

IEA CCS Roadmap

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US RCSP- Pittsburgh
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Technology Roadmap

Carbon capture and storage

International Energy Agency

Created in 1973

Currently 28 Member Countries

Goals:

- energy security
- environmental protection
- economic growth

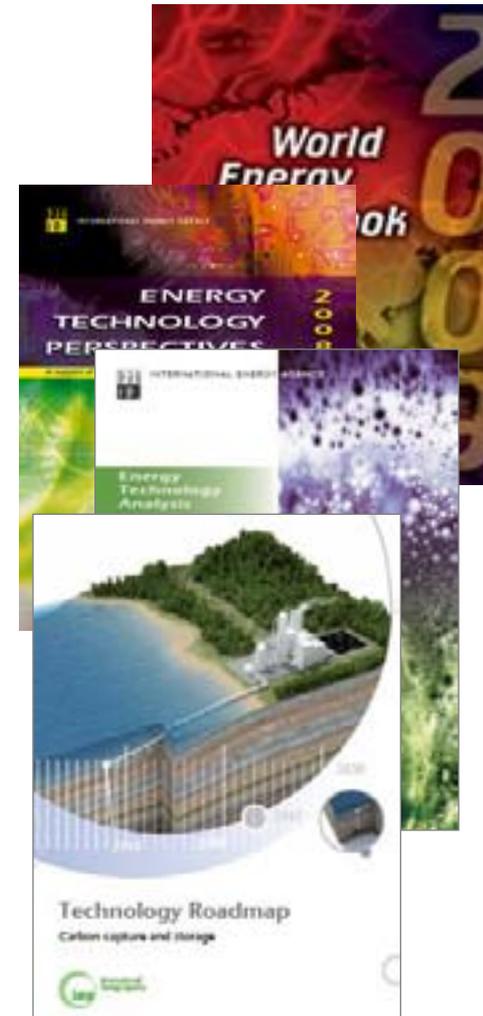
Activities:

- co-ordinates efforts to ensure energy security
- compiles energy statistics
- conducts policy analysis
- reviews energy policies & programs
- convenes, mobilizes science & technology experts



IEA CCS Activity

- World Energy Outlook (Annually)
- Energy Technology Perspectives (Every 2 years)
- IEA CCS Book (October 2008)
- IEA CCS Regulators' Network (Ongoing)
- IEA CCS Roadmap (October 2009)
- Development of model legal framework for CCS (early 2010)
- IEA CCS Unit (early 2010)

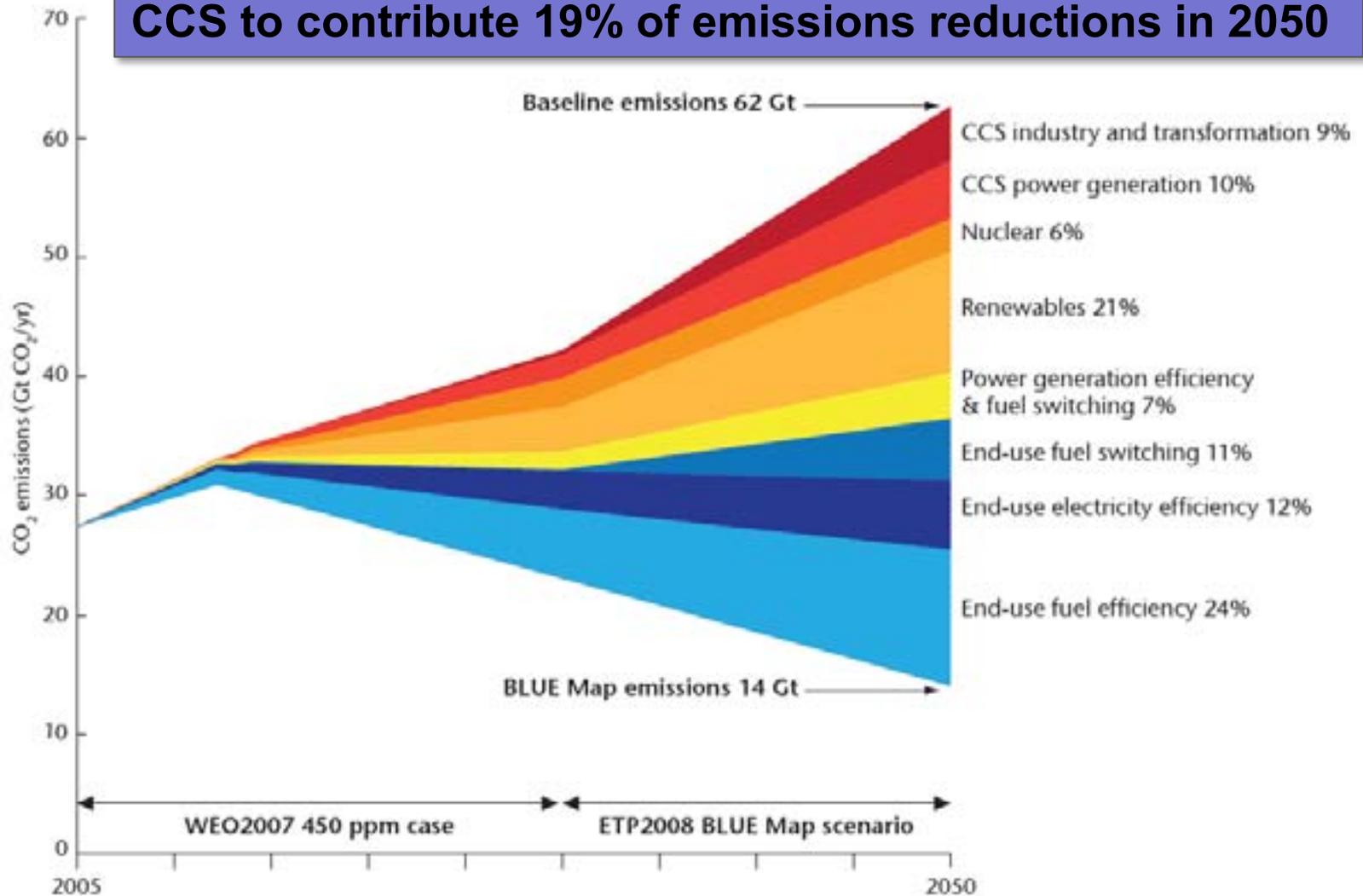


IEA Roadmap Process

- Establish the current technology baseline
- Assume a 50% reduction in energy-related CO₂ by 2050
 - Identify growth pathway
- Create technical, policy, legal, financial, and public acceptance milestones to achieve that pathway
- Identify priority near-term actions
- Create a process for enhanced collaboration
- Implement actions and track progress
- 19 Roadmaps in total

The ETP Blue Map Scenario

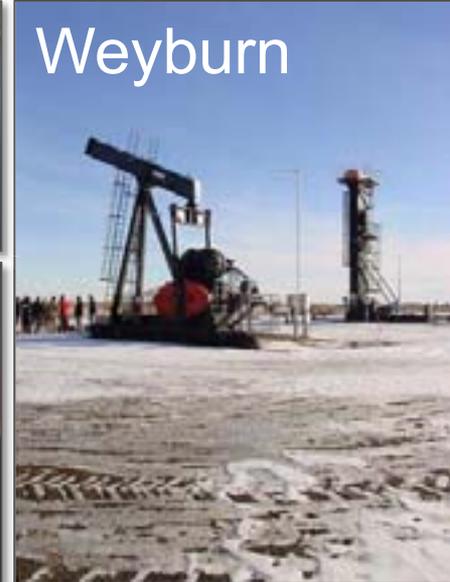
CCS to contribute 19% of emissions reductions in 2050



The rationale for CCS

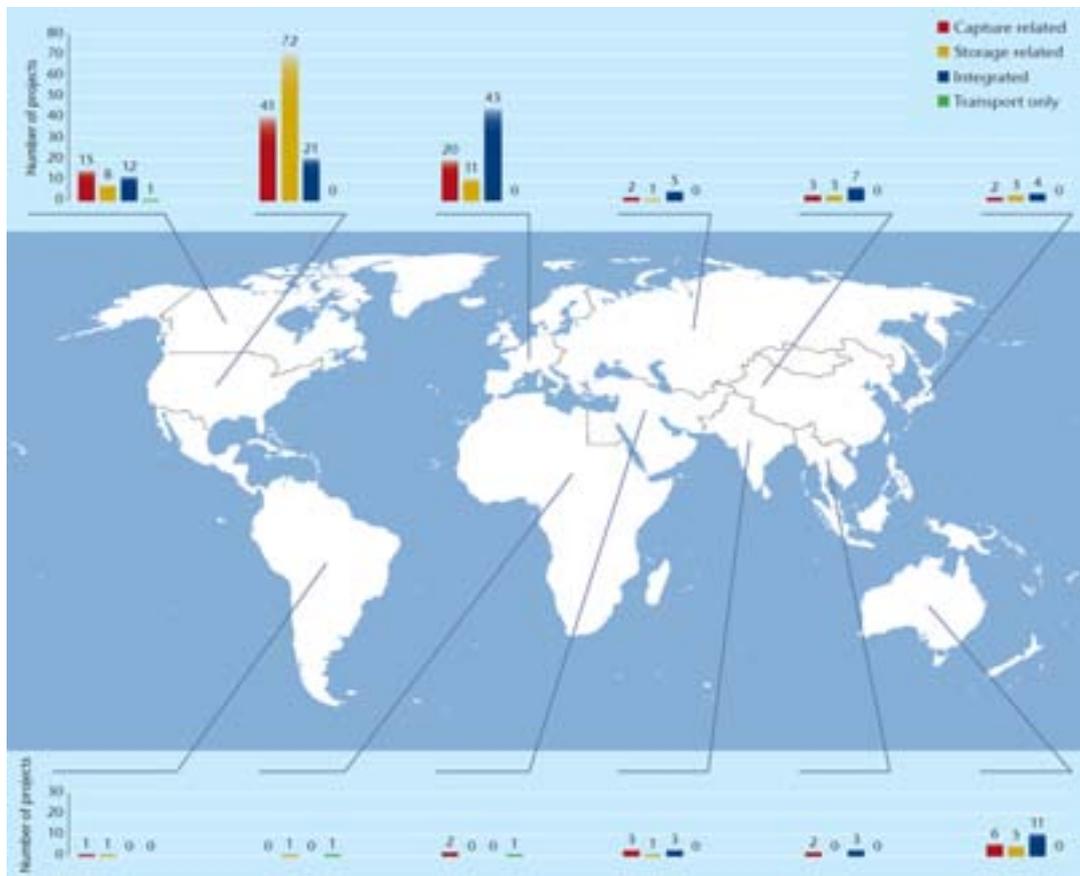
- Without new policies, global emissions increase by 130% by 2050, leading to a 4-7°C temperature rise
- CCS provides one-fifth of the needed CO₂ reductions in 2050
- Without CCS, cost of stabilization rises by 70%
- CCS is the only low-carbon solution for gas/coal, cement, and iron & steel sectors

Large-scale CCS today



Large-scale integrated projects are operating today, but none from power generation

Large-scale CCS planned



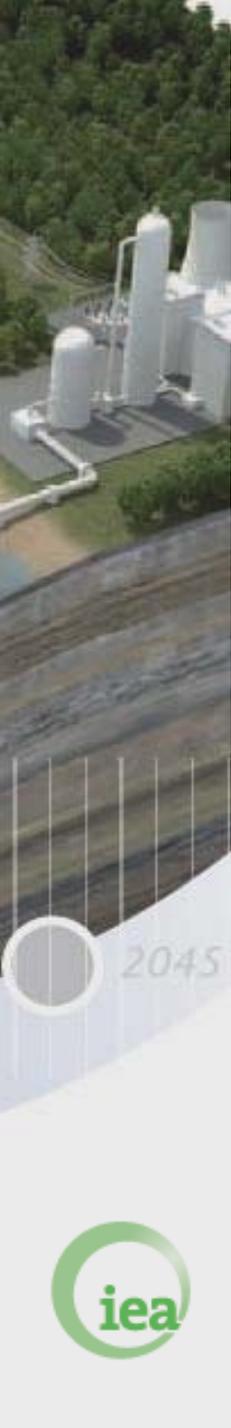
Over 100 large-scale integrated projects planned - 21 in USA

Source:GCCSI



CCS law and regulation today

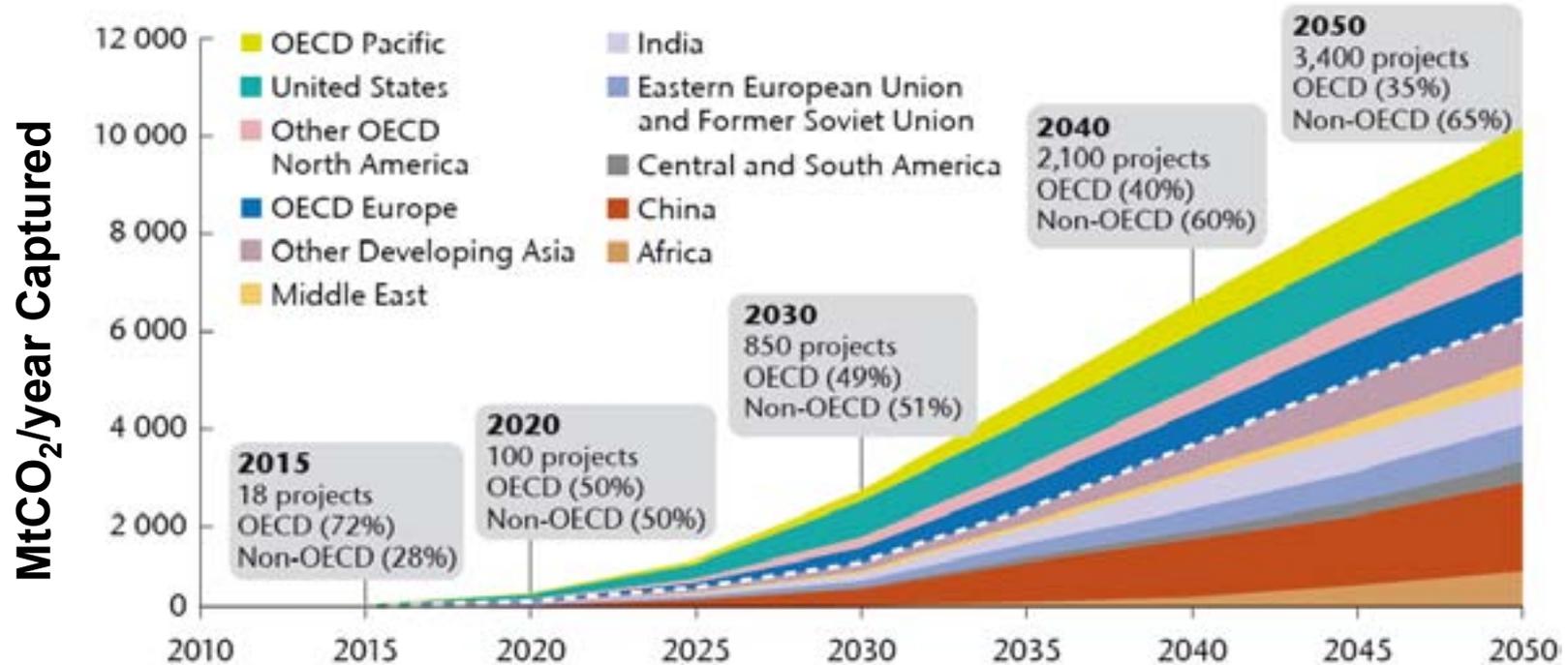
- IPCC 2006 Inventory Guidelines
- London Protocol
- OSPAR Treaty
- EU CCS Directive
- EU ETS Directive
- National Legal & Regulatory Developments
 - Europe
 - Australia
 - US
- UNFCCC



CCS financing today

- Australia: Aus\$2bn plus Aus\$300 for Global CCS Institute
- Canada: Can\$1.3bn plus Can\$2bn from Alberta
- EU: CCS is eligible in the EU ETS
€1.05bn from Economic Recovery Energy Programme and 300m allowances in the EU ETS
- Norway: ~US\$40/ton CO₂ tax on offshore oil and gas operations
- UK: Additional costs for 1-4 CCS plants in the UK
- US: US\$3.4bn from Economic Recovery Act plus funding for the US RCSP

An ambitious growth pathway



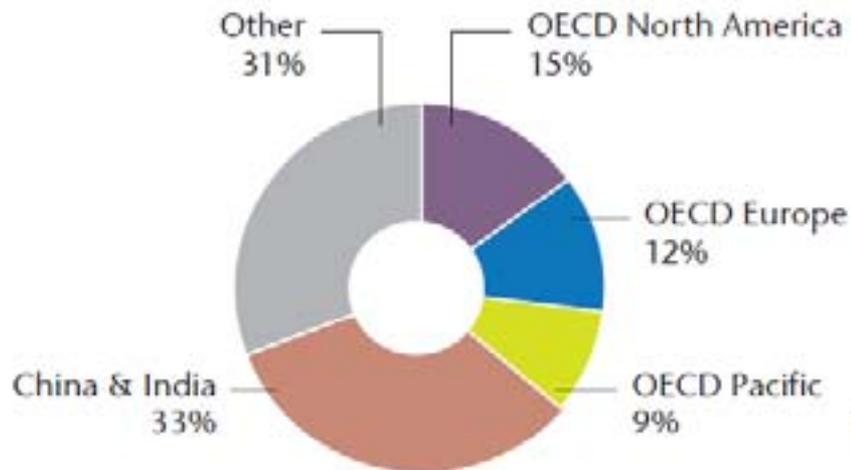
US\$2.5 – 3 trillion in additional investment required between 2010 and 2050

OECD regions must lead in demonstrating CCS, but the technology must quickly spread to the rest of the world

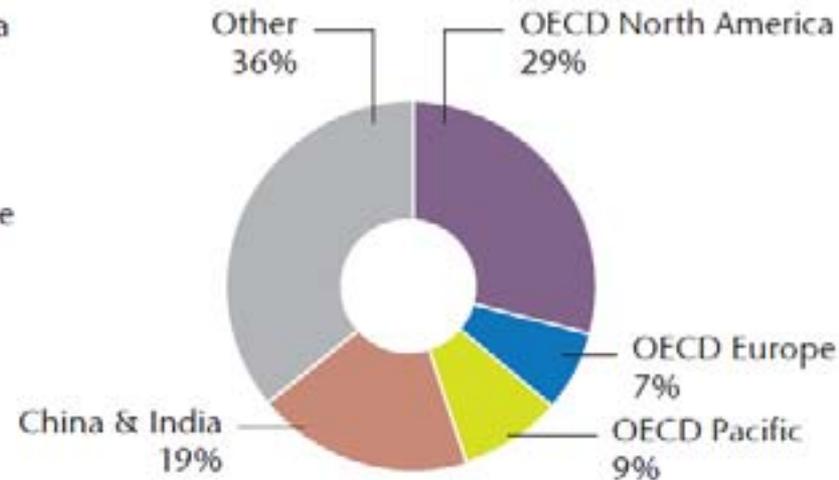
A Global Challenge

Regional contributions in 2050 (MtCO₂)

Power generation on 5.5 Gt CO₂ captured 2050

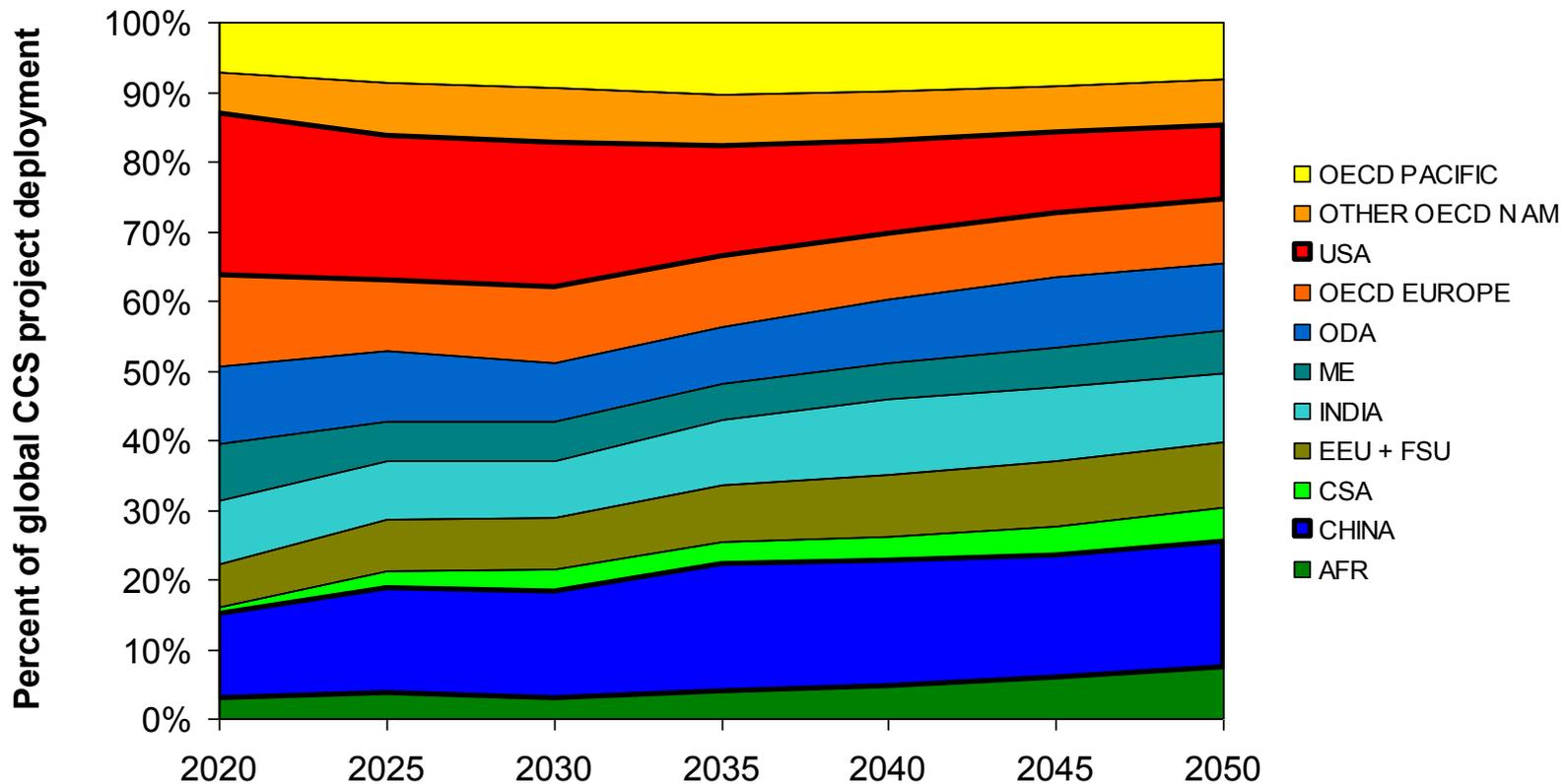


Industry & Upstream 4.5 Gt CO₂ captured 2050



CCS will be required in all regions of the world in power, industry and upstream

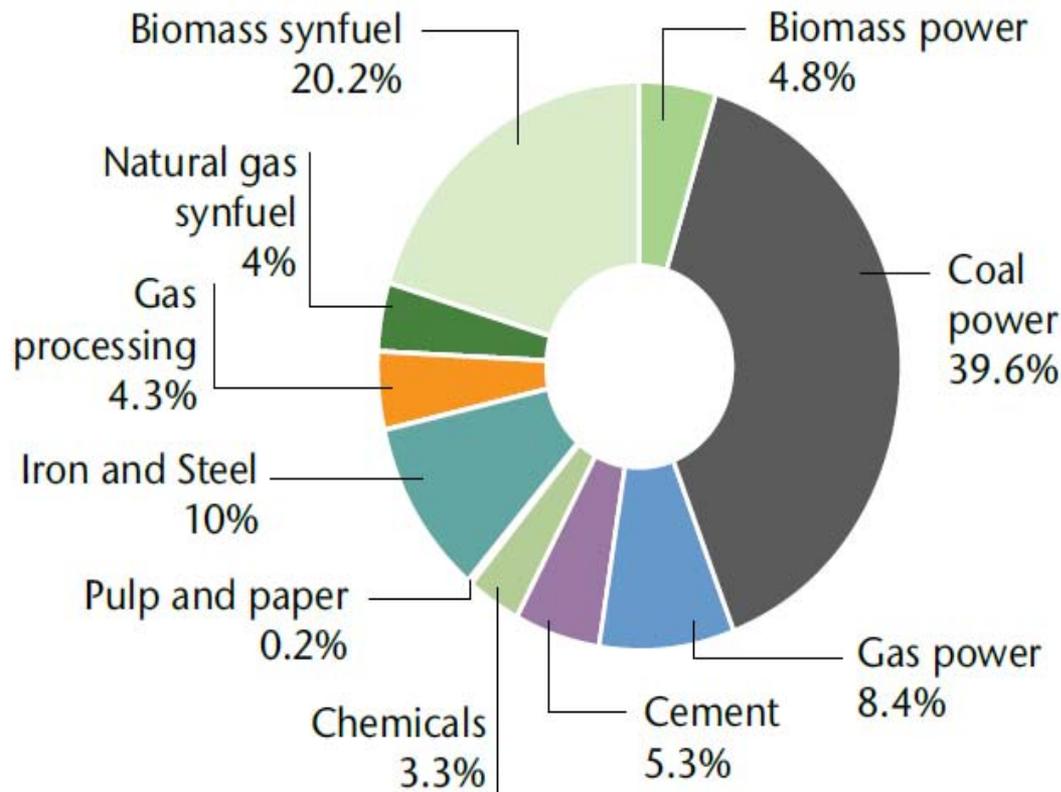
Global Contribution



US Contribution	2020	2050
Projects	23%	11%
tCO2/year	32%	18%

CCS is not just a “clean coal”

Sector contributions in 2050 (MtCO₂)



Coal power only makes up around 40% of stored emissions in 2050

Current challenges

- Accelerating R&D for capture technologies
- Exploring and documenting suitable CO₂ storage sites
- Identifying funding mechanisms for demonstration and deployment
- Developing appropriate legal & regulatory frameworks
- Ensuring public engagement
- Expanding international collaboration

The next 10 years: a critical period for CCS

- **Technological milestones**
 - Reduce cost of CO₂ capture
 - Reduce energy penalty of CO₂ capture
 - Improve storage capacity estimates
- **Demonstration milestones**
 - Meet G8 goal of 20 project announcements by 2010
 - Demonstrate CCS in industrial sectors
 - Demonstrate CCS retrofit
 - Achieve commercialization with 100 projects by 2020

The next 10 years: a critical period for CCS

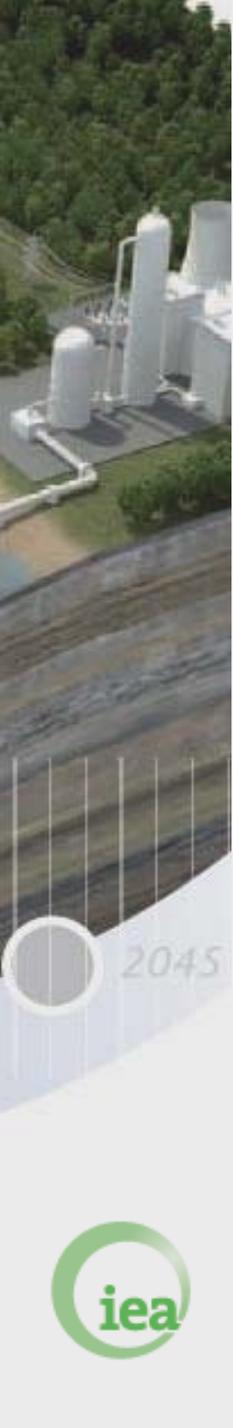
- **Financial milestones**
 - Provide funding for long-term R&D
 - Finance and plan CO₂ transport infrastructure
 - Incentivise both demonstration and large-scale deployment of CCS
 - Provide USD 3.5-4 bn annually from 2010-2020 for CCS in developed countries
 - Provide USD 1.5-2.5 bn annually from 2010-2020 in developing countries

The next 10 years: a critical period for CCS

- **Legal/regulatory milestones**
 - Amend existing frameworks to regulate demonstration projects
 - By 2015, all countries with CCS potential should have comprehensive frameworks
- **Public engagement milestones**
 - Increase government expenditures in 2010-2012
 - Provide greater (and earlier) information on planned projects

The next 10 years: a critical period for CCS

- **International Collaboration**
 - Grow collaborative R&D, demonstration, and information sharing efforts.
 - CSLF, IEA GHG, GCCSI, NZEC, etc.



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US Acknowledgements

- ARI
- AIG
- AJW Group
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- Conoco Phillips
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- EEI
- Electric Power Research Institute
- Illinois State Geological Survey
- Environmental Defense
- ExxonMobil
- Geosequestration International
- KinderMorgan
- Lawrence Livermore National Lab
- MGSC
- NETL
- New Mexico Oil Conservation Commission
- NRDC
- Schlumberger
- Shell Future Fuels & CO2
- Southern Company
- US Department of Energy
- US Department of Transport
- US Environmental Protection Agency
- US House - Energy Committee
- US Senate - Energy & Resources Committee
- Virginia Tech, Center for Coal and Energy Research
- WRI
- Zurich



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