Welcome DS3 Advisory Council Members

- Please log in with mic muted
- Cameras optional

- Questions can be asked using **Raise Hand**  function on MS Teams or submitted to DS3@Eirgrid.com

EIRGRID SONI

DS3 Advisory Council – Meeting 29

MS Teams – Virtual Meeting

23 March 2021

EIRGRID SONI

Agenda

Topic	Time	Speaker
Introduction & Welcome	13:00	Liam Ryan, EirGrid (10 min)
Industry Presentations • **DS3 System Services & Batteries**	13:10	Joe Duddy, RES (15 min)
NIEN – Flex Programme	13:25	Cormac Bradley, NIEN (15 min)
System Data Summary (2020)	13:40	Emma Fagan, EirGrid (5 min)
DS3 Milestone Plan – Replan **Programme Updates** • **Achievements 2020** • **Negative Reserve** • **RoCoF** • **70% SNSP Trial** • **75% SNSP Trial** • **Control Centre Tools (CCT) - LSAT /RMT-I** • **CCT remaining tools – RMT-E / VTT** • **DS3 System Services Procurement** • **Qualification Trial Process (QTP)** • **FlexTech**	13:45	Emma Fagan, EirGrid (30 min)

EIRGRID SONI

Agenda

Topic	Time	Speaker
BREAK	14:15	(10 min)
Shaping Our Electricity Future · **Future Networks** · **Future Markets** · **Future Operations**	14:25	Robbie Aherne, EirGrid (30 min) Jonathan O Sullivan, EirGrid (30 min) Eoin Kennedy, EirGrid (30 min)
Control Centre of the Future	16:10	Simon Tweed, EirGrid (10 min)
Future of the Advisory Council	16:20	Eoin Kennedy, EirGrid (10 min)
AOB	16:30	All (10 min)
Discussion / Questions	16:40	All (10 min)
Closing remarks and comments	16:50	Eoin Kennedy, EirGrid (10 min)

EIRGRID SONI

DS3 System Services & Batteries

Joe Duddy

23rd March 2021

power for good

Agenda

Response volume

Trajectory

Charging

Contracted service vs Grid Code expectation – response volume

DS3 contracts for frequency response are typically from 0 MW to MEC or MIC

e.g.

Under frequency response = MEC

Over frequency response = MIC

“Grid Code” (battery implementation note) expects response available over full operational range, where:

Operational range = MEC + MIC

Contracted service vs Grid Code expectation – response volume

	Active under frequency trigger setting (Hz)	Active under frequency trajectory setting (Hz)	Active Maximum under frequency response setting (MW)	Active over frequency trigger setting (Hz)	Active over frequency trajectory setting (Hz)	Active Maximum over frequency response setting (MW)
Mode 1	49.8	0.3	Operating range	50.2	0.3	Operating range
Mode 2 Based on units best capability	*	**	Operating range	*	**	Operating range
Mode 3	49.8	0.5	Operating range	50.2	0.5	Operating range
Mode 4	49.9	2	Operating range	50.1	2	Operating range
Mode 5	49.8	0.5	50% Operating range	50.2	0.5	50% Operating range

* Contracted trigger value

** Contracted trajectory value, scaled pro rata from contracted response to operational range, to ensure MW/Hz does not exceed contracted volume / contracted trajectory.

Speed of response over full operational range may be slower than contracted speed of response (i.e. MIC to MEC vs zero to MEC)

Contracted service vs Grid Code expectation – trajectory definitions

DS3 contract trajectory definition differs from Grid Code definition

Scope for confusion between contract “trajectory” and grid code / signal list “trajectory” values

Suggestion: Grid Code to define and reference frequency droop (consistent with present Grid Code and RfG) NOT trajectory

DS3 contract defined trajectories may result in different MW/Hz for overfrequency vs underfrequency responses

“Grid Code defined” (battery implementation note) trajectories require identical MW/Hz for overfrequency response vs underfrequency

Resolution of contradictions? Coordination between grid code drafting and DS3 system service teams?

Charging challenges

Limitations of IT and market systems:

a) Current market interfaces (MPI) cannot accept and process ‘negative’ Physical Notifications (PNs) into central scheduling, for charging of batteries;

b) Standard dispatch tools (EDIL) cannot relay ‘negative’ MW instructions for charging. Telephone instructions could be issued, but likely to be problematic for TSO and Users;

c) No appropriate battery storage market model, results in storage units being registered and setup as ‘Multi-Fuel Generator’ Units. Do not support a full operating range of export/import and preclude operation in the BM for charging.

Any questions?

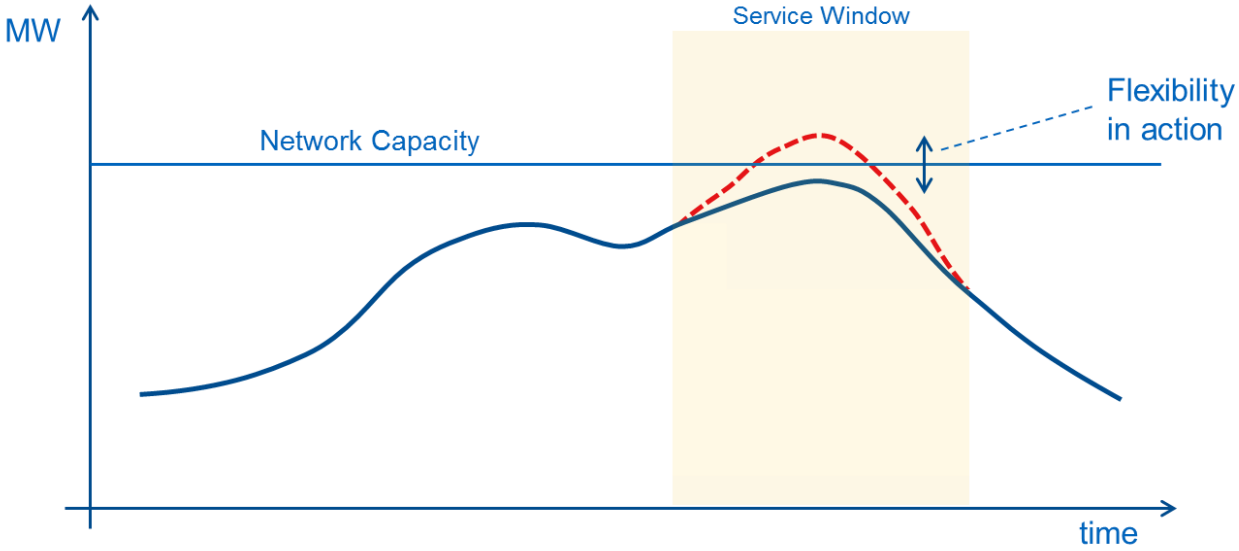
FLEX – DS3 ADVISORY COUNCIL

Tuesday 23 March 2021

FLEX Project

What is Flexibility?

A customers' ability to modify their generation or consumption in reaction to an external signal, thereby providing a service to the electricity network



Explicit Flexibility

Direct and indirect financial benefits to customers

Support investment in flexible, low carbon technologies

Faster delivery of network solutions, with minimal disruption

Optionality

Now: Active Power

Future: Reactive Power & more?

Objectives

Is Flexibility available, and can it be utilised effectively?

Availability

Technical & commercial viability

Develop processes – use of Flexibility services (present & future)

Principles

Visible & accessible	Simple & streamlined	Fair & neutral	Open & transparent

FLEX Trial in Numbers

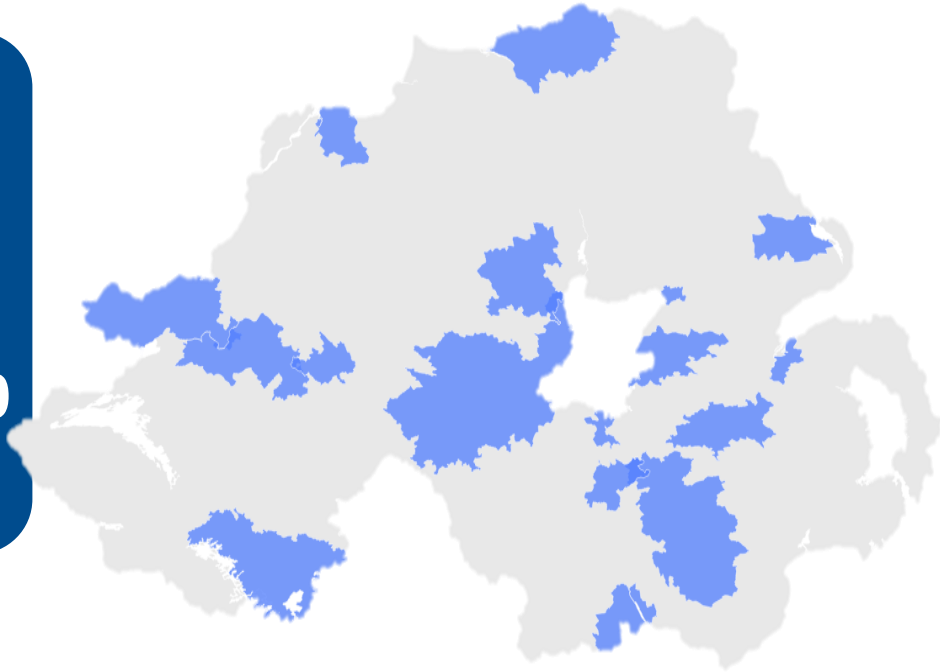
17
Flexibility Trial Zones

15%
Total NI coverage

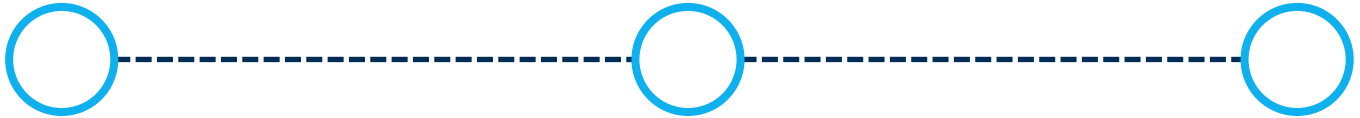
c.40 MW
35 GWh requirement
(A & U)

3
Flexibility products

£500,000
Budget available



Product Design



Sustain

Scheduled reduction in peak loading

Scheduled service delivery (months to years notice)

Utilisation payments only

Secure

Pre-fault reduction in peak loading, based on forecasts

≥ 24 hours activation notice/commitment

Availability & utilisation payments

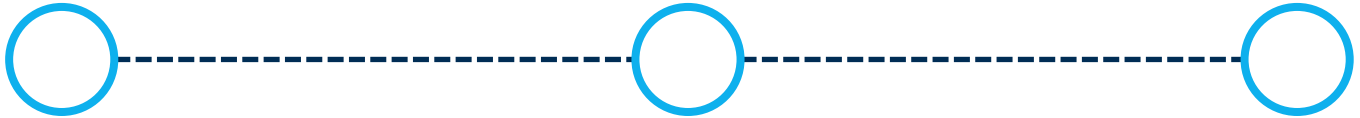
Dynamic

Post-fault reduction in peak loading

3 minutes activation notice/commitment

Availability & utilisation payments

Product Design



Sustain | **Secure** | **Dynamic**

50 kW minimum aggregate Flexibility & No individual asset minimum

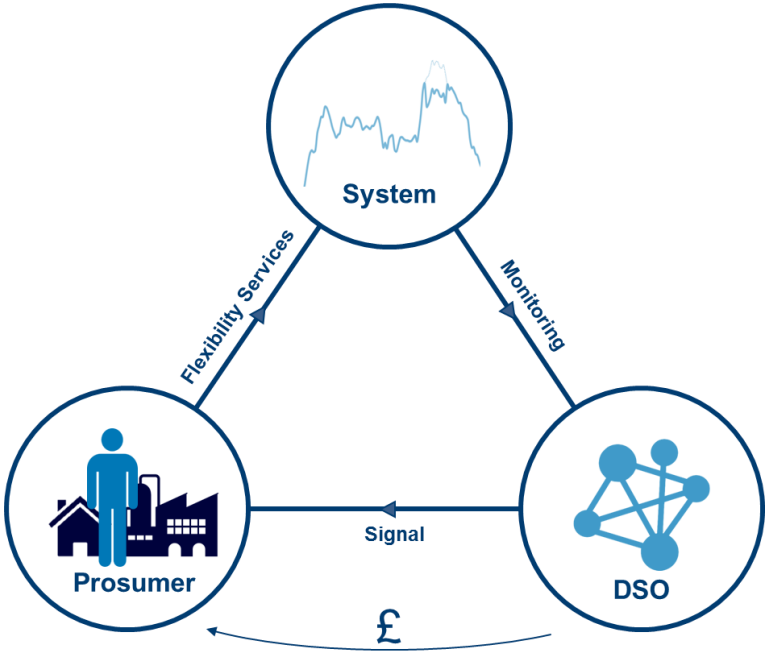
30 minute minimum service delivery (minimum run time)*

30 minute minimum meter data resolution

Streamlined testing arrangements & communications options

Removing barriers to entry - making Flexibility services (& FLEX trial) more accessible

Parameters



Initial contract 1 year (6 month Service Windows)

Expected commencement: October 2021

Service Windows identify periods during which Flexibility services are required

No obligation or payments outside of Service Windows

Flexible Capacity fixed for contract duration

Competitive Tender – Pay as Bid approach

16 zones demand turn down/generation turn up | 1 zone demand turn up/generation turn down

Trial Co-optimisation

Flexibility services are open to ALL

Not just market participants or balance responsible parties

No exclusivity clauses in Flexibility Service Agreements

Trial participants are responsible for managing their commercial obligations

Stakeholder engagement has identified potential pathways to realising stacked benefits and minimising conflicts

Central trial question: are conflicts material or theoretical?

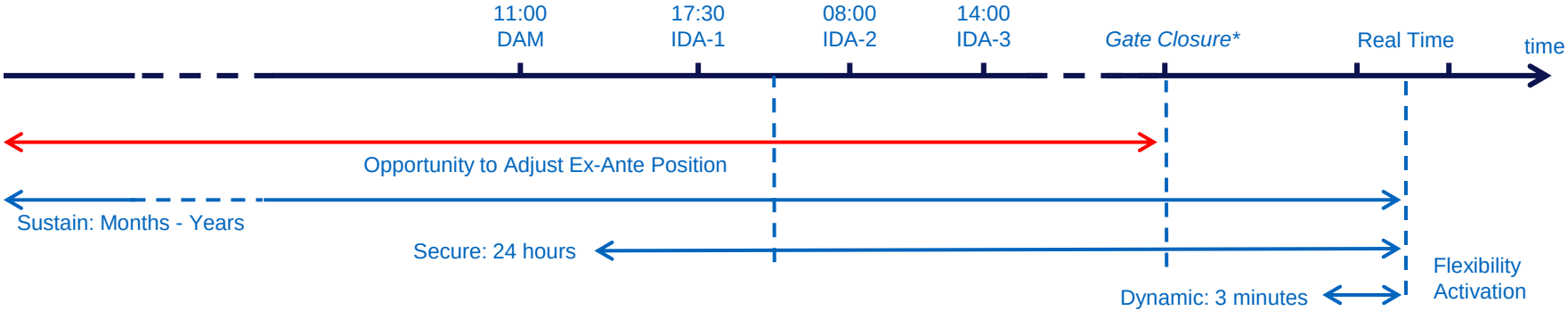
Expectations

Balance Responsible Parties – reflect Flexibility commitment/delivery in their balance positions

Dynamic product: different characteristics and commercial proposition

DS3 Providers – reflect Flexibility commitment/delivery in their availability declarations

FLEX & DS3 performance scalars and imbalance charges drive desirable behaviour overall



Key trial observation: how behaviour in markets and services evolves with a new commercial offering

Conclusion

Build	Test	Collate	Analyse	Report	Evolve

Trial Stages

- Market Assessment
- Commercial & Technical Design
- Stakeholder Engagement (refinement)
- Asset Registration
- *Procurement*
- Test (performance verification)
- Trial period
- Results analysis
- Report findings and recommendations
- Evolve Flexibility services

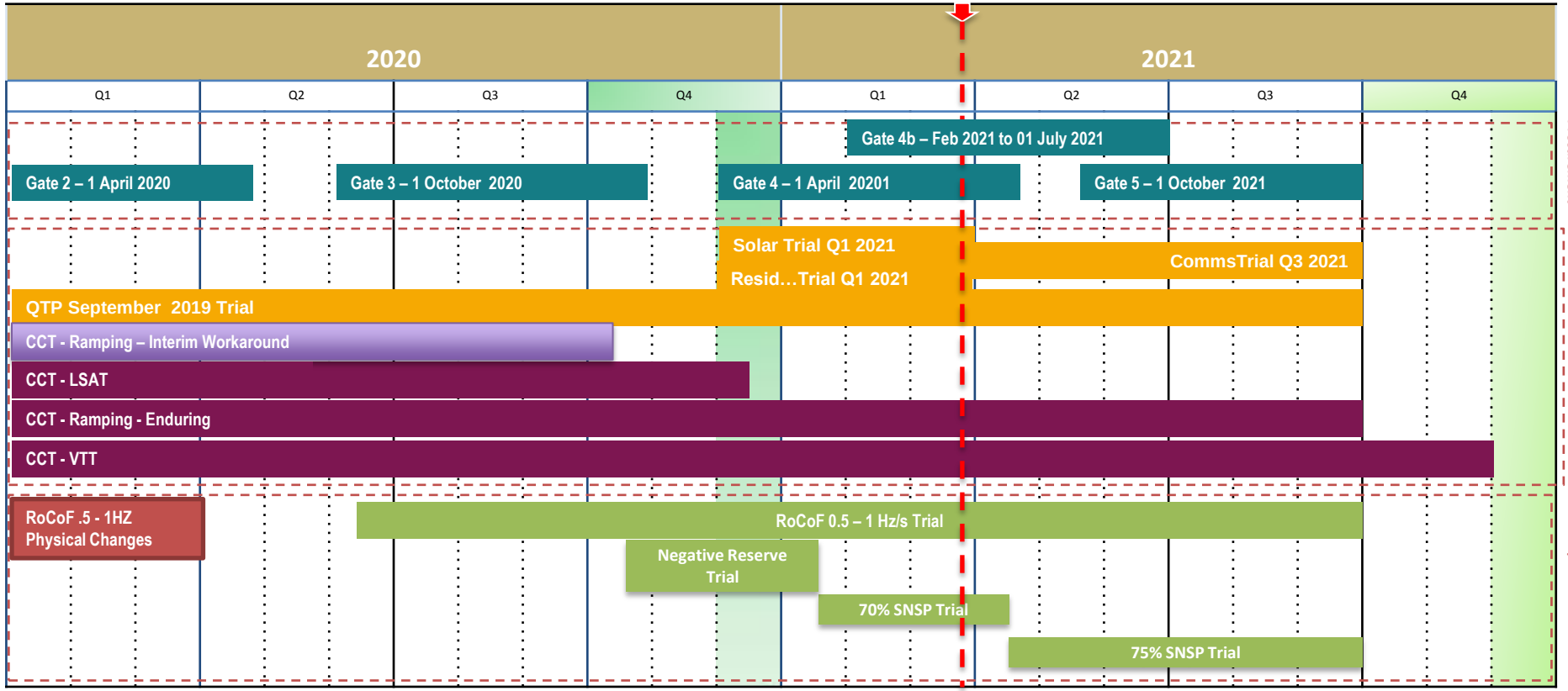
DISCUSSION

DS3 Programme

Emma Fagan, EirGrid

EIRGRID SONI

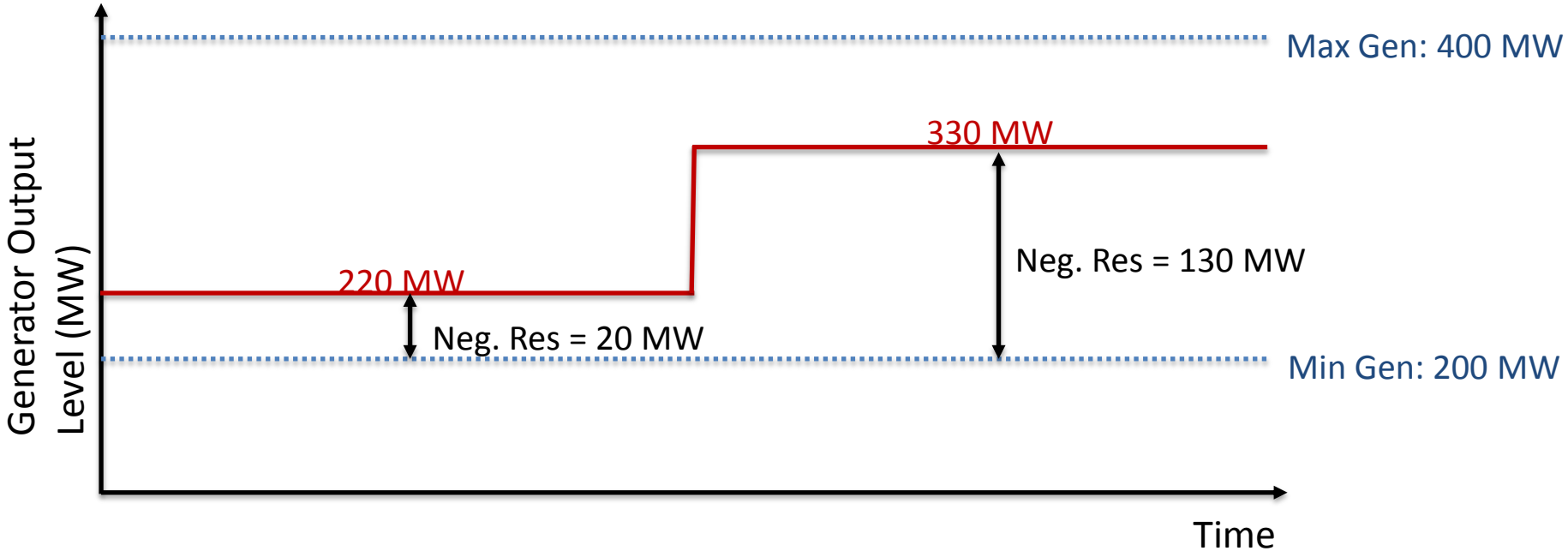
DS3 Revised Plan submitted to SEMC March 2021 – Milestone Plan V12.0



Achievements

- LSAT (Look Ahead Security Assessment Tool)
- Interim Ramping Margin Tool
- Negative Reserve trial completed
- RoCoF trial started
- 70% SNSP trial started
- DS3 System Services procurement - Gate 4 B

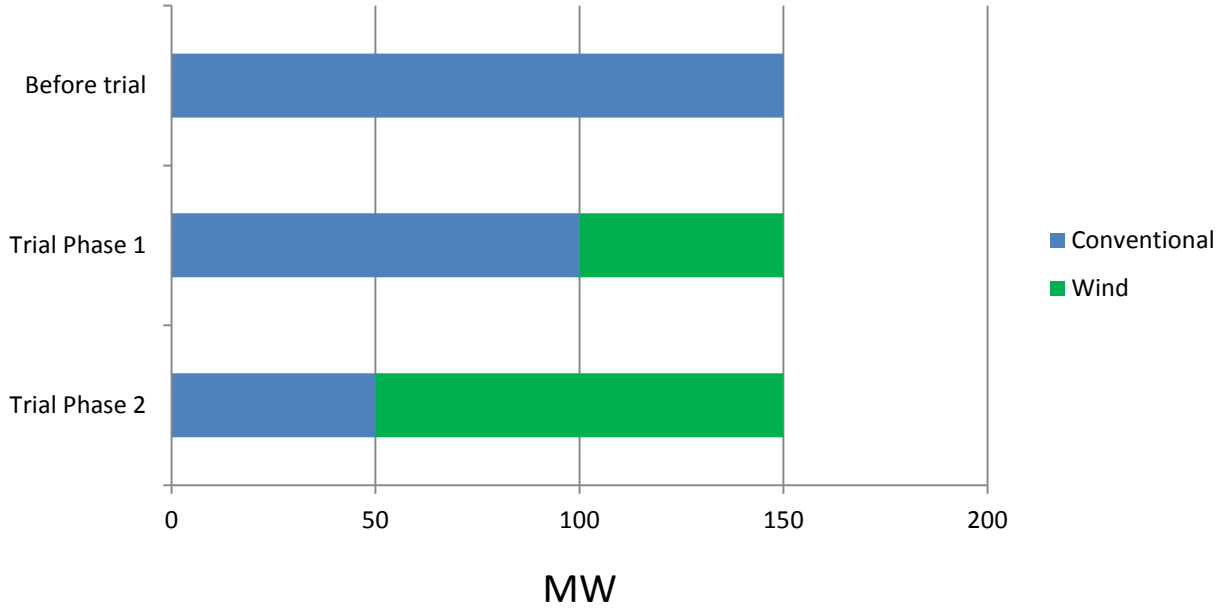
Concept of Negative Reserve



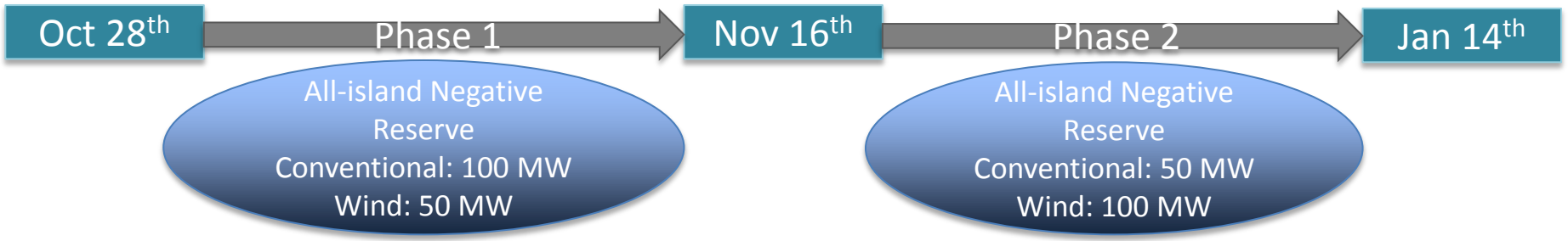
Negative Reserve Trial

- For a generator, the Negative Reserve provided is equal to the MW generation above its minimum operating limit
- In the event of the loss of a demand/outfeed, this MW generation held as Negative Reserve can be quickly reduced to prevent high frequency issues
- Negative Reserve has traditionally been provided by conventional generators
- The Negative Reserve Trial allowed wind generation to provide Negative Reserve in place of conventional units
- Trial commenced on October 28th 2020 and was successfully completed on January 14th

Negative Reserve Trial Progress



Negative Reserve Trial Overview



Allowing wind to provide negative reserve has avoided approximately 10% of curtailment

Status of Current Operational Trials

- 70% SNSP Trial
  - 250+ hours above 65% SNSP
  - New all-island wind record of 4,489 MW set in February 2021
  - No recorded difference in system behaviour to date with SNSP above 65%
  - Review of trial in April 2021

- RoCoF Trial
  - Trial commenced in June 2020
  - System is currently being operated with an upper limit of 1 Hz/s
  - Review of RoCoF trial outcomes in September 2021

75% SNSP Trial

- Studies are being finalised
- Plan to start trial in Q2 2021 and continue throughout summer

Completed Control Centre Tool Projects

- Look Ahead Security Assessment Tool
  - LSAT went live in December 2020 as the primary decision-support tool for real-time stability analysis by the Grid Controllers in Belfast and Dublin control rooms.
  - Work ongoing to optimise tool performance

- Ramping Margin Tool - Interim tool
  - RMT-I went live in September 2020

Remaining Control Centre Tool Projects

- Ramping Margin Tool - Enduring
  - Software development commenced for Sprint 1
  - Four Sprints planned with Go-Live planned for Q3 2021

- Voltage Trajectory Tool
  - Detail functional requirements and hardware design progressing
  - System Go-Live planned for Q4 2021

DS3 System Services Procurement

Gate 4

- Gate 4 tender is nearing completion.
- Signing of new agreements and amendments to existing contracts is in progress.
- Gate 4 outcome will be published in mid April after contracts have been executed on 01 April 2021.

Gate 4 B

- Gate 4B launched on 22 February 2021.
- The Bidders Conference was held on 03 March 2021.
- Tender submission deadline is 25 March 2021 with contract execution scheduled on 01 July 2021.

Qualification Trial Process

Solar

- The Solar trial is currently in the final stages of testing.

Residential

- Both trials are nearing completion. The trials have delivered the planned objectives of delivering system services at residential level.

Communication

- Both trials have taken longer to deliver than expected. The TSOs are engaging with both participants to complete the trials by September of 2021.

2021 QTP

- The TSOs received no tender applications for the 2021 QTP; however, the TSOs are in discussion with industry stakeholders on possible trials.

FlexTech

- The TSOs recognise that the level of stakeholder engagement has not been as comprehensive as originally planned for 2020
- We are now beginning to progress priority areas in collaboration with the DSO/DNO
- Throughout 2021 - TSOs are planning focussed engagement with industry at the necessary stages through consultations and workshops
- On the Hybrid Multiple Legal Entities consultation, the response is currently progressing through the final stages of review. This has taken longer than expected due to the complexity of the required changes and consideration of industry feedback.


Break – 10 min

Agenda Part 2

Topic	Time	Speaker
BREAK	14:15	(10 min)
Shaping Our Electricity Future · **Future Networks** · **Future Markets** · **Future Operations**	14:25	Robbie Aherne, EirGrid (30 min) Jonathan O Sullivan, EirGrid (30 min) Eoin Kennedy, EirGrid (30 min)
Control Centre of the Future	16:10	Simon Tweed, EirGrid (10 min)
Future of the Advisory Council	16:20	Eoin Kennedy, EirGrid (10 min)
AOB	16:30	All (10 min)
Discussion / Questions	16:40	All (10 min)
Closing remarks and comments	16:50	Eoin Kennedy, EirGrid (10 min)

EIRGRID SONI

Shaping Our Electricity Future

Robbie Aherne, EirGrid
Jonathan O' Sullivan, EirGrid
Eoin Kennedy, EirGrid

EIRGRID GROUP

Ireland & Northern Ireland

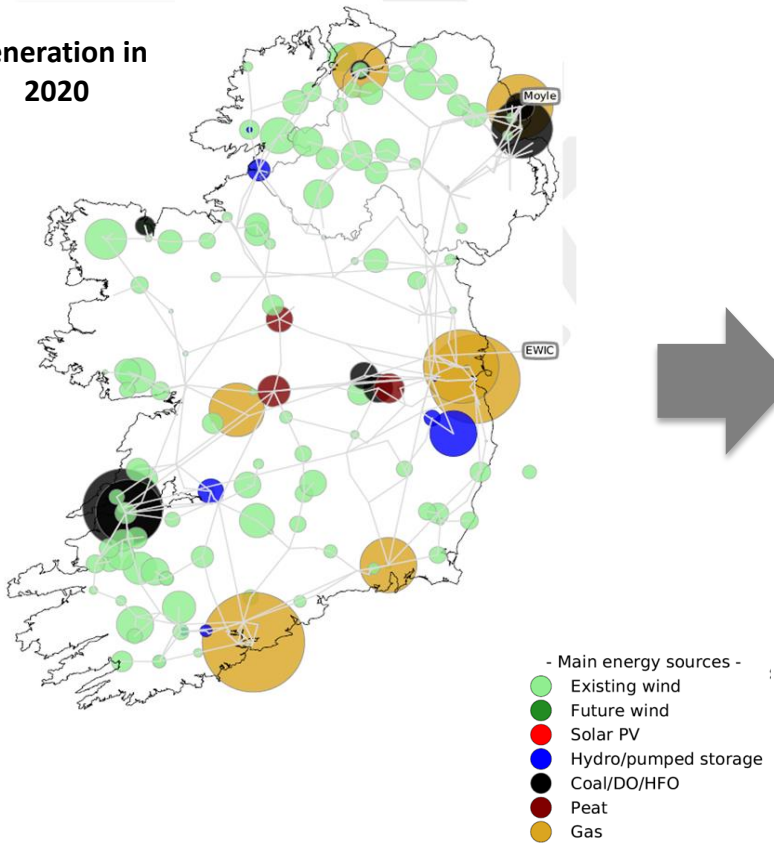
Develop an integrated vision of the power system and market in 2030.

70% RES-E by 2030: Whole of System Challenge

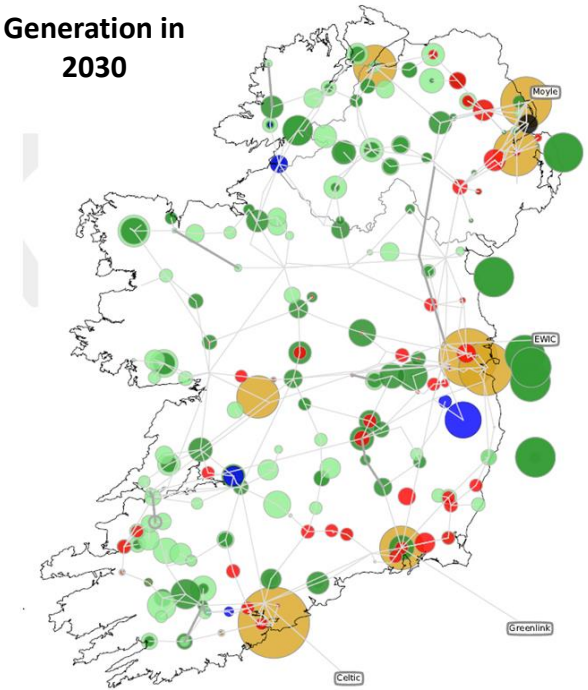
Shaping Our Electricity System Consultation

Generation Portfolio – Widespread Change

Generation in 2020

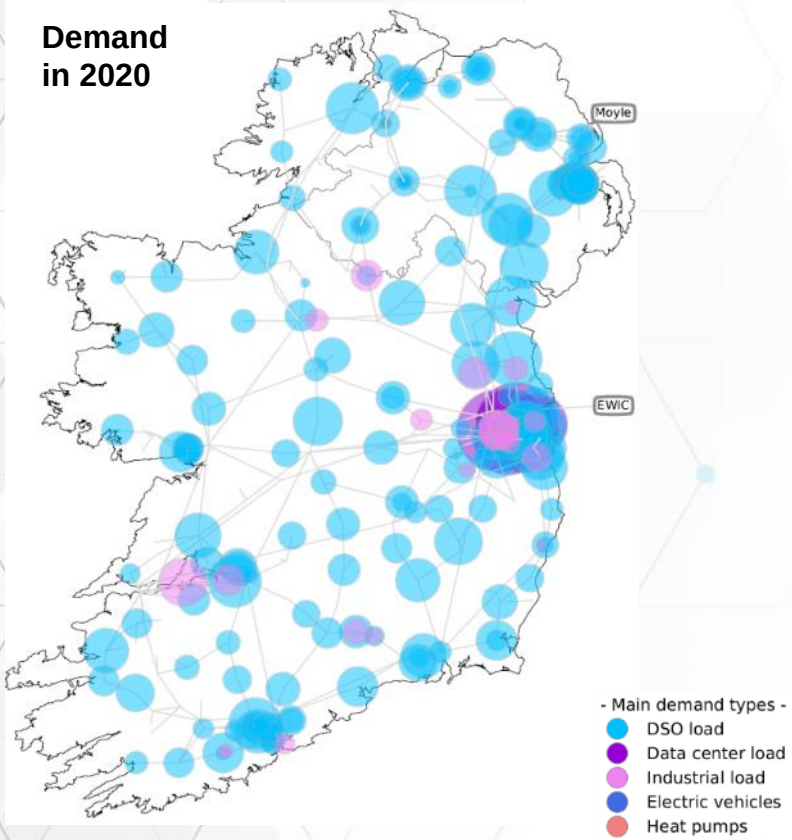


Generation in 2030

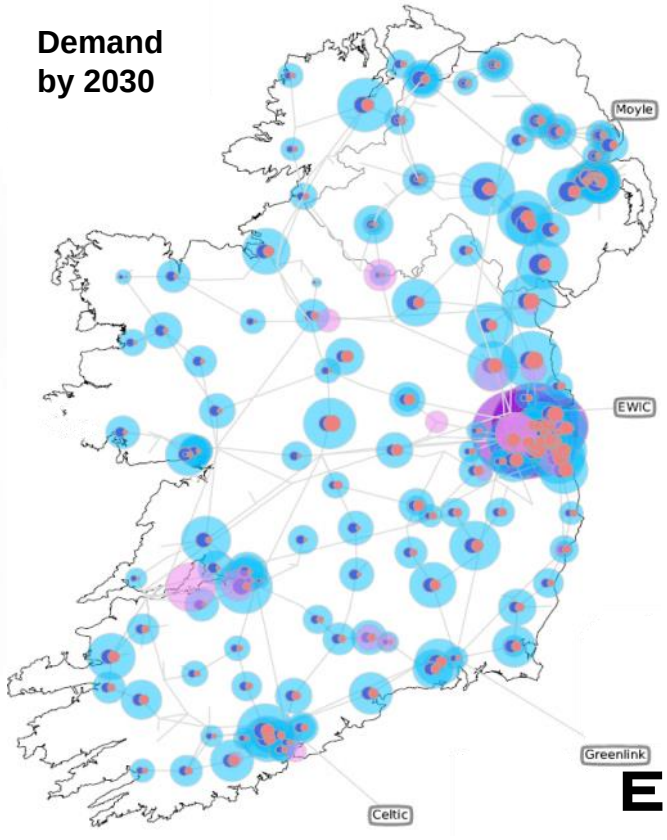


Demand Evolution

Demand in 2020



Demand by 2030




Focus on
Networks

Network Development to 2030

1 Generation-Led

Put clean electricity generation close to where most power is used

2 Developer-Led

Let developers decide where to locate clean electricity generation

3 Technology-Led

Try new ways to move clean electricity across the country

4 Demand-Led

Put large electricity users close to sources of clean electricity generation

To achieve renewable ambitions by 2030 significant grid delivery will be required

Final approach likely to be a blend

EIRGRID GROUP

Fundamentals For All Approaches

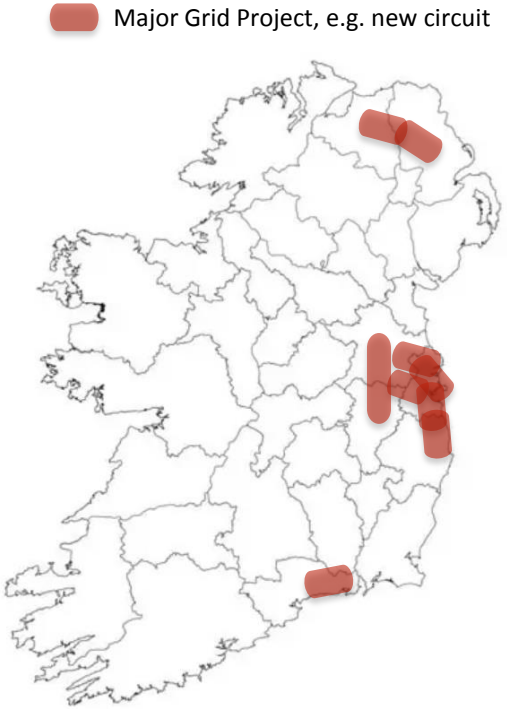
- We will **optimise the current network** in order to minimise requirement for new infrastructure
- To achieve renewable ambitions by 2030, **significant network delivery** will be required (existing projects, refurbishments, these new projects)
- **New, clean, flexible, conventional** generation will be required
- This analysis is **visionary**. Any future grid projects will follow EirGrid's network development and best practice engagement processes
- Government, Regulatory and Stakeholder **support is vital**
- Projects which are common to all approaches (approx. 15) will be **progressed in parallel** with consultation

EIRGRID GROUP

Approach 1: Generation Led

- **Approx. 45 Projects (~€1bn)**
- 1 GW Solar & Onshore Wind, 5 GW Offshore Wind

- Government policies will determine the optimum location of new renewable generation.
- Preferred locations will consider the strength of the existing grid and the local demand.
- Will lead to more offshore wind generation close to major cities, with less need for new onshore renewable generation.
- Significant grid infrastructure required

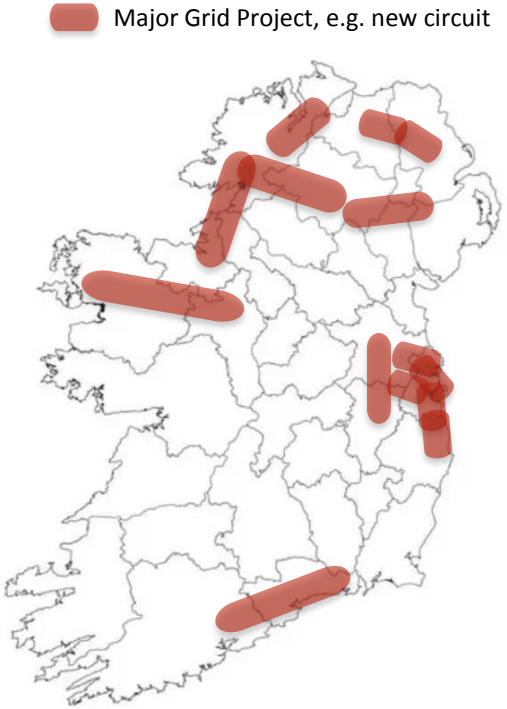


+ 35 Other Significant Projects Across the Island

Approach 2: Developer Led

- **Approx. 100 Projects (~€2.3 bn)**
- 2 GW of Offshore Wind, 2.5 GW of Solar and 4 GW of Onshore Wind

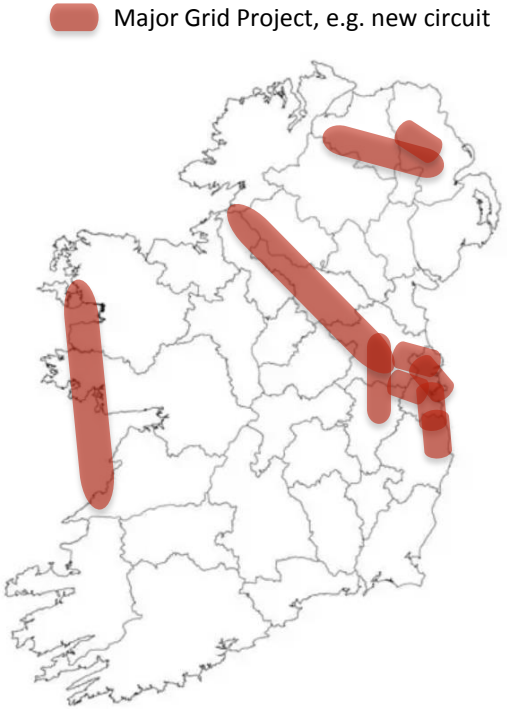
- Policy remains as is.
- Developers will continue to determine the location of renewable electricity infrastructure.
- This demands significantly more grid infrastructure and will stretch timelines beyond 2030
- This approach puts the target for 70% renewables by 2030 at risk



+ 85 Other Significant Projects Across the Island

Approach 3: Technology Led

- **Approx. 60 Projects (~€2 bn)**
- 2 GW of Offshore Wind, 2.5 GW of Solar and 4 GW of Onshore Wind
- Radical approach based on known alternative technologies.
- Move clean electricity from the west to the east
- Involves extensive use of underground cables carrying high voltage direct current. Rarely used in national grids
- Whilst underground, highly impacting from a construction and environmental perspective

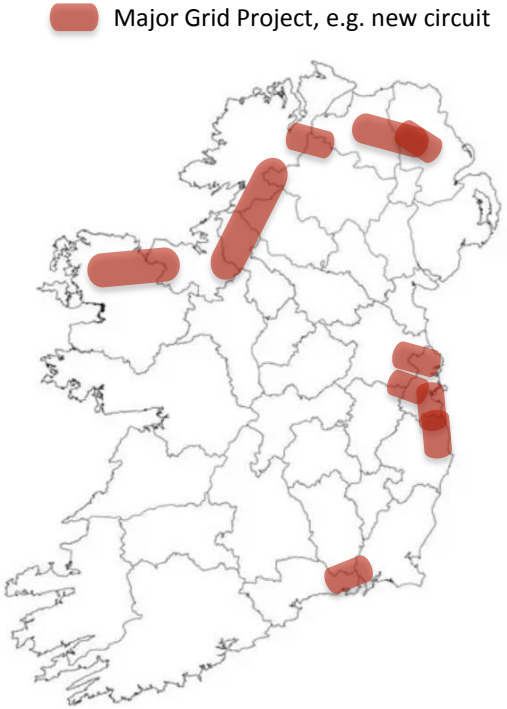


+ 45 Other Significant Projects Across the Island

EIRGRID GROUP

Approach 4: Demand Led

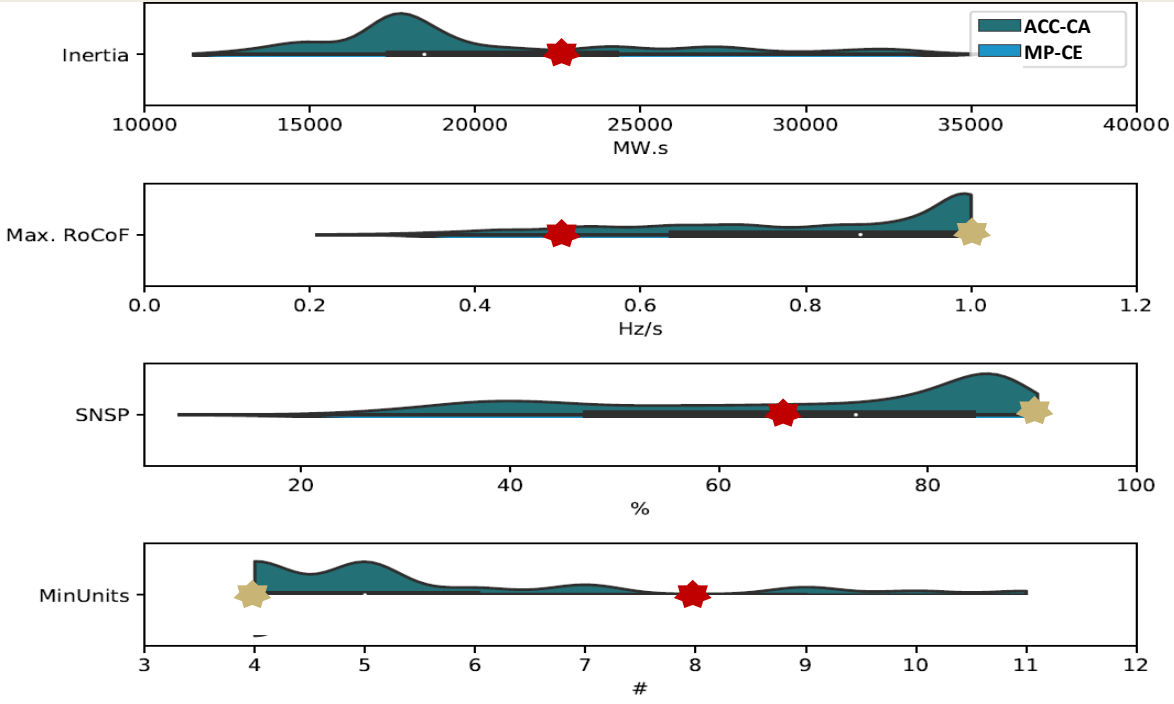
- **Approx. 50 Projects (~€0.7 bn)**
- 2 GW of Offshore Wind, 2.5 GW of Solar and 4 GW of Onshore Wind
- Government policies will determine the optimum location for large-scale electricity users
- This means determining the location of new high-demand customers (e.g. datacenters) so they are closer to sources of clean, renewable electricity
- Regional locations include Letterkenny, Sligo, Galway, Limerick, Cork and Waterford.
- Significant grid infrastructure required



+ 40 Other Significant Projects Across the Island


Focus on
Operations

70% RES-E implies operating at unprecedented levels



- Inertia levels are below today's minimum allowed level of 23,000 MW.s for ~ 70% of time.
- RoCoF levels are above today's maximum allowed level of 0.5 Hz/s for ~ 85% of time.
- SNSP levels are above today's maximum allowed level of 65% for ~ 60% of time.
- Number of large units online is below today's minimum allowed level of 8 for ~80% of time

Limit today Limit used in TES modelling to satisfy 70% RES-E

2030 Operational Challenges

Significant technical challenges will emerge if no action is taken

1. FREQUENCY STABILITY AND CONTROL

- Inertia
- Reserve
- Ramping
- Very low Frequency Oscillations

2. CONGESTION

- Lack of Transmission Capacity

3. TRANSIENT STABILITY

- Reduction in Synchronising Torque
- Reduction in Damping Torque

4. POWER QUALITY

- Harmonics

5. OTHER

- Voltage Dip Induced Frequency Deviation
- Frequency Regulation
- Power System Protection
- Power System Modelling
- Forecasting

CURTAILMENT

Curtailment due to overall power system limitations

6. VOLTAGE STABILITY

- Steady-State Voltage Control
- Dynamic Voltage Control
- Reduction in Available Fault Current

7. SYSTEM RESTORATION

- Less Black-Start Capable Plant

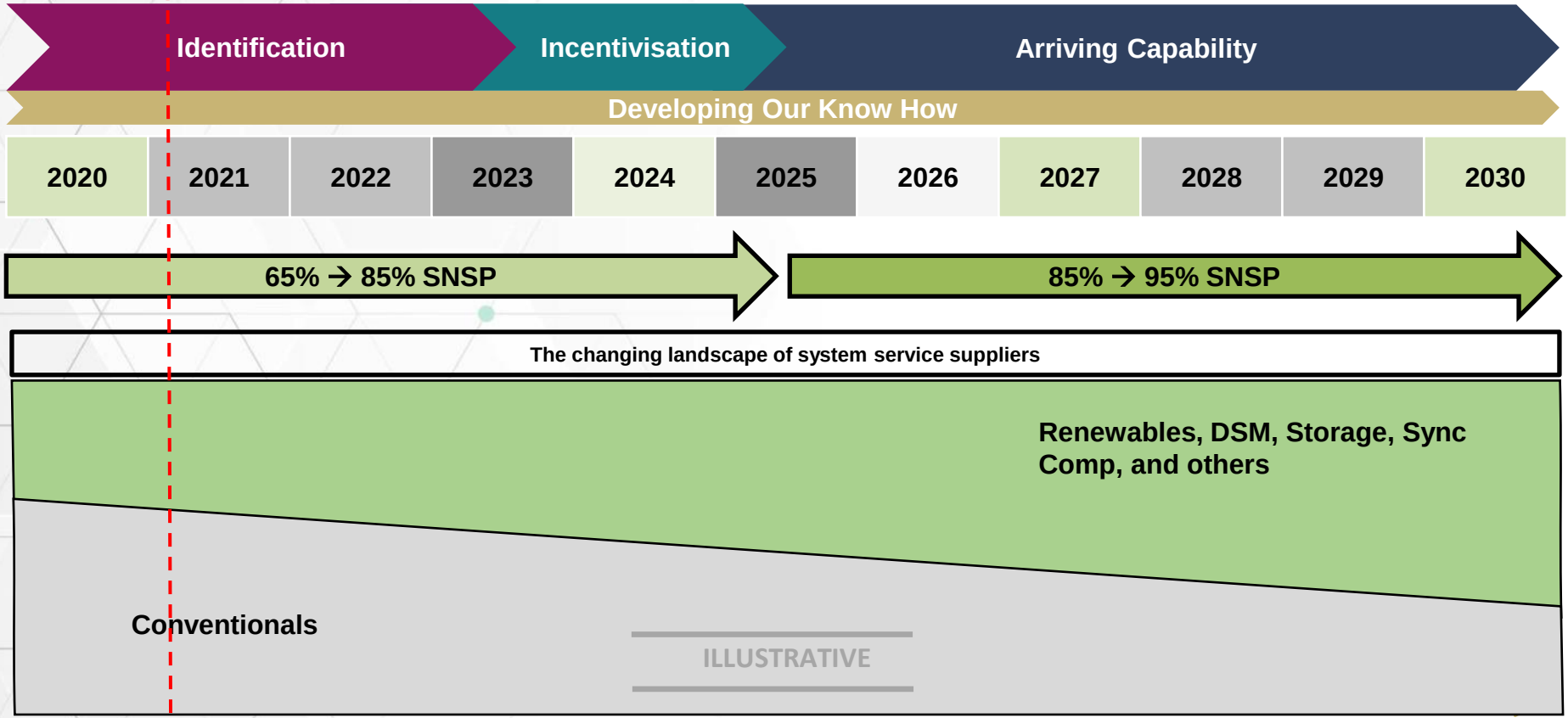
8. GENERATION ADEQUACY

- Capacity Margin
- Weather-Related Events

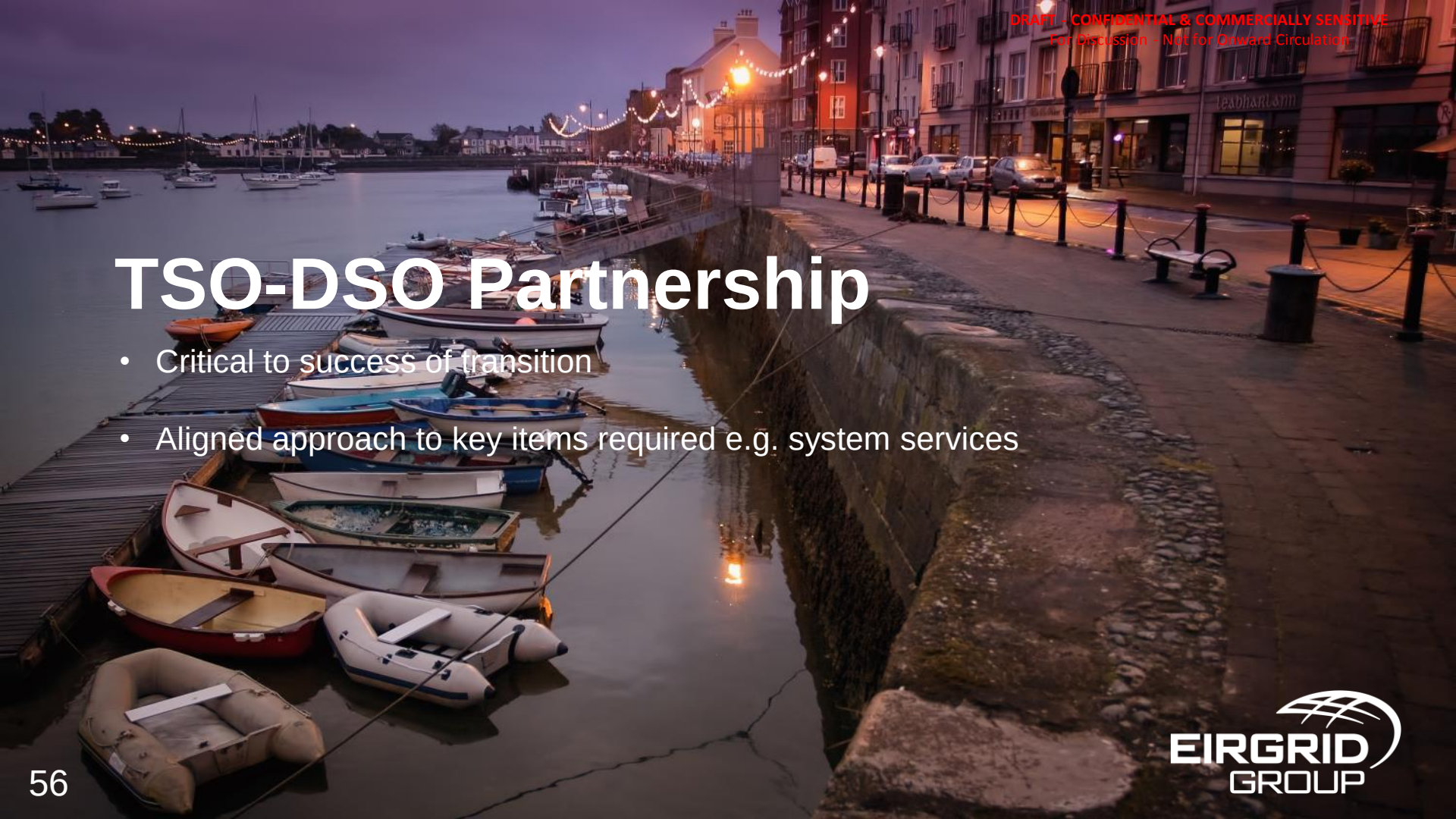
EIRGRID GROUP

Operational Transition Journey

70% RES-E by 2030 will mean operating at unprecedented levels



GROUP



TSO-DSO Partnership

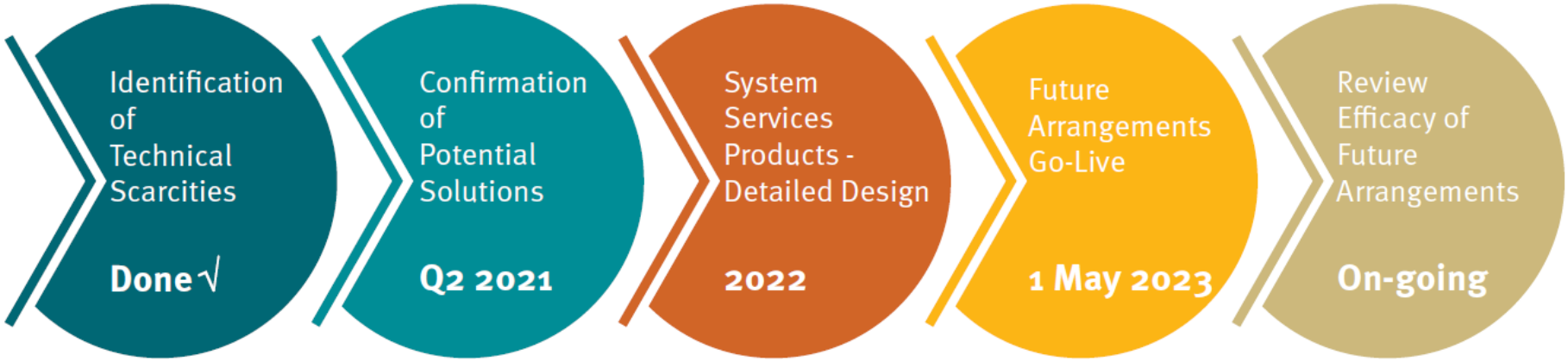
- Critical to success of transition
- Aligned approach to key items required e.g. system services

Operations: Roadmap to 2030

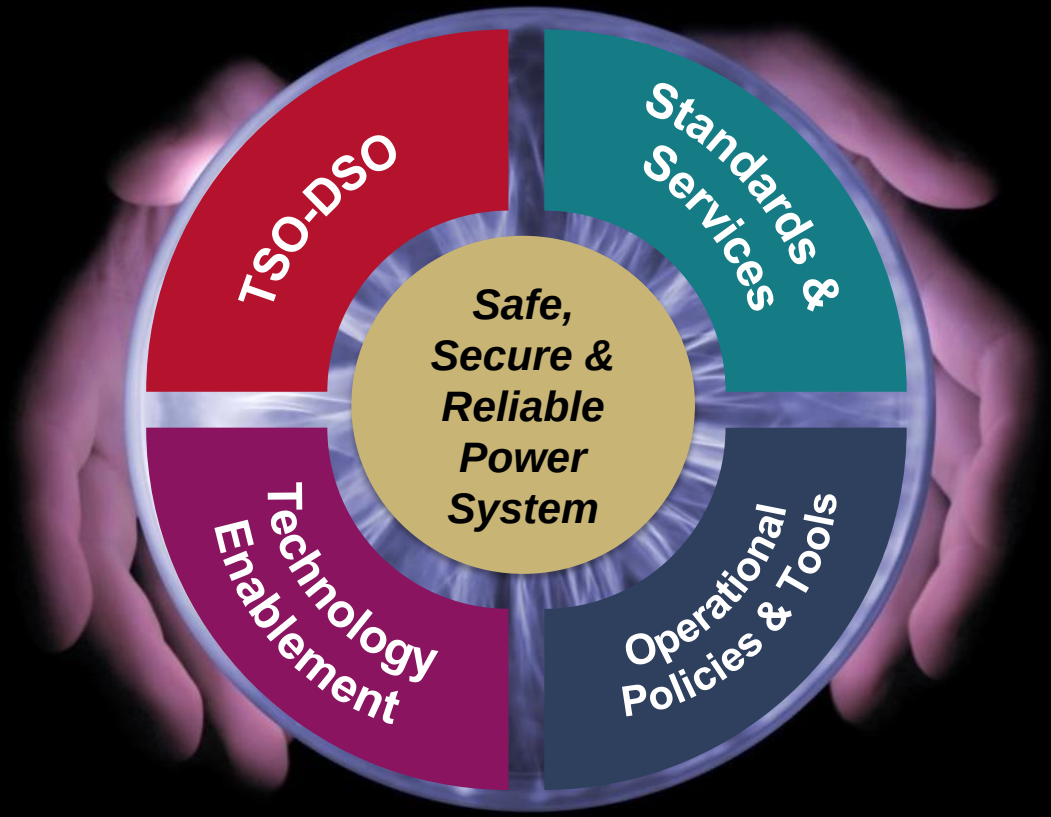
- **Safely and securely increase the instantaneous amount of renewable generation that can be accommodated on the power system to 95% SNSP:**
  - On-going studies and analysis on technical scarcities and potential solutions
  - Setting and clarifying operational standards, including grid codes and system services protocols, and subsequently monitoring performance against these standards
  - Enhancing the DS3 System Services arrangements to introduce new services and facilitate service provision by new and innovative technologies
  - Removing barriers to entry and enabling the integration of new technologies at scale
  - Continued evolution of operational policies e.g. minimum number of generation units
  - Developing new and enhanced control centre tools and systems

EIRGRID GROUP

System Services – Future Arrangements



System Operations to 2030



EIRGRID GROUP

Overview of Programme

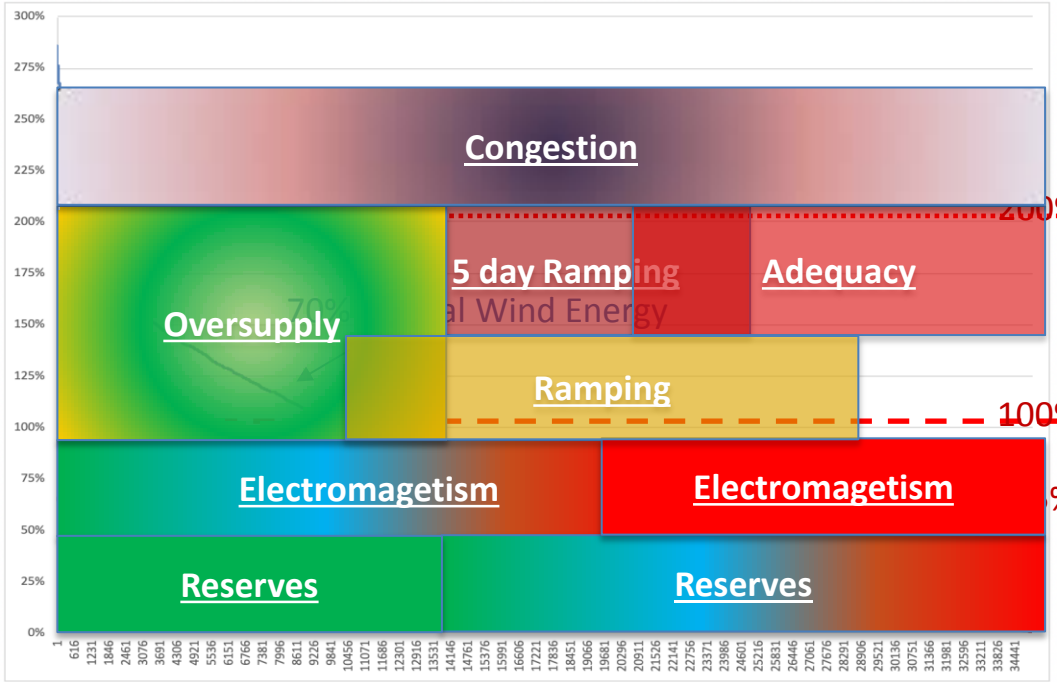
Focus on Markets

EIRGRID GROUP

Transforming the system for the future

	2020	2030	2040
Installed Wind	5000 MW	15000 MW	> 20000 MW
Annual RES-E	~40 %	70 %	>90 %
Real Time limit/SNSP	70%	>95 %	>95 %
Curtailment	5-7 %	~0 %	~0 %
Exports/Sector coupling	50:50	70:30	90:10

All-Island Wind Penetration Duration

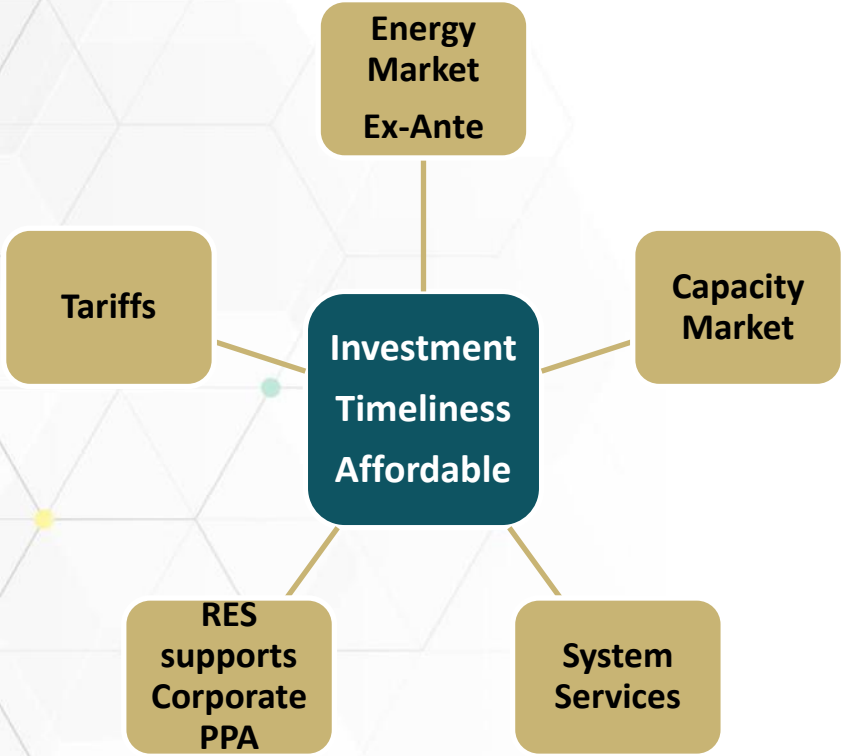


2030 wind was estimated by multiplying 2018 wind availability by 2.1612 to achieve an energy balance of 70% wind.

Markets drive 3rd party Investment

- Investment
  - Clarity on risk
  - Appropriate reward
  - Credible threat of enforcement
- Timeliness
  - Market maturity
  - Need increases in line with connecting renewables
- Affordability
  - Transition cost to be able to manage 100% SNSP
  - Active participation demand side in all markets improves affordability

Markets driving necessary investment



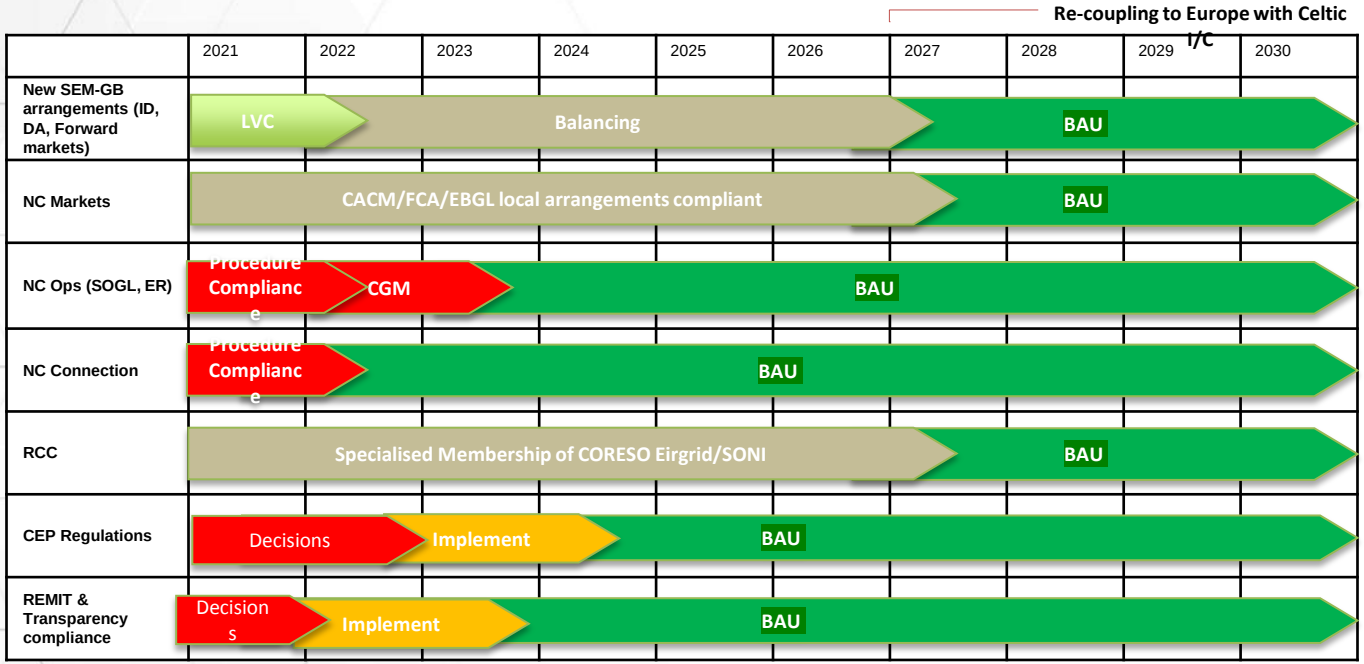
There are many "markets" that make up the environment to drive 3rd party investment in a timely affordable manner

Market Issues – EU and UK Model

- Energy only with CB trade and RES supports will deliver high RES….
- Our analysis for our situation does not concur.
  - Pioneering operations with RES
  - Increasing constraints
  - Oversupply of RES at times – who pays…?
- When we get to operate at 100% SNSP then EU/UK theory aligns with our challenges but only then
- In the meantime our transition needs to progress successfully while maintaining proactive and positive relationships between SEM/GB/EU
- So we need to leverage BREXIT and SEM isolation and aim for longer term reintegration with EU/GB

EIRGRID GROUP

Agree a plan to deliver for our partner…



Market Issues - Usability

- Should pay value of service same to all providers if you can use it
  - Break down barriers for new tech
  - Challenge implicit bias to conventional technology
- But Increasing operational challenges
  - Constraints
  - Curtailment
- Balancing the Risk between Investor and Consumer is key
  - Where and when investor connects their choice
  - Managing constraints and curtailment (redispatch) long term is the TSO responsibility

EIRGRID GROUP

Market Principles

- **Alignment**
  - Markets informed by operational issues at high RES-E
- **Commitment**
  - Move the risks that are outside of investors control in a balanced fashion to consumers in a predetermined manner over the decade
- **Clarity**
  - Develop a deep understanding of the service need and break down barriers for all technologies to reasonable deliver

EIRGRID GROUP

But are our markets delivering 70/30?

Type	Investment	Timeliness	Affordability	70/30
Energy	More volatility and lower prices reduce investment for energy. Conventional use Energy outcomes with carbon as exit signal	Energy not driving complementary investment in a timely manner	Energy market drives value only for 30% of the volume in 2030.	Need effective energy market aligned to other markets, supports and operational practice
Capacity	Has had some success in attracting new conventional capacity. But not good for new tech. Not clear investment is the right investment?	Market discipline is poor in that money given out and capacity not being made available. Periods of scarcity estimated in 2023/24 will need careful management	Reasonably efficient if it delivered	Need to review modelling forward, new tech and market discipline if it is to get complementary investment
Supports/ Corporates	Rollout of support programmes to make RES projects investible.	RESS designed to deliver new RES in line with objectives. Need NI version soon	Approved scheme require competition. Need to look at oversupply and redispatch down costs	Use of supports needs to be monitored to ensure transition cost affordable. Alignment with markets and ops critical to avoid double payment
System Services	Rollout of new service arrangements apt for 70%	New Future arrangements needed to be effective by 2023	Need to move to volume regulation with appropriate CBA	Critical 3rd party investment in solving technical scarcities with high RES

EIRGRID GROUP

Market Issues – System Build

- I-SEM built to Central Dispatch/ ex post pricing philosophy
- Operational Systems built with Conventional set the dominant unit- e.g. battery integration difficult
- Capacity and System Services with different vendors
- RES Support changes require Govt intervention (policy maker approval)
- Connection policy and tariff design require Regulatory intervention
- Pragmatically need to phase work across systems across the next 2-6 years

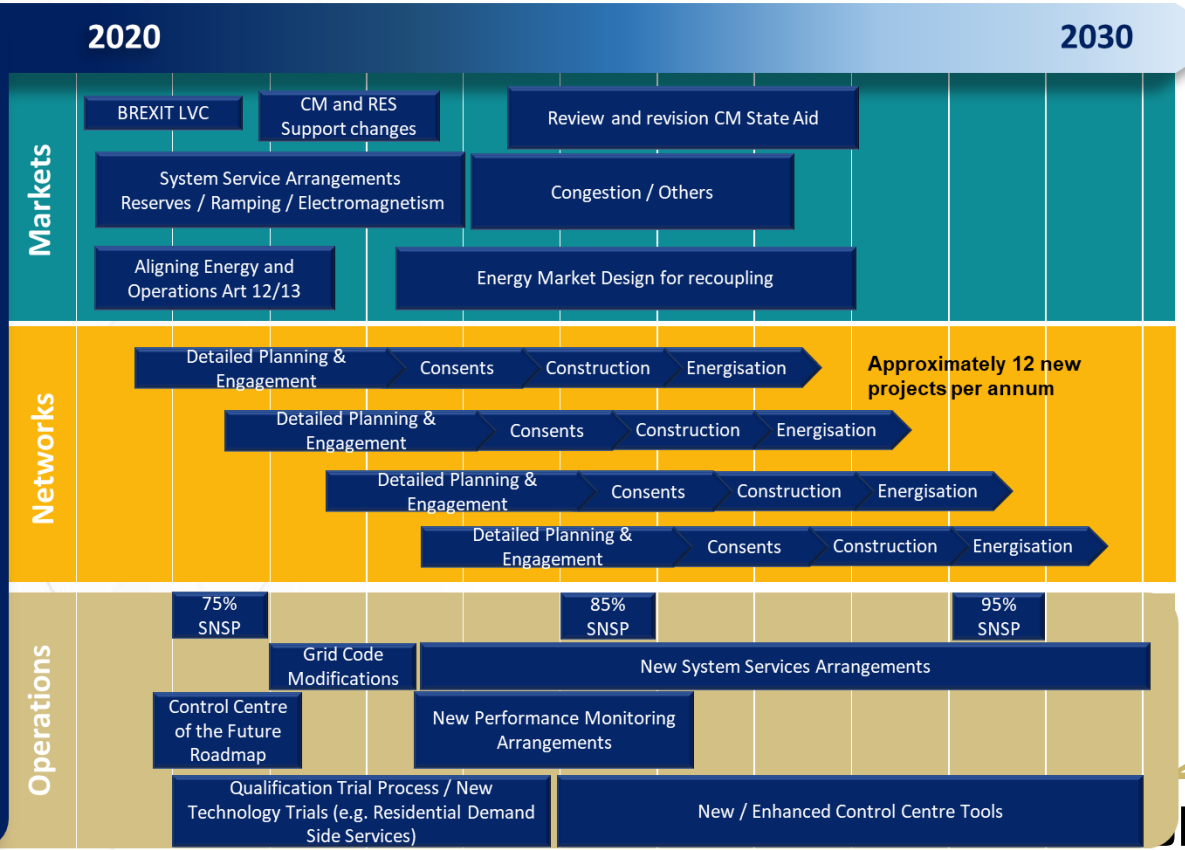
EIRGRID GROUP

Draft Roadmap

Draft Roadmap

Guiding Principles

1. 70% electricity from renewable sources
2. Customer centric - transparent engagement
3. Economically meet the Renewable Ambition and maintain power system reliability
4. Collaborative support from government, and regulators is a key success factor
5. Maximize the use of the existing grid
6. New infrastructure investment is needed
7. New clean conventional generation is needed
8. TSO and DSO collaboration is a key success factor
9. Considers beyond 2030 to 2050



Summary

Summary

- Enhanced renewable generation is at the centre of our approach
- This transformation will have a significant impact right across the country and will impact every county in Ireland
- Our engagement process will reach into all levels of society across the country
- We have options but all options include unpopular choices
- *Shaping Our Electricity Future* will provide the roadmap to deliver the policy objective

Control Centre of the Future

Simon Tweed, EirGrid

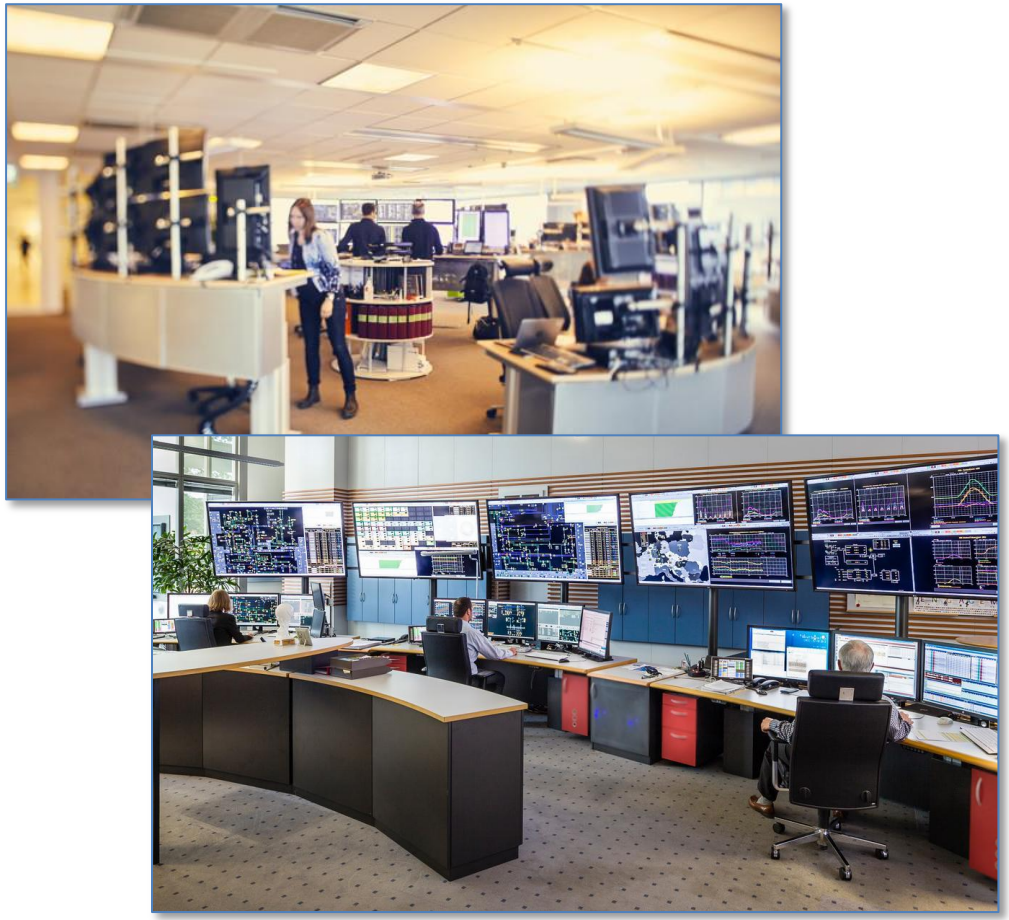
EIRGRID SONI

The Control Centre of the Future

- The Control Centre of the Future project is a key initiative under the Operational Policies & Tools pillar.
- The aim of the project is to develop our control centre capability to safely and securely operate a resilient power system as complexity and uncertainty increases.
- For the first phase of this project we have engaged the international expertise of EPRI and DNV GL.

Project Scope

- Review current EirGrid and SONI control centre operations.
- Review arrangements in other jurisdictions, in both energy and non-energy sectors.
- Assess the operational and IT challenges and potential solutions.
- Develop a vision of the control centre of 2030 and beyond.
- Develop a roadmap for the control centre to 2030.



Potential Areas of Development

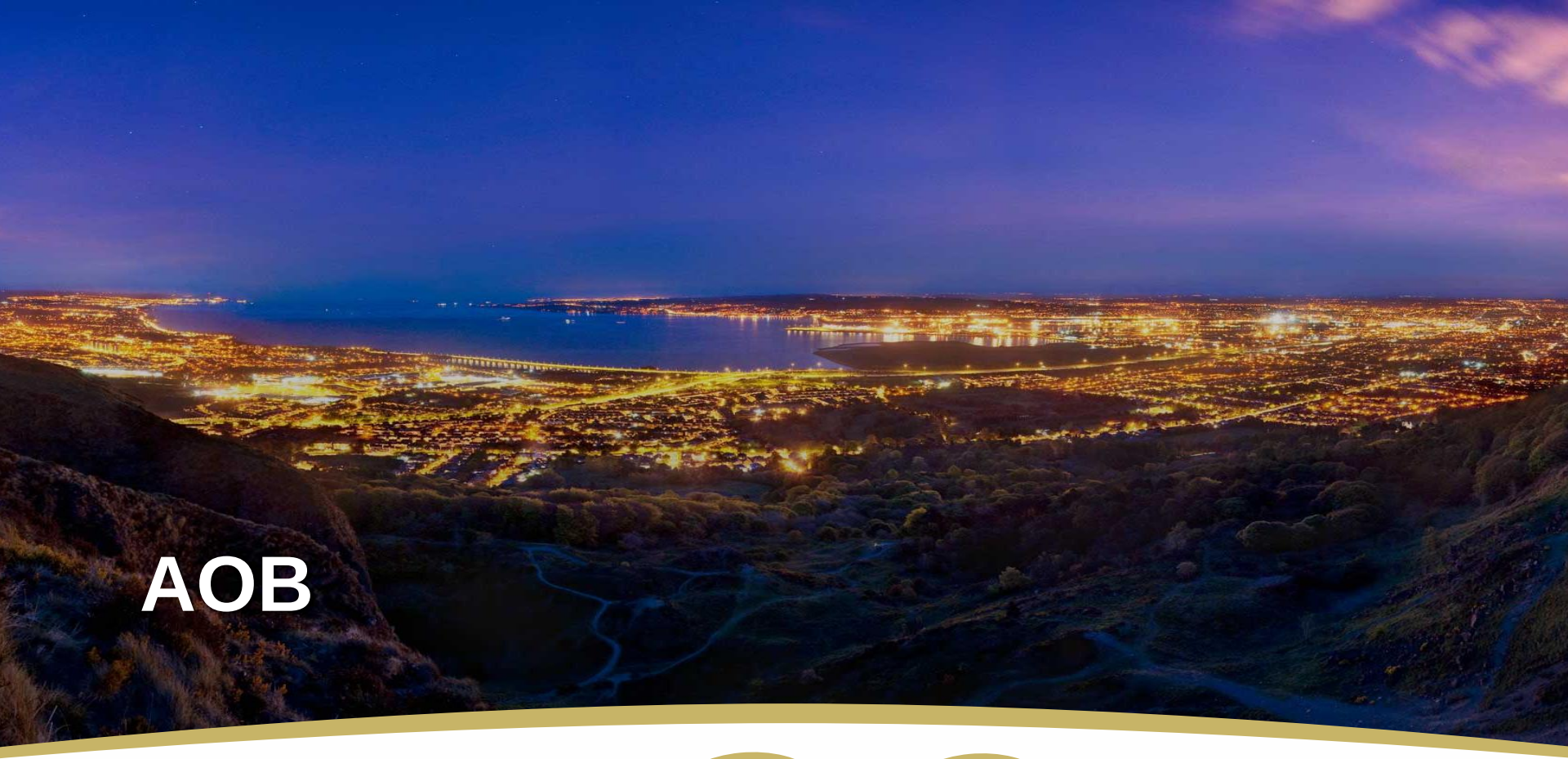
- Improved forecasting, constraint and curtailment management.
- Enhanced real-time and look-ahead analysis tools.
- Better access to, and analysis of, data.
- New and improved stakeholder interfaces – particular focus on TSO-DSO interaction.

Future of the Advisory Council

Eoin Kennedy, EirGrid

Future of the Advisory Council - Proposal

- Propose to expand the remit of the Advisory Council to cover the Networks, Markets and Operations dimensions of *Shaping Our Electricity Future*
- Membership of the Advisory Council would be widened
- All existing members would be invited to join the new Advisory Council
- Similar meeting frequency to today i.e. 3 times per year
- Meetings likely to be longer to allow for appropriate presentation and discussion on a broader range of topics; having split sessions is an option being considered


AOB

Closing Remarks