Towards a low carbon energy future

Integration of wind energy in GB electricity system

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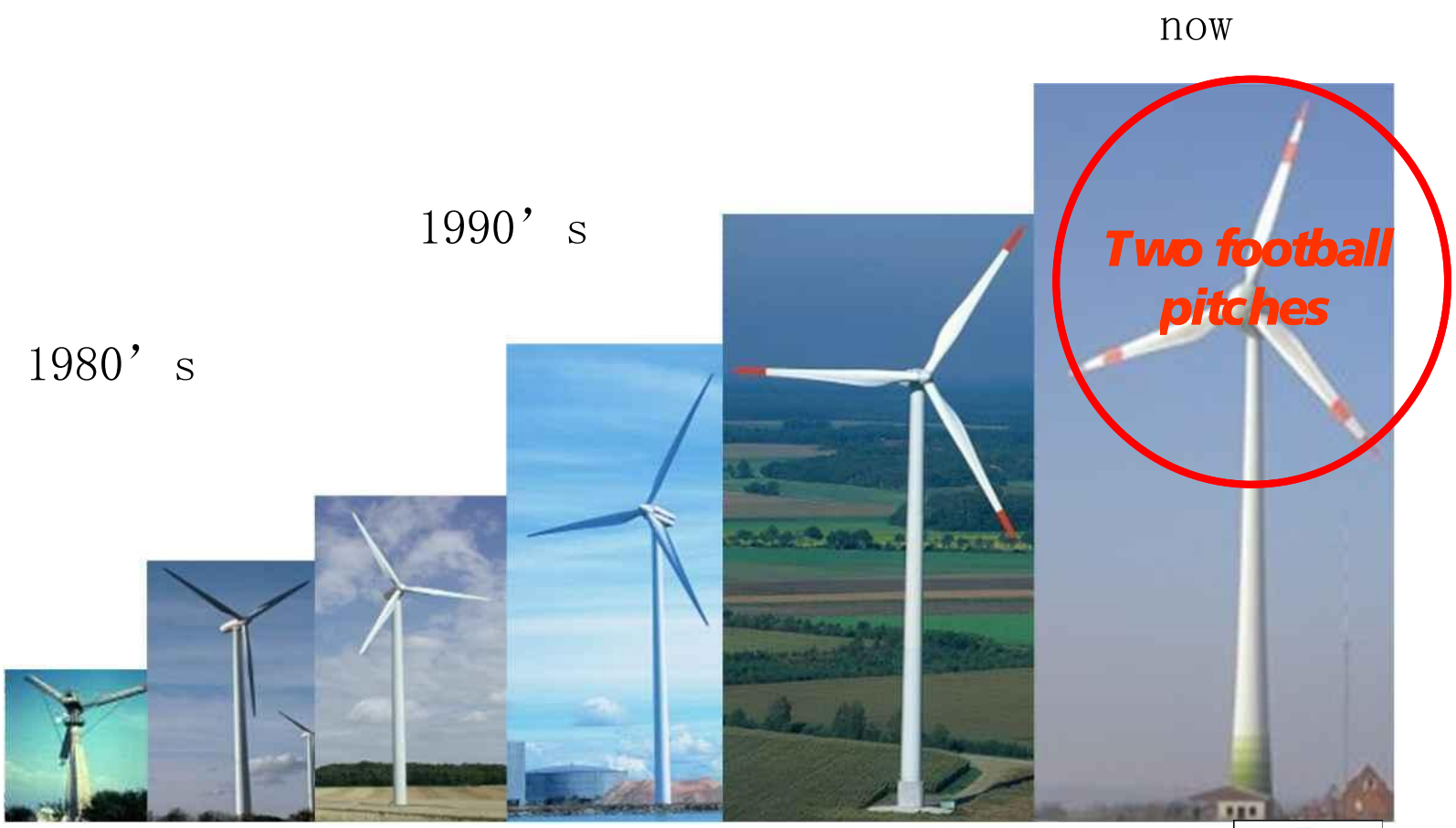
Wind Turbine Technology



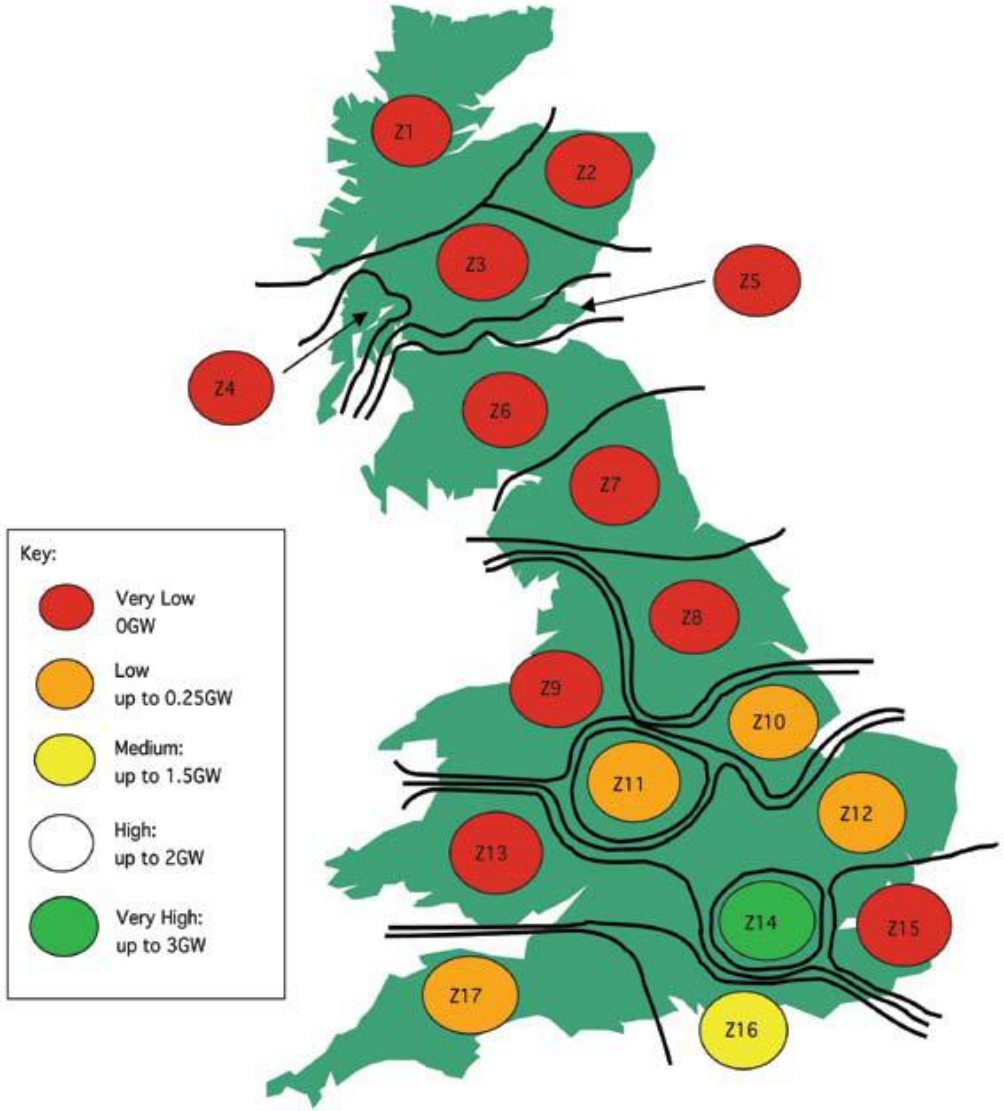
Technology design spectrum

Stall regulated	✓						
Active stall			✓	✓			
Fixed speed	✓	✓	✓				
Limited variable speed					✓		
Gearbox	✓	✓	✓	✓	✓	✓	
Pitch regulated		✓			✓	✓	✓
Variable speed				✓		✓	✓
Gearless							✓

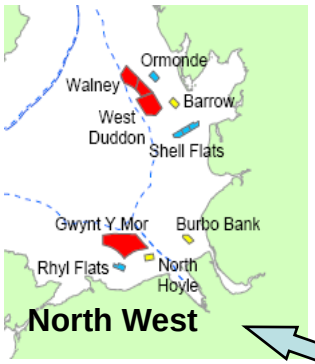
Technology trend

Short term: preparing for 2020

(UK RES Chapter 3)

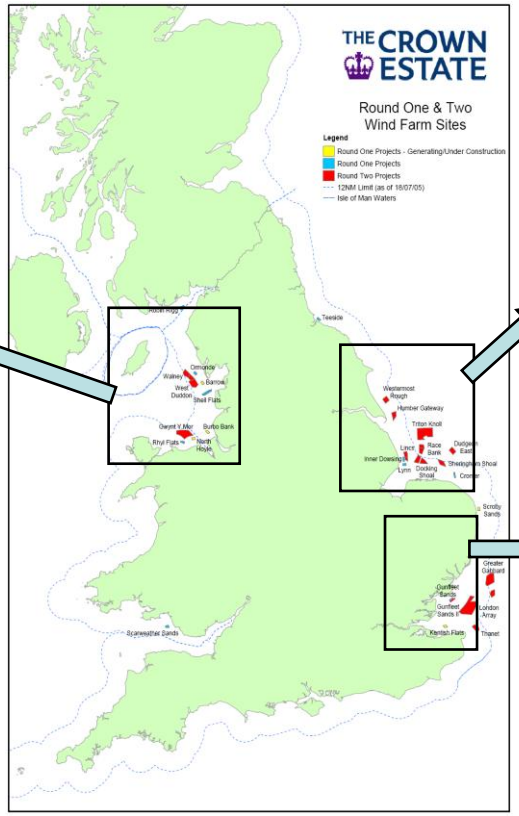


UK Offshore Development



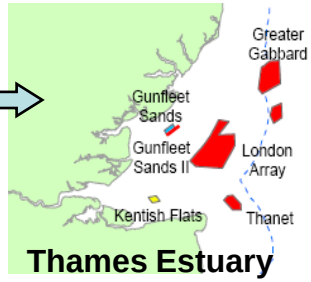
North West

Round 2 Capacity = 1700MW



Greater Wash

Round 2 Capacity = 3605MW



Thames Estuary

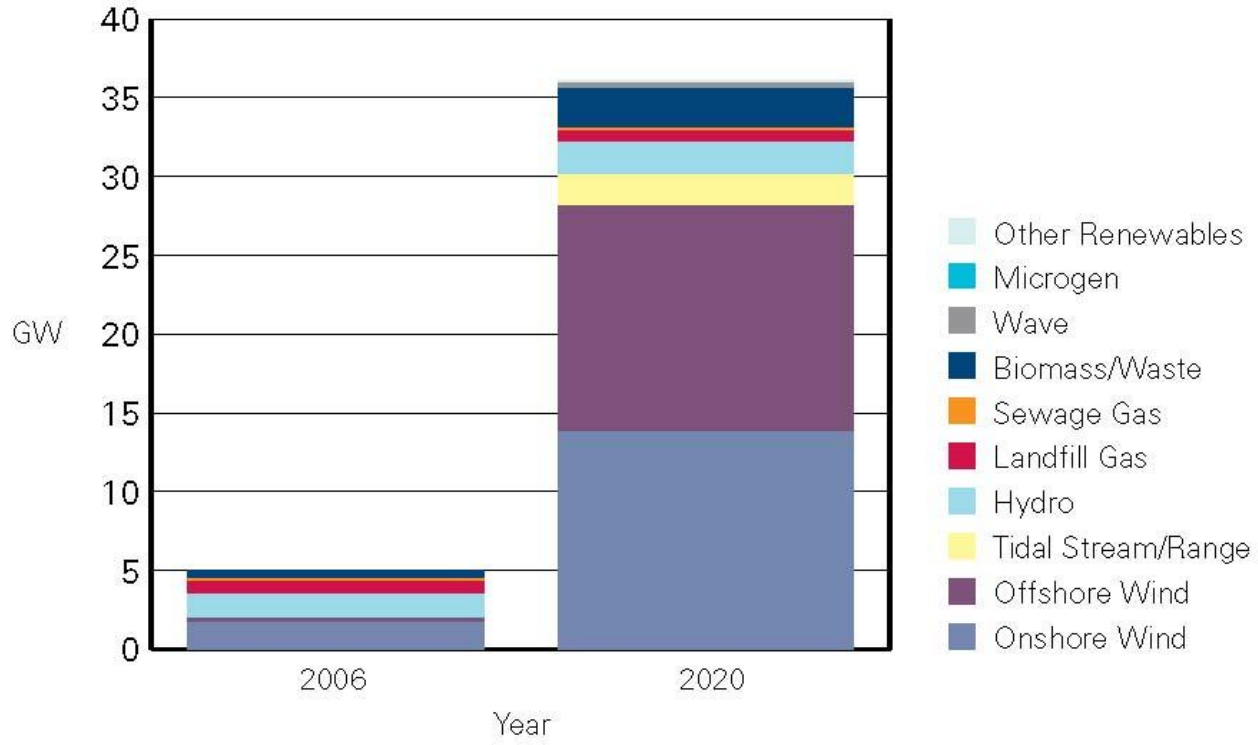
Round 2 Capacity = 1864MW

- Round 1 offshore wind farms, 5 are in operation (300 MW)
- There are 15 Round 2 projects amounting to 7.2GW expected to be installed by 2016.

Challenges in the short term

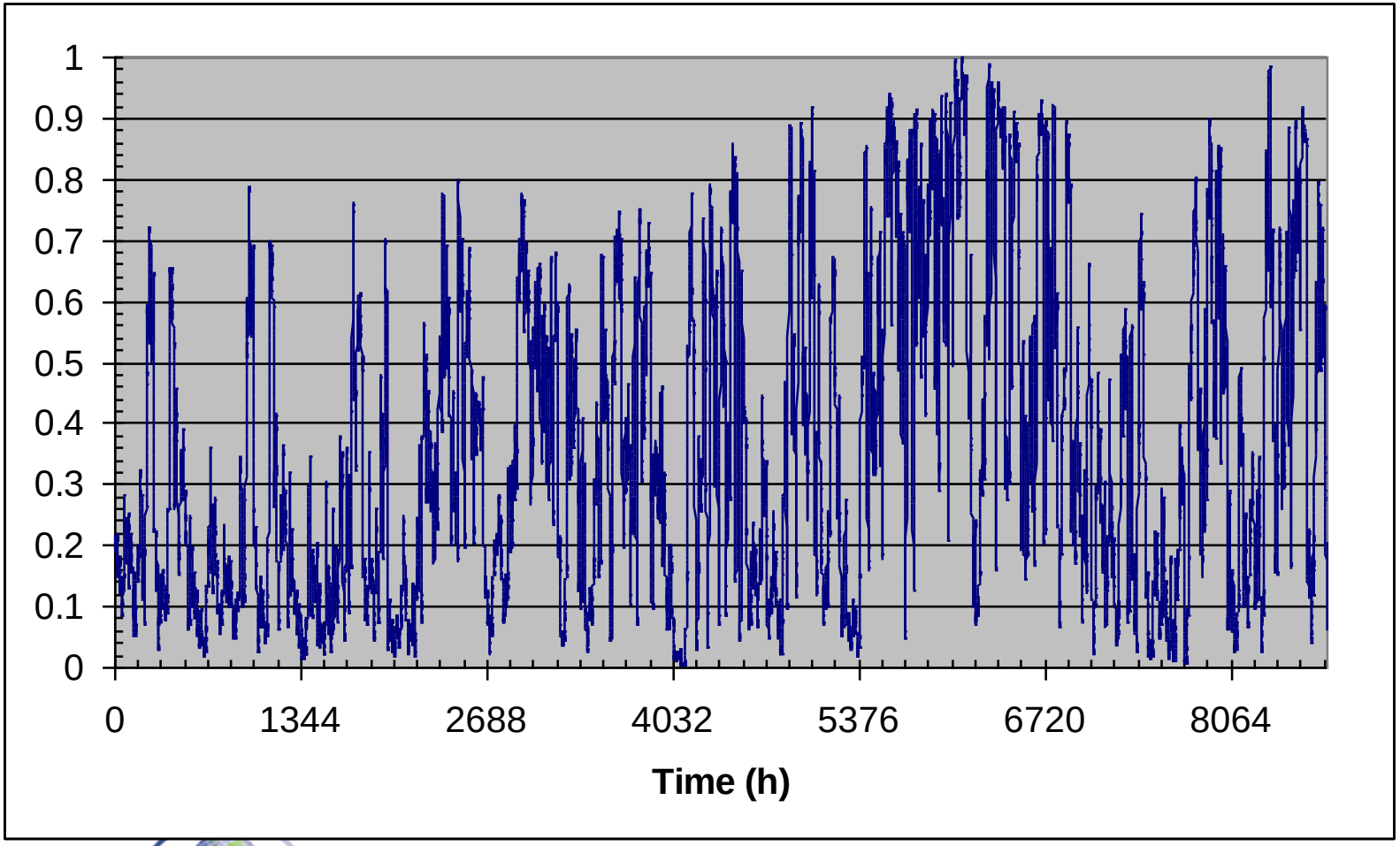
- Networks requirements
  - How much network capacity is required to efficiently transport wind energy?
- Technical, commercial and regulatory framework
  - Transmission Access Review
    - Will it support sharing of network capacity?
  - Network Security Standards: Fundamental Review of GB SQSS standards
    - Increased utilisation of the existing network?
  - Offshore regime
    - Proposed regime discriminatory and inefficient?

Medium term: UK RES



Source: DUKES 2007

System operation with wind power: *Capacity and Balancing*



Challenges

- Generation capacity adequacy and real time system balancing
  - How “reliable” is renewable generation as a source?
  - What are the needs for flexibility and reserve?
- System stability
  - What is the stability performance of the new system?
  - How can wind generation technology contribute to stabilization of the system?
- Technical, commercial and regulatory framework
  - Does the market reward flexibility and security adequately?

“Backup” options

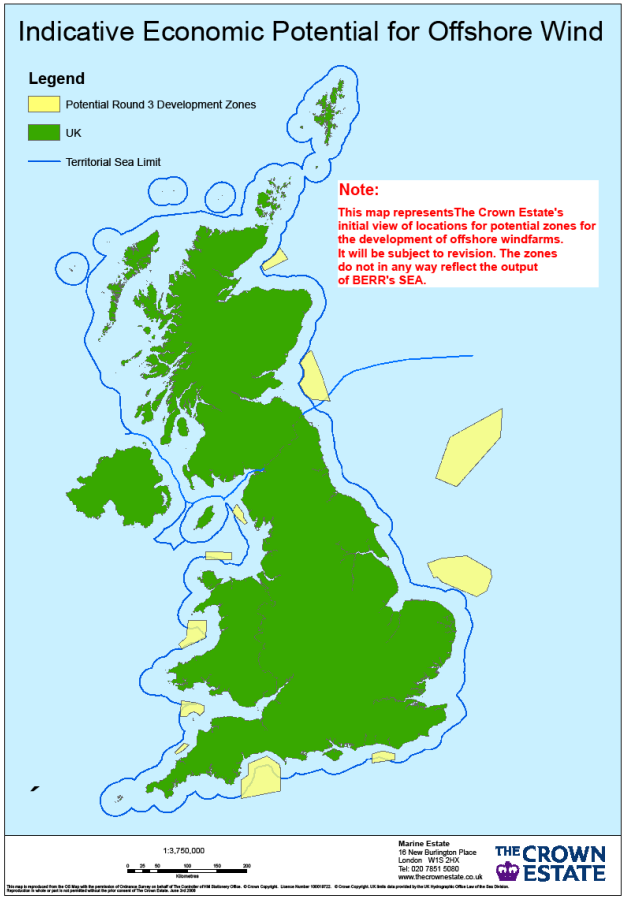
- Conventional generation capacity –
  - More than 25 GW of conventional generation operating at less than 10% load factor
- Interconnections: increasing diversity
  - Sharing of reserve between different geographical areas, “Firming” up wind by connecting wind farms in different areas
- Opportunities for Demand Side

Will flexibility be important?

Generation flexibility → / Demand ↓	High Flexibility	Low Flexibility
Demand 70 GW	364	1322
Demand 56 GW	455	2822

Number of hours of surplus electricity

Offshore wind



Application of HVDC

Long-term: Decarbonised Electricity System

- Business as usual will not be an option: prohibitively high cost, potentially very low utilisation of generating plant and networks;
- Fundamental change in system operation philosophy
  - Flexibility: reallocate control functions from generation to other sectors, demand and networks;
  - Enhance system control capability to release latent generation and network capacity
    - More sophisticated control and decisions making using advances in metering, communication, information and infrastructure
    - Enabling technology: demand side, storage, FACTS, multi-port DC networks
- Systems approach to informing technology strategy
- Design of new Commercial, Regulatory and Policy framework

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