



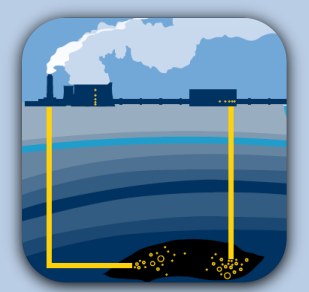



elementenergy

Understanding the CCS + EOR equation

Making CCS Investable in the Netherlands

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About Element Energy

Element Energy is a leading low carbon energy consultancy. We apply best-in-class financial, analytical and technical analysis to help our clients intelligently invest and create successful policies, strategies and products.

We operate in three main sectors

Low Carbon Transport

Built Environment

Power Generation

We offer three main services

Due Diligence
- Technology assessments
- Market growth
- Market share
- Financial modelling

Strategy and Policy
- Scenario and business planning
- Techno-economic modelling
- Stakeholder engagement

Engineering Solutions
- CFD
- Software tools
- Prototyping
- Installations

Recent Element Energy publications

- 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
- Scottish Enterprise (2014) ,“CCS Hub Study for Scotland and the Central North Sea”, available at: http://www.element-energy.co.uk/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
- 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 (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 Element Energy projects funded by the CO_2-EOR Joint Industry Project and Energy Technologies Institute.
- Multiple partners involved in these projects – including Dundas, Aberdeen University, and Poyry. Also data providers ETI/TCE/BGS.

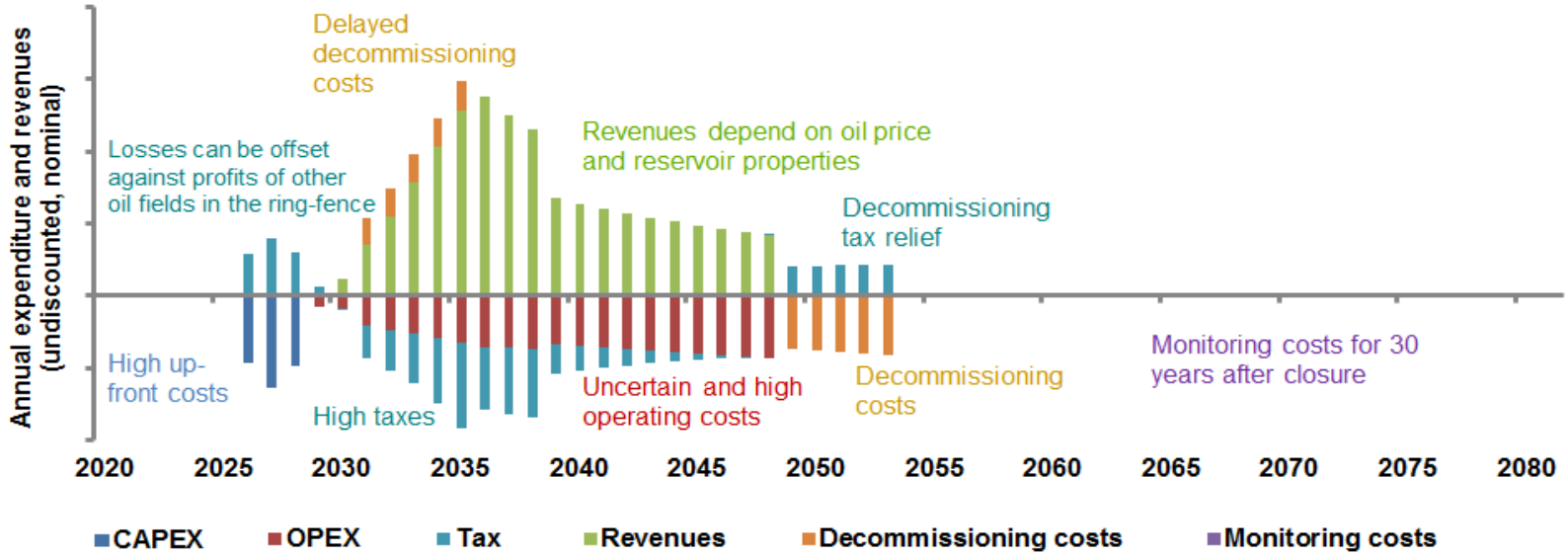
- DISCLAIMER - all material presented today represents the view of the author, not clients, partners or stakeholders.

Agenda

- Benefits and challenges of CO_2-EOR in the North Sea
- Tax incentives to kick-start CO_2-EOR
- Offshore CCS networks with CO_2-EOR

Recap of benefits and challenges for CO_2-EOR in the UKCS

Illustrative cash flow of a CO_2-EOR investment for a developer



Benefits

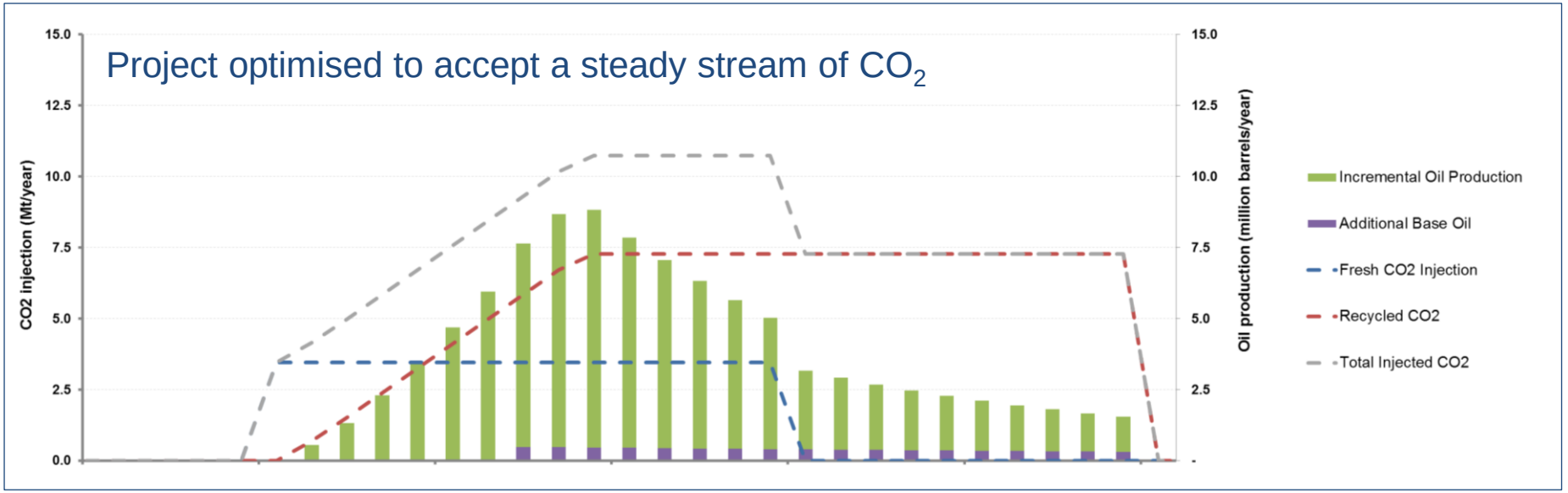
- Low or negative cost storage capacity
- Boost CCS project economics
- Leverage support from oil industry
- Support economy (tax receipts and jobs)

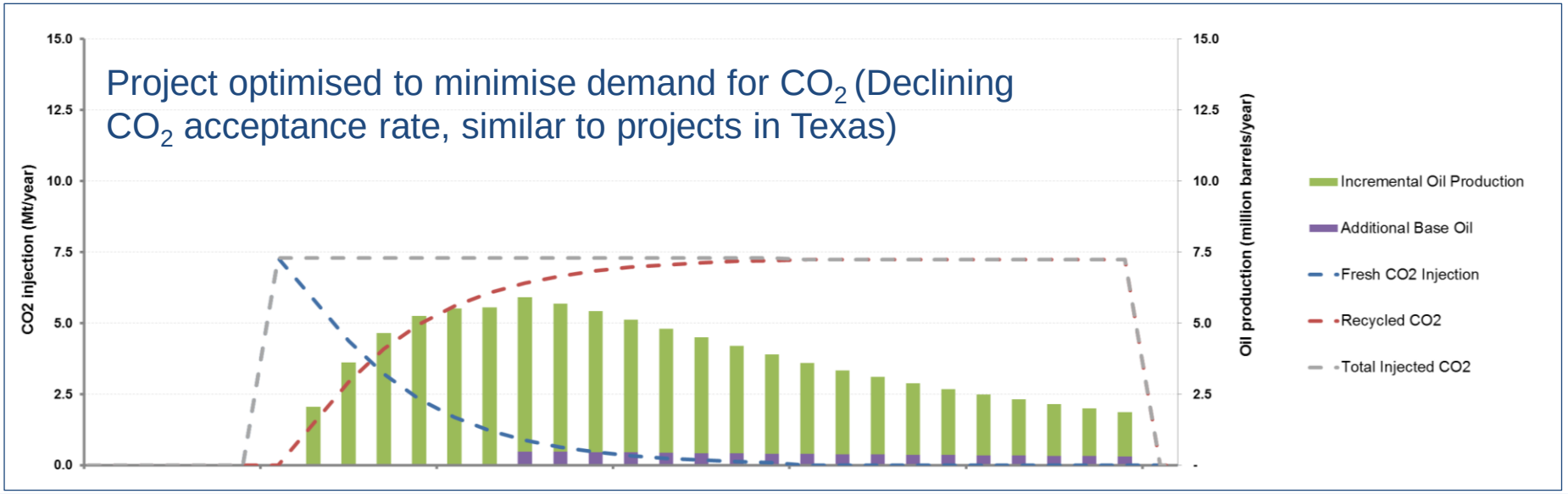
Challenges

- Limited and uncertain supply of CO_2
- Tight window of opportunity
- High first-of-a-kind project risks
- High cost and high tax

Source: Element Energy

Illustrative alternative theoretical CO_2 injection and recycling scenarios





Source: Element Energy

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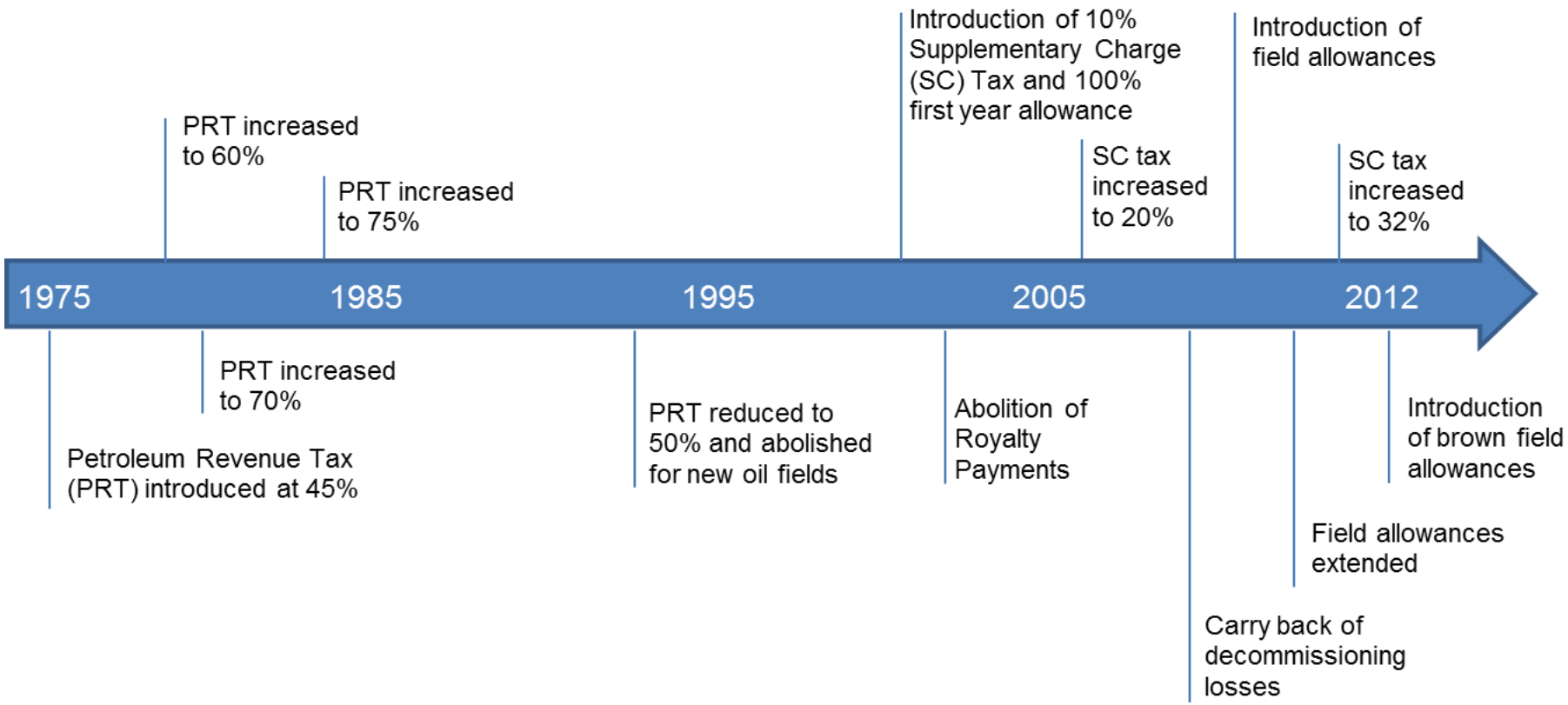
Since the 1970s, UKCS taxation structure has been dynamic to reflect the market conditions

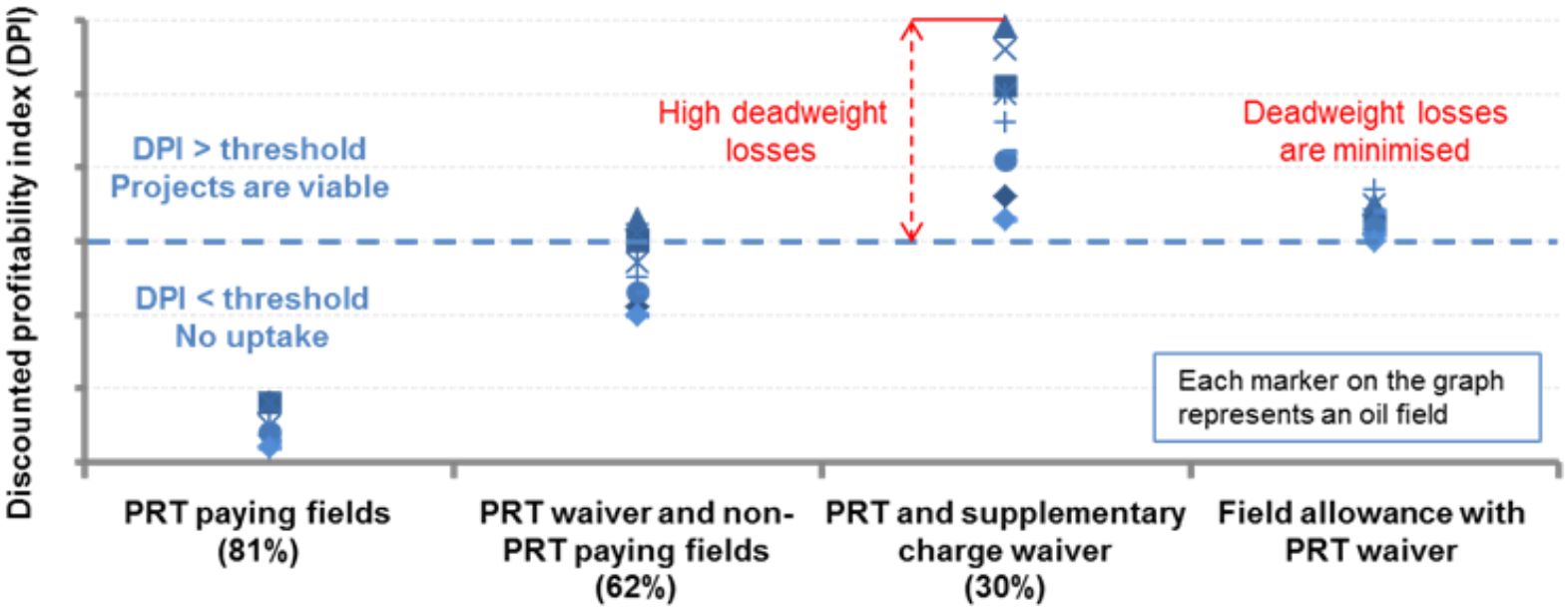
Simplified history of the UKCS taxation



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

If structured efficiently, field allowances encourage new investments without incurring substantial deadweight losses

Comparison of changing headline tax rate and field allowances



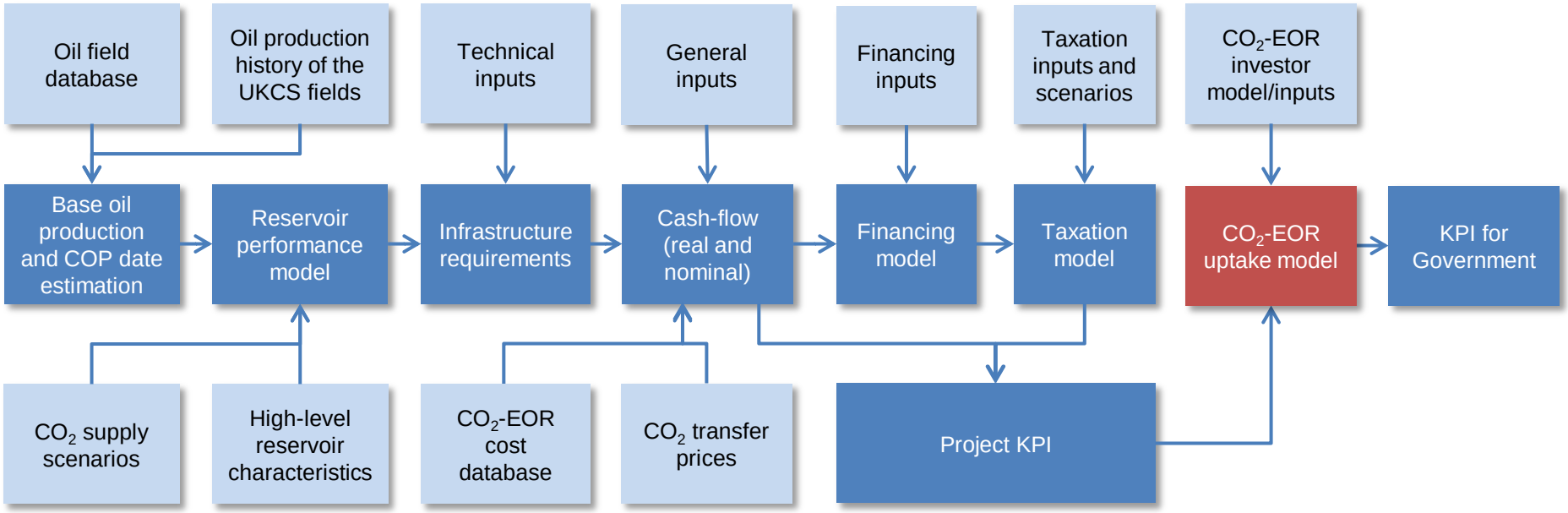
PRT= Petroleum Revenue Tax
DPI= discounted NPV /discounted capex

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

"CO_2-EOR Kick-start" model, developed by Element Energy, is used to quantify the impacts of tax incentives to kick-start CO_2-EOR for the UK

The CO_2-EOR Kick-start model consists of following sub-models;

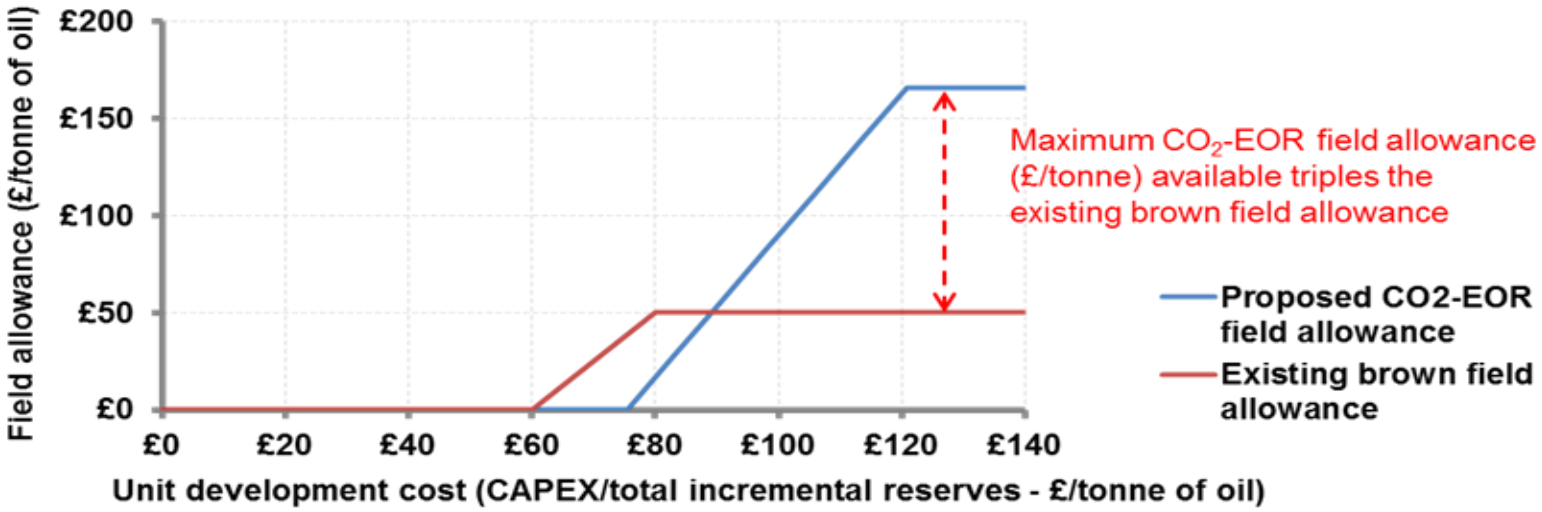
- **Reservoir performance model** creates oil and CO_2 production profiles based on annual fresh CO_2 injection rates, and oil field and reservoir characteristics such as CO_2 sweep efficiency, recycling system capacity, etc.
- **Financing model** calculates loan repayment with interest based on debt rate, interest rate and repayment schedule.
- **Taxation model** calculates corporation tax, supplementary charge, PRT, capital allowances, losses carried forward, decommissioning tax relief, ring-fence expenditure supplement and field allowances (if available).
- **Oil investor model** provides KPI thresholds for different types of oil investors
- **The uptake model** then calculates the cash-flow and KPI of each CO_2-EOR project, and predicts the viability of these EOR projects based on KPI thresholds for different stakeholders. Finally, economic impact model estimates the KPI for Government



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

Modelling suggests that it is possible to kick-start CO_2-EOR in the UKCS with tax incentives

Comparison of the proposed CO_2-EOR field allowance with the existing brownfield allowance

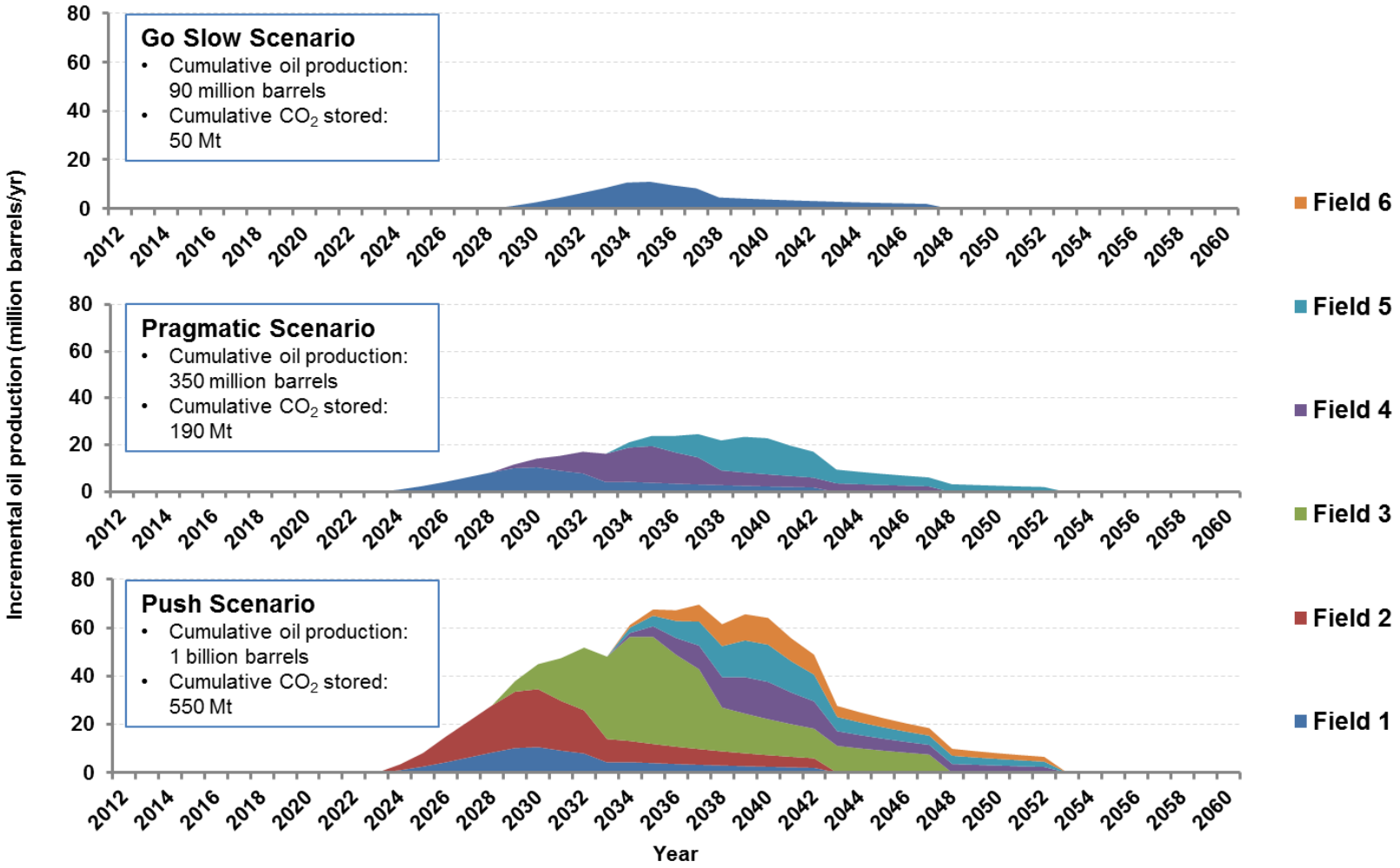


- A field allowance based on unit development cost with PRT removal for the first projects appears the most efficient structure in terms of minimising deadweight losses
- Unlike most oil field development projects, CO_2-EOR is not only CAPEX intensive but also OPEX and fuel intensive, with revenues emerging over long lifetimes - the amount of allowance would need to be higher compared to existing brown field allowance.
- Although the required amounts of field allowances are high, CO_2-EOR projects are able to bring billions of pounds of additional tax revenues for the Government.

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

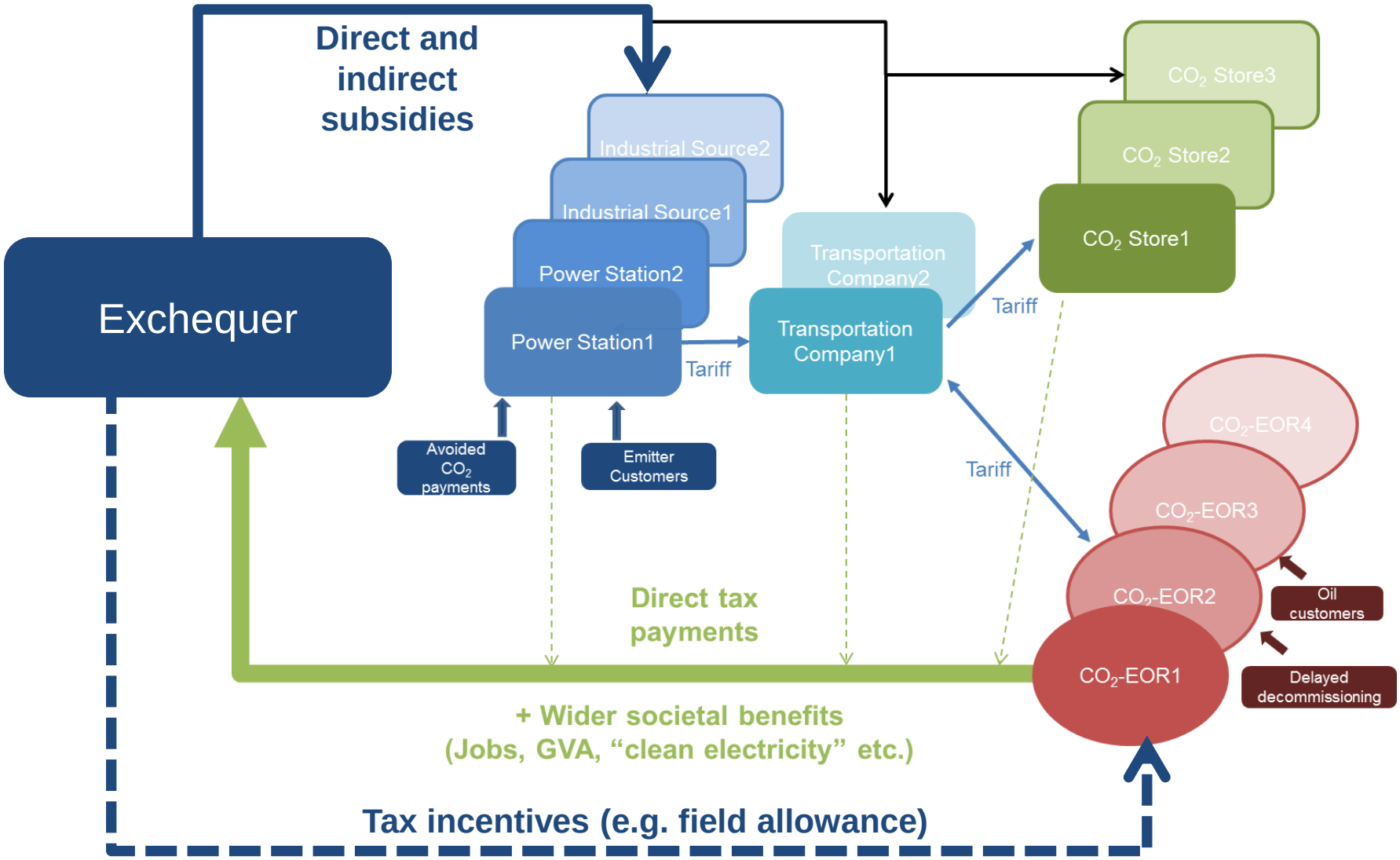
CO_2-EOR offers the opportunity to produce up to 1 billion barrels of incremental oil in the "Push" scenario

Predicted UKCS CO_2-EOR oil production for Go Slow, Pragmatic and Push CO_2-EOR scenarios in the UKCS



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

It will be necessary to monitor potential interactions between different onshore and offshore incentives



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

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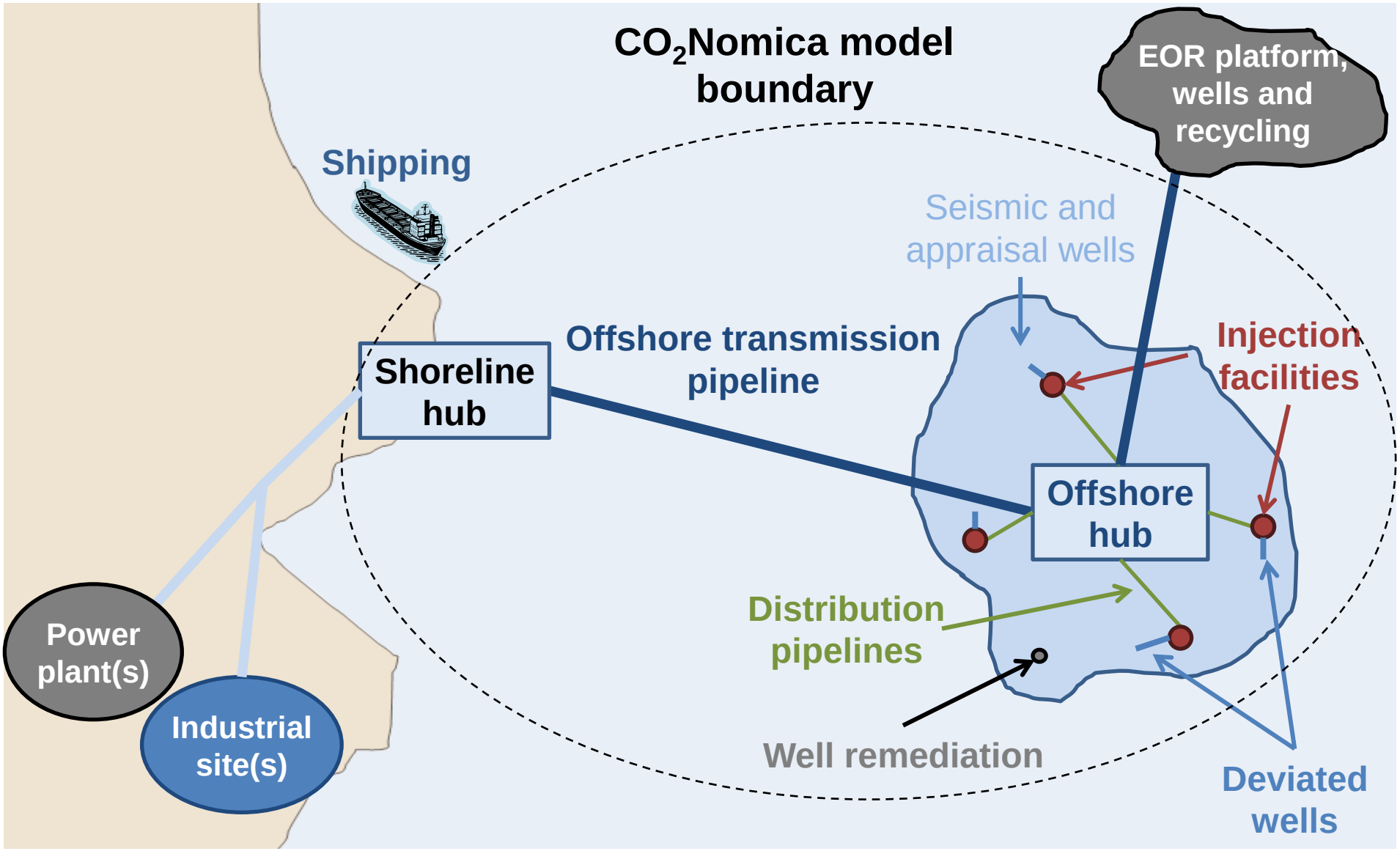
CCS-EOR network components



Source: Element Energy

CO_2-EOR development in the UK (illustrative)

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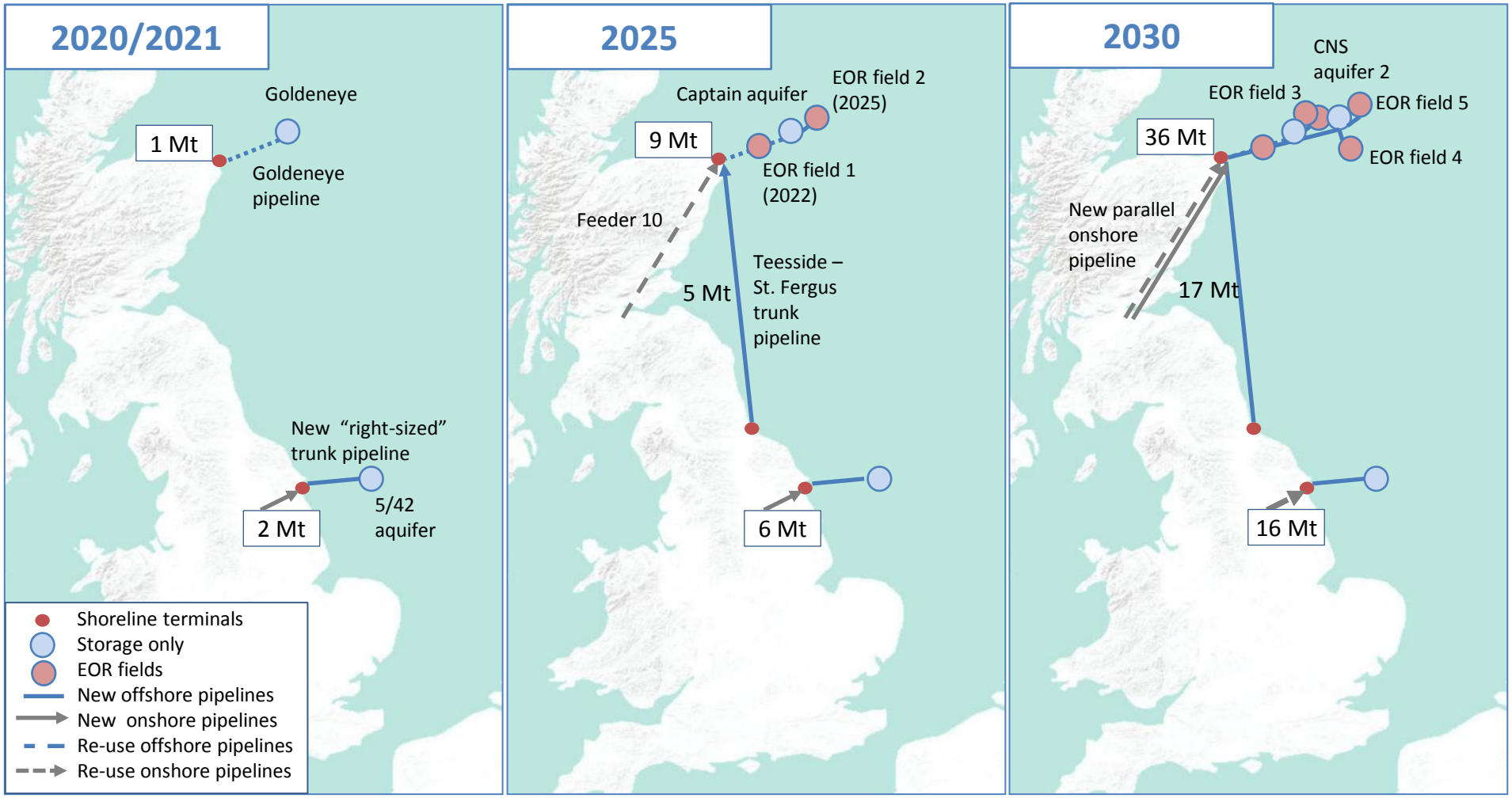
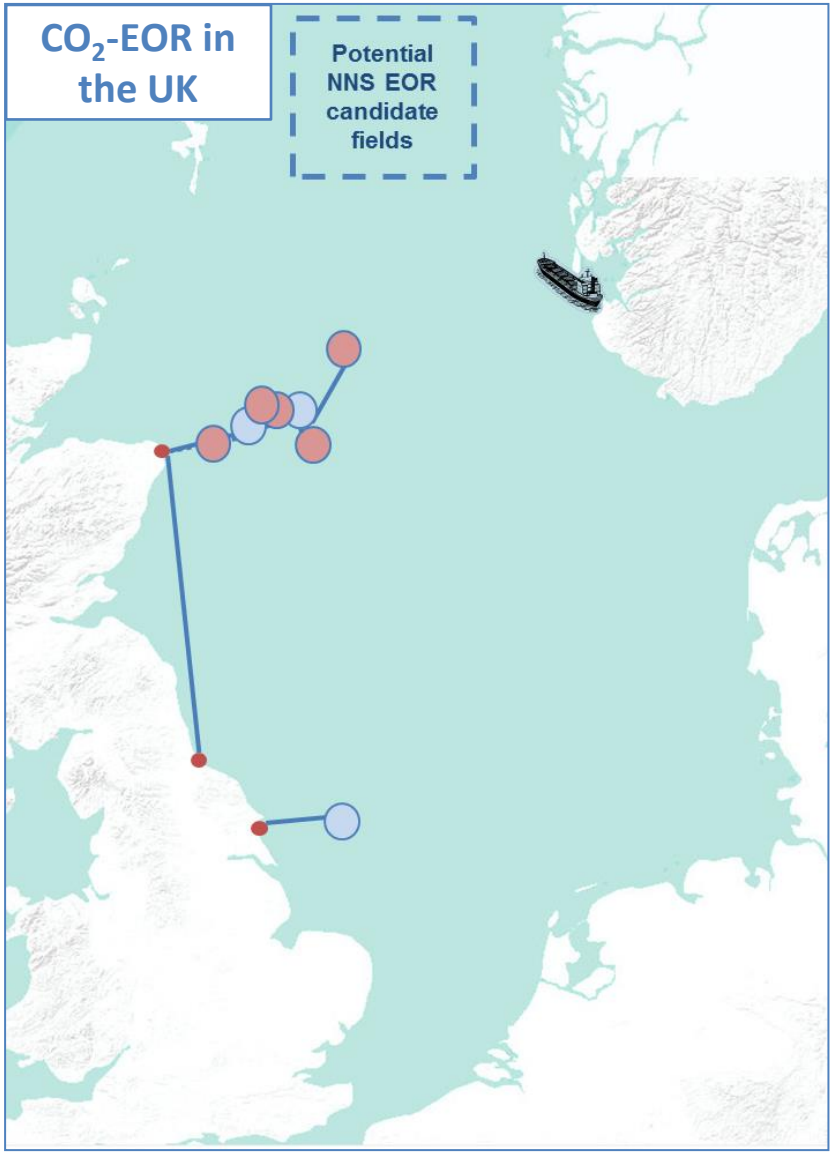
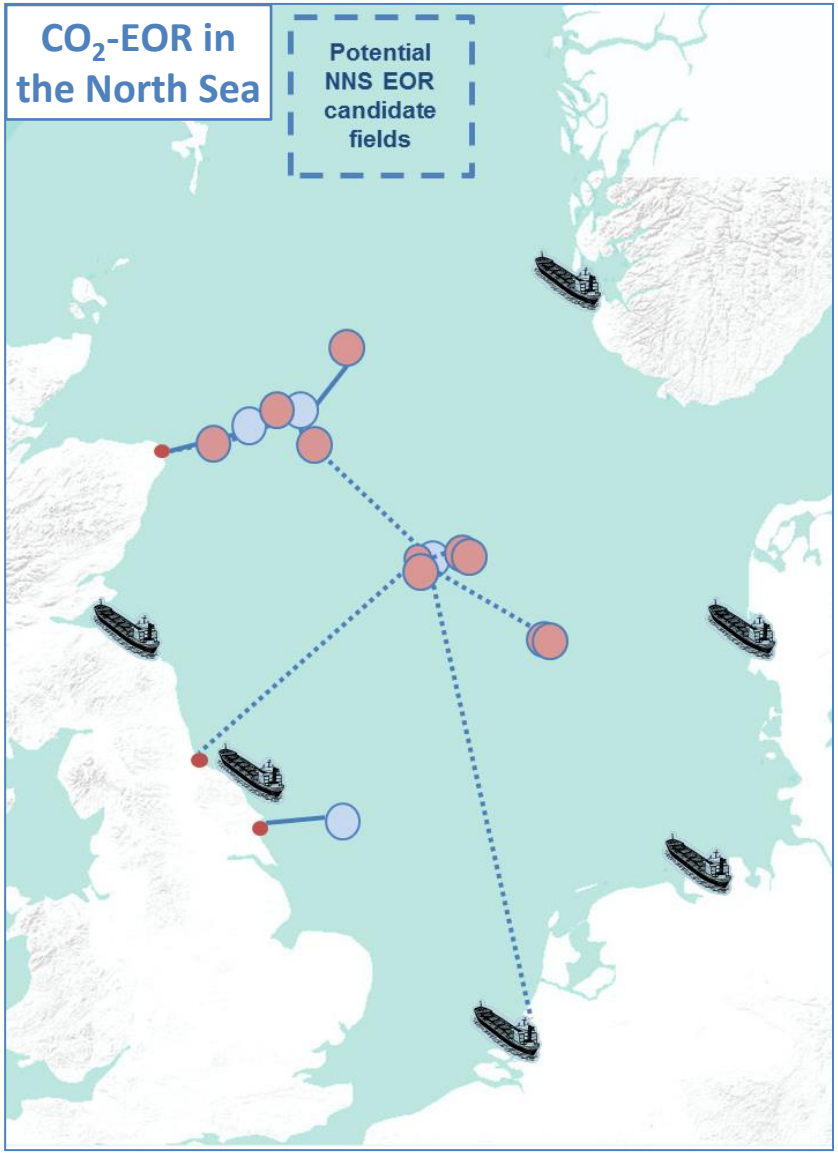


Source: ETI CCS sector development scenarios (work in progress)

CO_2-EOR development in the North Sea (illustrative)



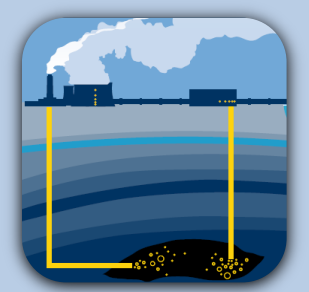


Source: ETI CCS sector development scenarios (work in progress)

Key points

- CCS projects in North America are taking advantage of CO_2-EOR; however, there are significant differences between the US experience and potential application in the North Sea.
- CO_2-EOR projects will require Government support. CO_2-EOR in the UK could be kick started through fiscal incentives.
- CO_2-EOR projects (developed by 2030) offer the opportunity to produce up to 1 billion barrels of incremental oil in the UK. This could increase significantly with the CO_2 supplied from the other North Sea countries.
- In addition to providing low or negative cost storage for the capture sites around the North Sea, CO_2-EOR projects provide high net Government receipts through taxation.
- In order to maximise CO_2-EOR benefits in the North Sea, a shared vision for deploying cost effective transport and storage infrastructure including CO_2-EOR and cooperation between North Sea countries are needed.







Thank you for your attention

If you have questions, please contact:

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