DS3 Advisory Council Meeting

21/09/2016

EIRGRID GROUP

Agenda

Topic	Time	Speaker
Introduction	10.30	Robin McCormick -EirGrid (5 mins)
Industry Perspective	10:35	Presentation: Graham Brennan – SEAI (10 mins) Presentation: Jag Basi – ESB GWM (10 mins) Presentation: Colin Spain – GAELECTRIC (10 mins) Discussion: All (10 mins)
Actions from last meeting	11:15	Presentation: David Cashman -EirGrid (10 mins) Discussion: All (10 mins)
DS3 Programme Status Update	11:35	Presentation: Jon O' Sullivan - EirGrid (20 mins) Discussion: All (10 mins)
Rate of Change of Frequency (RoCoF)	12:05	Presentation: David Cashman - EirGrid (10 mins) Presentation: Tony Hearne - ESB Networks (5 mins) Update: Rodney Ballentine - NIE (5 mins) Discussion: All (5 mins)
System Services(General Update)	12:30	Presentation: Ian Connaughton - EirGrid (30 mins) Presentation: Robert O' Rourke (15 mins) Discussion: All (15 mins)
Lunch & Networking (13:30 – 14:00)		
Topic	**Time**	**Speaker**
Power Off and Save	14:00	Presentation: David Phelan – Electric Ireland (25 mins) Discussion: (5 minutes)
EWIC Exports	14.30	Presentation: Diarmaid Gillespie – EirGrid (15 mins) Discussion: All (5 mins)
Closing Remarks and Actions	14:50	Robin McCormick (10 mins)
Session Closed / Networking	15:00	-

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Industry Perspective

DS3 Advisory Council Meeting 21/09/2016

10.35-11.15 am

The All Electric Aran Islands Project

Graham Brennan
Transport Programme Manager

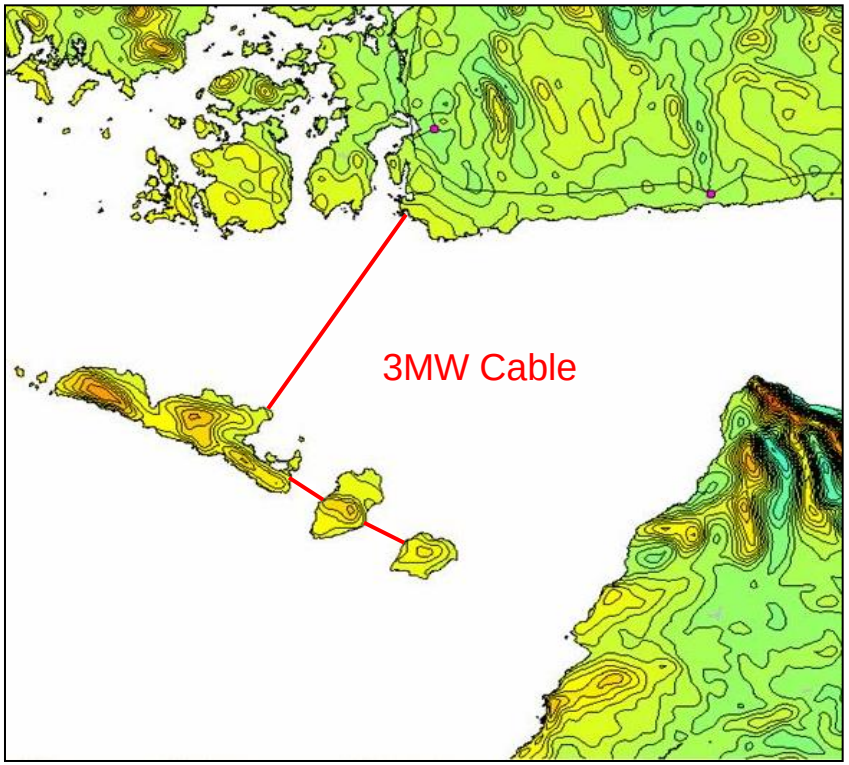
Aran Project Results
DS3 Advisory Council Meeting
21st Sept 2016

Overview of Aran Project

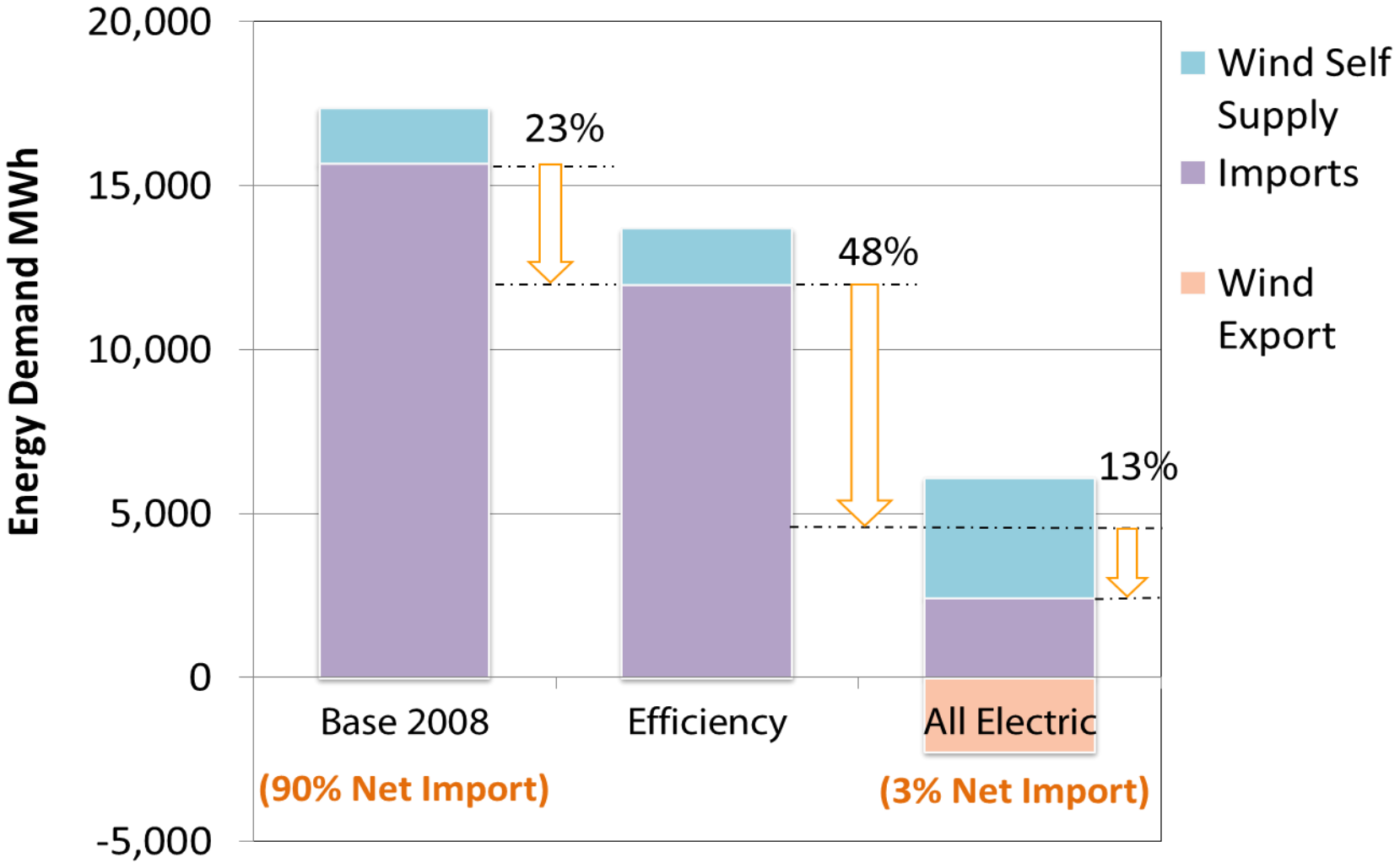
- **History of Project**
- **3 Elements:**
  - All Electric Island Study
    - For SEAI by Alan Mullane/Andrew Keane/Eleanor Denny
  - 3 Year EV Trial
    - Managed by Merrion Fleet
  - Community Energy Efficiency Programme
    - Comharchumann Fuinneamh Oileáin Arainn
    - http://www.aranislandsenergycoop.ie/

Energy Snap Shot of Aran Islands

- **1,500 Tonnes of Oil Equivalent**
  - 62% Heat (coal, kerosene)
  - 25% Electricity
  - 13% Transport (8,400km av)
- **1.2mEuro Energy Bill for Islands**
- **Renewable Energy Resources**
  - Wind, Wave & Tidal



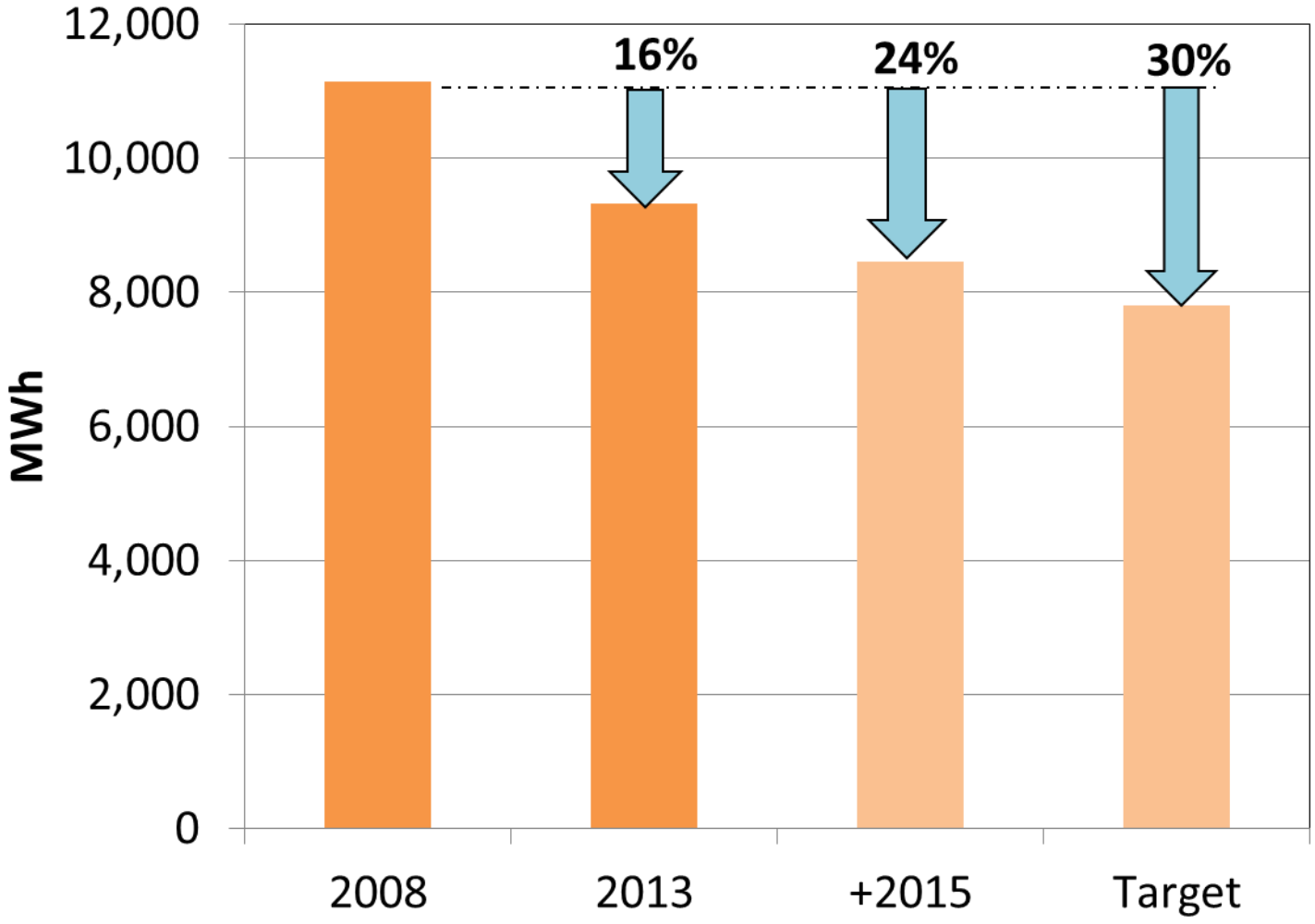
All Electric Aran Islands Concept – 84% Reduction in Energy Imports



3 Year Aran Islands EV Trial

- 8 Electric Vehicles - 30 participants
- 68% reduction in energy imports vs new diesel vehicle
- 19% wind energy content (vs 2.3% for biofuels)
- 78% reduction in energy costs

Community Energy Efficiency Progress to Date - Impact on Imported Heating Fuels



SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Thank you

Energy for generations

DS3 System Services: Advisory Council

Prices, Signals and Incentives

Jagtar Basi

21st Sept 2016

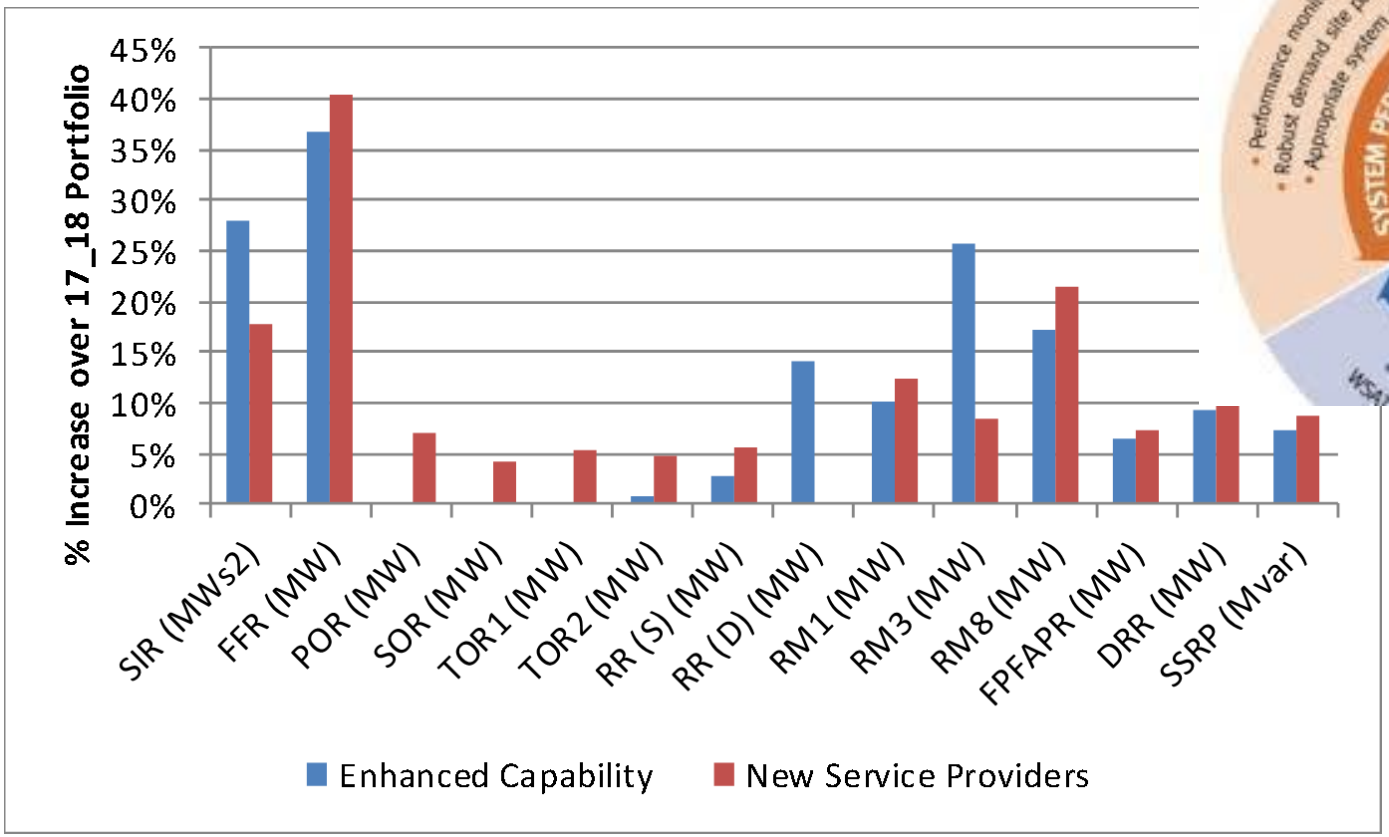
Capgemini CONSULTING.TECHNOLOGY.OUTSOURCING

BNFL

ofgem

THE UNIVERSITY of EDINBURGH

The Challenge Facing The Industry: meeting a policy objective



Working differently and **delivering new services**.

What are the objectives of industry participants?

Energy for generations

EirGrid SONI

Set prices to attract necessary volume of products to facilitate minimisation of curtailment.

Utility Regulator
ELECTRICITY GAS WATER

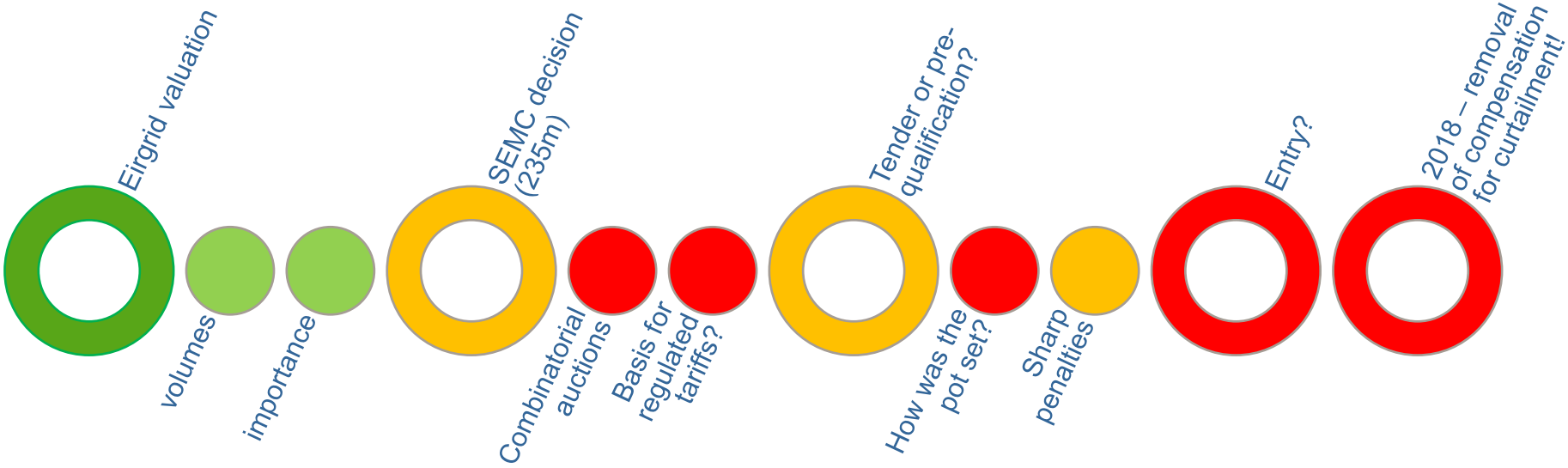
CER
Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Determine the right competitive cost and incentivise the right procurement volumes

Get the right rate of return for the assets that provide the service and see the right investment or service provision signals.

Are the signals working that allow these objectives to be met?

Getting the right signals at the right time?



Prices today need to send the right signal for products to be delivered tomorrow. Is this happening? Should we let a dynamic market drive down price?

The challenges

Energy for generations

Regulators

- Not meeting policy targets
- European penalties?

EirGrid/SONI

- Not given enough funds?
- Complexity of policing? unintended consequences of penalties and prices… .asymmetric reward and penalty?

Low prices

- Long term competition

Investors (new & existing)

- Need the price signal today
- Undisclosed pot..,… approach 235 v 80
- Regulatory uncertainty

High price signals

Isem – market risk

- Risks combined
- Complexity
- Inefficient exists and implications (DS3 & CRM)

"Electricity supply needs to be secure and reliable. The cost of too much is insignificant compared with the cost of too little." Dieter Helm

DS3 Auction Design – A New Entrant Perspective

DS3 System Services Advisory Council

Dublin
21/09/2016

Gaelectric®
Power from Nature

GTAMS Key Stats

TRADING & MARKETS

2015

Est. 2014, providing alternative route to market for GHL assets.

First Revenue Achieved in Nov 2015

Subsequently offering services to 3rd parties in late 2015

250MW / 565 MW

250 MW under contract today

565 MW to be under contract @ Q1 2017

1.05GW

A target of 1.05GW contracted @ Q1 2018

A system development team using best in class tools & techniques

4 staff 2015
18 staff 2016
21 staff 2017
25 staff 2018

The only non-utility PPA'd in NI

A trading team in GB ID/Bal Markets

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Project CAES, Larne- NI
Project Info

- Siemens Dresser-Rand;
  - 330MW Generation, 250MW Demand
  - both sources of inertia.
- Grid Secured, Planning submitted Dec 2015.
  - Project designated strategic infrastructure in N.I.
- Designated as a Project of Common Interest (PCI) by the European Commission
  - Awarded grant funding of €14.5mln from Connecting Europe Facility
- Currently progressing Front End Engineering Design (FEED)

Project CAES, Larne- NI

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Power from Nature

Project CAES, Larne- NI
DS3 Performance

- Generator & Compressor provides full range of DS3 services.
- Independent DS3 performance assessment undertaken
- CBA indicates significant consumer saving
- Strategic Partnership with Siemens Dresser-Rand
- Power Generation Mode
  - Minimum Generation: 10%
  - Flexibility: 10% - 100% rated power output in 5 minutes
  - 0% to 100% rated output; 10 minutes
  - Flat heat rate
  - Exceptional Load following capability
- Compression Mode
  - 65% to 110 % of rated output
  - High system efficiency over the operating range

Gaelectric®
Power from Nature

Project CAES, Larne- NI
Innovative use of Existing Technology

- 2 CAES plants in operation worldwide;
  - Huntorf, Germany: 1978
  - McIntosh, Alabama: 1991
    - >97% Generation Running Reliability since COD
    - >99.5% Compression Running Reliability since COD
- Over 1,200 compressors supplied
- Over 300 LP Expanders installed
- Salt Caverns used for storage over 50 years. >500 storage caverns throughout the world, primarily for gas storage

Context for Procurement

- TSO's have set themselves the following aims;
  - Increased SNSP (75%)
  - Reduce Curtailment
  - Minimise Dispatch Balancing Costs
- Other policy targets: Maintain security of supply via capacity contracts

- SoS & DS3 requires flexible capacity
  - Procurement model for DS3 must consider wider policy goals & vice-versa for Reliability Options

DS3 Auction Design
A New Entrant Perspective

- New Entrants require the following to secure finance;
  - Stable Revenues
  - Long Term Contracts
  - Clear auction design and unambiguous contract allocation
  - Appropriate allocation of risk

DS3 Auction Design
A New Entrant Perspective

- Challenges to date with the current structure;
  - Extensive work leading to impasse
  - Confusing Auction Design
  - Inappropriate allocation of risk
  - Risk of resorting to regulated tariff seems high
    - Tariffs as designed are not investable
  - TSO discretion for new entrants
  - Revenue clawback

Until design is complete it seems new entrants are not welcome!

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Power from Nature

Moving DS3 Forward

- Separate existing participants and new entrants
  - Existing participants: 1 year tariff
  - New Entrants: 15 year contracts
- Procure capacity simultaneously or in immediate sequence
- New entrant procurement
  - (a) Simpler Auction format – clear winners and losers
  - (b) tendered **value** based tariffs
  - (c) Separate Pots as per GB CfD

Need to consider selection criteria to maintain objectiveness

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Power from Nature

Moving DS3 Forward

- Minimum Annual Revenue Requirement (MARR) to cover only DS3 revenue
  - Must be re-established
  - Where contractual availability decreases below an agreed threshold, MARR pro-rata reduces to protect consumer
- Profit Capping
  - Entire profits to be capped (including capacity payment and energy revenue) for new entrants
  - Non-Profit Distributing Model is a commonly utilised structure
    - Above capped profit; return to the TUoS customer or similar.

Consideration of Capacity

- Profound issues around Security of Supply in Northern Ireland
  - Can the North/South Interconnector be delivered by 2019?
- Consideration of Locational Issues in the CRM auction may be limited to 1 year auctions
  - RO proposals seem to include potential that constraints impact clearing price.
- Will this achieve the wider policy objectives of maintaining security of supply whilst incentivising flexibility

Aligning Capacity & DS3

- Capacity **and** DS3 contract required by many new entrants to finance construction
- Projects must have sight of both auction results before accepting either/both contracts
  - Risk of pulling out of former after results of latter
  - If TSOs re-procure; litigation
- Both auctions should work together to procure flexible capacity to meet TSO aims

Conclusion

- Gaelectric believe that proposals must ensure;
  - Wider policy objectives are progressed
  - Investment opportunity is clearer
  - Transparency is incentivised

Actions and Membership

DS3 Advisory Council Meeting 21/09/2016

11.15-11.35 am

David Cashman

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Actions

1. TSOs to write to generators on publishing inertia data
2. TSOs to request new members to fill vacant positions on the Advisory Council
3. Members to provide feedback on membership constituencies and if new skillsets should be added
4. TSOs to provide updates on system RoCoF studies

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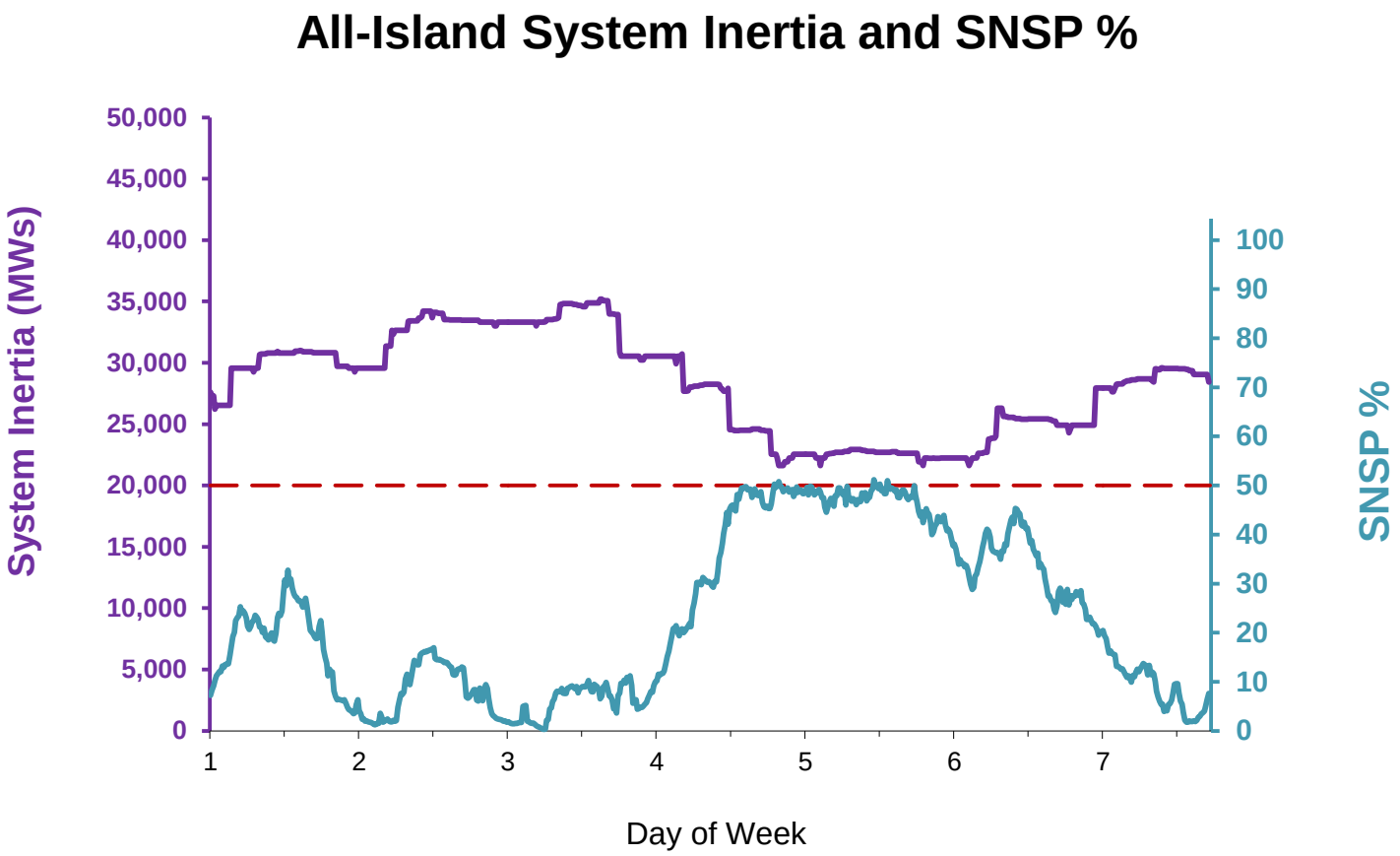
System Inertia Data



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DS3 Project Plan to 2020

DS3 Advisory Council Meeting 21/09/2016

11:35-12:05 p.m.

Jon O' Sullivan

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And we had a plan…

Grid Code

Performance Monitoring

DSM

System Services

ROCOF

Frequency

Voltage

Renewable Data

WSAT

Control Centre Tools

Model Dev. & Studies

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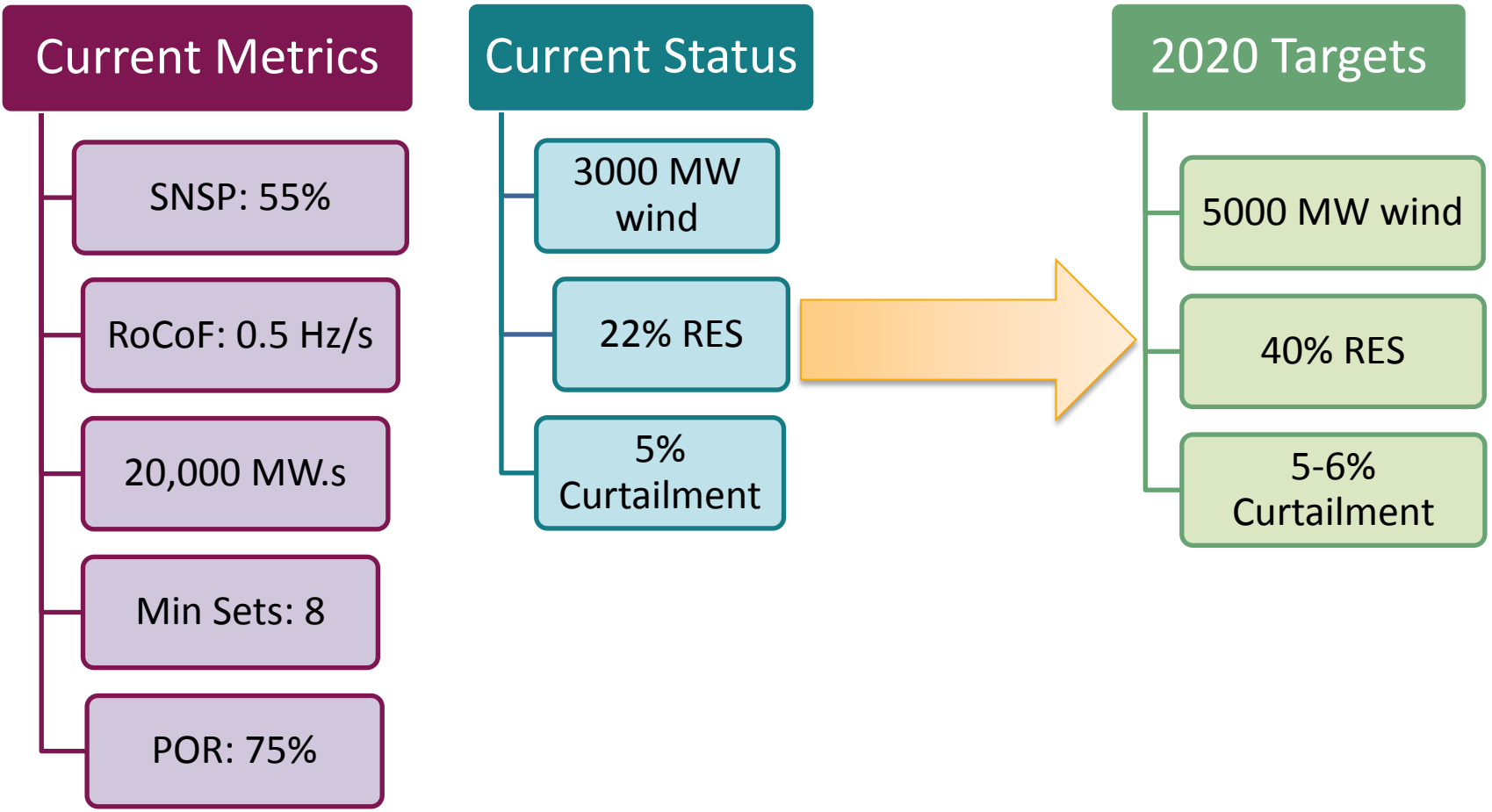
but what are we really trying to do?



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which changes how system operated…

	2016	2017	2018	2019	2020
SNSP	55% -> 60%	60% -> 65%	65% -> 70%	70% -> 75%	75%
RoCoF	0.5 Hz/s	0.5 -> 1 Hz/s	1 Hz/s	1 Hz/s	1 Hz/s
Inertia	20,000 MW.s	20,000 MW.s	17,500 MW.s	17,500 MW.s	17,500 MW.s
Min Sets	8	8	7	7	6
EWIC	300 -> 500 MW (interim)	500 MW (interim)	500 MW (interim -> enduring)	500 MW (enduring)	500 MW
Reserve	POR: 75% FFR: 47%	POR: 75% FFR: 47%	POR: 75% FFR: 47%	POR: 75% FFR: 47%	POR: 75% FFR: 47%->55%
Wind/Solar Policy	N/A	N/A	????	????	????

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So what is DS3 like to achieve this?

Task	2016	2017	2018	2019	2020
SNSP Limit	55% -> 60%	60% -> 65%	65% -> 70%	70% -> 75%	75%
Studies	Future Ops Policy/ Curl. 60% Study	Ramping V. Trajectory Inertia Floor Solar + DSM	Revised VDIFD Freq. Regulation	VDIFD? New Tech. Reserves	New Tech. Solar & DSM dispatch
Policies	Cat 1&2 Gen Studies	RoCoF -> 1 Hz/s	1 Hz/s Min sets: 7 17,500 MW.s	New Tech Dispatch Policy	Revised FFR, POR policies Min sets: 6?
Control Centre Tools	5 min WSAT SS Tools FFR monitor	Robust WSAT Ramping Nodal Controller	Look Ahead WSAT RES Dispatch	Voltage Trajectory	New Tech. Solar & DSM dispatch
Performance	Interim OFGS	New Tech. Trials LoM settings	Enduring OFGS	Renewables Variation	Reserves from New Tech

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But need to consider I-SEM…

Significant changes to system operations

- New unit commitment – SCUC, SCED
- New Market platform – Market Management System
- Intraday, forward and balancing markets
- Individual and Common Grid Models

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…and other operational issues

Control Centre Tools

- New Tools within EMS
- Situational Awareness: EMS Alarm consolidation
- Forecasting

Studies

- Oscillations
- Review of TCGs

Policies

- AGC
- Priority Dispatch: de-committing of generation
- Network Codes/Guidelines

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…what is still to come from Europe

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Copied from presentation Jan Papsch DGEN Jun 2016

..change coming in domestic capabilities

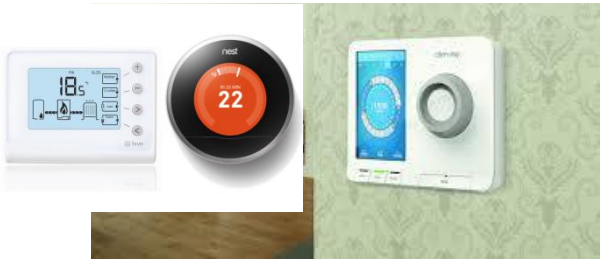
Energy management

HEMS – growing deployment

Large multinationals investing

- Non energy propositions
- Energy efficiency
- All suppliers in IRE installing

Industrial and SME using EMS



HomeKit

HomeKit is a framework for communicating with and controlling connected accessories in a user's home. You can enable users to discover HomeKit accessories in their home and configure them, or you can create actions to control those devices. Users can group actions together and trigger them using Siri.

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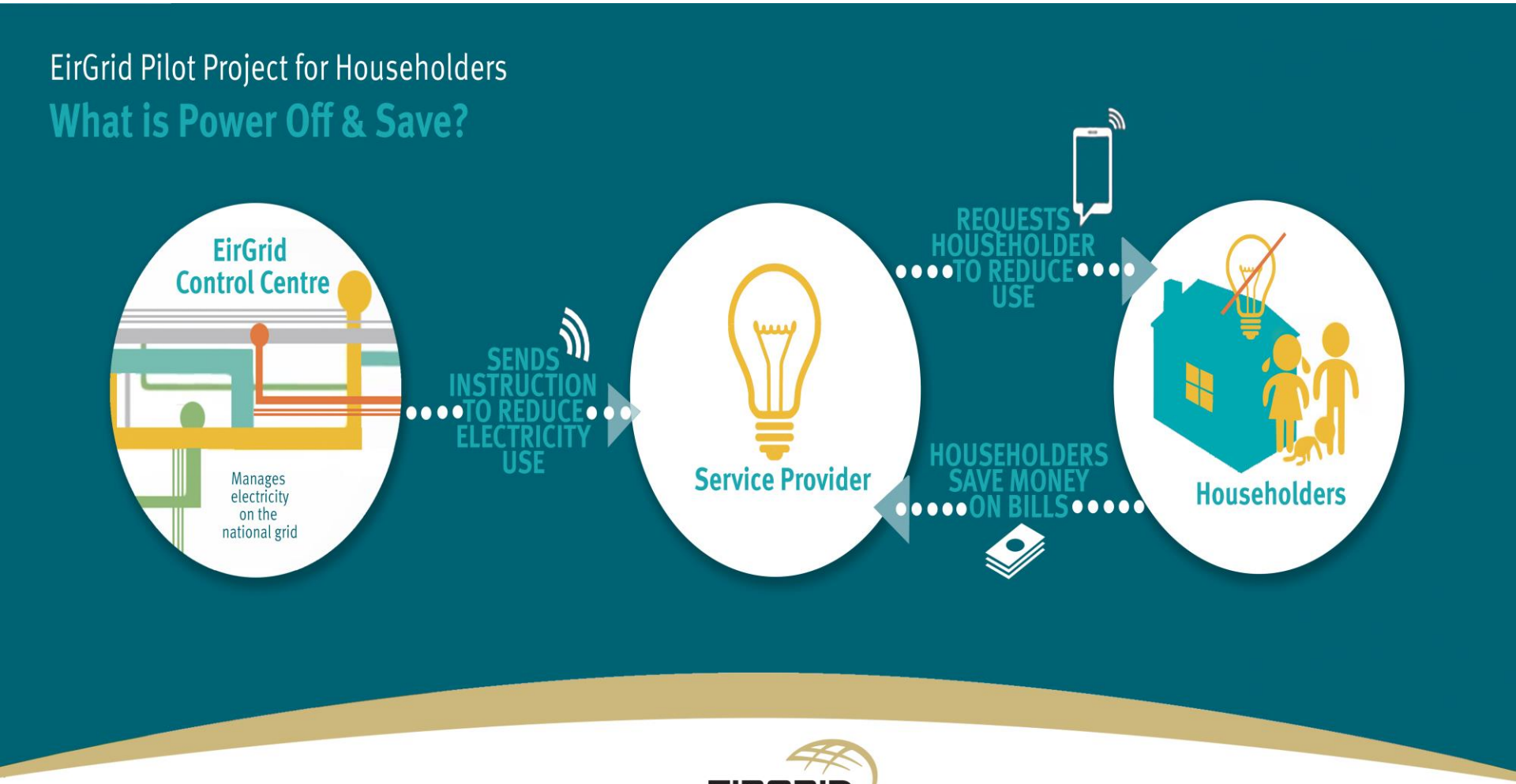
So we are trialling residential services…



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The current. The future.

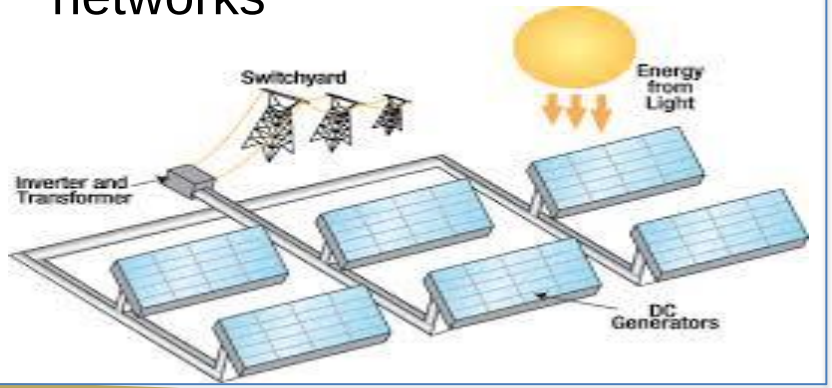
and solar PV is around the corner?

Context

- per unit cost falling
- supports likely soon
- Large scale deployment?
  - Embedded in homes and buildings
  - Dedicated Solar farms

Challenges

- system issues similar to DS3 but greater
- observability and controllability
- interactions with DNO
- bi-directional flows on radial networks



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So what are we doing about these…

Future system study

- Increase DSM, Solar
- Wind
- Interconnection
- Increased data centres
- Operational perspective of Advanced scenario planning

New technology

- Working group DSM
- DS3 SS Qualifier trials
- Expand membership of DS3 Advisory Council?
- Solar – Batteries - Storage

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Rate of Change of Frequency (RoCoF)

DS3 Advisory Council Meeting 21/09/2016

12:05-12:30 p.m.

David Cashman

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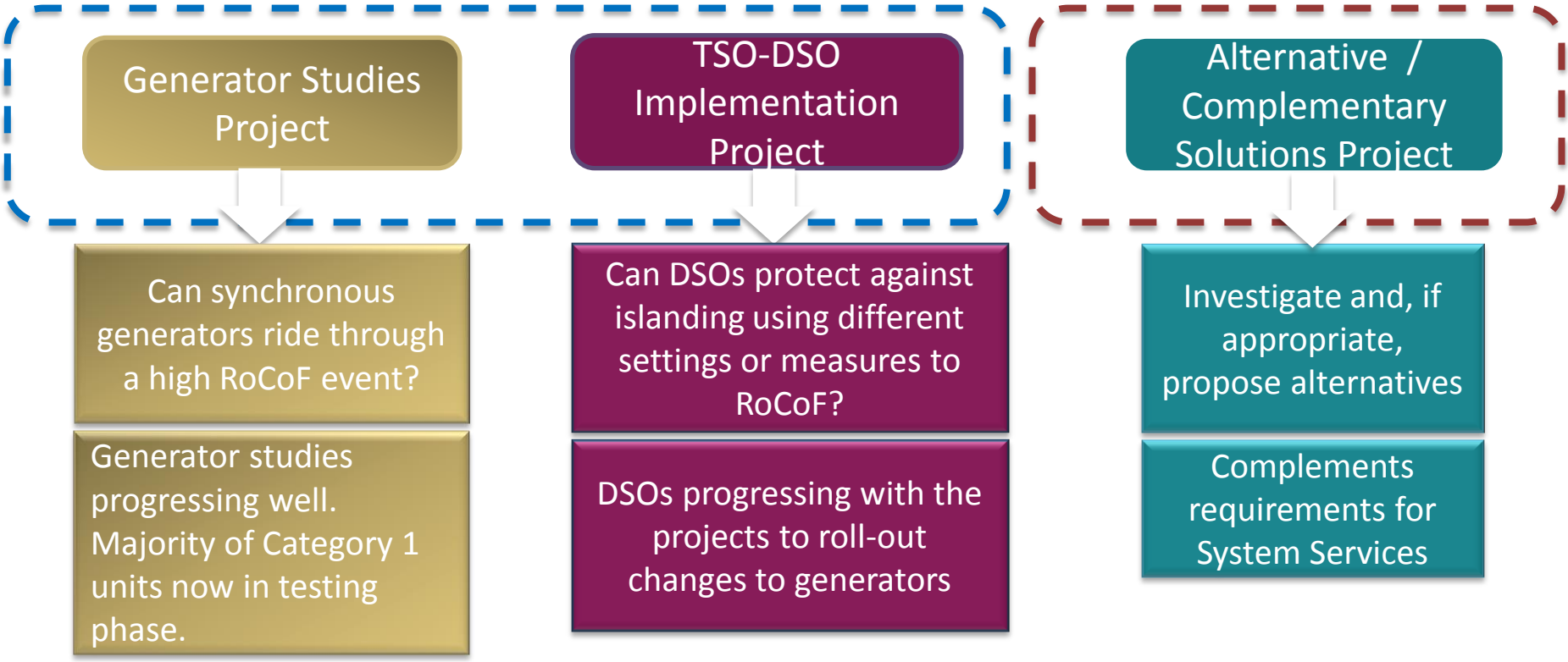
RoCoF Implementation Project



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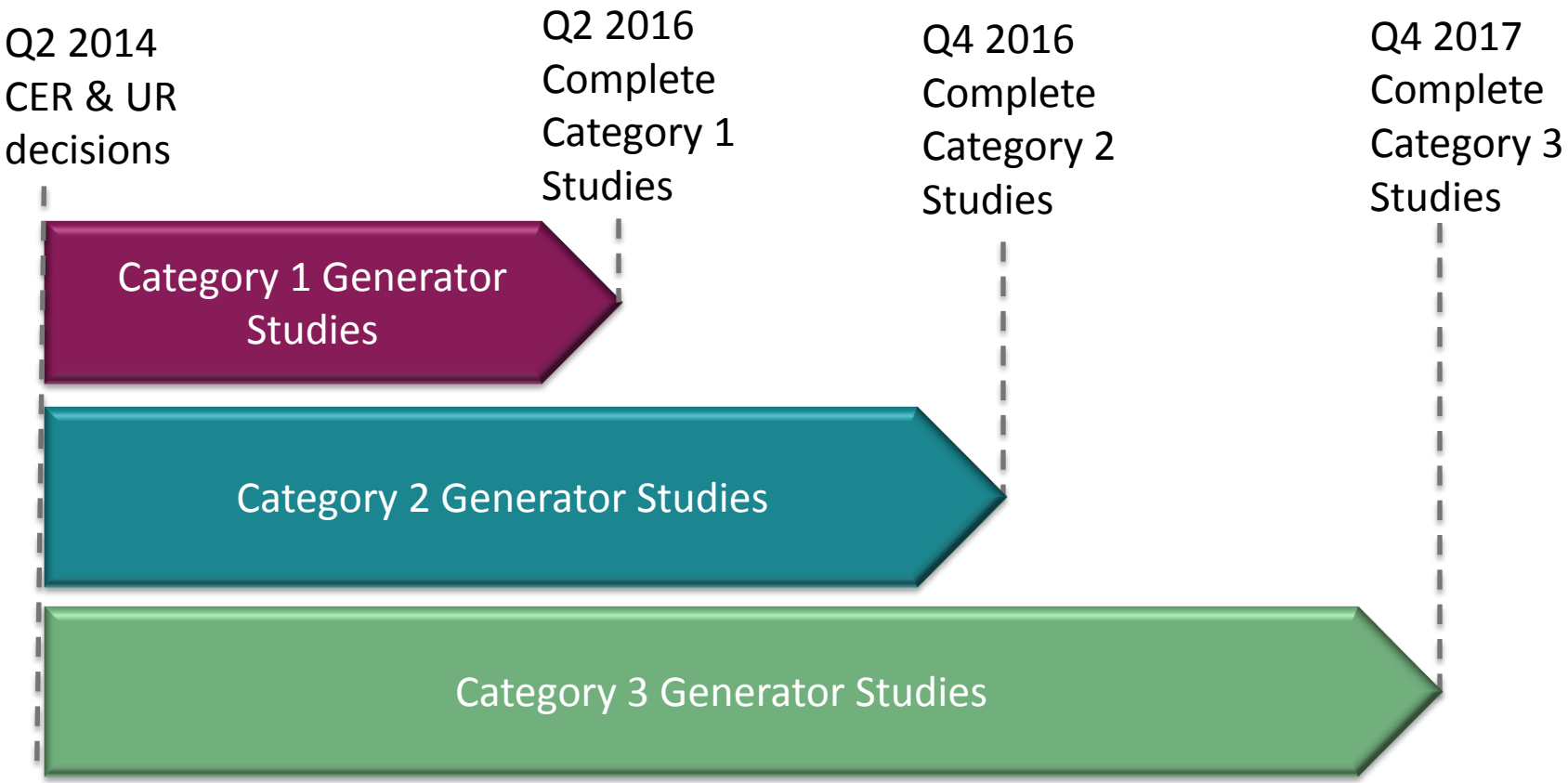
Generator Studies Timelines



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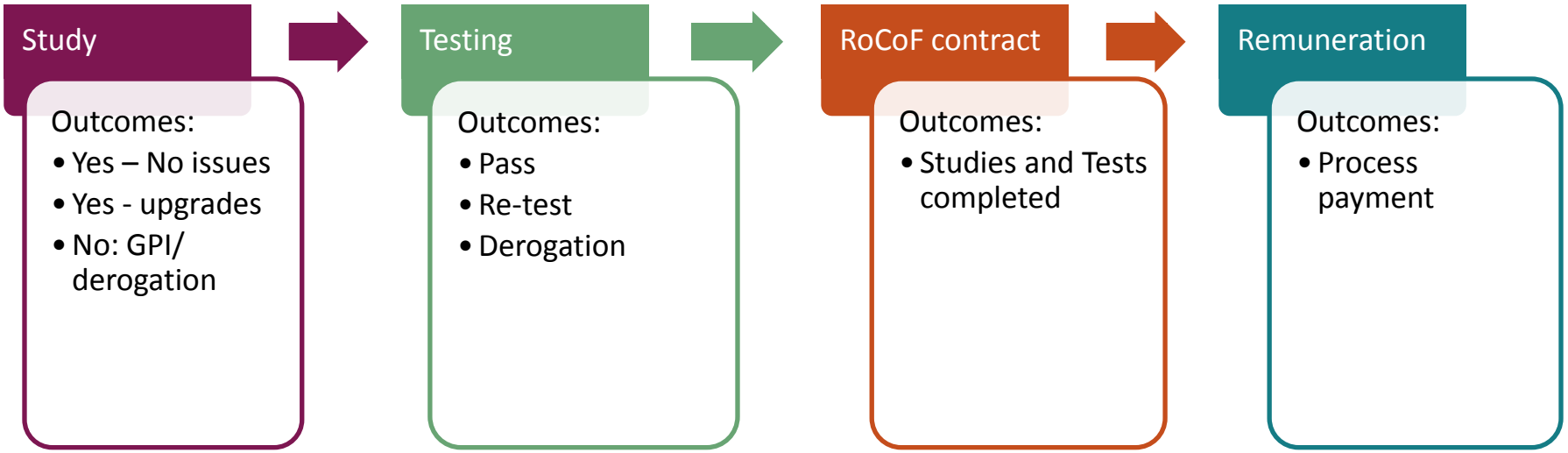
RoCoF Remuneration Method



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Progress to Date

- All reports submitted by May 31st deadline have been reviewed
- 22 units are now in the 6 month testing phase
- Settlement systems for GPI and remuneration mechanism established
- 3 generators have fully completed the process and have been issued contracts

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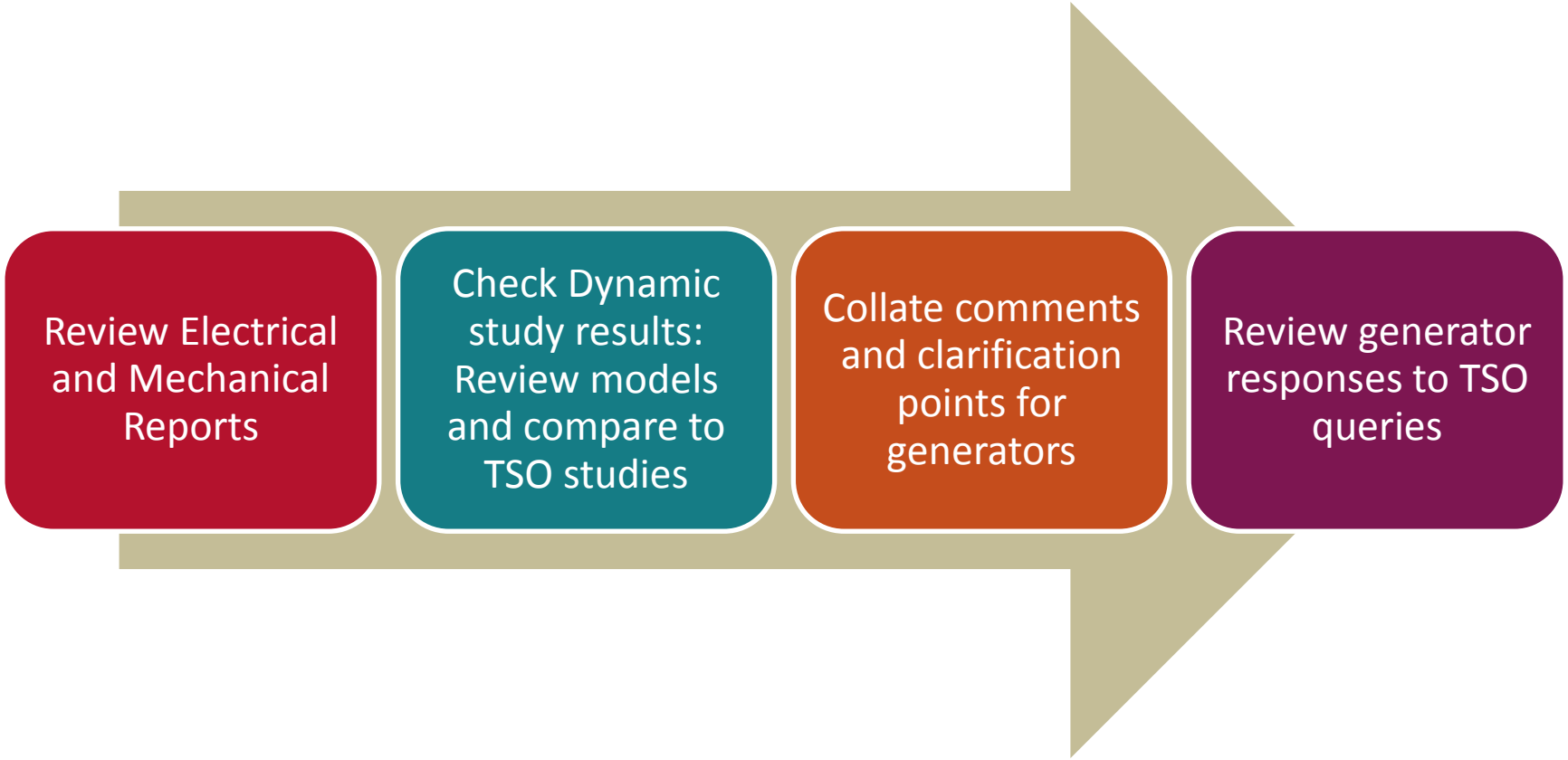
EirGrid Review Process



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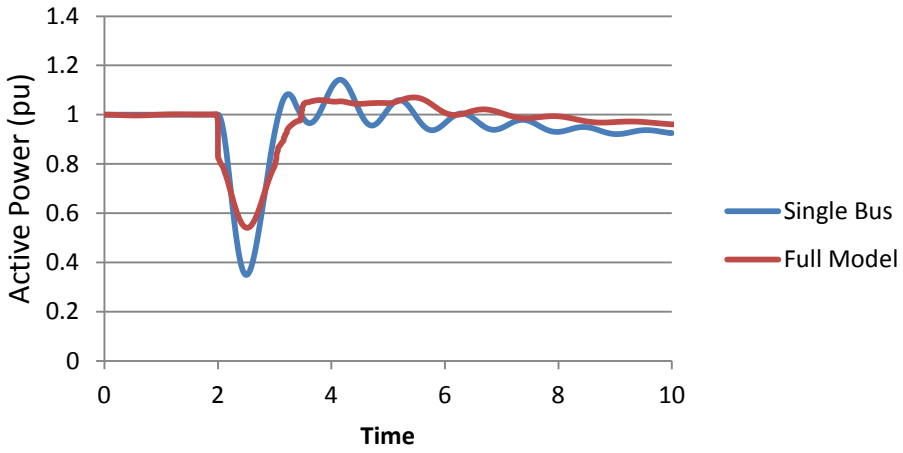
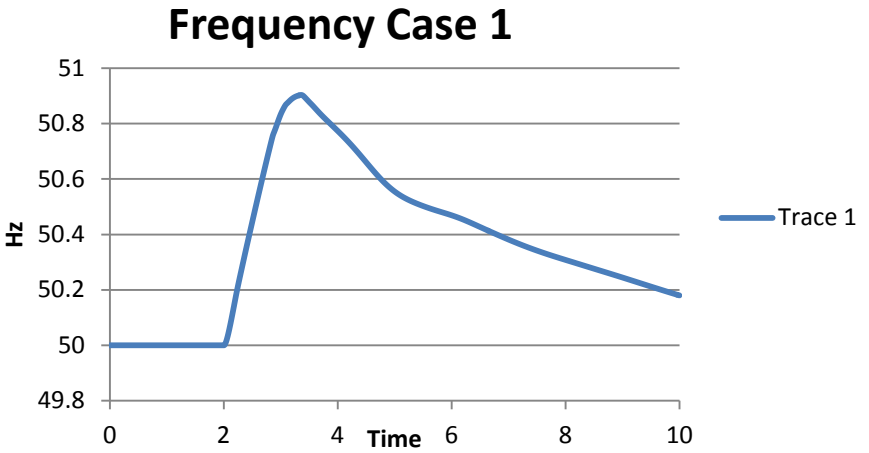
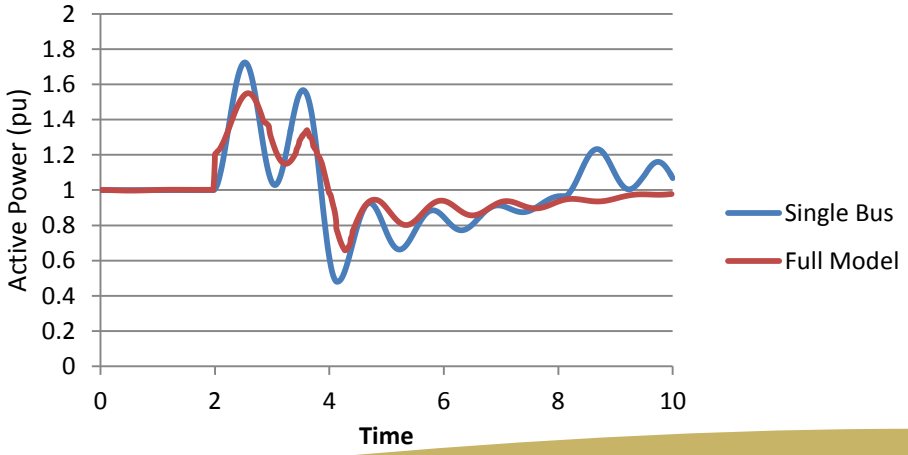
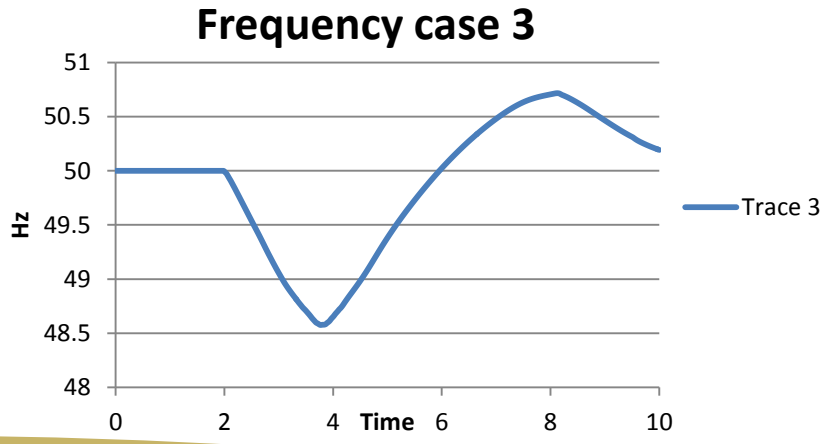
Example TSO results









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Next Steps

- Several reports outstanding which need to be processed
- Generator testing team are engaging with units to prepare testing timelines
- Category 2 units due to submit studies in November

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TSO-DSO Project

Ireland

- Requests for settings changes issued and roll-out is continuing
- Settings changes on 50% of wind farm sites completed
- Engagement with non-wind embedded generators ongoing

Northern Ireland

- University of Strathclyde WP1-3 studies for Large scale generation have been completed
- NIE N to engage with HSE NI and UR in coming weeks
- Roll-out of settings to commence subsequent to these meetings

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DS3 Advisory Council
ESBN Update

Tony Hearne

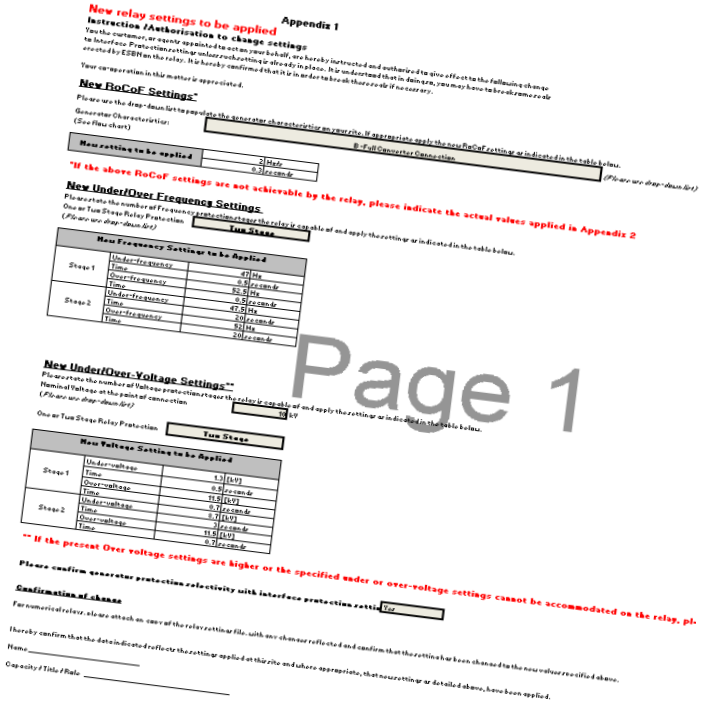
21st September 2016

TSO-DSO ROCOF Workstream

Questionnaire and Settings Change

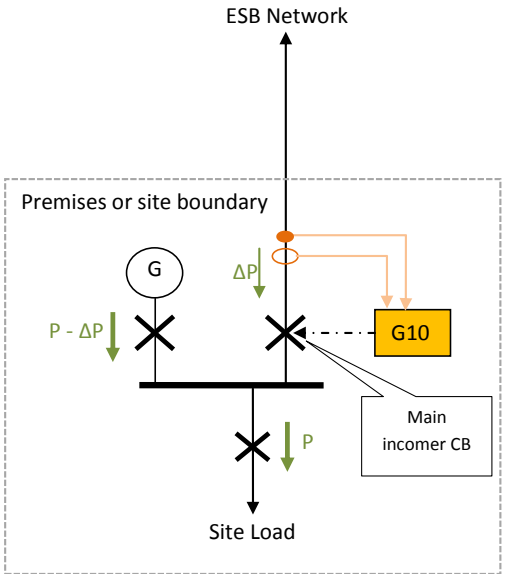
Wind Generators

- Wind Farm setting changes on-going
- 49% of fleet have changes their settings and returned formal notification to ESBN
- A further 28% have made the changes but not returned formal notification to ESBN
- 23% are being pursued by any channels available



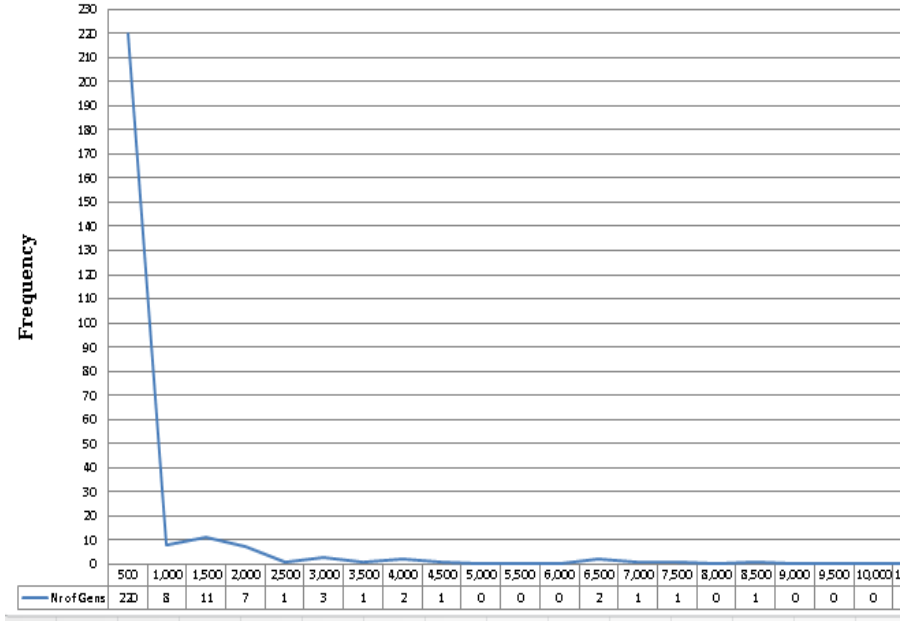
Non-Wind Generation

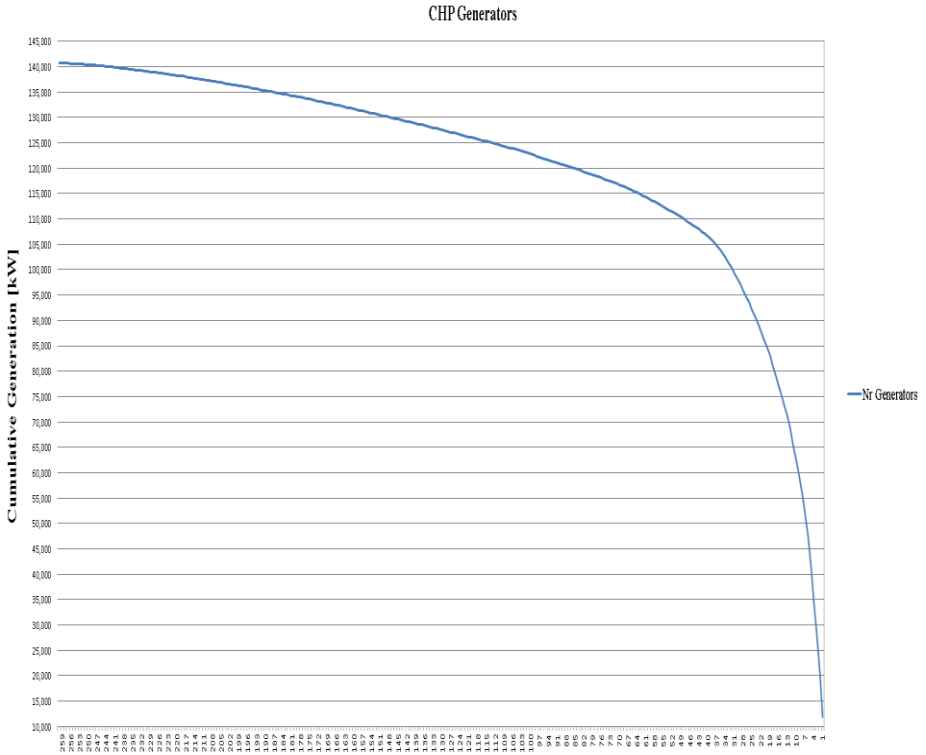
- Engagement with customers proving difficult – no monetary incentive for them
- Alternative channel established through OEMs – Agents for Generators. Official Rep now in place and has seat on DCRP
- Very useful engagements to date through that channel
- Relevance of some technical detail becoming evident – potential for win-win for an identified cohort, which EirGrid happy to leave alone and ESBN also need ROCOF setting to remain unchanged
- Work to quantify this cohort is on-going
- Prioritisation and targeted plan will be required for remainder



Efficiency of effort

Will need to target quick wins



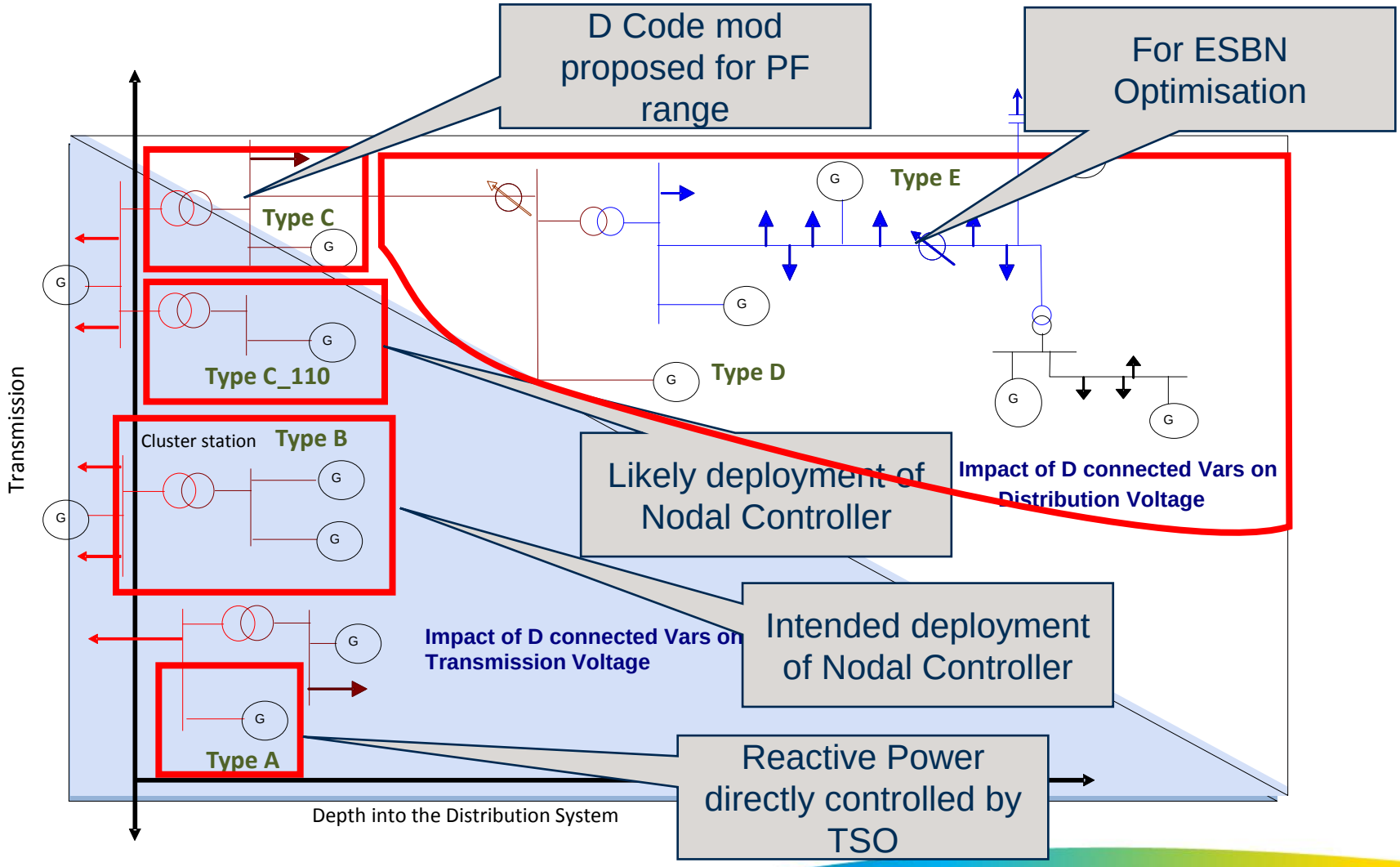


Conclusion

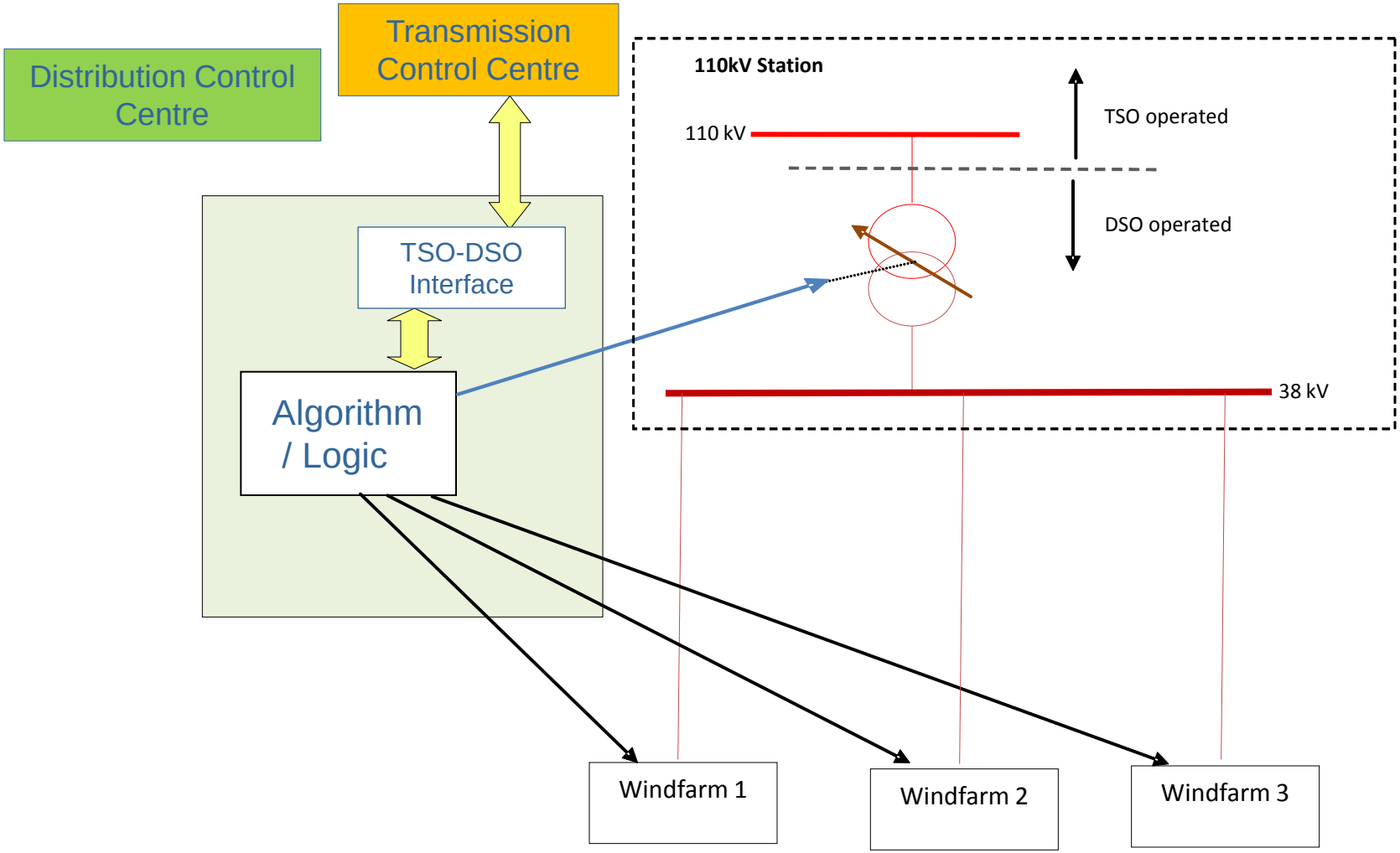
- **Efforts continuing on TSO-DSO ROCOF workstream**
- **Wind community needs to get over the line with their settings changes**
- **Challenge to get engagement on non-wind cohort**
- **Intention to close out analysis phase in near future and move to a focussed implementation phase**

Voltage Control /Reactive Power Workstream

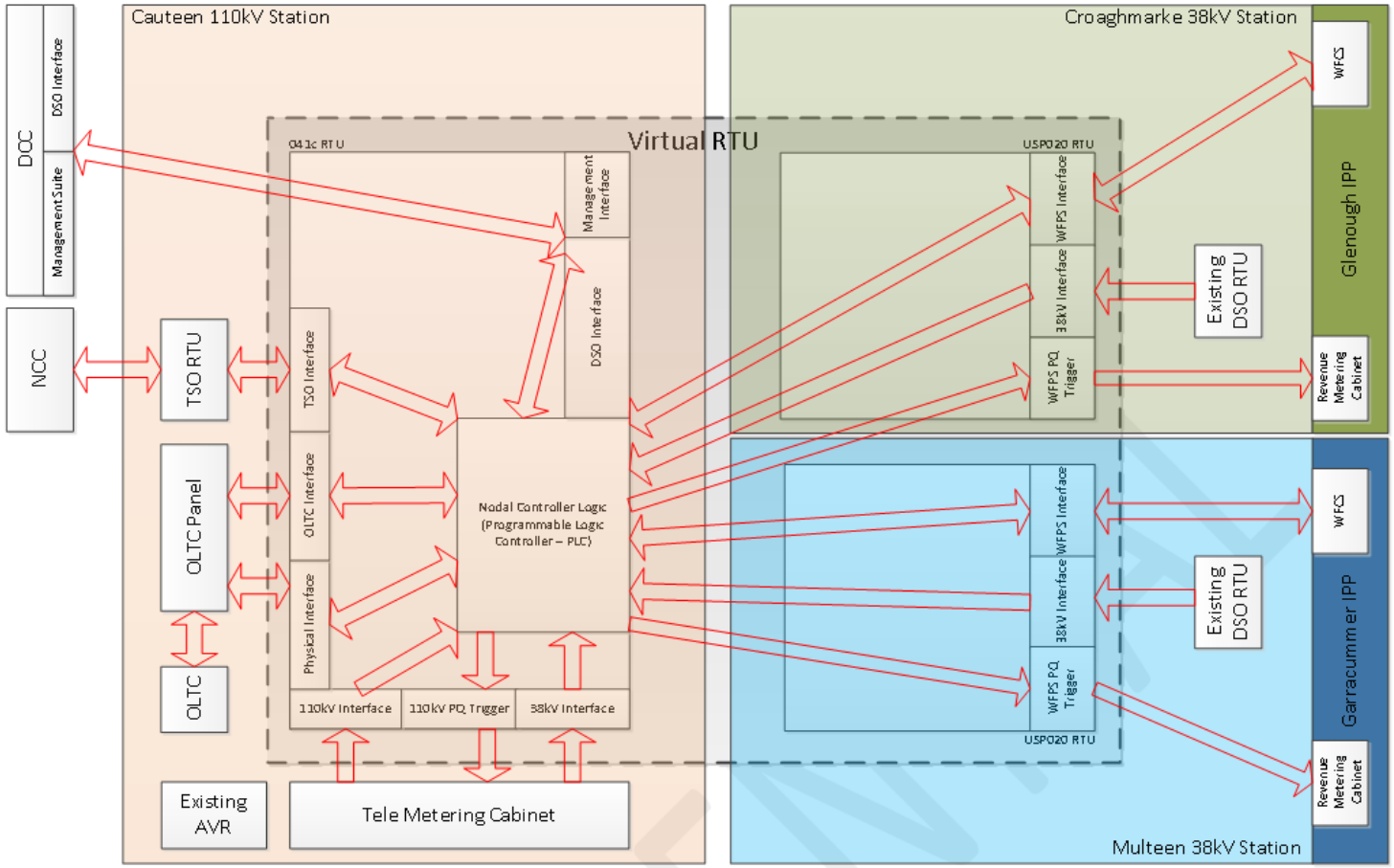
The overall landscape



Nodal Controller – Auto mode



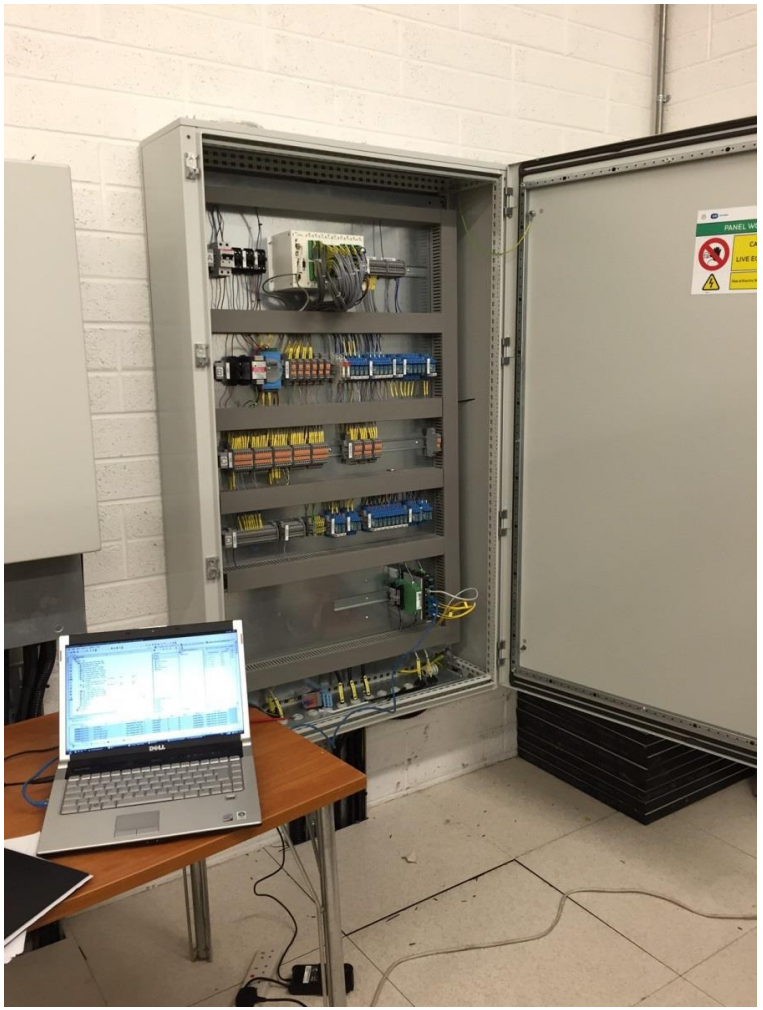
Techie stuff… Virtual RTU – Auto Mode



Nodal Controller – Automatic Mode

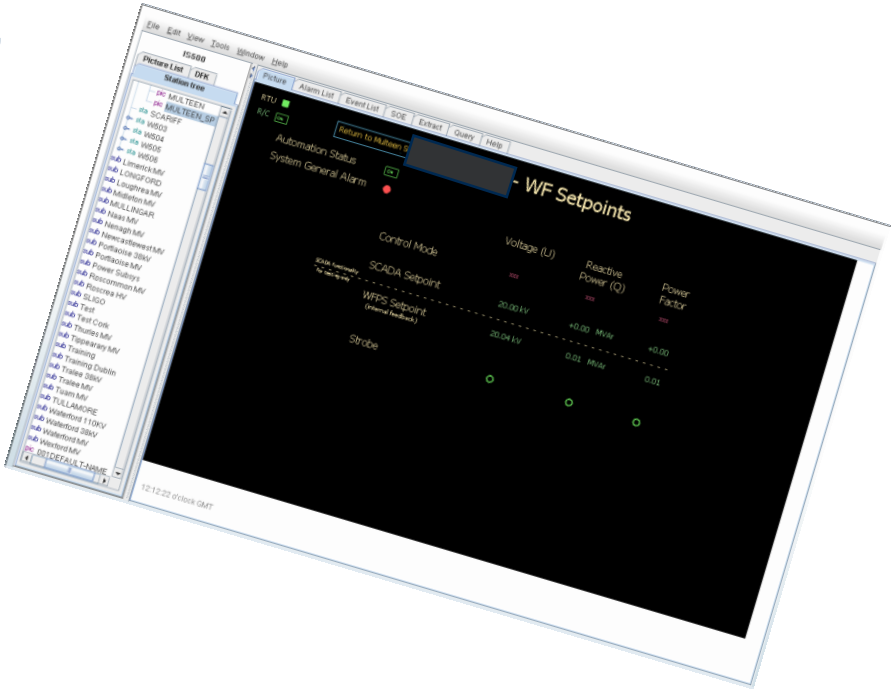
Cauteen Trial - 1

- NC Algorithm developed
- NC Functional Specification written and agreed with EirGrid
- Vendor appointed to implement the algorithm and work on coding has commenced
- Designs for RTU cabinets completed and available for deployment in wider roll-out
- All RTU's and associated telecoms ESBN infrastructure for two existing windfarms , who are expected to participate in the scheme, installed
- Virtual operation verified
- Design for interaction with 110kV station OLTC almost completed
- Windfarm capability and control testing methodology written and agreed with EirGrid



Cauteen Trial - 2

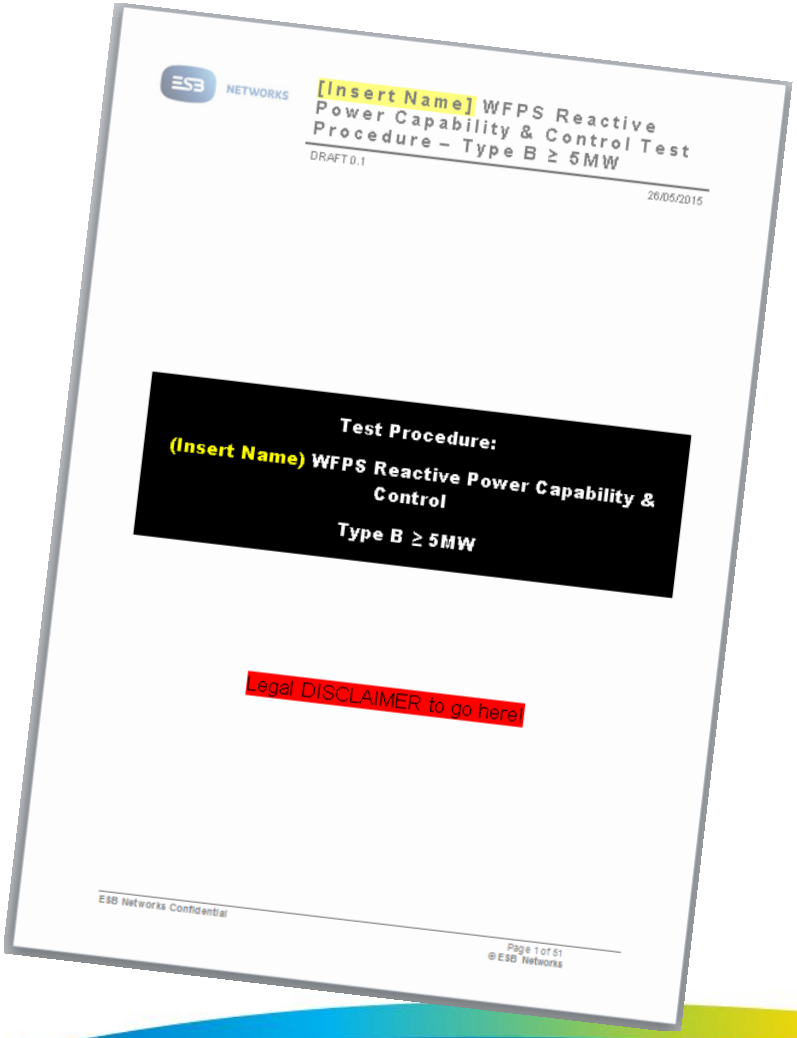
- Signal lists issued to two existing windfarms , who are expected to participate in the scheme
- Signal lists issued and mechanisms to install the required infrastructure to enable NC participation, in place for pipeline projects due to connect to Cauteen
- Expect to have two windfarms commissioned for manual operation by year end
- Expect to begin commissioning NC itself in early 2017
- Expect trial to conclude by June 2017
- Other Type B greenfield construction projects which may be part of the wider roll-out and are reaching the relevant milestones in their project timescales, are being intercepted as required.



Next steps

Manual testing [Control and Capability] of two windfarms

- One existing
- Due to be ready in October 2016
- One pipeline project
- Due to be energised in October 2016

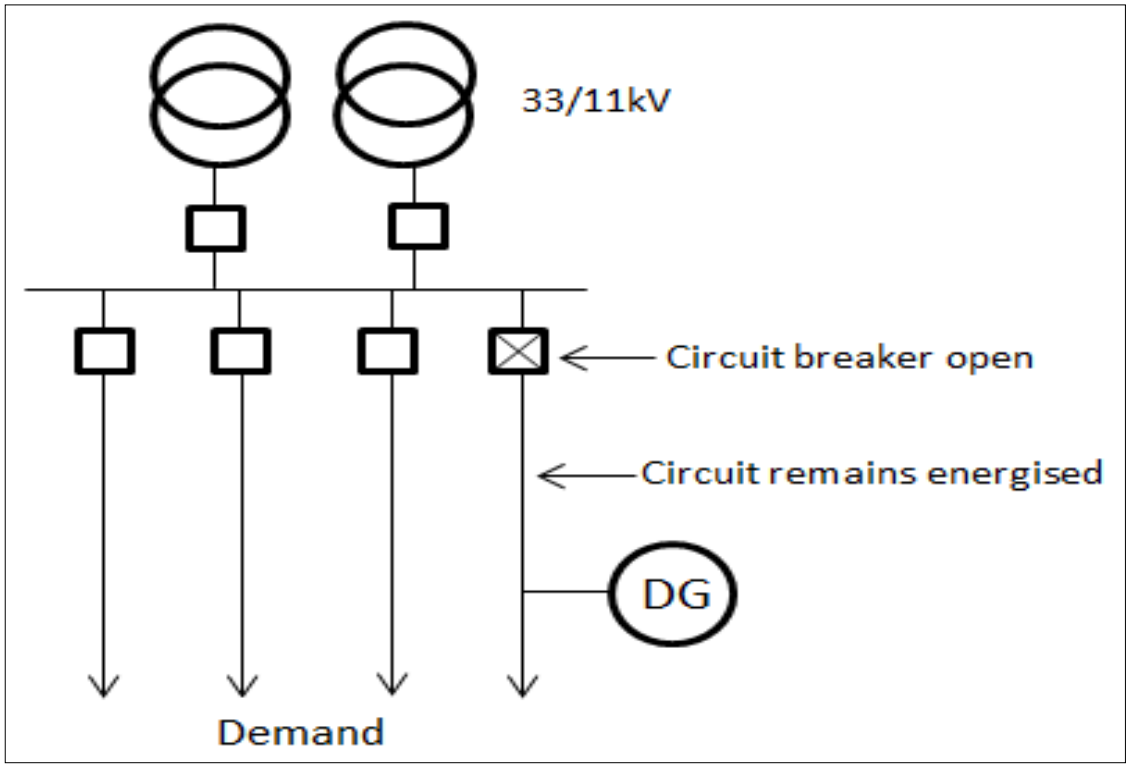


NIE NETWORKS' ROCOF IMPLEMENTATION PROJECT

DS3 ADVISORY COUNCIL
21 SEPT 2016

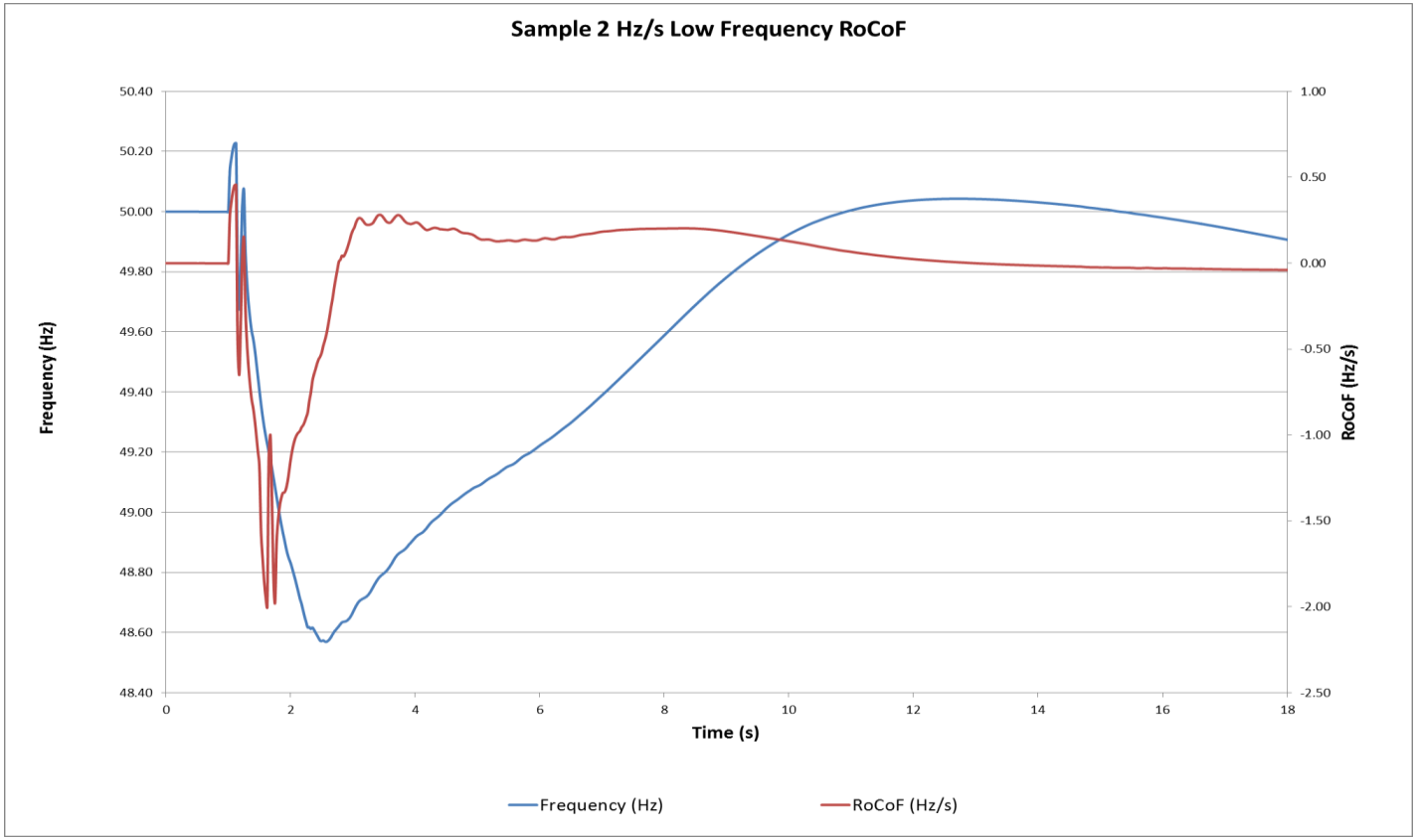
Interface Protection

Purpose – To prevent electrical Islanding!



The Problem

Moving towards 75% SNSP will result in higher system RoCoFs!



Overview

Two main work streams from a Distribution Network perspective:

1. Interface protection amendment process
   - Determine an appropriate interface protection setting for stability
   - Quantify the risks associated with this setting.

2. Generator Rate of Change of Frequency (RoCoF) withstand capability
   – Pass through requirement from Grid Code.

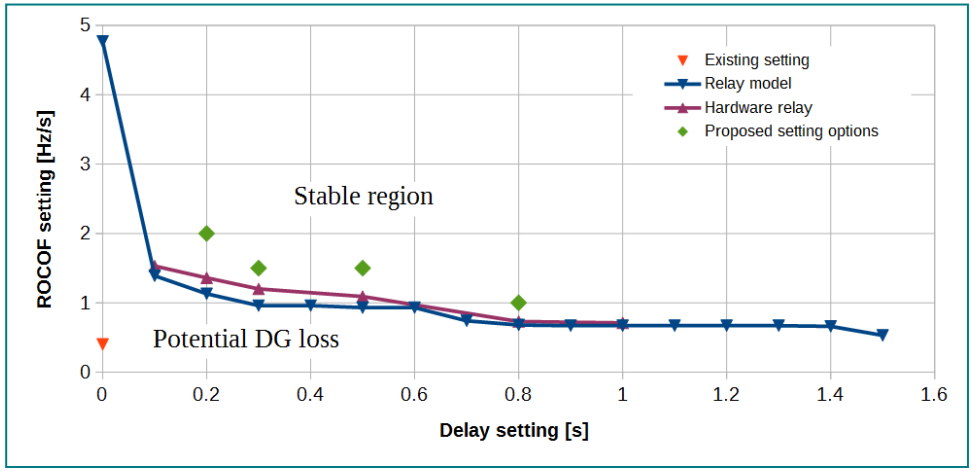
Interface Protection Amendment Process

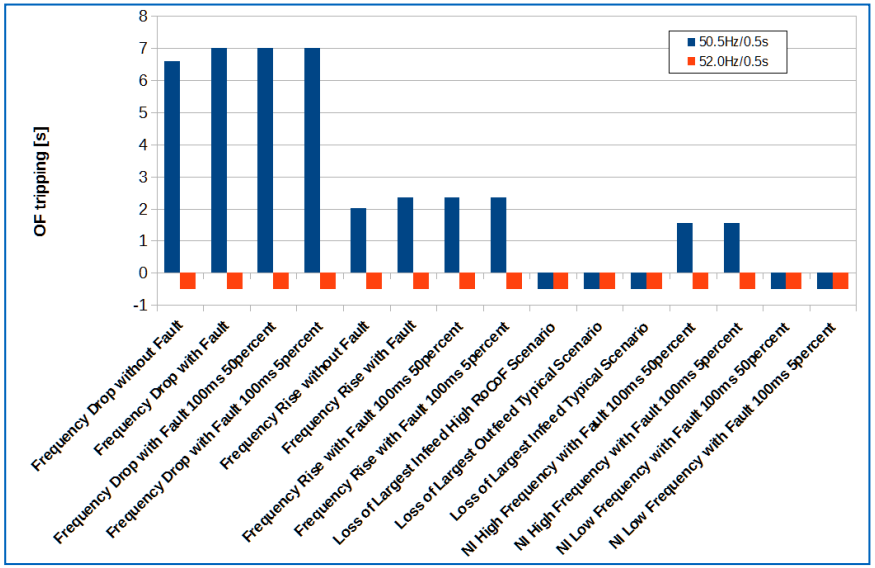
- Necessary to amend the following Interface Protection settings:

G59 Function	Current Setting	Change Required
RoCoF	0.125Hz/s – 0.4 Hz/s	Yes
Vector Shift	6deg – 12deg	Yes
Over frequency	50.5Hz	Yes
Under frequency	48Hz	No
Over Voltage	+10%	No
Under Voltage	-10%	Yes

Academic Research - Stability Analysis

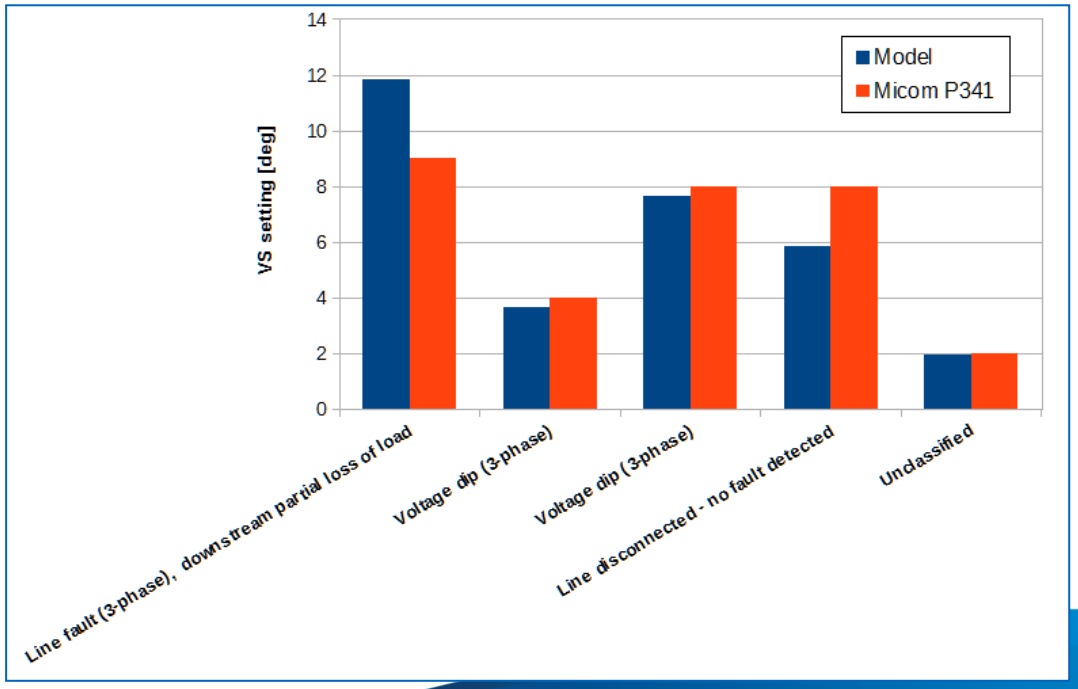
- Objective: Determine the required G59 settings to ensure stability for all system events
- 15 modelled events showing RoCoFs up to 2Hz/s measured over 500ms were used in the analysis.
- Relay models and actual relays were tested to determine correct settings.
- The following results were outputted for RoCoF and Overfrequency settings:





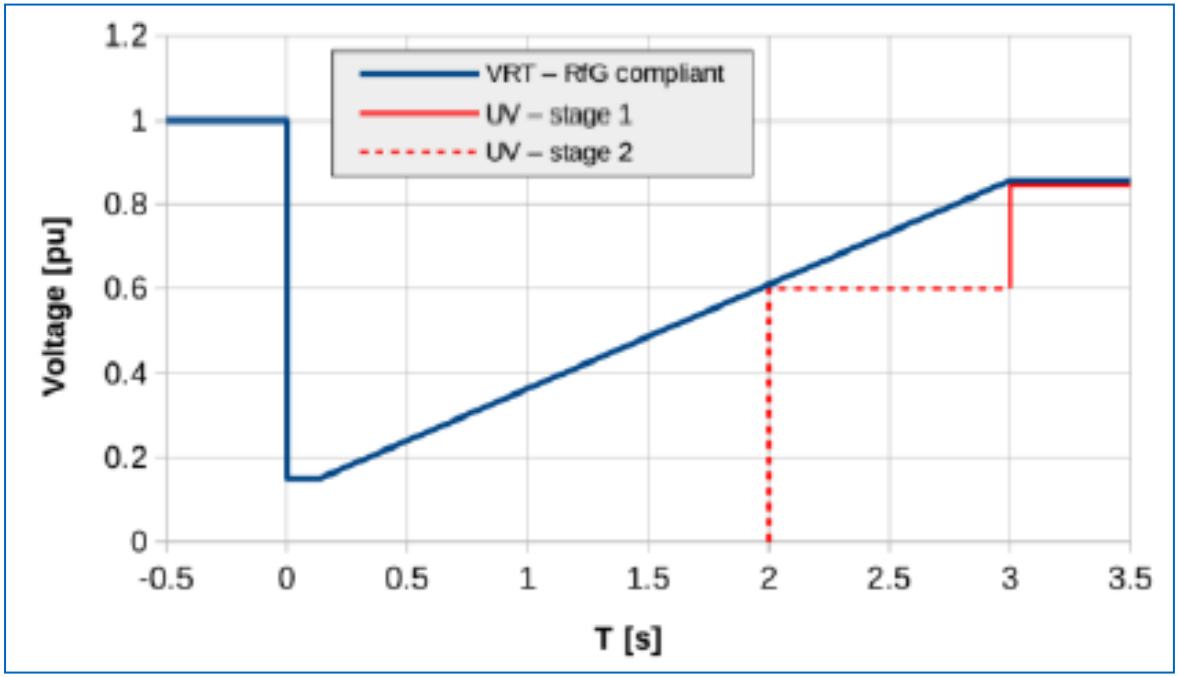
Work Package 2 – Stability Analysis

- Vector Shift was unstable during the 2013 snow storm.
- It was identified that the modelled events may not be suitable for modelling VS stability. VS is more prone to trip under transient phenomenon. Such phenomenon was not captured in the modelled events.
- To model VS stability, disturbance recorder data was extracted for 5 actual system events.



Academic Research – Stability Analysis

- Under Voltage Settings



Voltage protection		Voltage [p.u]	Time Delay [s]
Under Voltage	Stage 1	0.85	3.0
	Stage 2	0.60	2.0
Over Voltage	Stage 1	1.10	0.5

Academic Research – Sensitivity Analysis LSG

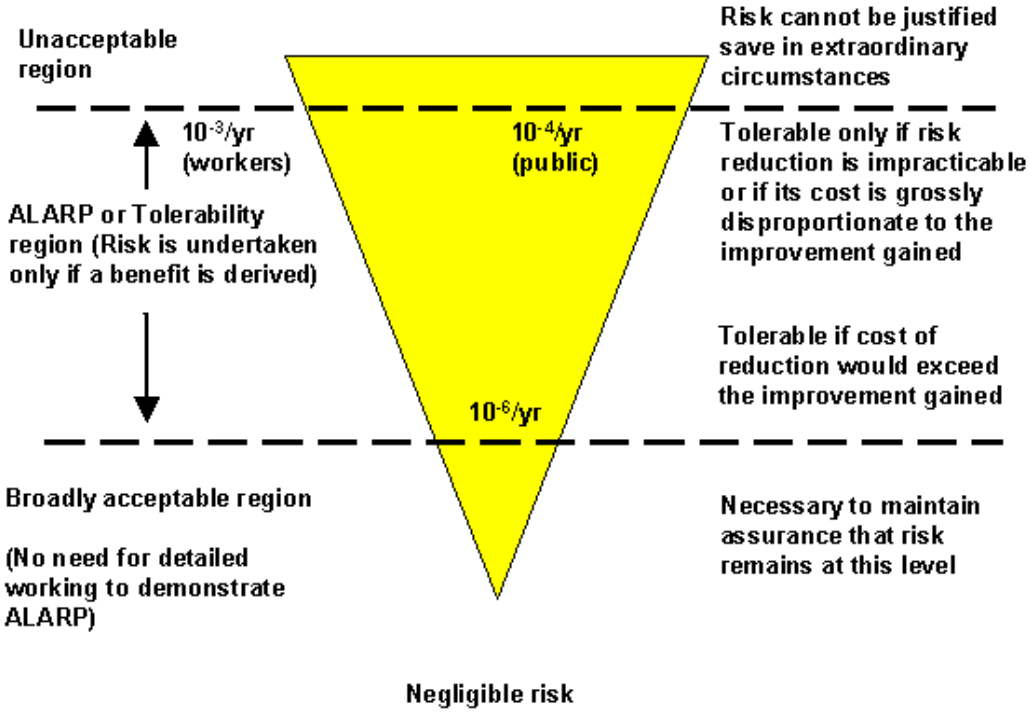
LOM Option	LOM Setting [Hz/s] or [°]	Time Delay [s]	Individual risk of electrocution			Risk of out-of-phase reclosure		
			$N_{LOM,E}$	IR_E	T_E [years]	$N_{LOM,AR}$	N_{OA}	T_{OA} [years]
1	0.4	0	3.84E-04	3.92E-09	2.55E+08	7.80E-06	6.24E-06	160,173.39
2	2.0	0.2	2.17E-02	3.43E-06	2.91E+05	6.85E-03	5.48E-03	182.51
3*	**1.5**	**0.3**	**2.16E-02**	**3.43E-06**	**2.92E+05**	**6.84E-03**	**5.48E-03**	**182.62**
4	1.5	0.5	2.61E-02	3.84E-06	2.60E+05	7.65E-03	6.12E-03	163.46
5	1.0	0.8	2.62E-02	3.86E-06	2.59E+05	7.70E-03	6.16E-03	162.40
6	6	-	2.14E-02	4.03E-06	2.48E+05	8.04E-03	6.44E-03	155.38
7*	12	-	2.28E-02	4.16E-06	2.40E+05	8.29E-03	6.63E-03	150.74
8	-	-	3.31E-02	5.39E-06	1.86E+05	1.07E-02	8.59E-03	116.45

*Recommended ROCOF and VS settings (in bold).

- Total Risk of Fatality associated with islanding on the NI system = 7.59E-6 = **1 fatality every 131,752 years**
- Total Risk of out-of-phase reclosure associated with islanding on the NI system = 1.513E-2 = **1 out-of-phase reclosure every 66 years**

NIE Networks' Position – LSG

- Risk of fatality falls within the HSE ALARP region. With NVD protection this risk moves to the broadly acceptable region.



- Risk of out-of-phase reclosure is significantly smaller than the GB risk. With NVD protection this risk will be further reduced.
- These risks are acceptable and new settings should be adopted.

Timelines

Activity	Due Date	Status
Work Package 1	Q4 2015	Complete
Work Package 2	Q1 2016	Complete
Work Package 3	Q3 2016	Complete
LSG G59 amendments complete	Q3 2017	On Schedule
Work Package 4	Q4 2016	On Schedule
SSG G59 amendments complete	Q3 2017	On Schedule

Generator RoCoF Withstand

- NIE Networks consulted on proposed D-Code RoCoF changes, from 1Hz/s to 2Hz/s, to:
  - Give the TSO an understanding of the capability of independent generating plant to remain connected to the distribution system and operate for RoCoFs up to 2Hz/s measured over 500ms.
  - Ensure harmonisation of the D-Code with the Grid Code.
- Direct contact made with 386 individual stakeholders and the consultation ran for 3 months.
- A total of 11 responses were received. The NIE Networks' response to the consultation can be found at the following URL:

http://www.nienetworks.co.uk/About-us/Distribution-code/DC-review-panel

- Some generators declared compliance with the 2Hz/s RoCoF standard, one anaerobic digester stated that they are not compliant whilst others stated that they are unaware what RoCoF their machines can remain connected and operate at.
- In the response to the consultation NIE Networks advised that the TSO satisfy themselves that all generating technologies are capable of withstanding higher RoCoFs.
- Utility Regulator agreed that the D-Code modification should be implemented inline with any Grid Code modification.

System Services Update

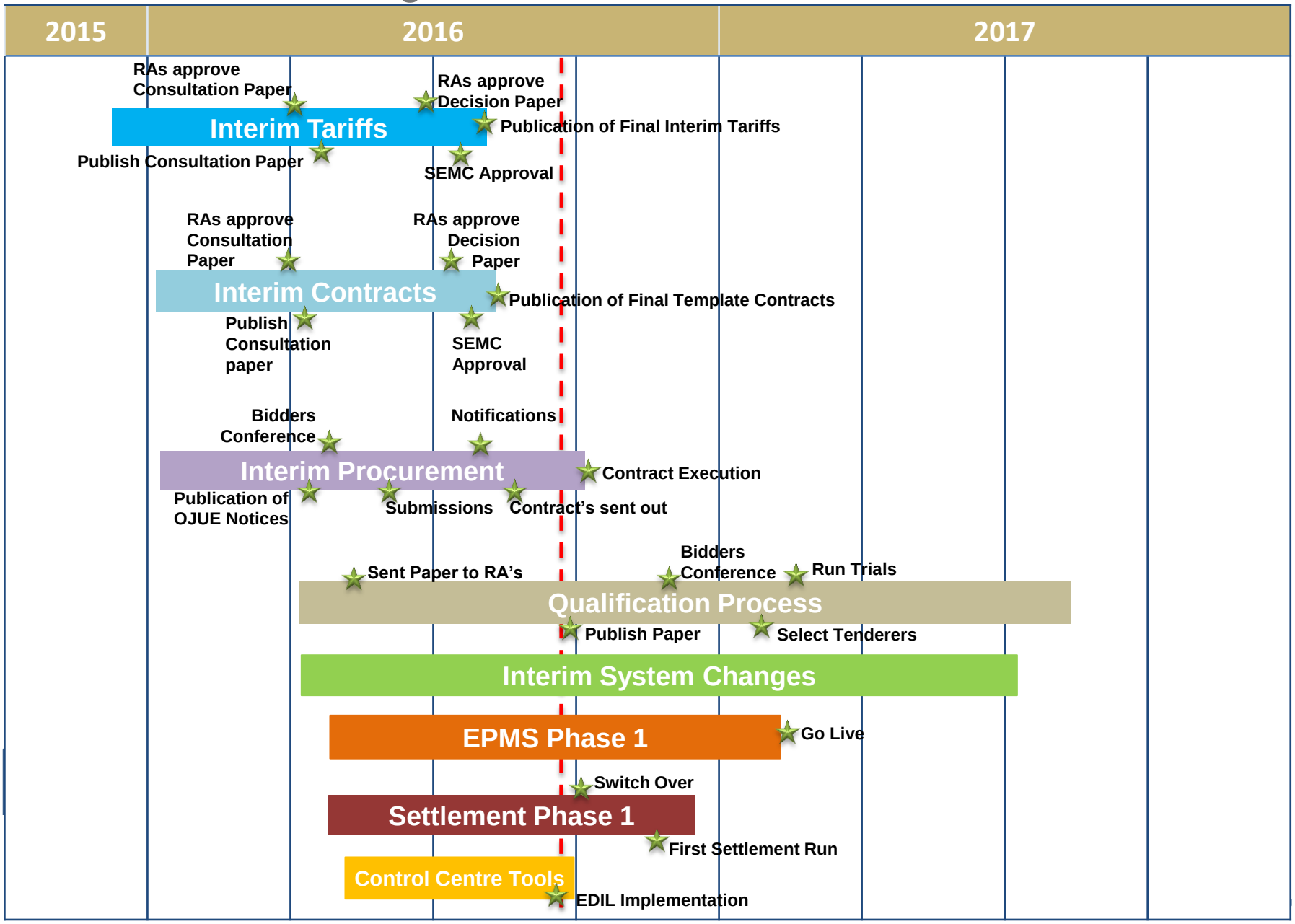
DS3 Advisory Council Meeting 21/09/2016

12:30-13:30 p.m.

Ian Connaughton

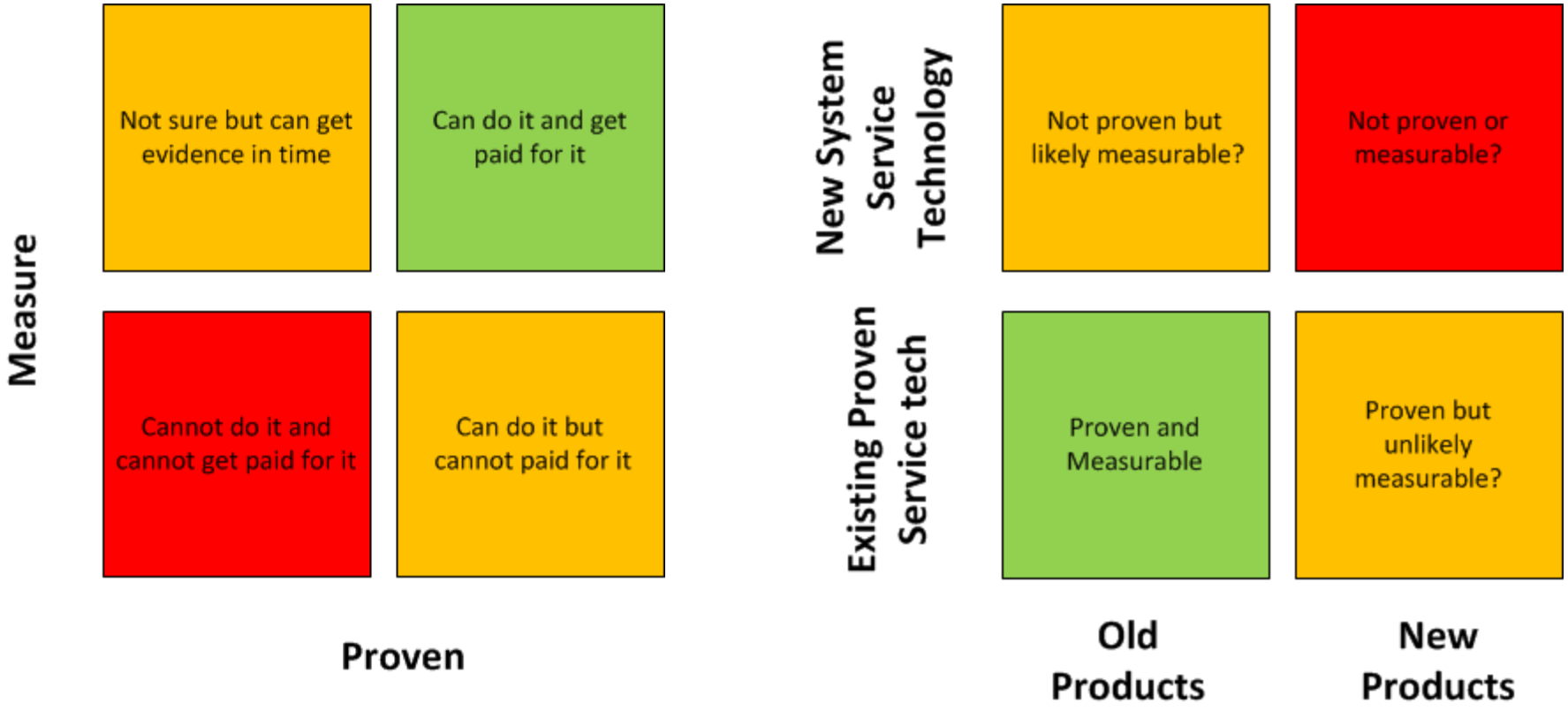
EIRGRID GROUP

DS3 SS Interim Arrangement – Milestone Plan



***RA** = Regulatory Authority; **SEMC** = Single Electric Market Committee; **PMIS** = Performance Monitoring Infrastructure Strategy*

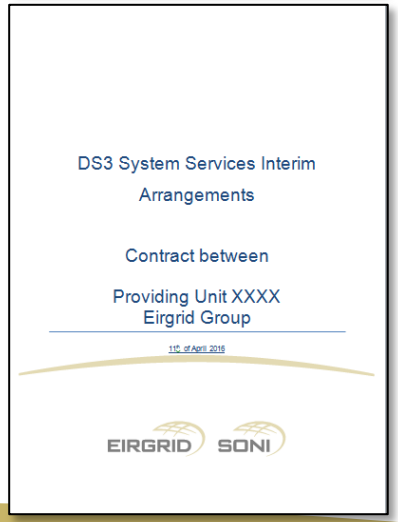
but there are some realities…!!



EIRGRID GROUP

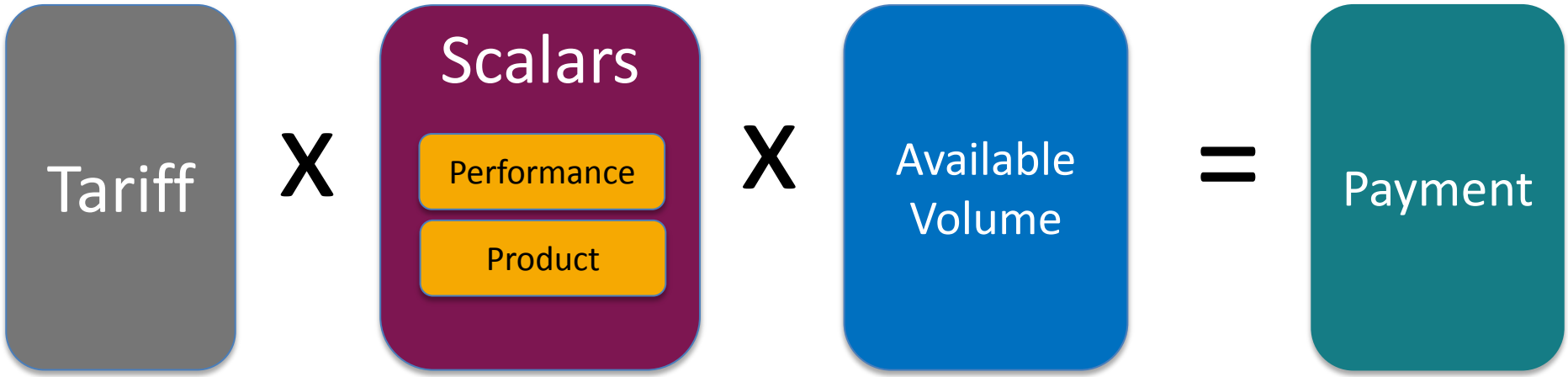
So what are we proposing?

Statement of Payments	**Testing and Compliance**
Settlement Rules	**Performance Metrics**



EIRGRID GROUP

Payment under Interim Arrangements



Note: Scarcity and Volume Scalars will only apply for Enduring Arrangements

EIRGRID GROUP

Regulatory Authorities Update

DS3 Advisory Council Meeting 21/09/2016

Robert O' Rourke

EIRGRID GROUP

Electric Ireland

Energy Services Innovation

EirGrid Power Off & Save Project

Presentation to DS3 Advisory Council

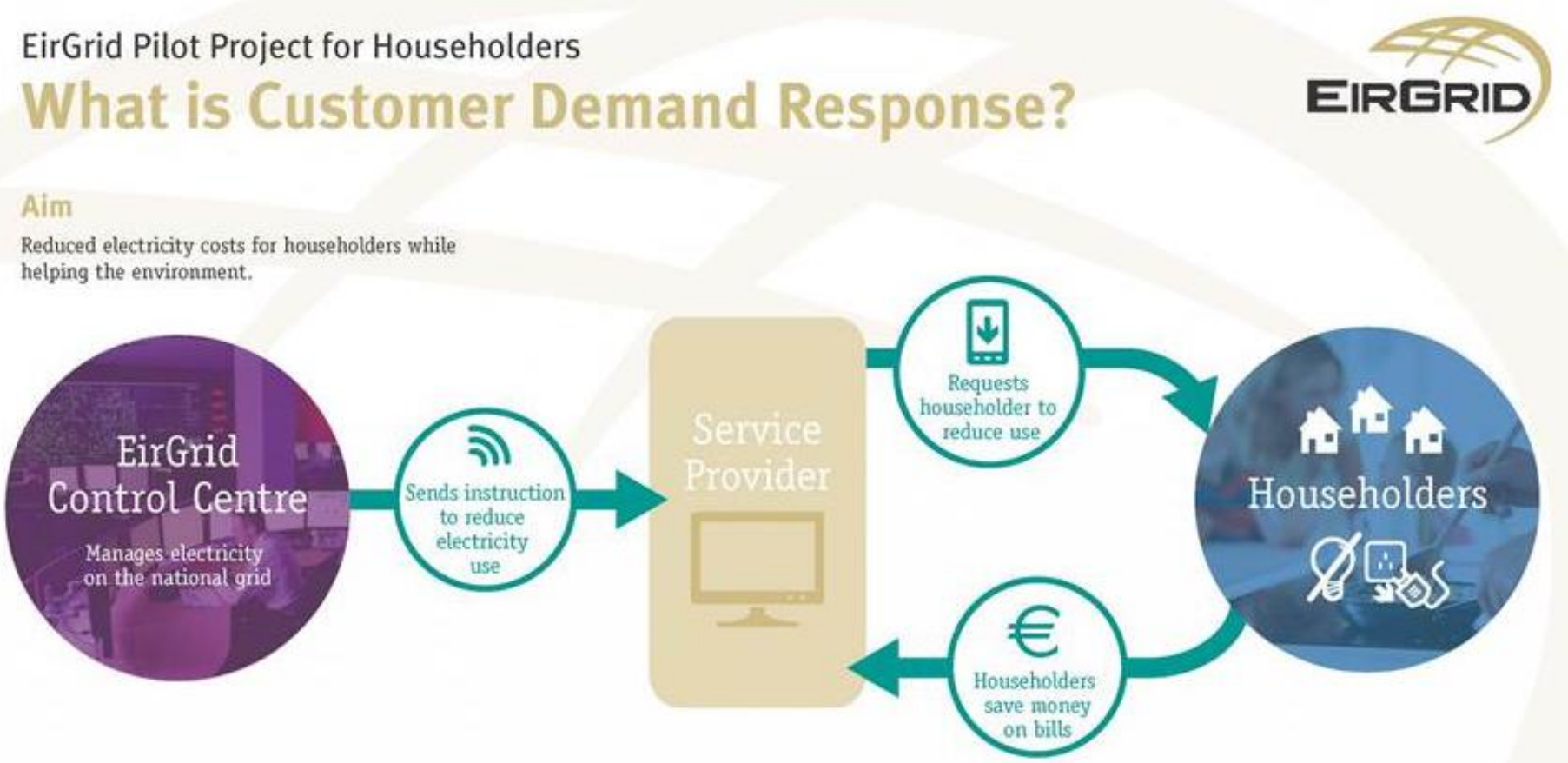
Wednesday 21st September, 2016

David Phelan, B.E, M.E, CEng
Project Manager

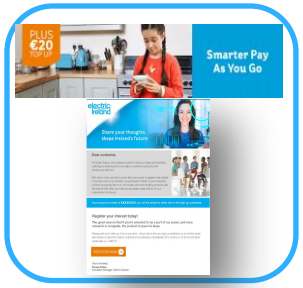
Contents

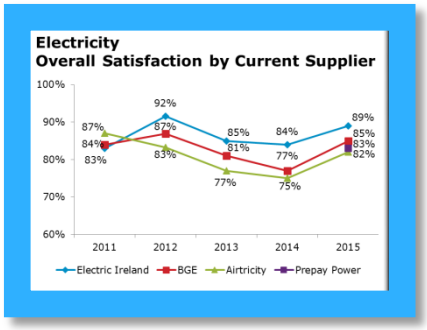
- **Brief Introductions**
- **Overview of Proposal**
  10 Minutes
- **Project Benefits, Learnings & Outcomes, Potential Risks and Constraints**
  5 Mins
- **Customer Engagement**
  5 mins
- **Questions and Answers / A.O.B.**
  10 mins

EirGrid launches competition to identify a company who will help it reduce electricity costs for householders



Electric Ireland at a Glance





1.4 Million Customers

Strong Capabilities

electric Ireland
Smarter Living

Leader

Proven Track Record

Partnership Experience

Honeywell

nest

climote

climote

accenture
High performance. Delivered.

Glen Dimplex
IRELAND

Our Proposed Solution will leverage the existing Smart PAYG and Smarter Living Trials looking into emerging energy technologies in the home of the future.

Smarter PAYG

Smarter Living Trials - Panel of 600 Customers

Smart Heating Controls

nest

climote

Honeywell

Smart Energy Management

Information
- Consumption Monitoring
- Price monitoring (TOU)

Advice
- Prediction and alerts

Control
- Appliance Scheduling
- Lighting Controls

Integrated Heating & Energy Systems

Control and optimisation
- Solar Monitoring
- Load control
- Optimisation and remote management

The Smarter Living trials address these areas.

electric Ireland

Programme Methodology

3

Ability to test use cases, measure outcomes and maximise learning through a broad expertise

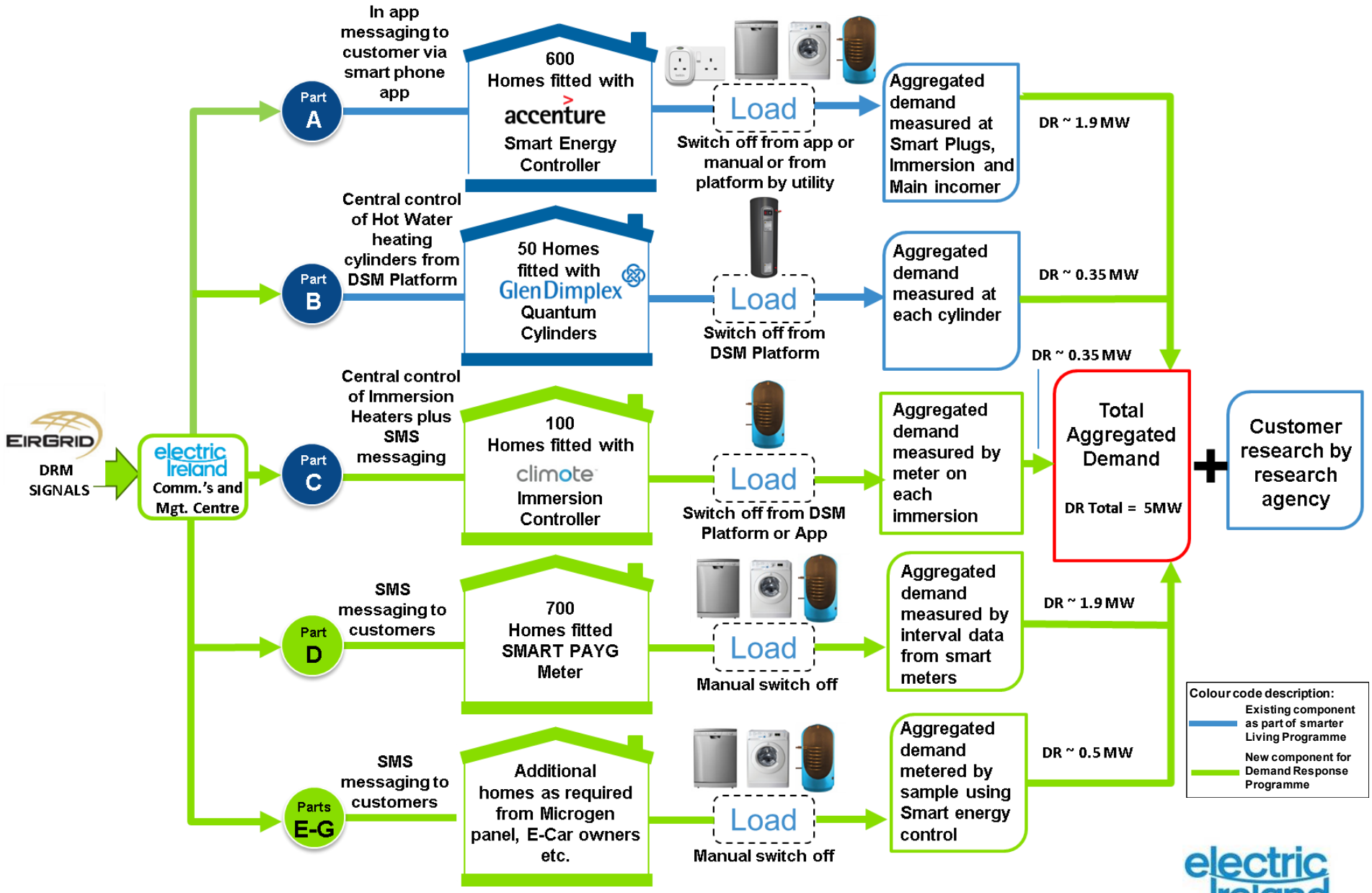
2

Appropriate Technology Solutions to test different use case and manage different loads

1

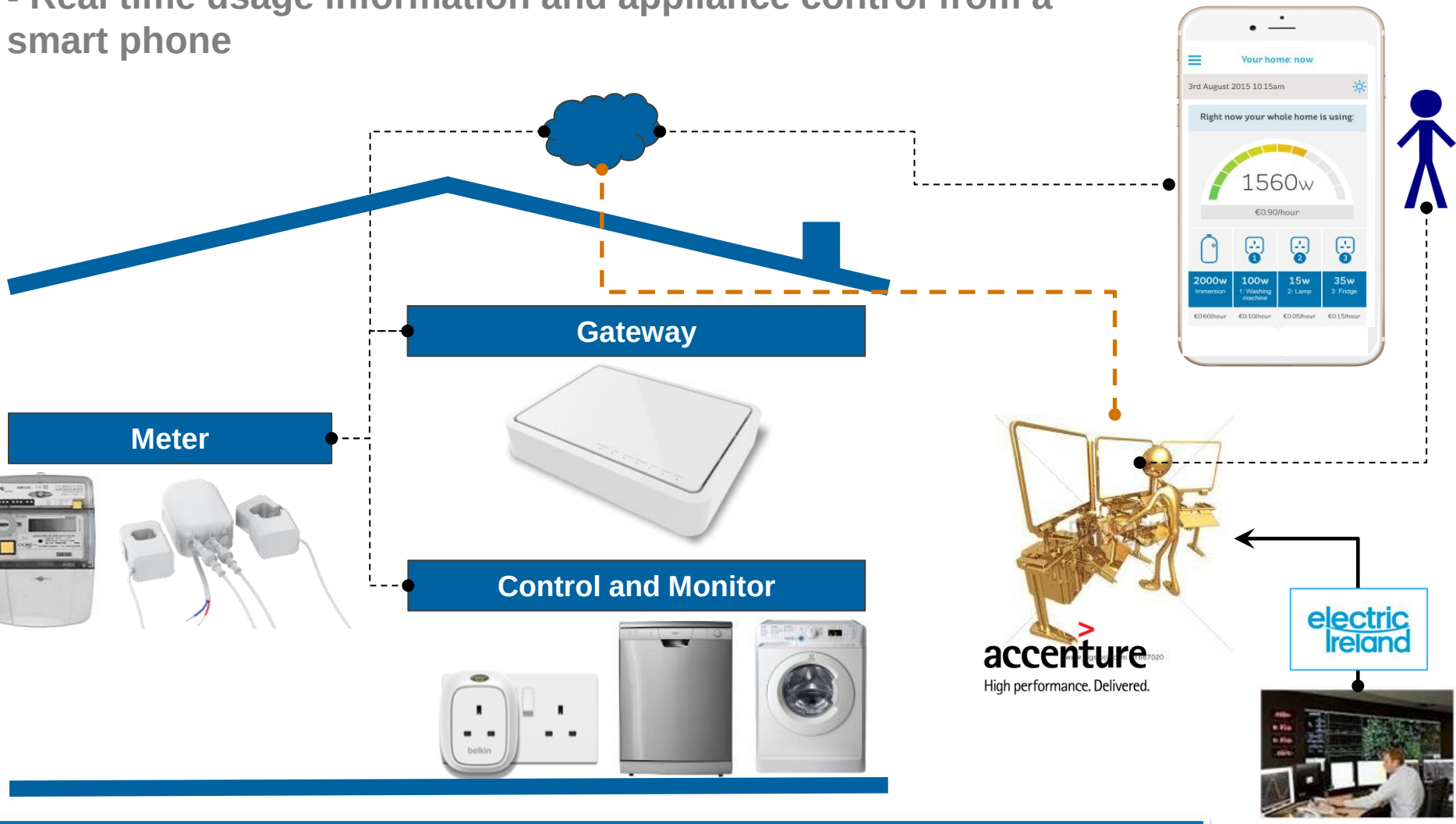
Engaged Participants & an ability to communicate and research these customers

Solution Overview



Smart Energy Controller - 600 Homes

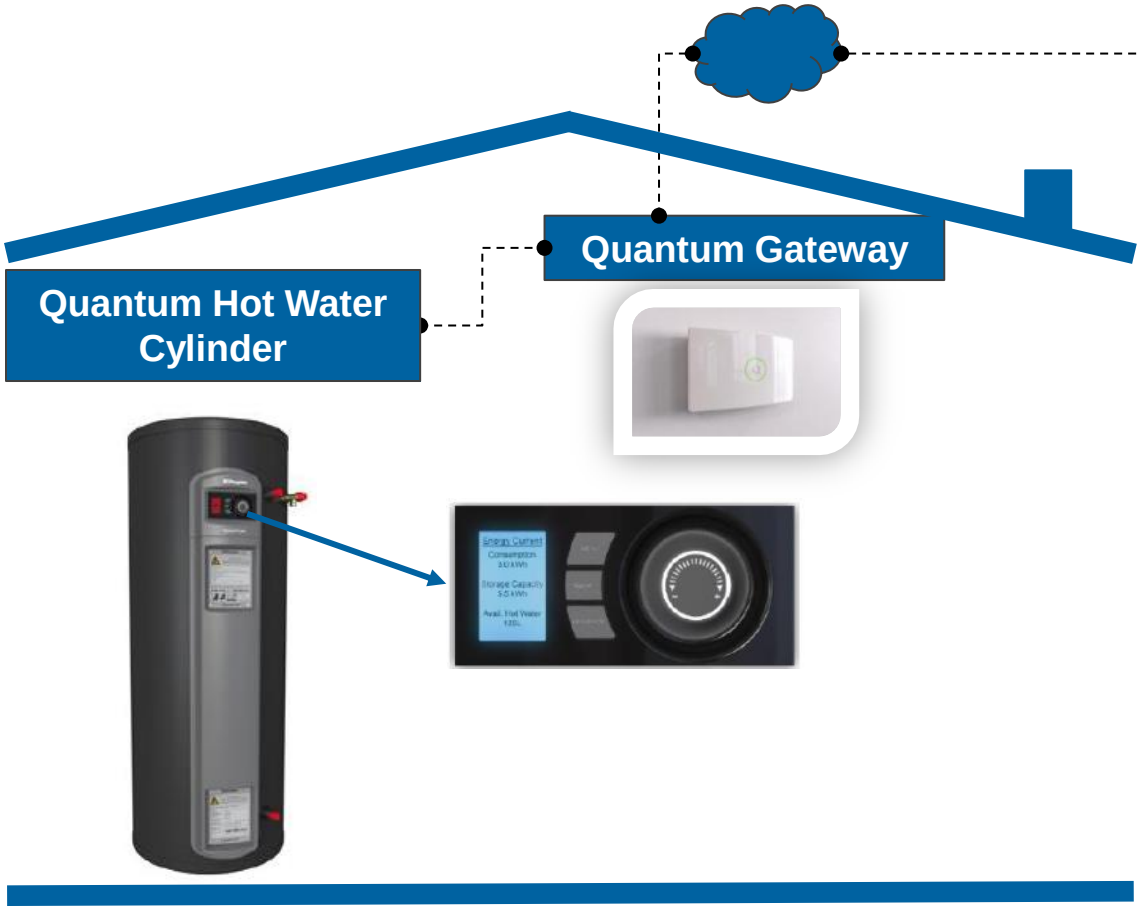
- Real time usage information and appliance control from a smart phone

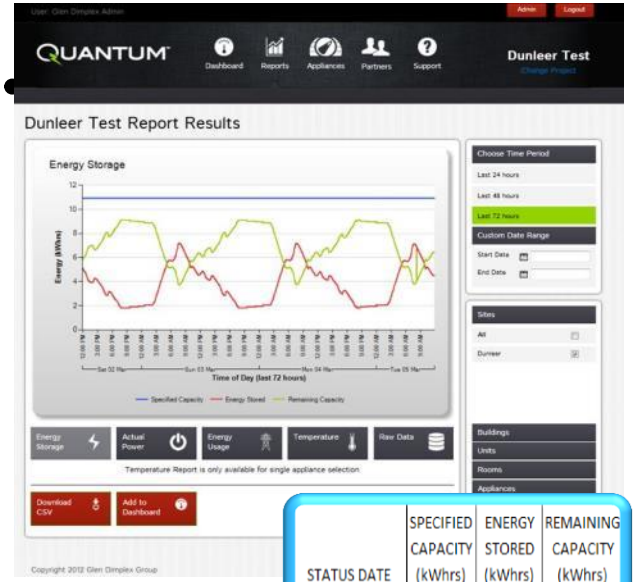


Time – 10 Seconds – Minutes -Potential System Services : Secondary Operating Reserve - Tertiary operating reserve 1 & 2, Replacement Reserve

electric Ireland

Quantum Hot Water Cylinder with DSM Platform – 50 Homes



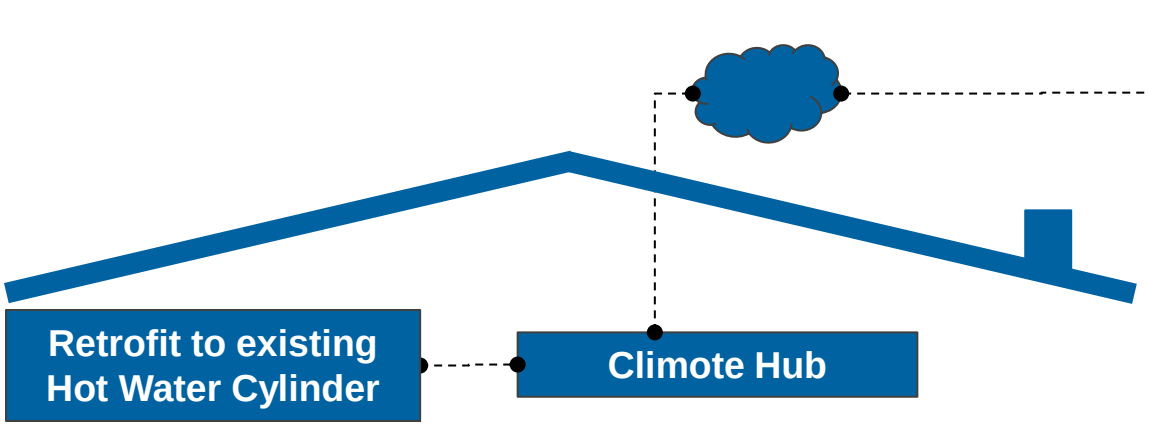


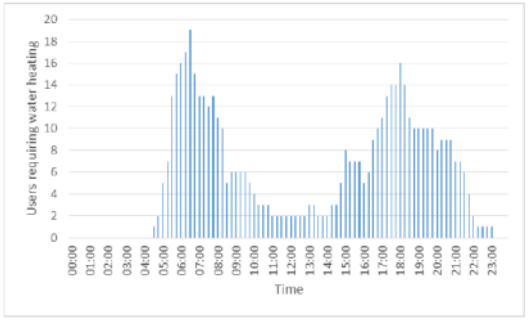
STATUS DATE	SPECIFIED CAPACITY (kWhrs)	ENERGY STORED (kWhrs)	REMAINING CAPACITY (kWhrs)
05/03/2013 09:40	10.92	5.665447	5.254553
05/03/2013 09:42	10.92	5.665447	5.254553
05/03/2013 09:43	10.92	5.618501	5.301499
05/03/2013 09:44	10.92	5.618501	5.301499
05/03/2013 09:45	10.92	5.571555	5.348445
05/03/2013 09:46	10.92	5.571555	5.348445
05/03/2013 09:47	10.92	5.52461	5.39539
05/03/2013 09:48	10.92	5.477664	5.442336
05/03/2013 09:49	10.92	5.477664	5.442336
05/03/2013 09:50	10.92	5.430718	5.489282
05/03/2013 09:51	10.92	5.430718	5.489282
05/03/2013 09:53	10.92	5.383773	5.536227
05/03/2013 09:54	10.92	5.383773	5.536227
05/03/2013 09:55	10.92	5.336827	5.583173
05/03/2013 09:56	10.92	5.336827	5.583173

Time – 10 Seconds – Minutes -Potential System Services :
Secondary Operating Reserve - Tertiary operating reserve 1 & 2, Replacement Reserve

electric Ireland

Climote Retrofit Hot Water Controller – 100 Homes

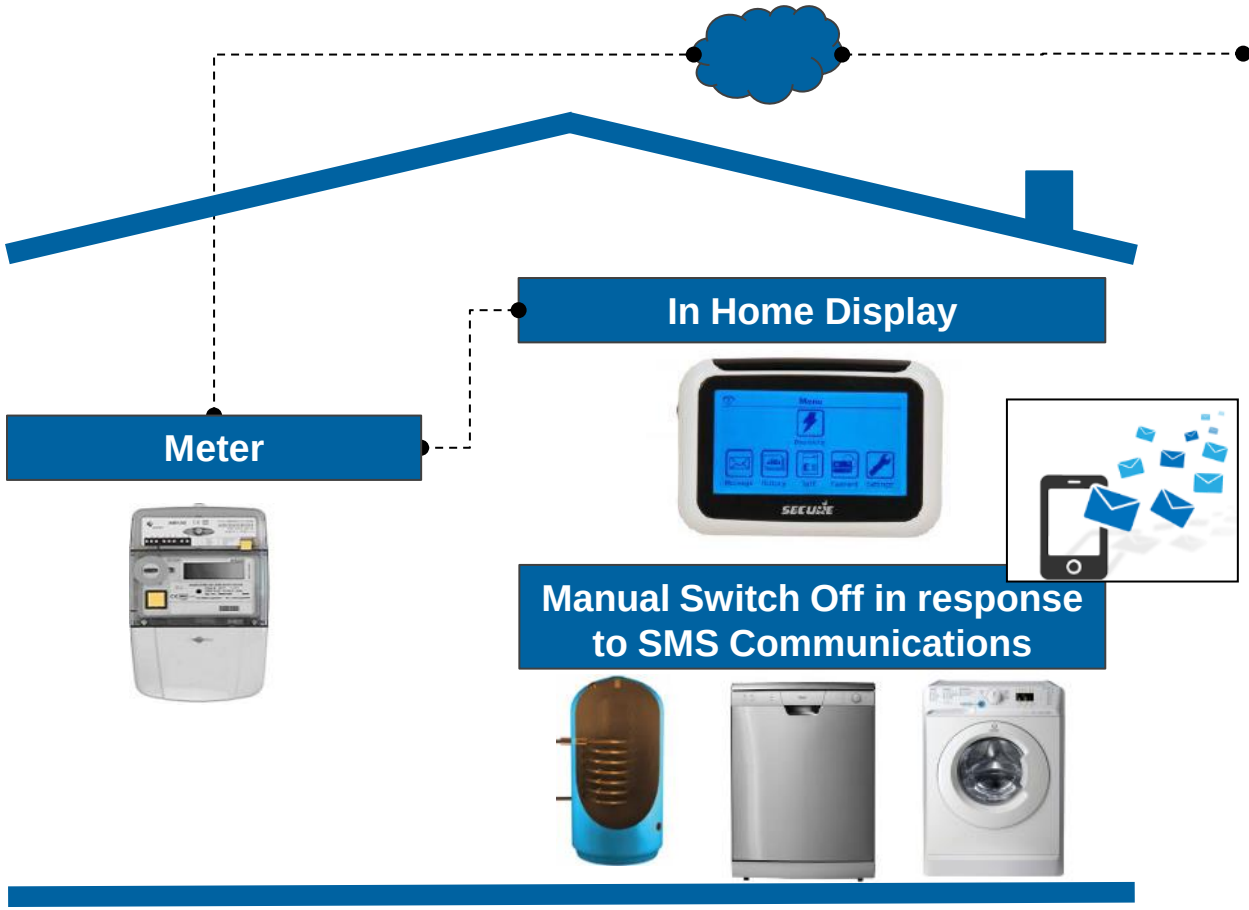


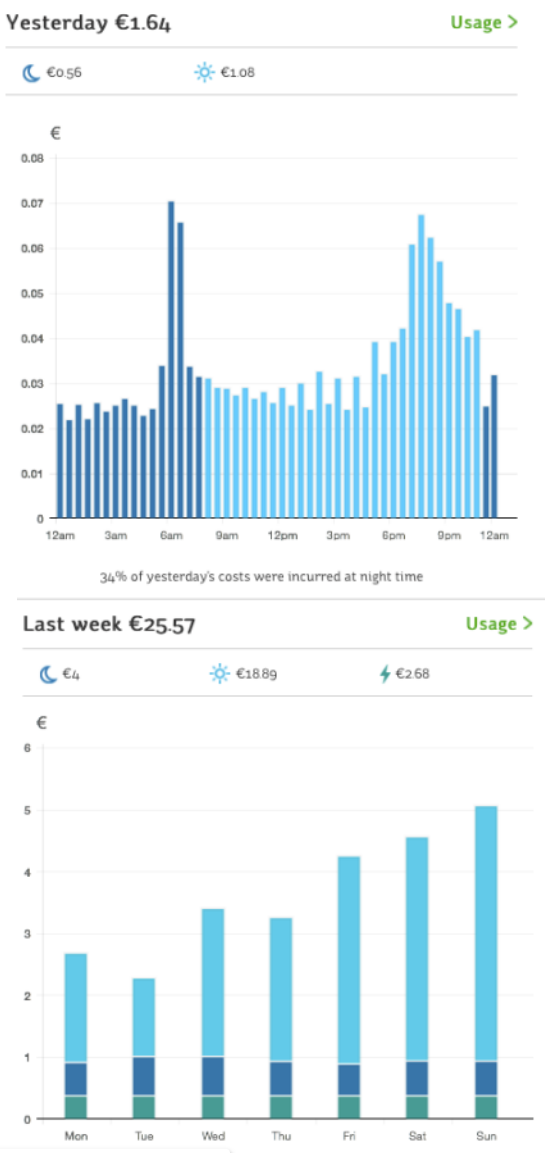


Time –10 Seconds -Potential System Services :
Secondary Operating Reserve - Tertiary operating reserve 1 & 2, Replacement Reserve

electric Ireland

Smart PAYG Meter and SMS Comms – 700 Homes

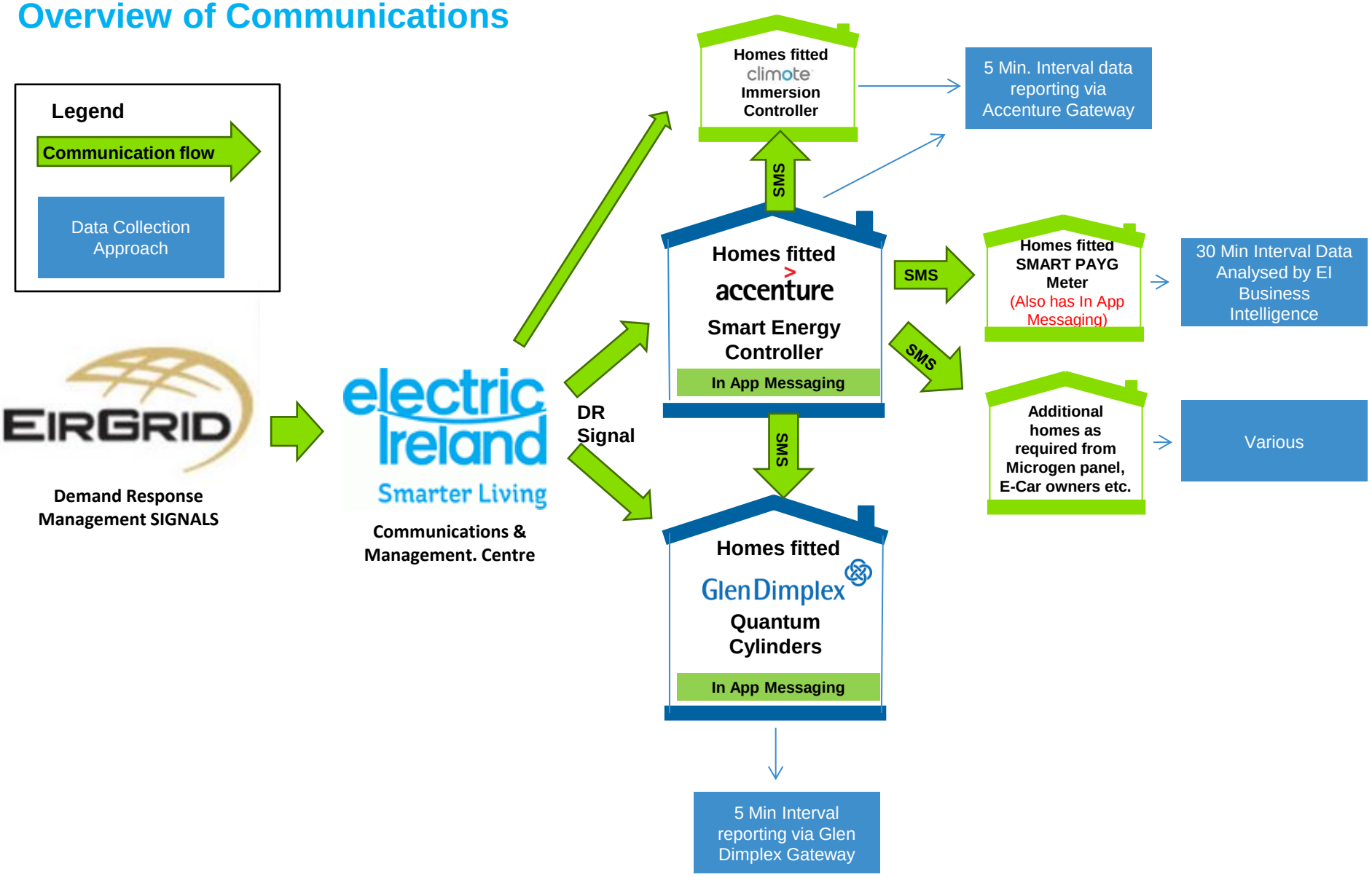




Time – longer -Potential System Services : Replacement Reserve

electric Ireland

Overview of Communications



Potential System Services

System Service	Time Response	A	B	C	D	E	F	G	H
Fast Frequency Response (FFR)	2-8s		P	P					P
Primary Operating Reserves	5-15s	P	P	P					P
Secondary Operating Reserves	15-90s	Y	Y	Y	P	P	P	P	P
Tertiary Operating Reserves 1	90s - 5mins	Y	Y	Y	P	P	P	P	P
Tertiary Operating Reserves 2	5-20mins	Y	Y	Y	Y	Y	Y	Y	Y
Replacement Reserve – minor modification proposed	20mins - 1 hr	Y	Y	Y	Y	Y	Y	Y	Y

A	Smarter Living Panel customer with Smart Energy Controller and Smart Heating Controls installed
B	Glen Dimplex Hot Water Control & DSM - plus Smart Energy Controller
C	Climote Hot Water Control & DSM - plus Smart Energy Controller
D	Smarter Pay as You Go Customers
E	Electric Vehicle Customers
F	Existing Customers on Electric Ireland Micro generation Scheme (includes Solar PV & Wind))
G	Existing Customers (including Nest & Climote HEMS). Prioritising customers on Night Rate Meters
H	Accenture Hot Water Control & DSM - plus Smart Energy Controller

P= Possibility
Y= Yes

Project Plan

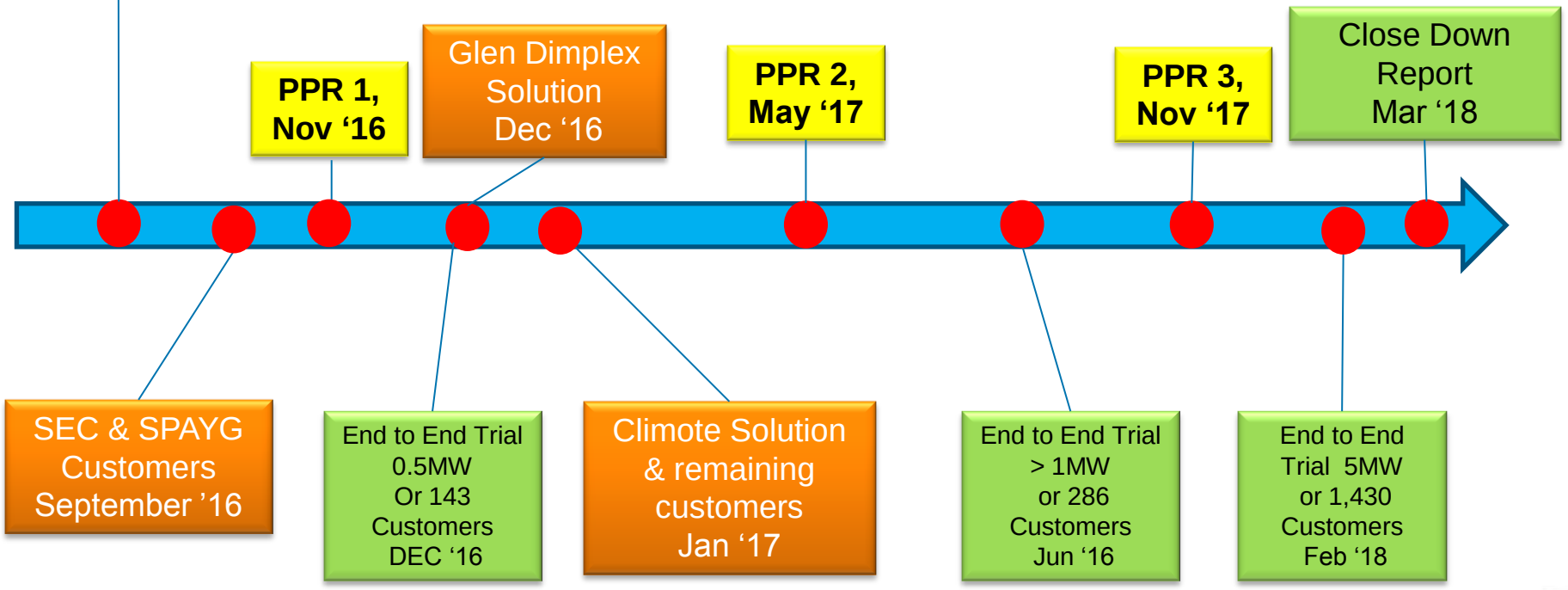
Electric Ireland Actions

Project Progress Reports

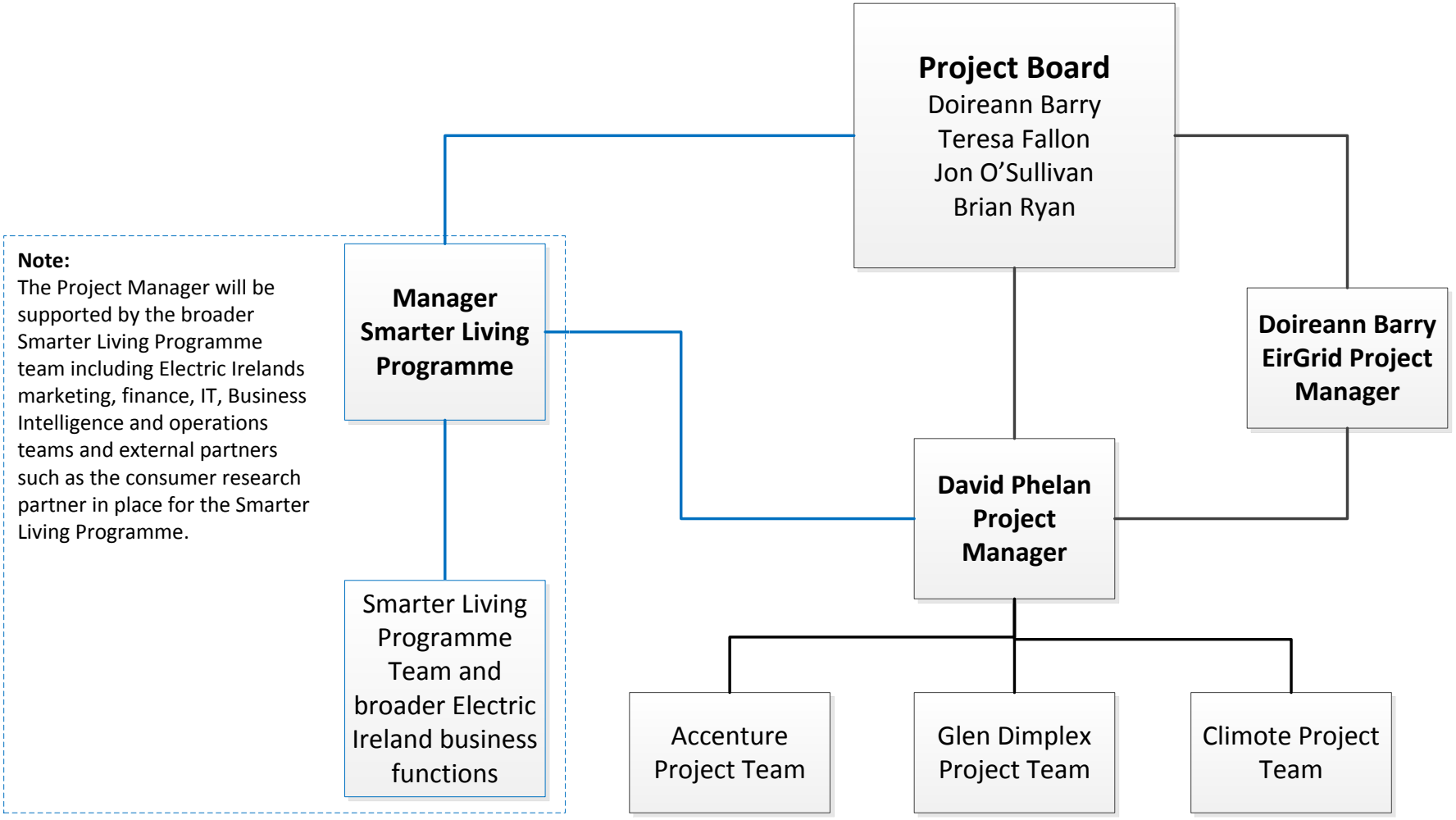
Key Project Milestones

Key Achievements to date

- ✓ Project Initiation Document & Consumer Engagement Plan (6th May)
- ✓ Process Maps for Customer Recruitment (26th May)
- ✓ Contract Agreement (27th May)
- ✓ Presentation to CER (31st May)
- ✓ Professional Customer Research (3rd June)
- ✓ Project Launch (15th June)
- ✓ Presentation to Smart Grid Advisory Group (20th June)



Project Organisational Structure



Project Benefits, Learnings & Outcomes, Potential Risks and Constraints

Potential Project Benefits, Learnings & Outcomes

Benefits - Policy Perspective

1. European and National energy efficiency policy and targets
2. National Energy Efficiency Action Plan for Ireland

Benefits - Power System Perspective

1. First of its kind in Europe from a TSO
2. Potential for greater accommodation of intermittent renewables, enhanced generation adequacy, reduced system/consumption costs and potential for avoided / deferred network investment

Benefits – Residential Consumer Perspective

1. Reduced bills.
2. Greater control over electricity they consume.
3. Awareness of electricity consumption and appliances with high usage requirements

Key Learnings & Outcomes

- Is there a residential consumer demand response market?
- Understanding of Residential consumer behaviour and insights,
  - Customers ability to respond and level of electricity reduction
  - Testing customer attitude to take up and level of engagement
  - Capabilities of technologies proposed, usefulness, Manual Vs Automatic
  - Preferred incentive mechanism
  - Preferred and most effective communications with the consumer
  - Customer journey

Potential Project Risks and Constraints

Technology Development and Lead Time

(Plans are in place at present and technology suppliers have bought into these)

Recruitment of Customers

(omitting vulnerable customers)

Communications and Technology Failure

(3rd party providers will provide assistance and support in line with existing SLA's)

Potential Project Risks and Constraints

Interaction with ESB Networks (DSO) re Congestion

Following a meeting with ESB Networks, any concern around congestion has been mitigated.

- Very low likelihood of congestion issues arising on the DSO system due to scale of project. If higher, there may be more of a concern.
- Project focusing on dispersed population as opposed to clusters.
- Blend of technologies with relatively low power ratings

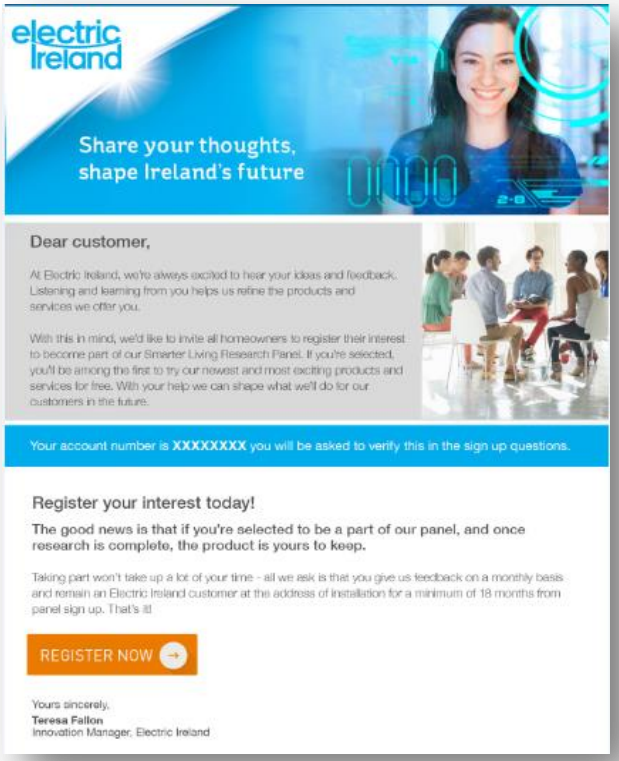
DSO – *"happy to learn from this project in terms of how this level of co-ordinated demand reduction impacts on the network."*

Consumer Engagement

- **Initial Engagement**
- **Customer Incentives and Rewards**
- **Ongoing Communications & dissemination of the learning to the public**
- **Customer Research**

Key Points on Consumer Engagement

- **Initial Engagement – Wide Sample**
  - Invitation to take part through Email
    - 600 Customer Smarter living Panel
    - 300 Customer Smarter PAYG panel
    - Smarter PAYG Customers
    - EV /MicroGen/Nest/Climote Customers
    - Other
  - EirGrid Promotion Campaign
  - On-Line Sign UP
  - Staged Sign up offerings
  - Phone invitations if necessary
  - Promotion through Electric Ireland and EirGrid Websites
- **Brochure Material**
  - Safety
  - Explanation of customer journey



Key Points on Consumer Engagement & Stakeholders

- **Event Notifications**
  - In App Push Notifications
  - SMS Text Notifications
  - Principal to ensure that Customers' Comfort will not be impacted
  - Customers Support Phone line

- **Ongoing Engagement**
  - Email update to participants on staged basis
  - Web update report
  - Six Monthly Project Progress Reports
  - Professional Research

- **Stakeholder Updates**

Research Plan

Data Analytics + Consumer Research

- All data will be managed and analysed by Electric Irelands Business Intelligence Team
  - Dedicated, in-house team working with significant energy specific expertise
- Analysis will be supported by Subject Matter Experts from:
  - Trading
  - Energy Services
  - Finance
  - Marketing
  - Operations
- Accenture Data Analytics Capability Statement

Ipsos MRBI

Quantitative + Qualitative

- Surveys by research agency on an ongoing basis
- Web based with phone follow up for non-respondents
- Existing experience on Smarter Living Trials has provided significant experience in this area

In-Depth Interviews

One-to-one interviews with individual trial participants, conducted either in-person or via the telephone

Focus Groups

Collective discussion of particular trial elements among a group a target trial participants

Ethnography

In-depth exploration of trial experiences through participant observation in their actual life

Thank you

Managing Exceptional High Frequency Events

DS3 Advisory Council Meeting 21/09/2016

14:30 – 14:50 p.m.

Diarmaid Gillespie

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High Frequency Concerns

- Exceptional High Frequency Events
  - Trip of an IC during a high export causes exceptional system HF
  - >50.3 Hz – one event per year typically
  - EWIC primary concern (500 MW export NTC)
  - Concern exceptional HF event, causes exceptional LF event, as excess wind trips
- Wind Farm Trip Settings
  - DSO >1200 MW at 50.5 Hz; TSO >1300 MW at 50.8 Hz
- Operational Constraints on EWIC
  - 300 MW export cap (as measured in Ireland)
- New Proposal
  - New strategy to manage HF events until WF Trip settings are changed
  - New initiatives involving changes to Control Centre tools and grid interface protection
  - Trial of EWIC Exports to 500 MW for all system conditions to commence in November 2016
  - Increased EWIC Exports leads to reduced curtailment

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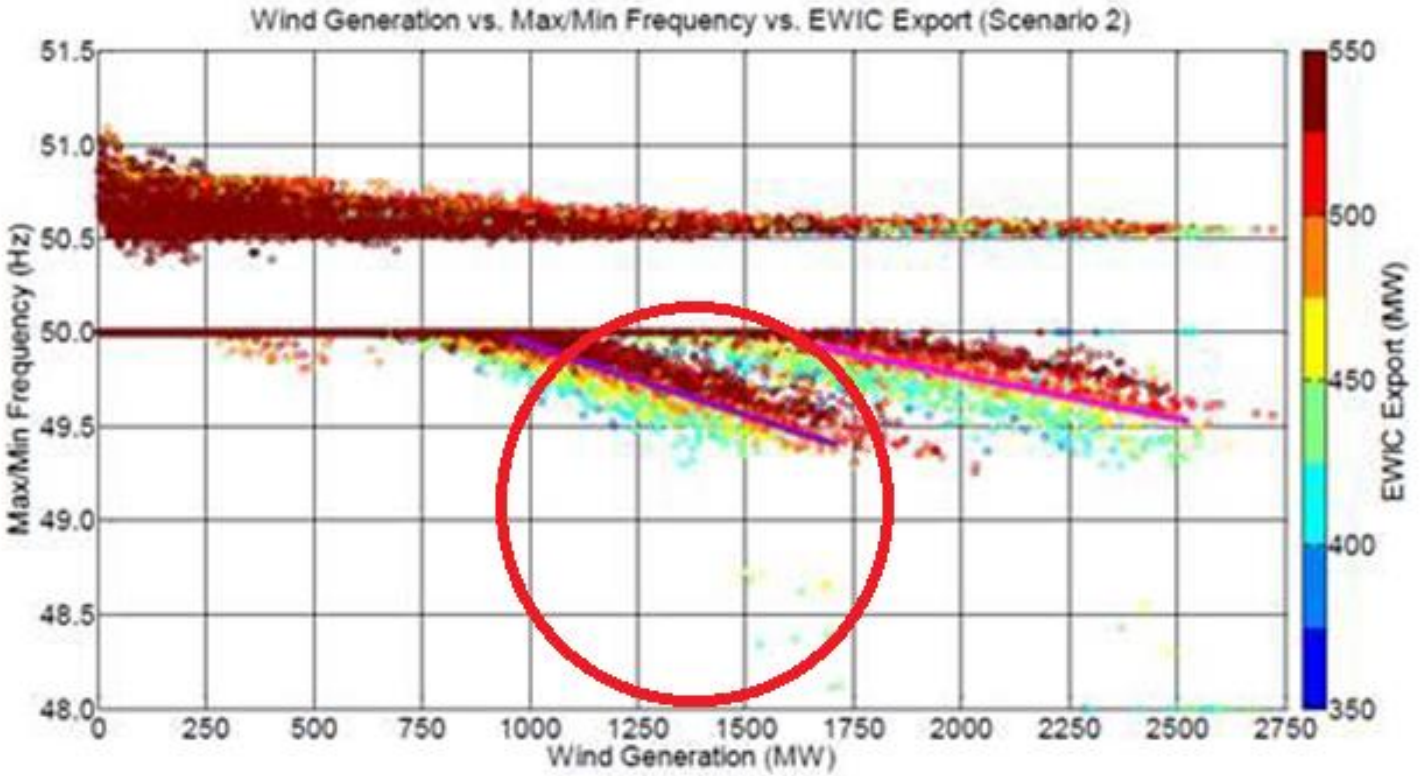
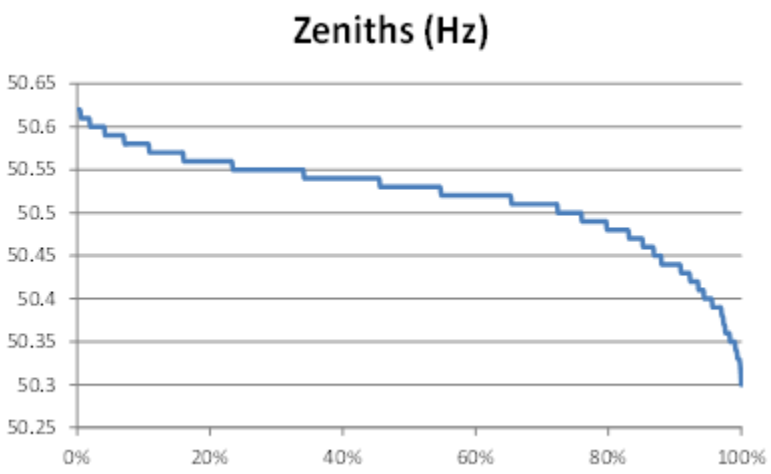
Export Study Recap

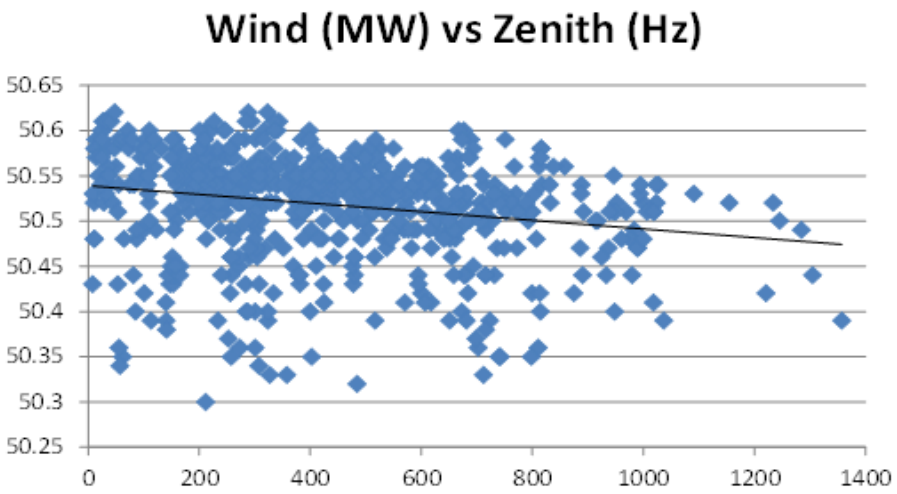
- EWIC Export Study (2015)
  - 300 MW limit could be relaxed for AI wind less than 1250 MW only



EWIC Export Trials: low/medium wind

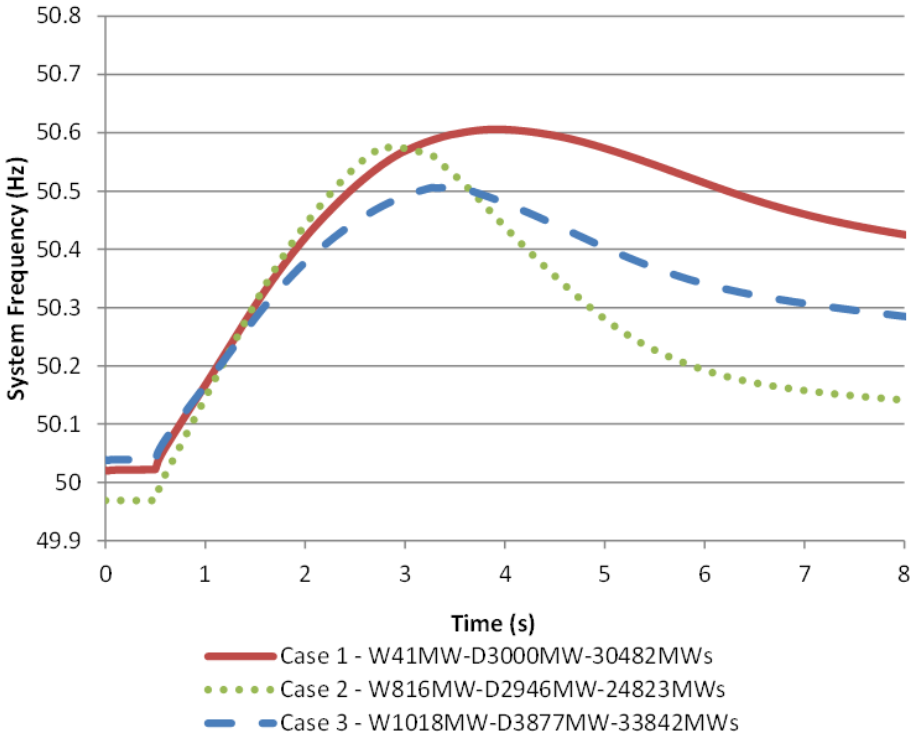
- EWIC High Export Trials for AI wind < 1000 MW
  - 400 MW Trial commenced 6 July 2016
  - 500 MW Trial commenced 17 August 2016
- 400 MW Export Trial Analysis
  - 800 cases with EWIC > 300 MW





EWIC Exports Trials: low/medium wind

- 400 MW Export Trial Analysis (continued)



EWIC 500 MW Export Rejection Test

Summary:

- Test conducted 9 August 2016
- Test required for validation purposes prior to 500 MW Export Trial
- System conditions:
  - AI Demand: 4384 MW
  - AI Wind: 944 MW
  - System Inertia: 33,763 MWs
  - System Frequency pre-test: 50.01 Hz
- High level results
  - Frequency zenith: 50.55 Hz
  - Frequency nadir: 49.94 Hz (8s)
  - ROCOF: 0.24 Hz/s
  - Frequency above 50.5 Hz for 1.4 s

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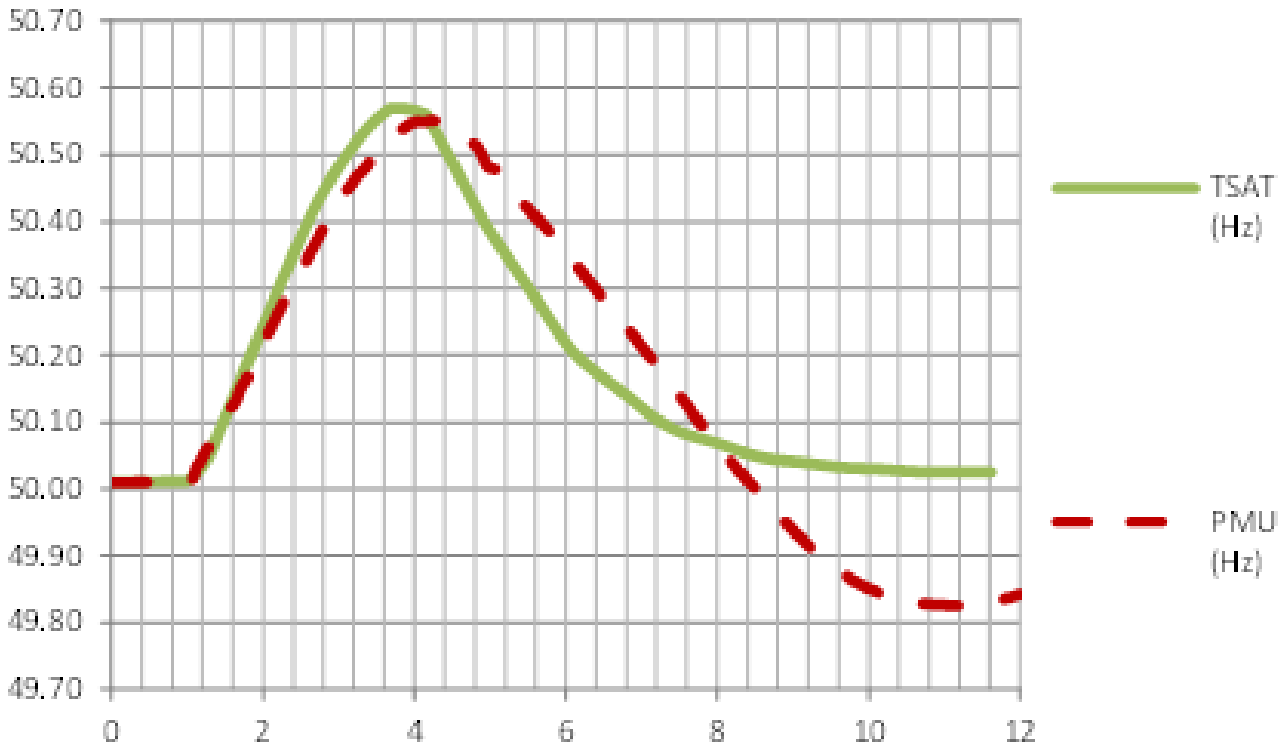
EWIC 500 MW Export Rejection

System Frequency: Actual versus Model



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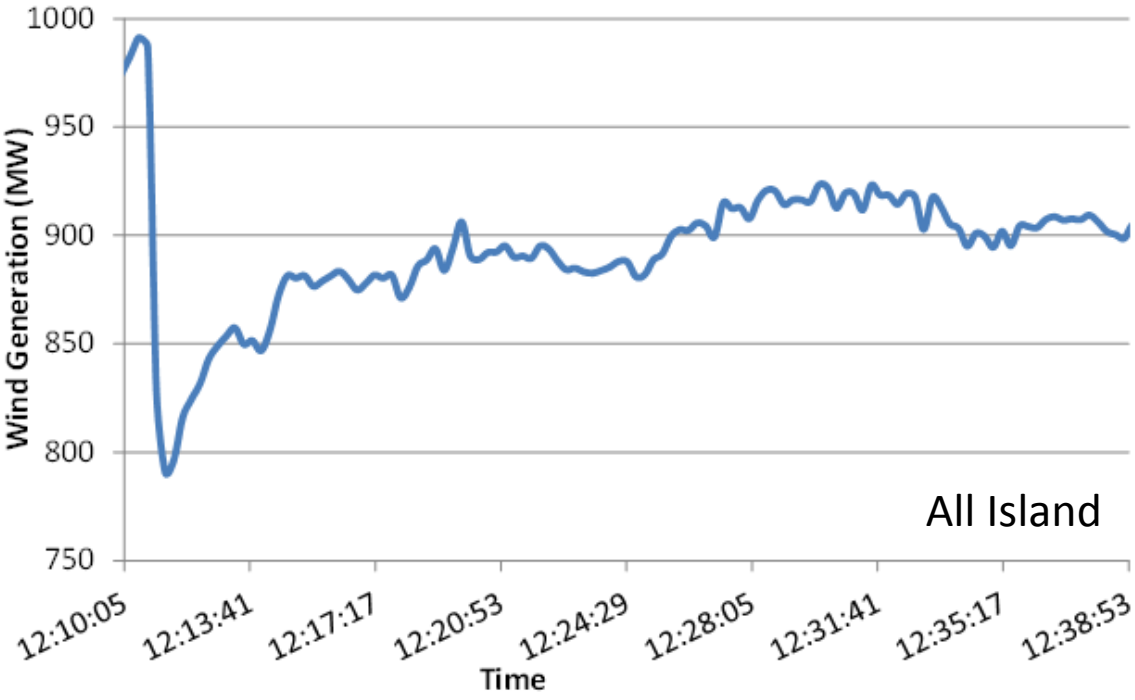
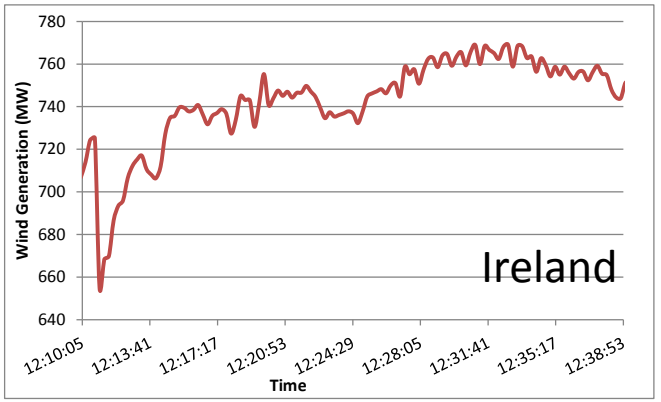
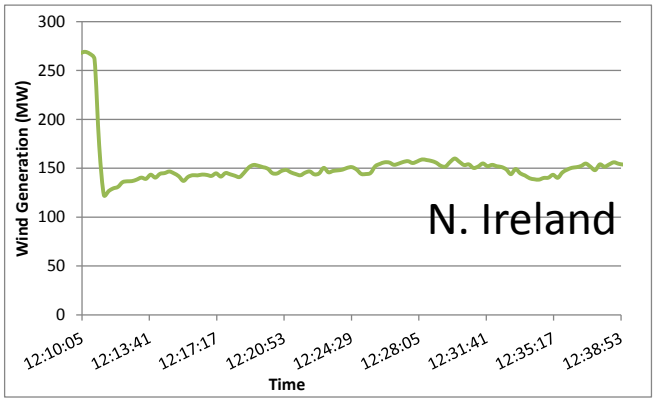
EWIC 500 MW Export Rejection

Wind Impact







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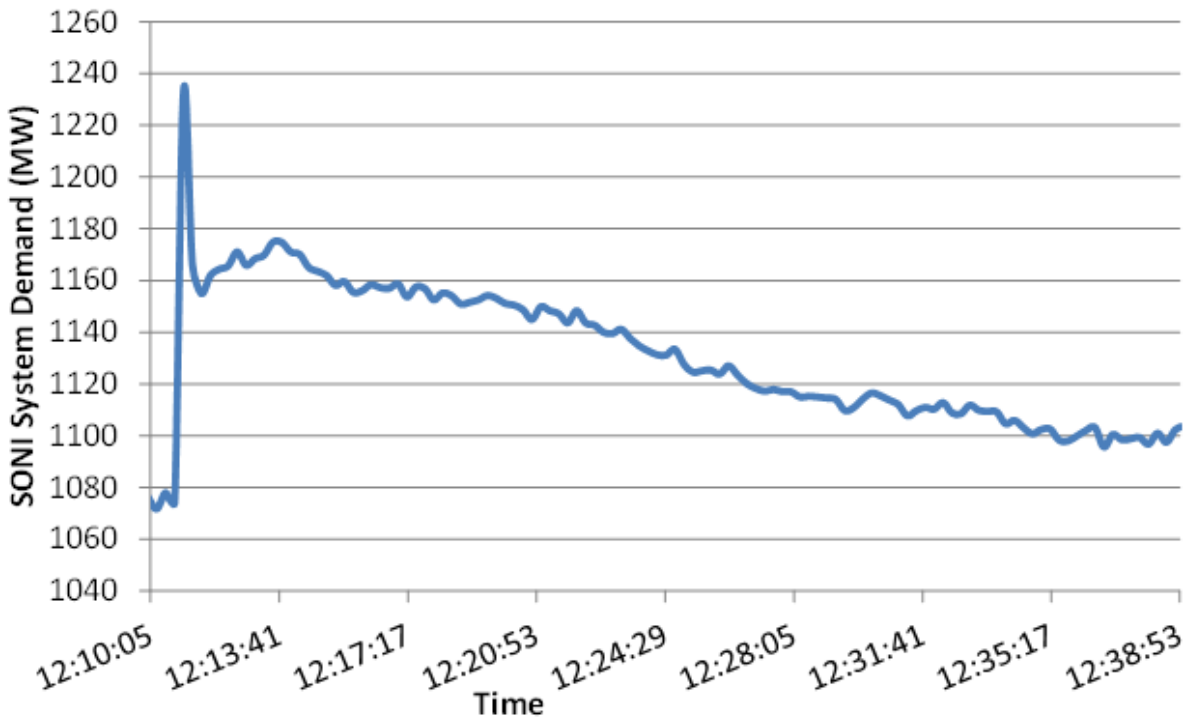
EWIC 500 MW Export Rejection Test

NI Demand Impact



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Increasing Exports all conditions: Interim Plan

- Increase exports for all system conditions until WF settings change
- New Initiatives:
  - 1. Modify HF Triggers on EWIC & Moyle
  - 2. Revised HF settings on WF Grid Interface Protection
    - ~600 MW of wind across 14 WFs in Ireland set to trip at grid interface (110 kV)
    - Three tranche tripping schedule proposed: 50.32 Hz, 50.37 Hz, 50.42 Hz – all undelayed
  - 3. Wind Farm HF Response
    - WF high frequency response used more pro-actively during exports
  - 4. Conventional Units – machine runback and/or trip
    - Capability to runback a CCGT for less onerous HF event
    - Capability to trip a CCGT for more onerous HF event
  - 5. Enhancements to Control Centre Tools
    - EMS Changes – observability and control ability
    - WSAT Changes – improved models and data feeds
    - Greater awareness of HF impacts to System Controllers

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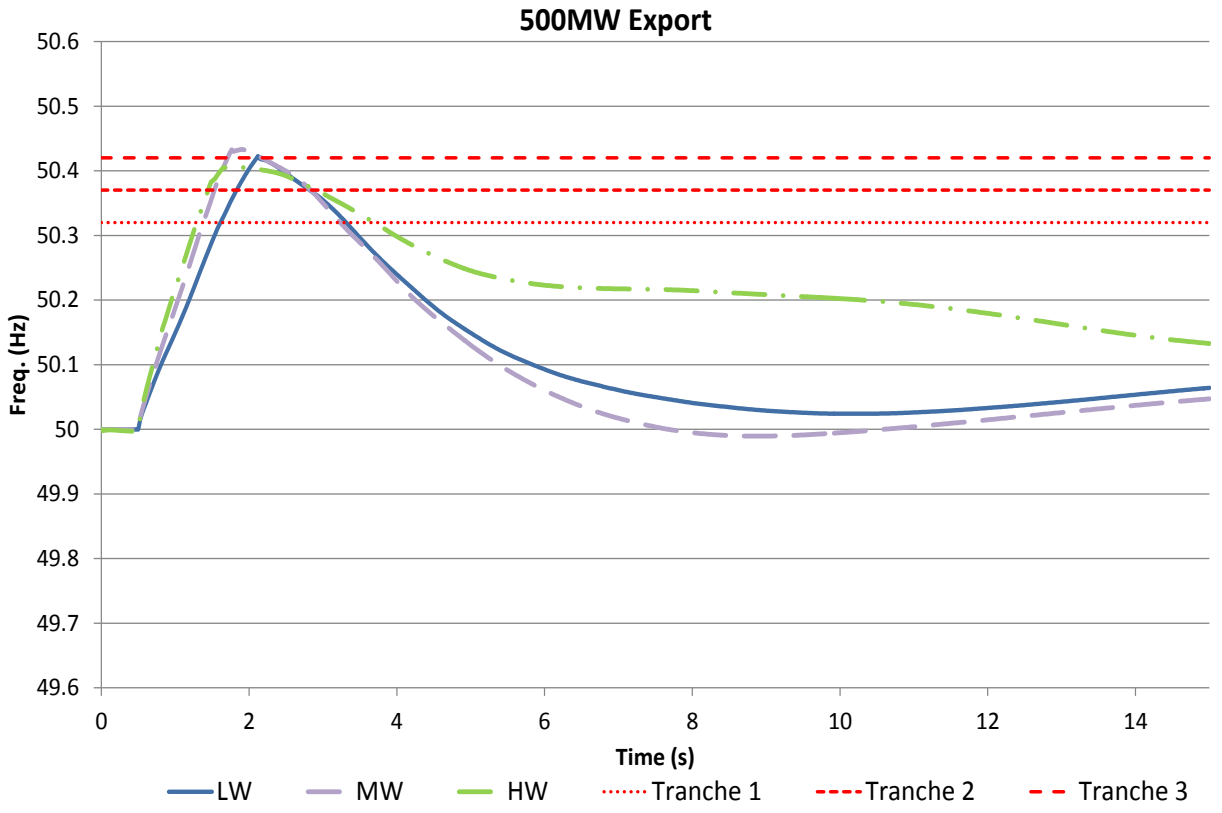
Increasing Exports all conditions: Interim Plan



Summary and Next Steps

- EWIC Export Trials for low/medium wind up to 500 MW
- New Interim Plan proposed for managing exception HF events
  - Plan involves changes to system tools and grid interface protection
  - Plan backed up by studies and model validation
- Increased exports on EWIC will mean less curtailment
- Full exports on EWIC expected by November

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Closing Remarks

DS3 Advisory Council 21/09/2016

14.50-15.00pm

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