Renewable Energy in Ireland and Emerging Technologies

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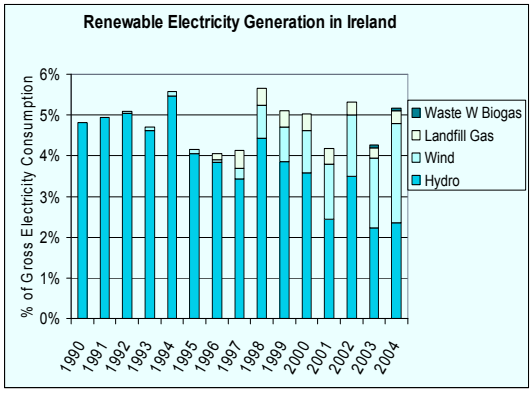
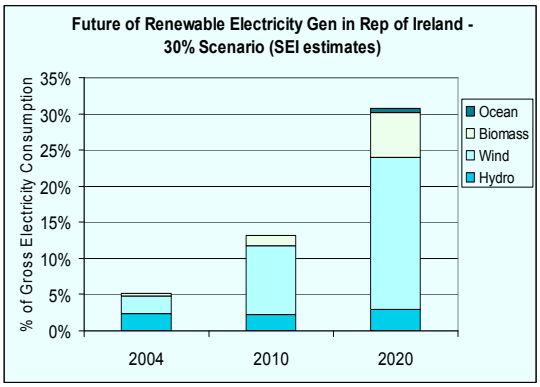
Overview

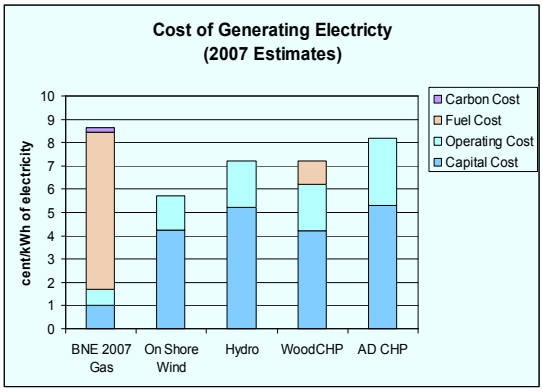
- Renewable Electricity Market
- Technologies – RE, H2 and Fuel Cells
- Carbon Capture and Storage

Introduction

- Electricity generation accounts for 34% of energy related CO2
- Market Drivers:
  - EU Directive on Renewable Electricity: 13.2% of electricity by 2010
  - EU Emission Trading Directive: CO2 allowances made to large combustion plants >20MW, surplus credits sold, shortfalls to be purchased (not the same as Carbon Tax)
- Supports:
  - Renewable Energy Feed In Tariff (REFIT) – fixed price for electricity from wind/hydro/biomass
  - Combined Heat and Power Programme 10mEuro – SEI
  - RE RDD programme support for technology innovation







Small Scale Wood Fuelled Biomass Electricity

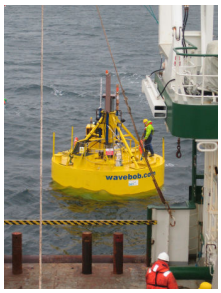
- Grainger's Sawmill, Co. Cork
- Ireland's first Biomass CHP Plant
- Up to 60,000 t of wood fuel pa
- 1.8MWe + 3.5MWt
- Thermal energy used to heat kilns
- Capital cost = 6.2mEuro
- SEI grant funding of 732kEuro
- Electricity Cost = 6.6 – 8.6c/kWh
- Profitability depends significantly on cost of fuel + value for heat

Farm Scale Anaerobic Digester/Biogas Combined Heat & Power Plant (CHP)

- Anaerobic digestion of organic material to produce methane gas
- 600m3 Digester Tank
- Example Inputs = 6,500t of manure+500t of fatty wastes p.a.
- 350kWe + 420kWt
- Revenue streams: electricity/heat/fertiliser/compost
- Example capital cost = 1mEuro
- Electricity cost = 7.2 – 8.2 c/kWh
- Profitability depends on gate fees and value of heat

Ocean Energy Development in Ireland

- Ireland has the best wave energy environment in Europe
- 5 Ocean Energy Prototypes currently under development
- Challenges – efficiency, reliability, cost
- 1:4 Scale Test Facility – Galway
  - Safety
  - Site access requirements
  - Performance/scalability
- Government launched an Ocean Energy Development Strategy
  - 4 Phase programme to develop sector

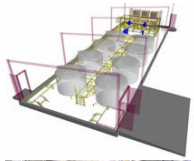


Wind Energy Challenges

- Grid access greatest issue in Ireland
- 3000MW of wind in grid planning
- Improved wind energy management essential for high wind scenario
  - Wind Farm Energy Forecasting
  - Demand side management – ind.
  - Increased use of local storage
    - Heat pumps (Geoth Atlas)/ Hot Water
    - Electric Vehicles
  - Distributed/Integrated Local Generation

Direct Electricity Storage

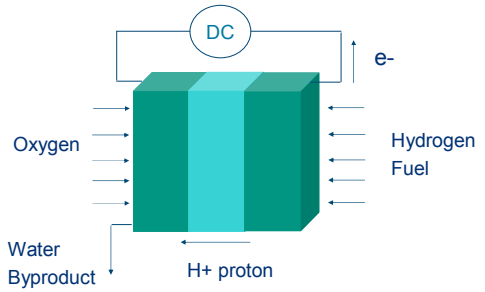
- Pumped Hydro –
  - 300MW Turlough Hill
  - High efficiency 85%, 30yr life
  - Cost, perform site dependent
- Flow Batteries –
  - 1.2MW Sorne Wind Farm
  - High efficiency 80%, 20yr life
- Hydrogen Fuel Cells –
  - Medium efficiency 40-50%
  - Portable fuel for transport



Hydrogen Economy & Fuel Cells

- Rationale for using Hydrogen:
  - Burning Hydrogen in a combustion engine will not produce Carbon Dioxide, however it will still produce NOx gases
  - Using Hydrogen in a fuel cell can eliminate all harmful vehicle emissions
  - Fuel cells can maintain good efficiency at part load
  - If H2 is the fuel of the future, Fuel Cell may be engine of the future
  - H2 must be manufactured from electricity or fossil fuels (steam reforming process)

Basic Principles of a Fuel Cell



Carbon Capture and Storage

Carbon Capture

- Post-Combustion Capture
  - Chemical absorptions with Amine
  - Low CO2 concentration 3-14%
- Pre-Combustion Capture
  - Steam reforming + water gas shift => CO2 + H2
  - High CO2 concentrations <60%
  - Potentially more efficient and cheaper
- Pre/Post can remove 80 to 90% of CO2

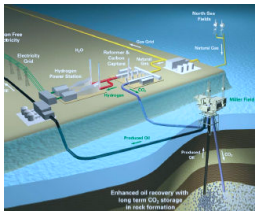
Carbon Storage Methods

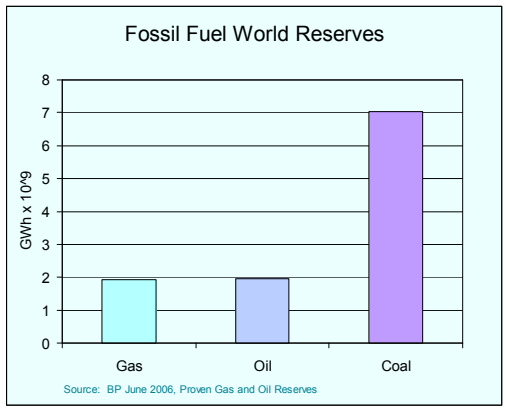
Method	Global Storage Potential (GtCO2)	No of Years of Storage World CO2 at 2003 Energy Rate
Depleted Oil & Gas Fields (including EOR/EGR)	2,000	80 years
Enhanced Coal Bed Meth	148	6 years
Deep Saline Aquifers	10,000	400 years

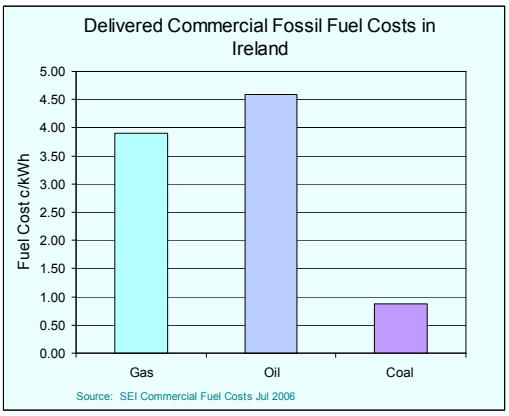
Source: IPCC Special Report "Carbon Dioxide Capture and Storage", IEA "Prospects for CO2 Capture and Storage"

UK Activities

- BP Peterhead EOR
  - 350MW H2 power station
  - H2 reformed from Natural Gas
  - 470mEuro, commencing in 2009
- RWE
  - Examining Clean Coal options for 1GW plant in Essex







International Activities

- EU FP7 research programme includes a technology platform for Zero Emission Fossil Fuel Power Plants
- UNFCCC – Scientific Meeting on Carbon Capture Bonn May 06
  - Good potential for geological storage with minimum CO2 leakage
  - Demonstration projects needed
  - Industry enthusiastic but need regulation to support investment
  - IPCC issuing methodologies for assessing CO2 saving of CCS
  - The integration of CCS with Emission Trading/Cleaner Development Mechanisms remains to be achieved

Summary of CCS

- IPCC Special Report indicated that by 2050 20-40% of global fossil CO2 could be suitable for capture.
- Cost of capture could be reduced by 30% with further R&D activity
- CCS could provide a starting point for a “hydrogen economy” – gasification is the cheapest option
- Could provide substantial reductions in CO2 for Ireland e.g. conversion of Moneypoint could reduce national emissions by 8% (in 2004, levels were 28% above 1990)
- Could provide low CO2 power support to Renewable Electricity

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