All – Island Generator Forum

15th May 2014

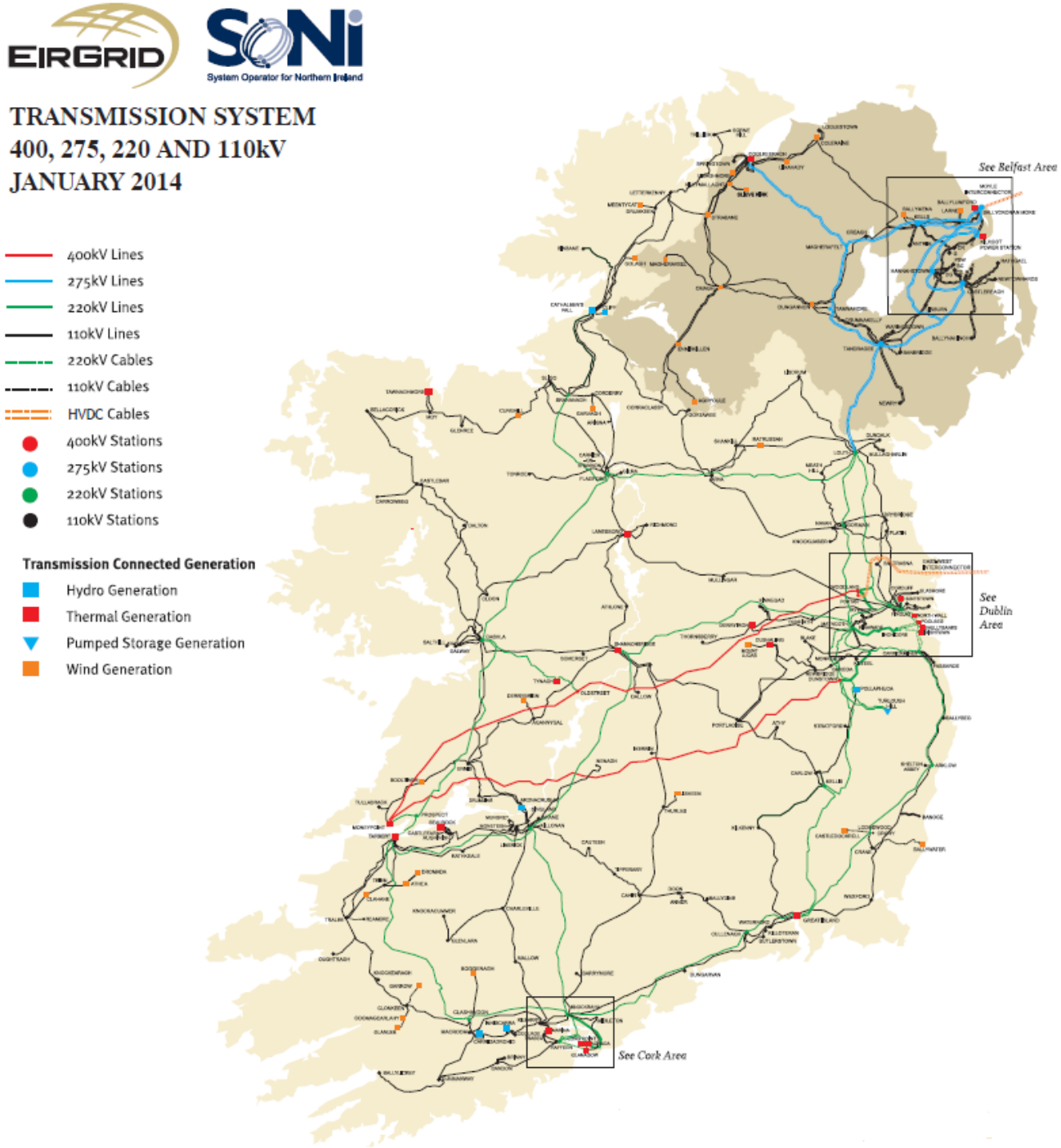
Bewleys Hotel, Ballsbridge

Objectives

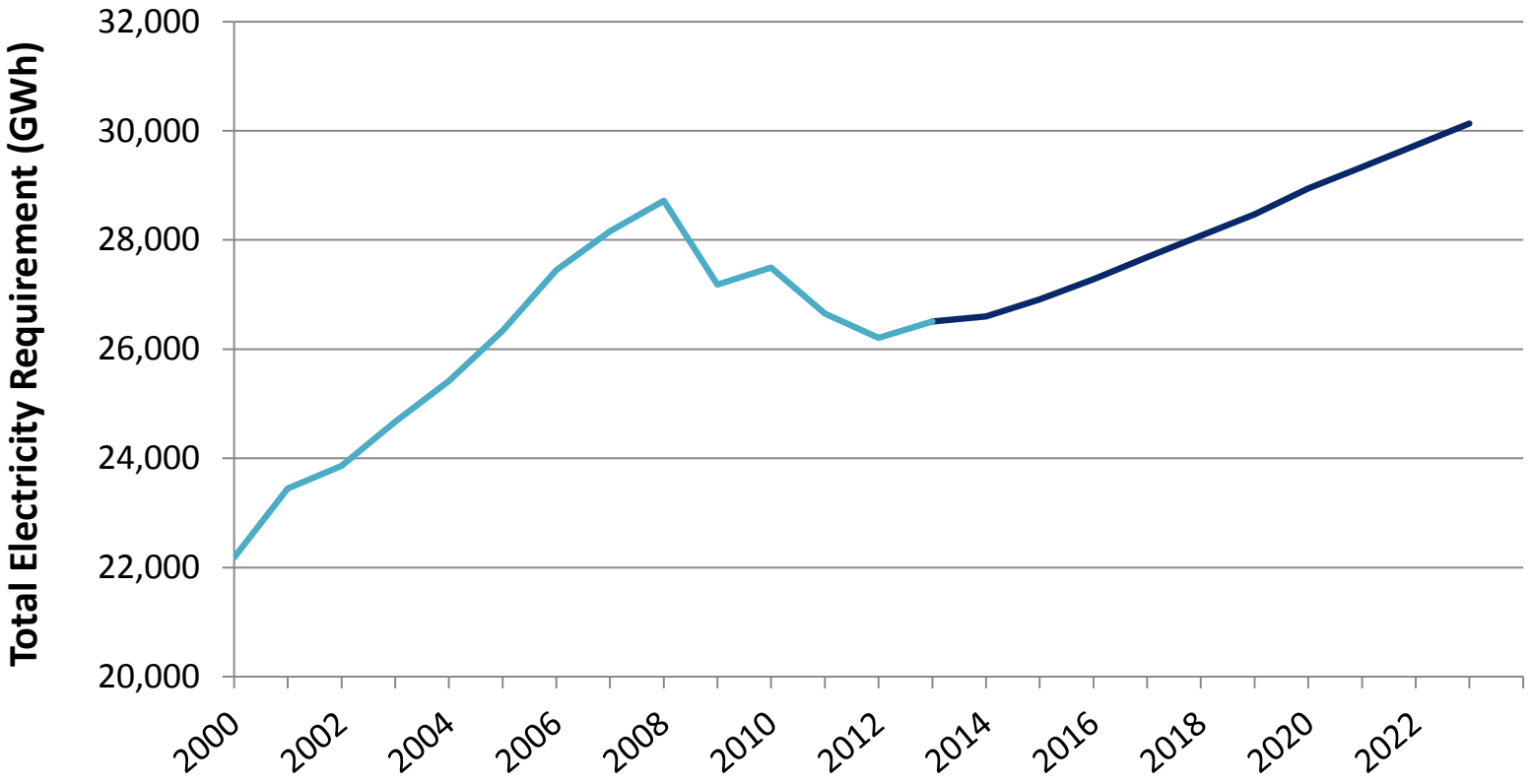
- Provides and opportunity for knowledge sharing and interaction between EirGrid/SONI operations and generators
- If issues cannot be dealt with today, further meetings etc. will be arranged
- Designed to facilitate an effective two way communication process
  - Items of interest
  - Presentations from industry
  - Networking opportunity
- Your input (formal or informal) is highly valued

Topic	Time	Speaker
Registration / Tea / Coffee	10.00	
Opening Remarks	10.30	Michael Kelly (Control Centre Development and Tools – EirGrid)
European Update: Network Codes/Target Model	10:40	Sam Matthews (Major Projects – EirGrid)
Generator view of Network Codes	11:00	David MacCartney (Risk Manager - Power NI Energy)
RoCoF	11:20	Robert O'Rourke (Electricity Transmission, Commission for Energy Regulation)
DS3 Programme	11:40	Robbie Aherne (Sustainable Power Systems – EirGrid)
Lunch / Tea / Coffee	12:00-13:10	
Enhanced Performance Monitoring and Testing	13.10	David Carroll (Operational Services and Performance – EirGrid)
EWIC Impact on SEM	13:30	Marie-Therese Campbell (SEMO Market Development - EirGrid)
Storm Darwin 12th February 2014 - Transmission System Performance	13:50	Diarmaid Gillespie (Near Time Operations – EirGrid)
Synchro Phasor Monitor	14.10	Ray Doyle (Power System Protection and Metering – EirGrid)
Closing Remarks	14.30	Michael Kelly (Control Centre Development and Tools – EirGrid)
Session Closed	14.45	

Transmission System 2014

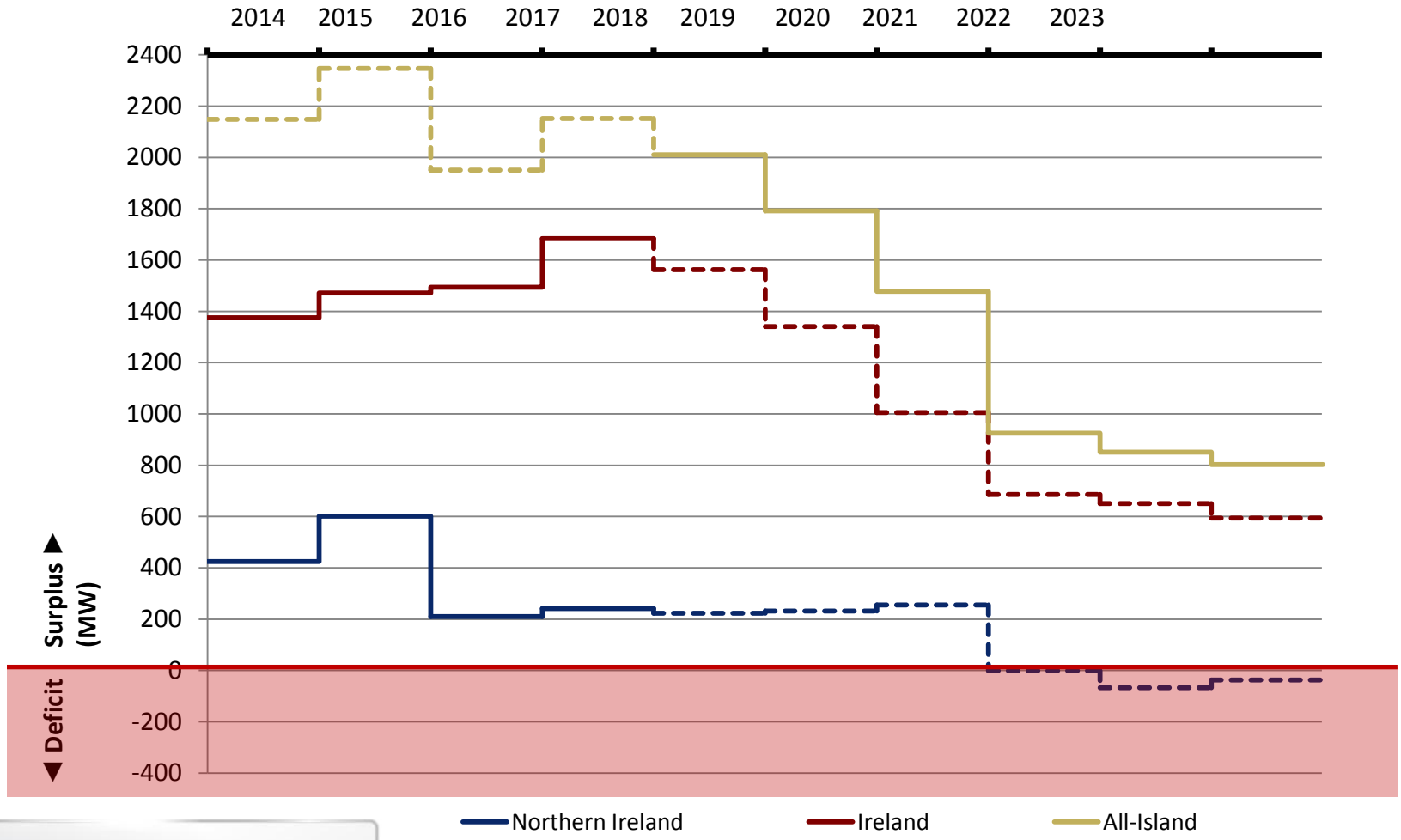


Ireland's Total Electricity Requirement

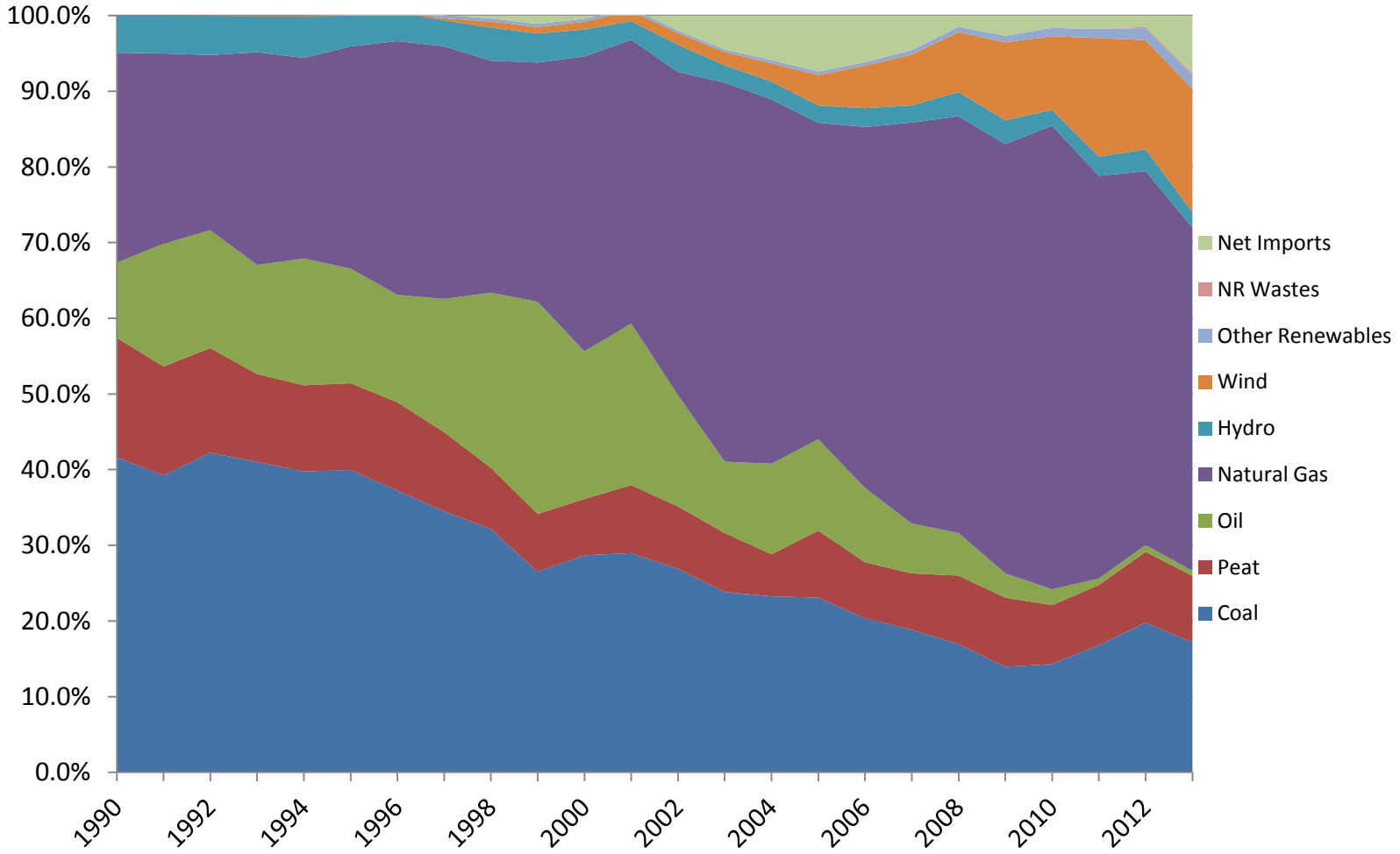


Figures from EirGrid's All Island Generation Capacity Statement 2014-2023
(Median Forecast based on the Recovery Scenario in ESRI's Medium Term Review)

Capacity Adequacy

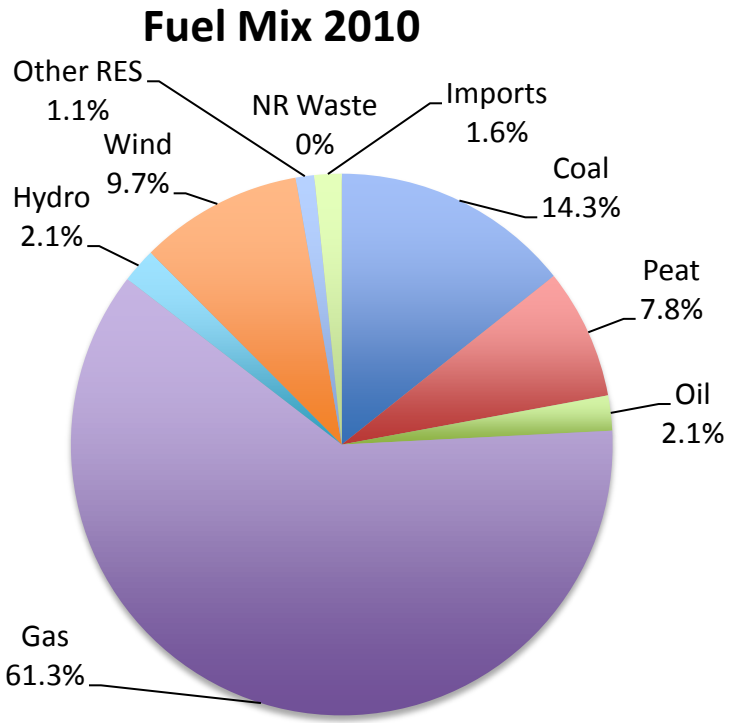


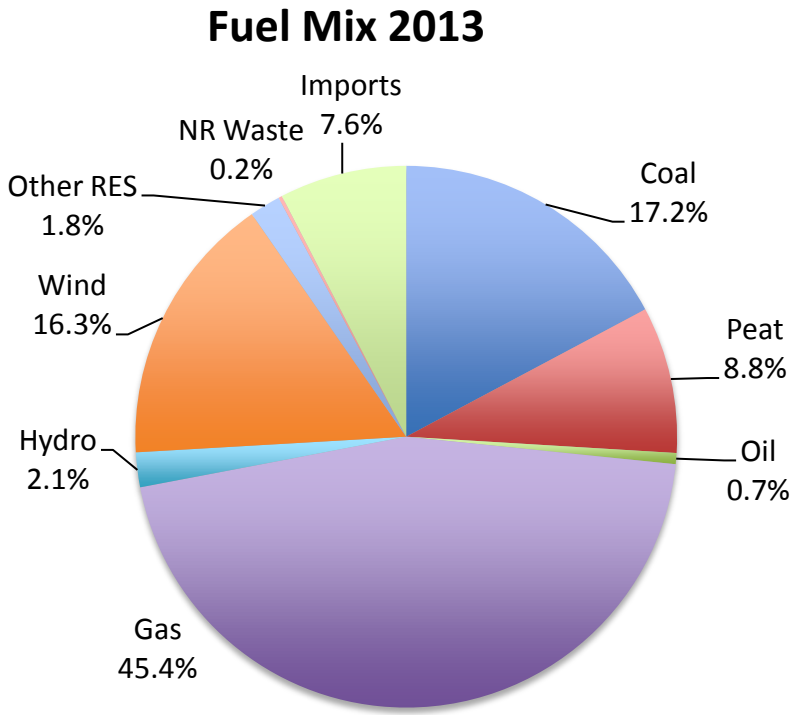
Ireland Fuel Mix



Figures courtesy of Sustainable Energy Authority of Ireland

Ireland Fuel Statistics 2010 - 2013





Figures courtesy of Sustainable Energy Authority of Ireland

Format

- Presentation
- Q & A
- Networking (lunch)
- Summary of action items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European Update
Network Codes / Target Model

Sam Matthews

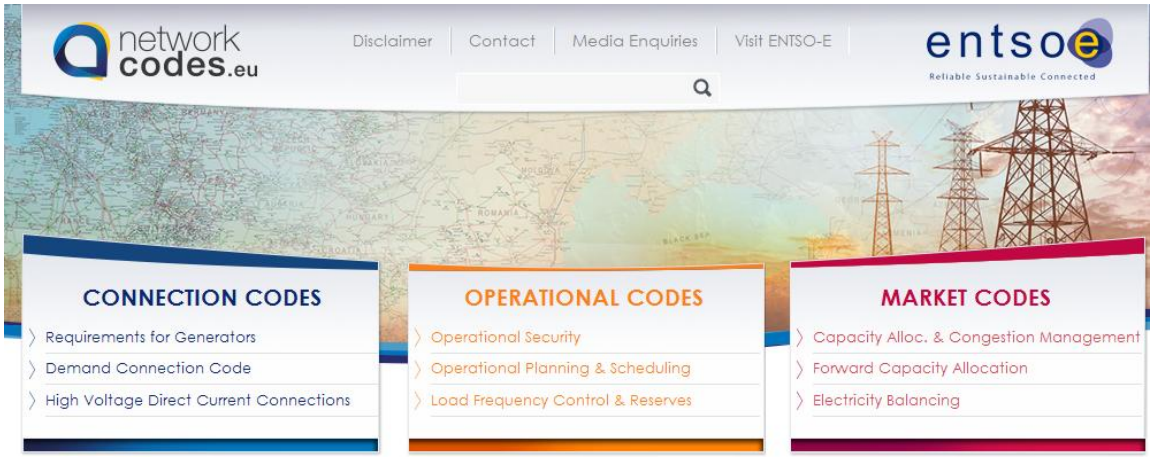
May 2014

Agenda

- European Network Code Process / Organisation
- Network Codes in Progress - overview
- EirGrid & SONI proposed approach to Implementation
- Highlight Requirement for Generators

Introduction

- Network codes are a set of rules drafted by ENTSO-E, with guidance from ACER, to facilitate the harmonisation, integration and efficiency of the European electricity market.



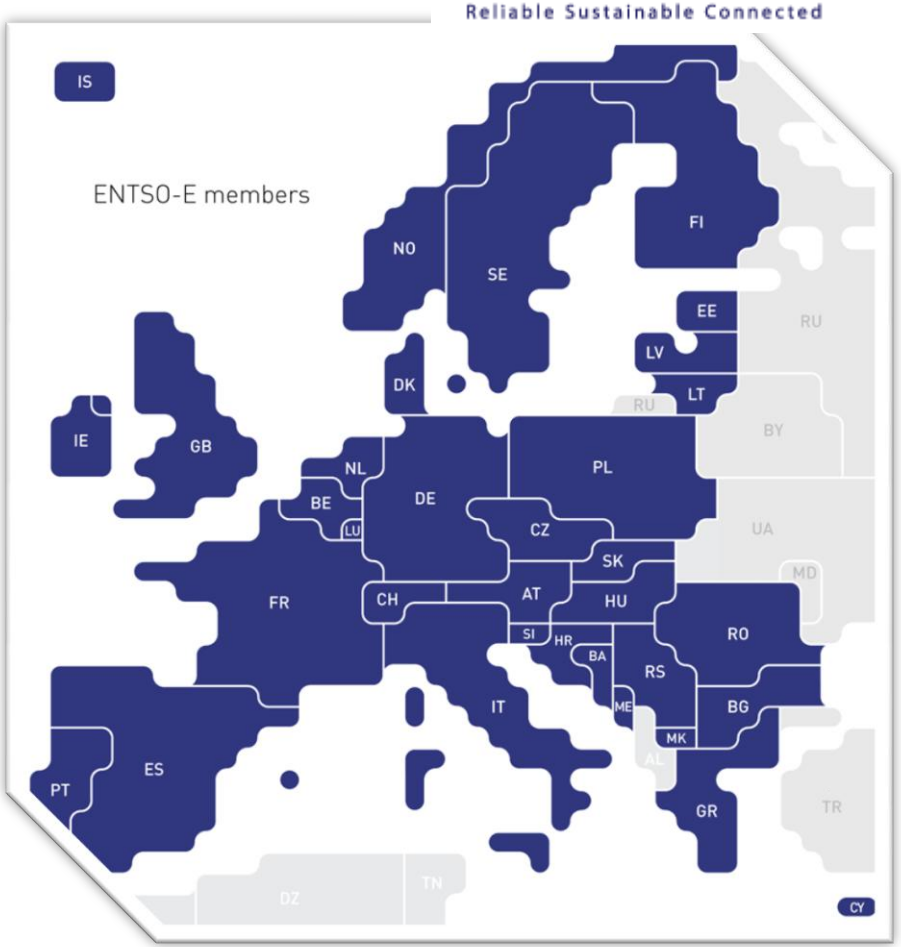
http://networkcodes.entsoe.eu/

ACER

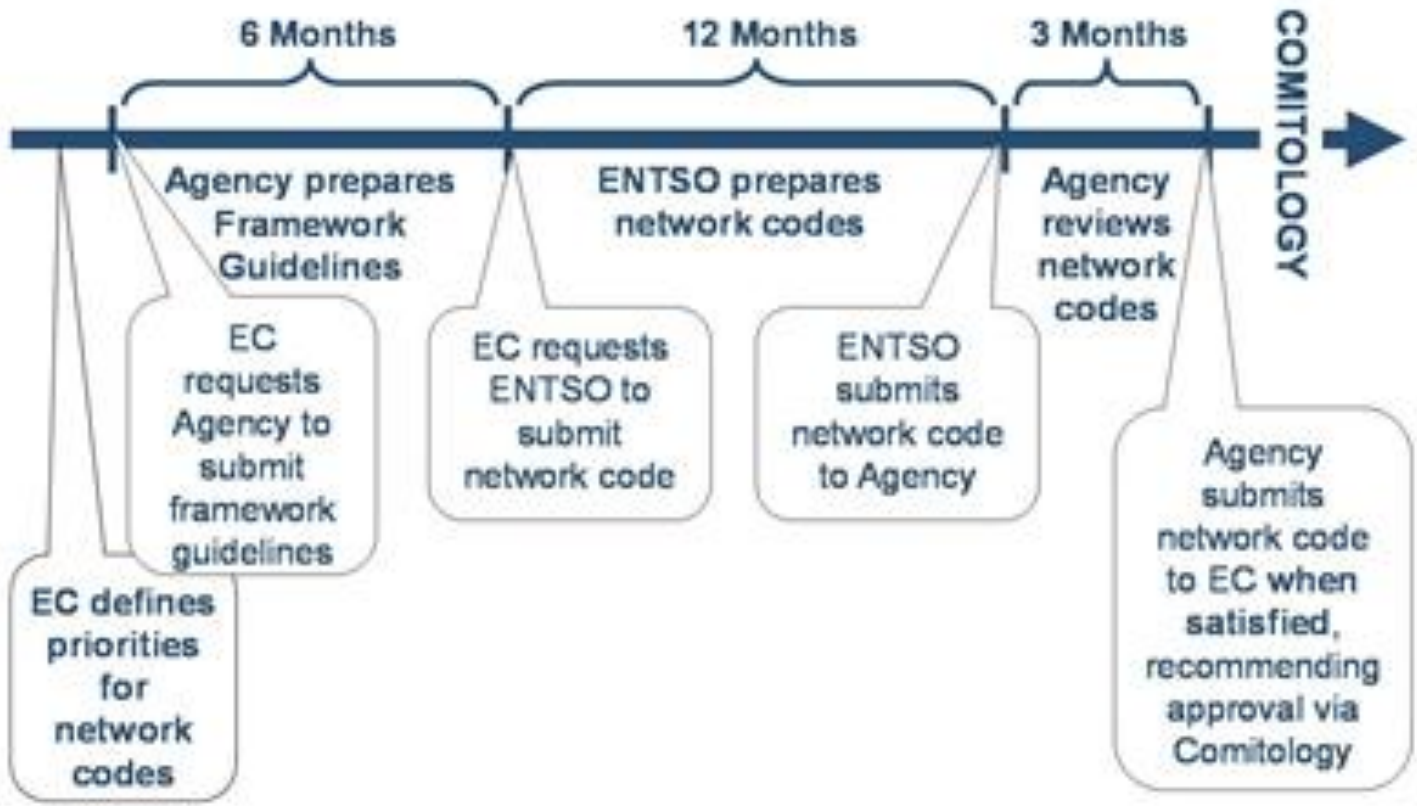
- launched in March 2011 (Gas & Elect)
- fosters cooperation among European energy regulators
- providing harmonized rules for cross-border exchanges of electricity.

ENTSO-E

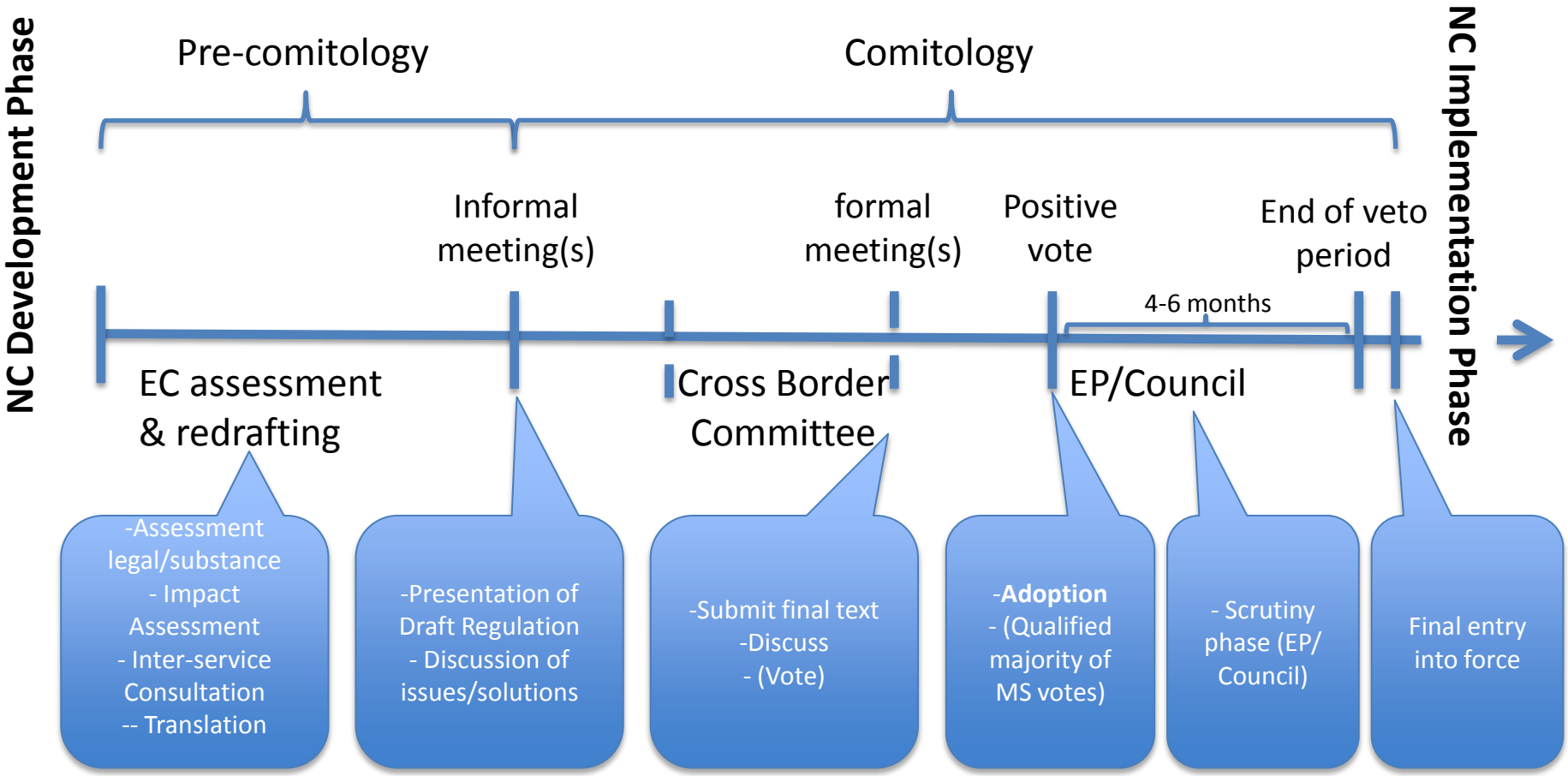
- 41 TSOs from 34 countries
- ... to become and remain *the* focal point for all European, technical, market and policy issues related to TSOs, interfacing with the power system users, EU institutions, regulators and national governments.



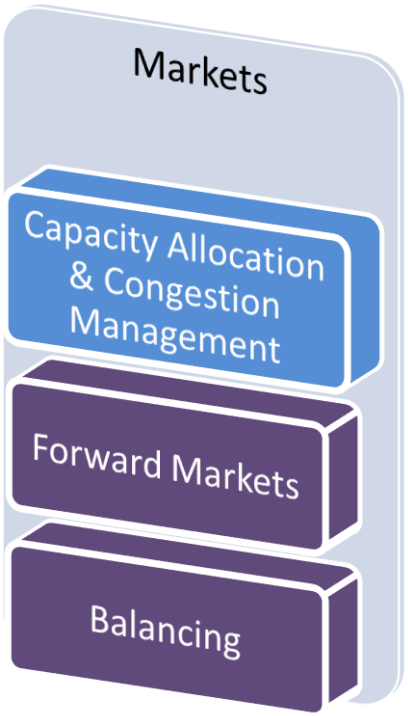
Network Codes: Development



Comitology: Adoption Phase



Network Codes – progress to date



Drafting | Public Consultation | ACER Opinion | Comitology

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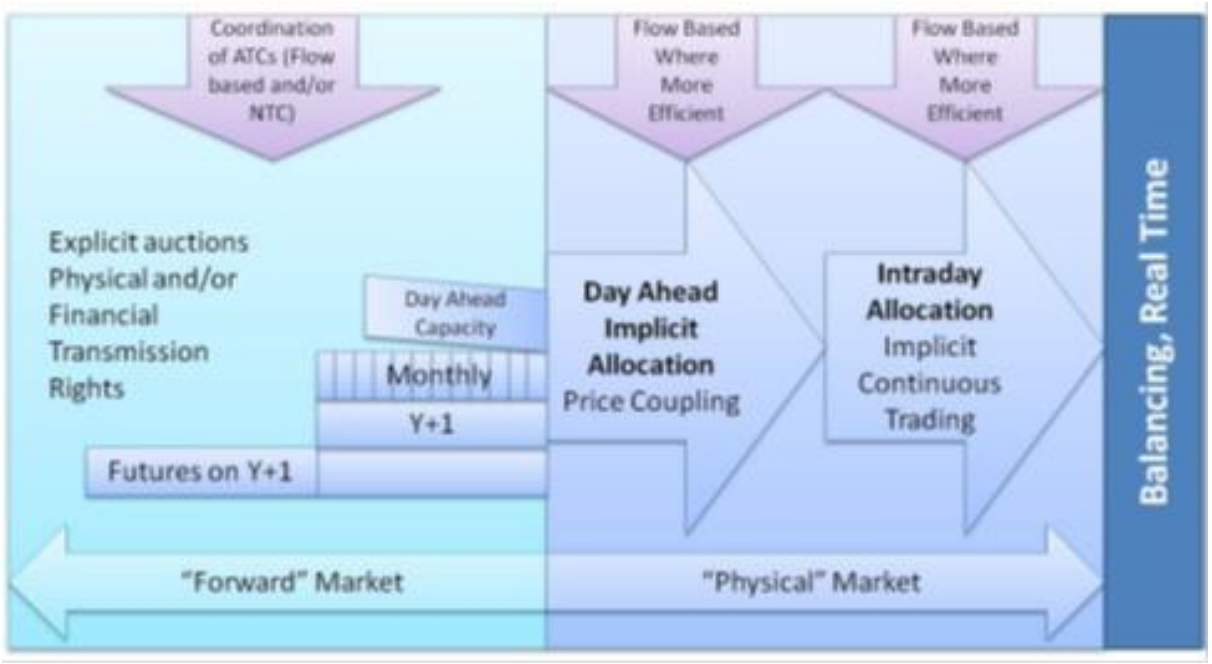
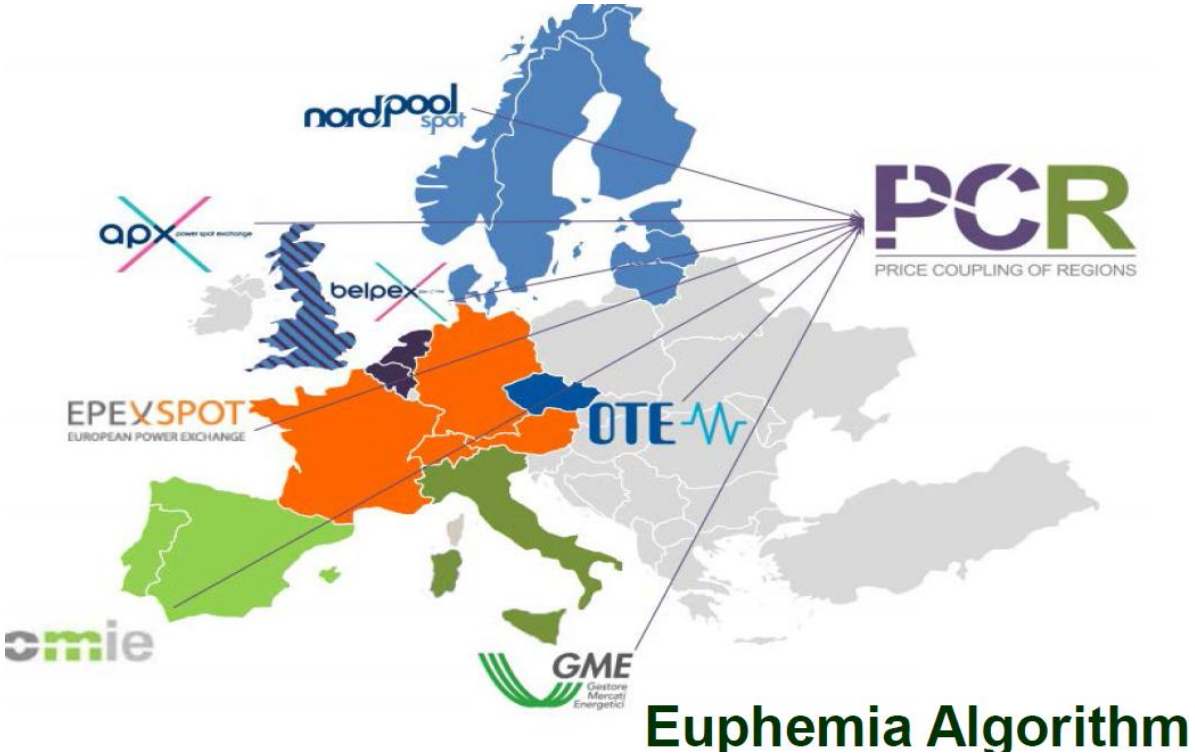
Target Model

- I-SEM consultation considering Options to deliver market codes



Target Model

- PCR – been live since start of Feb 14



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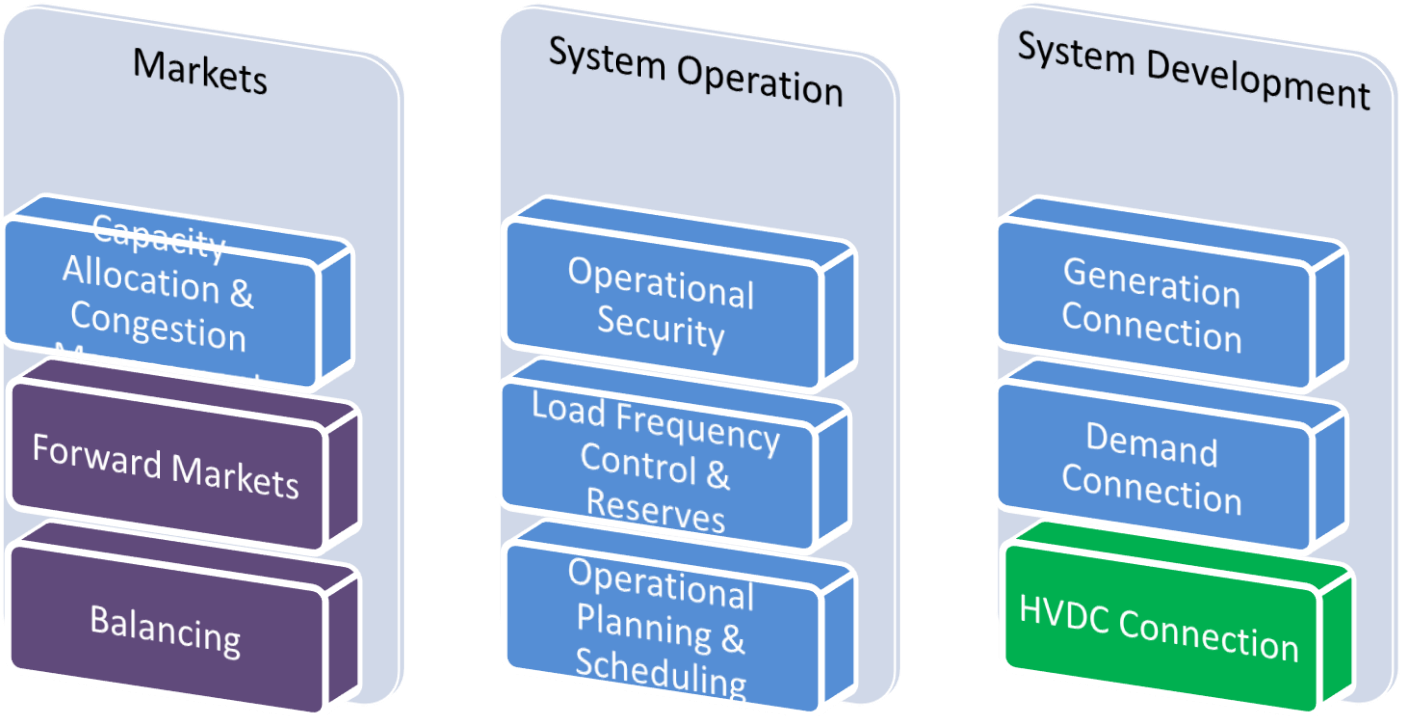
Network Codes – progress to date



Drafting | Public Consultation | ACER Opinion | Comitology

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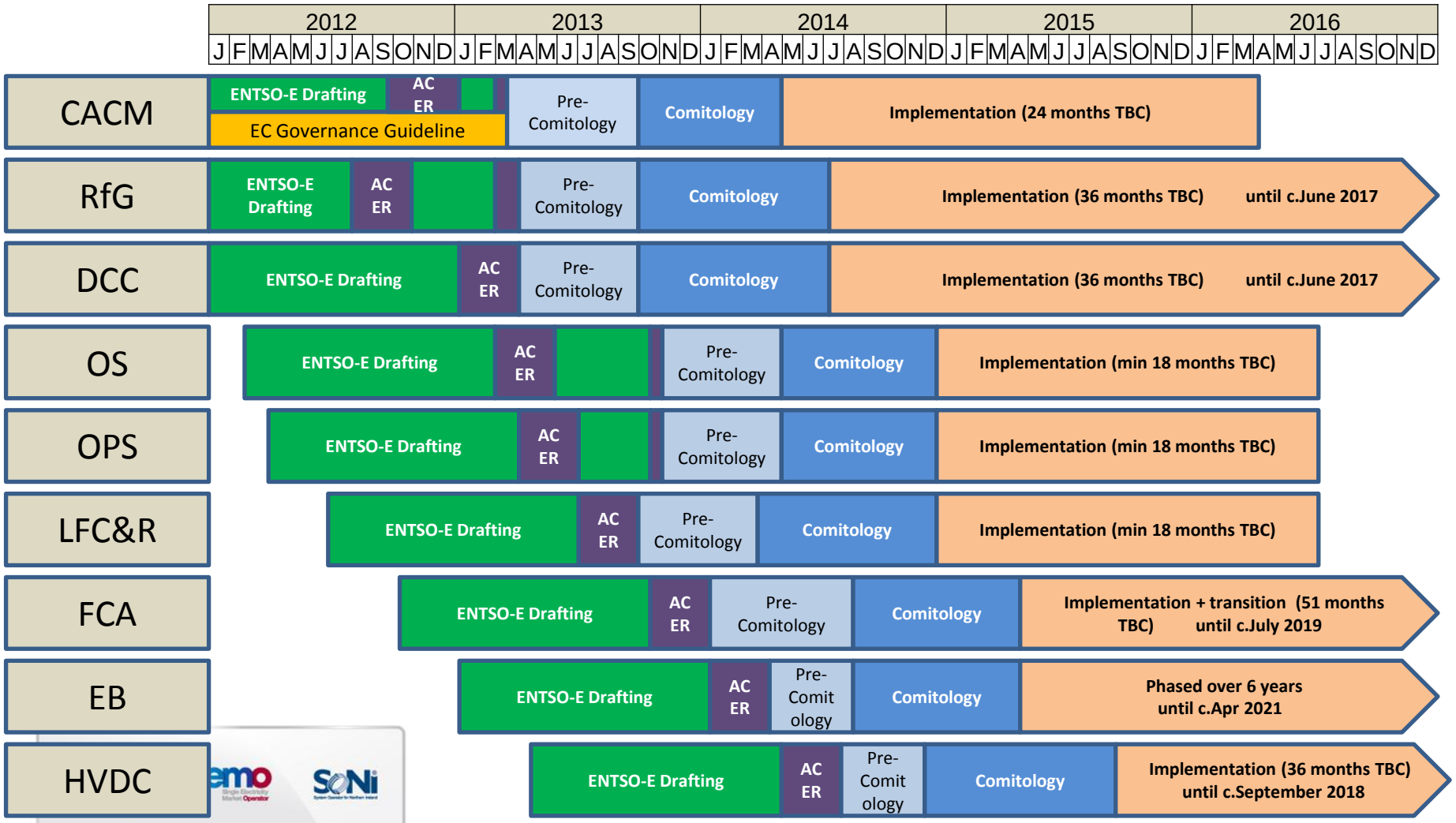
Network Codes - Timelines



Network Code - RfG

- Requirement for Generators
  - Has been anticipated as first Network Code to come through comitology
  - Not retrospective
- Type A,B,C,D
  - Type A - Connection Point is below 110 kV and its Maximum Capacity is 0.8 kW or more.
  - B,C,D

Synchronous Area	maximum capacity threshold from which on a Power Generating Module is of Type B	maximum capacity threshold from which on a Power Generating Module is of Type C	maximum capacity threshold from which on a Power Generating Module is of Type D
Continental Europe	1 MW	50 MW	75 MW
Nordic	1.5 MW	10 MW	30 MW
Great Britain	1 MW	10 MW	30 MW
Ireland	0.1 MW	5 MW	10 MW
Baltic	0.5 MW	10 MW	15 MW

Table 1: Thresholds for Type B, C and D Power Generating Modules

Network Code - Summary

- Various Network Codes will be required to be implemented into Grid Codes
  - Uncertainty on exact timings of Network Codes reaching end of Comitolgy
  - Significant area of work to implement
- Market changing to reflect Target Model
  - Covers FCA, CACM & EB Network Codes
- What is EirGrid & SONIs approach to implementation of Network Codes into Grid Codes?

Network Code - Implementation

- Joint Grid Code Review Panel Working Group
  - Review of Network Code text vs. Grid Code text
  - Reviewing suggested text and/or structural changes to the Grid Codes
  - Providing relevant input into parameter sets where this is under National control
  - Review of updated business processes that are impacted by Grid Code changes
- Membership of JGCRP
  - chairman and secretary appointed by the TSOs;
  - representatives of generators and other transmission system users
  - observers from CER/URegNI
  - technical advisors, experts or users who the TSOs or JGCRP consider appropriate for the working group

Network Code - Implementation

- JGCRP Working Group – current focus
  - Adoption Options to consider
  - When to start
  - Workload among members

Network Code - Adoption Options

Network Code Adoption Options

Issues	Option 1: Maintain Separate Codes and update both independently Clause-by-Clause	Option 2: Separate Codes with consistent Clause-by-Clause updates and greyed out jurisdictional differences	Option 3: Develop new Single All-Island Grid Code	Option 4: Freeze existing Codes, develop new overarching document with jurisdictional differences
Structure	Unchanged: Retains existing structures in each jurisdiction	Slight Changes to align with NC approach in both Codes.	Total Change to existing structure of Grid Codes	New structures for new Users and existing Users comply with old code.
Governance	Unchanged: Governed by jurisdictional Grid Code Review Panels	Governed by Joint and jurisdictional Grid Code Review Panels	Governed by Joint Grid Code Review Panel	Governed by Joint and jurisdictional Grid Code Review Panels
All-Island Applicable	Unchanged: Codes will not be All-Island applicable	Consistent Text with jurisdictional differences similar to existing SDC approach	Full All-Island Grid Code applicable across both jurisdictions	Consistent Text with jurisdictional differences similar to existing SDC approach
Implementation of Network Codes	Adoption of Network codes done separately effectively doubling the work for the same result.	Clause-by-Clause approach may result in repetition of work as subsequent NCs become applicable	Full re-write of the codes allows for 'blank sheet' approach to implementing network codes	'Blank Sheet' approach to implementing codes into new overarching document.
Long Term	Future changes to NCs must be implemented in both codes. Possibility for divergence.	Future changes to be reviewed and implemented by JGCRP and jurisdictional GCRP	Future changes are easier to implement in one code rather than separate codes.	New documents will trump old codes as the NCs are implemented and changed. Slow phasing out of existing codes.
Working Group	Working Group would probably need to split to handle each jurisdictional code separately.	More consistent workload and greater opportunity for collaboration across the group	Full integration of working group to develop a new document.	More consistent workload and greater opportunity for collaboration across the group
Overall Assessment	Maintains the existing structures, but doubles work load and misses out on All-Island application.	More consistent than option 1 and uses existing SDC structures. Clause-by-Clause leads to potential repetition of work	Attractive from perspective of All-Island harmonisation. Political, legislative and regulatory issues may deem this approach unrealistic	Allows for benefits of 'blank sheet' approach without requiring full harmonisation across the codes. Takes the 'best bits' from options 2 and 3.

Green – Straightforward Yellow – Some Issues Red – Difficult/Complex

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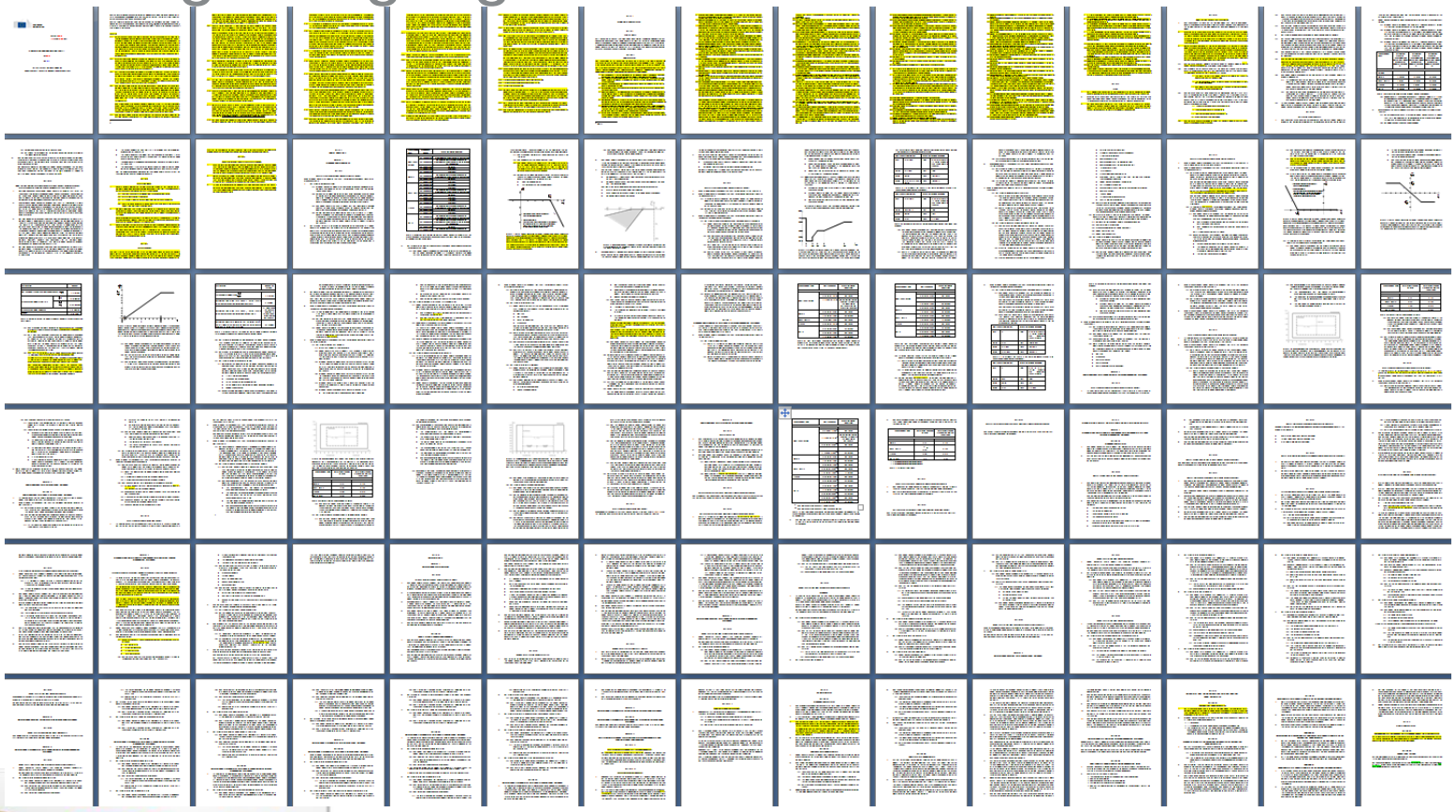
Network Code - RfG Update

- Changes highlighted in Yellow for latest RfG



Summary

- European Network Codes required to be implemented
  - Significant piece of work
- Joint Grid Code Review Panel Working Group formed to implement Network Codes
  - Wide membership from affected stakeholders
- EirGrid & SONI are starting to discuss methodologies with neighbouring TSOs before final versions (code dependent)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Generator View of Network Codes

David MacCartney

Risk Manager – Power NI Energy


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Rate of Change of Frequency

Robert O'Rourke

Electricity Transmission,
Commission for Energy Regulation

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Background

- RoCoF is a work stream in the DS3 Programme
  - Required to increase SNSP to 75%
- Extensive industry engagement
  - Joint Grid Code Review Panel
  - JGCRP Working Group
- Regulatory Process
  - Separate CER and UR consultation processes
  - Bi lateral engagement with generators
- CER Decision 4th April 2014
- UR Decision 7th May 2014

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Considerations

- System security
- 2020 RES targets
- Changing nature of the system
- Technical capability of conventional fleet
- Cost and timeframe for implementation

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CER Proposed Decision

- Approve MPID 229 in principle
- Effective in Grid Code after TSO confirmation re system security
- 18 month lead-time assumed (studies etc.)
- Co-ordinated project led by TSO with RA oversight
- Public status reporting
- Generators responsible for project management of own studies
- Co-ordination where possible (i.e. similar units)

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Responses (1)

- Consultation closed on 9 August;
  - 12 responses received.
  - Subsequent representations from industry
- Wind generators broadly supportive:
  - ROCOF should be implemented as matter of urgency
  - A key part of delivering the 2020 targets and reducing curtailment levels
  - GPI generally supported
  - Project Governance: hard deadlines & public reporting critical

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Responses (2)

- Conventional generators highly critical:
  - Should not approve mod before completion of studies;
  - Alternative solutions project needs to be prioritised;
  - The 18 month period unrealistically short; several years needed;
  - OEMs don't have resource capacity to carry out studies on all plant within 18 months;
  - Certain plant should be exempted e.g. older plant, peaking plant;
  - Generators should be allowed cost recovery as ROCOF capability is a direct cost with no benefit for a conventional plant;
  - The GPI is penal and not an appropriate incentive;
  - Project Governance: Concern re the role of TSO. CER or a CER appointed consultant should be in this role;
  - Strong support for alternative solutions project, but some calls for it to be completed before generator ROCOF studies commence

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CER Decision

- Overall framework of the proposed decision retained
- Flexibility introduced for study deadlines
- GPI reduced and introduction phased over 36 months
- Co-ordination of generator studies by independent expert
- Remuneration mechanism to proposed

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ROCOF Implementation Framework

Modification

- Approved in principle
- Effective after confirmation from studies
- 18-36 Month timeline

Implementation

- Generator studies; Independent co-ordination
- TSO-DSO implementation project
- TSO led alternative solutions project

Financial Arrangements

- No Cost recovery for study
- GPI to be phased in after 18 months
- Payments (e.g. HAS) to be developed

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Next Steps

- CER engaging with EirGrid
  - Plans for alternative solutions project
  - Preliminary stages of Generator Studies Project
- Independent expert to be appointed
- Direct engagement, as required, with generators prior to initial trilateral meetings
- Formal notification of project commencement
- CER and UR will continue to liaise on RoCoF implementation

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Questions


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DS3 Programme

15/05/2014

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

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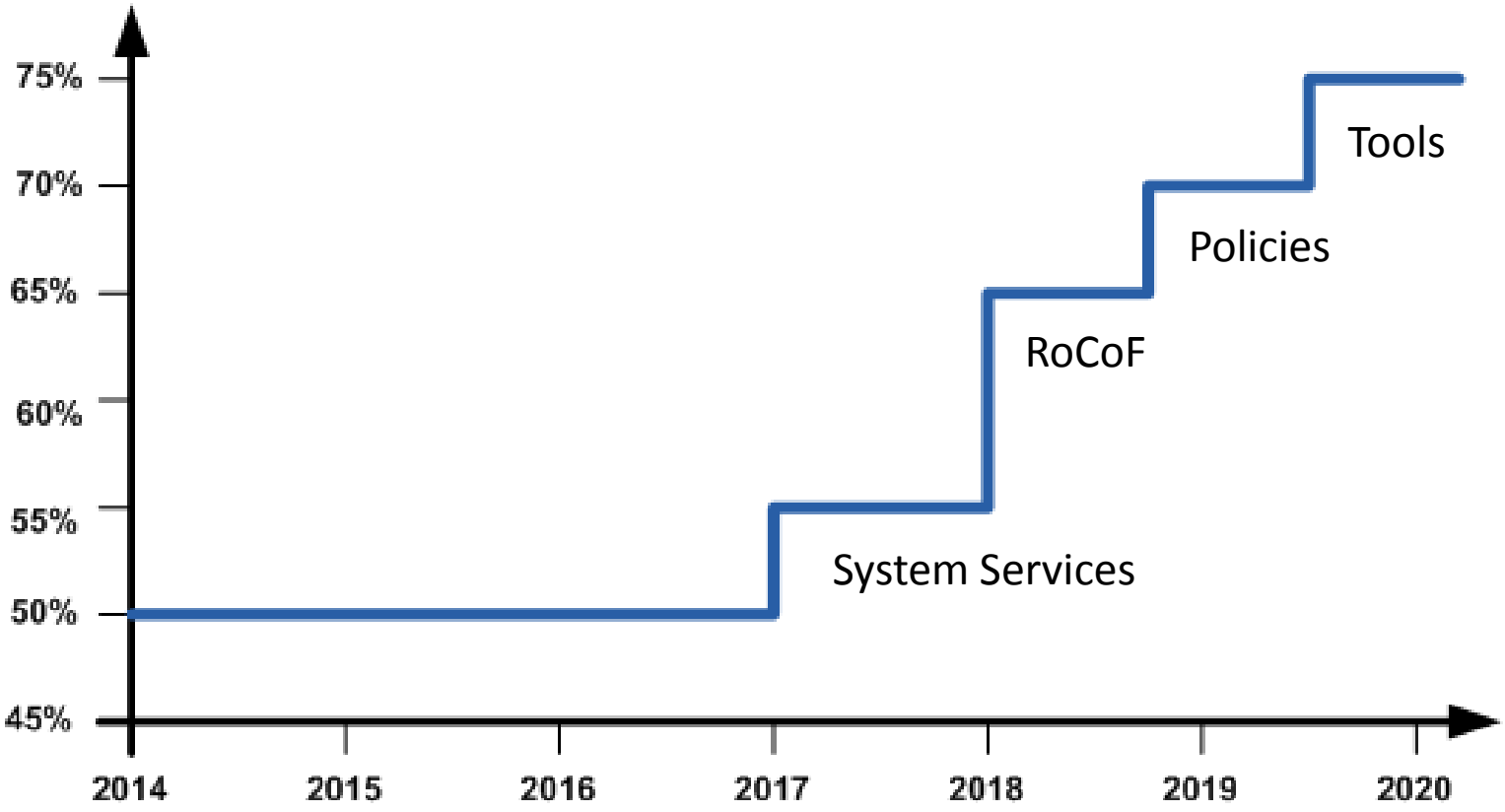
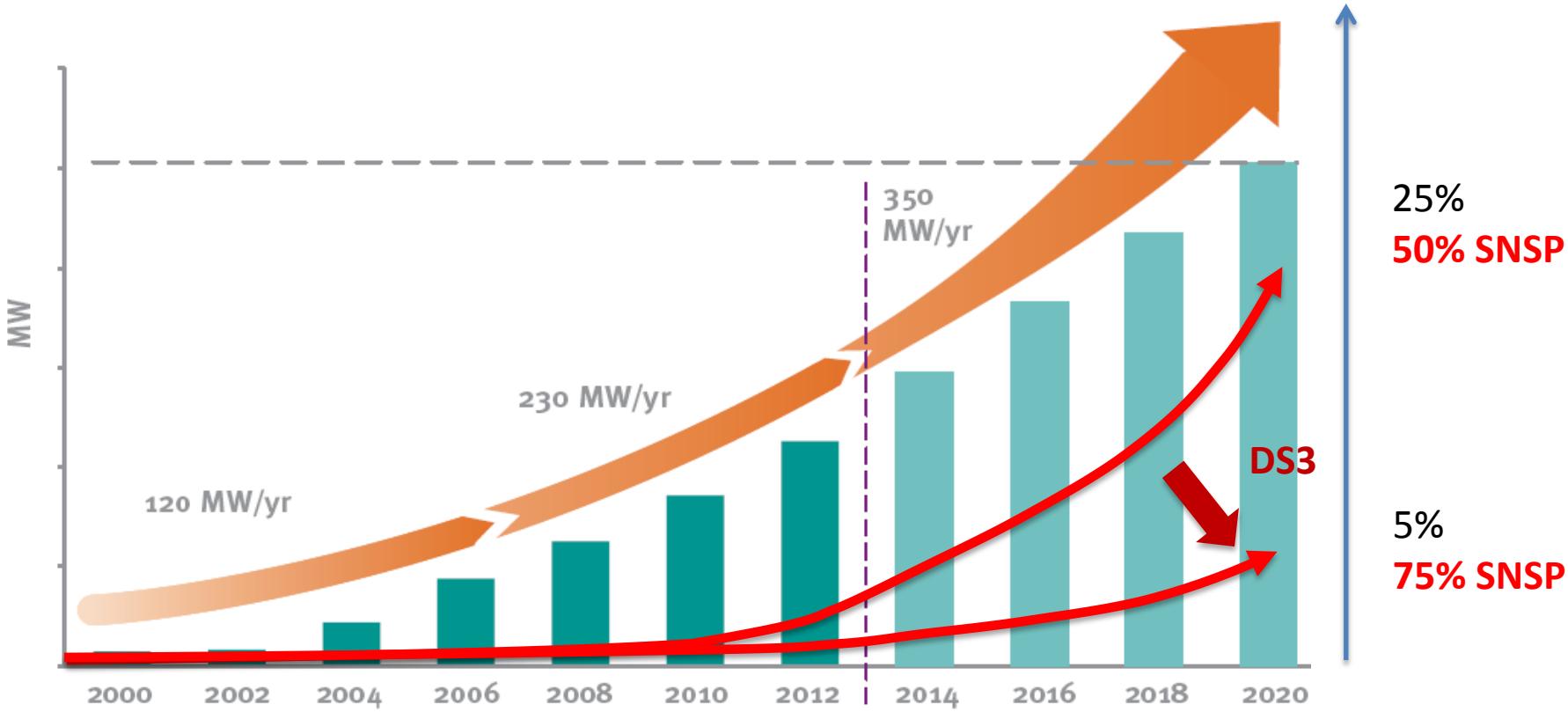
Operational Capability Outlook



Effect of SNSP on Curtailment



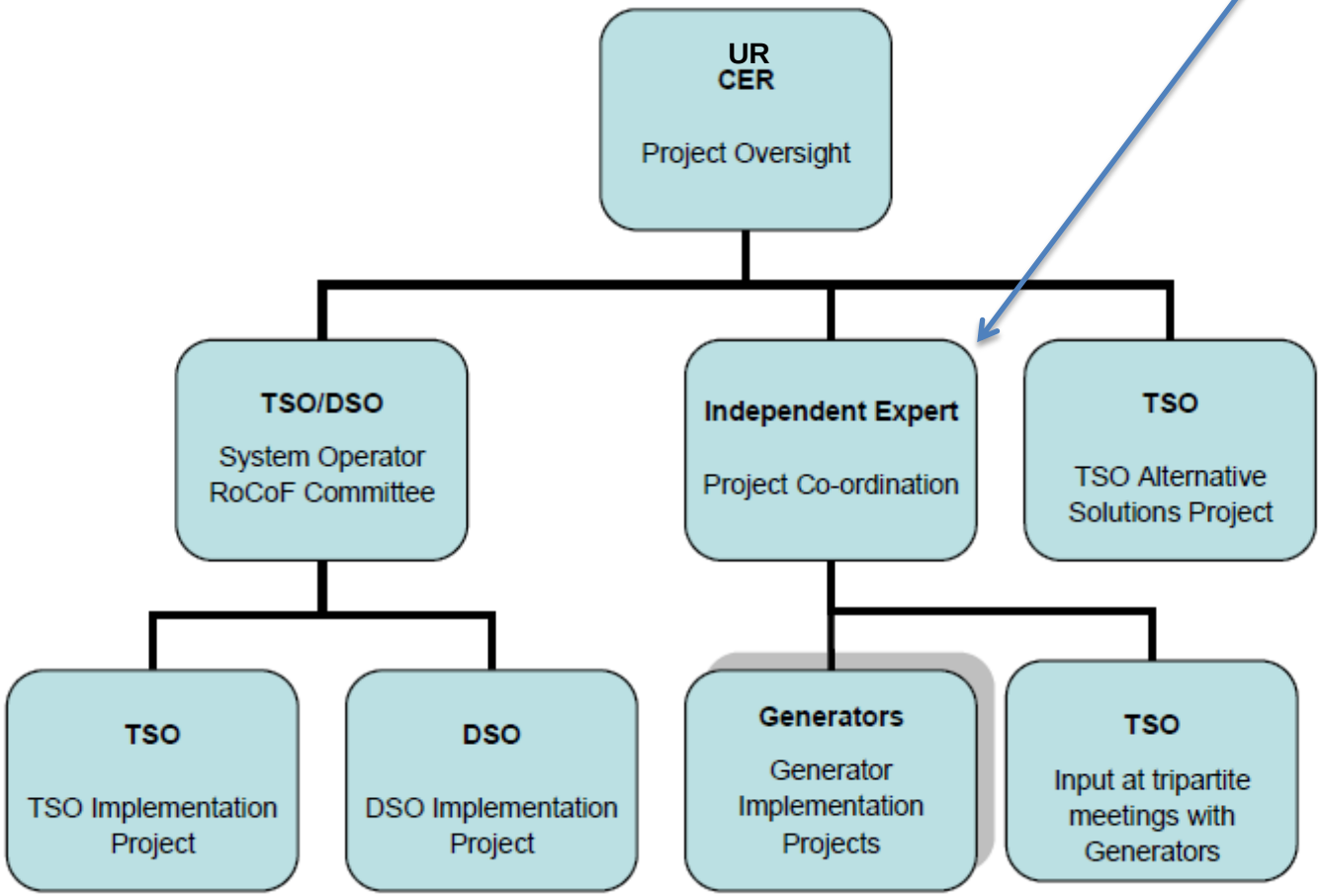
Illustrative SNSP curves

System Performance

- Grid Code
- Performance Monitoring
- DSM
- System Services
- ROCOF

RoCoF

UR Decision:
Carried out by SONI



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

Further Economic Analysis

TSOs

Plexos: System Service Valuation

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

Report delivered to RAs (7th Mar 2014)

RAs

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 Q2 2014
- SEMC Decision expected by end 2014

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System Policies

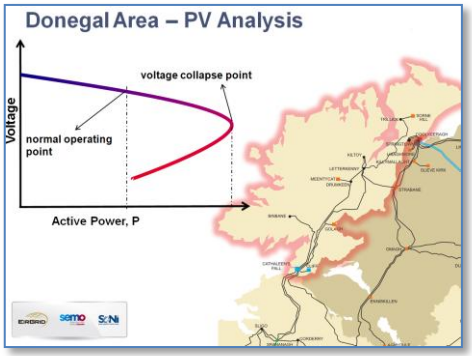
Frequency

Voltage

Renewable Data

Development of System Policies

…to maintain VOLTAGE



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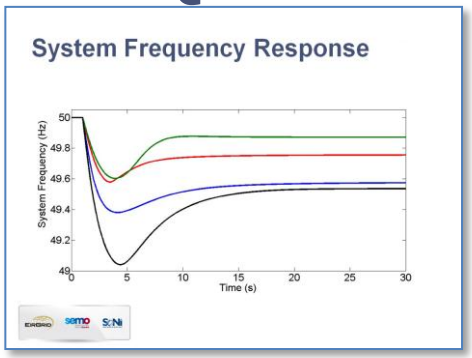


Ongoing Operational Studies

- High wind reports
- Nodal voltage control
- Minimum generation studies
- Secondary tripping study
- Over frequency generation shedding
- SNSP metric review

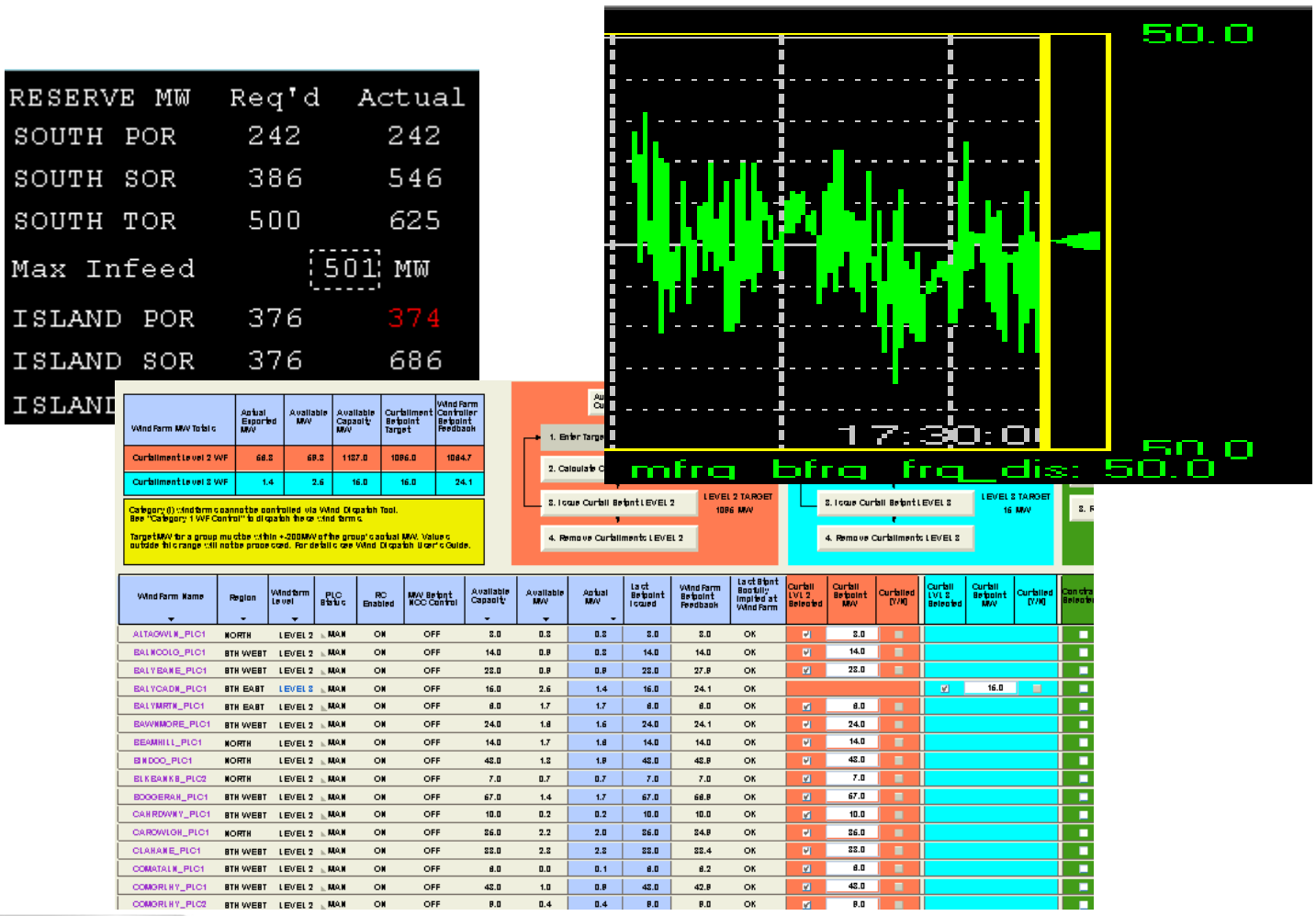
System Tools

WSAT

Control Centre Tools

Model Dev. & Studies

Control Centre Tools



Some Likely Tools and Policies?

- Frequency Control
  - Frequency Regulation
  - Ramping
  - Reserve from wind
- Voltage Control
  - TSO/DSO Voltage Control Interaction
  - Voltage Trajectory Studies
  - Security Constrained OPF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Lunch/Tea/Coffee

Next presentation 13.10

Enhanced Performance Monitoring & Testing

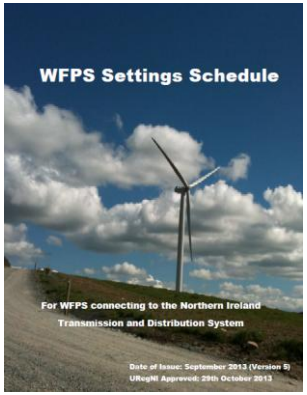
Dave Carroll

Operational Services & Performance

Context

- Grid Codes & SONI Windfarm Settings Schedule sets out the minimum technical requirements for generating units

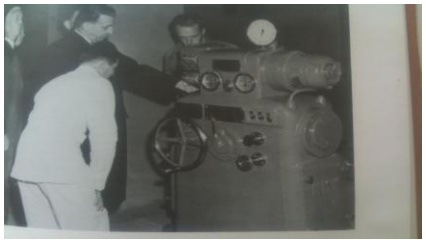
- Harmonised Ancillary Service Agreements for reserve, reactive power & black start



Generating Units – Performance Monitoring

- 169 individual units ~ 11 GW of capacity

Type	No
Hydro	14
Thermal	19
Combined Cycle Gas Turbines	10
Open Cycle Gas Turbines	6
Peakers	12
Pumped Storage	4
Waste to Energy	1
Combined Heat and Power	2
Demand Side Units	3
Aggregated Generating Units	1
HVDC Interconnectors	2
Wind (TSO connected)	23
Wind (DSO connected)	72



Generating Units – Testing

- Testing expected during 2013/2014

Technology	Type	No
Conventional	Existing	15
	New	1
	Refurb	6
Fuel	Primary	16
	Secondary	14
Windfarms	Existing	70
	New	30
	Remote	86
Demand Side Units	New/Existing	15

Performance Monitoring & Testing – Why?

- Carried out to ensure generators adhere to Grid Code, WFSS, HAS, TOD

- The basis of secure and economic system operation relies on the expected plant performance to match actual performance

- Changing portfolio

Performance Monitoring & Testing - Benefits

- Feeds into technical characteristics, TOD & HAS
- Feeds into Operational Policy e.g. understanding of actual OR performance so changes to OR policy
- DBC is closely aligned with Performance Monitoring. Helps reduce production costs to end consumer
- Increased controllability of windfarms

Current Monitoring Process

- Not systematic – as and when required
- Manual observation of plant
- Limited systematic monitoring e.g.
  - Generator loading / de loading automatically recorded and analysed for GPI purposes
  - Post event reserve analysis
- Very manual and resource intensive

System Services
Performance Monitoring
Grid Code
Demand Side Management

Frequency Control
Voltage Control
Renewable data
System inertia

Models Development
Control Centre Tools
AI Wind Security Assessment Tool

Scope of Enhanced Monitoring Project

- Standardise and harmonise
- Existing Grid Code and HAS Agreements
- Automate monitoring
- Transparent for generators and improved comms
- Investigate use of improved data
- Use data to validate dynamic models

Phase 1

- Monitoring of new System Service products

Phase 2

Generator Performance Monitoring

- Active Power
- Available Active Power
- Frequency Response
- Voltage Support
- Other

Scope of Enhanced Testing

- Recommendations to improve procedures and report documentation
- Standardise these where possible
- Published on TSO websites

Progress to date

2012

- Improving existing Performance Monitoring (PM)
- Standardise PM reporting
- Industry workshops on Testing

Q 1 2013

- Recommendations for Testing published
- Initiating and planning for PM project
- High level requirements for PM developed by TSOs
- Updates at Joint Grid Code Review Panel

Progress to date

Q2 2013

- All Island Industry Workshop to get feedback on high level requirements for PM
- Findings/Action document published on TSO website
- Update at Joint Grid Code Review Panel

Q 3/4 2013

- Development of detailed design specification by TSOs for PM
- Review of report templates for PM with Industry
- Update at Joint Grid Code Review Panel

Progress to date

Q1 2014

- Report templates published for Industry feedback
- Comments incorporated into final design spec

Q 2 2014

- Development of business processes
- Test procedures being published on TSO website
- http://www.eirgrid.com/operations/gridcode/compliancetesting/wfpstestprocedures
- http://www.eirgrid.com/operations/gridcode/compliancetesting/cdgutestprocedures

Next Steps

Q2 2014

- Industry workshop in Belfast on 24th June to present proposed business processes
- TSOs to consider feedback and refine processes
- Development of IS systems
- Continue to publish Testing procedures on TSO website

Q 3 2014

- Industry workshop in Dublin to present final business processes
- Development of IS systems
- Continue to publish Testing procedures on TSO website

Industry Workshop - Reminder

- 24th June in Belfast
- Invites to issue shortly
- Will focus on new process flow and discussion on tolerances, priorities, actions & times for EPM
- Kick off discussion on PM for new System Services

QUESTIONS?

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semo
Single Electricity
Market Operator
SONI
System Operator for Northern Ireland

EWIC Impact to SEM

Generator Forum
DUBLIN – May 15th 2014

Marie-Therese Campbell

WHOLESALE ELECTRICITY PRICES LOWER BY 9% DUE TO EIRGRID INTERCONNECTOR

- *East West Interconnector exerts significant downward pressure on wholesale electricity prices*

Wednesday, 30 April, 2014: EirGrid has announced, at the launch of its 2013 Annual Results, that wholesale electricity prices in the Single Electricity Market on the island of Ireland are lower by 9 per cent since the EirGrid East West Interconnector (EWIC) commenced full commercial operations.

EWIC links power markets in Ireland and Great Britain. It has contributed to downward pressure on wholesale electricity prices.

EWIC in the News

UK power link knocks a tenth off electricity costs, says operator

Potential €1bn French link could reduce costs by similar amount, says Eirgrid

UK power link has cut electricity prices, says EirGrid

A NEW electricity link connecting Ireland and the UK has helped push down electricity prices by 9pc, EirGrid has claimed.

The East-West Interconnector, which cost around €500m to build, has already pushed down wholesale prices in the 10 months since it began operations, according to the national transmission system operator.

The interconnector, which runs between Meath and Deeside in Wales, can import and export enough energy to power an extra 500,000 homes.

The savings created by this have been passed down to businesses and consumers through a series of deals offered by energy companies in recent months, EirGrid chief executive Fintan Slye said.

"The interconnector isn't the only reason for price falls, but it's a major contributor" said Mr Slye (pictured), discussing the company's 2013 annual results.

EirGrid made an underlying profit of €18.3m in the 12 months, virtually unchanged from 2012, and paid a dividend of €4m to the State. Revenues were €622m, up from €543m.

The success of the interconnector has come after the collapse of talks over a massive network of windfarms in the midlands has also denied the State access to an additional electricity source that could have seriously pushed down prices, EirGrid said.

The State would have been able to import as well as export electricity using an interconnector planned by UK developers as part of proposals to erect thousands of windfarms in the midlands – with most of the costs of the interconnector shouldered by the developers, rather than Irish taxpayers.

But this option disappeared when talks about the windfarms collapsed in March.

Sarah McCabe

Wholesale electricity prices down 9 per cent

Simon Cunningham

WHOLESALE electricity prices in Northern Ireland have lowered by nine per cent since an interconnector linking Ireland and Britain commenced full commercial operations last year.

That is according to energy firm EirGrid Group which includes the System Operator for Northern Ireland (SONI).

EirGrid made the announcement as it revealed pretax profits of €61.1 million ($80.2m) for the year to the end of September 2013.

tained its class-leading progress in facilitating renewable energy on the transmission system, and in delivering innovation and high standards of security of supply," he said.

EirGrid is electricity Transmission System Operator (TSO) in the Republic and also owns of the System Operator Northern Ireland (SONI Ltd).

The Single Electricity Market Operator (SEMO) is part of the EirGrid Group, and operates the wholesale market on the island of Ireland.

Herald Business

New interconnector brings 9pc price drop

ENERGY

A NEW electricity transmission system connecting Meath with Deeside in Wales has helped push down electricity prices by 9pc, Eirgrid has revealed.

The East-West Interconnector, which cost around €500m to build, has already had a major downward effect on wholesale prices in the 10 months since it opened, according to the national transmission system operator.

The savings have been passed down to businesses and consumers through deals offered by energy companies in recent months, Eirgrid chief executive Fintan Slye (above) said.

Eirgrid made an underlying profit of €18.3m in the 12 months, virtually unchanged from 2012, and paid a €4m dividend to the government. Revenues were €622m, up from €543m.

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Interconnectors SEM-GB

Moyle

- 250 import/80 export
- Half of original capacity foreseeable future

EWIC

- 530 import/ 500 export
- Fully operational since May 1st 2013

Future

- IC to France

Physical System

Indicative figures for All Island and Great Britain systems in 2016

	All Island		Great Britain	
Max. Demand	7,000MW		59,100 MW	
Installed Wind	3,581MW	51% Max Demand	18,000 MW	30% Max Demand
Interconnector Capacity	750 MW	11% Max Demand	4,000 MW	7% Max Demand
Largest Generation Infeed	445 MW	6% Max Demand	1,320 MW	2% Max Demand

Source: EirGrid All Island GSC 2012-21 and NGUK 2011 NETS 7 year statement

Interconnected Markets

SEM

- Ireland & Northern Ireland
- Transparent bidding
- Short Run Marginal Cost, Start- up costs
- Capacity Payments
- 3 gate closures
- Ex-post Pricing

BETTA

- England, Scotland, & Wales
- Non-transparent power trades Bilateral contracts
- Power Exchange and Balancing Market
- Hourly gate closures
- Ex-ante Pricing

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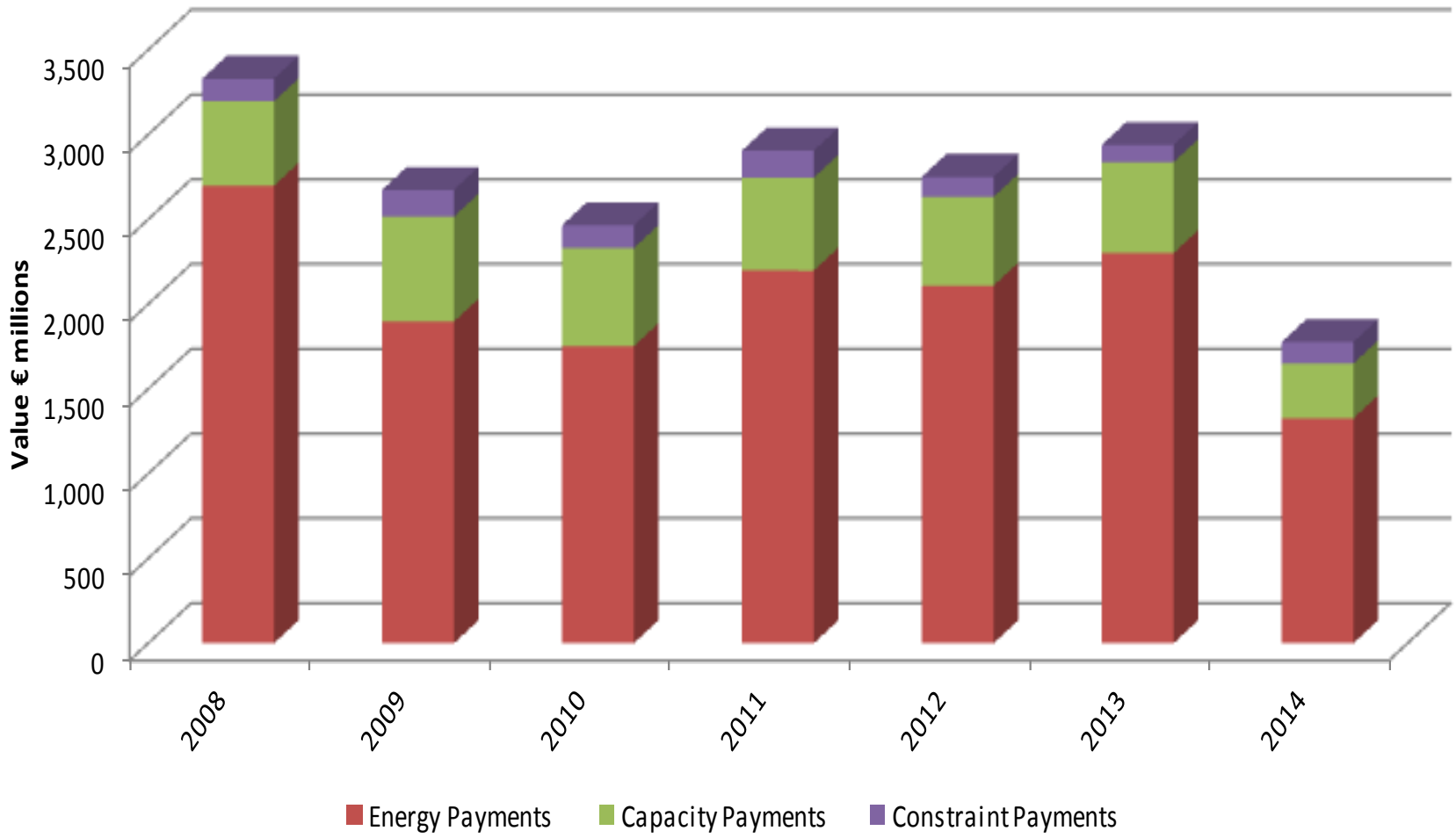
Value of SEM € - €7.3 M per day



EWIC Market Analysis

- **Economic Dispatch only**, no constraints, reserve or otherwise
- Central Market Systems (1 year, over 17k Trading Periods)
- Market Engine / Unconstrained Unit Commitment (UUC) used in Offline mode
- Base Case is actual UUC EP2 D+4 based on EWIC **fully available** from May 1st 2013 – April 1st 2014: **EWIC ON**
- Scenario EWIC **unavailable** from UUC for all trade dates May 1st 2013 – April 30th 2014: **EWIC OFF**
- Comparison of overall Production Costs and System Marginal Price (SMP)

UUC System Summary EWIC ON

System Summary					
	Legend for Alarm Flags				
	O over-generation	U min up time or max up time violation	E energy limit violation		
	L under-generation	D min down time violation	T Transmission Constraint Violation		
	R ramp violation	X multiple violation			
	System	Non-Wind Gen	Wind Gen	Demand-Side Unit	Moyle Interconnector
Trading Period	Load (MW)	(MW)	(MW)	(MW)	Flow (MW)
15/04/2014 06:00:00 IST	2992.65	2611.04	381.61	0	-46
15/04/2014 06:30:00 IST	3186.86	2809.13	377.73	0	-19.08
15/04/2014 07:00:00 IST	3545.1	3147.76	397.34	0	57.75
15/04/2014 07:30:00 IST	3864.18	3442.9	421.28	0	178.55
15/04/2014 08:00:00 IST	4192.8	3780.62	412.18	0	244.12
15/04/2014 08:30:00 IST	4378.93	3965.55	413.38	0	250

EWIC Interconnector Flow (MW)	Total Interconnector Flow (MW)	Total Gen Cost (€)	SMP (€/MWh)	Lambda (€/MWh)	Inter. Lambda (€/MWh)	Alarm	Penalty Cost (€)
58.4	12.4	44194	49.17	39.03	0		0
84.28	65.2	47948	55.18	39.03	0		0
227	284.75	53994	61.4	42.4	0		0
302	480.55	58700	64.7	45.69	0		0
452	696.12	59878	64.55	45.69	0		0
529.94	779.94	60375	64.48	45.69	0		0

Extract April 15th 2014 EWIC ON Basecase

UUC System Summary EWIC OFF

System Summary					
	Legend for Alarm Flags				
	O over-generation	U min up time or max up time violation	E energy limit violation		
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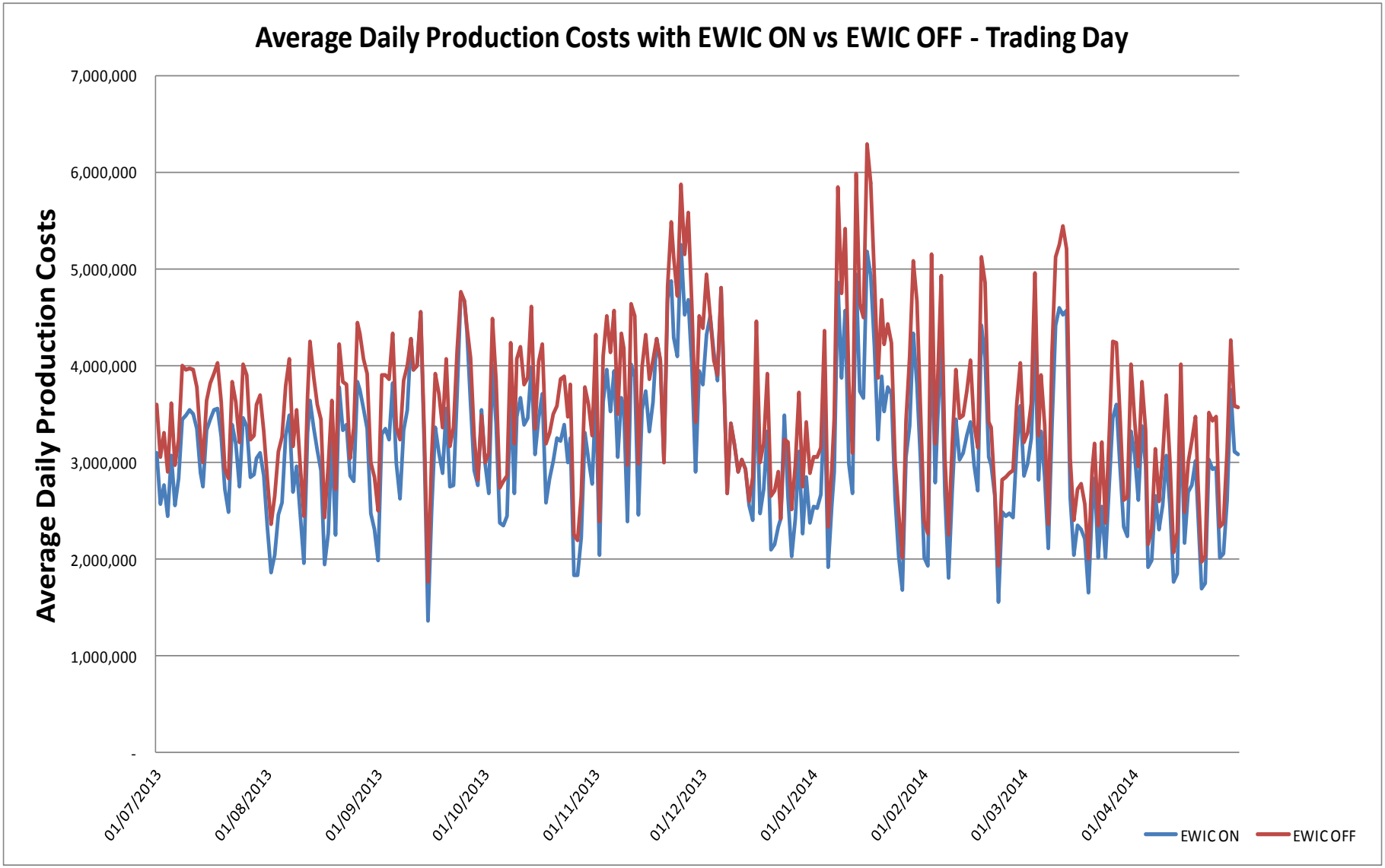
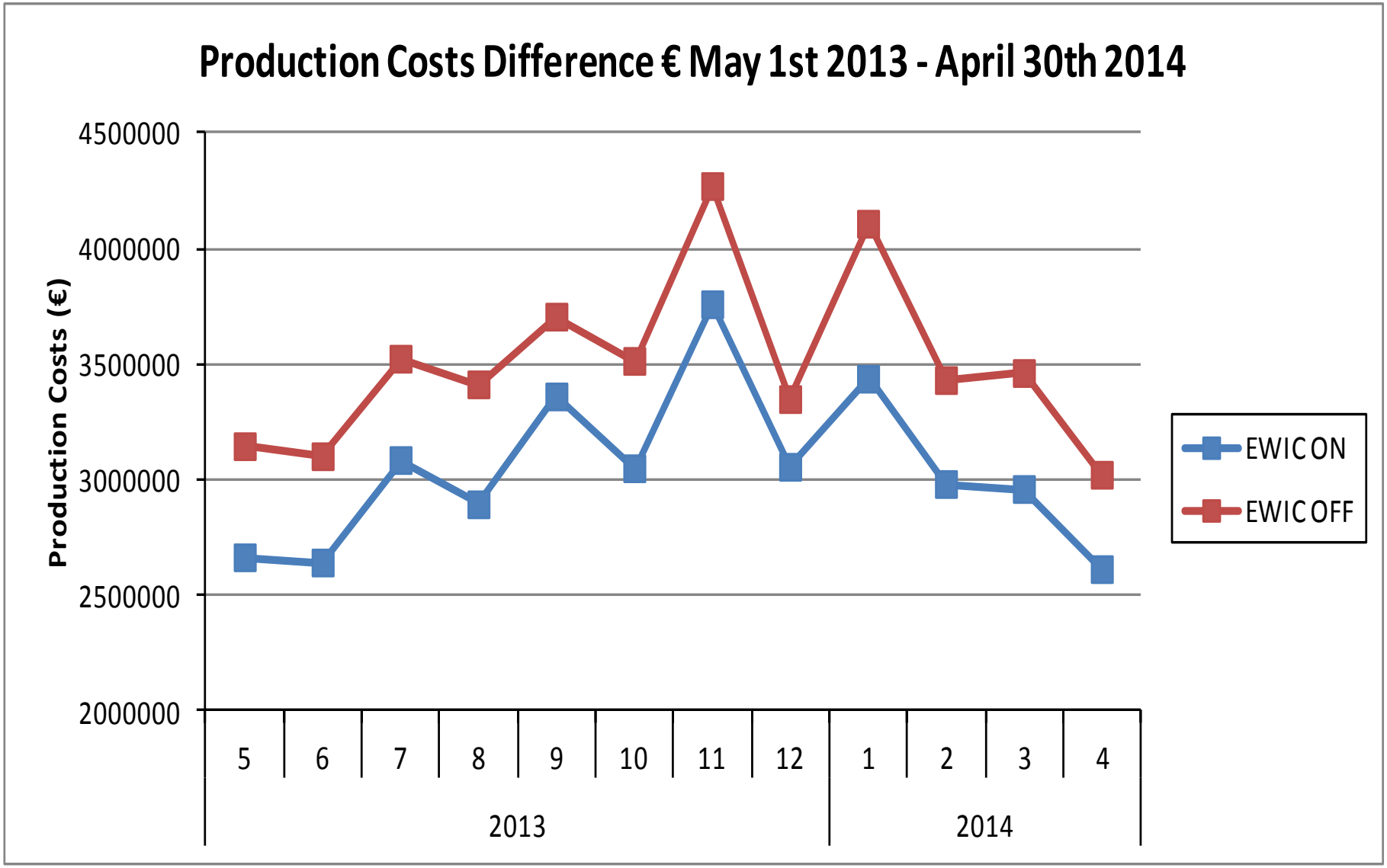
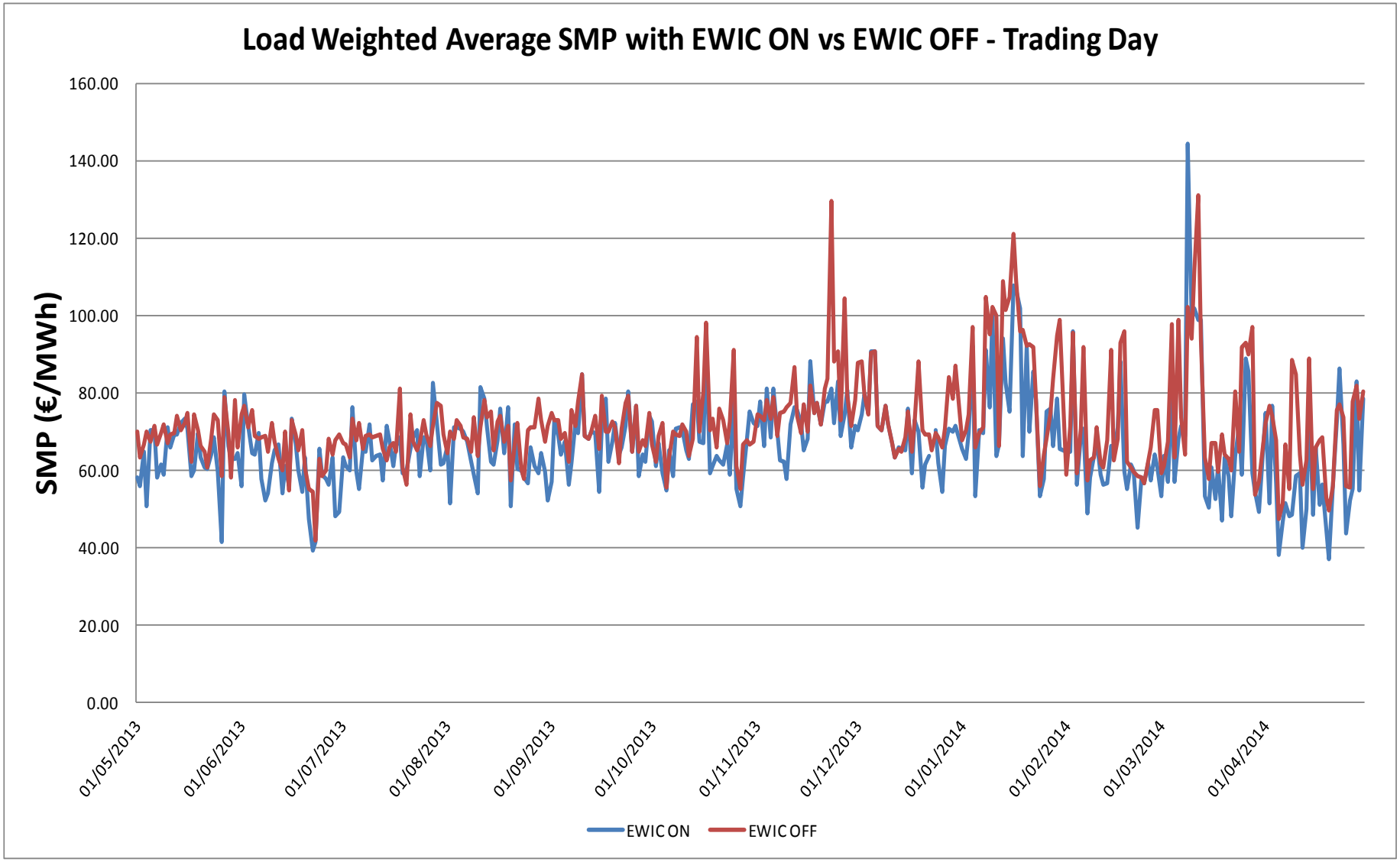
EWIC Interconnector Flow (MW)	Total Interconnector Flow (MW)	Total Gen Cost (€)	SMP (€/MWh)	Lambda (€/MWh)	Inter. Lambda (€/MWh)	Alarm	Penalty Cost (€)
0	-46	45872	39.03	39.03	0		0
0	-19.08	67786	39.03	39.03	0		0
0	72.44	56497	43.06	43.06	0		0
0	178.55	82420	45.71	45.71	0		0
0	244.12	64808	45.71	45.71	0		0
0	250	67952	45.71	45.71	0		0

Extract April 15th 2014 EWIC OFF



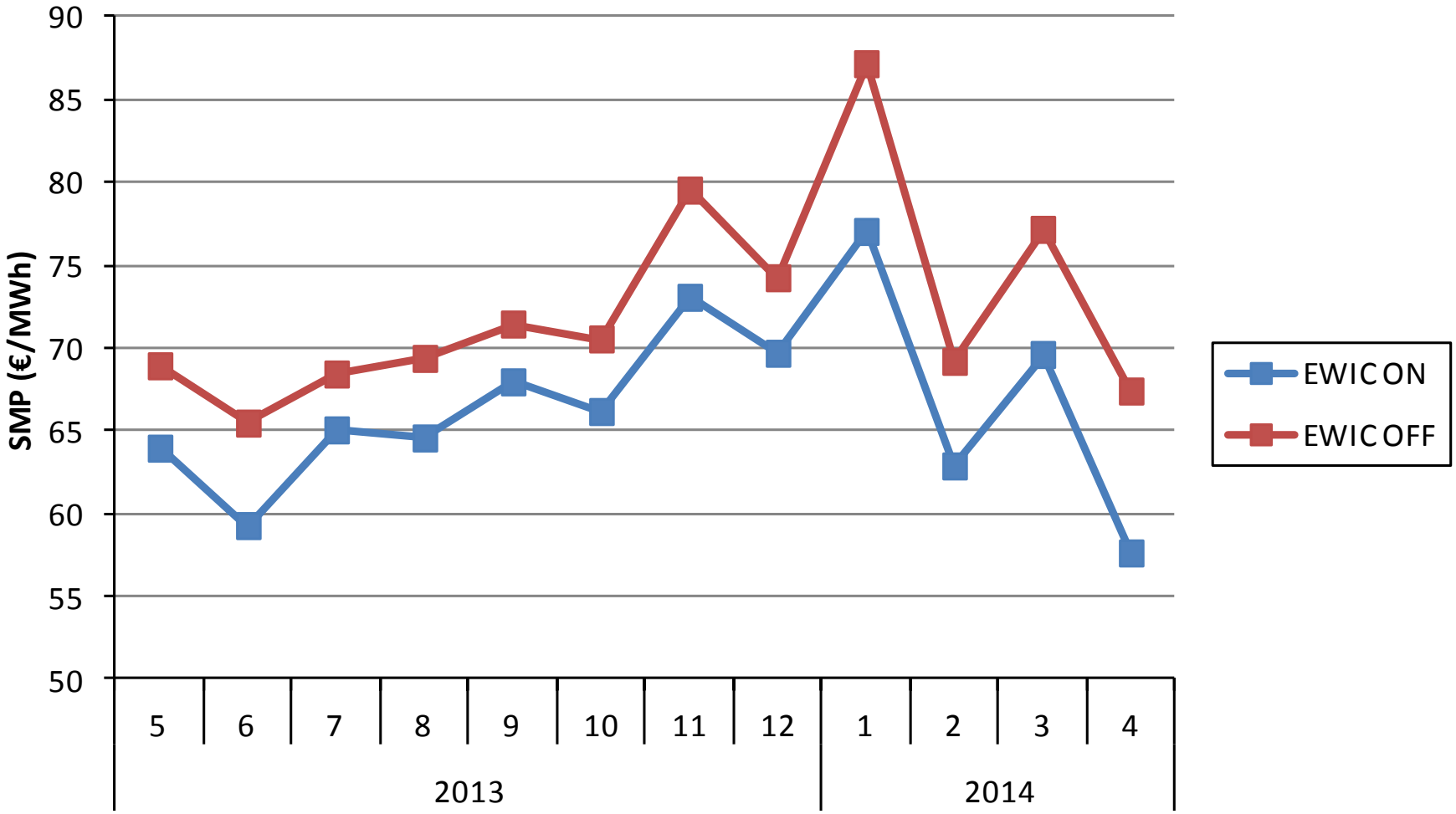
Relative Average Daily Savings in Prod Costs €462k or 15% Per Day


Production Costs Difference € May 1st 2013 - April 30th 2014
Production Costs (€)
4500000
4000000
3500000
3000000
2500000
2000000
5
6
7
8
9
10
11
12
1
2
3
4
2013
2014
EWIC ON
EWIC OFF

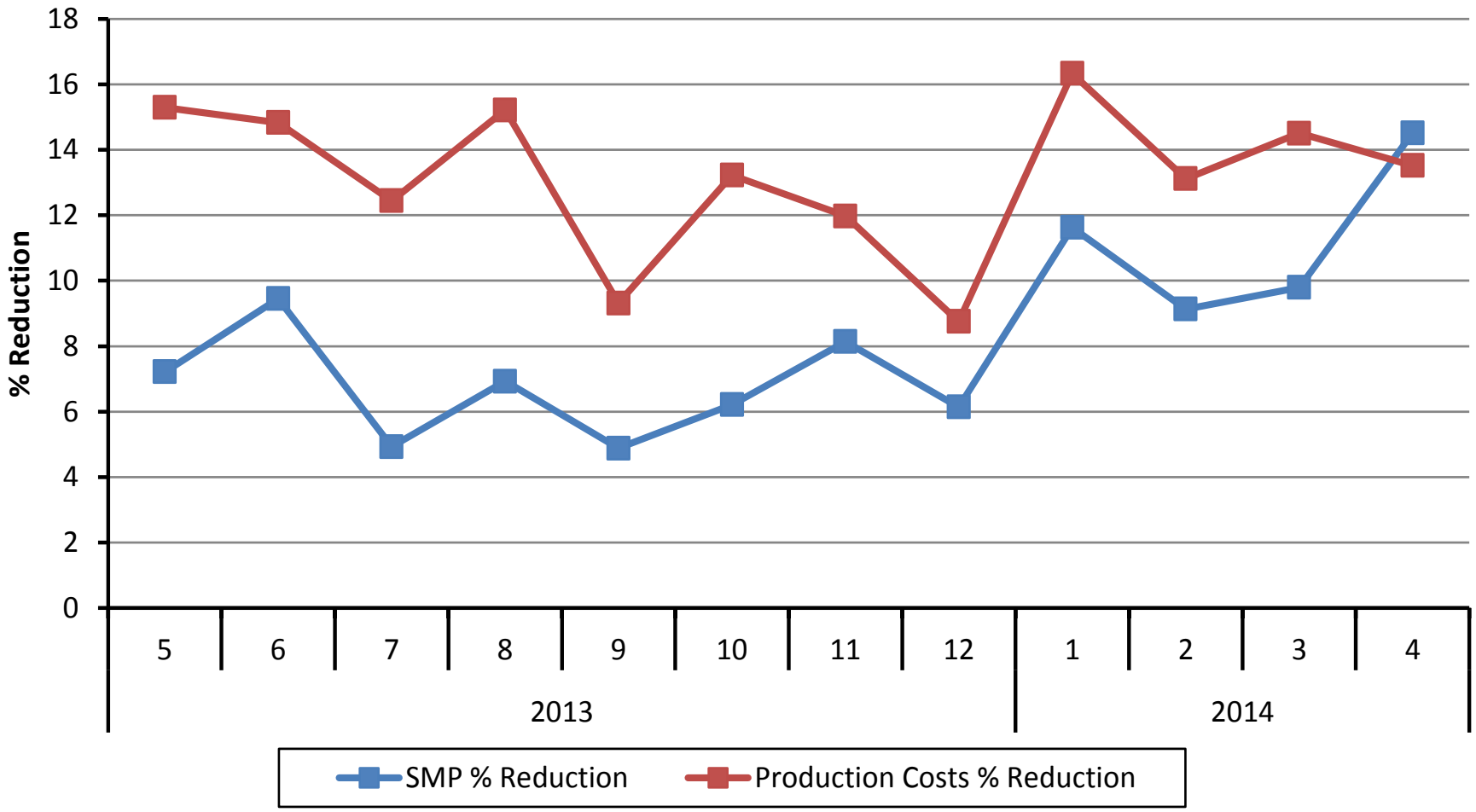


Relative Average Daily Savings in SMP 5.85 €/MWh or 9% on average since May 1st 2013

Load Weighted Average SMP May 1st 2013 - April 30th 2014

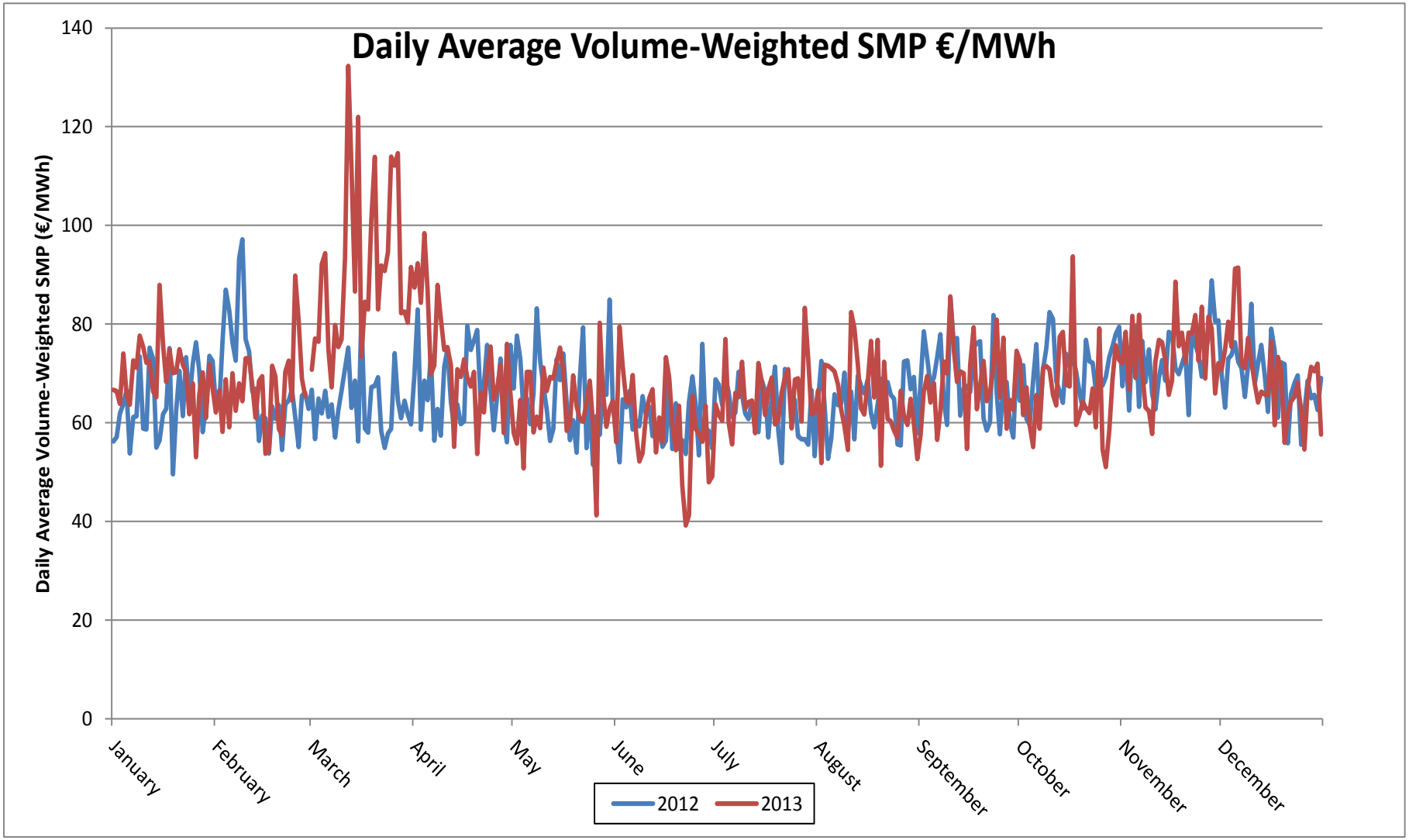


% Reduction Per Month

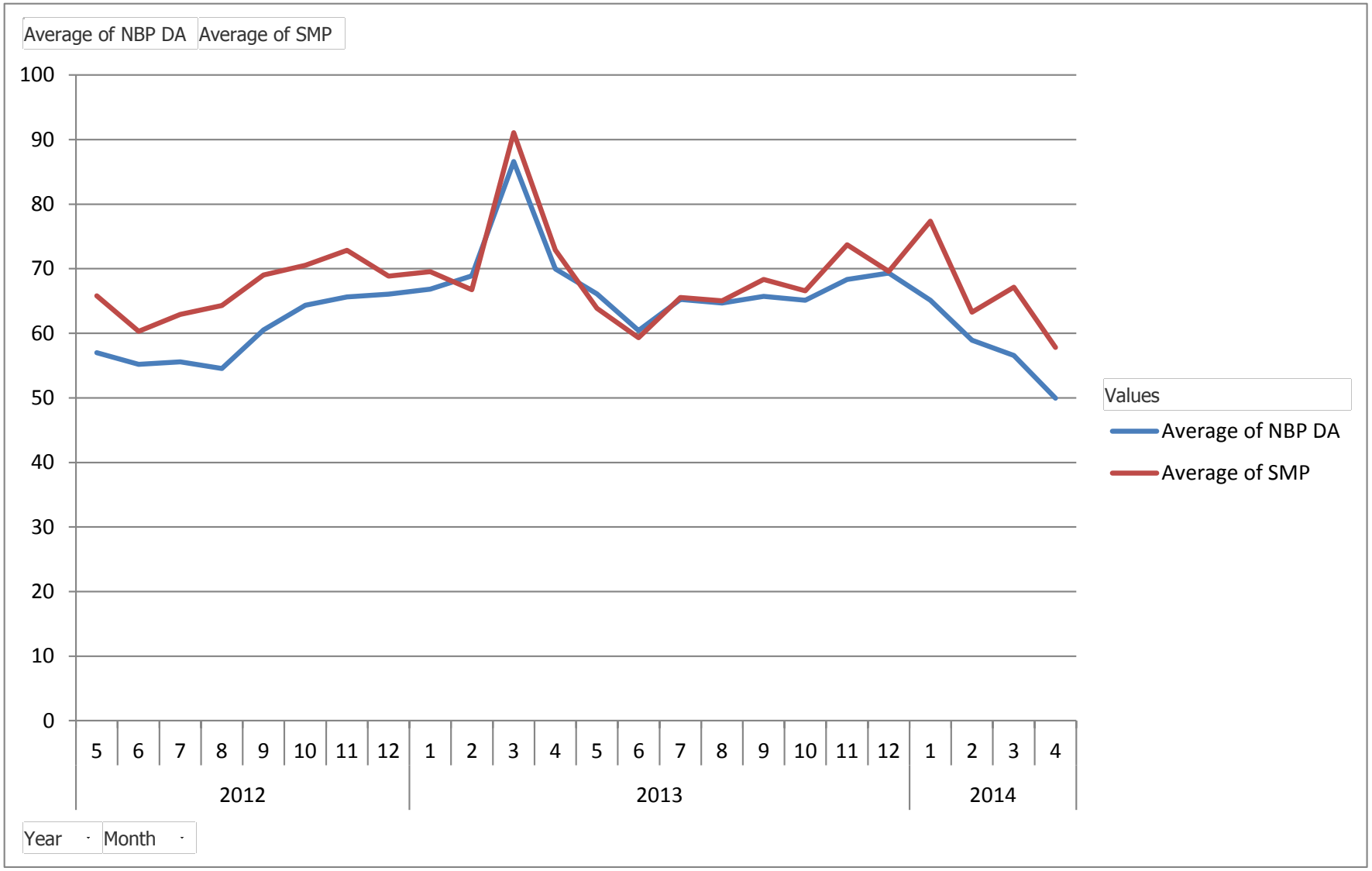


MSQs by Fuel Type

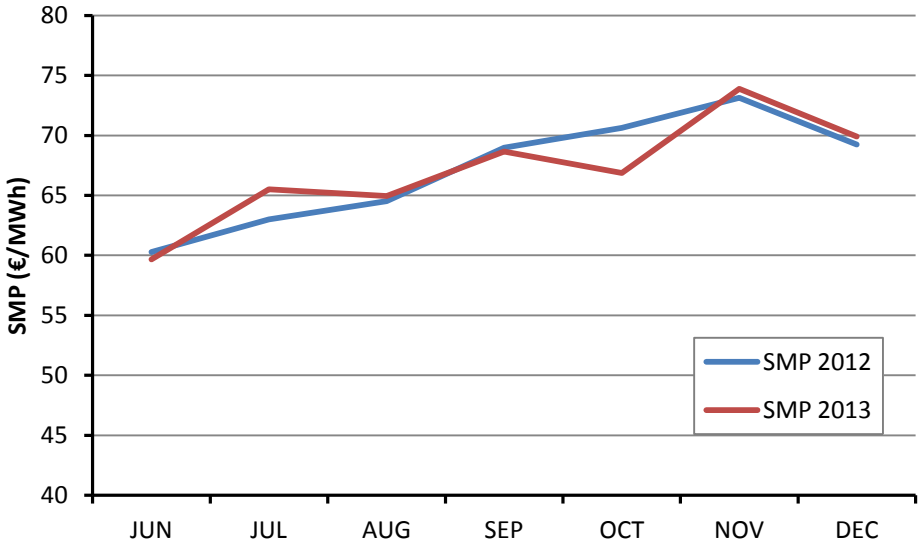
- Short video clip EWIC ON v EWIC OFF



Actual SMP Calendar Year 2012 v 2013


Average of NBP DA
Average of SMP
100
90
80
70
60
50
40
30
20
10
0
5
6
7
8
9
10
11
12
1
2
3
4
5
6
7
8
9
10
11
12
1
2
3
4
2012
2013
2014
Values
Average of NBP DA
Average of SMP
Year
Month

Year on Year (6 months) Difference in Monthly Average SMP and Gas Prices

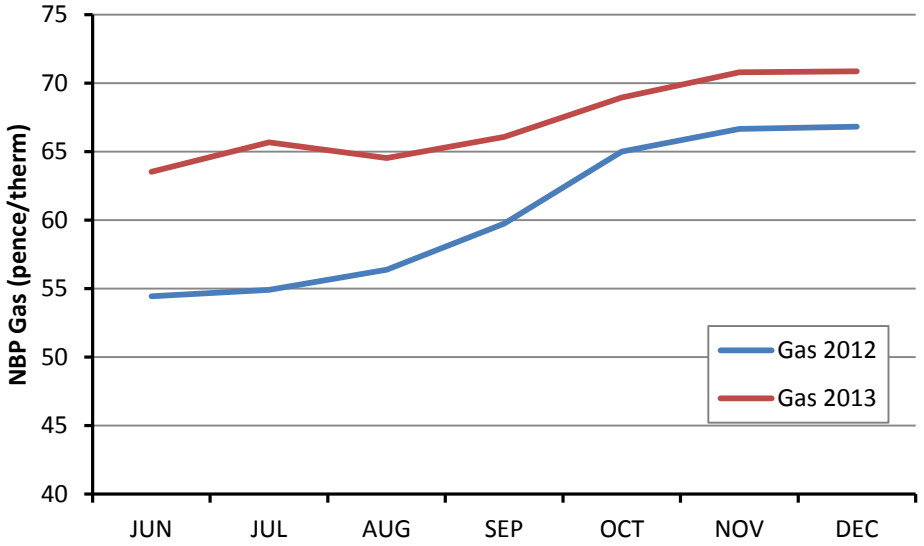


June2012/2013 – December2012/2013

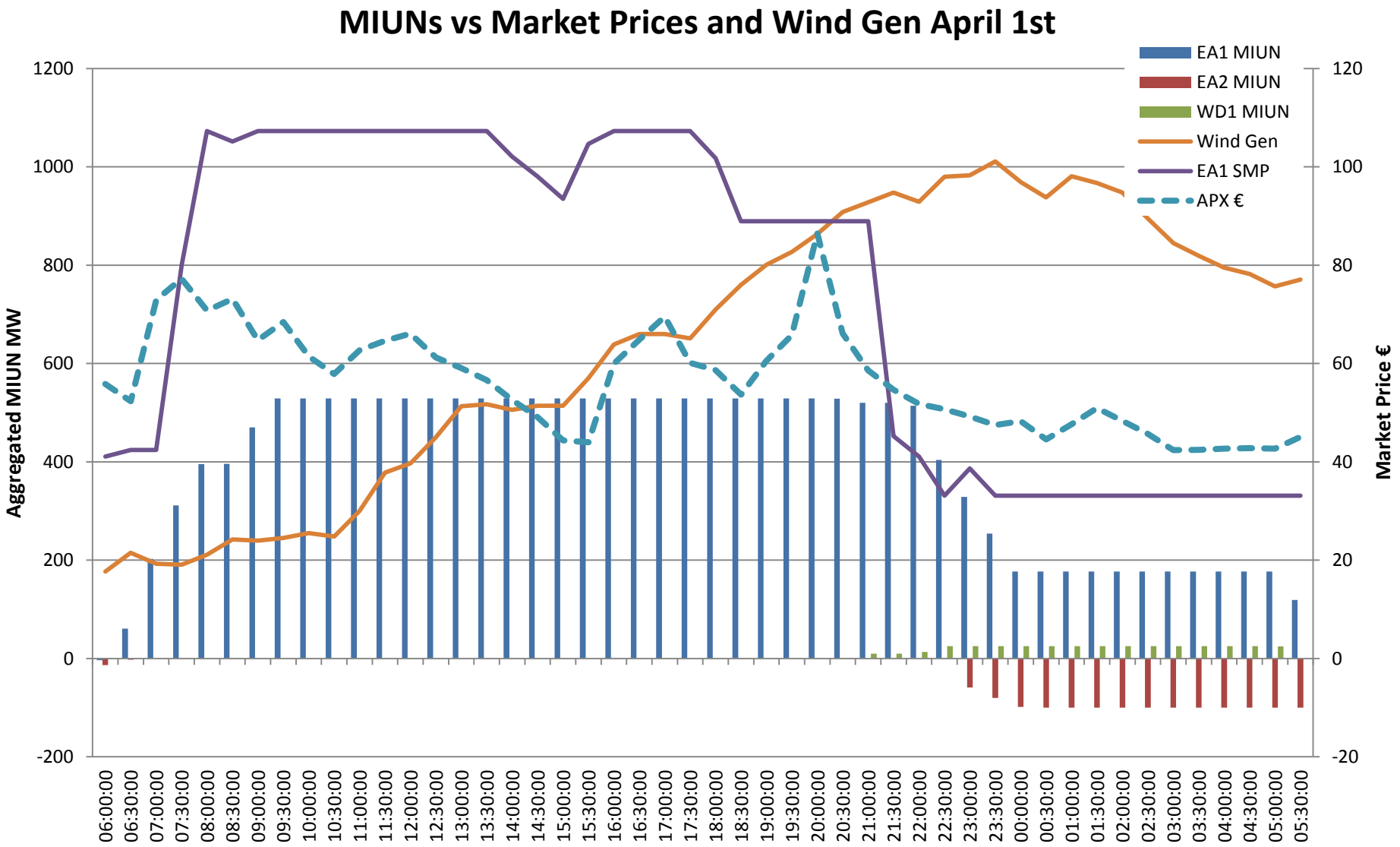
0.1% Decrease in SMP

June2012/2013 – December2012/2013

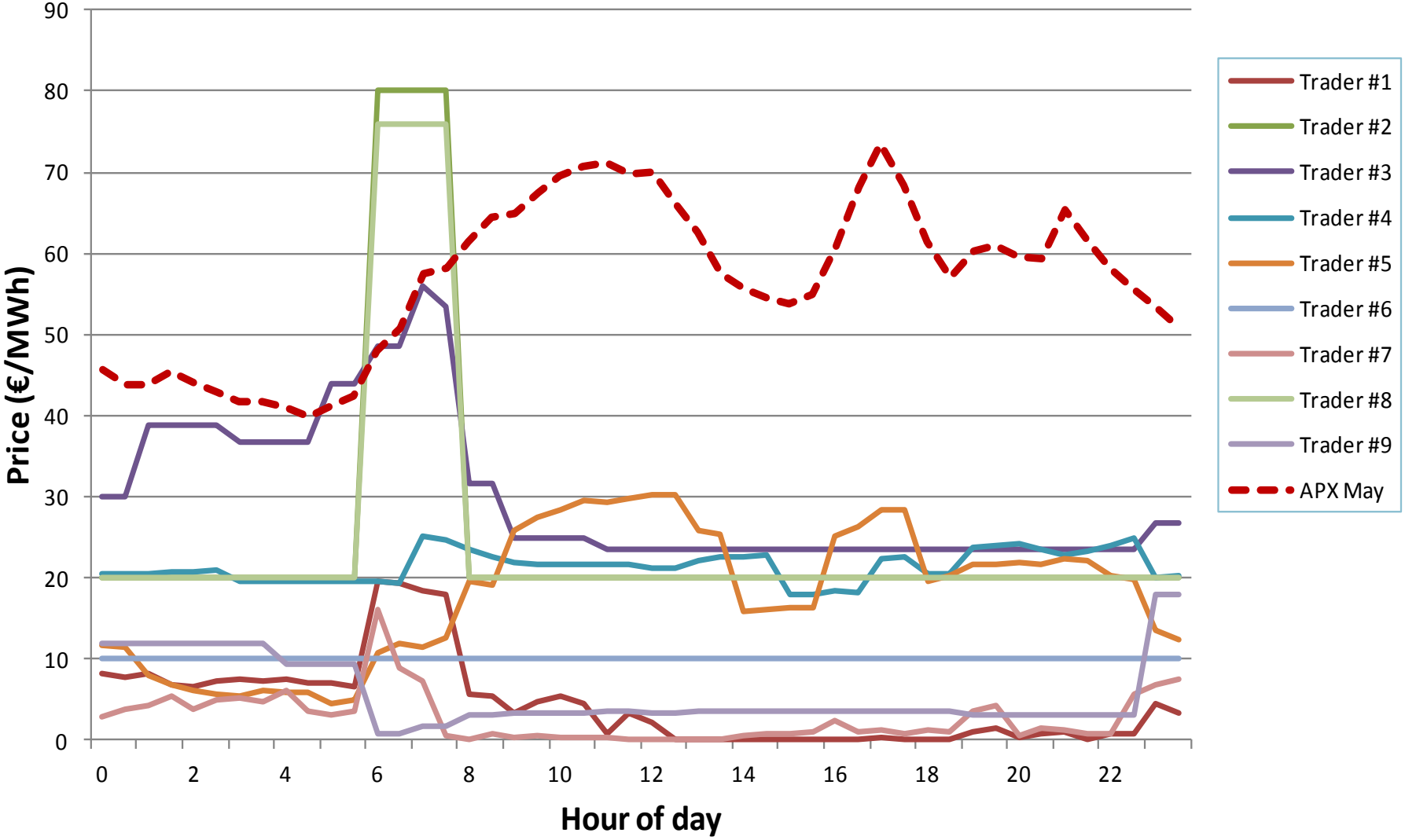
12.9% Increase in NBP Gas



Trading Behaviours



IC Trading Behaviour



Policy Influencers on Trading

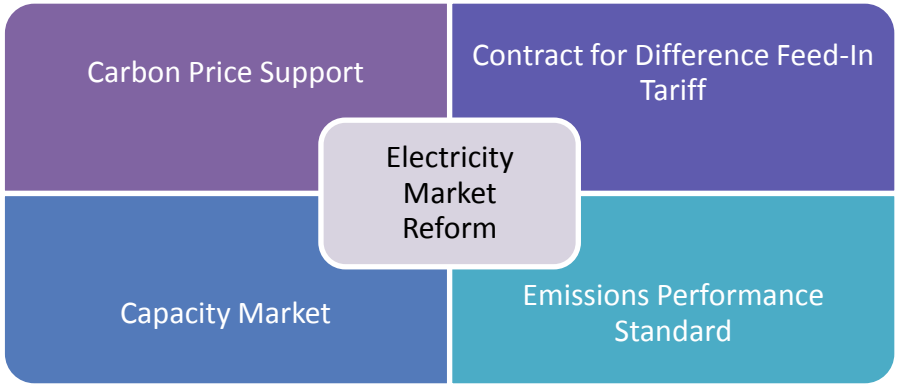
- UK EMR: Delivery in 2014
- EU Target Model (I-SEM)

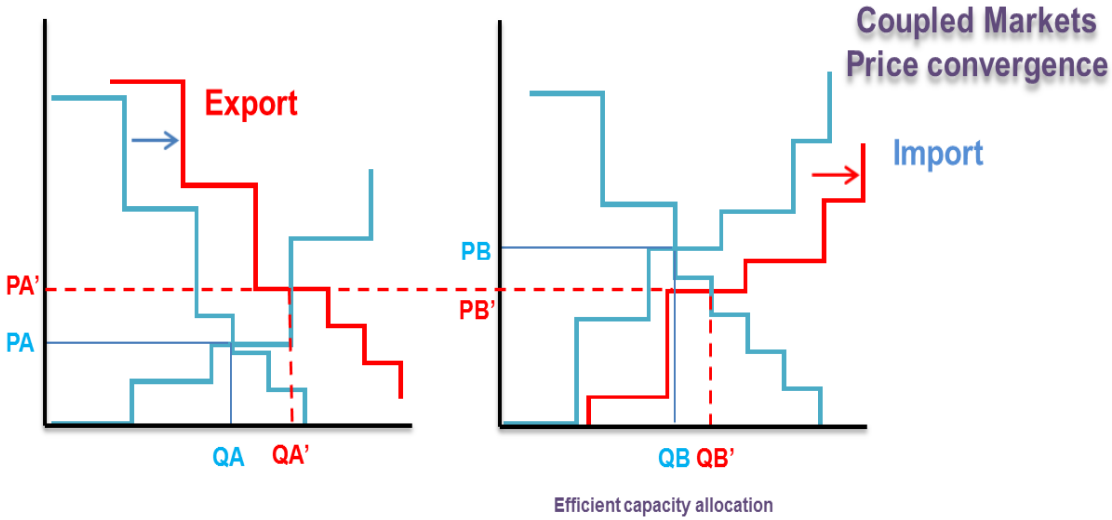
Consideration of:

- I-SEM Capacity Remuneration Mechanism (CRM) proposed?
- GB Capacity Mechanism implementation 2014

Is "Energy only" not enough?
Important to:

- ensure overall value for money for consumers
- promote good behaviour, drive efficiency and promote innovation
- promote more efficient cross-border trade





EWIC operationally

Pre EWIC TCG Dublin Generation

Dublin Generation	NB	N:>=	3 by night 2 by day	DB1, HNC, HN2, PBC,	There must be at least 2/3 large generators on-load at all times in the Dublin area. Required for voltage control.

Post EWIC TCG Dublin Generation

Dublin Generation	NB	N:>=	2 Units	DB1, HNC, HN2, PBC	There must be at least 2 large generators on-load at all times in the Dublin area. Required for voltage control. This assumes EWIC is operational. Current restriction: PBC is a must-run due to system conditions.
Dublin North Generation	NB	N:>=	1 unit	PBC, HNC, HN2	Requirement for generation in North Dublin (load flow and voltage control).
Dublin South Generation	NB	N:>=	1 unit	PBC, DB1	Requirement for generation in South Dublin (load flow and voltage control).

EWIC on occasion LSI

- can increase reserve requirement

- impacts constraints

- **Countertrading** for LSI is limiting impact

EWIC Contributing to reducing level of wind curtailment

- Particularly during exceptionally high sustained wind

To Conclude…

Many factors influencing real market price but study using actual Central Market Systems (CMS) has illustrated effect of EWIC on SEM

Considerations:

Demand, Fuel Prices, Gas Transportation Capacity Charge inclusion in BCOP, SNSP%, Reserve, TCGs, Interconnector Flows, Availability of Generation

- **Study has shown downward pressure on wholesale prices of 9%**
- **Daily Production Cost relative savings circa €450k on average**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Storm Darwin - 12 February 2014

Transmission System Performance

Diarmaid Gillespie, Grid Operations Near Time

Presentation Overview

- Winter 2013/14
- Disturbance Summary
- Line Faults
- Load Lost
- Wind Lost
- Damage / Restoration
- Key Messages

Winter 2013/14

- Weather
  - Wettest Winter on Record
  - Wettest February on Record
  - Very water logged soil
  - “Winter had above average wind with storm winds on occasions”
  - Met Éireann February Report:
    - Gale force winds reported on 23 days during the month, severe gales on 13 days.
- System Faults (pre Storm Darwin)
  - Above average number of faults – mostly 110 kV
  - 33 transmission faults over 11 different days since 16 Dec
  - Caused by high winds and lightning
  - DSO had 10 “Storm Days” from 1 Dec to 12 Feb

Storm Darwin

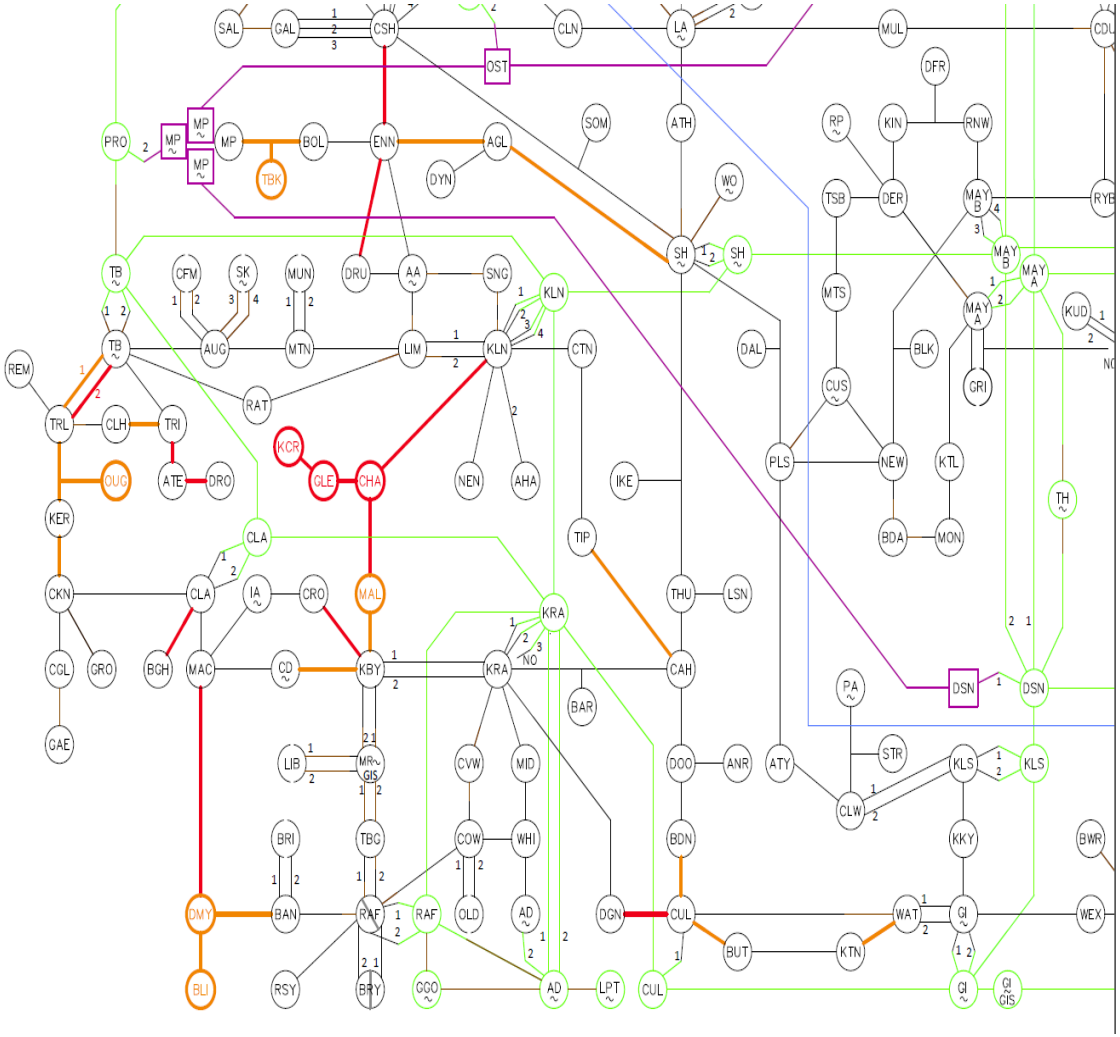
- Severe Weather Warning (Met Éireann Red Warning)
- “Significant Weather Event” and “Exceptional”
- Worst storm since 26 December 1998.
- Met Éireann Storm Darwin Report:

•Shannon Airport recorded the month’s highest gust of 86 knots (159 km/h) on the 12th, its highest gust for February on record (68 years)
•Mace Head reported a 10 minute mean hurricane force wind of 65 knots (120km/h)
•10 minute violent storm force wind of 61 knots (113km/h) was reported at Sherkin Island and Shannon Airport
•Kinsale Energy Gas Platform recorded a maximum wave height of 25m in the afternoon, its highest on record.

Storm Darwin - Disturbance Summary

- 67 line Tx faults: 11:36 - 16:21, all 110 kV system
- Seven 110 kV load stations disconnected (3 DSO)
- Three 110 kV connected wind stations disconnected
- Eight 110 kV lines remained forced out following storm
- Two lines subsequently forced
- EMS Video of Event

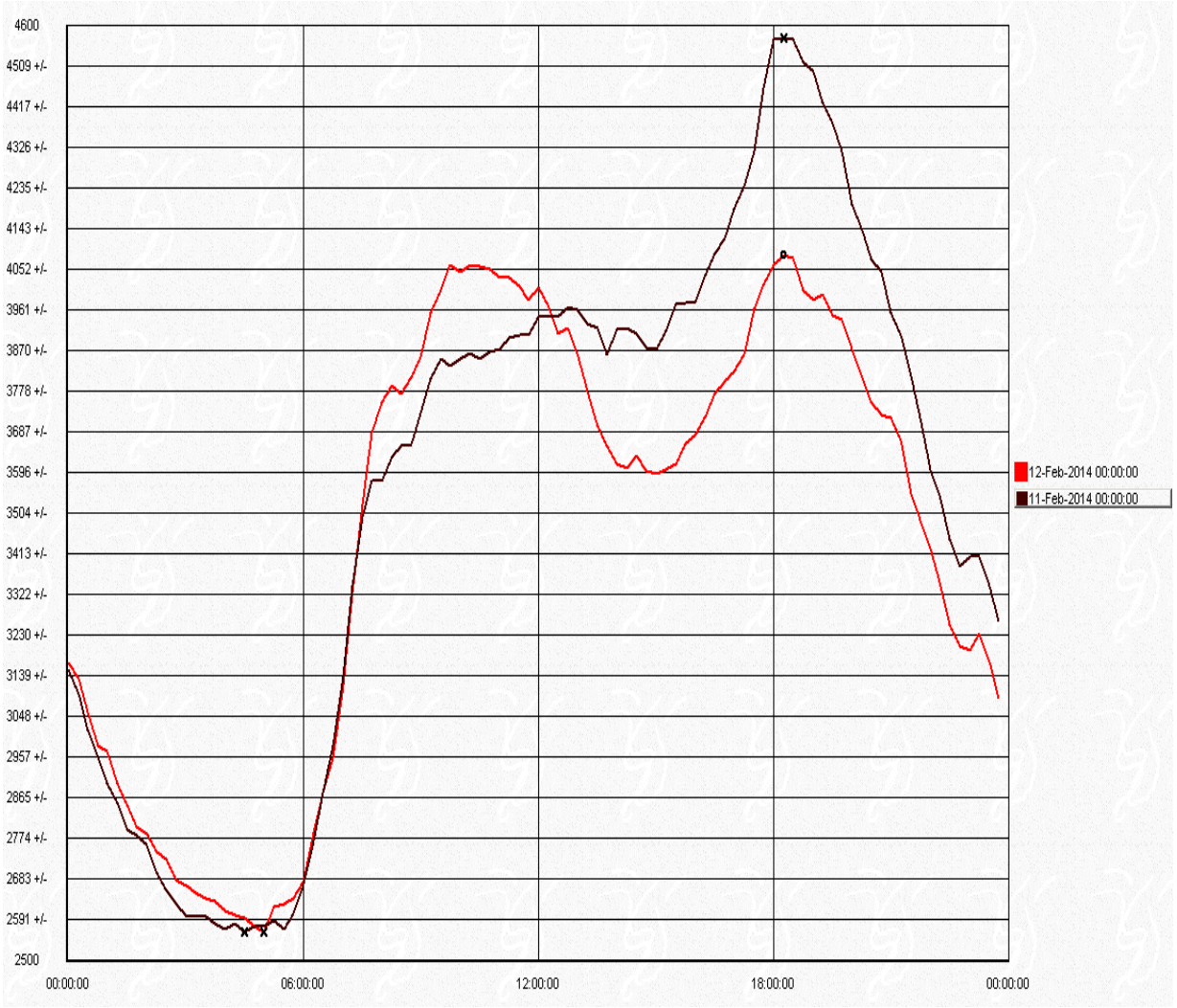
Line Faults



Red – Line forced and remained out

Orange – Line tripped and returned (Automatic & Remote Control)

System Demand – 12 Feb versus 11 Feb



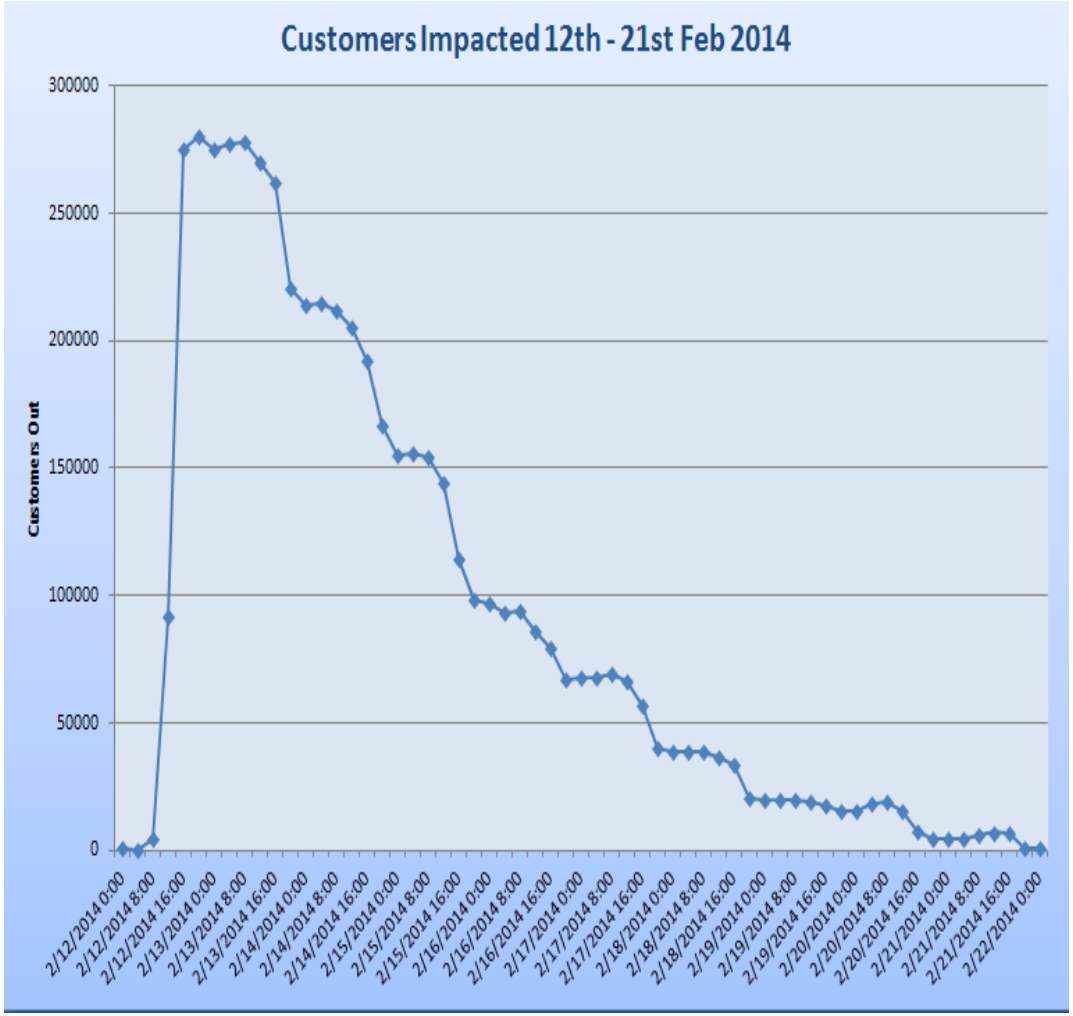
System Peak Demand reduced by 500 MW (~10%)

Transmission Stations Load Lost

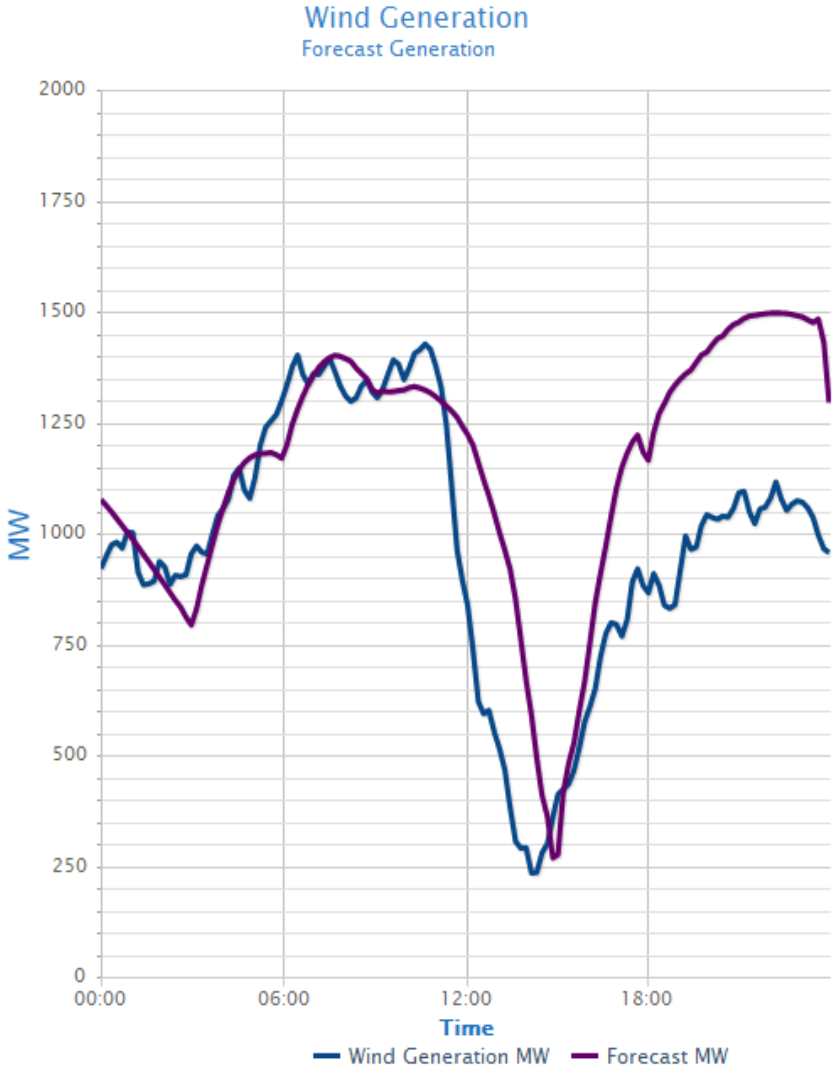
Time	Station	Load dropped, MW	Disconnected	Reconnected	Duration, Minutes
11:36	Dunmanway	27.7	11:36:19	12:42:23	66
11:36	Ballylickey (West Cork)	6.4	11:36:19	13:13:03	96
12:20	Oughtragh (Kerry)	4.7	12:20:51	12:20:51	0.003
12:24	Oughtragh	4.7	12:24:02	12:24:02	0.003
13:03	Mallow	13	13:03:55	14:40:11	96
13:03	Charleville	10.2	13:03:55	15:33:30	149
13:03	Glenlara	9.9	13:03:55	16:39:03	215
13:08	Tullabrack (Clare)	6.7	13:08:49	13:15:26	6.6
13:27	Tullabrack	1.5	13:27:13	16:04:45	157

DSO Customers Lost

- 280,000 Customers Disconnected on 12 February
- Resulting in 6 Storm Days
- Customer out until 21 Feb



Wind Generation – Forecast/Actual



- 1100 MW reduction in Wind over 4 hours
- Forecasted Accurately
- High Speed Shutdown – South
- Low Speed Shutdown – North (eye of storm)
- Windfarms disconnected from connection point

Transmission Stations - Wind Lost

- Charleville/Glenlara/Knockacummer 110 kV stations (77 MW Wind)
- Boggeragh 110 kV stations (77 MW wind)
- Athea (35 MW) and Dromada (29 MW) 110 kV stations

Damage / Restoration

- Transmission System Damage
  - Helipatrols commenced on 13 February to assess damage
  - 110 kV transmission system impacted only
  - Collapsed / Leaning polesets
  - Broken conductors / earth wires / fibre wrap
  - Conductor/Pole strikes (timber, electric fence)

- Restoration and Repair
  - Massive task given ground conditions
  - Straightening poles a major civil job in some cases
  - All TSO Load busbars energised by 11pm on 12 February
  - All lines returned by 21 February
  - Relentless work from ESBN/ESBI and Contracting Staff (NIE, ENS, Western Power and CIET)
  - 2000 poles, 500 km conductor and 500 transformers replaced (Transmission & Distribution)
  - 2000 locations where fallen trees had to be cleared.

Aftermath

Aftermath

Key Messages

- Significant Transmission System Incident
  - Scale of damage not witnessed in many years
  - More significant at distribution level
- Localised Incident
  - Loss of complete supply to some 110 kV Stations
  - Close to more widespread outages (though still localised) - “one line loss away” away from losing larger areas
- Backbone Transmission System not impacted
  - No 220 kV or 400 kV line faults (steel mast construction)
- Control Room
  - More Expert (technical) Staff supplemented Control Room Staff (weekday, office hours)
  - EMS Information supplemented by other Monitoring Systems (station recording devices)
  - Lines restored in safe manner whilst avoiding further load loss
- Overall Conclusion
  - Significant Incident
  - Localised
  - Power System as a whole not at risk at any time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