DS3 Programme Status Update

Yvonne Coughlan

DS3 Advisory Council Meeting

22nd October 2012

The DS3 Programme

Shaping the power system of the future

- Programme established 2011
  - Meet the 2020 renewable targets on the electricity power system while maintaining system security levels
  - Engaging with all industry stakeholders e.g. Industry Advisory Council, working groups for a
  - Holistically considering technical, commercial and regulatory needs of the system

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Achievements in first 12 months of DS3

Grid Code

- Wind Farm modifications drafted and proposed in Ireland
- Consultation completed on Wind Farm Settings Schedule

System Services

- International Review of System Services
- Significant analysis carried out on requirements of system
- Published 2 consultation papers
- Draft of financial Consultation paper currently with RAs

Achievements in first 12 months of DS3

Renewable Data

- System curtailment levels
- Impact on system of high wind
- Review of forecasted 36 month renewable connections
- Analysis of High Wind Speed Shutdown

Performance Monitoring & Testing

- All Island Generator Performance Reports developed
- Developing requirements specification for performance monitoring tool in line with system services workstream

Achievements in first 12 months of DS3

RoCoF

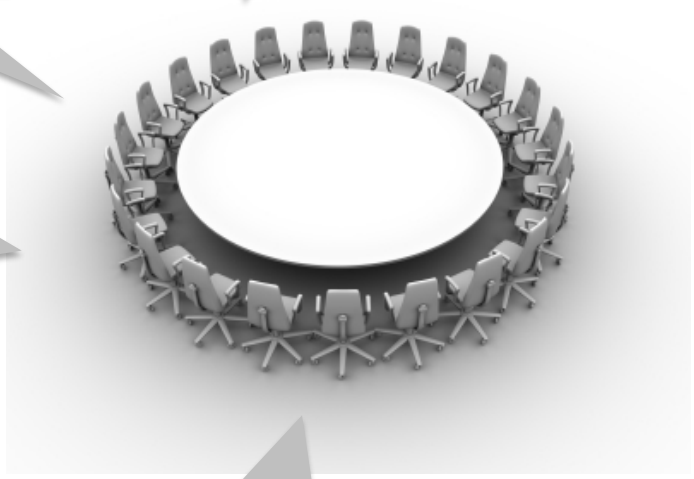
- RoCoF modification published for consultation in Northern Ireland
- Joint Grid Code working group position paper published
- TSOs Opinion paper published

Industry Engagement DS3

Website Updates

Industry Forums

Joint Grid Code Working Group



Bilateral Meetings

Advisory Council

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AES the power of being global

ESB

Department of Enterprise, Trade and Investment

DCENR

IWEA Irish Wind Energy Association

SSE

NORDEX We've got the power.

BORD GÁIS

Gaelectric POWER FROM NATURE

GE

Key Milestones to 2015

- System Services evolution and implementation to meet needs of the system
- Long term operational policy development
- Advanced Real Time tools implementation

Key Deliverables for 2013

DS3 Programme - Transitioning toward System Policies and Tools

- Final Decision on RoCoF approach
  - Dependent on results of DSO studies
  - Dependent on Grid Code modification proposals
- System Services
  - TSOs Recommendations Paper on System Services
  - Regulatory Decision on System Services
  - Kick off Implementation project for System Services
- Distribution Code changes
- Technical Studies
  - Review of operational policies for frequency and voltage control
  - Demonstration projects

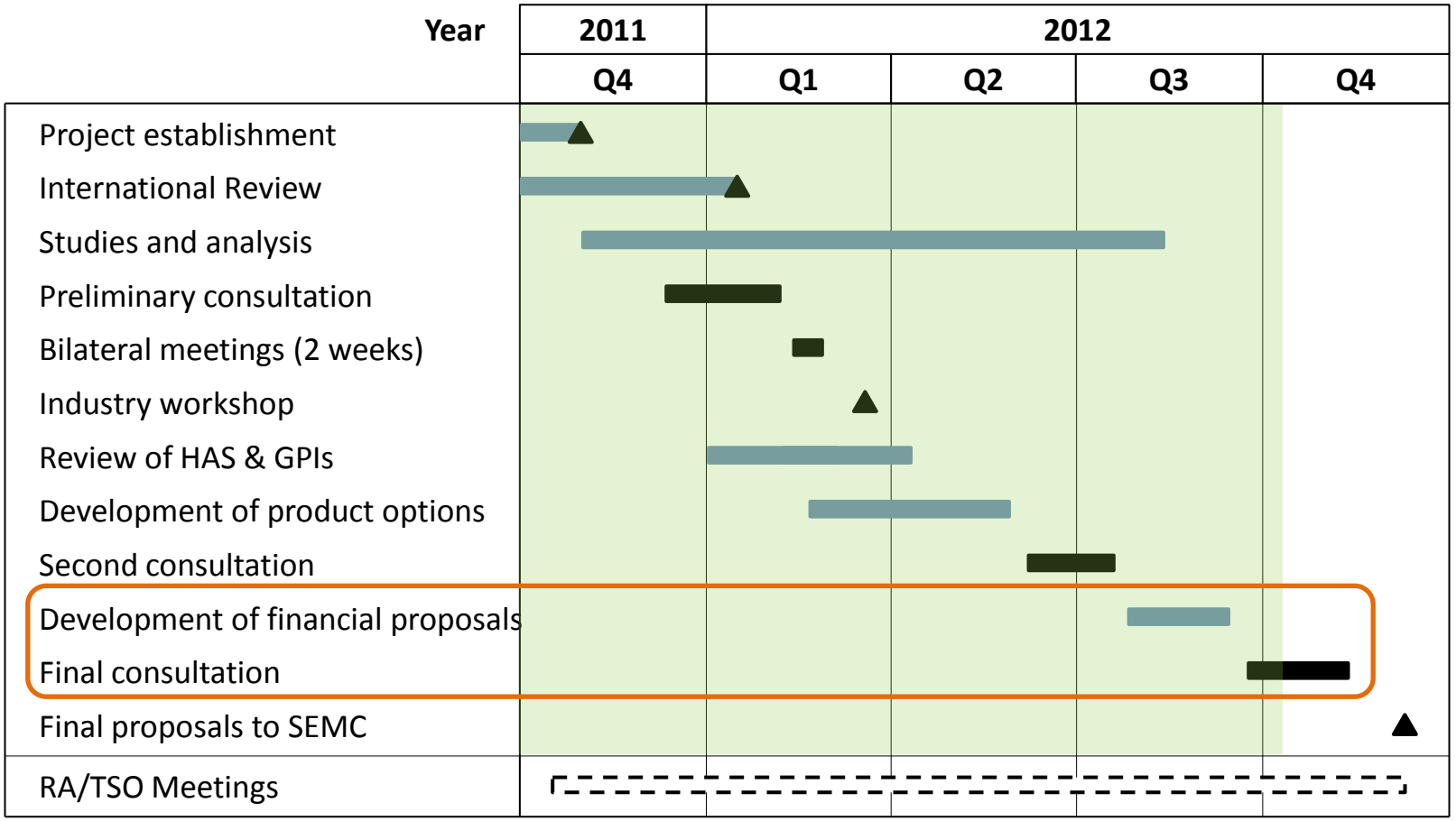
DS3 System Services Review

Shane Rourke

DS3 Advisory Council Meeting

22nd October 2012

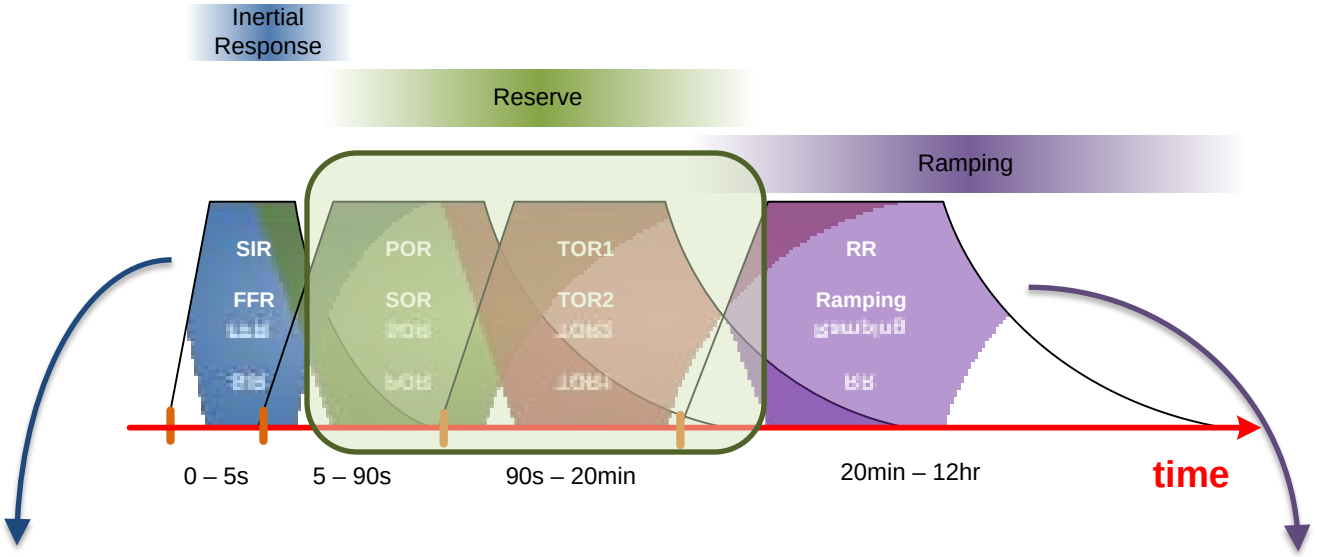
Progress to date



Second Consultation

- Focus on technical aspects
  - Identifying operational challenges
  - New services proposed to address issues identified
  - Proposed approach to remuneration and contractual arrangements
  - Enhanced focus on reliability
- 26 responses received
  - Comments incorporated into proposals in next consultation paper
- Industry forum held 4th July 2012

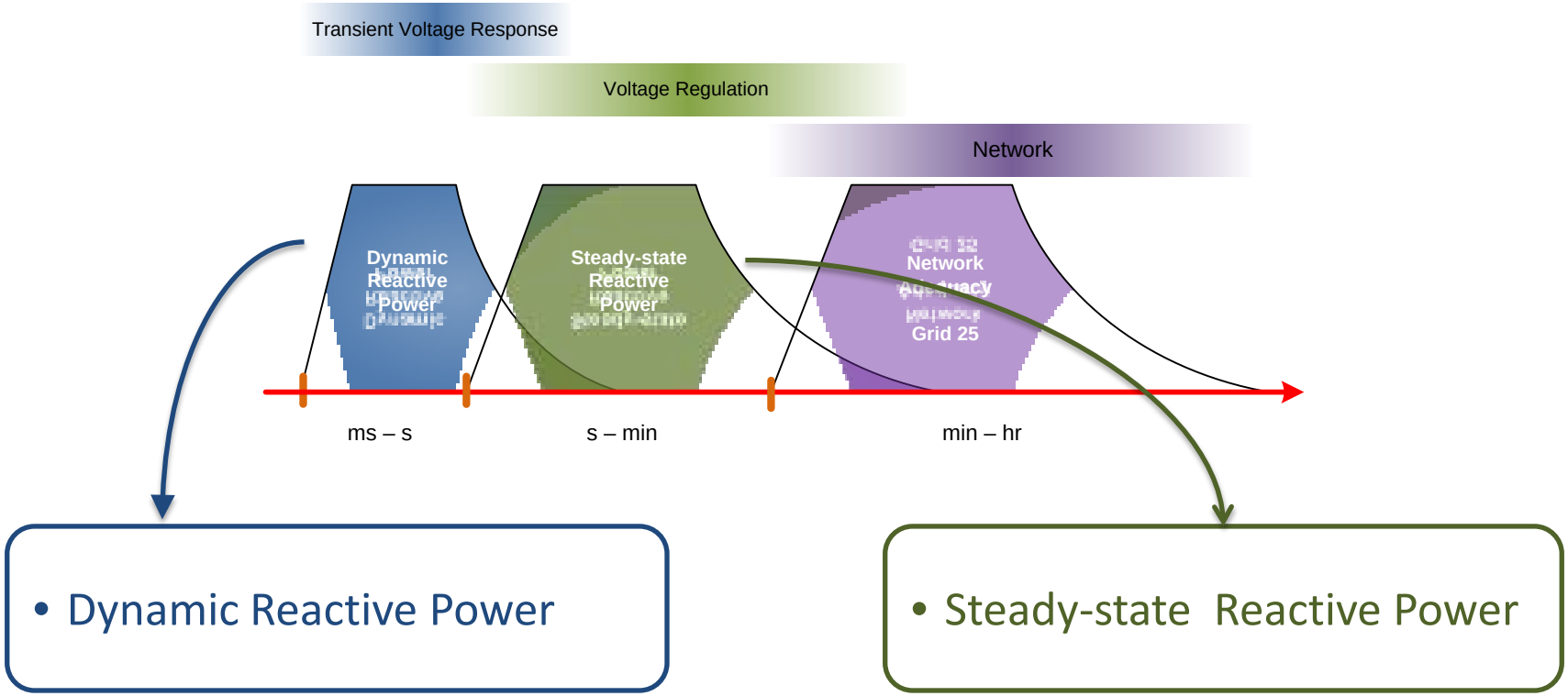
Frequency Control



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

- Ramping Margin

Voltage Control



Third Consultation Paper - contents

- Valuing System Services
- Financial modelling and analysis
- Revenue Allocation

- Remuneration approach
- Contractual Arrangements
- Proposed final product designs

Based on responses to second consultation

Next Steps

- Draft of financial consultation paper currently with RAs
- Aiming to issue 3rd Consultation paper as soon as possible
  - Four week consultation period planned
- Bilateral meetings will be offered to respondents during consultation window
- Recommendation paper to SEMC (based on three consultation phases)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DS3 Grid Code
Windfarm Standards

Alan Rogers

DS3 Advisory Council Meeting

22nd October 2012

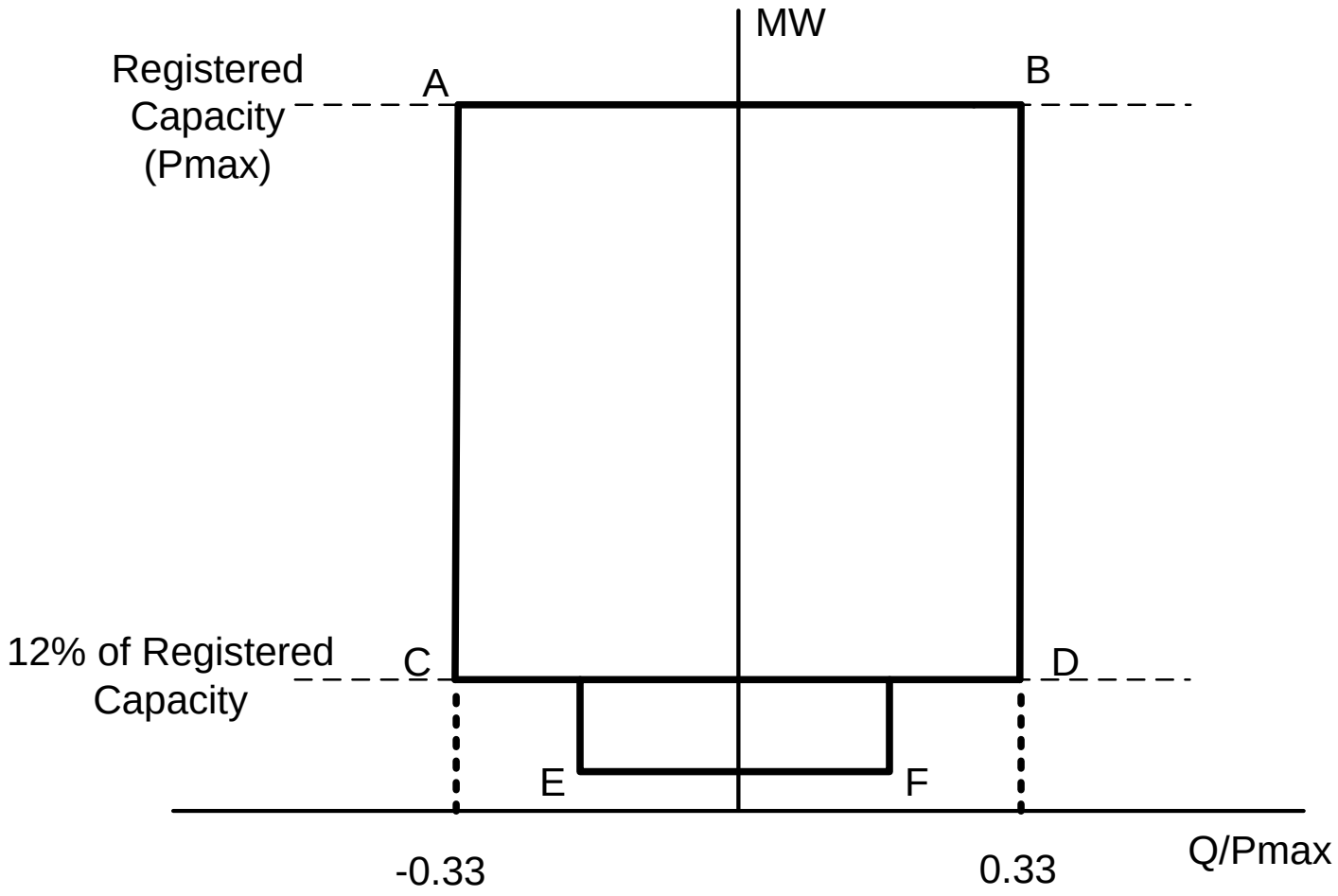
Grid Code Modifications

- Joint Grid Code Working Group discussed Windfarm modification proposals at length
- Bilateral discussions with wind turbine manufacturers - submission of comments incl. GE, Nordex, Enercon, Vestas, REPower, EWEA
- No material differences between Ireland and Northern Ireland Grid Code modifications

Grid Code Modifications

- Three Modification Proposal Documents
  - Reactive Power Standards
  - Fault Ride Through Standards
  - Frequency Response and Ramp Rates
- Proposals have been tentatively accepted by GCRP subject to some revisions
  - Revisions will be sent to GCRP Wind Reps
- Northern Ireland – Settings Schedule consultation has finished

Reactive Power Standard



Fault Ride-Through Standards

- Post-fault active power recovery – 500ms
- Dynamic Reactive Response within 100ms of fault inception
- These are critical to address voltage dip induced frequency dips and ensure transient stability at high wind penetrations

Frequency Response and Ramp Rates

- Windfarms must help control frequency (Governor Droop) when curtailed down
  - i.e. when they have upwards and downwards regulation capability
- Speed of response defined
- Ramp Rates – simplification: Wind Following Rate, Dispatch Rate (Faster) and a Frequency Response Rate (Fastest)

Next Steps

- Submit Ireland Windfarm Modifications to CER and NI WF Setting Schedule to NIAUR
- Ireland Distribution Code
- Other developments include:
  - Review of Negative Reserve (Over-Frequency Response) has been carried out
  - More analysis / testing, and better use of WFPS for frequency response among the recommendations
  - Grid Code modification on Dynamic Models is in preparation
  - Internal documents on Biomass, Energy Storage, and Frequency Response have been developed, which may lead to future Grid Code modifications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DS3 RoCoF Workstream

Tom McCartan

DS3 Advisory Council Meeting

22nd October 2012

Proposed RoCoF Modifications

All Island RoCoF Modification

- RoCoF Standard of 1 Hz/s measured over 500 ms

Northern Ireland RoCoF Modification

- Further system reinforcement is required between Ireland and Northern Ireland
- Results from System Separation Studies show RoCoF > 1 Hz/s
- Northern Ireland standard of 2 Hz/s is required as a temporary standard pending the system reinforcement

Progress to Date

Industry Interactions

- Significant discussions as part of the Joint Grid Code working group
- Joint Grid Code Working Group paper developed - position of all parties

TSOs

- Have developed and published a TSOs' Opinion paper

DSOs

- Both DSOs are undertaking separate studies to assess the impact of increased RoCoF standards

Regulatory Authorities

- Conventional generators have been asked to give an indication of the cost associated with the impact assessments they believe are required on their plant and equipment in order to meet the RoCoF requirements.

RoCoF Timeline

October	RoCoF modifications presented to Grid code Review Panels RoCoF modification published for consultation in Northern Ireland
November	RoCoF modification consultation closes in Northern Ireland
December	RoCoF Modification for approval at Ireland Grid Code Review Panel RoCoF Modifications will then be sent to regulators for approval
Q1 2013	Decision on RoCoF Modifications by Regulatory Authorities
2013	Testing and Analysis of RoCoF Capability

Outstanding Issues

- Date for finalisation of DSO reports
  - Will require further discussions with the TSOs
- Regulatory decision will be required on Grid Code proposals
- TSO cannot move from present 50% SNSP level until resolution of the outstanding RoCoF issues


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DS3 Update

ESB Networks

October 2012

Main Points

- New EGIP rules apply from 1st September to new connection offers
- Revised “Conditions Governing”/”G10”
- Report on RoCoF values in month
- Retrospective application

RoCoF Report

- Report looks at
  - Expected RoCoF on genuine island
  - Expected RoCoF for major system events
    - Thanks to EirGrid for system events
    - Look at n-1 and n-2 events
  - What RoCoF values best meet both requirements
    - May have two results
    - Synchronous machines have low setting
    - Asynchronous machines have high setting
  - Bench test on relay (7RW600)

RoCoF Report

- Report based on simulations and modelling
- Risk of non-detection of island
  - Islanded load and generation similar
  - Generator has fast frequency & voltage control
- Risk of spurious operation
  - During low voltage faults (Use u/v blocking)
  - During major system events
- Will need to keep settings under review

Retrospection

- Need to co-operate with industry
- Confirm machine capability, relay capability
- Low cost approach – change settings
- Allow time for implementation
- Consider target level of non-compliance

Loss of Mains Protection Update (Oct 2012)

Loss of Mains Protection

1. Background
2. Outcomes
3. Proposals

Northern Ireland Electricity

1. Background

- Strathclyde University on behalf of NIE has carried out a laboratory based verification of loss of mains protection (LOM)
- The scope was to determine the sensitivity and stability of LOM protection relays using RoCoF and Vector Shift (VS) algorithms up to and including frequency changes of 2hz/sec and delays of 500mSec and VS of 6 and 12 degrees
- These simulations included :-
  - Protection sensitivity tests for active and reactive power imbalances of up to +10 to -10% following an islanding situation
  - Protection Stability analysis for single, two phase and three phase faults with voltage retention from 20% to 80%
- 23 scenarios where simulated on both Synchronous and DFIG generation technologies

Northern Ireland Electricity

2 Outcome Summary

- Protection response depends significantly on the generation technology
- Syncronous DG
  - At 2 Hz/Sec the existing LOM protection is not capable of detecting genuine LOM events at power imbalances less or equal to 10% of generator rating
  - A poor sensitivity occurs when using any of the setting tested for a VS methodology – no operation for the minimal setting of 6 degrees
- DFIG based DG
  - At 2 hz/sec with no time delay all genuine LOM events were detected
  - At 2hz/sec with 500mSec delay some LOM events were not detected

2 Outcome Summary Cont

- DFIG based DG continued:-
  - VS based protection showed good sensitivity at both 6 & 12 degrees
  - Voltage instability occurs in all scenarios which would also prevent stable operation of systems supplied with DFIG generation
- LOM protection stability in response to remote system faults remains good for both types of technologies
- The introduction of fast frequency response for embedded generation could impact its capability to react to an LOM event using existing relaying.

3. Proposals/Next Steps

- All generation connected at 11kV and below will have no change to their present LOM setting regime.
- All Syncronous generation will have no change to their LOM setting regime other than VS will be removed as an option
- All other 33kV connected generation will have their LOM protection changed to accommodate the stability requirements for a major loss of generation. This presently will be:-
  - Where the generation is incapable of fast frequency response a RoCoF setting of 2hz/sec delayed by 500mSecs will apply. VS may be used subject to a suitable stability setting being advised by system operators
  - Where generation is capable of fast frequency response then other LOM settings or systems may be needed.
- G59/1/NI defines LOM protection requirements
  - It is silent on the actual LOM setting that is required
  - Not clear therefore that the document needs to be changed however it may be prudent to update it
- A change of approach needs to be approved internally within NIE

Northern Ireland Electricity

All Island Renewable Connection Report - 36 Month Forecast

Jonathan O'Sullivan

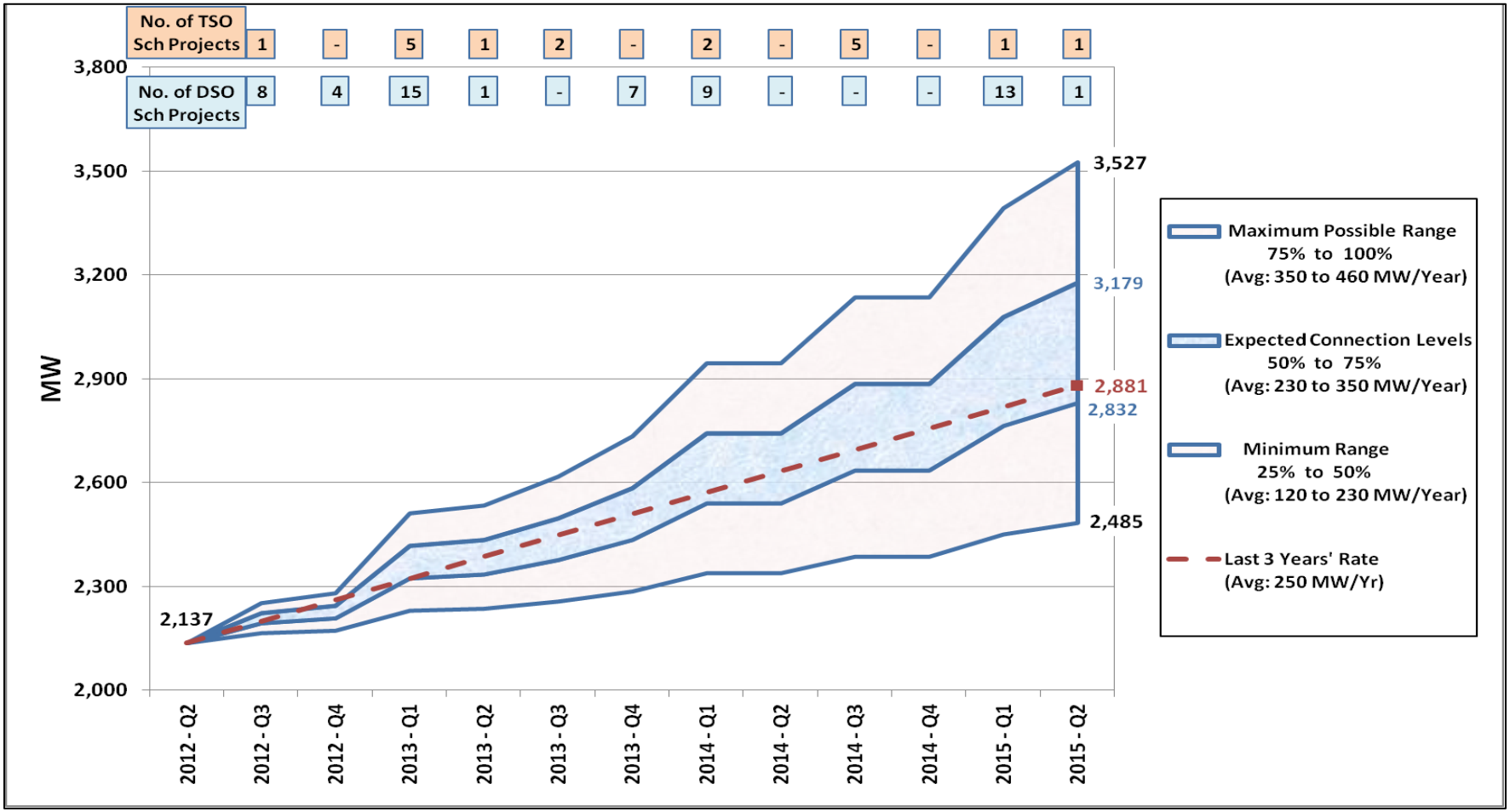
DS3 Advisory Council Meeting

22nd October 2012

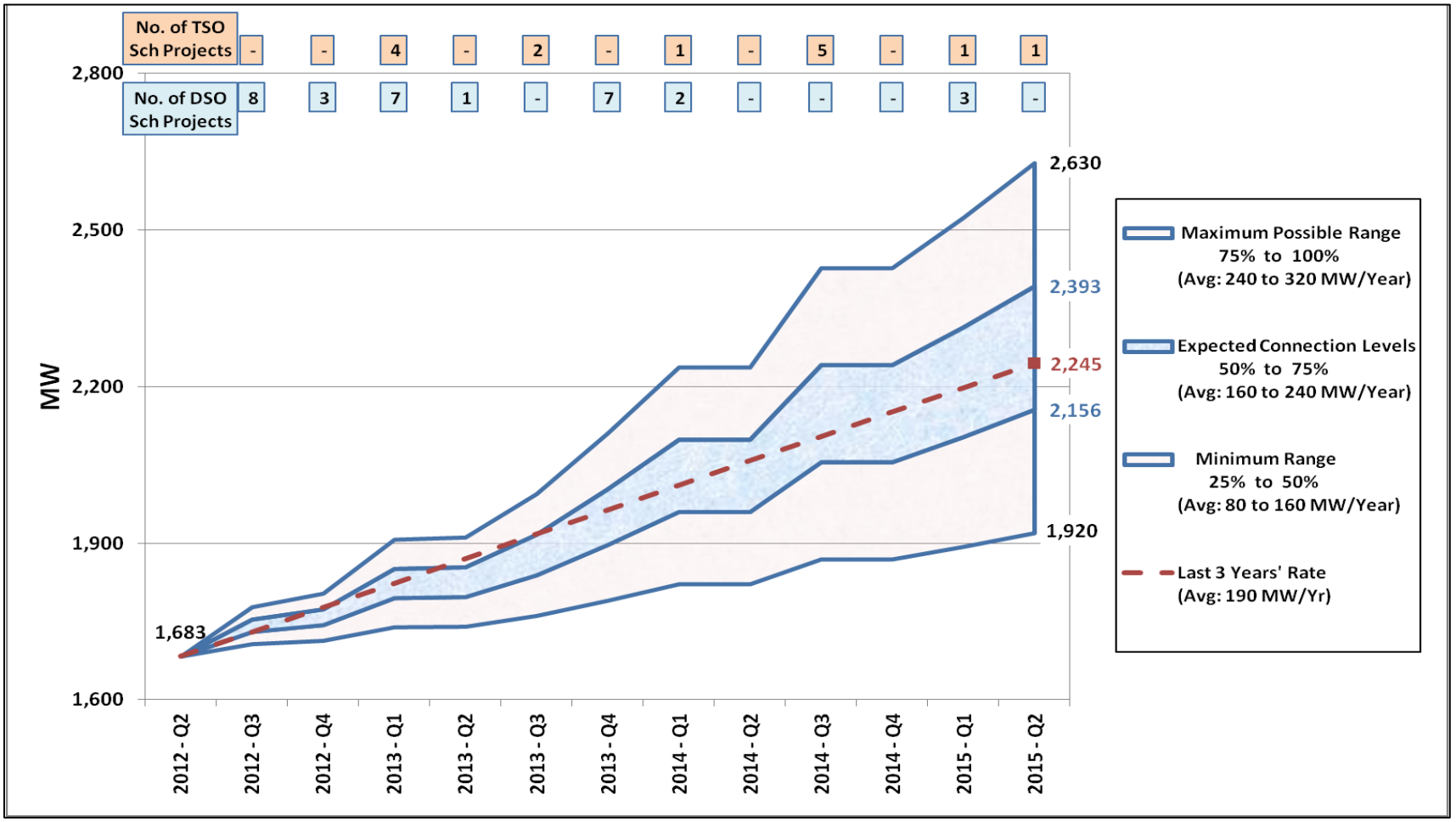
Assumptions

- Connection assessments are based on experience.
- The rate of these connections are contingent on a number of variables many of which are outside the control of the system operators, including:
  - Financing
  - Planning Permission
  - Commercial Decisions and
  - Construction of the wind farm itself
- No explicit link to these variables or to network rollout

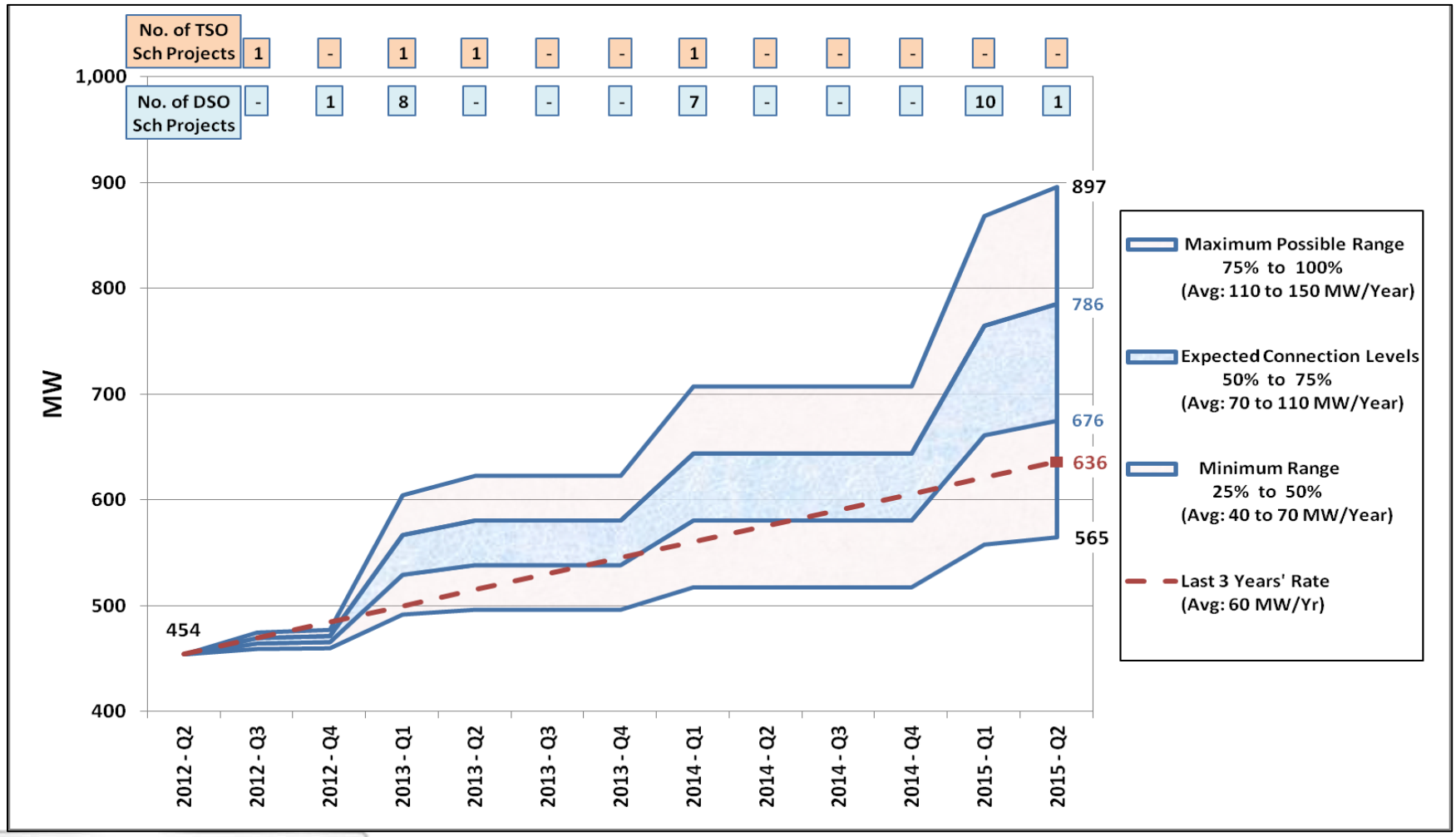
All Island: 36 Month Forecast



Ireland: 36 Month Forecast



Northern Ireland: 36 Month Forecast

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All Island Curtailment Report

Jonathan O'Sullivan

DS3 Advisory Council Meeting

22nd October 2012

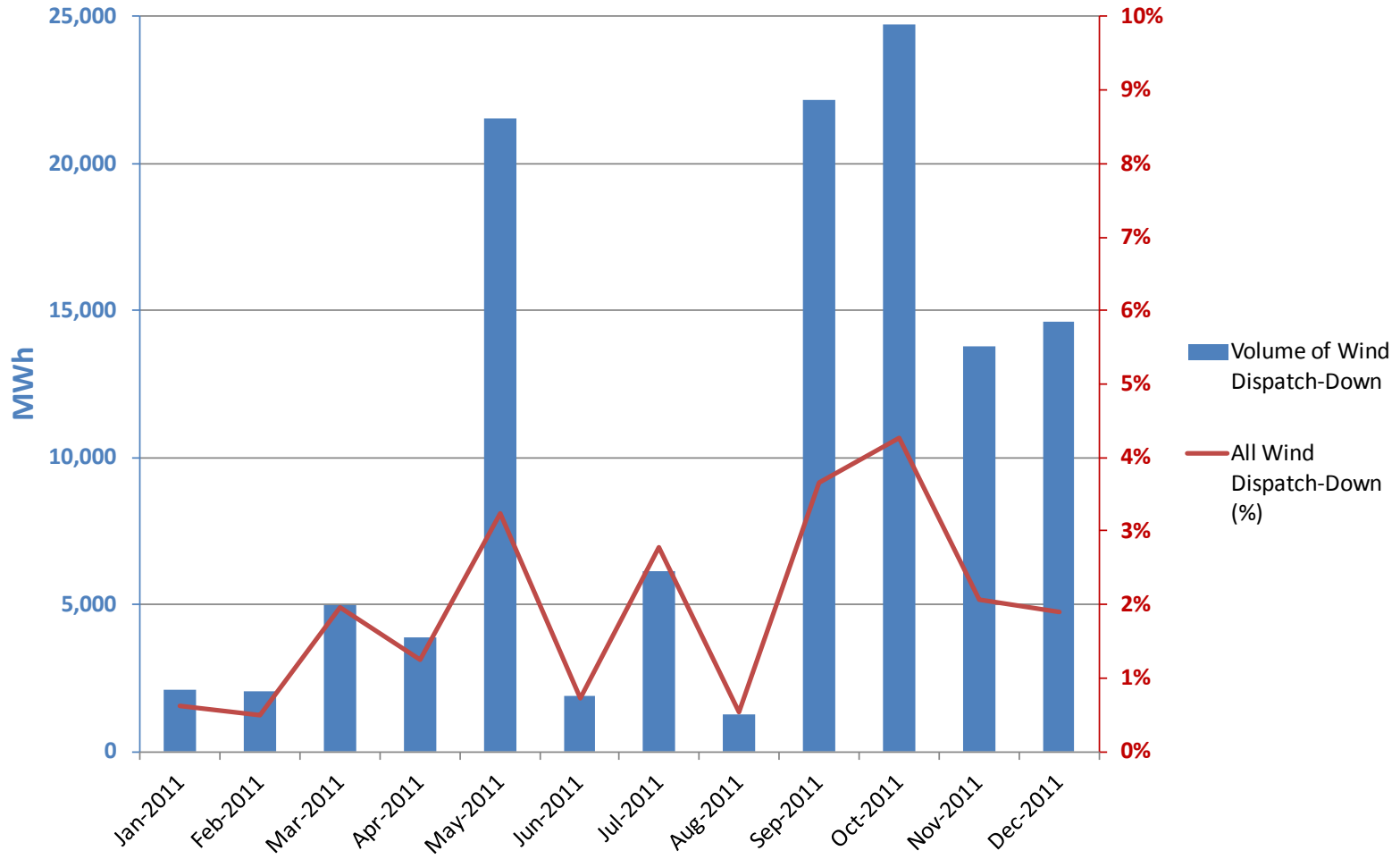
Results for 2011

- Report developed pre SEM 011-62
  - Hierarchy used based on VPTG
- Operational Issues of Note
  - Turlough Hill major overhaul
  - Moyle Interconnector outage
- Yearly wind profile
  - Later 6 months windier than first 6 months

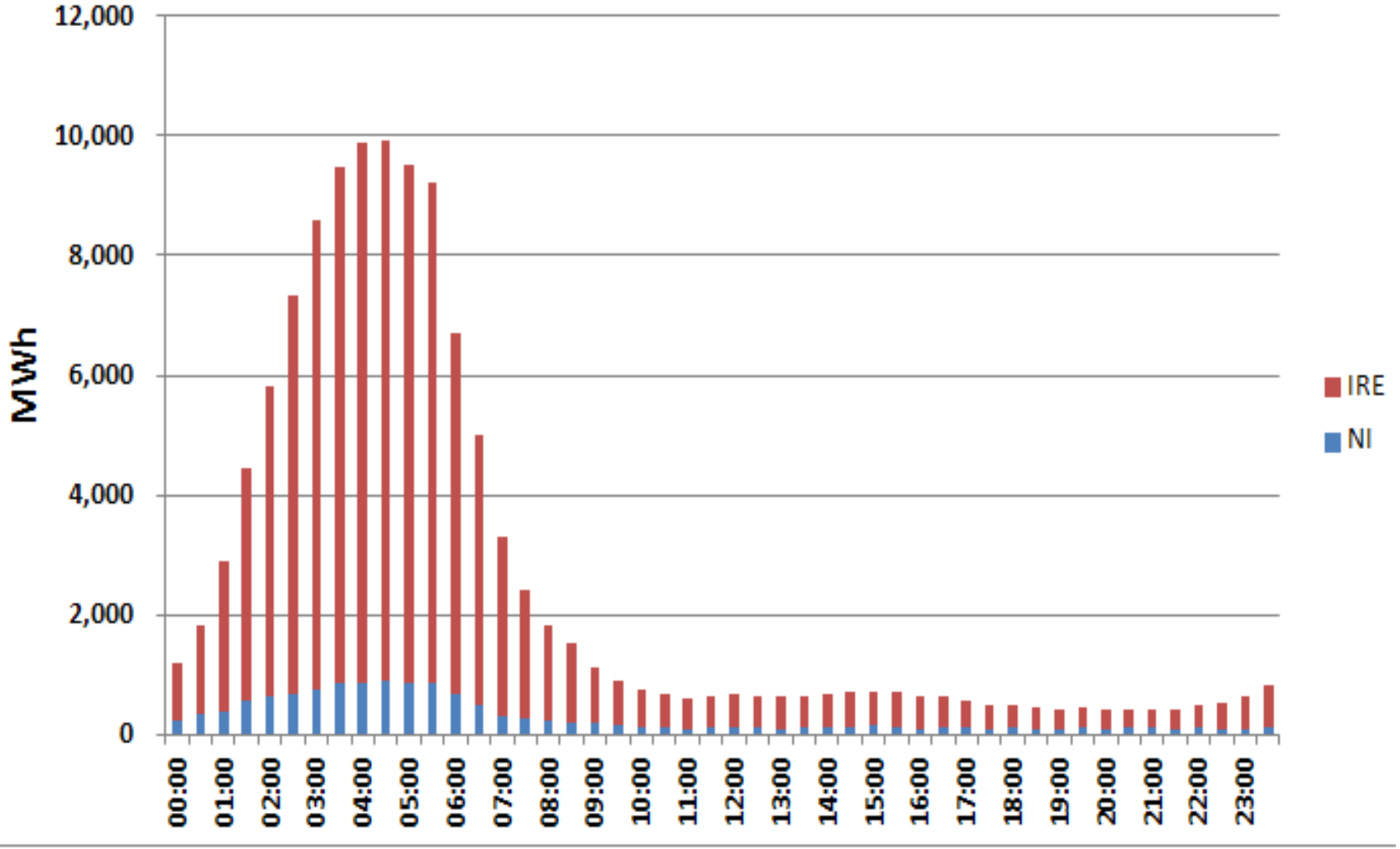
Jurisdictional Breakdown 2011

	IRE	NI	All Island
Total RES-E	18%	12%	17%
Total Dispatched Down (MWh)	105,741	13,415	119,156
Total Dispatched down RES-E	2.4%	1.3%	2.2%
Total Energy dispatched down on VPTG	7.5%	5.3%	7.2%

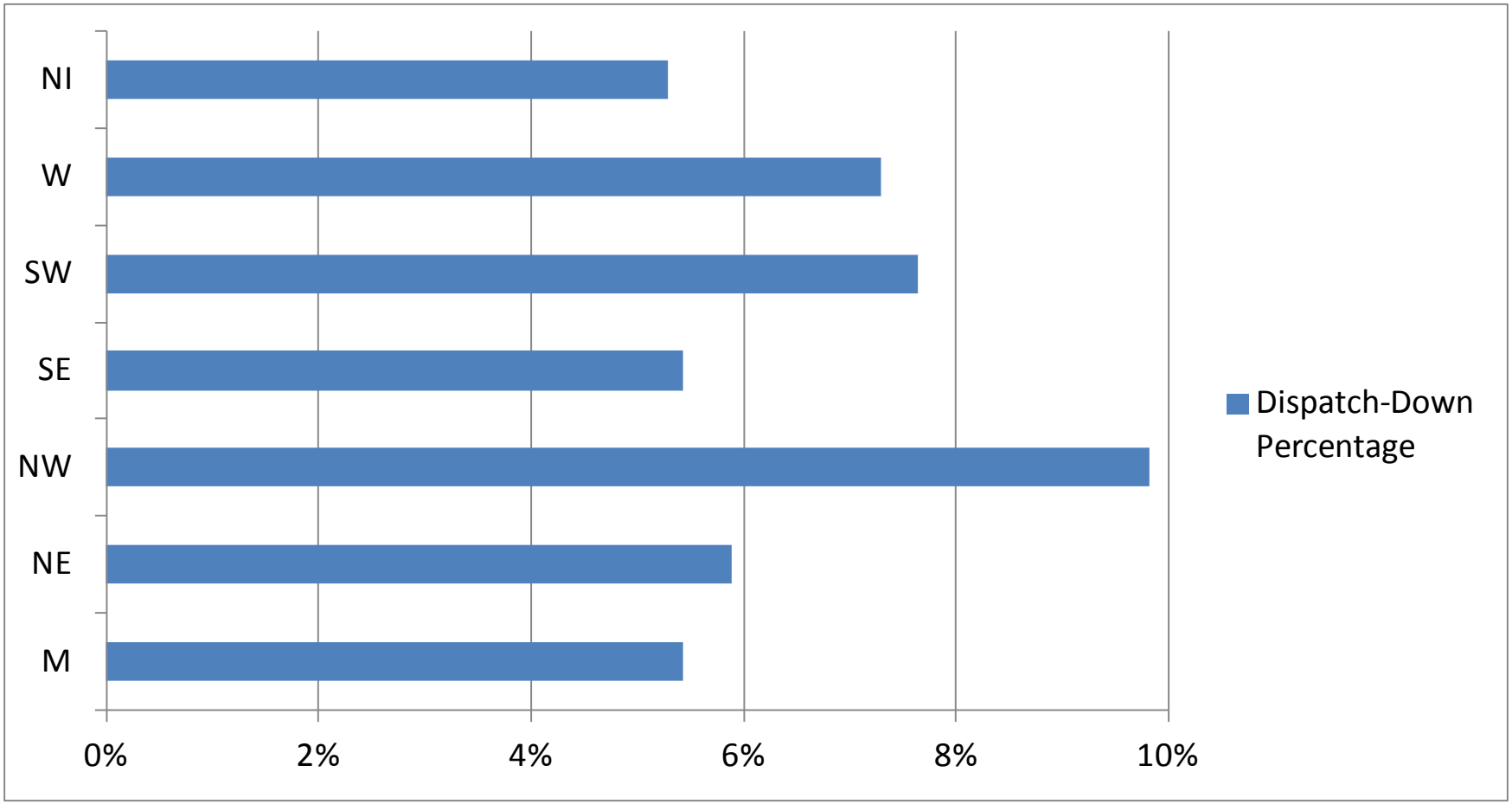
All-island monthly totals



2011 - 24 hour aggregate dispatch down



Regional Assessment



High Wind Analysis of the All-Island System

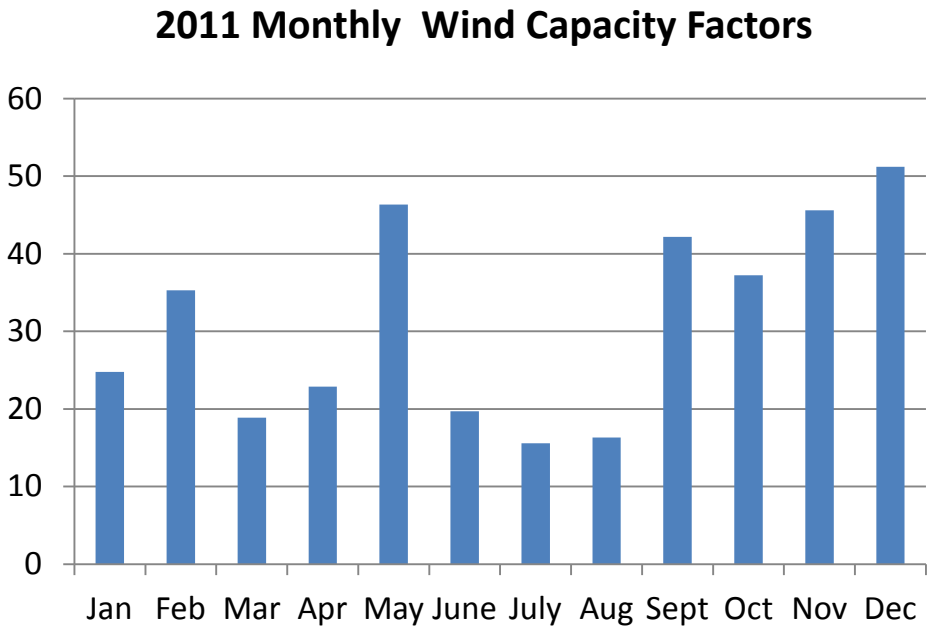
David Cashman

DS3 Advisory Council Meeting

22nd October 2012

Wind Statistics

- Capacity Factor 2011: 31%
- All-Island Wind Generation record of 1838 MW on November 30th 2011
- On November 26th 38.4 GWhrs generated accounting for 38.8% of demand
- Maximum recorded SNSP: 50%
- 103 Days in 2011 where wind exceeded 40% of demand during one or more trading period



Analysis of High Wind Reports - 2011

- In 2011 42 high wind reports compiled.
- At the beginning of 2012 a summary document was compiled outlining the major findings and operational recommendations in relation to transient, voltage and frequency stability.
- To date results do not demonstrate any voltage or transient stability issues at current levels of SNSP.

Date	SNSP %	Voltage Stability	Transient Stability
27-11-11	49	✓	✓
02-11-11	46	✓	✓
24-11-11	42	✓	✓
26-05-11	40	✓	✓
29-05-11	40	✓	✓

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Analysis of High Wind Reports – 2011

- Simulate tripping of largest generating unit and determine ROCOF for the system.
- RoCoF originally measured at 100 ms intervals – results approached 0.5 Hz/s standard.
- EirGrid and SONI Grid Code modifications state units must withstand RoCoF of 1 Hz/s and 2 Hz/s in Ireland and Northern Ireland respectively.

Date	SNSP %	Fmin Hz	RoCoF Hz/s 100 ms	RoCoF Hz/s 500 ms
27-11-11	49	49.6	0.34	0.25
02-11-11	46	49.6	0.37	0.26
24-11-11	42	49.6	0.32	0.22
26-05-11	40	49.6	0.32	0.23
29-05-11	40	49.6	0.37	0.26

Outcomes and Next Steps…

- Results from HWRs have reinforced and built on findings of the FOR study.
- The findings of the reports provide recommendations on operational policies.
- RoCoF analysis has helped to provide technical basis for the development of the revised Grid Code standard.
- Further analysis in 2012 is ongoing with improved methodology.
- Development of All-Island WSAT model to improve accuracy of results.


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Role of DS3 Advisory Council

Yvonne Coughlan

DS3 Advisory Council Meeting

22nd October 2012

Advisory Council – To Date

- Established Advisory Council in September 2011
- Have had 4 meetings of Advisory Council
- Opportunity to understand each other….
- Useful for TSOs to know industry support is there for programme

Future of Advisory Council

- Is the level of engagement appropriate?
- Are the key questions addressed/is there anything we haven't covered?
- Are there any gaps?
- How does the role of the Advisory Council change as we move into the next phase of the project?


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Smart Grid:
Demonstration Projects
Smart Grid Innovation Hub

Ciara Corby

DS3 Advisory Council Meeting

22nd October 2012

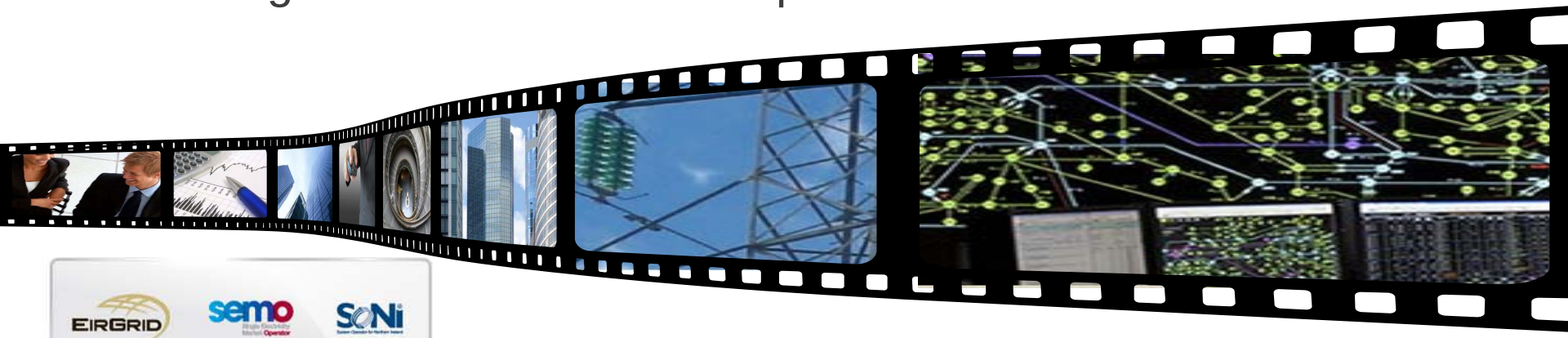
EirGrid/SONI Demonstration Projects

Issued call to demonstrate new Smart Grid concepts including:

- Demand side management
- System Operation – e.g., advanced voltage control
- System Services – e.g. reserve provision
- Transmission Technology types

2 Projects selected, healthy pipeline of additional projects

Results generated will be made public.



Glen Dimplex Quantum – Greenway Project

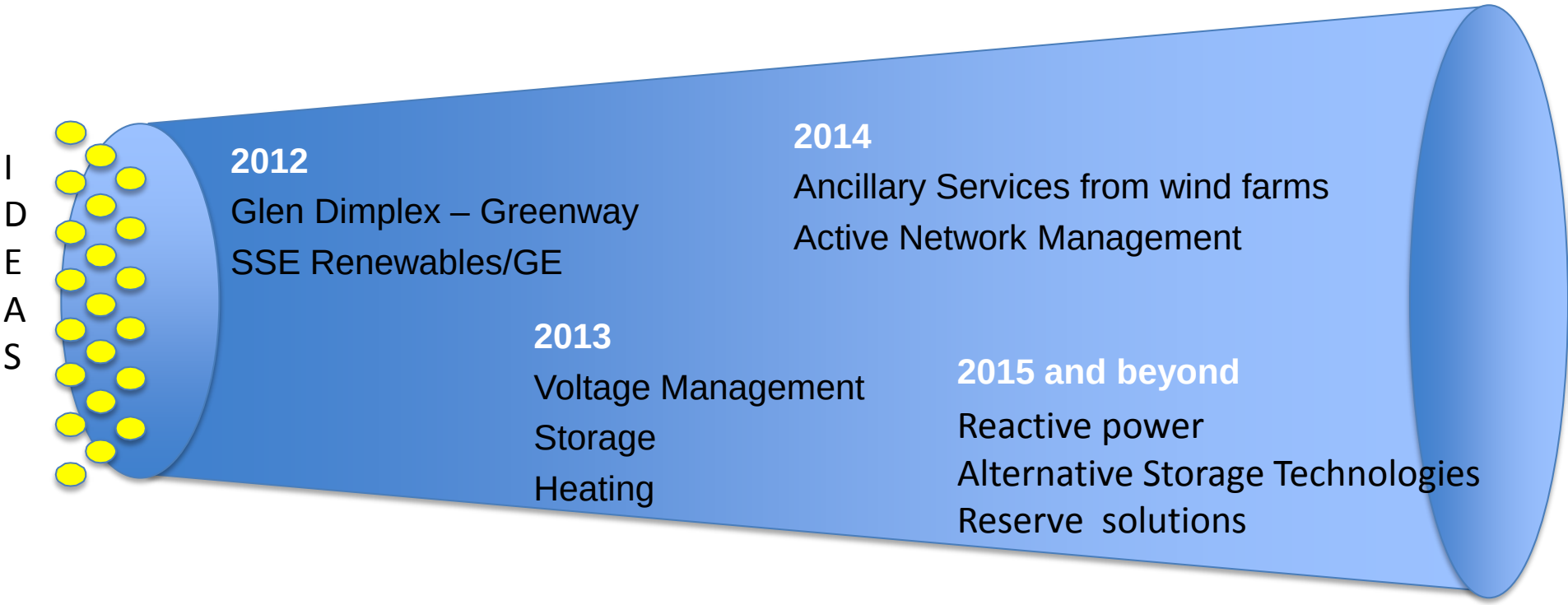
- Demonstrate how the Glen Dimplex Quantum space and water heating system can be deployed as an aggregated demand side management tool
- Green Way will identify and make available up to 1,000 properties
- Demonstrate how a distributed population of energy stores can be switched on and off remotely in response to an operational command.
- Eirgrid will facilitate grid level monitoring of the system's responsiveness

Fast Frequency Response (SSE Renewables/GE)

- Demonstrate fast frequency response from a Wind Farm Power Station using GE's WindINERTIA™ Control

- Demonstrate the automatic additional aggregate MW response from a WFPS during a frequency disturbance
  - Identify what is the minimum MW capability which can be provided at all MW output ranges in normal operation,
  - Determine what the time frames are where this MW injection can be achieved during the time period in advance of the POR timeframe.
  - Determine how can the performance be monitored.

Demonstration Project Pipeline



Smart Grid Innovation Hub

- A collaborative initiative between EirGrid, SONI and the National Digital Research Centre (NDRC) to promote the development of innovative Smart Grid solutions with entrepreneurs and companies in ROI and NI.
- NDRC is dedicated to “accelerating research from idea to income”
- A facility – ‘the Sandbox’ to enable prototyping, test, integration and demonstration of Smart Grid systems and applications
- Commercialisation support structures, project spaces, access to a network of experts, leading to investment
- Industry Group to provide guidance and input to the work of the Smart Grid Innovation Hub and also facilitate the sharing of information

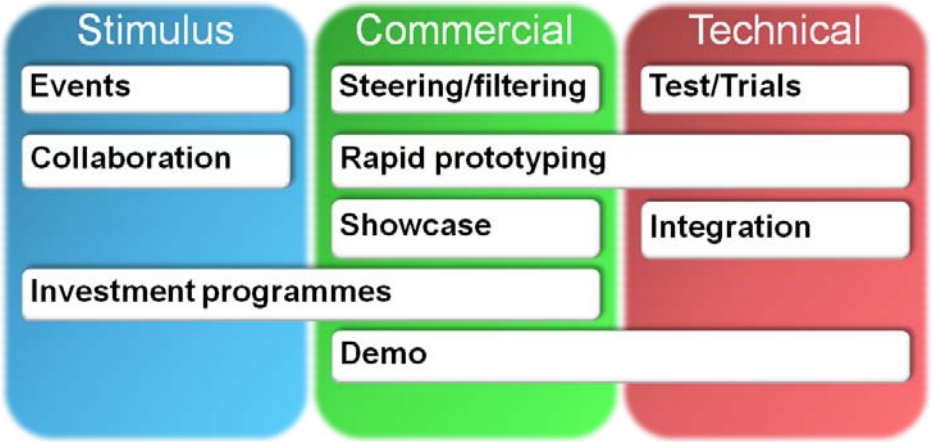
Smart Grid Innovation Hub Programme

IDA Ireland

ESB Networks
Serving all electricity customers

Invest Northern Ireland

erc
electricity research centre



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Irish Software Association

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INTERNATIONAL LOW-CARBON ENERGY TECHNOLOGY PLATFORM

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