

Development of CCS in the UK

Australia All-Energy '09

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Engineering a sustainable future

PB – one of world's largest engineering consultancies

- Over 8,500 staff worldwide





PB

- Technical Adviser to UK Government on Carbon Capture and Storage (CCS)
 - UK CCS demonstration project
 - Competition for complete chain CCS project
 - 300 MW
- Role
 - Initial appraisal of potential UK schemes
 - Development of competition documents
 - Competition evaluation

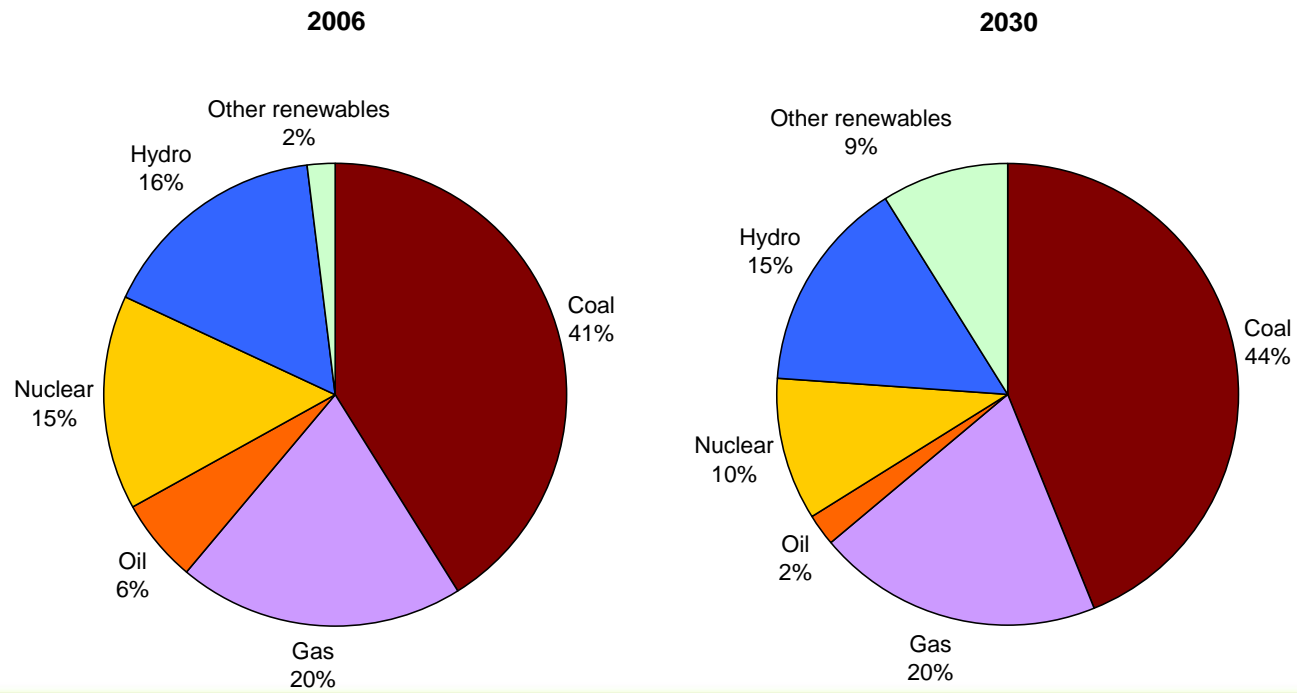


Contents

- Why coal & CCS?
- Generation Costs
- Challenges for clean coal CCS projects
- UK CCS demo project
- EU & UK perspectives

World Power Generation Fuel Mix

(based on present policies)



Source: International Energy Agency, World Energy Outlook, 2008

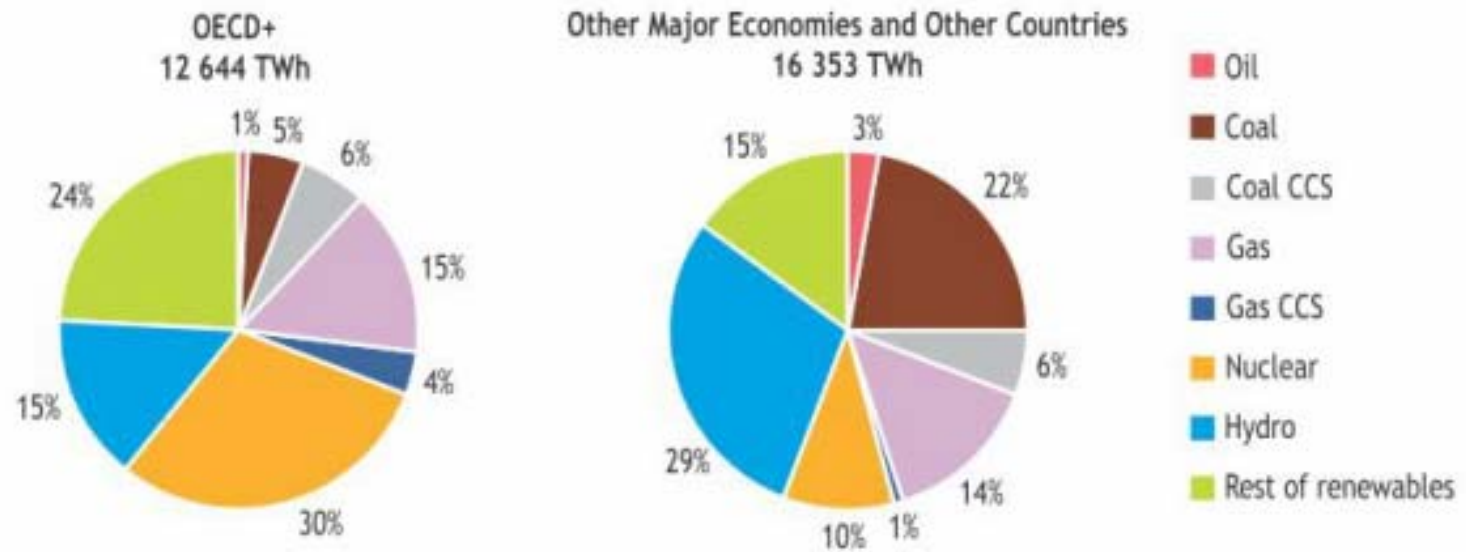
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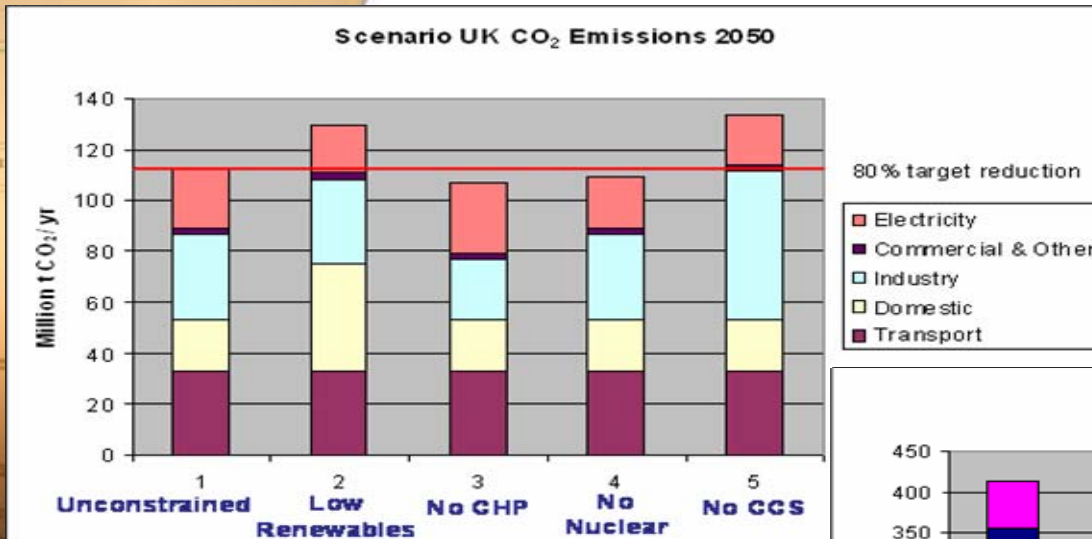
IEA - Climate Change Scenarios

- Reference scenario
 - Energy & CO₂ emission increase of 45% by 2030
 - 6°C average global temperature increase
- 550 scenario
 - Long-term stabilisation of greenhouse gas concentration at 550 parts per million of CO₂ equivalent
 - 3°C average global temperature increase
 - Carbon price \$90/tonne by 2030
- 450 scenario
 - Long-term stabilisation of greenhouse gas concentration at 450 parts per million of CO₂ equivalent 2030
 - 2°C average global temperature increase
 - Carbon price \$180/tonne by 2030

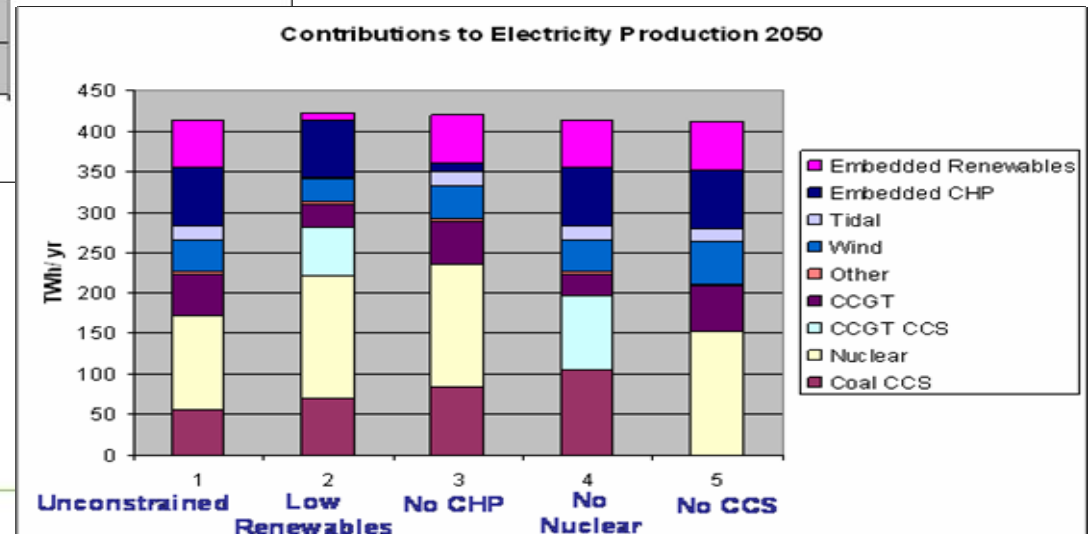
Electricity generation by fuel in IEA 450 Policy Scenario, 2030



PB - Powering the Future



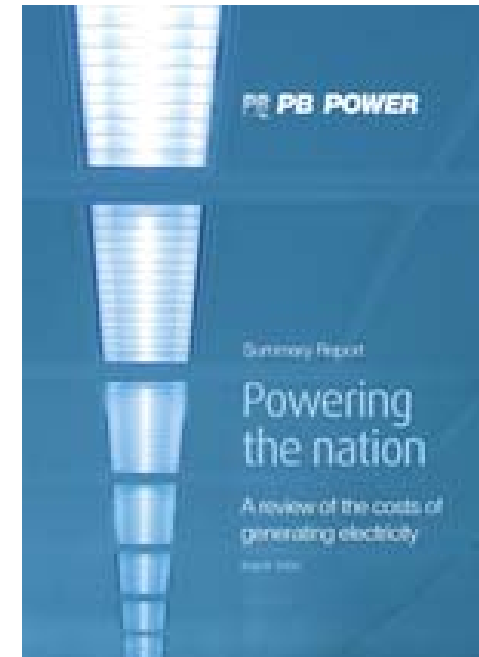
- Scenarios to deliver 80% reduction of CO₂ by 2050 across all CO₂ emitting sectors



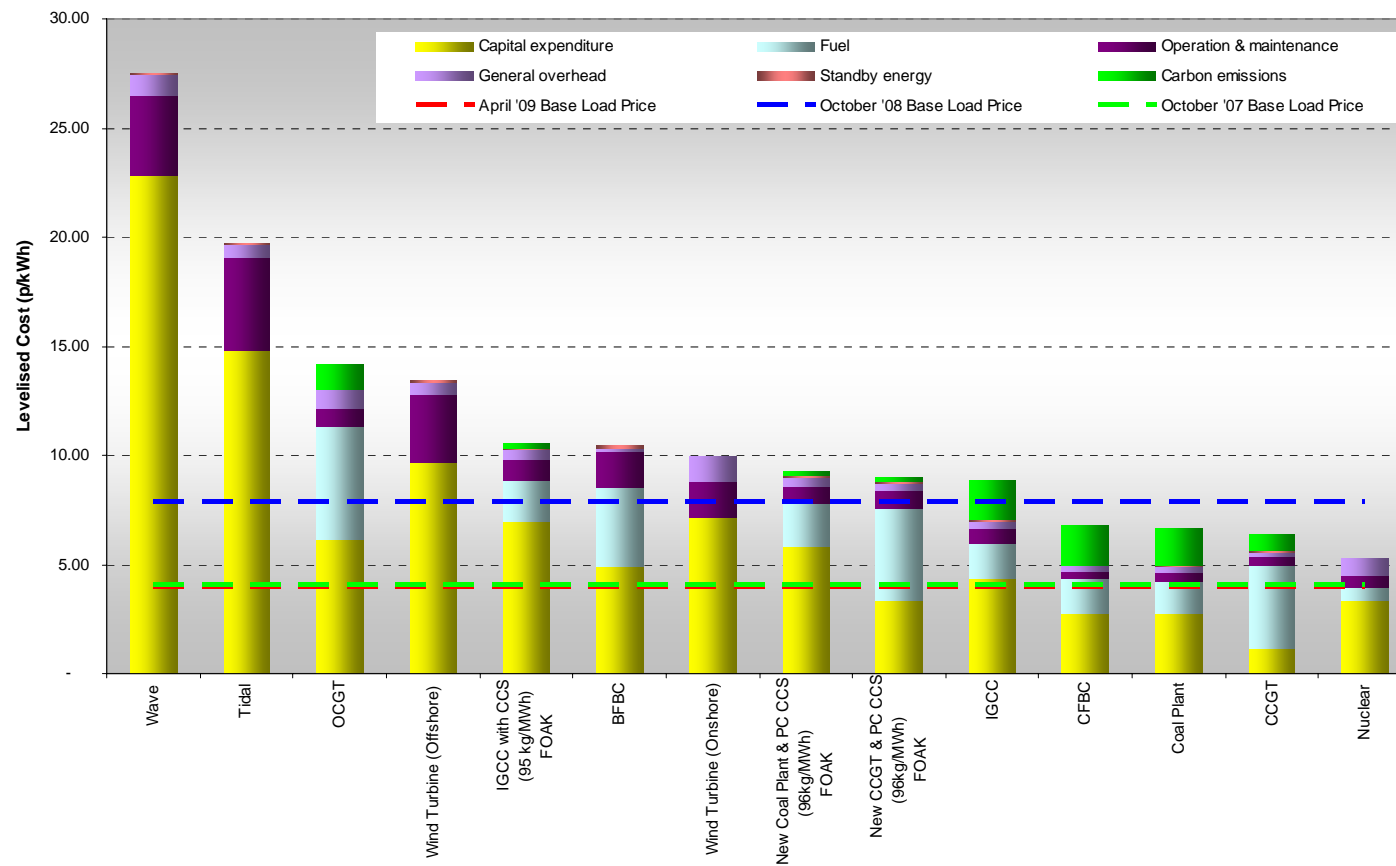
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Levelised Generation Costs

- Fuel Prices – DECC (UK Govt.) forecasts
 - Updated energy and carbon emissions projections report, November 2008
- Carbon Price 25 €/tonne
 - DECC Updated energy and carbon emissions projections report, November 2008
- Carbon Allowance: 90% until 2012, 0% from 2013 onwards
- 2009 capital prices



March 2009





UK generation requirements

- UK transmission system connects ~ **80GW** of generation to meet ~ **65GW** peak demand
- Circa **20GW** of existing generation due to close by 2020 (coal, oil & nuclear)
- 2020 targets require an additional **30** to **35GW** of renewable capacity
 - Plus thermal (fossil) back up plant as to cover intermittency of renewable energy i.e. wind has < 35% utilisation
- Security of supply / fuel diversity



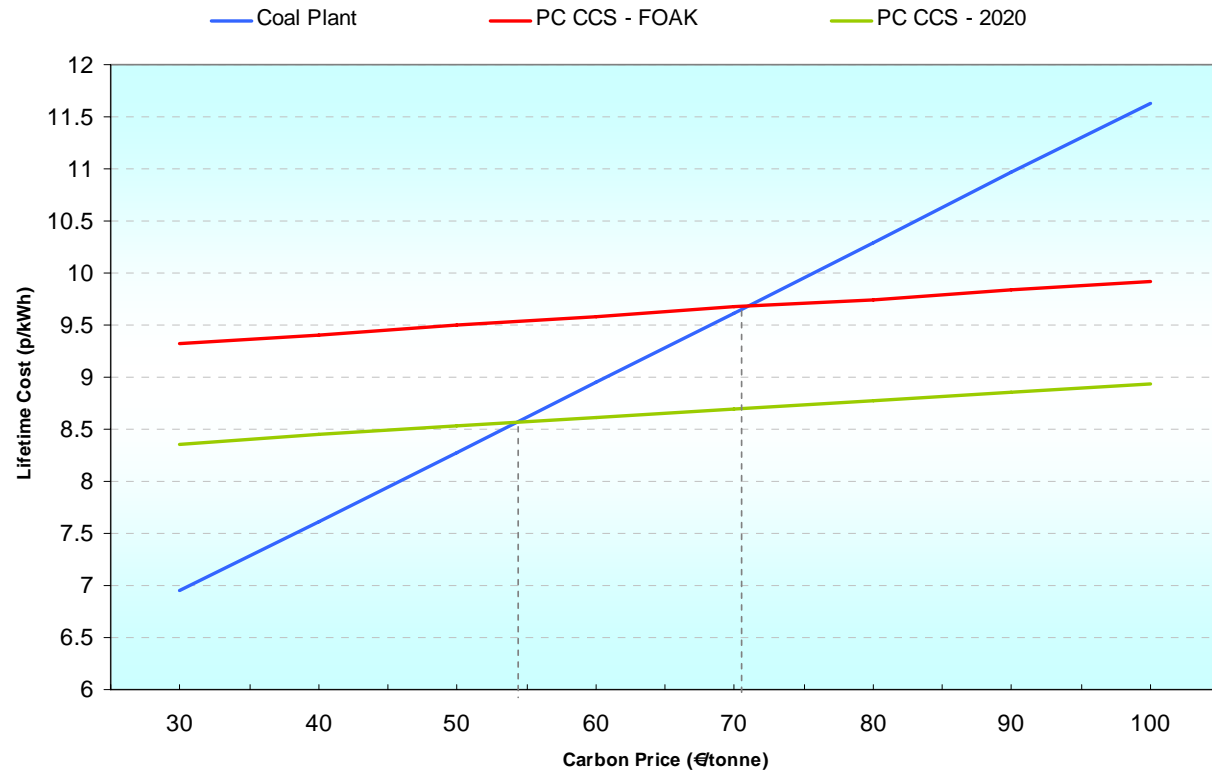
UK - what to build?

- **Renewable Energy – 30 to 35GW?**
 - Onshore wind – limited availability of sites / lower yields
 - Offshore wind – escalating costs
 - Biofuels, tidal – limited scale [*Severn barrage ~ 5GW+!*]
 - Development/investment in emerging technologies
- **CCGT – 10 to 15GW?**
 - Remains attractive option
 - But need fuel diversity to mitigate against high gas prices
- **Nuclear – 3GW?**
 - Capital & decommissioning costs
 - Public acceptance
 - Limited availability of sites
- **Coal (with some CCS) – 3GW?**

Typical impact of CCS on modern coal/IGCC plant

Efficiency before CCS	41 to 45%
Efficiency after CCS	34 to 37%
Approximate power reduction	20%
Typical Transport & Storage Capital Costs (based on 200 to 400 km pipeline)	180 to 1000 £/kW
- very much project specific!!!!	

Incentive to build CCS?



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New coal plant – project development challenges

- Capital costs, fuel prices?
- EPC or multi contract?
- Carbon price?
- CCS
 - Capture ready?
 - Full CCS?
 - By incentive or mandatory?
 - Costs?
 - Capture technology choice?
 - Transport & storage solution?
- Early CCS mover ‘obsolescence’ risk



UK CCS Demonstration Project

- 300 MW (net after CCS)
- Full chain
- Post combustion or oxyfuel technology
- 15 year operation
- Storage of 20 million tonnes of CO₂
- 3 pre-qualified bidders
 - EoN
 - PECCS (Peel Energy, RWE & Dong consortium)
 - Scottish Power

UK CCS Demonstration Project - timeline

2007 to date	Decision to proceed with competition Competition development Prequalification of Bidders Bidder consultation
Nov 2009	Submission of Bidder outline proposals
Feb to Dec 2010	Design & development stage for down selected Bidders
2011	Submission of Bidder final proposals & Contract Award
2014	Commencement of operation



UK Competition in EU context

- EU
 - commitment to a 20% reduction of CO₂ emissions by 2020 compared to 1990 levels, rising to 30% if global deal is reached
 - 20% of all energy to come from renewable sources by 2020
 - 100% EU Emission Trading Scheme (ETS) auction for power sector across most EU countries from 2013
 - 300 million EU ETS allowances to part-fund up to 12 CCS demonstration plants (Poznan, Dec 2008)
- United Nations
 - Copenhagen climate change summit – Dec 2009?

European Energy Programme for Recovery

C. CARBON CAPTURE AND STORAGE PROJECTS

Project Name/ Location		Envisaged Community contribution (EUR million)	Fuel	Capacity	Capture Technique	Storage Concept
Huerth	Germany	180	Coal	450 MW	IGCC	Saline Aquifer
Jaenschwalde			Coal	500 MW	Oxyfuel	Oil/Gas fields
Eemshaven	Netherlands	180	Coal	1200 MW	IGCC	Oil/Gas fields
Rotterdam			Coal	1080 MW	PC	Oil/Gas fields
Rotterdam			Coal	800 MW	PC	Oil/Gas fields
Belchatow	Poland	180	Coal	858 MW	PC	Saline Aquifer
Compostilla (León)	Spain	180	Coal	500 MW	Oxyfuel	Saline Aquifer
Kingsnorth	United Kingdom	180	Coal	800 MW	PC	Oil/Gas fields
Longannet			Coal	3390 MW	PC	Saline Aquifer
Tilbury			Coal	1600 MW	PC	Oil/Gas fields
Hatfield (Yorkshire)			Coal	900 MW	IGCC	Oil/Gas fields
Porto Tolle	Italy	100	Coal	660 MW	PC	
Industrial carbon capture project						
Florange	France		50	Transport of CO ₂ from industrial installation (steel plant) to underground storage (saline aquifer)		
TOTAL						1050

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UK Govt – 23 April 2009

- No new coal without CCS demonstration from day one.
- Full scale retrofit of CCS within five years of the technology being independently judged as technically and commercially proven.



UK Budget Statement – 22 April 2009

- Intention to put in place a mechanism to deliver up to four CCS demonstration projects, including both pre- and post-combustion coal projects.
- Subject to receiving suitable bids and being able to reach appropriate terms, it remains the Government's intention to proceed with the current competition to contract award.
- £90 million is being allocated to fund companies in the current competition to undertake detailed preparatory studies for CCS.



UK CCS Demonstration Project - Challenges

- **Complex procurement**
 - Negotiated Procedure, EU legislation, state aid rules
 - Fair treatment of Bidders / possibility of one Bidder receiving partial EU funding out with the competition
- **Regulatory uncertainty**
 - CO₂ storage regulations & long term storage liabilities?
 - Safety classification for onshore CO₂ transport?
 - Future requirement for full scale CCS?
- **Technical/project uncertainty**
 - Technical risk
 - Unresolved 'optioneering'
- **Knowledge transfer requirements**
 - Share knowledge / IP rights
- **Complex payment mechanism**
 - Major capital cost, operational costs dependent on carbon price, uncertain market despatch




final observations

Carbon Capture and Storage Challenges

- Reduce cost & improve performance
- 1st of a kind costs likely to be much higher than 2nd/3rd generation projects
- Funding/commitment for demo projects
- Bringing partners together to make projects happen





In advance of electricity markets which place sufficient value on CO₂ emissions

- CCS technology requires international government support, investment & collaboration for:
 - R&D
 - Pilot scale demonstrations
 - Commercial scale demonstrations
-to facilitate commercial deployment of CCS technology post 2020
- Otherwise
 - Failure to tackle climate change
 - Or greater cost burden for widespread implementation of 'sub-optimal' CCS technology
- Regulatory uncertainty may deter CCS / clean coal deployment
 - Investment requires long term clarity



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