



SCOTTISHPOWER
RENEWABLES

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October 2016

Technology from the Utility perspective

PROMOTionN Workshop

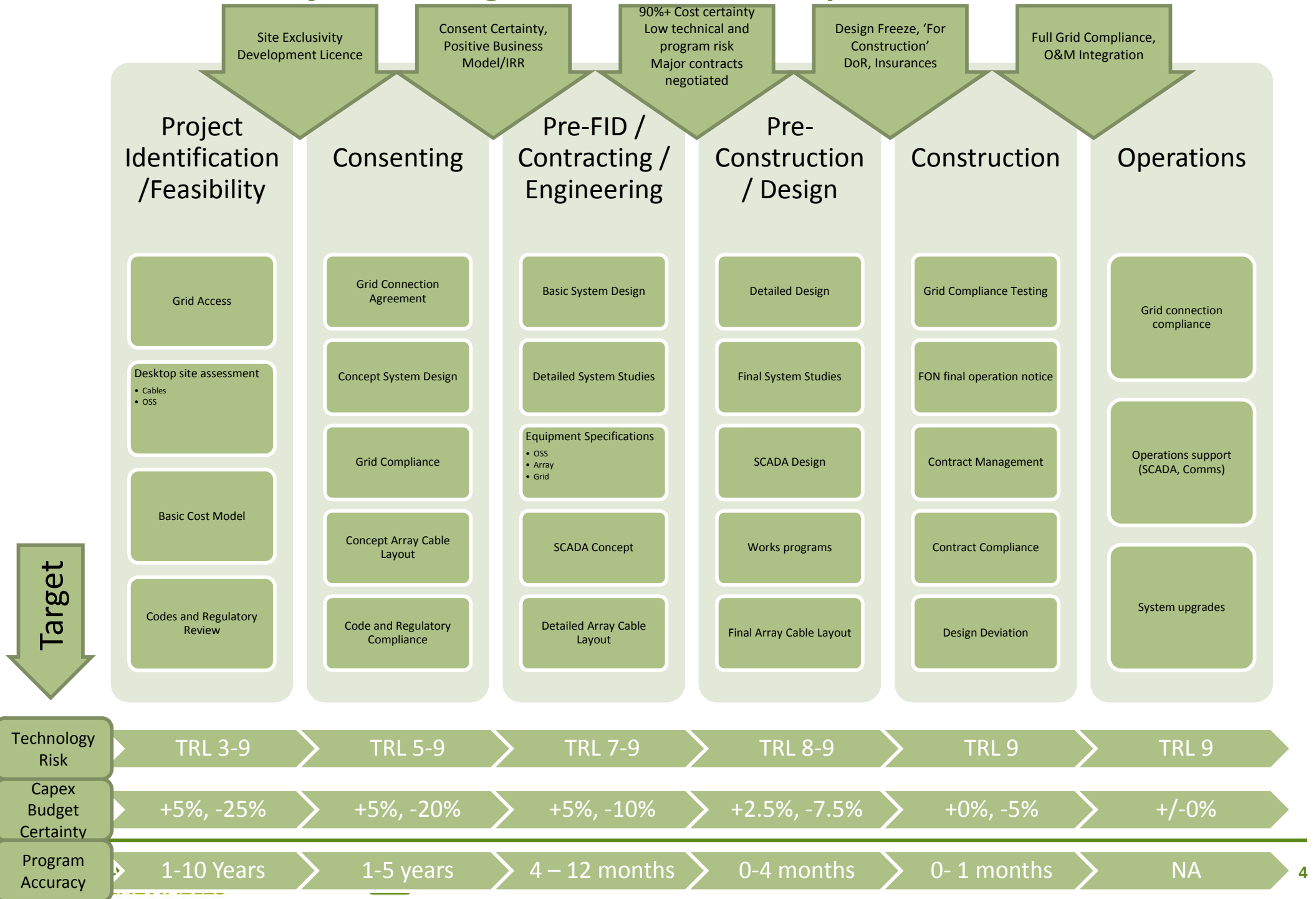
Agenda

- About Iberdrola, SPR Renewables
- Project Stages
- Technology development and acceptance
- Example of technology and feasibility reviews.
- Consent Challenges
- Financing Challenges
- Worked example – UK offshore wind

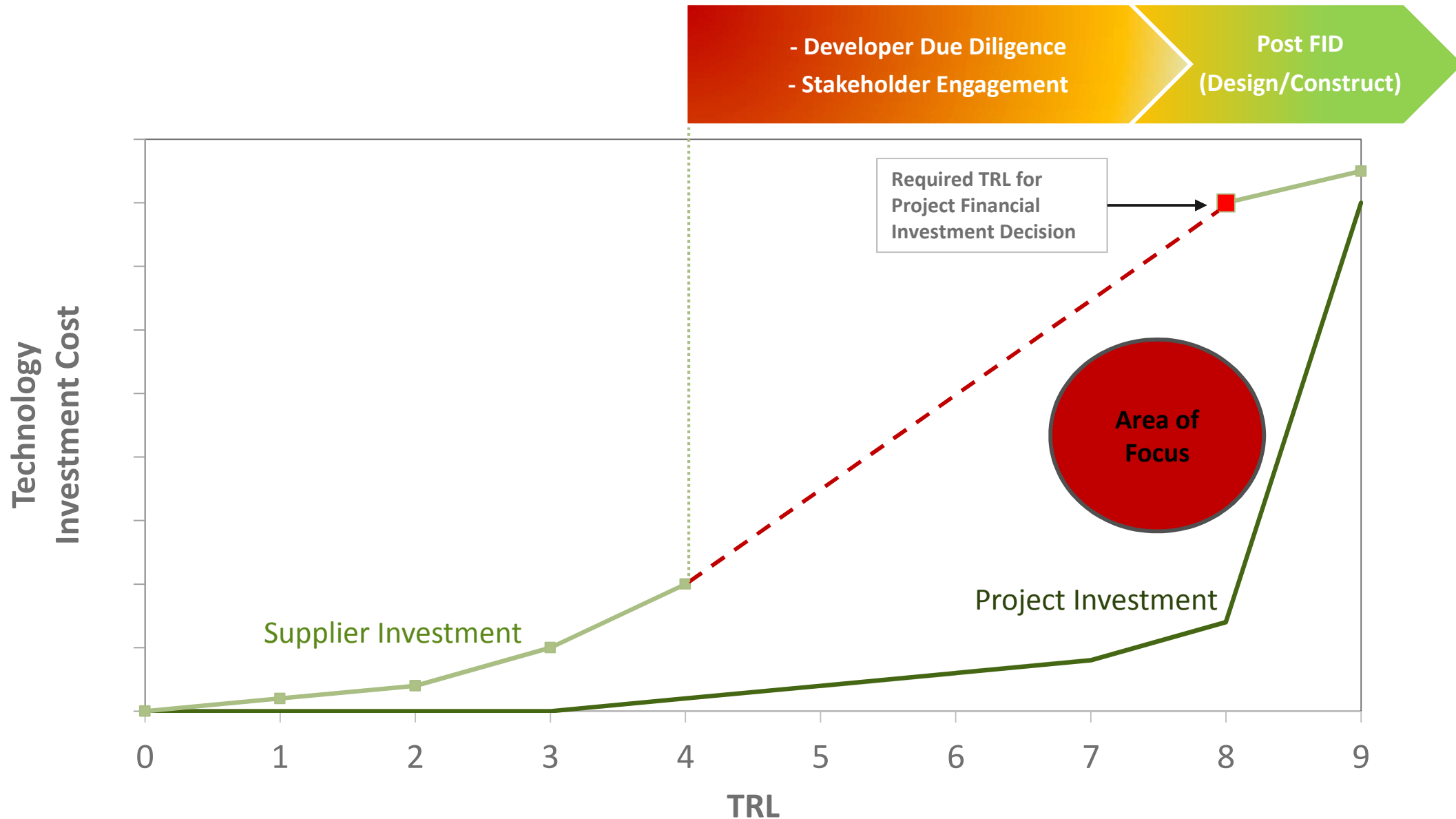
About ScottishPower Renewables

- ScottishPower Renewables (SPR) is part of Iberdrola, one of the world's largest utilities and a leading wind energy producer.
- Iberdrola has a renewables capacity of over 24,900 megawatts (MW).
- SPR has 30 operational windfarm sites producing over 1,600 MW.
- With a further 500 MW of onshore windfarm projects due to be constructed, SPR is set to maintain its position as the UK's leading wind developer.
- With the 350 MW Wikingen Offshore Windfarm in the German Baltic Sea due to be constructed in 2017 and the East Anglia ONE Windfarm, which has full planning consent and a contract that will allow us to develop up to 714 MW, SPR is set to position Iberdrola as the world's leading offshore wind developer.

Project Stage Gates Example



Project Stages - Investment Cost vs Risk



Acceptance of Technology

What to expect from a supplier in order to demonstrate they are offering a technically acceptable solution for TRL 7 and 8.

Calculations and design

- Detailed design calculations (electrical and mechanical)

Grid Compliance

- Modelling of system to demonstrate required (standard) Acceptance/modelling by System Operator

Design Layouts

- Physical layouts and configuration of plant and assets
- SLD and electrical system configuration layout showing all key components

Robust development, test and delivery, manufacturing and construction plans

Proof of concept

- Demonstration of a scale model of system
- Testing of full scale components
- Testing of elements of packaged system and subsystems

Environmental Impact

Assessment of construction risk

- Novel, new techniques, applying design to offshore.
- Health and safety issues
- CDM/Hazid/Design Risk

Budget cost

- Supported costs basis.
- Appropriate levels of accuracy for project development phase

System availability calculations (design and guaranteed)

- Using appropriate standards and benchmarks.

System losses calculations

O&M plan and costs.

Integrated Offshore Projects - What has been looked at to date.

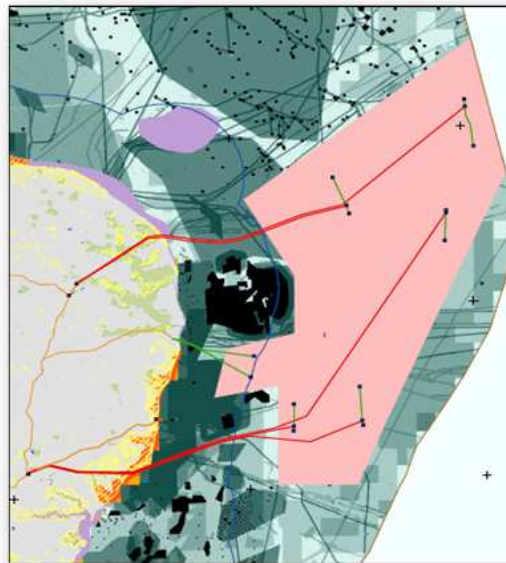
Developer led work
National Grid – IOTP-E
Ofgem - ITPR



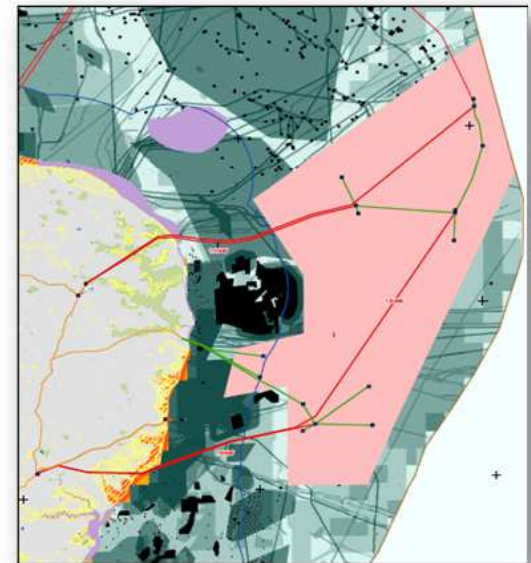
Considerations

- Availability
 - Failure rates
 - Redundancy in design
- Lost generation cost
 - Project conditions
 - System Efficiency
- NPV
 - Cost of capital
 - Utilisation
- Capex
- Sensitivities
- Commodity Pricing

East Anglia Radial



East Anglia Coordinated



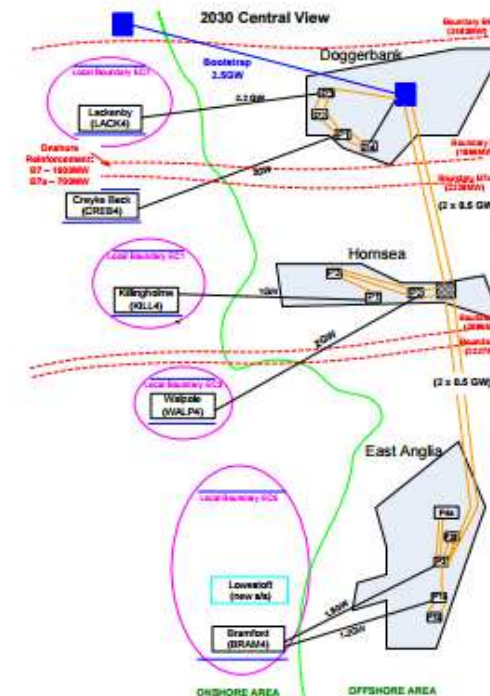
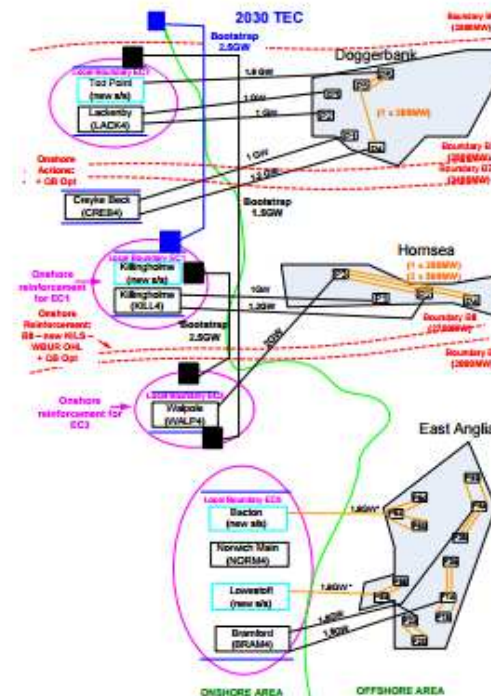
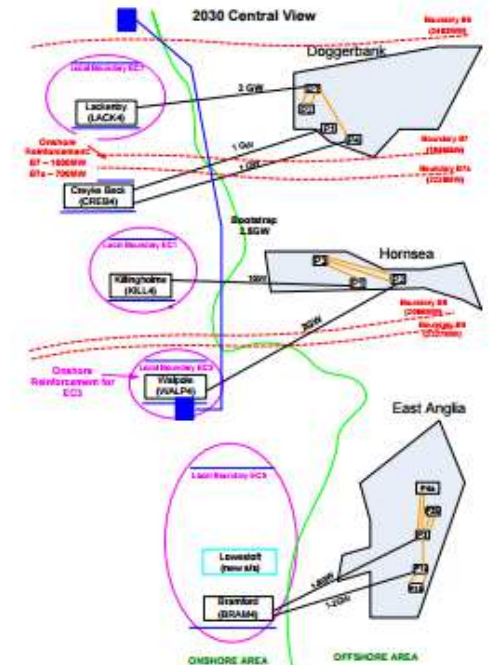
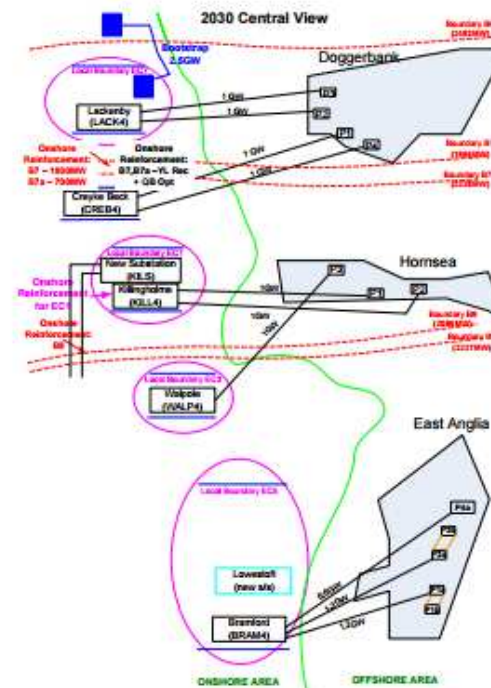
IOTP-E National Grid Led Project

Project Established in 2012,
Involved Vattenfall, Forewind,
Smart Wind and SPR

Conclusion:

As a result the project team does not believe it would be economic and efficient to progress with the development of an integrated design philosophy or delivery of anticipatory assets at this time.

Final report, August 2015,
<http://www2.nationalgrid.com/uk/industry-information/future-of-energy/>

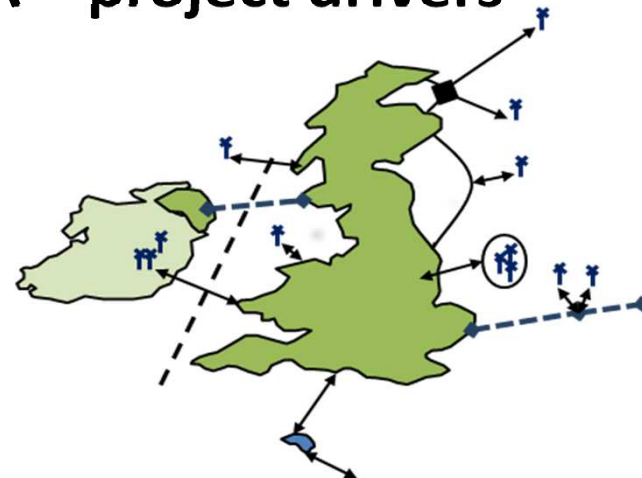


From 2014 Ofgem ITPR Presentation

Context

- The GB energy system is facing **new challenges that could trigger significant investment in the transmission network**
 - Higher proportion of intermittent renewable generation
 - Replacing ageing infrastructure
 - European market integration
- There are also **new opportunities** from technological developments and innovations
- ITPR considers these and looks at whether the current **regulatory arrangements** are sufficient to ensure that the future electricity transmission system will be **planned** and **delivered** in a coordinated, economic and efficient way.

ITPR – project drivers



Key questions ITPR is considering:

- Who plans the electricity transmission network?
- Who delivers investments in the network?
- Where can competition drive value in transmission asset delivery?
- How are multiple purpose projects (MPPs) treated?
- How are connections to non-GB generators treated?
- How do we ensure that the planning process is free from bias and there is a level playing field for competition?

Consenting Requirements

- Design options
- Routeing alternatives
- Environmental impact assessment
- Planning Application
- Stakeholder Engagement
- Landowner Agreements
- Feasible designs

Issues: New technologies

- Limited experience across industry
- Limited consultants/contractors

Risks:

- Changing regulatory regime
- Changing IPC planning regime
- Failure /delay in securing consents

Financing and Support

- Supply chain commitments
- Transmission Charges
 - Socialised assets
 - Shared Assets
- Commercial vs regulated assets
- Funding source, CfD's, FITs, Regulated Asset
- Cost of debt/borrowing/bankability
- High risk technology vs rate of return
- Reverse auctions / Price control
- Investment complexity

Issues:

- Variable through life of project
- Wider issues, banking crisis, low carbon targets, competing sectors

Risks:

- Changing regulatory regime
- Wholesale, trading price fluctuation
- Uncertain charging and cost sharing
- Uncertain future project status

September 2016

Questions?