

Enabling the deployment of industrial CCS clusters

Confidential

CSLF Policy Group Meeting

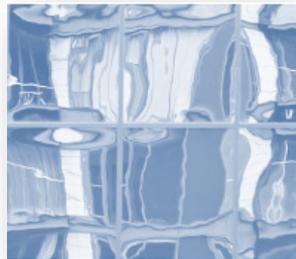
4th May 2017

elementenergy

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Introduction to Element Energy

- 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 systems, energy networks, renewable energy systems, the built environment, hydrogen and low carbon vehicles**
- We apply **best-in-class financial, analytical and technical** analysis to help our clients intelligently invest and create **successful policies, strategies and products**



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

Background to material presented

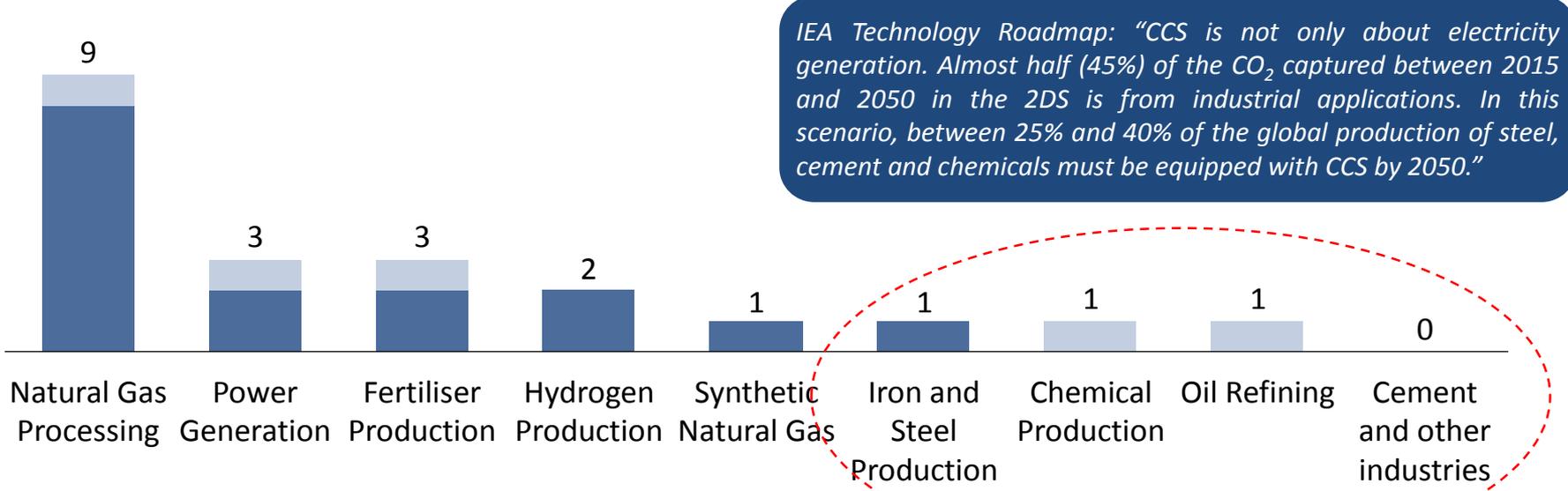
This talk draws on insights from:

- **“Enabling industrial CCS clusters”** project for **IEAGHG** and **IEA CCS Unit**. The project aims to evaluate the commercial and economic arrangements needed to enable the deployment of industrial CCS clusters (Confidential – report is under review)
- **“CCS market mechanisms”** project for **a group of oil and gas companies**, which examined which market mechanisms are likely to be effective globally from both a government and industry perspective considering the issues inhibiting CCS deployment at scale (Confidential - report has not been published yet)
- **“European funds and financing mechanisms for industrial CCS clusters in Europe”** for **European Climate Foundation** (Confidential – work in progress)

DISCLAIMER - all material presented today represents the view of the author, not clients, partners or stakeholders. The reports above are not publicly available yet so no specific results from our analysis will be presented today

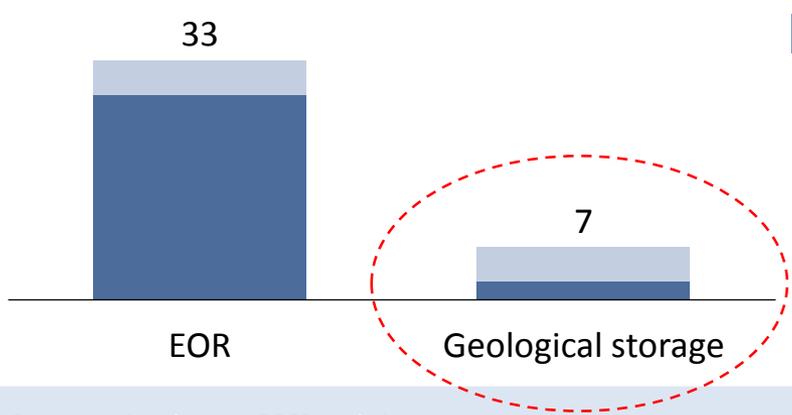
Large-scale CCS projects, delivered on-time and on-budget, are required to educate project developers, governments, and investors

Number of large-scale CCS projects by sector



IEA Technology Roadmap: "CCS is not only about electricity generation. Almost half (45%) of the CO₂ captured between 2015 and 2050 in the 2DS is from industrial applications. In this scenario, between 25% and 40% of the global production of steel, cement and chemicals must be equipped with CCS by 2050."

CO₂ storage by store type (MtCO₂ per annum)

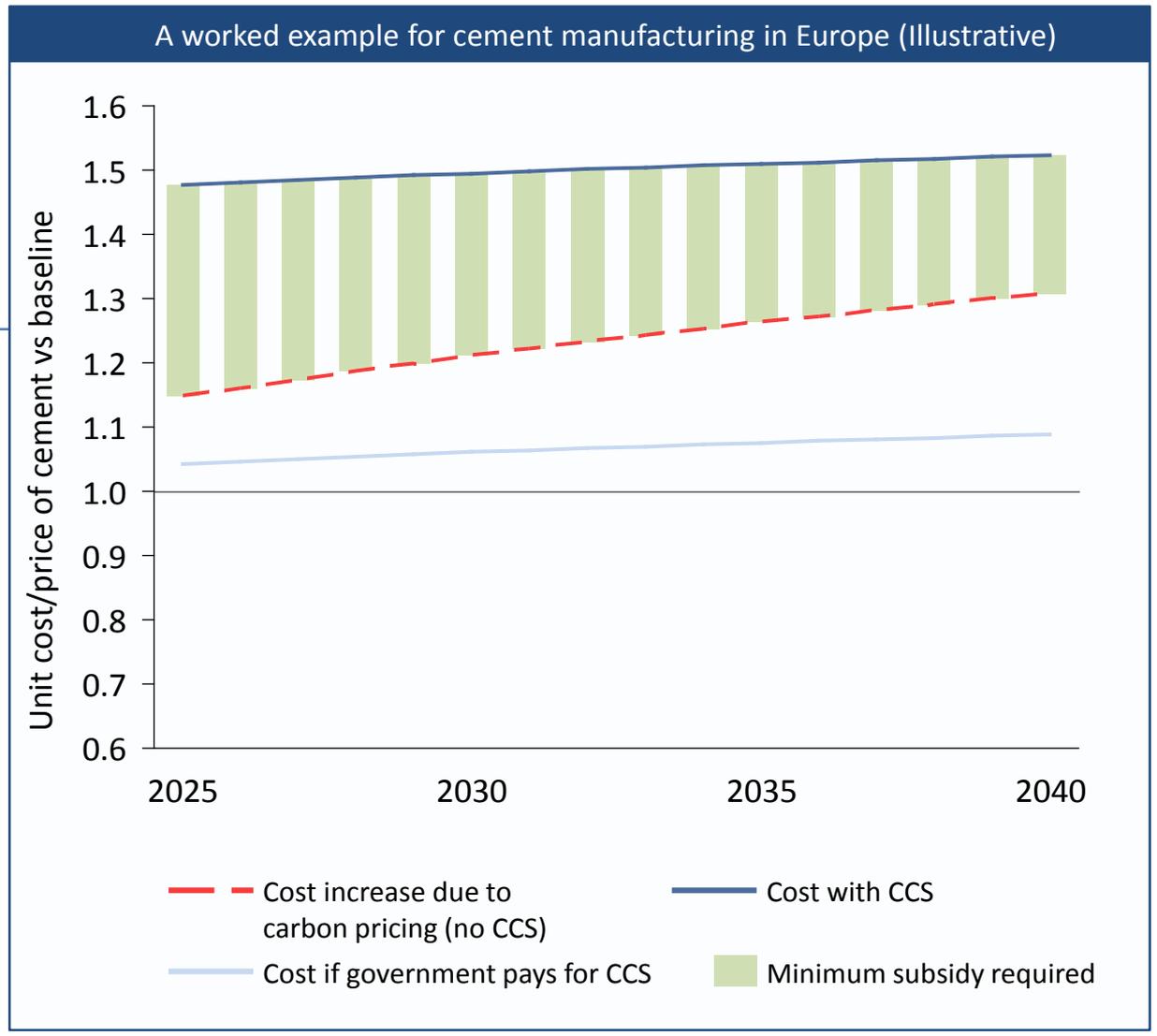


Legend:
■ Operational
■ Under construction

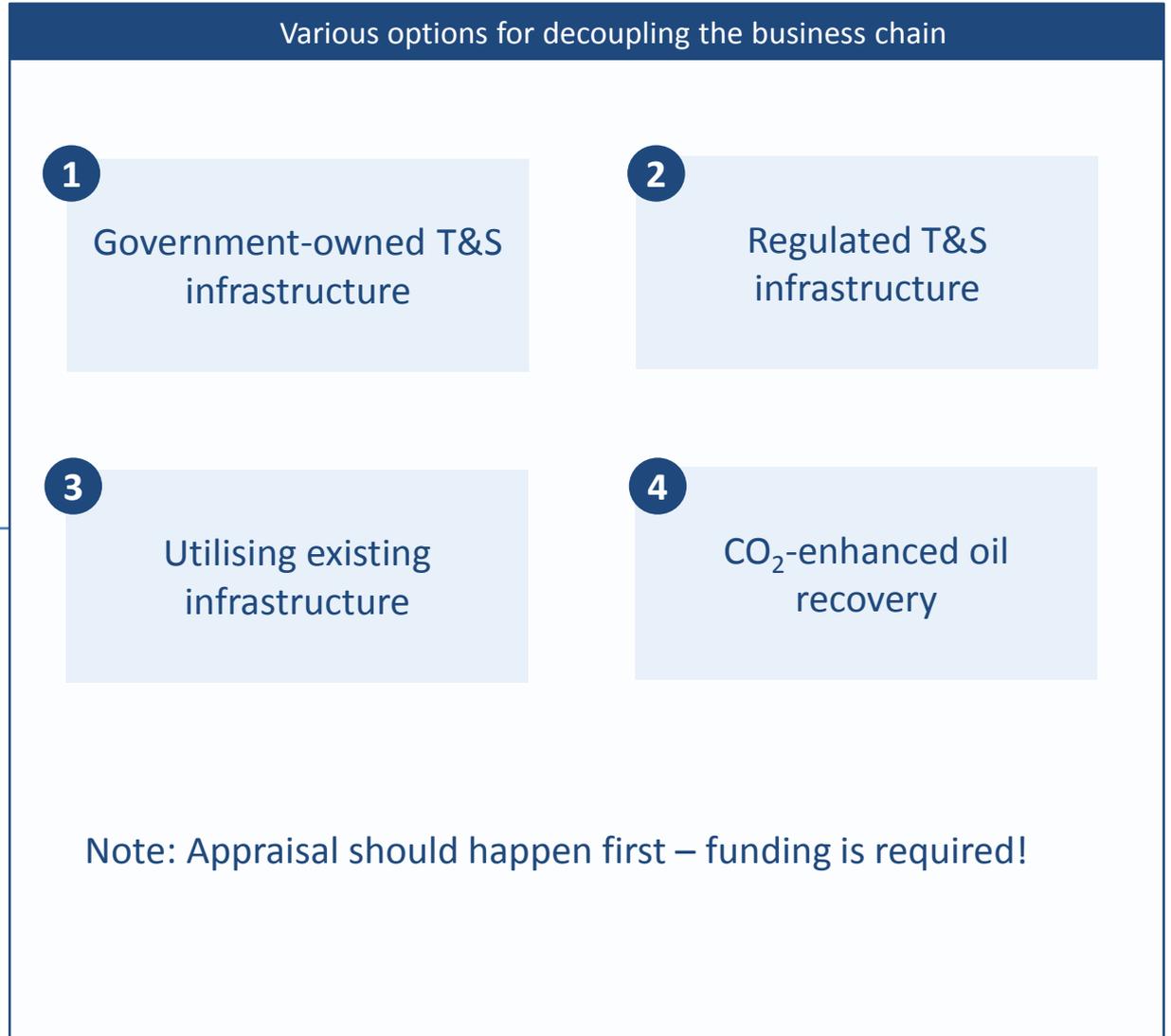
IEA Technology Roadmap: "A total cumulative mass of approximately 120 GtCO₂ would need to be captured and stored between 2015 and 2050, across all regions of the globe."

Source: Using data on GCCSI website

Revenue certainty is required to motivate private investment in industrial capture, and this can only be achieved through tailored subsidies



Transport and storage must be delinked from capture businesses



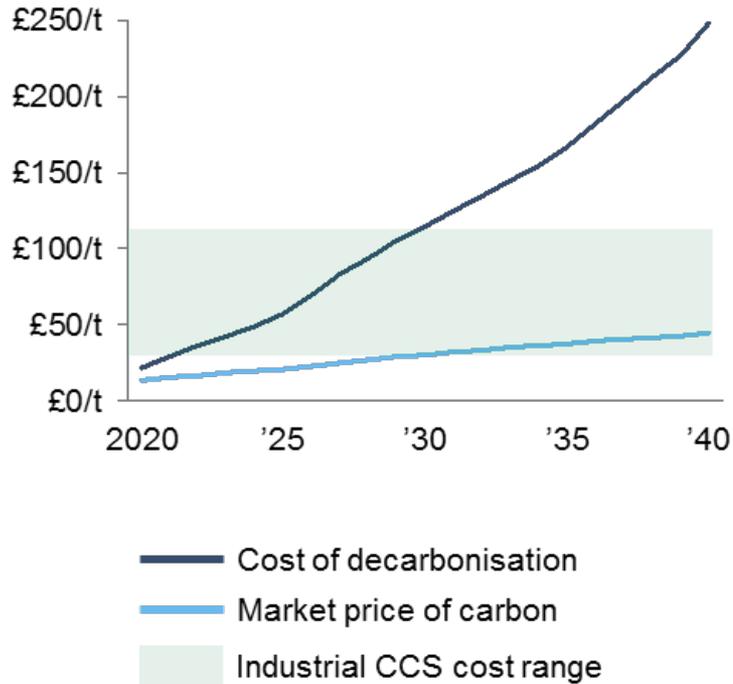
Show-stopper risks require government back-stops



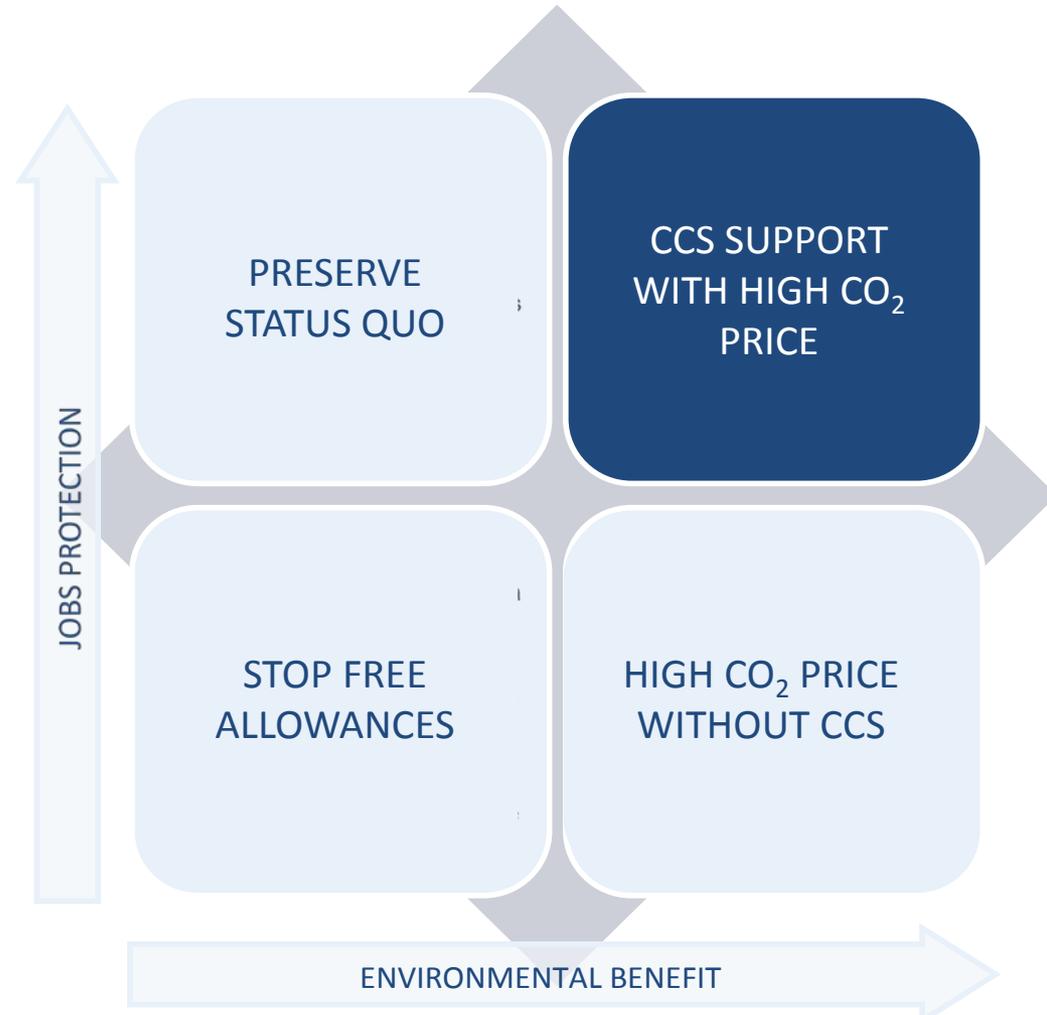
Illustrative show-stopper risks	Suitable government mitigation
<ul style="list-style-type: none"> Uncapped liability from CO₂ leakage long after storage site decommissioning 	<p>Back-stops or caps on the long-term storage liability to enable a layered insurance approach, where the storage operator can get insurance coverage up to the capped amount.</p>
<ul style="list-style-type: none"> Emitter default Volume risk 	<p>Volume guarantees reduce the loss experienced by the T&S operator.</p>
<ul style="list-style-type: none"> Storage failure after completion of development phase (risk for the emitters) 	<p>Storage guarantees to provide minimum payments in replacement of subsidy and carbon cost avoidance.</p>
<ul style="list-style-type: none"> Risk of default on loan repayment makes project not bankable 	<p>Loan guarantees ensures project bankability despite the low creditworthiness of some of the project parties.</p>
<ul style="list-style-type: none"> Storage failure after completion of development phase (risk for the T&S company) Emitter unable to reach FID due limited capital availability 	<p>Grants to cover the cost of storage development, potentially also of a back-up storage.</p> <p>Grants to the emitters decrease the need for external financing and the expected shareholder equity contribution.</p>

Government has few options to preserve local industrial jobs while addressing the market undervaluation of CO₂

industrial CCS might be cost-effective



CCS can stimulate local industrial activity

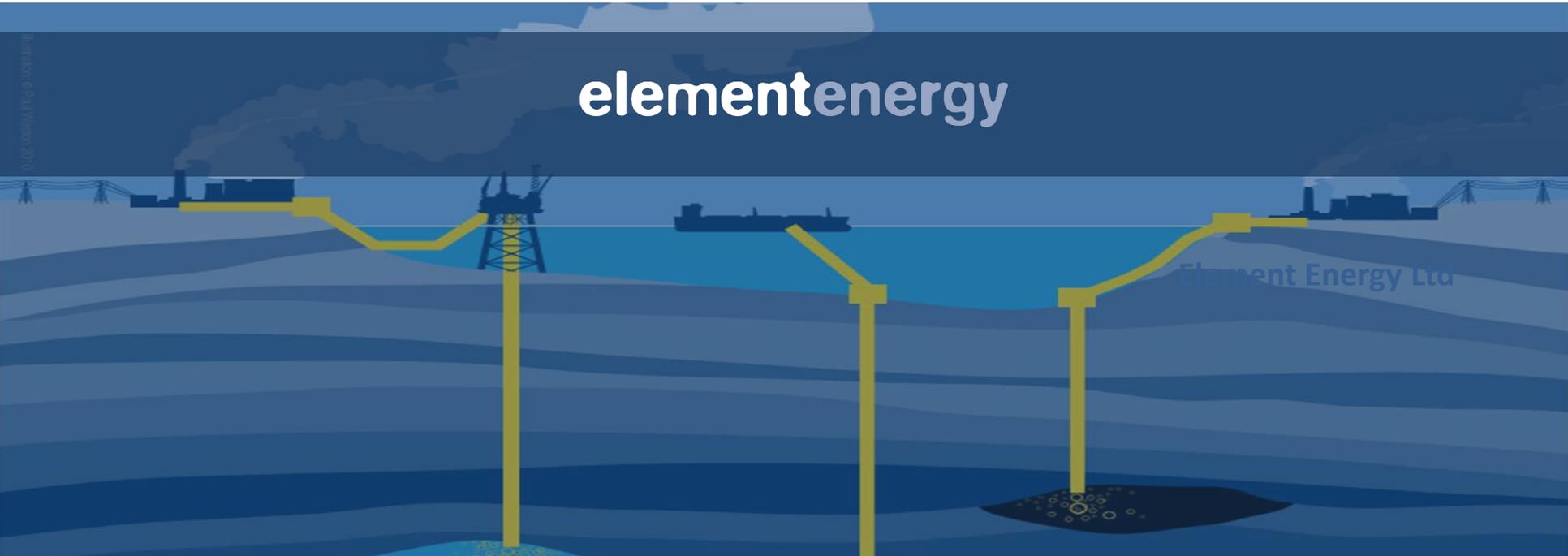


Key messages for CSLF

- **Clarify specific role(s) of CCS in each region considering decarbonisation pathways/timeline**
 - Power: Flexible gas generation in Europe, base-load coal plants in India, etc.
 - Industry: Iron & steel, cement, chemicals, H₂, etc.
 - Bio-CCS to achieve negative emissions
- **Decide whether further demonstration/education is required for each application**
 - Limited experience in specific industrial applications and flexible gas generation
 - Significant storage appraisal requirement
 - Investors need confidence and cost/performance benchmarks
- **Focus on value of CCS**
 - Retaining industrial jobs
 - Substantial tax revenues from fossil fuel production, which will go down without CCS
 - Focussing only on low-cost “low hanging fruit” projects is not a long-term solution!
- **Collaboration to enable timely deployment of CCS**
 - International collaboration to deliver archetypal/benchmark CCS projects on budget, on time
 - Public-private collaboration to implement successful CCS policies
 - Similar to international collaboration on CCS R&D

Element Energy is a leading low carbon energy consultancy working in a range of sectors including carbon capture and storage, low carbon transport, low carbon buildings, renewable power generation, energy networks, and energy storage. Element Energy works with a broad range of private and public sector clients to address challenges across the low carbon energy sector.

For further information please contact:
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The background of the lower half of the slide is a stylized illustration of an industrial carbon capture and storage (CCS) system. It shows a cross-section of the earth with various layers. On the surface, there are silhouettes of industrial plants with smokestacks emitting smoke, and a large ship. Yellow pipes connect these surface facilities to underground storage reservoirs. One pipe goes down to a reservoir on the left, another to a central reservoir, and a third to a reservoir on the right. The rightmost reservoir is shown with a dark, circular area containing small circles, representing the captured carbon being stored. The word 'elementenergy' is written in white lowercase letters across the center of the illustration. The text 'Element Energy Ltd' is written in a smaller, light blue font on the right side of the illustration. On the far left edge, there is a vertical copyright notice: '© 2020 Element Energy Ltd'.

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