

DS3 Industry Forum

Ballsbridge Hotel
8th April

As part of the DS3 programme (*Delivering a Secure Sustainable Electricity System*), EirGrid and SONI are committed to engaging with all our customers and stakeholders through regular and open communications. As part of this commitment we host Industry Forums to provide updates on the programme.



WSAT

Model Dev. & Studies

Control Centre Tools

ROCOF

Voltage

Performance
Monitoring

Grid
Code

DSM

System
Services

Frequency

Renewable Data

Agenda

1) **Introduction** – *Jonathan O’Sullivan*

2) **Context of DS3** - *Robbie Aherne*

3) **Recent High Wind Generation** - *Maria Geraghty*

4) **DS3 Programme Status Update** - *Robbie Aherne*

Tea & Coffee Break

5) **System Performance:**

- **RoCoF** - *Tom McCartan*
- **System Services** – *Jonathan O’Sullivan*

6) **System Policies:**

- **Voltage & Frequency Control** – *Simon Tweed*

7) **System Tools:**

- **System Tools Update** - *Jonathan O’Sullivan*

8) **Annual Renewable Report 2013 & Energy Policy Developments** - *Frank Groome*

9) **Questions and Answers**

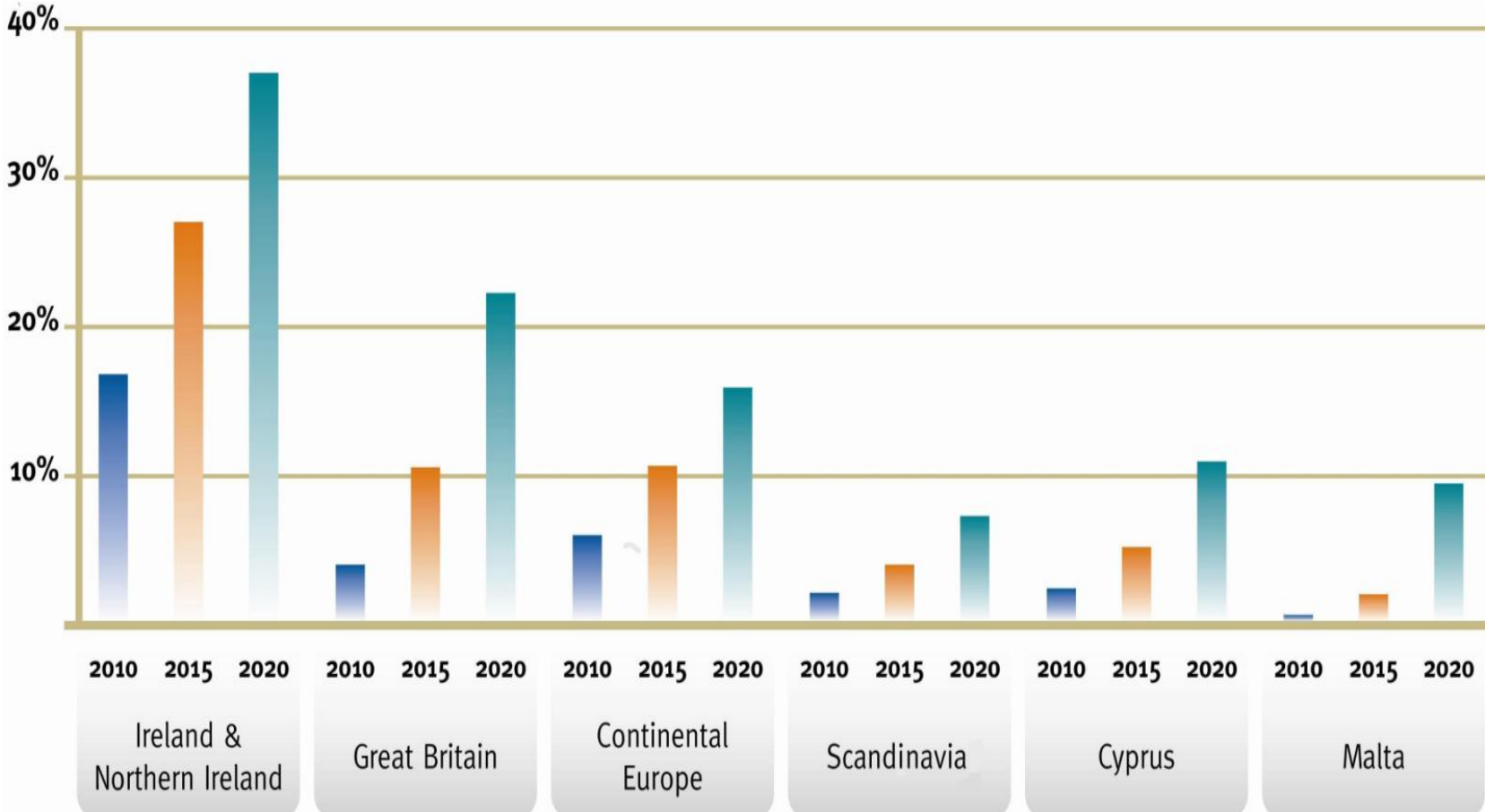


DS3 Programme

8th April 2014
Robbie Aherne



European Targets



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

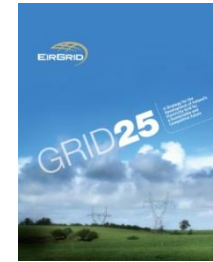
Challenges and Response

Challenges

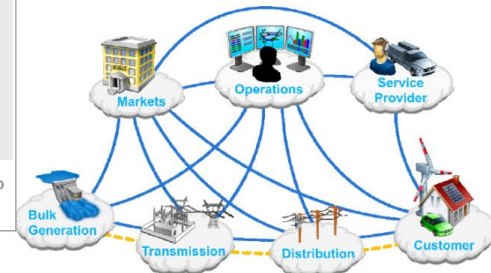
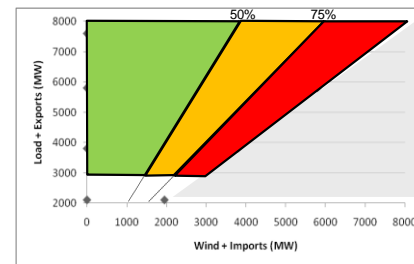
- System Stability
- Resource Variability
- Complexity
- New connections
- Changed power flows

Responses

① Infrastructure: EWIC & Grid25



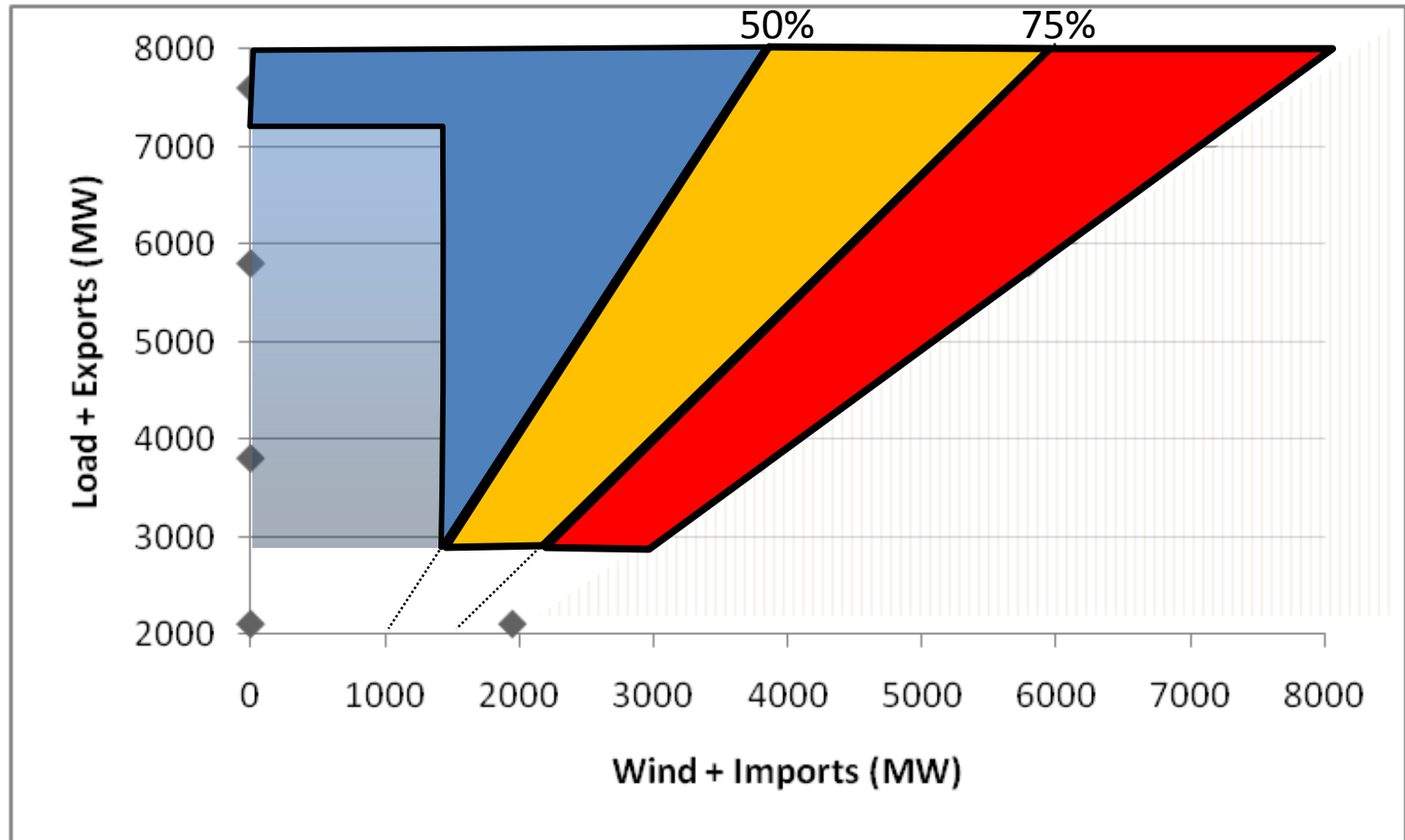
② Operational: DS3 and Smart Grids



NIST Smart Grid Framework 1.0 Sept 2009



Real Time Limit Operational Limits



Background – Operations and DS3



Detailed Technical Analysis

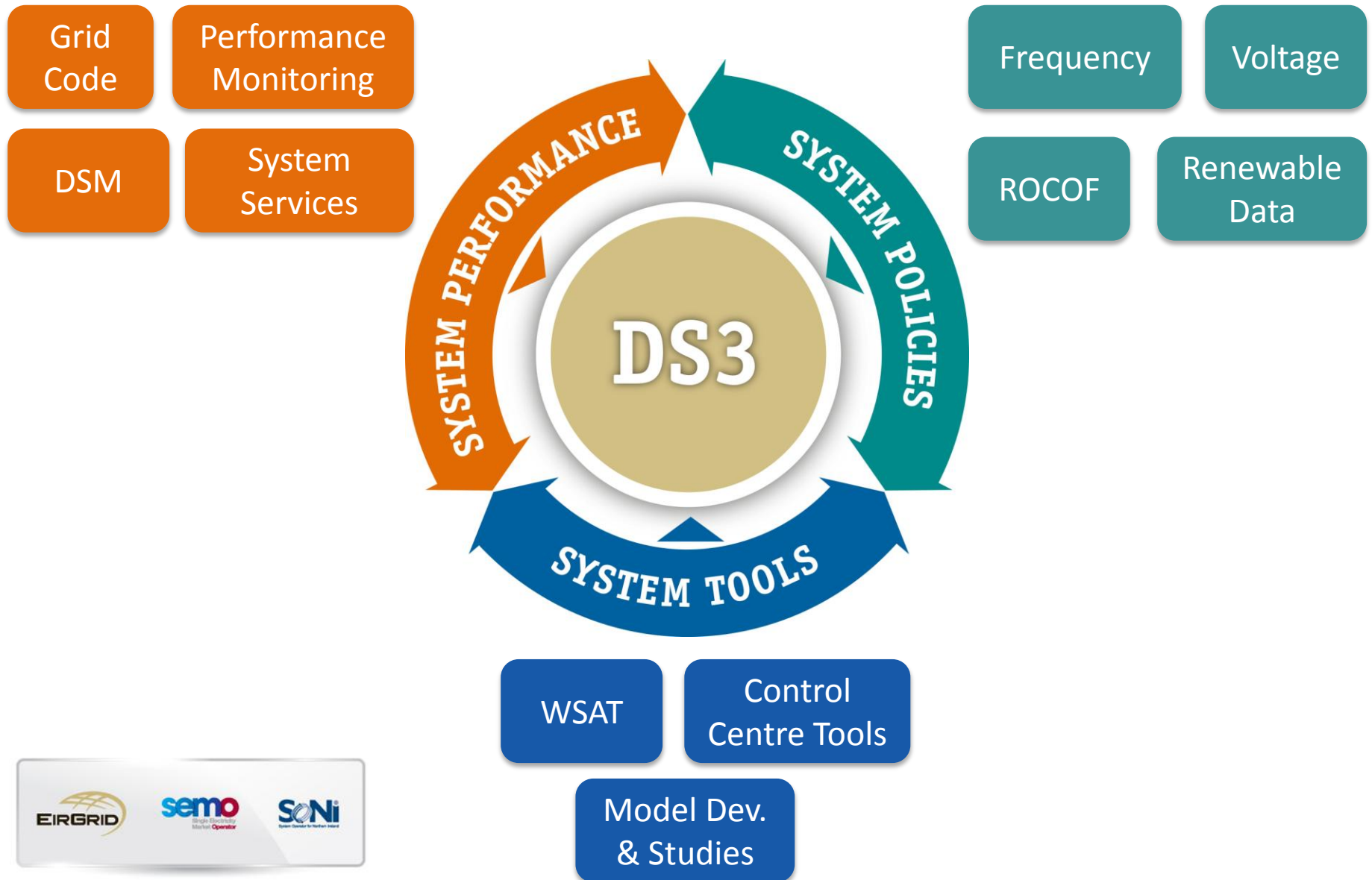
- 2008 - All Island Grid Study
- 2010 - Facilitation of Renewables
- 2011 - Ensuring a Secure Sustainable System

Delivering a Secure Sustainable System

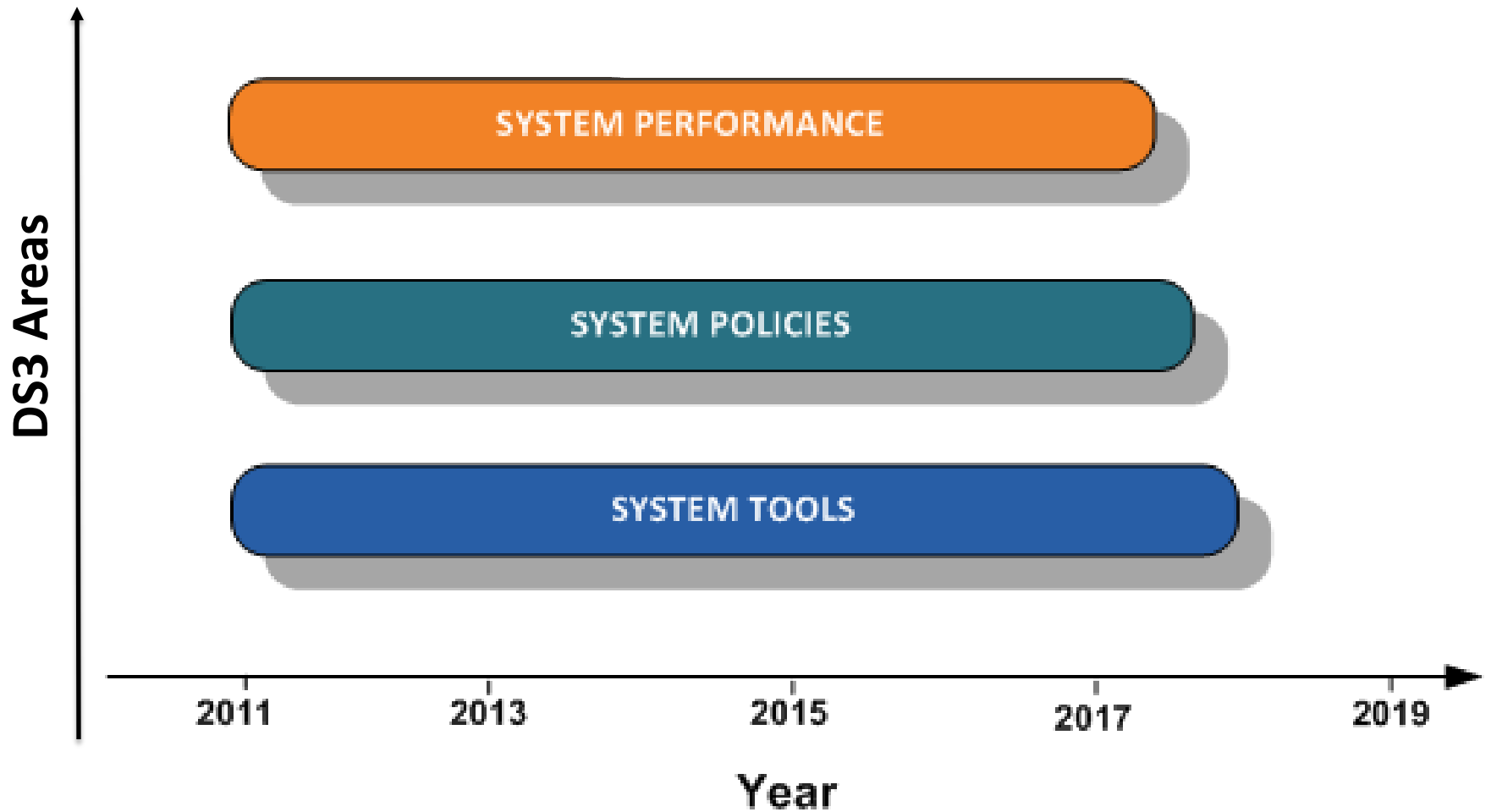
- 2011 – Programme established
- Meeting the RES Policy Objectives efficiently while maintaining system security
- Holistically considering technical, commercial and regulatory needs of the system
- Engaging with all industry stakeholders



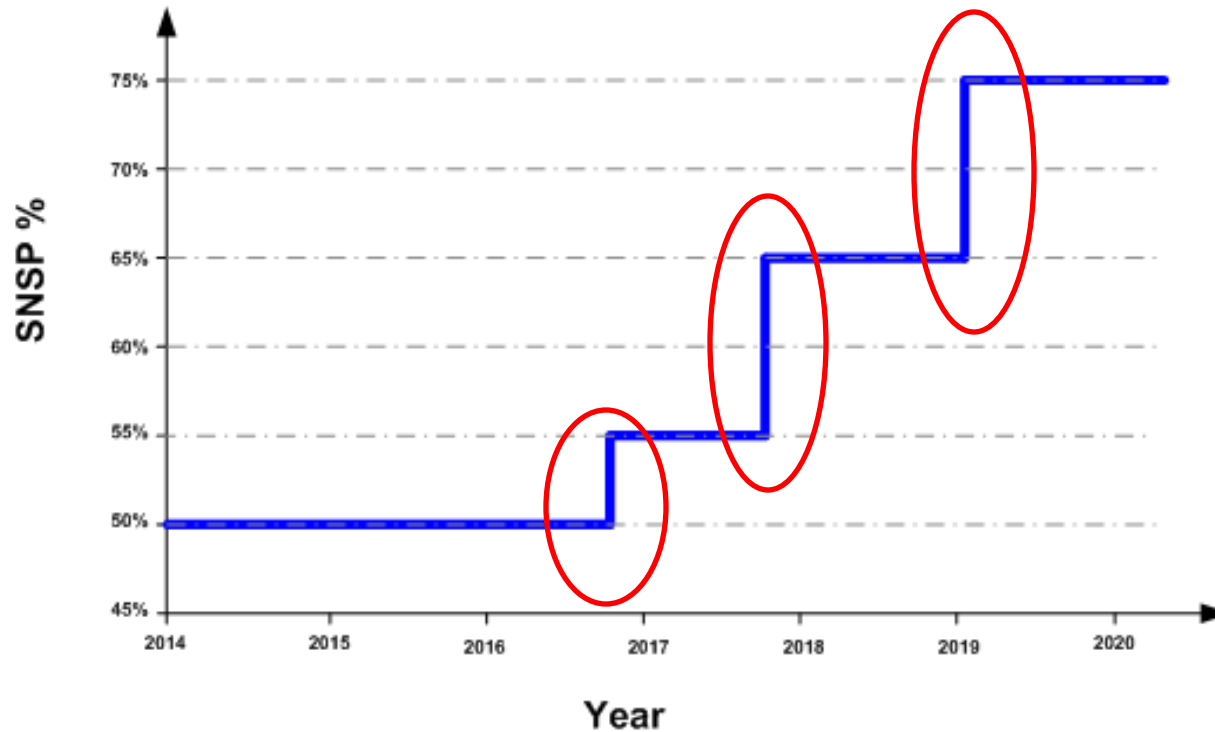
DS3 – Shaping the System of the Future



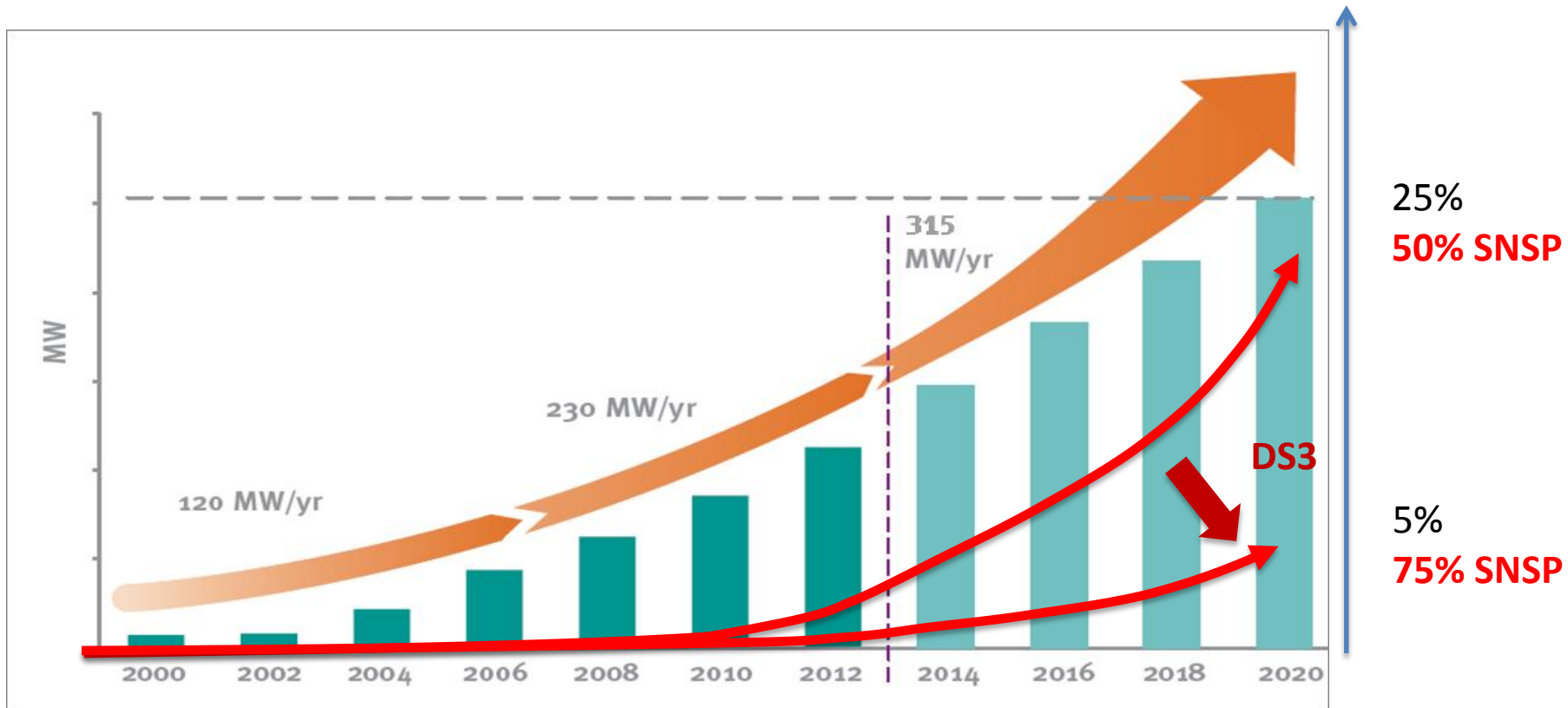
DS3 – Changing



Operational Capability Outlook



Effect of SNSP on Curtailment

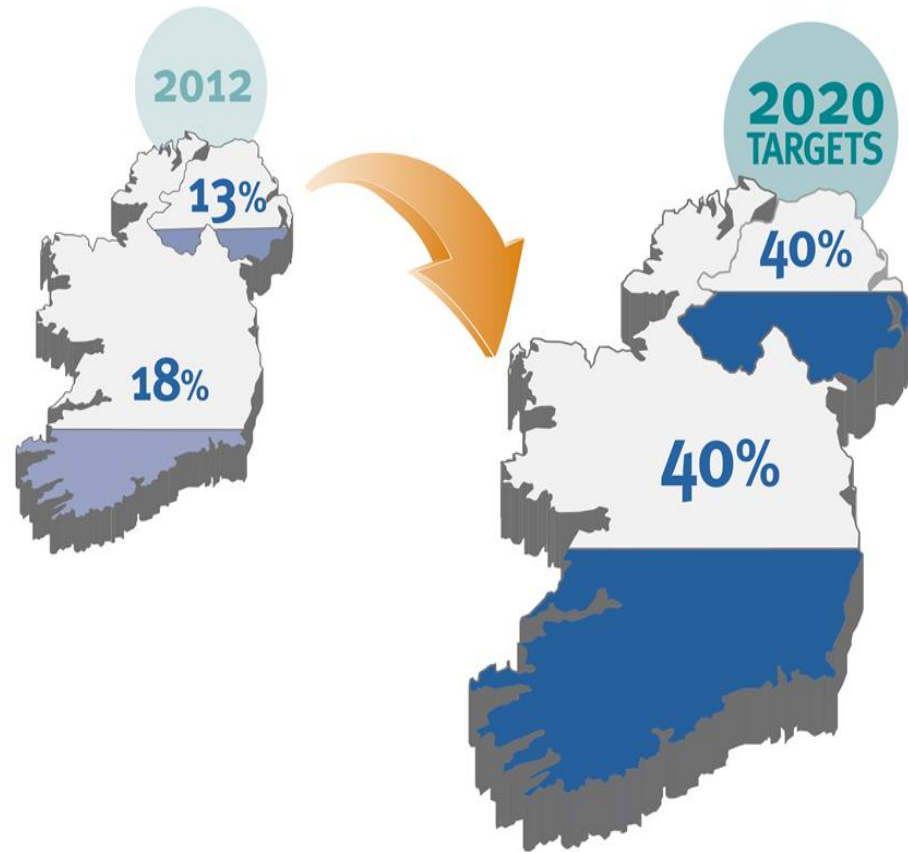


Illustrative SNSP curves

DS3 Delivery

Key Building Blocks

- Operational Policy and increased resolution on SNSP
- Supported by performance monitoring and new systems tools
- System Services and RoCoF



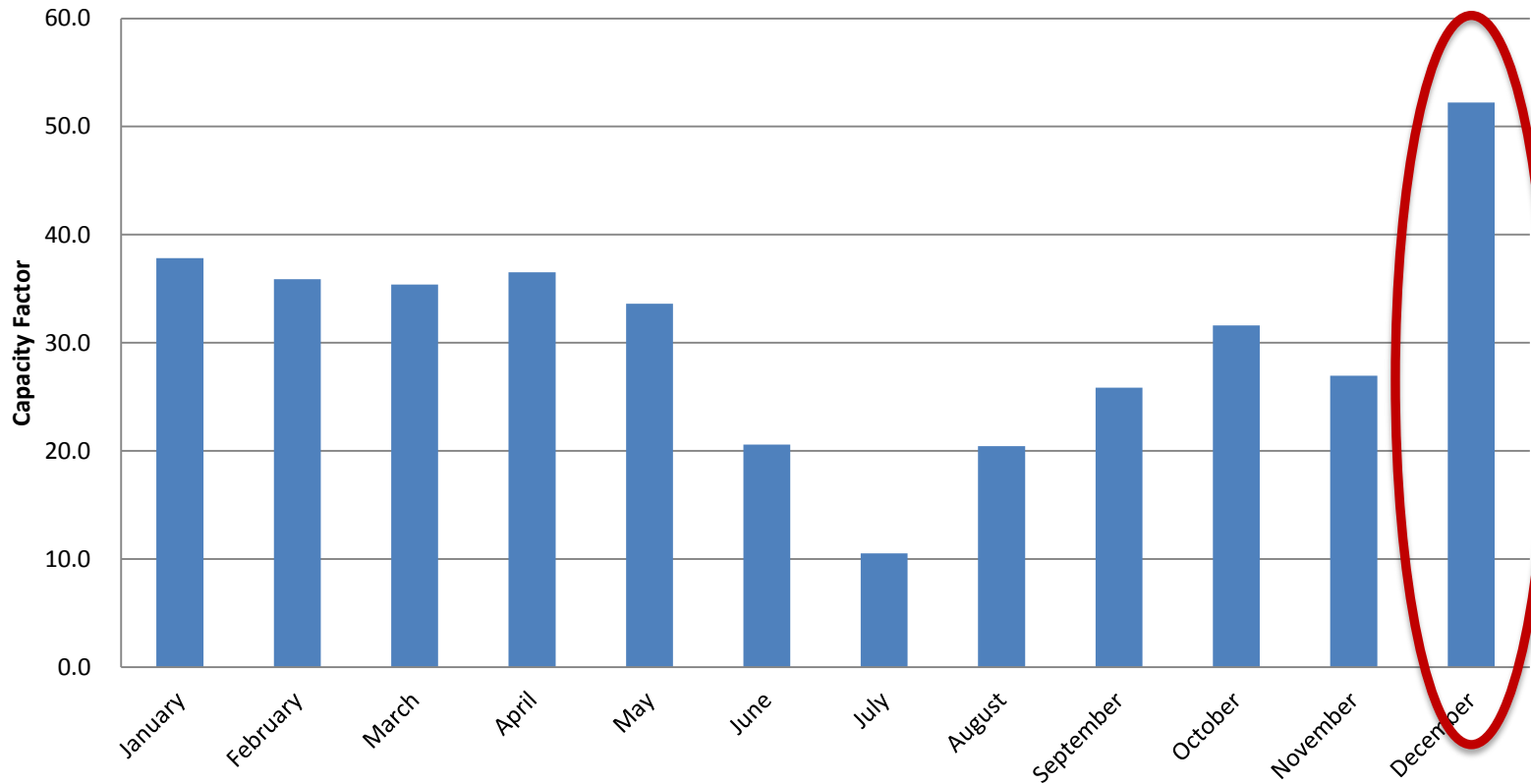


Recent High Wind Generation

8th April 2014
Maria Geraghty

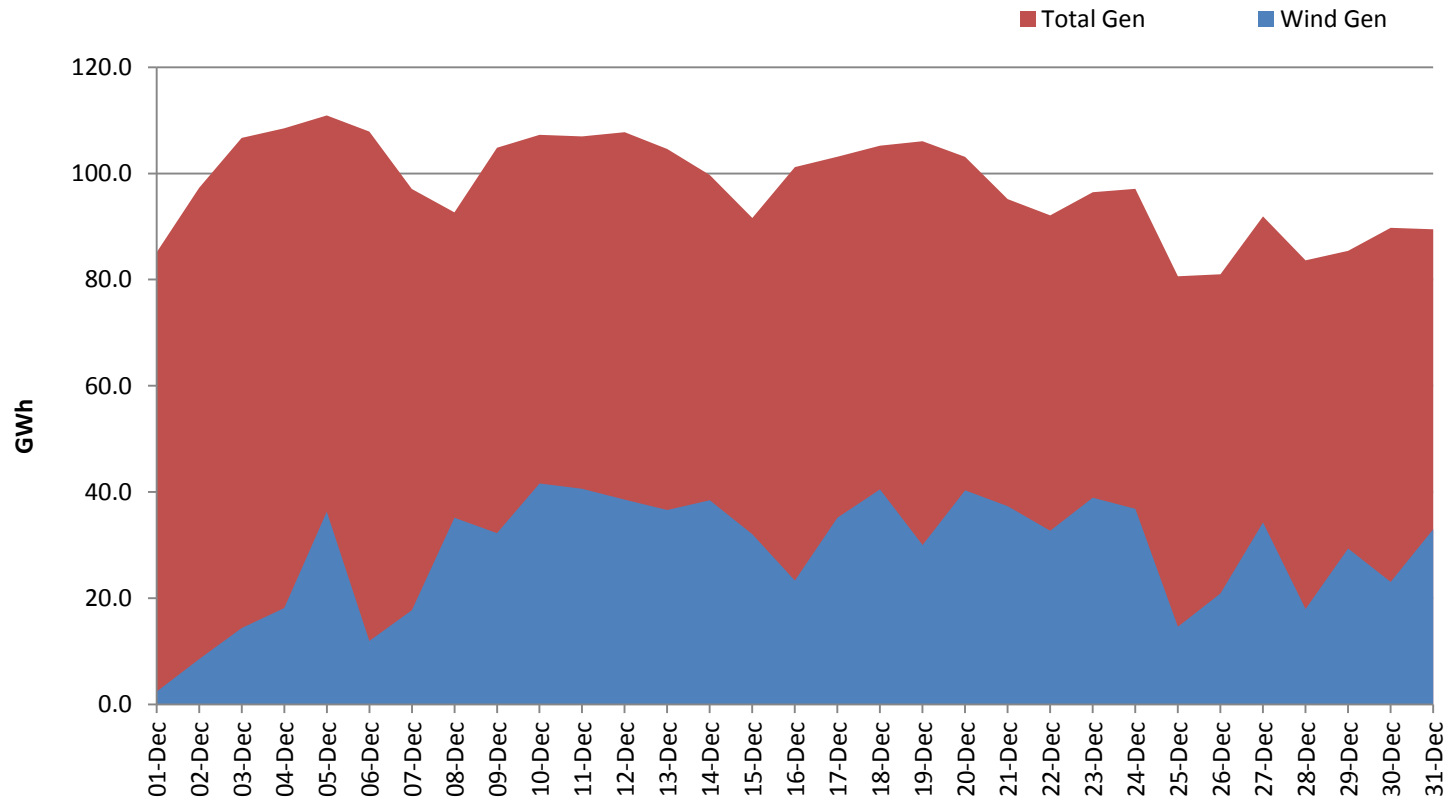


All Island Wind Capacity Factor 2013

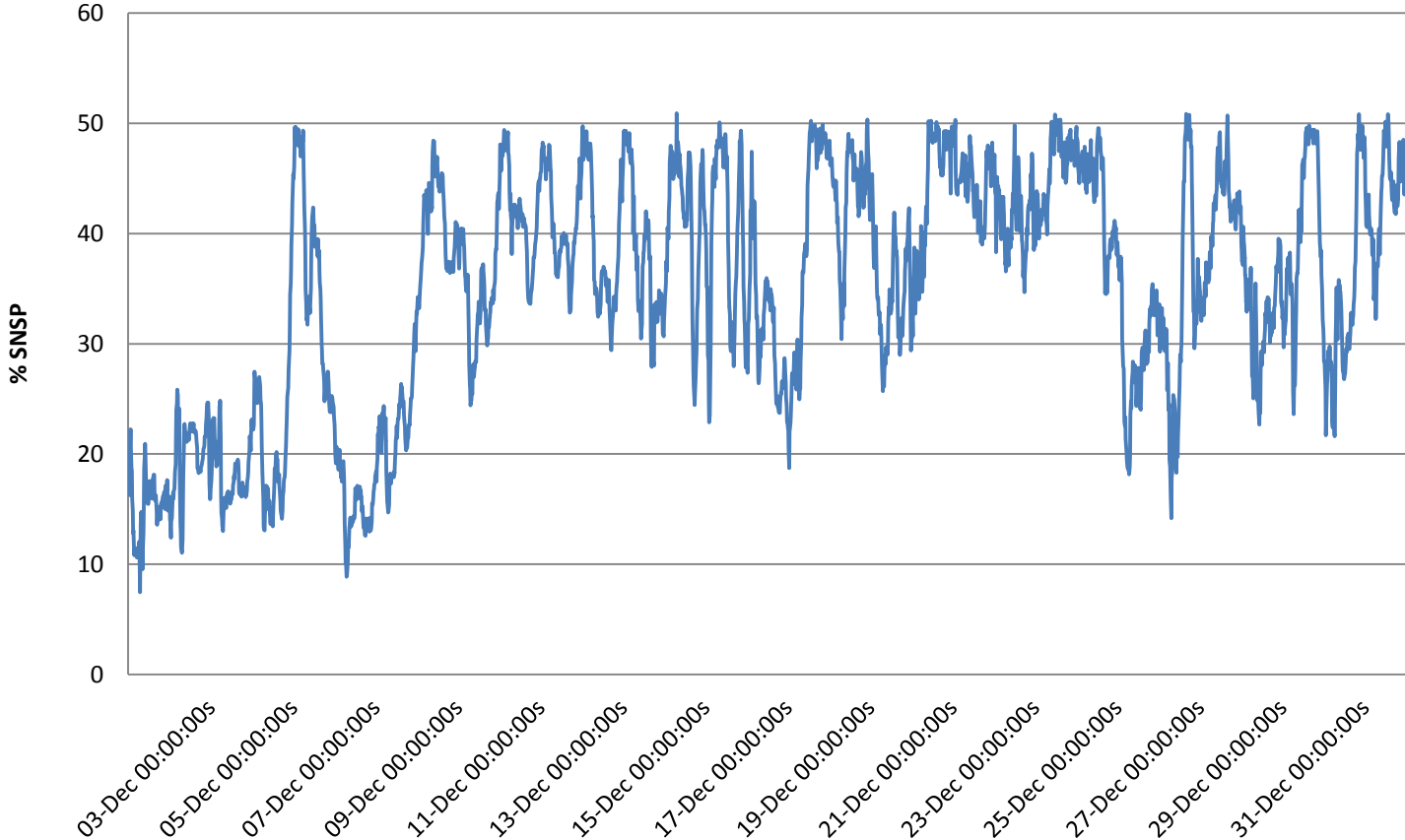


Note: All values used are based on 15 min historical SCADA values

December 2013: Wind and Total GWh



December 2013: SNSP

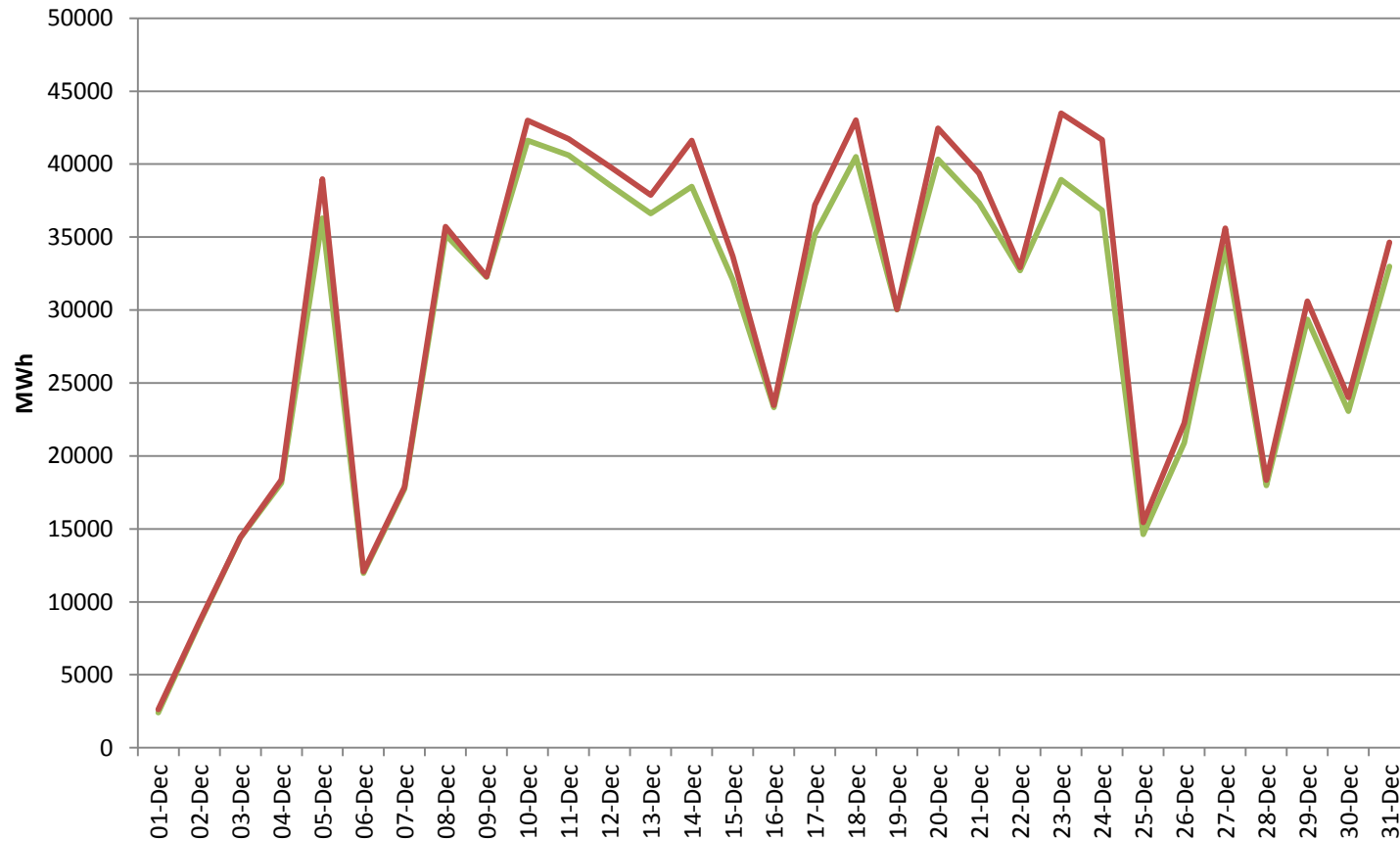


All Island Peak Demand

	2013
Peak System Demand (MW)	6192
Time of Peak Demand	17 th Dec 17:30
Wind Generation at Peak (MW)	2274
% Wind of Total Demand	36



December 2013: Wind Curtailment

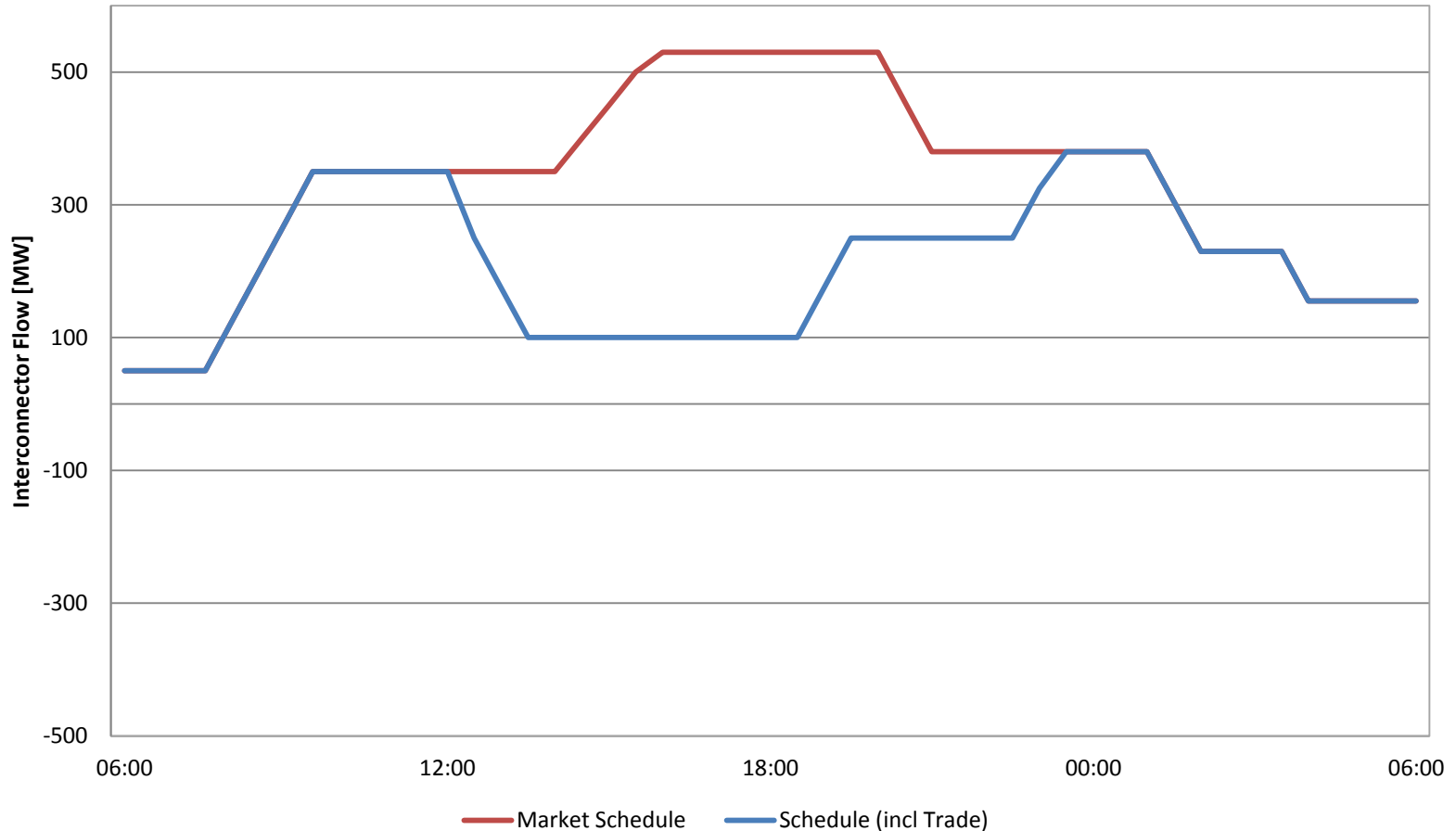


Generated Wind

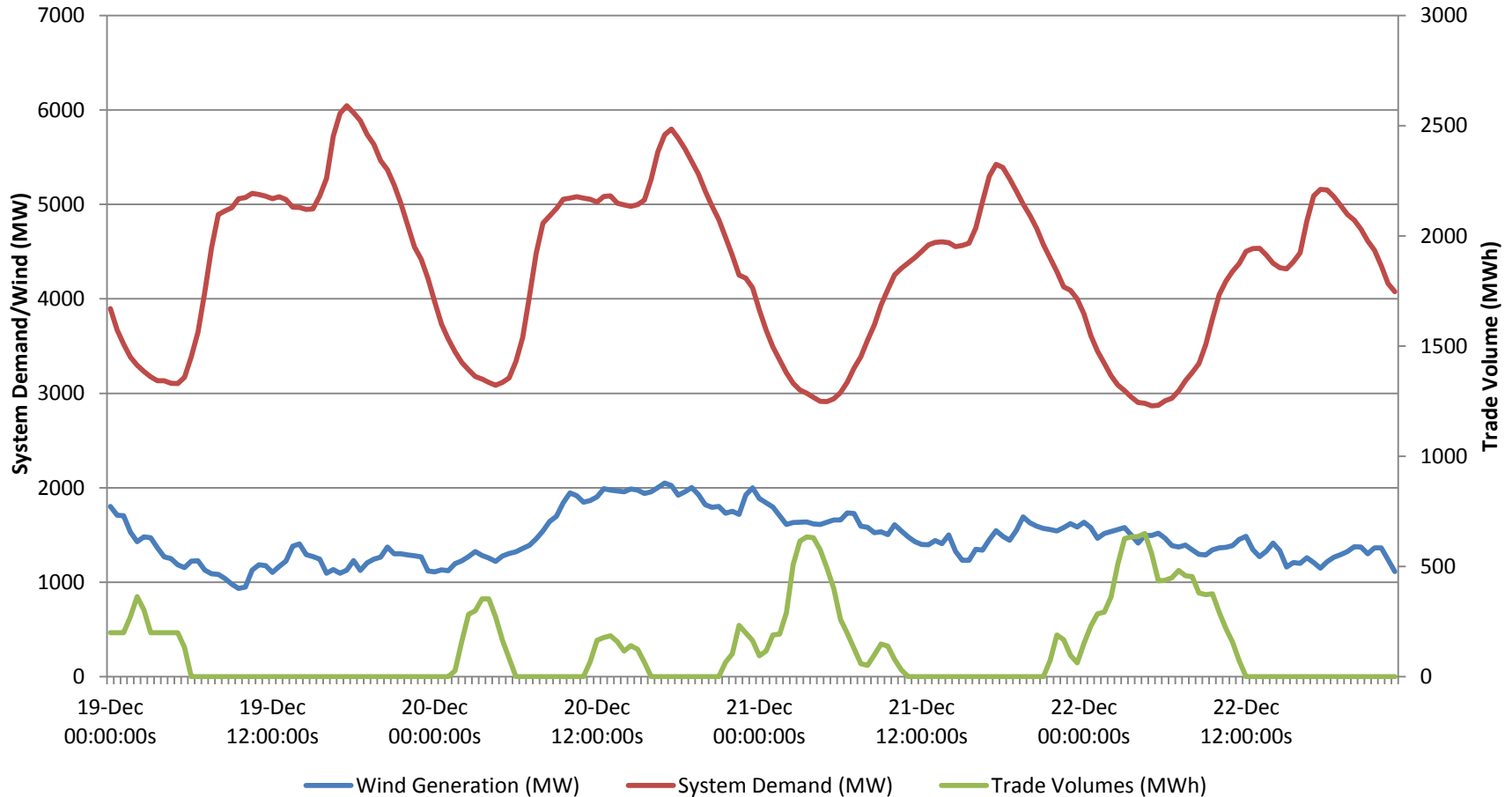
Available Wind



Counter Trading for Priority Dispatch



Counter Trading for Priority Dispatch







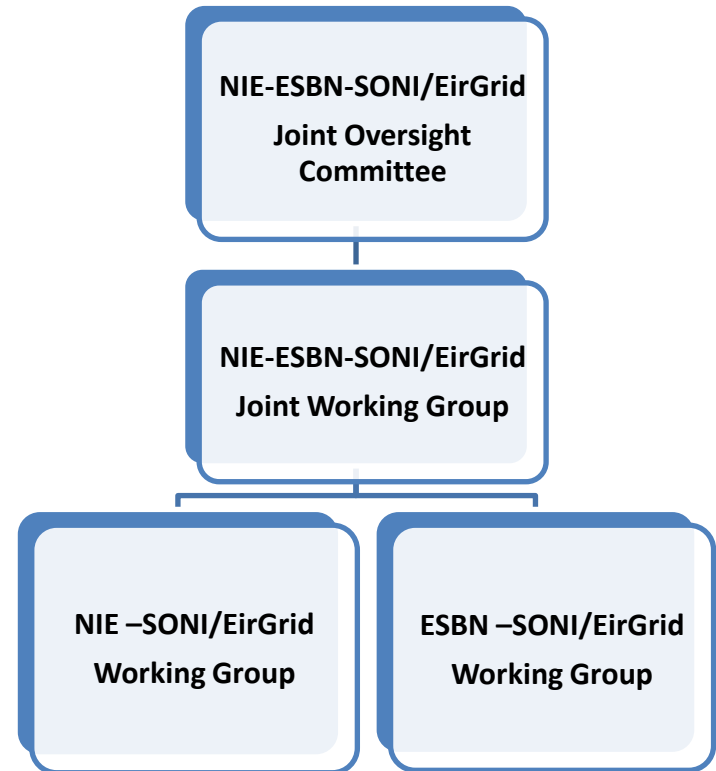
DS3 Programme Status Update

8th April 2014
Robbie Aherne



TSO-DSO Interaction

- DS3 TSO-DSO Engagement Plan
- Voltage Control, Frequency Control, Performance Monitoring, ROCOF and Demand Side Management
- Regular engagement



System Services

- TSO Recommendations paper published on 24/05/2013
- SEM Committee published a Decision Paper on System Services Product Definitions on 20/12/2013
- EirGrid Demand Side Report sent to SEM Committee on 07/03/2014
- Substantial interest from different technology providers
- Final Regulatory Authority decision expected by end 2014



DSM

- 3 DSUs operational (~ 120 MW)
- Grid Code mods for Ireland and Northern Ireland
- DSU workshop held in July 2013
- Secure ICCP comms mechanism implemented – awaiting customer to become operational
- DSU JGCRP Working Group



ROCOF and WSAT

ROCOF:

- TSOs have engaged with RAs on proposed ROCOF implementation project
- CER RoCoF decision issued on 04/04/2014

WSAT

- Model validation work ongoing
- Frequency control in the control centres – Q3 2014



Renewable Data and CCTC

Renewable Data

- Annual Renewable Report launched on 28/11/2013
- Ongoing analysis and reporting
- Quarterly Constraint and Curtailment Report – with RAs for final approval

CCTC

- EMS Integration Project – harmonisation of displays
- Work continuing on EMS Wind Dispatch Tool – Q2 2014
- Inclusion of RoCoF and inertia in RCUC – Q4 2014



Grid Code and EPM

Grid Code

- Guidance notes for DS3 WFPS mods finalised and sent to Ireland GCRP on 04/12/2013
- Dynamic Model modifications presented to both GCRP on 04/12/2013
 - NI: consultation on modification closed
 - IRE: Will be discussed again at next GCRP on 12/02/2014

Enhanced Performance Monitoring

- Focussed on Grid Code and AS Agreement requirements
- Internal workshop to scope out high level performance monitoring requirements for System Services



Operational Studies

- All island study on future levels of reactive compensation
– Q3 2014
- Matrix of system security and stability metrics compiled
- All island min generation analysis complete; outputs under review
- Over frequency generation shedding
- Secondary tripping study (related to RoCoF)



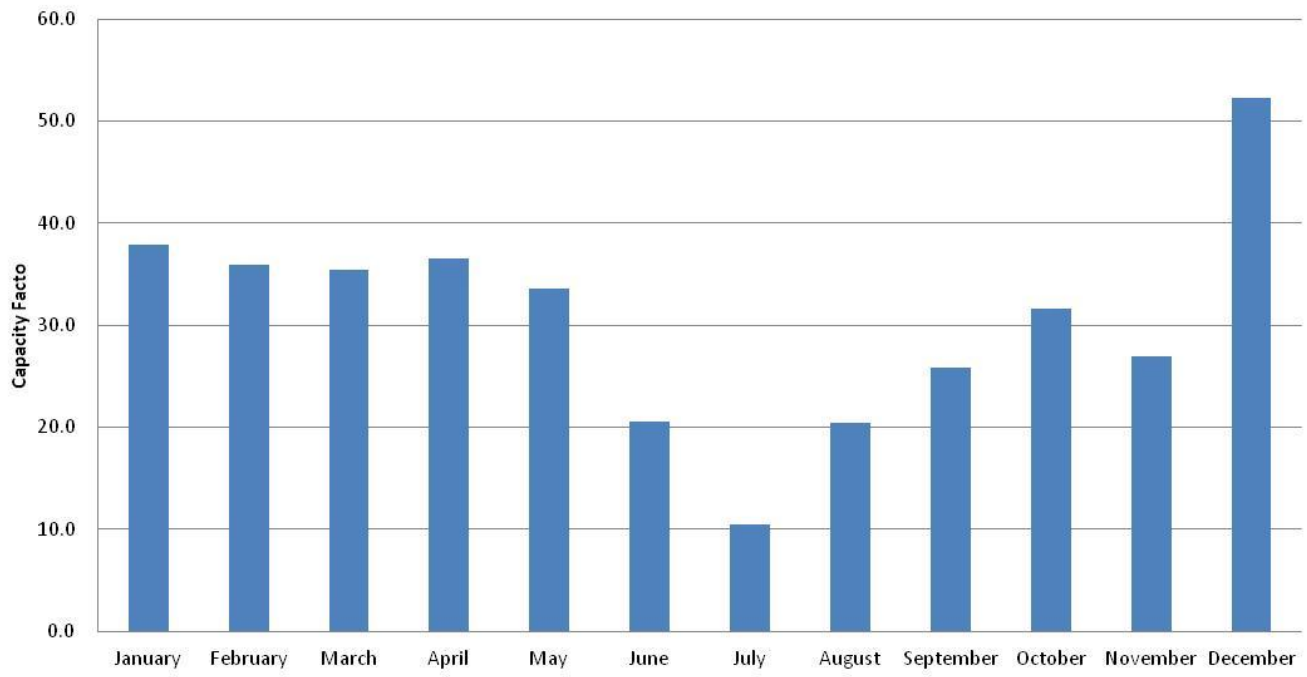
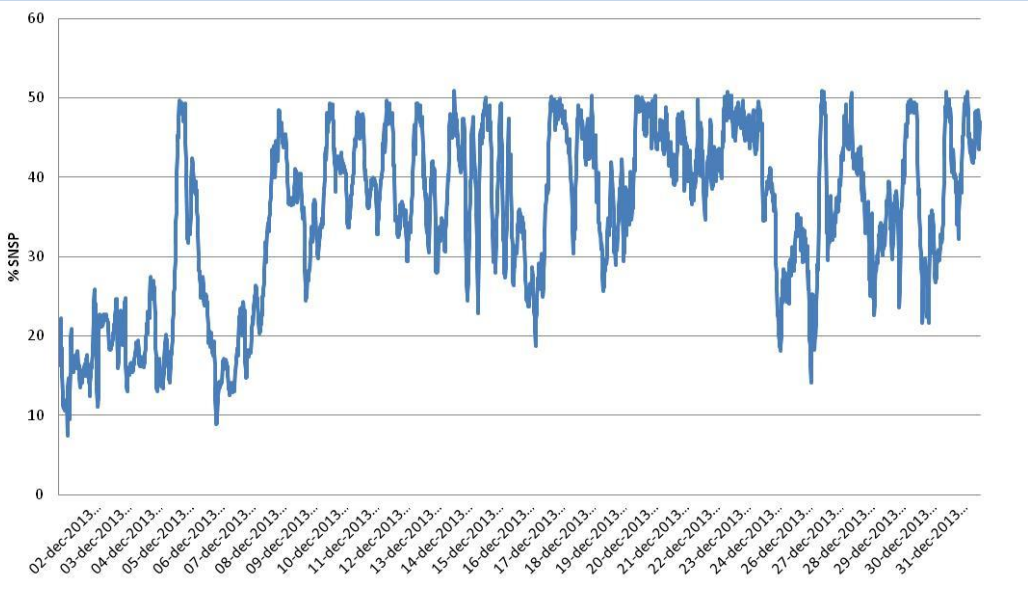
Revised DS3 Workstream Plans

HIGH-LEVEL PLAN

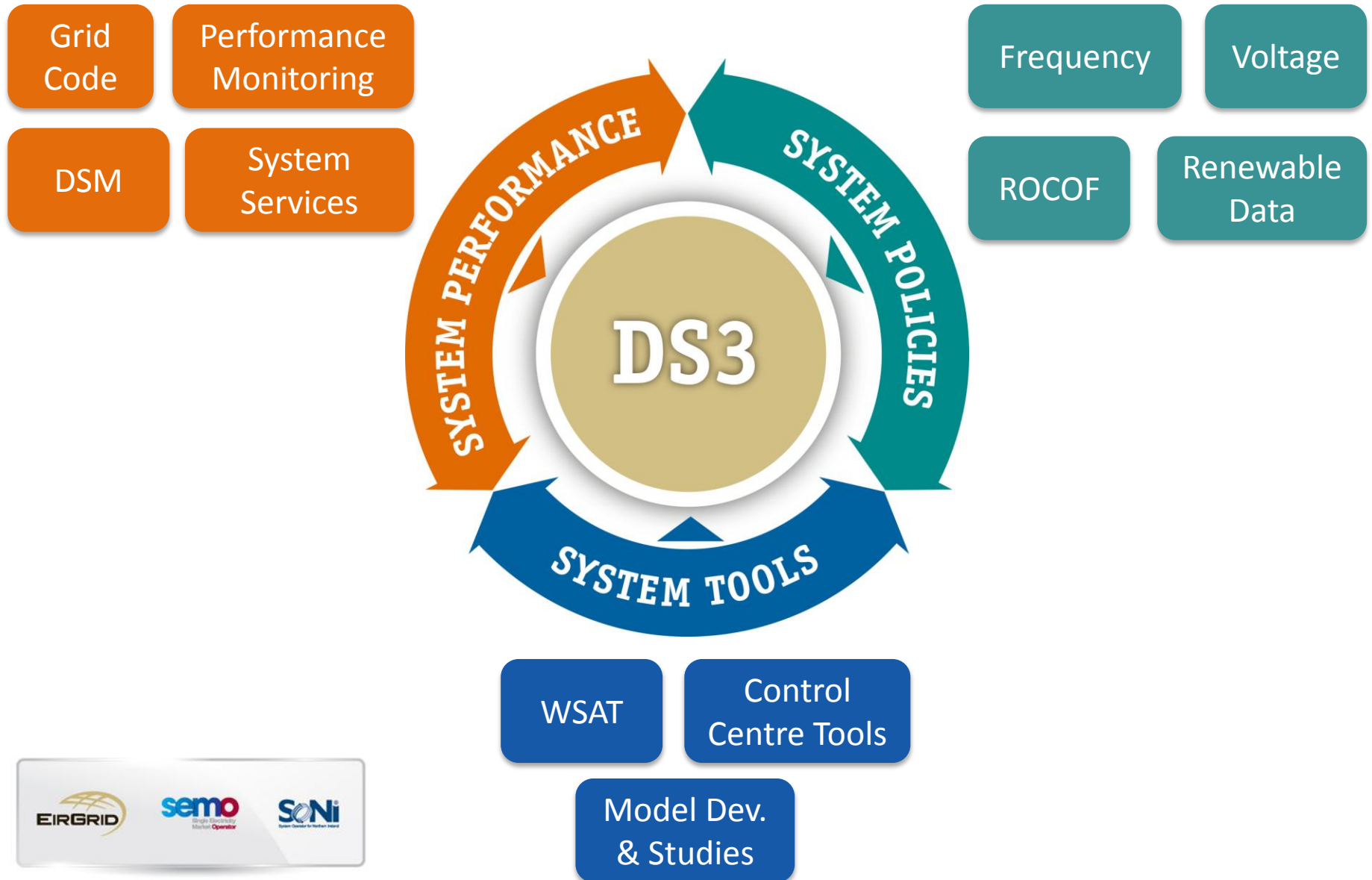
TASK NO.	TASK	RESPONSIBLE	ORIGINAL DUE DATE	DUE DATE
DSU Readiness				
DSM.1.1	Approval of Grid Code Modification for DSU (MOD_36_10)	CER	Q4 2011	Complete
DSM.1.2	Northern Ireland Grid Code Modification Consultation	TSOs & RAs	Q4 2011	Complete
DSM.1.3	Northern Ireland Approval of DSU Modification	UReg	Q1 2012	Complete
DSM.1.4	Delivering T&SC Modification	SEMC	Q1 2012	Complete
DSM.1.5	System Services Consultation #1	TSOs / RAs	Q4 2011	Complete
DSM.1.6	System Services Consultation #2	TSOs / RAs	Q3 2012	Complete
DSM.1.7	WPDRS phase out	EirGrid / CER	2012 – 2013	Complete
DSM.1.8	DSU Operation (Ireland Pilot)	TSOs / Industry	Q2 2012	Complete
DSM.1.9	Review of System Services arrangements for DSUs and AGUs	TSOs	Q3 2013	Q1 2014
DSM.1.10	DS3 TSO-DSO Engagement Strategy modified to take account of DSM	TSOs/DSOs	New Task	Q1 2014
DSM.1.11	Review of relevant Network Codes from perspective of DSM	TSOs	New Task	Q1 2014



December 2013 – SNSP and Capacity Factor



DS3 – Change in Focus





System Performance

8th April 2014
Jonathan O'Sullivan



Rate of change of frequency (RoCoF) Modification

8th April 2014
Tom McCartan



Presentation overview

- RoCoF Consultation Timeline
- RoCoF Averaging concept
- International Examples
 - National Grid
 - Tasmania
- CER decision

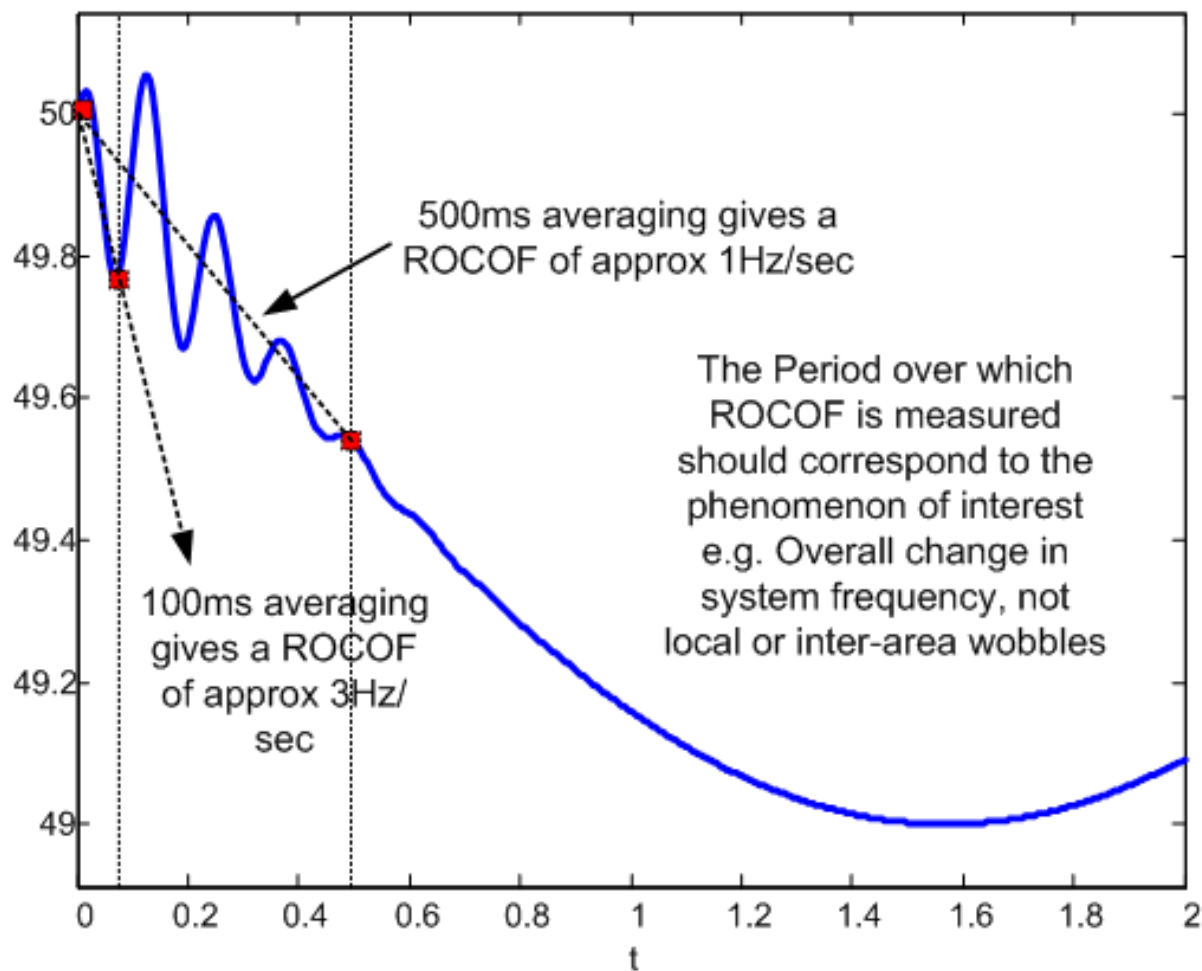


RoCoF Timeline

February - August 2012	DS3 Grid Code Working Group
December 2012	TSO RoCoF GC modification submitted
February 2013	DNV KEMA publish TSO commissioned RoCoF report
May 2013	PPA publish CER commissioned RoCoF report
June/August 2013	CER and UREGNI Consultation on RoCoF Modification to the Grid Code
April 2014	CER decision paper issued 4 th April 2014 no NIAUR decision to date



Illustration – Averaging Concept



National Grid and Tasmania

- National Grid
- Joint Distribution and Grid code working group established to determine the need for a change to the existing RoCoF standard of 0.125Hz/s
- RoCoF protection settings should be changed at new and existing distributed generators in stations of registered capacity of 5MW and above to 1Hz/s, using a delay setting of 500ms.
- Tasmania
- Increasing amount of non-synchronous generation has resulted in the need to re-evaluate the Network security risks due to changes in system dynamic behaviour
- From analysis it was determined that a delayed RoCoF of less than 1.176Hz/s would limit the initial maximum RoCoF to less than 3Hz/s



CER decision



Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Rate of Change of Frequency (RoCoF) Modification to the Grid Code

DOCUMENT TYPE:	Decision Paper
REFERENCE:	CER/14/081
DATE PUBLISHED:	4 th April 2014
QUERIES TO:	rorourke@cer.ie

*The Commission for Energy Regulation,
The Exchange,
Belgard Square North,
Tallaght,
Dublin 24.*

www.cer.ie





System Services

8th April 2014
Jonathan O'Sullivan



Context and Progress

- Multi-stage consultation process (2011 – 2013)
- Recommendations Paper to RAs (April 2013)
 - Product definitions (5 new, 2 revised)
 - Remuneration framework
 - Valuation approach - €355m
- SEMC Consultation (Sep 2013) and Decision on product definitions (Dec 2013): SEM-13-060
- Further analysis on framework and financials
 - Request for TSOs to carry out revised financial analysis



DS3 System Services – Consultation process

First paper (Dec 2011)

- Scope & Principles
- Bilateral meetings (Feb 2012)
- DNV Kema International SS Review

Second paper (Jun 2012)

- Products & Technical aspects
- Workshop (July 2012)

Multi-stage Consultation

Third paper (Dec 2012)

- Financial aspects
- Bilateral meetings (Jan 2013)
- DNV Kema Capital Cost Paper

Recommendation (April 2013)

- Response to queries
- Price regulation with review
- Products/Rates/Next Steps

System Services: Proposed Approach

Increased revenue

- Currently 2%
- Increase to ~ 10%

New services

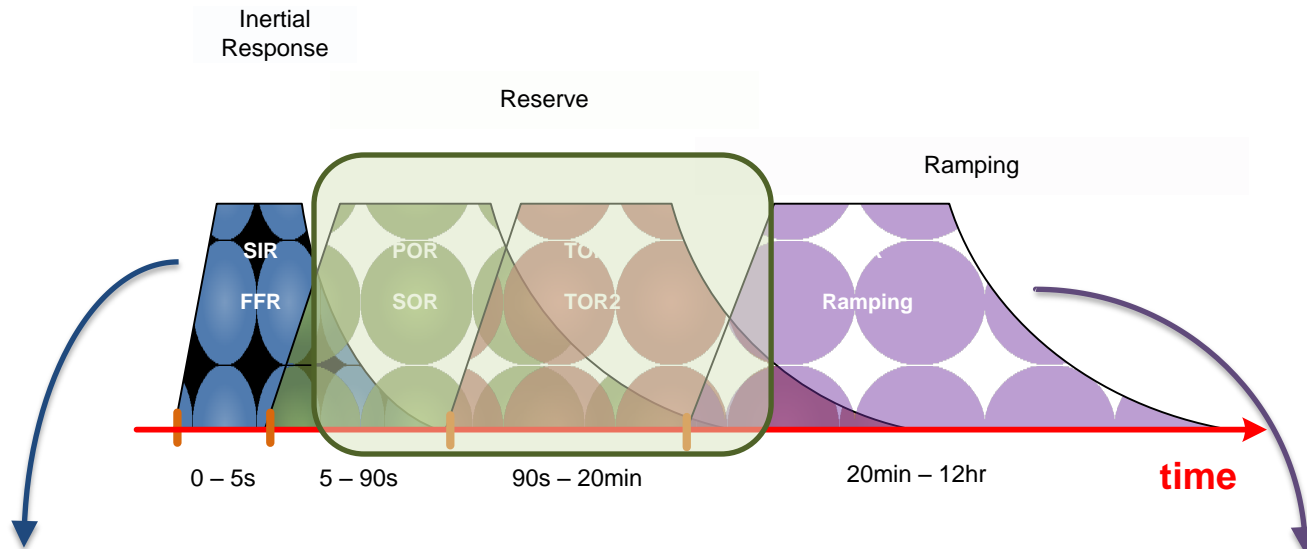
- Fewer synchronous generators
- Increase in variability

Focus on performance

- Efficient operation
- Maintain security



New Services: Frequency Control



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

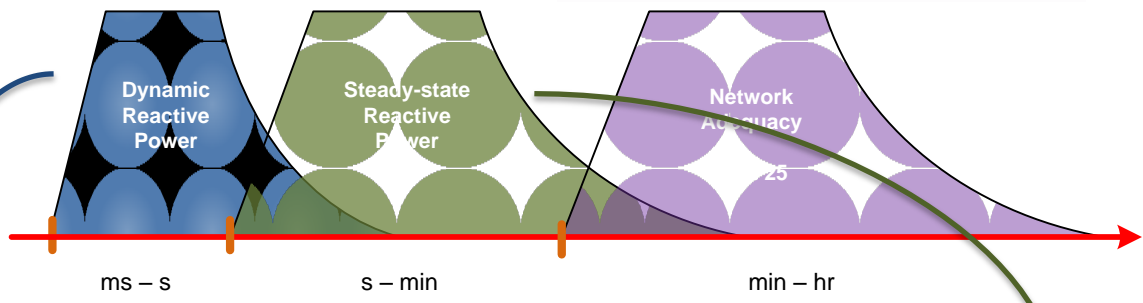
- Ramping Margin

New Services: Voltage Control

Transient Voltage Response

Voltage Regulation

Network



ms - s

s - min

min - hr

Dynamic
Reactive
Power

Steady-state
Reactive
Power

Network
Adequacy

25

• Dynamic Reactive Power

• Steady-state Reactive Power



Further Economic Analysis

TSOs

Plexos: System Service Valuation

- Updated inputs
 - Demand and wind
 - New counterfactual
 - Model refinements

Report delivered to RAs (7th Mar 2014)

RAAs

Evaluation of “supply-side”

- Investigation of potential costs for system service provision
 - Industry call for evidence
 - Building on KEMA costs analysis

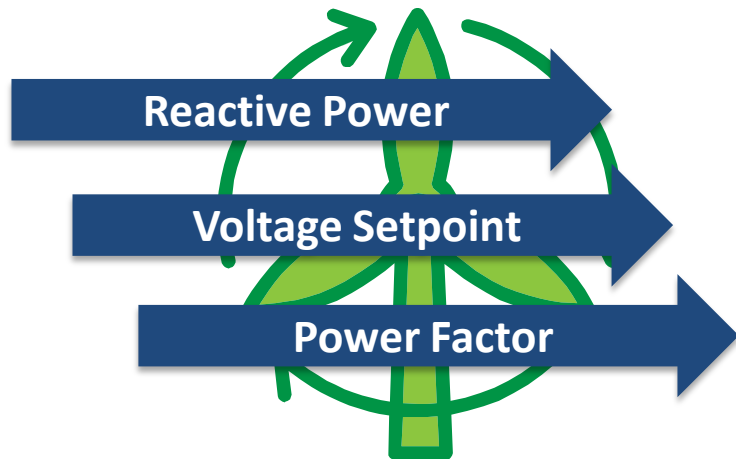
Consideration of Procurement Options

- RAs developing proposals for SEMC
- SEMC Consultation paper expected in May 2014
- SEMC Decision expected by end 2014



DS3: Grid Code and Performance

Control Modes



Approved
Grid and Distribution Code
Modifications

Enhanced Performance Monitoring





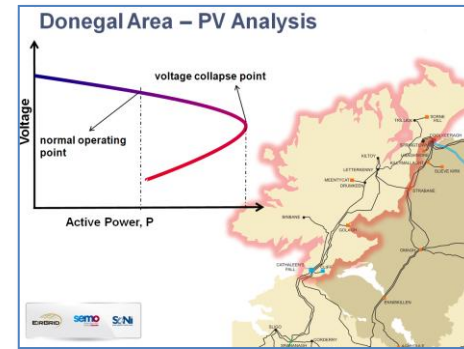
Development of System Policies

Simon Tweed
8th April 2014

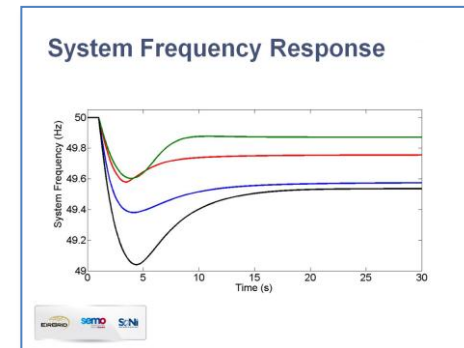


Development of System Policies

...to maintain **VOLTAGE**



and **FREQUENCY**



Control: Ad hoc Study Reports

Document 1: Reactive Power from Wind Farm Clusters

Document identifier: []
 Document version: Draft 1.0
 Date of current issue: 19th March 2013

Author: []
 Checked by: []
 Approved by: []

Author: Páid Cuffe (paic.cuffe@eirgrid.ie)
 Checked by: []
 Approved by: []

Document 2: All-Island TSAT Frequency Comparison Report

Document identifier: []
 Document version: 1.0
 Date of current issue: 21st May 2013

Author: Séamus Power
 Checked by: Ivan Dudurych
 Approved by: Michael Kelly, Alex Baird

Document 3: Pilot Study into Minimum Conventional Generation on the Island Power System: Part 1 - Frequency Security Issues

Document identifier: []
 Document version: Draft v. 1.1
 Date of current issue: 2nd May 2013

Author: Ivan Dudurych
 Reviewed by: []
 Approved by: Jonathan O'Sullivan

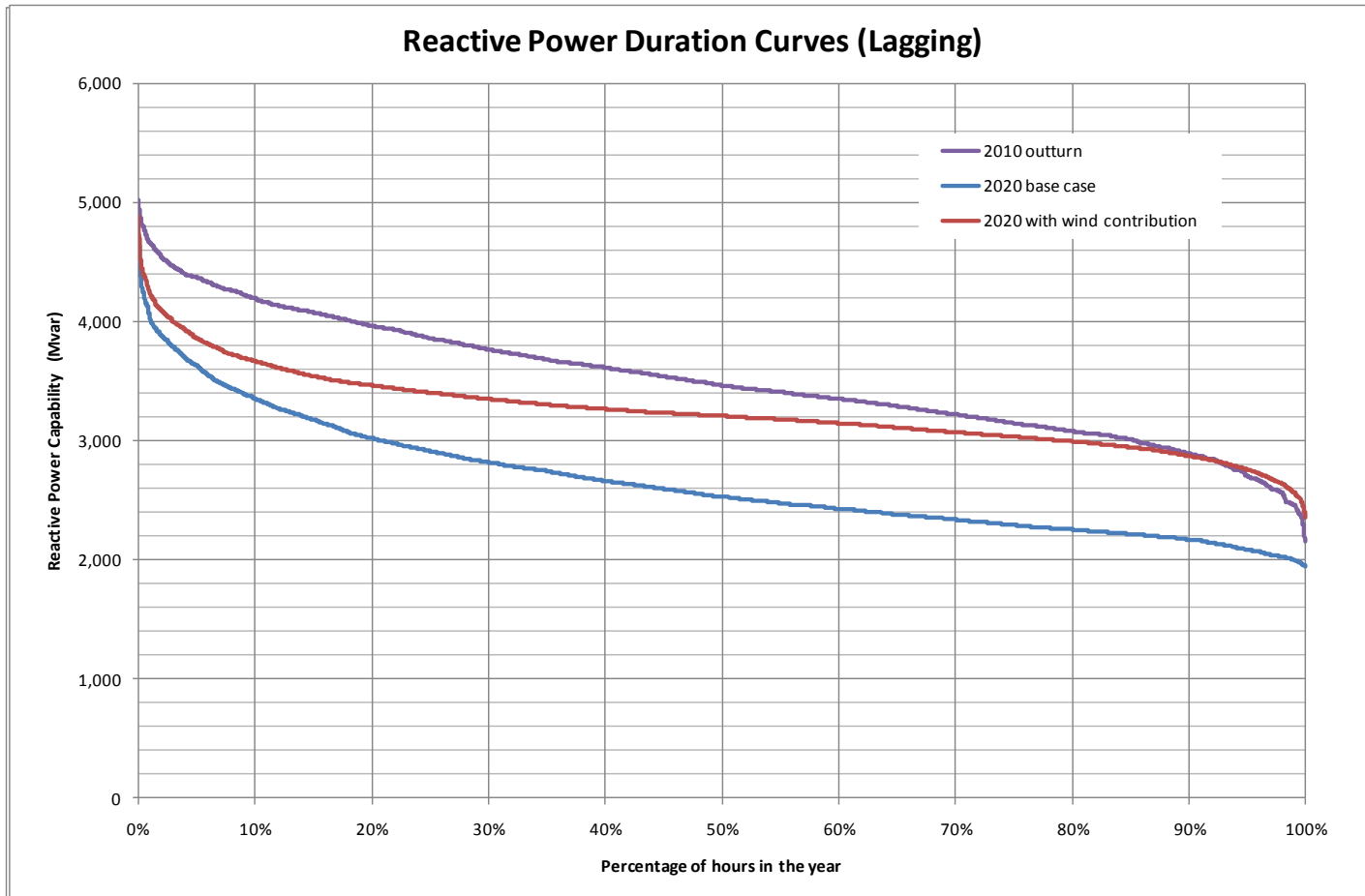
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Voltage Analysis



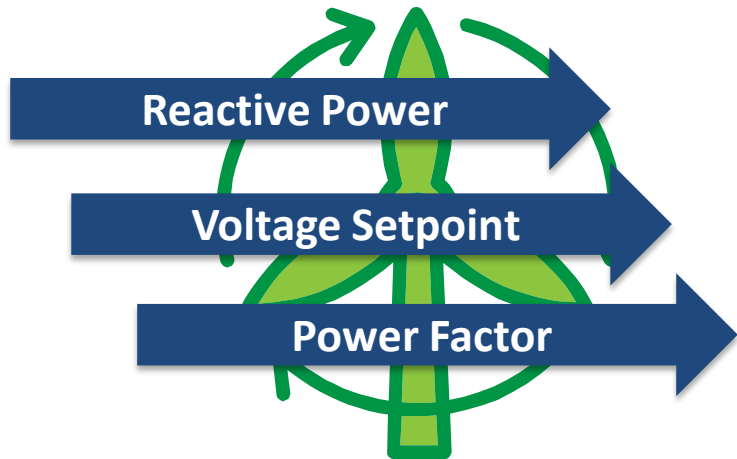
Reactive Power Availability (Sync)



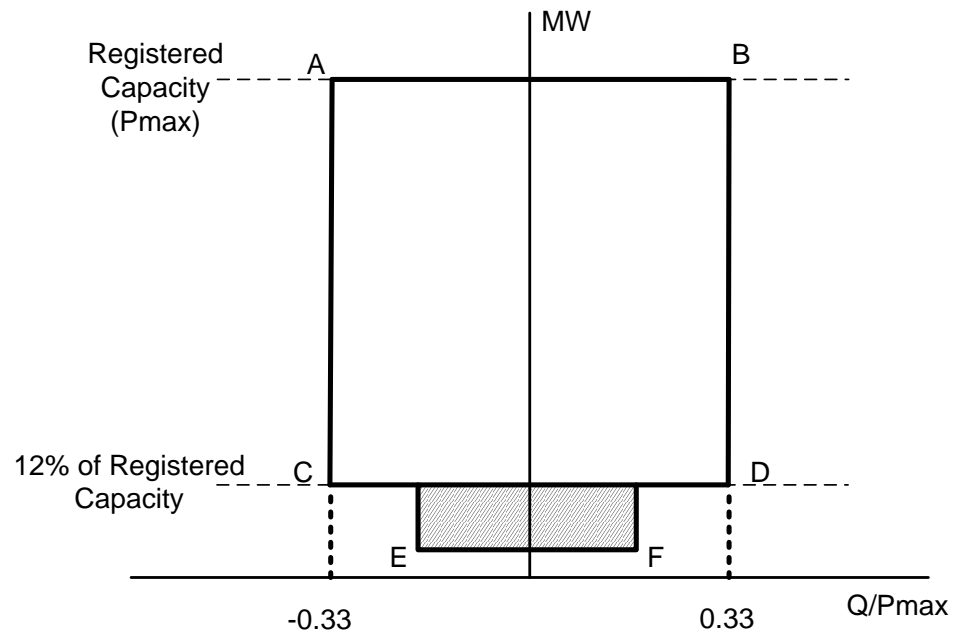
Grid / Distribution Code Mods



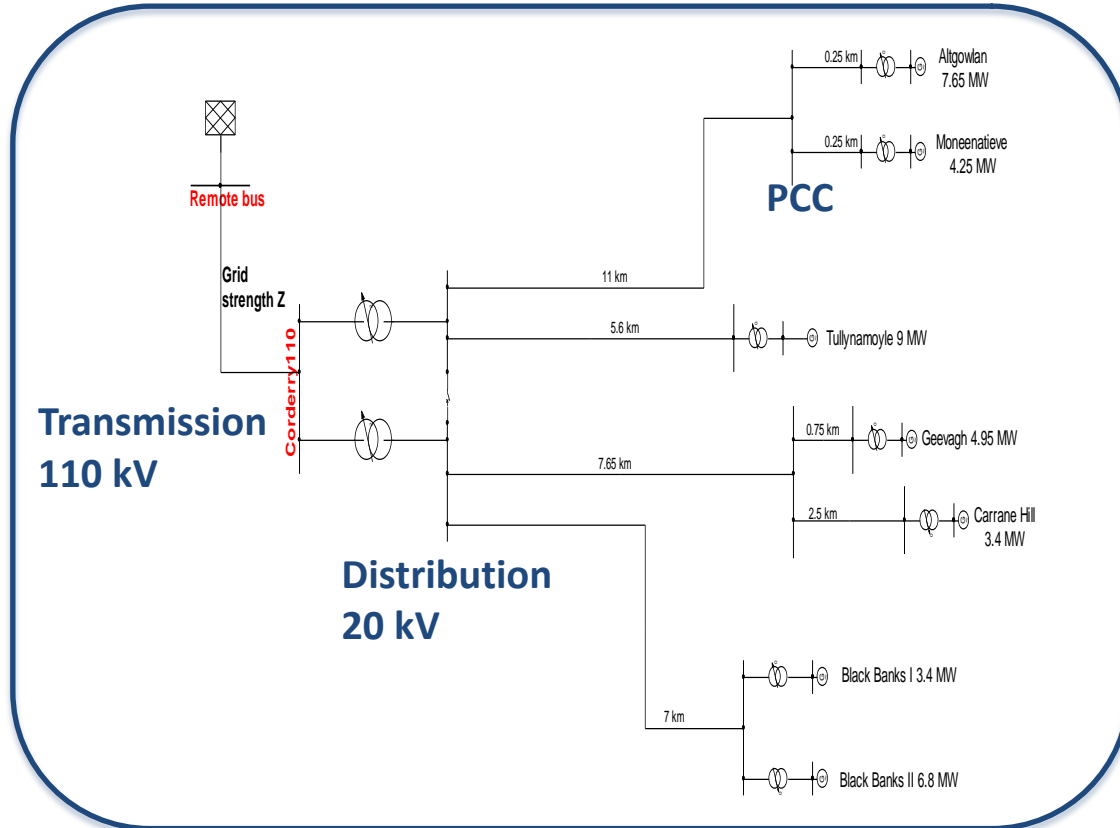
Control Modes



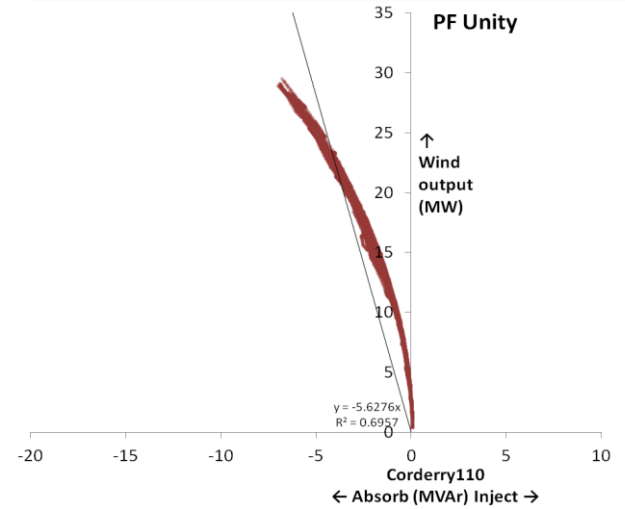
Capability



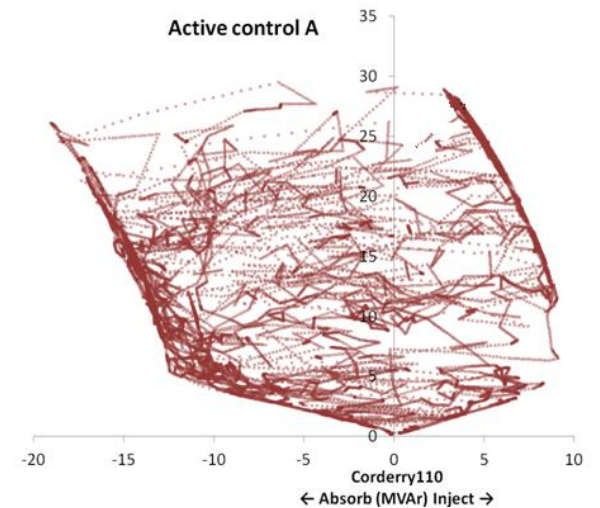
Cluster Analysis



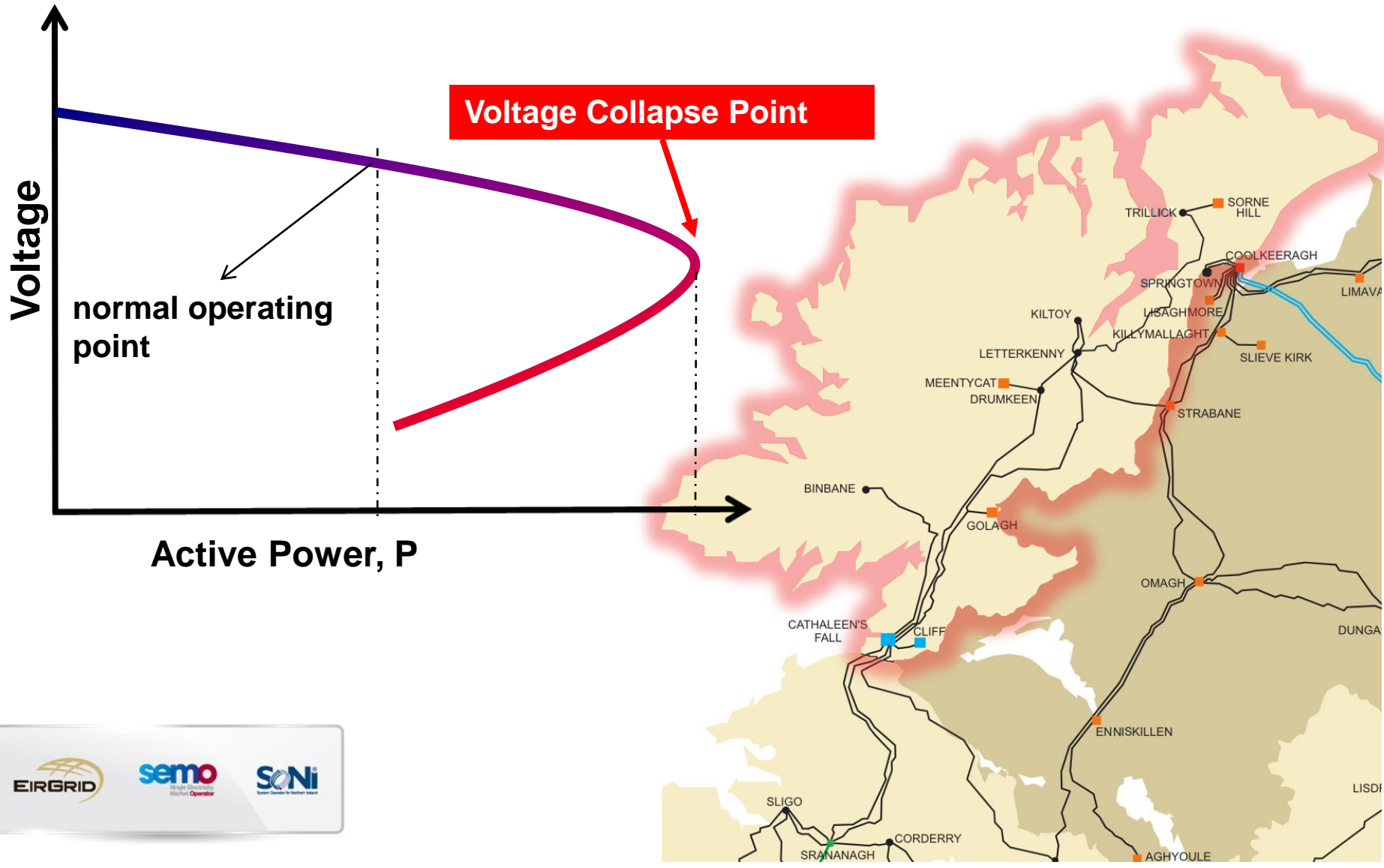
Fixed Power Factor



Voltage Control

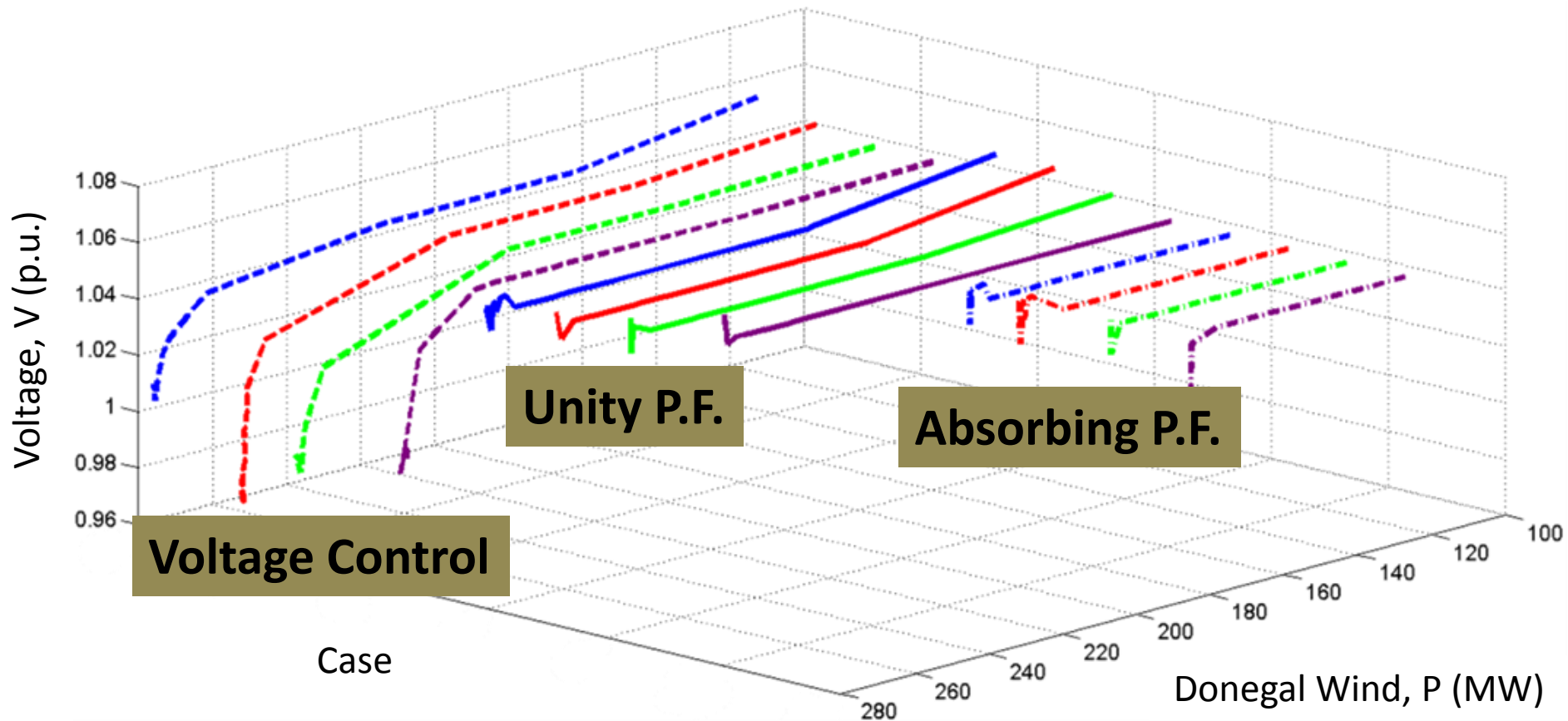


Donegal Area Analysis



Donegal Analysis Results

High Wind (111 MW) Low Demand (28MW), bus Letterkenny



- VC: 100% Capacity
- UPF: 100% Capacity
- Absorbing 0.95: 100% Capacity
- VC: 120% Capacity
- UPF: 120% Capacity
- Absorbing 0.95: 120% Capacity
- VC: 140% Capacity
- UPF: 140% Capacity
- Absorbing 0.95: 140% Capacity
- VC: 160% Capacity
- UPF: 160% Capacity
- Absorbing 0.95: 160% Capacity

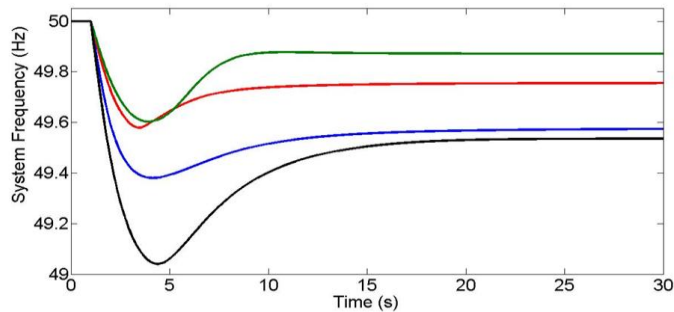
Frequency Analysis



Frequency Analysis

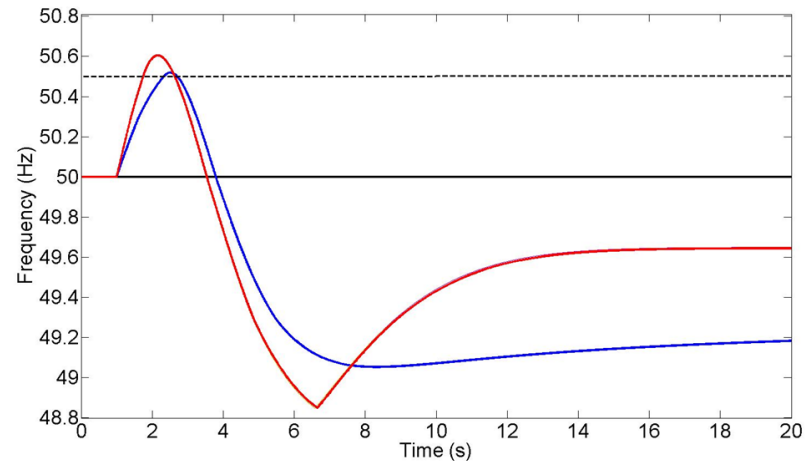
Low Frequency Analysis

System Frequency Response



High Frequency Analysis

Over Frequency Generation Shedding

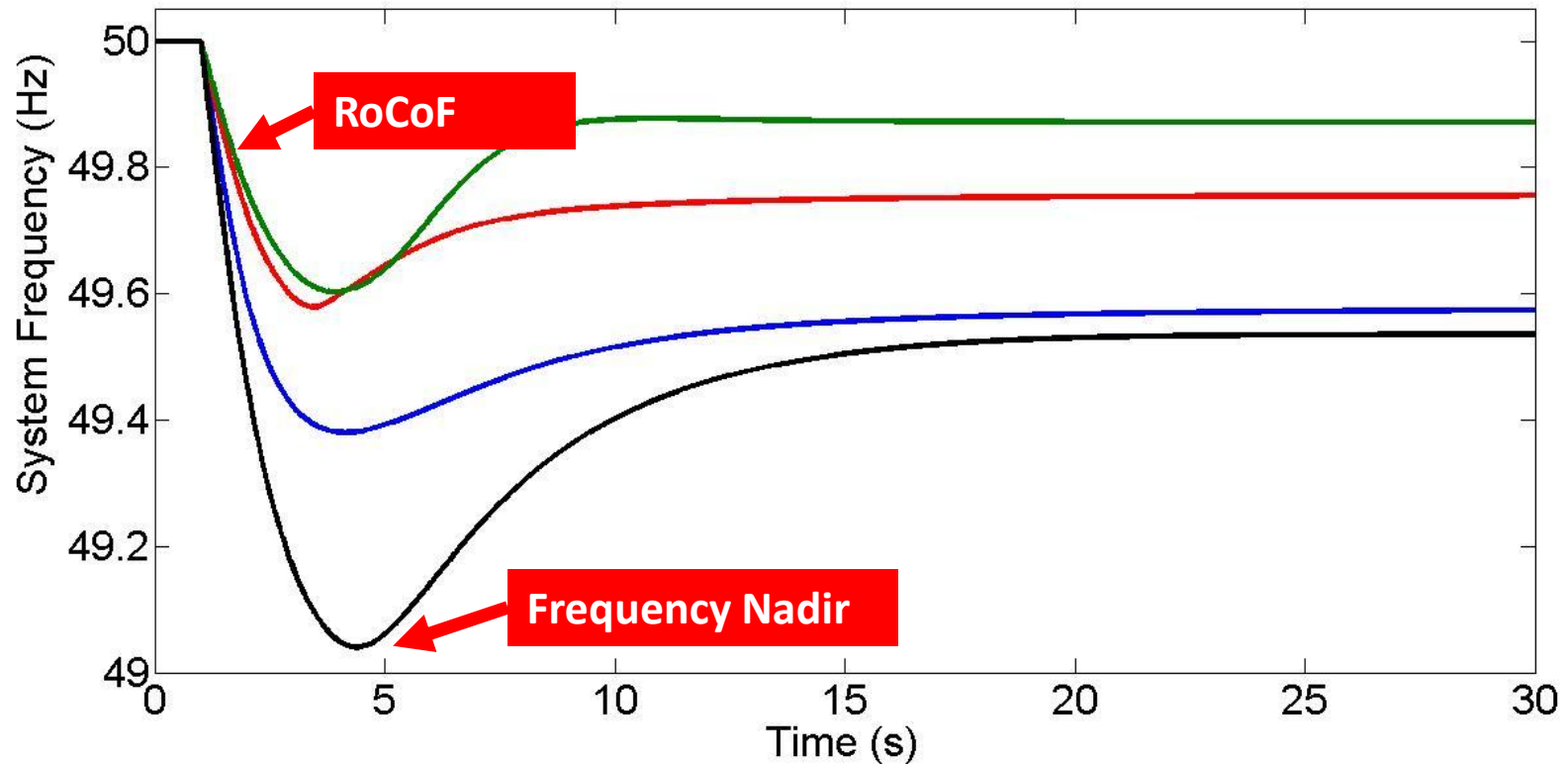


Frequency Analysis

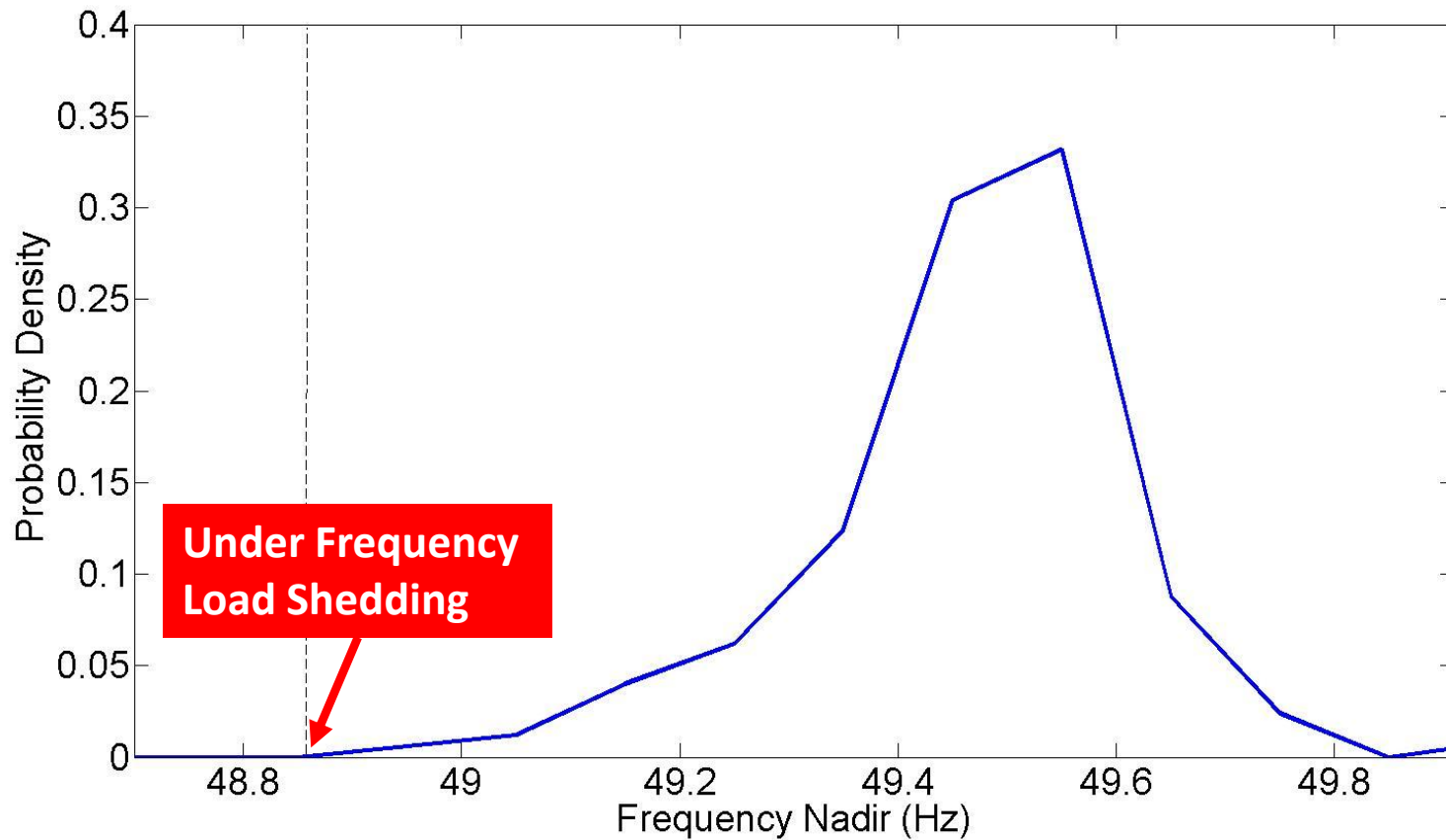
- Low Frequency



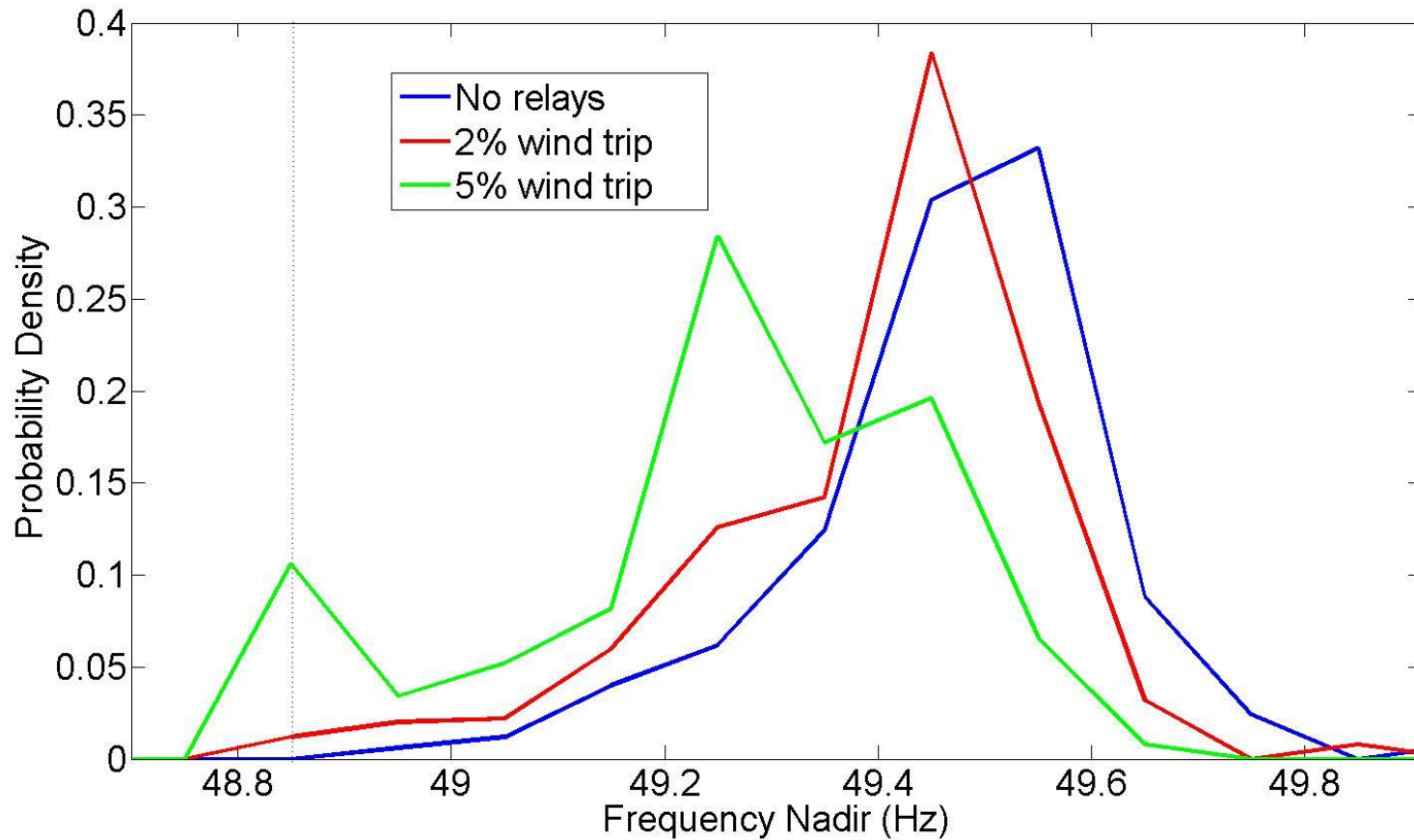
System Frequency Response



Frequency Nadir Distribution



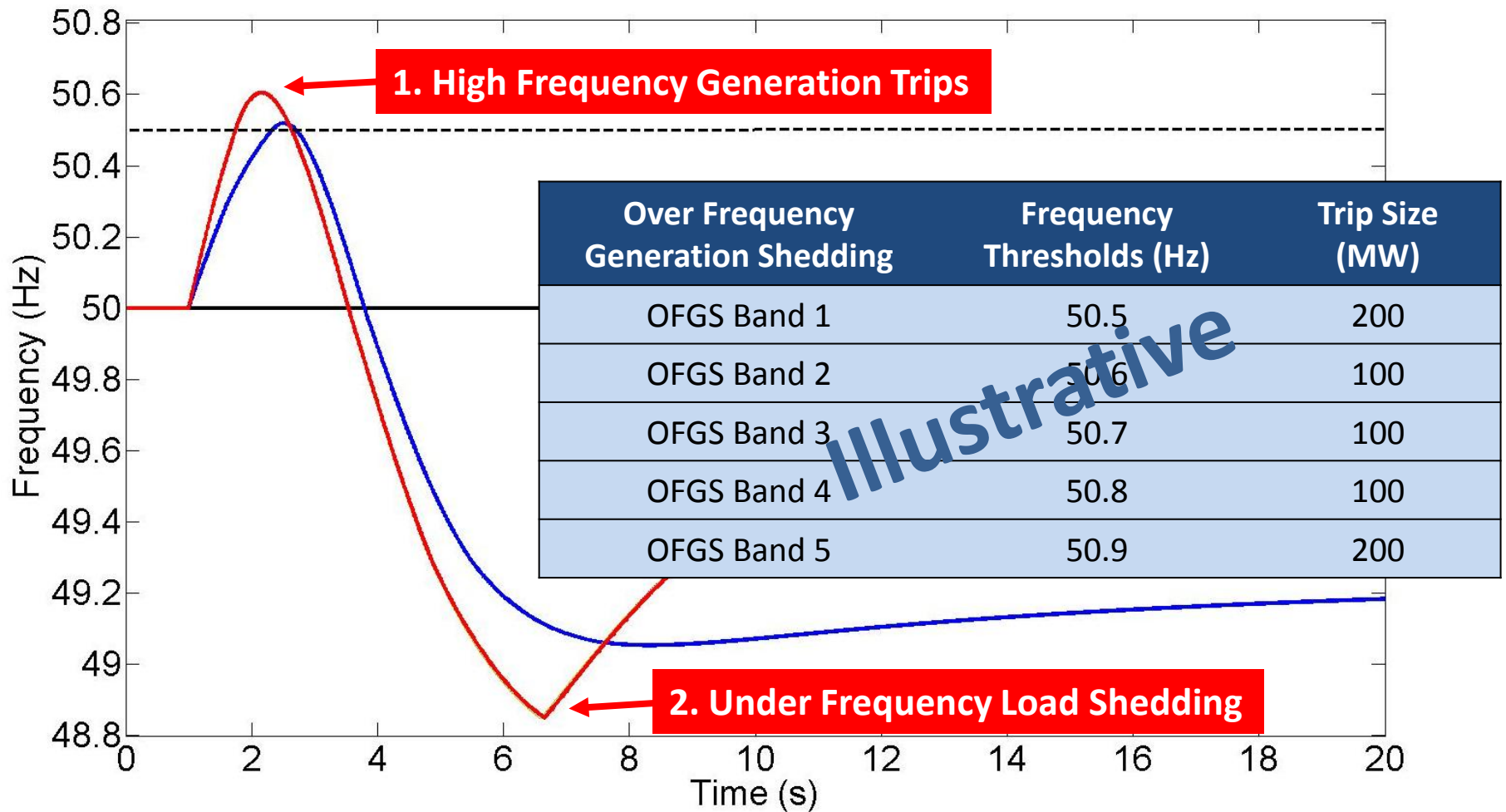
Impact of 'Secondary Tripping'



Frequency Analysis - High Frequency



Over Frequency Generation Shedding



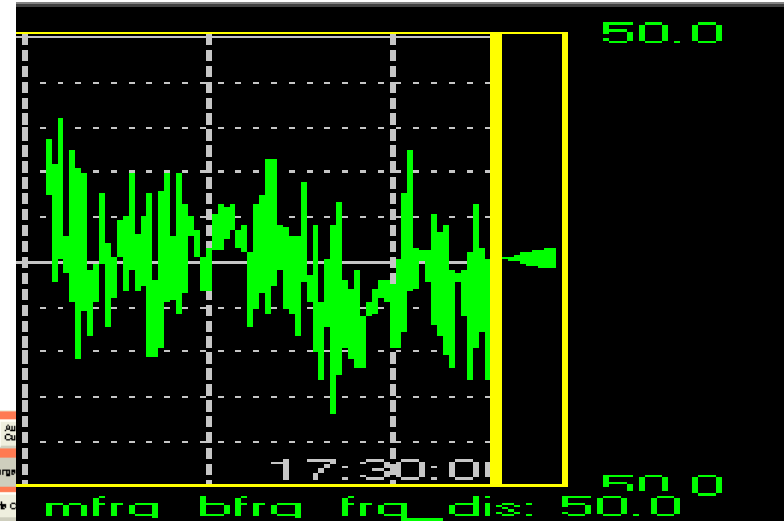


System Tools



Control Centre Tools

RESERVE MW	Req'd	Actual
SOUTH POR	242	242
SOUTH SOR	386	546
SOUTH TOR	500	625
Max Infeed		501 MW
ISLAND POR	376	374
ISLAND SOR	376	686
ISLAND		



Wind Farm MW Totals	Actual Exported MW	Available MW	Available Capacity MW	Curtilment Beipoint Target	Wind Farm Controller Beipoint Feedback
Curtilment Level 2 WF	68.2	68.2	1107.0	1086.0	1084.7
Curtilment Level 3 WF	1.4	2.6	16.0	16.0	24.1

Category 0) Wind farm cannot be controlled via Wind Dispatch Tool. See "Category 1 WVF Control" in dispatch tool user's guide.
 Target MW for a group must be within +200MW of the group's actual MW. Value is outside this range will not be group total. For details see Wind Dispatch User's Guide.



Wind Farm Name	Region	Windfarm Level	PLC Status	RC Enabled	MW Beipoint MCC Control	Available Capacity	Available MW	Actual MW	Last Beipoint Issued	Wind Farm Beipoint Feedback	Last Beipoint Issued at Wind Farm	Curtil Lvl 2 Enabled	Curtil Beipoint MW	Curtilled (%)	Curtil Lvl 3 Enabled	Curtil Beipoint MW	Curtilled (%)	Can clear Beipoint
ALTAOWL9_PLC1	NORTH	LEVEL 2	MAN	OK	OFF	0.0	0.0	0.0	0.0	0.0	OK	<input checked="" type="checkbox"/>	0.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BALWOOLO_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	14.0	0.9	0.9	14.0	14.0	OK	<input checked="" type="checkbox"/>	14.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BALYBAKE_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	22.0	0.9	0.9	22.0	22.0	OK	<input checked="" type="checkbox"/>	22.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BALYCADN_PLC1	BTH EAST	LEVEL 3	MAN	OK	OFF	16.0	2.6	1.4	16.0	24.1	OK	<input type="checkbox"/>		100.0	<input checked="" type="checkbox"/>	16.0	0.0	<input type="checkbox"/>
BALYMRK_PLC1	BTH EAST	LEVEL 2	MAN	OK	OFF	8.0	1.7	1.7	8.0	8.0	OK	<input checked="" type="checkbox"/>	8.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BAWMOORE_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	24.0	1.8	1.6	24.0	24.1	OK	<input checked="" type="checkbox"/>	24.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BEAMHILL_PLC1	NORTH	LEVEL 2	MAN	OK	OFF	14.0	1.7	1.8	14.0	14.0	OK	<input checked="" type="checkbox"/>	14.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BHDOO_PLC1	NORTH	LEVEL 2	MAN	OK	OFF	42.0	1.2	1.9	42.0	42.9	OK	<input checked="" type="checkbox"/>	42.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BLKBAKBL_PLC2	NORTH	LEVEL 2	MAN	OK	OFF	7.0	0.7	0.7	7.0	7.0	OK	<input checked="" type="checkbox"/>	7.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
BOODERAH_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	67.0	1.4	1.7	67.0	68.9	OK	<input checked="" type="checkbox"/>	67.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
CAHROWAY_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	10.0	0.2	0.2	10.0	10.0	OK	<input checked="" type="checkbox"/>	10.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
CARDWELL_PLC1	NORTH	LEVEL 2	MAN	OK	OFF	26.0	2.2	2.0	26.0	24.9	OK	<input checked="" type="checkbox"/>	26.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
CLARABEL_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	22.0	2.2	2.2	22.0	22.4	OK	<input checked="" type="checkbox"/>	22.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
COMATLH_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	8.0	0.0	0.1	8.0	8.2	OK	<input checked="" type="checkbox"/>	8.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
COMORRY_PLC1	BTH WEST	LEVEL 2	MAN	OK	OFF	42.0	1.0	0.9	42.0	42.9	OK	<input checked="" type="checkbox"/>	42.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>
COMORRY_PLC2	BTH WEST	LEVEL 2	MAN	OK	OFF	9.0	0.4	0.4	9.0	9.0	OK	<input checked="" type="checkbox"/>	9.0	0.0	<input type="checkbox"/>		0.0	<input type="checkbox"/>

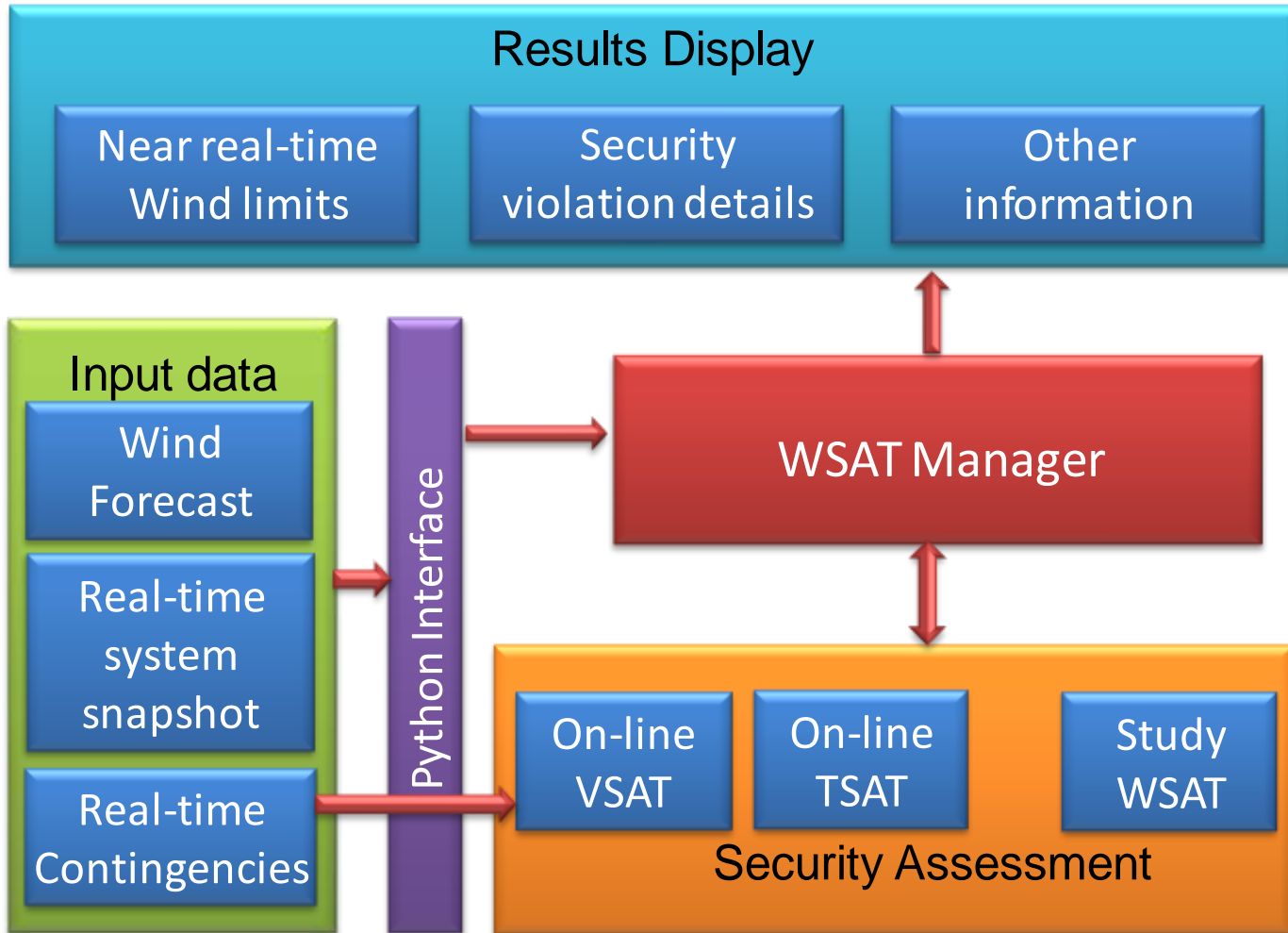


Developments to Date

- All Island WSAT Implemented
- All Island Generator Overview
- SNSP: EMS & RCUC
- EMS Inertia Monitoring
- EMS ROCOF Monitoring
- EMS Integration Specification
- Windfarm Voltage Control

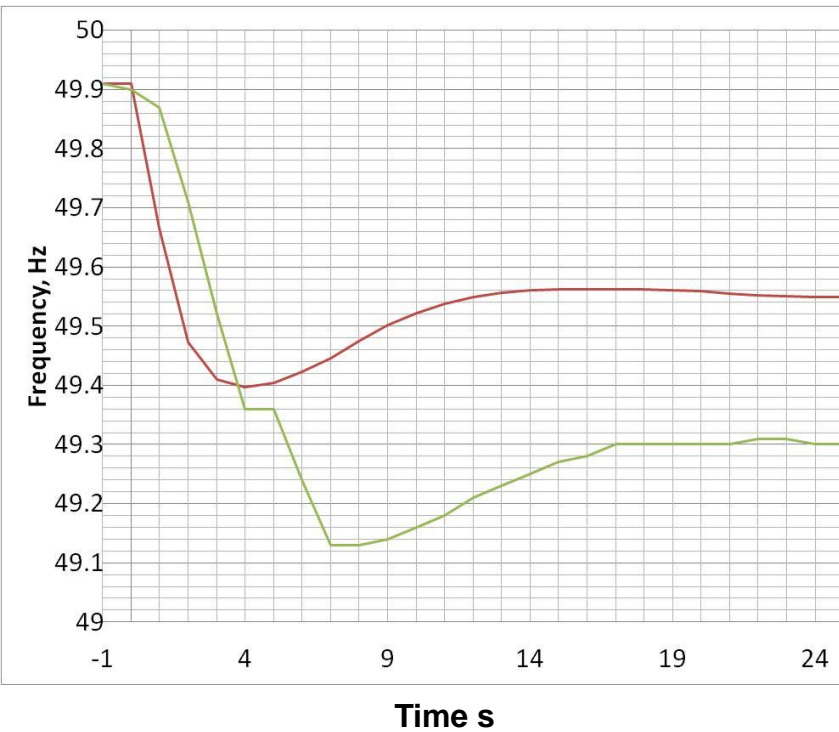


WSAT – Software Structure

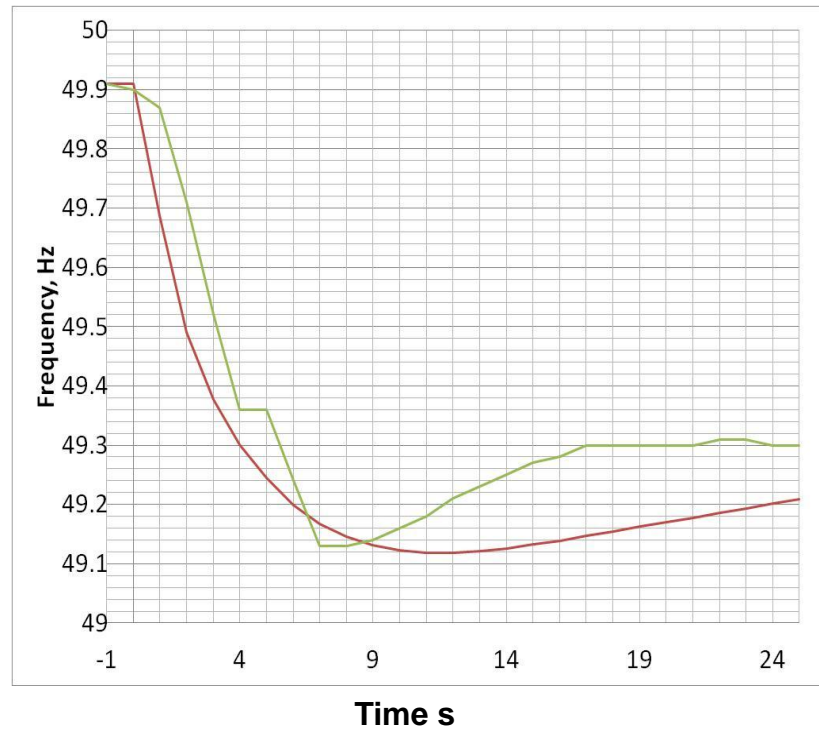


Further Work with WSAT

Unvalidated



Validated



Some Likely Tools and Policies?

- Frequency Control
 - Frequency Regulation
 - Ramping
 - Reserve from wind
 - ROCOF/Inertia/SNSP Policies
- Voltage Control
 - TSO/DSO Voltage Control Interaction
 - Voltage Trajectory Studies
 - Security Constrained OPF?
- System Services
 - Schedule & Monitor



Others Tools?

- Real Time use of Phasor Monitoring
 - Improve State Estimation
 - Predict source of problems
 - Oscillation Defence & Disturbance Management
 - Monitoring during WSAT cycle time
- Intelligent Alarm Processing
 - Help find root cause of disturbance
- Probabilistic tools?
- Smart Grids e.g. Glen Dimplex Demand Side





Annual Renewable Report 2013 and 2030 Energy Policy Framework

8th April 2014
Frank Groome



Progress towards the 2020 All Island Targets

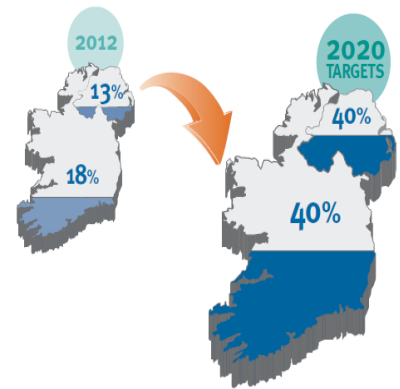
❑ Total Wind : c. (16.5% IE) / (14.8% NI)

❑ Total RES: c.19%

❑ Installed Wind: 2395 MW

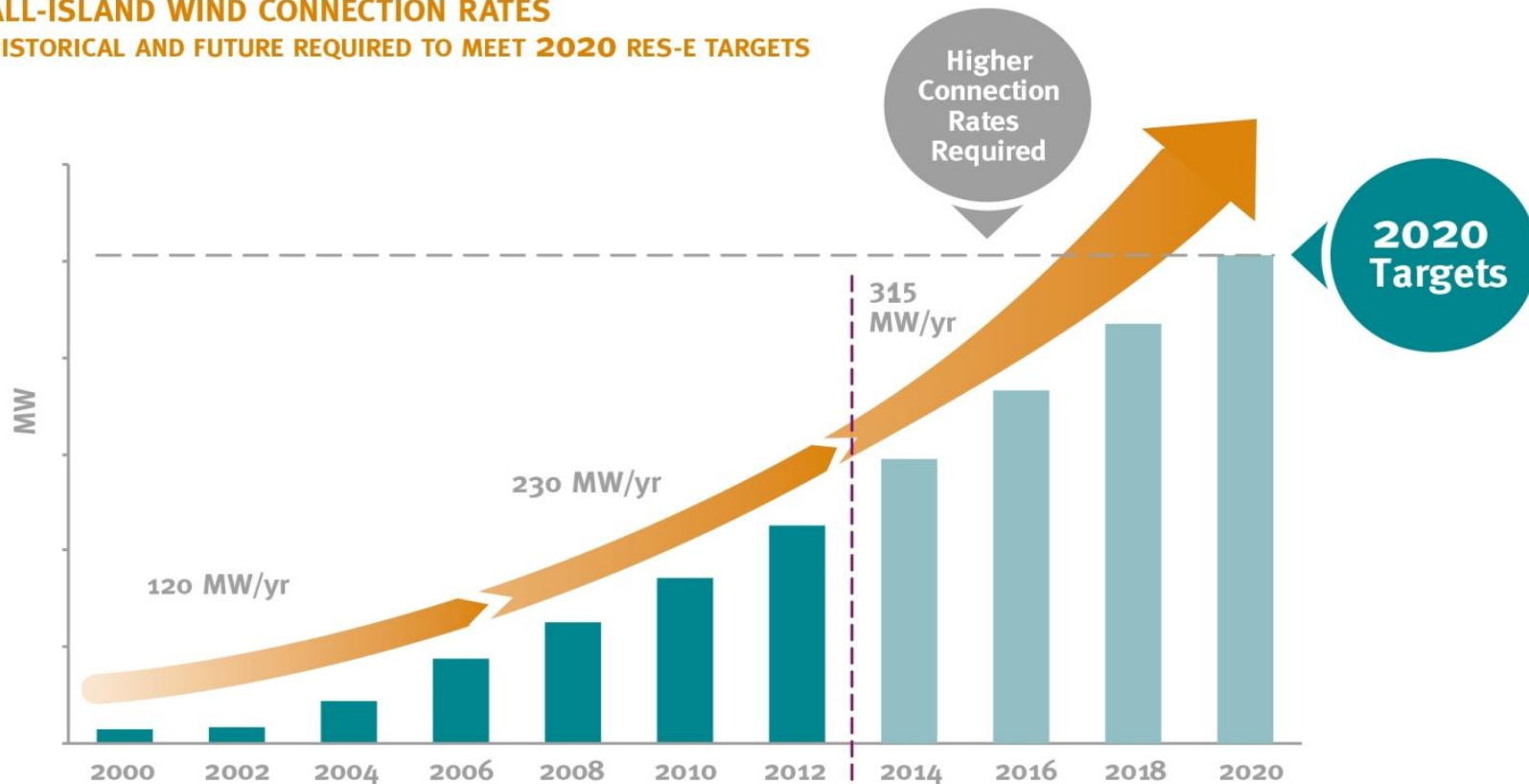
❑ Installed RES: 2750 MW

❑ 2013 Maximum Wind Output: 2274 MW



All-Island connection rates need to Increase

ALL-ISLAND WIND CONNECTION RATES
HISTORICAL AND FUTURE REQUIRED TO MEET **2020 RES-E TARGETS**



EU 2030 Energy Policy Developments An Overview



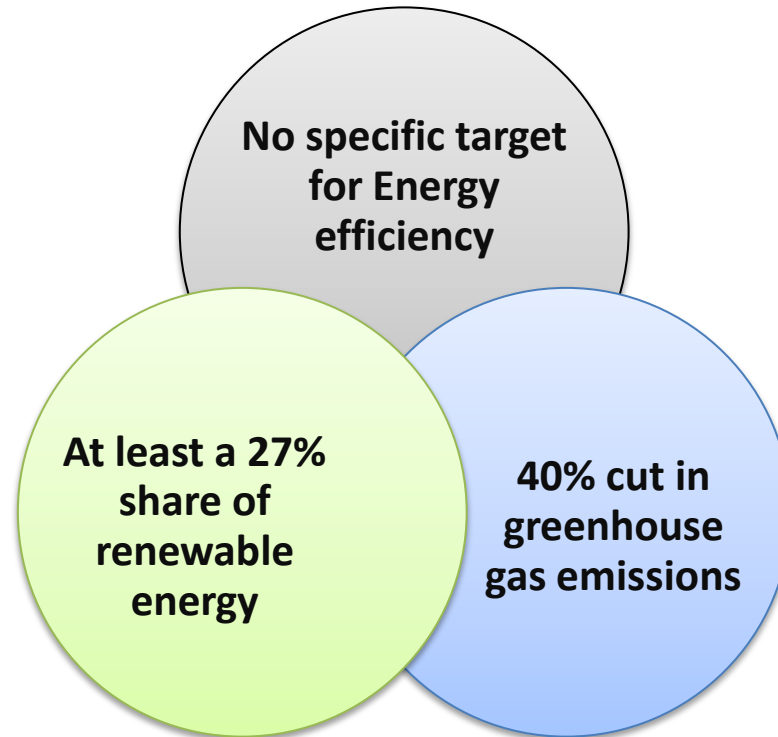
EU 2030 Energy Policy Framework

- **Why?**



- 65 GW of existing plant to retire by 2030
- EU oil and gas dependency >90% oil and 80% gas by 2030, €400 billion (energy diversification)
- Costs of a low carbon transition equivalent to costs incurred from upgrading aging energy system in any event.
- Investments in the transition to sustainable energy needed to protect the climate.
- Risk that a European approach to decarbonisation, particularly of electricity systems, will be weakened by isolated initiatives by Member States
- 2020 Achieved (except Energy Efficiency)

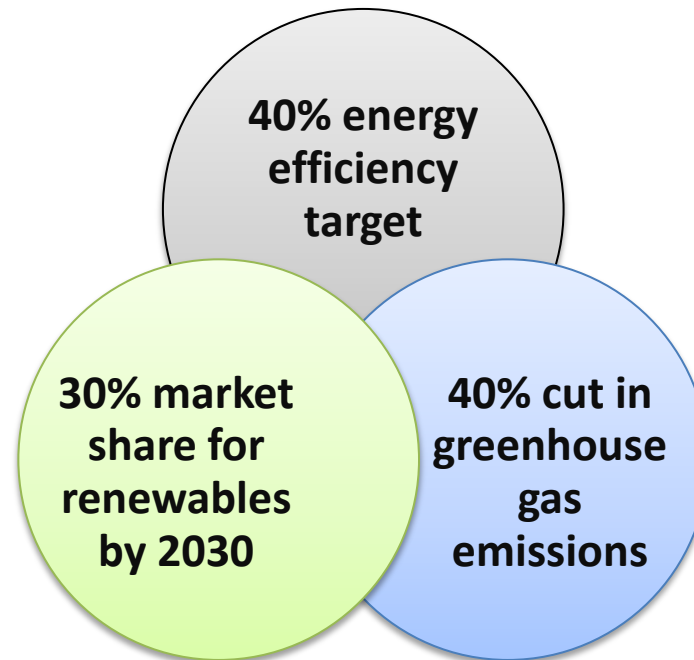
2030 Commission Proposals



- New EU governance structure (based on MS plans for a secure, competitive energy future)
- Reform ETS (market stability reserve for adjustments)



EU Parliament Proposal



□ EU Parliament has voted for three binding energy and climate targets in 2030:



European Council – March Conclusions



**March 2014
Conclusions**

**Energy Security
Assessment
June 2014**

**IC Assessment
June 2014**

**Convergence
of Support
Measures for
RES July 2013**

**2030 Policy
Framework
October
2014**



International factors shaping future decisions



- ***The Road to Paris - IPCC***

- Global warming were already being felt “on all continents and across the oceans”.
- Emissions 60% higher than when the first IPCC report was produced in 1990.

- ***Energy Security***

- Geopolitical risks
- EU Commission SoS report
- Towards energy independence* - EU-US Summit
- Energy diversification (shale gas and RES)



Impact of Proposals



- **No impact** on the current 2020 targets.
- Likely electricity sector will need to increase share of RES.
- MS options to 2030:
 - Increase in RES-E?
 - Increase RES-T and RES-H?
 - Agricultural and Transport sector emissions will need to reduce



Questions & Answers



