Industrial applications in the IEA CCS Roadmap

clarifying the need for targeted action

IEAGHG Industry Workshop

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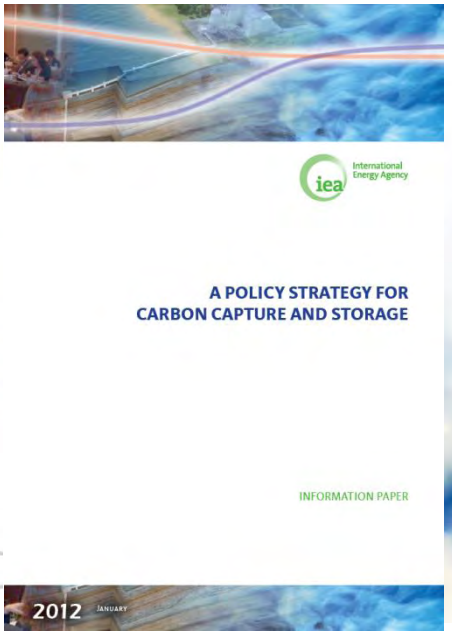
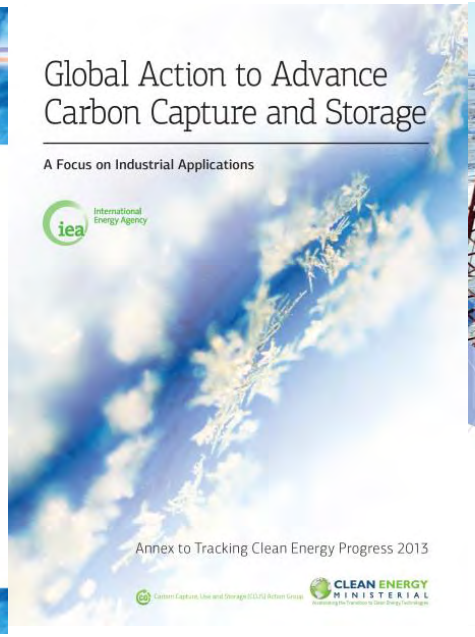
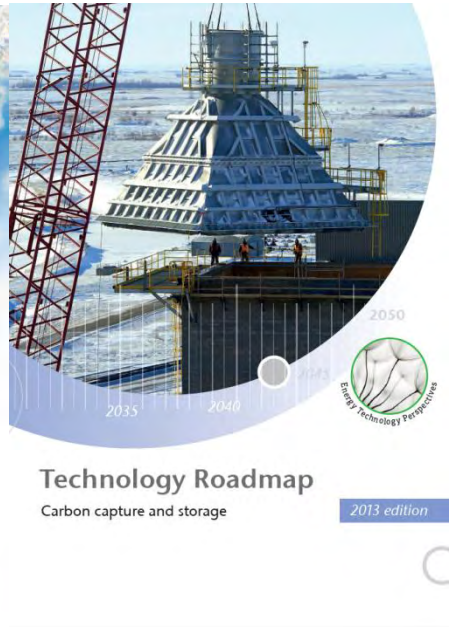
Carbon capture and storage

Reading list for this talk







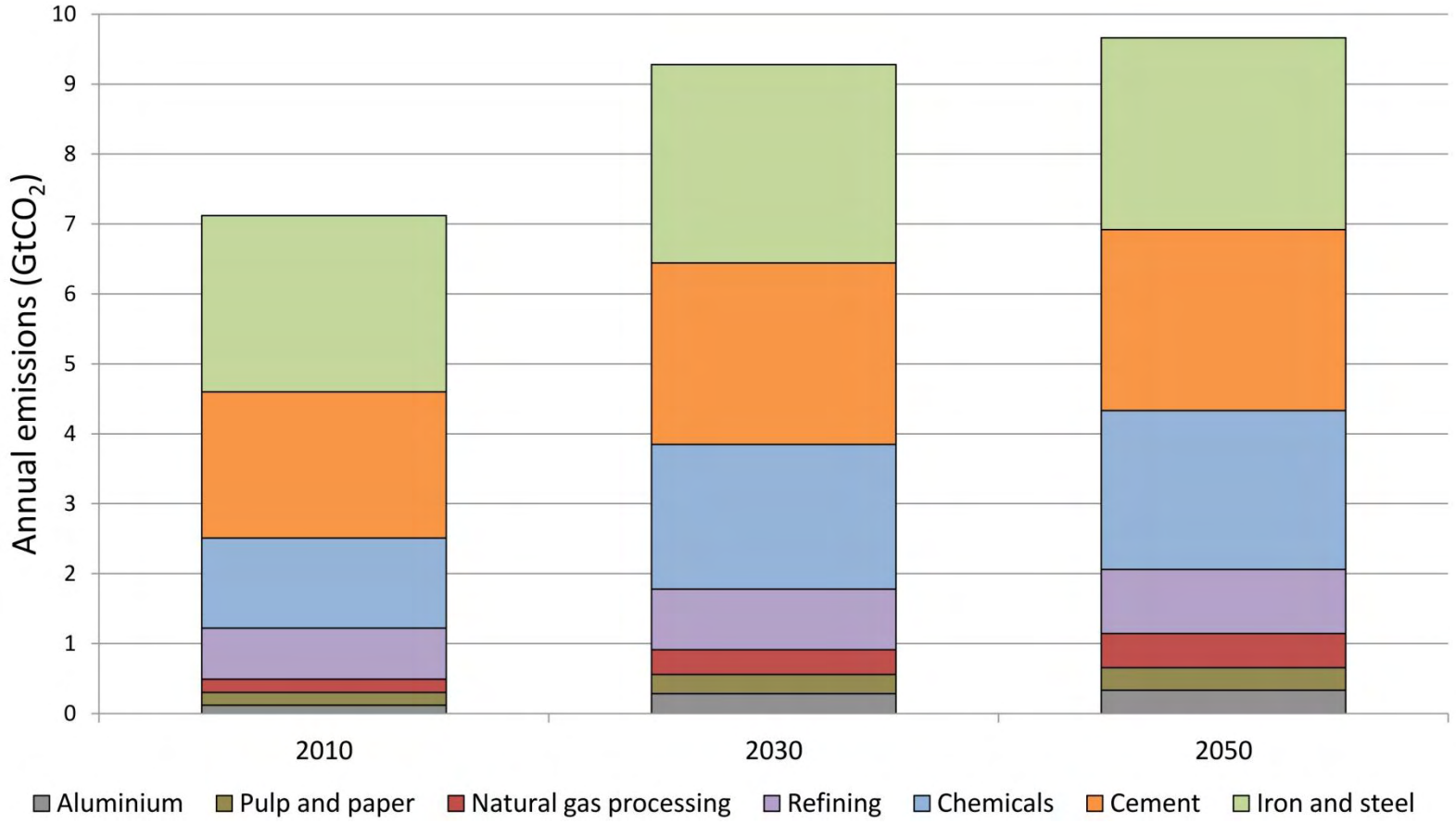
CCS Roadmap 2013: key findings

- **CCS is a critical component in a portfolio of low-carbon energy technologies**, contributing 14% of the cumulative emissions reductions between 2015 and 2050 compared with business as usual.
- **The individual component technologies are generally well understood**. The largest challenge is the integration of component technologies into large-scale demonstration projects.
- **Incentive frameworks are urgently needed** to deliver upwards of 30 operating CCS projects by 2020.
- **CCS is not only about electricity generation**: 45% of captured CO_2 comes from industrial applications between 2015 and 2050.
- **The largest deployment of CCS will need to occur in non-OECD countries**, 70% by 2050. China alone accounts for 1/3 of the global total of captured CO_2 between 2015 and 2050.
- **The urgency of CCS deployment is only increasing**. This decade is critical in developing favourable conditions for long-term CCS deployment.

CCS roadmap 2013: Relevant messages

- Need to raise the profile of CCS in industrial applications to a level alongside CCS in the electricity sector
- Different sectors are at different stages of development
- Government policy for CCS in industrial applications needs to be sensitive to the international competitiveness of the sectors concerned
- Different policy instruments will be needed
  - Generate knowledge of CCS in industrial applications in the near term
  - Make it a cost-effective proposition in the longer-term
- The time to start building capacity and shaping expectations is now

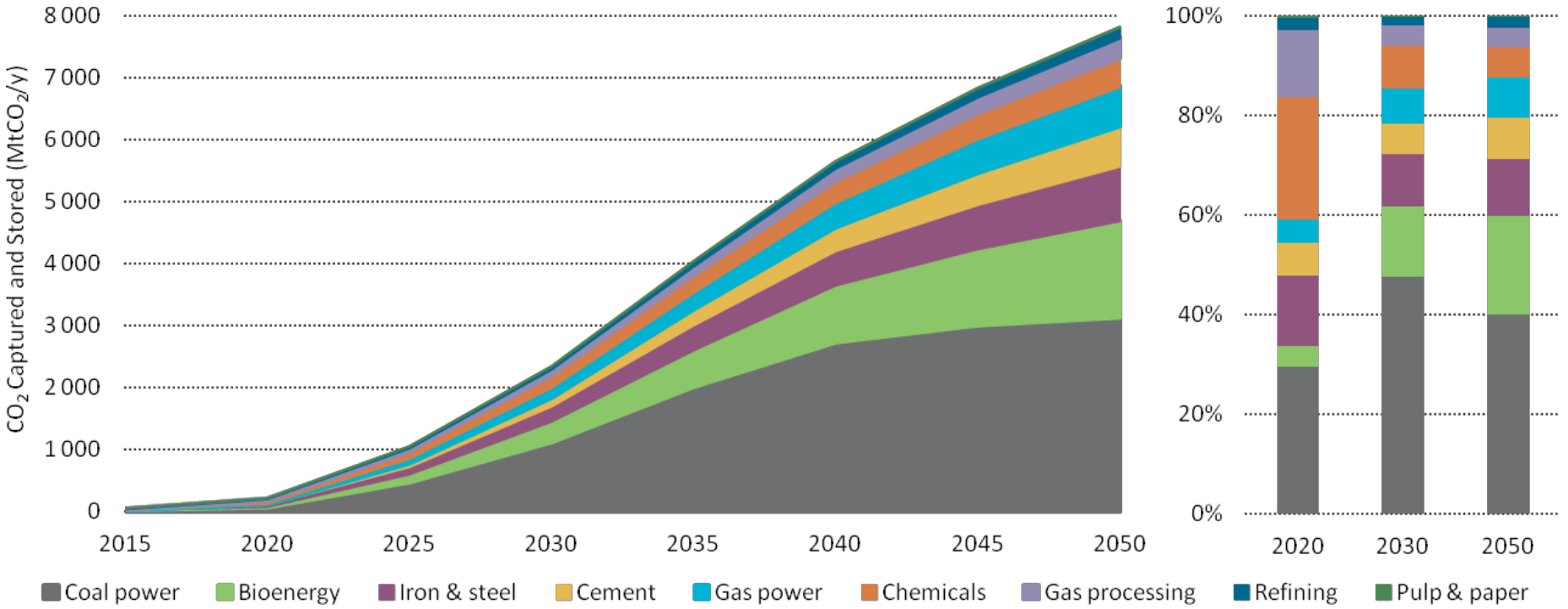
>20% of global CO_2 & growing demand



Source: IEA ETP 2012 4DS, incorporating recent policy pledges

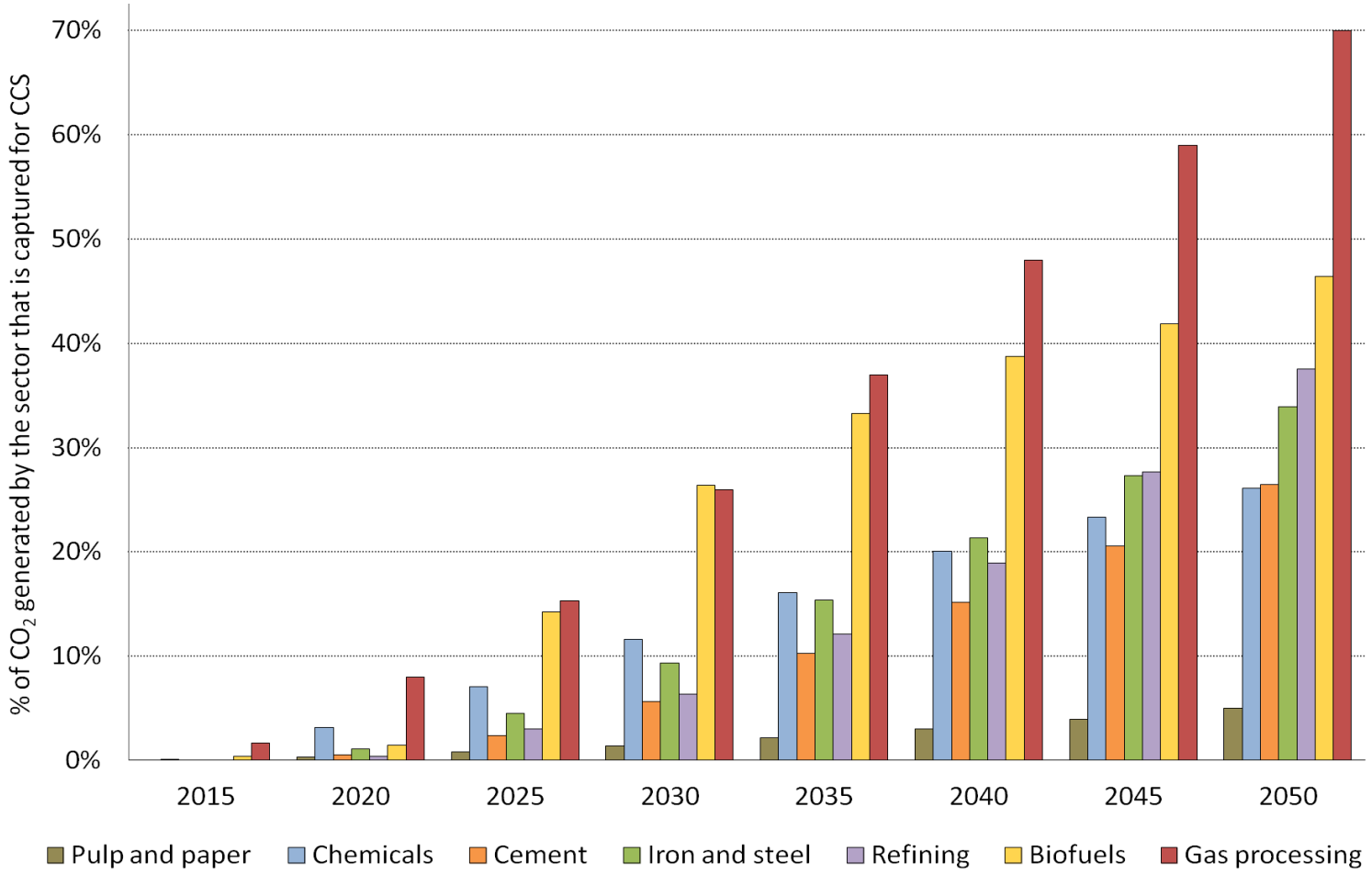
CCS is the only known option to decarbonise these sectors by more than ~30%

IEA 2DS: 45% of stored CO_2 from industry



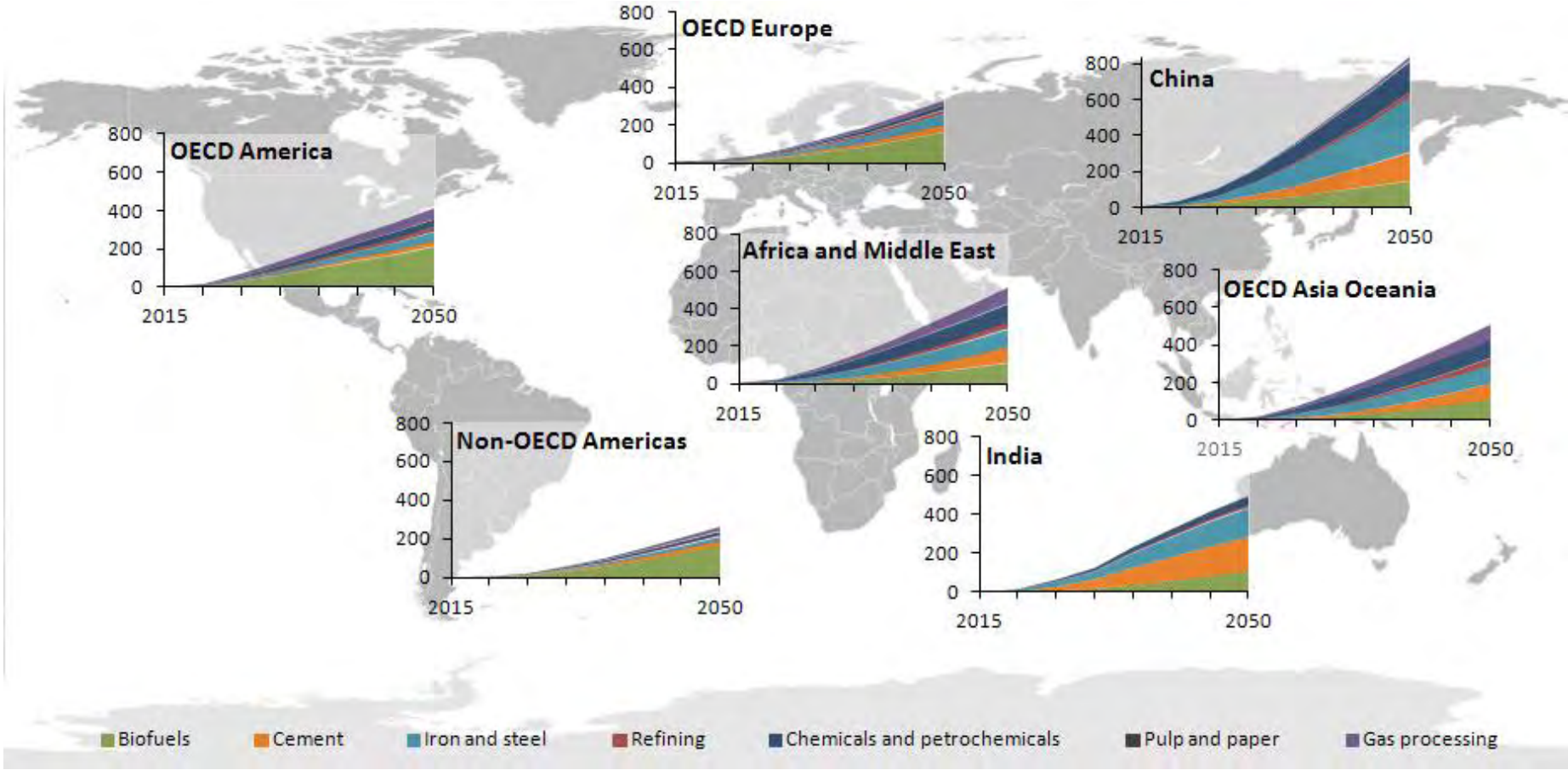
CCS in a lowest-cost pathway to a 2°C scenario involves much more than coal-fired electricity

A high % of each sector would need CCS



For these sectors, 2050 is only one investment cycle away
Low-carbon production routes need to be available as early as 2025

Different regions, different needs



Sectoral penetration will vary by country and region

Clear difference in scale and integration

- Projects on processes with relatively low cost impacts of CO_2 capture
  - Quest (refining H_2, 1.08 $MtCO_2$/yr stored, Canada, Shell, 2015)
  - Gorgon (gas processing, 4 $MtCO_2$/yr stored, Australia, Chevron, 2015)
  - Illinois (biofuels, 1 $MtCO_2$/yr stored, US, ADM, 2014)
  - Lula (gas processing, 0.7 $MtCO_2$/yr for EOR, Brazil, Petrobras, 2013)

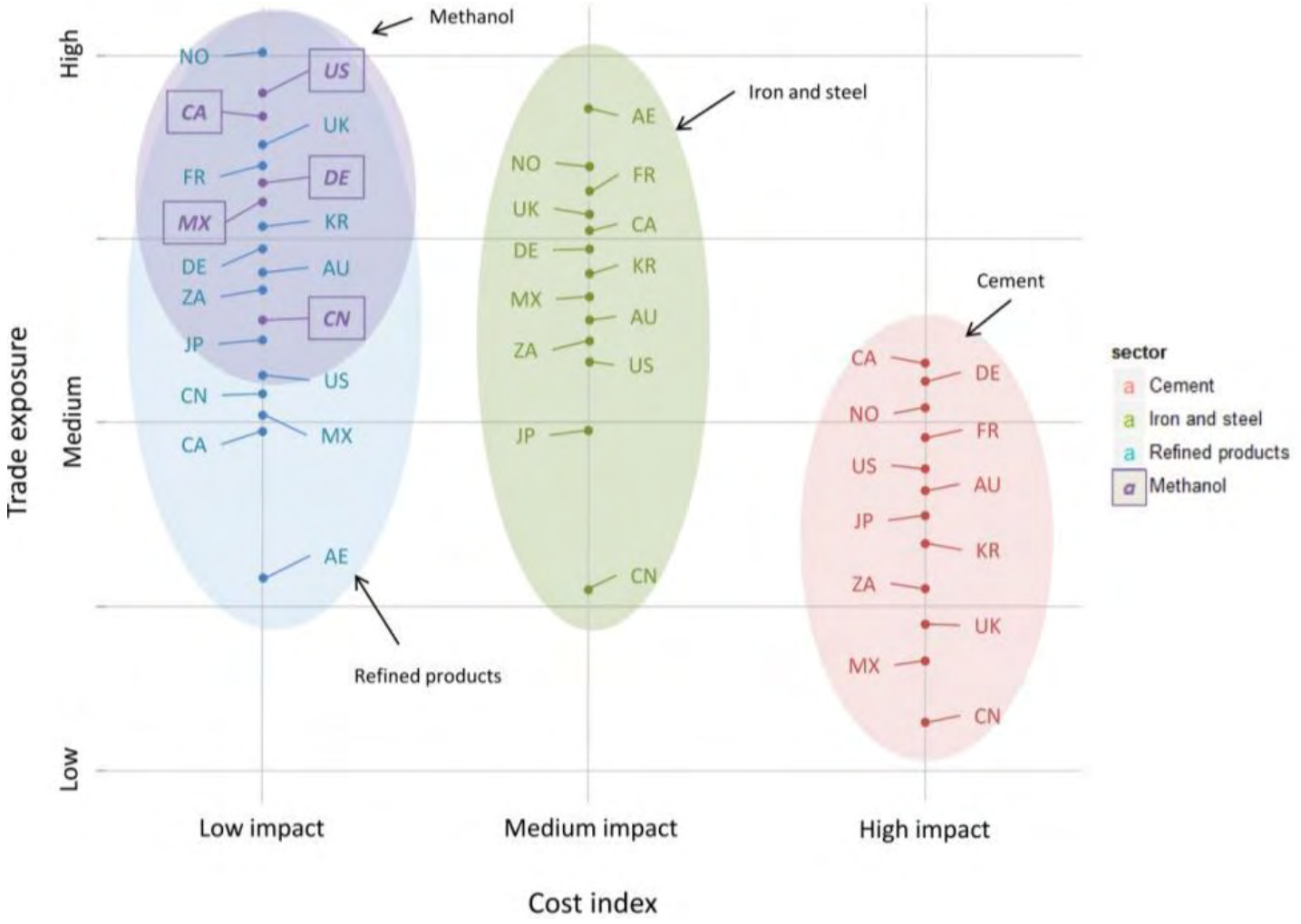
- Projects on processes with relatively high cost impacts of CO2 capture
  - Brevik (cement, 0.7 $ktCO_2$/yr vented, Norway, Norcem, 2014)
  - SkyMine (cement, 83 $ktCO_2$/yr utilised, United States, Skyonic, 2014)
  - TCM (refining FCC, 80 $ktCO_2$/yr vented, Norway, Gassnova, 2012)
  - Florange (steel, 0.7 $MtCO_2$/yr stored, France, ArcelorMittal, cancelled)

Why do industry sectors drag their feet?

- Two critical factors
  1. Exposure of a sector in a given country to international trade
  2. The relative impact that CCS would have on production cost

- Compounding issues (especially in Europe)
  - Economic and financial crisis
  - Intra-sectoral coordination dilemma – first-mover (dis)advantage
  - Regulatory dilemma – more mature technologies permit regulation
  - Inter-sectoral misalignment of perceptions of responsibility/timing
  - Inter-regional misalignment of climate policy and capacity expansion

Trade exposure vs. CCS cost impact



Source: IEA report to the Clean Energy Ministerial 2013
Cost index impact the impact of adding CCS to the production cost of a unit of output

No easy-wins. Industries with less exposure to trade are those with high additional costs of CCS

Who should invest in knowledge?

- **Who benefits?**
  - Countries with high value-added from primary/process industries
  - Countries with exportable raw materials (coal, oil, gas, iron ore etc.)
  - Firms wishing to be competitive in a low carbon world
  - The public, who will use fossil fuels in excess of the climate's capacity
  - Purchasers of 'green' CO_2 (EOR, chemicals, fuels)

- Governmental funders don't need to be hosts; **knowledge is transferrable**
  - Pilot projects could be in the country exporting (e.g. iron ore exporter)
  - Demo projects could be in region of capacity expansion (e.g. ore user)

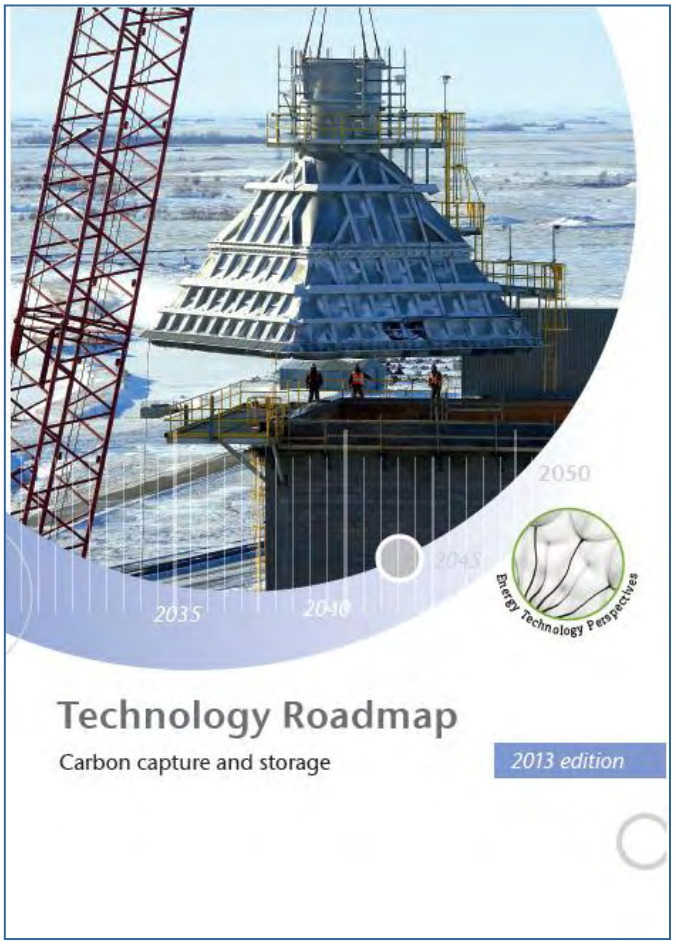
- **Collaboration will be key**
  - Resources are limited in governments and trade-exposed sectors today

There are good examples of collaboration

- **ULCOS** (Ultra-Low CO2 Steel), since 2004
  - Evaluated technologies to reduce CO_2 intensity by >50%; 2 pilot tests
  - Up to 2010, funded by 48 industry members (60%) and EC (40%)
  - Patents owned and managed by inventor firm, but use rights shared
- **ECRA** (European Cement Research Academy), since 2003
  - Considers CO_2 capture designs and economics, including lab-scale test
  - 40 cement producers (3 of 4 main global equipment suppliers)
  - No public funding
  - IPR waived by members, who share all results
- Plus: **COURSE50, CO2 Capture Project**
- But, EU sectoral roadmaps are defensive about CCS (steel, cement, paper) and firms are yet to see CCS as something beneficial in the long-run. Need to reduce the 'threat' of CCS and raise the rewards from innovation

Seven key actions for next seven years

- Introduce **financial support mechanisms** for demonstration and early deployment.
- Develop laws and regulations that effectively require new-build power capacity to be **CCS-ready**.
- Significantly increase efforts to **improve understanding** among the public and stakeholders of CCS technology.
- Implement policies that **encourage storage** exploration, characterisation and development for CCS projects.
- Reduce the **cost of electricity** from power plants equipped with capture through continued technology development.
- Prove capture systems at pilot scale in **industrial applications**.
- Encourage efficient development of CO_2 **transport infrastructure**.



thank you for your attention

iea.org/topics/ccs/ccsroadmap2013