CARBON CAPTURE AND STORAGE

International Energy Agency

Carbon Capture and Storage:

IEA work on CCS in industrial applications – building knowledge, recommendations, actions

Carbon Capture and Storage: Opportunities in energy-intensive industry
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What is 'industry-CCS'?

The capture, transport, (utilisation) and storage of CO_2 that would otherwise have been emitted from commercial facilities outside the power sector

Enables energy-intense industrial sectors to reduce the CO_2 intensity of their operations in a cost-effective manner.

In some sectors (iron and steel, cement, chemicals) process emissions and existing technologies prevent emissions reductions below ~25% unless CCS is applied.

- $CaCO_3 \rightarrow CaO + CO_2$
- $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
- $C + H_2O \rightarrow CO + H_2$ / $CO + H_2O \leftrightarrow H_2 + CO_2$

Process emissions usually require minimal additional capture effort → excellent early opportunities for reducing emissions and learning about CO_2 storage, business and regulation.

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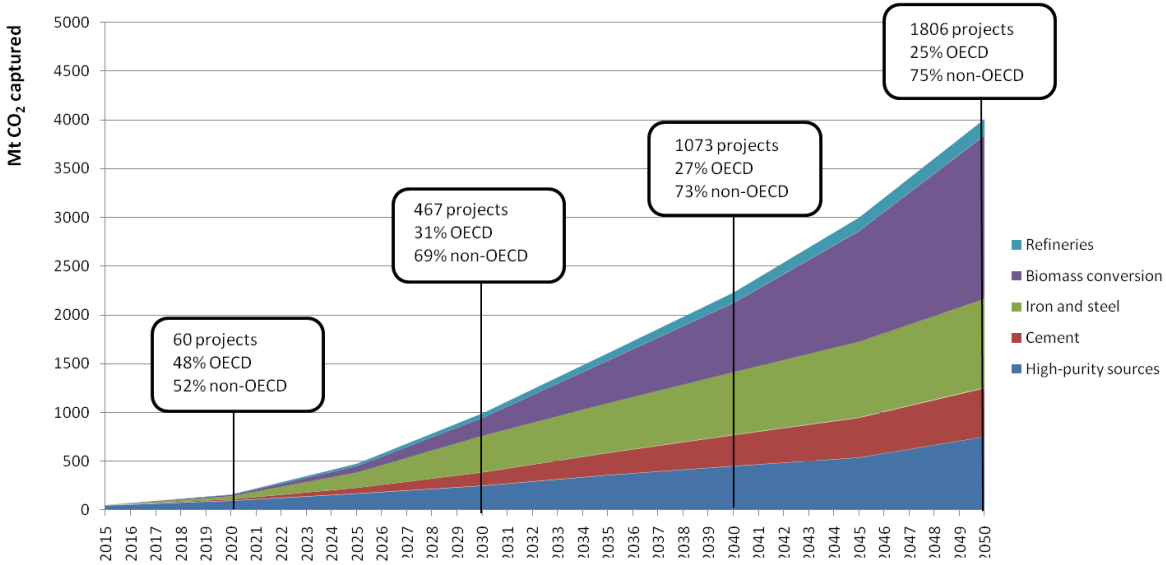
Technology Roadmap: CCS in Industrial Applications 2011

- In-depth sectoral assessments of:
  - Biomass
  - High-purity
  - Iron and Steel
  - Refineries
  - Cement
  - Enhanced Oil Recovery
  - Sources and sinks matching

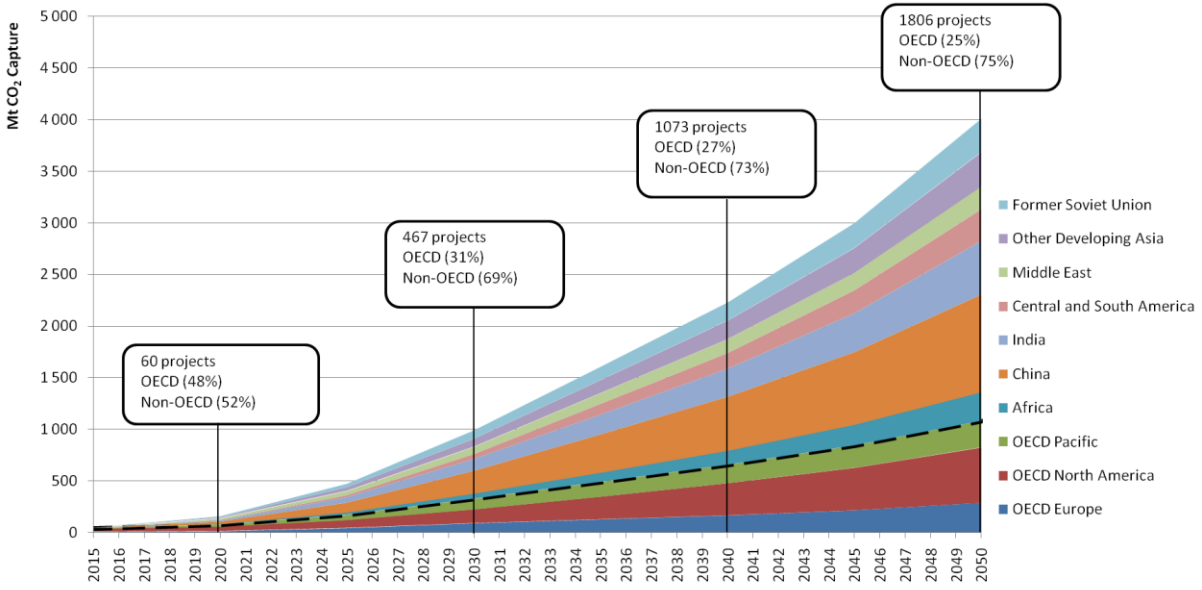
http://www.iea.org/roadmaps/ccs_industrial_applications.asp

The scale of the opportunity



Up to 4Gt of emissions reduced by 2050; 1806 projects!

75% of the opportunity is outside the OECD



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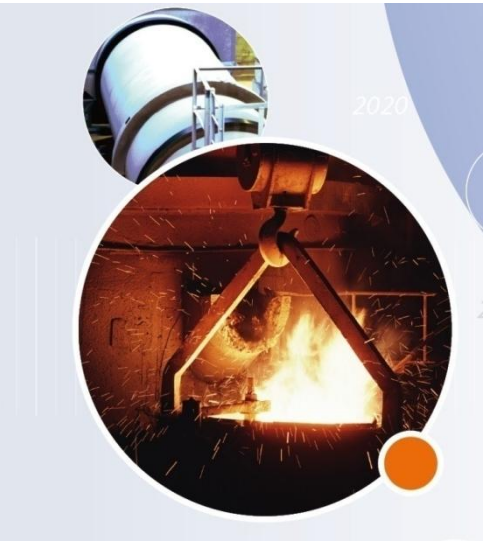
Roadmap conclusions



- A varied picture, many sectors, no one-size-fits-all policy possible
- But if all emissions are treated equally, high purity CO_2 emissions are the best opportunities
- Industrial agglomerations and clusters - several CO_2 sources to be matched with a suitable sink or reutilisation opportunity, reducing costs
- Total investment of USD 3 trillion 2010-2050

Recommendations:

- Variety of incentive mechanisms for varying maturities of technologies
- Improve data on emissions, technologies and costs
- Public research and development programmes are required to bring more information in the public domain
- Governments need to ensure adequate funding for CCS demonstration projects in industrial applications
- Continue analysis of business opportunities

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Follow-on: Clean Energy Ministerial

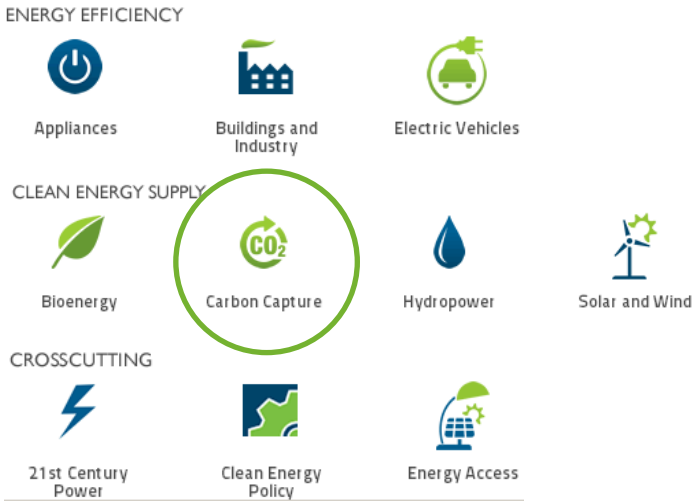
CLEAN ENERGY MINISTERIAL
Accelerating the Transition to Clean Energy Technologies

- CEM
  - 23 countries at Energy Minister level
  - 80% of CO_2 emissions, 90% of clean energy funding

Recommendation 7: "Recognize the potential of CCS for industrial emission sources and review demonstration"

Endorsed in April 2011, but little action since. In 2012, a working group was formed to drive progress.

- Working group
  - Led by IEA and CCSA
  - Workshop in January 2013
  - Report in March 2013



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On which industries are we focusing?

- 4 key sectors
  - Cement
  - Iron & Steel
  - Refining (including upgrading and coal-to-liquids)
  - Chemicals (ammonia, olefins, methanol)
- Other early opportunities
  - Gas processing
  - Biofuels
- Areas for longer-term progress
  - Pulp and paper
  - Aluminium
  - Food & Drink

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How can we make progress?

- Vital need for demonstration of technologies that are:
  - Sector specific (adjusted to deal with impurities, scale, CO_2 concentrations, new technical configurations)
  - Integrated into complex industrial sites
  - It is not necessary for every country to test every technology at scale, but learnings must be shared
- Good understanding of the fate of captured CO_2 is needed before investments are made. Storage capacity/location is key
- Questions:
  - Where can capture projects of <500tCO_2/yr be tested to aid learning in China and contribute to the CEM objective?
  - Can projects be clustered with other projects to handle enough CO_2 for meaningful storage?
  - What is the value of developing this technology in China and who would be suitable partners?
  - What are the easy >500MtCO_2/yr sources for full-chain demos?

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Thank you!

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