Introduction

14th January 2015

Andrew Cooke

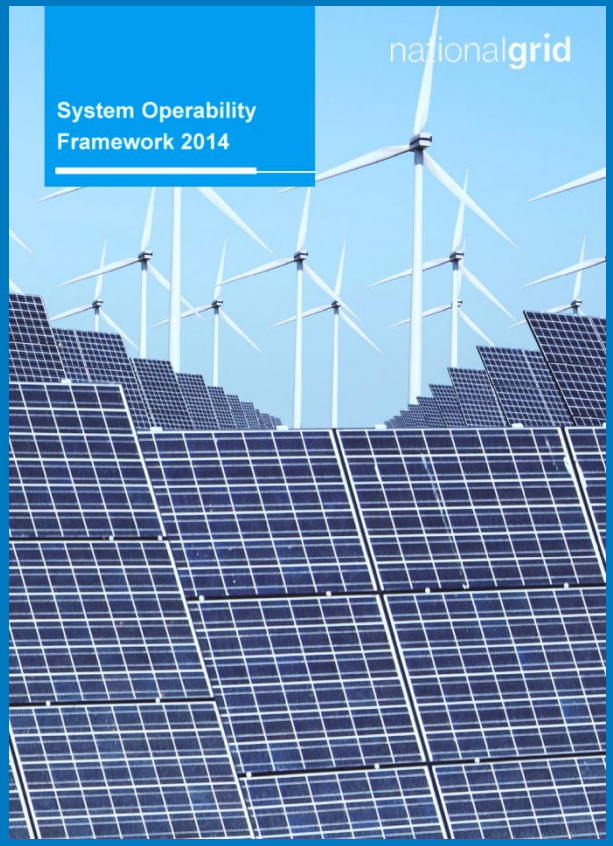
Agenda

	Time	Speaker
Introduction	10.30	Andrew Cooke (5 mins)
Industry Perspective	10:35	Presentation: Vandad Hamidi (NG UK) (15 mins) Presentation: Paddy Finn (Electricity Exchange) (15 mins)
Actions from last meeting & DS3 Programme Update	11:05	Presentation: Robbie Aherne (35 mins)
Rate of Change of Frequency (RoCoF)	11:40	Presentation: Eoin Kennedy (10 mins) Presentation: DSOs (10 mins) Discussion: All (10 mins)
System Services	12.10	Presentation: RAs (20 mins) Presentation: Sam Matthews (10 mins) Discussion: All (30 mins)
Lunch & Networking (13:10 – 13:45)		
High SNSP Report H1 2014	13:45	Presentation: Séamus Power (10 mins) Discussion: All (10 mins)
High Wind Speed Shutdown Report 2013	14:05	Presentation: Séamus Power (10 mins) Discussion: All (10 mins)
Recent Operational Experience	14:25	Presentation: Tom McCartan (10 mins) Discussion: All (10 mins)
Closing Remarks and Actions	14:45	Andrew Cooke (15 mins)
Session Closed / Networking	15.00	

Industry Perspective

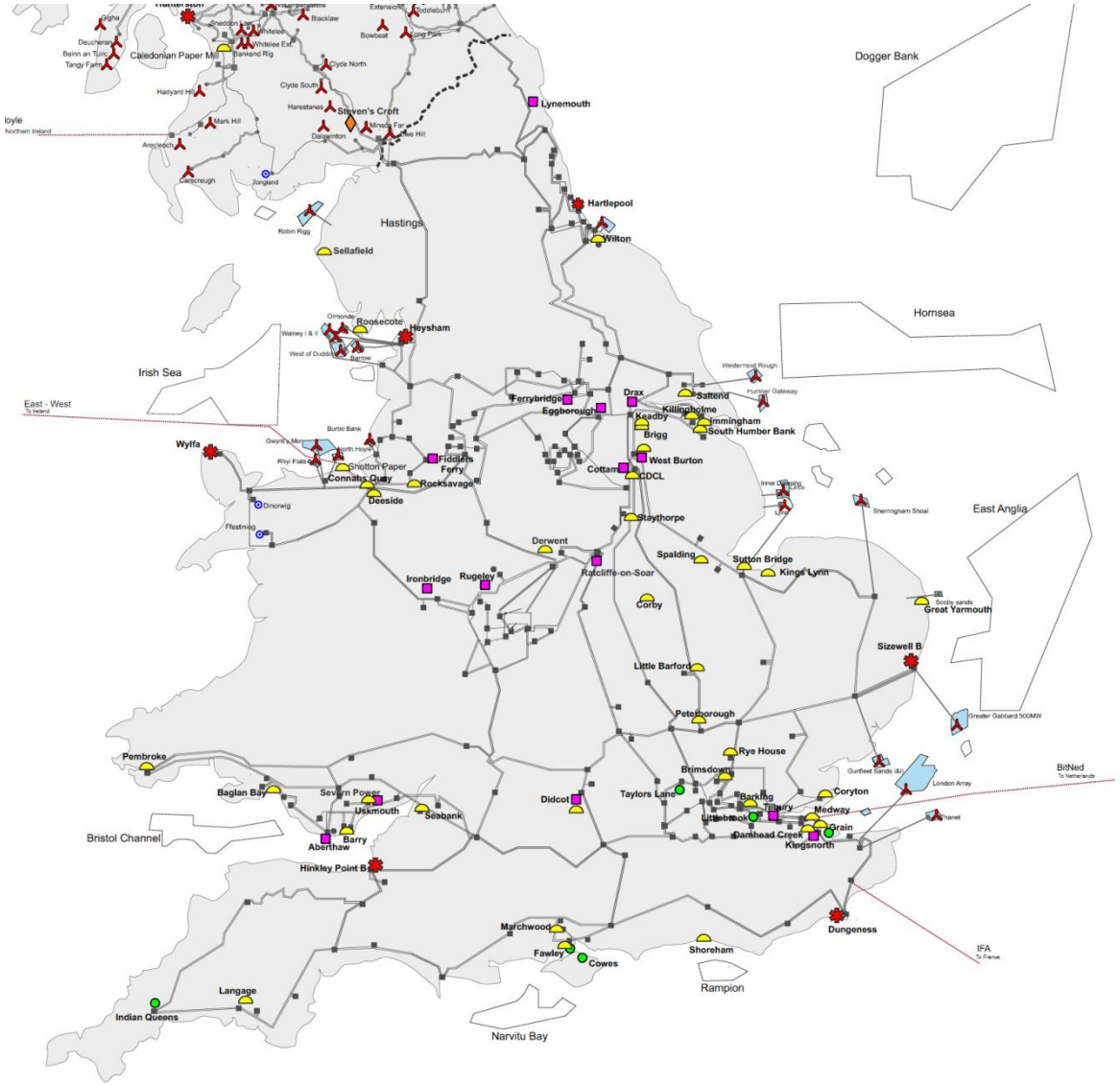
14th January 2015

System Operability Framework (SOF) 2014



Vandad Hamidi
Transmission Network Services

GB Power System



What's happening in GB?

Islanded AC Power System

Changes in the Energy Landscape

Generation

- Increase in non-synchronous generation
- Closure of conventional plants

Demand Side

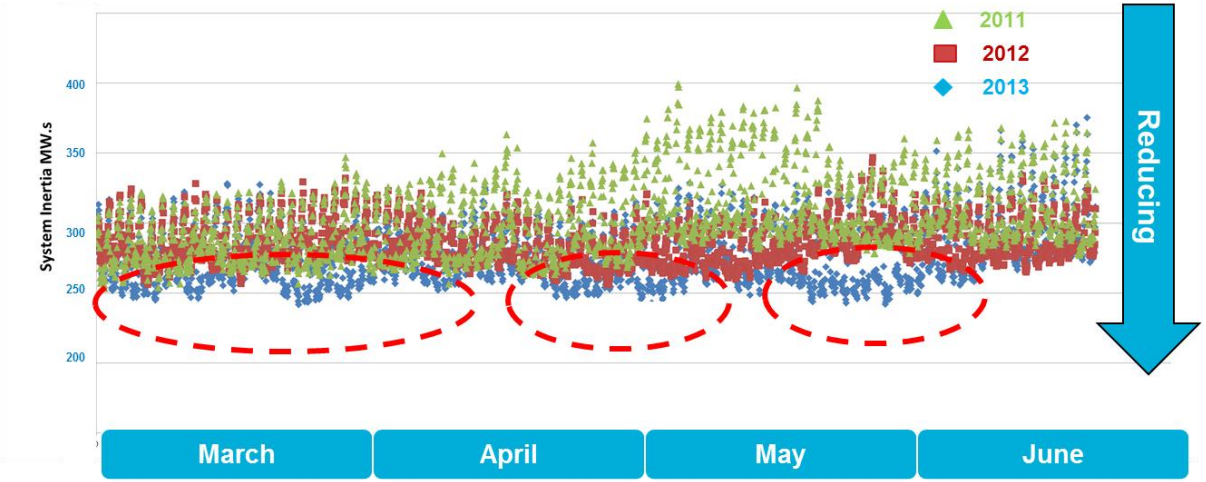
- Increase in Embedded non-synchronous generation
- Change in Demand type (LED lights – Heat Pump)

Network

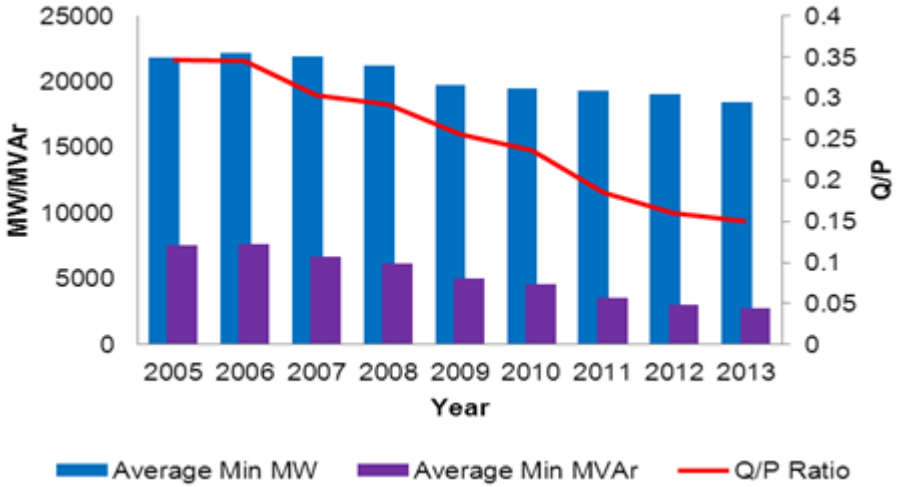
- First Embedded HVDC Link (parallel to AC)
- Thyristor Controlled Series Compensation (TCSC)

And the Impact?

System Inertia



MVAr Demand



System Operability Framework (SOF)

nationalgrid

Future Energy Scenarios

Change in Energy Landscape

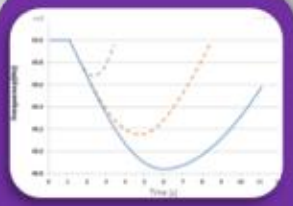
- Generation mix
- Interconnection
- Demand side services

Performance Requirements

Economic, Efficient and Operable System

- Large infeeds (>1800MW)
- System stability
  - Frequency
  - Voltage
  - Rotor angles
- Constraint minimisation
- Market facilitation

Operational Challenges



Reduction in System Strength

- System inertia
  - RoCoF
  - Primary response
  - System stability
- Short circuit level
  - Power quality
  - Protection
  - HVDC commutation
  - System stability

Operation Solutions & Opportunities

SMART Grid Development

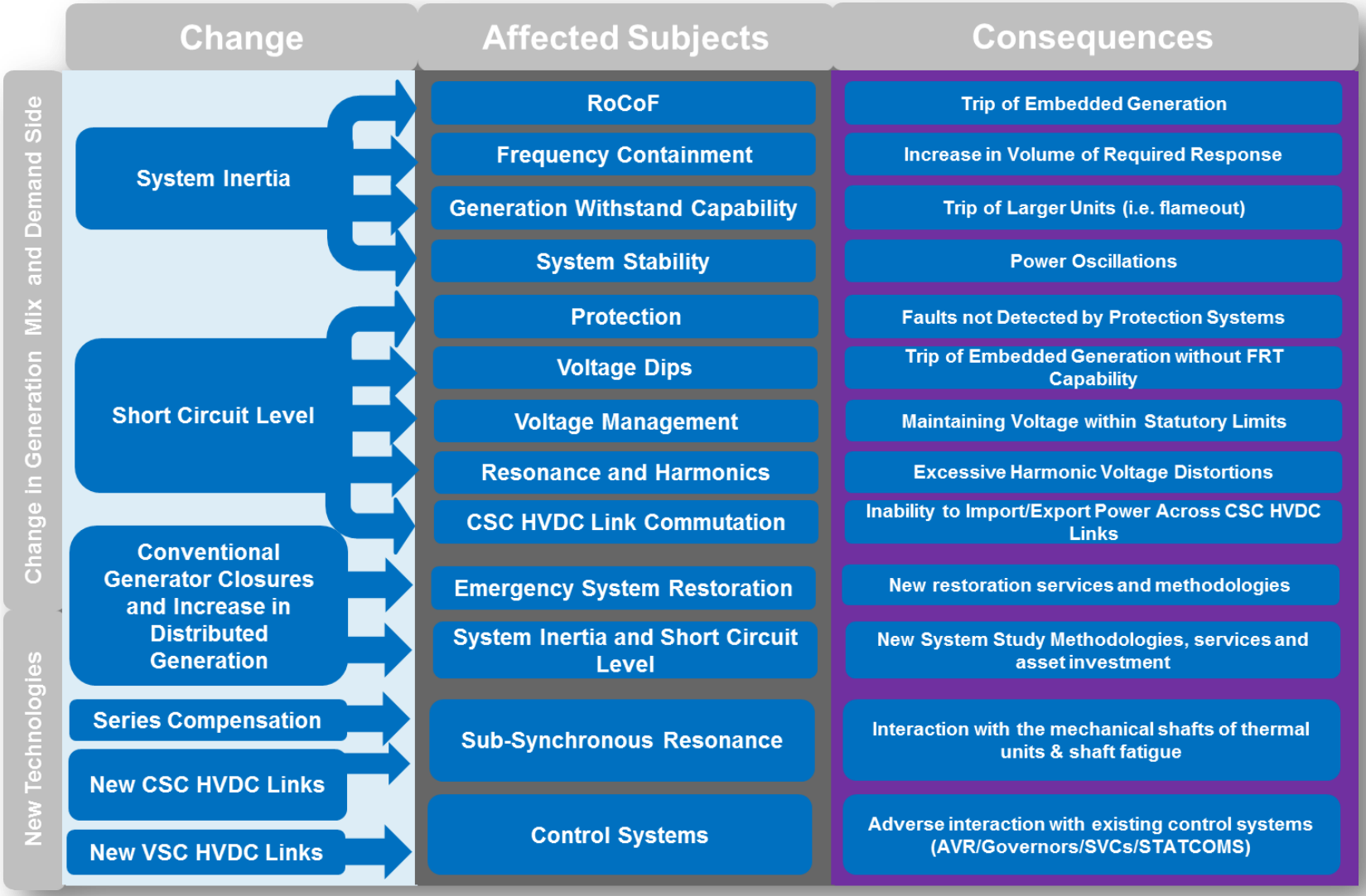
- Rapid response
- Demand side response
- Low load operation of thermal plants
- Dynamic thermal ratings
- System wide controller
- Parallel HVDC links

Electricity Ten Year Statement

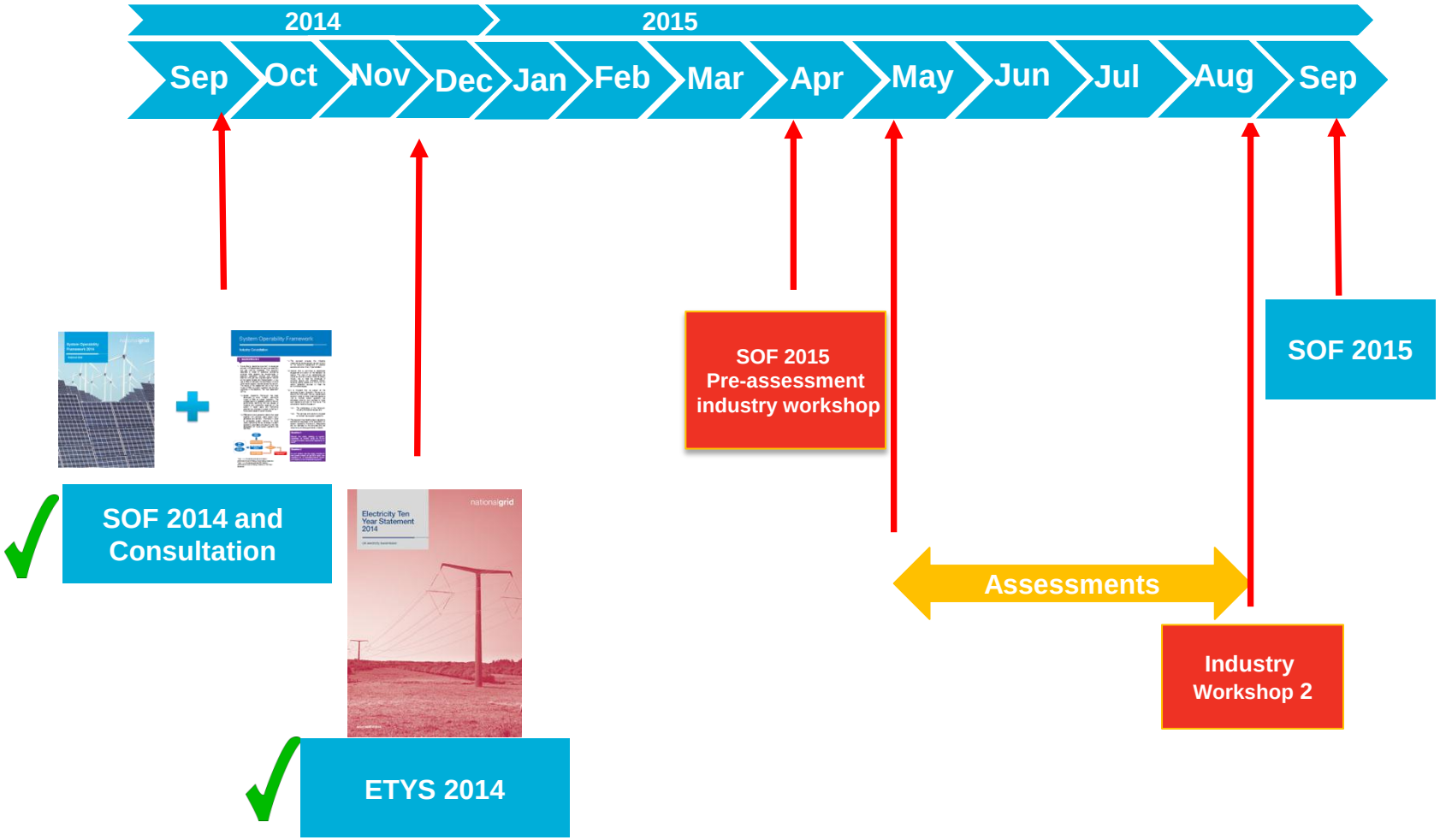
System Operation Chapter of ETYS

- Variations in each topic
- Opportunities for stakeholders to provide new services
- Stakeholder feedback

SOF 2014 Topics



Timeline for Development of SOF 2015 (High Level)

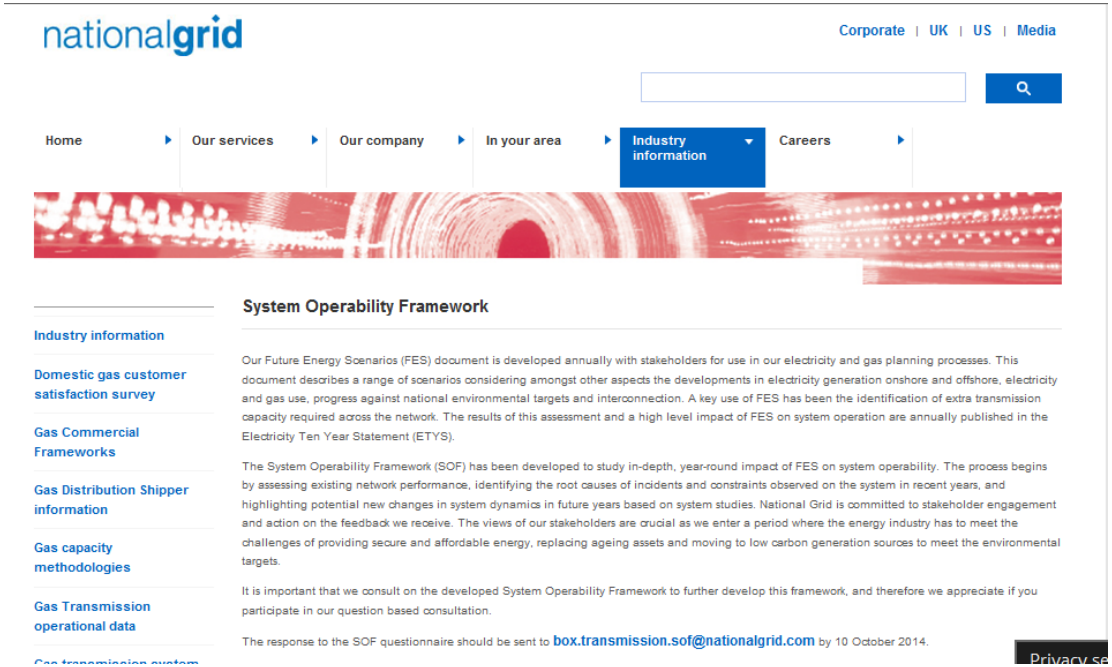


System Operability Framework

Thank you for your attention

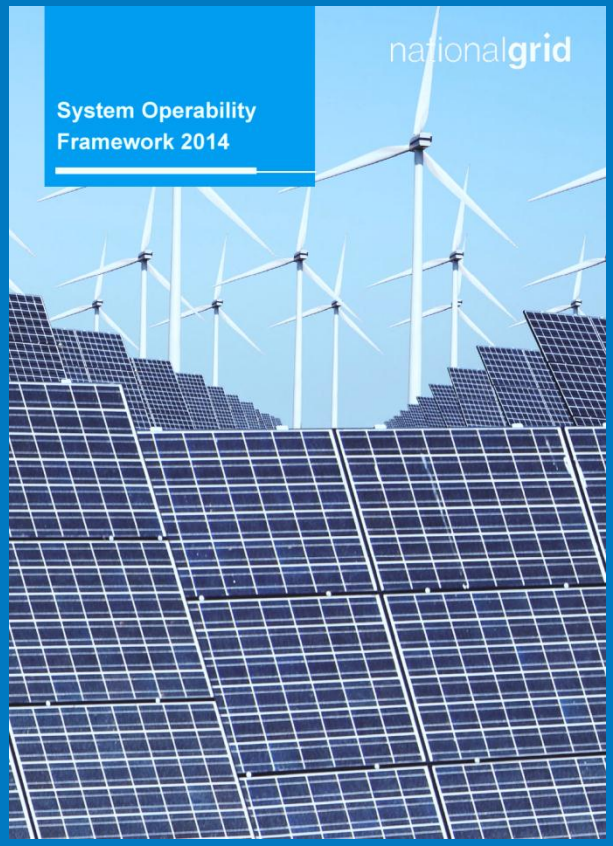
For more information please email:

box.transmission.SOF@nationalgrid.com



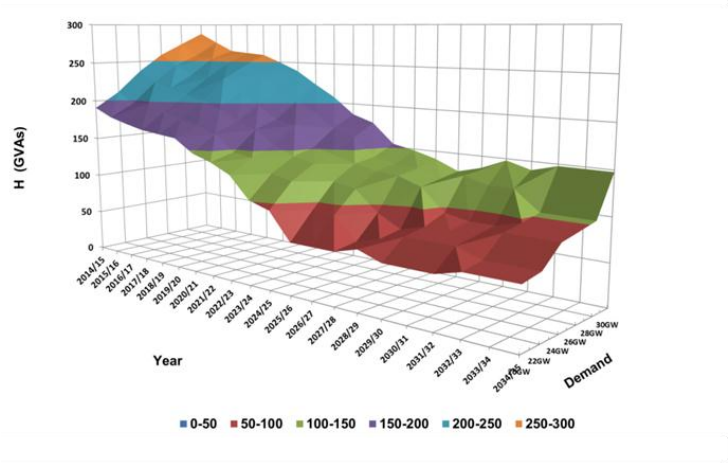
http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/System-Operability-Framework/

Appendix

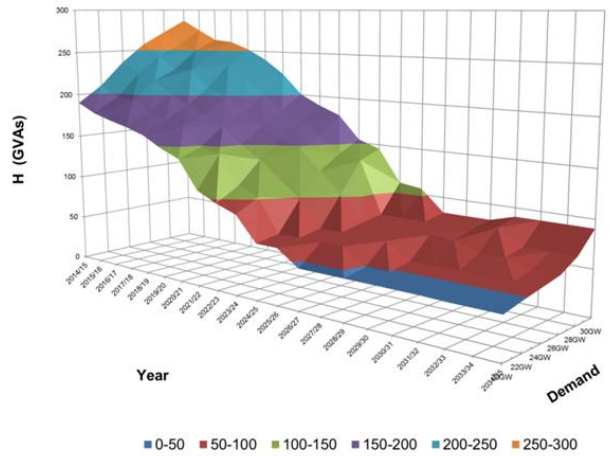


Example - System Inertia

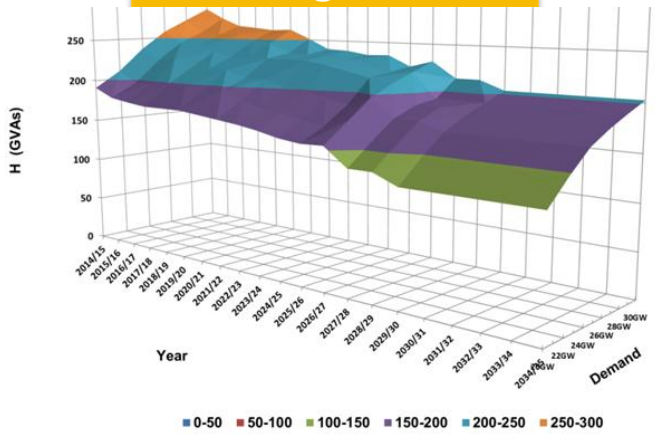
Low Carbon



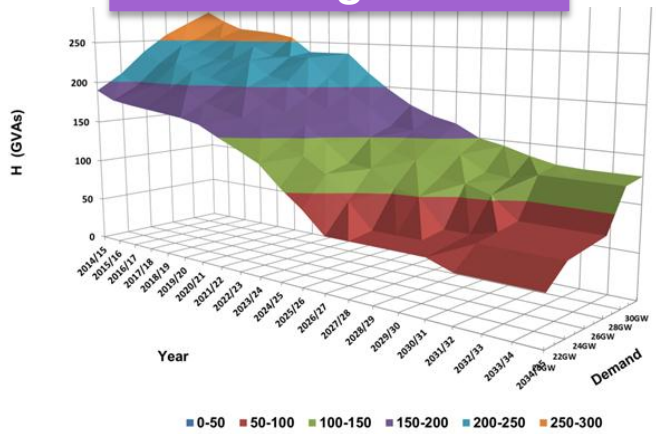
Gone Green



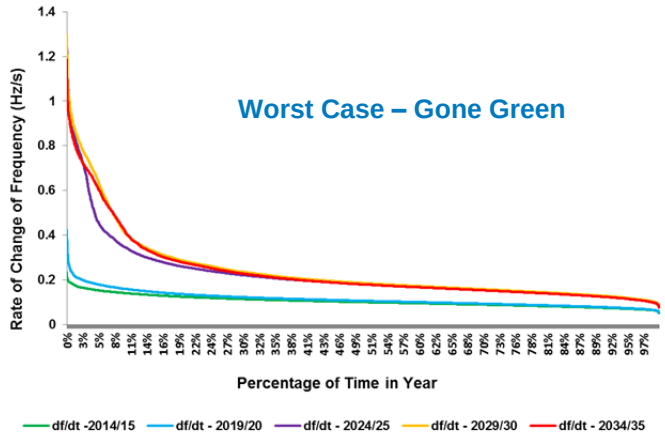
No Progression

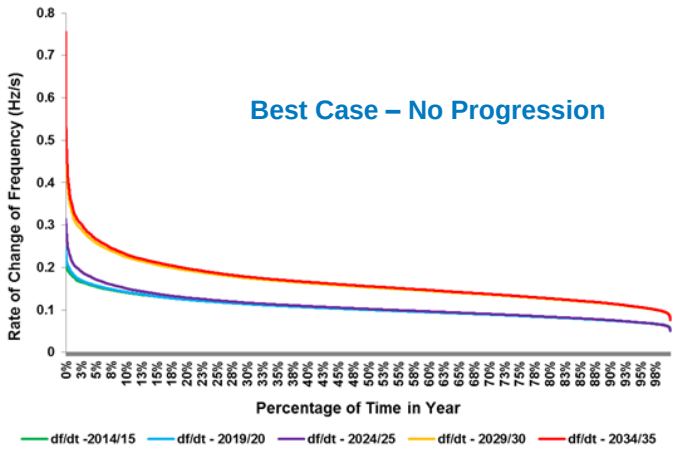


Slow Progression



System Inertia – Rate of Change of Frequency





Key Messages

df/dt>0.125Hz	2014/15	2024/25	2034/35
Gone Green	19%	92%	90%
Slow Progression	19%	38%	96%
Low Carbon Life	19%	88%	93%
No Progression	19%	23%	82%

df/dt>0.5Hz	2014/15	2024/25	2034/35
Gone Green	0%	5%	8%
Slow Progression	0%	1%	8%
Low Carbon Life	0%	2%	3%
No Progression	0%	0%	1%

df/dt > 1Hz/s less than 1% of time in all scenarios

Example - System Inertia & Frequency Containment (1)

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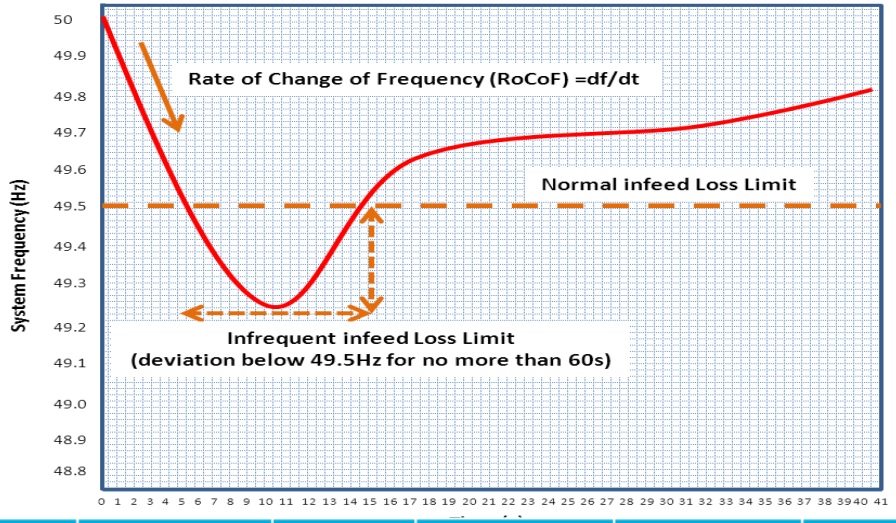
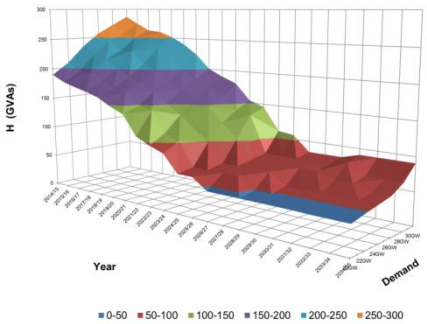


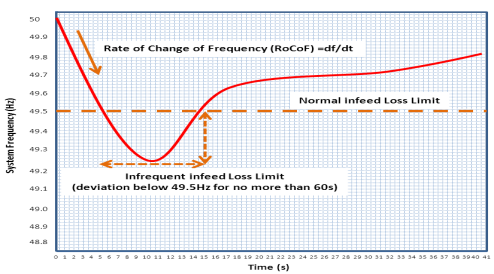
RoCoF (Hz/s)	Slow Progression	Gone Green	Inertia GW.s	Action Time (to reach 49.2 Hz)	Response Rate (MW/s)
0.125**	2013/14	2013/14	360	9	185
0.2	2019/20	2018/19	225	4	400
0.22	2022/23	2019/20	205	3.4	489
0.25	2023/24	2020/21	180	2.4	679
0.3	2024/25	2021/22	150	1.2	1148

Three times greater than current system capability

*Figures assume a 2s delay between detection/response activation time

Example - System Inertia & Frequency Containment (2)



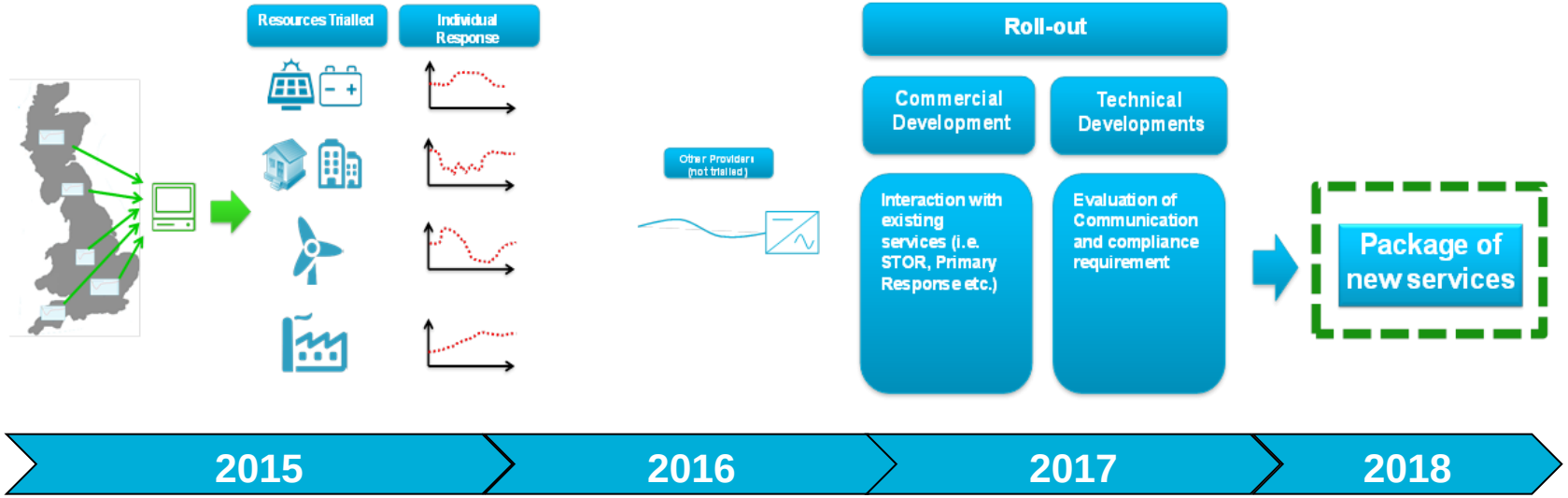


	Solution	Cost (2020 Gone Green)
Conventional Services	Constrain generators	Extra £600m
	Constrain largest infeed/outfeed	Extra £130m-£270m (depending on when the large infeeds are connected)
	Carry larger volumes of response	Extra £210m

	Solution
New Services	Enhanced Frequency Control (Fast Response)
	Low Load Operation of Thermal Plants
	Synchronous Compensator

Innovation in System Operation

- **Need for fast response was identified as part of SOF**
- **SMART Frequency Control - Enhanced Frequency Control Capability (EFCC) will demonstrate the effectiveness of such service**



Change in Generation Mix – Embedded Generation

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- **Increase in embedded generation**
  - Could results in **high voltage** due to reduction of loading level in the network up to certain level

  &

  - Could results in **voltage collapse** at high penetration level following a fault
- **SOF considers this <u>together</u> to ensure the optimum solution is identified from a range of possible options – i.e.**
  - **Voltage control by EGs / DNO**
  - **Optimum installation type/location for shunt compensation**

Industry Perspective

14th January 2015

Demand Response Overview

PADDY FINN

Demand Response Overview

"Demand Response (DR) refers to changes in electricity usage by end-use consumers from their normal consumption pattern in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized"

US Department of Energy

Altering demand to utilise supply more efficiently

Demand Response in Ireland

- Night Saver Electricity
  - Improved system's load factor
  - Long-term strategy
  - Cannot respond to near to medium term events

- Winter Peak Demand Reduction Scheme
  - Increased capacity without the need to build additional infrastructure
  - Cannot respond to near to medium term events

Demand Response in Ireland

- Short Term Active Response
  - Takes advantage of demand's ability to provide fast response
  - Response behaviour is not adjustable post-installation

- Demand Side Unit
  - Inexpensive way to increase capacity
  - Has promoted demand side participation among large consumers(>100 MW)
  - Capacity is provided from within load centres
  - Stepping stone in smart grid evolution
  - Expensive energy – limits utilisation
  - Market mechanisms don't consider the peculiarities of underlying capacity

Demand Response – My Perspective

Expecting demand response to perform like conventional generation ignores its strengths and highlights its limitations

- Useful Strengths
  - Capacity is available directly within load centres
  - Low capital costs associated with increasing capacity
  - Diversifies the system's generation portfolio
  - Short time to synchronise
  - Has the potential to provide near-instant response to system events
  - Potential to strategically increase demand to utilise available energy resources
  - Modern communications are allowing the desired response profile to be reconfigured in near real-time

Demand Response – My Perspective

The desired results of a demand response programme should be clearly defined to maximise the resulting benefits

- Limitations to consider
  - Demand response is effectively energy limited
    - The shorter the maximum run-time, the greater the availability of capacity
  - Available capacity varies in short, medium, and long term
  - Underlying capacity may have very different commercial and technical characteristics:
    - Dispatchable Demand
    - Embedded Diesel
    - Embedded CHP

Defining a Demand Response Mechanism

1. Define the system issue to be addressed
   - Poor load factor
   - Peak demand
   - Capacity shortage
   - Limited rapid response to system failures

2. Define desired demand side response
   - Increased baseload demand
   - Reduced demand at peak times
   - Reduced demand on instruction
   - Reduced demand during system events

3. Incentivise desired behaviour
   - Time-of-use tariffs
   - Stand-by payments
   - Event based rewards
   - Increased payments for fast reaction times

DS3 Programme Status Update

14th January 2015

Robbie Aherne

SEM Committee Correspondence

- Letter sent to TSOs on behalf of Advisory Council on 14/11/2014

- Conveyed Advisory Council concerns about delays in DS3
  - Significant impact on consumers
  - Generator owners and developers
  - 2020 Targets

- SEM Committee response received on 05/01/2014

System Services

- DS3 System Services Decision – 19/12
  - *"Decision on the Procurement Design of System Services and its Emerging Thinking for the Detailed Design Phase"*

SEM committee

SINGLE ELECTRICITY MARKET COMMITTEE

DS3 System Services Procurement Design and Emerging Thinking

Decision Paper

SEM-14-108

19 December 2014

- Fundamental building block for DS3 Programme
  - Expenditure cap of €235m per annum will apply from 2020
  - Interim tariff from Oct 2016 to Oct 2017
  - Hybrid of regulated tariff and auction from Oct 2017
  - Availability payment basis

- System Services portfolio capability
  - Indicative assessment of aggregate portfolio capability of products
  - Identified an indicative portfolio
  - Not predetermining or forecasting technologies which will be, or should be, successful in a system services procurement process

RoCoF Implementation Project

- TSOs believe "Plan A" is achievable
- CER and UR timelines aligned from 21/11/2014
- RoCoF Alternatives / Complementary Solutions workshop
  - Highlighted that will be a techno-economic study and is not a procurement exercise
  - 70 attendees with 15 post workshop submissions

EPM & DSM

Enhanced Performance Monitoring (EPM)

- Work on going on delivery of EPM IT system

- Impact assessment arising from recent System Services decision underway

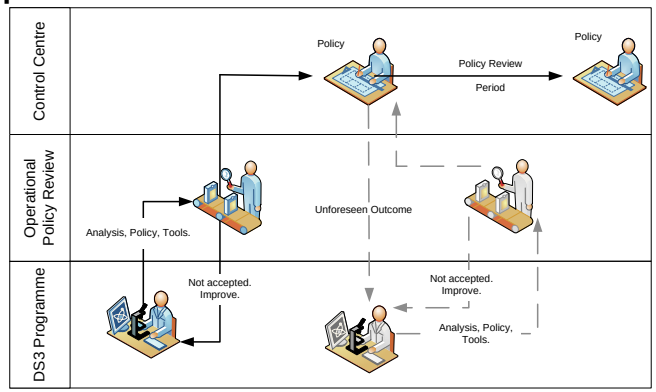
Demand Side Management (DSM)

- Impact of large scale, coordinated demand switching on system frequency stability was completed

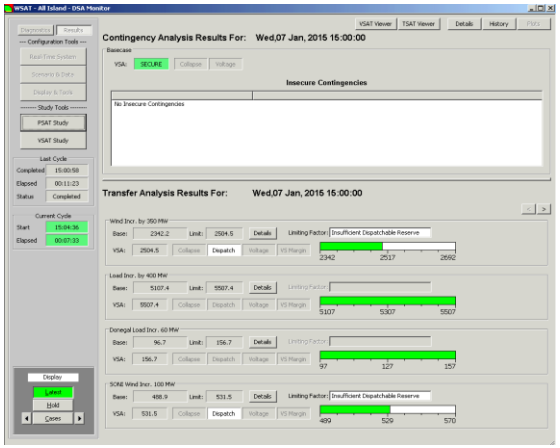
- DSU Grid Code mods arising from DSU WG discussed

System Policy

- Cauteen Nodal Voltage Control Pilot Project with ESBN – progressing
- Magherakeel Nodal Voltage Control Pilot Project – revising workplan
- Ramping policy and tool development – progressing
- Primary and static reserve requirement study – progressing
- Automated approach to large scale dynamic studies using Plexos – complete *
- High SNSP Report – H1 2014 complete *
- High Wind Speed Shut Down report 2013 – complete *
- Glenree unity power factor study – complete *



WSAT & CCTC



WSAT

- WSAT frequency assessment gone live in Dublin and Belfast

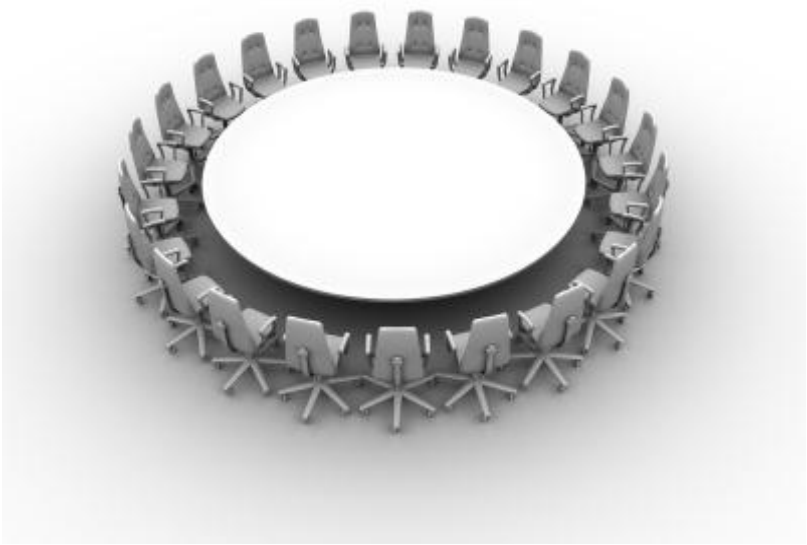
Control Centre Tools & Capability

- Inertia and RoCoF constraints functionality included in RCUC on 15/11/2014
- Significant improvements in accuracy of short circuit tool – due to be complete by Q1 2015
- Method of managing DSO wind constraints via wind dispatch tool agreed and implemented

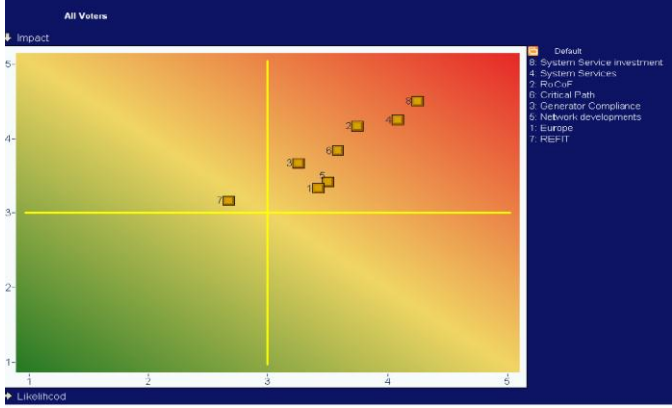
Advisory Council

- Membership update
  - Vandad Hamidi – National Grid UK
  - Paddy Finn – Electricity Exchange (DSM)
  - Mick Hogan – ABB (HVDC)

- Next Meetings
  - 14/05/2015
  - 22/09/2015



Risk Review



- Risk workshop on 23/09/2014
- Document identifying draft *controls* and *risk response*
  - 28th January 2015
- Next workshop: September Advisory Council

Workstream Plans – Annual Review

First group of workstream plans will be circulated w/b 26th January

Draft to DSOs

Draft to RAs

Draft to Advisory Council

Publication

Revised "Operational Capability Outlook"

2015 Focus Areas

- RoCoF Implementation Project
- System Services Detailed Design and Implementation Project
- Operational policy
  - Frequency regulation
  - Ramping
  - Voltage dip induced frequency dips
  - System high frequency mitigation etc.
- Control Centre Tools
  - Short circuit analysis tool
  - Increased WSAT functionality
  - EMS Integration Project
- Continued TSO-DSO co-operation

EIRGRID

semo
Single Electricity Market Operator

SONI
System Operator for Northern Ireland

Rate of Change of Frequency (RoCoF)

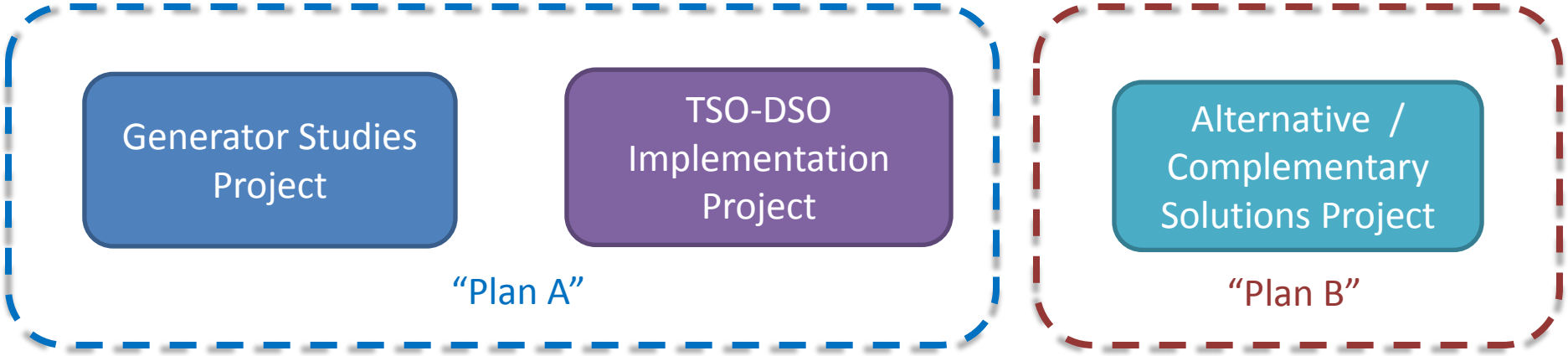
14th January 2015

Eoin Kennedy

Presentation Overview

- Background and timeline update
- Generator Studies Project
- TSO-DSO Implementation Project
- Alternative / Complementary Solutions Project

RoCoF Implementation Project



<u>Timeline Update</u>

- CER and UR timelines aligned

- Project start date: 21st Nov 2014

Generation Studies Project

- Kick-off meetings held with generators individually
  - EirGrid, individual generators, Independent Consultant and CER in Ireland
  - SONI and individual generators in Northern Ireland

- Studies to be undertaken by generators over 18 – 36 months

- Common approach adopted and scenarios aligned in Ireland and Northern Ireland

Scope of Studies: TSOs' Requirements

Electrical dynamic simulations

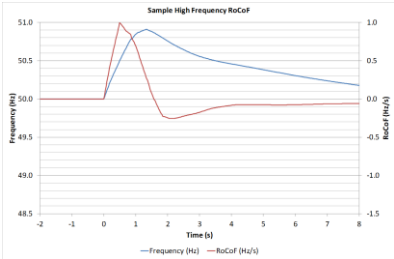
- Purpose is to assist the TSOs in assessing the impact on the transmission system of each unit's response to higher RoCoF values
- EirGrid / SONI have specific requirements

Mechanical / plant integrity studies

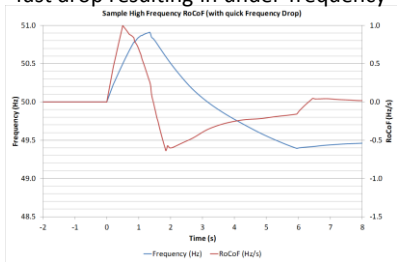
- Generator can decide on the assessment methodology and cases to study
- Where mechanical / plant integrity issues have been raised, evidence that a prudent process has been adhered to in investigating those issues is required by the TSOs

Electrical Dynamic Simulations
High Level Process

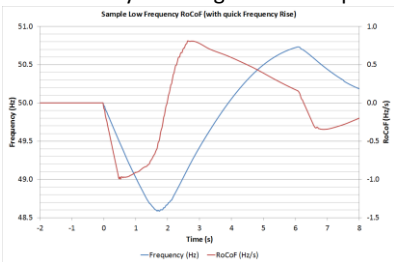
1 Hz/s frequency rise



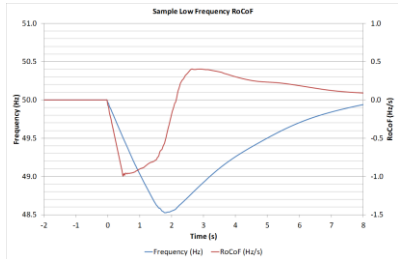
1 Hz/s frequency rise with subsequent fast drop resulting in under-frequency



1 Hz/s frequency drop with subsequent fast recovery resulting in over-frequency

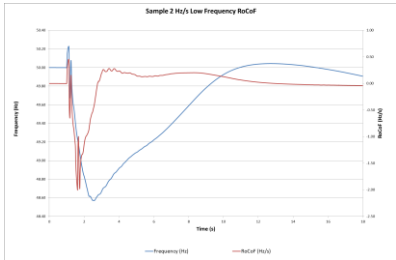


1 Hz/s frequency drop

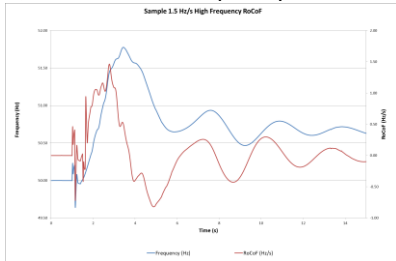


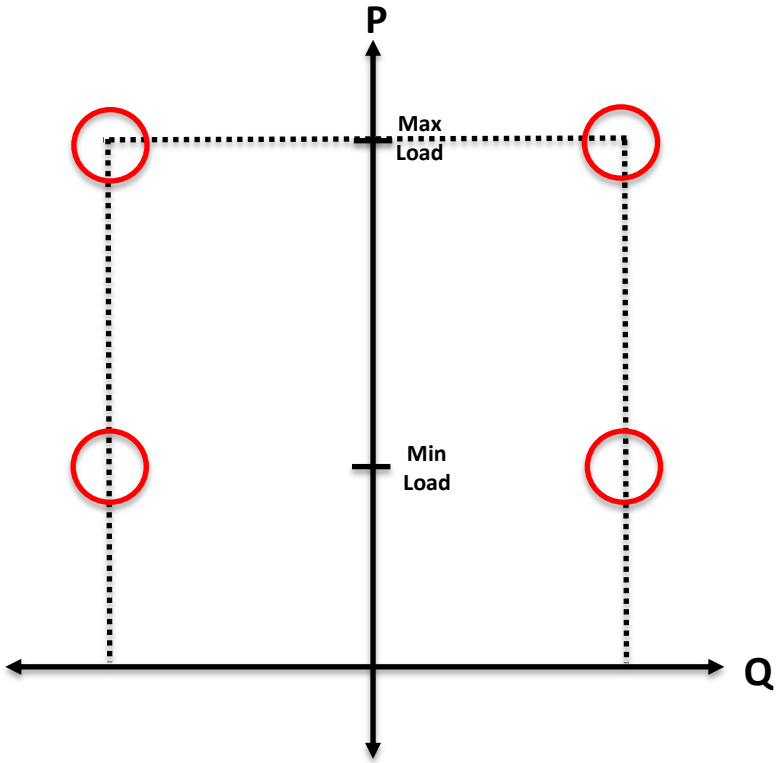
NI only

2 Hz/s frequency drop



1.5 Hz/s frequency rise





=> Core Scenarios

- Process completed if there are no Grid Code compliance issues arising for all scenarios
- If issues arise => examine more scenarios

Generator Categorisation

- Draft categorisation lists submitted to CER / UR in July 2014
- TSOs' assessment of prioritisation was based on:
  - Run hours (existing/forecast)
  - Constrained-on
  - Priority dispatch
- CER has approved the final Ireland categorisation list
- Proposed final Northern Ireland categorisation list recently submitted to UR for approval

TSO-DSO Implementation Project

- Managed through existing TSO-DSO governance structure

- Loss of Mains (LoM) protection setting change process initiated by DSOs

Alternative / Complementary Solutions Project

- Techno-economic assessment not the start of a procurement exercise

- RoCoF Alternative / Complementary Solutions Workshop held Nov 2014
  - 70 attendees
  - Significant industry input on the day

- 15 industry submissions received post-workshop

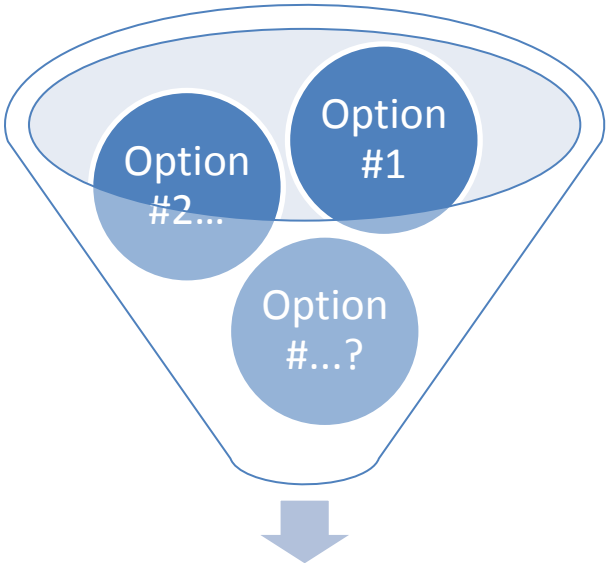
<u>*Communication with industry*</u>

- *Via DS3 Advisory Council and website*
- *Workshops/forums will also be used where TSOs or DS3 Advisory Council consider that wider participation would be beneficial*

Phase 1 Assessment On-going

No.	Category
1	Synchronous compensators with greater inertia
2	Non-synchronous response • HVDC interconnectors • Batteries and flow batteries • Flywheels • Wind turbines • Demand side technologies
3	Storage (assuming synchronous machines deployed) • Pumped storage • Compressed Air Energy Storage
4	“Parking” of conventional generators or reduction in min MW generation threshold
5	AC interconnection with Great Britain
6	Flexible thermal power plant
7	TSO operational measures

Phase 2 Overview



Phase 2: Shortlisted Options

- More detailed analysis likely including technical and economic studies of shortlisted options
  - Dynamic simulations
  - Plexos studies to assess economic benefit

Summary

- CER and UR project timelines aligned
- Project commenced on 21st Nov 2014
- Generator Studies project in progress
- Loss-of-Mains protection setting change process initiated
- Phase 1 of Complementary / Alternative Solutions project underway

EIRGRID

semo
Single Electricity Market Operator

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System Operator for Northern Ireland

DS3 Advisory Council
ESBN LoM Protection Update

Tony Hearne

14th January 2015

Presentation Overview

- **Loss of Mains (LoM) Protection Overview**
- **G10 Questionnaire**
- **Alternative LoM Protection**
- **G10 Relay testing**
- **Conclusion**

Loss of Mains Protection Overview

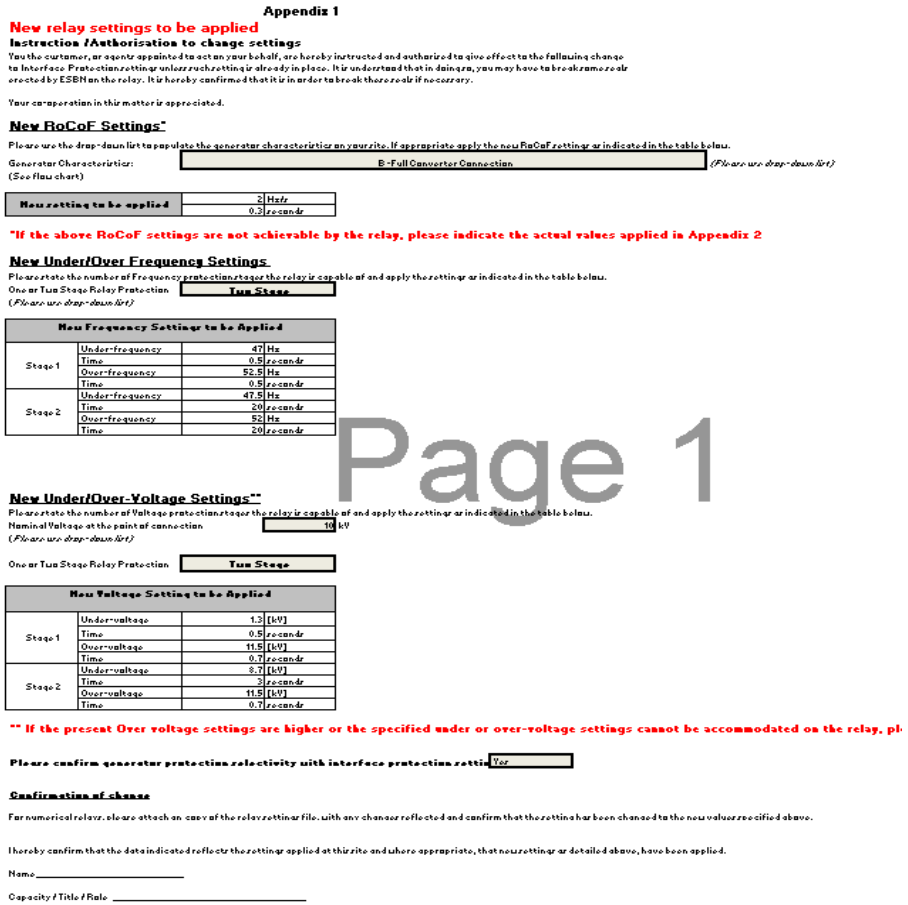
- Distribution System Users need to be protected against safety and power-quality risks from an unplanned island
- RoCoF (Rate of Change of Frequency) has traditionally been a reliable and cost effective way of protection against islanding
- Challenge is to detect and trip a generator for a genuine island event but remain connected for a system wide disturbance
- When islanded, for a given level of load-generation mis-match, the Inertia value H (MWs) of embedded generator will determine RoCoF experienced on the network
- New RoCoF settings developed based on generator type (DFIG, Full converter, etc.)

G10 Questionnaire

- **Questionnaire sent out on the 6th June 2014 to wind generation**
- **This was done to confirm existing records and instruct a change to the following settings:**

1. *Move RoCoF settings where appropriate*
2. *Change the under/over voltage settings to align with new fault ride through requirements*
3. *Extend both over and under frequency protection settings*

- **To date the response has been poor, more engagement from industry required**
- **Engagement with non-wind generation has begun, greater challenge as no group representation exist**



Appendix 1

New relay settings to be applied

Instruction /Authorisation to change settings

You the customer, or agent appointed to act on your behalf, are hereby instructed and authorised to give effect to the following change to Interface Protection settings unless such settings are already in place. It is understood that in doing so, you may have to break seals erected by ESBN on the relay. It is hereby confirmed that it is in order to break these seals if necessary.

Your co-operation in this matter is appreciated.

New RoCoF Settings*

Please use the drop-down list to populate the generator characteristics on your site. If appropriate apply the new RoCoF settings as indicated in the table below.

Generator Characteristics: E - Full Converter Connection *(Please use drop-down list)*
(See flow chart)

New setting to be applied	2	Hz/s
	0.3	seconds

***If the above RoCoF settings are not achievable by the relay, please indicate the actual values applied in Appendix 2**

New Under/Over Frequency Settings

Please state the number of Frequency protection stages the relay is capable of and apply the settings as indicated in the table below.

One or Two Stage Relay Protection **Two Stage**
(Please use drop-down list)

New Frequency Settings to be Applied			
Stage 1	Under-frequency	47	Hz
	Time	0.5	seconds
	Over-frequency	52.5	Hz
	Time	0.5	seconds
Stage 2	Under-frequency	47.5	Hz
	Time	20	seconds
	Over-frequency	52	Hz
	Time	20	seconds

Page 1

New Under/Over-Voltage Settings**

Please state the number of Voltage protection stages the relay is capable of and apply the settings as indicated in the table below.

Nominal Voltage at the point of connection 10 kV
(Please use drop-down list)

One or Two Stage Relay Protection **Two Stage**

New Voltage Setting to be Applied			
Stage 1	Under-voltage	1.3	[kV]
	Time	0.5	seconds
	Over-voltage	11.5	[kV]
	Time	0.7	seconds
Stage 2	Under-voltage	8.7	[kV]
	Time	3	seconds
	Over-voltage	11.5	[kV]
	Time	0.7	seconds

**** If the present Over voltage settings are higher or the specified under or over-voltage settings cannot be accommodated on the relay, pl**

Please confirm generator protection selectivity with interface protection settin Yes

Confirmation of change

For numerical relays, please attach a copy of the relay settings file, with any changes reflected and confirm that the settings has been changed to the new values specified above.

I hereby confirm that the data indicated reflects the settings applied at this site and where appropriate, that new settings as detailed above, have been applied.

Name _____

Capacity / Title / Role _____

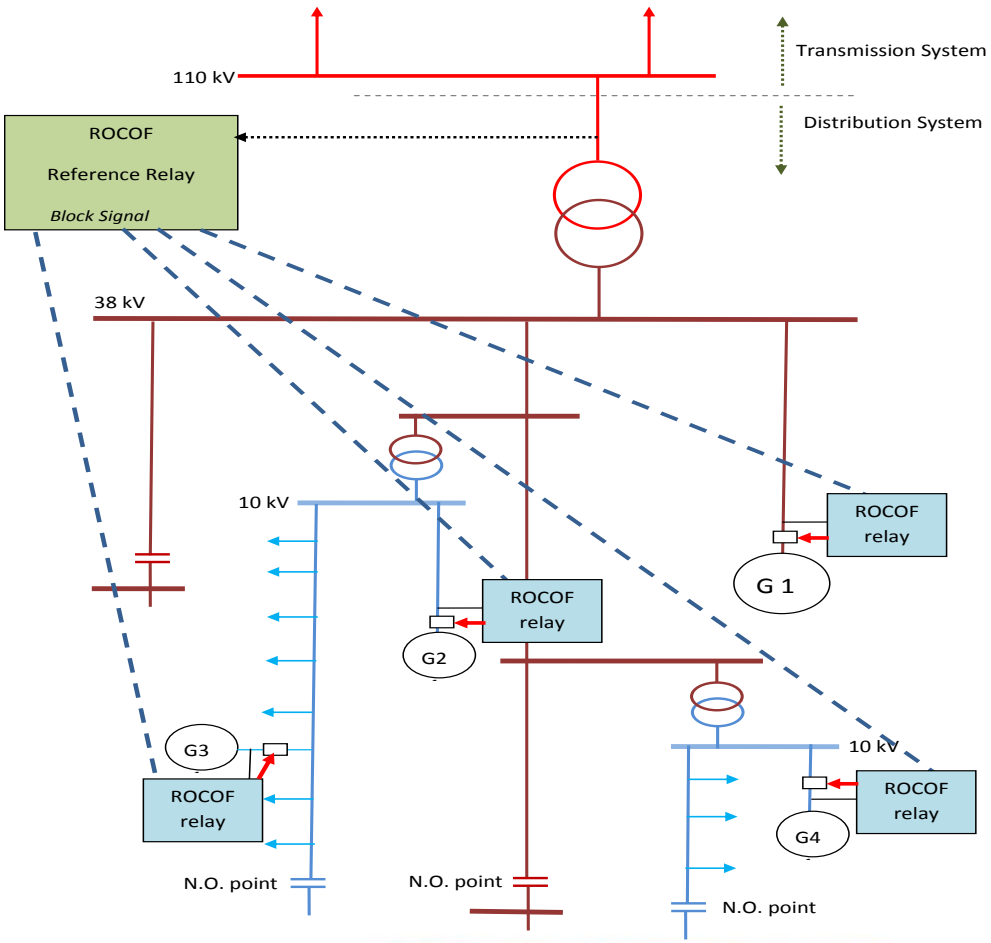
Alternative LoM Protection

- **Where a RoCoF setting of 1Hz/s cannot be applied, alternative LoM protection maybe required**
- **Selection of Alternative LoM Solutions being explored are:**

1. ***Supervised RoCoF***: G10 type relay monitors the Transmission system voltage, in the event of a disturbance a blocking signal is sent to a local network G10 relay inhibiting operation.

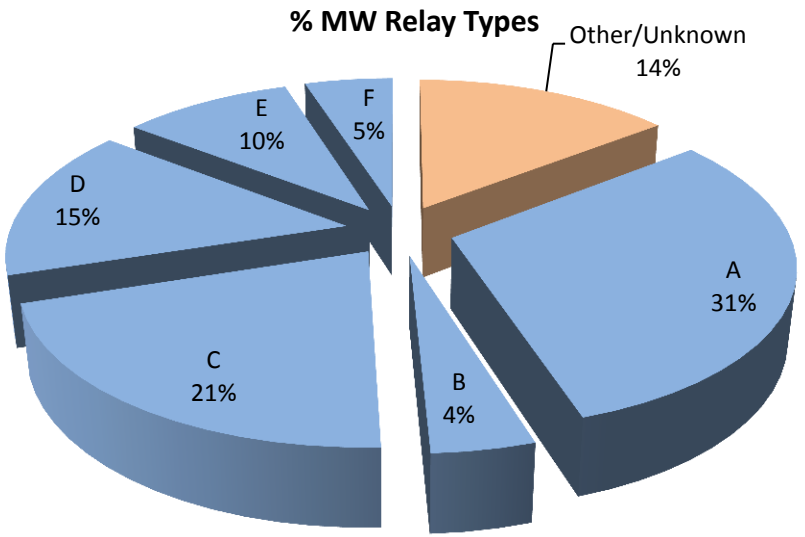
2. ***And RoCoF & Vector Shift***: The relay needs to see both a RoCoF and Vector Shift to initiate a trip signal. This may reduce the sensitivity of relays to grid disturbances. Studies required.

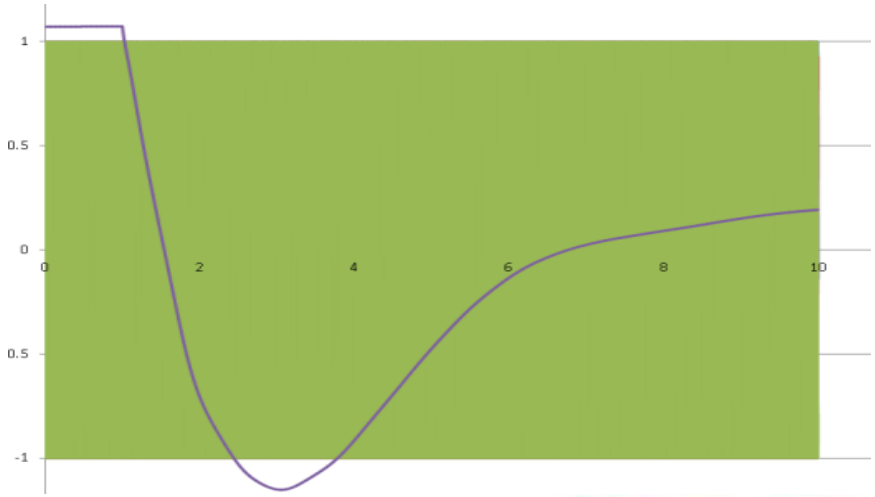
3. ***Exchange Relay:*** This option will be informed by analysing of the installed fleet of G10 relays. Early indications show that some relays maybe not operate for the sample traces provided by EirGrid using a RoCoF setting of 0.6Hz/s.



G10 Relay Testing

- **Procured a large sample of G10 relays**
- **11 sample traces representative of potential system disturbances received from EirGrid**
- **Secondary injection tests of G10 relays ongoing**





Initial Test Results

- **Initial results show a wide variety of responses for the same events across a range of manufactures**
- **It is not the RoCoF element that trips in most cases with legacy Voltage & Frequency settings**
- **New settings applied reduce number of trip operations**

		Legacy Voltage & Frequency Settings				New Voltage & Frequency Settings			
	Relay	A	B	C	D	A	B	C	D
RoCoF 0.4 Hz/s	Frequency Drop without Fault	5.065	2.581	2.863	2.352	4.534	2.585	NOOP	1.746
	Frequency Drop with Fault	4.557	2.827	2.860	2.347	4.549	2.822	NOOP	1.825
	Frequency Drop with Fault 5%	7.490	3.018	4.980	2.307	NOOP	3.023	NOOP	1.586
	Frequency Drop with Fault 50%	4.550	3.012	2.870	1.820	4.559	3.015	NOOP	1.825
	Frequency Rise without Fault	2.497	2.085	2.501	1.745	NOOP	2.589	NOOP	1.745
	Frequency Rise with Fault	2.823	2.052	2.815	1.824	NOOP	NOOP	NOOP	1.824
	Frequency Rise with Fault 5%	3.316	2.520	2.822	1.585	NOOP	NOOP	NOOP	1.585
	Frequency Rise with Fault 50%	2.827	2.515	2.799	2.063	NOOP	NOOP	NOOP	2.062
	Loss of Largest Infeed - Typical	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Outfeed - Typical	NOOP	1.157	NOOP	2.334	NOOP	NOOP	NOOP	2.334
	Loss of Largest Infeed - High RoCoF	NOOP	1.581	NOOP	NOOP	NOOP	1.580	NOOP	NOOP
RoCoF 0.6 Hz/s	Frequency Drop without Fault	4.573	2.608	2.858	1.746	4.553	2.604	NOOP	1.746
	Frequency Drop with Fault	4.577	2.872	2.858	1.824	4.559	2.864	NOOP	1.825
	Frequency Drop with Fault 5%	7.491	3.021	4.972	1.825	NOOP	3.020	NOOP	1.586
	Frequency Drop with Fault 50%	4.582	3.014	2.863	1.824	4.548	3.012	NOOP	1.825
	Frequency Rise without Fault	2.501	2.093	2.514	1.745	NOOP	NOOP	NOOP	1.745
	Frequency Rise with Fault	2.826	2.054	2.797	2.775	NOOP	NOOP	NOOP	NOOP
	Frequency Rise with Fault 5%	3.327	2.521	2.818	2.774	NOOP	NOOP	NOOP	NOOP
	Frequency Rise with Fault 50%	2.825	2.515	2.800	2.775	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Infeed - Typical	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Outfeed - Typical	NOOP	1.159	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Infeed - High RoCoF	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
RoCoF 1.0 Hz/s	Frequency Drop without Fault	7.083	6.061	7.059	7.032	NOOP	NOOP	NOOP	NOOP
	Frequency Drop with Fault	7.489	6.449	7.449	1.825	NOOP	NOOP	NOOP	1.825
	Frequency Drop with Fault 5%	7.493	6.437	7.463	1.586	NOOP	NOOP	NOOP	1.585
	Frequency Drop with Fault 50%	7.514	6.455	7.496	1.825	NOOP	NOOP	NOOP	1.825
	Frequency Rise without Fault	2.496	2.096	2.498	2.496	NOOP	NOOP	NOOP	NOOP
	Frequency Rise with Fault	2.825	2.049	2.808	2.735	NOOP	NOOP	NOOP	NOOP
	Frequency Rise with Fault 5%	3.296	2.517	2.786	1.585	NOOP	NOOP	NOOP	1.586
	Frequency Rise with Fault 50%	2.826	2.515	2.818	2.774	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Infeed - Typical	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Outfeed - Typical	NOOP	1.153	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP
	Loss of Largest Infeed - High RoCoF	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP	NOOP

Trip On
Voltage/frequency
RoCoF
Unknown

Conclusions

- **Slow response on G10 Questionnaire, will be sent to non-wind generators in coming weeks**

- **Actively looking at alternative LoM protection schemes**

- **Bench-testing of G10 relays ongoing, interesting initial results**

Thanks for Listening

Questions?

System Services

Regulatory Authorities
14th January, 2015

DS3 System Services
SEM Committee Decision

DS3 Advisory Council, Belfast

14th January, 2015

SEM committee

Agenda

- Introduction & Overview
- High Level Procurement Design
- Next Steps

SEM committee

SEMC Decision Concludes a Significant Body of Work

TSO Consultations & Recommendations	December 2011 to May 2013
SEMC Decision on Technical Definitions	December 2013
Economic Analysis	March 2014
Procurement Design Consultation	July 2014
SEMC Decision on Procurement Design	December 2014

- Extensive analysis carried out by both the TSOs and RAs
- Comprehensive consultation with Industry

SEM committee

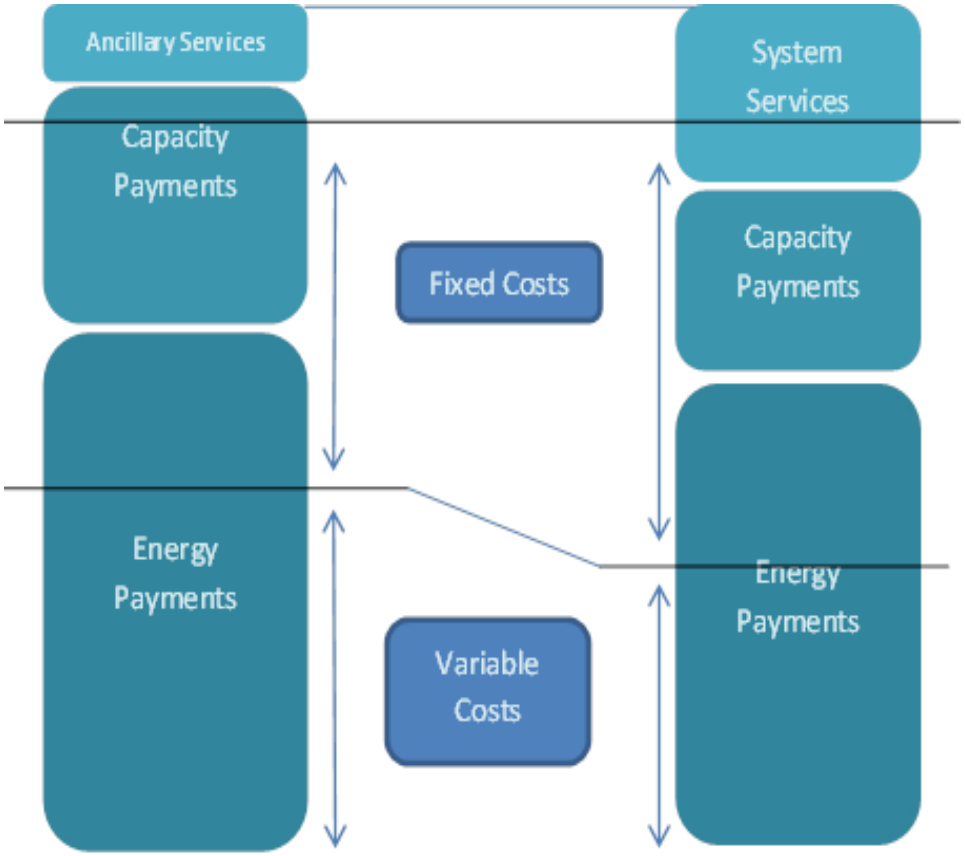
System Services & the Wider Context

- The SEM is the first market to face these challenges
  - Limited international experience to draw on
- Required to facilitate the 2020 Renewables Targets
- DS3 will deliver consumer benefits
- System Services must work with I-SEM and CRM to efficiently reward the providers most needed by the system

SEM committee

Rebalancing of Revenue Streams

- System Services review involves incentivising the right mix of "services" to continue to operate the system as levels of non-synchronous generation increase;
- Financial mix in the market will move to higher capital cost, lower variable cost i.e. more wind on system, different mix of conventional plant;
- Challenge is to incentivise the required plant mix (and performance of existing plant) in the absence of established value and price for each individual service.



SEM committee

RoCoF Implementation Project

- Generator Implementation Projects commenced 21st November 2014
  - This is the priority RoCoF workstream
  - First studies due within 18 months
- TSO-DSO Implementation Project on-going
  - Due to be completed within 18 months
- Alternative/Complementary Solutions Project
  - “Plan B” Option
  - Commenced 21st November, to be completed within 18 months
- RAs will undertake holistic assessment of progress of RoCoF implementation after the 18 month milestone and whether any addition action is required
  - Where such actions relate to a SEM matter, such as System Services, the RAs will make proposals to the SEM Committee

SEM committee

Consultation Responses

- Many focused on finance, revenue certainty
- Cost vs. Value based approach
- Competitive approach; concerns regarding complexity and market power

SEM committee

Balance of Competing Objectives

Consumer Interest	Cost-based approach; consumer value should be maximised
Competitive approach	Favoured by the SEMC; in the best long-term interests of consumers; best deals with the inherent complexity of the issues
Balance of Risk between Consumer and Providers	Providers must take on some risk. Procurement design shares risk between the consumer and providers.
Financial certainty for investment	Contractual arrangements; long-term & take-or-pay contracts
Suitability of the Competitive Environment	Phased approach; fluid transition from regulation to competition
2020 Targets	Interim tariff puts arrangements in place ahead of enduring framework

SEM committee

High Level Procurement Design

SEM committee

SEM Committee Decision

- SEMC Vision
  - Competition where possible, regulation where necessary
  - Success is a framework which facilitates an increase in SNSP and delivers a consumer benefit
- TSOs Procurement Strategy
  - Document required by end Q1 2015
  - Will set out TSO's high level strategy and plan for implementing the SEMC decision
- SEMC High Level Decision Framework
  - Sets out the SEMC's decisions in a number of key areas
  - The next slides go through these decisions

SEM committee

Procurement High Level Design - Summary

TSO Procurement

- Annual expenditure cap
- TSO Incentives
- Volumes

Interim Tariffs

- Q4 2016

Enduring Procurement Design

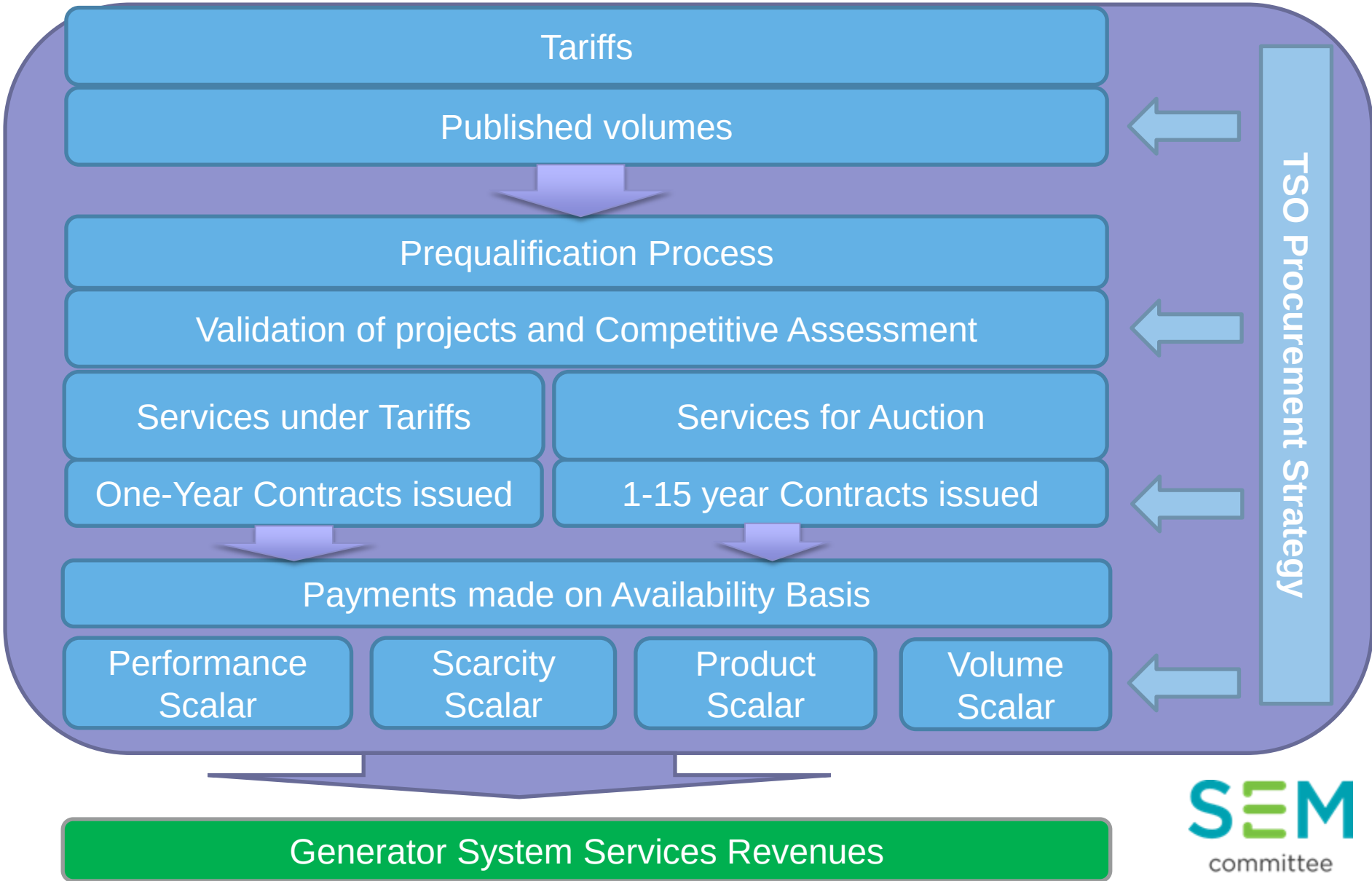
- Phased transition from Regulated Tariffs to Competitive Auction
- Q4 2017

Financial Arrangements

- Pre-Qualification Process
- Payment on Availability Basis
- Scalars (Performance; Volume; Scarcity; Product)
- New investment: Long-term contracts, take-or-pay contracts

SEM committee

System Services Procurement Framework



SEM committee

TSO Procurement

Annual Expenditure Cap

- Cap of €235m per annum
- Represents the Consumer Savings and existing budget
- Cap will increase to this level between 2016-2020, dependent on volumes delivered

TSO Incentives

- To be introduced to encourage the efficient procurement of system services by the TSO

Volumes

- TSO to develop methodology and scenarios to forecast volumes
- Consultation to take place 2015

SEM committee

Interim Tariffs

- Interim tariff for 2016/17
  - Prepared for all services
  - Cost-plus based on a BNE model
  - TSO consultation to propose tariff methodology
- Allows for Early Implementation of System Services
- Reveals the capability of the current fleet

SEM committee

Enduring Procurement Design

Regulated Tariffs

- Prepared for all services
- Applies to services where competitive approach not appropriate
- Cost-based BNE methodology
- Set for five years

Auction

- Process established for those services which are to be procured competitively
- Multiple Bid Auction – similar to the SEMC consultation but simplified
- Long-term contracts for new investment; one-year for existing capability

SEM committee

Financial Arrangements (1/2)

Pre-Qualification Process

- All potential and existing plant must submit capability
- Projects are assessed against criteria (to be developed)
- Competitive conditions for each service are assessed
- TSO recommends to SEMC which services to be procured competitively and which to be paid through regulated tariff (key output)
- Based upon guidance published by SEMC

Payment on Availability Basis

- Provider paid if service could have been used by TSO in that trading period
- Providers will be kept whole against TSO dispatch decisions
- Provides a balance of risk between consumer and provider

SEM committee

Financial Arrangements (2/2)

Scalars

- Performance Scalar to incentivise reliability and reduce payments to unreliable providers
- Volume Scalar to protect consumer from overpayment and adjusts relative tariff levels if required
- Scarcity Scalar to incentivise availability from providers of most value to the system in terms of time/location
- Product Scalar to incentivise enhanced delivery of services from providers

Contractual Arrangements

- Long-term contracts (1-15yrs) will be issued through the auction for new investment
- Take-or-pay contracts will be issued through the auction for new investment to ensure minimum annual revenue from system services
- These contractual arrangements provide investor certainty. Combined with the competitive process and payment basis facilitates the appropriate balance of consumer and investor risk

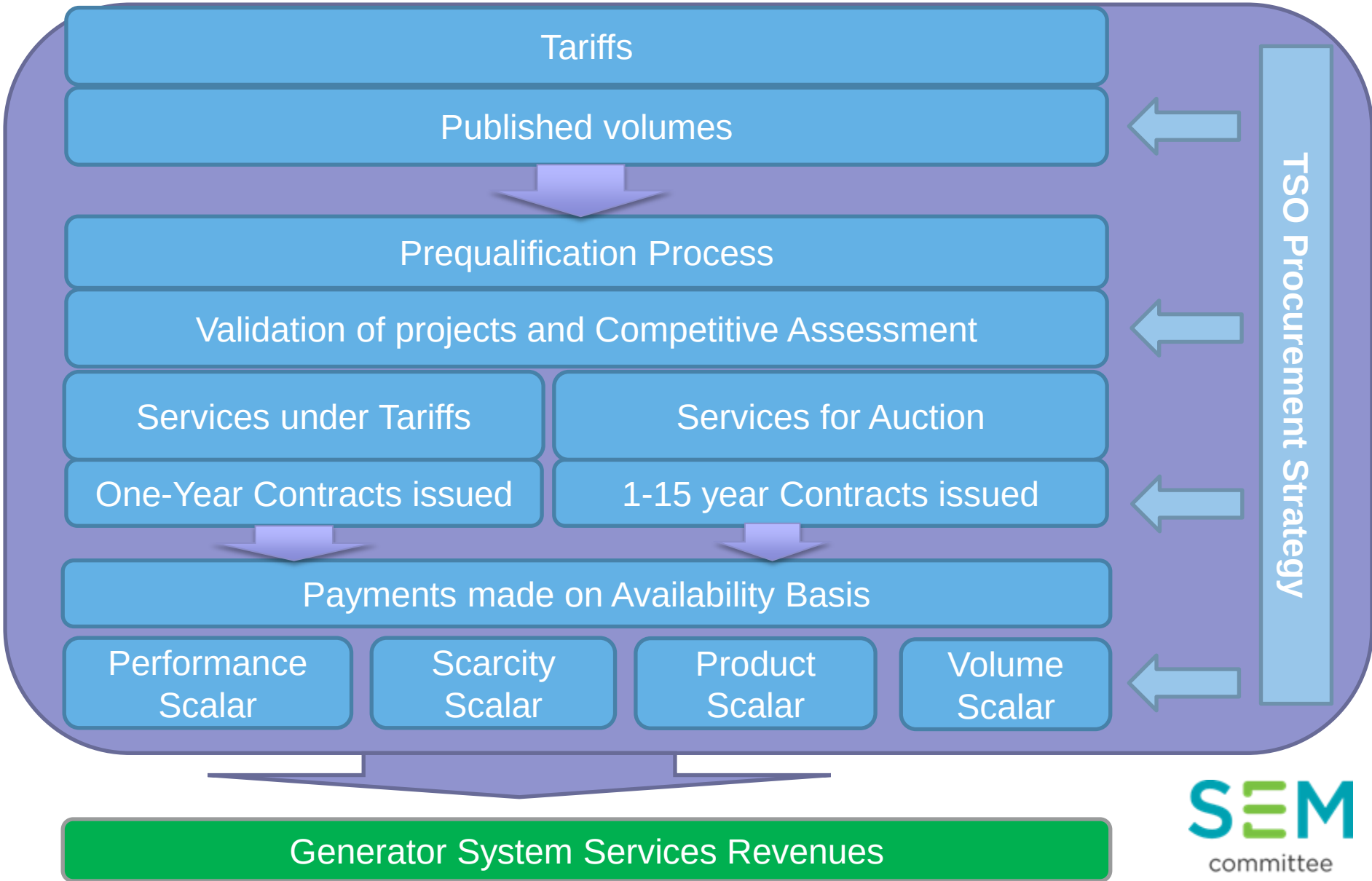
SEM committee

East West Interconnector

- EWIC is a publicly funded piece of infrastructure and its use should be maximised insofar as this is in the consumer's interest
- Given the role of EirGrid in procuring system services the SEMC considers it appropriate that EWIC be a price-taker and not participate directly in the auction

SEM committee

System Services Procurement Framework



SEM committee

Conclusion

- System Services is a complex and pioneering development for the energy market
  - The SEM is the first market to face this challenge
- The SEMC has put in place a framework that strikes a balance between maximising the consumer benefit and ensuring adequate investor certainty
- The overall procurement design ensures the timely implementation for the procurement of system services and allows for a smooth transition to a competitive process over time
- Significant programme of work to be completed between now and 2017

SEM committee

Next Steps

Q1 2015	Detailed Design Commences Programme to be published
Q1 2015	TSO Procurement Strategy
Q4 2016	Interim Tariffs in place
Q1 2017	First Auction run
Q4 2017	Go-Live of first competitively procured services

SEM committee

Questions

SEM committee

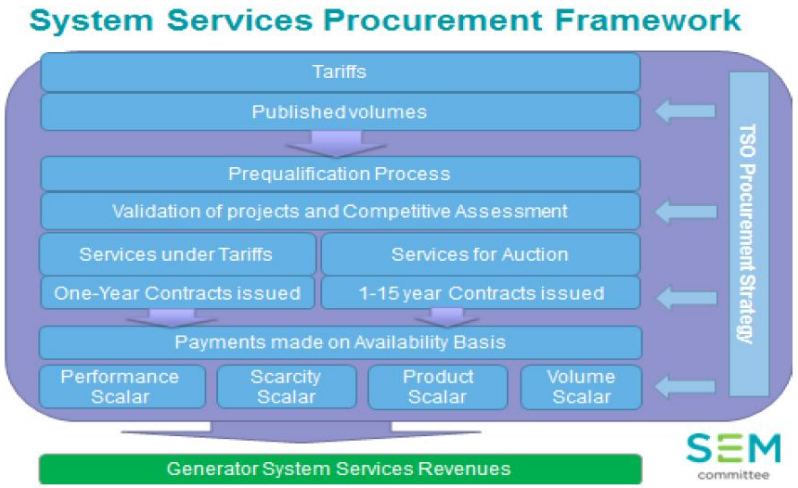
System Services

14th January, 2015

Sam Matthews

TSO thoughts

- Significant project
  - Tariffs & Auction
- 6 work streams
  - WS1 - Regulated Tariffs
  - WS2 - System Services Volumes
  - WS3 – Pre-Qualification Process Design
  - WS4 – Auction Design
  - WS5 – Contract Design
  - WS6 – Product Design and I-SEM



Next Steps

- HAS Procurement Policy
  - Provide clarity on amendments to current HAS contracts and for new providers
  - Transition from HAS to System Services
  - Feb 2015 as part of HAS

- TSO Procurement Strategy
  - Q1 2015

- Agreed final programme of work with RAs
  - Q1 2015

TSO Approach

- Consultation will be a key element of process
- Input from Advisory Council on consultation methodology
- Flexible on approach
  - Within direction provided by SEMC

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System Operator for Northern Ireland

High SNSP Report Summary (HSR) H1 2014

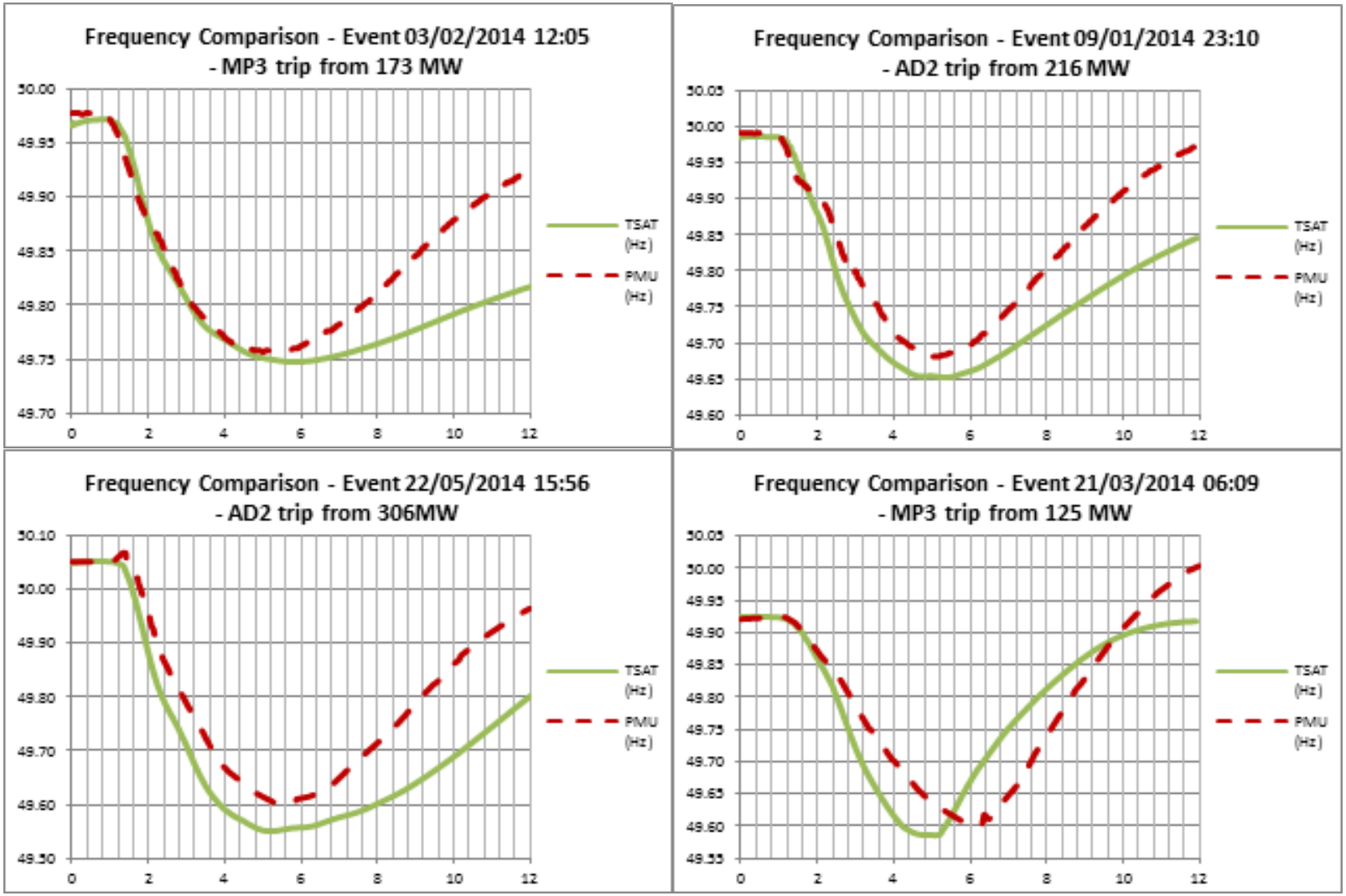
14th January 2015

Séamus Power

All-Island High SNSP Reports (HSR)

- Snapshot of the All-Island System taken
  - High Wind
  - High SNSP
  - Low Inertia
  - Low Inertia relative to size of Largest In-/Out-feed
- Voltage Stability
  - Power transfer analysis
- Frequency Response
  - Fault followed by Loss of In-/Out-feed
- Critical Clearance Time
  - Angular stability

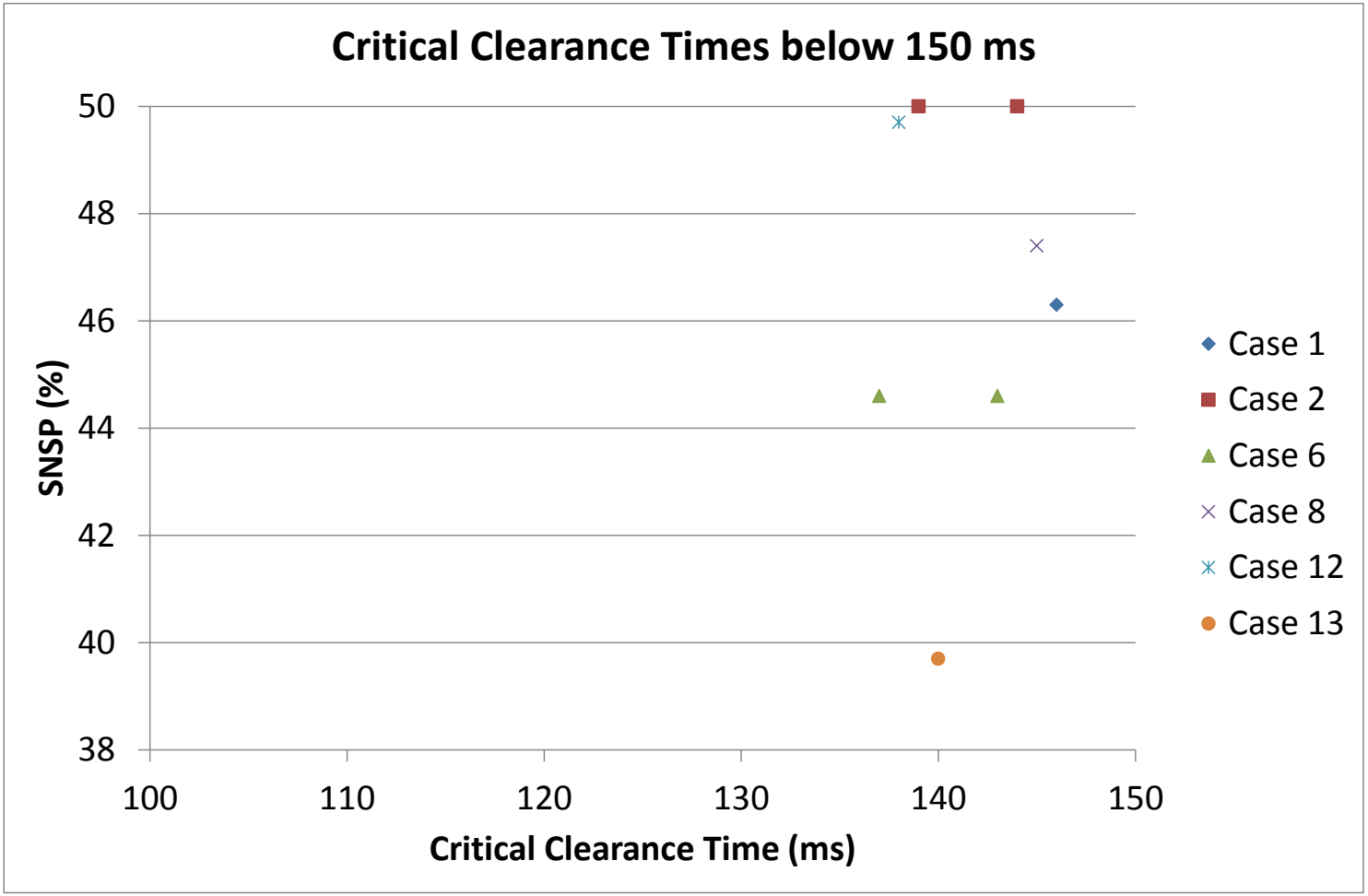
All-Island WSAT Model Accuracy



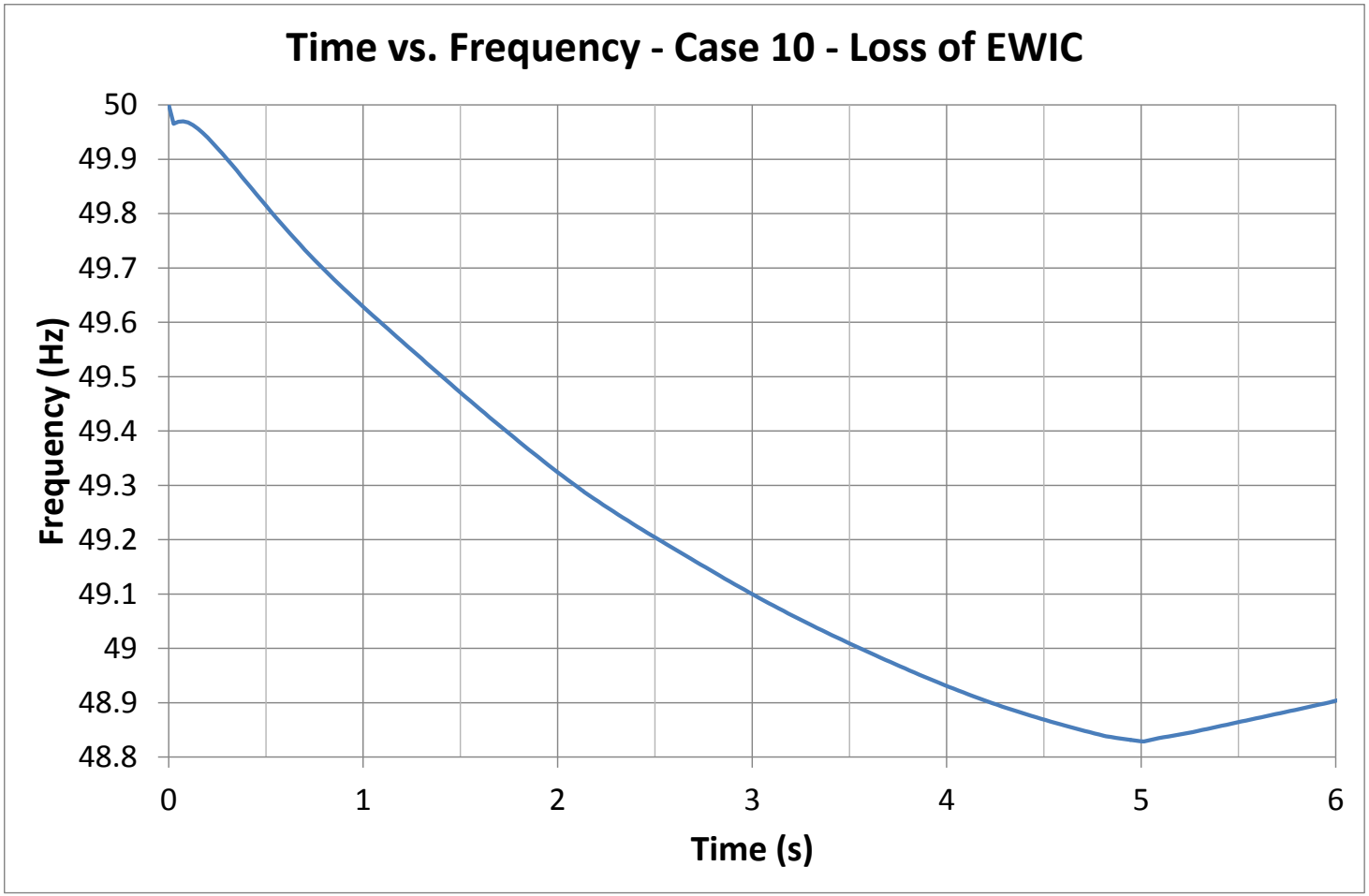
Analysis of All-Island HSRs – H1 2014

- 14 reports compiled between January and June 2014
- Very small number of voltage (during maintenance outages) and transient stability issues
- If RoCoF Operational Limit maintained unlikely to be any major frequency stability issues
- Results suggest that there may be times (low inertia, large infeed) where there may be a requirement for more fast-acting reserve

Transient Stability



Frequency Stability



Outcomes and next steps…

- Continue validating and tuning all models
  - Conventional
  - Wind
  - Load
  - Protection relays
- Investigate current Fast Frequency Response requirement
- Add sensitivity with increased wind and SNSP %

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High Wind Speed Shutdown Report 2013

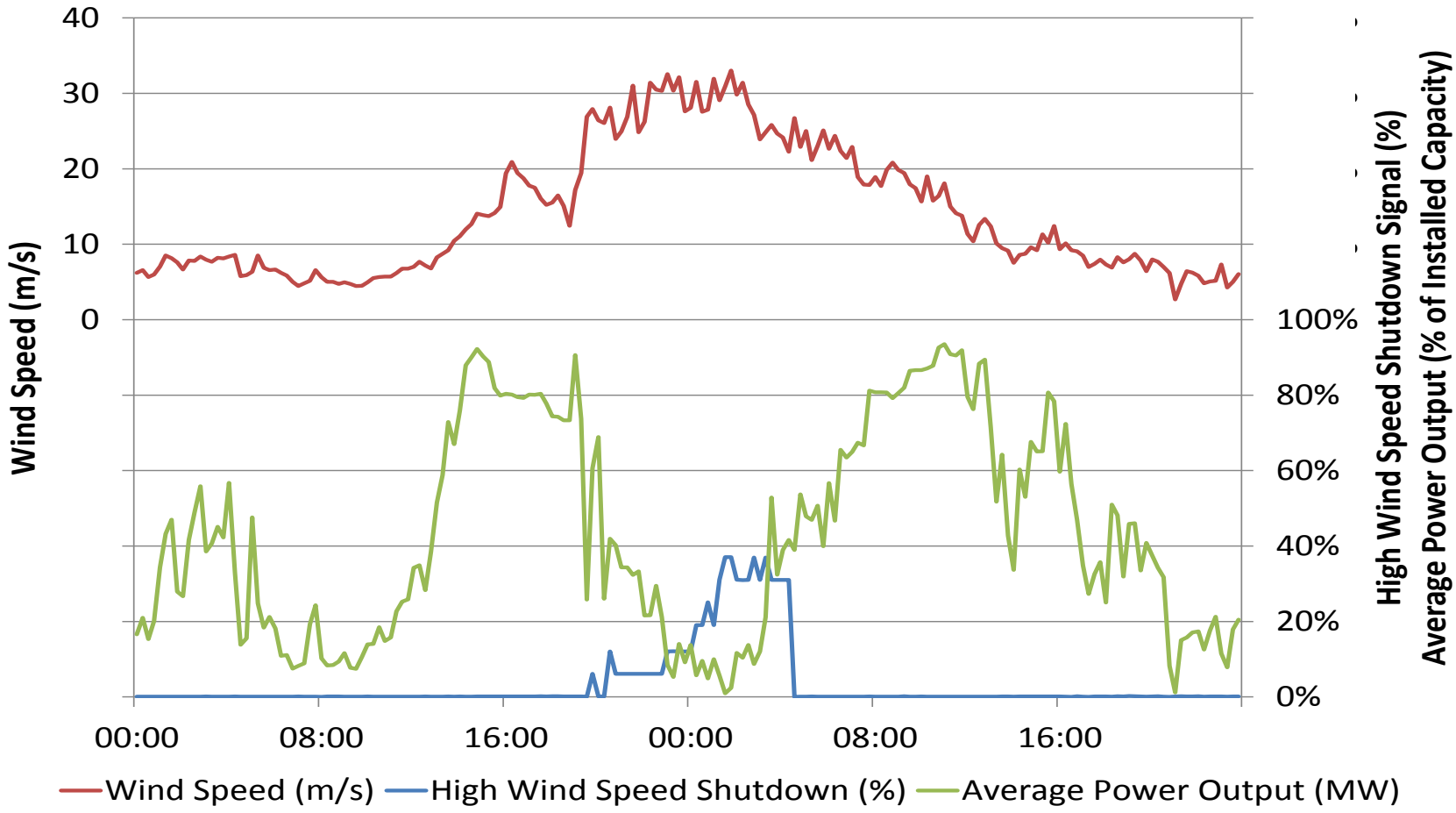
14th January 2015

Séamus Power

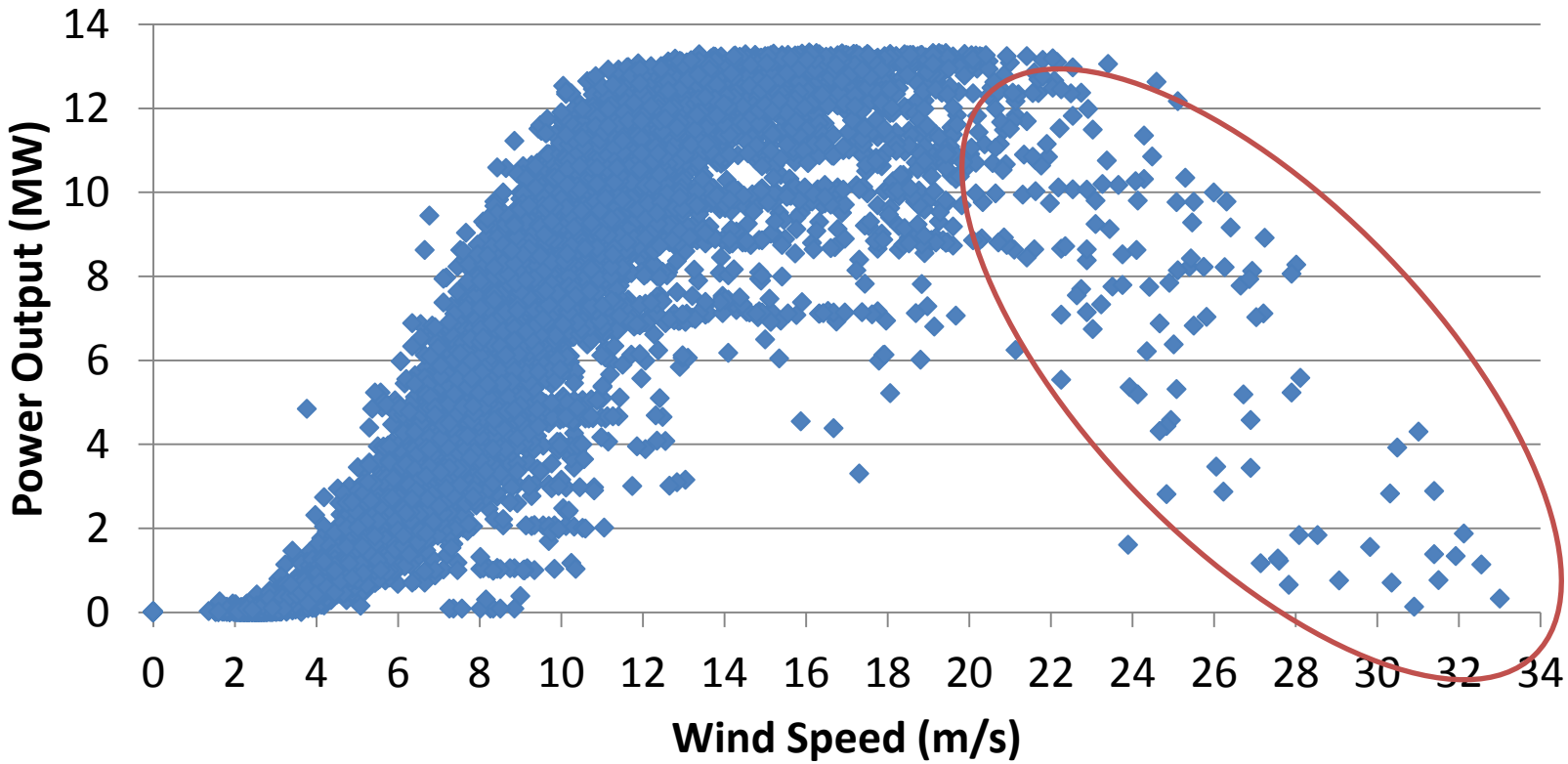
2013 Statistics

- 49 days with High Wind Speed Shutdown Events
- 16 days in December 2013
- Estimated 2 GWh of abatement on December 27th due to HWSSD

High Wind Speed Shutdown



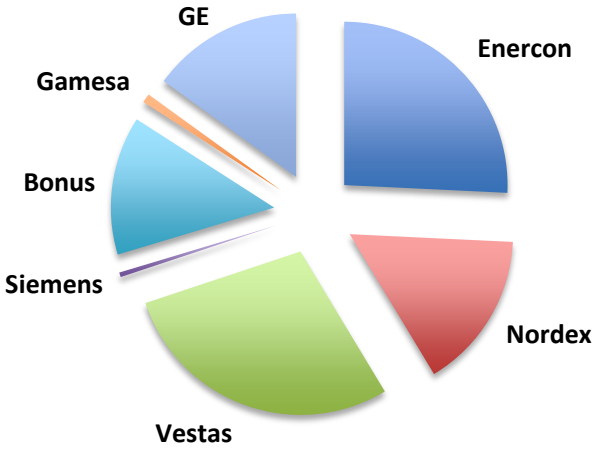
Wind Farm Power Curves

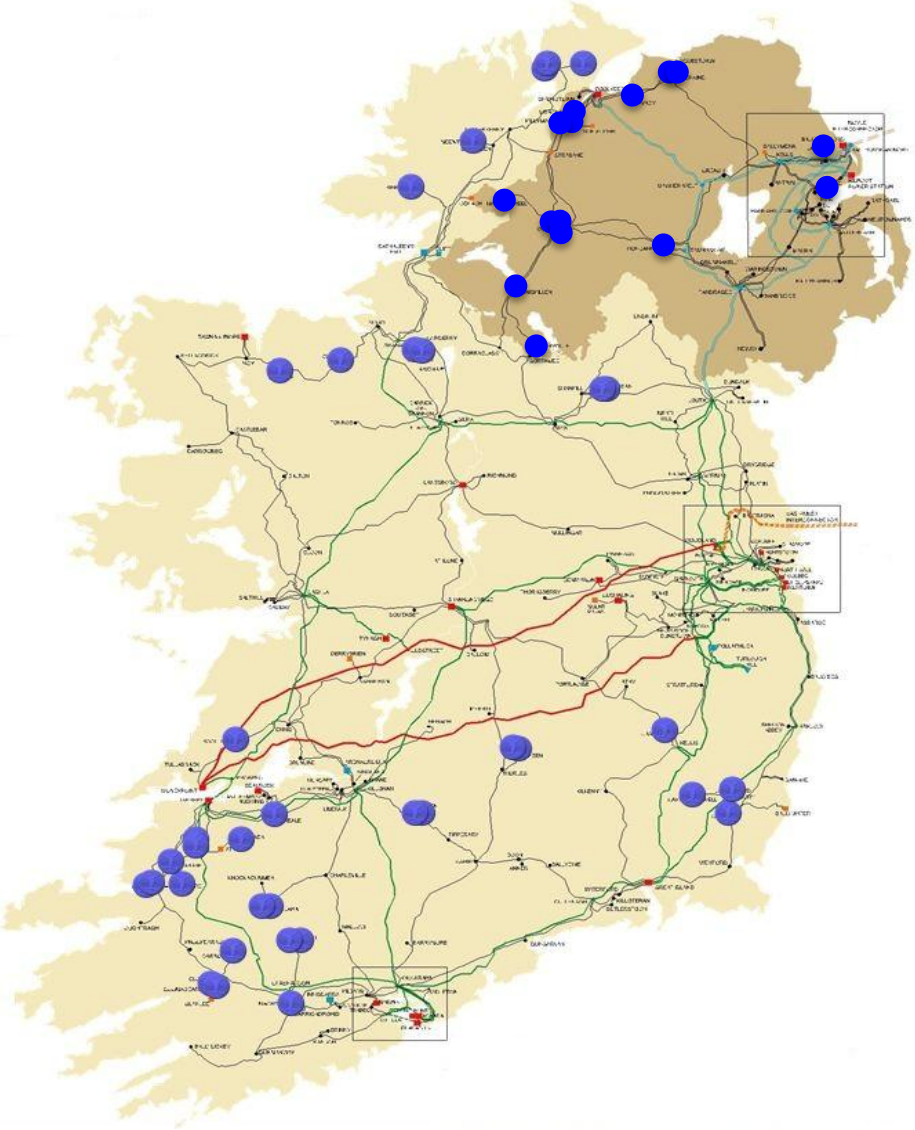


Selection

- 55 Wind Farms
  - North-West : 11
  - South-West : 19
  - South-East : 7
  - Northern Ireland: 18

- Installed Capacity 1552 MW
  - TSO Connections: 46%
  - DSO Connections: 54%





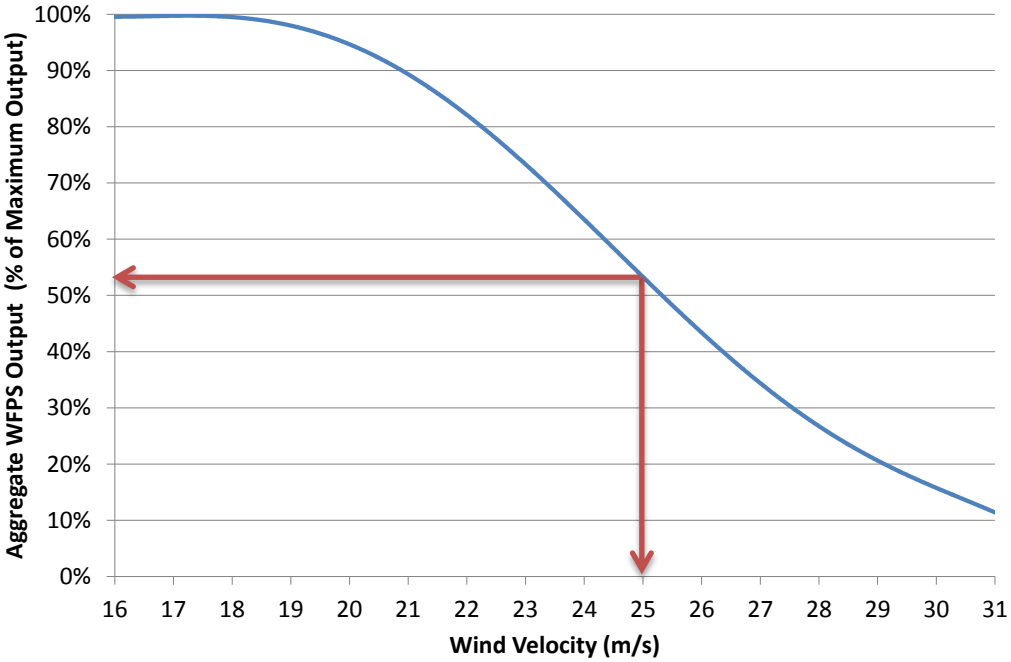
Findings

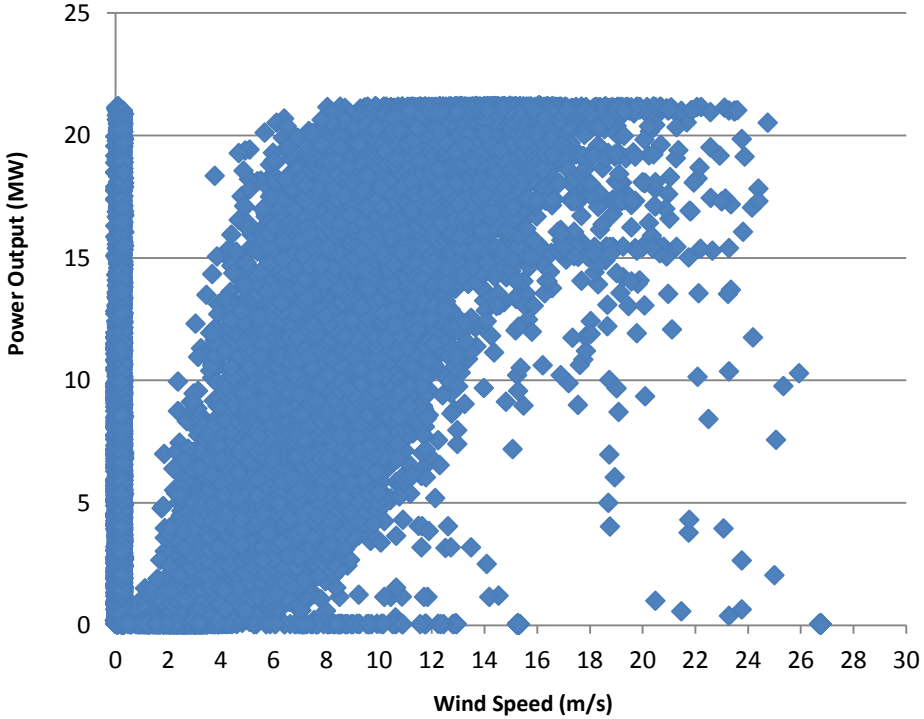
- Current Control Centre procedure remains valid
- Number of High Wind Speed Shutdown and Wind Speed signals not functioning correctly
- Varied wind turbine performance
- Some wind farms were more affected by high wind speed shutdown than others, due to turbine type and geographical location

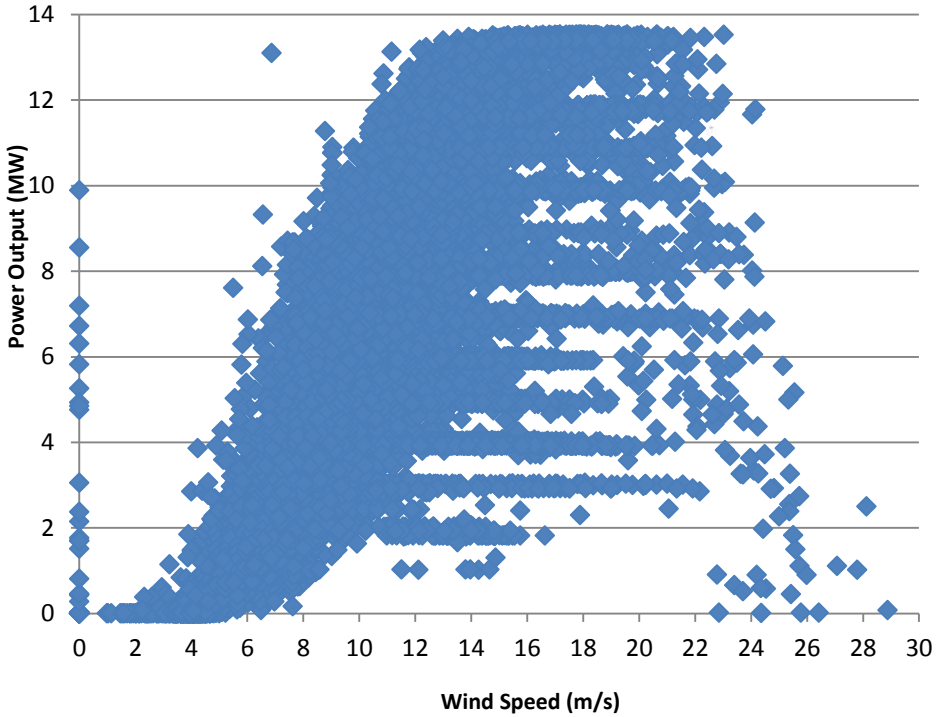
Control Centre Procedure

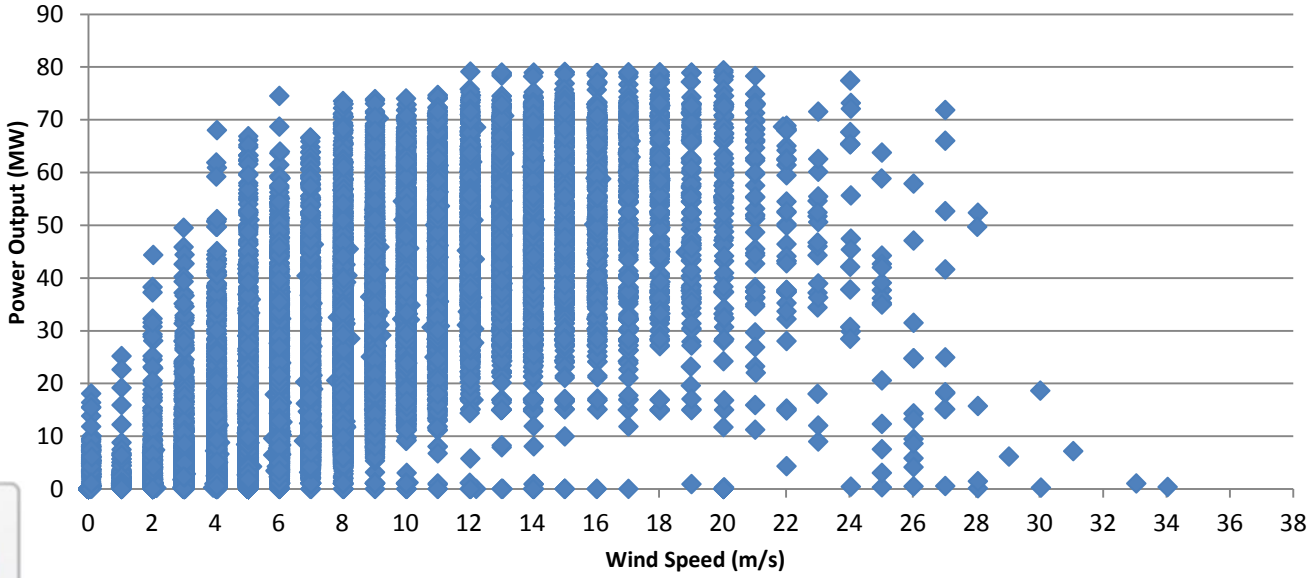
- High Wind Speed Shutdown Indicator: Forecast of <u>continuous</u> wind speeds in excess of 25 m/s

- Assume 50% of wind generation in affected areas disconnected

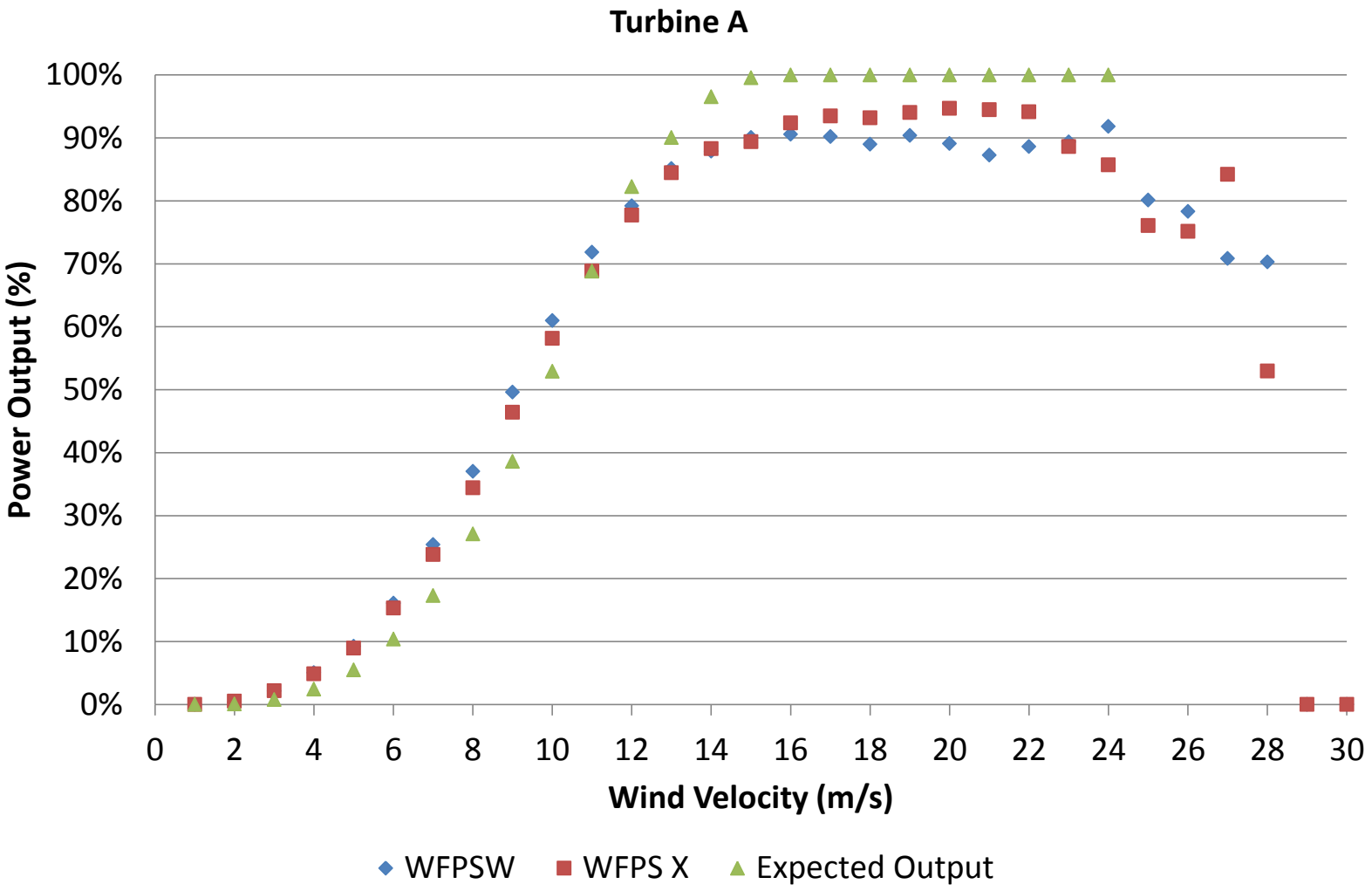



Power Output (MW)
Wind Speed (m/s)

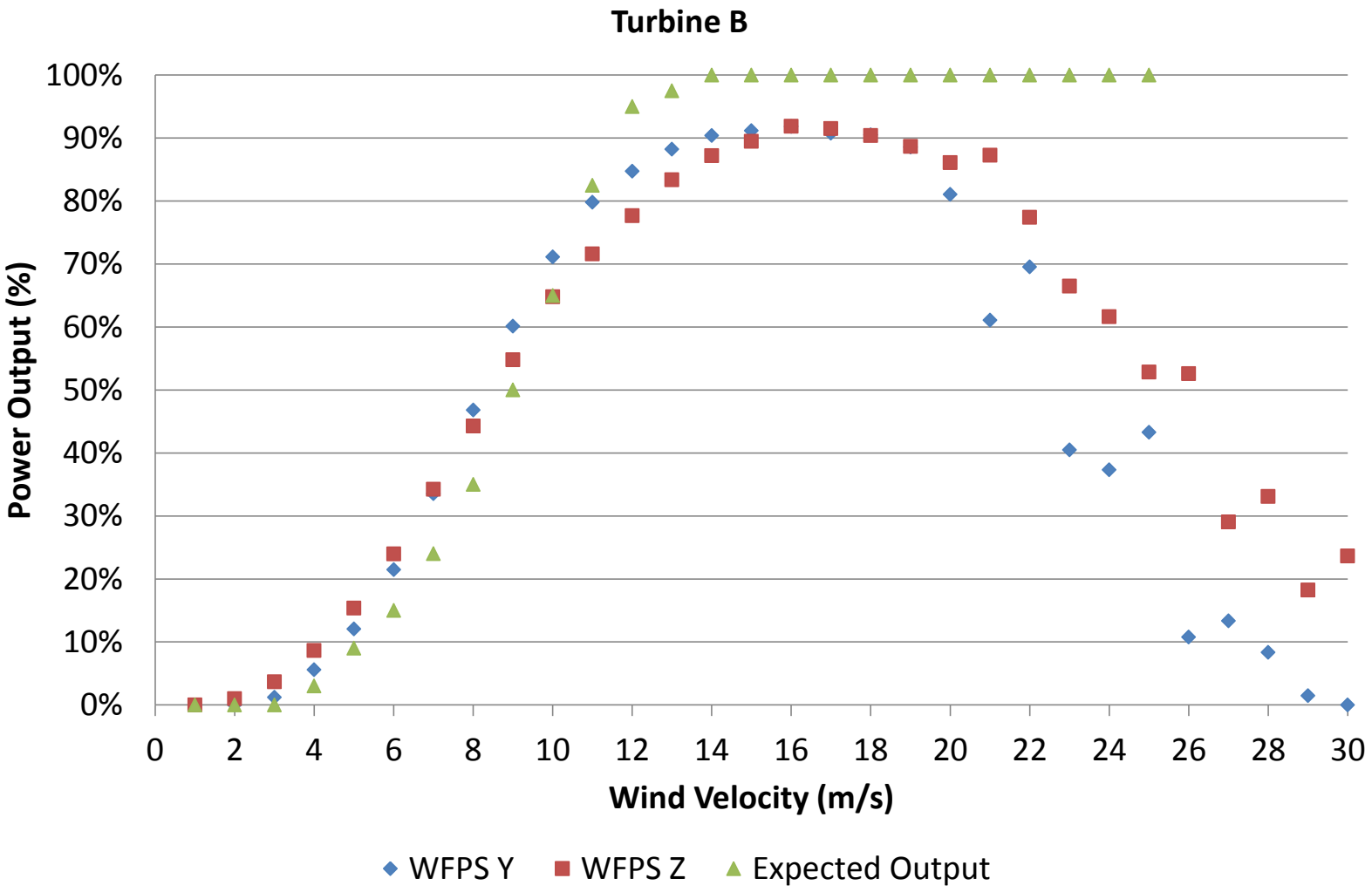

Power Output (MW)
Wind Speed (m/s)


Power Output (MW)
Wind Speed (m/s)

Wind Turbine Performance



Wind Turbine Performance



Next Steps

- Continue to operate current Control Centre High Wind Speed Shutdown procedure
- Follow up on wind farms with suspect signals
- Investigate requesting reports from windfarms post serious events
- 2014 report: Examine Storm Darwin

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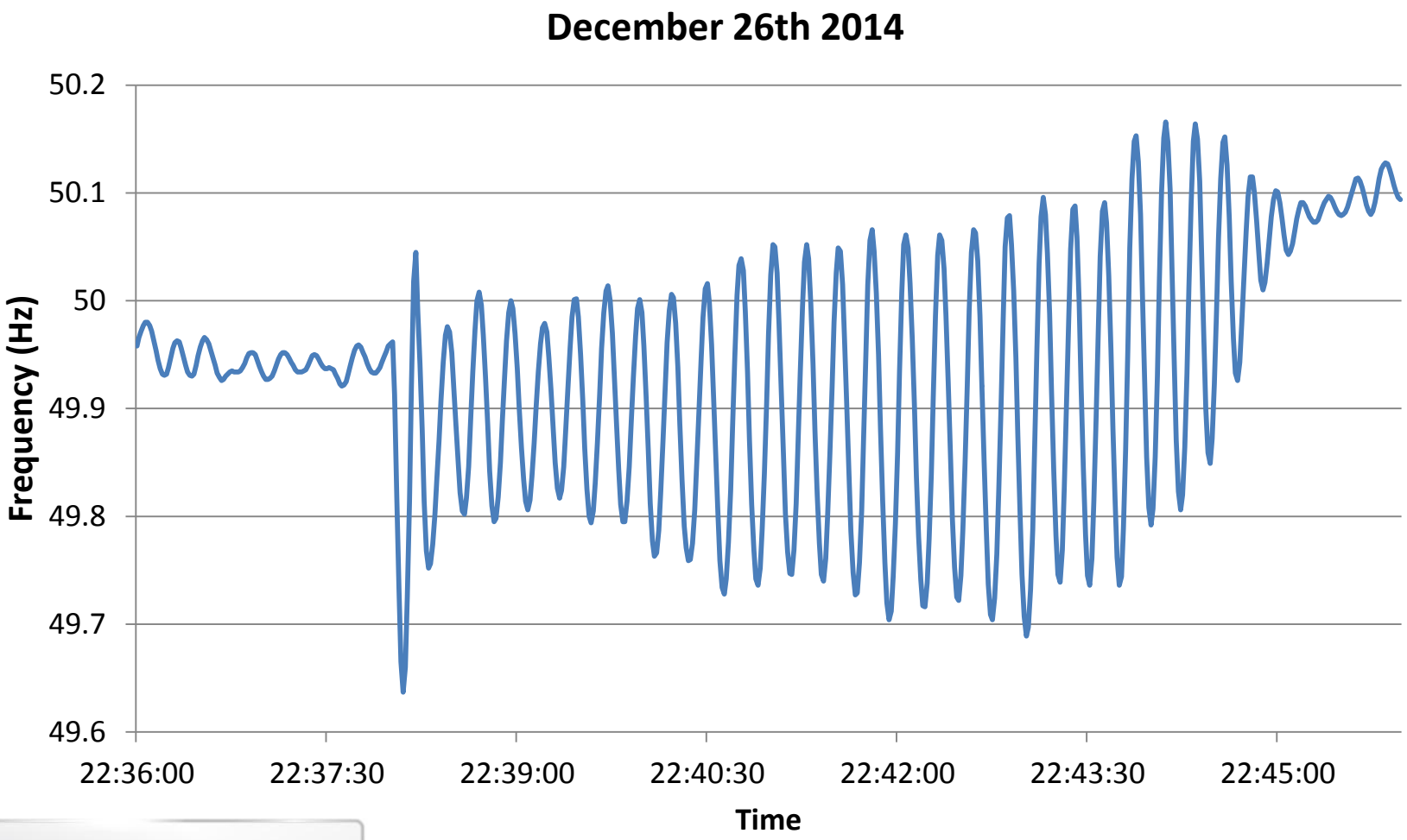
Recent Operational Experience

14th January 2015

Tom McCartan

Recent System Incident

Incident Currently under Investigation



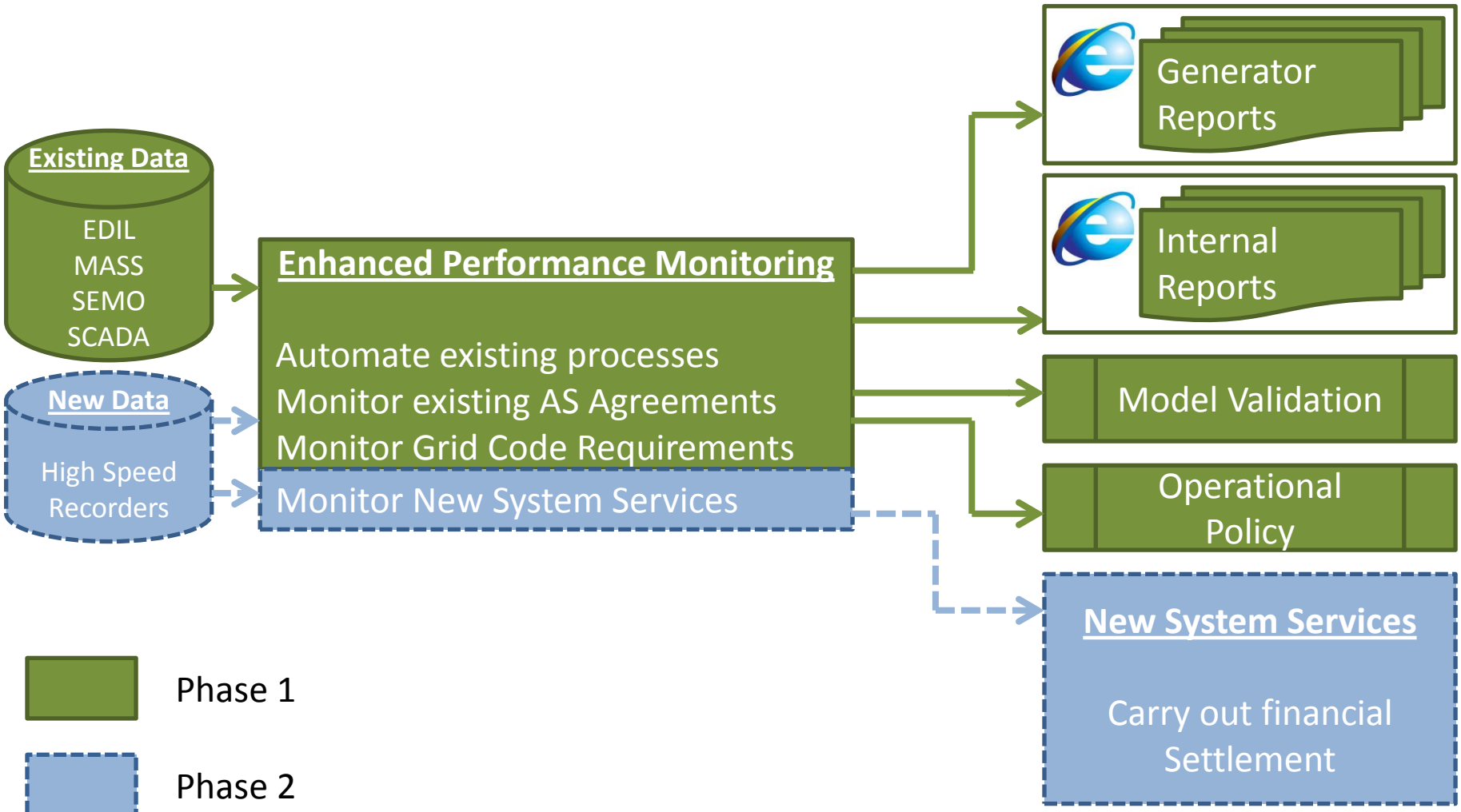
DS3: Synchrophasor System

System Frequency Measurements

Frequency Spectrum Analyser

Generator Stability Status

DS3: EPM System

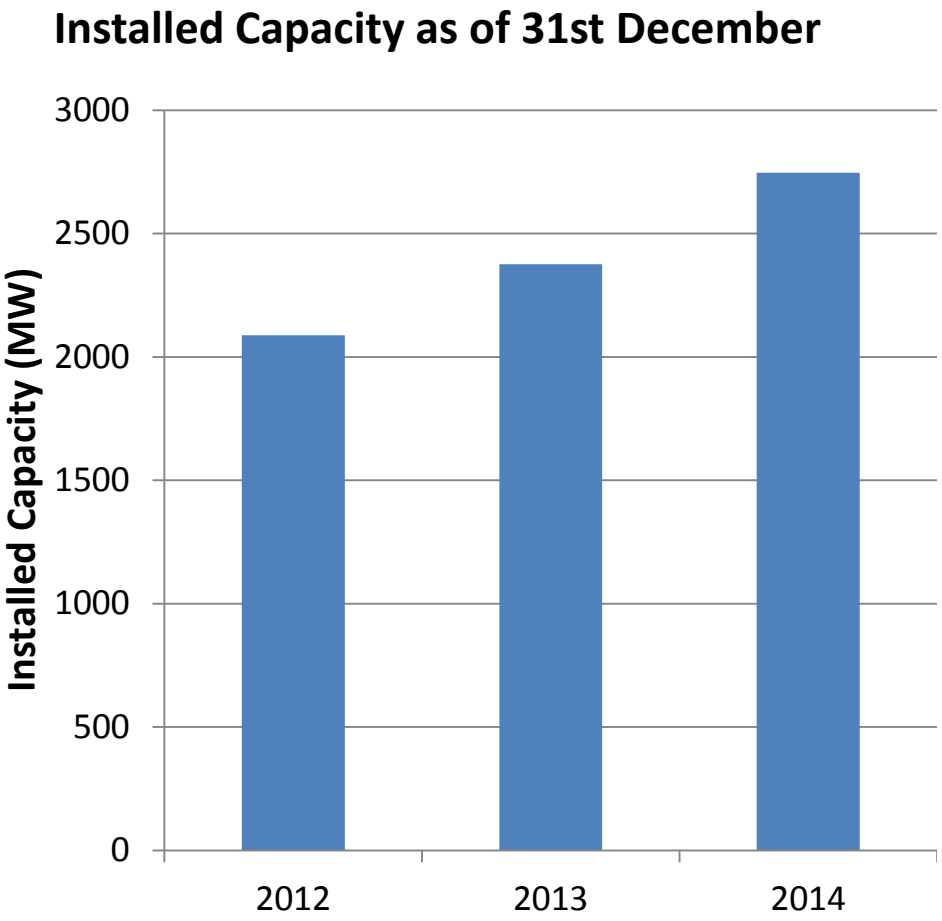


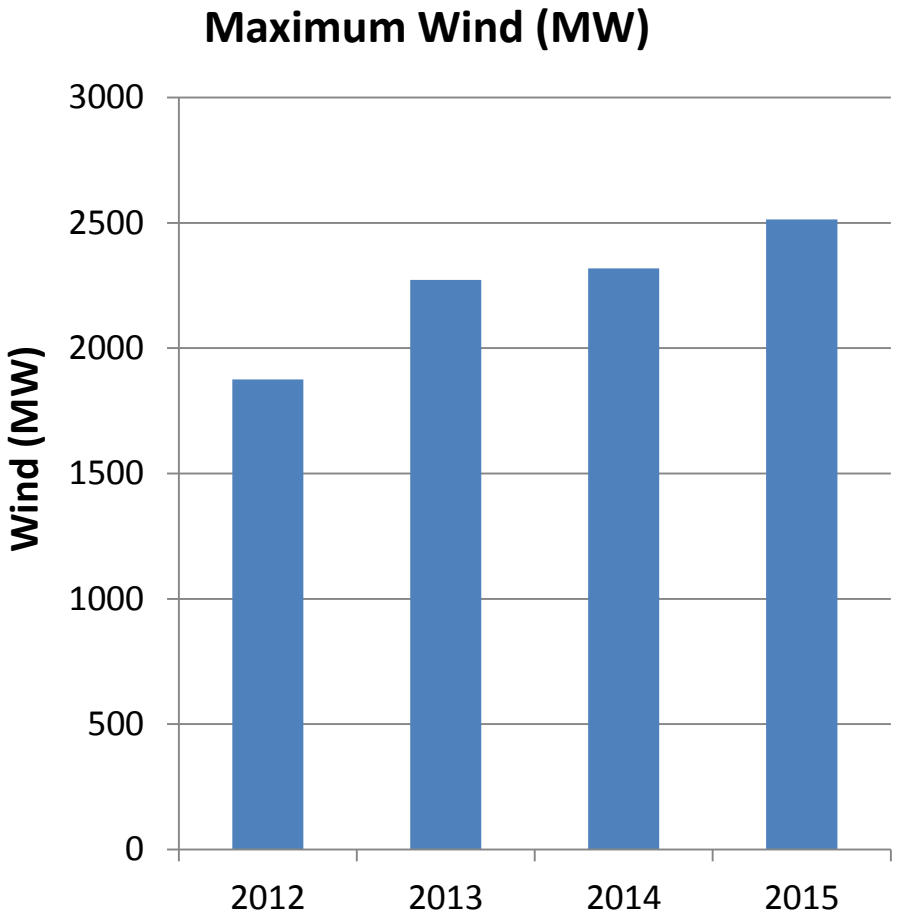
Phase 1

Phase 2

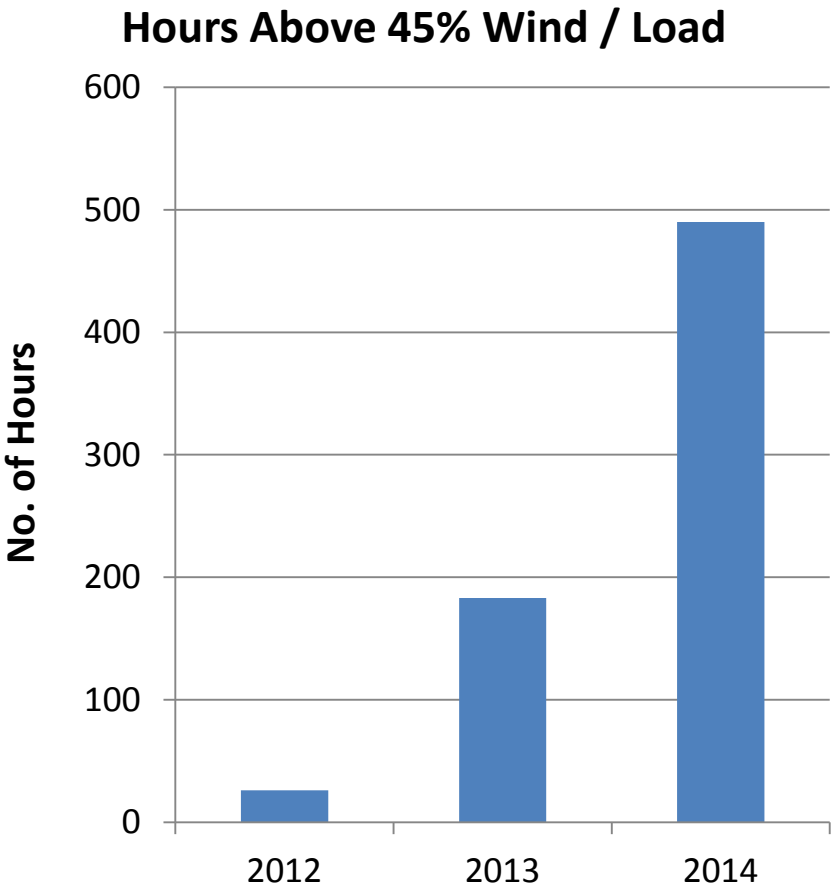
Wind Generation Statistics

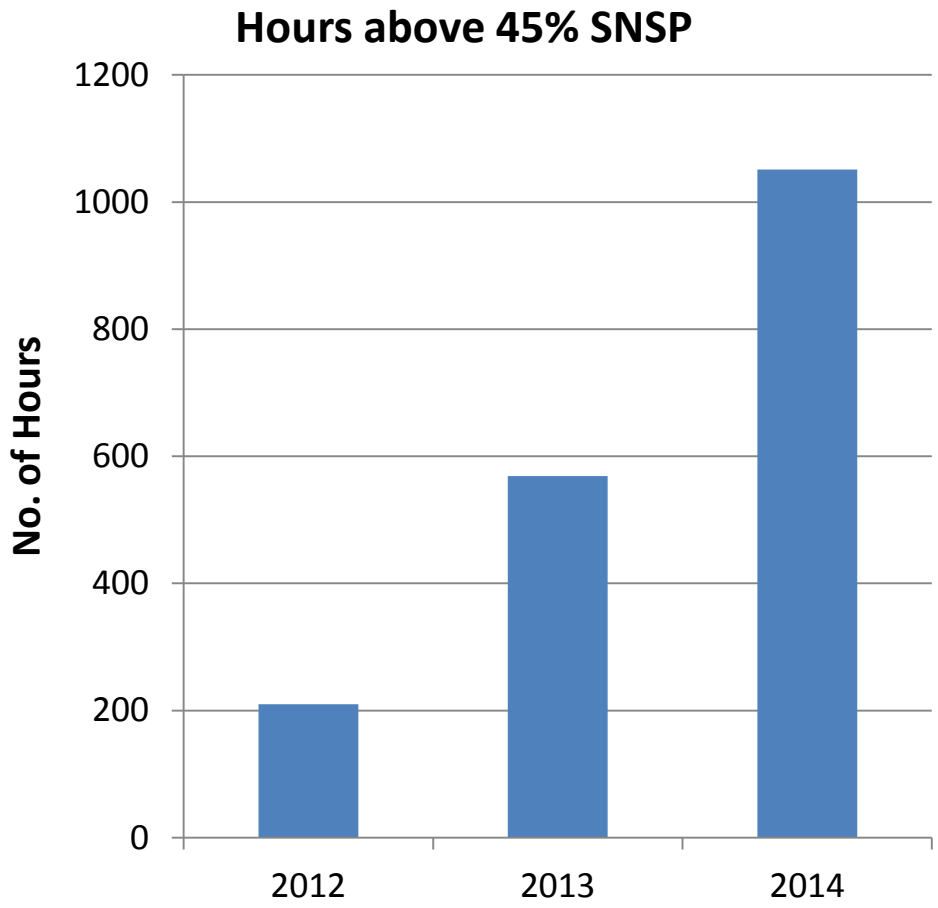
Installed Capacity & Maximum Wind



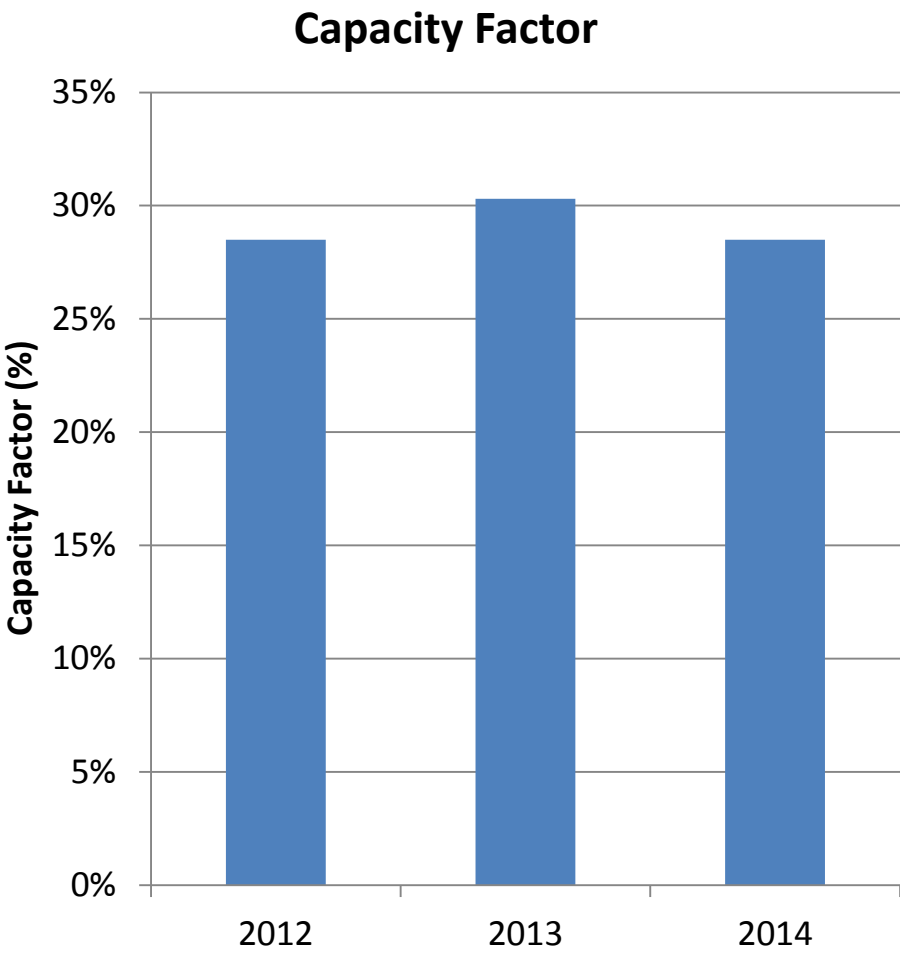


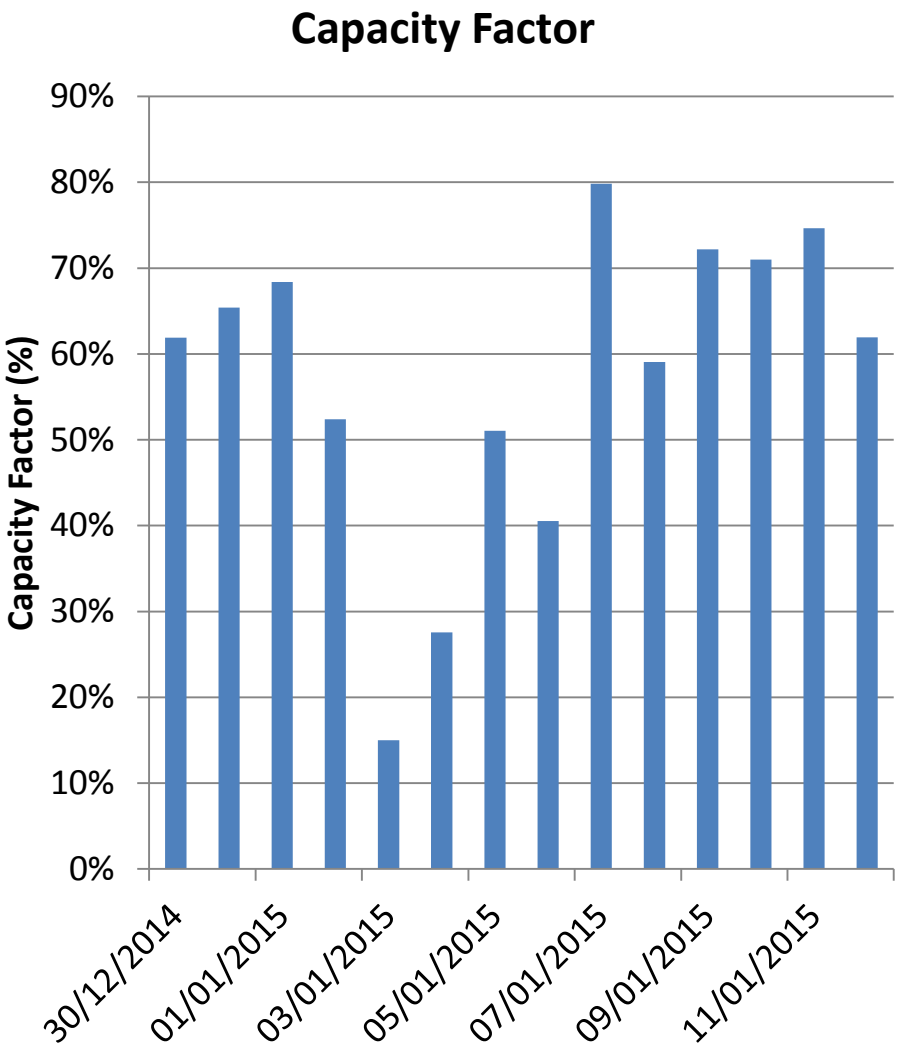
High Wind Trends



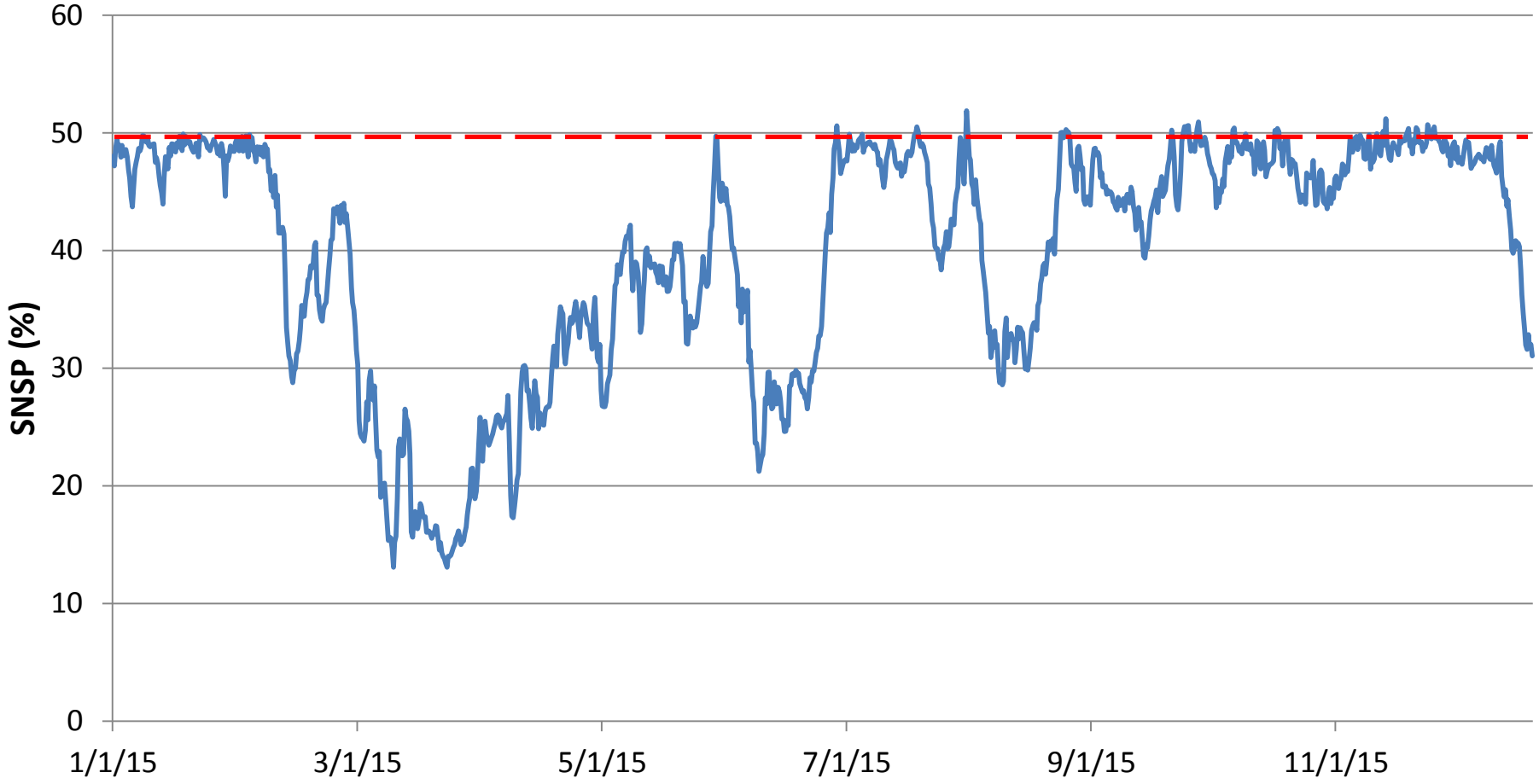


Wind Capacity Factor

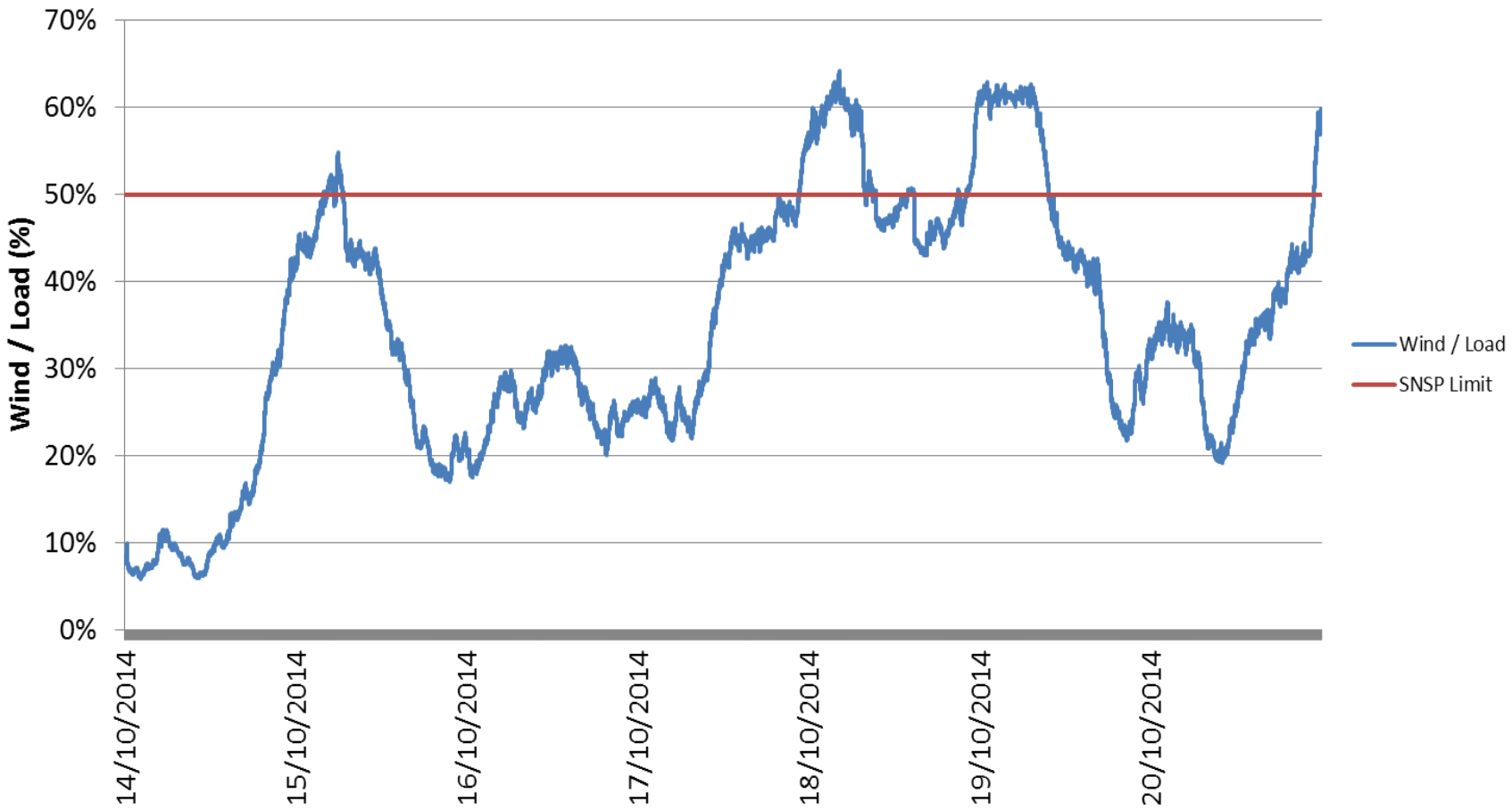




SNSP – Early 2015

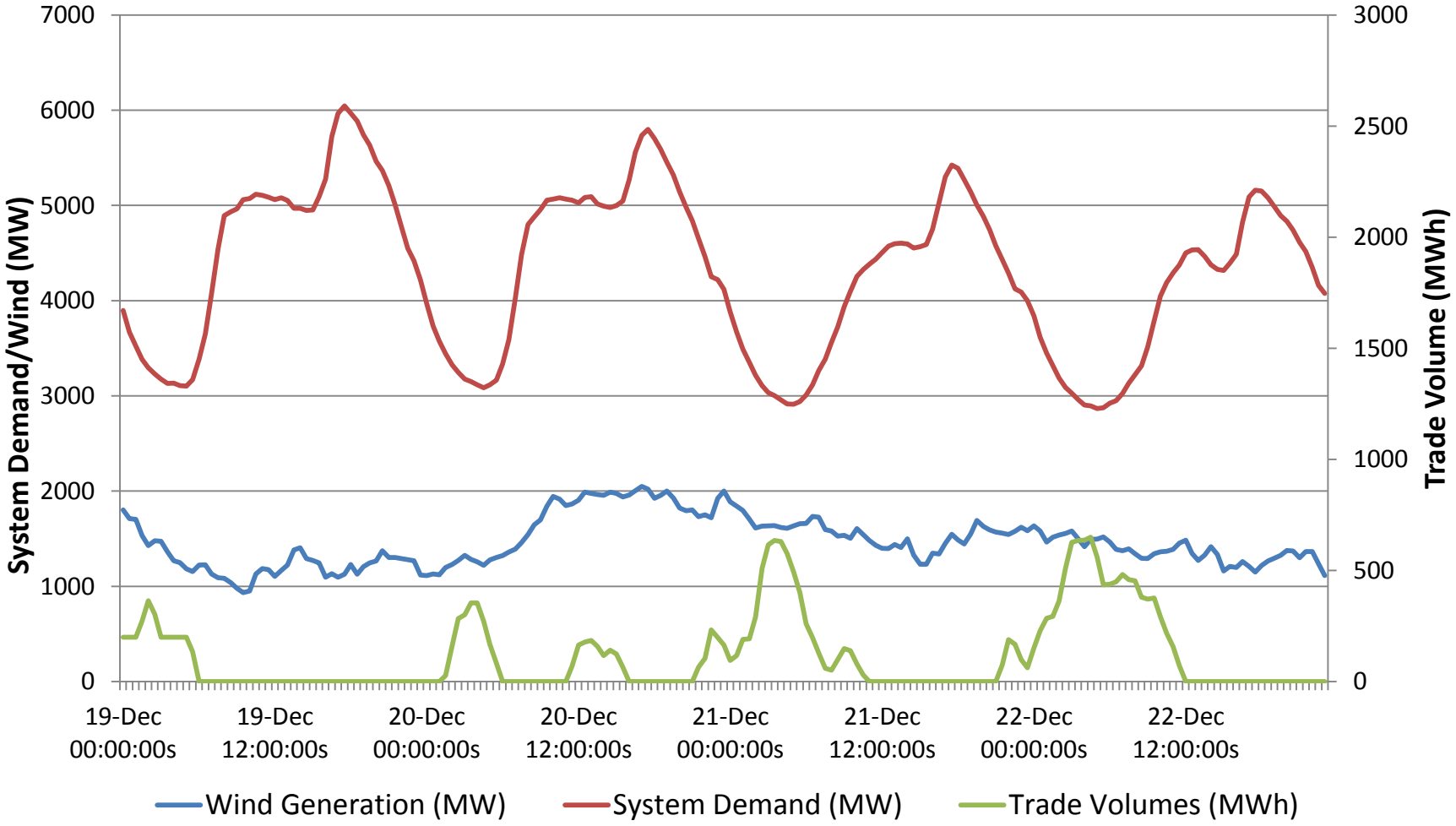


Example – Exporting When Wind/Load > 50%

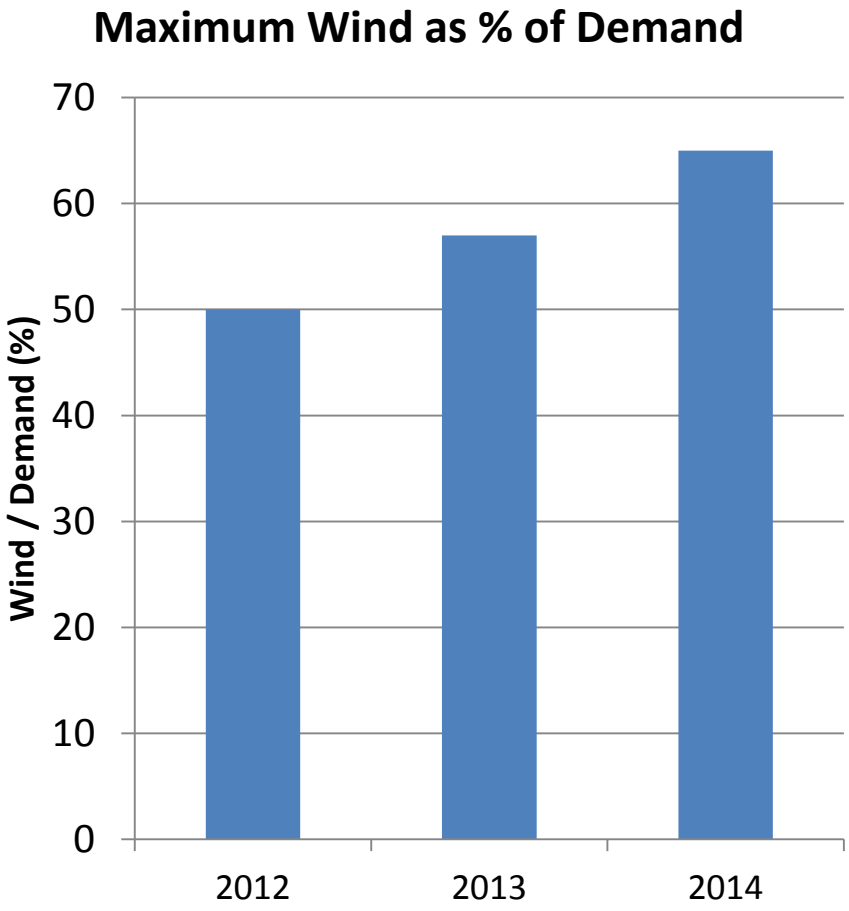


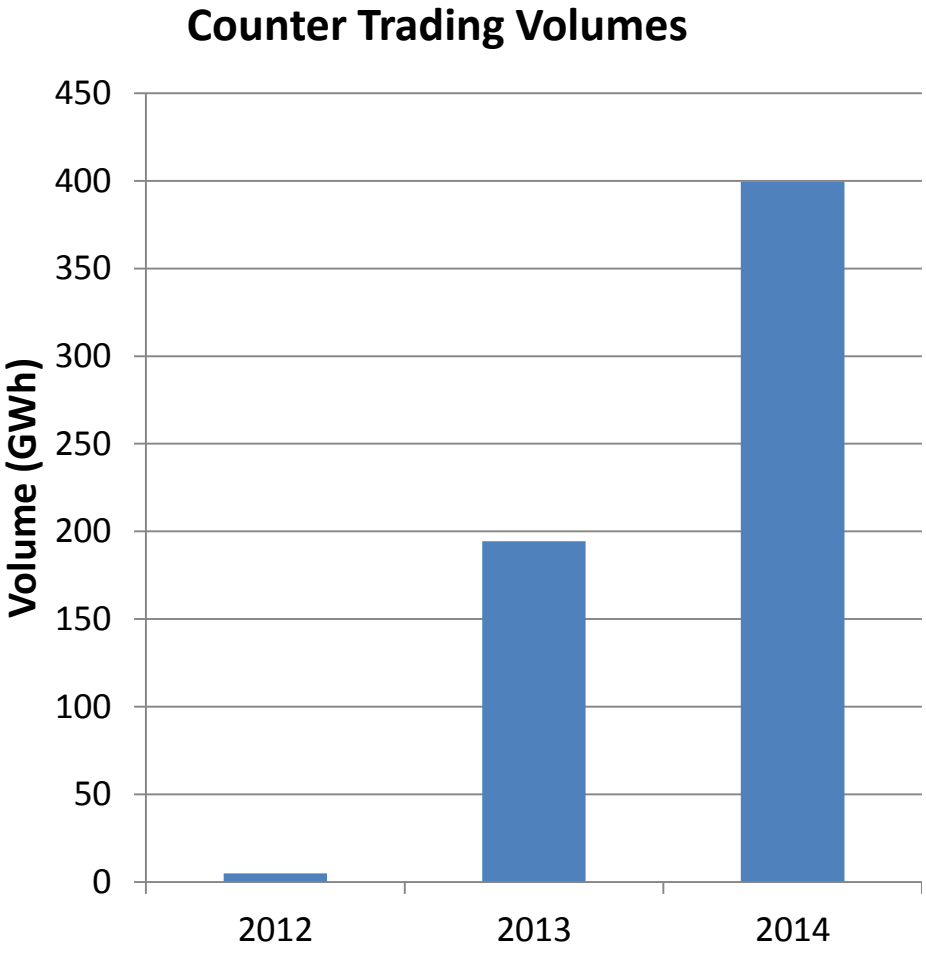
	2012	2013	2014
Maximum Wind as % of Demand	50	57	65

Counter Trading Example

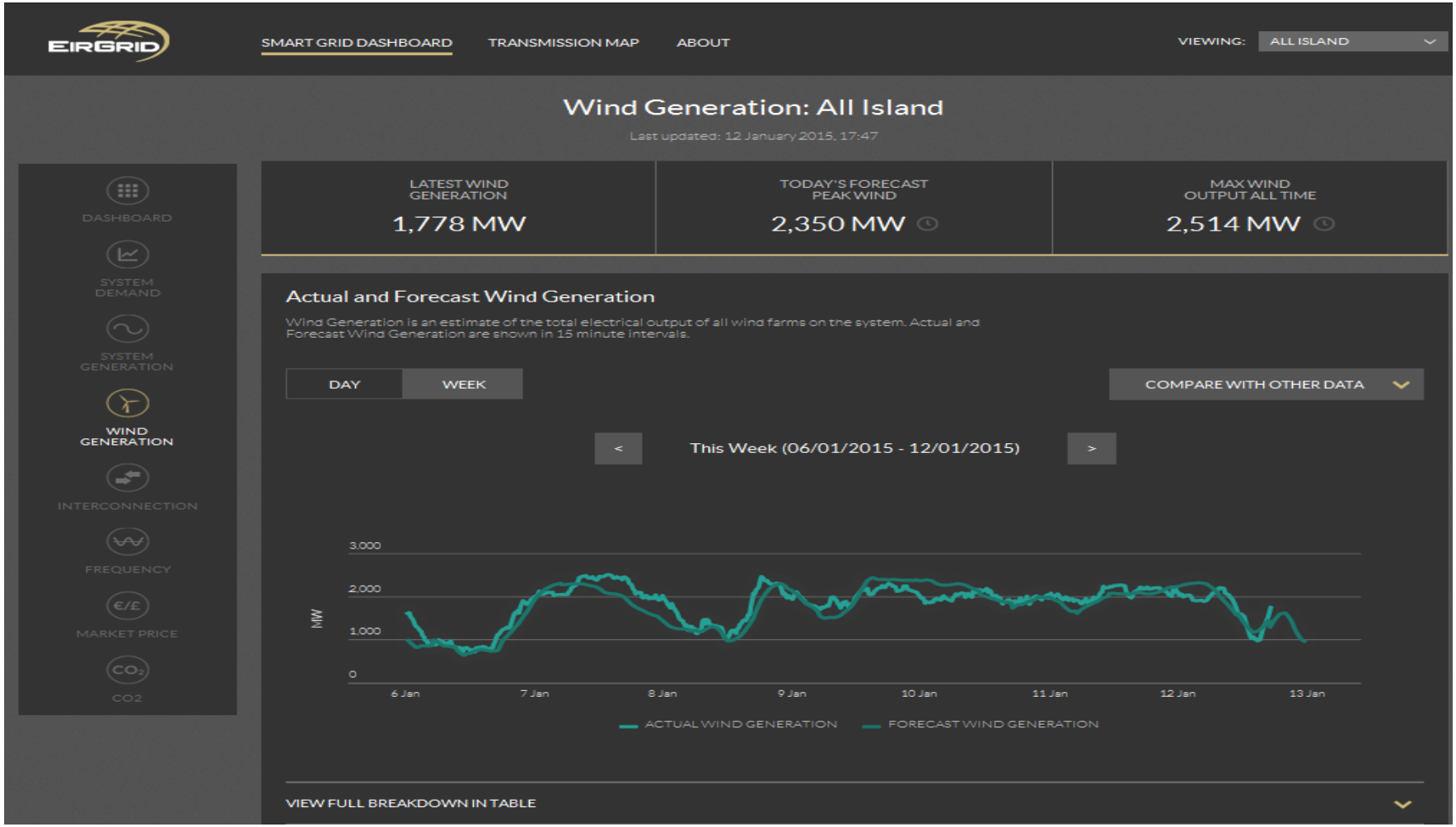


Max Wind % & Counter Trading





Smart Grid Dashboard



http://smartgriddashboard.eirgrid.com/#all

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