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The challenges of low carbon technology demonstration and deployment: The case of carbon capture and storage

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Agenda

1. Context: Why is CCS important?
2. International progress so far
3. Case study of UK CCS policy
4. Conclusions

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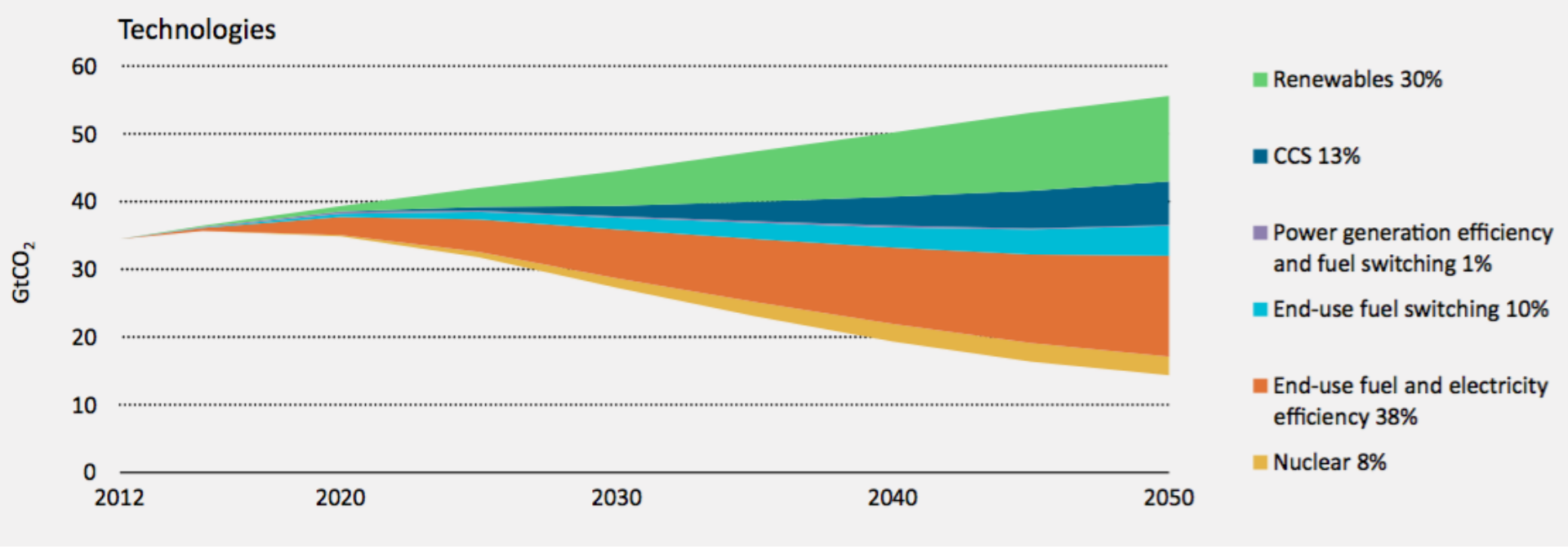
CCS and the low carbon transition

- CCS often seen as essential to meet global climate change targets (e.g. 2 degree limit on warming)
- Meeting targets likely to be more expensive without CCS available (e.g. 2 x more expensive in the UK)



Source: IEA Energy Technology Perspectives (2015)

Policy drivers for CCS

- **United States**: Climate change; technological leadership / industrial policy; importance of coal / fossil fuel industries in some States; regional greenhouse gas initiatives
- **Canada**: International pressure to 'clean up' unconventional fossil industry; large resources sector; decentralised responsibility for natural resources
- **UK**: Climate change; international diplomacy, domestic climate change targets; industrial policy

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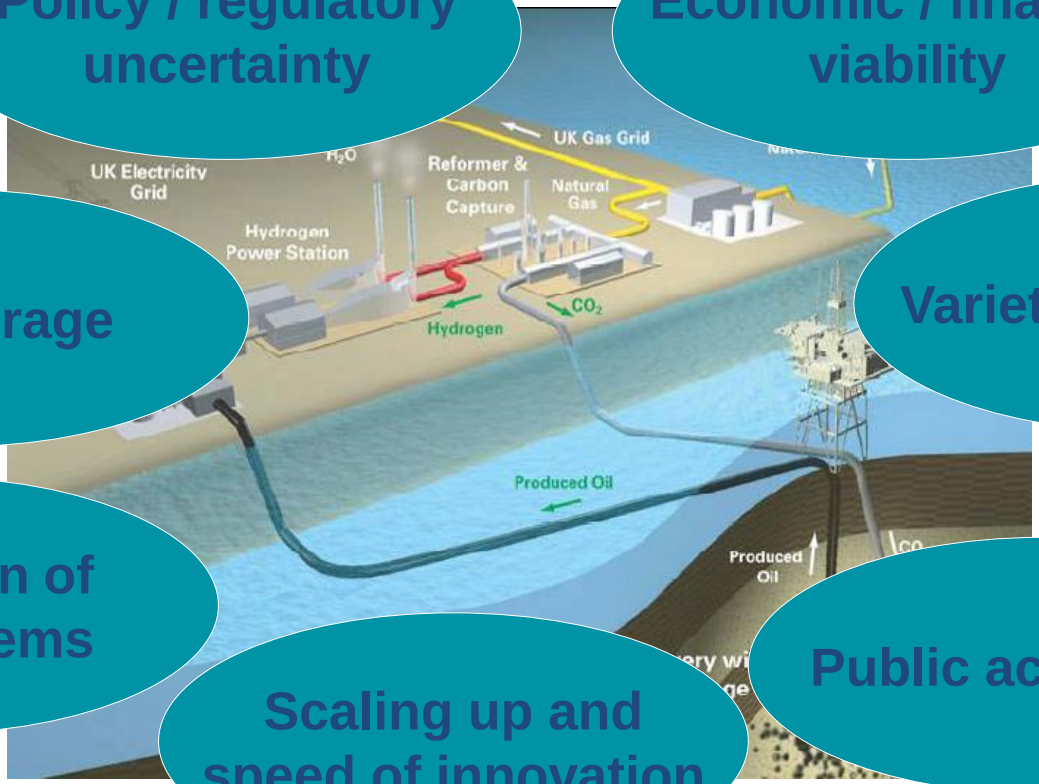
But CCS has multiple uncertainties



Policy / regulatory uncertainty

Economic / financial viability

Safe storage

Variety of pathways

Integration of CCS systems

Public acceptance

Scaling up and speed of innovation

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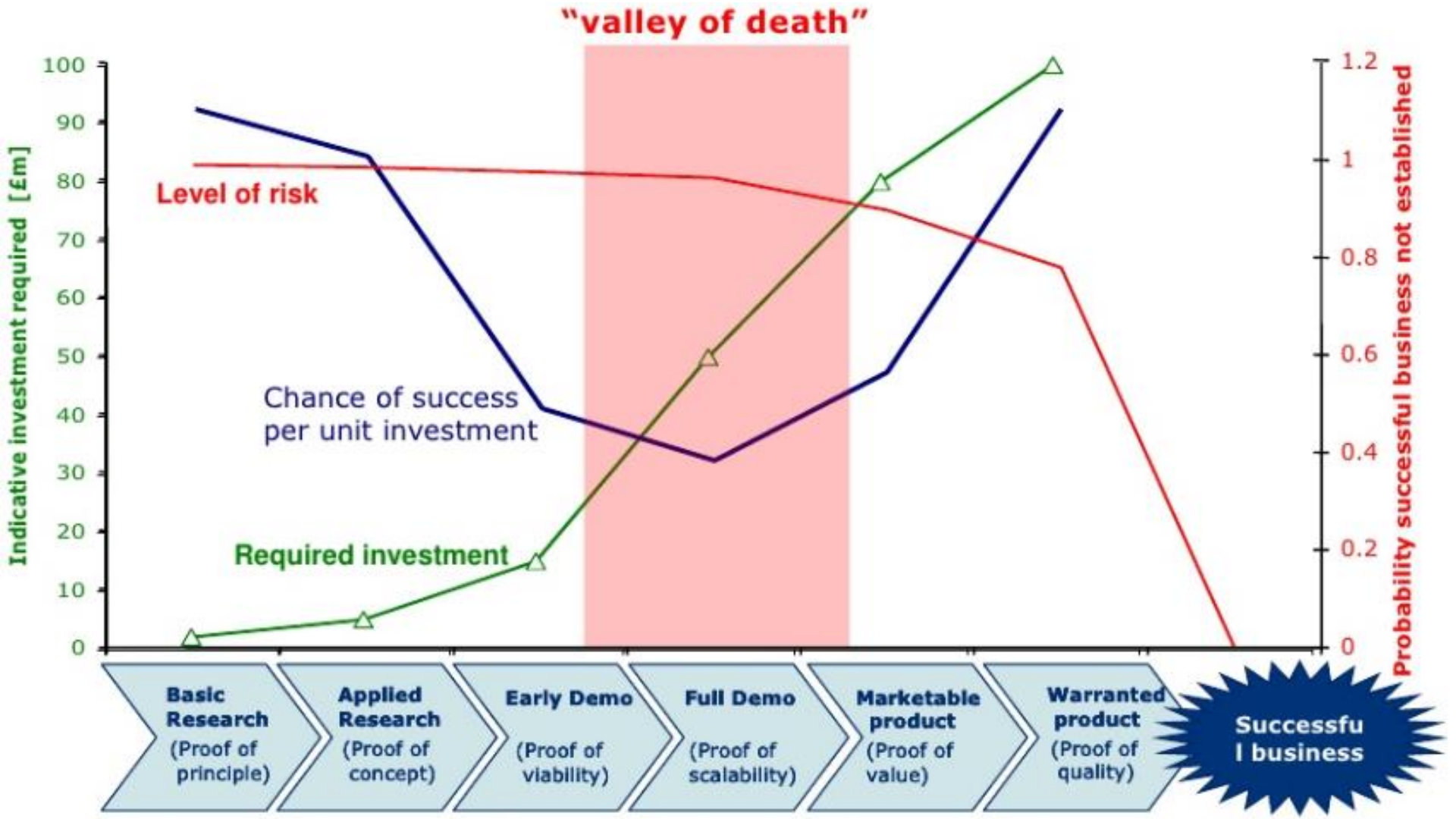
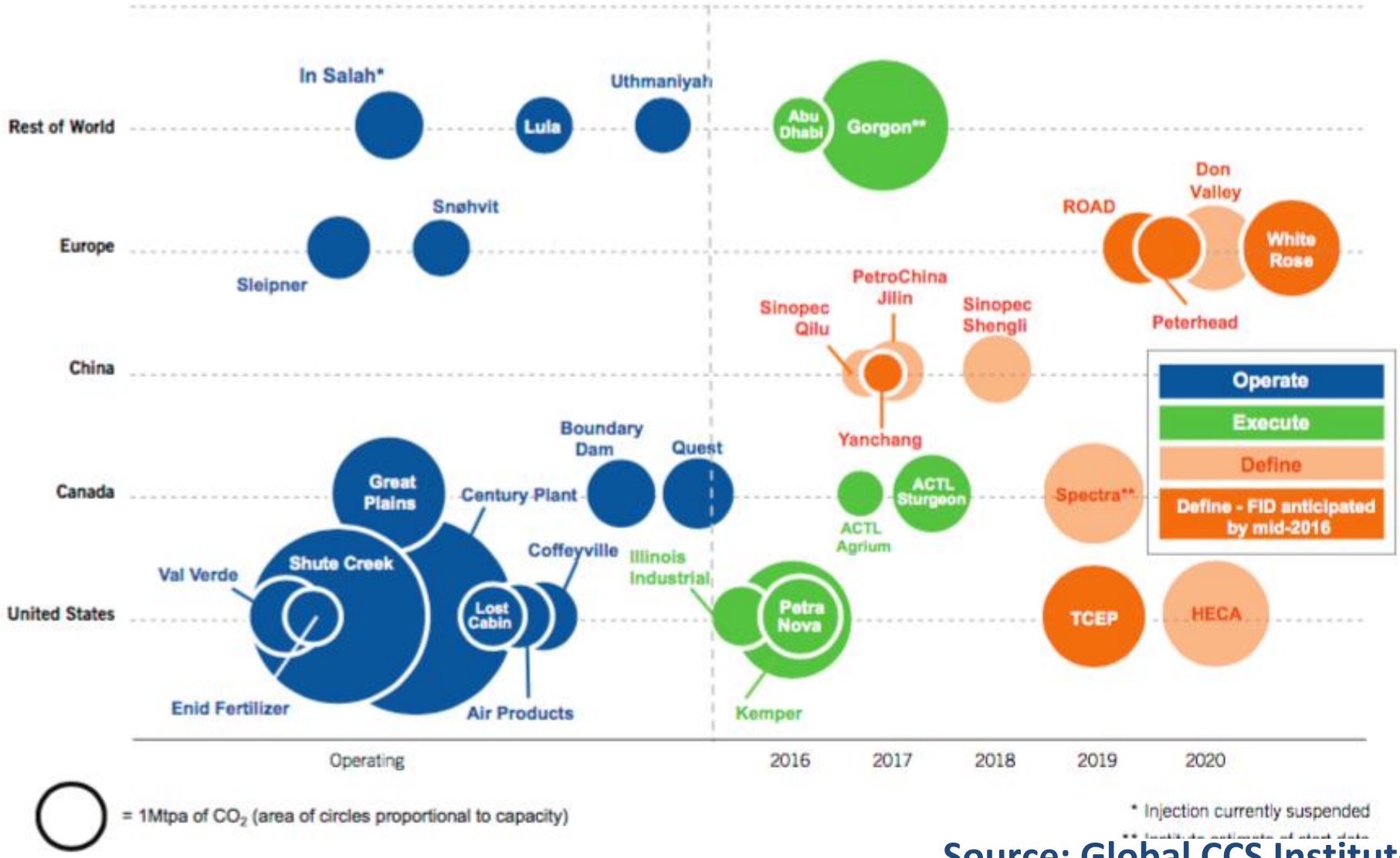
Why technology demonstration is difficult



Source: The Carbon Trust

Global status of CCS



Source: Global CCS Institute

Global status of CCS: a difficult history

'The most frequently cited reason for a project being put on-hold or cancelled is that it was deemed uneconomic in its current form and policy environment. The lack of financial support to continue to the next stage of project development and uncertainty regarding carbon abatement policies were critical factors that led several project proponents to reprioritise their investments, either within their CCS portfolio or to alternative technologies'

Global CCS Institute 2011

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Comparing the USA, Canada & UK

Country	Project	Capital grant	Carbon price	EPS	Electricity contract	EOR
Canada	Boundary Dam (Saskatchewan)	Yes (tax c	o	Yes	Regulated monopoly utility	Yes
	Weyburn-Midale (Saskatchewan)	Yes (	o	n/a	Not applicable (synfuels plant)	Yes
USA	Port Arthur (Texas)	ital ax	No. Production subsidy per tonne of stored CO_2	n/a	Not applicable (steam methane reforming)	Yes
	Kemper county IGCC (Mississippi)	es ($270m from US DoE & ITCs)	No.	Yes	Regulated monopoly utility	Yes
UK	Peterhead	Yes (UK	Yes	Yes	Competitive market; long-term contract with government	No
	White Rose	Government; NER300 application)		Yes	Competitive market; long-term contract with government	No

Operational

Delayed and over budget

Government funding cancelled

Source: Jones and Watson (2015)

Abbreviations: EOR = Enhanced Oil Recovery; EPS = Emissions Performance Standard; ITC = Investment Tax Credit

UK CCS policy

'[The UK should] take maximum advantage of opportunities for international collaboration, whilst fostering a competitive UK capability to design, manufacture and operate CCS systems. The ultimate goal should be full scale demonstration of CCS that will showcase UK technologies and capabilities'

DTI *Review of the Feasibility of CCS* (2003)

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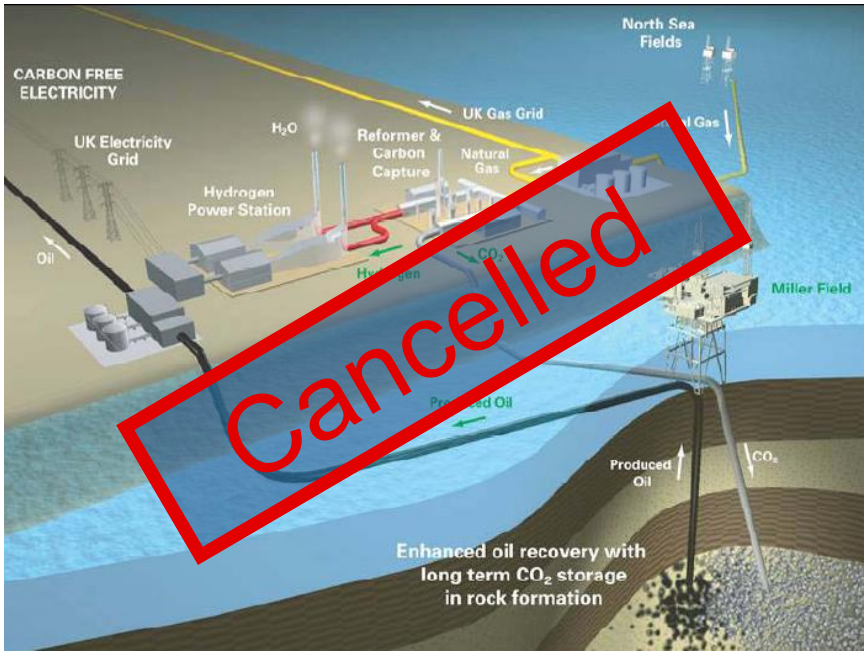
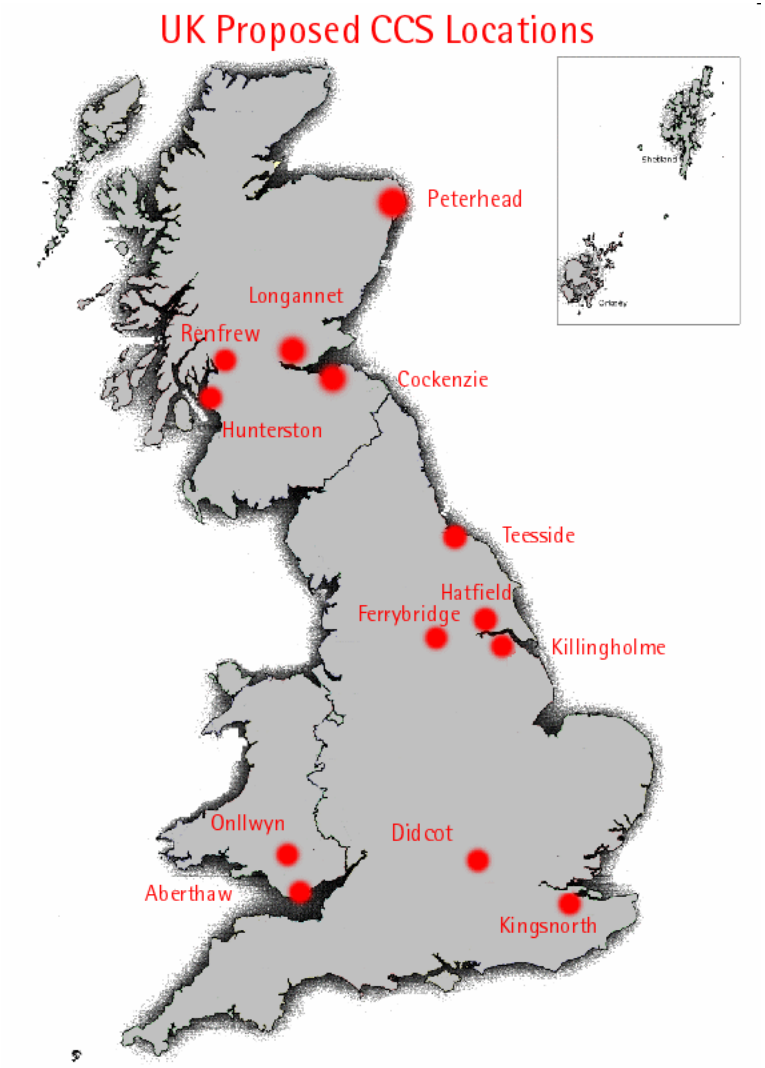
UK CCS policy: Plan A

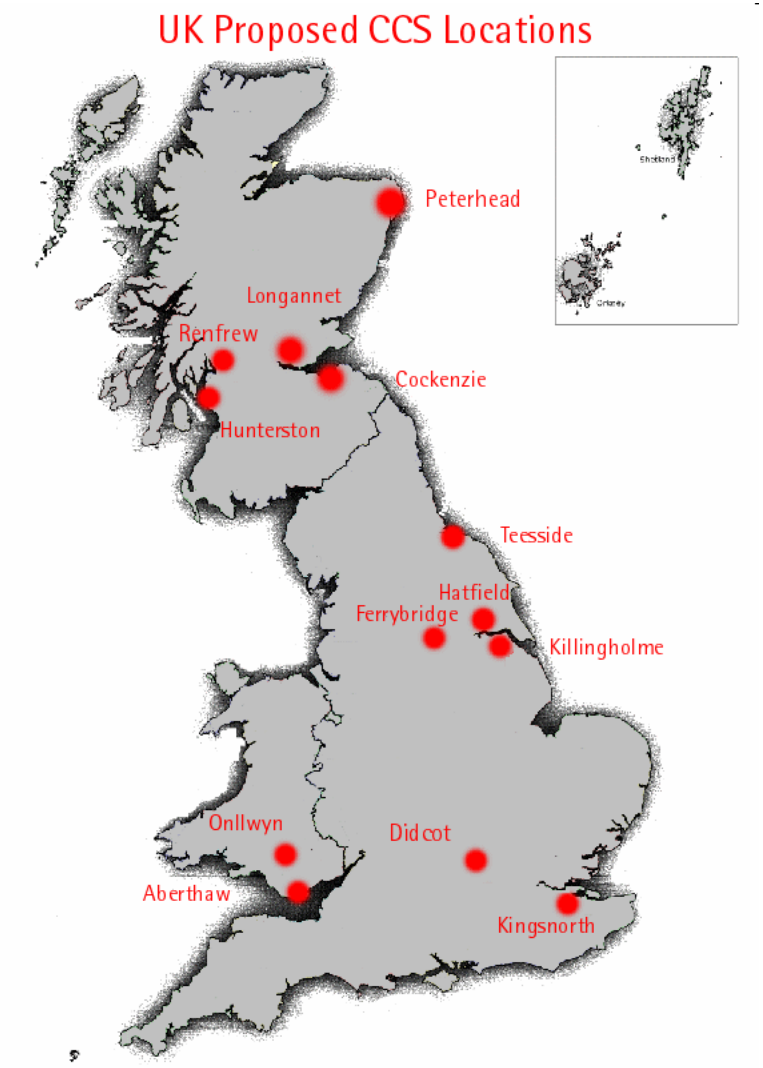
- BP proposal for CCS plant at Peterhead in mid-2000s
- But too early for government to commit funding





UK CCS policy: Plan B

- First competition with government funding in 2007
- Focus on post-combustion CCS at a coal-fired plant



UK CCS policy: Plan B

Developing new technologies is an inherently risky undertaking. Taking calculated risks is perfectly acceptable if those risks are managed effectively; but in this case DECC, and its predecessor, took too long to get to grips with the significant technical, commercial and regulatory risks involved …

The Department must learn the lessons of the failure of this project if further time is not to be lost, and value for money achieved on future projects

Amyas Morse, Head of National Audit Office

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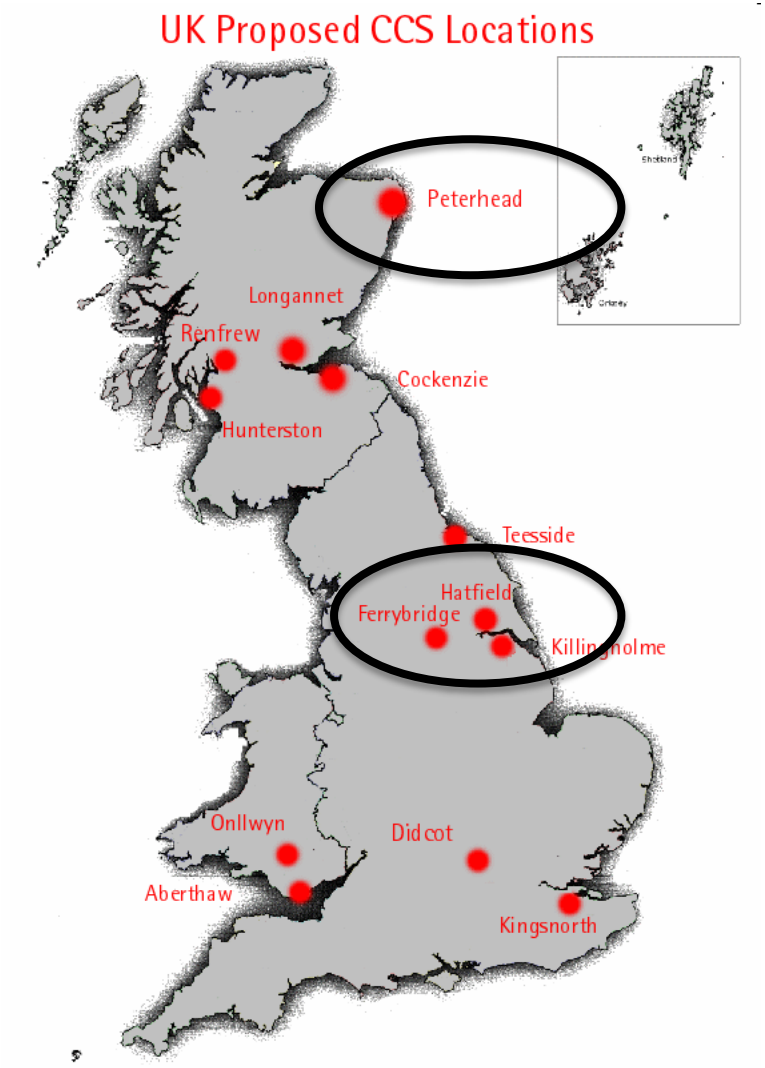
UK CCS policy: Plan C

- New competition in 2012
- More technology neutral approach (coal or gas)
- Capital grants plus contracts for power generated
- Two projects awarded money for engineering design work
- EU funding for White Rose

Cancelled



UK CCS Policy: Plan C

'Governing is about making decisions, and it seemed to me that the right decision was to say that we would not go ahead with the £1 billion, because that is £1 billion that we can spend on other capital investment projects, including energy projects such as making progress on energy storage or modular reactors'

David Cameron, Liaison Committee, 12th Jan 2016

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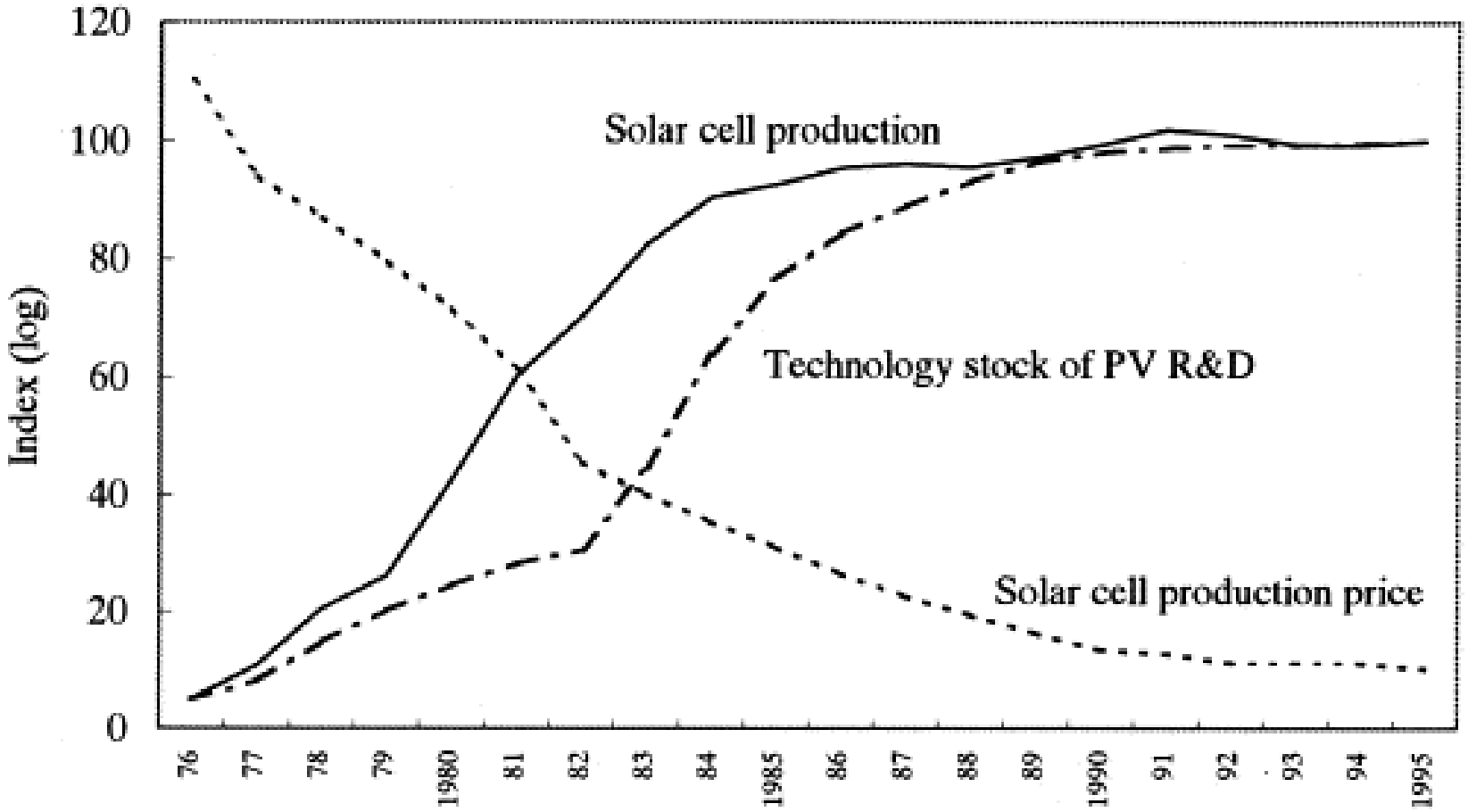
UK CCS policy: Plan C

Costs often fall with increasing deployment



Source: Watanabe et al, 2000

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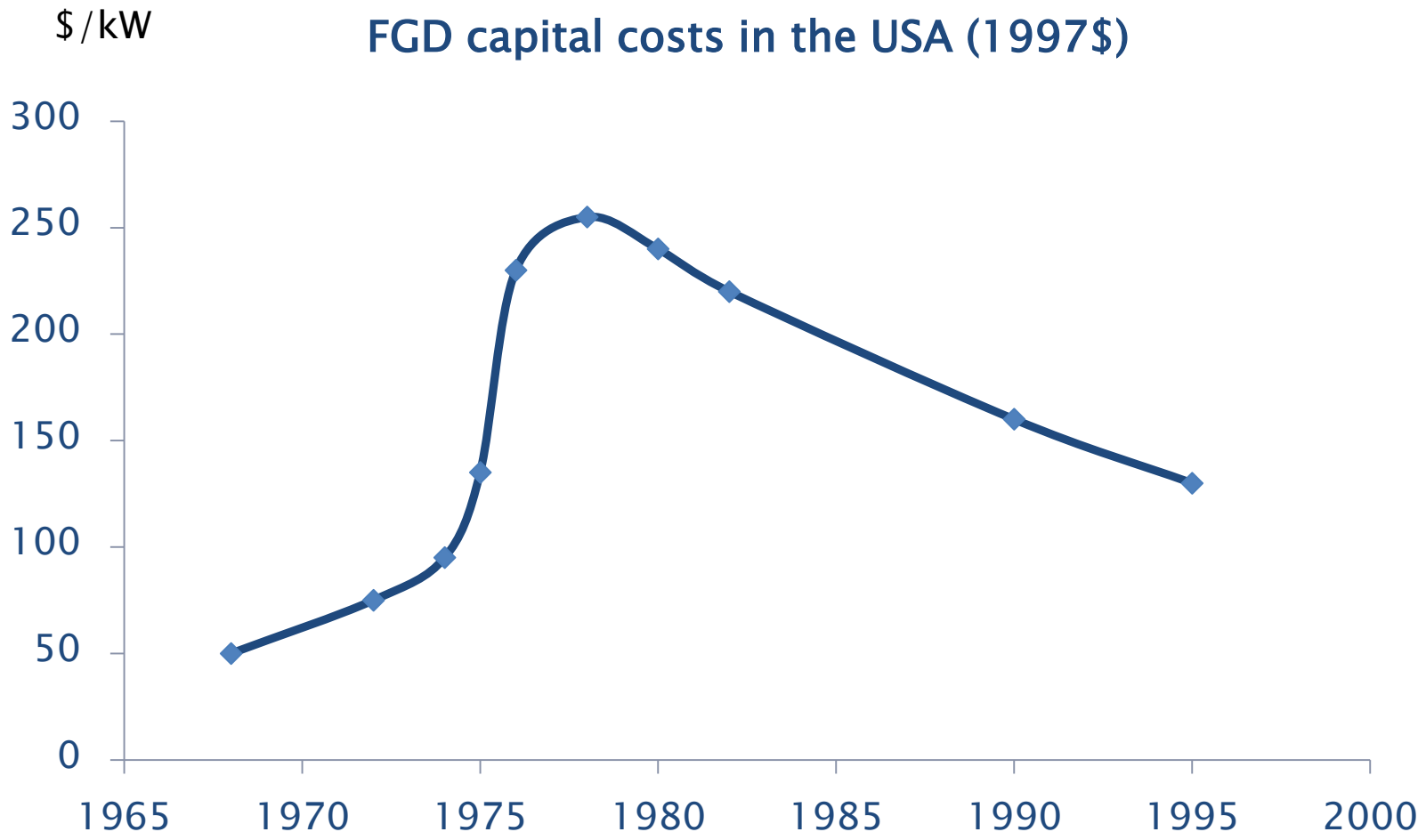
UK CCS policy: Plan C

Sometimes, costs rise in early deployment



Source: Rubin et al, 2004

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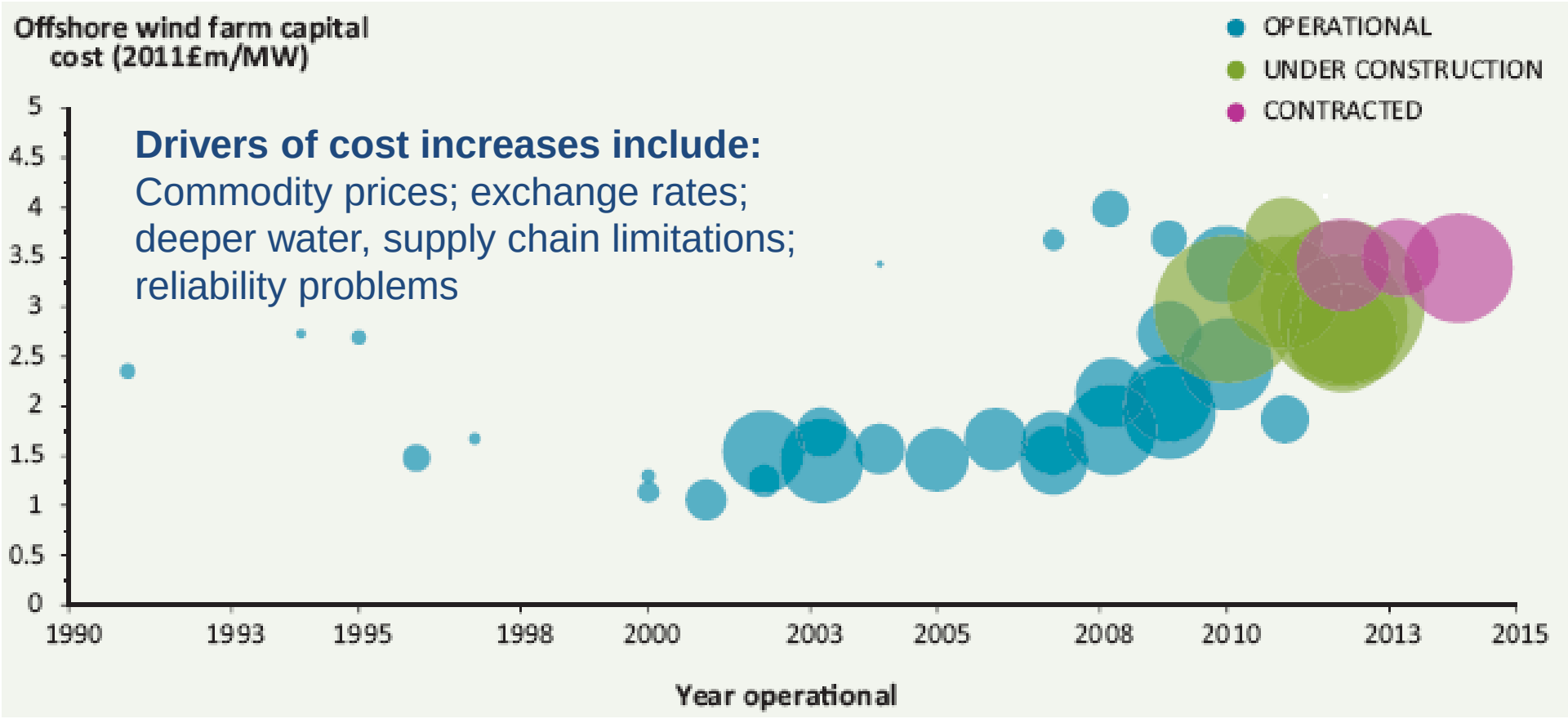
UK CCS policy: Plan C

Sometimes, costs rise in early deployment



Drivers of cost increases include:
Commodity prices; exchange rates; deeper water, supply chain limitations; reliability problems

Source: The Crown Estate (May 2012)

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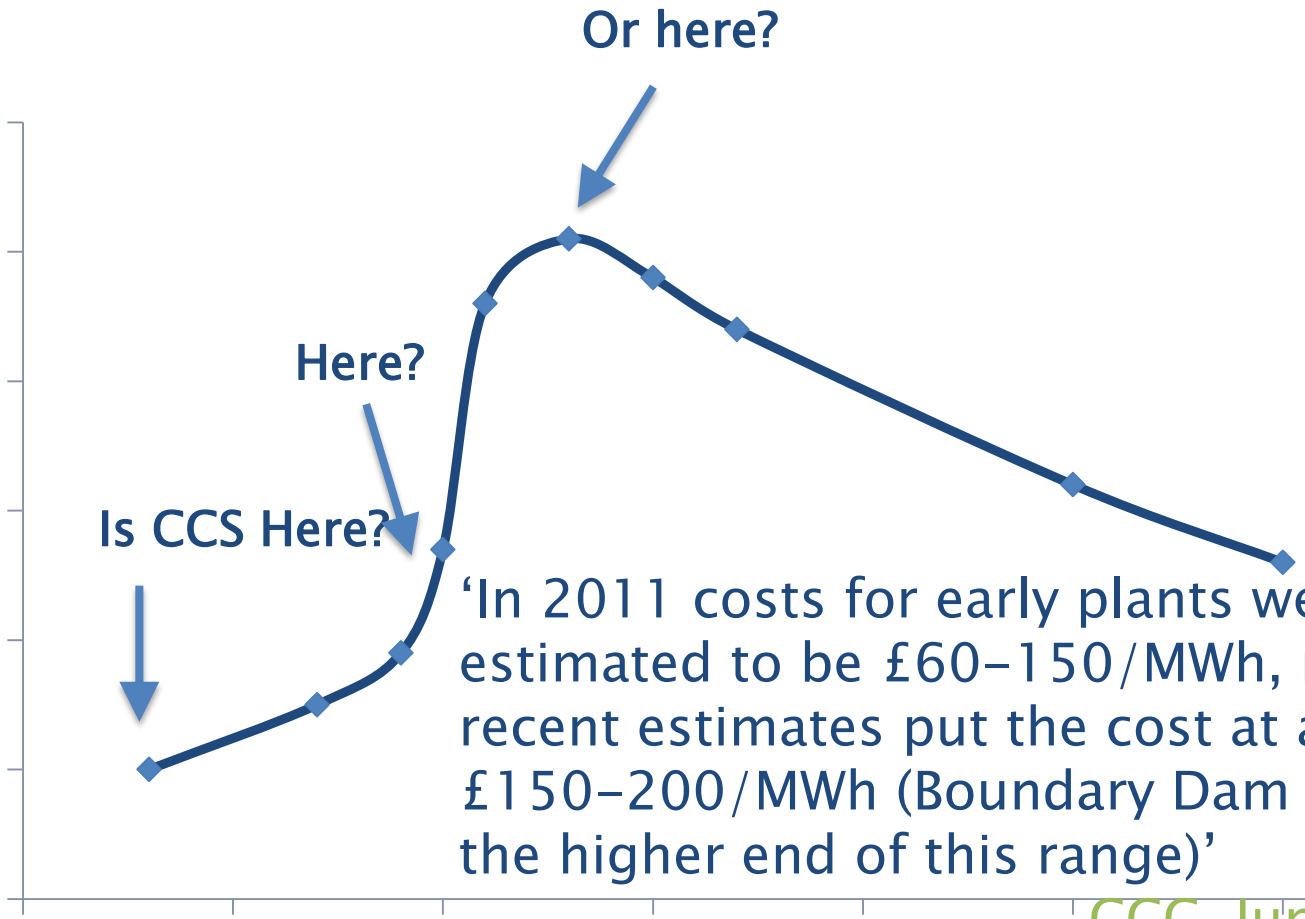
UK CCS policy: Plan C



'In 2011 costs for early plants were estimated to be £60–150/MWh, more recent estimates put the cost at around £150–200/MWh (Boundary Dam was at the higher end of this range)'

CCC, June 2015.

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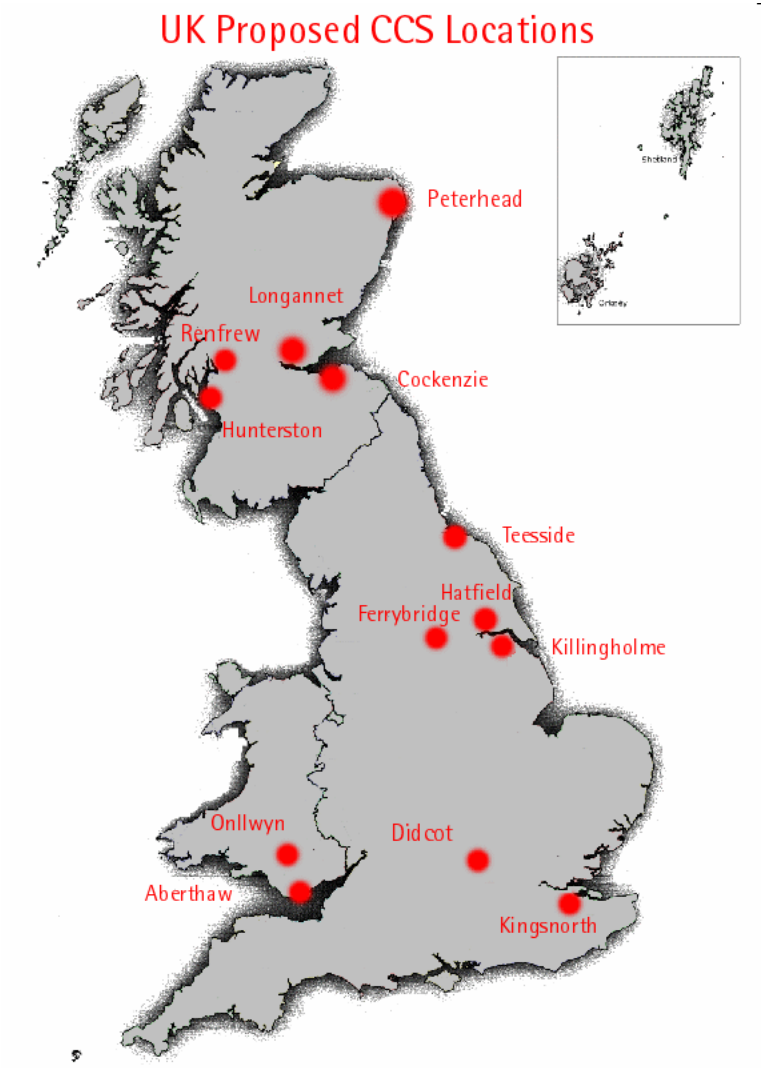
UK CCS policy: Plan D?

- Not clear what will come next, apart from continued R&D
- Can UK 'buy' CCS when other countries have reduced costs?
- But many other demonstration plans also in trouble
- CCS is not a solar panel: much of system is location specific
- Refocus on regulated investment in pipelines & storage for power & industry?



Conclusions

- Many assessments conclude CCS technologies are essential to tackle climate change
- Multiple uncertainties for CCS: technical, economic, policy, social and environmental
- Demonstration of large-scale technologies like CCS has high costs and high risks: the 'valley of death'
- History shows that these challenges can be overcome
- But patience required: costs sometimes rise before learning effects dominate
- A large gap remains between CCS ambitions and current policies / global demonstration activity

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Thanks

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