DS3 Programme Status Update

23rd September 2014

Robbie Aherne

DS3 – Shaping the System of the Future

Grid Code

Performance Monitoring

DSM

System Services

ROCOF

Frequency

Voltage

Renewable Data

WSAT

Control Centre Tools

Model Dev. & Studies

System Performance

Grid Code

Performance Monitoring

DSM

System Services

ROCOF

System Services

- DS3 System Services Procurement Design
  - *Competitive Multi Bid Auction* and *Regulated Tariff*
  - Industry workshop hosted by RAs on 29th July

- TSO concerns on competitive forces, practical implementation, product payment basis

- Decision paper by end of 2014
  - Detailed design in early 2015
  - Go live date Q3 2016

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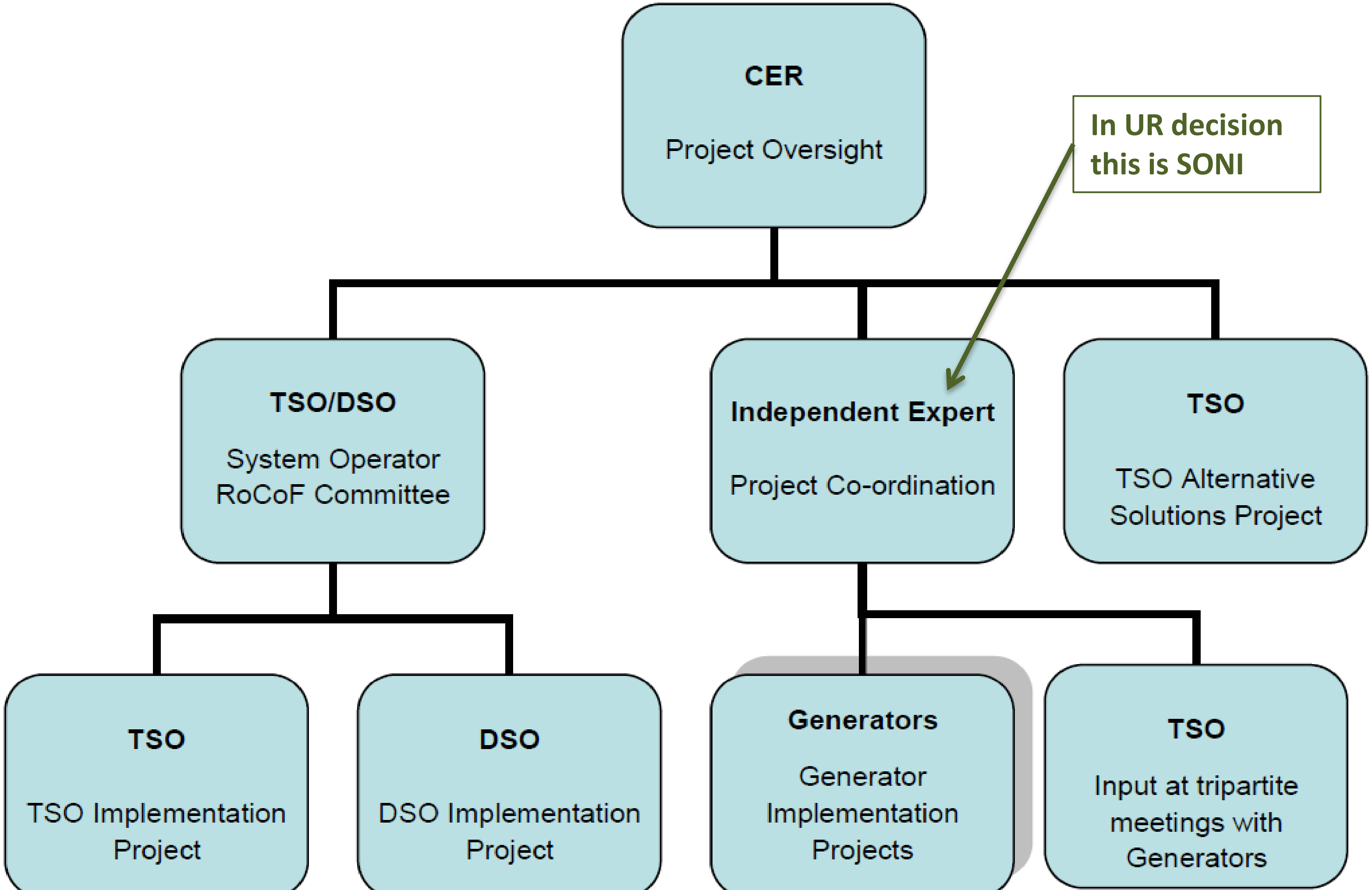
RoCoF Implementation Project



Demand Side Management

- DSU Grid Code Working Group
  - 4 modification approved by the Ireland GCRP
  - Further consultation on frequency requirements and performance monitoring
  - SONI to open consultation on Grid Code modifications

- ESBN and NIE expressed concerns about impact of DSUs on their system security

- Work on identifying and removing barriers to service provision close to completion

DSU
150 MW

AGU
85 MW

Powersave
10 MW

STAR
45 MW

Economy 7
Night Saver

DS3 – Shaping the System of the Future

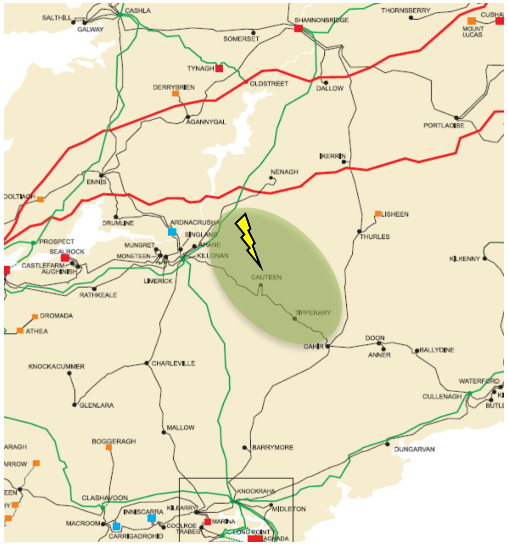
Frequency

Voltage

Renewable Data

Voltage Control

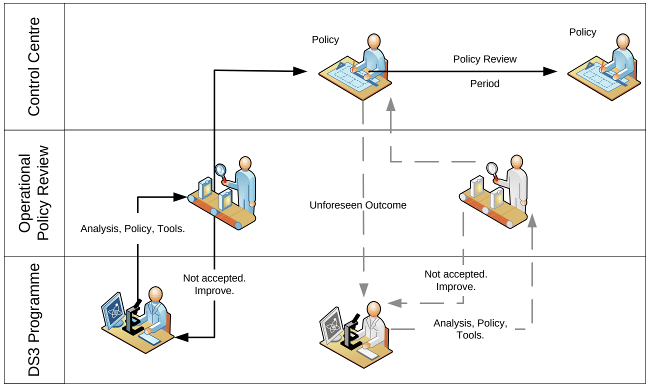
- ESBN implemented TSO-DSO agreed changes at Cauteen wind farm cluster
- Interim measure to improve voltage stability in the area
- Wider reactive compensation studies underway
  - Value of DSO windfarms: significant off setting of transmission reactive compensation requirements



2025	Power Factor of TYPE B Wind Farms @ CAUTEEN	MVAr Required @ CAUTEEN
WP	0.95 Leading	145
WP	0.98 Leading	105
WP	Unity Power Factor	55
WP	Voltage control ± 0.95	15

Operational Studies

- Voltage Dip Induced Frequency Dip (VDIFD) studies – due end October
- Ramping policy study and tool – due end 2014
- Automated approach to large scale dynamic studies using Plexos – pilot complete
- Windfarm models tuned to exhibit slow active power recovery
- Minimum no. of conventional generation – complete *
- High SNSP Report – H2 2013 complete *, H1 2014 almost complete *
- High wind speed shut down report – almost complete *



DS3 – Shaping the System of the Future

WSAT

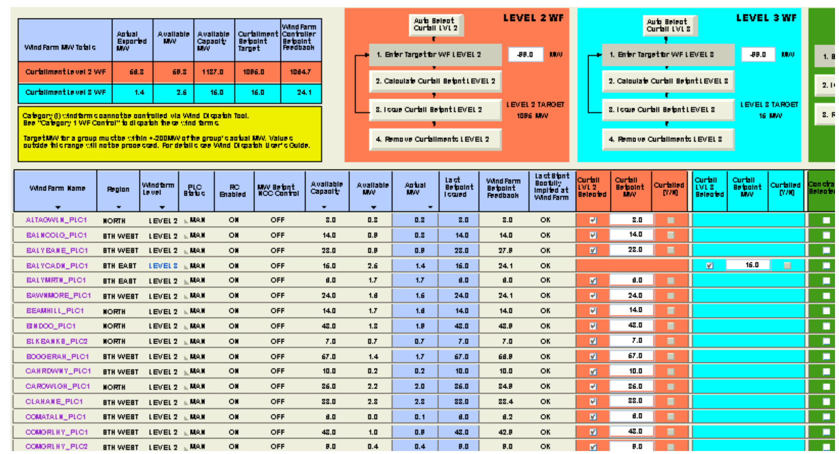
Control Centre Tools

Model Dev. & Studies

CCT and WSAT

CCT

- Wind dispatch tool went live in Belfast on 24/07/2014
  - *DCC Constraint*
  - *Developer Outage*
  - *High Frequency/Min Gen*
  - *RoCoF/Inertia*
  - *SNSP Issue*
  - *Test – Developer*
  - *Test – TSO*
  - *Transmission Constraint*



WSAT

- Validation of dynamic model performance underway – (1) tuning and (2) cross validation using real events

Advisory Council

- Recent engagement

- Membership update
  - National Grid UK
  - Large Energy Users
  - Demand Side Management
  - HVDC interconnection

DS3 – Since 2011….

- 652 MW of additional wind
- 150 MW of demand side units
- 27 x Grid Code modifications
- 7 x Reports through OPR Committee (est. Q2 2014)
- 6 x new control centre tools
- 3 x System Services consultations
- 10 x Advisory Council meetings
- 10 x Industry Forums
- 4 x Annual Renewable Reports
- ……..

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Rate of Change of Frequency (RoCoF)

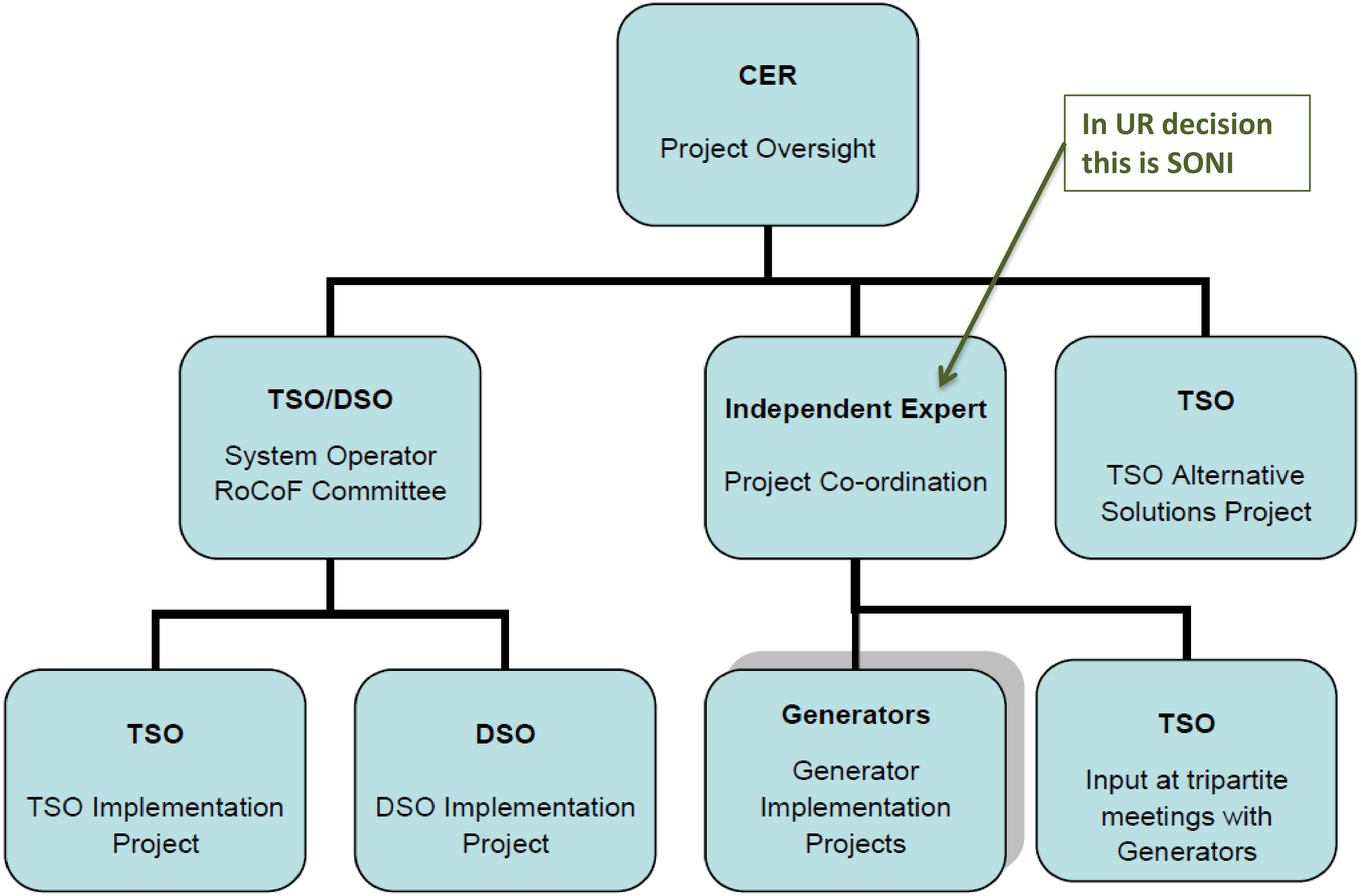
23rd September 2014

Eoin Kennedy

Presentation Overview

- Background
- TSO-DSO Implementation Project
- Generator Project
- Alternative Solutions Project

RoCoF Implementation Project



TSO- DSO Project

- Managed through existing TSO-DSO governance structure
- Loss of Mains (LoM) protection setting change process initiated by DSOs
- Some LoM protection settings will remain at 0.5 Hz/s or lower and will need to be managed

Generation Project

- Proposed categorisation of generator study priorities by TSOs completed

- CER expect to appoint ‘Independent Expert’ very soon

- Studies undertaken by generators over 18 – 36 months
  - Divergence in timescales between Ireland and Northern Ireland

- TSOs intend to co-ordinate all relevant aspects of our consideration of issues, and engagement with industry/RAs as far as possible

Generator Categorisation

- TSOs' assessment of prioritisation based on:
  - Run hours (existing/forecast)
  - Constrained-on
  - Priority dispatch

- TSOs are available to discuss categorisations with generators ahead of trilateral discussions with Ind. Expert

Category	Northern Ireland Units				Ireland Units			
	Station	Unit ID	Capacity (MW)	Owner	Station	Unit ID	Capacity (MW)	Owner
1- High Priority 18 mths	**Kilroot**	K1	194	AES	**Turlough Hill**	TH1	73	ESB
		K2	194	AES		TH2	73	ESB
	Ballylumford	B10	97	AES		TH3	73	ESB
		B31	245	AES		TH4	73	ESB
		B32	245	AES	**Moneypoint**	MP1	285	ESB
	Coolkeeragh	C30	402	ESB		MP2	285	ESB
						MP3	285	ESB
					Sealrock	SK3	81	AAL
						SK4	81	AAL
					Poolbeg CCGT	PBC	463	ESB
					Aghada CCGT	AD2	431	ESB
					Whitegate CCGT	WG1	444	Centrica
					Edenderry	ED1	118	EPL
					Meath W2E	IW1	15	Indaver
2- Mid Priority 24 mths	(UR decision does not reference a 24 month period)				**Huntstown**	HNC	337	Viridian
						HN2	395	Viridian
					Dublin Bay	DB1	399	SynerGen
					Tynagh	TYC	384	TPL
					Aghada	AD1	258	ESB
3 - Low Priority 36 mths	**Ballylumford**	BST4	170	AES	**Edenderry OCGTs**	ED3	58	EPL
		BST5	170	AES		ED5	58	EPL
		BST6	170	AES	**Tawnaghmore**	TP1	52	SSE
		BGT1	58	AES		TP3	52	SSE
		BGT2	58	AES	**Rhode**	RP1	52	SSE
	Kilroot	KTG1	29	AES		RP2	52	SSE
		KTG2	29	AES	**Aghada OCGTs**	AT1	90	ESB
		KTG3	42	AES		AT2	90	ESB
		KTG4	42	AES		AT4	90	ESB
	Coolkeeragh	CTG8	53	ESB	**Tarbert**	TB1	54	SSE
	AGU*		12	Contour Global		TB2	54	SSE
	AGU*		74	iPower		TB3	241	SSE
	AGU*			EmPower		TB4	243	SSE
	***Further consideration required for AGUs connected at and below 33kV.**				**Lough Ree**	LR4	91	ESB
					West Offaly	WO4	137	ESB
					Ardnacrusha	AA1-4	86	ESB
					Erne	ER1-4	65	ESB
					Lee	LE1-3	27	ESB
					Liffey	LI1,2,4,5	38	ESB
					Marina	MRC	88	ESB
					North Wall	NW5	104	ESB
4 - Exempted (Closing)	(None)				**Great Island**	GI1	54	SSE
						GI2	49	SSE
						GI3	109	SSE
5 - New (Currently undergoing compliance assessment)	(None)				**Great Island CCGT**	GI4	431	SSE

Alternative Solutions Project

- Joint project by TSOs
- Communication with industry via DS3 Advisory Council and website

Phase 1 (Oct 2014 – Feb 2015)

- Range of theoretical options assessed at a high level via weighted scoring matrix approach
- Subset of viable options (2 to 3) selected for Phase 2 analysis

Phase 2 (March 2015 – March 2016)

- More detailed review of the viable options from Phase 1
- Analysis focused on technical and financial aspects of each option

Alternative Solutions – Phase 1

- Qualitative assessment resulting in a shortlist of 2 to 3 options

- High-level criteria
  - Technology maturity
  - Effectiveness in achieving policy objective
  - Operability
  - Ability to deliver to required timelines
  - Costs and benefits
    - Investment and operational costs i.e. cost to consumer
    - Benefits
  - Others?

- Share analysis and conclusions with industry and consider responses before starting Phase 2

Possible Phase 1 Options

Industry invited to submit other potential solutions

Operational Strategy

1. Operational measures
   a) Carry higher levels of fast-acting reserve if available
   b) Reduce the size of the largest single infeed
   c) Operate with a small number of non-RoCoF compliant generators

2. Load management (i.e. more aggressive UFLS, installation of reactors, reduction in voltage, demand side response, STAR)

3. "Parking" of machines

Infrastructure Investment

4. Installation of synchronous compensators

5. Use of synthetic inertial response (HVDC and wind)

6. Storage

7. Reduce the min MW generation thresholds of conventional generation

8. Construction of AC interconnectors to Great Britain

9. Use of combination of synchronous compensators, synthetic inertial response, flywheels, and storage

Other potential solutions

- Industry invited to submit other potential solutions and assessment criteria

- Email to DS3@eirgrid.com by Friday 10th October

Alternative Solutions – Phase 2

- Technical and economic studies of shortlisted options
  - Dynamic simulations
  - Plexos studies to assess economic benefit

- Cost-benefit analysis

Summary

- LoM protection setting change process initiated
- Proposed categorisation of generator studies completed
- Alternative solutions project set to commence
  - Industry invited to submit potential solutions by 10^{th} October
- Bulk of RoCoF work about to get underway

Thank You

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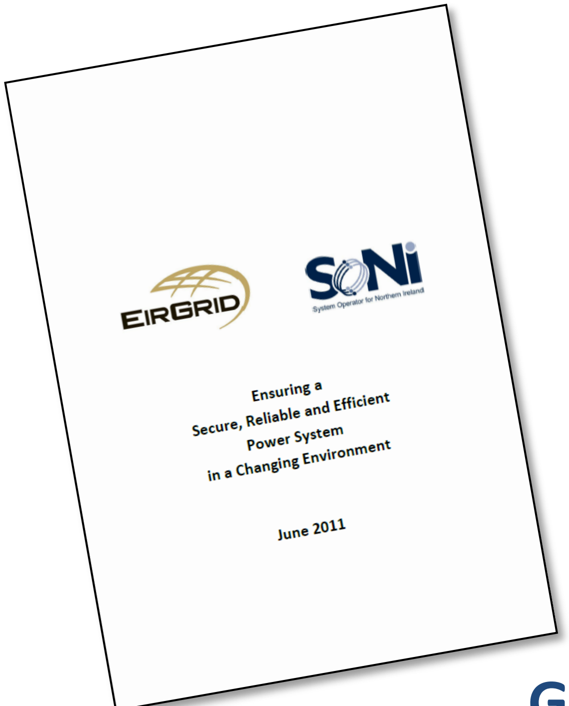
System Services Volumes Discussion

23rd September 2014

Simon Tweed

Ensuring a Secure, Reliable and Efficient Power System (2011)


Ensuring a
Secure, Reliable and Efficient
Power System
in a Changing Environment

June 2011

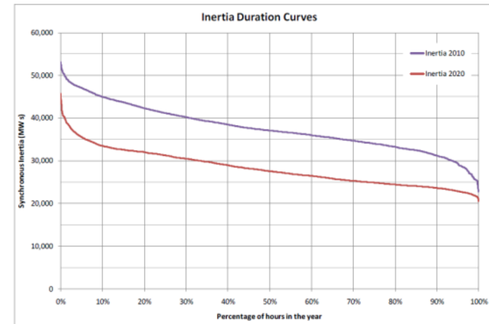
SYNC REACTIVE POWER

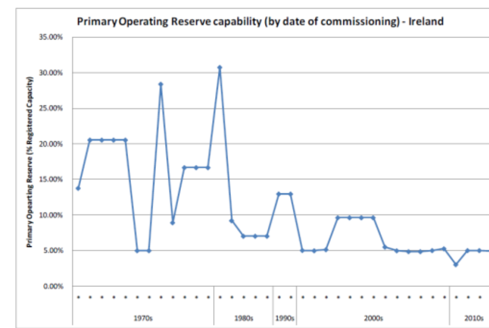
INERTIA

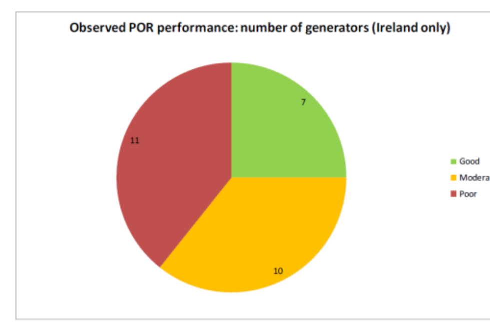
RAMPING

GEN RESERVE CAPABILITY

GEN PERFORMANCE



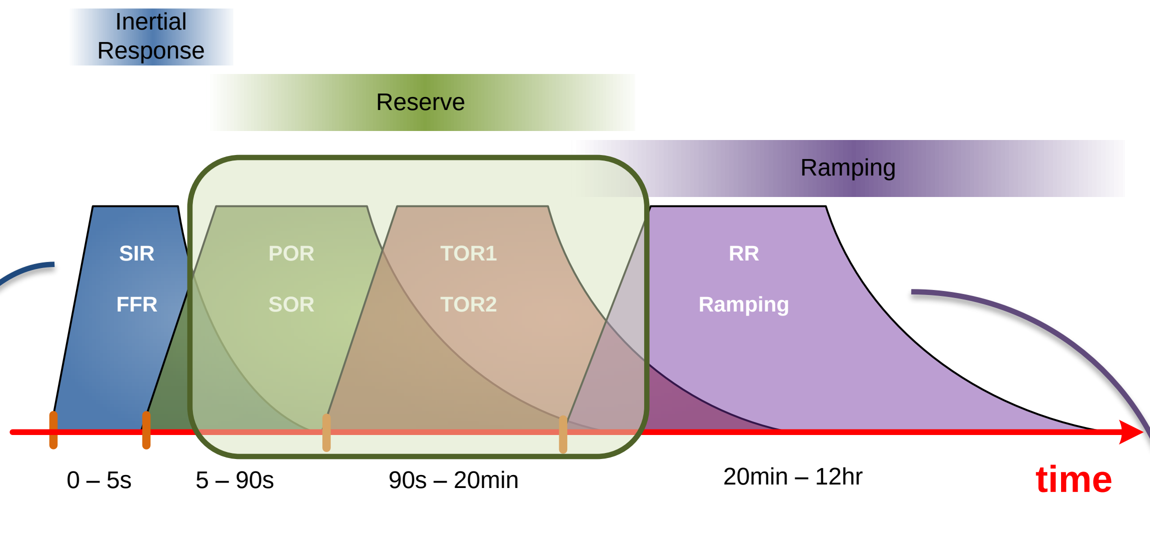




System Services Requirements

- The current portfolio does not deliver the technical capability required to meet the 2020 RES targets.
- There are a range of potential portfolio solutions.
- Each individual component of a solution has its own technical characteristics – i.e. particular System Services that it can / cannot provide.
- By setting the volume of individual System Services a particular technical outcome may be determined and advantage / disadvantage certain technology types.

System Services Frequency Products



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

- Ramping Margin

System Services 3rd Consultation

Generation Investment Scenario (table 2)

	Capital Cost *(€/MW or €/Mvar)*	**Volume** *(MW or Mvar)*	**Total cost** *(€m)*
Enhanced Wind (incremental cost)	€139,000	1300	€181m
Enhanced New CCGT	€30,000	450	€14m
Improve Existing CCGTs	€122,000	2000	€244m
Enhanced OCGT (incremental cost)	€74,000	400	€30m
Sync Comp conversion	€63,000	200	€13m
STATCOM (total cost)	€109,000	500	€55m
TOTAL			**€535m**

	Capital Cost *(€/MW or €/Mvar)*	**Volume** *(MW or Mvar)*	**Total cost** *(€m)*
Synch Comp / Flywheel	€766,000	840	€643m
Enhanced OCGTs - Strategic Reserve	€724,000	400	€320m
Batteries	€829,000	0	
STATCOM	€109,000	2,500	€303m
TOTAL			**€1,206m**

Alternative Investment Scenario (table 3)

System Services - Requirements

- **Real Time** and **Portfolio** requirements

- The **Portfolio** must be capable of meeting the full range of system conditions (e.g.):
  - demand ranging from 2000 MW to 7000 MW
  - wind up to 4700 MW
  - full import to full export
  - largest infeed / outfeed: 200 MW to 500 MW
  - transmission infrastructure build-out and outages
  - service provider size / location / capability / performance

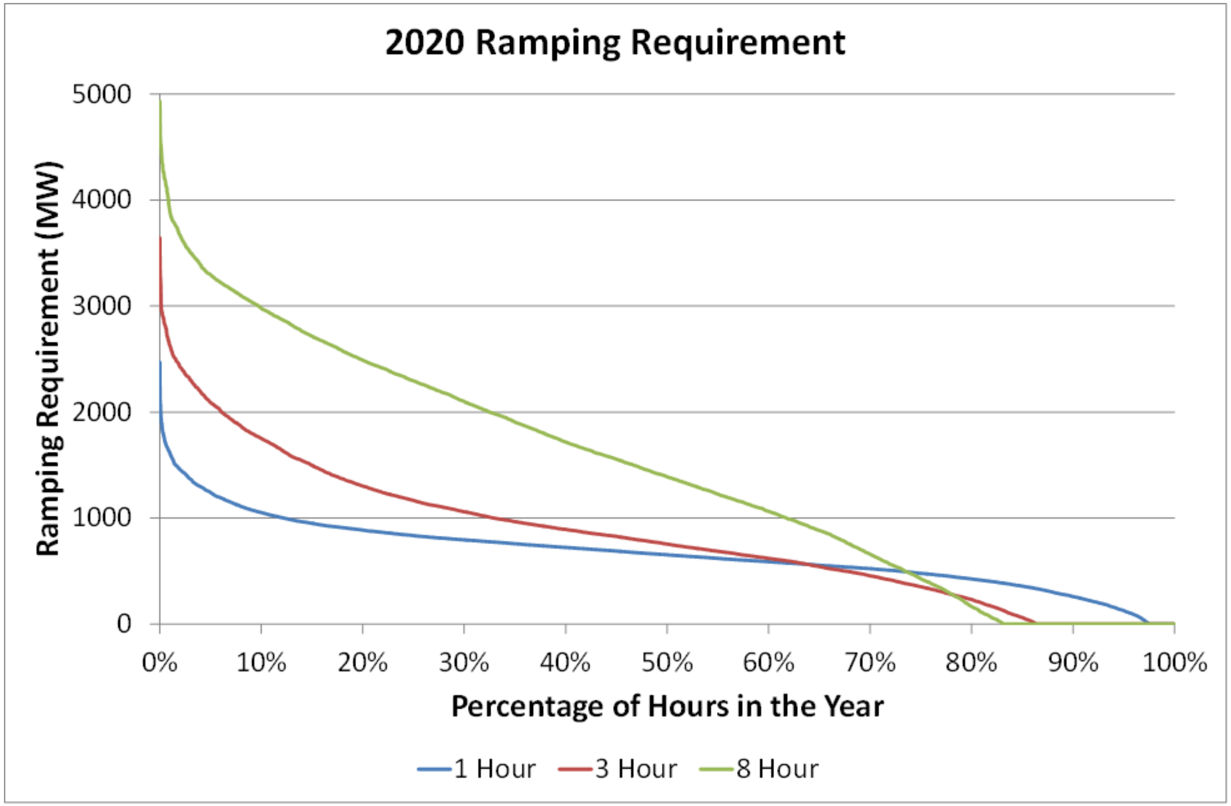
- The **Real-time** requirements for System Services vary with these system conditions and also needs to take into account the cost of delivering the services.

Requirements – POR / SOR / TOR

	POR	SOR	TOR
Current Rules (Aug 2014)	75 % of LSI*	75 % of LSI*	100 % of LSI*
2013/4 Average Requirement	300 MW	300 MW	400 MW
2013/4 Average Available	412 MW	589 MW	688 MW
2020 Average Requirement	266 MW	266 MW	355 MW
2014/2020 Maximum Requirement (LSI = 500 MW)	375 MW	375 MW	500 MW

*LSI = Largest System Infeed.
Current maximum is EWIC = 500 MW

Requirements – RM1 / RM3 / RM8



	1-hour	3-hour	8-hour
2020 Average Requirement	666 MW	829 MW	1444 MW
2020 Maximum Requirement	2471 MW	3643 MW	4933 MW

System Services Requirements

- While the TSOs have already published indications of future system requirements it is important that further information is provided to developers to indicate future product requirements.

- Significant effort is required to estimate volumes for ‘newer’ products of Synchronous Inertial Response (SIR), Fast Frequency Response (FFR) and Dynamic Reactive Response (DRR).

- It must be recognised that portfolio assumptions will influence the volumes required.

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Industry Perspective

23rd September 2014

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Gaelectric Holdings Limited
Colin Spain – Head of Energy Markets

DS3 from the CAES Perspective

- **DS3 Advisory Council Meeting**
- **23rd September 2014**

Contents

Introduction - Gaelectric Group

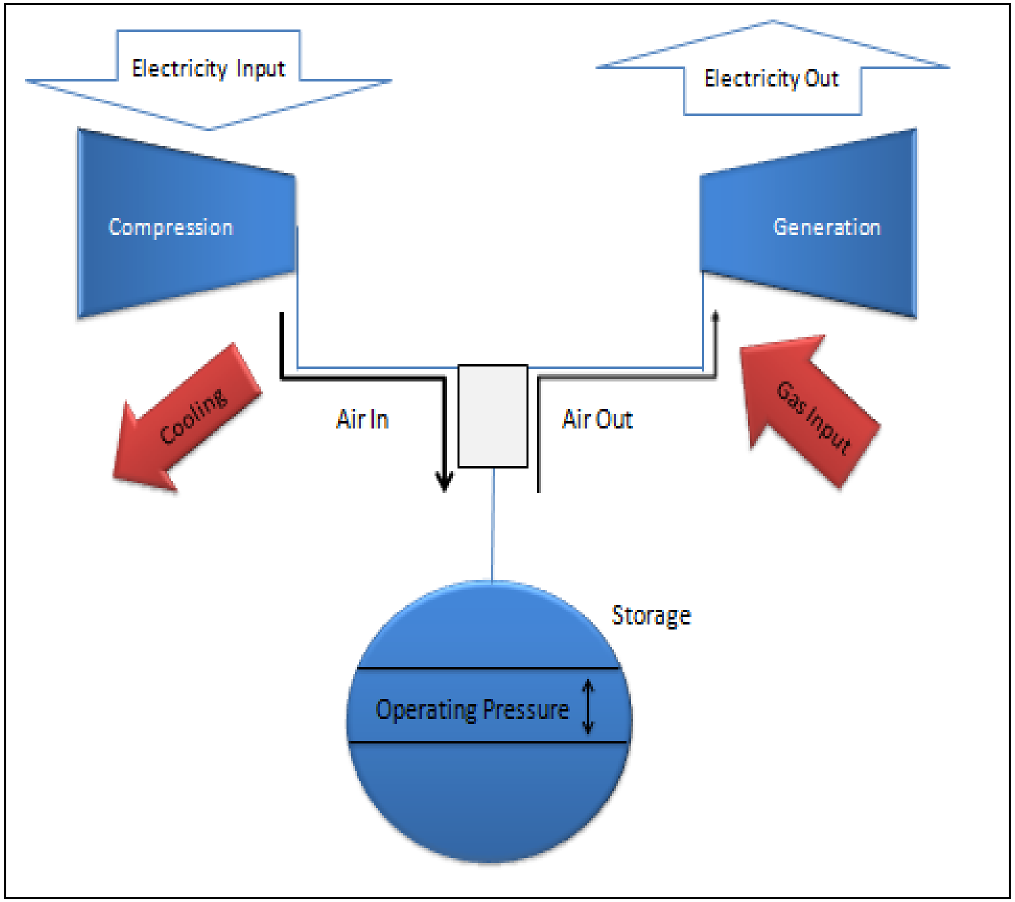
- Gaelectric Energy Holdings was established in 2006, currently employs 70 people in Ireland & US
  - Biomass – recently purchased Imperative Energy
- Ireland / NI Wind Development:
  - Manage 60MW in operation
  - 42MW Dunbeg wind farm - COD in Nov 2014.
  - Further 150MW in development
- US Wind
  - 550MW Wind Farm in Montana awaiting PPA to Pacific Northwest
- Storage
  - Developing a Compressed Energy Storage (“CAES”) 268MW in Larne NI
  - Investigating developing distributed storage in Ireland.
  - Further feasibility on CAES in UK & Europe also underway.

CAES: Technical Characteristics

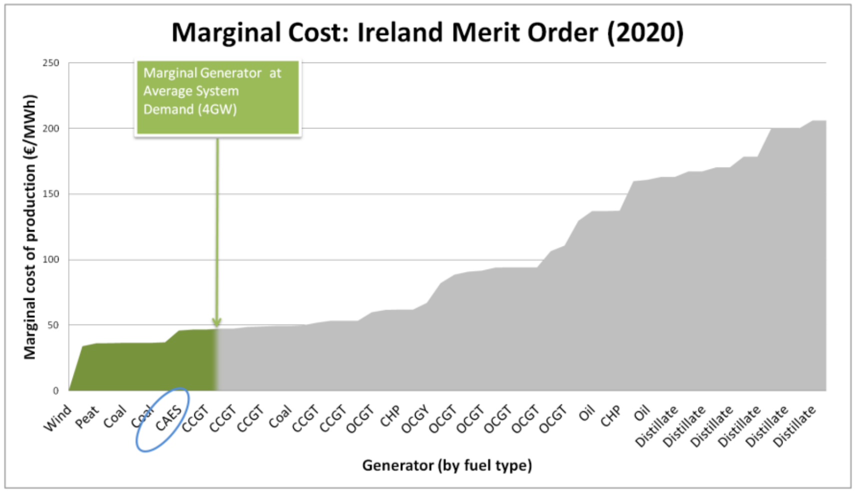
- Fast start up times:
  - 5 minute compression start.
  - 10 minute generation start.
- Fast ramping “when on”:
  - 20% per minute in generation mode.
  - 35% per minute in compression mode.
- Capable of simultaneous generation and compression (cavern bypass).
- Synchronous electrical machines for both generation and compression (inertia).
- Low minimum generation level: 10%
- Turn down capability during compression. (65% minimum).

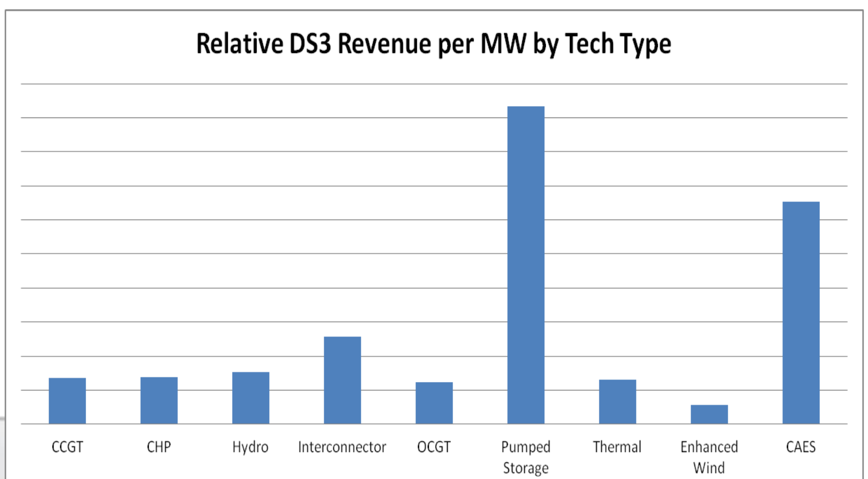
CAES Energy Balances

- 4 -stage Compression train uses electricity to inject air into an underground salt cavern, where it is stored at high pressure.
- Generation train consists of a 2-stage expansion process, with natural gas combustion to replace heat lost during compression.
- Generation process far more efficient than compression process ("flat" Heat Rate).
- Energy balances in the system characterised by changes in temperature and pressure.



CAES - Market Position 2020





- CAES characteristics ensure “in-merit” generation.
- CAES designed optimally:
  - High Efficiency.
  - High System Service Capability
- DS3 revenue per MW of CAES is indicative of superior system service capability and ability to compete in merit order.
- CAES synchronous demand side capable of providing system services

Project Status

- Planning due to be submitted Nov 2014
  - Article 31 status expected (strategic infrastructure)
- Designated as a PCI by the European Commission
- Drilling Programme Complete - £1.5m spent proving salt suitable for CAES operation
- Grid - Point to point studies complete; In discussions on grid connection agreement
- Engineering - Started FEED
- Commercial - Awaiting DS3 and I-SEM Design
- Investment – In discussion with International Infrastructure Funds & European Investment Bank

DS3 Comments

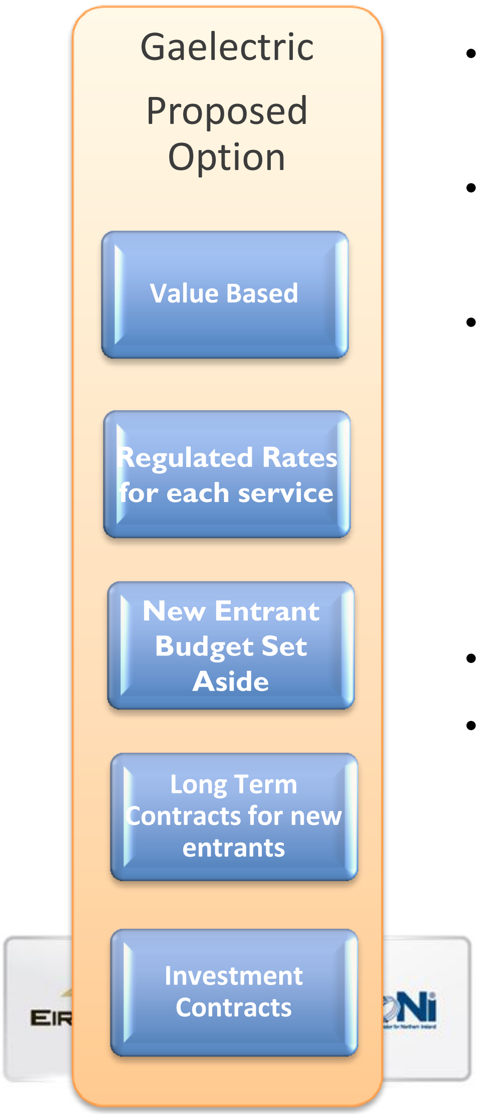
Option 5 – Multiple Bid Auctions

- Overly complex
  - Market concentration (HHI) such that competitive auction is not feasible
- Requires TSO subjectivity to resolve the auction
  - Open to legal challenge
  - Contrary to TSO licence conditions
- Uninvestible given price & volume risk.
  - Lack of forward certainty on auction volumes
  - Definition for remuneration for both Availability & Dispatch
- Proposal to regulate bids is contrary to a competitive auction seeking price discovery.

In conclusion, we believe Option 5 is not suitable for the All-Island market, and provides a barrier to entry for new entrants given the level of risk.

Gaelectric have therefore proposed a modification of Option 1 that we believe supports new investment and more rapid implementation.

DS3 – Why Our Proposed Option Works



- The proposal provides a clear investment signal to new entrant generation, whilst maintaining value to the consumer.
- We believe the proposed option can be implemented sooner than Option 5.
- Dispatch risk is mitigated against the concerns in Option 5 given that the proposed option relies upon capability based payments which do not interact with the market
    - Reserve products and Fast Frequency Response retain dispatch risk on generators however.
- Pre-Qualification removes the chance of speculative bids.
- Investment contracts to support financial close and construction

Thank you for Listening

DS3 Risk Identification and Assessment Process

Purpose

1. To capture those risks which may **impact on the ability of the DS3 Programme to deliver its objectives**, namely developing solutions to the challenges of operating the electricity system in a secure manner while facilitating 2020 renewable electricity targets;

2. To assess the impact of the identified risks should they occur; and

3. To assess the likelihood of the identified risks occurring taking into account how well they are currently being managed.

Capturing the Risks

- Provide Eoin Sweeney with the key risks your organisation is exposed to in the context of DS3 objectives (no more than 3);

  COB 22nd Sept 2014

- Record any additional **<u>key</u>** risks further to morning session of the Council;

  10 minutes

- These will be uploaded to the Resolver system;

  10 minutes

- Vote via keypads on IMPACT then LIKELIHOOD;

  30 minutes

- Review Heatmap

  5 minutes

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Assessing Impact (Inherent – no control)

Impact Criteria			
Score	**Schedule**	**Operational**	**Stakeholders**
5 **Very High**	Complete deferment of programme or major disruption to schedule	Operational problems which could lead to **insecure** system operation	Industry stakeholder relationships permanently damaged.
4 **High**	Significant problems and major delay to programme	Operation problems which could lead to **insecure/uneconomic** system operation at times	Industry stakeholder relationships damaged significantly
3 **Moderate**	Problems in specific aspects of delivery and delays to programme	Operational problems regularly resulting in suboptimal generation dispatch	Industry stakeholder relationships impacted.
2 **Low**	Minor problems in specific areas of delivery	Minor operational problems resulting at times in suboptimal generation dispatch	Minor stakeholder engagement problems.
1 **Very Low**	Very minor problems with delays to programme	Very minor operational problems	Very minor stakeholder engagement problems.

Assessing Likelihood (Residual – take into account current control levels)

Likelihood Criteria	
5 **Almost Certain**	90% likely to happen
4 **Likely**	75% likely to happen
3 **Mode-rate**	50% likely to happen
2 **Unlikely**	20% likely to happen
1 **Rare**	5% likely to happen

Identified Risks

#	Risk Name	Description
1	Europe	There is a risk that the implementation of Network Codes and other EU interventions could impact on DS3 delivery
2	RoCoF	There is a risk that a large number of generators are incapable of moving their RoCoF settings to 1 Hz/s over 500ms
3	Generator Compliance	There is a risk that a large number of older generators' equipment is non compliant with Ireland/Northern Ireland Grid Codes.
4	System Services	There is a risk that there will be no clear System Services decision by the end of 2014
5	Network developments	There is a risk that delays to network development will affect impact on DS3 Delivery
6	Critical Path	There is a risk that the critical path for DS3 is not clearly outlined.
7	REFIT	There is a risk that the lack of clarity on the future of REFIT contracts will impact on DS3 delivery.

Review

- Review Heatmap

Going Forward:

- Summary report produced within 7 days;
- Roles allocated;
- Controls identified and assessed; and
- Ongoing monitoring arrangements.

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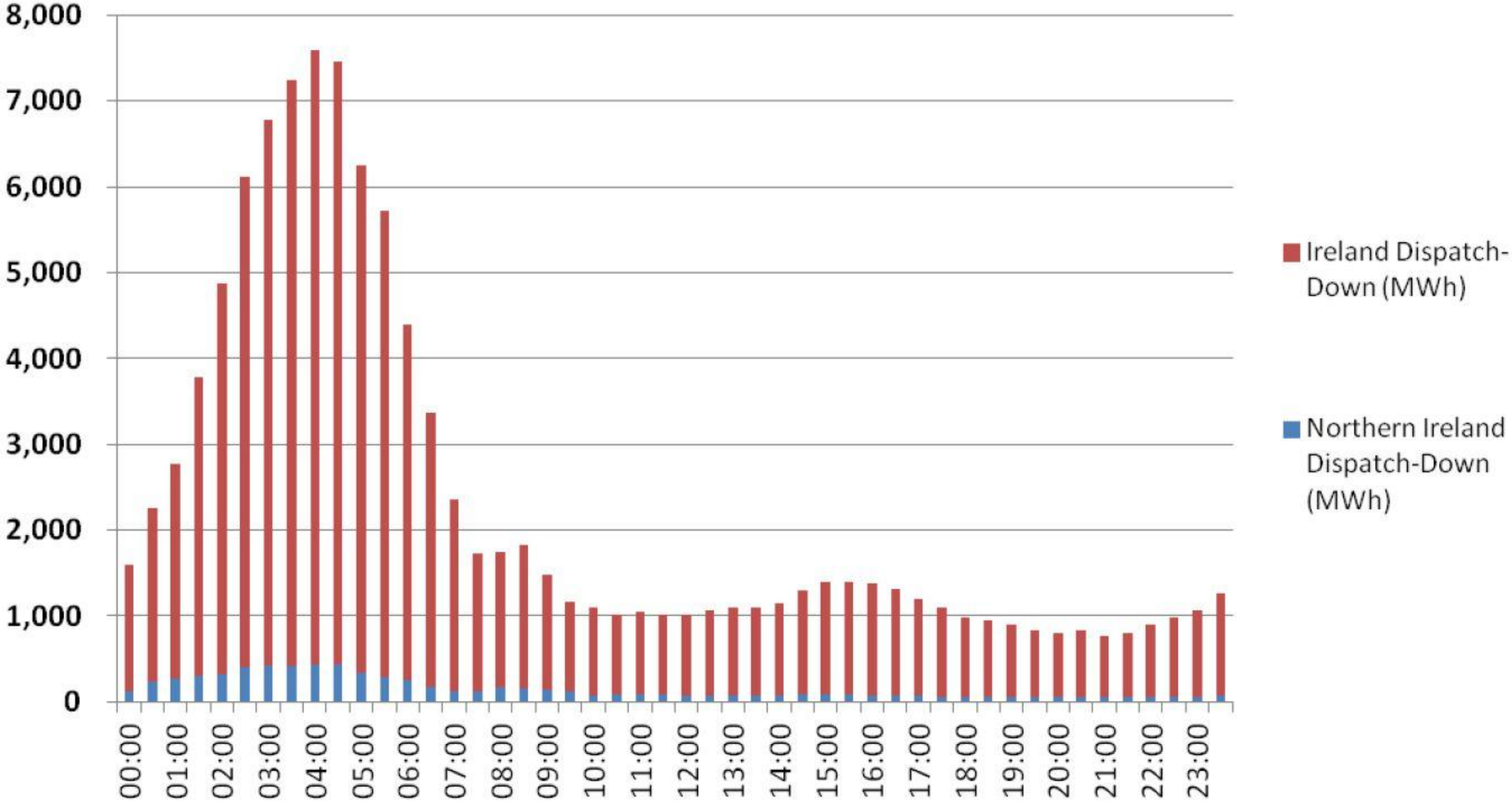
Minimum Number of Units Study

23rd September 2014
Ivan Dudurych

Objective of the Study

- Can the system be operated with fewer conventional units at night than the present Operational Policy while continuing to maintain the standard level of operational security of power system at low loads and high winds during a summer maintenance period?
- If yes, what can be done operationally to achieve this?

All Wind Total Dispatch Down Volumes (MWh) in 2012 by Hour of Day



MNU Study Approach

Scenarios

84 High-Wind, Low-Load system scenarios

WSAT Studies

Stress the system by further increasing wind balanced by decreasing conventional generation

Reserve Studies

Make sure Primary and Secondary Operational reserves are met

Ramping Studies

Make sure ramping requirement is met in time horizons from 30 min to 12 Hours ahead

Sensitivity Studies

- -Load Models
- -Wind Models
- -Merit Order
- -Sympathetic tripping
- -1Hz/s RoCoF anti-islanding protection settings

Main Findings

- Current operational policy is prudent over the widest range of operating conditions
  - 3 units in Northern Ireland
  - 5 units in Ireland
- Study indicates that at times system can be securely operated with fewer large units than required in the existing operational policy
- Analysis of results has indicated that a clear, implementable operational policy with less than 8 units cannot be derived prior to delivery of enhanced system performance and tools

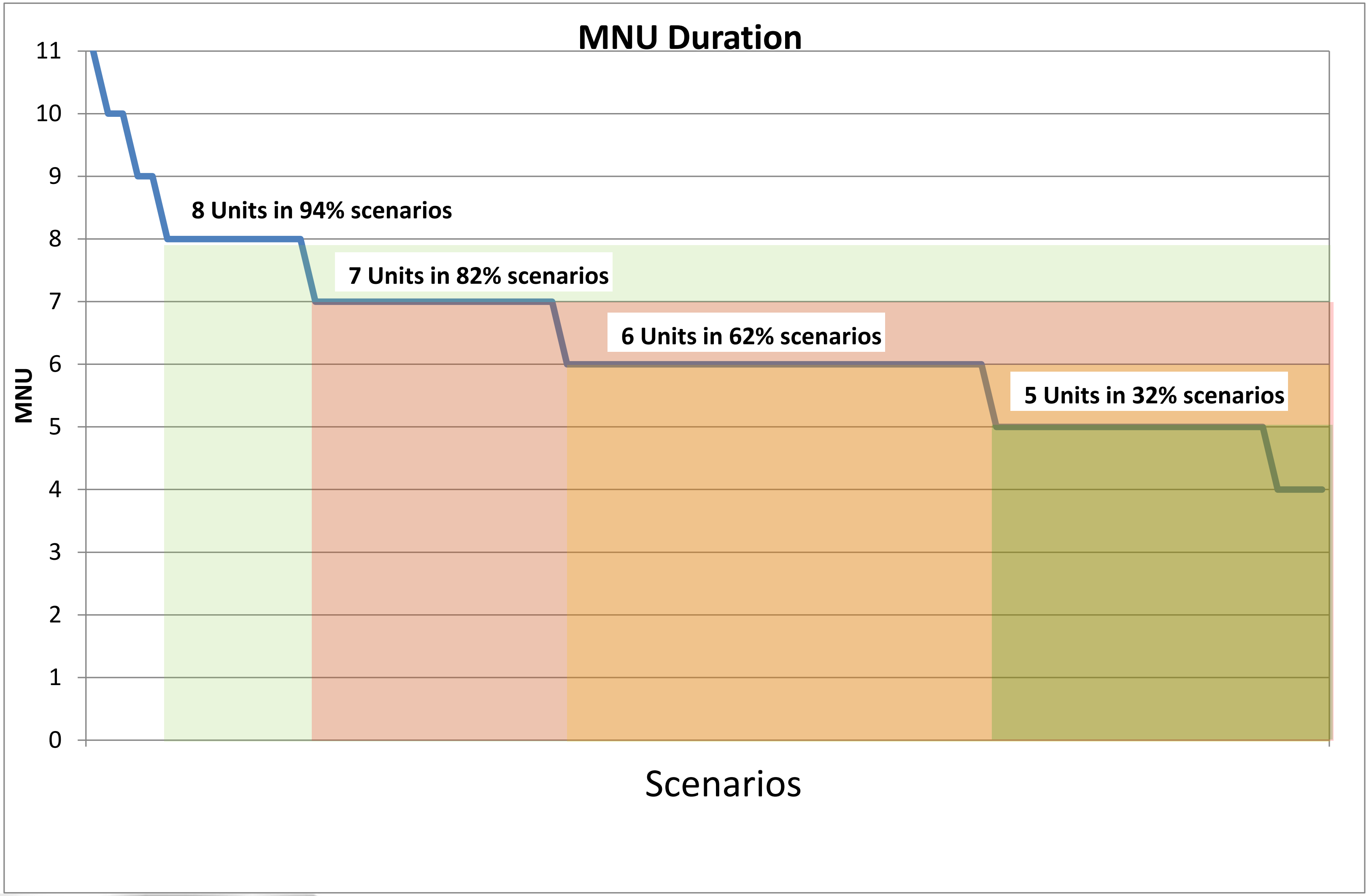
Main Recommendation

- No change should be made to the current policy until
  - System Services Capability in the power system develops
  - Processes and Tools that fully understand the challenges are developed and implemented.

- These issues are covered in the DS3 programme and related to System Services decision and RoCoF outcomes.

- Until significant progress on all these, current operational policy is likely to remain with consequential impacts for wind curtailment.

Results: Cases which were secure



Examples of 7 MNU derived from different limiting factors and limiting contingencies

Scenario	SNSP %	Moyle	EWIC	Tie-line	TH Pumps	Limiting contingency	Limiting factor
14	48%	No	Import 290 MW	Low	Yes	Large unit trip	Voltage
46	50%	Import 250 MW	Export 530 MW	Medium	Yes	System Separation	Ramping
69	38%	Import 130 MW	Import 400 MW	Low	No	EWIC trip	Reserve
80	50%	Import 200 MW	No	Low	Yes	Large unit trip	Frequency

Next Steps: Implement DS3 programme

New Policies

- RoCoF
- Operational Reserve
- Ramping Reserve
- Voltage Control Tx
- Voltage Control Tx/Dx

New Capability

- Static reactive power
- Ramping
- SIR, FFR
- Dynamic reactive power

New Tools

- Include RoCoF in RCUC
- Wind Secure Level Assessment Tool (WSAT) with Forward-looking Assessment feature
- Reserve Calculation Tool
- Ramping Assessment Tool
- Voltage Trajectory Tool

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SONi
System Operator for Northern Ireland

Reactive Compensation Studies

23rd September 2014

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Agenda

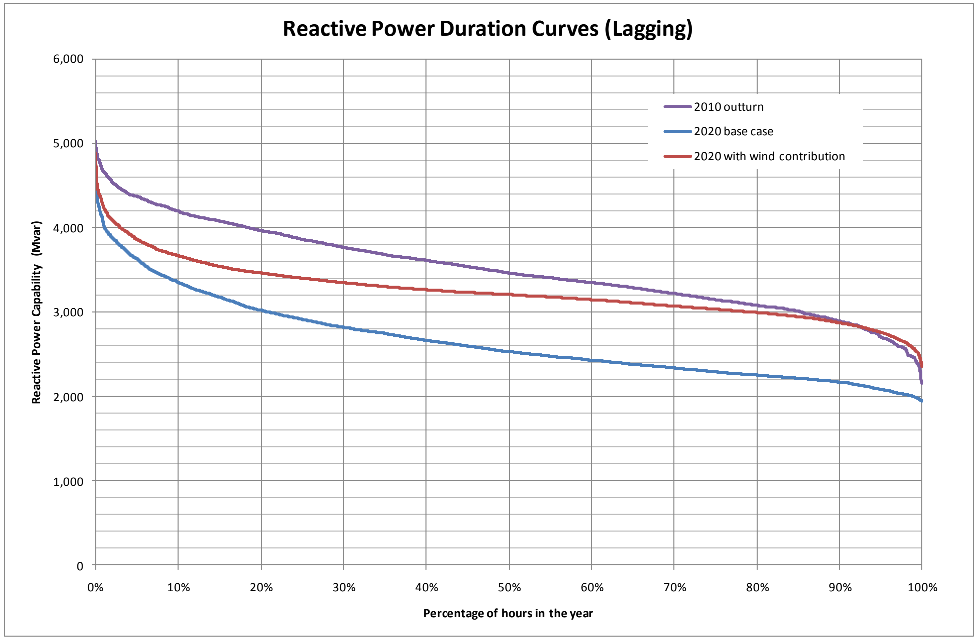
1. Background
2. Objective of study
3. Assumptions
4. Methodology
5. Areas identified for investigation and timelines for analysis
6. Case Study 1: Need for North West NI
7. Case Study 2: Need for Cauteen 110 kV station

Background

All Island Facilitation of Renewable Study 2010

- Significant reactive power sources had to be added to maintain voltage stability in intact network conditions
- Recommendation from the study included even more reactive power sources to cater for contingency events

- Further analysis has highlighted a 25% reduction in synchronous reactive power sources by 2020 from 2010 levels
- Renewable generation could contribute with their reactive capability to breach the deficit



Objective of Study

Objective of Study

Define the required transmission system reactive compensation to ensure that system voltages are maintained within specified limits to deliver a safe, secure and reliable transmission system.

Assumptions

- All Island network
- Study Years 2025 & 2016-2018 (depending on indicative connection dates)
- Three demand & generation scenarios for each year
- Reactive capabilities for WFPSs as per Grid Codes and Distribution Codes
- A range of voltage control modes on some distribution WFPSs are being considered:
  - 0.95 leading Power Factor
  - 0.98 leading Power Factor
  - Unity Power Factor
  - Voltage control ±0.95

Methodology

- Consistent methodology applied to all analysis
- Three technical analysis carried out for each area/node

1. Steady state analysis

Establish the amount of compensation required and optimum locations by carrying out PV – Analysis, QV – analysis & Voltage step analysis

2. Dynamic simulation

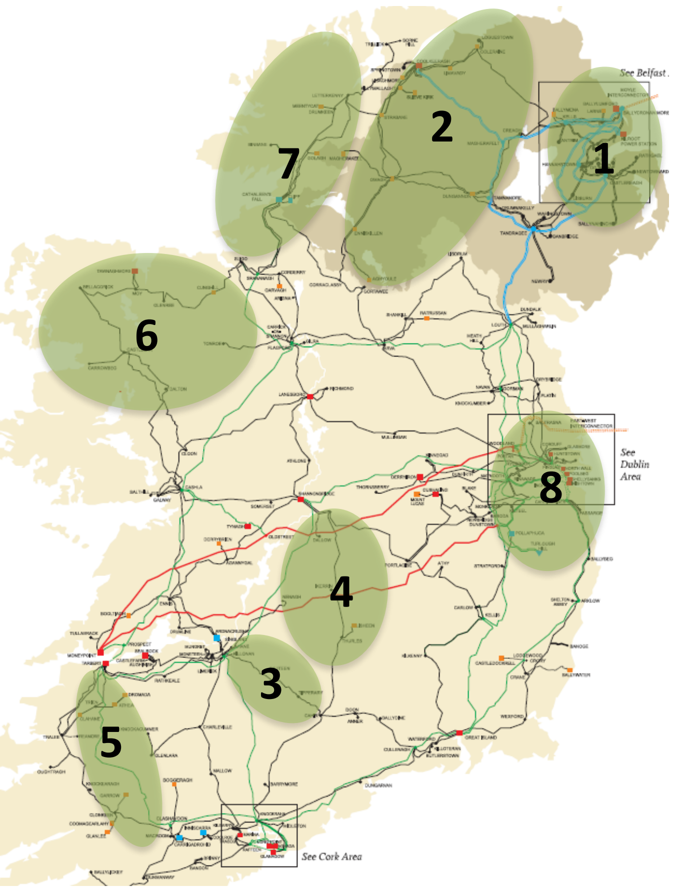
Validate steady state result and establish the reactive power sources responses during and following systems faults

3. Harmonic screening studies

Assess reactive power sources influence of impedance characteristics of the transmission system

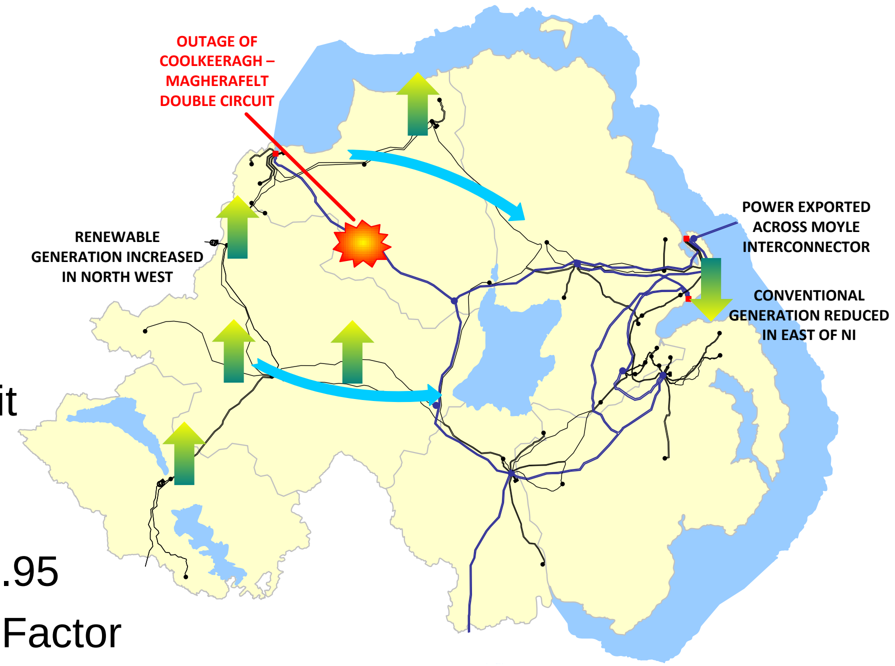
Areas identified for investigation and timelines for analysis

	Area/Station of investigation	Timelines
		Identify need
1	Belfast	√
2	North West Northern Ireland	√
3	Cauteen 110 kV station	√
4	Thurles and Ikerrin 110 kV	√
5	South West 220 kV stations	Dec 2014
6	Co. Mayo	Dec 2014
7	Donegal	Q1 2015
8	Dublin	Q1 2015

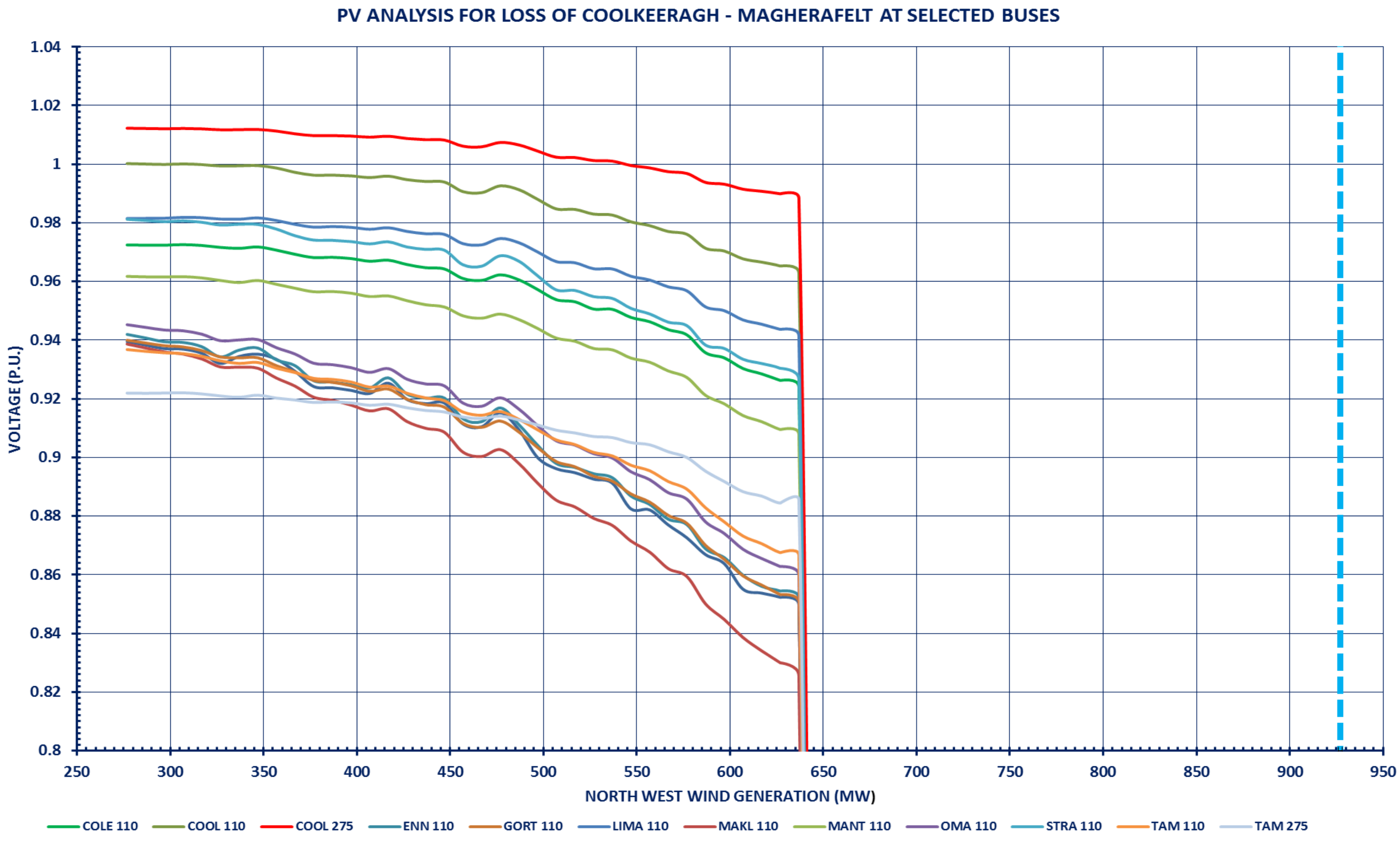


Case Study North West, Northern Ireland

- Renewable generation
  - In 2018 – 923 MW
  - In 2025 – 1674 MW
- Worst contingency:
  Coolkeeragh – Magherafelt 275 kV double circuit
- WFPS setup:
  - Transmission connected: voltage control ±0.95
  - Distribution connected: 0.95 leading Power Factor
  - Cluster connected WF: Voltage control policy varied



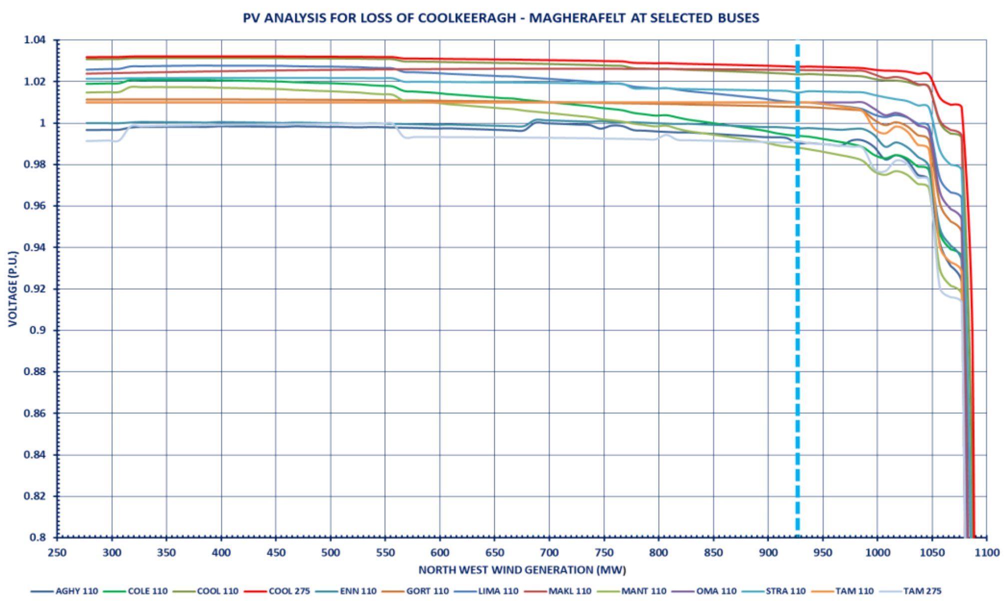
Case Study North West, Northern Ireland



NI Solutions

- Three locations required for reactive power compensation.
- Optimum locations are **Omagh**, **Coleraine** and **Tamnamore**.
- Possible alternative solution has **Castlereagh** in place of Tamnamore.

2025	Power Factor of Cluster Wind Farms in North West	MVAr Required in North West
WP	0.95 Leading	550
WP	0.98 Leading	450
WP	Unity Power Factor	370
WP	Voltage control ± 0.95	320

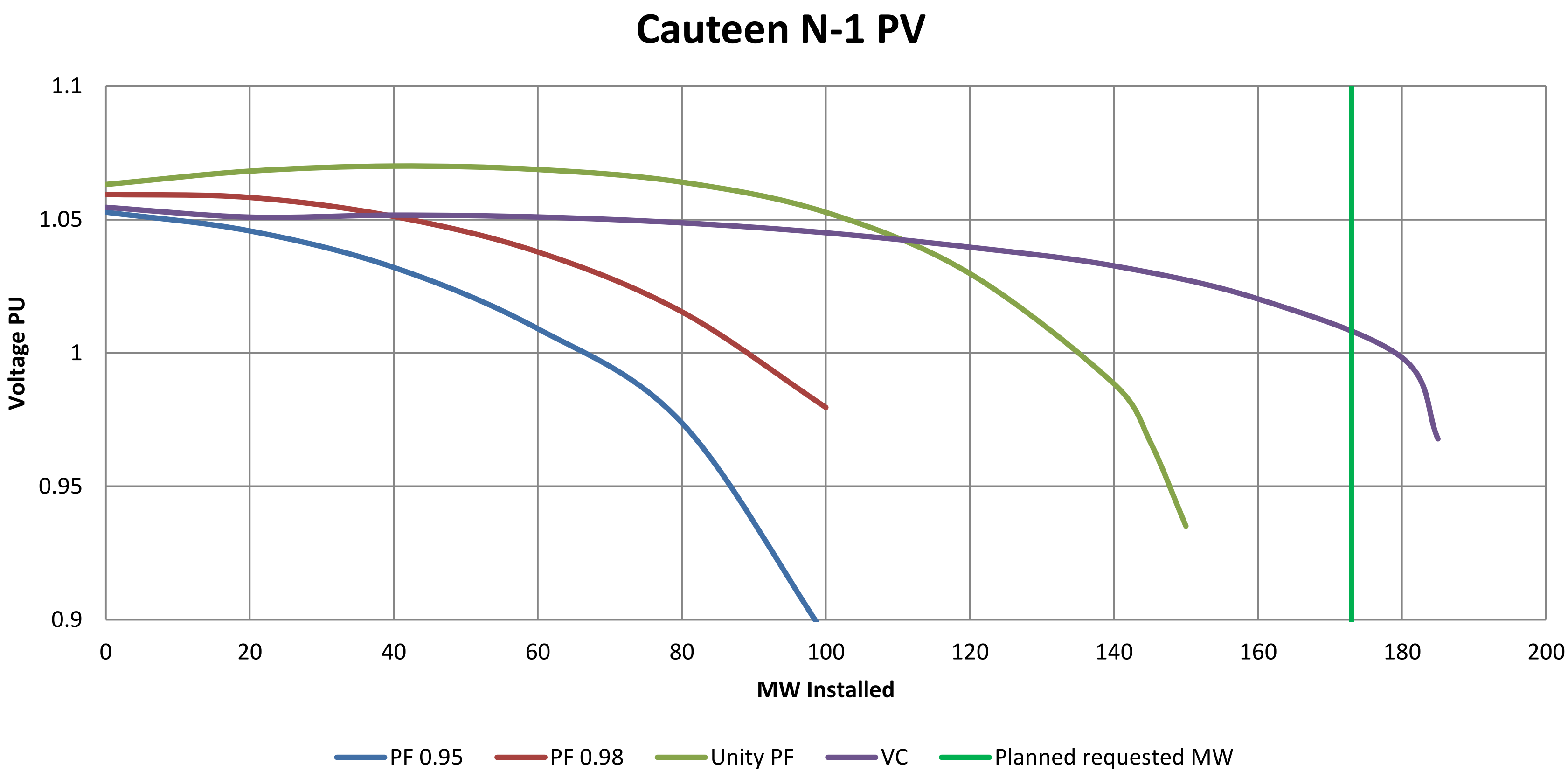


Dynamic and Harmonic analysis of solution options are ongoing

Case Study Cauteen

- Renewable generation
  - In 2014 – 79 MW connected
  - In 2017 – 173 MW, in total 7 windfarms
- DSO cluster – all type B
- Worst contingency:
  Loss of Cauteen – Killonan 110 kV

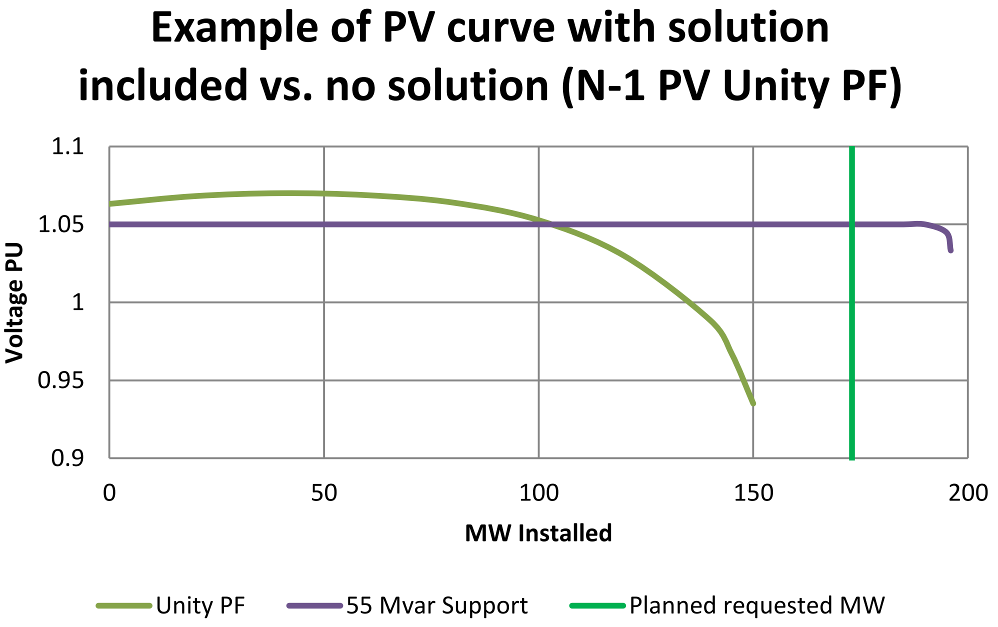
Case Study Cauteen



Case Study Cauteen

Reactive compensation requirement for Cauteen

2025	Power Factor of TYPE B Wind Farms @ CAUTEEN	MVAr Required @ CAUTEEN
WP	0.95 Leading	145
WP	0.98 Leading	105
WP	Unity Power Factor	55
WP	Voltage control ± 0.95	15



Dynamic and Harmonic analysis of solution options are ongoing

Conclusions

- Reactive compensation requirement studies are in progress
  - By Q1 2015 all areas will have been assessed and compensation requirements defined.
- TSO and DSO assessments and trials of possible voltage control and reactive power policy for distribution connected clusters are continuing

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Demand Side Management

23rd September 2014

Séamus Power

Policy Landscape

Why DSM?

- Greater accommodation of variable RES
- Enhanced capacity adequacy
- Reduced system / consumption costs
- Avoided / deferred network investment

System Benefit

- Reduced bills
- Greater control over and engagement with the energy they produce and consume

Consumer Benefit

DSM Today

Demand Side Management				
Dispatchable				Non-Dispatchable
Demand Side Bidding	Ancillary Services	Emergency Programmes	Direct Load Control	Response to Tariffs / Incentives
Demand Side Unit	STAR	Powersave	Glen Dimplex Demo	NightSaver Economy 7 RT Pricing

Demand Side Unit (DSU)

- Aggregation of sites that deliver a Demand Reduction
  - Load Reduction
  - Storage
  - On-site Generation
- Registered in the SEM
  - Bids demand reduction into the pool
- Dispatched by the EirGrid/SONI Control Centre
- Payments Processed through SEM
- Open to Sites with Interval Meters only

Cendeco
Technology Leader in Smart Grid Optimisation

Electricity Exchange
Expect More From Your DSU

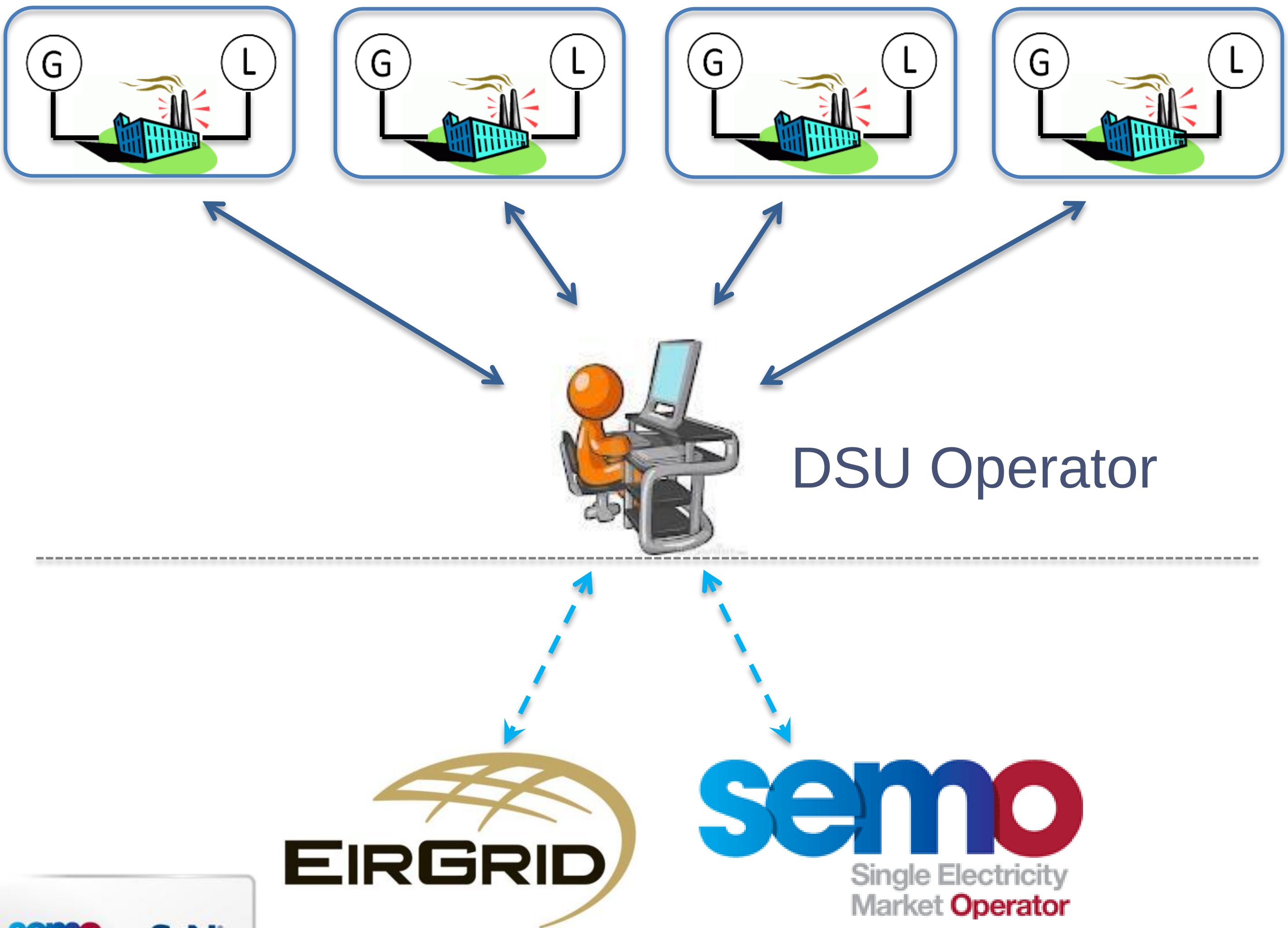
Dalkia

electric Ireland

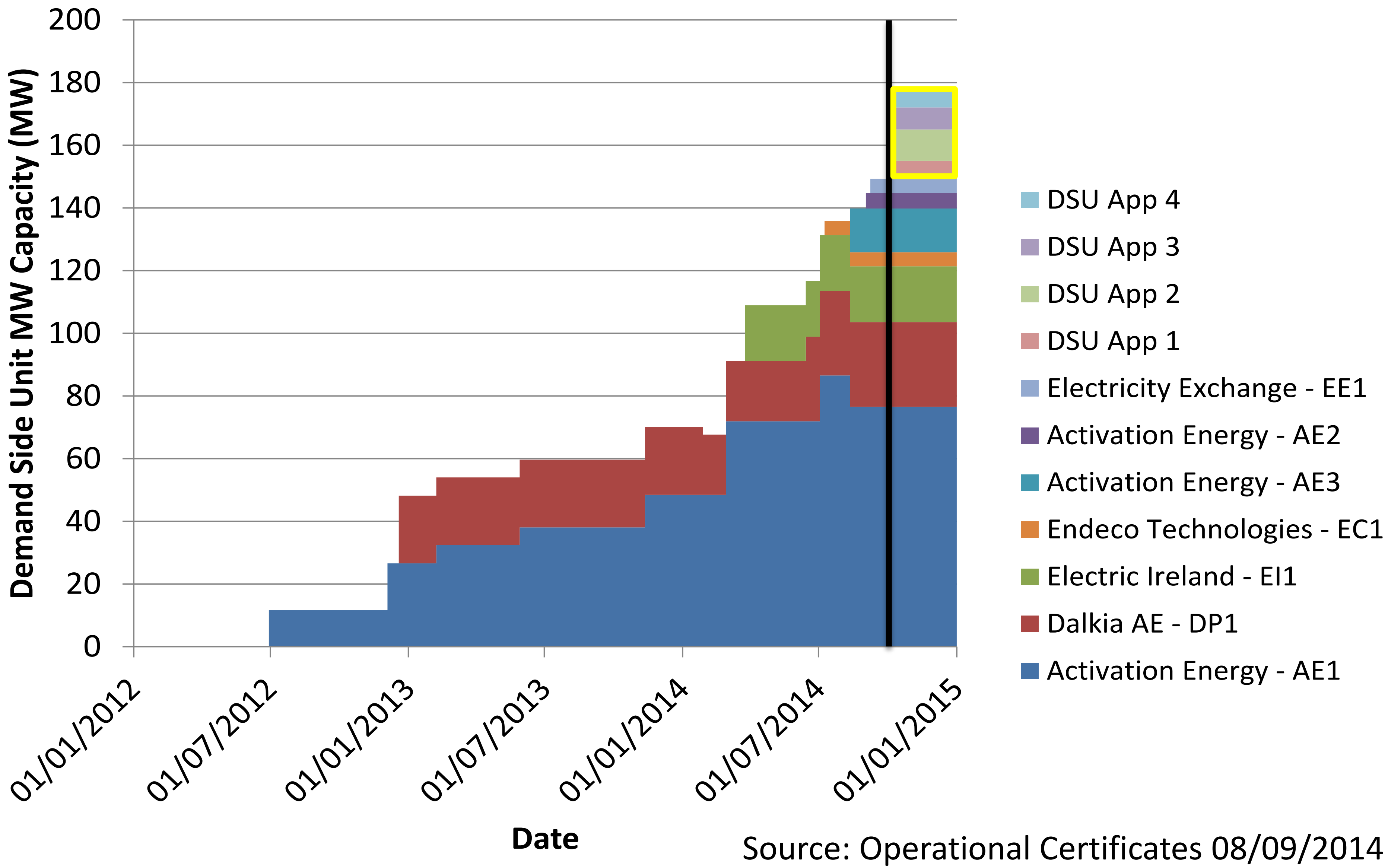
ACTIVATION ENERGY
An EnerNOC Company

EIRGRID semo SONI

Demand Side Unit



DSU Registered Capacity Growth

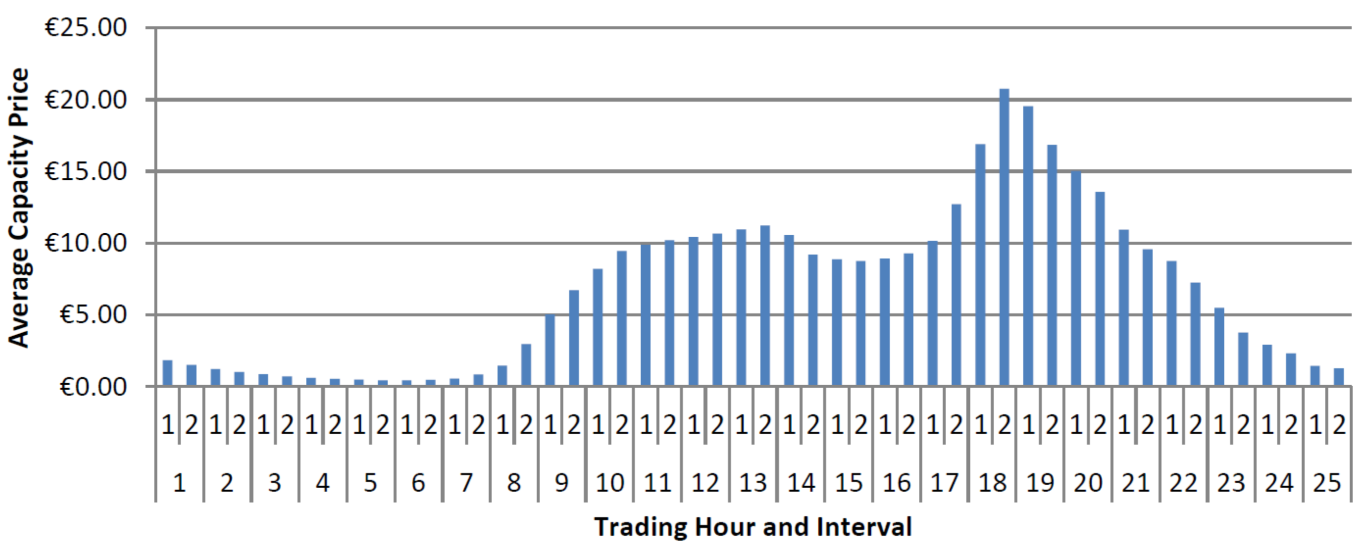


Source: Operational Certificates 08/09/2014

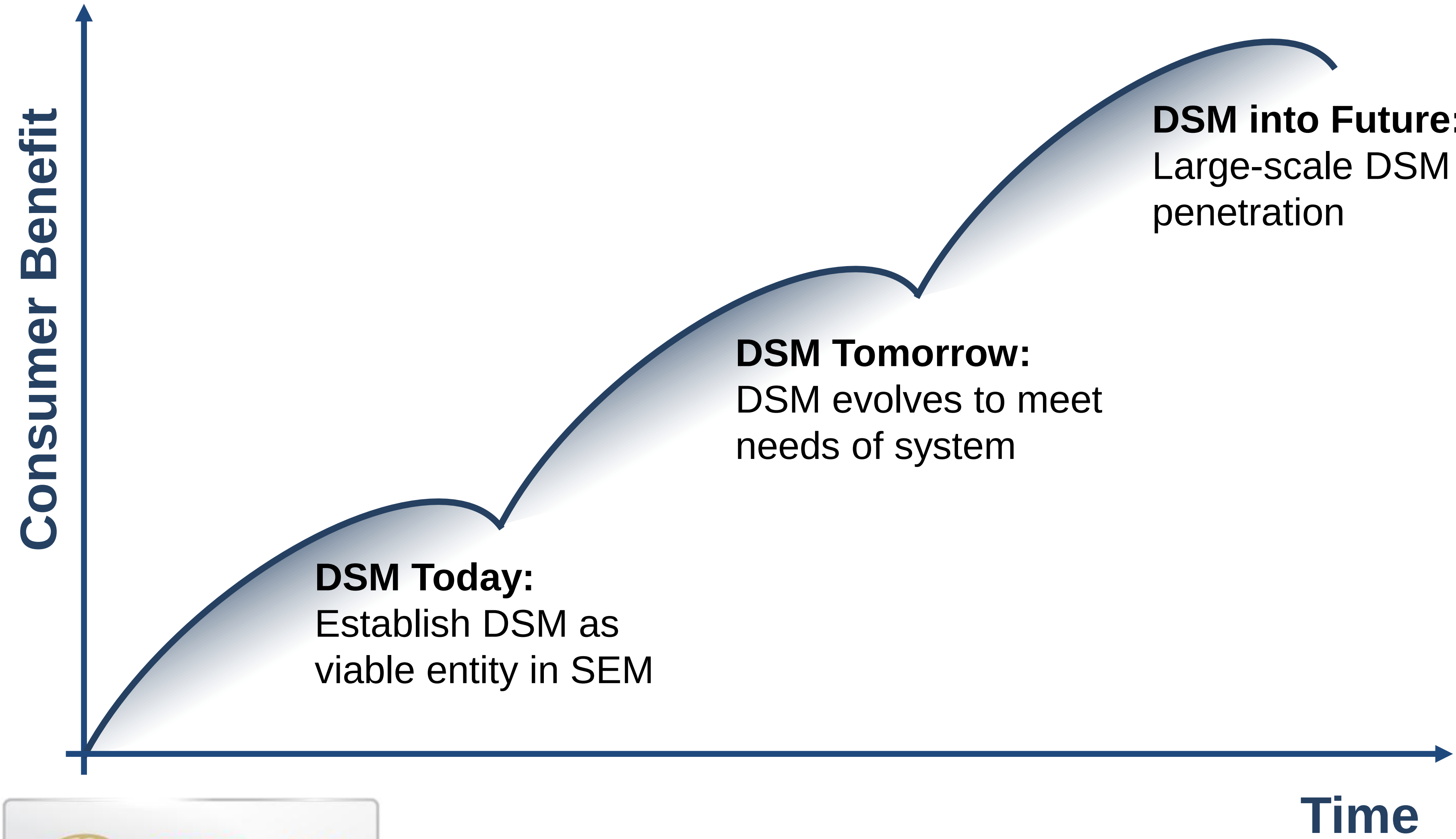
Potential DSU Revenues (SEM)

Availability Period	Demand Reduction Offered	Estimated Capacity Payments p.a.
09:00 – 19:00	1 MW	Approx. €42,000
24/7	1 MW	Approx. €62,000

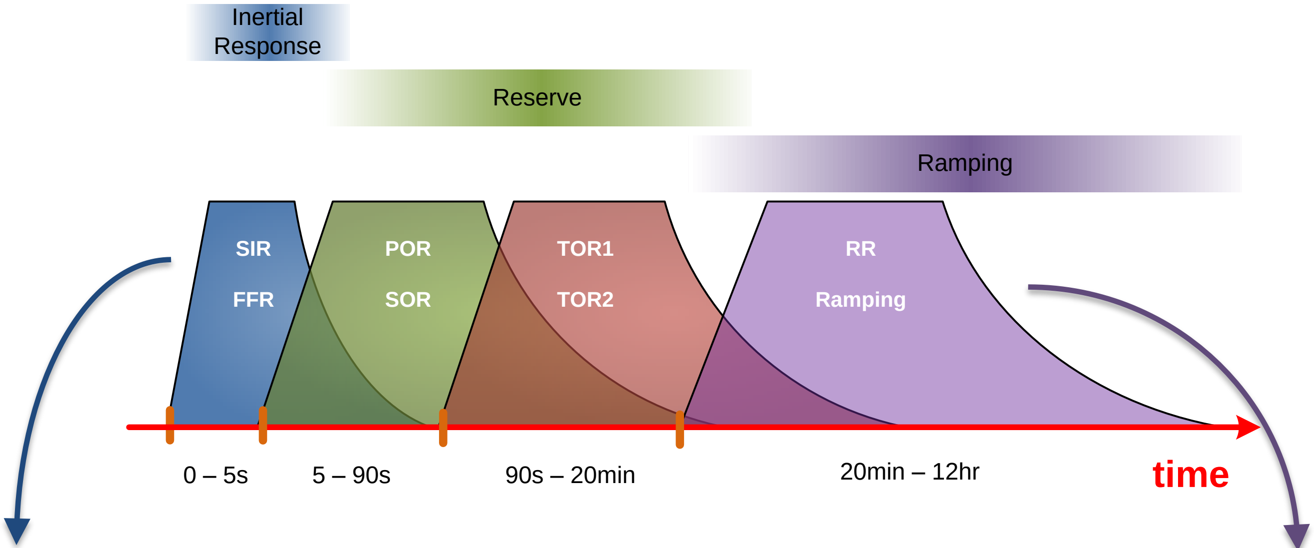
Average Capacity Price by Trading Period



DSM Next Steps



Demand Side Participation Opportunities



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

- **Ramping Margin**

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