

EAST WEST INTERCONNECTOR AND MOYLE INTERCONNECTOR 5TH ANNUAL CONFERENCE

WEDNESDAY 21ST NOVEMBER 2018

The Clayton Hotel, Ballsbridge, Dublin



The current. The future.



The East West Interconnector and Moyle Interconnector Customer Conference will discuss commercial and operational aspects in relation to the interconnectors.

AGENDA

Time	Topic	Speaker
09:30	Registration & Coffee	
10:00	Welcome	<i>Peter Lantry (EIDAC)</i>
10:10	EWIC and Moyle Commercial Overview	<i>Fergal McParland (EIDAC)</i> <i>Paul McGuckin (Mutual Energy)</i>
10:40	EWIC and Moyle Operational Update	<i>Philip Jordan (EIDAC)</i> <i>Stephen Hemphill (Mutual Energy)</i>
11:00	Break	
11:30	European Codes Development	<i>Mark Lane (EirGrid)</i>
11:50	I-SEM Update	<i>Mark Needham (I-SEM)</i>
12:10	Celtic Interconnector	<i>Gary Nolan (Celtic)</i>
12:30	Questions / Discussion	
13:00	Lunch	

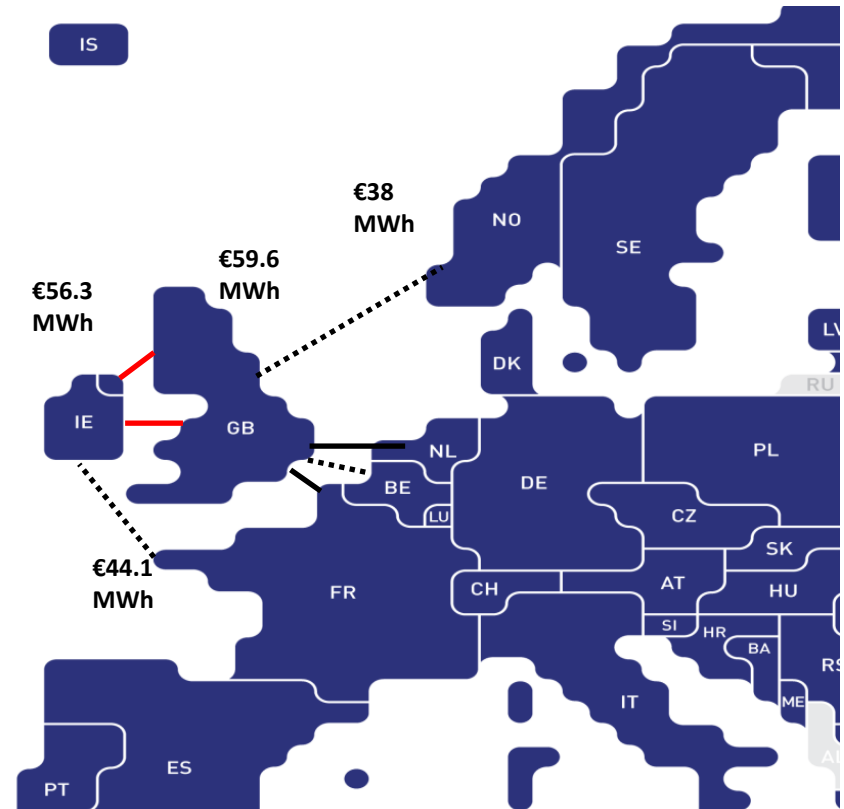


The current. The future.



Introduction

- Interconnection is fundamental to the delivery of EU energy and climate objectives
- 5 Key benefits:
 - Market Integration
 - Security of Supply
 - Climate and Environmental
 - European integration
 - Competitiveness and Innovation
- Moyle & EWIC deliver against these benefits
- Celtic will deliver similar benefits on delivery



Sample regional wholesale electricity prices Q1 2018 (EU Market Report)

East West Interconnector Commercial

November 2018

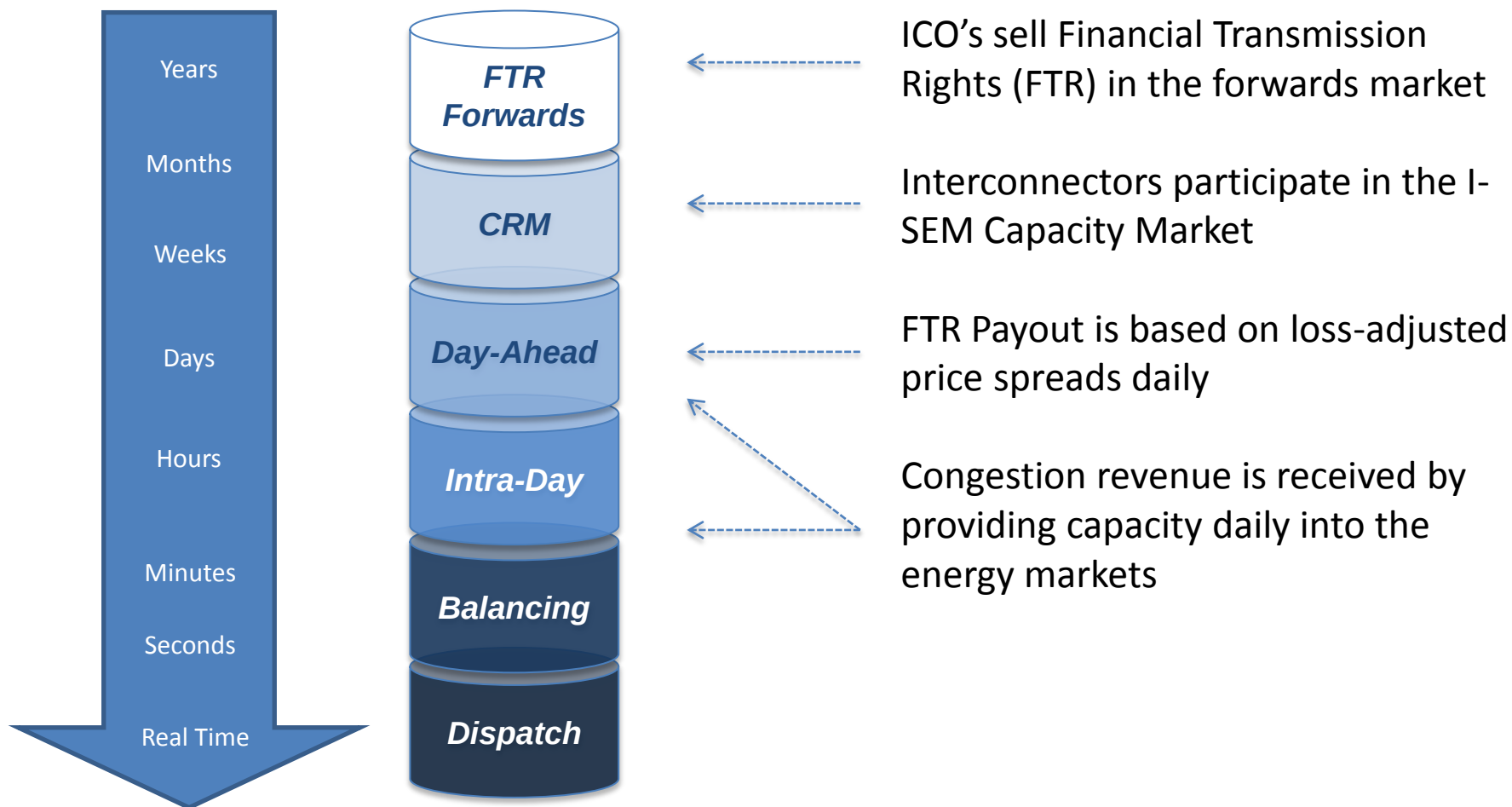


EWIC - Commercial



- EWIC has been commercially operational with unrestricted power flows since 1st May 2013
- EWIC offers capacity products to customers and ancillary services to EirGrid and National Grid

Interconnector Operators & I-SEM

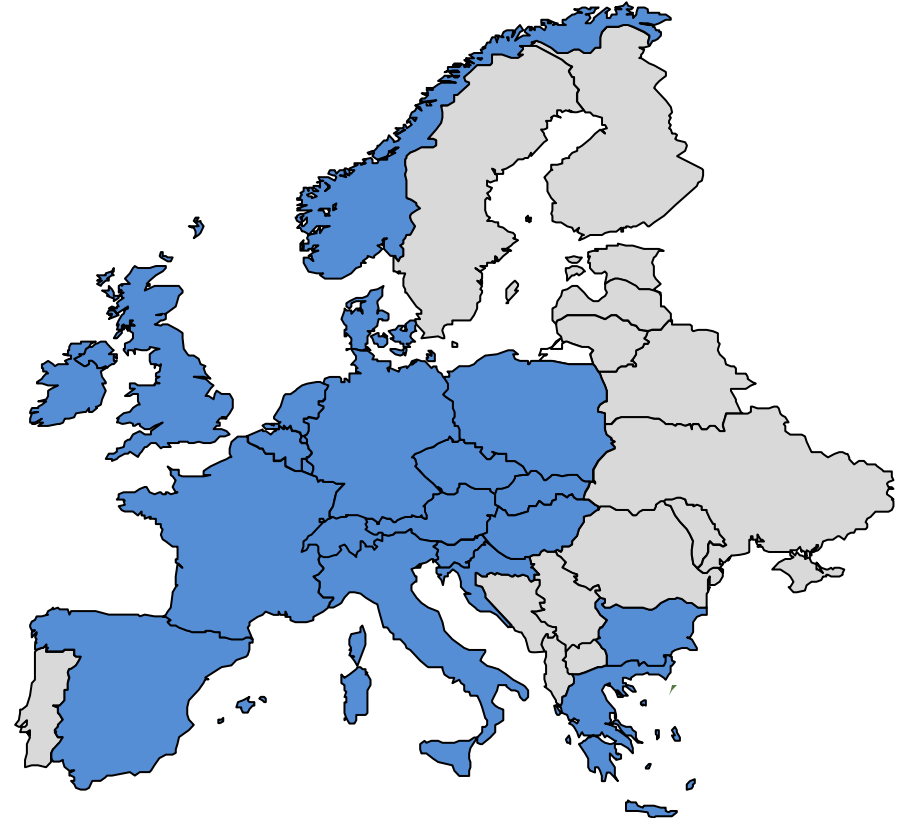


JAO: I-SEM Forwards Market

JAO Auctions

- JAO now operates the Single Allocation Platform (SAP) in accordance with Article 49(1) of the FCA Regulation
- EWIC & Moyle offer FTR's to customers through the JAO E-CAT Platform
- Register for auctions on JAO:

<http://www.jao.eu/support/resourcecenter/overview>

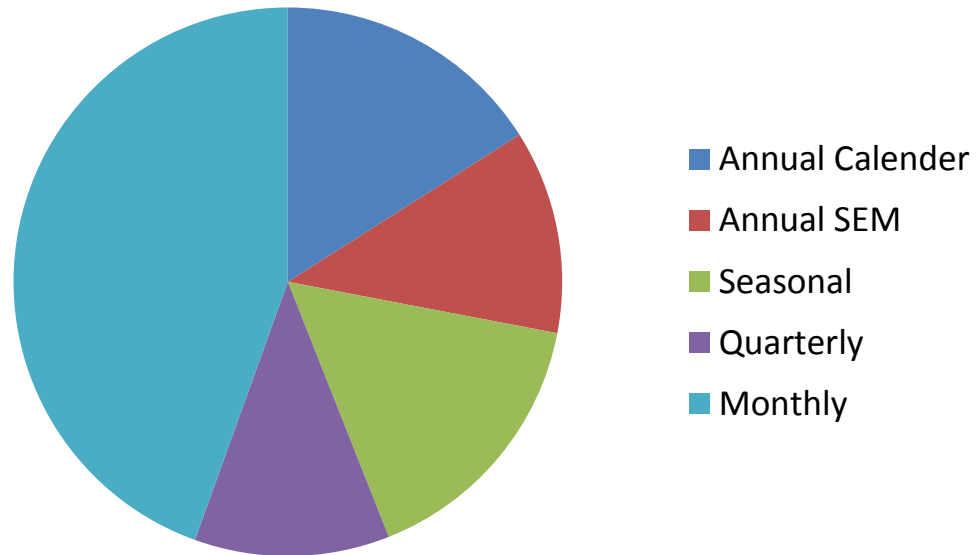


Working Area for JAO Explicit Auctions

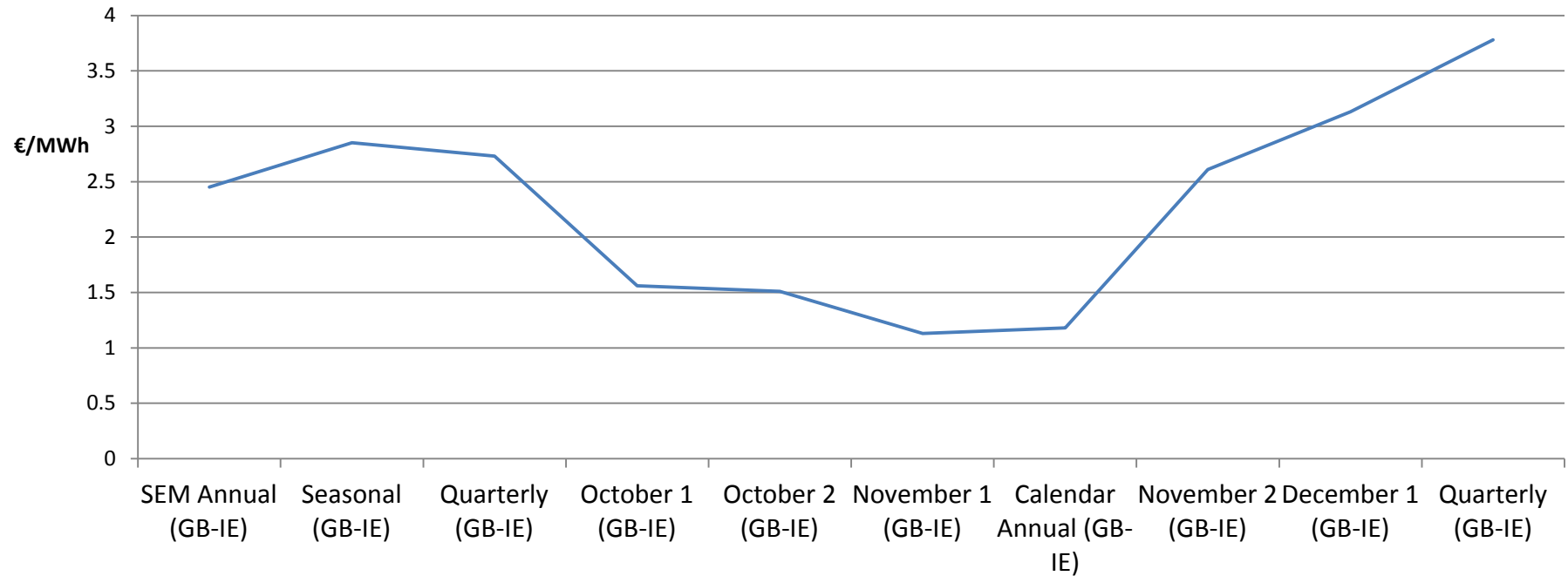
EWIC: FTR Auctions

- Large capacity mix offered to auction on JAO by EWIC & Moyle in line with FCA objectives
- Forthcoming consultation on Long Term Capacity Calculation and Splitting (Dec 2018)

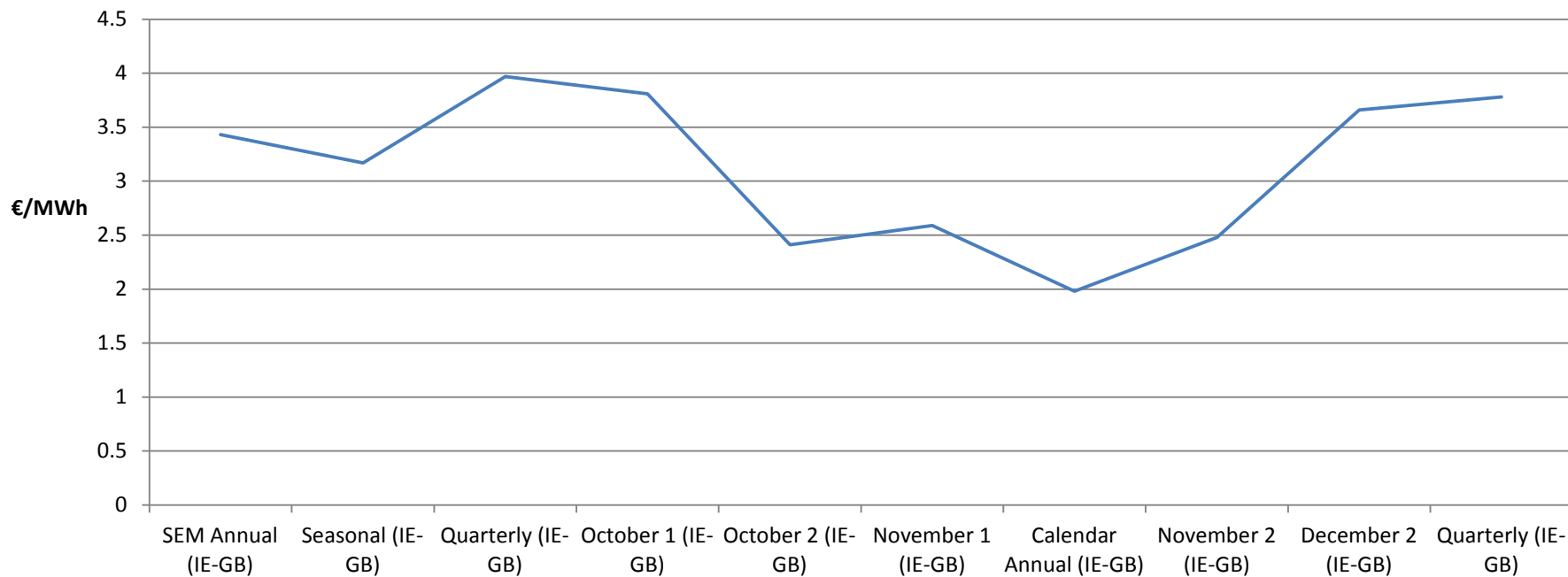
Capacity Auctions per Product



EWIC: FTR Auction Prices (GB:IE)

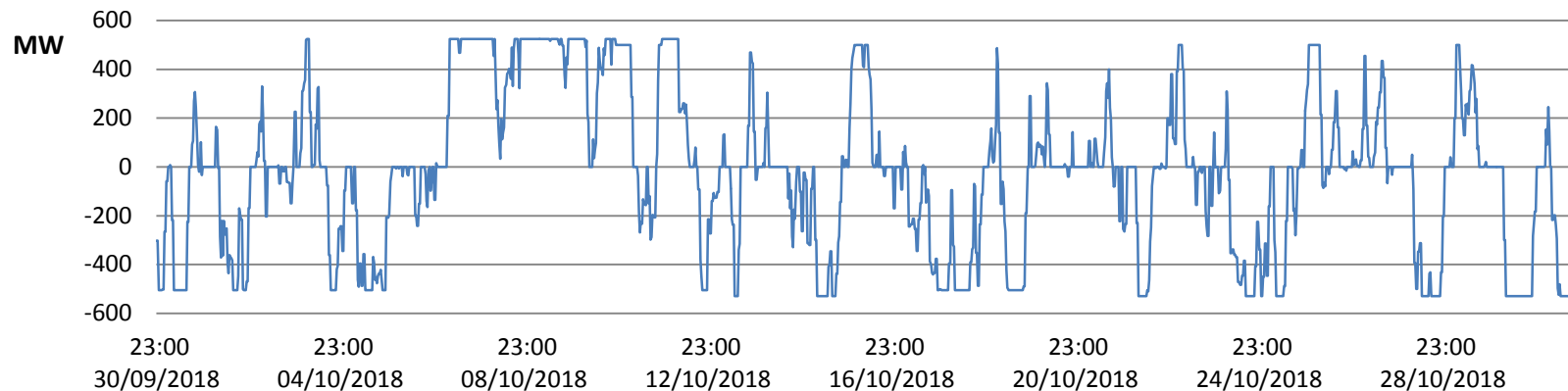


EWIC: FTR Auction Prices (IE:GB)

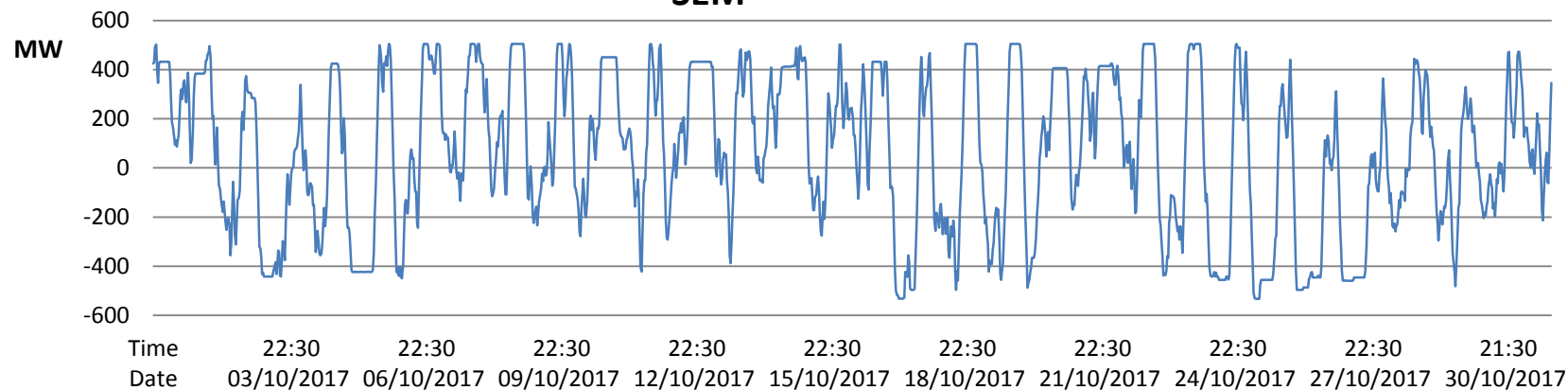


EWIC: Interconnector Flows (Oct 17 v Oct 18)

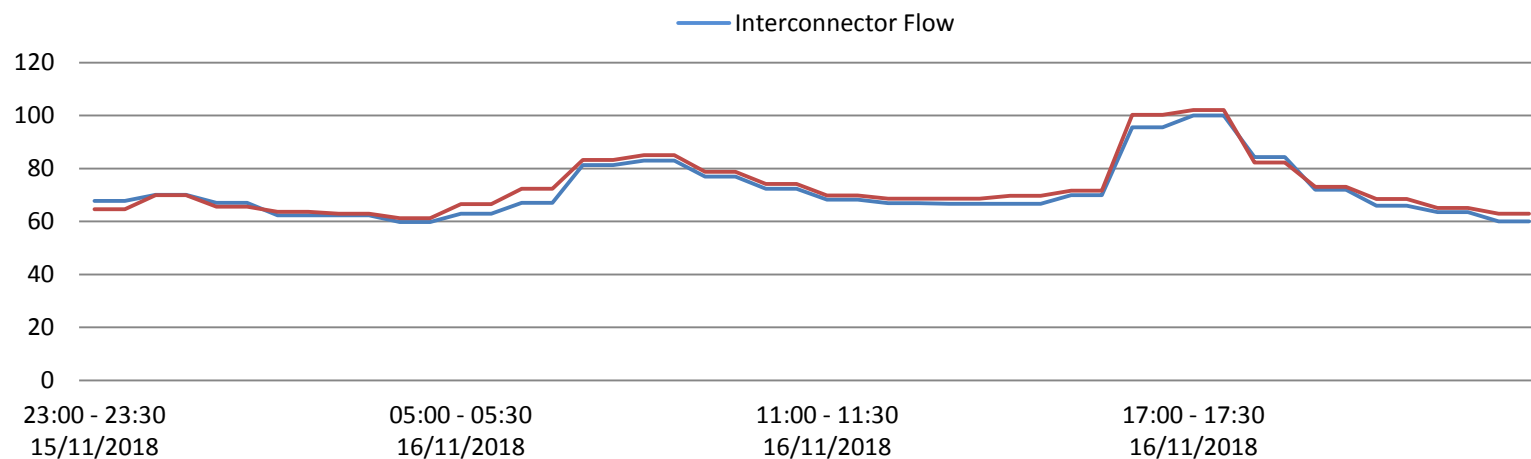
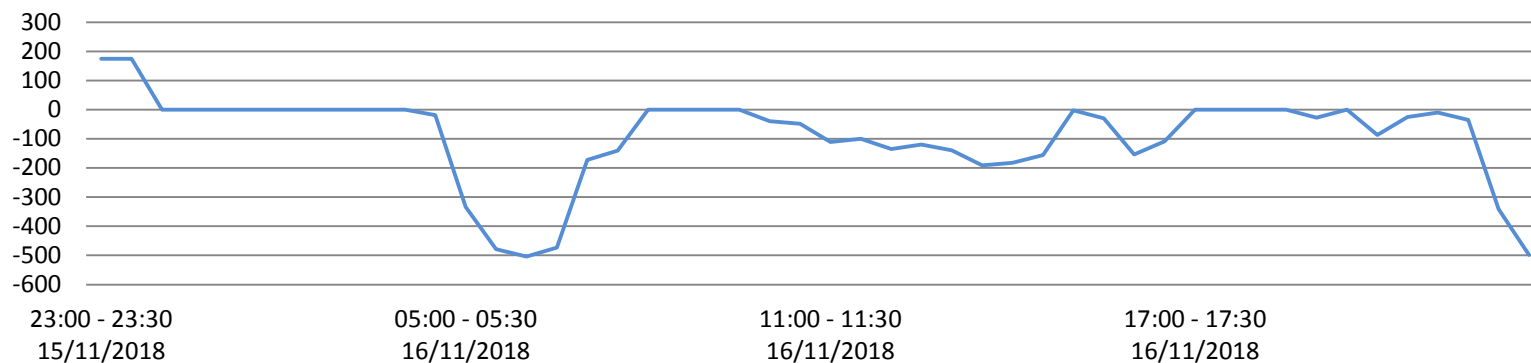
I-SEM



SEM



EWIC – Sample daily flow & price spread



REMIT Reporting

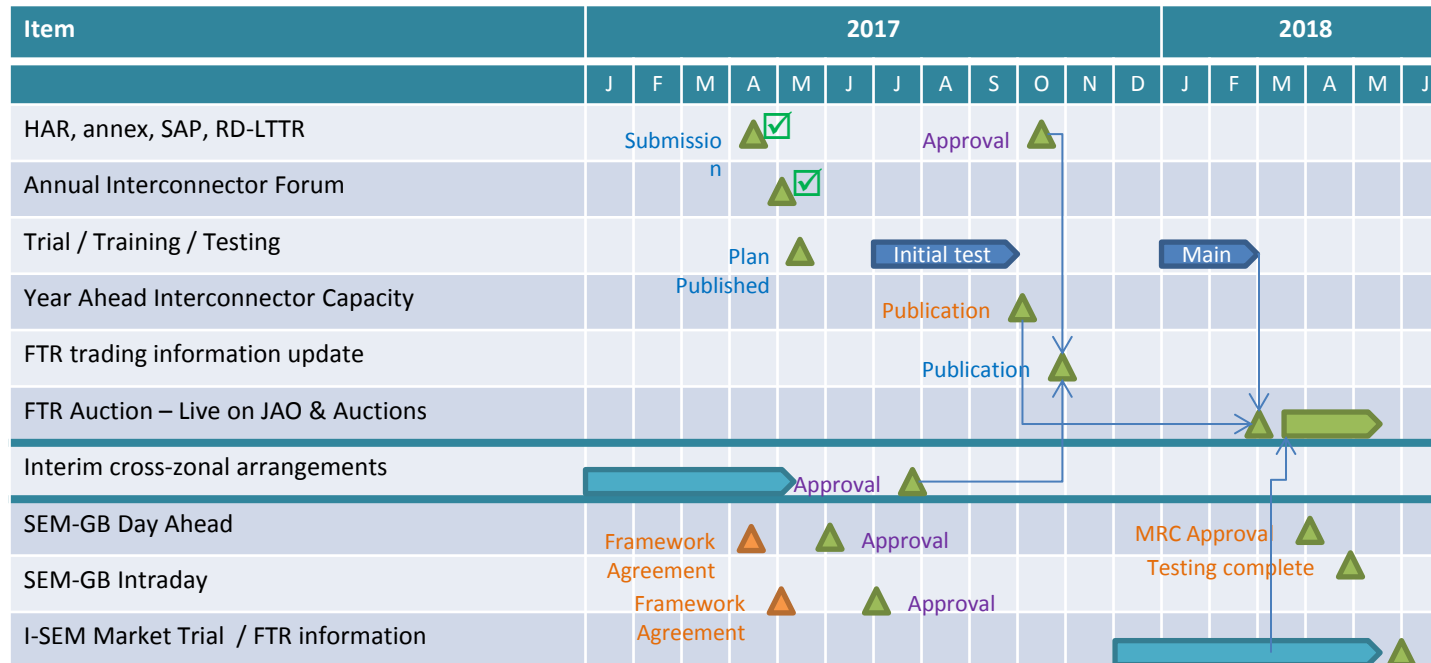
- Market participants required to complete REMIT disclosure practice and compliance with regulation (EU) No 1227/2011
- EIDAC has been using the ENTSO-E Transparency platform as an interim disclosure process
- Third party Urgent Market Messaging (UMM) platforms referred to by ACER in their guidance now being proactively assessed for use
- Customers should link to the selected platforms RSS feed when the platform is selected.

Moyle commercial overview

Paul McGuckin

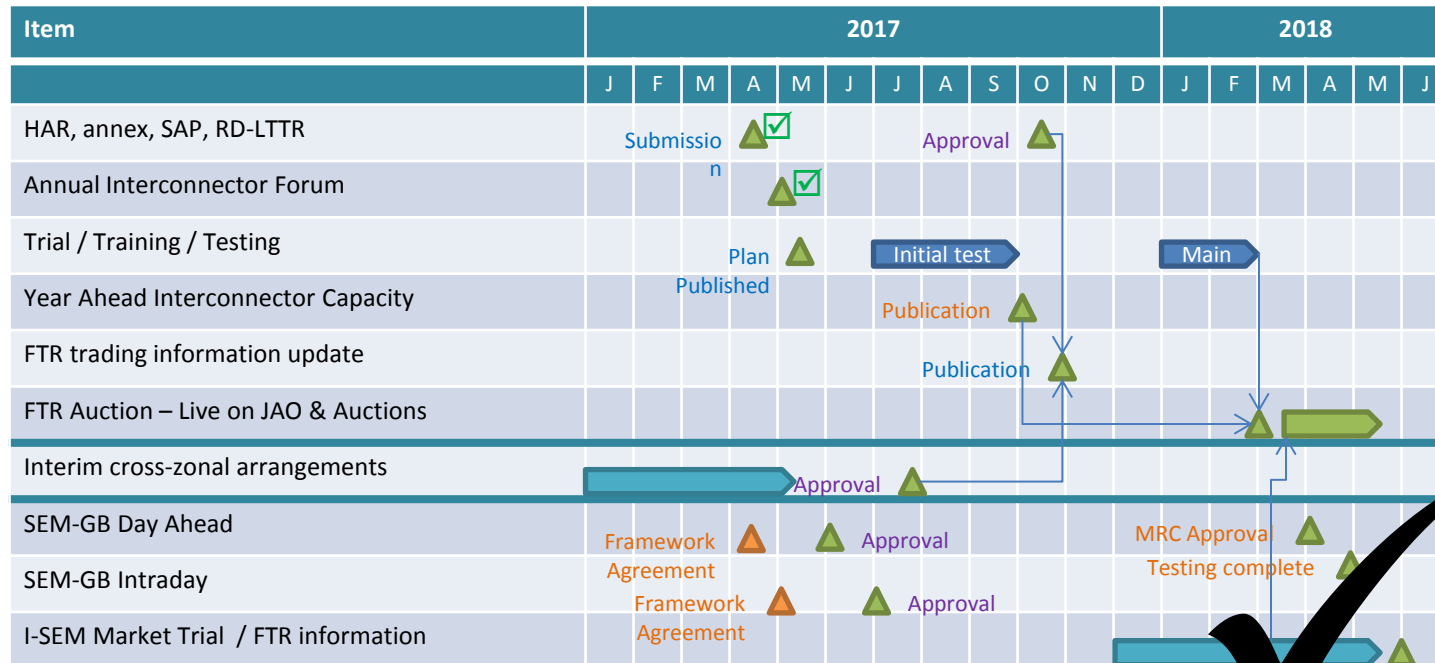
November 2018

Last year.....



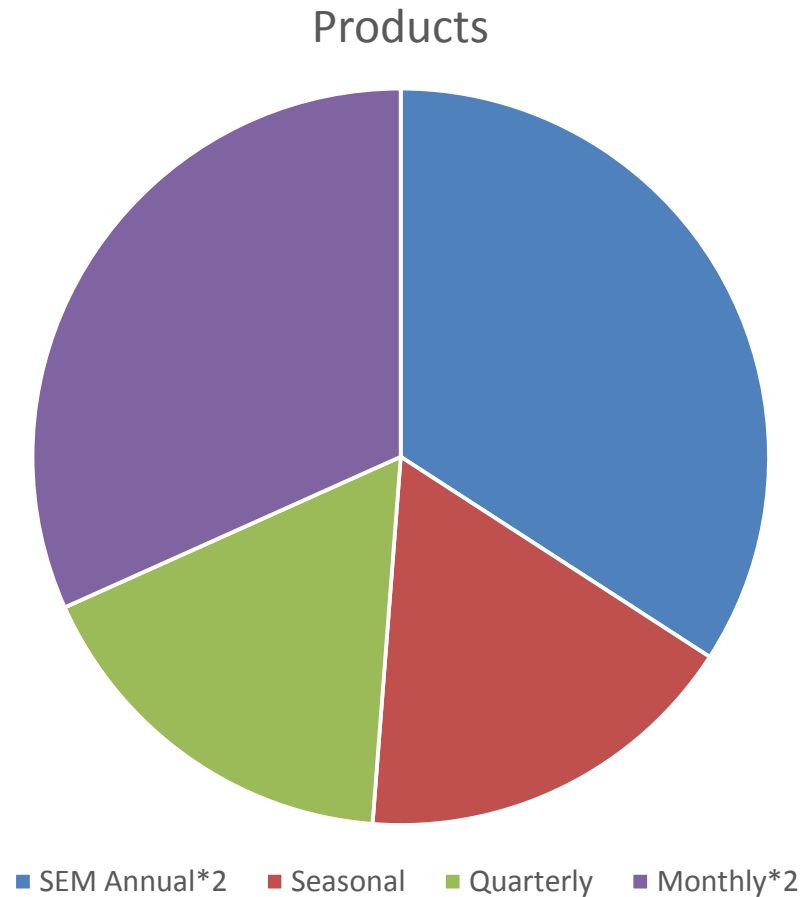
Key: RA; ICO; TSO

Last year.....



Key: RA; ICO; TSO

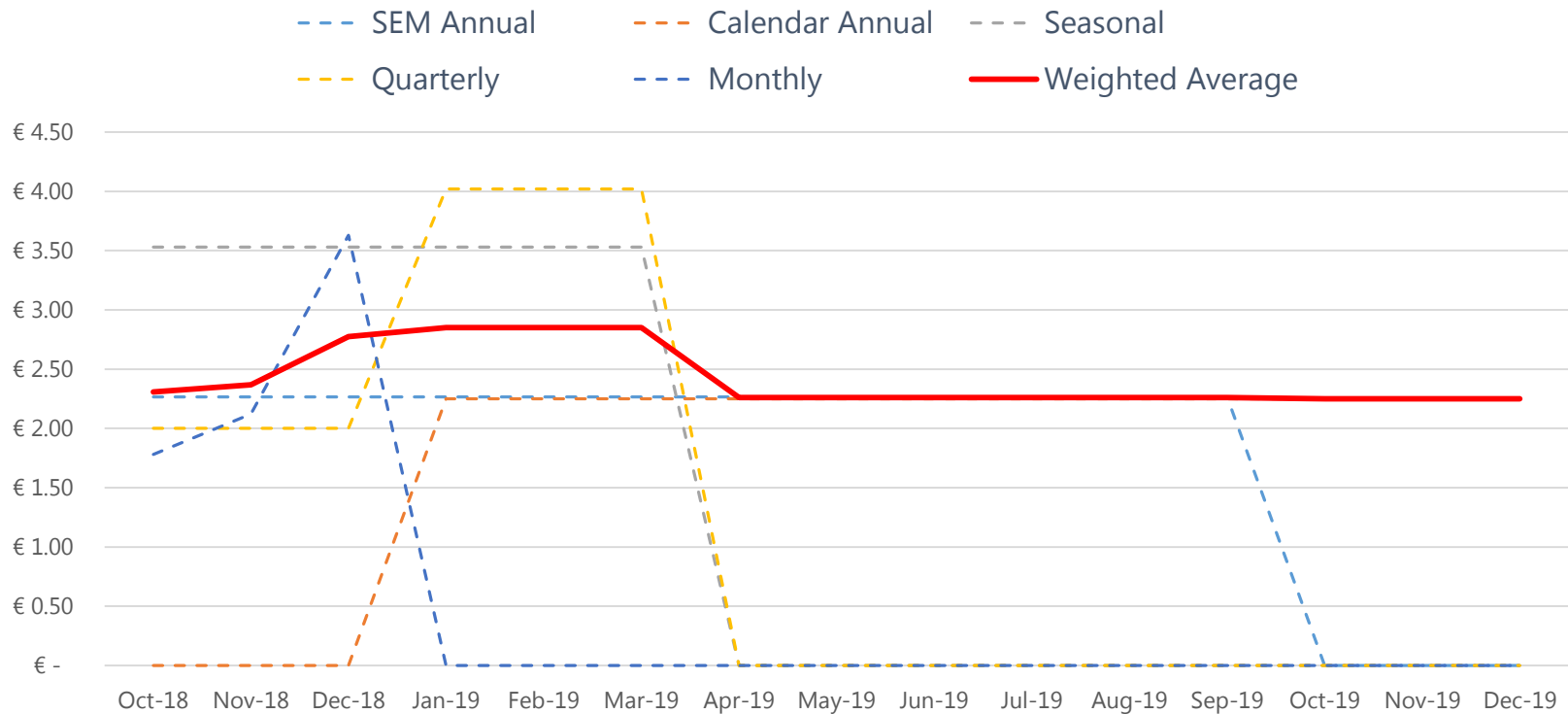
Pre go-live auctions



- Full capacity of interconnector allocated
- 6 auctions in 6 weeks (plus same again for EWIC)

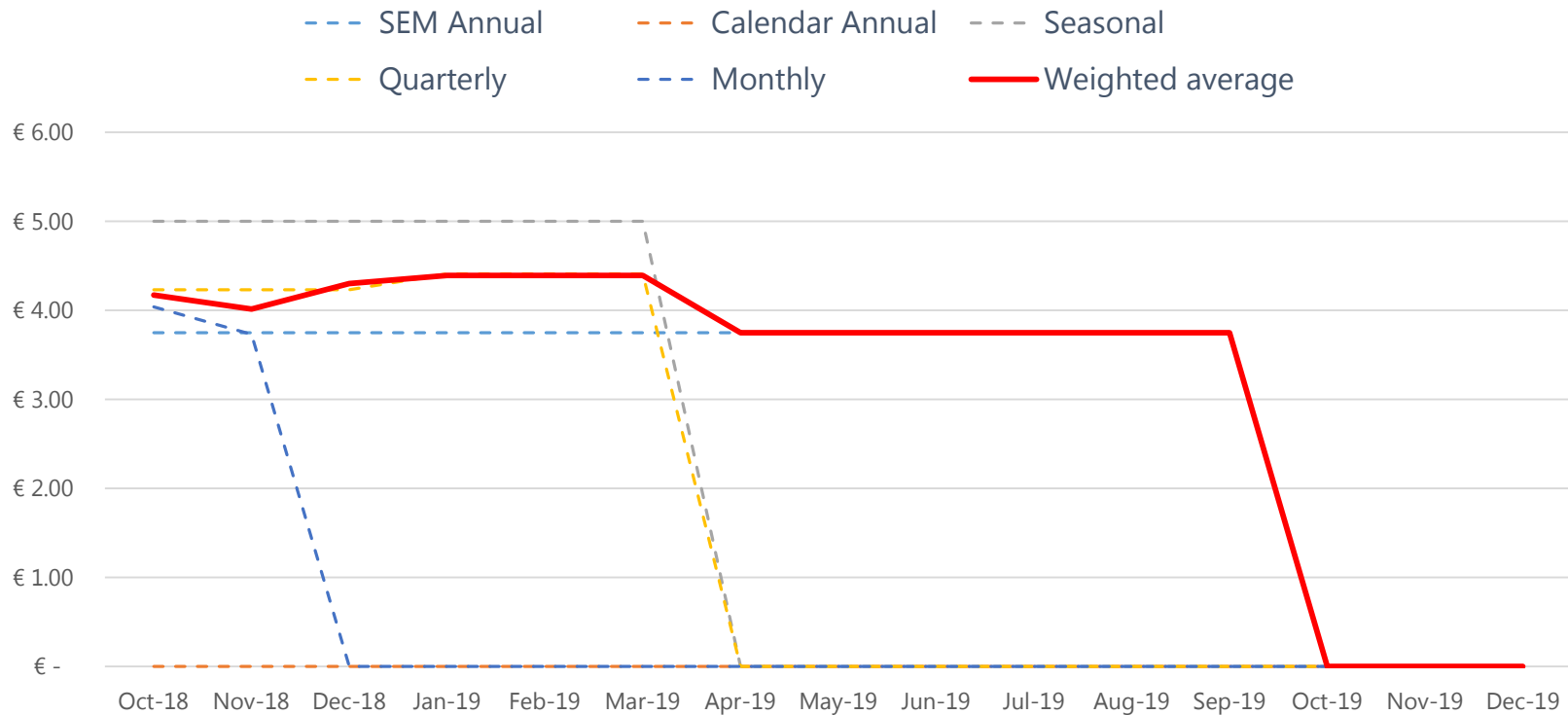
Auctions out-turn

Import (GB -> NI)

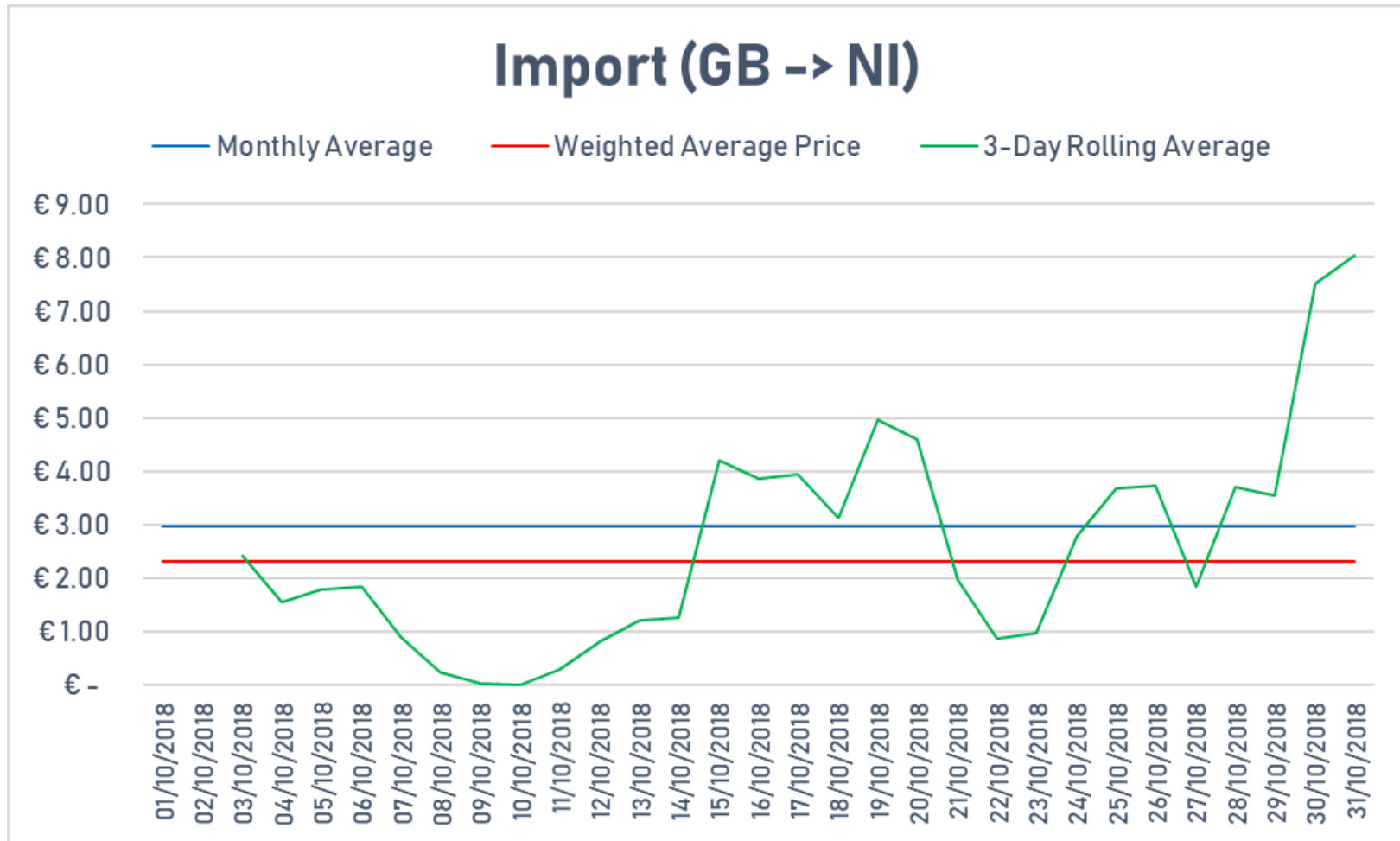


Auctions out-turn

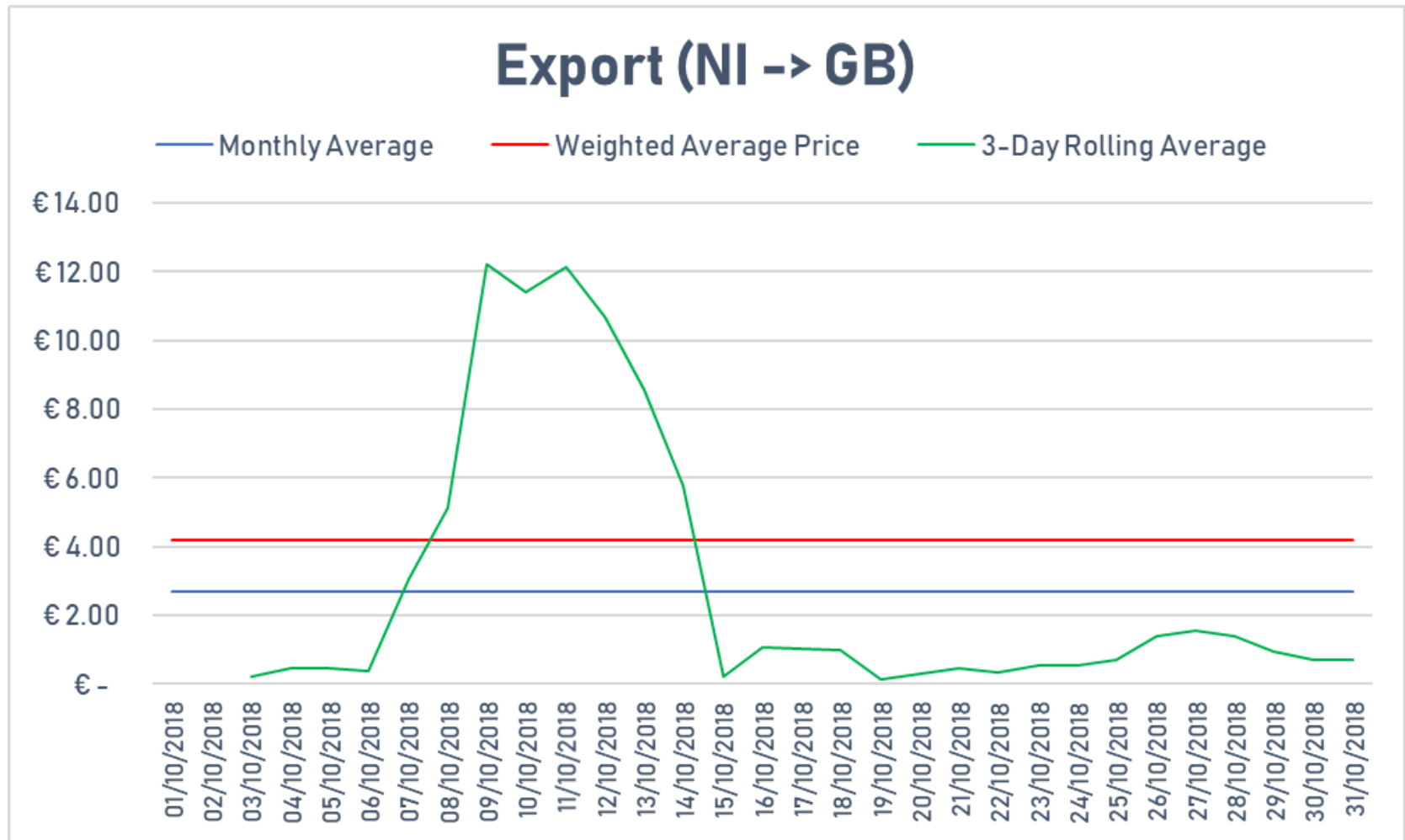
Export (NI -> GB)



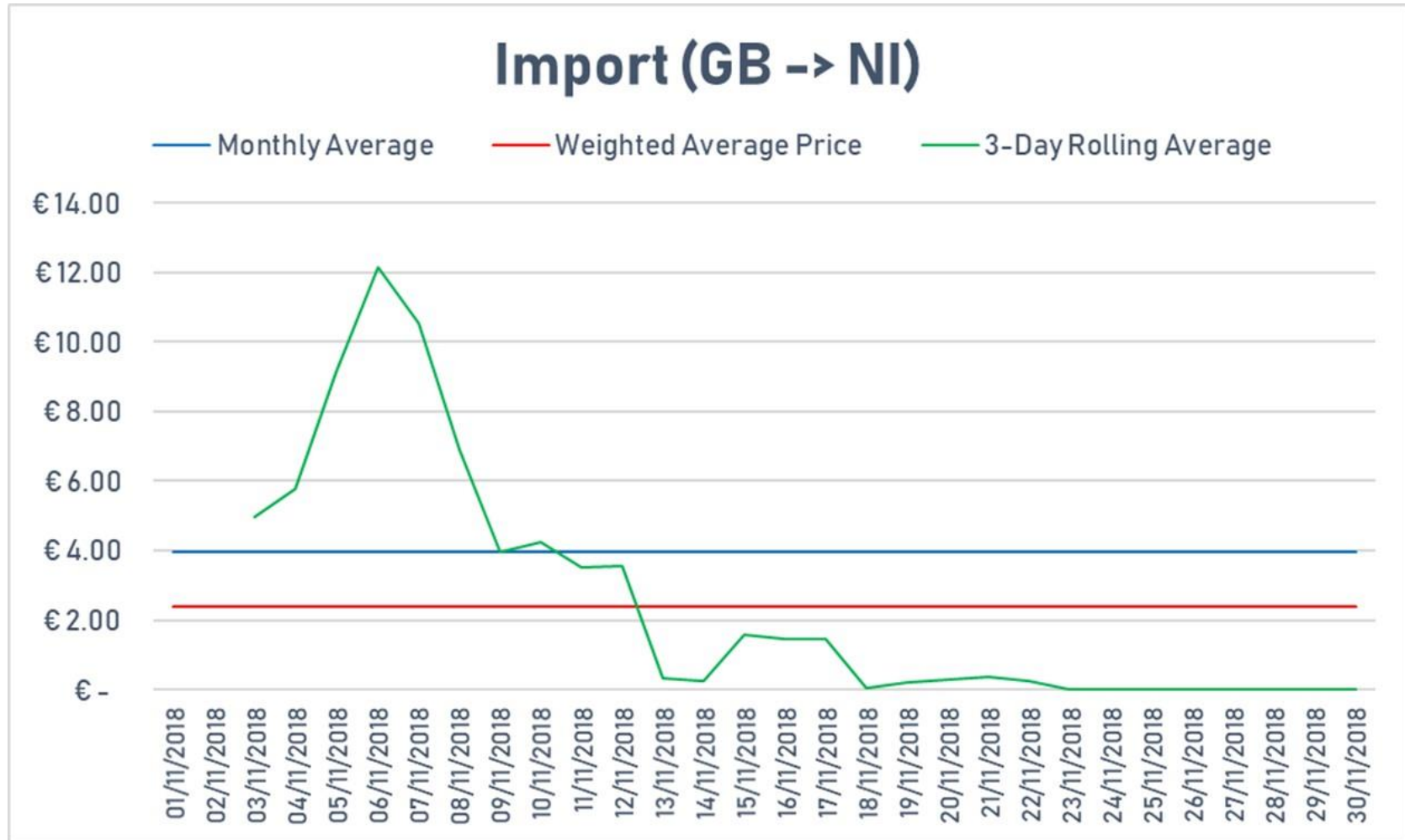
Auctions out-turn (Oct)



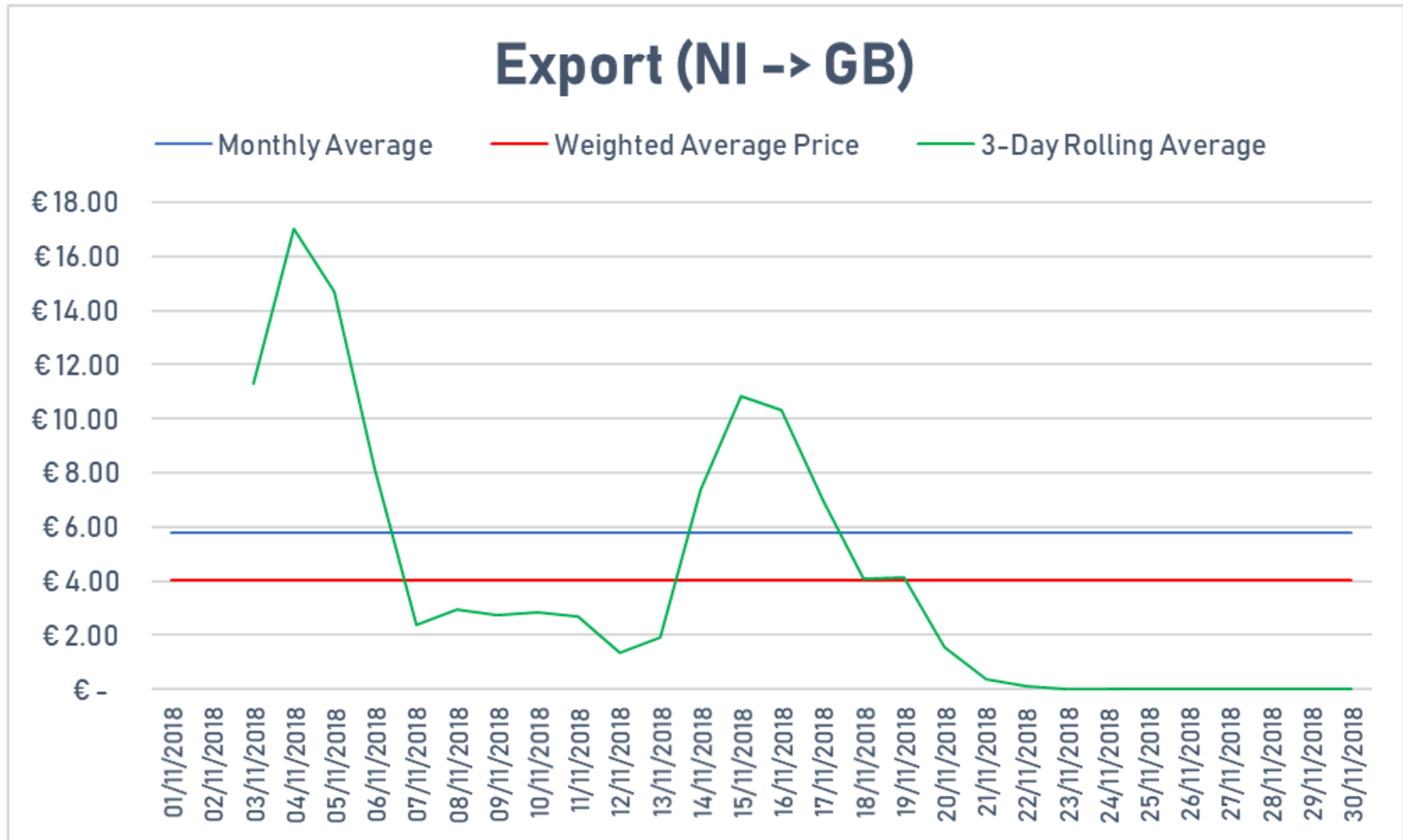
Auctions out-turn (Oct)



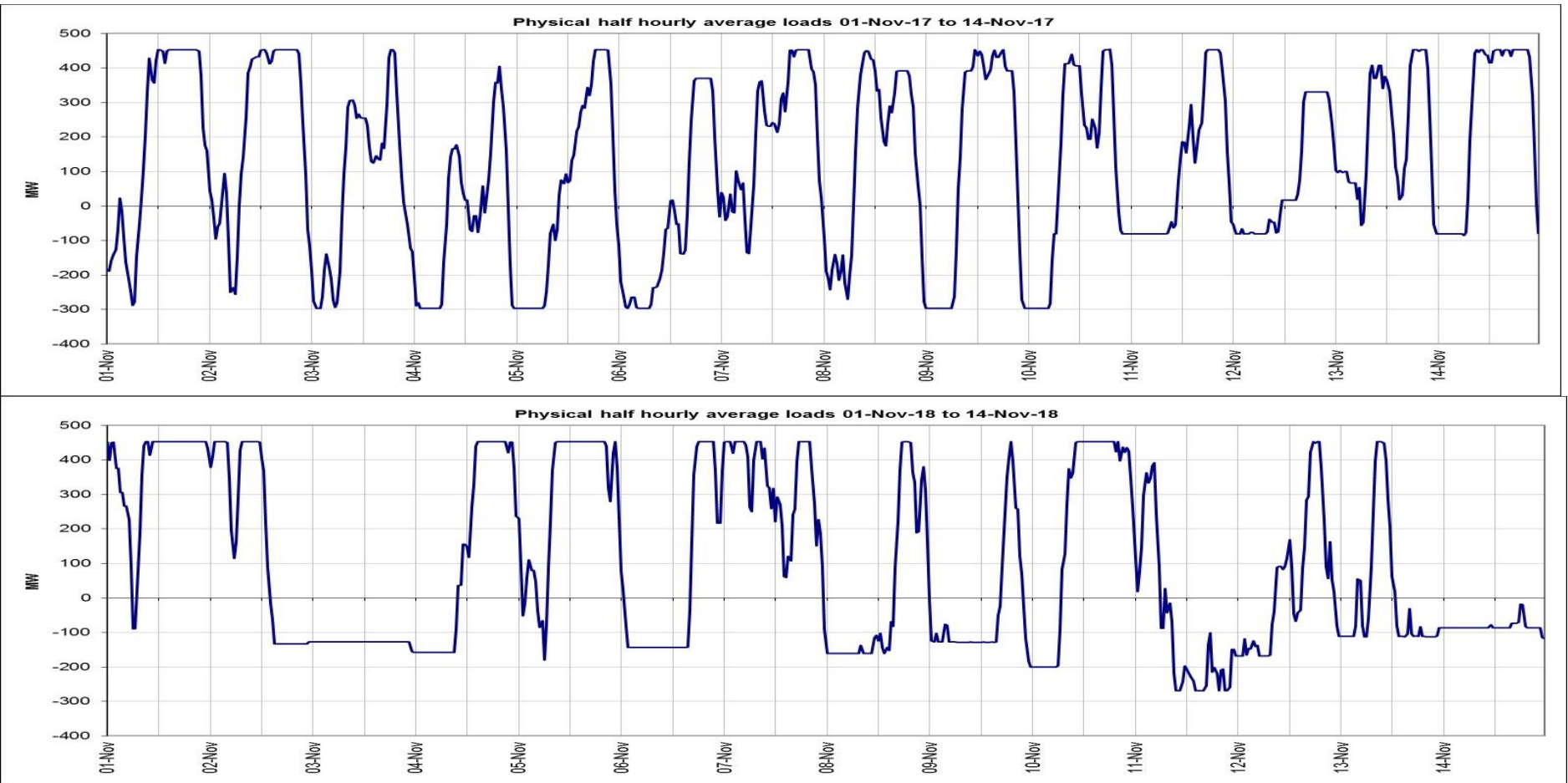
Auctions out-turn (Nov)



Auctions out-turn (Nov)



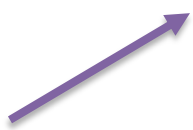
Physical flows – Nov 17 v 18



NI->GB capacity

National Grid Transmission Entry Capacity “TEC” offer

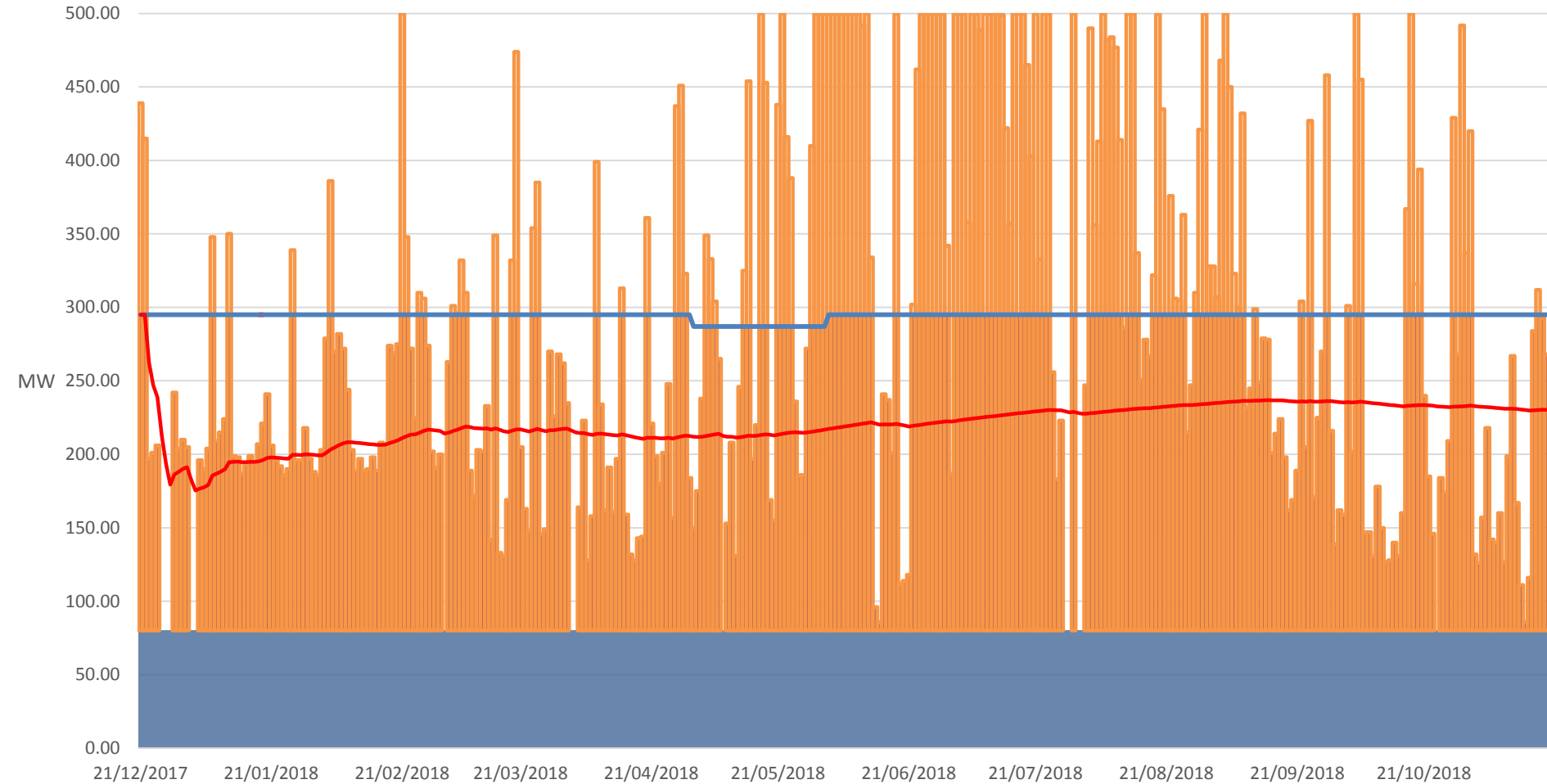
Date	TEC not subject to restrictions - MW	Additional TEC subject to limitations (reduces as forecast wind production rises with forecast wind levels) - MW
01/11/17	80	420
01/12/19	307	193
01/06/20	250	250
01/04/22	500	0

- 
- Commercially firm capacity available all the time

- 
- Commercially firm capacity not available all the time
 - Calculated and released on a short term basis
 - Based on an estimate of the capacity not used by windfarms

D-2 capacity release

Moyle Capacity Release (West to East)



Future/current issues

- Day ahead capacity calculation at both sides
- GB Capacity Market
- Long term capacity calculation and splitting
- Brexit.....



EWIC Operational Performance

EWIC User Conference

November 2018

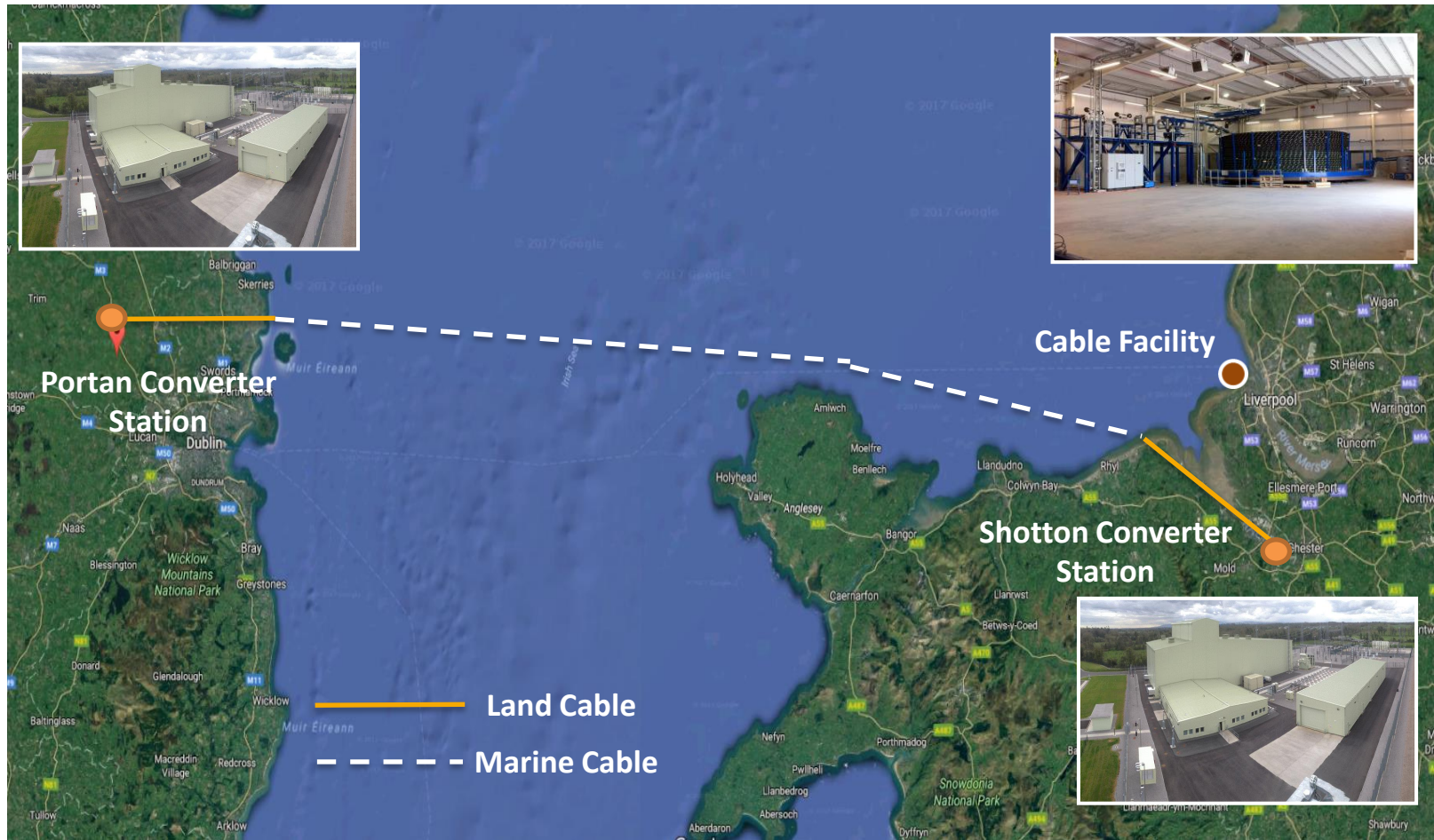


Co-financed by the European Union
Connecting Europe Facility

Contents

- Overview of the EWIC Assets
- Availability Performance
- EPC Warranty Arrangements
- Maintenance & Repair Performance
- Year Ahead

Overview of the EWIC Assets

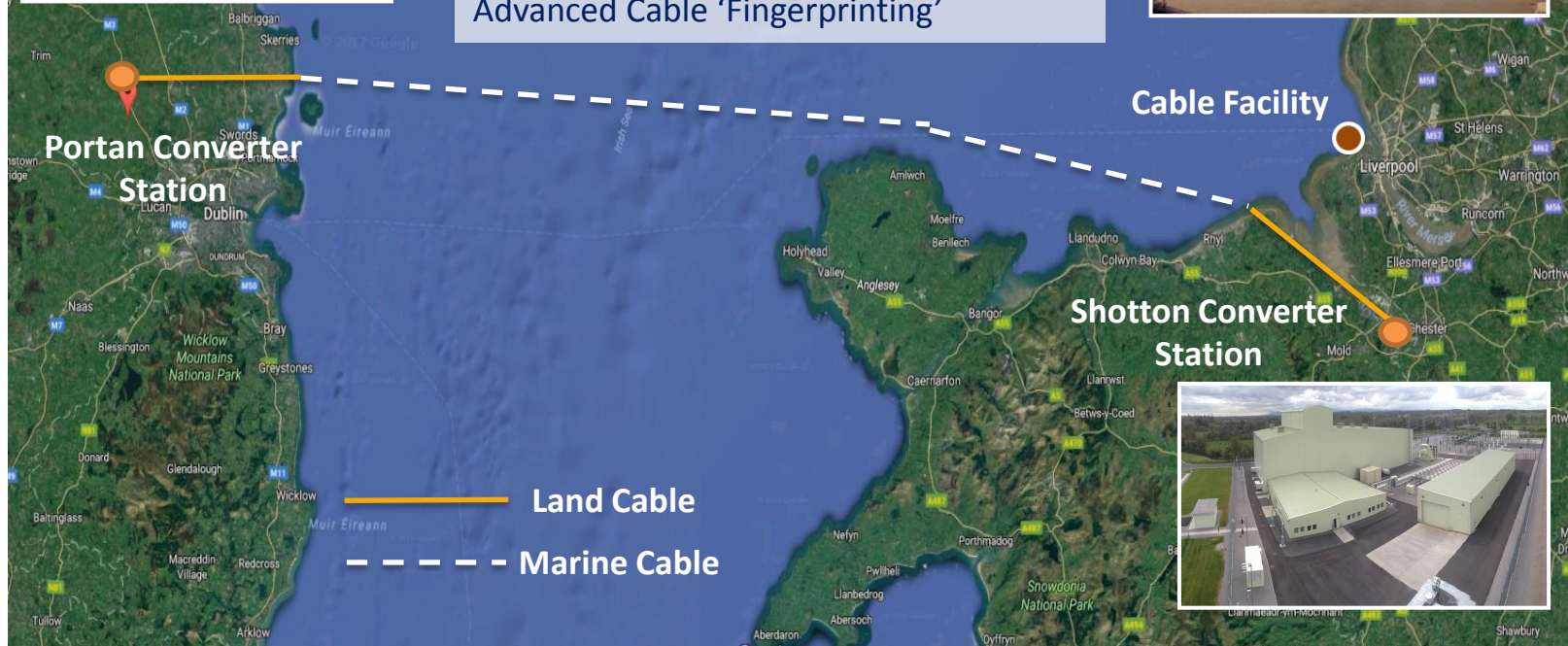


Improvements to the EWIC Assets



Capital Investments

- Advanced IT Servers Upgrade
- Cyber Security Improvements
- Procured Additional Strategic Spares
- Comprehensive Marine Surveys
- Advanced Cable 'Fingerprinting'

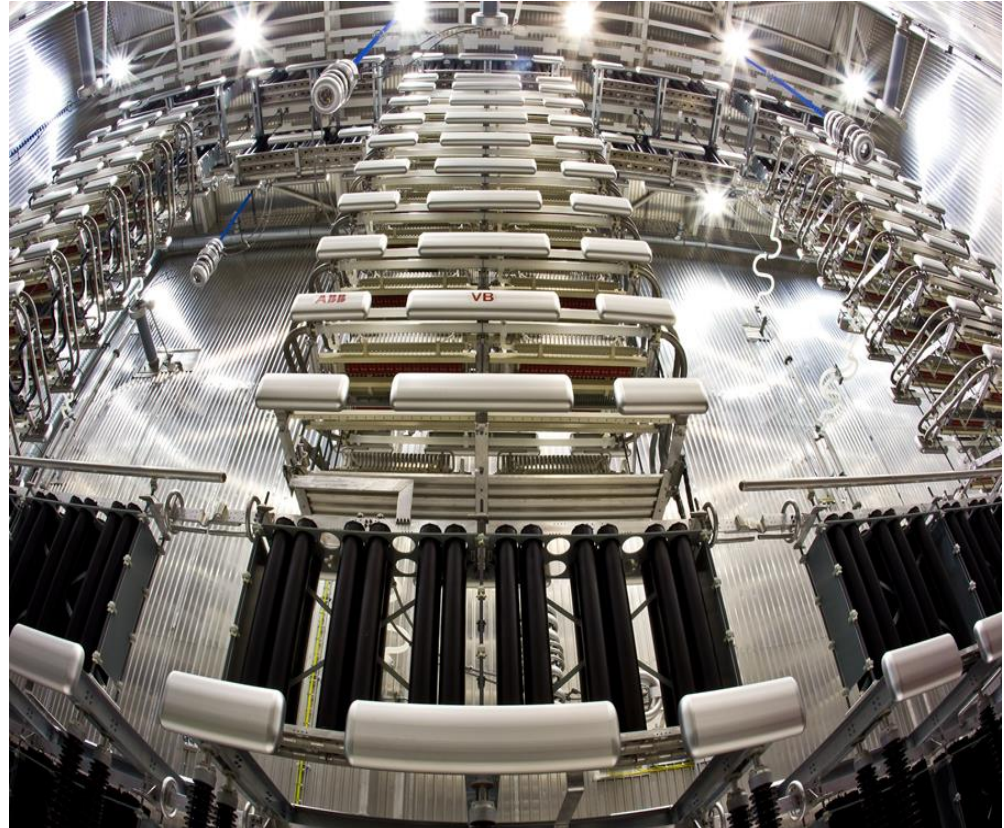


Availability Performance

Reliability & Availability

2014	97 % (7)*
2015	98 % (6)*
2016	76 % (2)* (Major Fault)
2017	96% (1)*
2018	89% (2)*
2019	97 % (Forecast)

* No. of forced outages



Picture: HVDC Valve Hall

EPC Warranty Arrangements

- **EPC Contract with ABB**

- Full warranty cover of 6.5 years expires in January 2020 (extending to '22)
- Reliability and Availability period (target 98%)
- Allowed 1% (84 hrs.) forced outages and (1%) for annual maintenance

- **Maintenance & Repair (M&R) Contract**

- ABB Ireland employed as M&R Contractor (Parent Company Guar.)
- Initial term of 5 years (2013-2018), recently renewed – 2023
- Services include 24/7 monitoring of alarms and 1 hr. response to site

ABB Maintenance/Repair Performance (Cont'd)

- ABB M&R Performance during the past 5 years
 - Excellent emergency response times to site, averaging 1 hour from receipt of alarm; (2hrs in Contract) [4-5 call outs per month]
 - Fault finding capabilities reduce the reliability on remote fault finding (Sweden) reducing downtime
 - Delivered on Major projects, such Connahs Quay Cable Relocation and have performed very well during major repairs



Zero Safety Incidents or accidents in 5 years of operations

Plant Performance

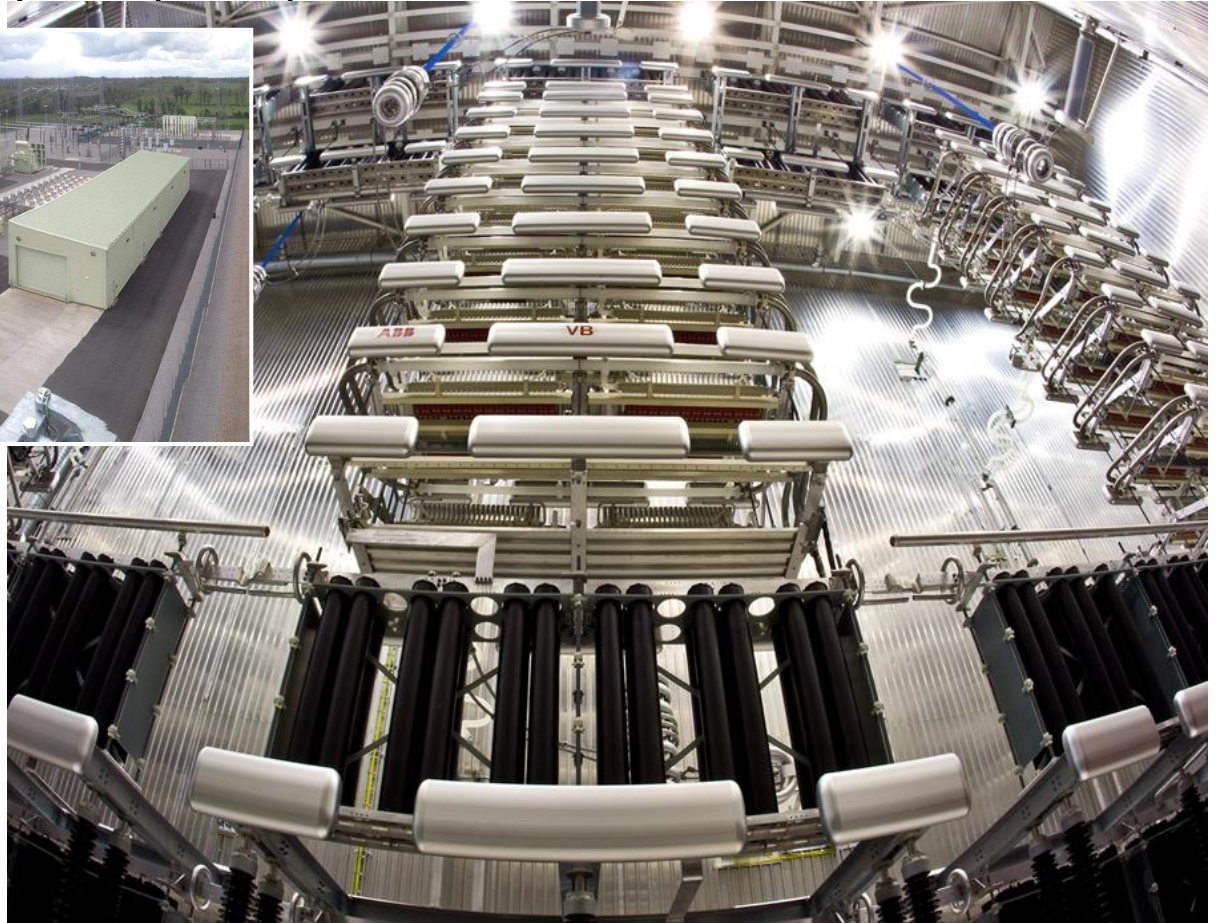
- **ABB Plant Performance** during the past 5 years
 - Traditional Plant, Power Transformers & Cables Very Reliable
 - Issues primarily associated with the Valve Hall (Cooling Systems & Micro Electronic Boards)
 - These are typical across the industry with HVDC VSC schemes
 - Additional Spares now held on site to mitigate outage durations
 - Constant updating of IT Security (Firewalls etc.) required

Resolution of Technical Faults (Example)

- 2016 and 2018 Repairs (IGBT)

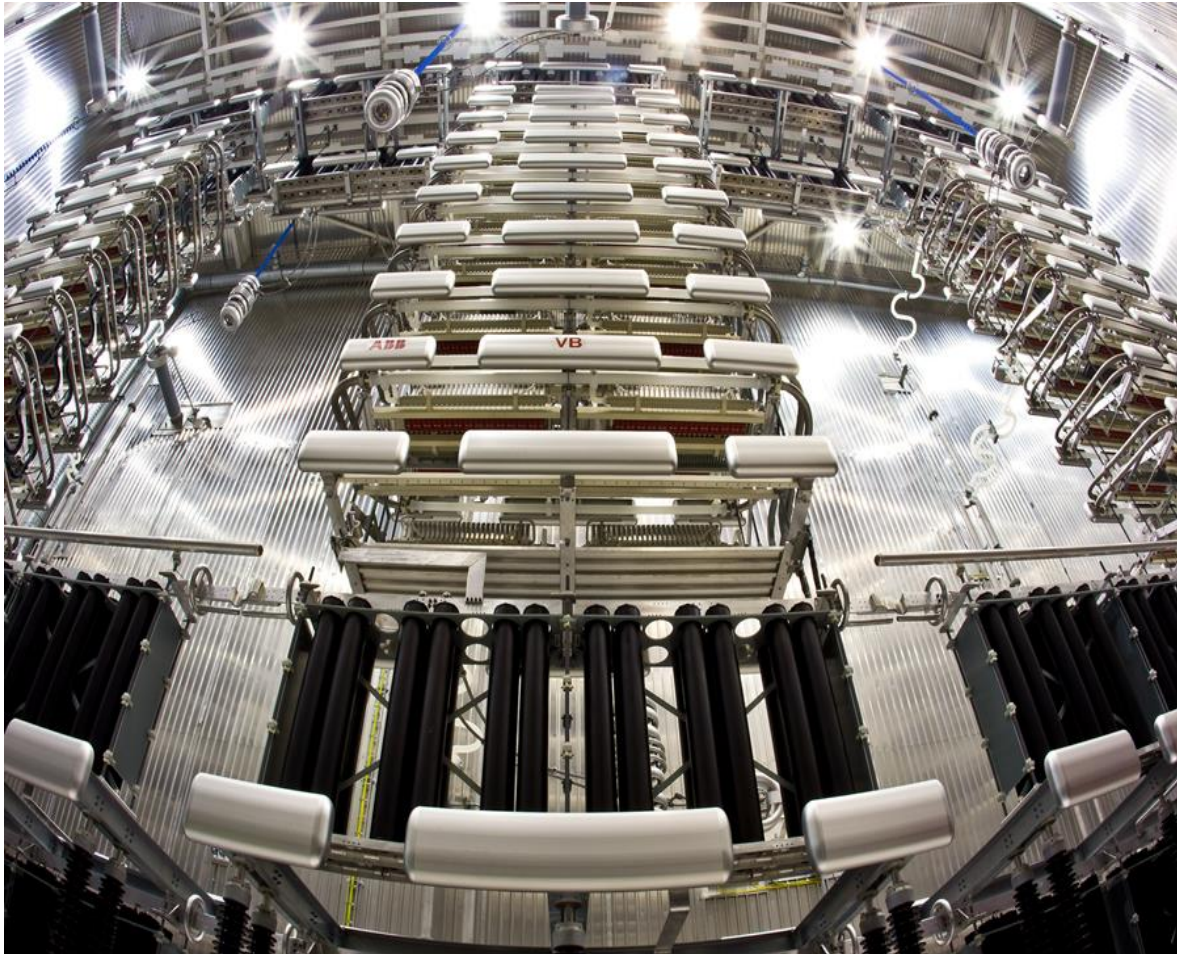


HVDC Hall



Resolution of Technical Faults

- Each Converter has **2,500** IGBT's



Resolution of Technical Faults

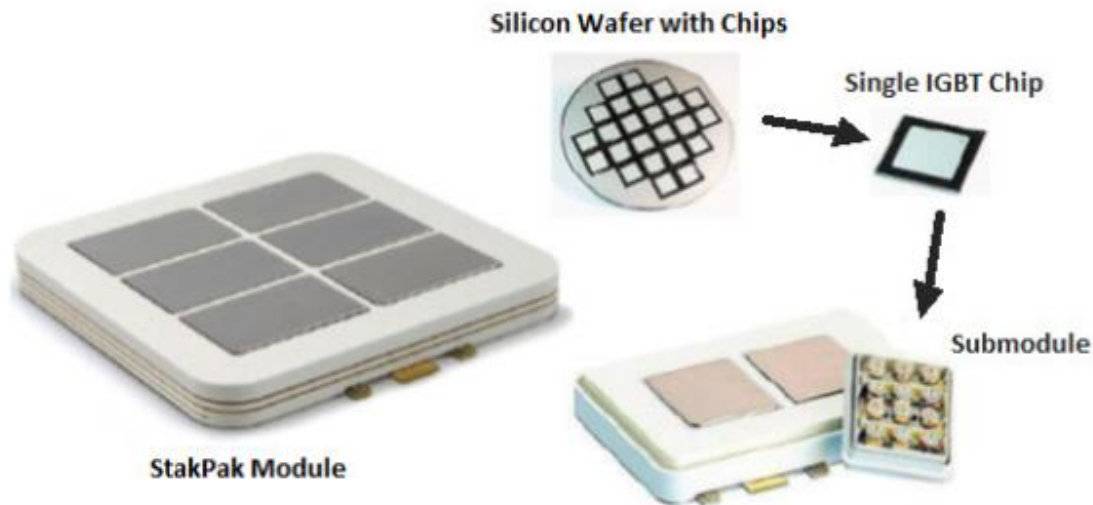
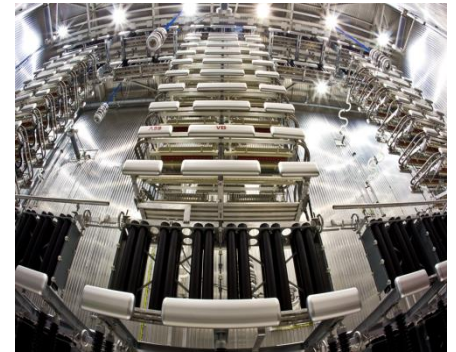
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StakPak Module

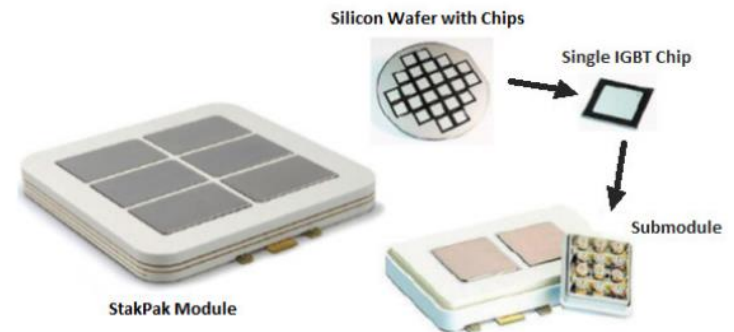
Resolution of Technical Faults

- Each Converter has **2,500** IGBT's
- Each IGBT has in excess of **100** components



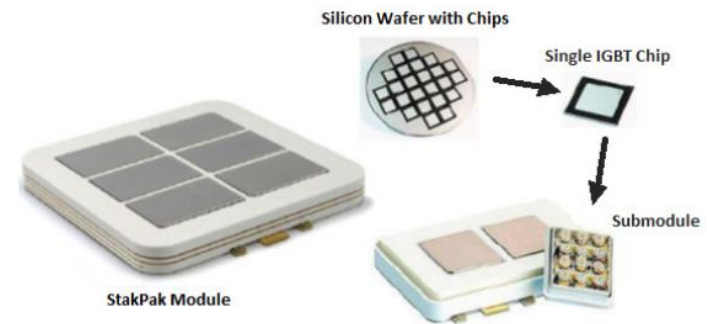
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- Each Converter has **2,500** IGBT's
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- Total of **25,000** components



Resolution of Technical Faults

- Each Converter has **2,500** IGBT's
- Each IGBT has in excess of **100** components
- Total of **25,000** components
- All Switching 25 times per second
- Perfectly in synch
- At **70** degrees Celsius (ambient!)
- With 400,000 Volts flowing through constantly
- Being force cooled by 20,000 litres of high pressure Glycol
- While riding through external faults on the system
- **Operating 358 days, 24 hours per day.**
- **But there is redundancy built in!.**



Year Ahead

- Finalise Warranty Negotiations with ABB Sweden
- Further Enhancements to Cyber Security Infrastructure
- Technical Workshops to further improve repair times
- IGBT performance monitoring – further investigations with the supplier to improve reliability
- Implement the necessary control system changes to provide additional DS3 services to the TSO
- Undertake a Marine Survey to ensure the integrity of the Marine Cable

Interconnector Users Forum

Dublin

21st November 2018

Stephen Hemphill

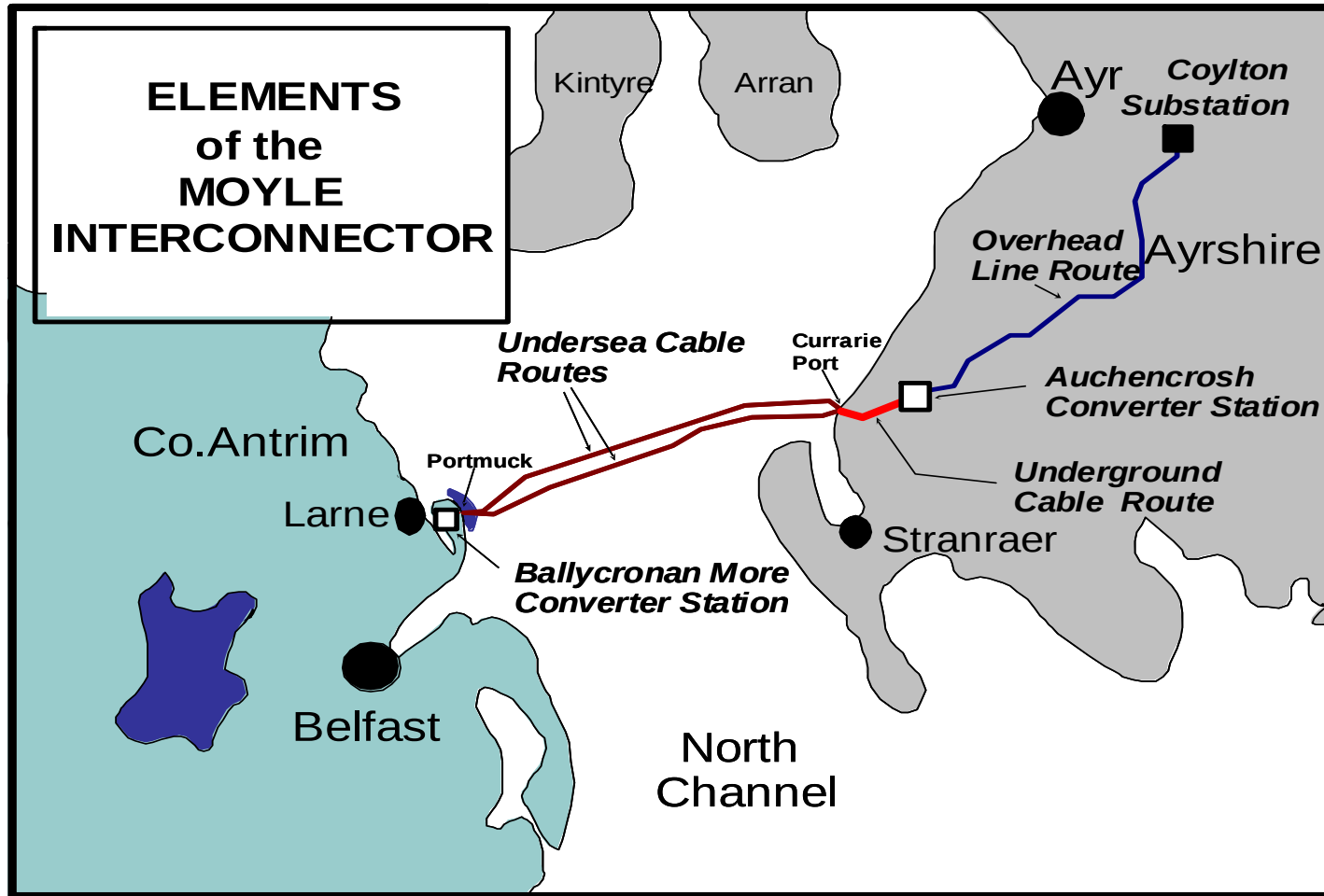
MEL Operations Director

Moyle Operational Update

- Recap – the physical asset
- What we envisaged 17/18
- What we actually did 17/18
- Availability results
- Operational priorities 18/19



The physical asset



Key characteristics of Moyle

Positives

Negatives

Convertor Technology (LCC vs VSC)

Less losses

- (1) No black start capability
- (2) More vulnerable to ac disturbance

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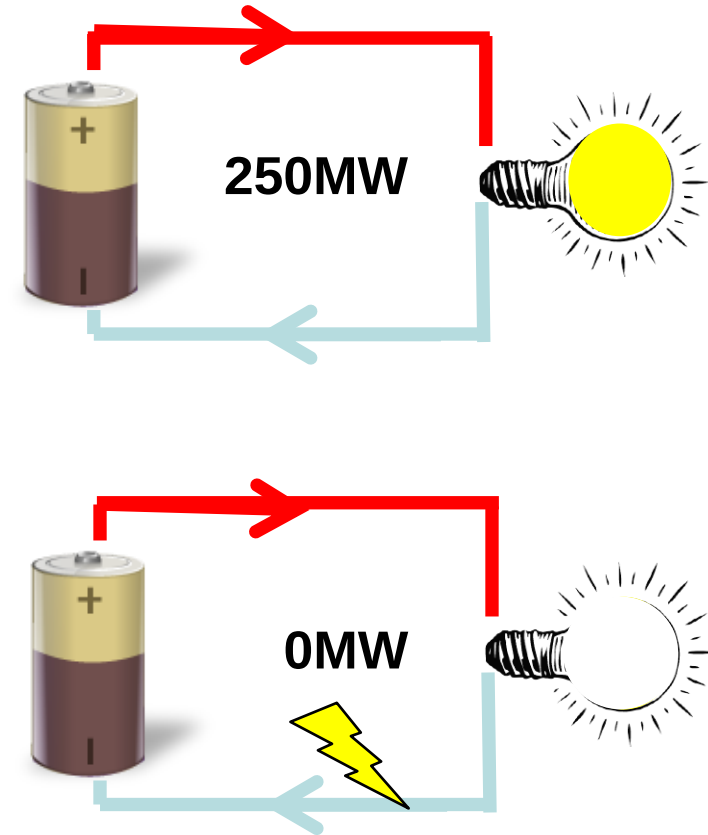
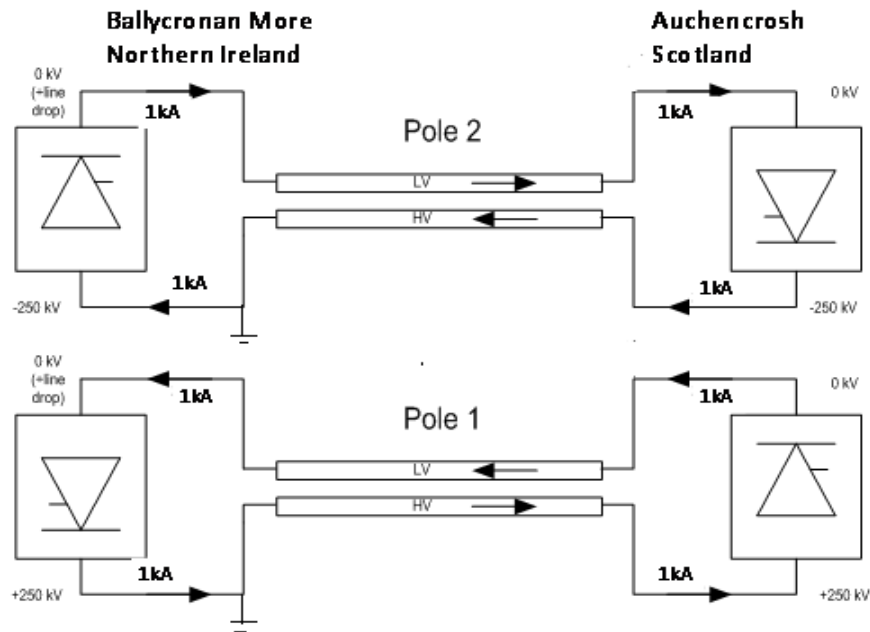
- (1) No black start capability
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Dual monopole (2 x 250MW vs 1 x 500MW)

Higher availability

- (1) More cables
- (2) More complicated to operate

Dual Monopole HVDC 2 x 250MW



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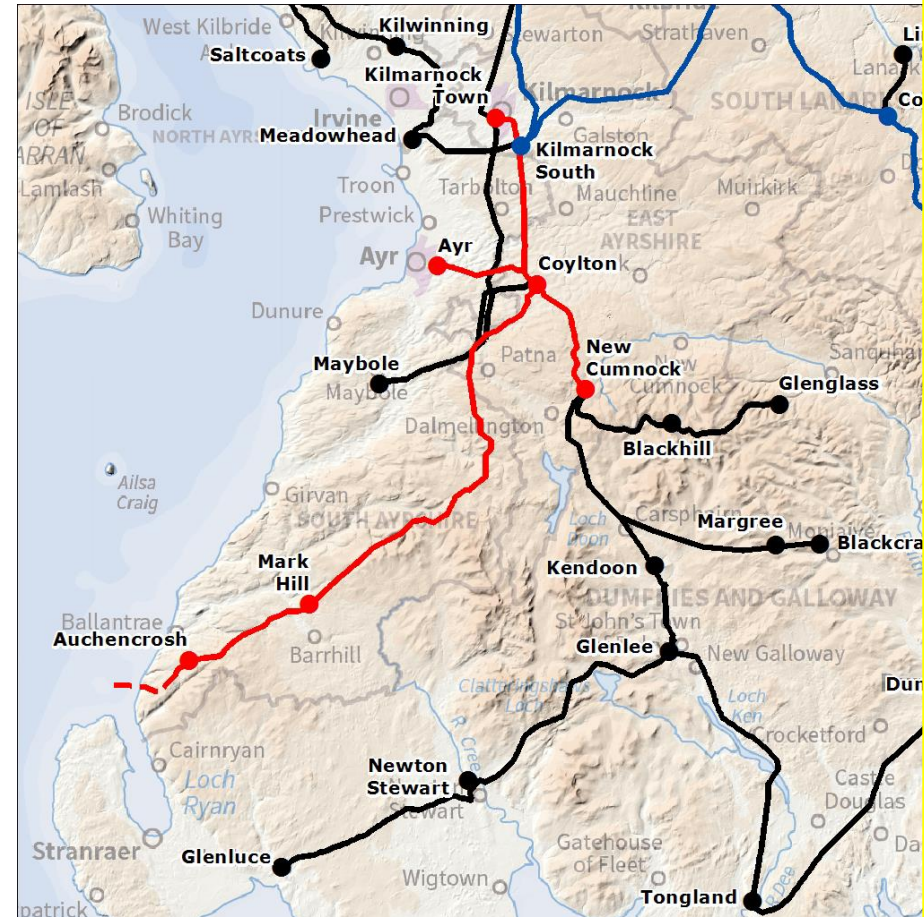
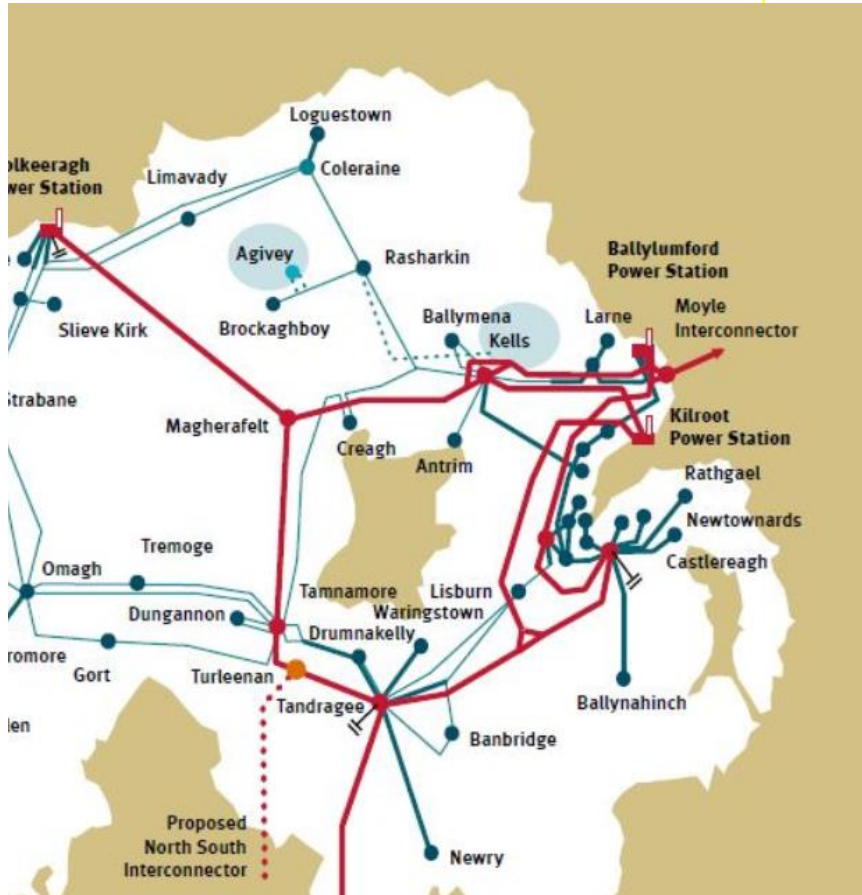
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AC System Connection

Robust location on NI grid...

- (1) ... but size still leads to constraint
- (2) Scotland single circuit

Grid Connections NI & Scotland



A Northern Ireland company working for consumers

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Asset Maturity & Obsolescence

- (1) Operational confidence
- (2) Opportunity to refurbish control system and incorporate enhancement

- (1) Increasing effort to maintain high levels availability
- (2) Costs and risk of refurbishment project

Our Forecast Operational Priorities 17/18 (3rd May 2017)

- Cables
 - Two campaign submarine cable repair
 - First end-to-end survey of all four cables now due in 2018
- Converter stations
 - Integration of new cable system into control system
 - Control system replacement & obsolescence planning
- Changing commercial use of Moyle
 - Directions of flow – we now have two system operators keen to know that we are reliable
 - Value of ancillary services
 - Interconnected system – Moyle reacts to IFA incident
 - New SEM trading arrangements i-SEM due 2018
 - Maximising what headroom on SPT system will be made available through the capacity calculation
- General
 - New staff

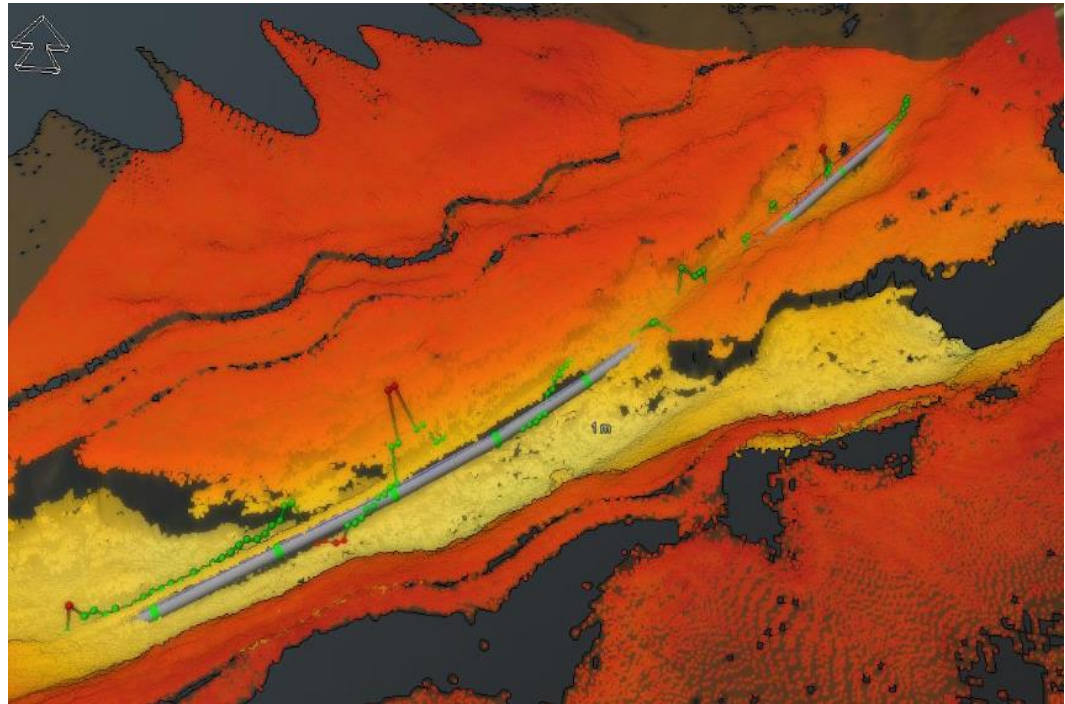
What actually did 17/18

- Cables
 - Timely completion of cable repair at minimal impact on CAIRt



What we actually did 17/18

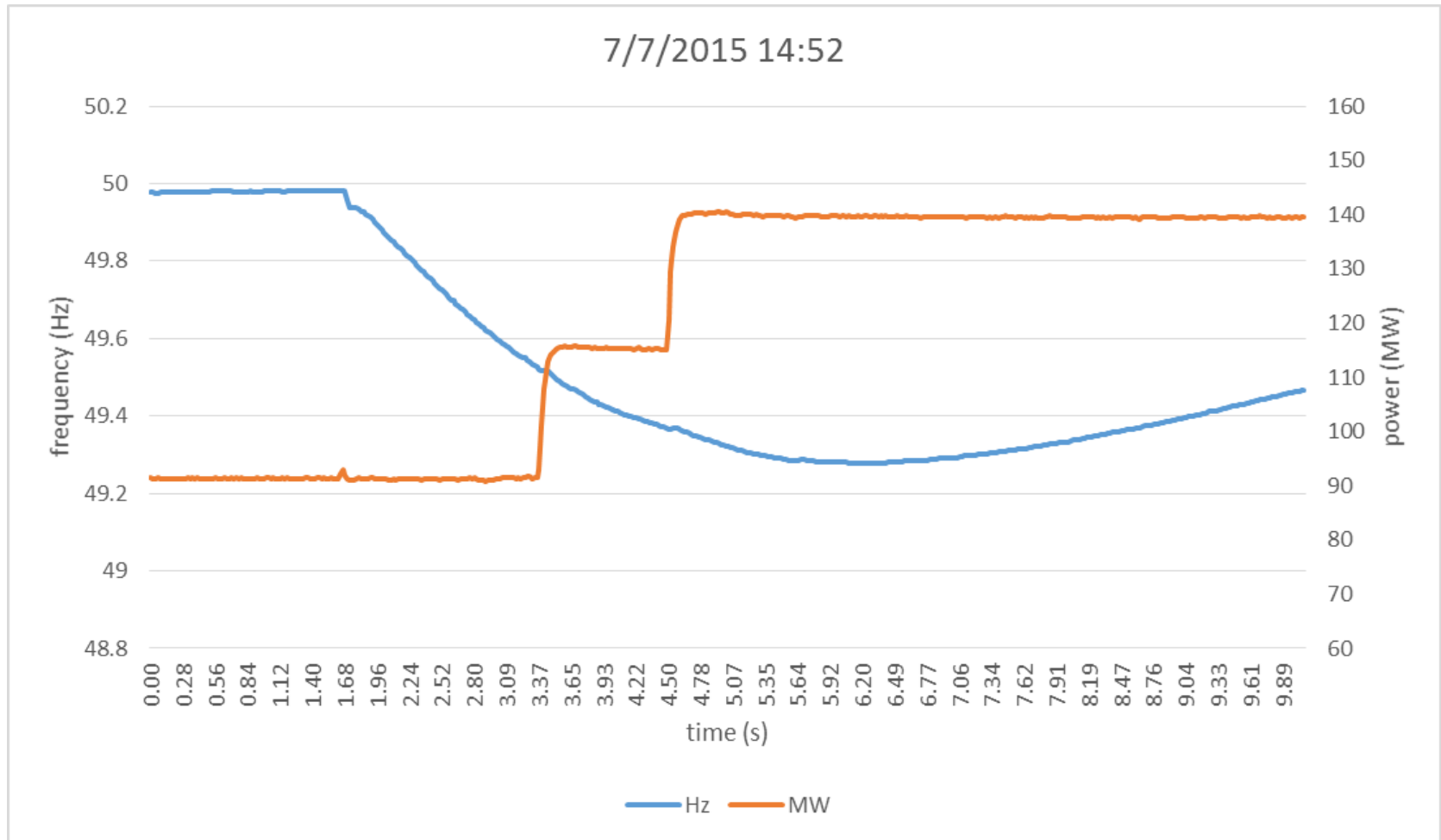
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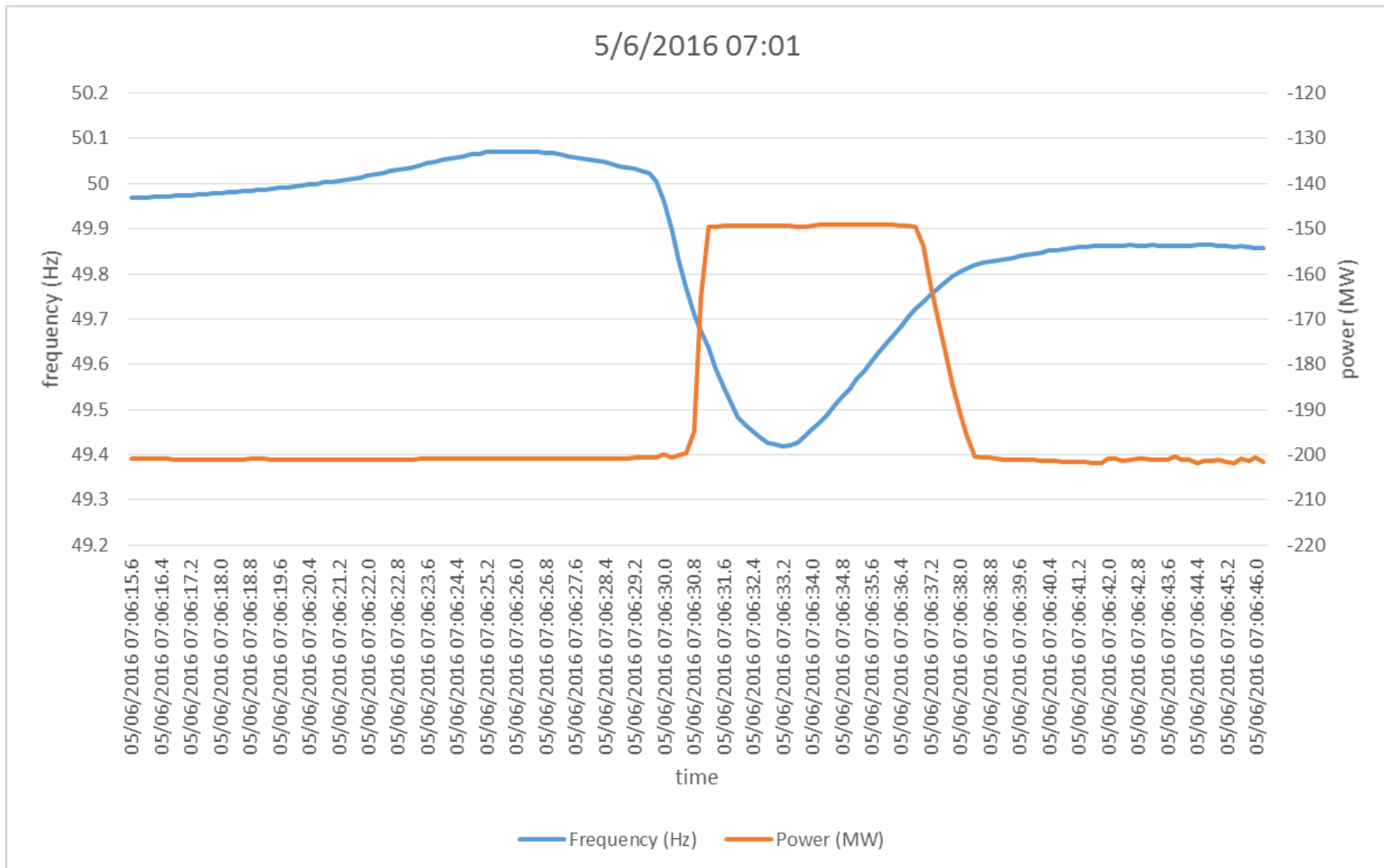
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 - Demonstrating compliance to NGT notably control system behaviour against reducing fault levels in Scotland
 - DS3 & i-SEM : Availability & Reliability

System Service - Static



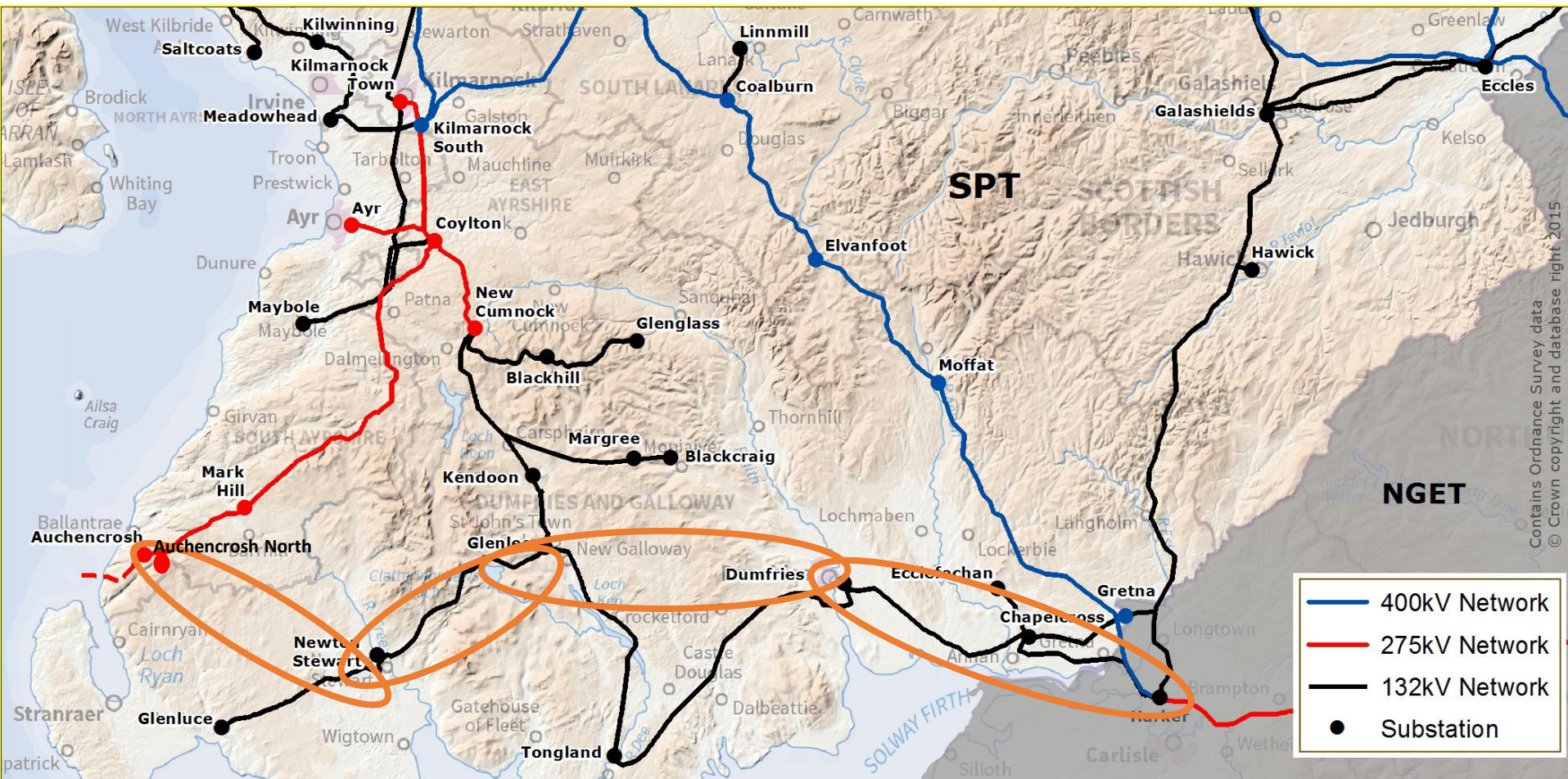
System Service - Dynamic



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 - Maximising TEC – NGT calculation to release headroom when available

Maximising TEC Scotland



A Northern Ireland company working for consumers

Increased levels of TEC against contracted position, plus the ability to flow above this where conditions allow

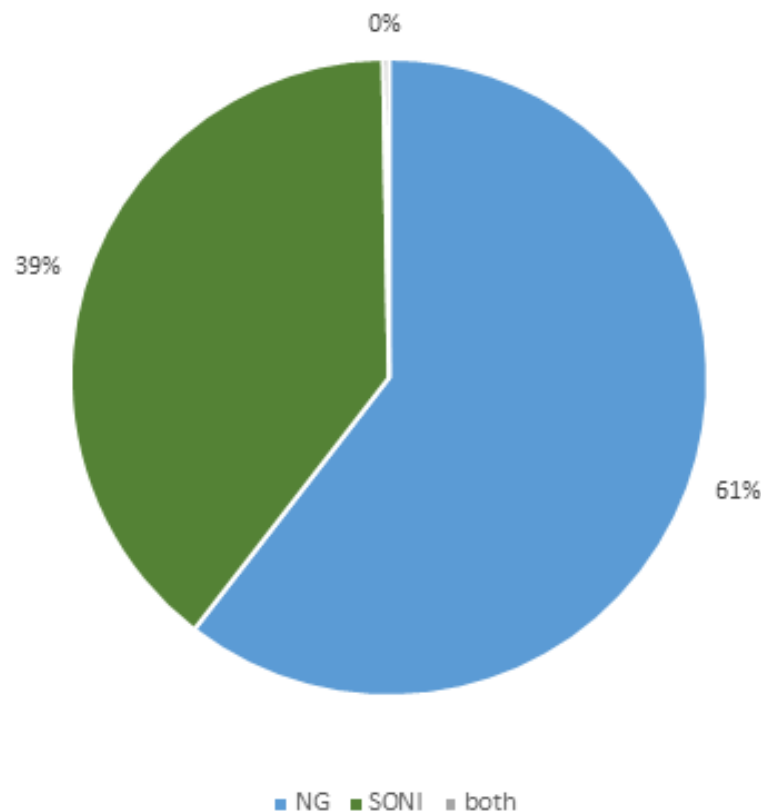
Version C2.1.0.1.M

nationalgrid

Dates	Contracted	TEC	CACM	Solution
Up to 2017	~295	~295	~295	~295
Nov 2017	80	80	80	500 (80)
Dec 2019	80	307	500 (307)	500 (307)
Jun 2020	80	250	500 (250)	500 (250)
Nov 2021	80	160	500 (160)	500 (160)
Apri 2022	80	500	500 (500)	500 (500)
Beyond 2022	80	500	500 (500)	500 (500)

Maximising TEC Northern Ireland

Since 17 December 2017, Moyle capacity west to east has been constrained by:



What we actually did 17/18

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- Control System Refurbishment Project



What actually ended up keeping us busy 17/18

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 - Engaged OEM in a FEED Study Q4 2018

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- Control System Refurbishment Project
 - Procured client side technical advisers Q1 2018
 - Engaged OEM in a FEED Study Q4 2018
- New members operational team & building the wider project team

Availability Results



1. Pole 1 back after cable fault
2. Pole 2 trip UPS issue **4hr9m**
3. Pole 2 trip in preparation for scheduled outage **19min**
4. Pole 2 replace thyristor **2hr45m**
5. Pole 1 planned repair control system fault **4hr56m**
6. Pole 2 trip faulty sensor **24min**
7. Pole 2 trip faulty sensor **11hr27m**
8. Pole 2 operator issue **2hr 57m**
9. Pole 2 planned **48hr** annual outage
10. Pole 2 trip UPS issue **1hr27m**
11. Pole 1 trip activation of fire protection system **5h32m**

For
Sch
Total

99.5%

Operational Priorities 2018/19

- Cables
 - Potential marine campaign to rock dump elements of cable system with insufficient burial based upon risk analysis of the 2018 survey data
 - Utilisation of distributed temperature sensing for ongoing condition monitoring of cable system
- Converter stations
 - Strive to maintain high levels of availability & reliability
 - Planning to maximise what we can get done in 9 day outage required by SPT for works in Scotland 12th June -20th June 2019
- Control System Refurbishment Project
 - Continue with refurbishment front end engineering design and finalise specification, costs and programme for delivery
- ISO55001

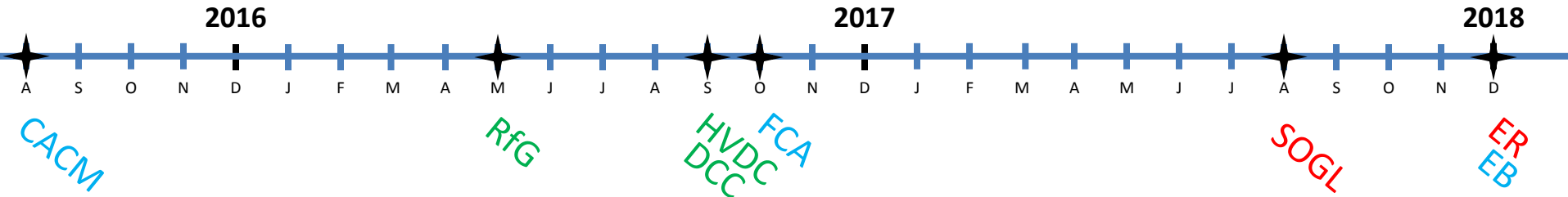
EWIC & Moyle Interconnectors Conference

European Codes Development

Mark Lane



All 8 Network Codes have entered into force



Requirements for Generators to connect to the grid



Demand Connection Code for connecting large RES as well as demand response facilities



HVDC requirements for long distance direct current (DC) connections



System Operations specifies what TSOs should do to manage and coordinate their grids



Emergency & Restoration processes that TSOs must follow when they face an incident on the grid



Capacity Allocation & Congestion Management for calculation & allocation in day-ahead/ intraday

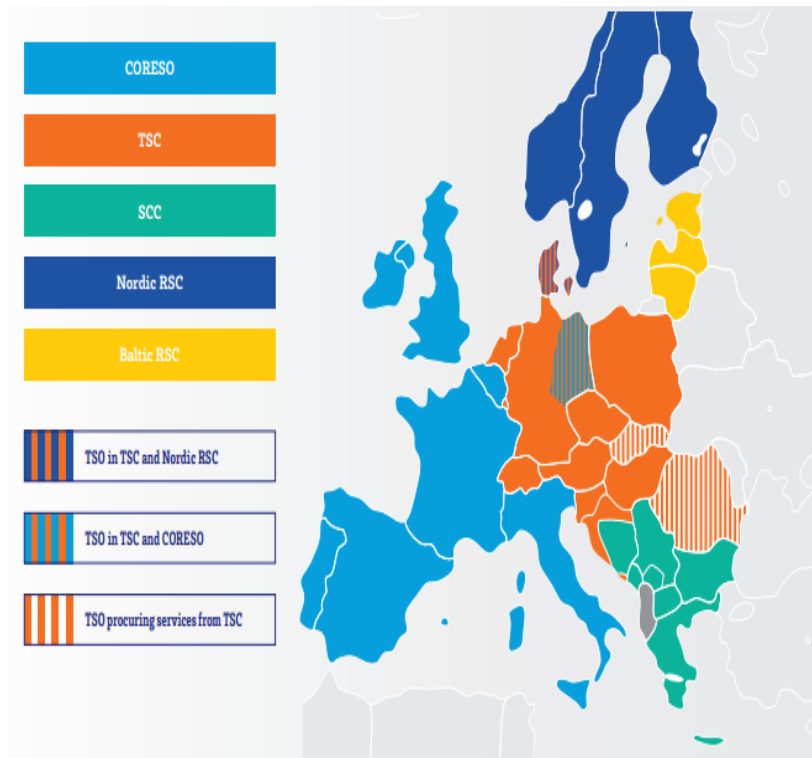


Forward Capacity Allocation for calculation & allocation before day-ahead for hedging purposes



Electricity Balancing creating new platforms for sharing capacity for balancing purposes

Capacity Calculation



- CACM CCM approved & FCA CCM consultation starting in Dec '18
- Capacity is by default Maximum Permanent Thermal Capacity of the HVDCs (except during planned outage on CNE)
- Takes top down approach. Other regions apply bottom up approach
- CEP advocating 75% target, EWIC and Moyle already surpass this

Forward Market



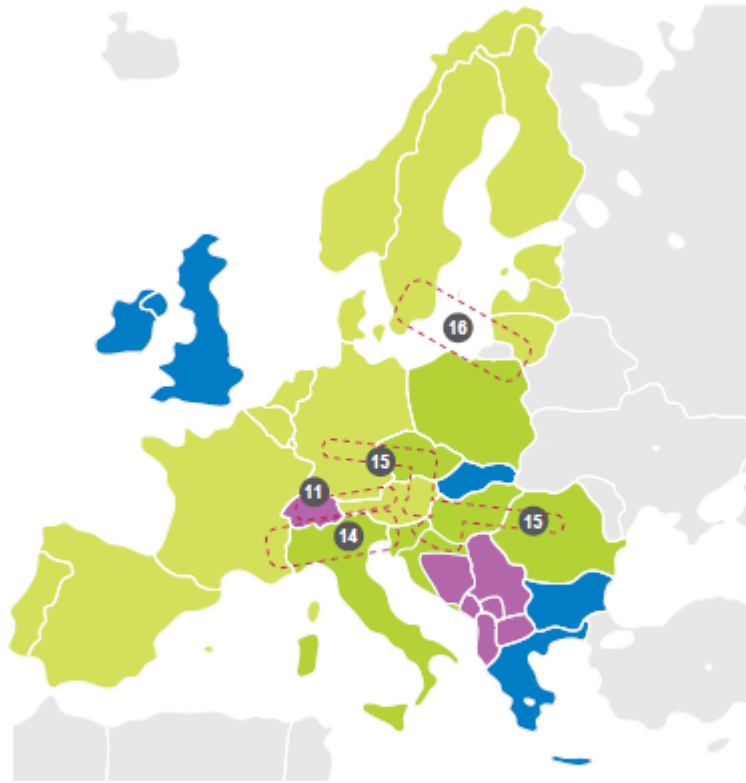
- Single Allocation Platform operational from Oct 2018. EWIC and Moyle already joined even though HVDC not required to do so until end 2019
- Harmonised Allocation Rules review every two years so next review expected before end 2019
- Ireland-UK Long Term Capacity Calculation and Splitting Methodologies for consultation in Dec 2018

Day- ahead Market



- I-SEM introduced market coupling on 1 Oct 2018, joining the SDAC
- Work in progress to finalise the DAOA
- Group established to work on single enduring Day-ahead and Intraday governance solution
- I-SEM go-live had little effect on PCR performance but issues looming
- PCR Multiple NEMO Arrangements expected end 2018

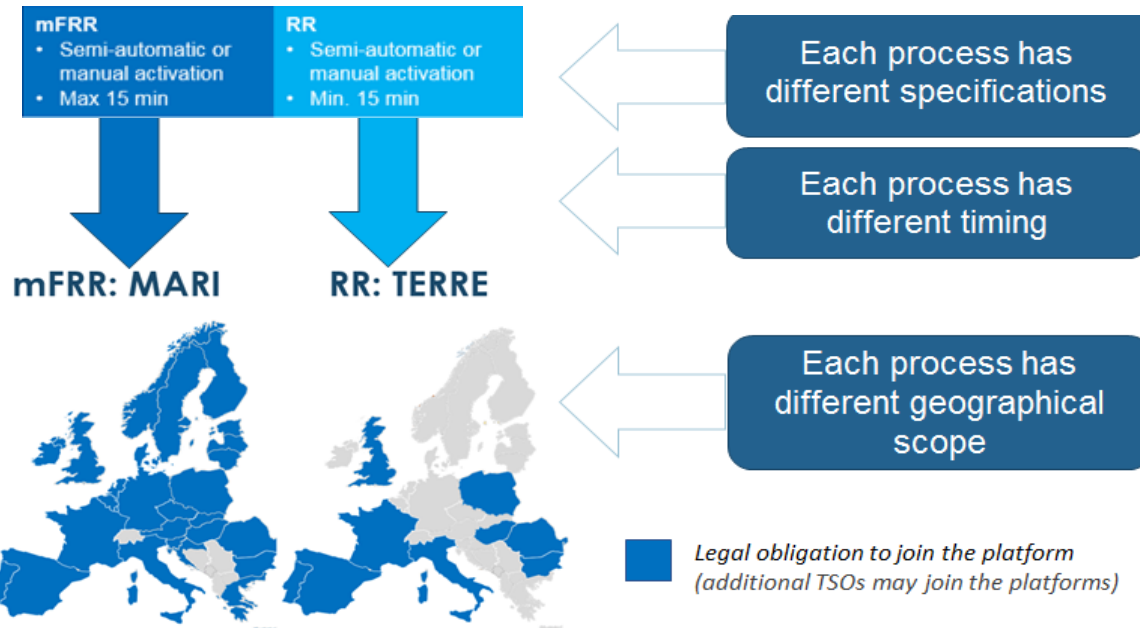
Intraday Market



- XBID went live on 12/13 June 2018
- I-SEM interim Intraday Auctions went live on 1 Oct 2018
- ACER decision on 24 Apr 2018 calls for harmonised Intraday GOT at 15.00 CET & GCT of 60 mins
- EC study on future Intraday market design due in Dec 2018
- ACER decision on Intraday Capacity Pricing in Jan 2019

Balancing Market

																				Key		Proposal		Deadline		Derogation			
Obligations		2017				2018				2019				2020				2021				2022				2023			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
RR TERRE					RR IF EIF+6m					RR EU Platform EIF+2yrs					TSO Join Derogation +2yrs														
mFRR MARI								mFRR IF EIF+1yr								mFRR EU Platform EIF+4yrs										TSO Join Derogation +2yrs			



Clean Energy Package

- 4th trilogue: 13 November
- 5th trilogue: 5 December
- Austrian Presidency's objective is still to have political agreement for 19 December 2018 European Council
- Some issues being discussed include:
 - Definition of interconnector
 - Cross Border reservation of capacity for balancing
 - Intraday GCT – 60-15 mins,
 - Imbalance Settlement Period to 15 mins
 - Use of congestion income
 - Capacity Mechanisms

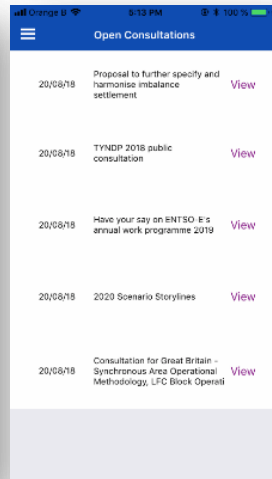


ENTSO-E Network Code APP

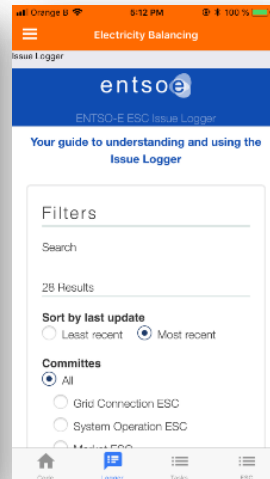
And all this information available in your pocket? **ENTSO-E App**



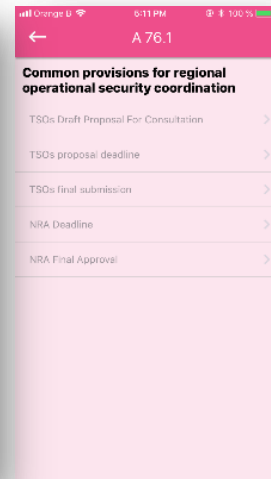
Consultations



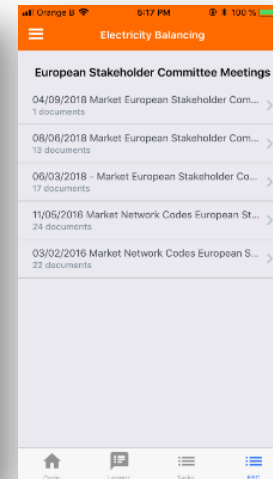
Events



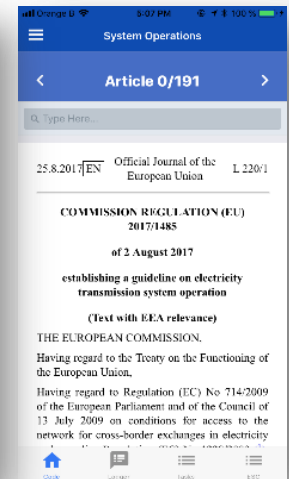
Network codes



Status of deliverables



Issue log



Action tracker

The app can be downloaded from the [App Store](#) and from [Google Play](#).



Available for iOS and Android...

I-SEM Overview

Mark Needham

I-SEM



I-SEM Market Timeframes



Forwards

- Forwards Market (From years in advance up to 12:00 CET day-ahead)



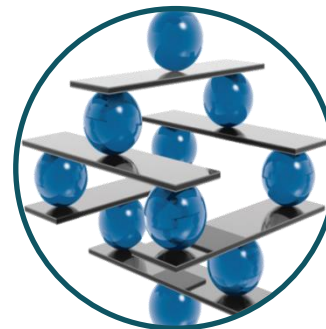
Day Ahead

- Gate Closure At 12:00 Noon CET day-ahead for trading day from midnight 00:00 CET to following midnight 00:00 CET



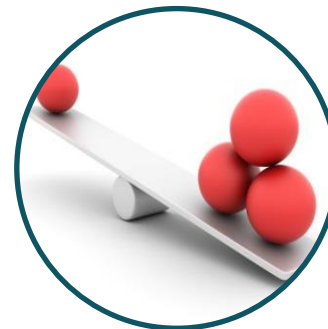
Intraday

- Continuous trading from day-ahead market clearance to 1hr before real-time



Balancing and Dispatch

- From 1hr before real-time to real-time



Imbalance

- Marginal price based on balancing or ex-post unconstrained market schedule



Ex-Ante Markets : 31 Days Our Highlights

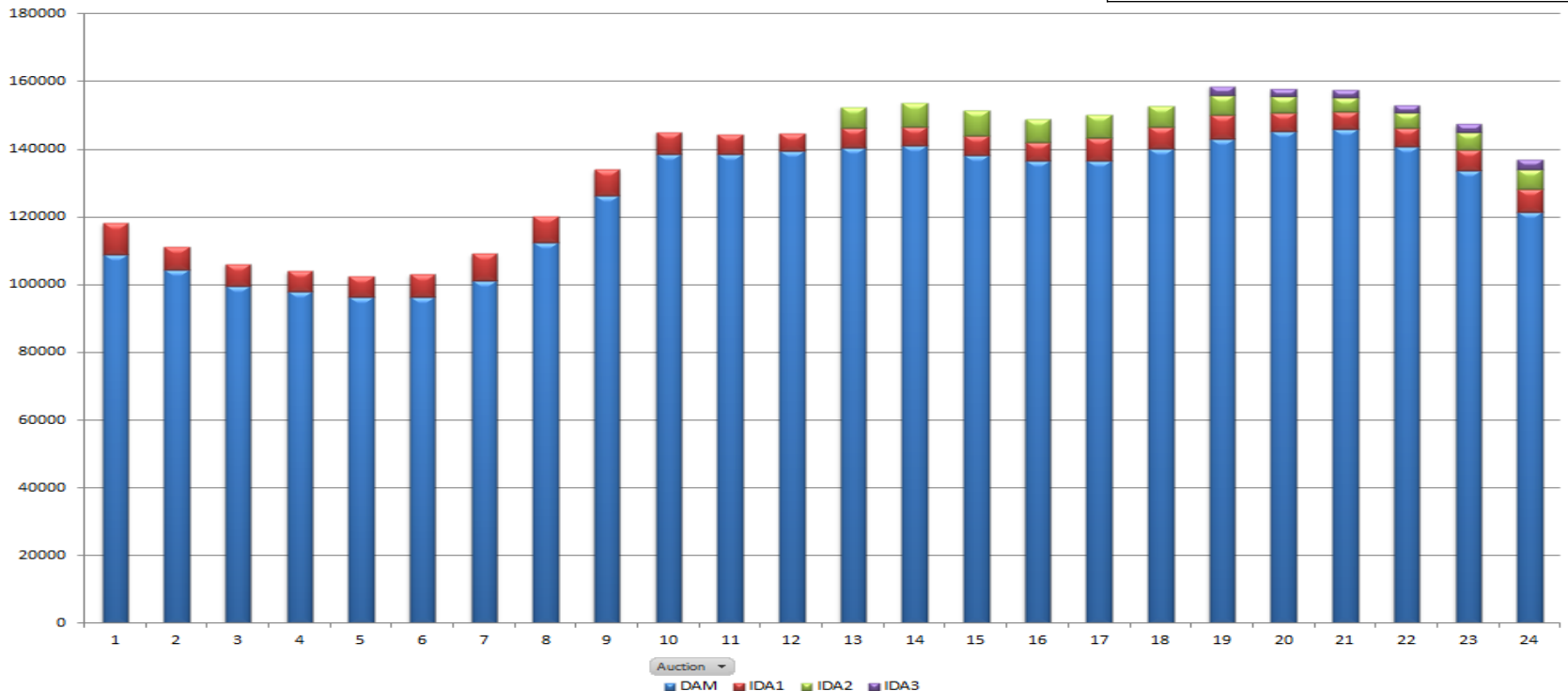
- Market **STABLE** and performing
- Approx. **€ ¼ BILLION** Cleared through our EX-ANTE MARKETS
- Just over **3TWh** of Energy traded in October
- Our DAM auction is clearing **98%** of Suppliers' demand requirements
- With Average price of **€72.44** (GB neighbour avg price **€72.57**)
- As expected we are highly correlated with our Euphemia partners!
- Interconnectors are efficient
 - Importing when demand is high and exporting off the Island when excess energy available

Ex-Ante Markets

- Volumes from ex-ante auctions (1st Oct – 31st Oct)
 - DAM still dominant

*Using approx. prices

Market	Value	% of DAM
DAM	€228,120,058	
IDA1	€10,715,591	4.70%
IDA2	€5,377,678	2.36%
IDA3	€1,273,174	0.56%
IDC	€1,243,887	0.55%



I-SEM Market Timeframes



Forwards

- Forwards Market (From years in advance up to 12:00 CET day-ahead)



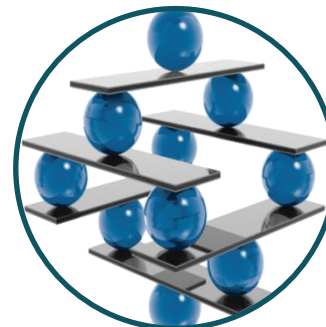
Day Ahead

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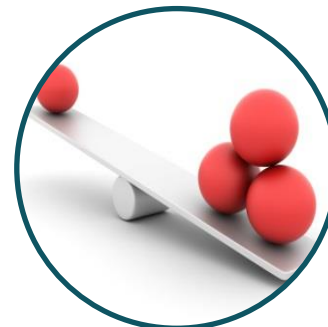
Intraday

- Continuous trading from day-ahead market clearance to 1hr before real-time



Balancing and Dispatch

- From 1hr before real-time to real-time



Imbalance

- Marginal price based on balancing or ex-post unconstrained market schedule



Balancing Market: 31 Days Our Highlights

- Market **performing and participation** is as planned
- **5 minute** and **30 minutes prices** being calculated as



Today's Operational Indicators



Pricing



Settlement



Invoicing



Funds Transfer



CRM

- Working on **repricing**
- **Resettlement**



Questions

Thank you for listening....Any questions?



Celtic Interconnector

Connecting Ireland to Continental Europe

EWIC Conference Presentation 21/11/2018

Gary Nolan, Celtic Project Manager



Co-financed by the European Union
Connecting Europe Facility

Introduction

- EirGrid TSO Licence - “explore and develop opportunities to interconnect the transmission system with other systems”.
- Delivered East West Interconnector 2012.
- Celtic Interconnector – new direct energy link between Ireland and continental Europe.

Key Facts



575km



2



700 MW



EU PCI

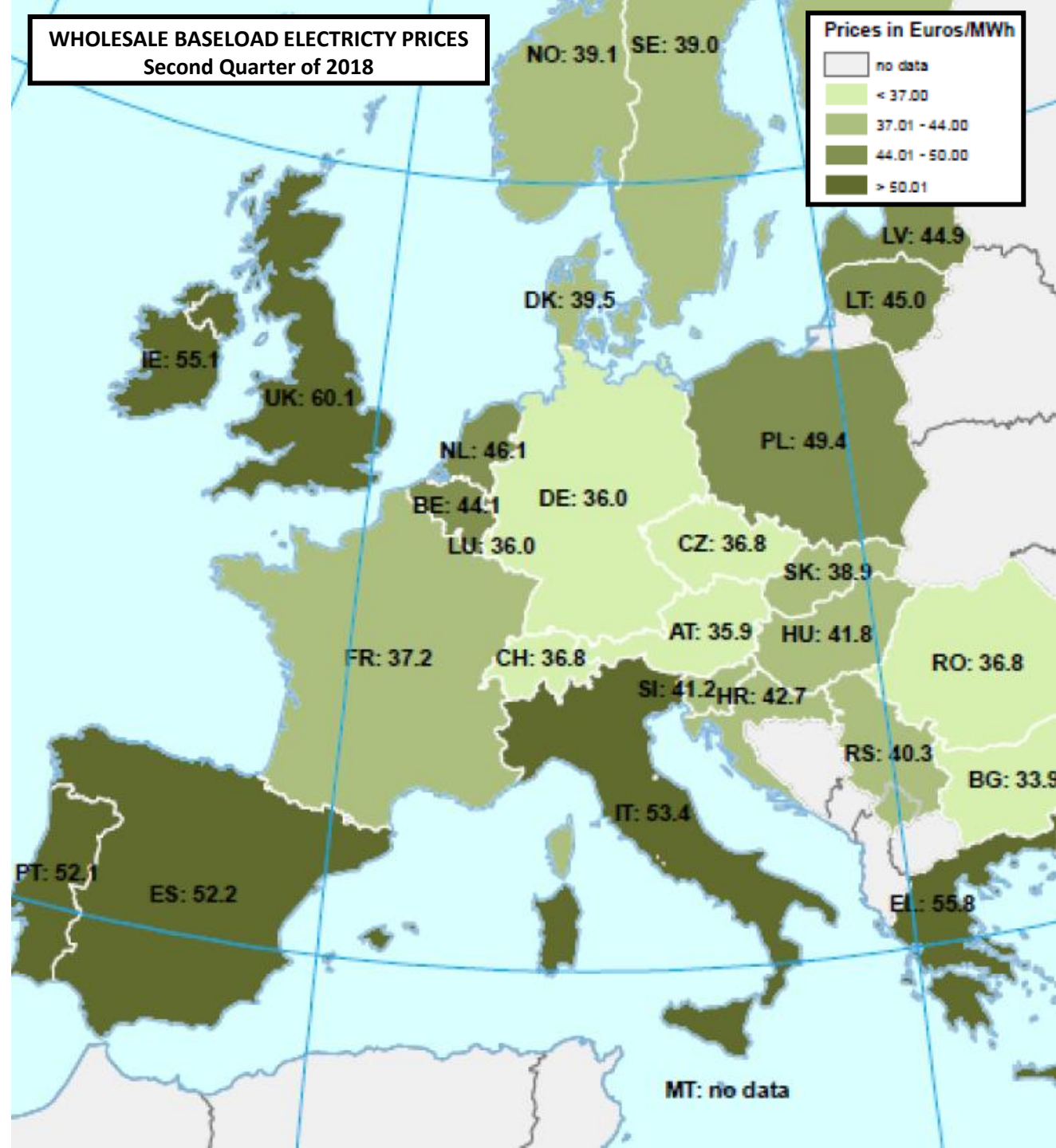
212km

5

100 MW

**EIRGRID
GROUP**

Competition



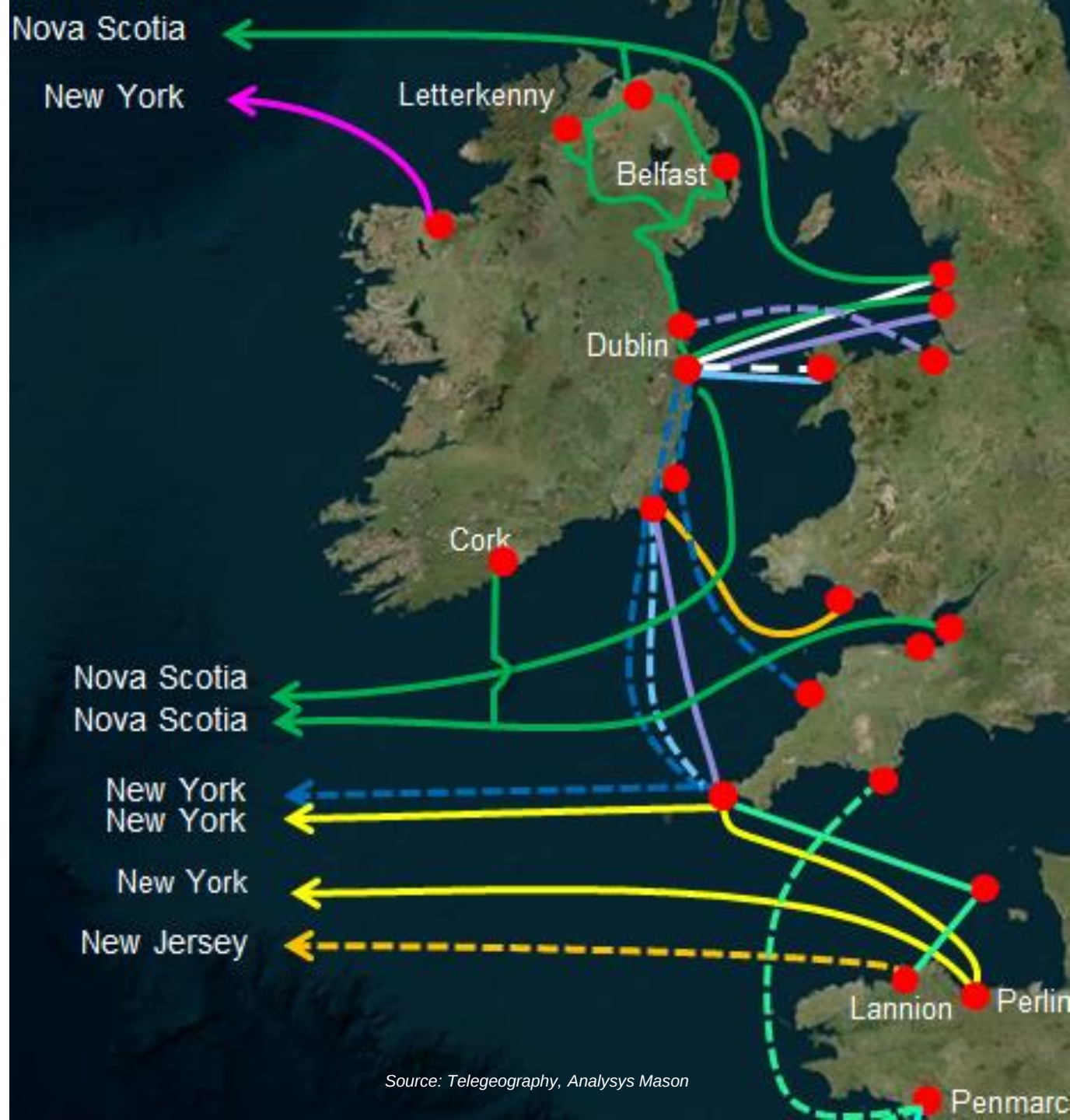
Security of Supply



Sustainable Energy



Telecoms



Strategic Imperative

- Allows Ireland directly contribute to, and be part of, EU's Energy Union.
- Reduces Ireland's electrical isolation (below EC's targets and thresholds for Interconnection).
 - Average yearly price difference > €2/MWh.
 - Interconnection capacity is < 30% of peak load.
 - Interconnection capacity is < 30% of installed renewable generation.



Green: meet all three thresholds

Yellow: meet two of the thresholds

Red: meet one or none of the thresholds

Project Roadmap

Phase Description	Feasibility	Initial Design & Pre-Consultation	Detailed Design & Consents	Construction
Timetable	2014 - 2016	2016 - 2019	2019 – 2021	2021 – 2025/26
EirGrid / RTE Project Work Streams	Marine survey Project Parameters Economic & Financial Analysis	Initial Design Pre-Consultation Investment Request Grant Application	Detailed Design EPC Procurement Consenting	Contract Award Manufacturing Energisation
Key Milestones			• <i>Early 2020 – Launch EPC Tender</i> • <i>Mid 2020 – Submit Consents Applications</i> • <i>End 2021 – Final Investment Decision</i>	• <i>2026 – Go Live</i>

Investment Request

Following TEN-E Regulation:

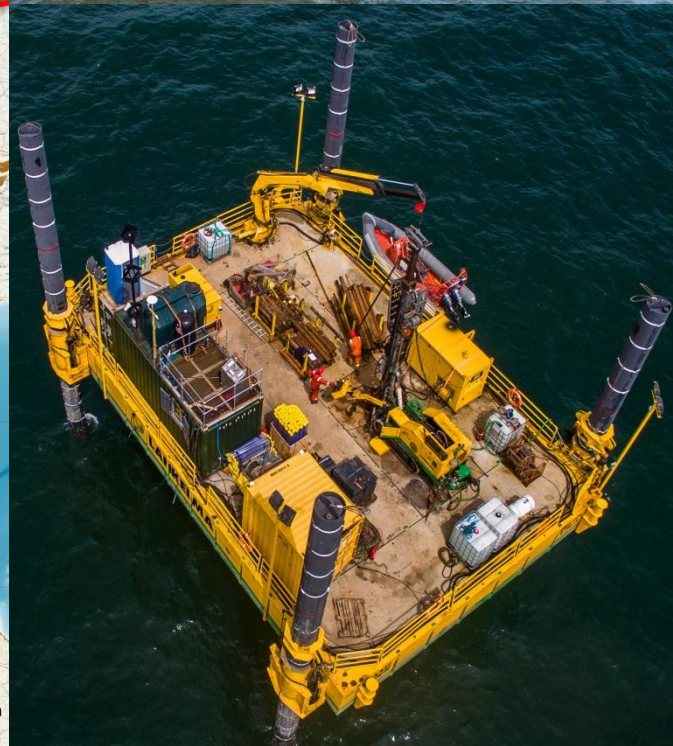
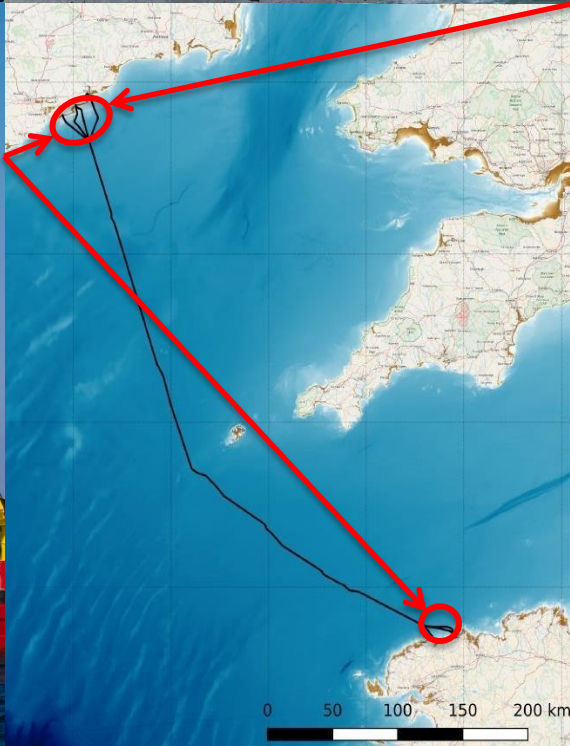
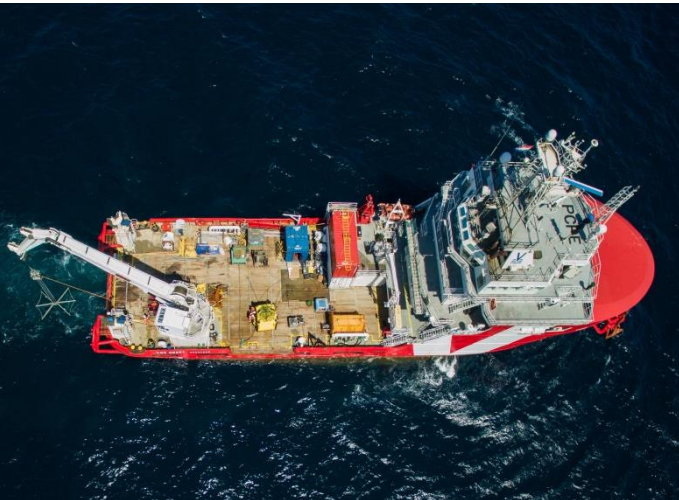
- Investment Request submitted to the Irish and French National Regulatory Authorities (NRAs) in September.
- NRAs have 6 months to decide under regulation (decision Mar/Apr 2019).
- Grant application to be made under EU Connecting Europe Facility (expected April 2019 subject to EC timing).

Funding

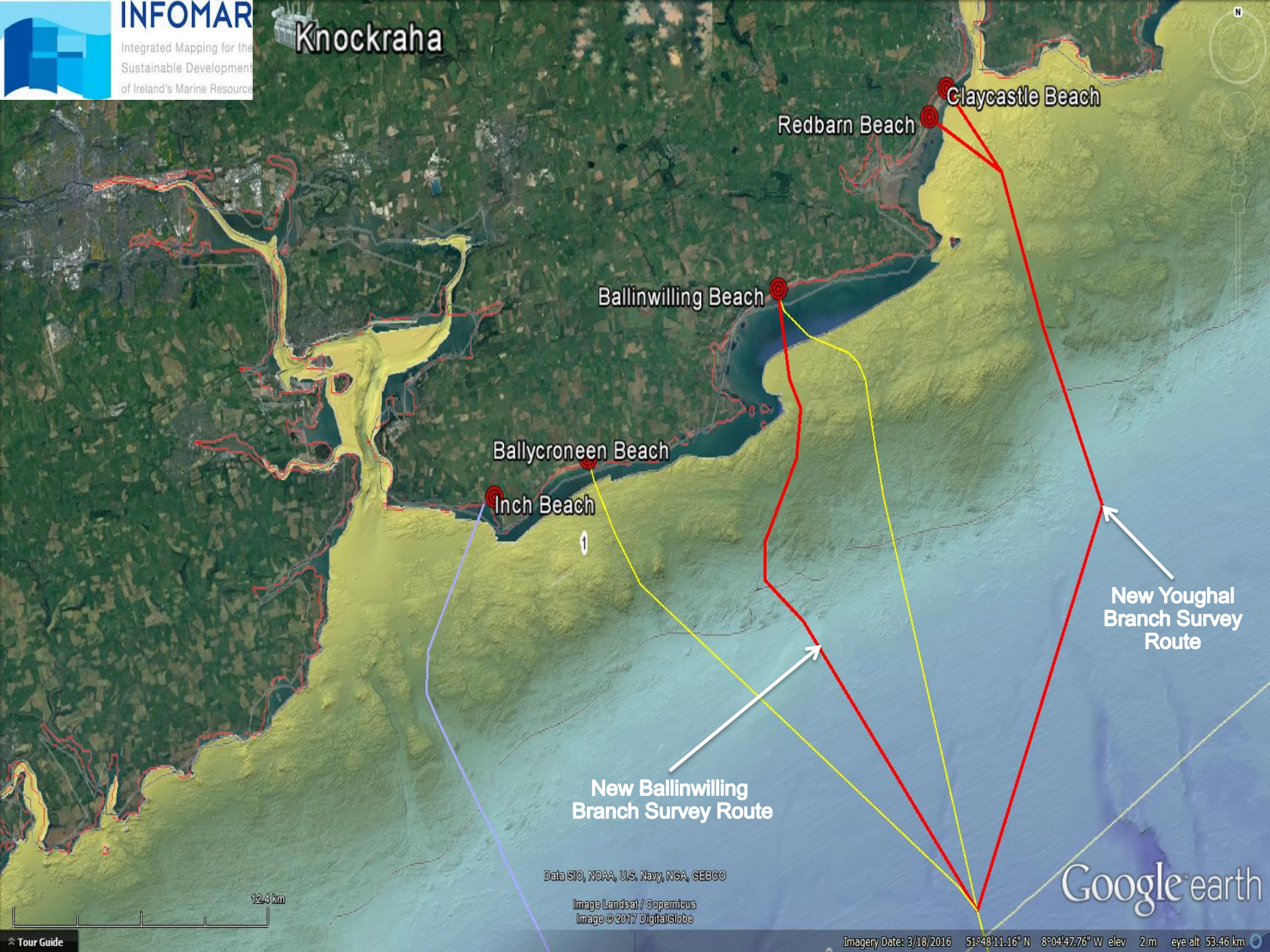
- Estimated cost €930m (-12% / +15%)
- Cost split between EirGrid and RTE.
 - Proposal made to both National Regulatory Authorities (CRU & CRÉ).
- Connecting Europe Facility:
 - EU funding instrument for targeted infrastructure investment.
 - Celtic has received grant of €3.6m and allocated further €4m to date.
 - Budget of €4.7bn for grants for energy projects up to 2020.



Project Development – 2017/18 Surveys



Knockraha



Claycastle Beach

Redbarn Beach

Ballinwilling Beach

Ballycroneen Beach

Inch Beach

New Youghal
Branch Survey
Route

New Ballinwilling
Branch Survey Route

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat / Copernicus
Image © 2017 DigitalGlobe

Google earth

Imagery Date: 3/18/2016 51°48'11.16" N 8°04'47.76" W elev 2m eye alt 53.46 km

Project Development



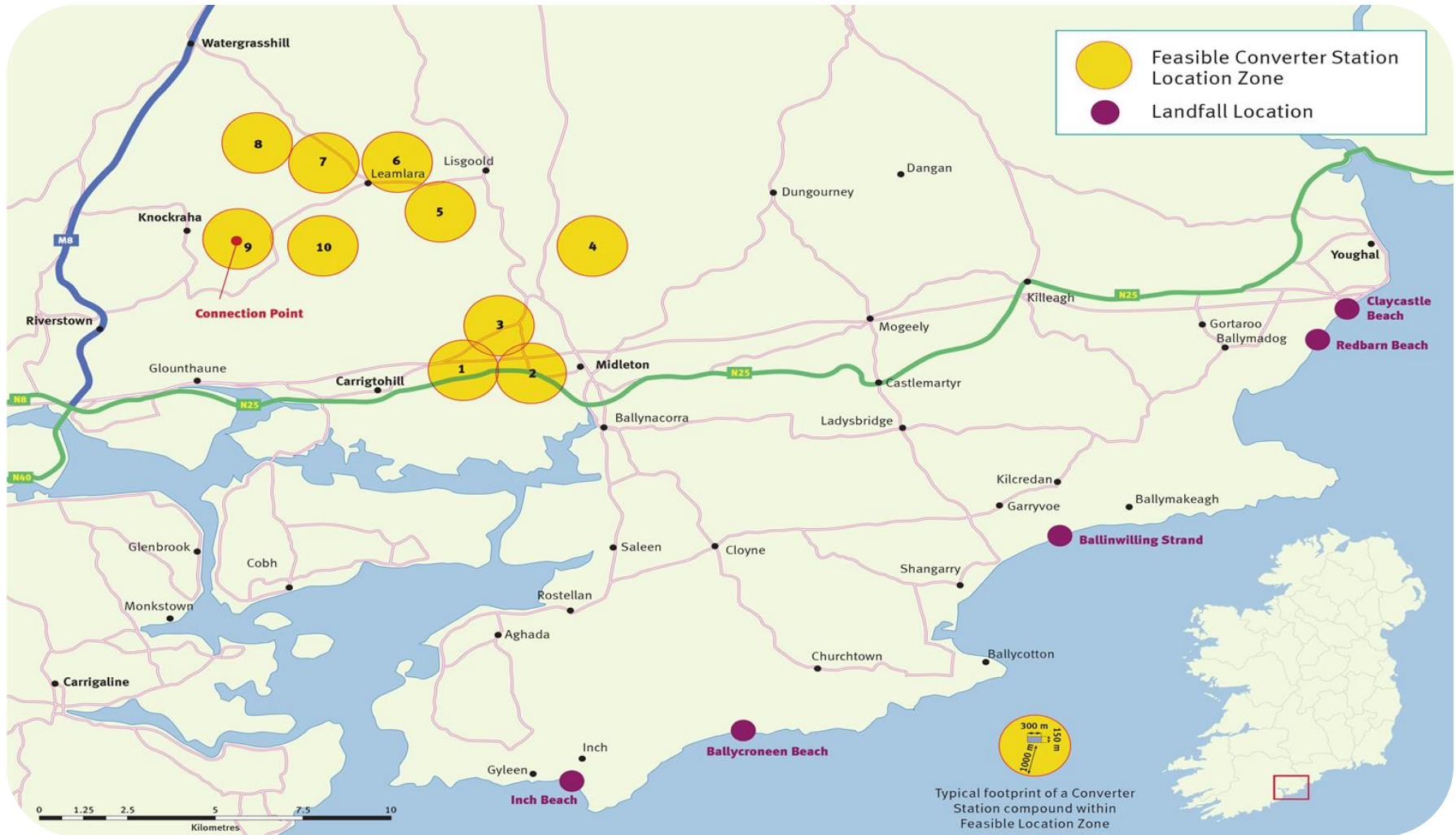
- Confirmed East Cork as best performing connection point in February 2018.
- Current objectives:
 - Identification of a shortlist of converter station location zones.
 - Identification of best performing landfall options (narrow down current shortlist).



Message of support for Celtic Interconnector from Simon Coveney.
An Tánaiste and Minister for Foreign Affairs Simon Coveney delivers a message of support for the Celtic Interconnector at EirGrid's announcement regarding a preferred landing point on Monday 05 Feb 18



East Cork



Summary



Benefits

- European energy market integration
- Facilitates low carbon future
- Improved security of supply
- Direct telecoms link to EU



Key Approval Steps

- Investment Request
- Grant Application



Project Development

- Project progressing on all fronts
- Consultation and engagement ongoing

EAST WEST INTERCONNECTOR
AND
MOYLE INTERCONNECTOR
5TH ANNUAL CONFERENCE

Q&A



The current. The future.

