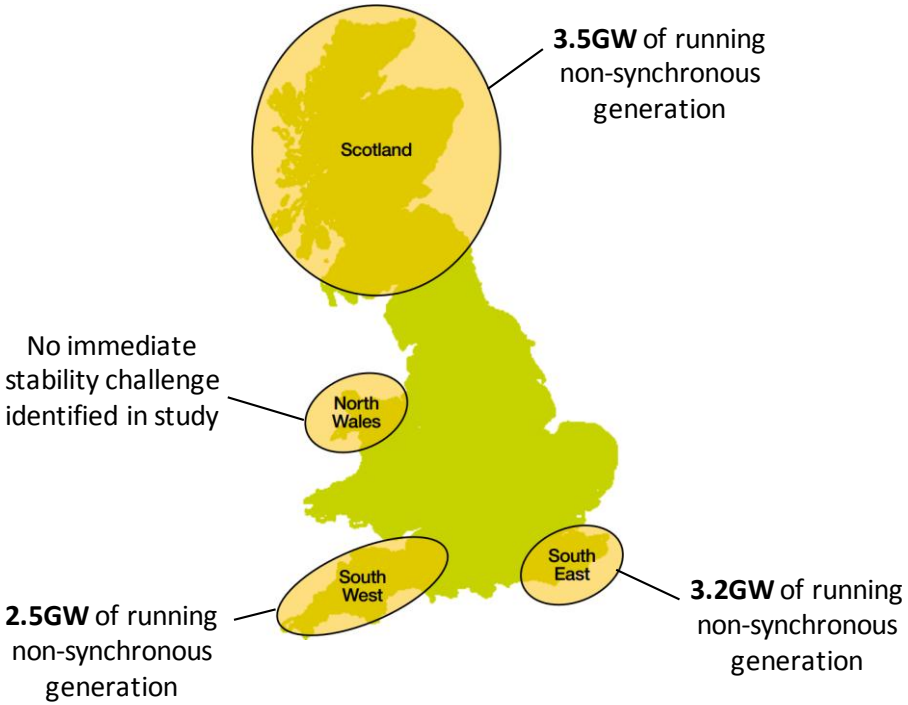
Embedded Generation



Immediate review
of Low Frequency Demand Disconnection (LFDD) schemes

Demand forecasting
improvements expected as with experience of wind generation

Embedded Generation



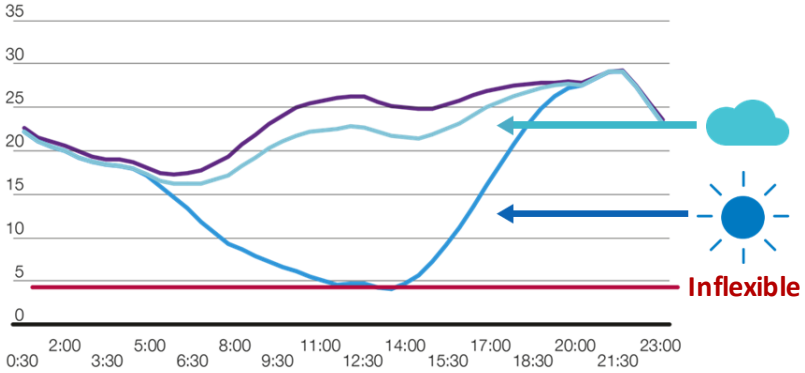
Immediate review
of Low Frequency Demand Disconnection (LFDD) schemes

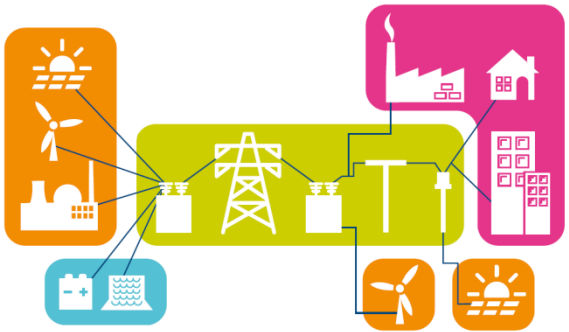
Demand forecasting
improvements expected as with experience of wind generation

Regional stability challenges
present service opportunities for whole system resources

New Technologies

Consumer Power 2035 – Summer Demand Profile



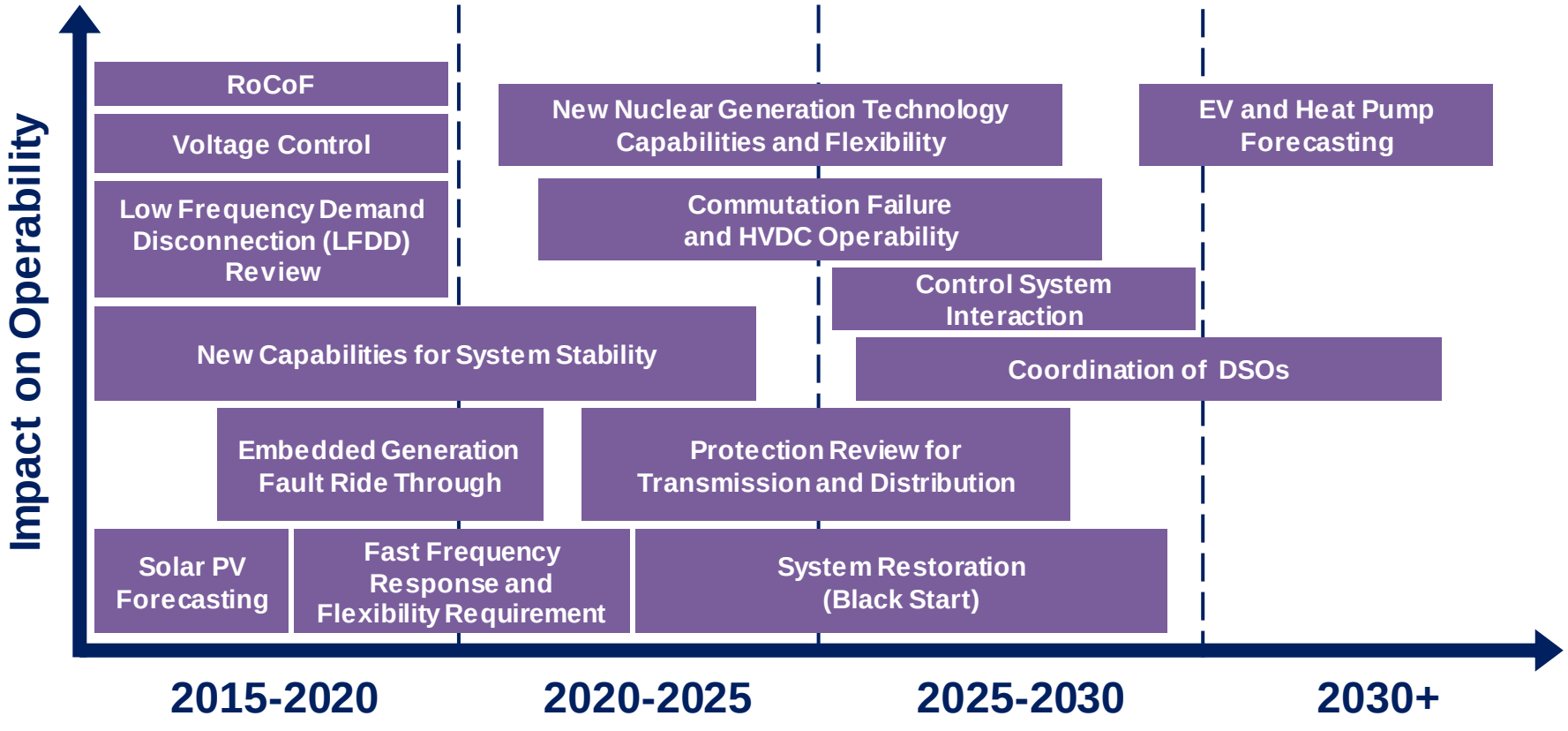


Flexible operation of new synchronous plant and provision of frequency response

Demand side technologies have capability to address numerous challenges

Whole system impact requires coordinated approach and resource optimisation

Timeline of Operability Challenges



SOF 2015 – Three Strategic Themes

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1

Services and Capabilities

It is essential that **new system services** are developed to access existing and new capabilities from both synchronous and asynchronous generation

2

Whole System Solutions

Transmission and distribution companies must consider the **whole system** impact of technologies and enable access to demand side resources

3

Increased Flexibility

The **value** of new system services, in particular **flexibility**, must be considered at the design stage by manufacturers and developers for future revenue streams

New Services and Potential Providers

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Operability Areas	New Operability Services								
	Demand Side Services	**Energy Storage**	Flexible Synchronous Generation	Flexible Non-Synchronous Generation	Interconnector Services	Synchronous Compensator	Support from Embedded Generation	**Distribution System Operator Services**	**New Services from Non-Synchronous Generation**
RoCoF Management	■	■	■	■	■	■			■
Frequency Management	■	■	■	■	■	■	■	■	■
Voltage Management		■	■		■	■	■	■	■
Protection System Effectiveness			■			■			
System Restoration Capability		■			■			■	■
Low Frequency Demand Disconnection	■	■			■				
Commutation of HVDC Links			■			■			

Example: Energy Storage

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Jaguar Hybrid Flywheel www.mdpi.com

Leighton Buzzard Battery Facility bbc.co.uk/new/business

Operability Areas
RoCoF Management
Frequency Management
Voltage Management
System Restoration Capability
Low Frequency Demand Disconnection

Key Actions:

New Service Valuation

Technical Assessments

Regulatory Barriers

Example: New Services from Non-Synchronous Generation

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www.csenergygroup.co.uk

www.offshorewindworks

Operability Areas
RoCoF Management
Frequency Management
Voltage Management
System Restoration Capability

Key Actions:

Engage to understand potential

Demonstrations and Trials

Develop Framework for Utilisation

Example: Distribution System Operator (DSO) Services

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Operability Areas
Frequency Management
Voltage Management
System Restoration Capability

Potential Actions:

Engage with DNOs for service procurement

Identify best-value options for consumers

Develop new services

Whole-system modelling techniques

Summary

- Assessment of technical requirements
- Future operability strategy
- Continuous feedback and engagement

Summary

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Thank You

DS3 Programme – Ireland and Northern Ireland Experience

30th November 2015

System Operability Framework – Robbie Aherne

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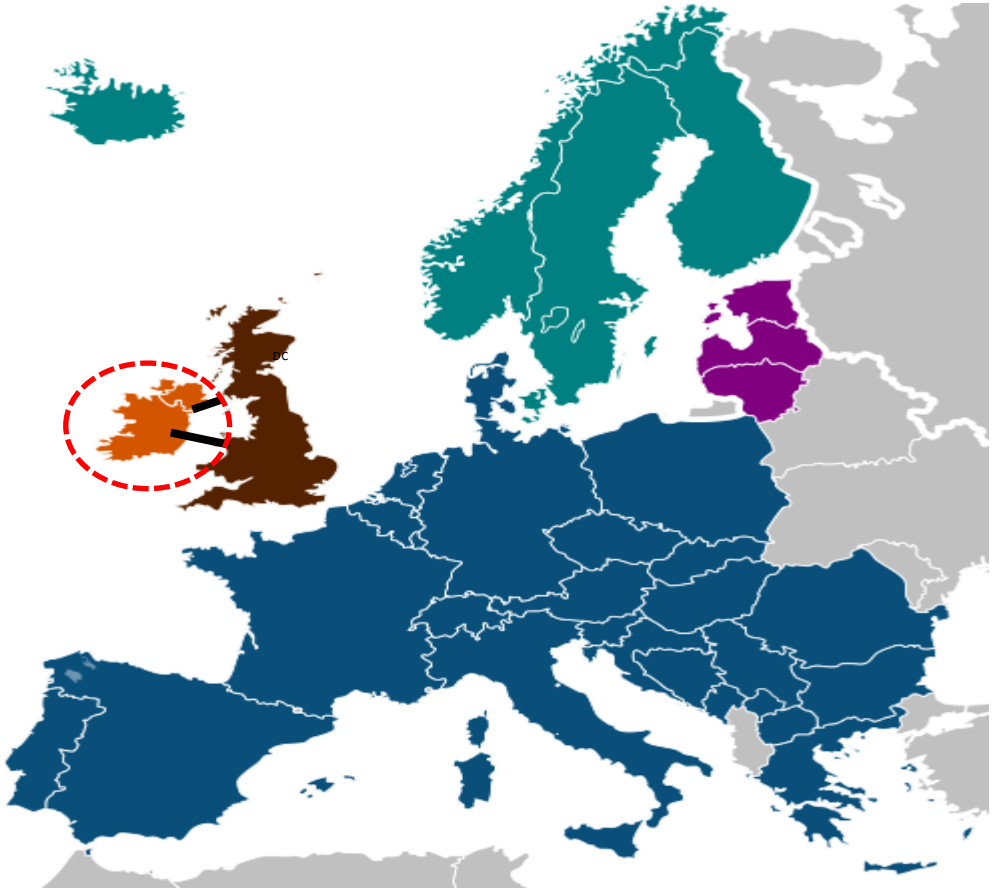
Power System of Ireland and Northern Ireland

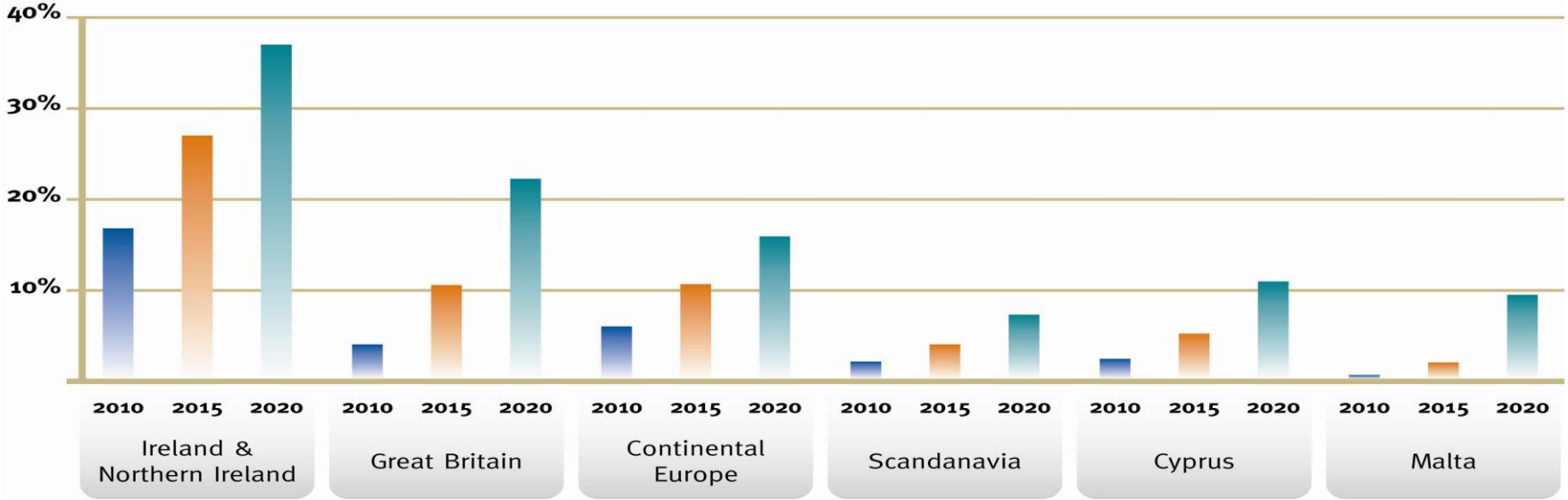
- 9000 MW of conventional plant
- 3000 MW of Windfarms

- Peak Demand of ~6800 MW
- Valley Demand ~2300 MW

- HVDC Interconnection: 1000 MW



Wind Targets – European Power Systems



* Based on analysis of National Renewable Action Plans (NREAPs) as submitted by Member States

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DS3 – Shaping the System of the Future

Grid Code

Performance Monitoring

DSM

System Services

ROCOF

Frequency

Voltage

Renewable Data

WSAT

Control Centre Tools

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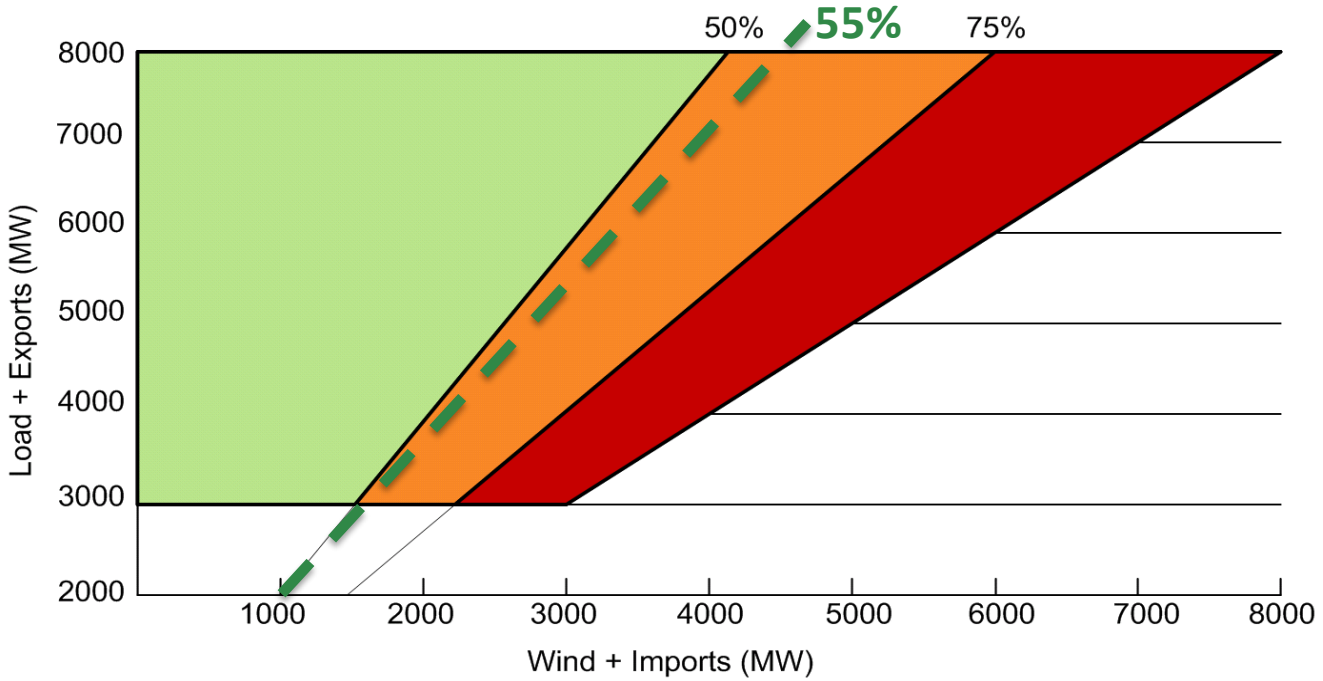
System Non-Synchronous Penetration



$$SNSP = \frac{\text{Wind + Imports}}{\text{Demand + Exports}}$$

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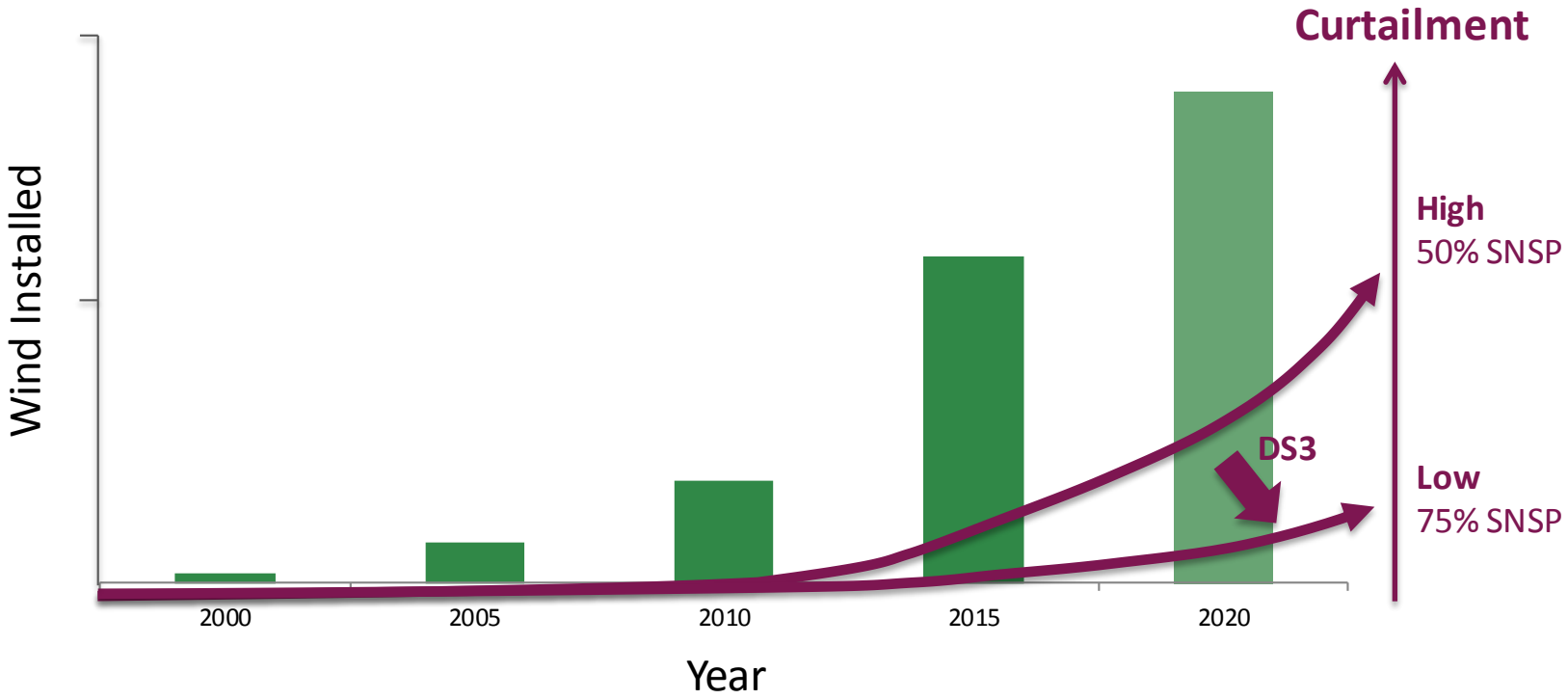
Effect of SNSP on Curtailment



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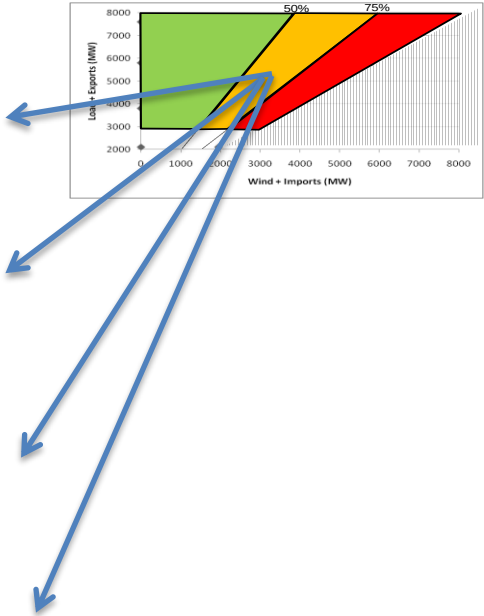
Tomorrow: Enabling 75% SNSP.....

1. RoCoF to 1 Hz/s over 500 ms
2. Additional System Services
3. Revised Operational Policies
4. New Control Centre Tools



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Operational Challenges – System Services

RoCoF

Lack of Synchronising Torque

Voltage Dip Induced Frequency Dips

Low System Inertia

Frequency Nadirs

Reactive Power Shortfall

System Ramping Capability

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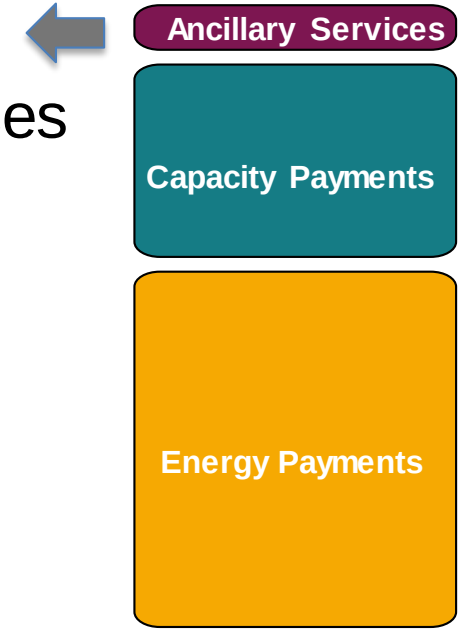
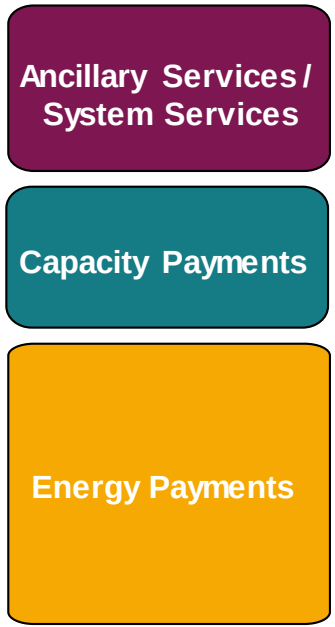
Incentivising Portfolio Performance

- 60 €m
- 7 Services



Today



Tomorrow

- 235 €m cap in 2020/21
- 14 Services

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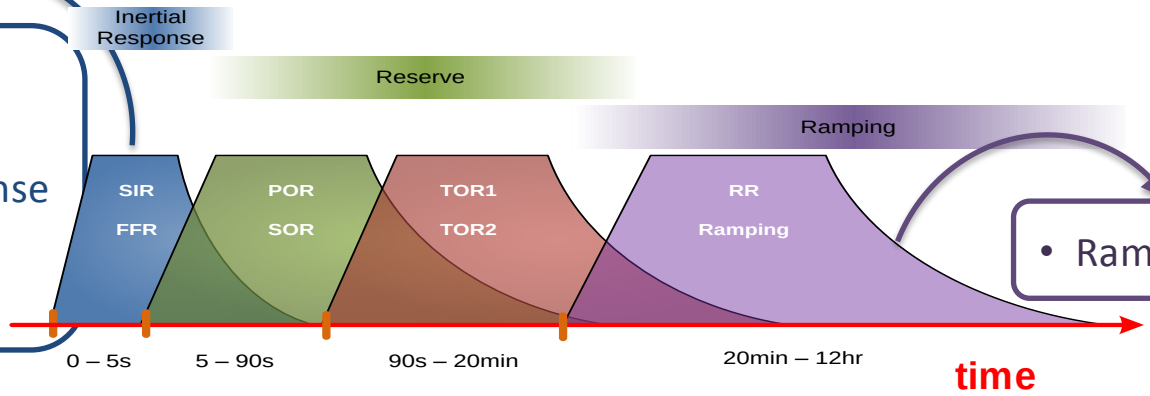
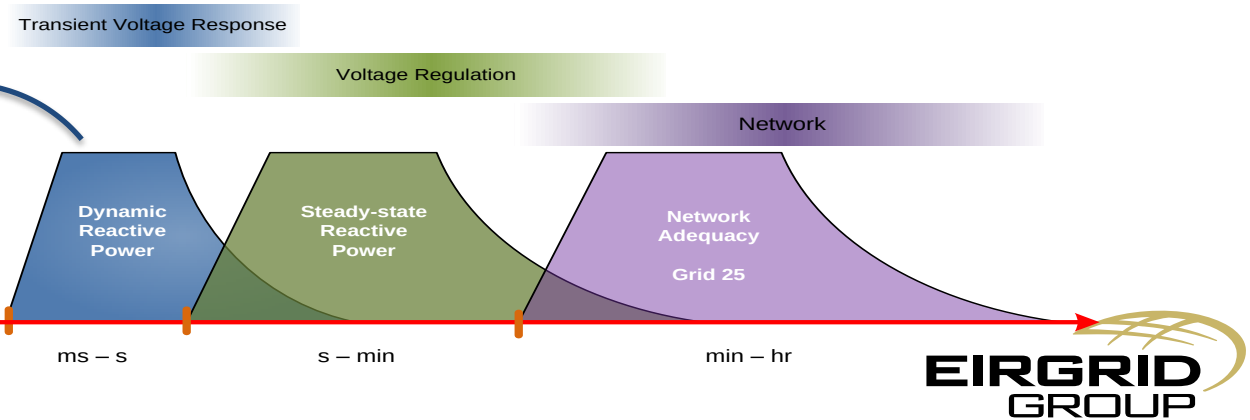
DS3 System Services

- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery



- Ramping Margin



- Dynamic Reactive Power

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New DS3 System Services

Service	Short Definition
Synchronous Inertial Response	Stored Kinetic Energy * (SIR Factor - 15)
Fast Frequency Response	MWh delivered between 2 and 10 seconds
Fast Post Fault Active Power Recovery	Active Power >90% within 250ms of voltage >90%
Dynamic Reactive Response	MVAr capability during large (>30%) voltage dips
1 hour Ramping Margin	The increased MW output that can be delivered with a good degree of certainty for the given time horizon
3 hour Ramping Margin	
8 hour Ramping Margin	

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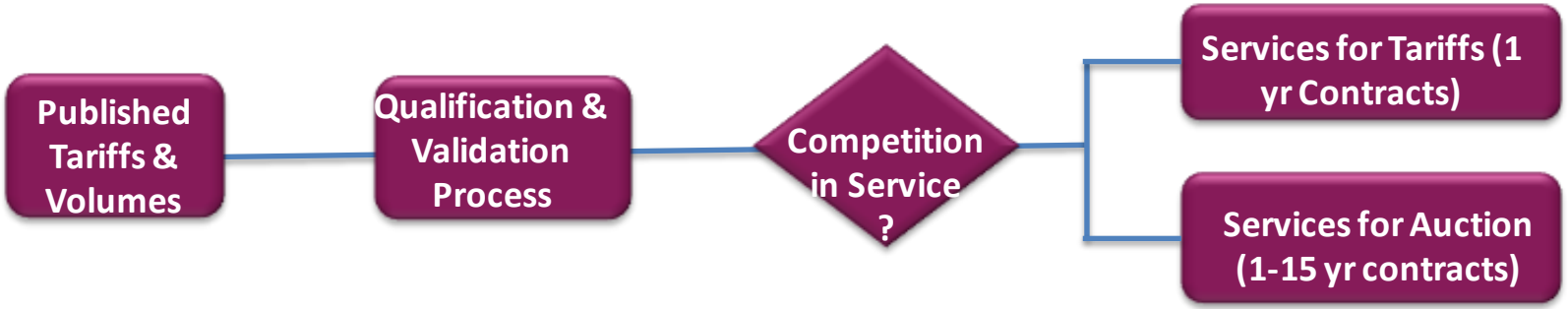
System Services Procurement Framework



Regulated Tariffs

- Tariff fixed for 5 years
- 1 year contract issued to all providers (potential for competitive process to be reviewed each year)
- BNE or similar “Cost-plus” methodology

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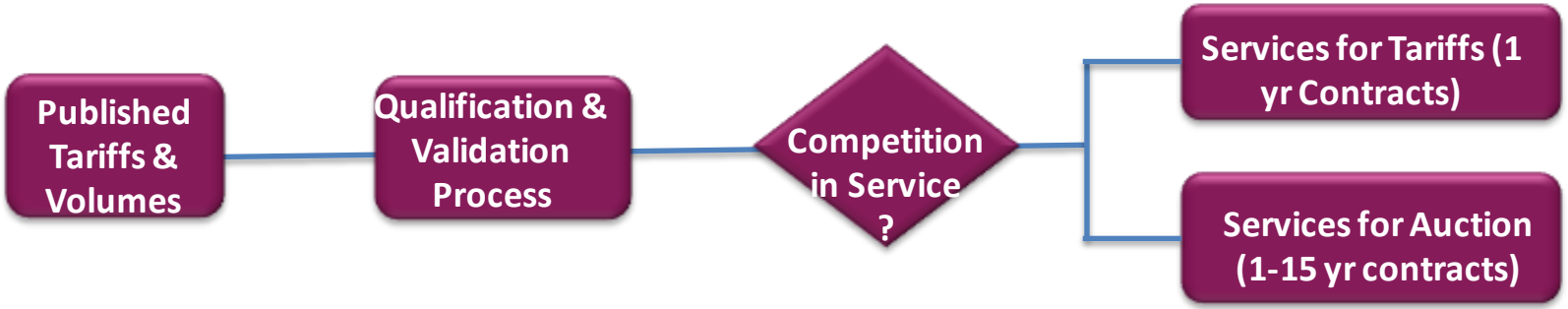
System Services Procurement Framework



Annual Auctions

- 1-15 year contracts for new investment
- "Take-or-pay" contracts to cover minimum annual revenue requirement
- Scope to include impact on production costs into evaluation

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Scalable Solutions

intel

IBM

AES Energy Storage

Google

TESLA

Microsoft

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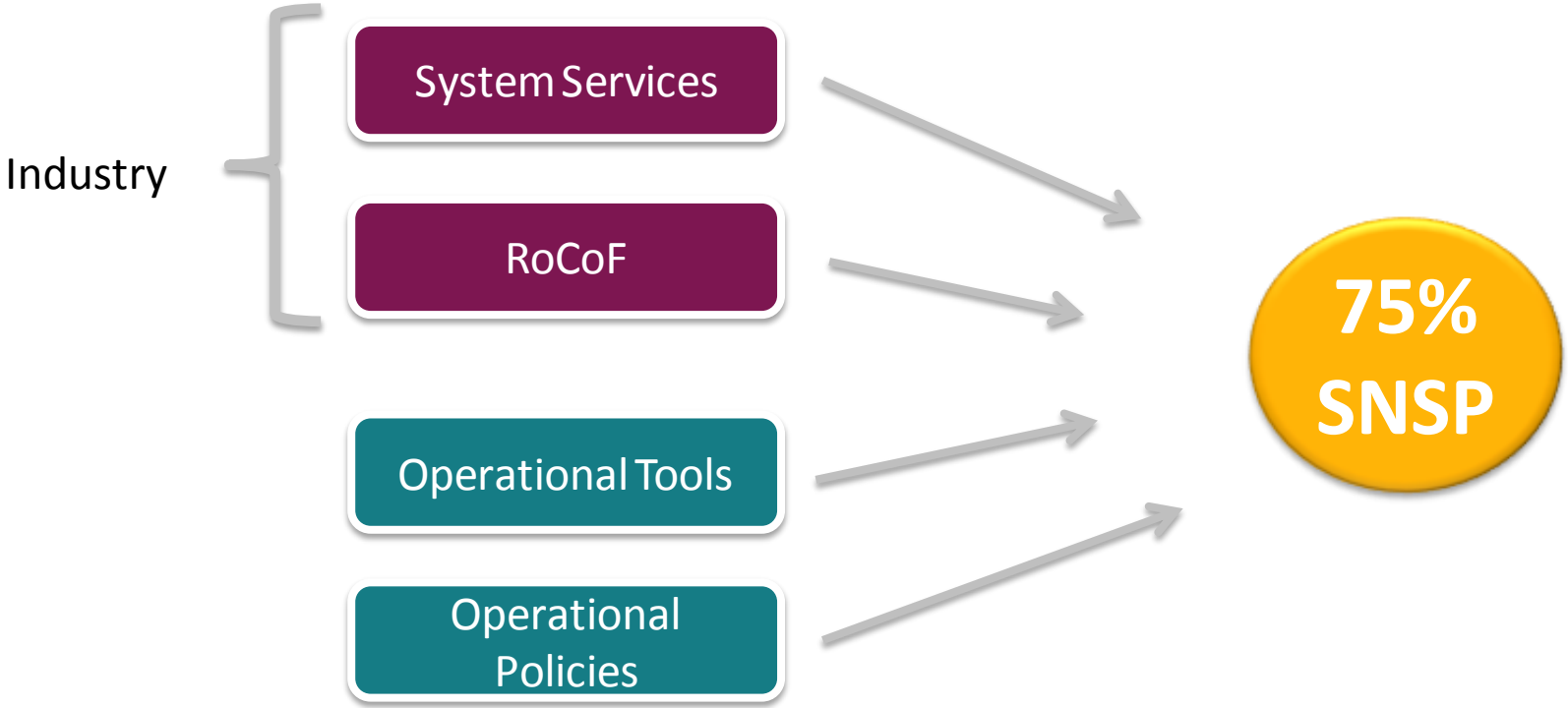
Complementary Progress Essential



New services – a service provider's perspective

Julian Wayne
Energy Storage Networks Manager, RES
30th November 2015

How is RES a service provider?

Developed and/or built >10GW of wind energy

Developed and/or built >300MW of solar PV

Demand Side Management

Built and operating 67.4MW of battery projects

RES Group Headquarters

So what do service providers & NGET need to think about?

Service provision is moving from **large, transmission connected generators** to **numerous smaller distribution connected generators and other service providers.**

1. Financial model – contract lengths
2. Service provision exclusivity
3. Customer expertise – NGET systems and processes
4. The technical opportunities of new providers and the limitations of distribution connections

How important is ancillary service revenue and certainty?

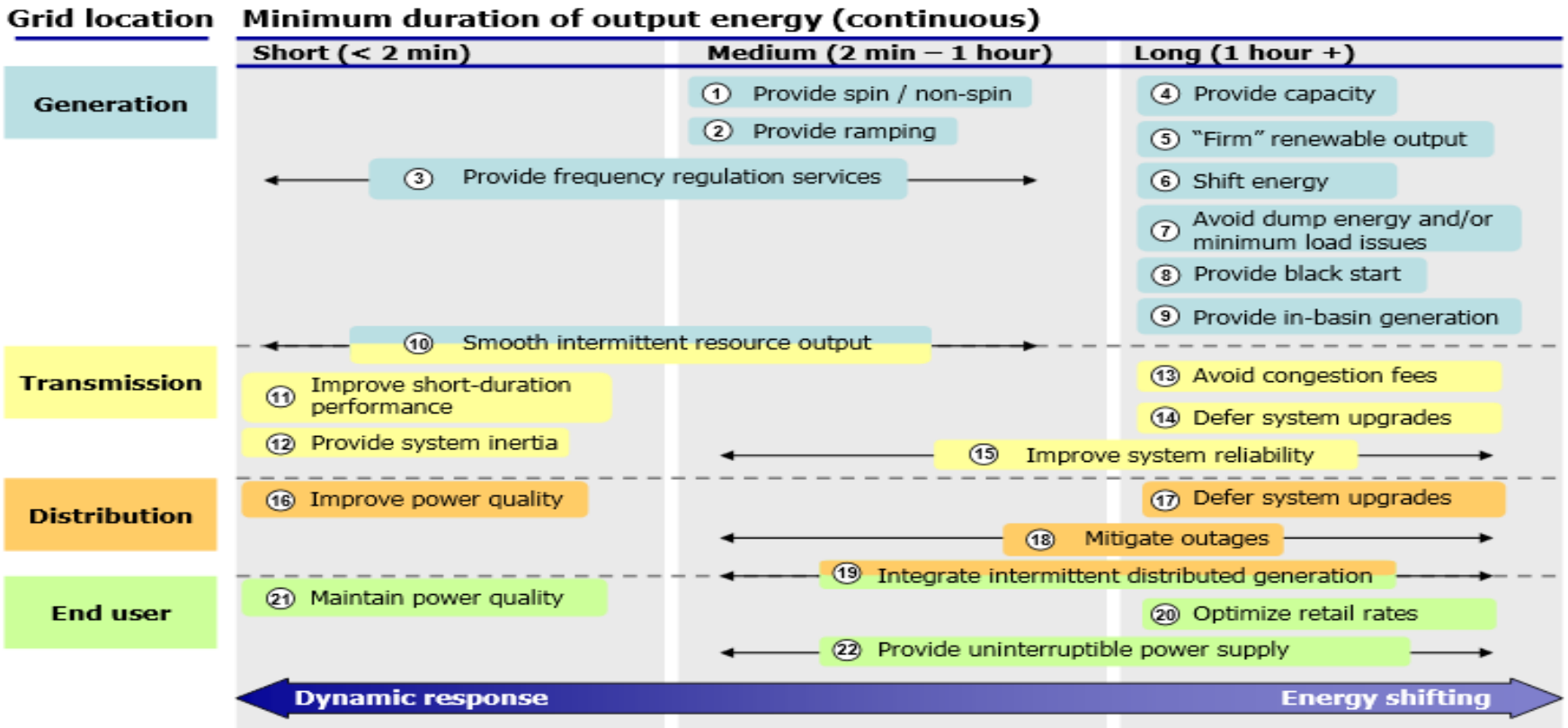
Existing operational plant

New CFD plant

Non-generation service providers

New onshore renewables

Service provision exclusivity?



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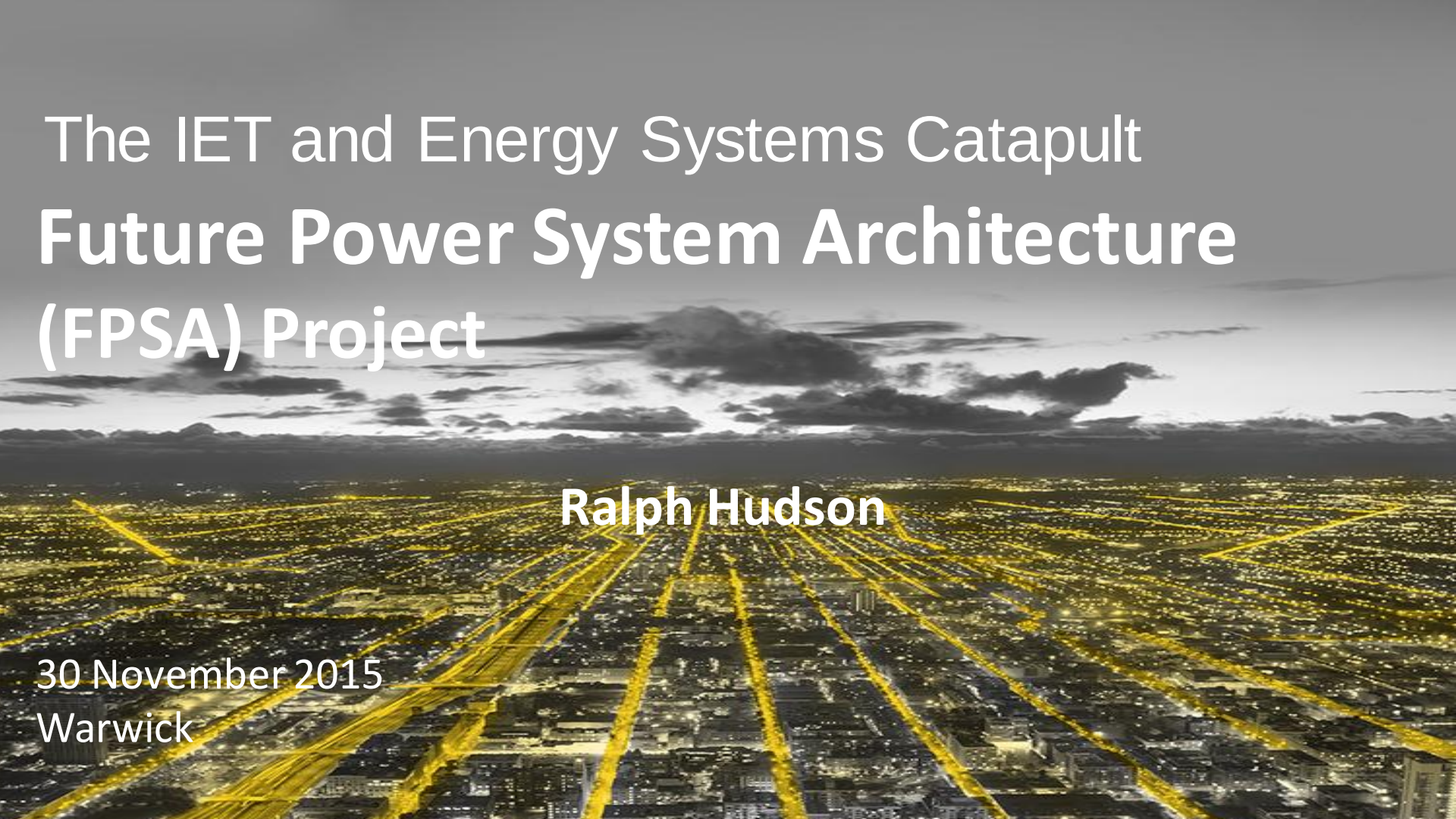
Service provision is moving from **large, transmission connected generators** to **numerous smaller distribution connected generators and other service providers.**

1. Financial model – contract lengths
2. Service provision exclusivity
3. Customer expertise – NGET systems and processes
4. The technical opportunities of new providers and the limitations of distribution connections
5. Mandatory capability versus clearly defined services?


powering change



The IET and Energy Systems Catapult

Future Power System Architecture (FPSA) Project

Ralph Hudson

30 November 2015
Warwick

Aim

Aim

To set out, and provide evidence for, the functions that will need to be performed in the future Power System as a result of its on-going transformative change……

……focus on the proposed functions that will be needed to manage the technical challenges facing the system.

(Paraphrased)

Context

Priorities and Focus:

- 2030 horizon.
- The implications for the technical architecture of the GB Power System, including the consumer side of the meter.
- Electrical services. Other vectors considered as interfaces.
- National Grid Future Energy Scenario (FES) **Gone Green.**

Avoiding:

- Solutions.
- Implications for governance (but realistic influences allowed for).

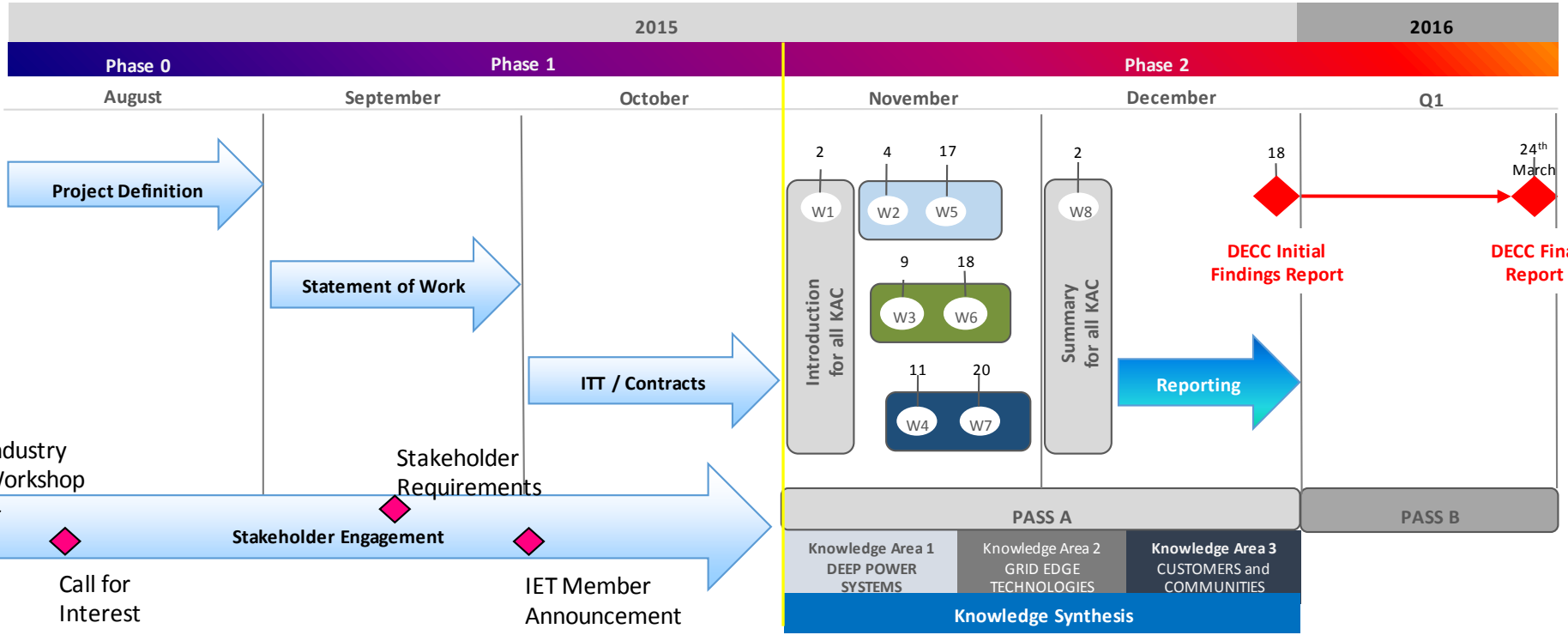
Applied Definition:

'Function': A statement of what a system or person does, (not how it is done).

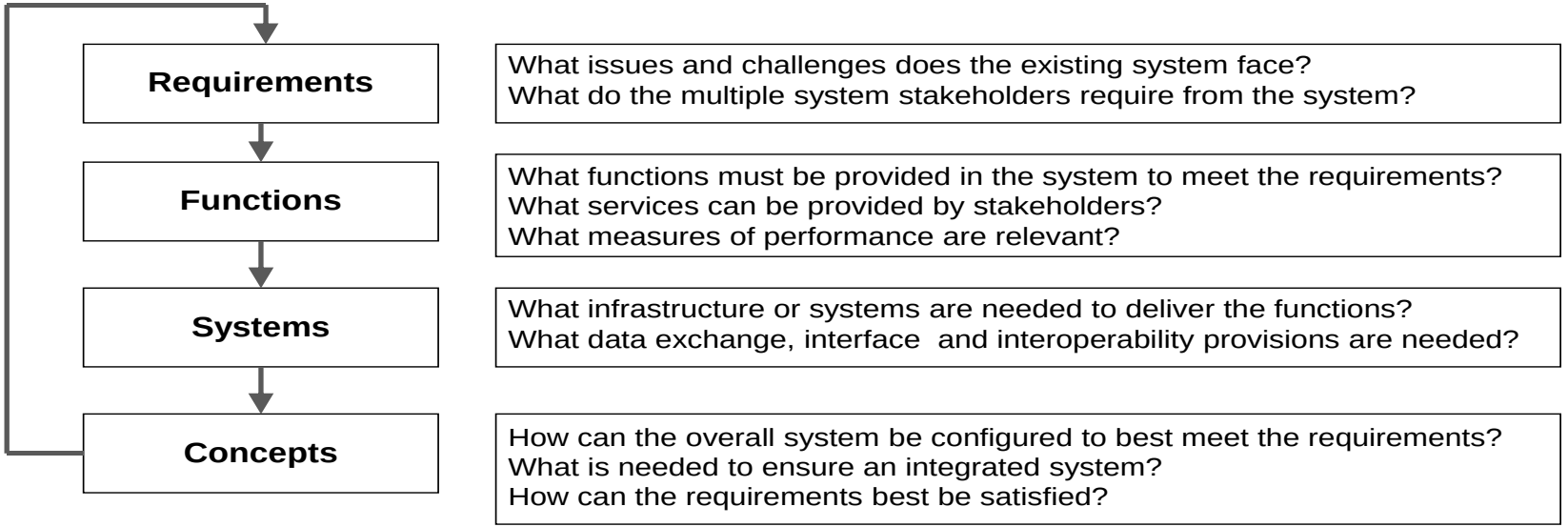
- May be used as a collective description of services, tasks, roles or any other assigned action.
- The top level function of the Transmission System is to 'Transmit Power'.

Process

FPSA Programme - Overview



Concept Analysis



Concepts:

- Are 'configurations of systems' that map functions onto the systems that will implement them.
- Validate candidate requirements.
- Are the simplest possible models that allow comparison of viable strategies and therefore underpin the evidence base that all options have been covered.

Concept Development

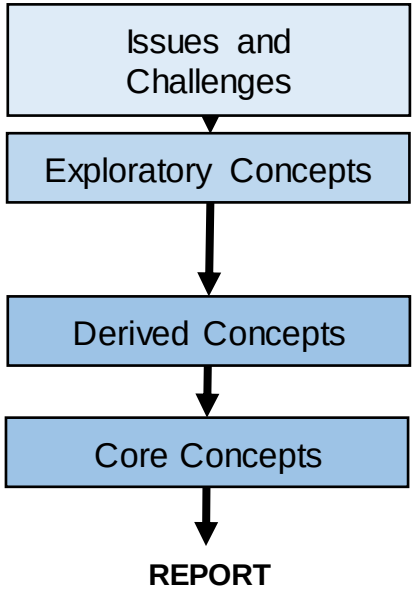
Concepts may be evolved in several stages

1 Issues and Challenges: Based mainly on PNJV, System Operability Framework and DS2030.

2 Exploratory Concepts: Address particular issues or opportunities. All perspectives valid. The building blocks for whole system concepts.
Focus of first workshops.

3 Derived Concepts: Viable whole system concepts expressed as integrated and coherent packages.
Focus of second workshops.

4 Core Concepts: Down-selected concepts as the basis for stakeholder requirements and 2030 functions. Suitable for consideration by DECC.
Focus of FPSA Report.



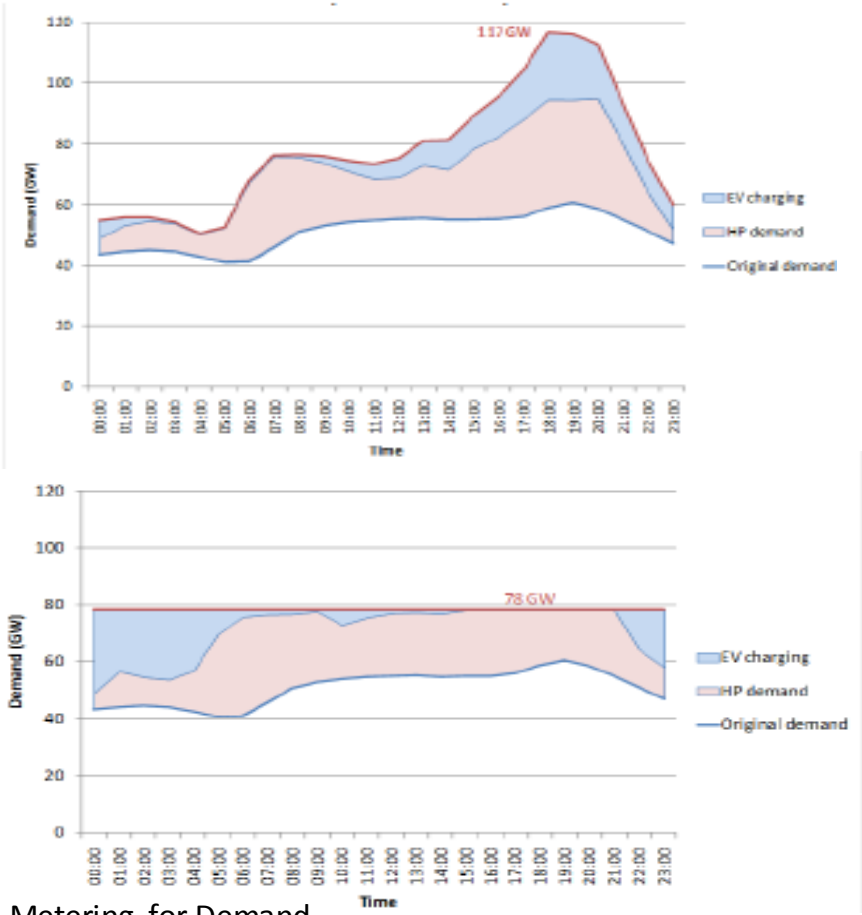
Knowledge Area Consultants

Knowledge Area	Consultant	Technical Lead
Deep Electrical Power Systems	Frazer-Nash	Dave Openshaw
Grid Edge Technologies	Frazer-Nash	Mike Kay
Customers and Communities	Ricardo Mapsar	John Scott and Duncan Botting

Analysis

Mass Introduction of Electric Vehicles and Heat Pumps

- How can the demand growth associated with a mass take-up of EVs and HPs be accommodated without creating the need for major system reinforcement (including generation)?
- How will the power system cope with the latent demand masked by micro-generation and the cold load pick-up demand associated with EVs and HPs when supplies are restored following a prolonged outage?
- What technologies, control systems and/or customer incentives might be implemented to mitigate the impact of EVs and HPs on peak demand, or even enable these demands to support system balancing and stability? (for example V2G)?



Source: ENA Benefits of Advanced Smart Metering for Demand Response Based Control of Distribution Networks 2000

Many Pulls Towards Community Energy

The Peer-to-Peer trend

CUT OUT THE MIDDLE GUY, KNOW WHO YOU ARE DEALING WITH, ENGAGE WITH YOUR NEIGHBOURS. AND IT'S OFTEN SO VERY WELL FACILITATED BY APPS

Ofgem's recent consultation – NTBMs

NON-TRADITIONAL BUSINESS MODELS:

'SUPPORTING TRANSFORMATIVE CHANGE IN THE ENERGY MARKET'

Strong in Germany

- SIGNIFICANT GROWTH OF ENERGY COOPERATIVES
- 9.5% OF TOTAL CAPACTITY OWNED BY CITIZENS

Government Policies

LOCALISM, DEVOLUTION, DECC HAS A COMMUNITY ENERGY STRATEGY,

EMPOWERED MAYORS

Emerging in Britain

5,000+ PROJECTS, CITIES INCLUDE: BRISTOL, REPOWERING LONDON, PLYMOUTH ENERGY COMMUNITY, MOZES (Nottingham), MANCHESTER COMMUNITY ENERGY STRATEGY

Home Decarbonisation

INTEGRATION WITH HEAT NETWORKS, CHP, REQUIRES LOCAL GEOGRAPHIC IDENTITY

Local Markets

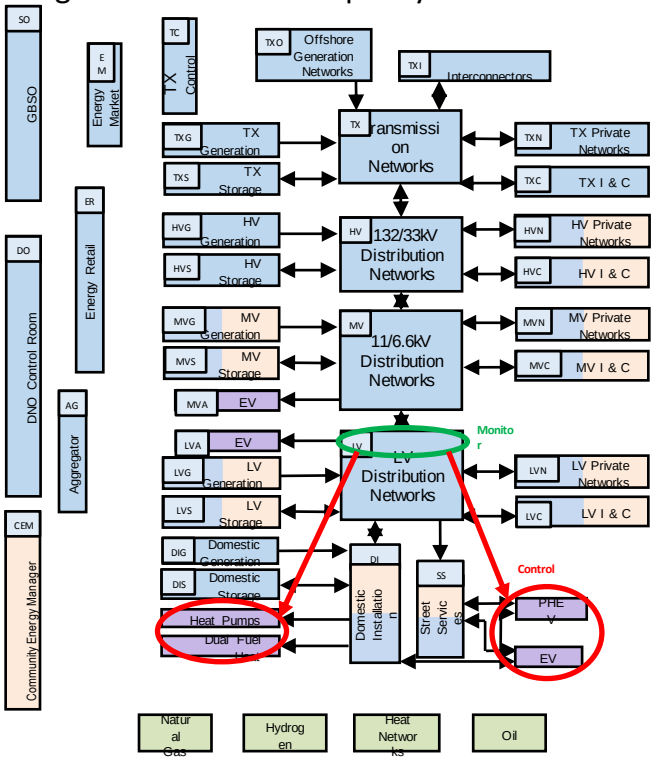
e.g OVO, ORIGAMI, ENERGY LOCAL etc

Microgrids

A MAJOR DRIVER IN USA FOR STORMS RESILIENCE,

Typical Exploratory Concept (1 of 50)

[XB5] Mass EV/HP: Controlled LV Distribution, Fit and Forget Upstream, operating within available capacity



Issues:

- Customer acceptance
- Investment in HV Distribution to achieve fit and forget above LV level
- LV Distribution must be able to supply all energy within 24hr period
- Communication network required between local substation and EV/HP
- There may be interaction with Home or Vehicle TOU charging

SO

- Forecast magnitude and timing of new loads
- Estimate level of frequency sensitive demand using frequency/demand correlation

DO

LV

- Monitor capacity available on local network
- Monitor loading of local network
- Limit EV/HP to available capacity using Smart Charging or other Active Network Management techniques
- Potential data collection and communication for forecasting purposes

MVA/LVA

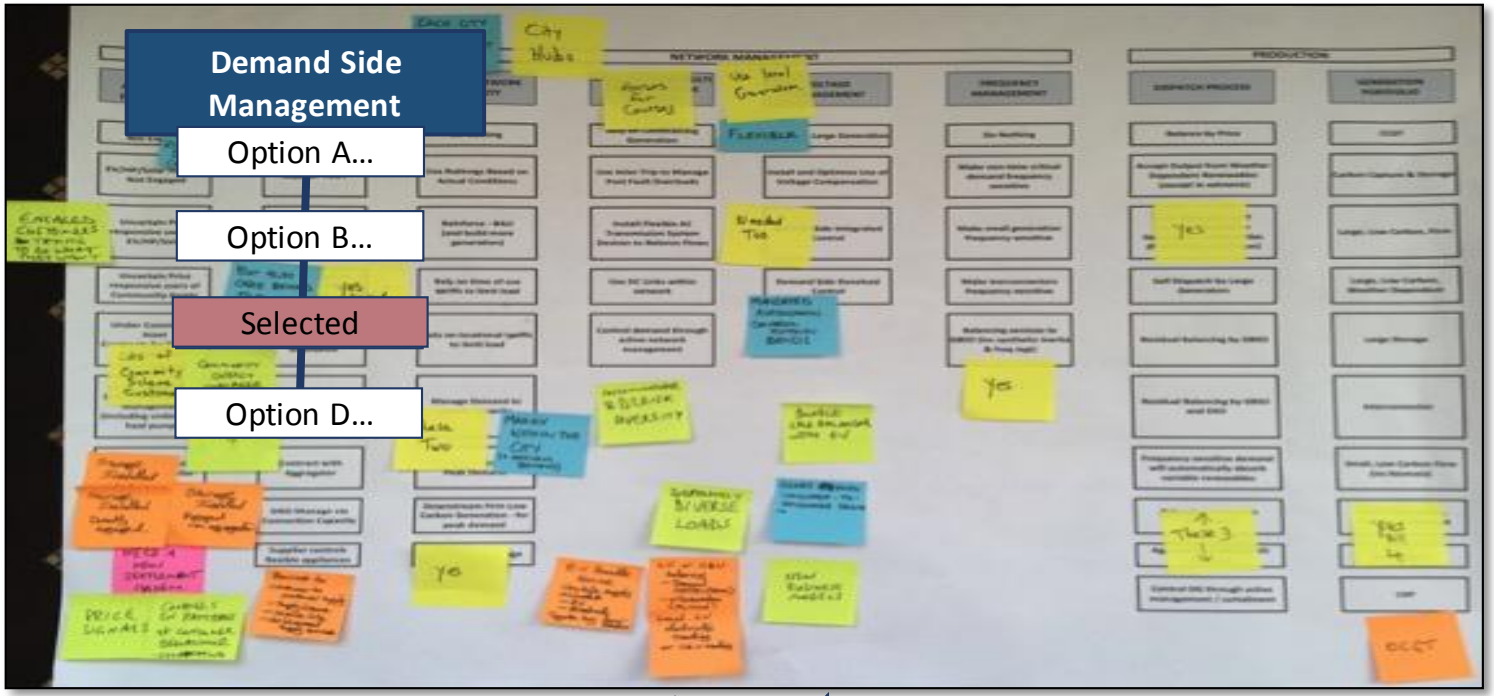
(Modelled as having a fully rated connection)

Device

- Moderate load in response to system frequency
- Moderate load in response to Dx request
- Monitor state of charge
- Enable user selection of charging requirements
- Charge vehicle/operate heat pump to meet customer requirements at minimum cost

ER

Simplifying Whole System Strategies



CONSUMPTION **PRODUCTION**

The options selected must all be **consistent** and **coherent** within each strategy.

Outcome

Provisional Core Concepts for Whole System (1)

Do Nothing

- Not meaningful. The transformation has started!

Power Sector Adaptation

- **Power sector maintains business as usual, accommodating incremental development**
- Evolutionary approach. Largely reactive to new demands and opportunities.
- No expectations of major changes in customer behaviour.

Power Sector Leadership

- **Power sector provides leadership, engaging extensively with active customers**
- Development of existing statutory and license obligations. DNOs undertake DSO roles.
- GBSO/DSO coordination for integrated approach to balancing and constraint management.
- More active engagement by customers reflected in new services, recognition and rewards.

Provisional Core Concepts for Whole System (2)

Customer Empowerment

- **Power sector becomes the facilitator, empowering commercial parties and consumers**
- Driven mainly by individual customer and commercial interests.
- Individuals and virtual networks of consumers organise themselves under new business models.
- New sector arrangements facilitate the entry of third parties, new services and edge technologies.

Community Empowerment

- **Power sector expands it facilitator role, empowering communities and smart cities**
- Driven by local interests and strong investment in smart city infrastructure.
- Communities, geographic and virtual, will need flexibility to follow complex agendas.
- Part of a wider 'Internet of Things' with greater peer to peer engagement including local market and services.


Thank you

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OFGEM Response to 2015 System Operability Framework

Catherine Williams
Head of Commercial Regulation,
Electricity Transmission

The SOF

- We are in a period of significant change - we welcome the SOF as an important tool in identifying and addressing ways in which the impact of that change can be managed.

- SOF sits alongside FES, ETYS and new NOA report – all inform development of a long term, efficient system at lowest cost to consumer which is not just about building new transmission lines

- Encourage all parties to contribute to development of these and share thoughts/ideas to inform their development, and the development of solutions to address some of the challenges they identify.

- Encourage continued development of these by NGET – particularly thinking about how to incorporate whole system impacts. Important role for DNOs to play to ensure that they provide clear information to NGET about how their networks impact on the transmission network.

The bigger picture

- There are many pieces of work across industry that will help address some of these issues – both technical and regulatory/commercial
- Some of the issues require fundamental thinking on questions of policy and broader impact on the whole market need careful consideration

Technical aspects	Broader issues
DECC/Ofgem Smart Grid Form e.g. WS6 & WS7	Ofgem/DECC flexibility project (see next slide)
EU network codes – e.g. RfG	DECC – smarter energy system, independent system operator
ENA work streams e.g. high volts, SoW process	IET/ESC – future power system architect
Grid code workgroups	National Infrastructure Commission
SQSS modifications	SO incentives
	EU context e.g. CEER DSO working group, flexibility task force

- Also actions that individual parties can take e.g. NGET and DNOs agreeing a framework for engagement that allows DNOs to support NGETs role in managing the whole system

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Our work on flexibility

A joint project with DECC

- Position paper published on 30 September, launching work in 5 priority areas:

Clarifying the legal and commercial status of **storage**	Clarifying the role of **aggregators**	Encouraging the transition from **DNO to DSO roles**	Enabling increased **I&C participation in DSR** opportunities	Examining the evolution of **distribution tariffs**

Over the next year we will be working to:

- Clarify the future activities of DNOs, following the transition to a DSO role
- Clarify the nature of DNO interactions with the SO and TO, with a view to ensuring effective engagement
- Identify any barriers to, and consider what steps are needed to effect, the transition to these new activities/interactions

We welcome expressions of interest in the DNO-DSO, or any other work streams. Please email flexibility@ofgem.gov.uk if you wish to register interest or share views/thinking.

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Ofgem is the Office of Gas and Electricity Markets.

Our priority is to protect and to make a positive difference for all energy consumers. We work to promote value for money, security of supply and sustainability for present and future generations. We do this through the supervision and development of markets, regulation and the delivery of government schemes.

We work effectively with, but independently of, government, the energy industry and other stakeholders. We do so within a legal framework determined by the UK government and the European Union.

www.ofgem.gov.uk

Electricity Ten Year Statement 2015

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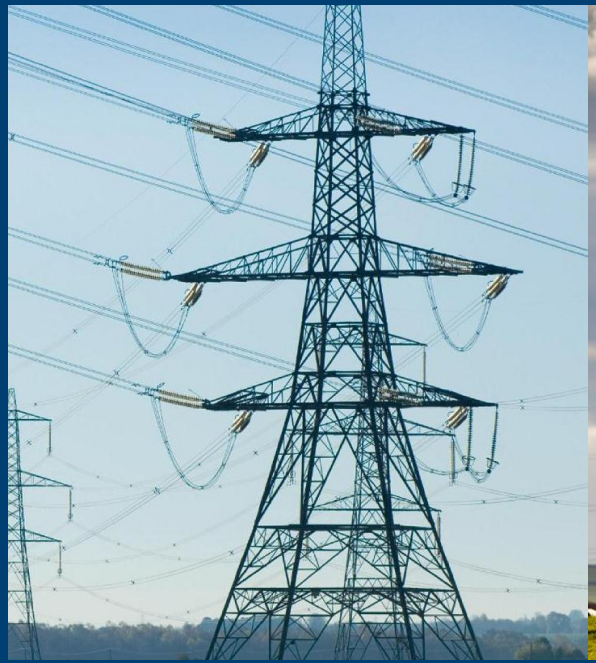
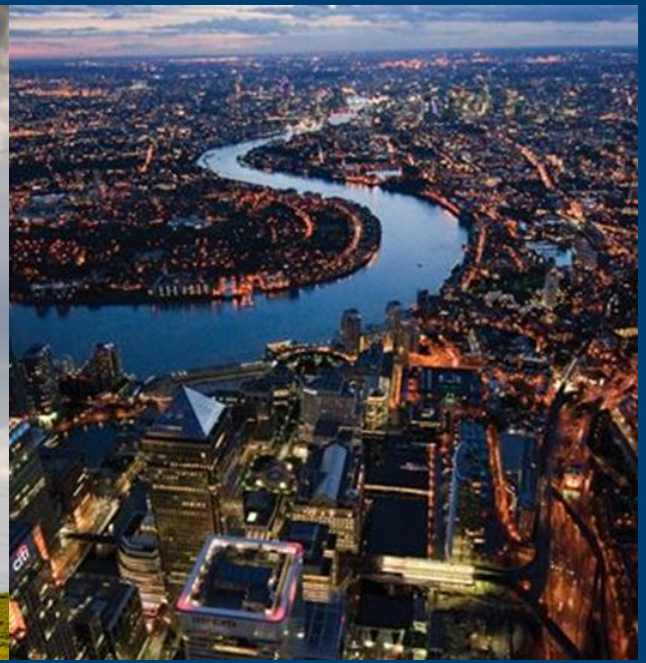




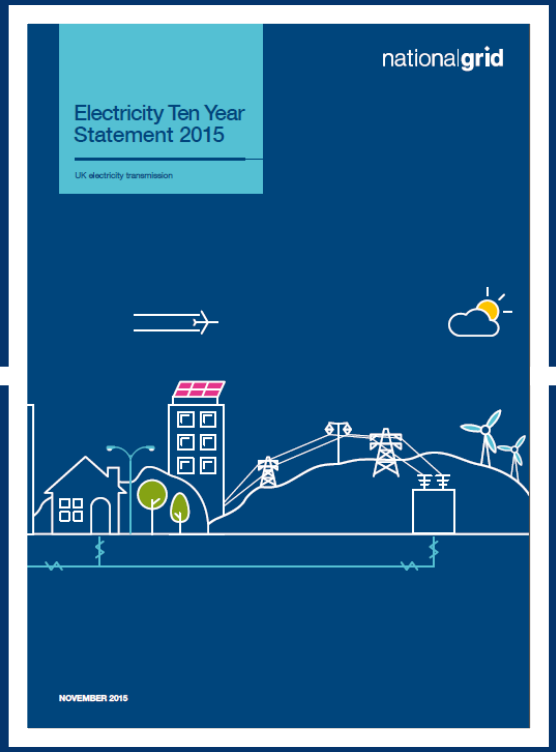
Nicholas Harvey – Network Development Strategy Manager

Network Capability - Electricity, System Operator

From Requirements to Solutions

nationalgrid

The Future Scenarios



The Future Requirements

The Future Solutions

From Requirements to Solutions

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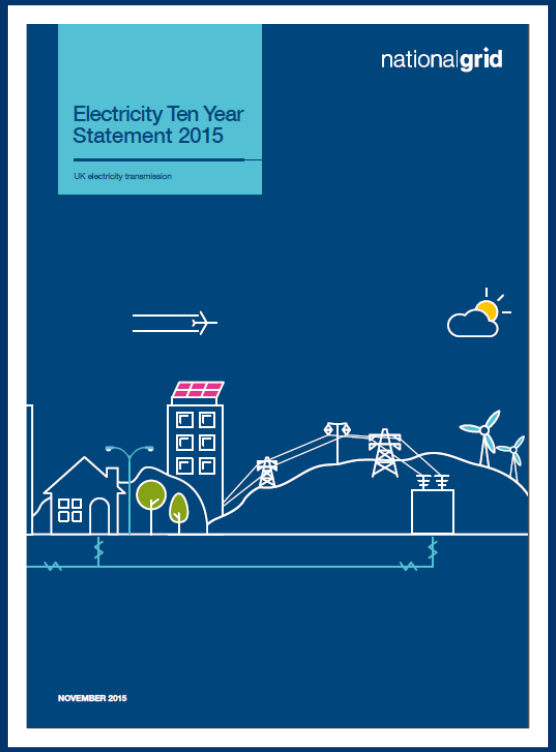
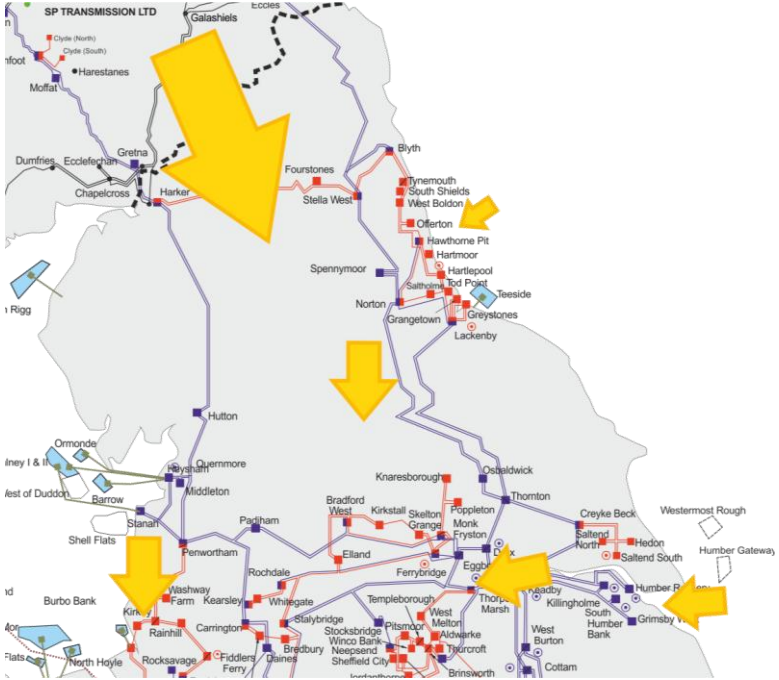


- Electricity Ten Year Statement
- Part One of our annual wider works planning cycle
- Focuses on future capability needs of transmission network
- Part Two will be the Network Options Assessment (NOA)

ETYS Overview

- Translate the Future Energy Scenarios into bulk power transfers across network boundaries
- Each boundary cuts across a major power route of the transmission system
- Highlights need for future boundary solutions
- Allows base for GB economic assessment



Driven by External Factors

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New Nuclear and high volume of Renewables connect towards the periphery of the network so power has to travel longer distances to reach demand

More interconnectors connect around the country which can import and export with Europe which vary power flows significantly

Closure of ageing traditional generation which is usually synchronous and located close to the demand which leads to decreasing system support

Unprecedented growth in Embedded Generation connect at distribution levels across the country which reduces demand and introduces high voltage issues

Increased Interconnection

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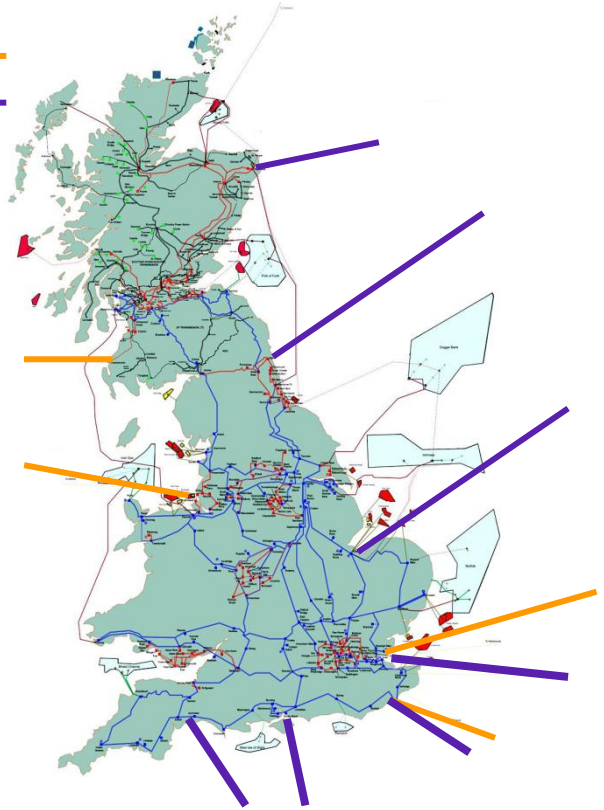
Name	Connects to	Capacity	Key Date
IFA	France	2000 MW	1986
Moyle	N. Ireland	450 MW	2002
BritNed	Netherlands	1200 MW	2011
EWIC	Ireland	500 MW	2012
ElecLink	France	1000 MW	2016
Nemo	Belgium	1000 MW	2018
NSN	Norway	1400 MW	2019
IFA 2	France	1000 MW	2019
FAB Link	France	1400 MW	2020
NorthConnect	Norway	1400 MW	2021
Viking Link	Denmark	1000 MW	2022

6 have Cap and Floor Regime agreed with Ofgem

- **Nemo**
- **NSN**
- **IFA 2**
- **FAB Link**
- **Viking Link**
- **Greenlink**



Regional Challenges

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Large growth in renewable generation capacity in remote locations

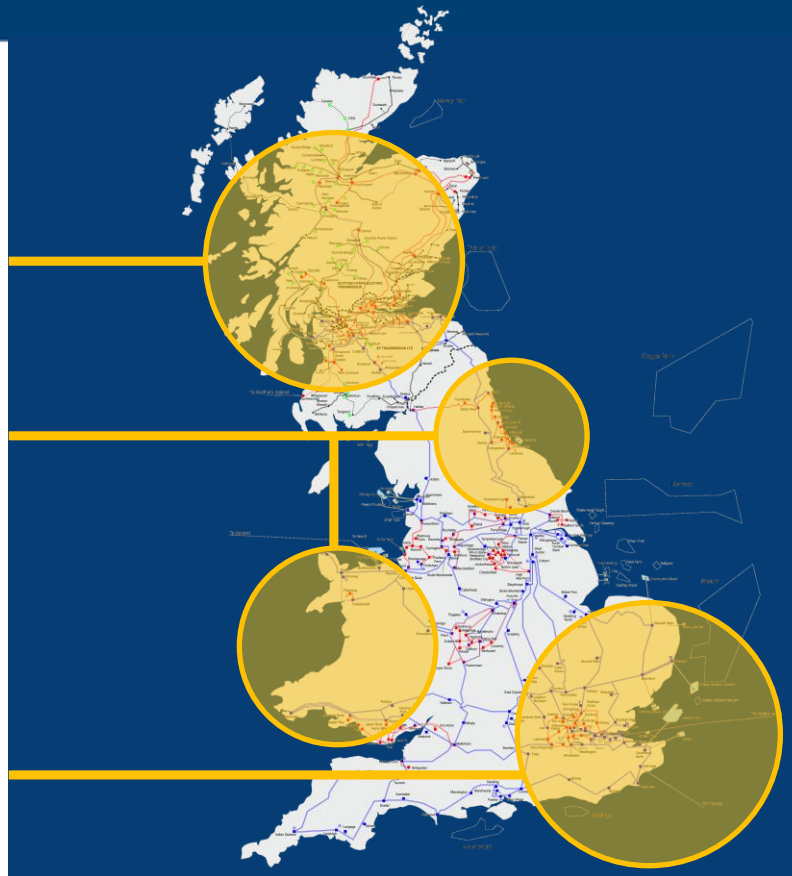
The restrictions of the Scottish boundaries are often caused by the rapidly increasing generation (mostly from renewable sources) connecting with Scotland. Need to transport the generation through the Scottish networks to southerly demand centres in England

Rapidly growing north-to-south power flows

Generation increase in Scotland, Humber and NE England needs to be transported to southern demand centres through this region. Rapid generation rise in Wales with relatively low capacity networks require solutions to export to rest of country

Offshore Wind and Interconnection

Long double circuits require strong voltage support especially in times of a fault. Voltage compliance and stability need to be maintained whilst allowing sufficient thermal capacity for interconnector import and export

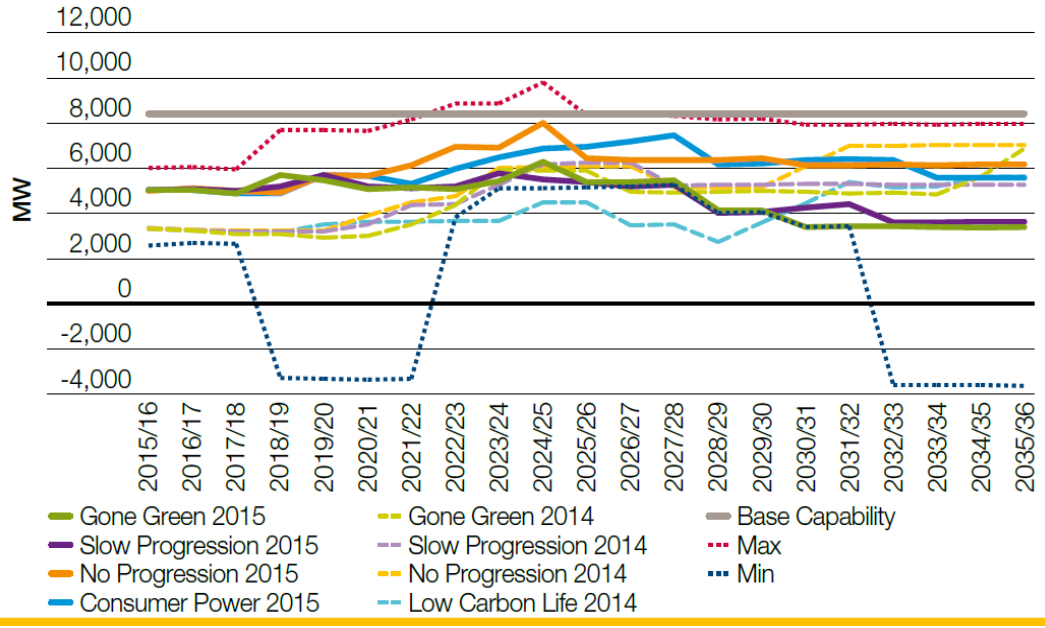


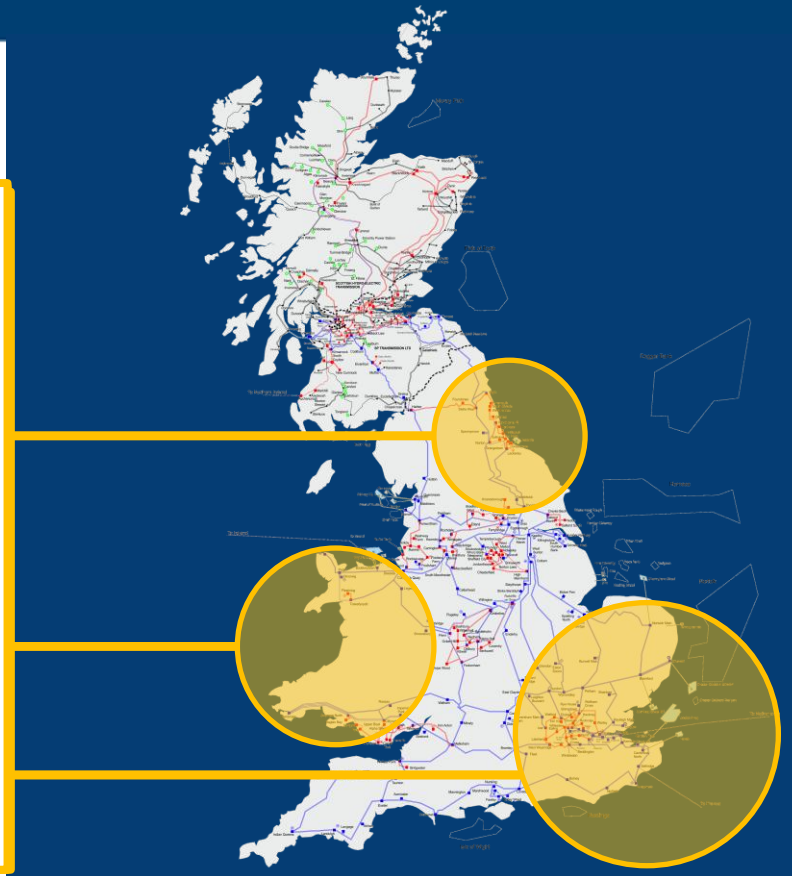
Regional Challenges

nationalgrid

Changing generation drives changes in transmission requirements

Required transfer and base capability for boundary B15





Meeting these Challenges

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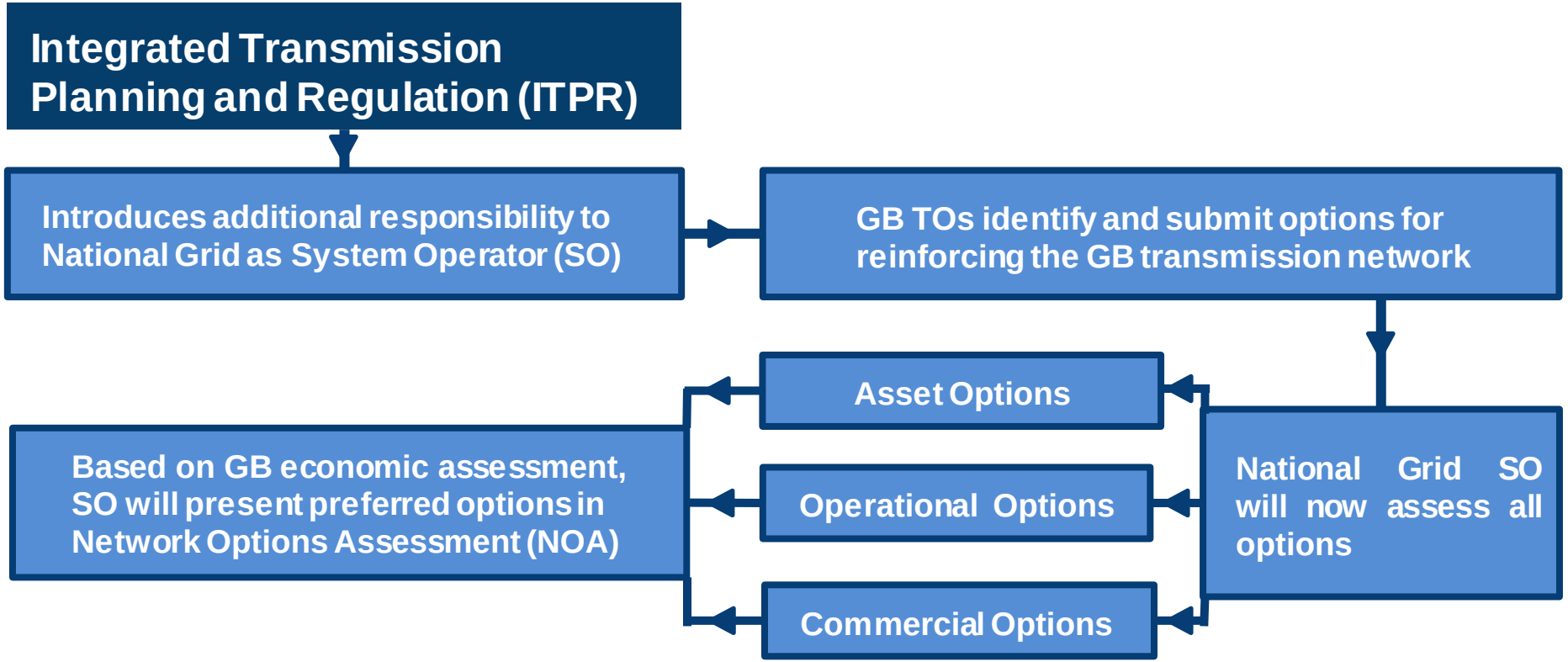

Listening to Our Customers

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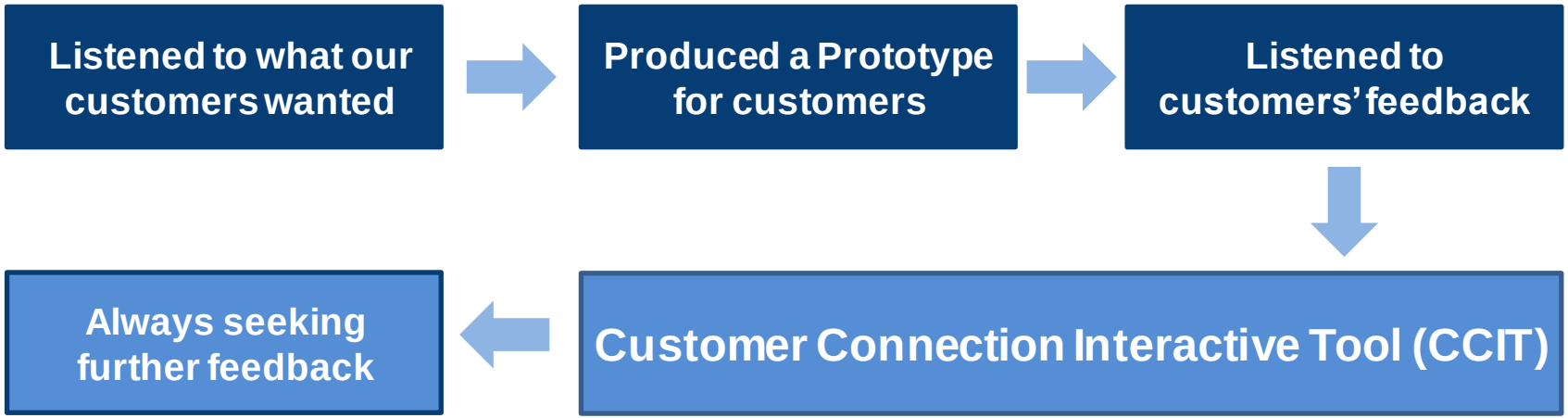
- We want to help our customers early in the NETS connection process

- We want to give them access to information about the England and Wales Network in a simple and clear way



Customer Connection Interactive Tool

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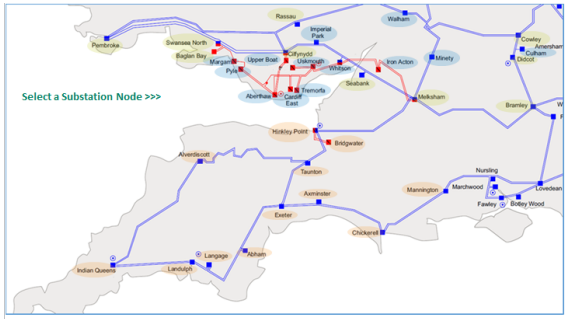
- Information about substations in England and Wales
- Graphical representation of expected connection to the regional network
  - Contracted (TEC/Interconnector Register)
  - Future Energy Scenarios
- Colour-coded heat map illustrating expected connection capacity and time frames
- Data related to incremental wider works in various parts of the network



View TEC/FES Data

View ETYS Data

Return to Dashboard

Select Capacity (MW)

<=300

Connection Timeframes Index

4 - 7 Years

7 - 10 Years

10+ Years

Substation	Chickerell
Location	Click for location in Google maps
GIS/ AIS Status	AIS
Indoor/ Outdoor Status	Outdoor
Substation Layout	Double Busbar

Air Insulated Switchgear (AIS):
Components of AIS equipment are typically discrete and connected by open busbars in air. A traditional design requiring more space compared to GIS solutions. Indoor AIS is usually harder to extend compared to outdoor AIS.

Indoor/ Outdoor Substation:
Indoor substations usually pose more challenges to extend as opposed to outdoor substations depending on several factors including space, cost, flexibility and reliability

Double Busbar Substation:
Double busbar configurations, depending on specific conditions, are generally easier to expand depending on several factors including space, cost, flexibility and reliability.

Let's Keep This Engagement

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Visit our ETYS site for this year's ETYS and explore the Customer Connection Interactive Tool: http://www.nationalgrid.com/etys

Join our mailing list via the ETYS page and receive updates for the ETYS newsletter and the CCIT

Take part in our Launch Survey:
https://www.surveymonkey/r/ETYS2015

Tell us how we can improve things further:
transmission.etys@nationalgrid.com

Thank you for Listening

nationalgrid

ETYS 2015: http://www.nationalgrid.com/etys

Launch Survey: https://www.surveymonkey/r/ETYS2015

Further Feedback or Questions: transmission.etys@nationalgrid.com

Nicholas Harvey – Network Development Strategy

Network Capability, System Operator

Contract Services Workshop 2015

nationalgrid

Nick Blair & Andrew Ford – Senior Account Managers, Commercial Operations

Contents

- Who We Are
- Balancing Services Incentive Scheme
- Contracting for Existing Services
- Developing New Requirements
- Feedback Session

Contract Services

Mike Edgar,
Contract Services Manager

Adam Sims

Leads our response contracting activities:

- FFR
- Enhanced FFR

Andrew Ford

Leads our system security contracts:

- Black Start
- Intertrips
- BM Start Up

Nick Blair

Leads our reserve contracting activities:

- STOR
- Fast Reserve
- Demand Turn Up

Rebecca Yang

Leads our Demand Side Response engagement:

- DSR Forum
- New Customers
- New Contracts

Will Kirk-Wilson

Leads our interconnector contracting activities

Balancing Services Incentive Scheme

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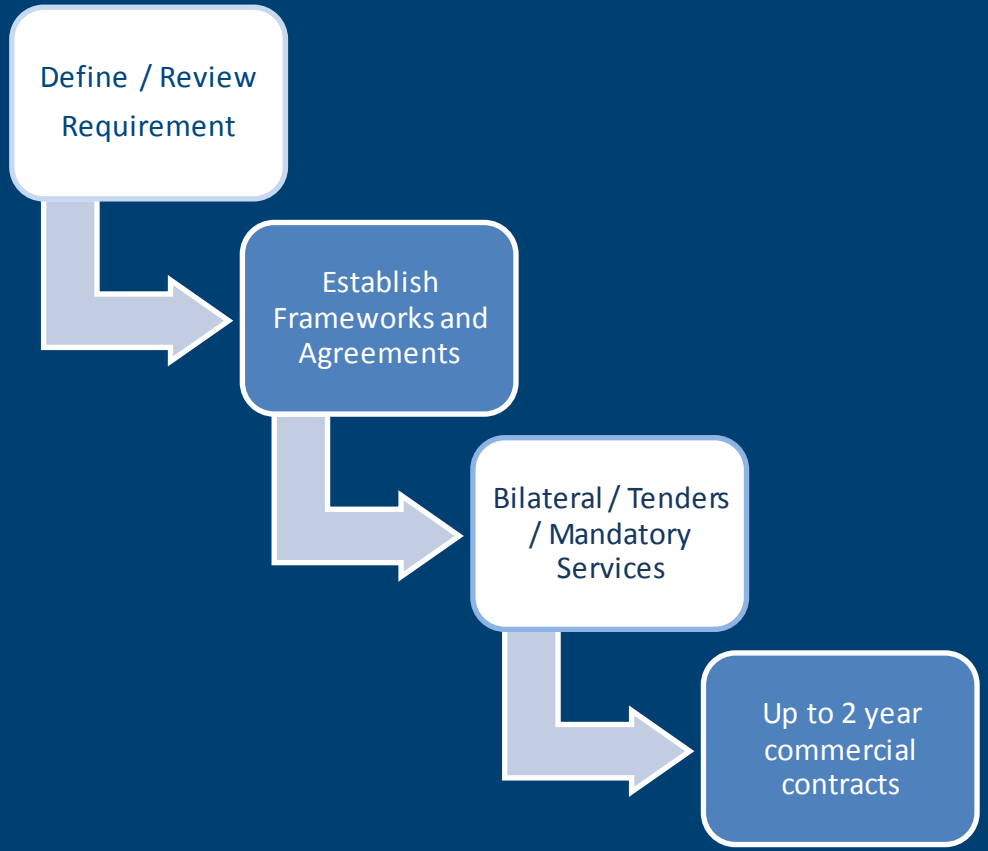
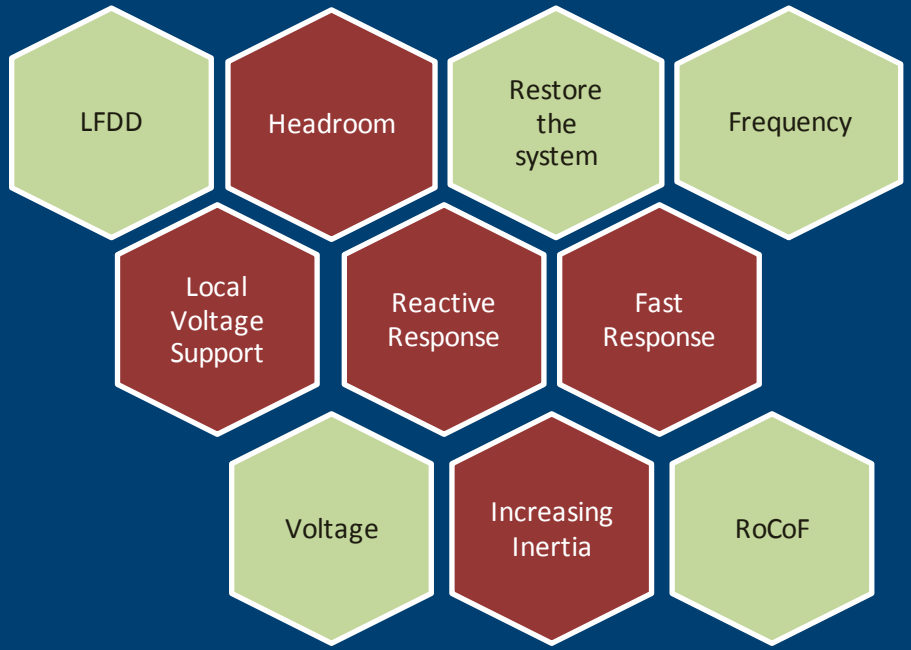
- Current scheme is two years long
- The system and the markets change
- We are discussing the merits of a longer term deal

Contracting for Existing Services



Developing New Requirements



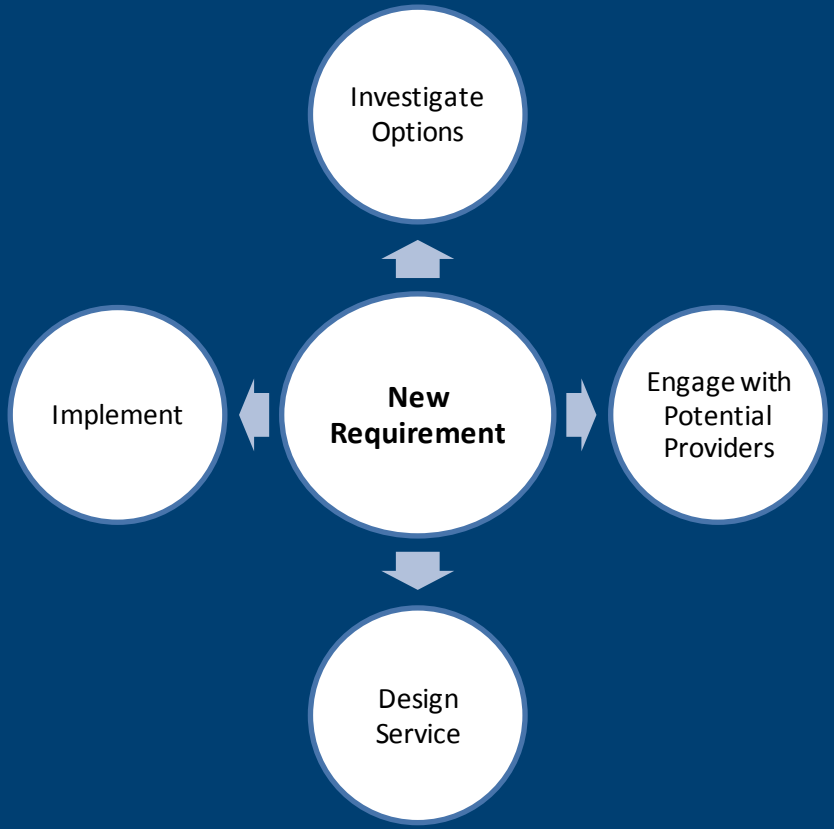
KEY

Requirement

Solution

Please note: requirement / solution links for illustration only

Developing New Requirements



Case Study – Enhanced Frequency Response

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Nov '14	• New Requirement: Issue with reducing inertia identified
Jan – Jun '15	• Investigate Options: Explore technical solutions
Apr – Jul '15	• Engagement: Discussions with providers
Sep '15	• Engagement: Invitation for Expressions of Interest
Nov '15	• Implement: Pre-qualification of participants for tender event

Summary

- The SOF highlights some interesting challenges
- The way we need to contract for services is changing
- Our development relies on provider engagement

System Operator Innovation Strategy

nationalgrid

John West-Electricity Policy & Performance Manager,
Network Capability - Electricity

National Grid SO Innovation Themes

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Examples of Ongoing Innovation Projects

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- SOF 2014 identified the need for 2 major innovation projects:
  - Smart Frequency Control Project (Non-Synch Generation)
  - South East Smart Grid (Smart Grid)

- Other ongoing projects include:
  - DIVIDE Voltage Dependent Load Behaviour (Demand)
  - Control & Protection Challenges in Power Systems (Non-Synch Generation)
  - PV Monitoring & Forecasting (Distributed Generation)
  - Detection and Control of Inter Area Oscillations (Non-Synch Generation)

SOF 2015 Future Operability Strategy - Future Innovation Areas

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Topics	SOF 2015 Strategy Recommendations	Future Innovation Areas	SO Innovation Themes
	Services and Capabilities	Energy Storage; Support from Embedded Generation	1. Demand; 2. Non-sync Generation
	Whole System Solutions	DSO Services and Co-ordination; Support from Demand Customers	3. Distributed Generation; 4. Smart Grid
	Increased Flexibility	Flexible Non-Synchronous Generation; Flexible Synchronous Generation	5. Risk Management

Future Operability Strategy

SOF 2015 Future Operability Strategy
- Future Innovation Areas

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Support for Innovation Projects

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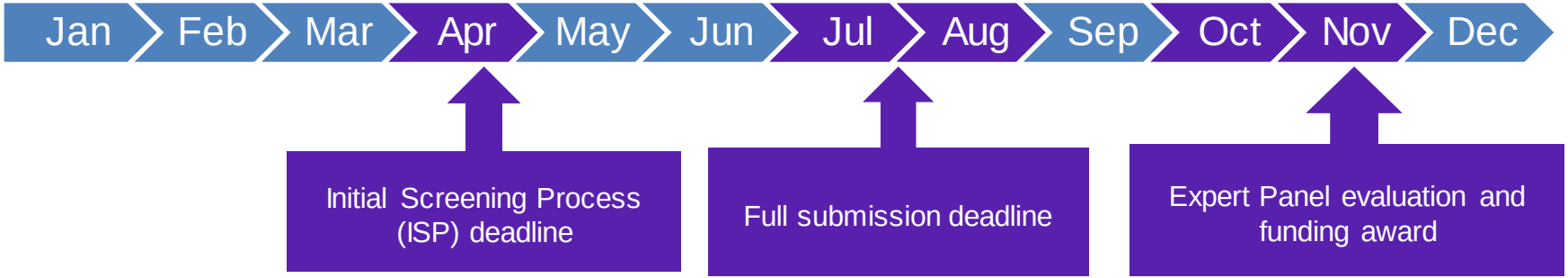
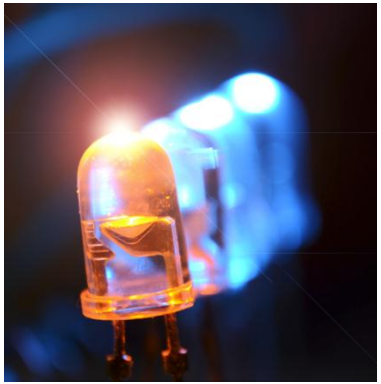
- We already work with many partners nationally and internationally (e.g. DS3) to identify innovation needs
- Innovation funding is available including our Network Innovation Allowance (NIA) and the Network Innovation Competition (NIC)
- NIA projects can be relatively small or larger scale
- NIC projects are larger and go through thorough evaluation and review



Innovation

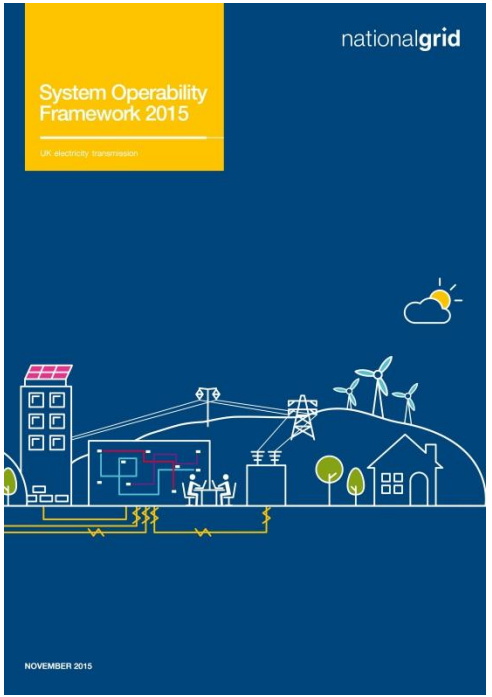
- As in other areas of energy, innovation is key to meeting network challenges.
- The challenges shown in SOF are areas where innovation projects may help.
- We want to use support that is available to develop further innovation projects.
- We want to collaborate nationally and internationally.
- We'd like your ideas on innovation opportunities.



System Operability Framework 2015 – Next Steps

Vandad Hamidi

SMARTer System Performance Manager



System Operability Framework 2015 – Next Steps

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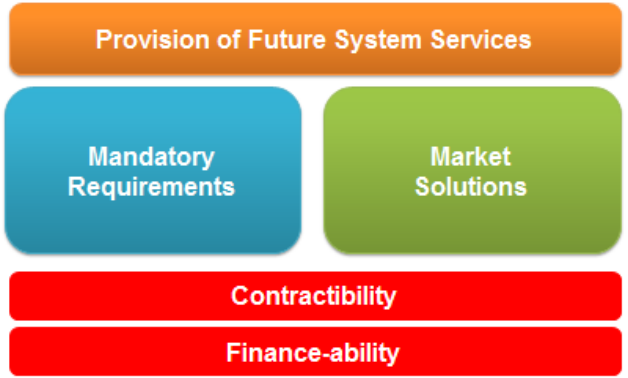
- Continue developing commercial appraisal methodology:
  - Multiple-service
  - Dependencies
  - Sharing with the industry
- Extend technical assessments to economic assessment;
- Interaction with Grid Code and Distribution Code Review Panels;



System Operability Framework

Thank you and have a safe journey back!

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