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Co-operation for the development of large scale CO_2 transport and storage infrastructure in the North Sea

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Element Energy is an independent and impartial low carbon energy technology consultancy.

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Previous studies

- *Economics of CO_2 storage* (for the Energy Technologies Institute)
- *Financial modelling of CO_2 network* (for One North East)
- *Worldwide CCS pipeline economics and engineering* (for IEA GHG)
- *Asset-wide economic appraisal* of opportunities in capture, transport and storage (FTSE100 oil and gas company).
- *The role of CCS for UK gas power and industry* – analysis and consultation (Committee on Climate Change)
- *Economics of CO_2 storage around Scotland* (Scottish Carbon Capture Study)
- *CO_2 storage in depleted gasfields* (IEA GHG).
- *Designed the UK's feed-in tariff*, an economic investment model supporting the market for sub-5MW renewable electricity (DECC, value of commitments £4 billion).
- CO_2 pipeline infrastructure in the North Sea (for the North Sea Basin Task Force)

The ‘One North Sea’ study established a vision and strategy for CCS deployment in and around the North Sea.

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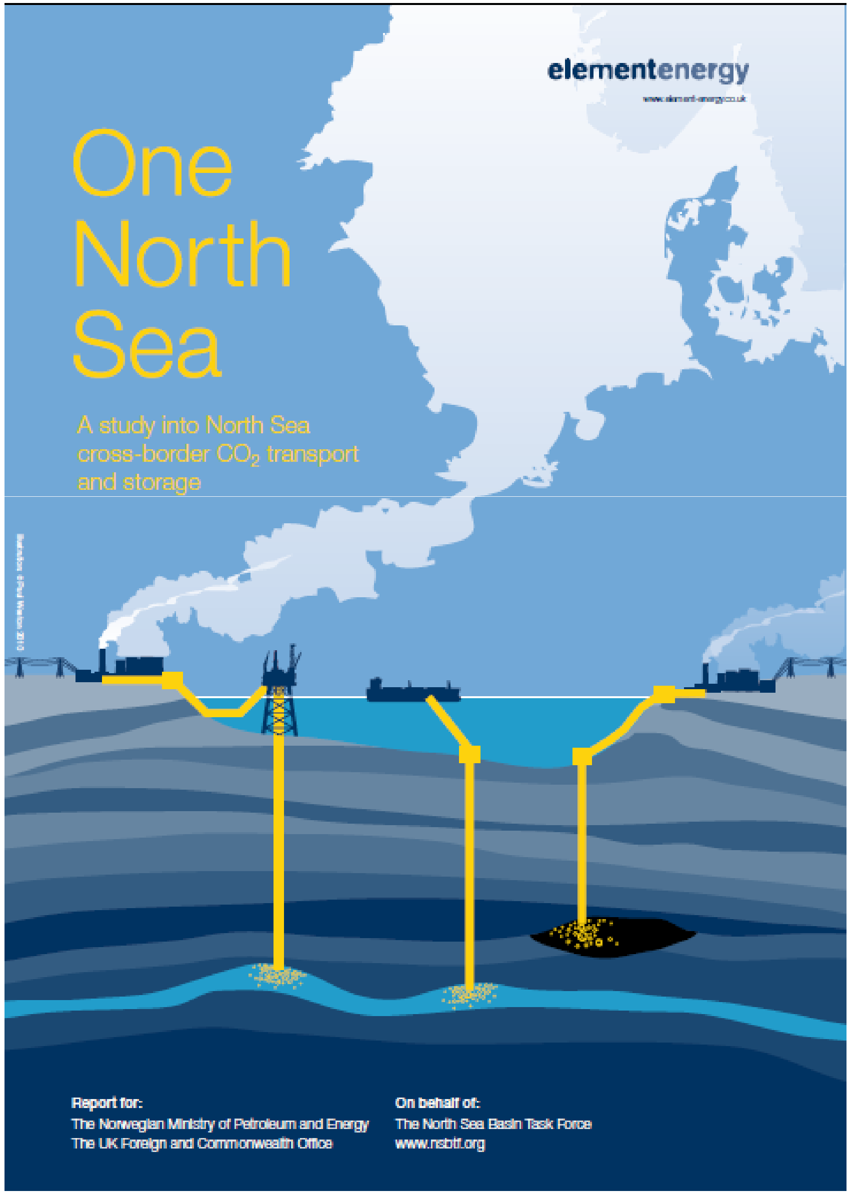
- Involved extensive quantitative analysis of capture, transport and storage scenarios
- Included engagement with more than 60 stakeholders.
- Started in September 2009, completed March 2010.
- ‘One North Sea’ Report available at www.element-energy.co.uk
- Funded by UK Foreign and Commonwealth Office and Norwegian Ministry of Petroleum and Energy, on behalf of the North Sea Basin Task Force.



Large uncertainties in the locations, timing, capacity, designs and economics of CCS projects challenge both policymakers and industry.

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Capture	Transport	Storage
CO_2 caps? Renewables/nuclear contribution? Commodity prices? CCS cost reduction? Industrial sources? Power demand? Efficiency improvements? Site-specific issues?	Point-to-point or integrated infrastructure? Cross-border projects? Pipeline reuse? Shipping? Site-specific issues?	Aquifer viability? Hydrocarbon field storage? Onshore storage? Enhanced oil recovery? Site-specific issues?

Many alternative scenarios for CCS deployment (examined through quantitative modelling supplemented with lit. and stakeholder review)

To understand the requirements for North Sea CCS infrastructure in 2030, we developed a number of CCS scenarios.

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Scenario	CCS demand drivers	Transport drivers	Storage drivers
Very High	Tight CO_2 caps Substantial CCS cost reductions CCS efficiency improvements High power demand CCS mandatory for new build Moderate renewables Limited new nuclear Low gas prices CCS from industrial sources	Integrated infrastructure Cross-border pipelines allowed	Unrestricted – all sinks available for storage
Medium	Moderate CO_2 caps Moderate CCS cost reductions and efficiency improvements No increase in power demand High renewables and nuclear No industrial sources	Point-to point (up to 2030). No cross-border transport before 2050.	No onshore storage permitted. Aquifer storage limited
Low	Unfavourable e.g. Combination of weak CO_2 caps, CCS cost increases, no CCS policies.	Transport investment restricted	Very low availability

With optimistic developments in technology, policies, organisation, social acceptance, CCS could provide *ca.* 10% of European abatement in 2030.

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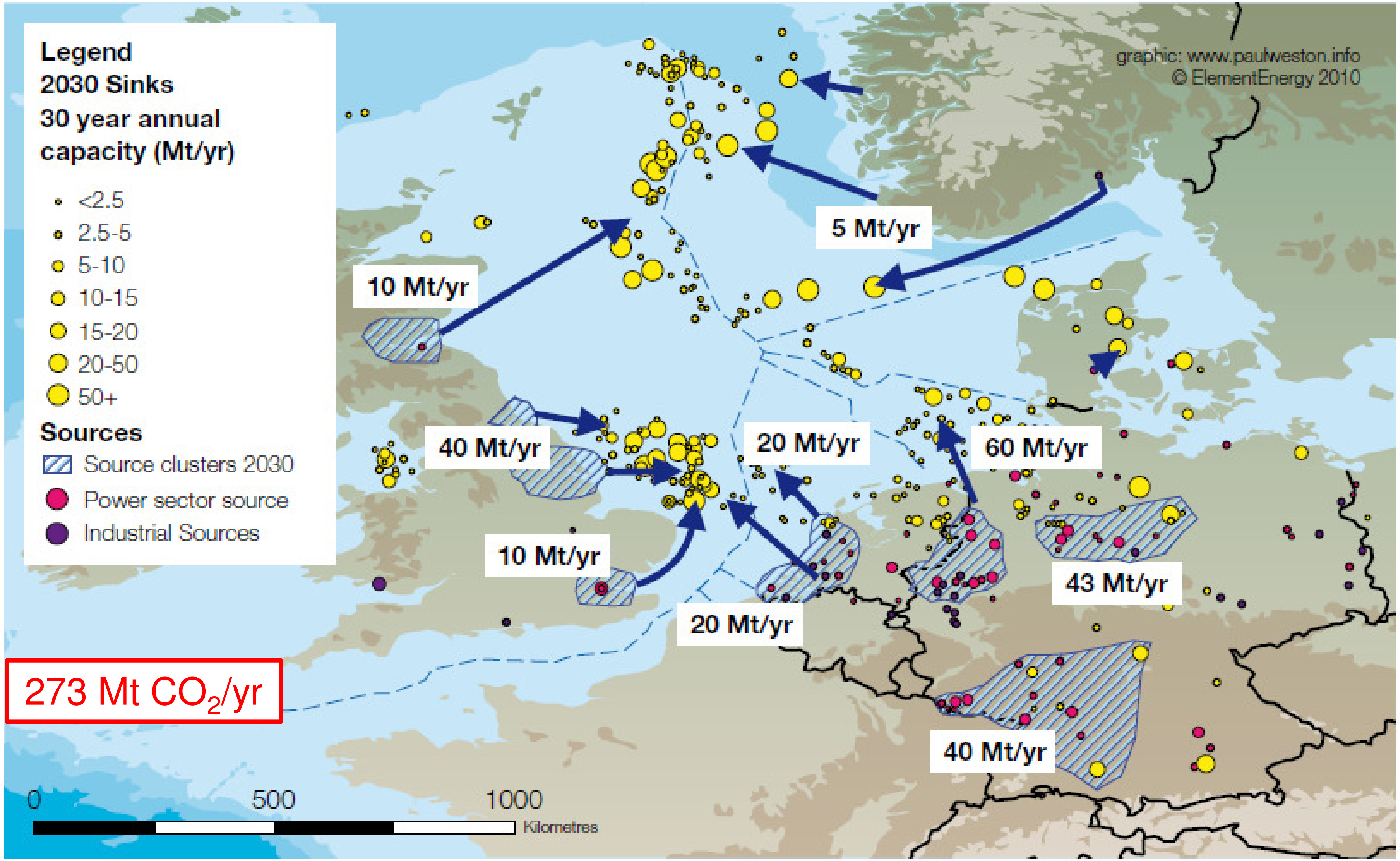

Figure 2: CCS activity in the 'Very High' scenario in 2030

However, with limited support and technology development, CCS deployment in 2030 could be limited to only a few simple projects.

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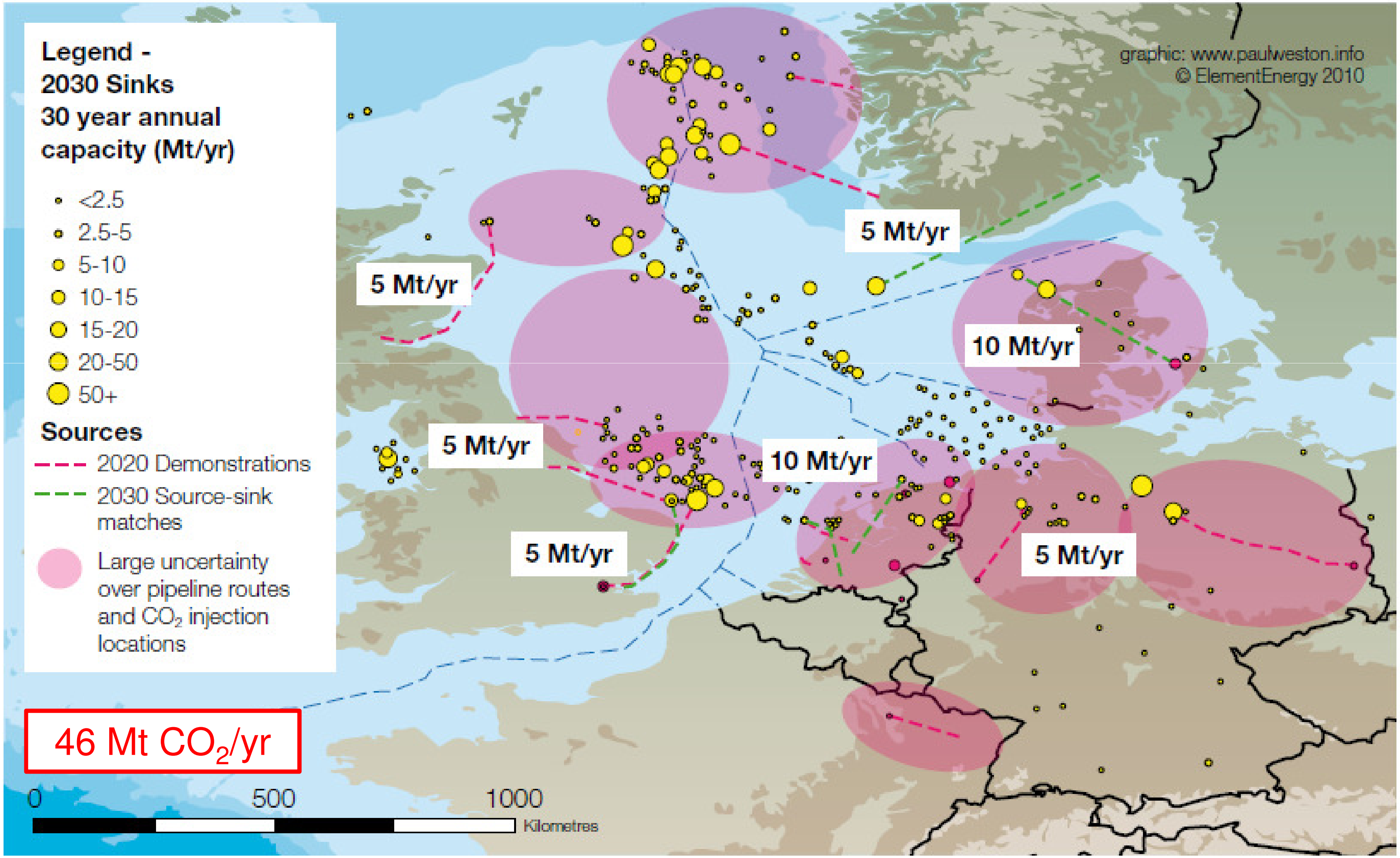
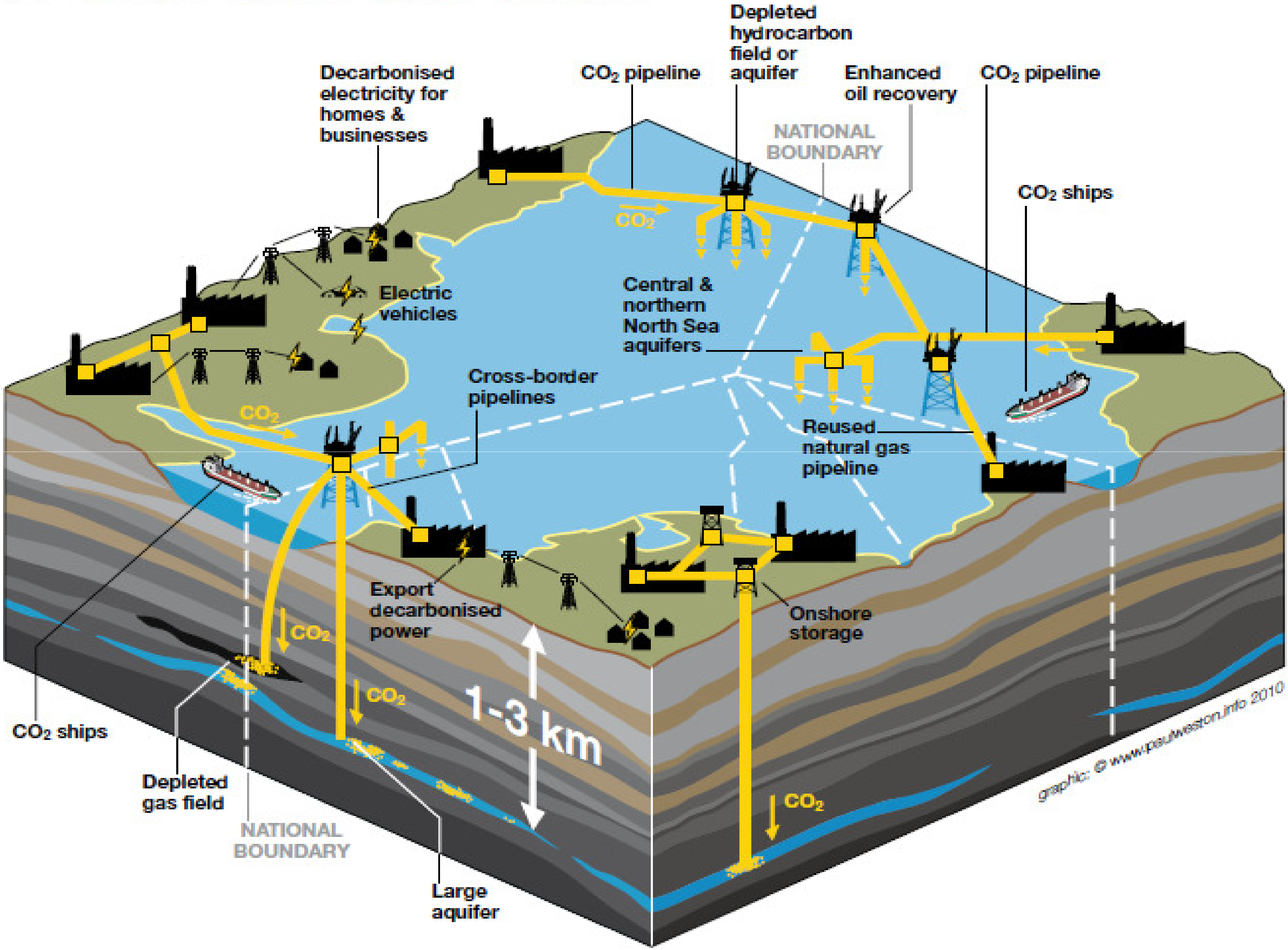


Figure 1: CCS activity in the 'Medium' scenario 2030

A ‘One North Sea’ vision



A vicious circle of limited investment and uncertainty could restrict the development of CCS systems.

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- Limited operational experience and significant interdependencies for large scale CCS systems create significant uncertainties in the potential capacities, locations, timings and costs.
- Therefore policymakers and wider stakeholders are reluctant to provide now the support that would underpin large scale CCS deployment in 2030.
- But, optimised transport and storage infrastructure has long lead times and requires investment and the support and organisation of diverse stakeholders.
- Currently, insufficient economic or regulatory incentives to justify the additional costs of CCS, and uncertain legal and regulatory frameworks (particularly for storage) further limit commercial interest from potential first movers.
- Efficient investment in transport infrastructure requires much more certainty in the locations, capacities, timing and regulations for storage and robust and sufficient economic and regulatory frameworks for capture.

Overcoming the barriers to large scale CCS deployment by 2030 requires leadership and co-operation.

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Major investment in low carbon energy technologies (e.g. renewables) has been achieved through a combination of :

- Robust, substantial and long term economic incentives
- Successful demonstration at intermediate scale
- Confirmation on (large) resource availability and locations
- Solving interdependencies within the value chain
- Clarity on regulations
- Some degree of standardisation to reduce transaction costs
- Political and public support.

Delivering large scale CCS infrastructure requires action at global and European levels.

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Actions at global level

- Worldwide agreement on CO_2 emissions limits
- Operational experience with capture and storage at scale, through safe and timely demonstration projects.
- Reducing the costs of CCS through improving technologies, standardising, and efficient designs.
- Improved guidelines on capacity and suitability of storage.
- Engagement with the public and NGOs.

Additional actions at European level

- Improve the quality of information on storage available.
- Introduce measures that promote CCS beyond first wave of demonstration.
- Set up supportive national regulatory structures for storage developers.

Delivering large scale transport and storage infrastructure in the North Sea requires the co-operation of regional stakeholders.

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Actions for North Sea stakeholders

- A shared, transparent and independent storage assessment involving stakeholders to improve confidence in storage estimates.
- Reduce uncertainties through sharing information on technologies, policies, infrastructure, regulations, costs and challenges.
- Take advantages of ‘no-regrets’ opportunities, such as capture readiness and re-use of existing data and infrastructure where possible.
- Improve stakeholder organisation to ensure infrastructure is efficiently designed, located and delivered.
- Develop frameworks for cross-border transport and storage to reduce the risks for individual countries.
- Determine how site stewardship should be transferred between hydrocarbon extraction, Government and CO_2 storage operators.

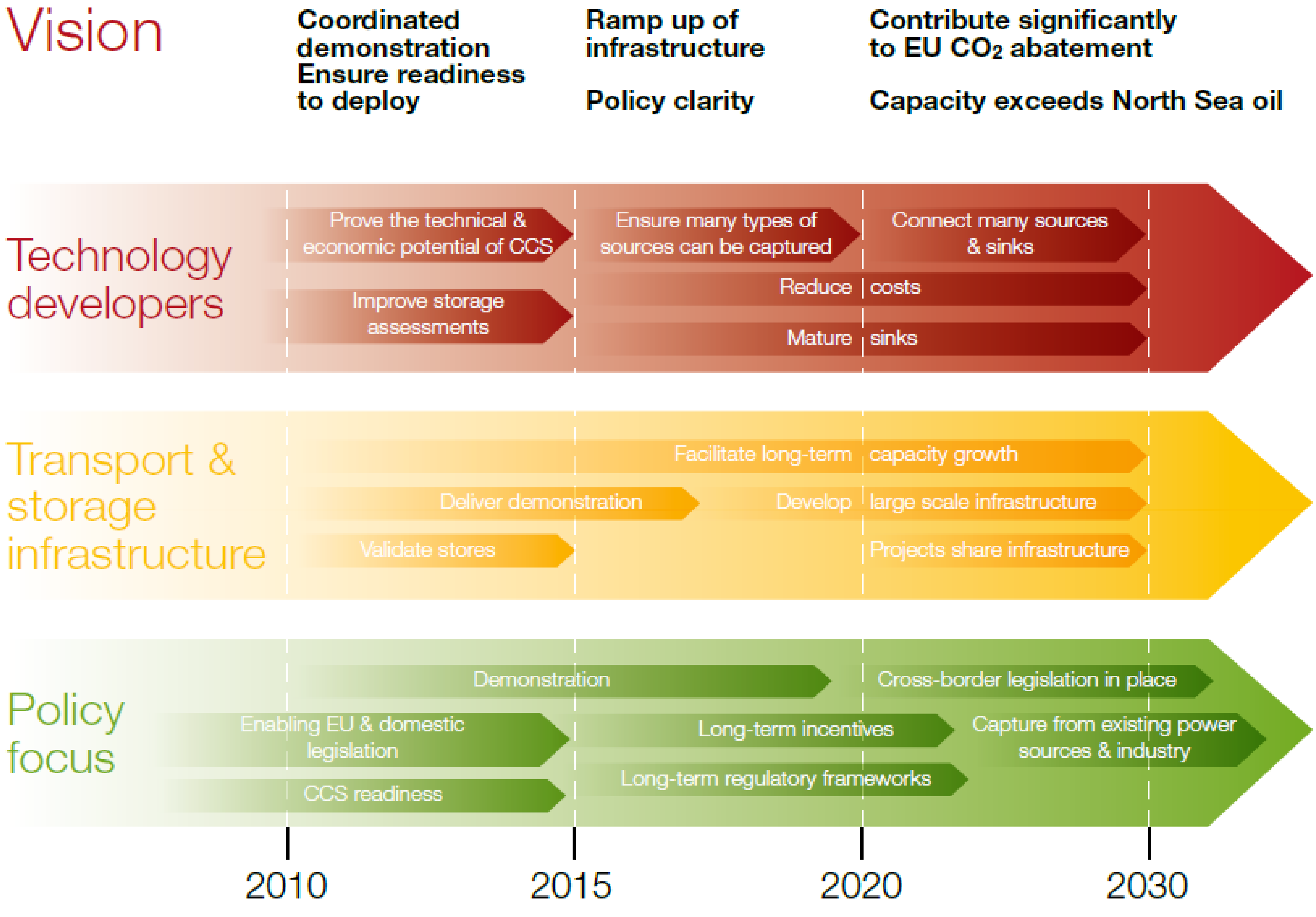

Figure 3: Timeline reflecting the focus of CCS stakeholders in the North Sea region (assumes 'Very High' scenario).

Thank you for your attention. In case of questions please contact:

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