

Facilitation of Renewables

Forum

February 2009



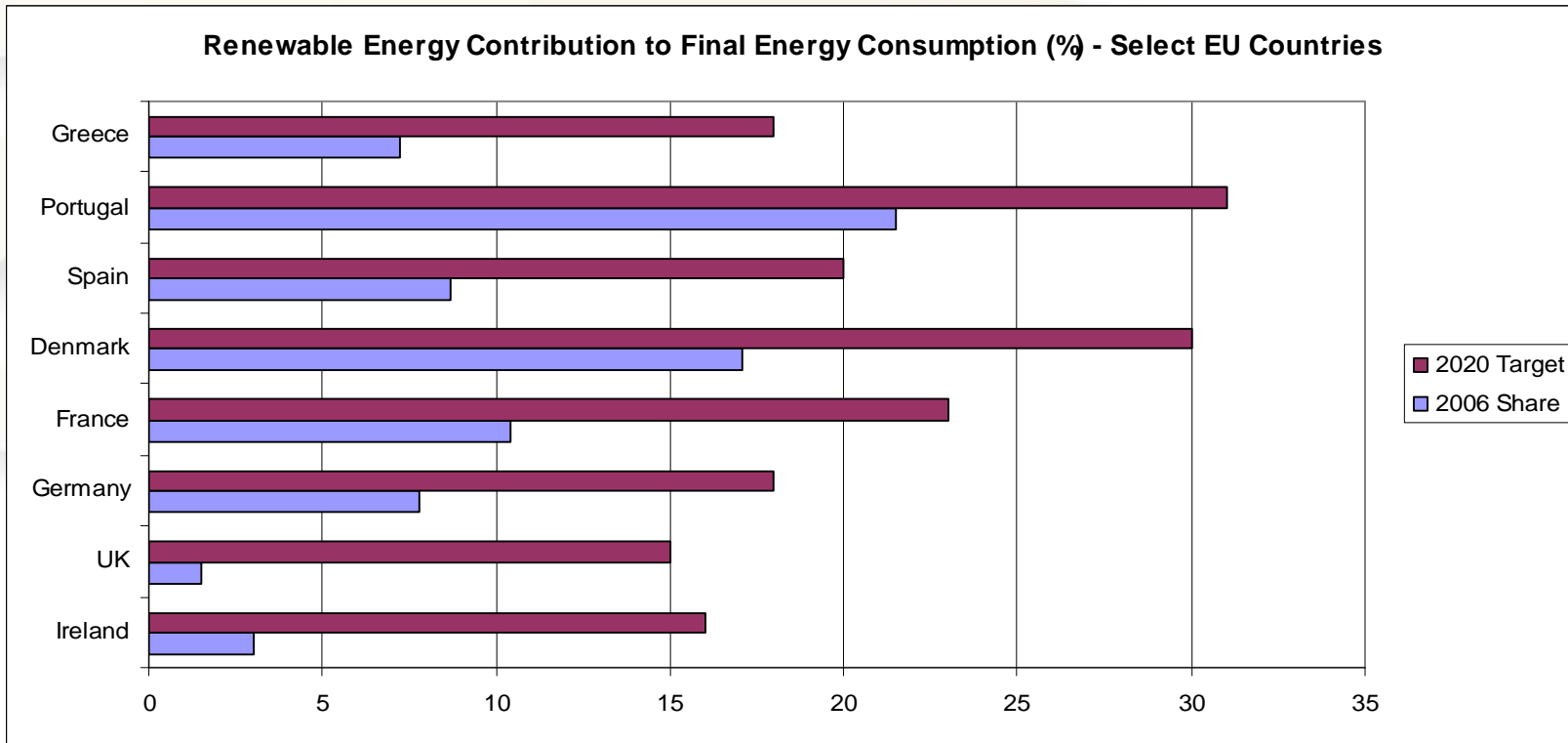
Agenda

- Introduction
- Renewable Energy Context
- Challenge to the Industry
- TSO's Programme of Work
- Stakeholder Engagement
- Follow on Grid Study
 - TSO's Facilitation of Renewables Study
- Discussion



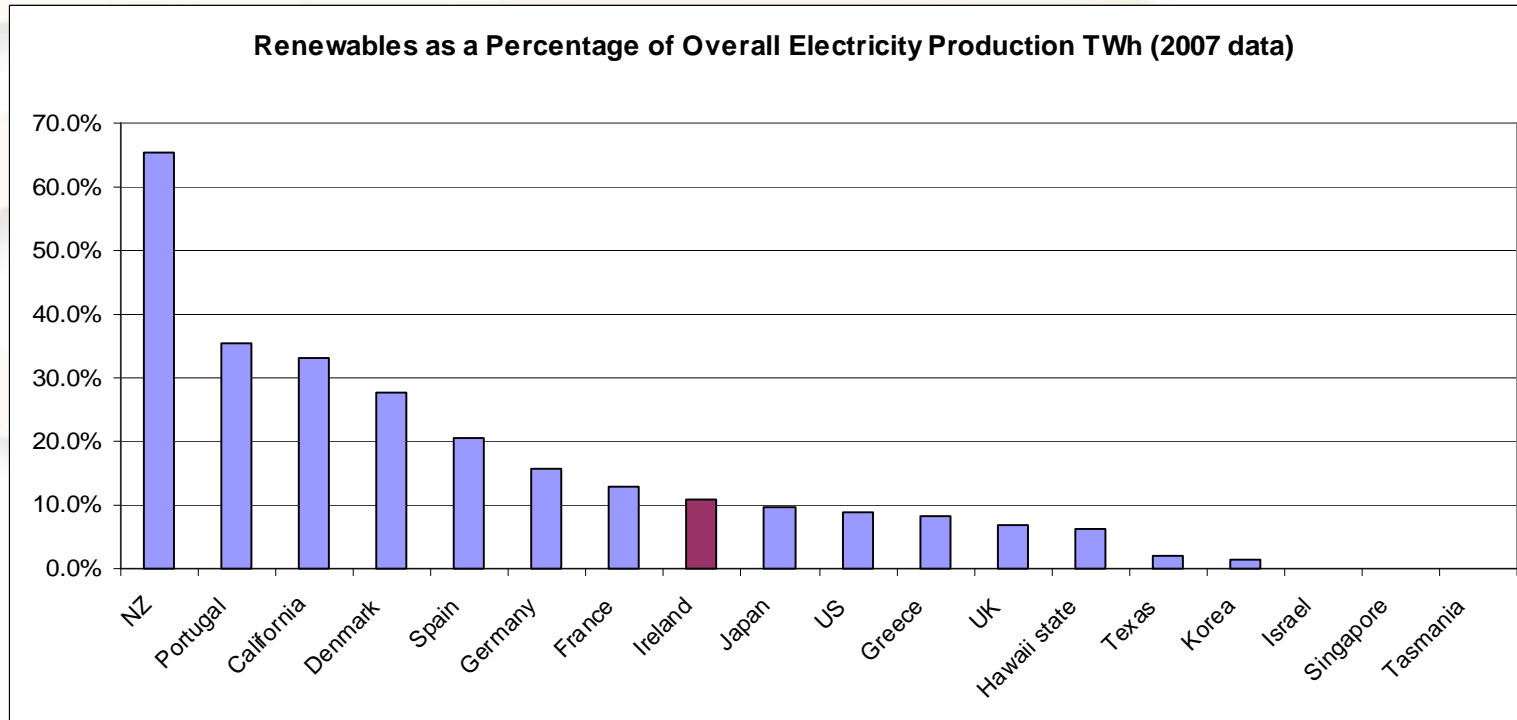
Renewable Energy Context

EU Targets - 2020



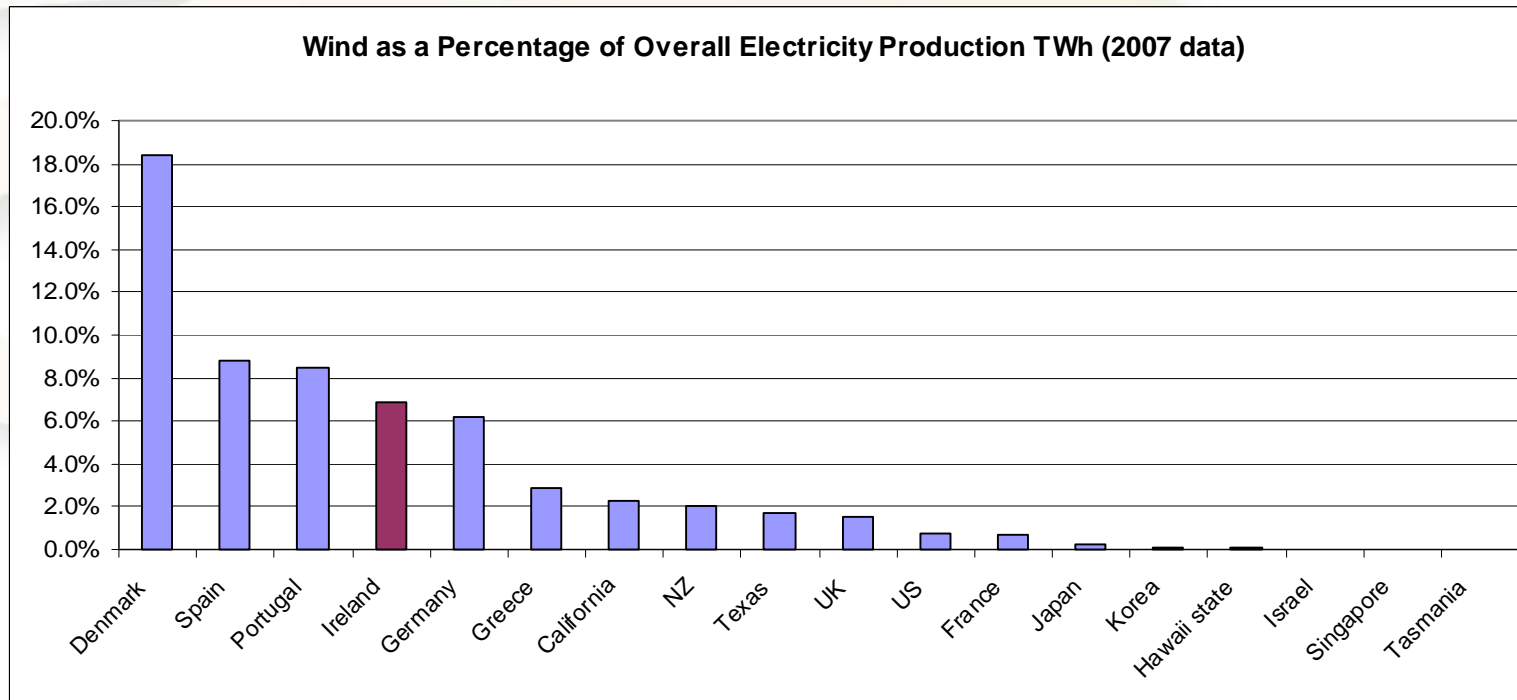
Renewable Energy Context

RES Production



Renewable Energy Context

Wind Energy Production



The EirGrid Goal

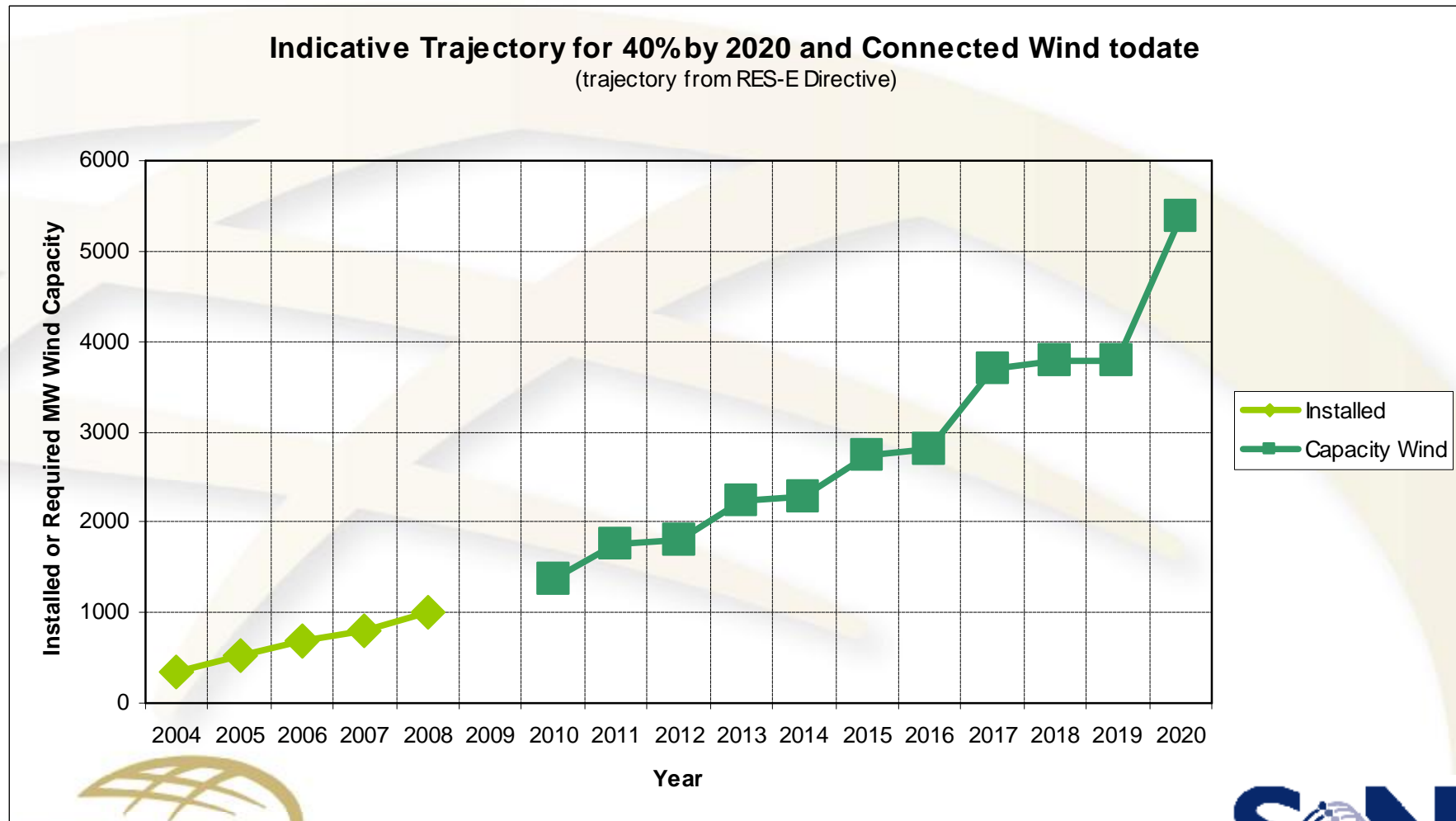
Policy on Renewables

“As a core part of our corporate objective of becoming a World Class TSO, EirGrid intends to be a world leader in the facilitation of renewables. In order to achieve this, EirGrid is committed to proactively working with all stakeholders and customers to ensure all government targets in relation to renewables are realised while ensuring the continued security, safety and reliability of the power system.”

<http://www.eirgrid.com/EirgridPortal/uploads/Announcements/Eirgrid%20Renewables%20Policy%20Final.pdf>



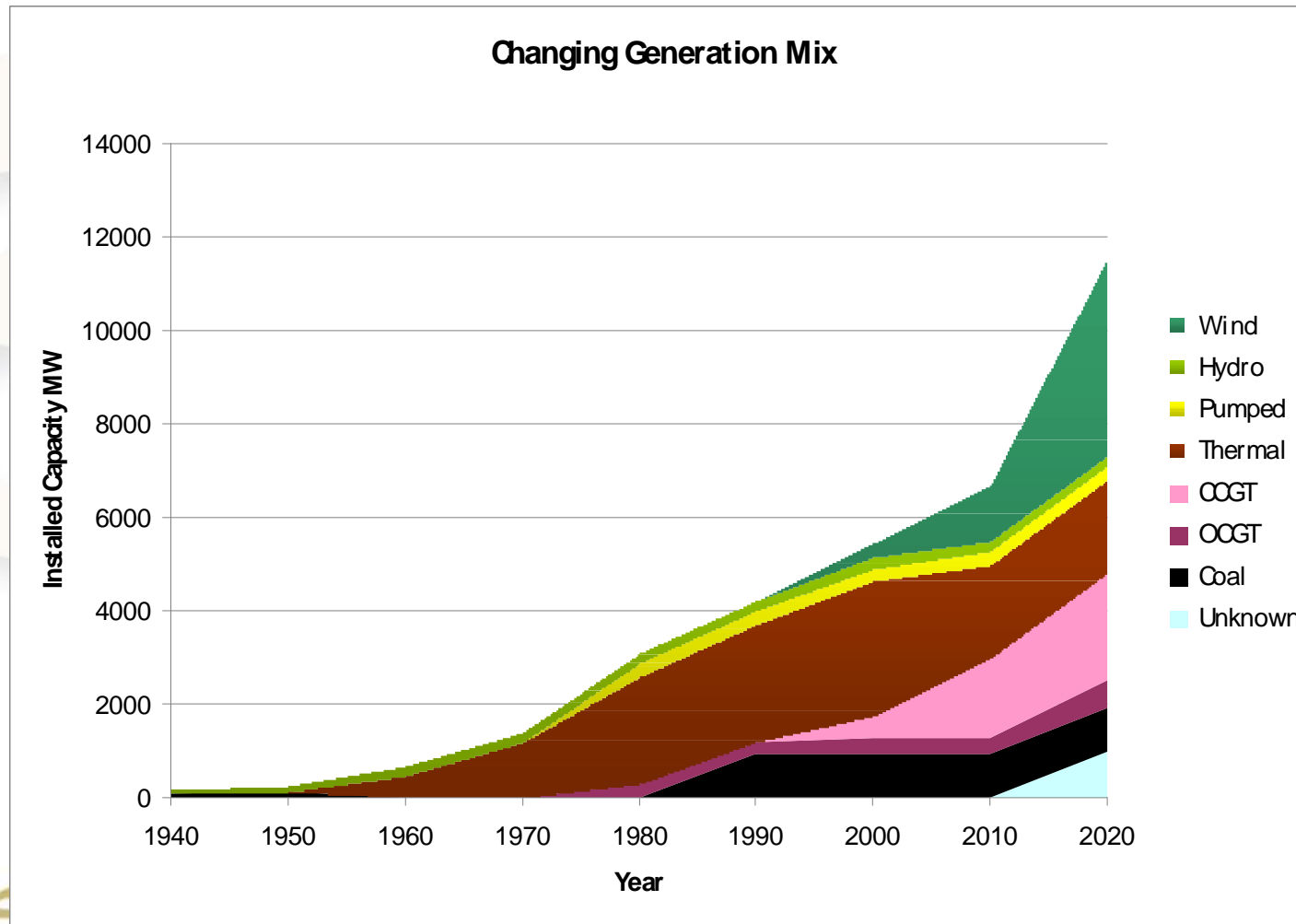
The Challenge: Renewable Targets



Based on analysis of historical Capacity Factors and projected load growth



The Challenge: The Rest of the Portfolio

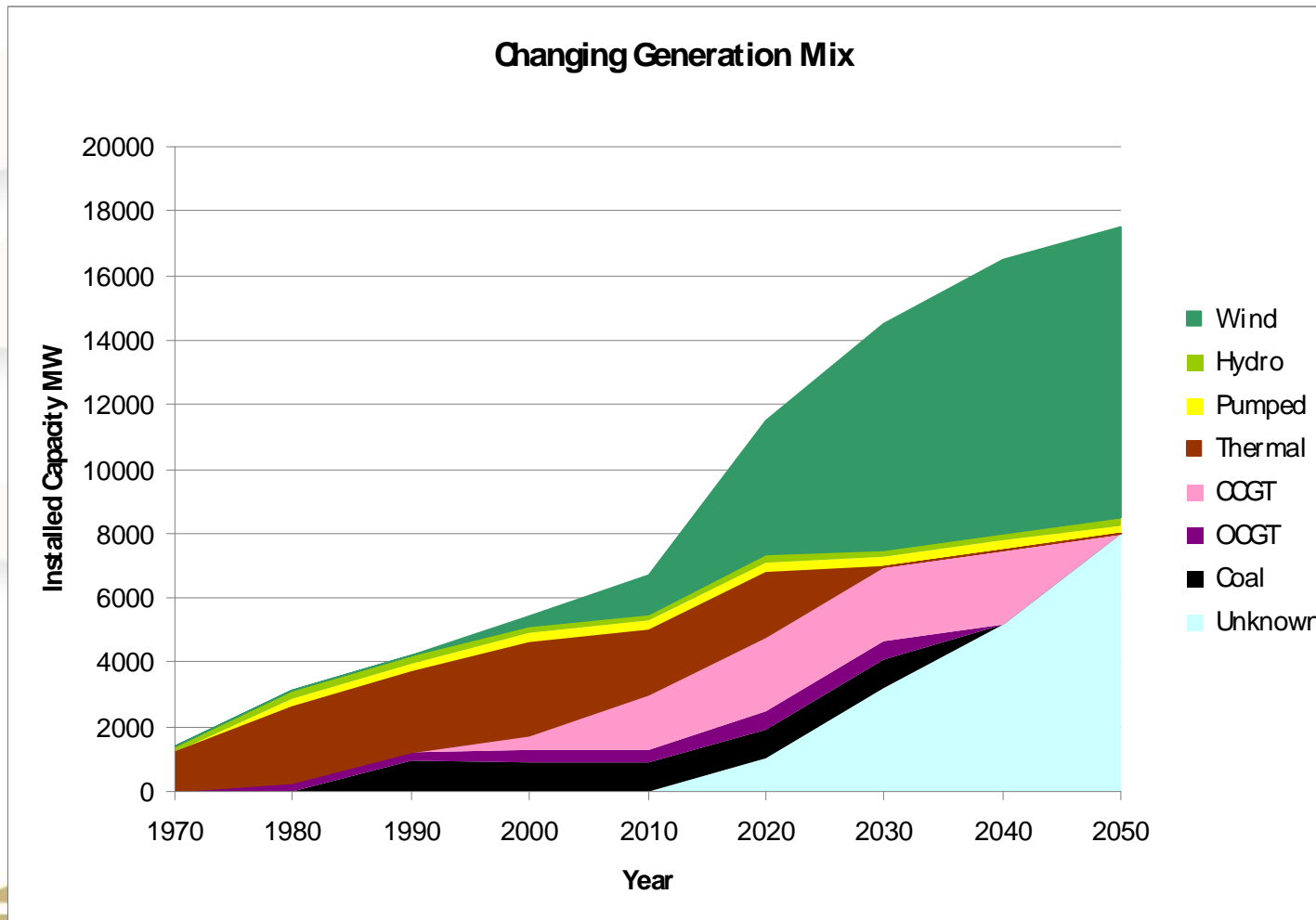


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Source: O'Riordan and the Government white paper with assumptions on load factor and hydro contribution

The Next Frontier: Beyond 2020



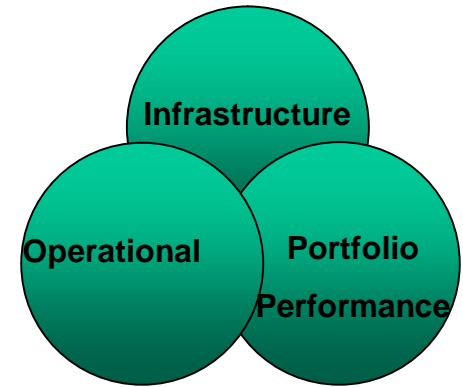
Source: O'Riordan, Government White paper and assumptions on plant life length

Programme: Making it all work by 2020 and beyond

- Infrastructure
 - Issues that have to be overcome, that act as barriers to generators, network customers, operators and owners in identifying potential projects, understanding their possible returns and constructing their assets in a timely and cost efficient manner
- Operational
 - Issues that need to be understood and managed that impact safe, secure and reliable operation of the power system
 - In the short to medium term as transition to system with more renewable power
 - In the long term when significant generation from renewable
- Portfolio Performance
 - Issues that need to be overcome to ensure that the necessary mix of generation and demand flexibility capability is provided and continues to behave and be controllable in line with system requirements



Programme: Infrastructure



Issues

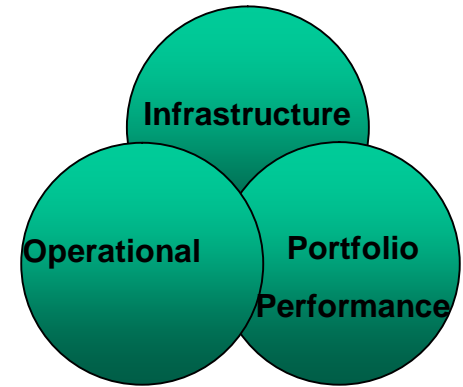
- Issuing connection offers
- Identifying infrastructure requirements
- Building it on time
- Connecting generation

Actions/Controls

- Implementation of the **Gate 3 process** and beyond
- Design and implement a mechanism for the **strategic development of the power system** which has involvement and buy in from all sectors of the industry GRID25
- **Planning Permission** and necessary consents
- **Effective project management** backed up by required study and analysis
- Ensuring **adequate resources and processes** to deliver connections on time



Programme: Operational



Issues

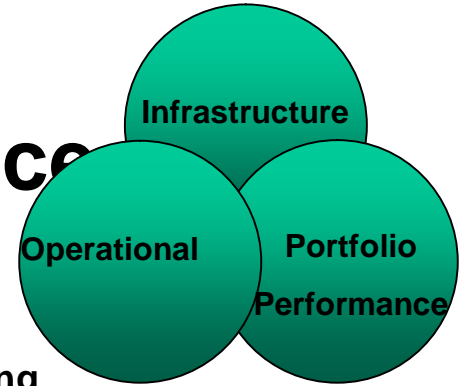
- Increasing Complexity
 - Increased decision making
 - Increased use of infrastructure
 - Exploring new operational territory
- Variability
 - Increasing wind penetration
 - Changing demand profile
 - Changing dynamic characteristics
 - Frequency and voltage control
- Uncertainty
 - Wind production uncertainty
 - Demand uncertainty
 - SMART Metering
 - Transport

Actions/Controls

- **More Tools**
 - WSAT
 - Operational Policy
- **Develop and Learn**
 - Best Practice, Learn from others
 - Training, studies and simulation
- **Flexibility**
 - All island grid study follow on
- **Changing Controls**
 - AGC
 - Reactive power strategy
 - Dynamic line ratings
- **Prediction**
 - ANEMOS, SAFEWIND
 - Improved demand prediction
 - SMART Metering
 - Electric Powered Vehicles



Programme: Portfolio Performance



Issues

- Compliance and monitoring
- Supporting standards for a changing power system
- Identifying the properties of a portfolio capable of supporting renewable targets
- Incentivising and supporting the necessary flexibility

Actions/Controls

- Develop a **performance monitoring framework** to ensure all users of the Grid are and remain compliant
- **Develop the Grid Code** to enshrine principles to deal with the changing nature of the power system
- **All Island Grid Study Follow On** will quantify levels of flexibility required to support target levels of renewable energy
- **Develop a holistic policy** for the basic financial structures: Energy, Capacity, Ancillary Services and UoS to deliver this necessary portfolio of users



Key Success Factors to 2020 and beyond

- **Infrastructure**

- Build the necessary infrastructure, networks and interconnection, for the long term needs

- **Operational**

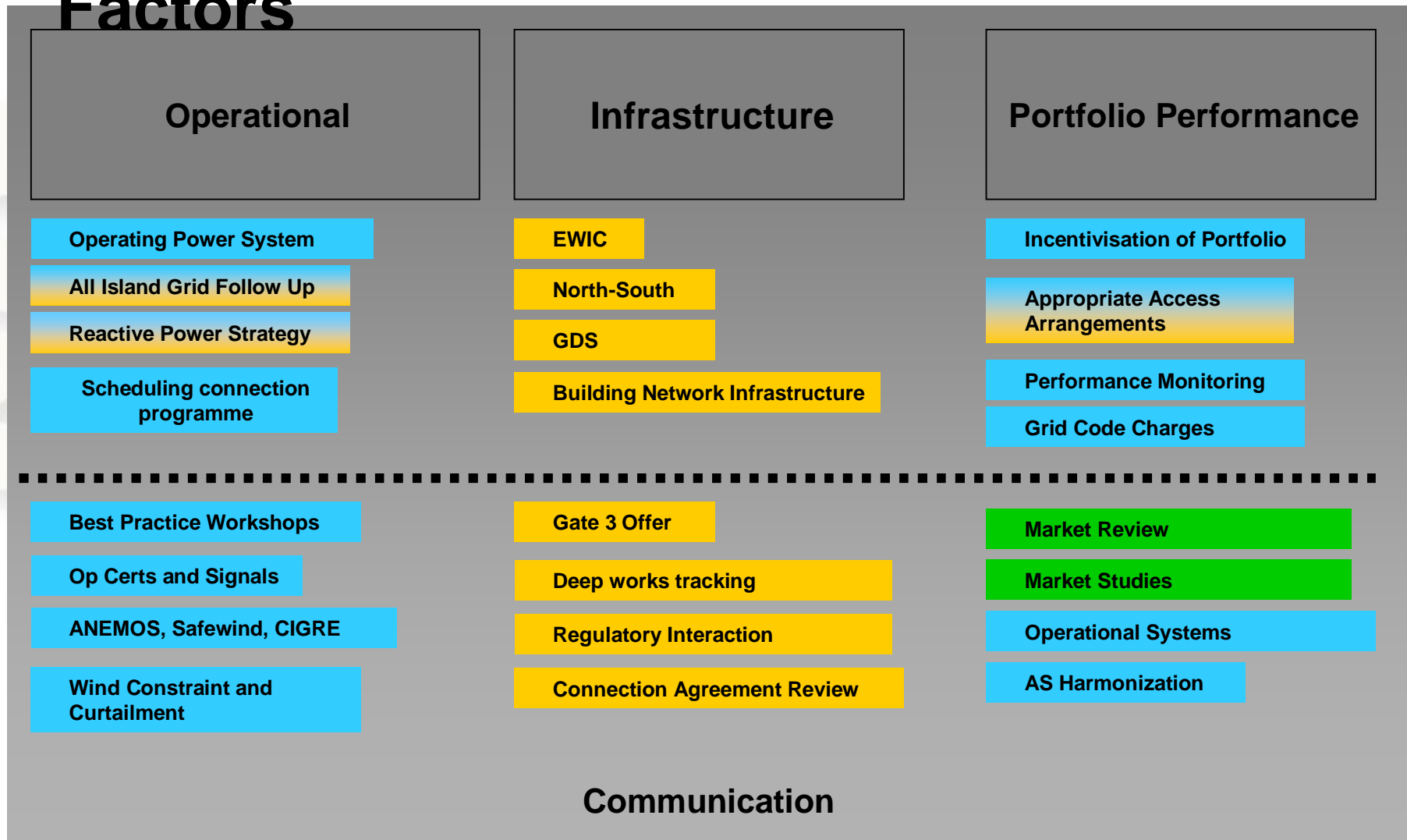
- Manage the system with increasing complexity
- Understand the core drivers for flexibility and variability and develop new operational paradigm to successfully manage

- **Portfolio Performance**

- Develop and implement a consistent approach across the design (and level) of the market mechanisms to incentive the correct behaviour and mix of users of the power system



EirGrid focused on the Key Success Factors



TSO's Work Programme

	2009				2010				2011			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
EWIS	█	█	█	█								
ANEMOSPlus	█	█	█	█	█	█	█	█	█	█		
Safewind	█	█	█	█	█	█	█	█	█	█	█	█
QGRE Task Force in Integration of High Penetration of Wind	█	█	█	█	█	█						
WSAT Offline	█	█	█									
Dynamic Incidents Review	█	█										
TSO's Facilitation of Renewables	█		█	█								
North-West Studies	█	█	█	█								
Offshore Network Review	█		█	█	█	█						
Dispatch and Scheduling	█	█										
AS Harmonisation	█	█	█	█								
Performance Monitoring Prototype	█	█										
Operational Certificate Review and Clarification	█	█										
Poyry	█	█										
Further Interconnection Studies	█	█	█	█								



Stakeholder Engagement

- Facilitation of Renewables Forum
 - Improve the understanding of the issues, to promote discussion and debate on the key technical challenges and to share the knowledge and expertise with all interested industry stakeholders to facilitate the integration of renewable energy onto the power system
 - Regular open meeting
 - Updates on TSO work progress to date
 - Organise best practice workshops
 - International presenters to talk and discuss relevant items of interest



TSO Facilitation of Renewables Studies

Jody Dillon
February 2009



Overview

- Context and Background
 - All Island 2020 Grid Study
- Objectives and Areas of Study
 - What and why
- Indicative Time Lines
 - What and when



All Island 2020 Grid Study

- First comprehensive assessment of the ability of the power system to absorb large amounts of energy from renewable sources
- Five part study including:
 - Screening study
 - Resource assessment
 - Dispatch Study
 - Network Study
 - Cost Benefit Study

Excerpts from Executive Summary of WS4 Report:

“However, in particular within the high penetration portfolios, a number of limitations of the studies methodologies have to be acknowledged.”

“The focus of technical follow up studies should be on the dynamic behaviour of the system accommodating high portions of renewable generation.”

TSO Renewable Facilitation Studies

Objectives:

- Increase our understanding of the behaviour of the power system with large amounts of renewable generation
- Identify any potential technical issues
- Develop mitigation measures
- Wrap it all up in a comprehensive strategy for the operation of the power system with large amounts of renewables

Outcome will inform:

- Future operational policies
- Grid code and standards
- Discussions on remuneration regimes for all generation

Areas of Study

- Dynamic Stability
- Fault Levels
- Congestion Management
- Reactive Power and Voltage Control
- Flexibility needs of the system
- Frequency Response of the system

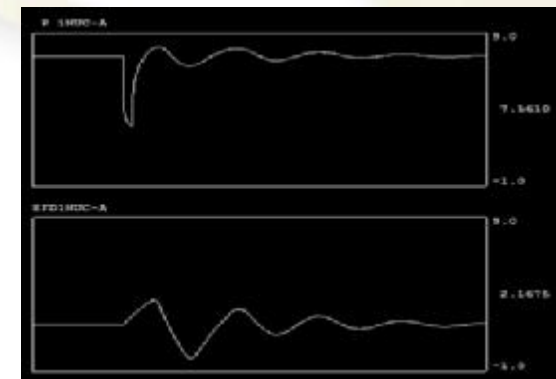
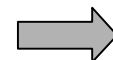
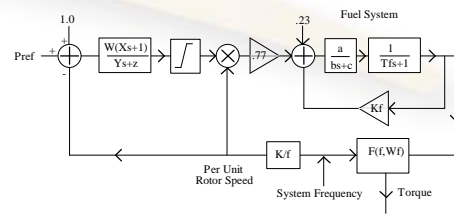
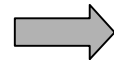
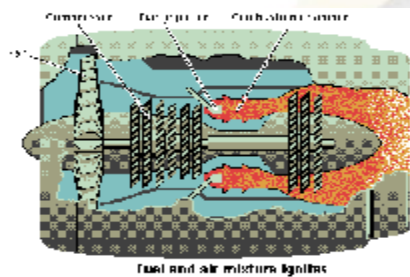


Dynamic Stability

How will machines and load respond and interact in the event of a system disturbance?

“...then we started another engine and threw them in parallel. Of all the circuses since Adam was born, we had the worst then! One engine would stop, and the other would run up to about a thousand revolutions, and then they would see-saw. The trouble was with the governors.”

From “Edison, His Life and Inventions” by Frank Lewis Dyer



Dynamic Stability

- Investigations will cover three main areas of dynamic stability
 - Transient Stability (0 to 10 seconds)
 - Rotor angle stability
 - Dynamic Stability (0 to 1 minute)
 - Critical clearance times
 - Protection operation and philosophy
 - Small Signal Stability (steady state)
 - Steady state analysis
 - Under-damped modes?
 - Inter-area modes?



Fault Levels

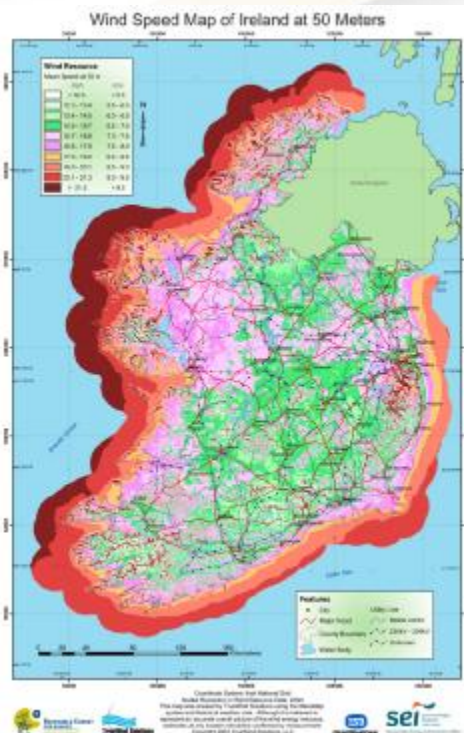
Will single and three phase faults at different points on the network be cleared safely and will protection operate correctly?

- With large amounts of wind power, fault levels, in general, will decrease.
- Will single and three phase faults at different points on the network be cleared safely and reliably and will protection operate correctly?
- What is the impact of increased levels of wind power on fault levels and protection operation?



Geographic Variability of Wind Generation

Will geographic variances in wind power lead to significantly increased congestion and how often is this likely to occur?



Studies will involve:

- Analysis of historical geographical wind patterns to identify potentially problematic geographical wind patterns
- Load flow studies to identify issues
- Probabilistic analysis to identify likelihood of occurrence

Image Credit: www.surfacepower.com

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Flexibility Requirements

What are the flexibility needs of the system in 2020 resulting from increased uncertainty and variability of demand and generation?

Sources of Variability

- Demand
- Electric Vehicles
- Variable Generation

Sources of Uncertainty

- Demand forecast error
- Forecast error of variable generation sources
- Generator forced outages

Flexibility Requirements

- Reserve
 - Regulation Reserve
 - Primary Operating Reserve
 - Secondary Operating Reserve
 - Tertiary Operating Reserve
 - Replacement Reserve
 - Substitute Reserve
- Additional Reserve Products?
- Total ramping capability in MW/Min
- Minimum synchronous generation



Reactive Power and Voltage Control

What are the reactive power needs of the system in 2020, how will voltage be controlled and what role will wind generation play?

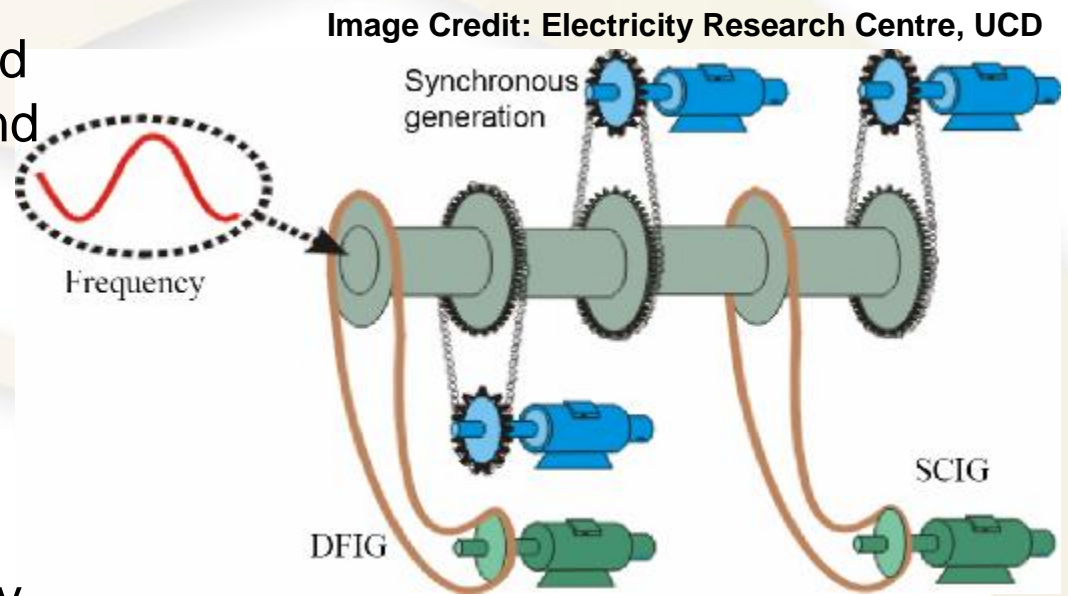
- Reactive power compensation requirements for the power system in 2020
- Voltage control regimes with large amounts of wind power connected to the distribution system
 - Utilisation of distribution wind farm reactive power capability
 - Voltage control regimes for wind farms and/or wind farm clusters
- Voltage control strategy



Frequency Performance

In the event of a generation or load loss event, will system frequency performance be adequate with large amounts of wind power?

- How will the system respond in a variety of generation and load loss events with large amounts of wind power?
- Is a minimum level of synchronous generation required?
- What role can wind generation play in frequency control



Wrapping it All Up

- What are the technical issues?
- How do we solve or mitigate them?
- What are the impacts on:
 - Real time dispatch and control
 - Forecasting and its role in decision making
 - Codes and standards
 - Ongoing studies and planning

Towards a comprehensive operational strategy backed up by study and analyses of all the technical issues



Approximate Timelines

- 18th February 2009: Facilitation of Renewables Forum
- 26th February 2009: RFP Issue
- April 2009: Contract Commencement
- June 2009: Interim Reports
- June 2009: Facilitation of Renewables Forum
- October 2009: Final Report
- November 2009: Facilitation of Renewables Forum



Thank you for your attention.

Questions?

