Grid issues in connecting offshore wind

Offshore wind: Exploring the supply chain opportunities

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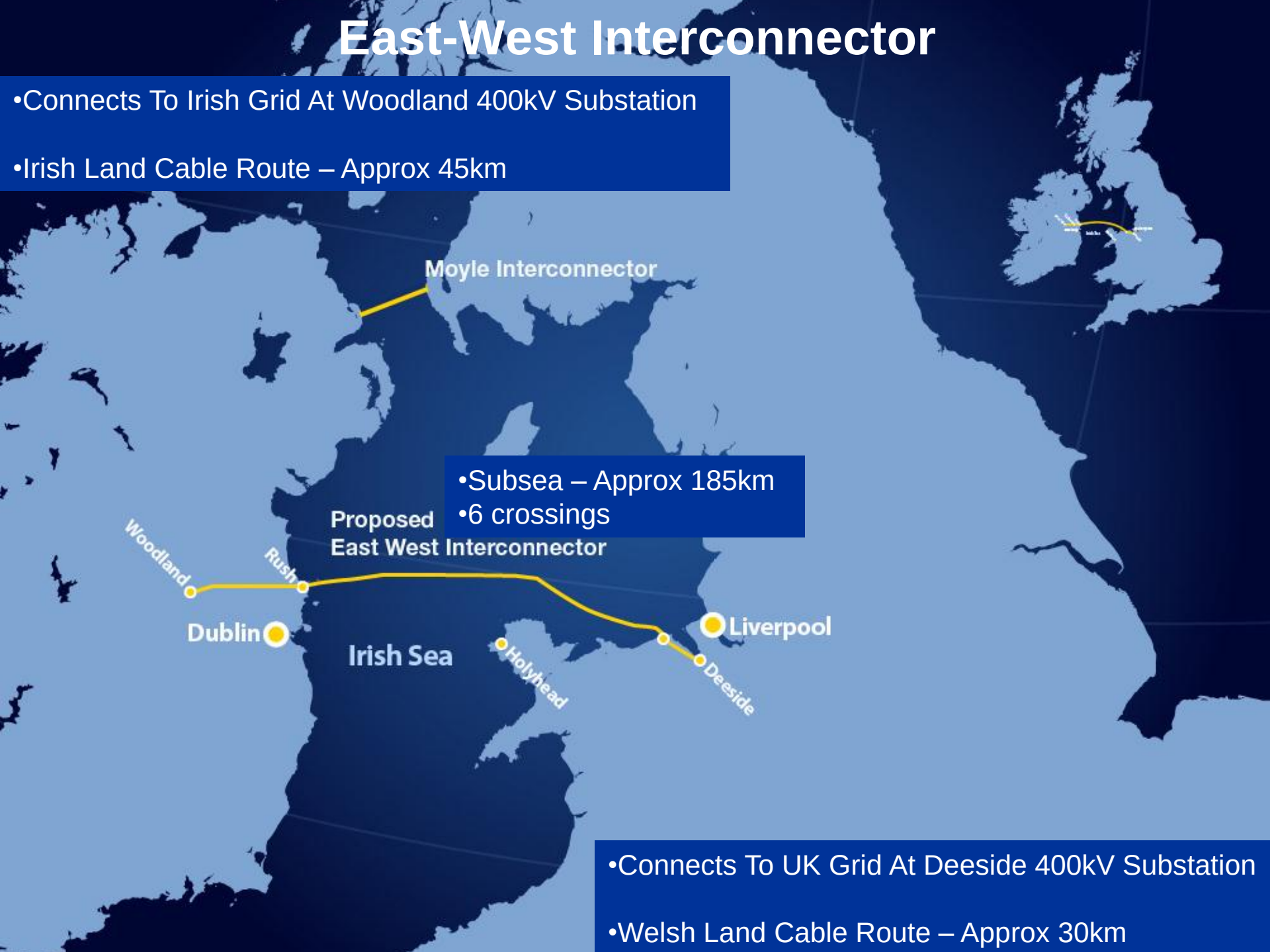
Overview of Presentation

- Update on East-West Interconnector
- Investigation of further interconnection
- Offshore grid modelling
- Technology and standards

East-West Interconnector

- Connects To Irish Grid At Woodland 400kV Substation
- Irish Land Cable Route – Approx 45km



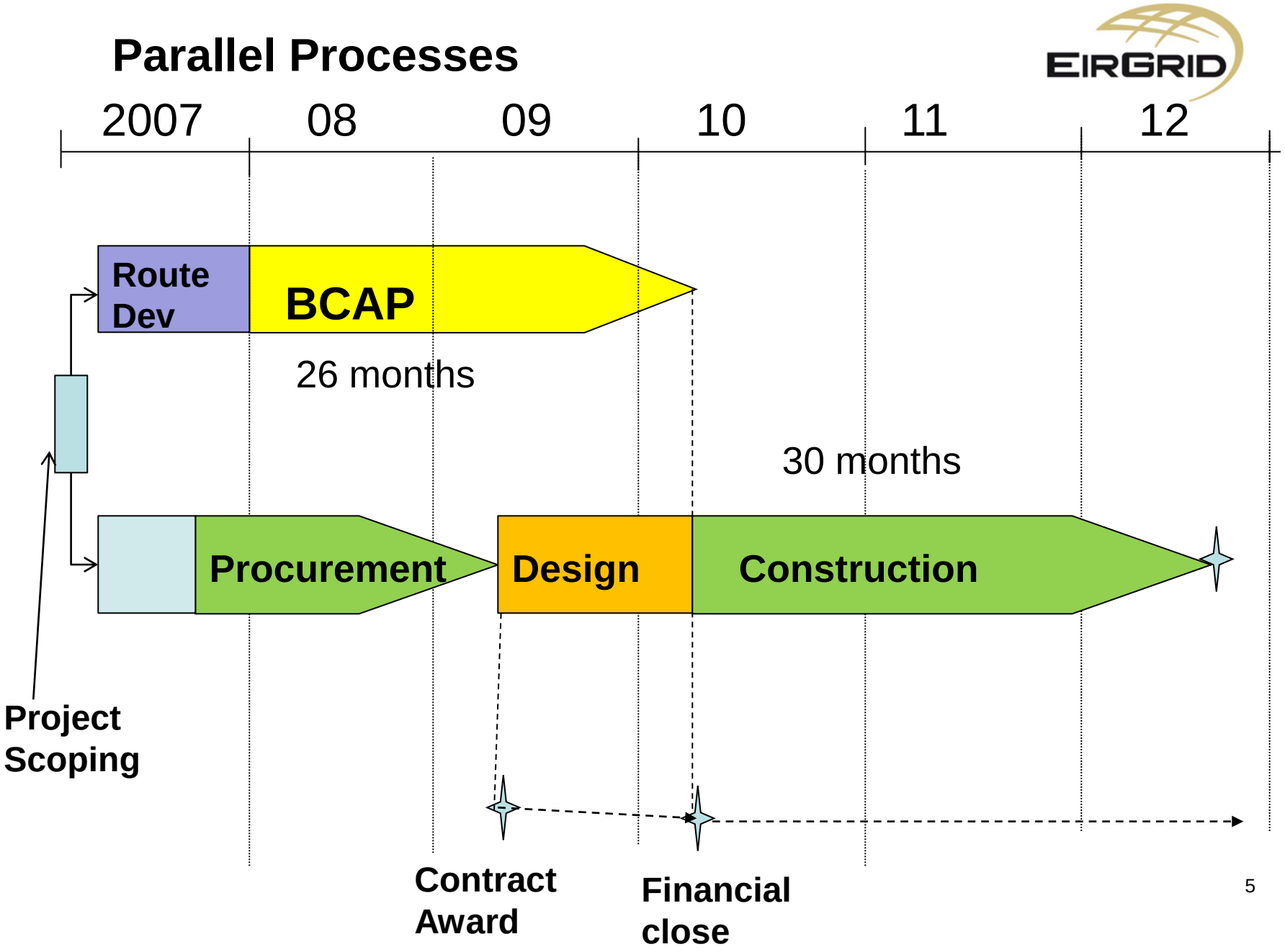
- Subsea – Approx 185km
- 6 crossings

- Connects To UK Grid At Deeside 400kV Substation
- Welsh Land Cable Route – Approx 30km

East-West Interconnector

- 500MW of HVDC interconnection between Ireland and Great Britain
  - Renewables, Market Integration, Competition, Security of Supply
- Under development since 2007, fully permitted 2009
- ABB awarded EPC turnkey contract in 2009 for completion in 2012
- €110m of €600m budget from EU (EEPR) Grant
- 600 people currently employed on the Project
- Co-ordinate extensively with National Grid, Utilities, and statutory bodies

East-West Interconnector timeline



Converter station - Woodland

Converter station - Woodland

44km DC – Duct **99%** Cable **61%** Grouting **7%** Joints **25%**

0.5km AC – Duct **0%** Cable **0%** Grouting **0%**

0.9km HDD – 100%

Cable Route Ireland

Nostag 10 - Barkby Beach

Lay and burial by Team Oman and Island Pioneer (pictured)

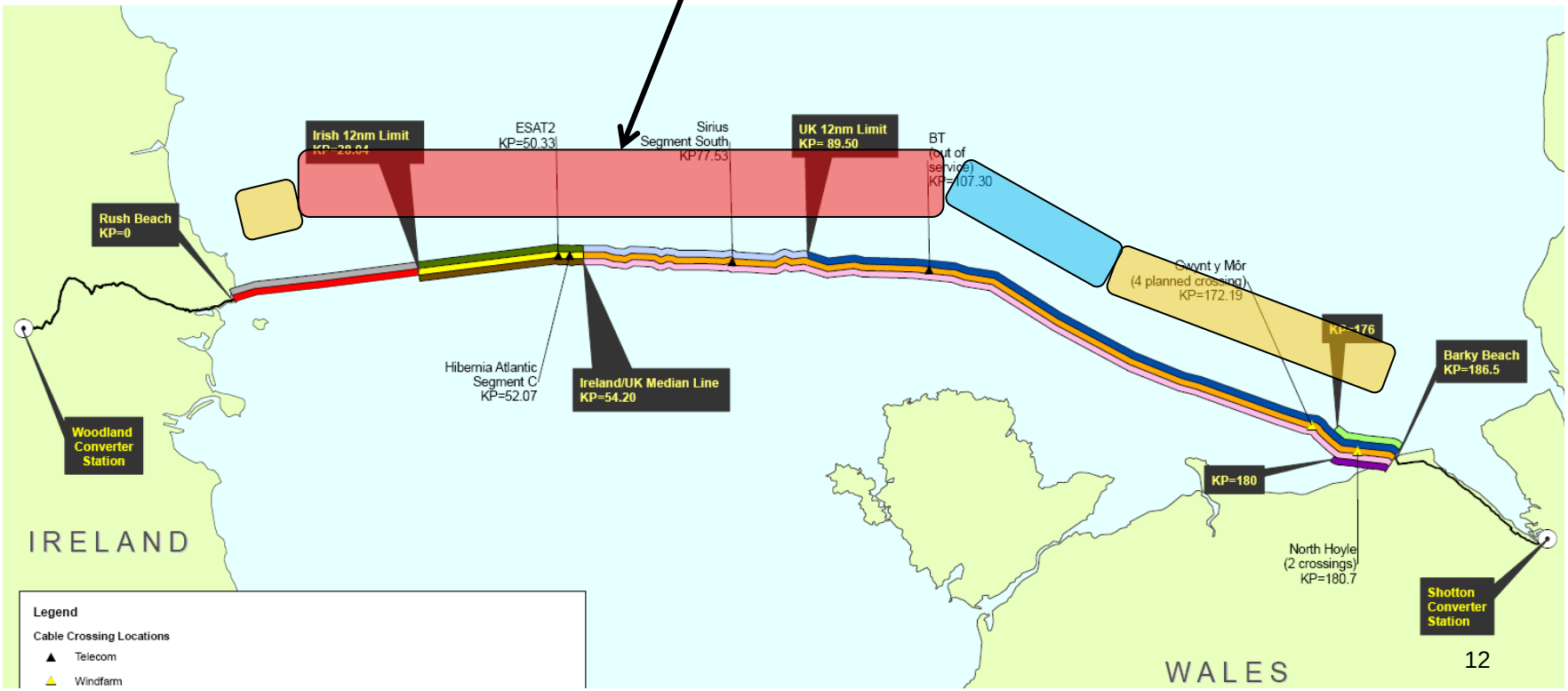
Irish 12nm Limit KP=28.04
ESAT2 KP=50.33
Sirius Segment South KP77.53
UK 12nm Limit KP= 89.50
Rush Beach KP=0
KP0
KP8
KP1 13
KP1 57
KP1 86
Gwynt y Môr (4 planned crossing) KP=172.19
KP=176
Barky Beach KP=186.5
Hibernia Atlantic Segment C KP=52.07
Ireland/UK Median Line KP=54.20
Woodland Converter Station
Boulder Fields
KP=180
North Hoyle (2 crossings) KP=180.7
Shotton Converter Station
IRELAND
WALES

Legend

Cable Crossing Locations

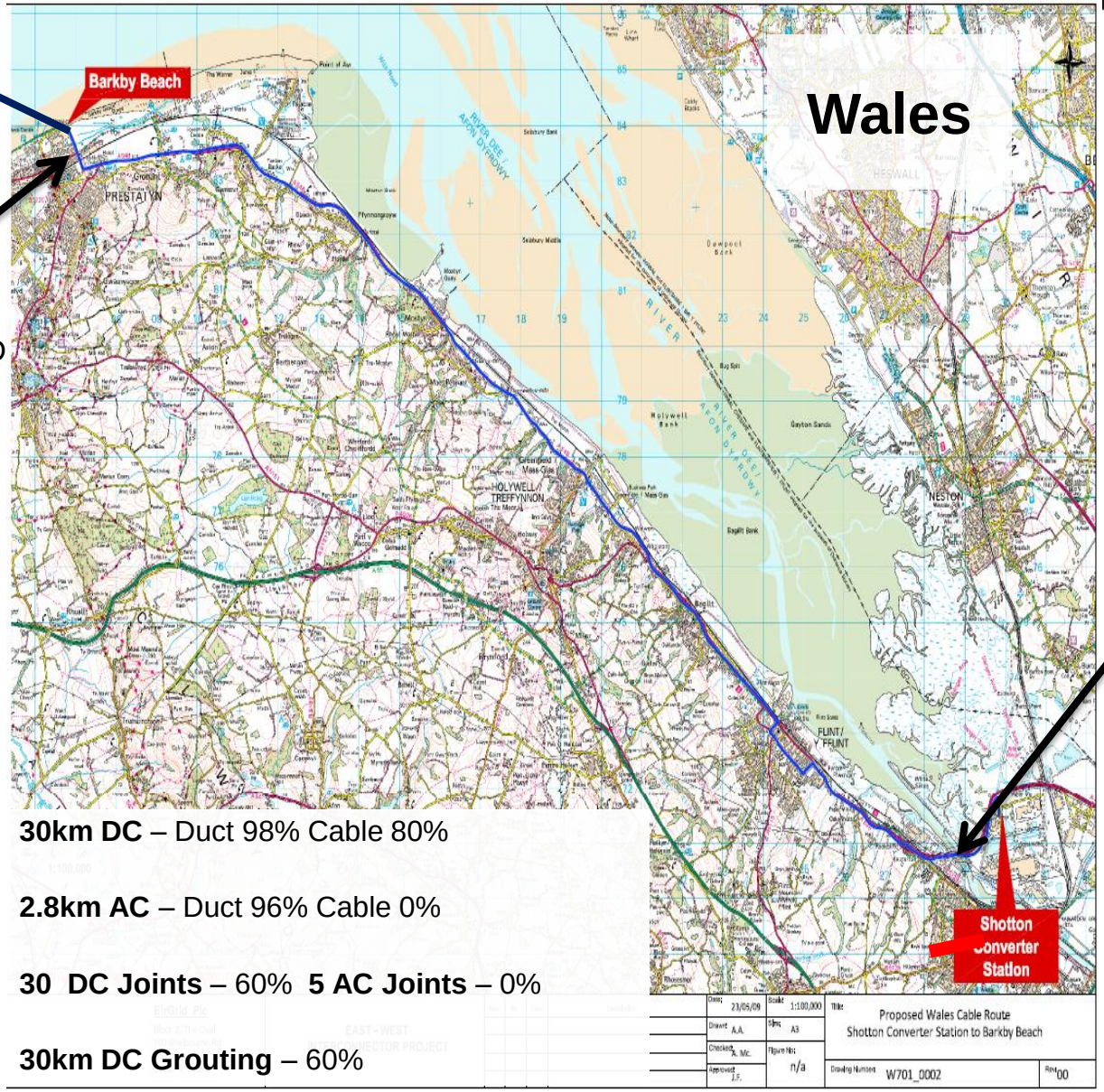
- Telecom
- Windfarm

2012 Installation Window
Lay & Burial by EMAS and Canyon
using Aker Connector & Island Pioneer



Nostag 10 works

Prestatyn Rail HDD Complete



River Dee HDD Duct complete

30km DC – Duct 98% Cable 80%

2.8km AC – Duct 96% Cable 0%

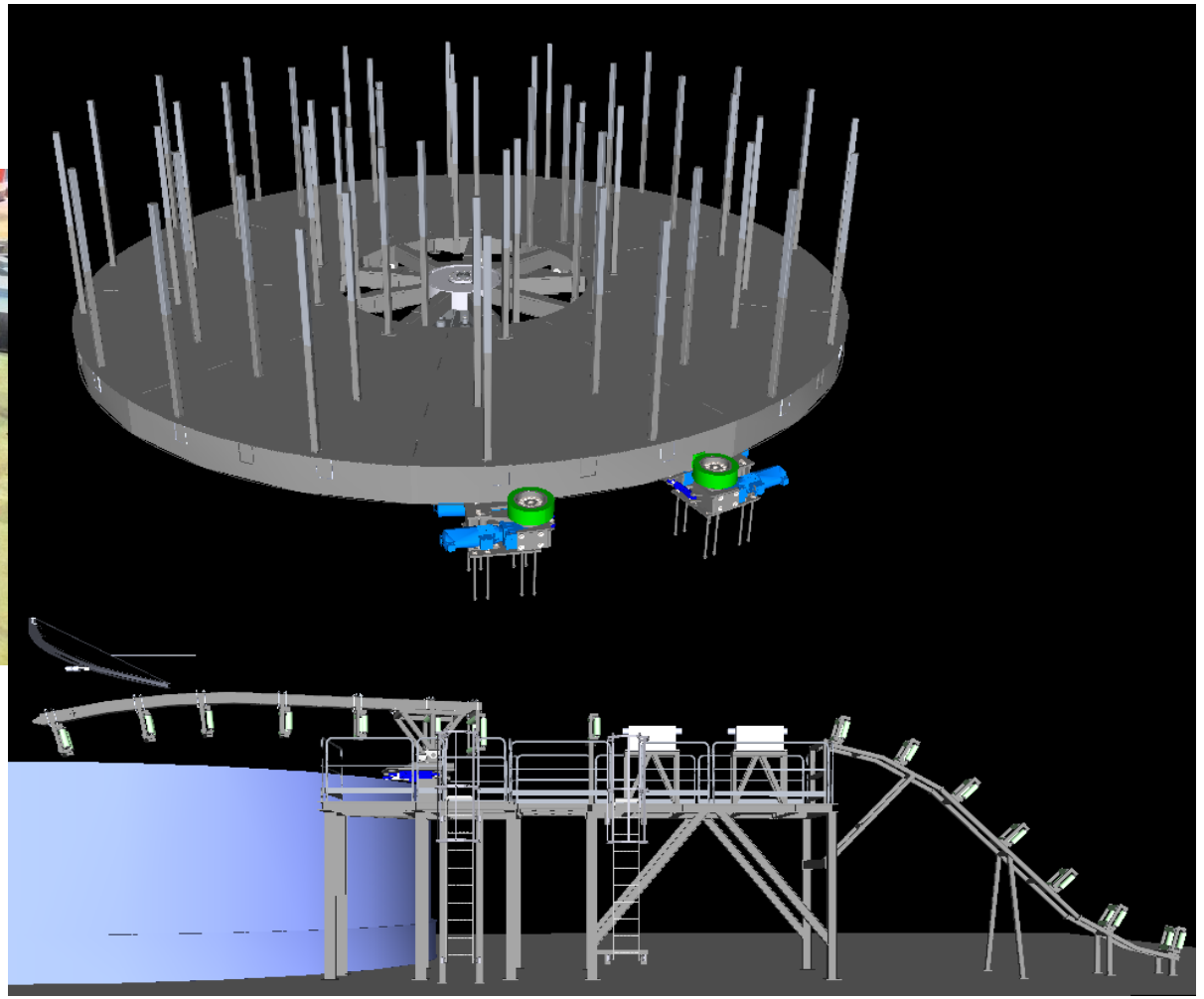
30 DC Joints – 60% **5 AC Joints** – 0%

30km DC Grouting – 60%

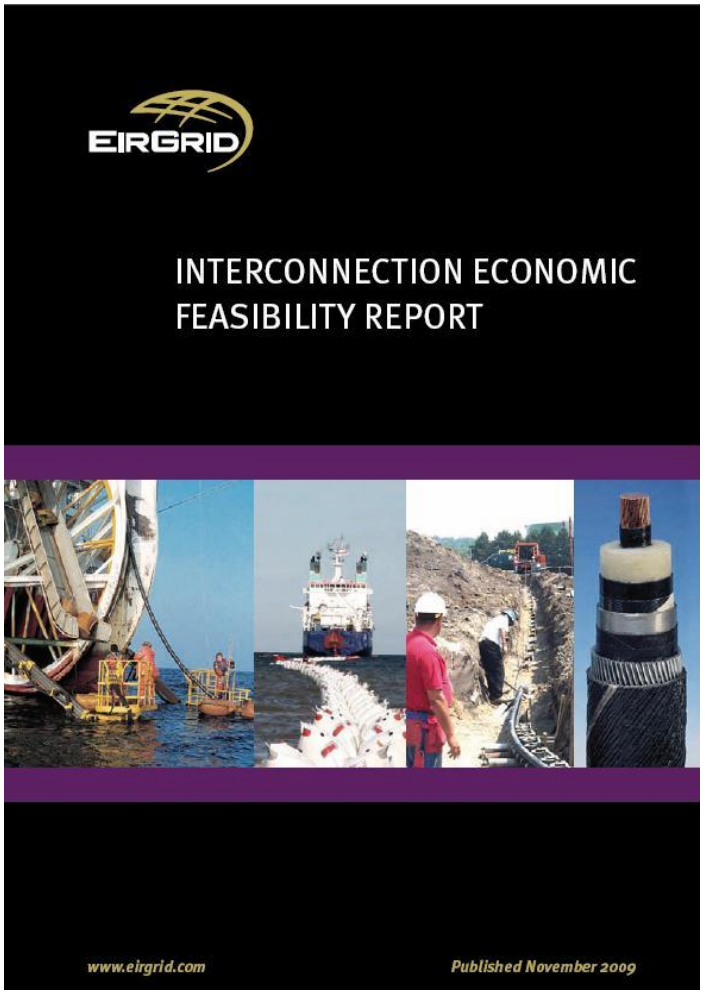
Converter station - Shotton

Liverpool Spare Cable Storage Facility

Liverpool Spare Cable Storage Facility



Case for further interconnection



- Further interconnection between Ireland and GB is economically attractive.
- Interconnection from Ireland to France also appears beneficial
  - Further detailed work is ongoing to verify this and evaluate against Ireland – GB interconnection.
- Project initiated to take to next stage
  - Engaging with neighbouring TSOs & key stakeholders, optimising destination, size & timing of next interconnector
- Continued participation in key groups e.g. ENTSO-E

EirGrid collaboration with RTE

- EirGrid and RTE have agreed a collaborative work programme
- Aimed at assessing the potential benefits of interconnection between Ireland and France.
  - Jointly performing market modelling studies

Offshore Grid Study

Questions that arise for offshore infrastructure

- What should the structure of the offshore grid be?
  - Meshed or radial ?
- What are the optimum transmission technologies?
  - HVAC or HVDC ?
- Are there synergies with the onshore Irish transmission system?
  - Yes or no?

Offshore Grid Study objectives

- Determine the connection strategy that:
  - Optimises overall system costs
  - Maintains system reliability
  - Allows offshore power delivery

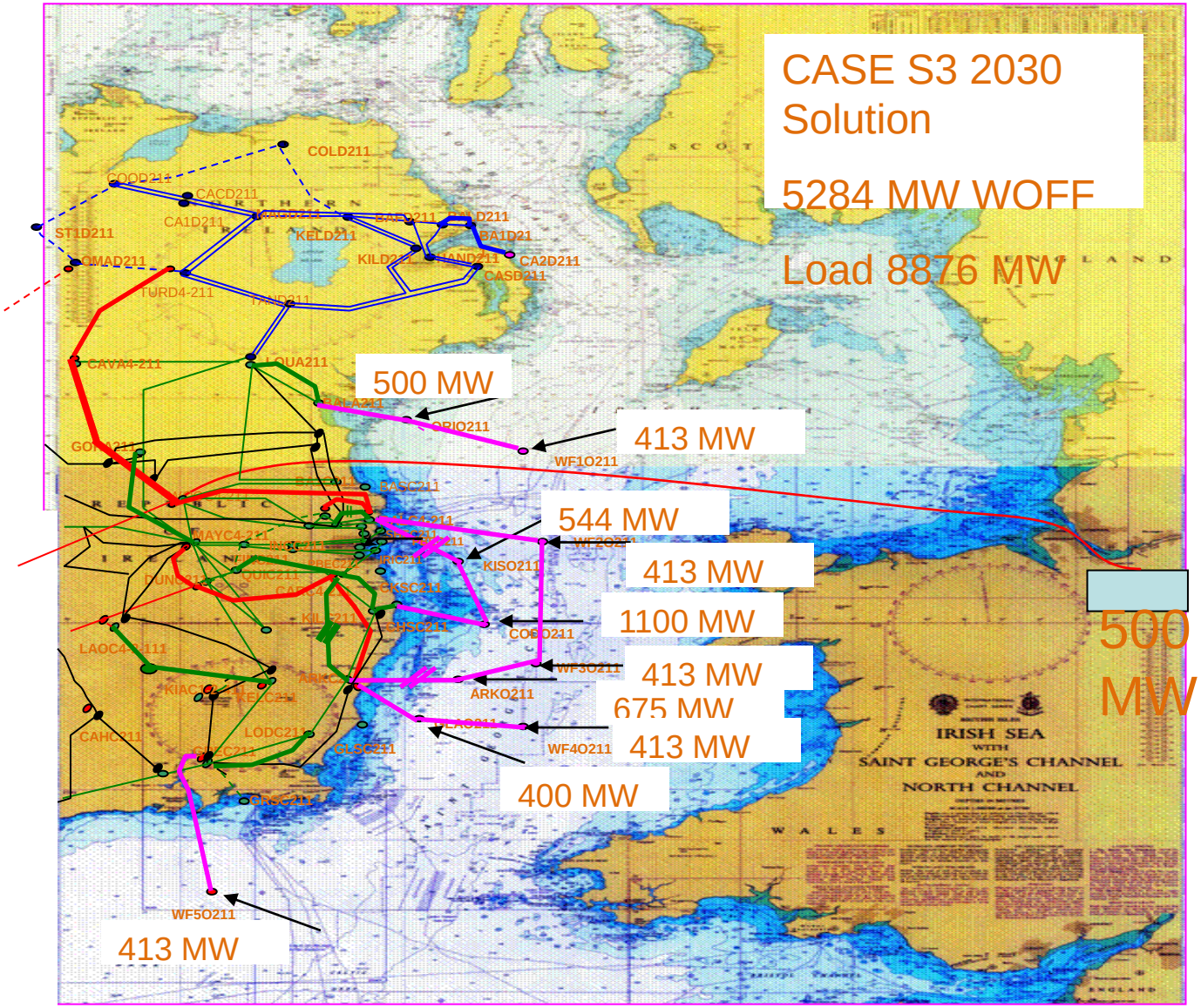
- ESPAUT software developed in-house used for the modelling

Offshore Wind and Grid

- Keys findings
  - Meshed network is optimum
  - Probably a mix of AC and DC
  - Network can be developed incrementally
  - Offshore/Onshore network are symbiotic
  - Smart grid devices can enhance network flexibility and reduce build

- Used to inform the TSO offshore functional designs and policies

Offshore Grid - Ireland

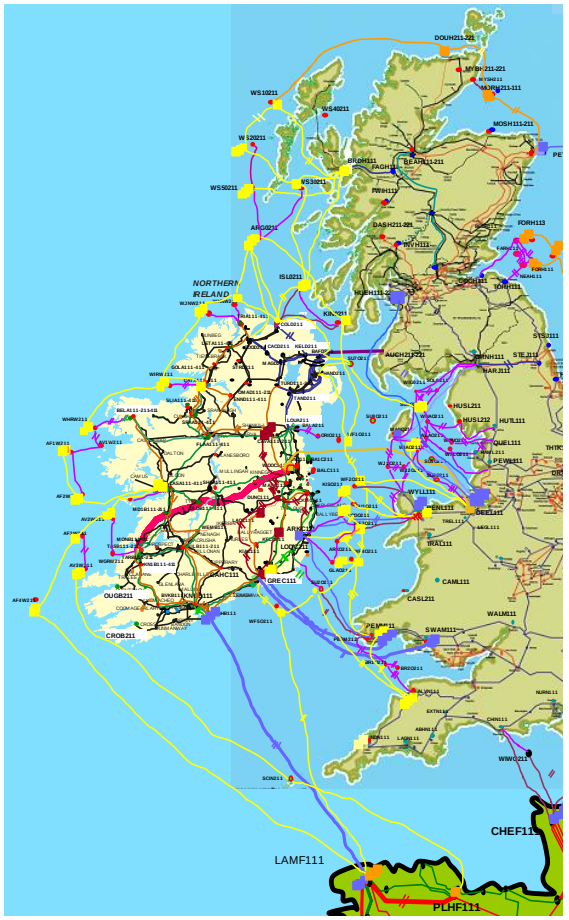


Offshore Grid – Ireland and Great Britain

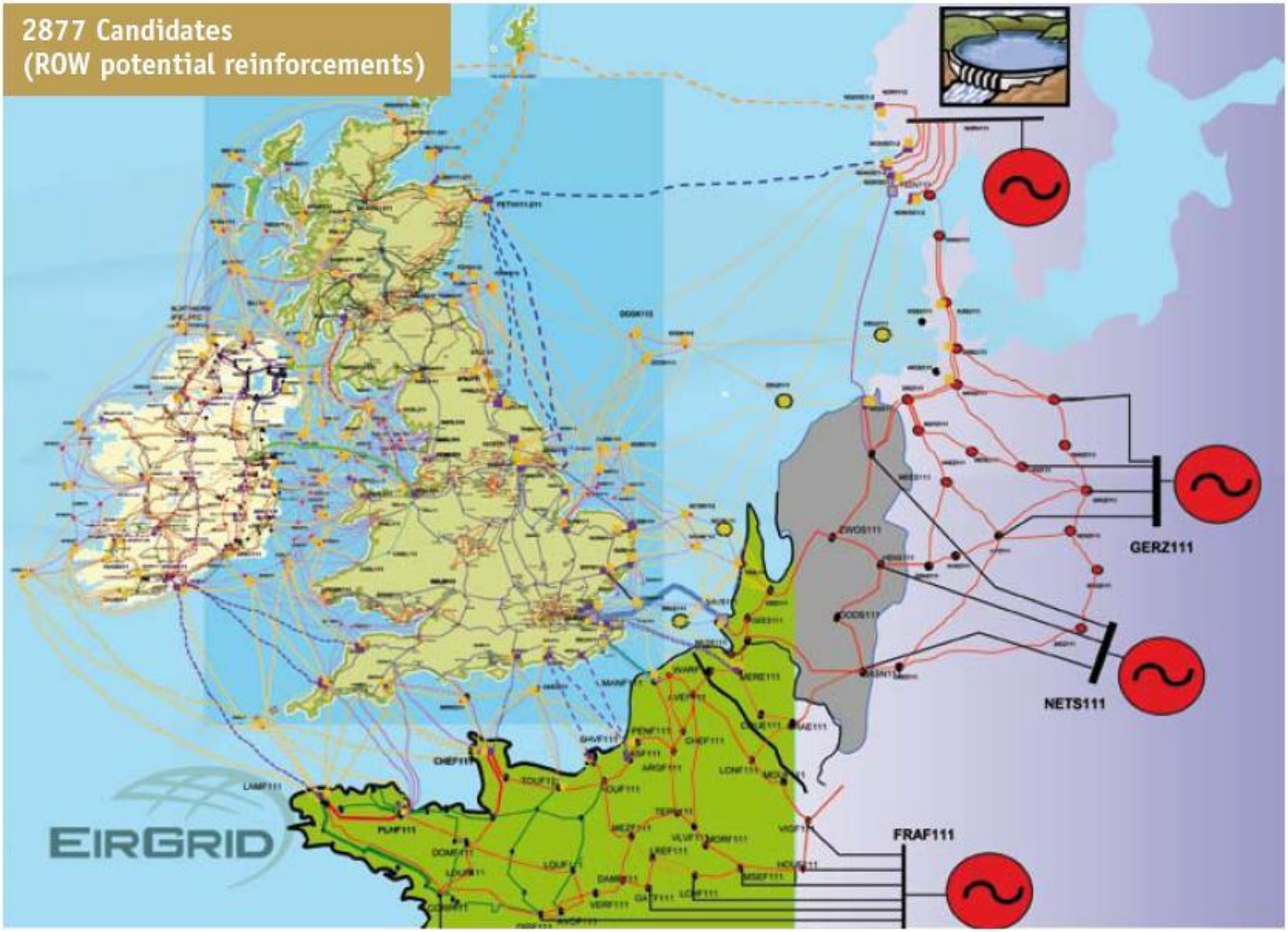
MAX10 (7GW)

MAX10 +ISLES (7GW + 4GW)

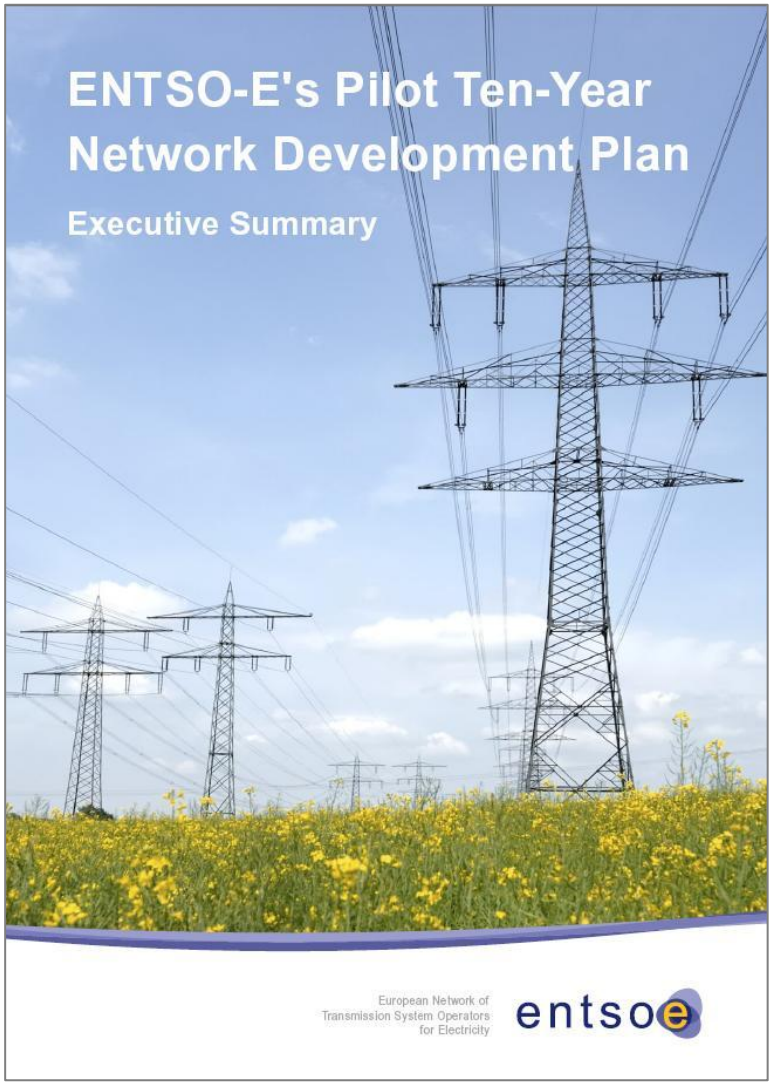
MAX10 +ISLES + Waves (7GW + 4GW +4GW)



Offshore Grid – North Sea Region



Ten Year Network Development Plan



- Published every two years by ENTSO-E as required under the European Third Package
  - Next plan in June 2012
- EirGrid one of three TSOs doing market modelling for the North Seas region
- Results help to inform which interconnection projects will be included in TYNDP 2012

North Seas Countries' Offshore Grid Initiative (NSCOGI)

Work Group 1

Grid Development

Work Group 2

Regulation & Markets

Work Group 3

Planning & Permitting

Identify a number of plausible offshore grid configurations and assess costs and benefits

EirGrid leading this work using our ESPAUT offshore grid model

EirGrid also one of three TSOs doing the market modelling

Technology and Standards

- **National Standards and European Law**
  - Transmission System Security and Planning Standards (TPC)
  - Requirements for Generators European Network Code

- **Policies**
  - Offshore cable policy
  - Offshore station policy
  - x3 Gate 3 offshore grid connection offers

- **New Tools e.g.**
  - Automated reactive compensation planning tool (Q1 2012)
  - Harmonic resonance software for resonance studies of offshore/onshore grid (end 2011)

Summary

- East-West Interconnector on track for Q3 2012
- EirGrid examining the case for further interconnection
- EirGrid has developed significant expertise at offshore grid modelling and optimisation
  - Well positioned to examine and optimise physical grid assets appropriate for a range of scenarios of interest to Ireland
  - Leading NSCOGI offshore grid modelling work
- Ongoing work on technology and standards for offshore connections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