







Developing CCS in the UK

For

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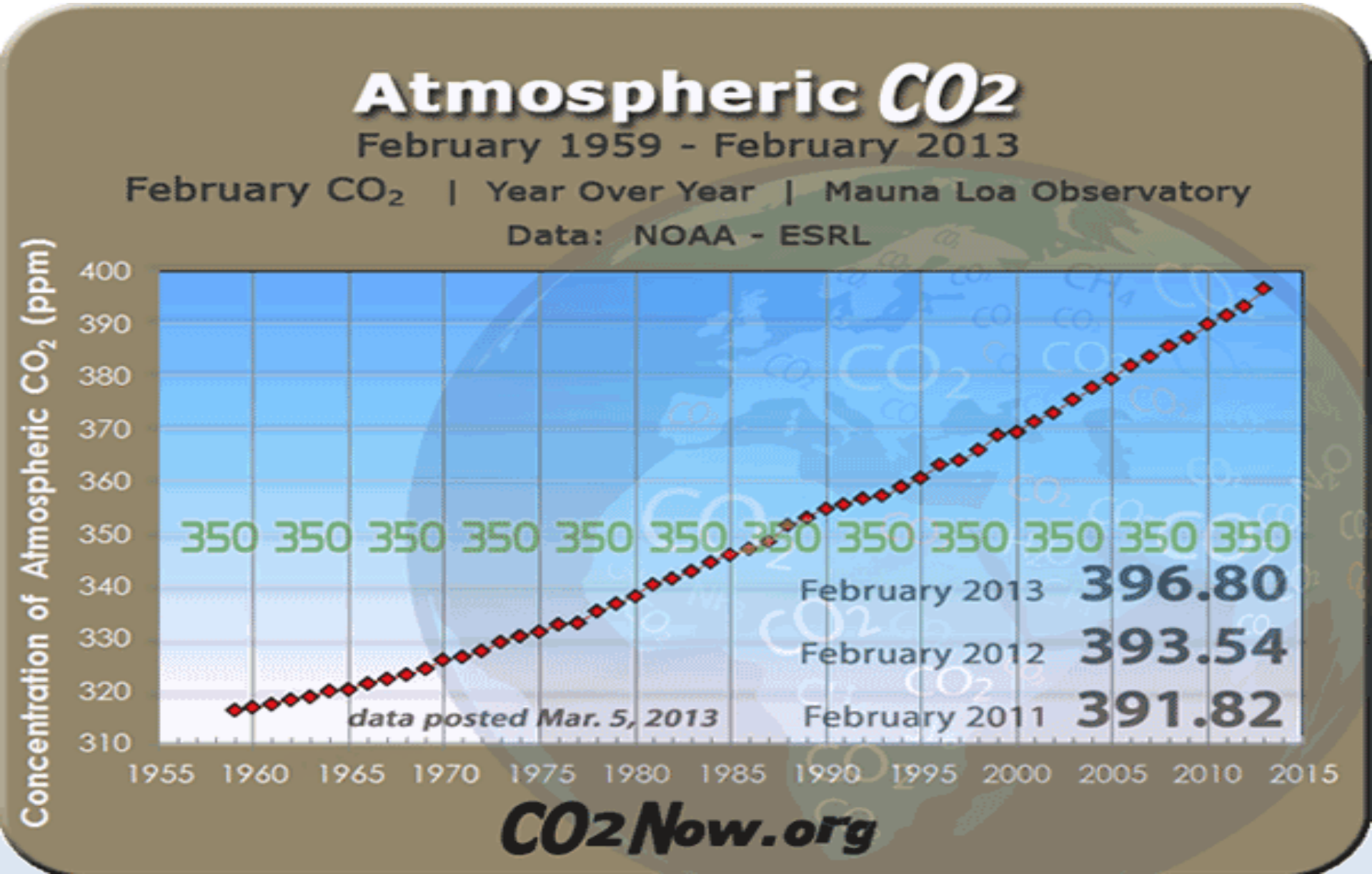
Outline

- Why CCS?
- Where we are today with CCS?
- Where might we like to get to?
- What are the barriers to getting there?
- How might we get from where we are to where we want to be?

CO_2 industrial and power emissions are still rising…



Why CCS?

- Most UK, European and global energy scenario modelling predict continued use of fossil fuels in power and industry for many decades.
- Unabated CO_2 emissions will lead to significant human impacts from climate change.
- CCS deployment could be very large scale (Gt/yr), feasible and cost competitive (£/t or £/MWh) with alternative in many parts of the world.
- Cheap low carbon electricity/hydrogen enables decarbonisation of heat and transport (in addition to power and heavy industry).
- Large scale deployment of CCS could reduce the costs of meeting 80% CO_2 reduction targets by more than 50% under several plausible scenarios.
- Alternative CO_2 reduction measures still necessary, but also hard to implement.

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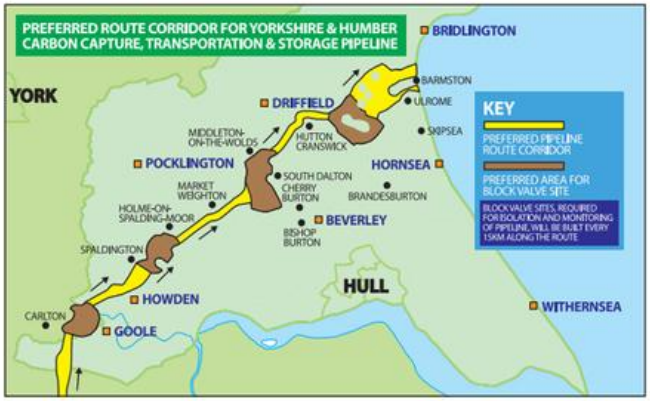
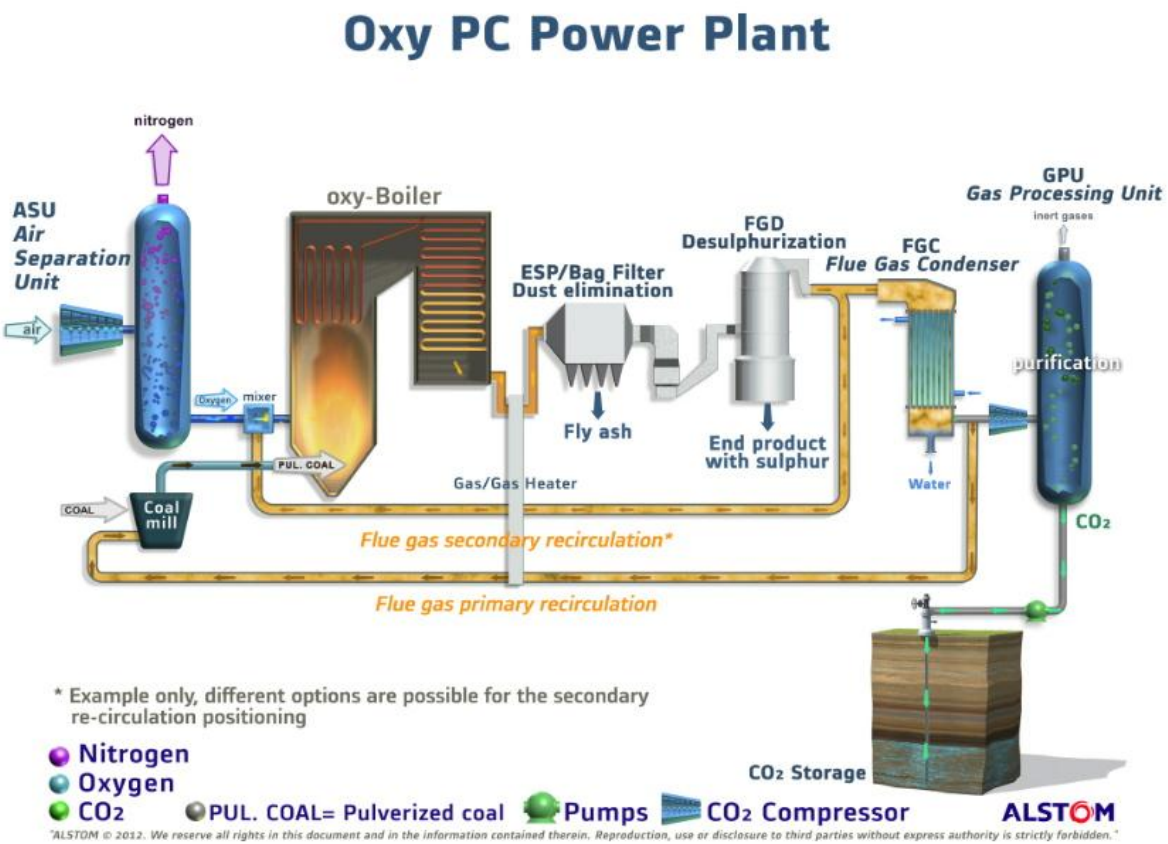
Where is the UK today with CCS?

- Cross-party political and trade association support, driving improving economic and regulatory environment for CCS.
- Experience of the challenges, as even “unsuccessful” projects deliver valuable learning to industry, Government and wider stakeholders.
- Two projects shortlisted for DECC commercialisation programme (up to £1bn capex + Feed-in Tariff support under EMR)
- Academic and industrial R&D and UK supply chain potential to participate in demo and eventual £trillion global CCS market (but intense global competition)
- Need to build new power stations soon
- Some clusters of emitters are developing plans for CCS networks
- Multi Gt theoretical offshore storage capacity identified, although only a handful of sites examined in detail

White Rose CCS Project





SSE Peterhead – Shell Goldeneye CCS Project

http://www.shell.co.uk/gbr/environment-society/environment-tpkg/peterhead-ccs-project.html

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Take advantage of better economics for plant operating with CCS in the 2030s (as long as it is capture ready)

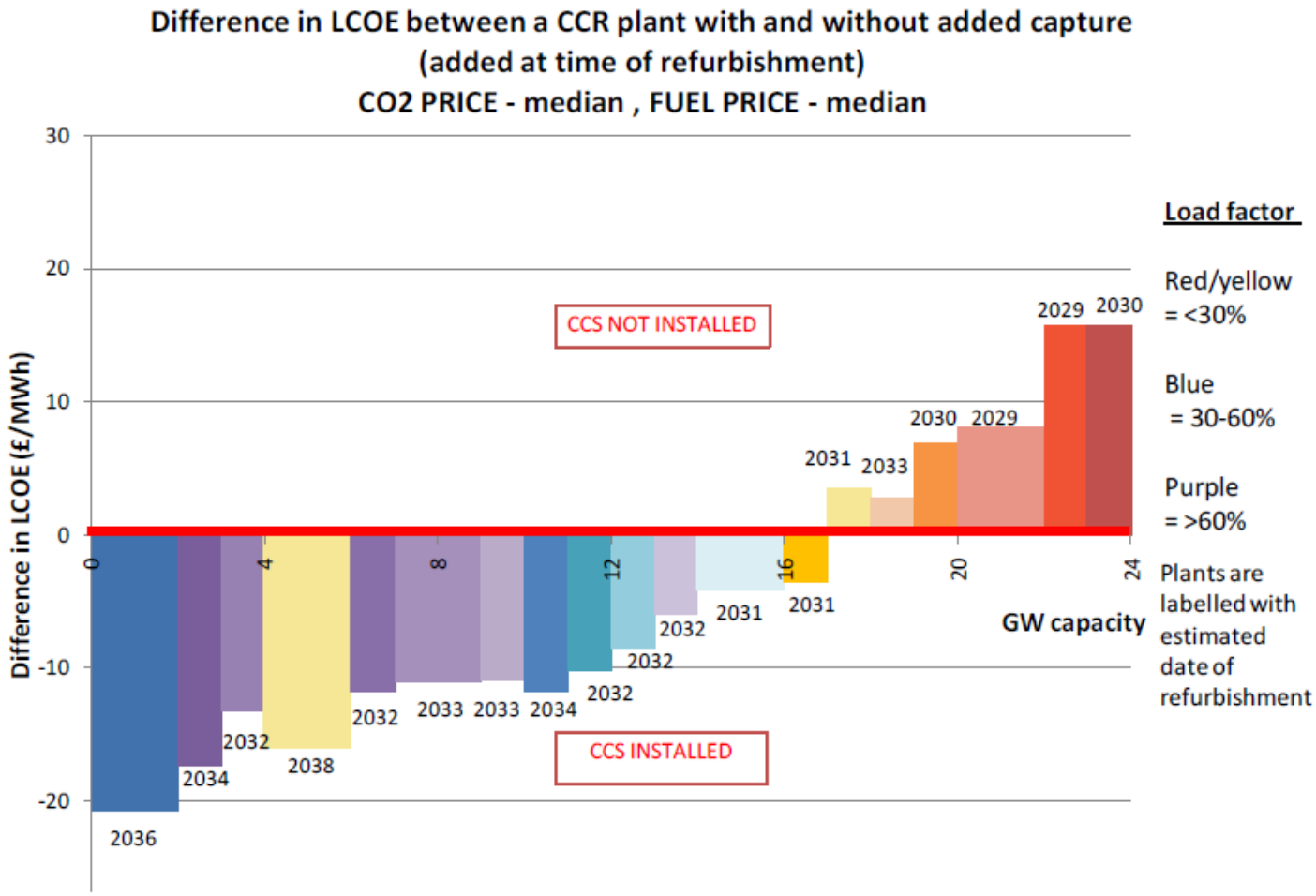
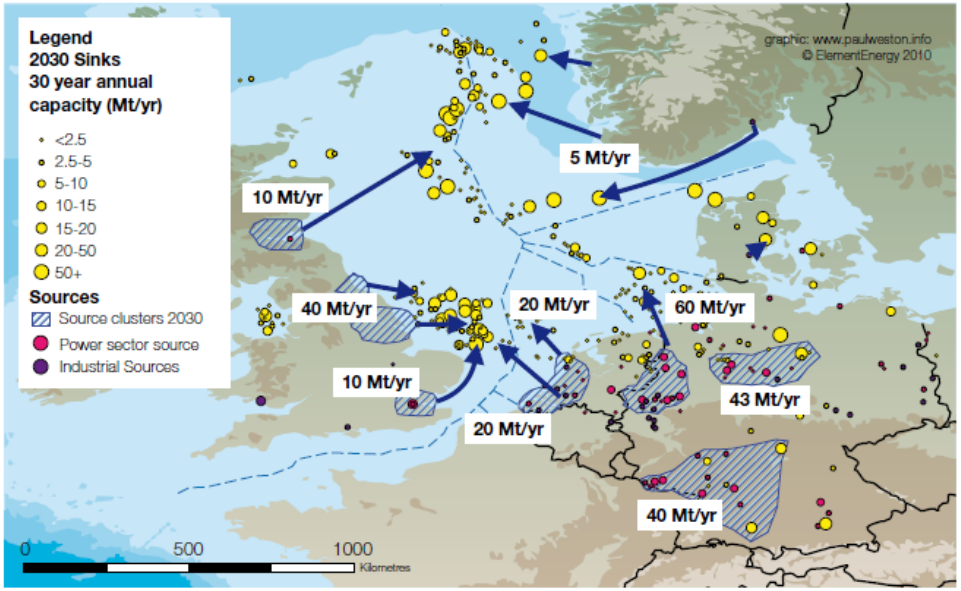
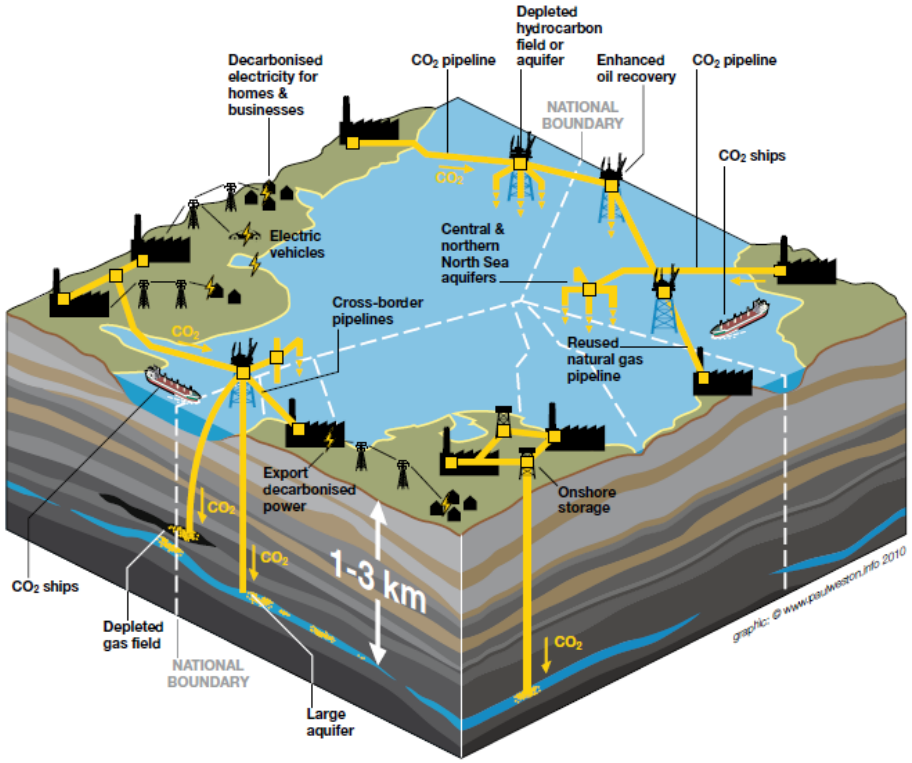


Figure 36 Difference in LCOE for CCR plants with and without capture, at time of refurbishment.

Ref: Element Energy et al. 2009 Report for the CCC

The highest CCS deployment scenarios would involve CO_2 transport and storage infrastructure in the North Sea in the 2030s with capacity comparable to the oil and gas networks.





For the UK sector, net present offshore CO_2 transport and storage costs are £2-16bn for period to 2030, depending on how we develop it.

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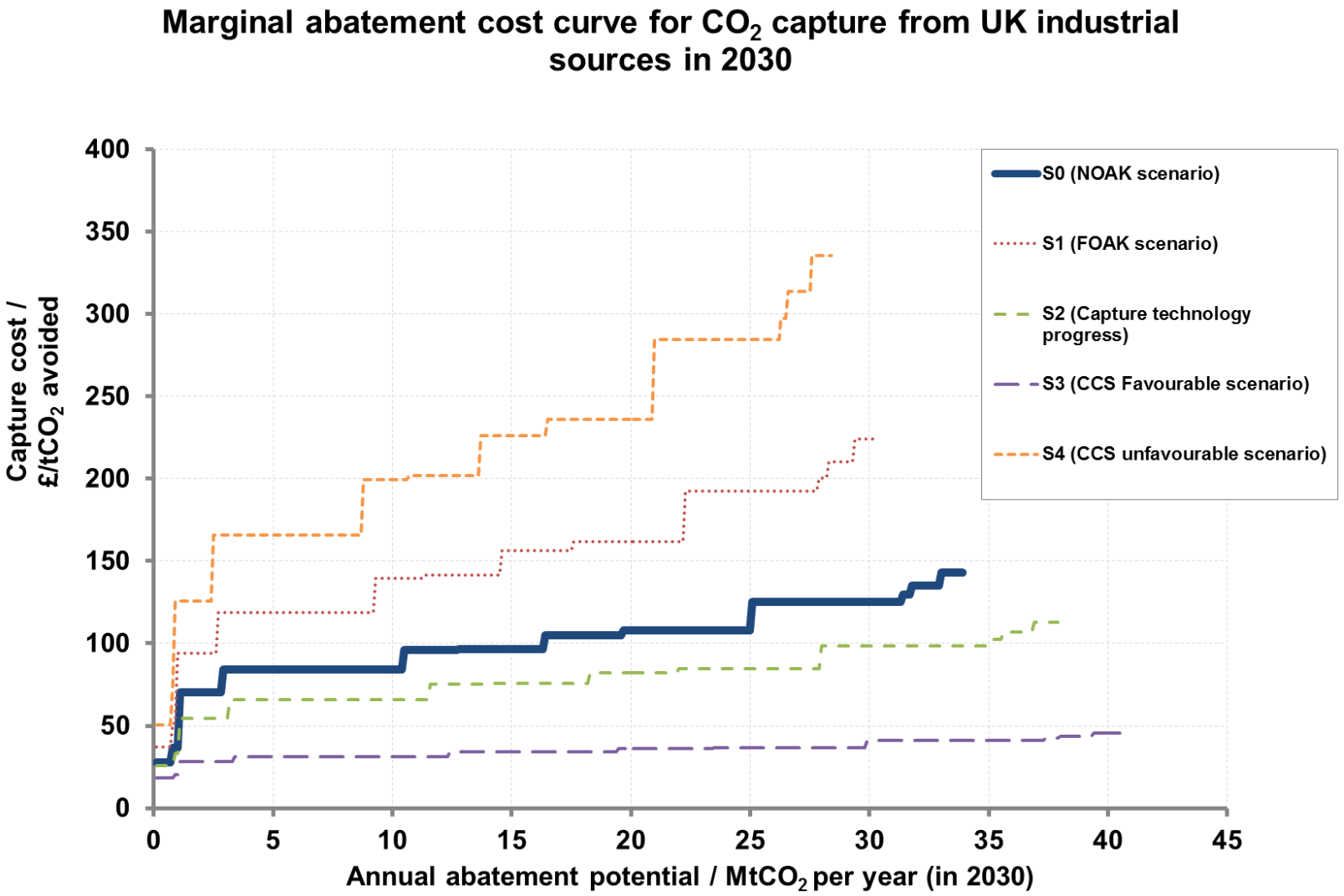
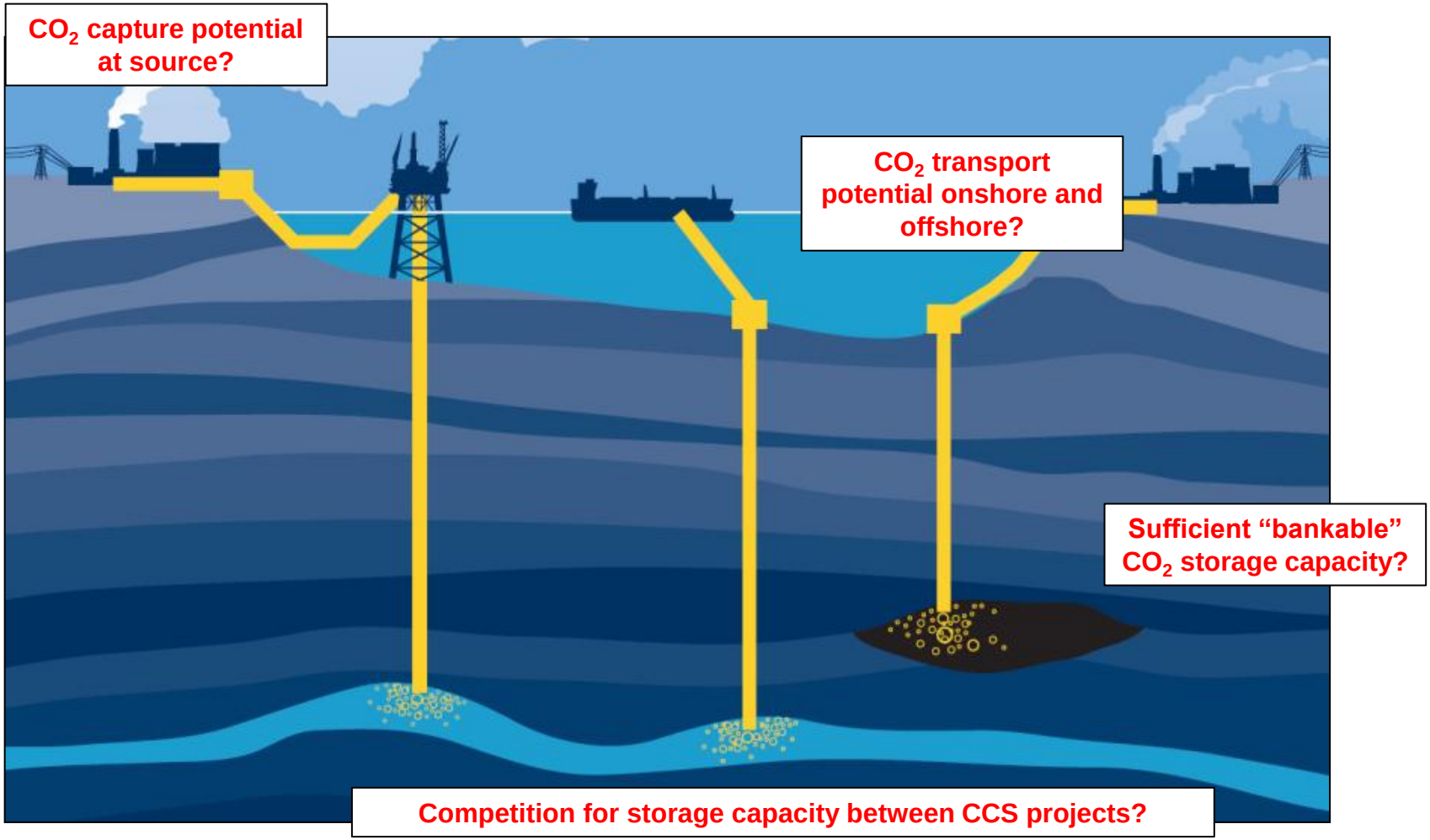
Diverse challenges to retrofitting CCS for UK industrial sources.

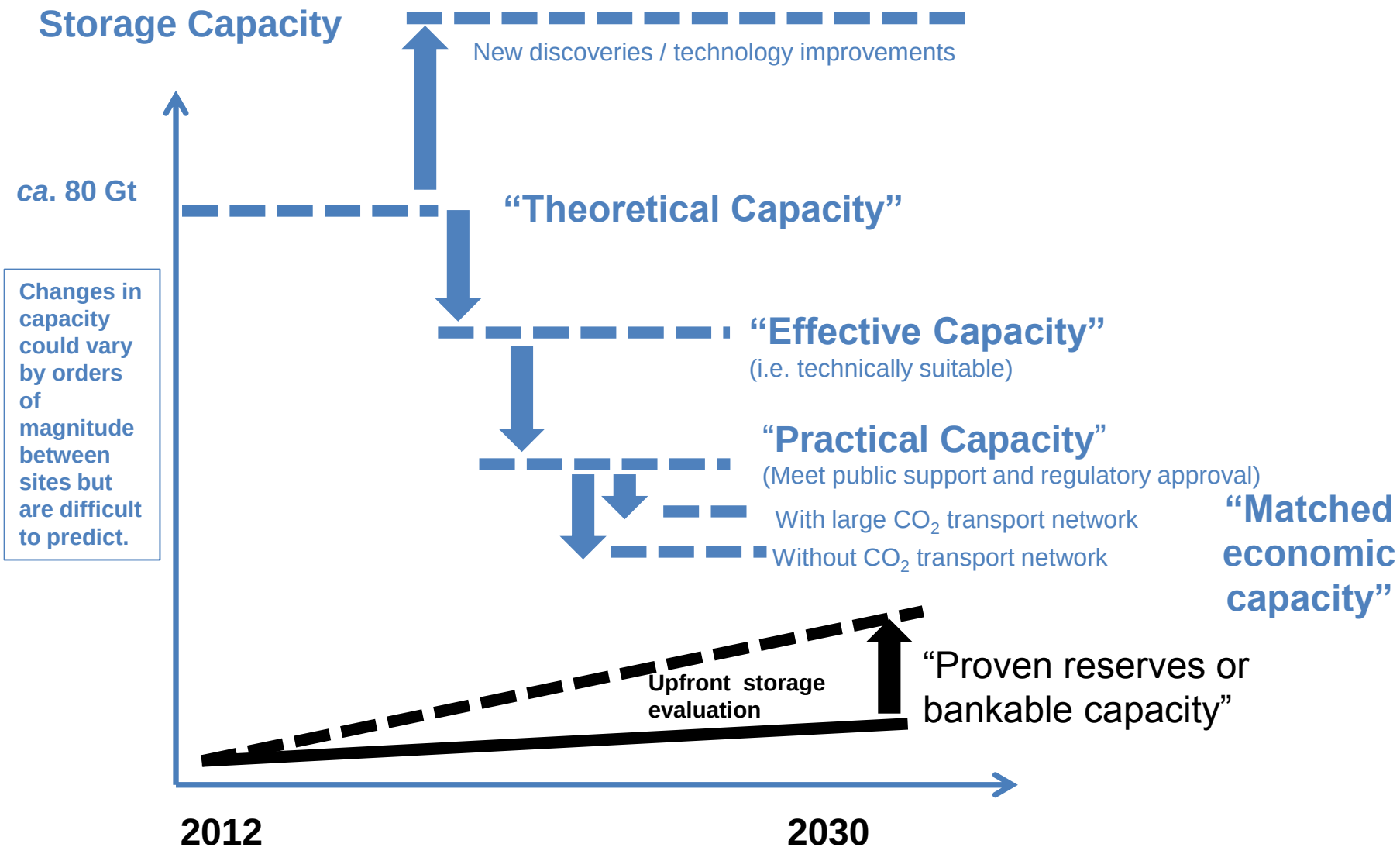


Source : Element Energy (2013)

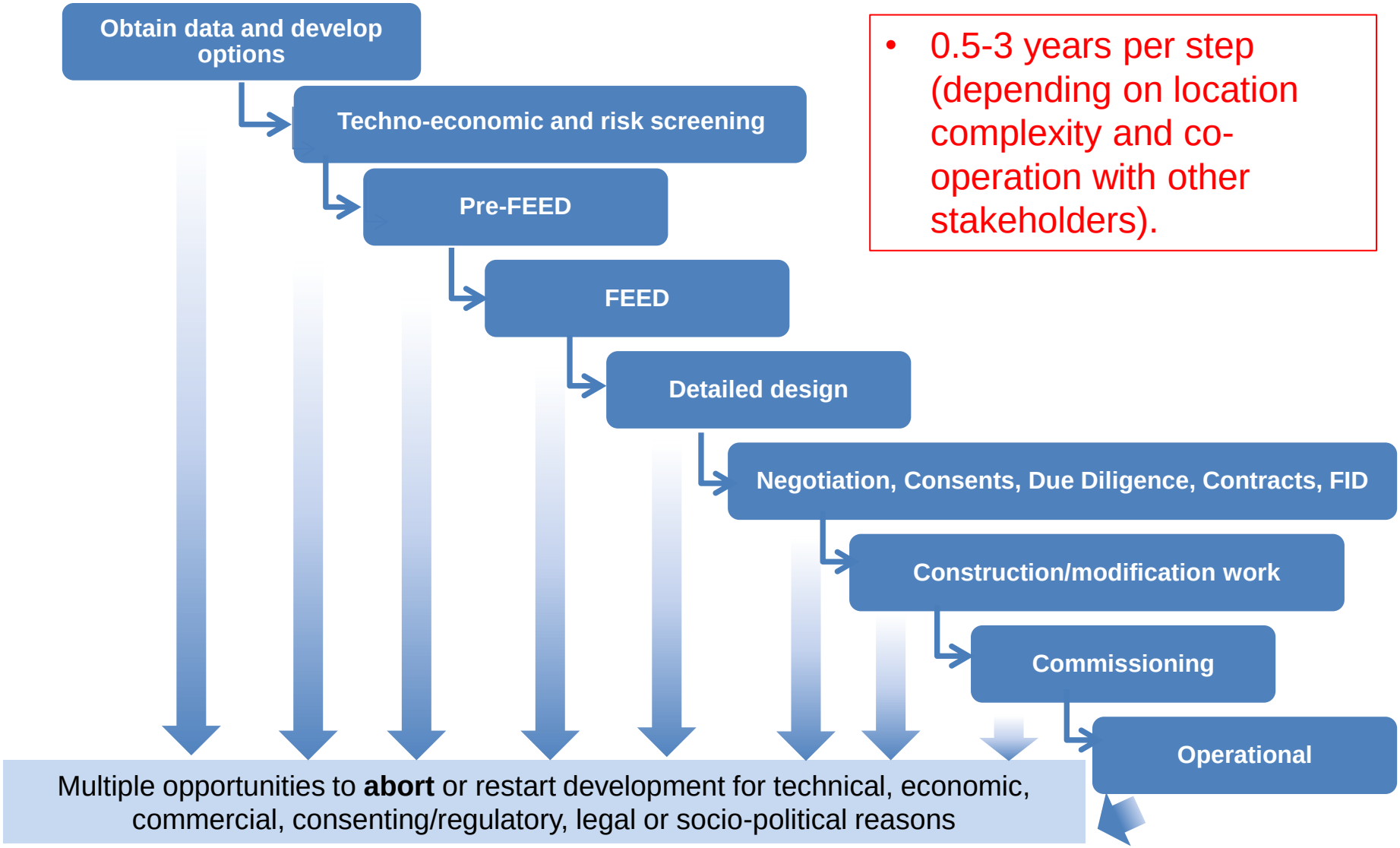
Meaningful CCS readiness demands capture readiness, transport readiness and storage readiness. Failure of any of these will limit or eliminate the potential for CCS.



Need to assist in unlocking early funding mechanisms to ensure high levels of confidence in CO_2 storage site performance in time to underpin CCS investments.



Transport and storage options are highly specific, developing them takes time and is fraught with risks, many of which are pre-FID.



- 0.5-3 years per step (depending on location complexity and co-operation with other stakeholders).

Source: Element Energy: Business and Regulatory Models for CO_2 Transport and Storage, for ETI

Unrealistic to expect a competitive or efficient market in transport and storage to occur due to multiple market difficulties

Examples of market difficulties

- Missing markets
- Information failure
- Information asymmetry
- Property rights / concentration of market power
- Transaction costs (inc. high entry and exit barriers)
- Positive and negative externalities
- Monopoly tendencies
- Environmental externalities
- Public good properties
- Moral hazard/free rider issues

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Other industries provide lessons on how to (and how not to) incentivise infrastructure…

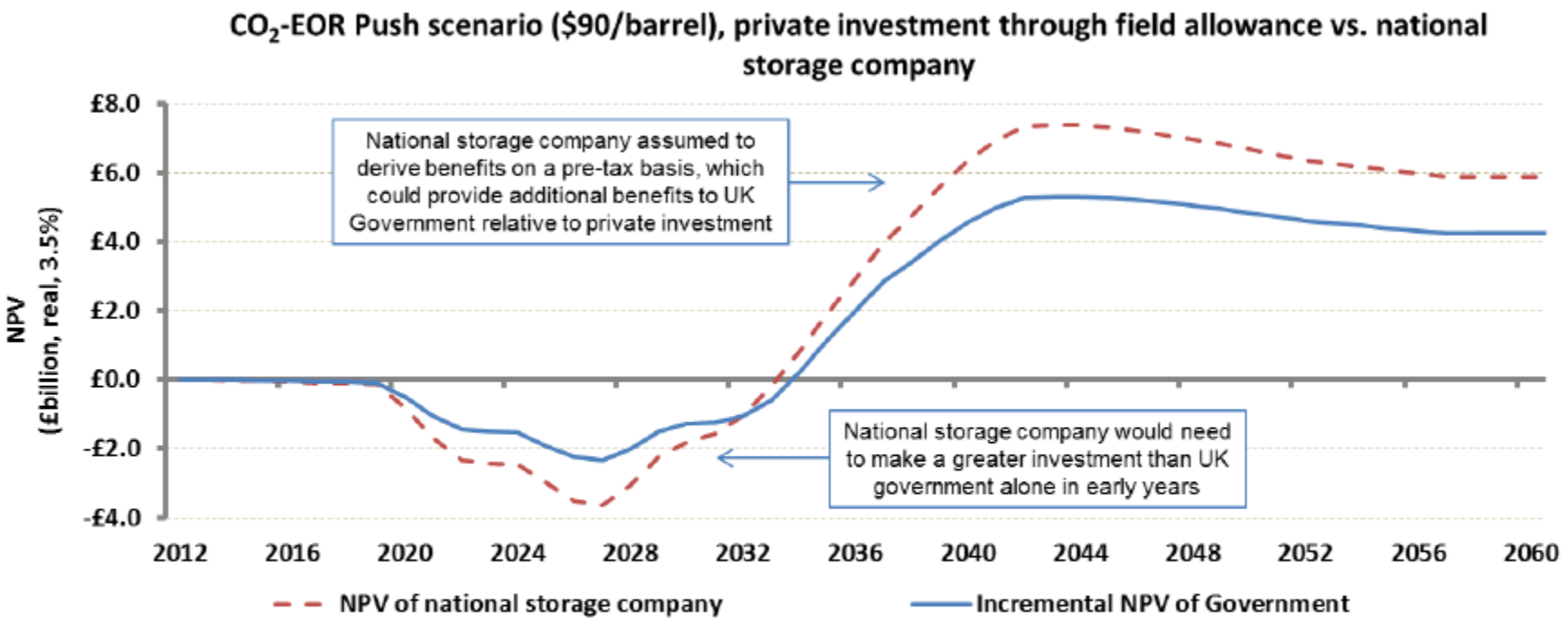
- CO_2 pipelines in North America for EOR projects
- Upstream oil and gas exploration, appraisal and production
- Large oil transmission pipelines
- Gas transmission pipelines and systems
- Onshore electricity transmission
- Offshore electricity transmission (for offshore wind)
- Water and sewerage infrastructure
- Waste Regulations
- District Heating Networks
- Major transport projects
- Nuclear Decommissioning Authority
- Telecommunications (Mobile and Broadband)

Preliminary assessment of strengths and weaknesses of bundles of measures for CO_2 transport and storage infrastructure following the commercialisation project.

	Example of Market Challenge			
Policy environment	Inefficient T or S capacity within tight timescale (insufficient, stranded or sterilised assets)	Unnecessary costs or risks or delays (Data & infrastructure sharing, congestion)	Excess transmission or storage price	Ease of implementation
1. UK Govt informs and enables competitive market				
2. Industry leadership and self-regulation (Govt. enabling)				
3. Regulated regional private monopolies				
4. Regulated regional public-private Joint Venture Monopolies				
5. Govt design and build CO_2 transport and storage infrastructure				

Source: Element Energy: Business and Regulatory Models for CO_2 Transport and Storage, for ETI

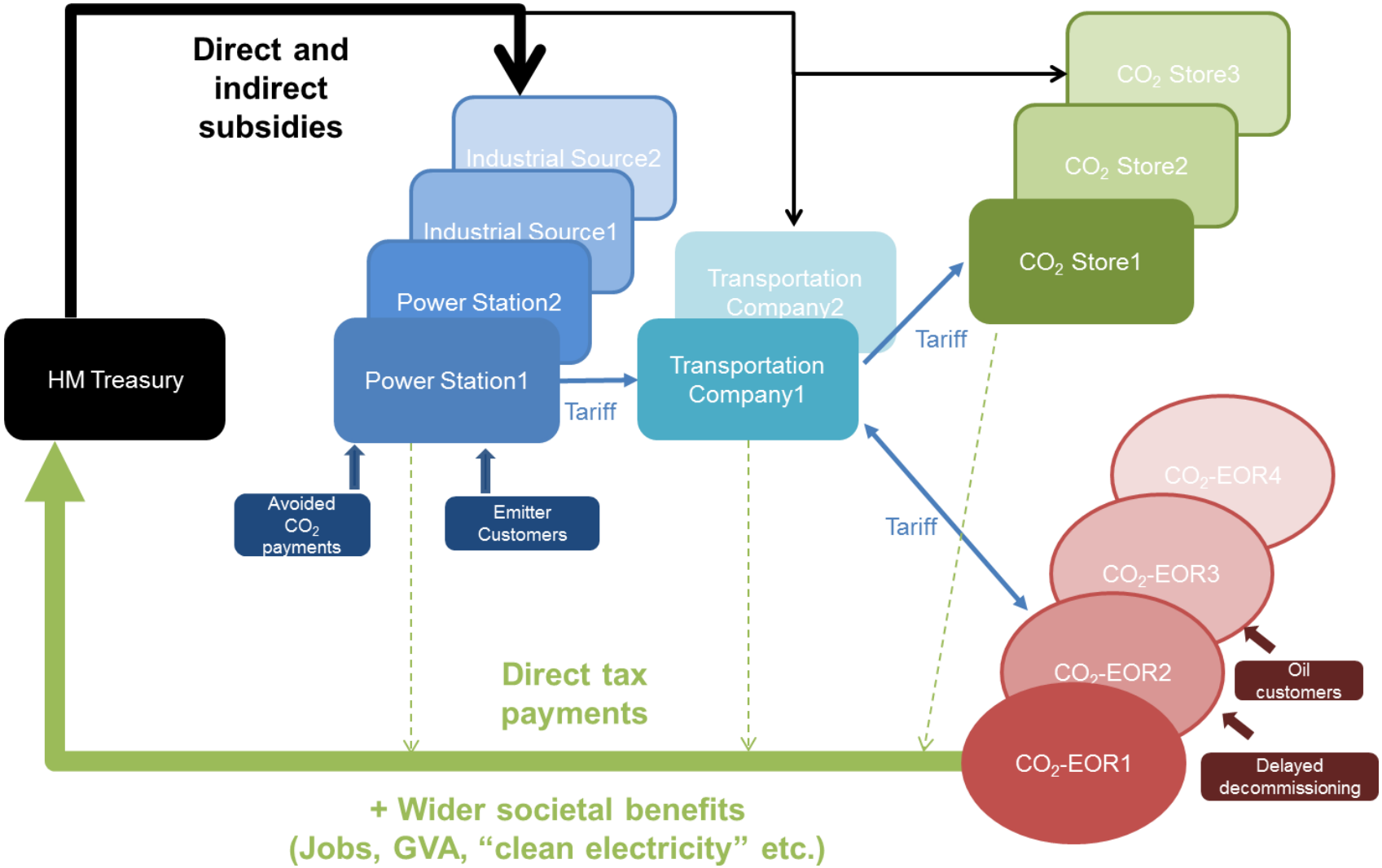
A carefully designed incentive could kick-start CO_2-EOR and bring in £billions to Government and/or the CCS industry.



Comparison of UK Government NPV in the CO_2-EOR Push Scenario with the NPV of a hypothetical national CO_2 storage company under similar conditions.

Source: Element Energy: Illustrative results from CO_2-EOR modelling

CO_2-Enhanced Oil Recovery could provide some support for CCS economics.



Conclusions

- CCS will be needed globally, and the UK has significant strategic interest in commercialising CCS quickly.
- There is steady progress with DECC's new CCS commercialisation programme, with a realistic chance that the UK will have one or more projects operational before 2020.
- The least cost pathways to decarbonising the economy involve rapid adoption of CCS during the 2020s and 2030s, in power and industry.
- Implementation of CCS readiness will make this much easier, but there are diverse challenges across power, industry, transport, and storage.
- The markets for industrial CO_2 capture, transport, storage and enhanced oil recovery are difficult and there will be substantial benefits from further policy support (i.e. beyond Electricity Market Reform and carbon pricing).

Acknowledgements

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The views represent those of Element Energy, not those of the funders.

Thank you for your attention -

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