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Special Operational Forum

Balancing the System on Difficult Days

Tuesday 20th January 2015

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Agenda

10:30	Welcome and Introduction	Audrey Ramsay
10:45	Case Study 1: Low demand & High Wind	Audrey Ramsay
11:15	Managing High Voltage	Mat Hofton
11:45	Case Study 2: High demand & low wind	Simon Williams
12:15	CLOSE	
	Lunch	

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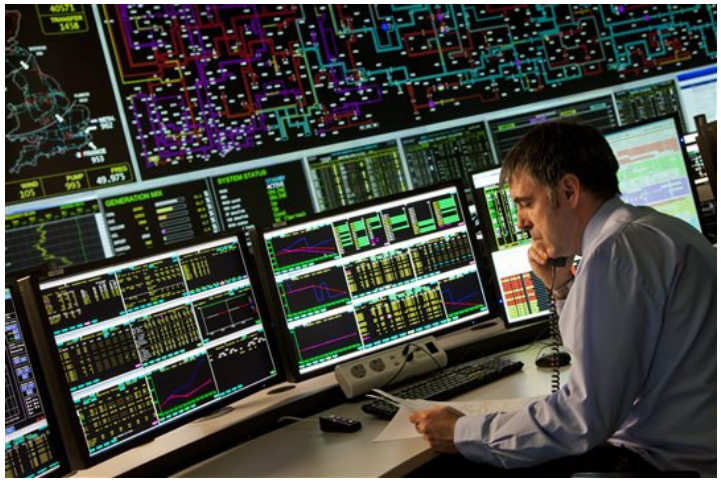
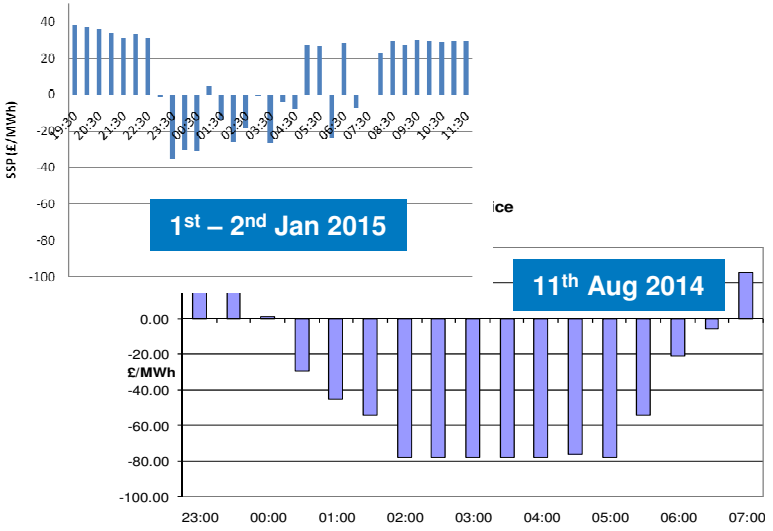
Case Study 1: Low Demand & High Wind

1st – 2nd January 2015: Overnight minimum period

Why is this scenario significant?



- Adds operational complexity



- Can create Negative System Sell

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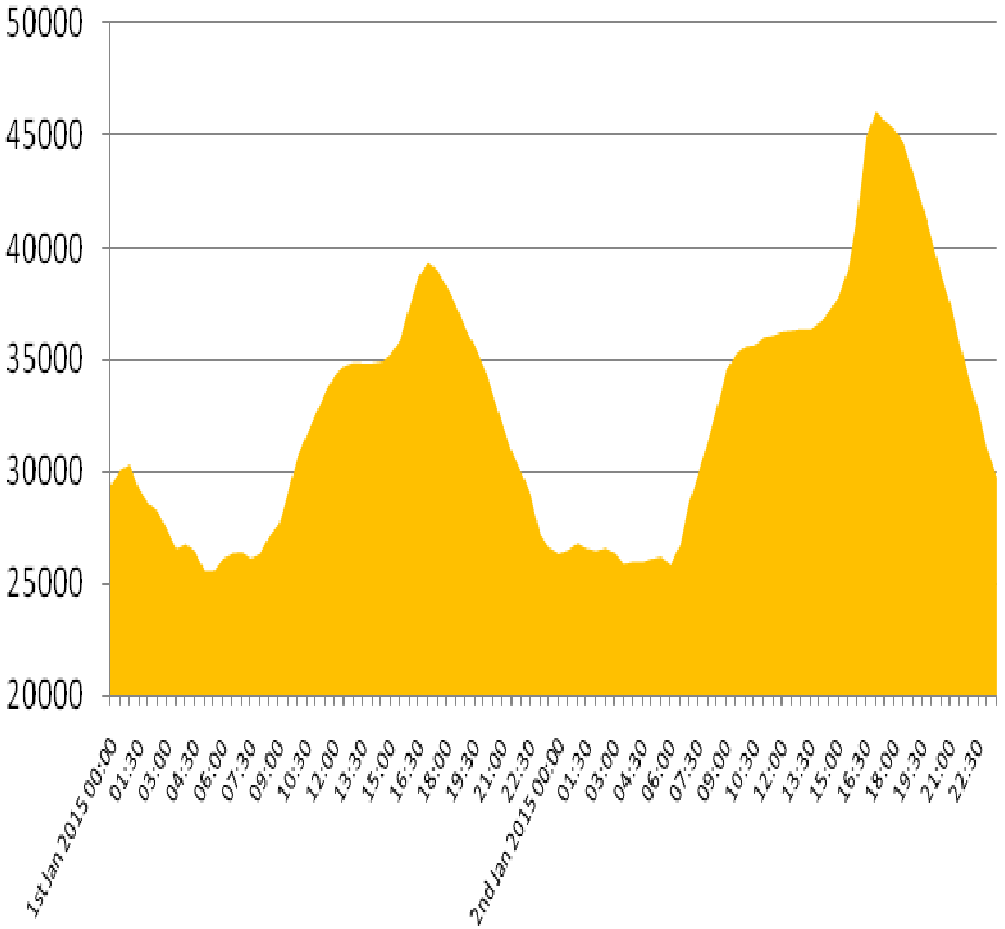
Background

Demand (1st – 2nd January 2015)

- Demand dropped below 26GW.
- Approx 1GW lower than 2nd Jan 2014
- Exacerbated by embedded wind



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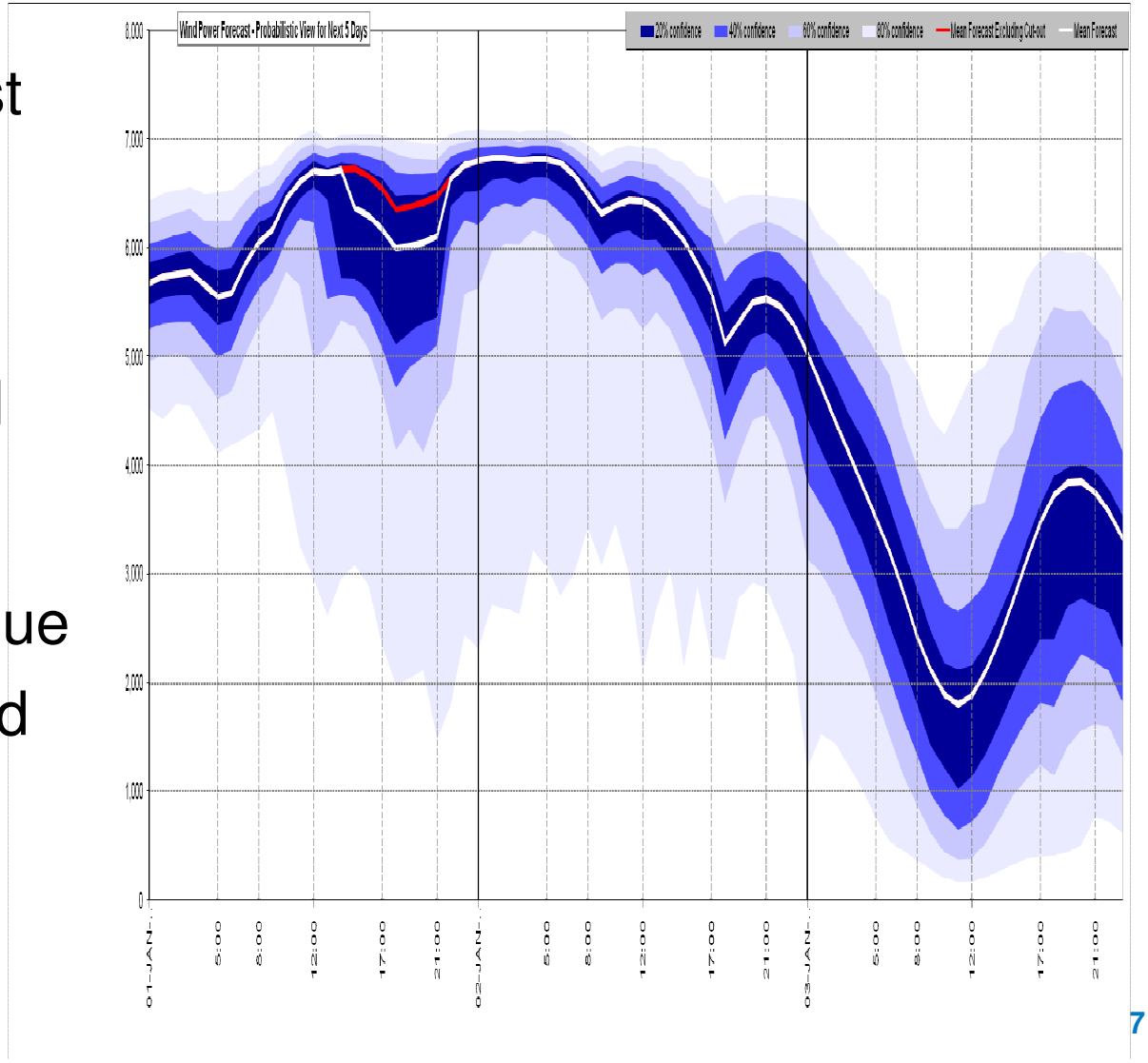
Wind 1st – 3rd January 2015

- Forecast to just below 7GW overnight
- ~80% metered total wind
- Output lower due to National Grid actions



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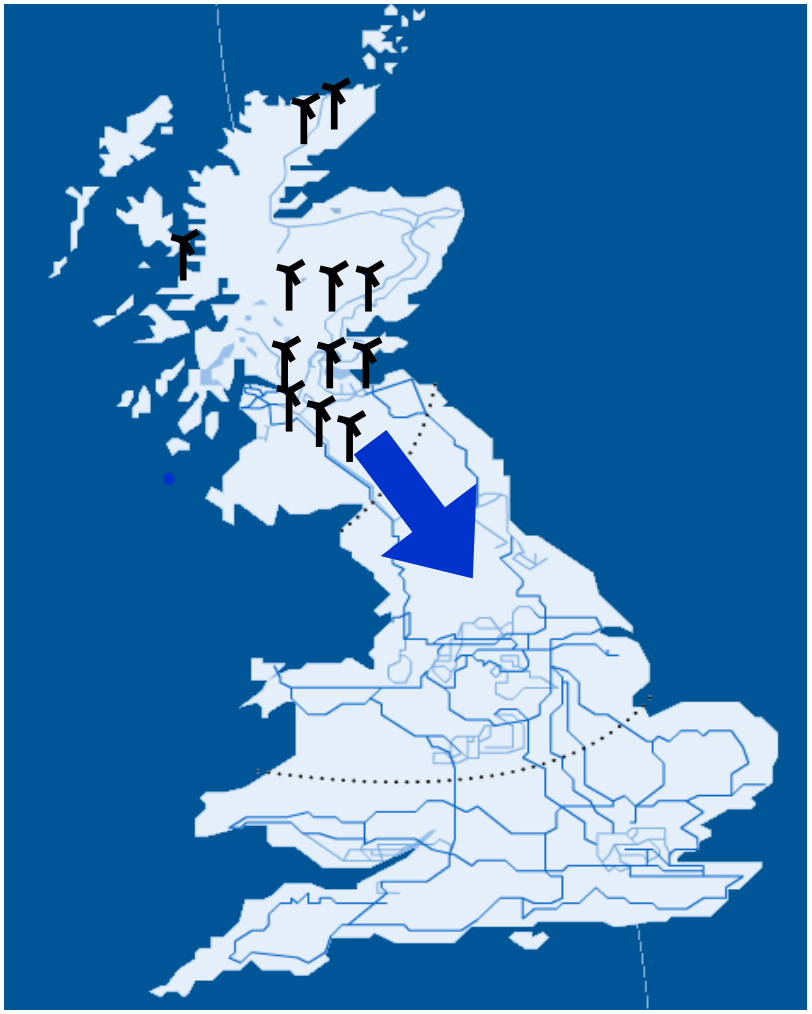
Transmission Issues

SCOTEX

- Intact boundary
- Transfer exceeding boundary capability
- Significant action required to reduce exports
- But, requirement to keep some conventional plant in Scotland due to volts



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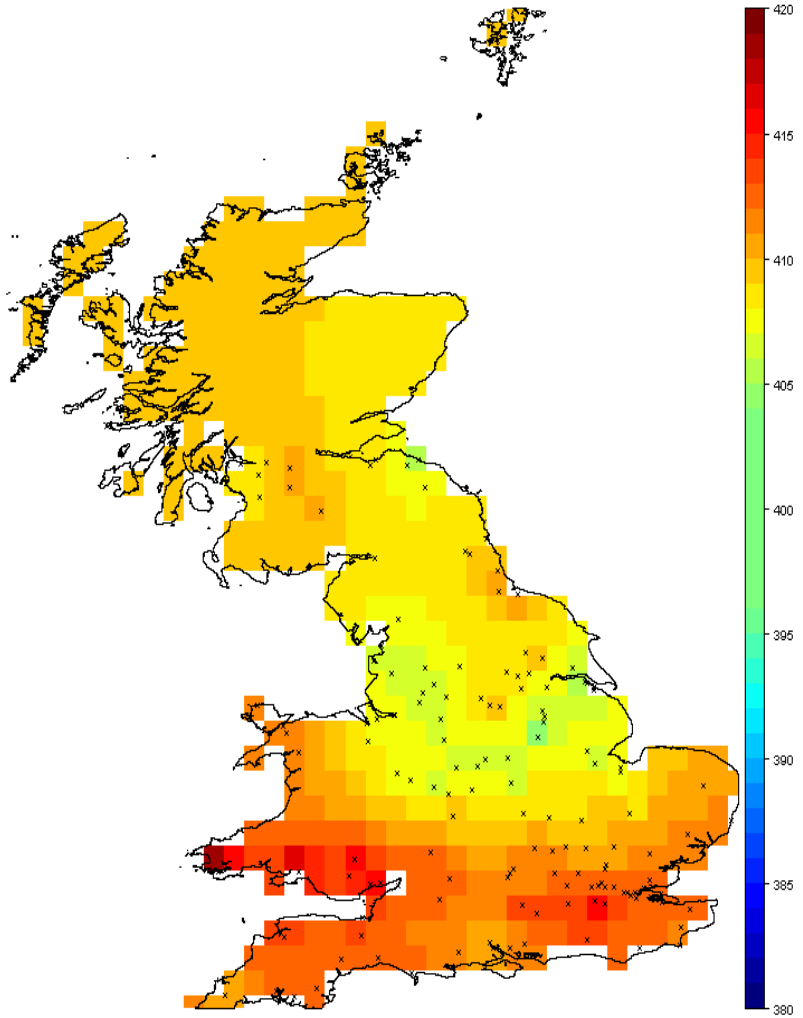
High Voltage

- Increased requirement for generation overnight with lower demand
- 5 machines traded/BOAd to secure system



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Margin Requirements

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Response & Reserve

Service Name			Physical Supply	Typical MW
Positive Regulating Reserve			Headroom on Gen	1200MW
Short Term Operating Reserve	BMU Instructed/LF	1300MW	OCGTs Pumped Storage	1800MW
	Non-BM	500MW	Demand Embedded Gen	
Low Frequency Response	Dynamic	520MW	Automatic Delivery By Gen / Demand	910MW
	Static (LF)	390MW		
Demand				
High Frequency Response			Automatic Delivery By Gen / Demand	600MW
Negative Regulating Reserve			Synch Footroom on Gen	900MW

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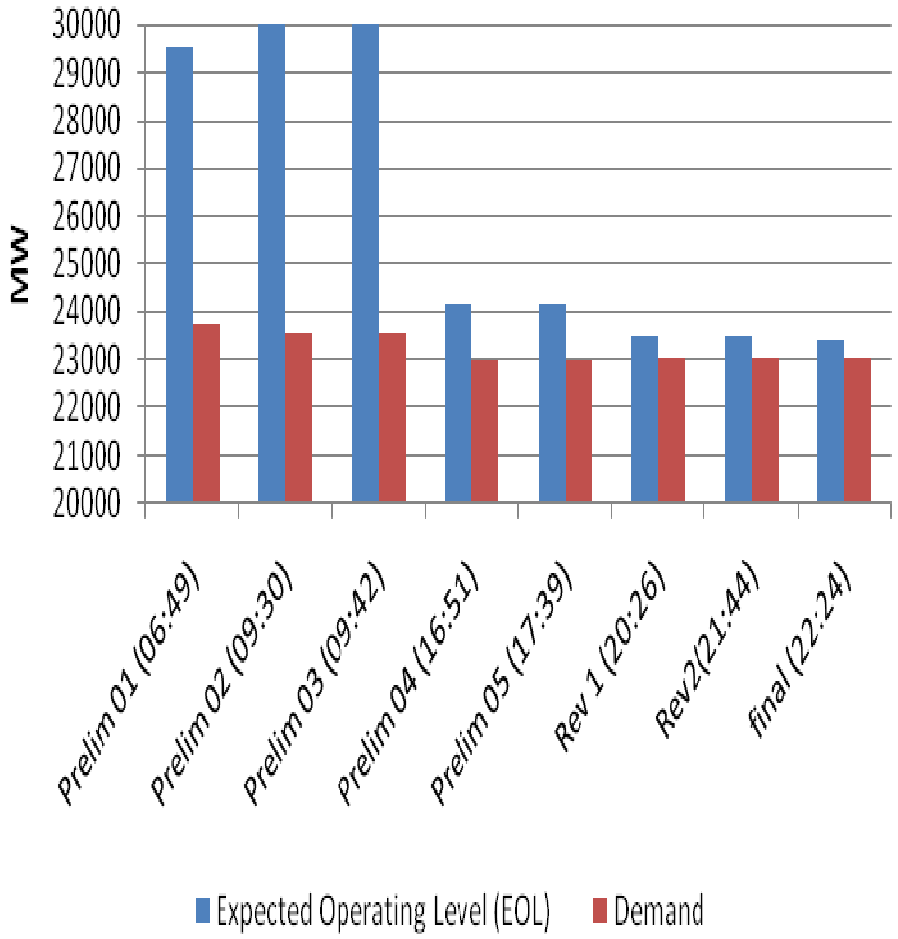
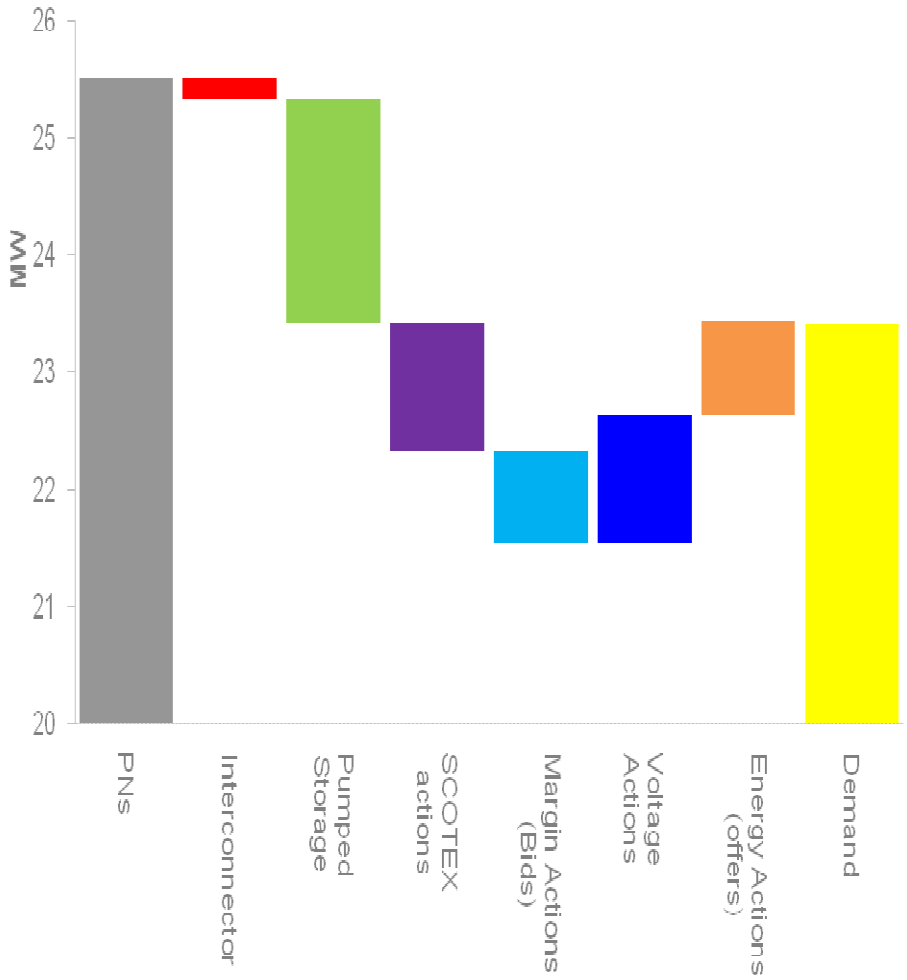
ENCC Actions: 1st – 2nd January 2015

System Operating Plan



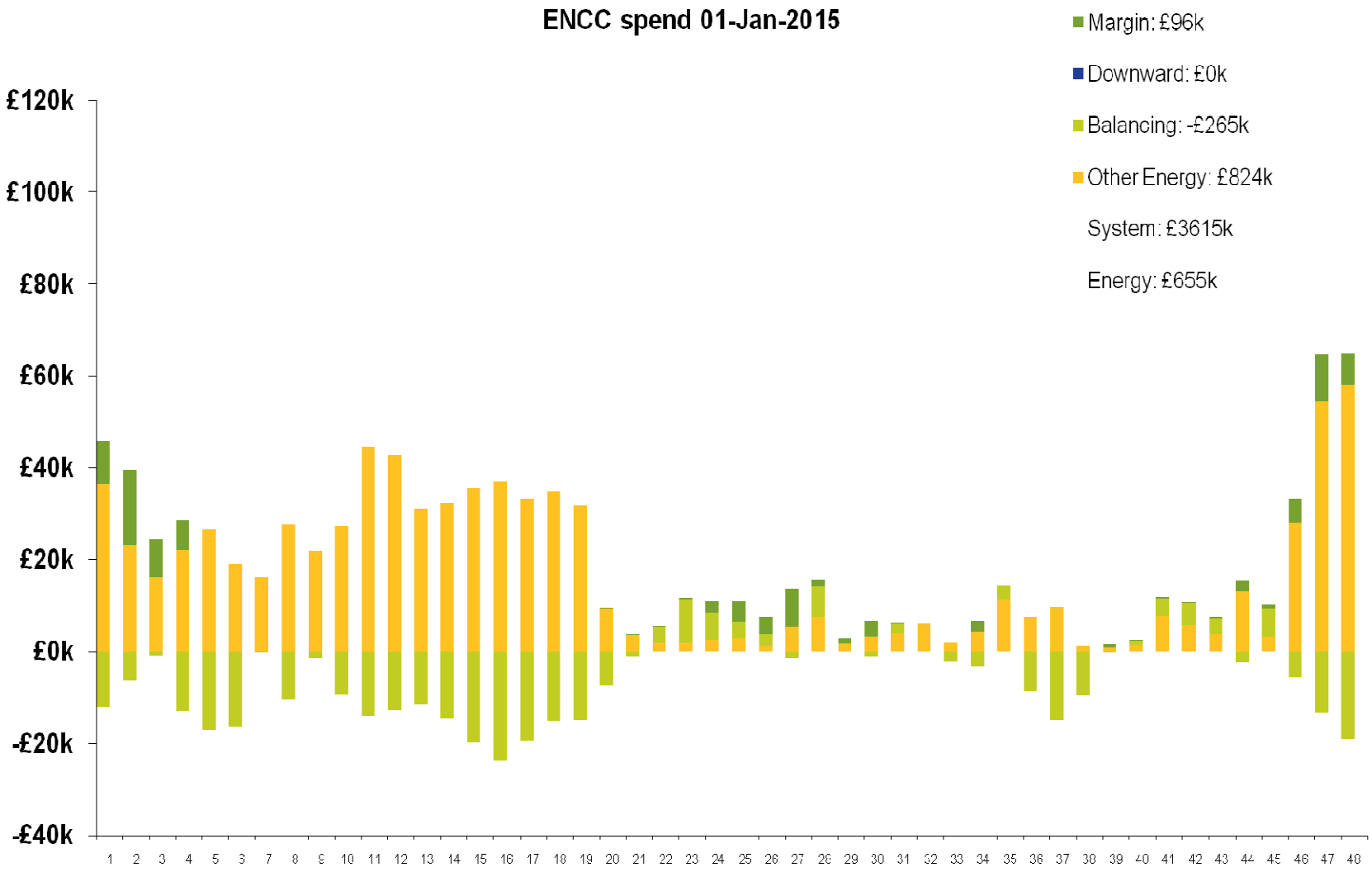
- ENCC issue a System Operating Plan at 06:49 1st January
- Over 6GW oversupply expected at this point
- 6 more SOPs produced until Final at 22:24
- Only 400MW oversupply expected at this point
- Final SOP includes ENCC expected adjustments (BOAs)

ENCC Actions

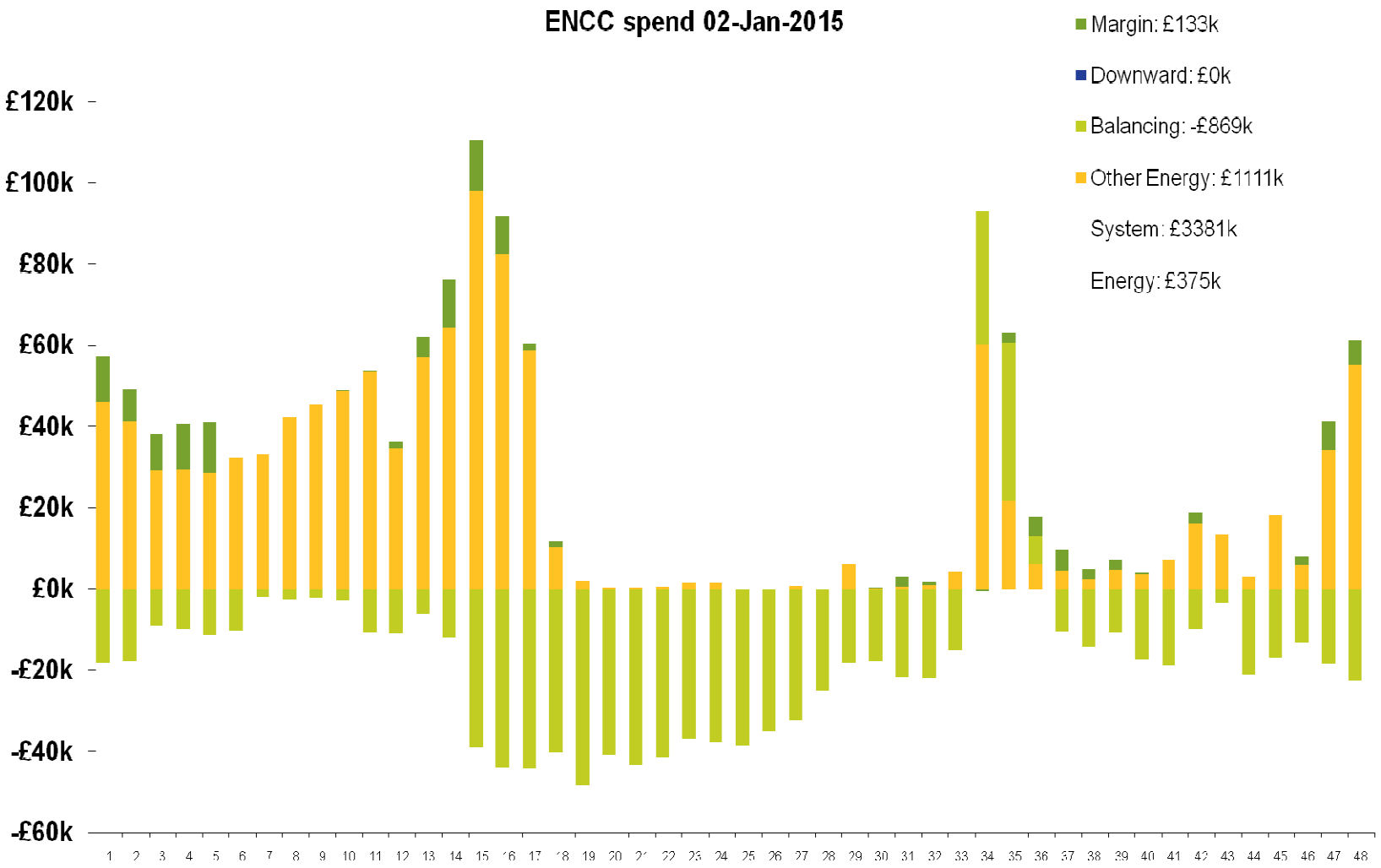


- 200MW traded on Interconnector
- Over 1GW bids taken to manage Scotex
- 500MW traded
- 5 machines required on for voltage requirements
- Bids/offers taken to create headroom and footroom

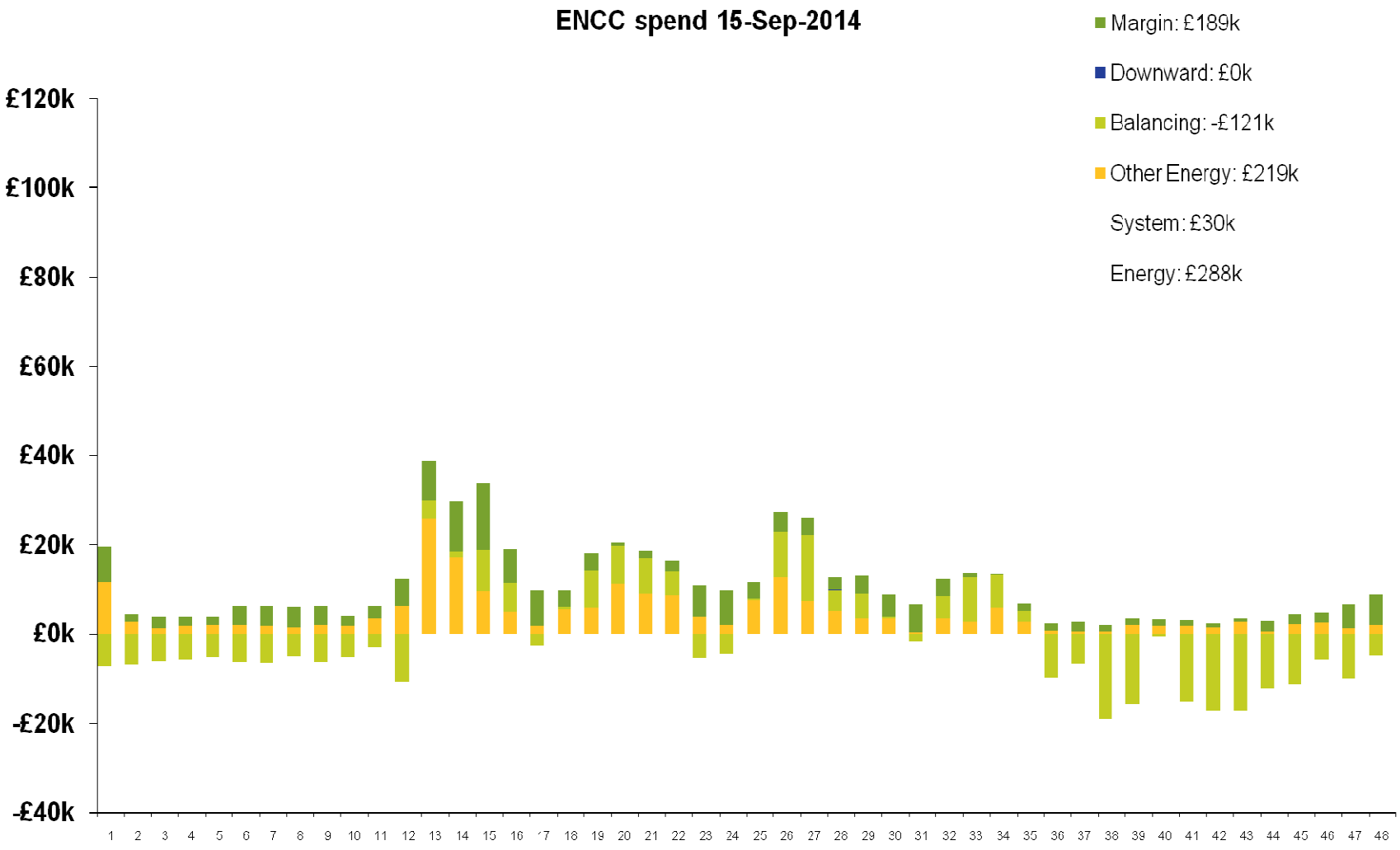
ENCC Actions – 1st January 2015



ENCC Actions – 2nd January 2015



ENCC Actions – 15th September 2014



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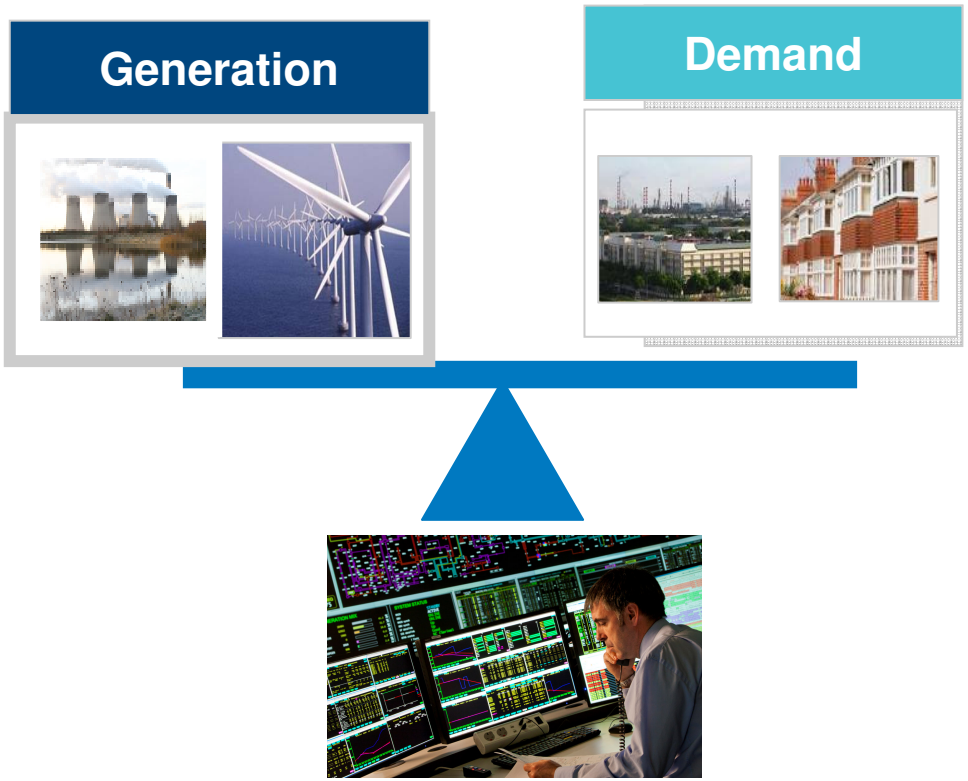
What could have helped?

Being balanced?



- Meeting contracted position would help
- Market was very long across the minimum period requiring significant number of actions by ENCC

Less restriction on Scotex?

- Reinforcement underway
  - HVDC Link
  - Series Compensation
  - East-West Reinforcement
- Reduction in volume of bids for System
- But …..
  - These would move to Energy in this example.

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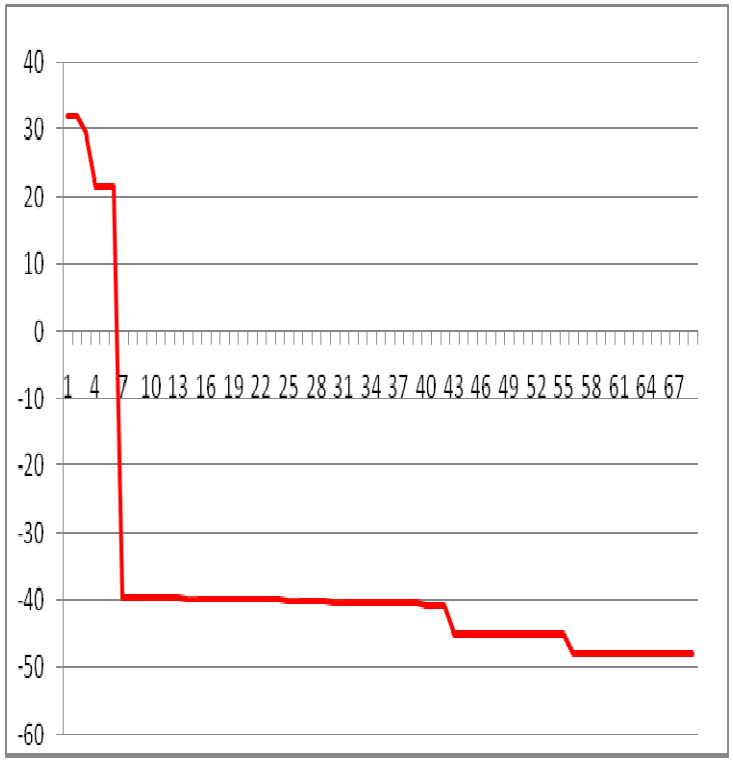
Increased reactive on windfarms?

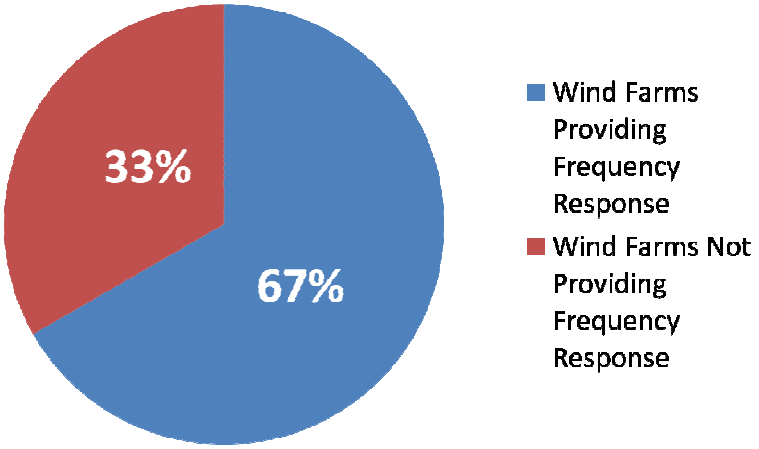
- More availability of reactive capability on windfarms would help to reduce reliance on conventional units in some areas.

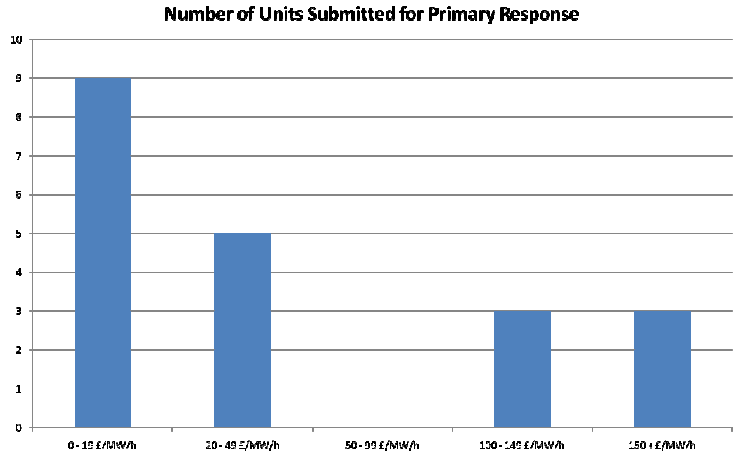
More flexibility on plant?

- Low SEL plant with Leading MVAr range helps.
- Demand turn-up service would be of benefit.
- Flexibility was available but at negative bid price to move from MEL.
- Some conventional generators taken at negative Bid on 2nd Jan have moved to positive Bid.
- But…..
- Negative bid to move from MEL remains on some conventional generators.



Holding more response on wind?





- 33 Windfarms have a Mandatory Service Agreement in place to provide Frequency Response
- 20 Windfarms submit prices to National Grid for FR provision
- Prices submitted by windfarms are higher than conventional but are being used for response.

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Any Questions?

Contact

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Transmission System Voltage

Mathew Hofton – Market Requirements Manager

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Background

- Historically voltage issues predictable: during minimum demand periods at extremities of the network
- Period of occurrence increasing
- Wider area of the network
- Increase in embedded generation making minimum demand increasingly difficult to predict
- Experiencing high voltage challenges across the network this winter – minimum demand in October was c. 19GW
- Exposure to trip of dispatched generation is increasing risk
- Risk of withdrawal of reactive range
- Major challenge and huge focus on voltage management

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Causes of high volts

- Low loaded cables and transmission lines over night
- Limited generation close to load centres
- Decline in reactive demand, Q/P ratio
- Increasing levels of embedded generation
- Transmission and Distribution networks look increasingly capacitive (undergrounding of lines)
- Interconnectors

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Current Voltage Profile Issues

Unpredictable Distribution EG spill (MW & Mvar) - pre fault voltage containment

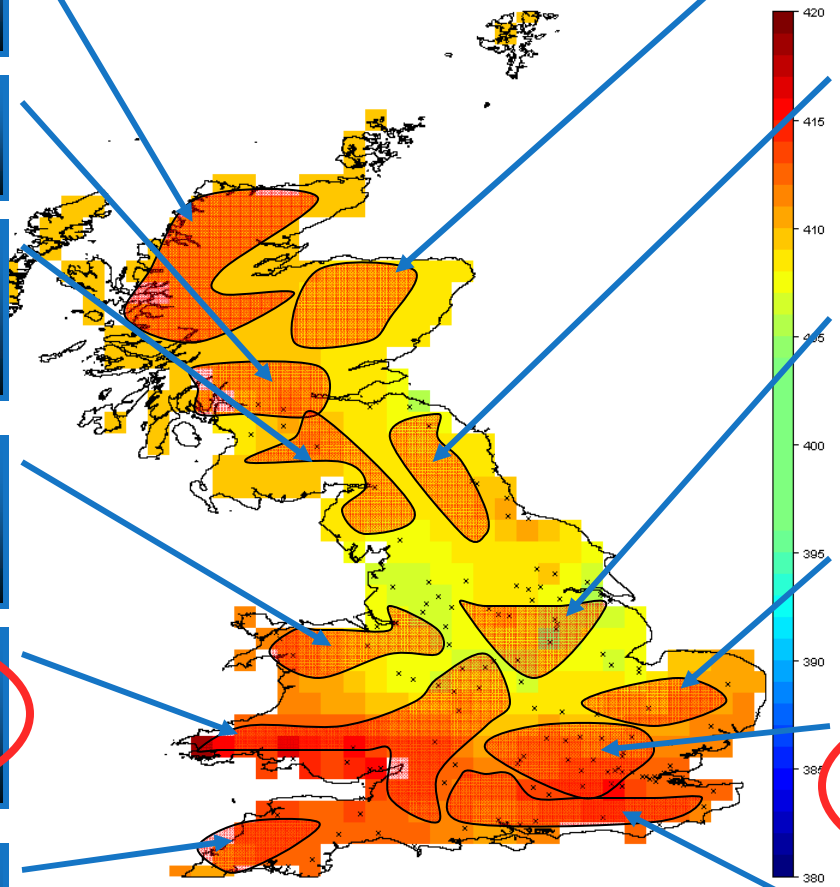
HVDC, Series compensation, high wind penetration

High embedded wind reducing loading of long transmission corridor- post fault containment

High EG and load prediction uncertainty & dynamic overnight behaviour- pre fault containment

Long transmission lines, limited generation close to load centres; declining Q/P

Low generation overnight, high EG penetration inc, significant PV; pre fault containment issues



Vulnerability to availability of conventional plant- post fault security – exacerbated by EG driven Q/P change

Little transmission plant, growing EG, high rate Q/P decline (undergrounding)- pre-fault, transmission boundary flow impact

Over-utilisation risk of Generation to transport absorption to NE, EA and Wmids- post fault stability & voltage issues

Reliance on limited Generation- high EG penetration, low system flows

Highly capacitive T & D networks, declining Q/P, pre and post fault issue

Interconnector flow sensitive; high EG content

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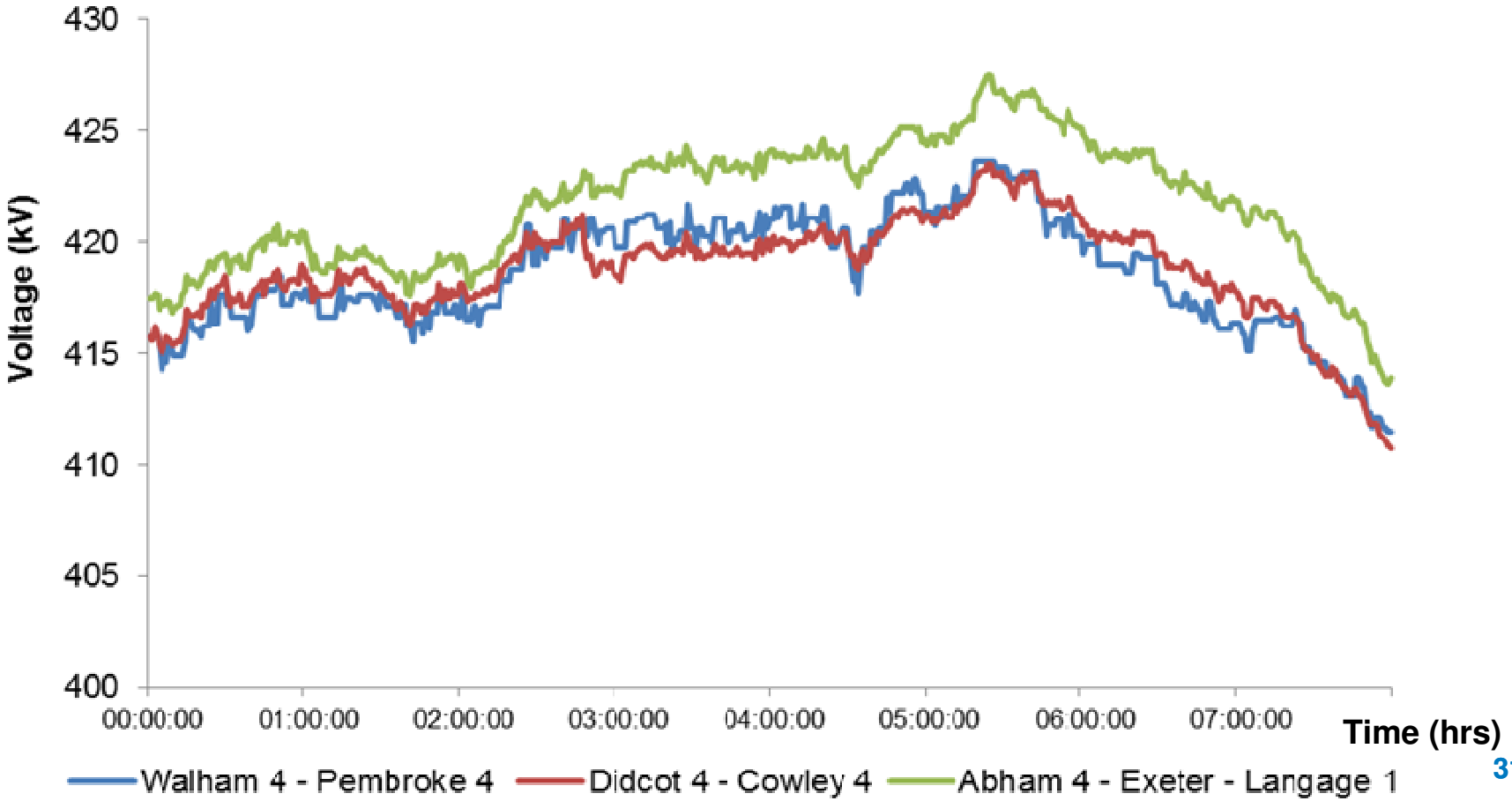
11/05/2014 Event

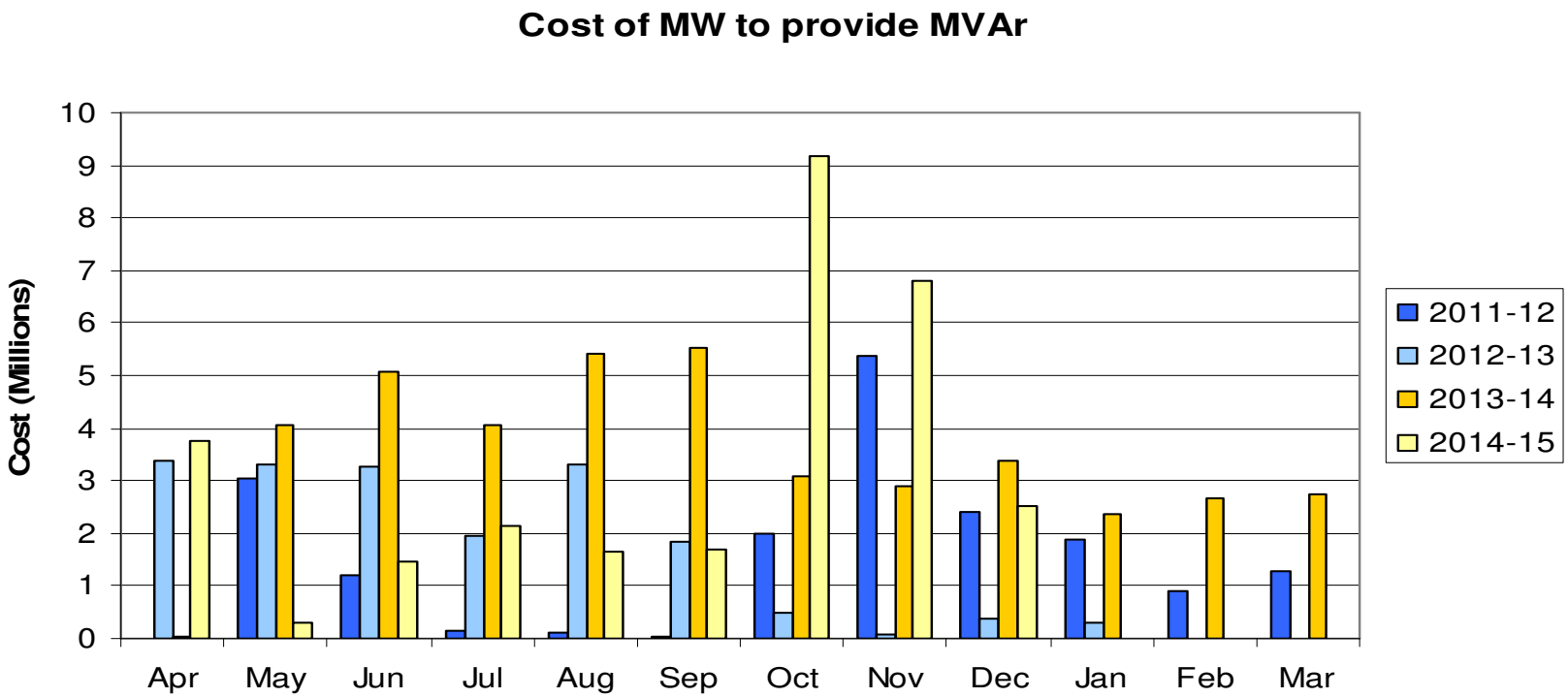
- Transmission System Performance Report
- High Voltage Excursion Event – S. West, S. Wales, south coast England (02:15 11 May 2014)
  - The event was caused by a number of factors coinciding:
    - Pembroke-Walham circuit could not be switched out due to low fault levels and a protection issue.
    - One of Pembroke machines ordered on tripped during loading
    - Indian Queens unit 1 was not available
    - Demand for the period was 800MW lower than studied
    - High voltage profile was already being observed in South West peninsula, South Wales and South Central England.

11/05/14 Event

- All of the above lead to long voltage excursions in many areas, most notably:



Cost of MW to provide MVAr



- Generator Contracts
- Reactive Equipment Switching & Simultaneous tapping of Supergrid Transformers
- Circuit Switching - high gain cables and OHLs switched out of service sometimes up to 18 circuits
- Facilitating commissioning of reactive equipment

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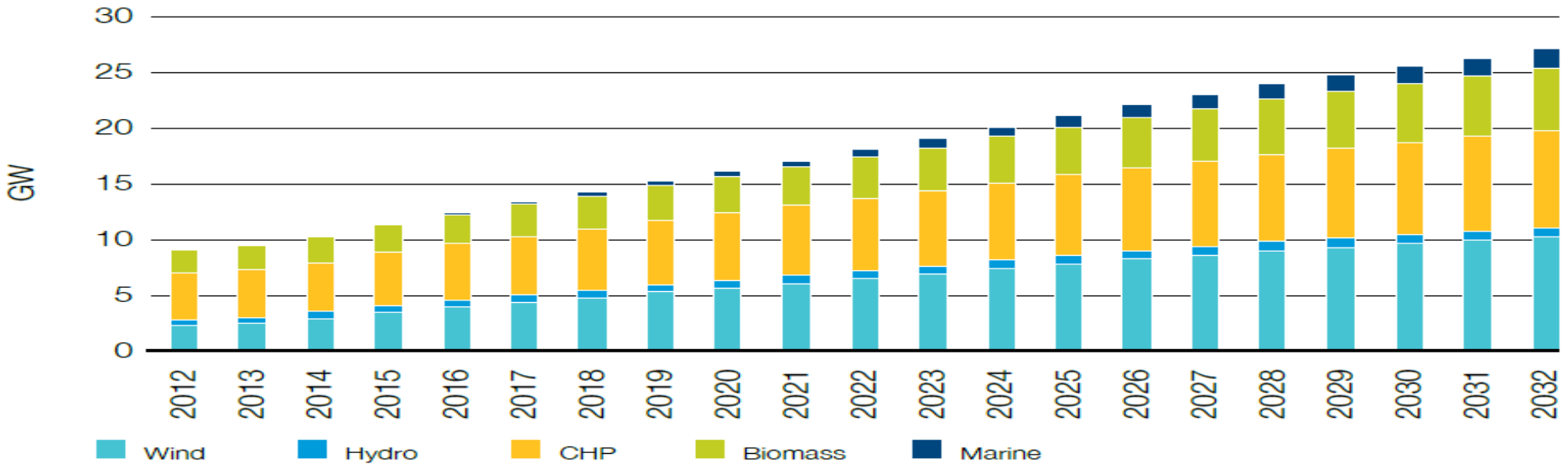
The Embedded picture going forward

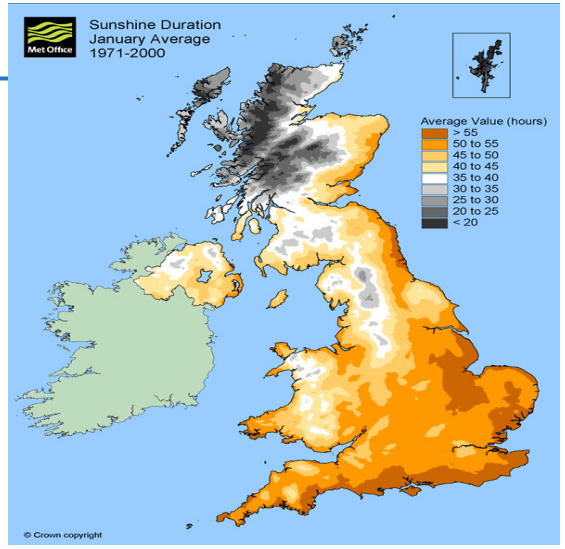
Embedded Generation Installed Capacity Scenario.

Source: 2013 Electricity Ten Year Statement

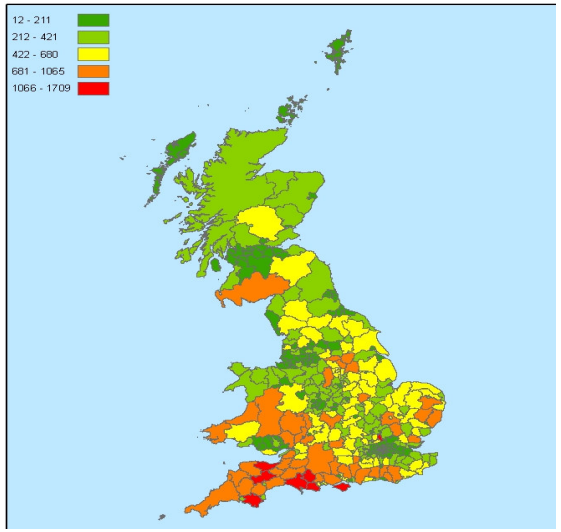


Solar PV

- Daytime min weekend demand is expected to become a greater risk 2015/16 onwards
- Dependent on the rate of solar PV growth – currently around 4GW
- National Grid has limited direct experience
- Initial information from some DNOs suggest existing installations have no useable reactive range
- As such arrangements are being explored to mange these contributions at times of high system voltage, if no alternative management strategy exists



Sunshine duration



no. of domestic PV FiT installations (per 100,000 households)

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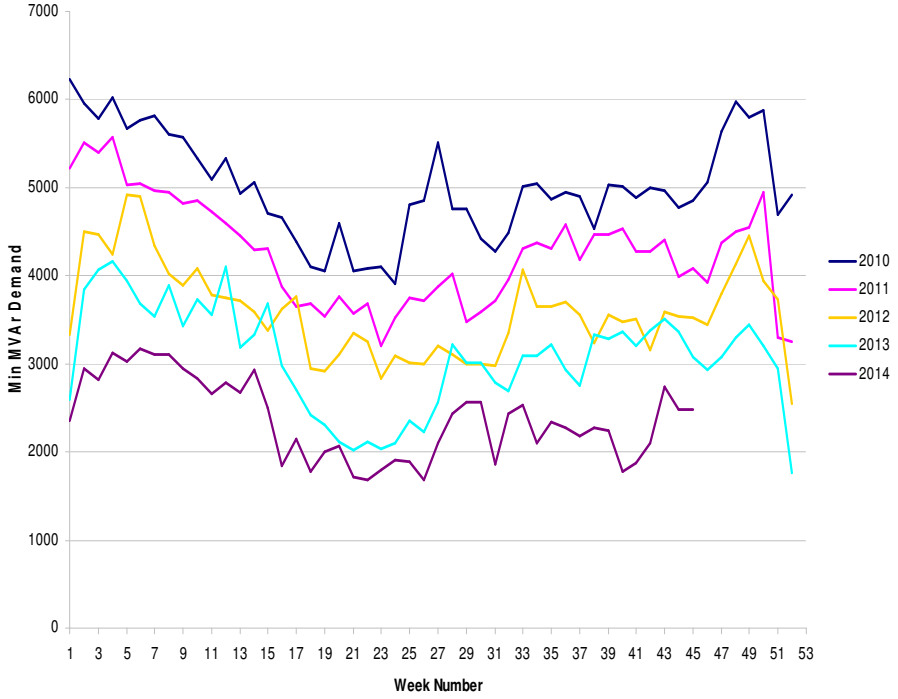
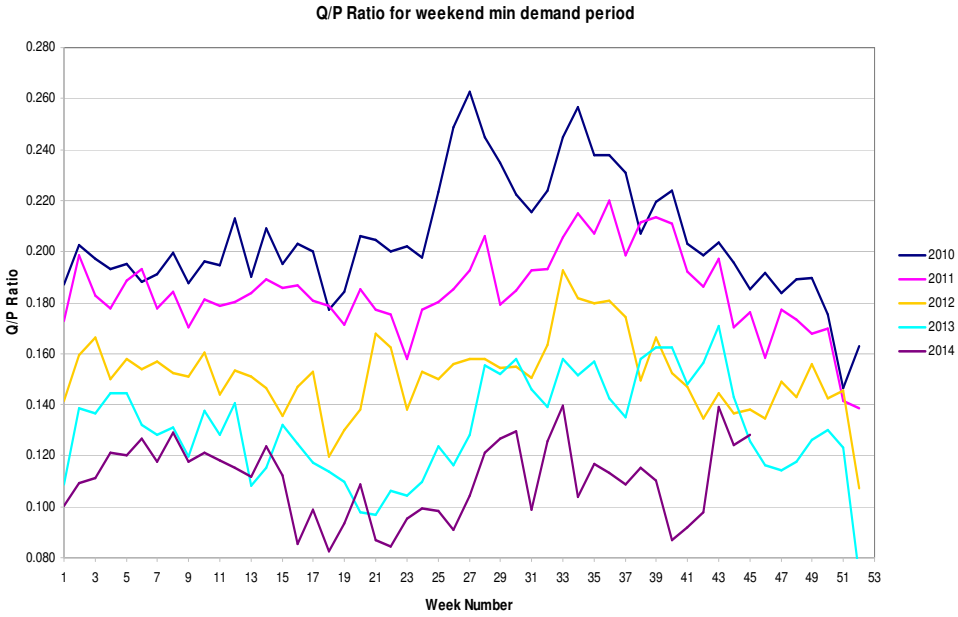
Decline of Reactive Demand continuing





- Year on year reduction in reactive power demand and Q/P ratio
- Net MVAr export from DNO to Transmission System
- Understanding this trend is an industry wide challenge

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Possible reason for reduction

- Embedded Wind / PV Generation
- Changes to DNO network characteristics (more cables) and operating regime
- Demand reduction (recession, council street-lighting policy)
- Changing air conditioning operation overnight
- Low energy light bulbs
- Energy efficiency measures

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GBSO & TO Short Term Actions

- Relocate 200MVAr Reactor from Sundon to Ninfield in July 2012 – Completed
- Delivery of 2011 strategy of investments- *In progress*.
- Contract generators to provide additional MVAr support – *Completed*
  - *14/15: Marchwood, Medway, Grain, Damhead, Longannet, Didcot, Suton Bridge, Pembroke*
- Explore Filter Bank and alternate operating modes on Interconnectors – *Interim agreement reached on reducing filters on French Interconnector*
- Opportunities for additional circuit switchouts being explored – *Completed*
- Increased focus on studies during periods of low demand – *Daily study and handover of minimum demand issues being produced- processes to align long term planning.*

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GBSO & TO Medium Term Actions

- In conjunction with DNO's, work to understand the decline in reactive power and identify future actions
- Modifications to Grid Code to cap the level of reactive power being supported at the interface to the DNOs – *Ongoing in conjunction with draft European Code proposals to limit reactive power transfer from DNO's at low demand periods*
- Working closer with the DNOs on system planning and operation
- Since 2011 in E&W, 11 new shunt reactors have been in delivery, with 4 commissioned, 7 further by end 2015, which the GBSO has been facilitating
- In E&W a prioritised delivery of a further 8 reactors across 2015 and 2016 was sanctioned as part of a programme of actions to address a 2800MVAr deficit in absorption identified by end 2016
- Identified an investment of 720MVAr by Scottish TOs by 2017
- There is a limit however to the pace, space and technical viability of concentrations of shunt reactors of this scale on the transmission system.

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Any Questions?

Contact

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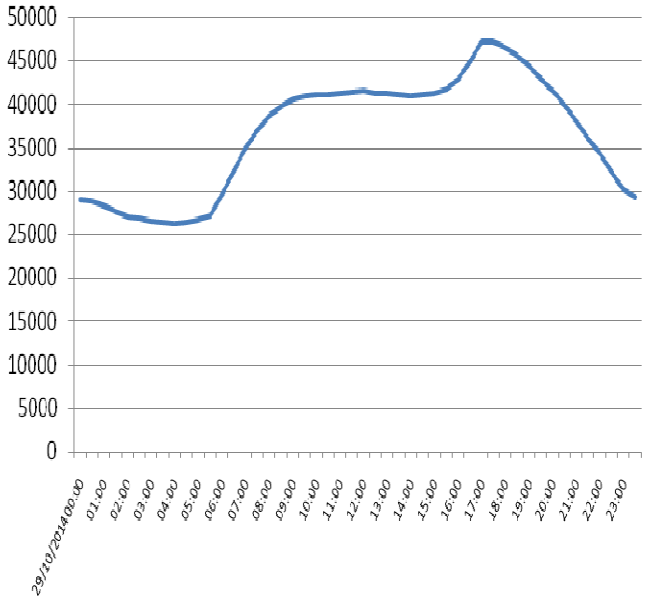
Case Study 2: High Demand & Low Supply

29th October 2014

Demand (29th October 2014)

- Daily peak = 47.2GW
- Add Reserve and Contingency required to give a generation requirement at Day Ahead = 48.7GW
- Short Market
  - At Day Ahead, 3.4GW Offers required to meet demand
  - By 4 hours ahead this had dropped to 1.2GW Offers required
- Normal Peak winter demand ~ 53GW



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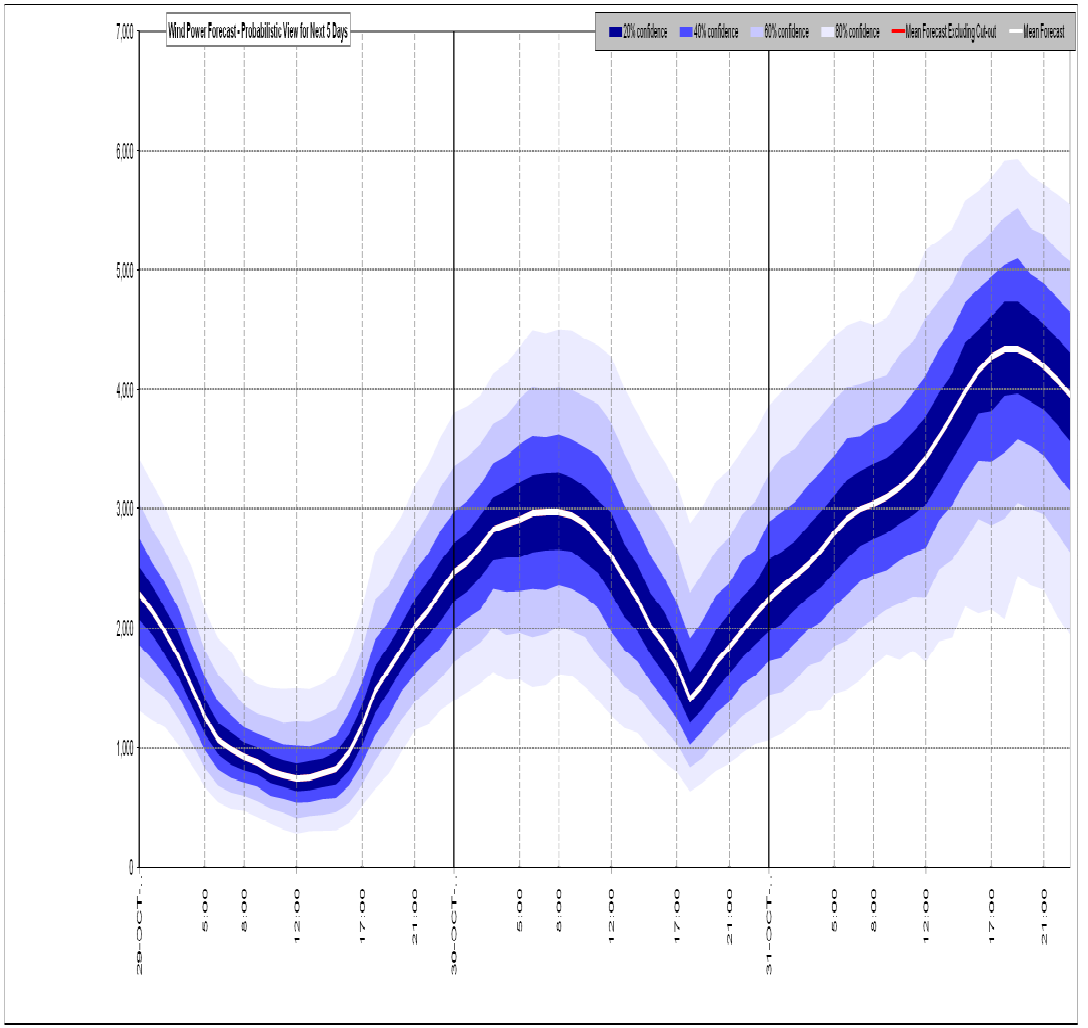
Wind 29th October 2014

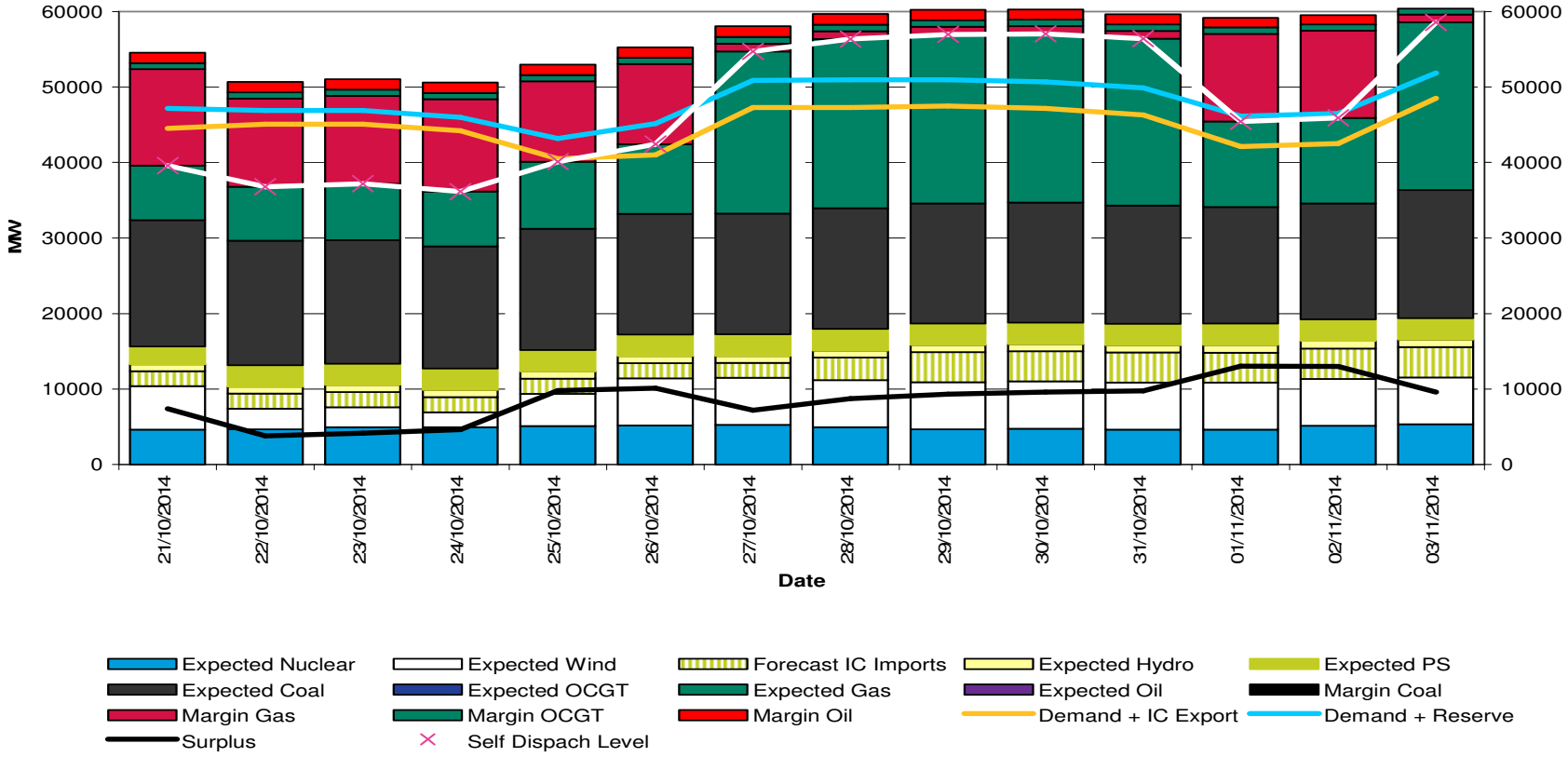
- Forecast at ~1GW at peak
- ~14% metered total wind
- Low embedded wind and hence higher demand
- Outturned at ~1.5GW



Generation availability

- Margins were forecast to be tight across the week after clock-change
- Several units had not returned from planned maintenance

Weekly Margin Forecast



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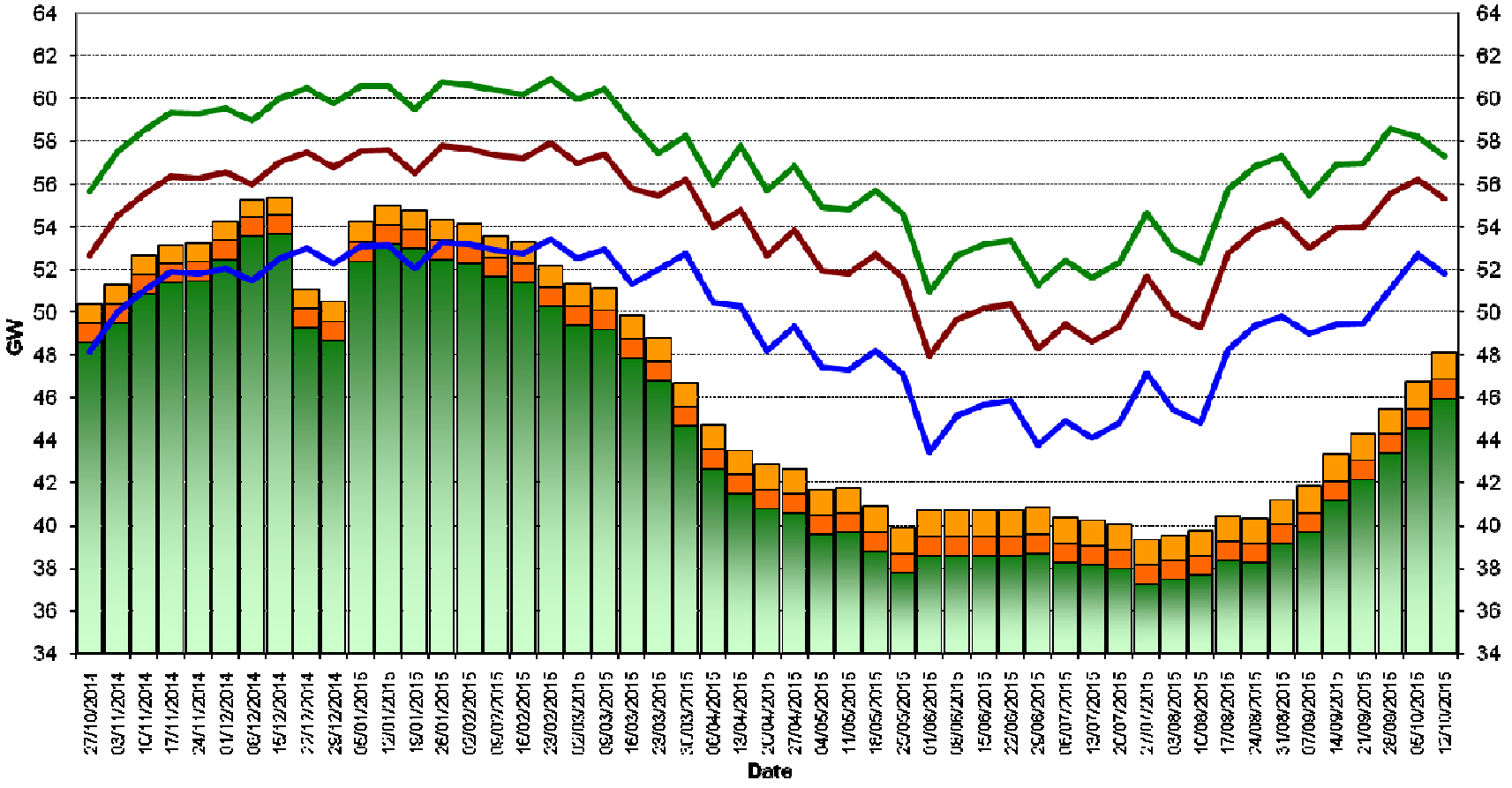
Annual Margin Forecast



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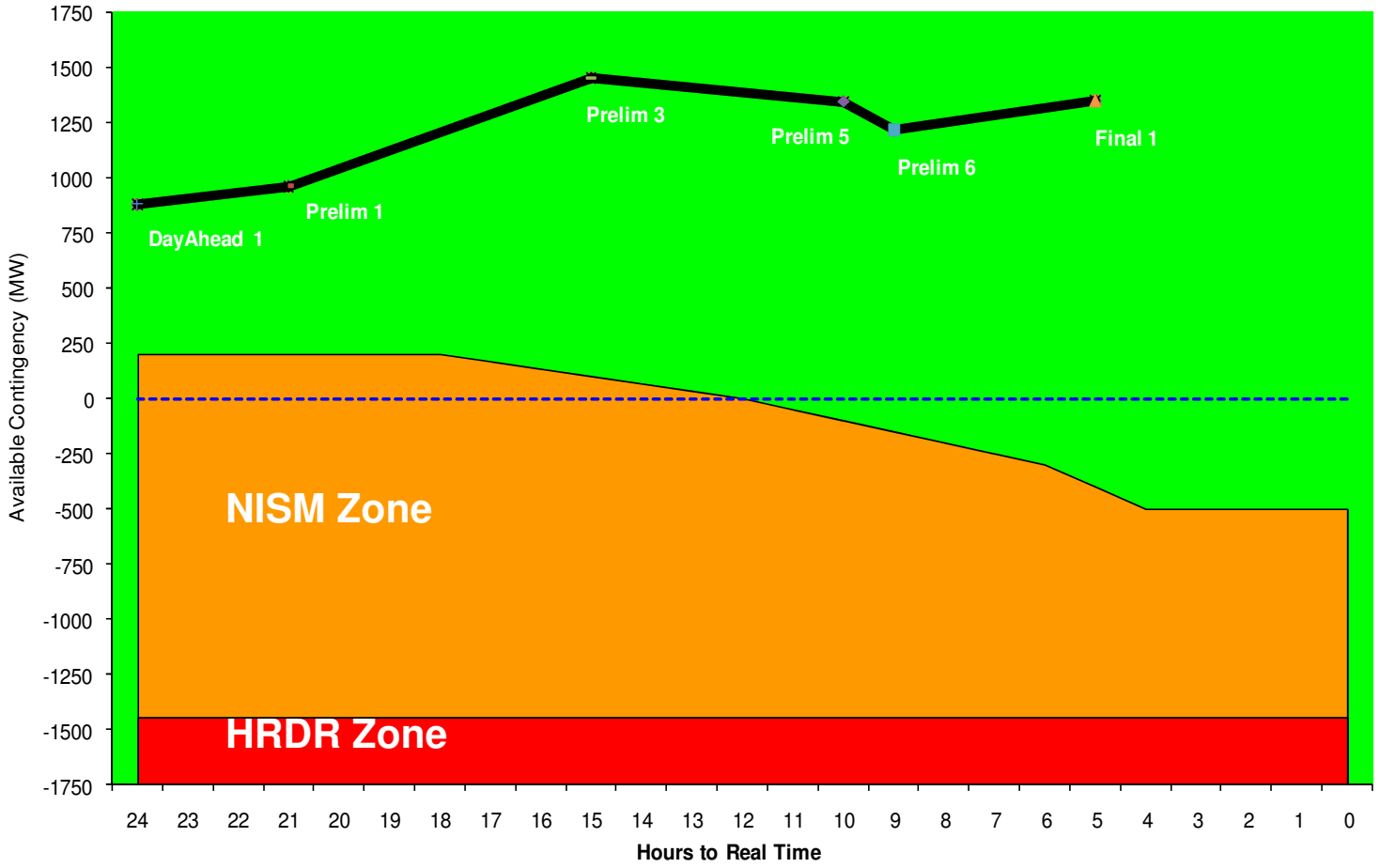
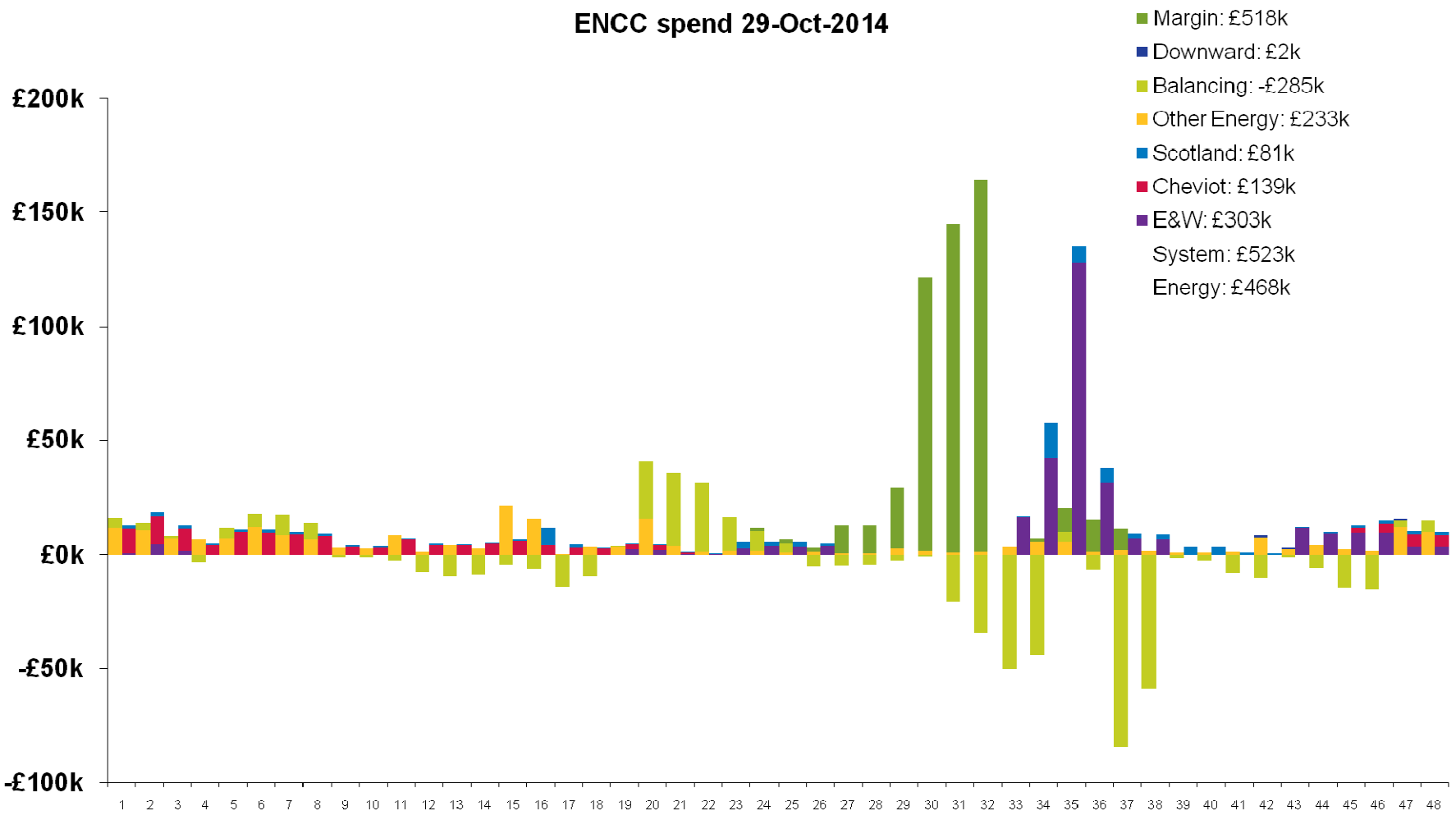
Darkness Peak Plans

- Detailed plans are produced at regular intervals from 24 Hours ahead of real time
- The focus of these plans is to ensure Operating Margin can be met
- These are the basis for issuing System Warnings
- Plant is scheduled in cost order with the aim of minimising overall cost
- NGET do not plan to minimise System buy/sell prices
  - A short run expensive unit may have an overall lower run cost than a long run unit with a lower offer cost
  - Other plant characteristics (SEL, RURs etc.) also have an effect on overall run cost

29/10/14 – Plant Margin Position



ENCC Actions – 29th October 2014



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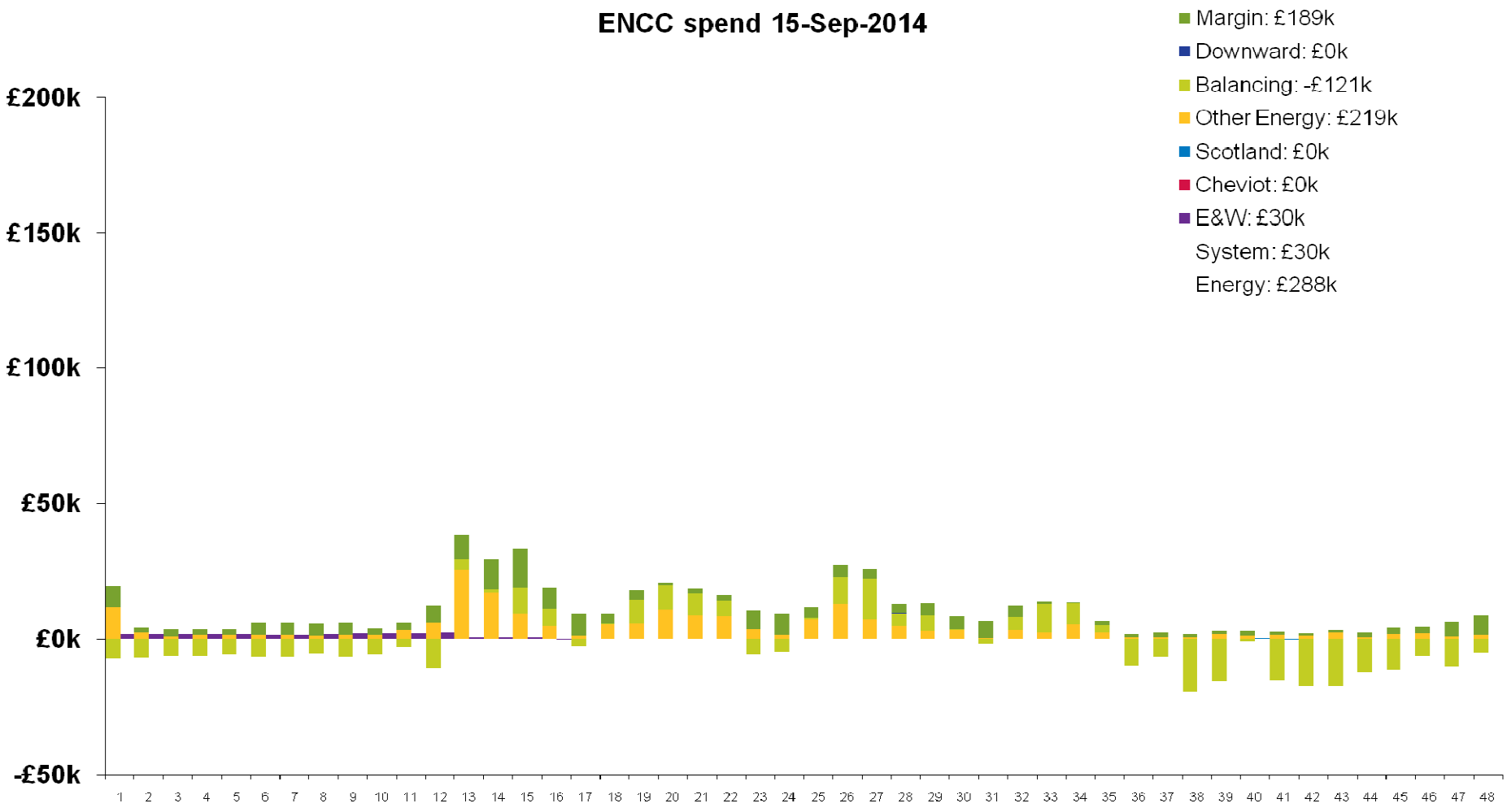

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29/10/14 - Summary

- Plant Margins were satisfactory throughout the planning process
- No System Warnings were issued
- Circuit Outage restricting Dinorwig generation
- 1 Additional Unit instructed on at £400/MWh with the marginal unit used priced at £850/MWh
- Contingency Units were priced between £350/MWh and £575/Mwh (overall run costs at SEL higher than the units instructed)
- Other changes were MEL changes throughout the day
- Reduction in available plant occurs as long notice plant becomes unusable

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Any Questions?

Contact

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