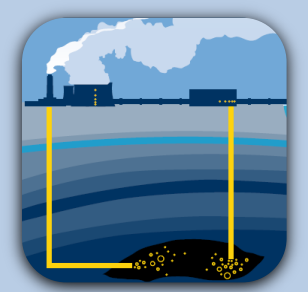








elementenergy

CCS sector development scenarios in the UK

Getting ready for Phase 2 and Phase 3

20th November 2014

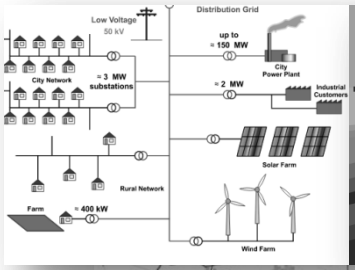
Emrah Durusut
emrah.durusut@element-energy.co.uk

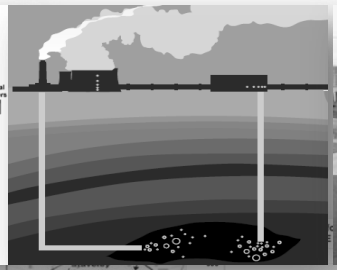
Element Energy Limited
www.element-energy.co.uk

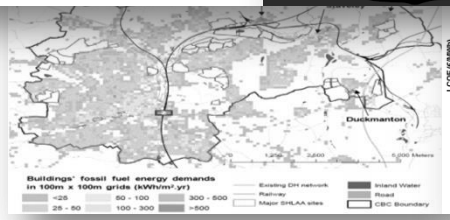
About Element Energy – a consultancy focussed on the energy sector

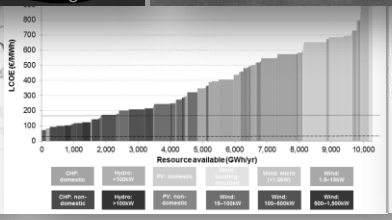
- Element Energy is a **specialist energy consultancy**, with an excellent reputation for rigorous and insightful analysis across a wide range of low carbon energy sectors
- These include: **Carbon capture and storage, energy strategy development, energy policy, energy networks**, **renewable energy systems, the built environment,** and **low carbon vehicles**
- We consult on both **technical and strategic issues** – we believe our technical and engineering understanding of the real-world challenges support our strategic work

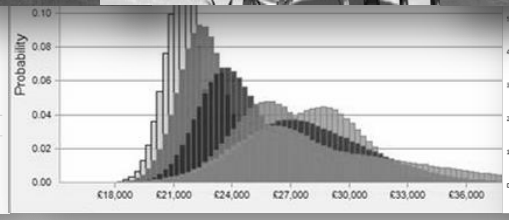
Energy technologies modelling	**Consumers behaviour modelling**	**Energy networks modelling**	**Advanced geographic modelling**	**Project management**
Policy recommendations	**Strategic market analysis**	**Commercialisation strategies**	**Techno-economic studies**	**Project financing**

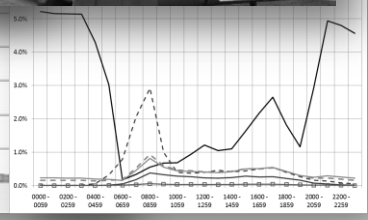












Recent Element Energy publications

- Energy Technologies Institute (2014), "CCS Sector Development Scenarios" – work in progress
- The CCC (2014), "Infrastructure in a low-carbon energy system to 2030: CCS", available at: http://www.theccc.org.uk/wp-content/uploads/2013/12/CCC-Infrastructure-CCS-report-290114.pdf
- SCCS CO_2-EOR JIP (2014) , "Analysis of Fiscal Incentives", available at: http://www.sccs.org.uk/expertise/reports/sccs-co2-eor-joint-industry-project
- DECC and BIS (2014) "Demonstrating CO_2 capture in the UK cement, chemicals, iron and steel and oil refining sectors by 2025", available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311482/Element_Energy_DECC_BIS_Industrial_CCS_and_CCU_final_report_14052014.pdf
- Scottish Enterprise (2014) ,"CCS Hub Study for Scotland and the Central North Sea", available at: http://www.element-energy.co.uk/publications/
- Scottish Enterprise (2012), "Economic impacts of CO_2 enhanced oil recovery for Scotland", available at: http://www.scottish-enterprise.com/knowledge-hub/articles/publication/co2-enhanced-oil-recovery

Background to material presented

This talk draws on insights from:

- Energy Technologies Institute, “CCS sector development scenarios” – in partnership with Poyry (work in progress)
- The CCC, “Infrastructure in a low-carbon energy system to 2030: CCS”

DISCLAIMER - all material presented today represents the view of the author, not clients, partners or stakeholders.

Agenda

- CCS sector development scenarios
- Key requirements for CCS roll-out

CCS is uniquely valuable and widely applicable

- CCS can play a critical role in enabling low cost decarbonisation of the broader UK energy system including industrial CCS.
- Without CCS, the cost of reaching UK Climate Change targets will double from a minimum of around £30bn per year in 2050 and each five years of delay in implementing CCS until 2030 will add the equivalent of £4bn per annum to the total cost of the compliant UK energy system.*
- ETI ESME scenarios suggest that a cost-optimal 2050 energy system would require building a sector storing ca. 100 million tonnes of CO_2 by 2050.
- To reach this target requires the establishment of a CCS sector and associated infrastructure by 2030, storing ca. 50 million tonnes of CO_2 with ~10 GW of power CCS and contribution from industrial sources.

*Source: The Energy Technologies Institute's (ETI) modelling of the UK energy system

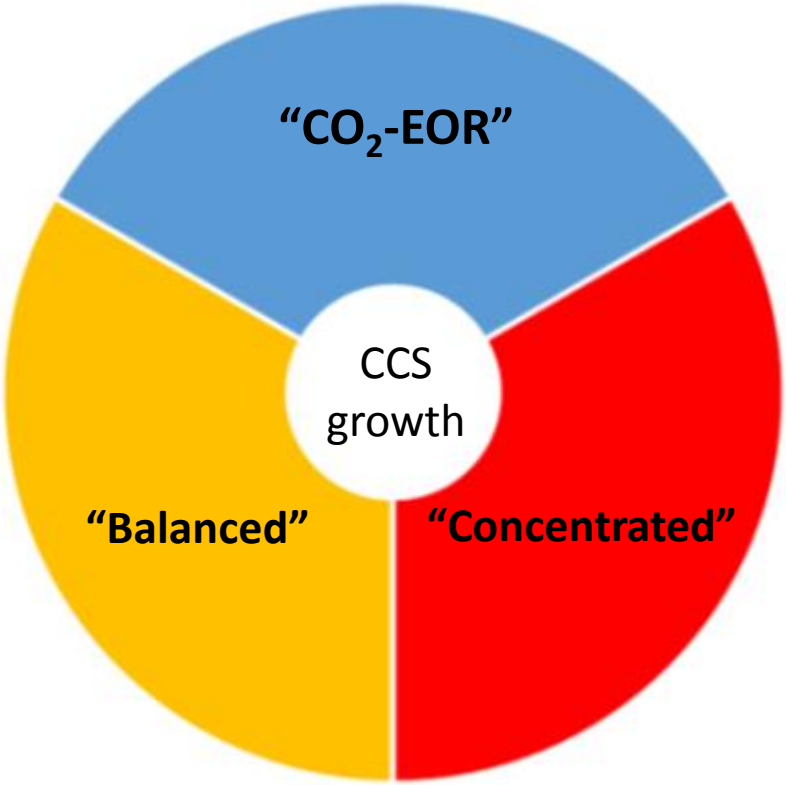
Process for scenario development

Process	Key aspects
Review key actions to support large-scale CCS development from previous studies	• The key objective of this study is to build a range of scenarios for the development of CCS at scale in the UK • Key actions to support large-scale CCS development in the UK identified in the recent CCS studies
Identify themes/drivers for scenario development	• Themes (or drivers) for CCS scenario development were identified based on the suggested actions for policy makers
Filter and prioritise themes for scenario development	• In order to achieve large-scale CCS development by 2030, a large number of actions have to be taken by the policy makers • This leads to a limited number of degrees of freedom for scenario development, namely **"CCS location"** and **"CO_2-EOR"**
Three CCS sector development scenarios	• 3 scenarios were developed based on the two key themes (i.e. remaining degrees of freedom)

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Three main scenarios based on policy backdrop

- Implement Wood's recommendations to coordinate UKCS oil production and increase commercial attractiveness.
- High CO_2-EOR policy support (e.g. tax incentives)
- CO_2 has a value due to the CO_2-EOR projects

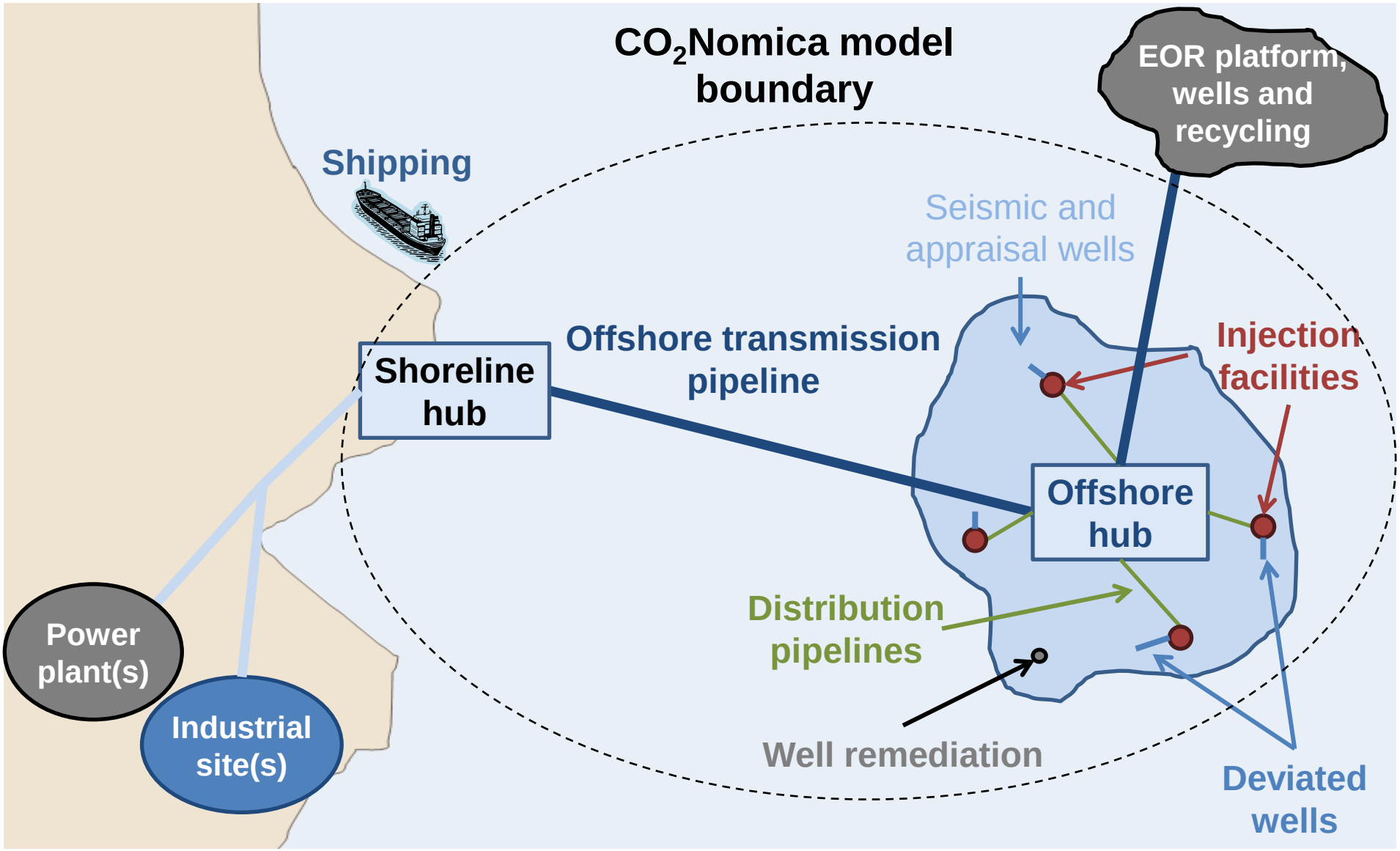


- Push "on all fronts" to win support from diverse stakeholders.
- A variety of regional source clusters
- Multiple fuel sources
- Multiple capture technologies
- There won't be any leading technology

- Geographic concentration around the two competition projects and standardisation to reduce T&S costs and barriers.
- Dominant role for SNS storage and gas CCS

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Transport and storage network development: network components



Source: Element Energy

Transport and storage network development: “Balanced” scenario

Map withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Transport and storage network development: "CO_2-EOR" scenario

Map withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Transport and storage network development: “Concentrated” scenario

Map withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Agenda

- CCS sector development scenarios
- Key requirements for CCS roll-out

Three or more follow-on CCS projects should take FID before the first demo project is operational (i.e. before 2020)

Image withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Bankable storage capacity should be available ahead of final investment decisions

- 10-20 years or more worth of proven storage capacity might be required at project FID (final investment decision) around 3-5 years before the project commissioning date.
- In order to deliver the bankable capacity, much more storage capacity should be appraised assuming several of these storage sites may fail. The ratio of bankable capacity to appraised storage capacity is highly uncertain.
- Appraisal requirement by mid-2020s could therefore be several gigatones.

Image withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

Timing issues for new build CCS capacity: Analysis suggests that retrofitting could be an important option

Image withheld

If you have any questions, please contact:

emrah.durusut@element-energy.co.uk

Slow but positive demand growth in long-run, combined with expected capacity decommissioning (led by IED requirements) suggests ~10GW of new conventional thermal capacity required by the late 2020s

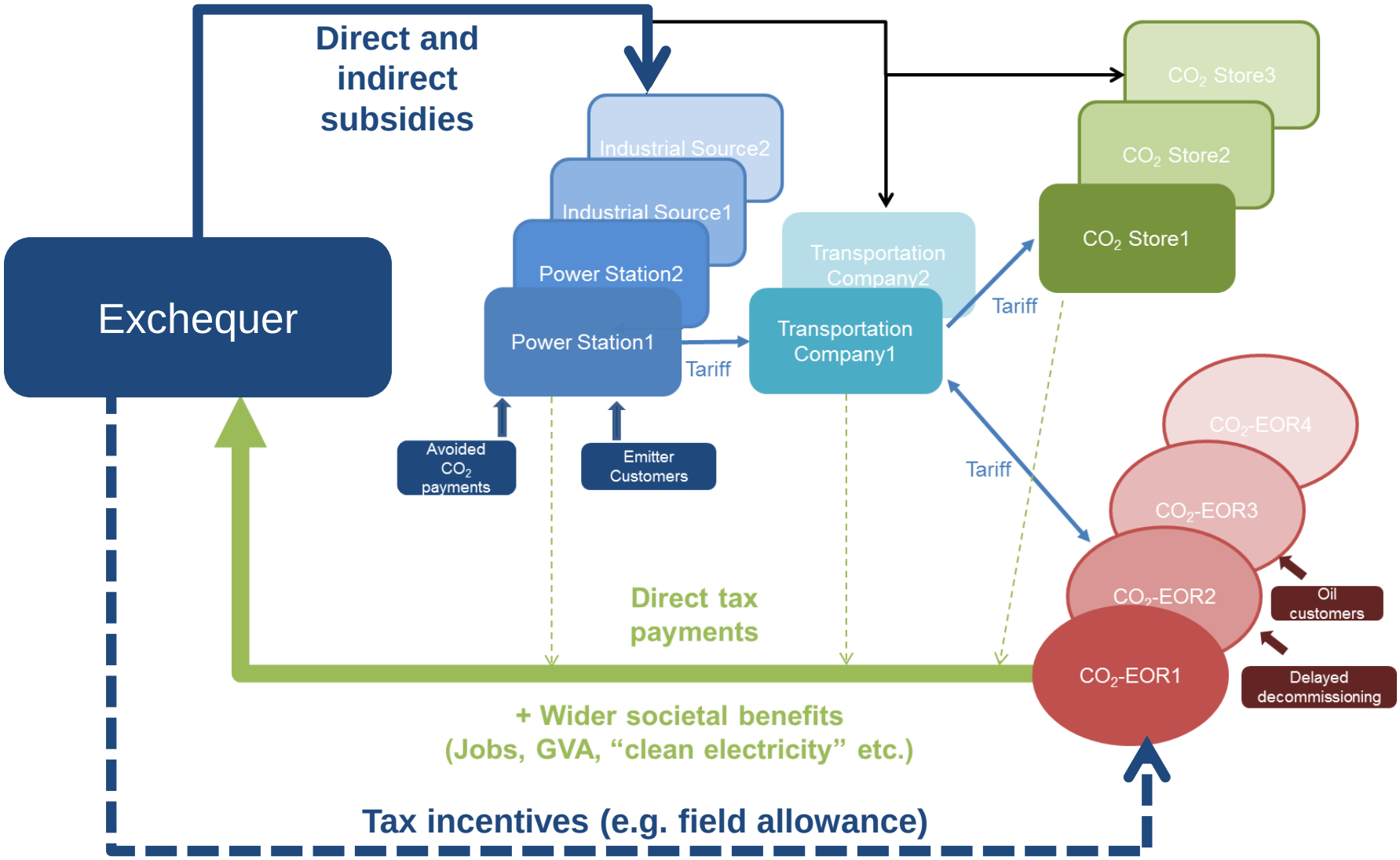
However, current expectations suggest that much of the new-build capacity is required in the period to 2023 – earlier than the expected commissioning of power plants with CCS

If new gas capacity is built in early 2020's to meet gap, potential that need for new thermal capacity in the late 2020's may be lower than CCS roll-out plan requires

- **Retrofitting** could be an important option to help solve timing mismatch
- **CCR** is important - **Locations** of potential CCS clusters and T&S networks should be considered for 'capture ready' new-build thermal plants

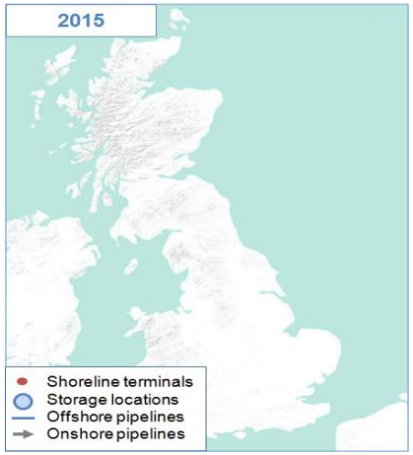
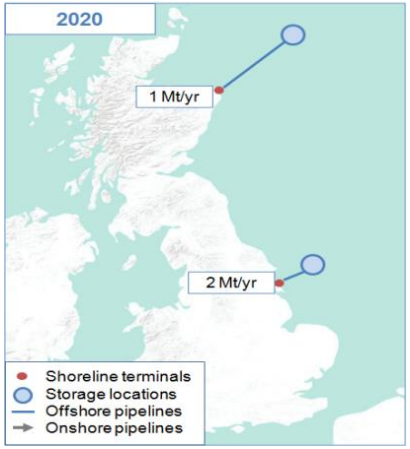
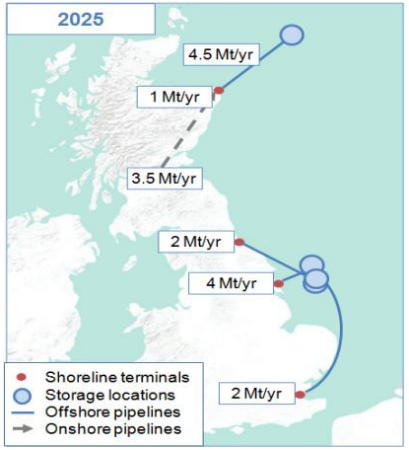
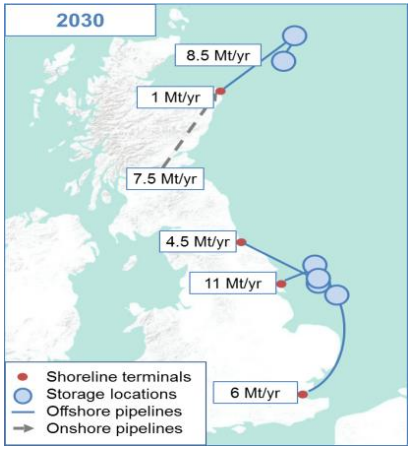
Source: Element Energy and Poyry for the Energy Technologies Institute, CCS sector development scenarios (work in progress)

CO_2-EOR in the UKCS could be kick-started through fiscal incentives; however, it will be necessary to monitor potential interactions between different incentives



Source: Element Energy analysis for the CO_2-EOR Joint Industry Project

Most/all of the CCS barriers should be overcome before 2020

2014-2019	2020/2021	2025	2030
			

Key actions by 2020

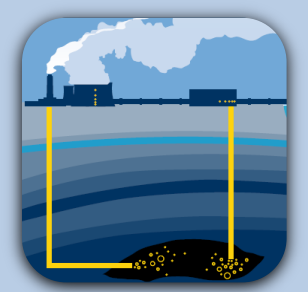
- A clear vision for CCS by the Government
- Business models, funding mechanisms, guidelines for development of CCS projects from demo projects to widespread adoption.
- A regulatory framework reflecting complex geological realities
- Knowledge transfer from the demo projects
- Consider incentivising CO_2-EOR
- Conduct various studies (e.g. optimum CCS networks, storage locations and pipeline entry specifications, and CO_2 migration)
- Examine the options for characterisation of storage areas/sites
- A variety of financial institutions and insurance companies should understand risk mitigation options of CCS better
- Necessary regulations and business models for shared pipelines and storage sites.
- Funding mechanisms and UK Levy cap should reflect immature market conditions of CCS
- Effective supply chain planning
- Necessary policy and financing regimes for industrial CCS

Key actions by 2030

- Significant cost reduction by the late 2020s
- CCS is cost competitive with other technologies, and all necessary frameworks and guidelines are in place.

Source: Element Energy analysis for the CCC, 2013







Thank you for your attention

If you have questions, please contact:

Emrah Durusut
emrah.durusut@element-energy.co.uk

Element Energy Limited
www.element-energy.co.uk