



CO₂ Capture and Storage: A Global Call to Action

NCCSA Briefing
23 April 2009

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Office of Sustainable Policy and Technology

Overview

- **The Importance of CCS**
- **CCS Status Globally**
- **CCS in the Future: Issues and Challenges**
- **The IEA's CCS Activities**

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International Energy Agency

Goals:



- energy security
- environmental protection
- economic growth



Activities:

- co-ordinates efforts to ensure energy security
- conducts policy analysis
- links research activities and governmental directives
- compiles energy statistics
- reviews energy policies & programs
- convenes, mobilizes science & technology experts



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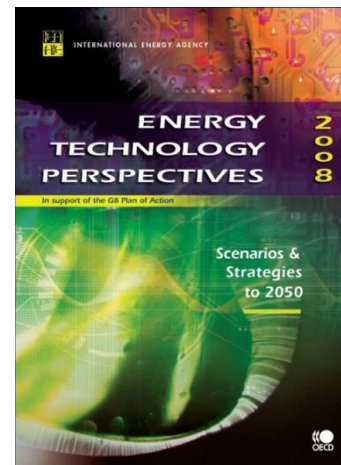
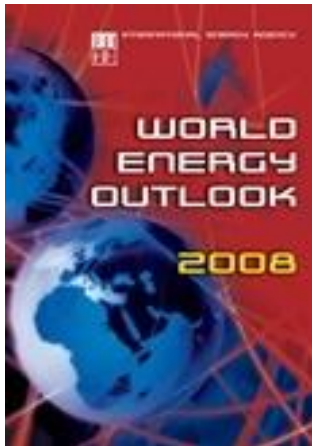
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Global Analysis for a Clean Energy Future

- **World Energy Outlook**
 - Base case and advanced policy case
 - Timeline: 2030
 - Published annually in November
- **Energy Technology Perspectives**
 - Assessments of technology options and portfolio
 - Timeline: 2050
 - Published biennially



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The Importance of CCS

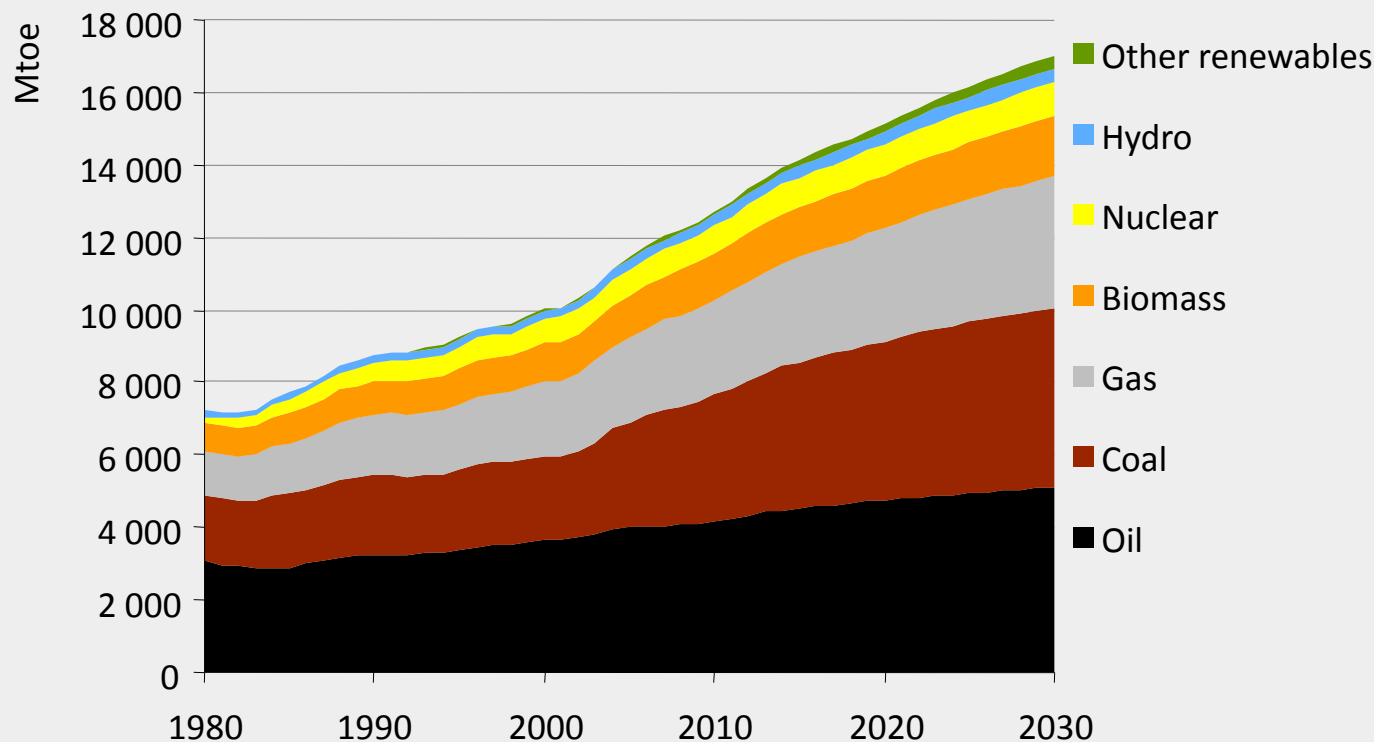
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World primary energy demand in the Reference Scenario

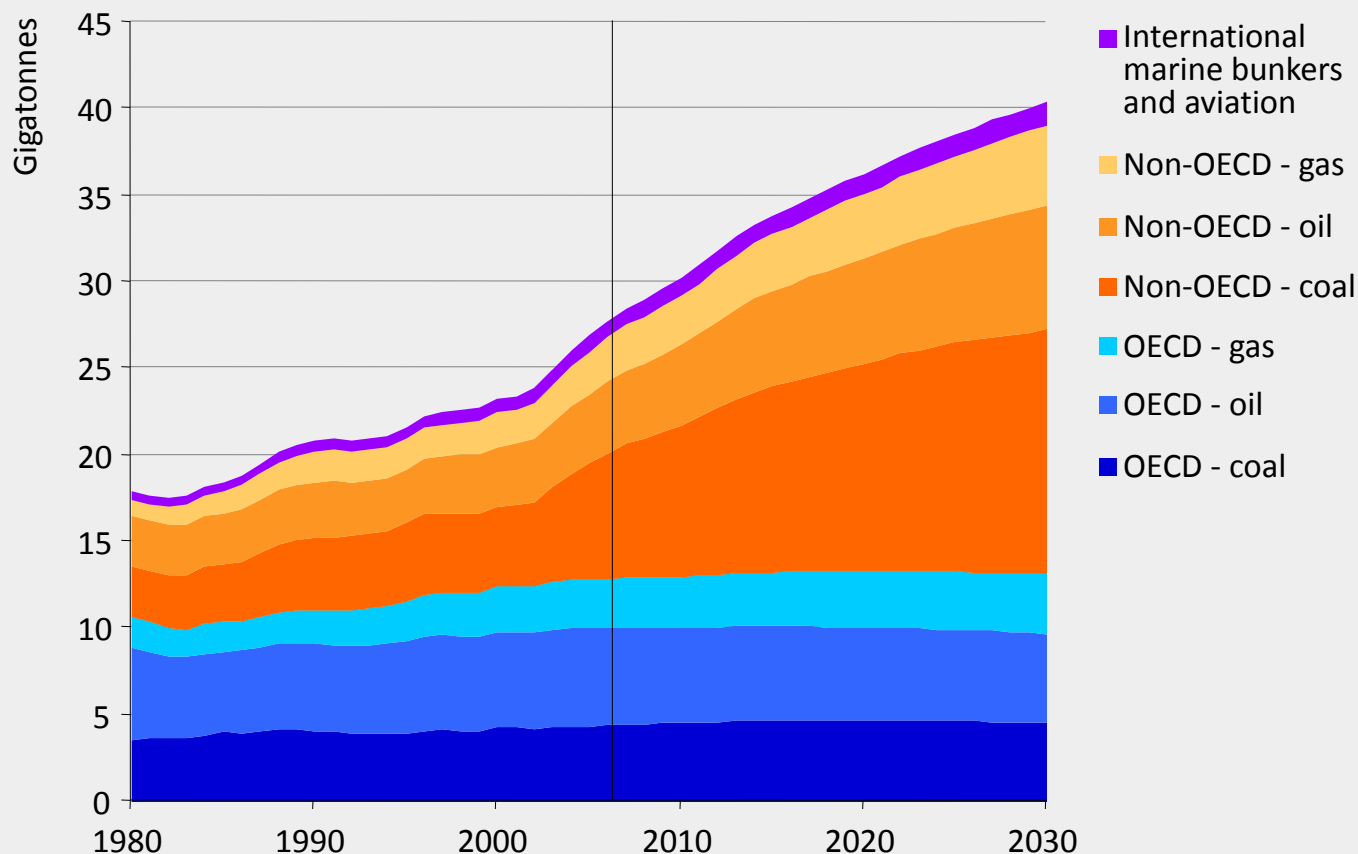
World Energy Outlook 2008



World energy demand expands by 45% between now and 2030 – an average rate of increase of 1.6% per year – with coal accounting for more than a third of the overall rise

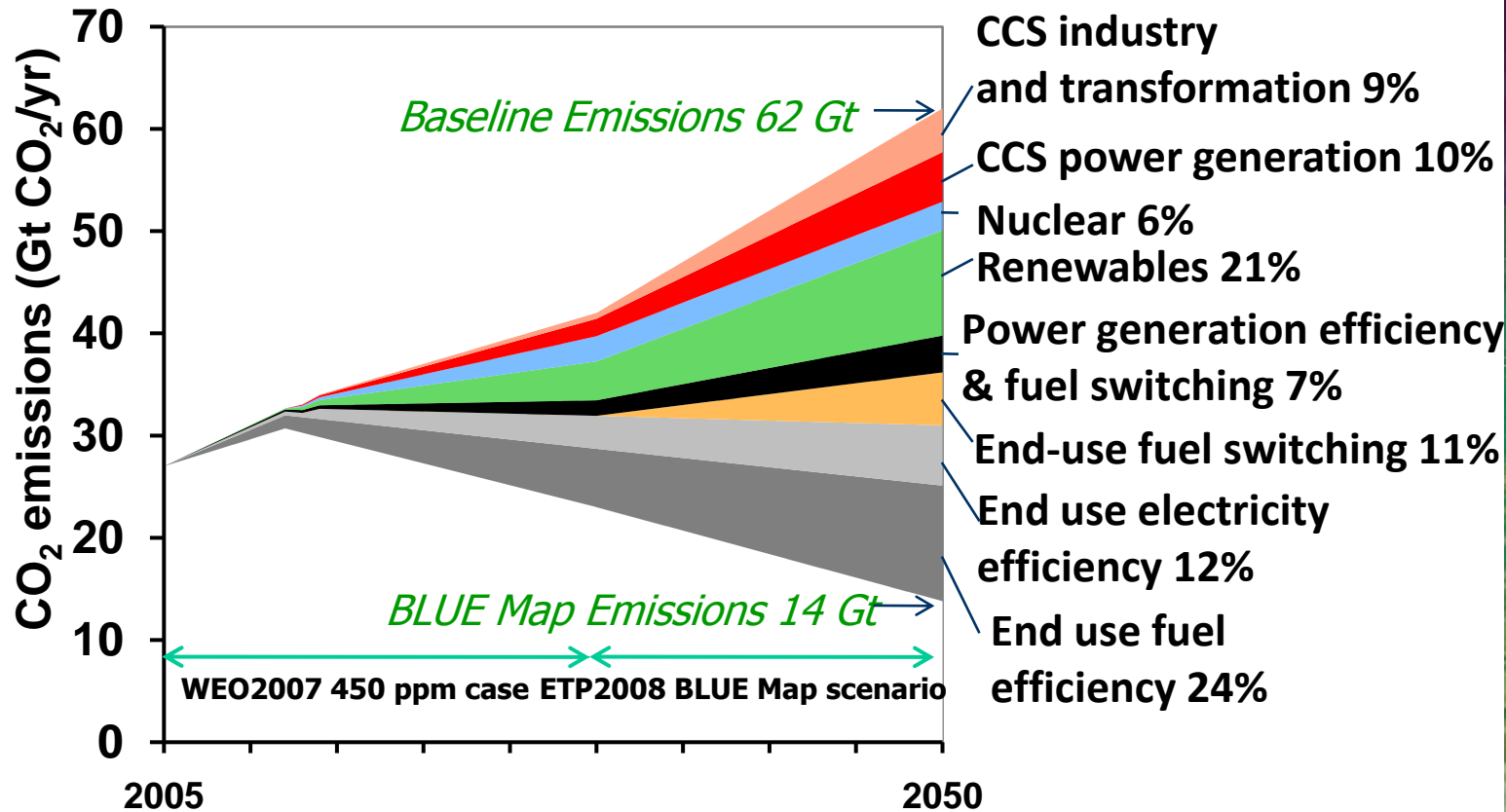
Energy-related CO₂ emissions in the Reference Scenario

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97% of the projected increase in emissions between now & 2030 comes from non-OECD countries – three-quarters from China, India & the Middle East alone

Achieving Global GHG Stabilisation Requires a Technology Revolution



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Key Technology Options to Achieve BLUE goals by 2050

● Supply side

- **CCS power generation**
- **Coal – IGCC**
- **Coal – USCSC**
- **Nuclear III + IV**
- **Solar – PV**
- **Solar – CSP**
- **Wind**
- **Biomass – IGCC & co-combustion**
- **2nd generation biofuels**

● Demand side

- **Energy efficiency in buildings**
- **Energy efficient motor systems**
- **Efficient ICEs**
- **Heat pumps**
- **Plug-ins and electric vehicles**
- **Fuel cell vehicles**
- **Industrial CCS**
- **Solar heating**
- **Cement industry**

Work on roadmaps has started

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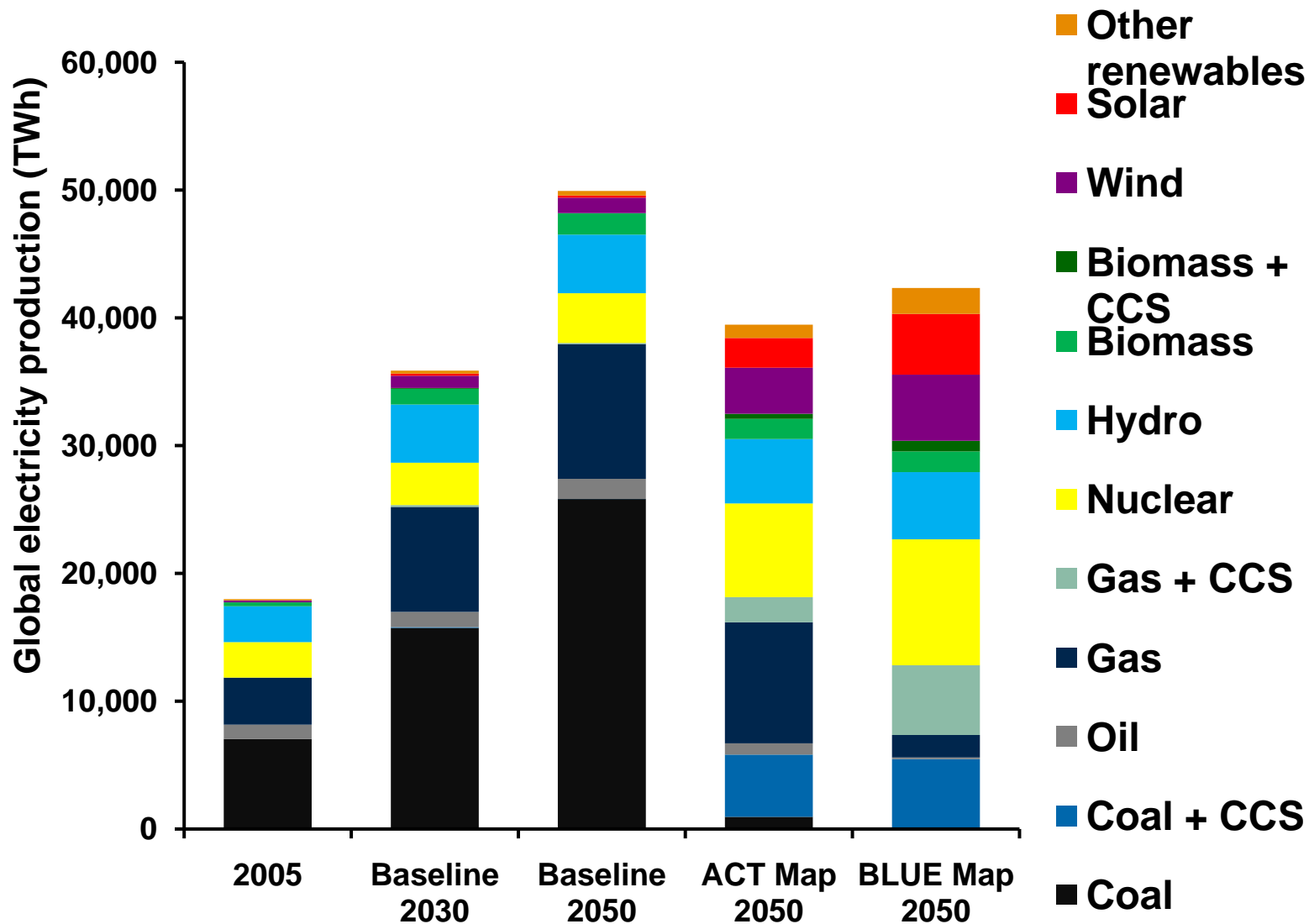
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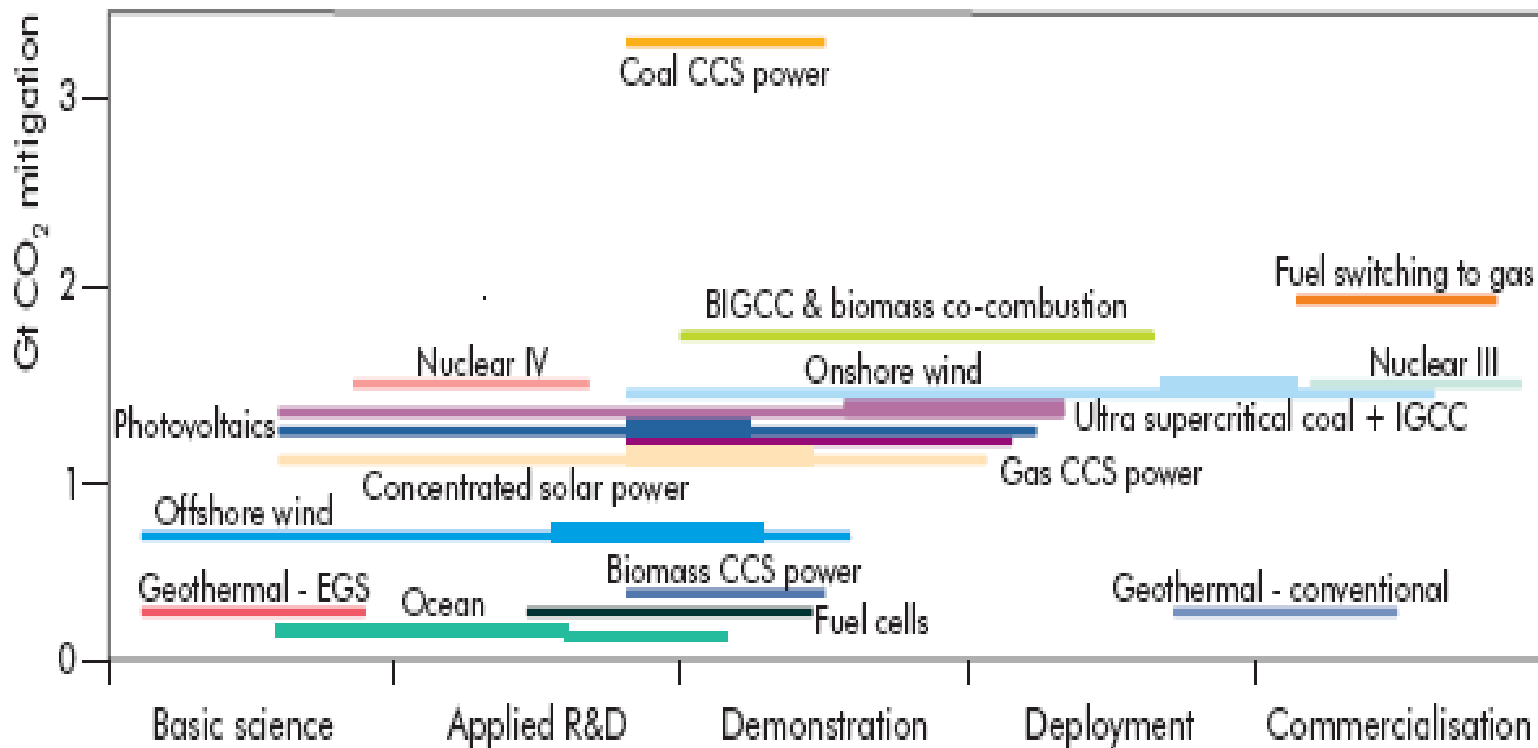
Global Power Generation Mix



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Technology RD&D Needs – Power Generation



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CCS Status Globally

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CCS Is a Key Part of a Low-Cost GHG Solution...

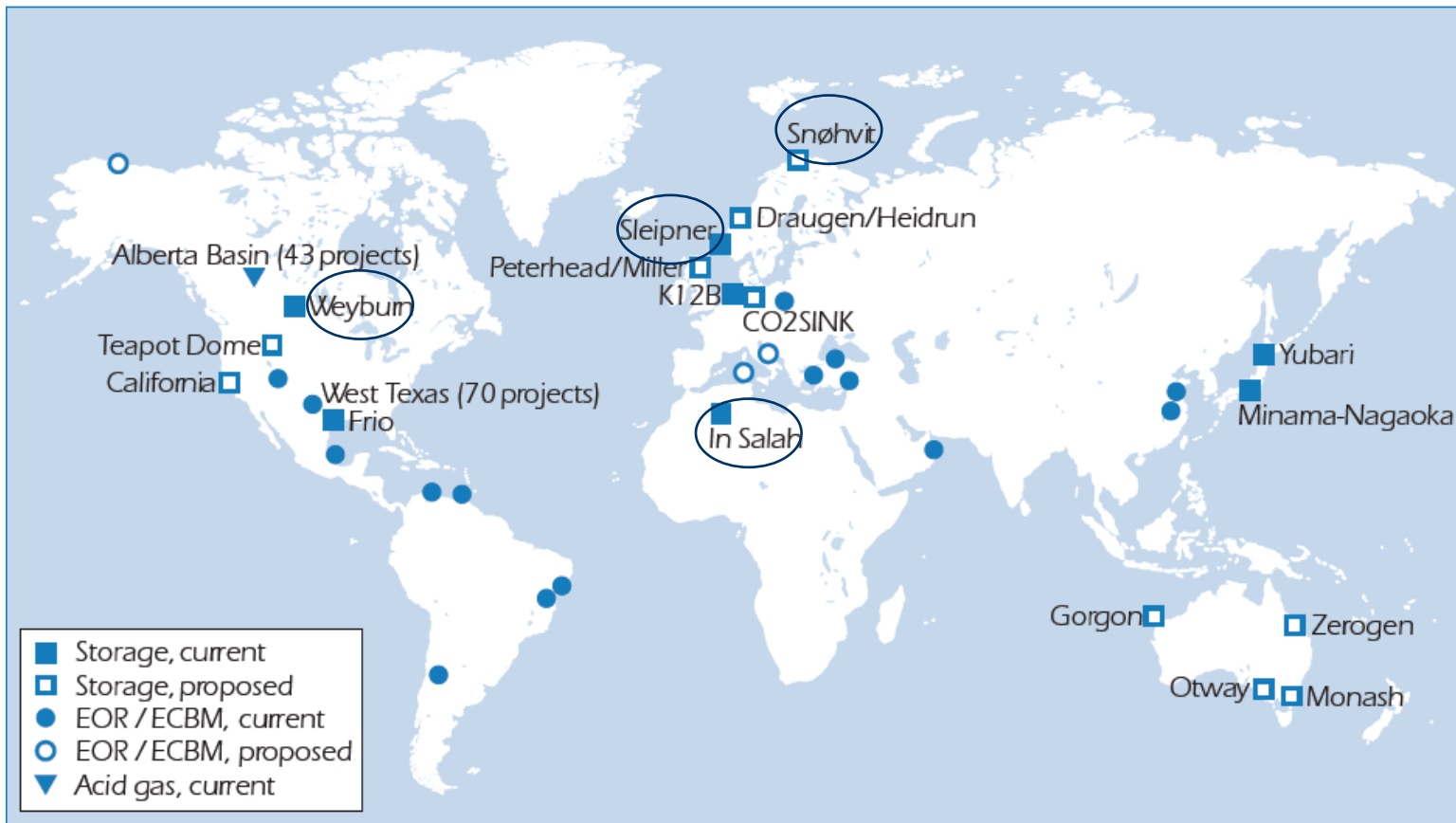
- Without new policies, global emissions increase by 130% by 2050, leading to a 4-7°C temperature rise
- CCS provides one-fifth of the needed CO₂ reductions in 2050
- Without CCS, cost of stabilisation rises by 70%
- CCS the *only* low-carbon solution for gas/coal, cement, and iron & steel sectors

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...but Only 4 Full-Scale Projects Exist



G8 goal: 20 full-scale demonstrations announced by 2010

CCS Demonstration

- **The number of major CCS efforts is expanding...**
 - **Alberta, Canada: \$2B funding**
 - **Australia: NLECI, CO2CRC, GCCSI @ AUD100M/year**
 - **EU: Norway's Gassnova, UK CCS competition, EU ZEP**
 - **US Regional Sequestration Partnerships, FutureGen**
 - **China's GreenGen**
- **...but some major economies/regions are not sufficiently investing in CCS**
- **CCS must also be demonstrated in key industrial sectors (cement, iron & steel, chemicals)**
- **CCS retrofit demonstrations at coal-fired power plants urgently needed**

The next 10 years are critical

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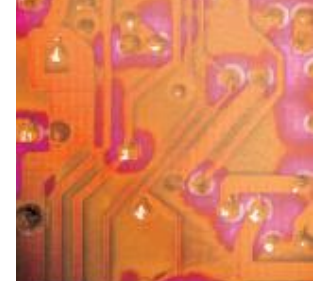
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CCS Demonstration Projects


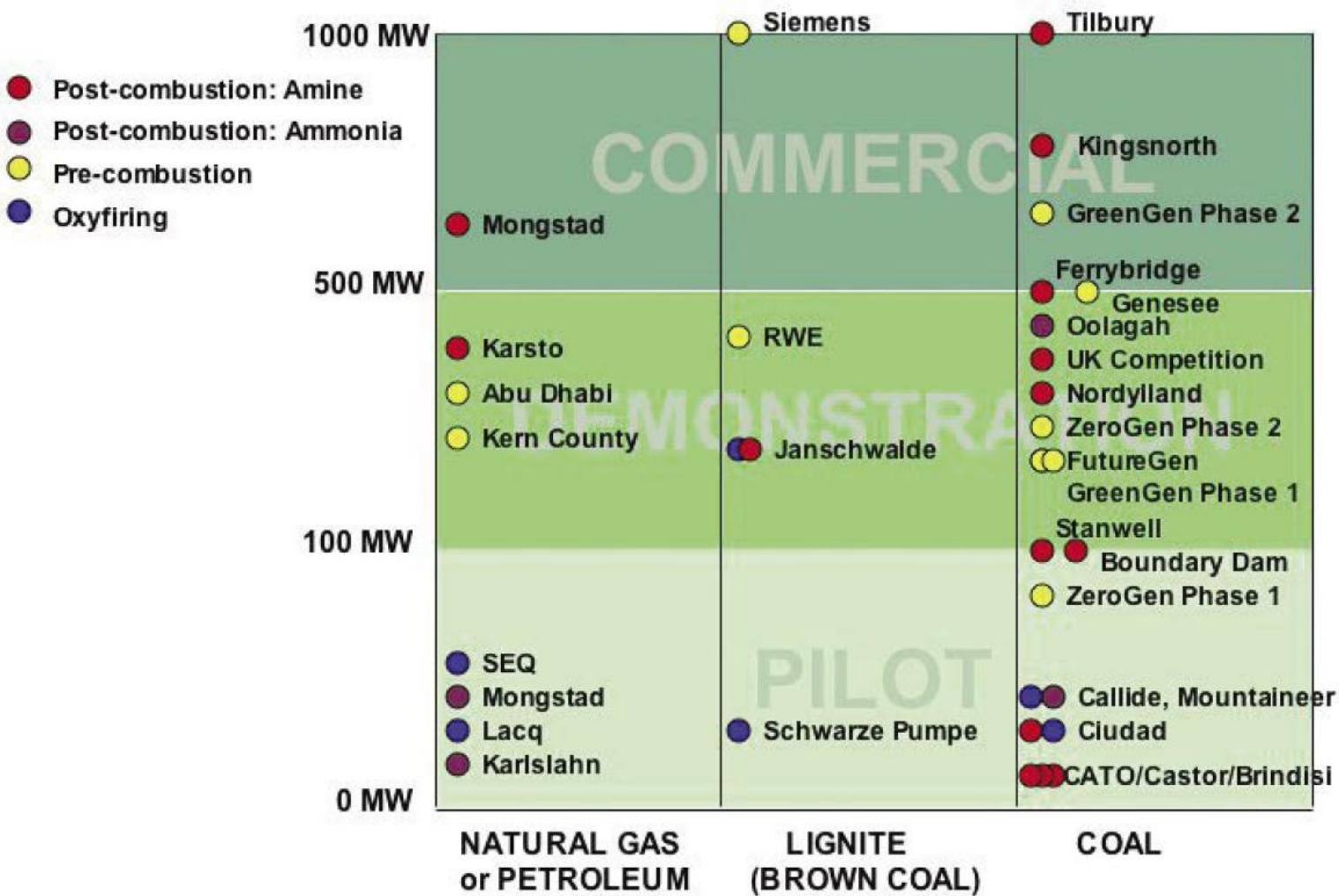


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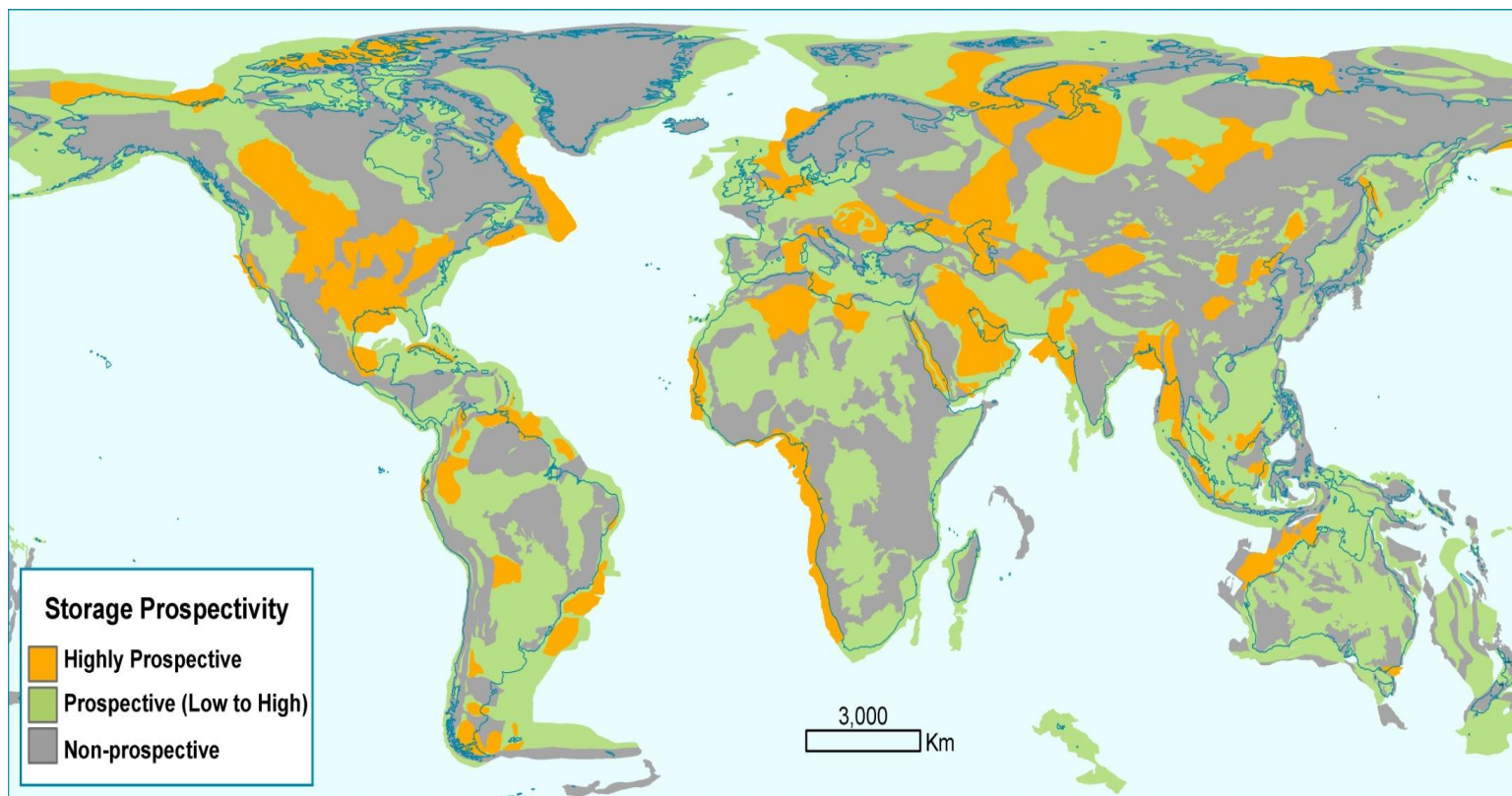
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Source: IEA GHG, *Carbon Capture and Storage: Meeting the Challenge of Climate Change* (2008).

CO₂ Storage Prospectivity



Source: Bradshaw, J. and Dance, T. (2004): "Mapping geological storage prospectivity of CO₂ for the world's sedimentary basins and regional source to sink matching," in (E.S. Rubin, D.W. Keith and C.F. Gilboy eds.), GHGT-7, Proc. Seventh International Conference on Greenhouse Gas Control Technologies, Vancouver, B.C., Canada, September 5-9, 2004.

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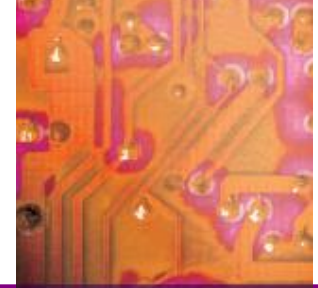
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CO₂ Storage Demonstration Projects



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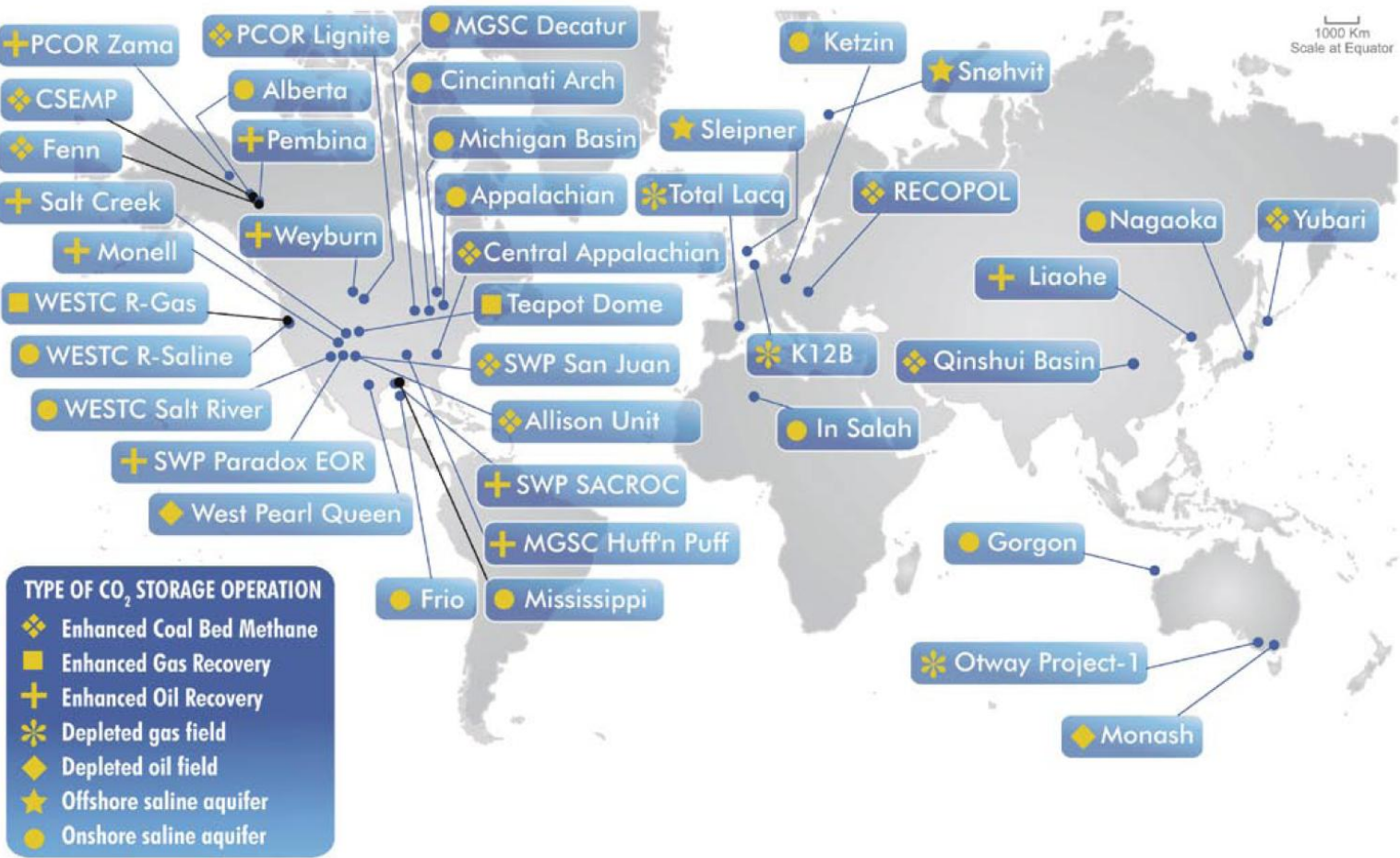
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1000 Km
Scale at Equator



- TYPE OF CO₂ STORAGE OPERATION**
- ◆ Enhanced Coal Bed Methane
 - Enhanced Gas Recovery
 - ⊕ Enhanced Oil Recovery
 - * Depleted gas field
 - ◆ Depleted oil field
 - ★ Offshore saline aquifer
 - Onshore saline aquifer

Source: IEA GHG, Carbon Capture and Storage: Meeting the Challenge of Climate Change (2008).

CCS in the Future: Challenges and Opportunities

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CCS Challenges

- **Financing large-scale, integrated demonstration projects**
 - Including retrofits and industrial sector CCS
- **Incorporating CCS into GHG mechanisms**
 - Emissions trading schemes
 - Clean Development Mechanism (CDM)
- **Developing legal frameworks**
 - To ensure safe, permanent CO₂ storage
- **Gaining public awareness/acceptance**
- **Technology diffusion**

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CCS Financing

- **Different financing needs for near-term demonstration and longer-term commercial use**
- **For demonstration projects, USD 20B incremental funding needed**
- **Many proposals for special treatment for CCS in GHG emissions schemes**
 - **Bonus allowances**
 - **Use of allowance revenues to create special CCS funds**
- **Economic stimulus packages supporting CCS**
 - **EU infrastructure package**
 - **US \$3-5B support for demos; tax credit of \$20/tonne stored**
- **CO₂ pipeline transport presents unique challenges in financing, site selection, access rules**

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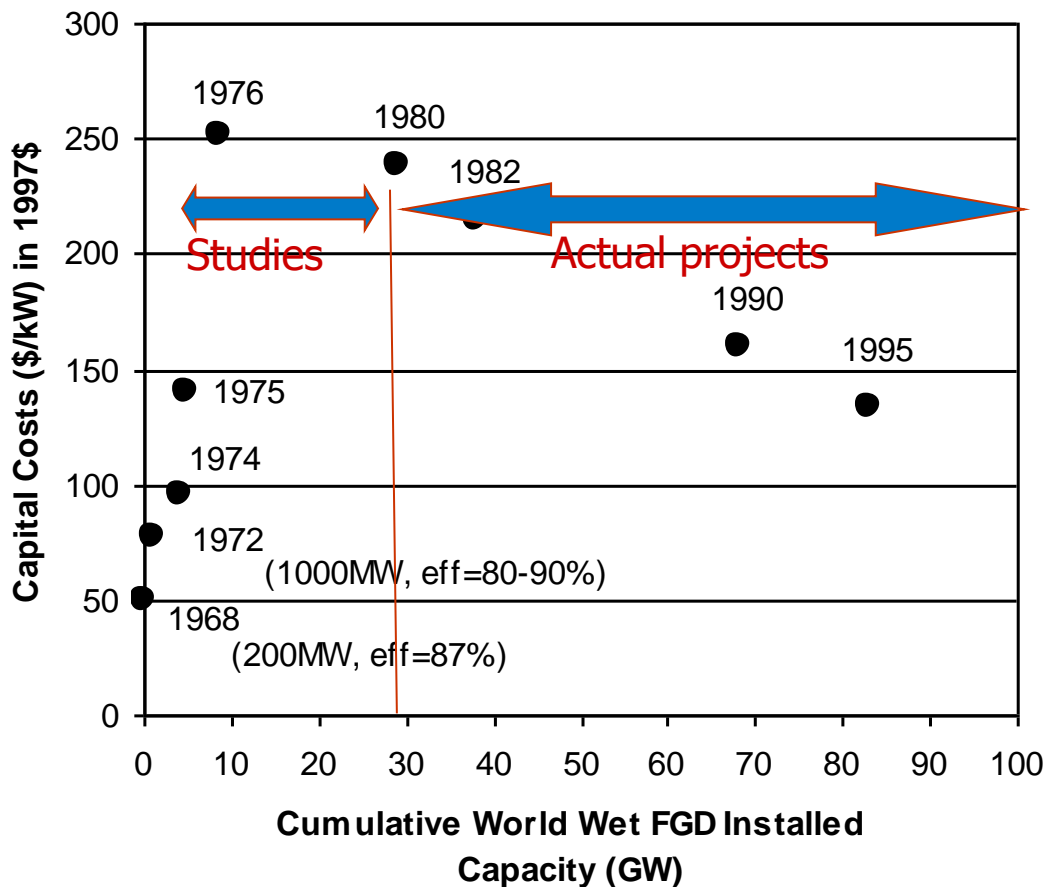
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Pollution Control Technology Cost Reductions – An Example



FGD = Flue Gas
desulphurisation

SCR = Selective catalytic
reduction

*CCS costs starting at 60 EUR/tonne CO₂ in 2015;
expected to reduce to 30 EUR with commercialisation*

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Legal & Regulatory Actions

- **Explosion of activity in this area since 2005**
 - **EU CCS Directive**
 - **London Protocol/OSPAR amendments**
 - **US, Australia, Canada, Japan frameworks**
- **Need to develop flexible, adaptive approaches for early demonstration projects**
 - **Project-specific regulations**
 - **Amendments to existing oil & gas laws**
 - **Require monitoring data from projects**
- **Take permitting schemes, site selection, and M&V methodologies to the next level of detail**
 - **Share results internationally to aid harmonisation**
 - **IPCC 2006 *Inventory Guidelines* a good start**

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CCS Regulation Updates - Australia

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- Passed amendment to *Offshore Petroleum Act 2006* which establishes
 - property access and property rights
 - approvals process to ensure safe and secure storage
 - gives regulators power to mitigate/remediate
 - mechanisms for interactions with other resource users, especially petroleum
 - long term liability framework
- 10 offshore areas have been released for bidding for exploration permits.
 - Successful bidders will have the exclusive right to convert to injection licences, subject to successful exploration and approvals
 - Details available from www.ret.gov.au
- Some States have developed similar frameworks for their jurisdictions

CCS Regulation Updates - Canada

- **Federal/Provincial jurisdictional split**
 - Alberta, Saskatchewan, and BC have well-developed regulatory frameworks for acid gas disposal that include CO₂ injection and monitoring
 - Groundwater protection will fall to provinces
- **Additional issues include long-term liability, M&V, and linkages to GHG regulations**
 - ERCB expects to produce a public document in 2009 with specific regulatory requirements and associated application process for CO₂ disposal
 - Alberta – GHG regulatory framework includes technology fund for CCS, offsets from CO₂ storage; draft long-term liability framework developed
 - Federal government CO₂ intensity limit appears to mandate CCS after 2015

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CCS Regulation Updates - Europe

- **CCS not included in 20% GHG reduction goal for 2020**
- **CCS goal is 12 large-scale demonstrations by 2015**
- **CO₂ capture and transport handled under existing directives**
- **CCS Directive contains framework for CO₂ storage**
 - Permits for exploration
 - Site characterisation and selection criteria
 - Performance-based CO₂ acceptance criteria
 - Monitoring and reporting obligations, notifications for leakage
 - State assumes long-term liability after performance hurdle met
- **For EU ETS, CO₂ captured and stored will not be considered as emitted**
- **Recent decision to set aside 300 M allowances for funding Zero Emissions Platform (ZEP) projects**
- **Financial rescue package also allocates some infrastructure financing to CCS**

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Public Awareness

- **Need to move beyond opinion surveys**
- **Pioneering public consultation work being done at local level**
 - **US Regional Sequestration Partnerships**
 - **EU ACCSEPT**
 - **Australia**
- **Need to synthesize lessons learned from these efforts and share internationally**
- **Near term focus on public consultation at the local level for demo projects**

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The IEA's CCS Activities

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International Collaboration: the IEA CCS Roadmap

- **Facilitate greater international coordination**
- **Accelerate deployment process**
- **Provide detailed action items for policy makers, industry, NGOs**
- **Reduce costs, improve efficiencies**
- **Build from existing efforts**



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Roadmap Activities

- **Set a baseline for current capture, transport and storage RD&D globally**
 - Identify breakthrough technologies
 - Identify duplication and gaps
- **Identify metrics for capture, transport, storage**
- **Identify financing options, pros/cons**
- **Identify regulatory, public awareness action items**
- **Identify strategies for emerging countries**
 - Series of CCS Roundtables planned
 - Donors' conference planned
- **Publish at IEA/CSLF Ministerial October 2009**

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IEA CCS Activities

- **Current activities**
 - **Tracking G8 goals**
 - **Developing the CCS Roadmap**
 - **Managing the CCS Regulators' Network**
 - **Conducting CCS technology analysis**
 - **Advancing international collaboration**
- **Future activities may include**
 - **Developing a Global CO₂ Storage Atlas**
 - **Examining 'capture readiness' options**
 - **Developing a model CCS legal framework**
 - **Creating a partnership with multilateral funding institutions**
 - **Creating a CCS Centre of Excellence in an IEA non-Member country**

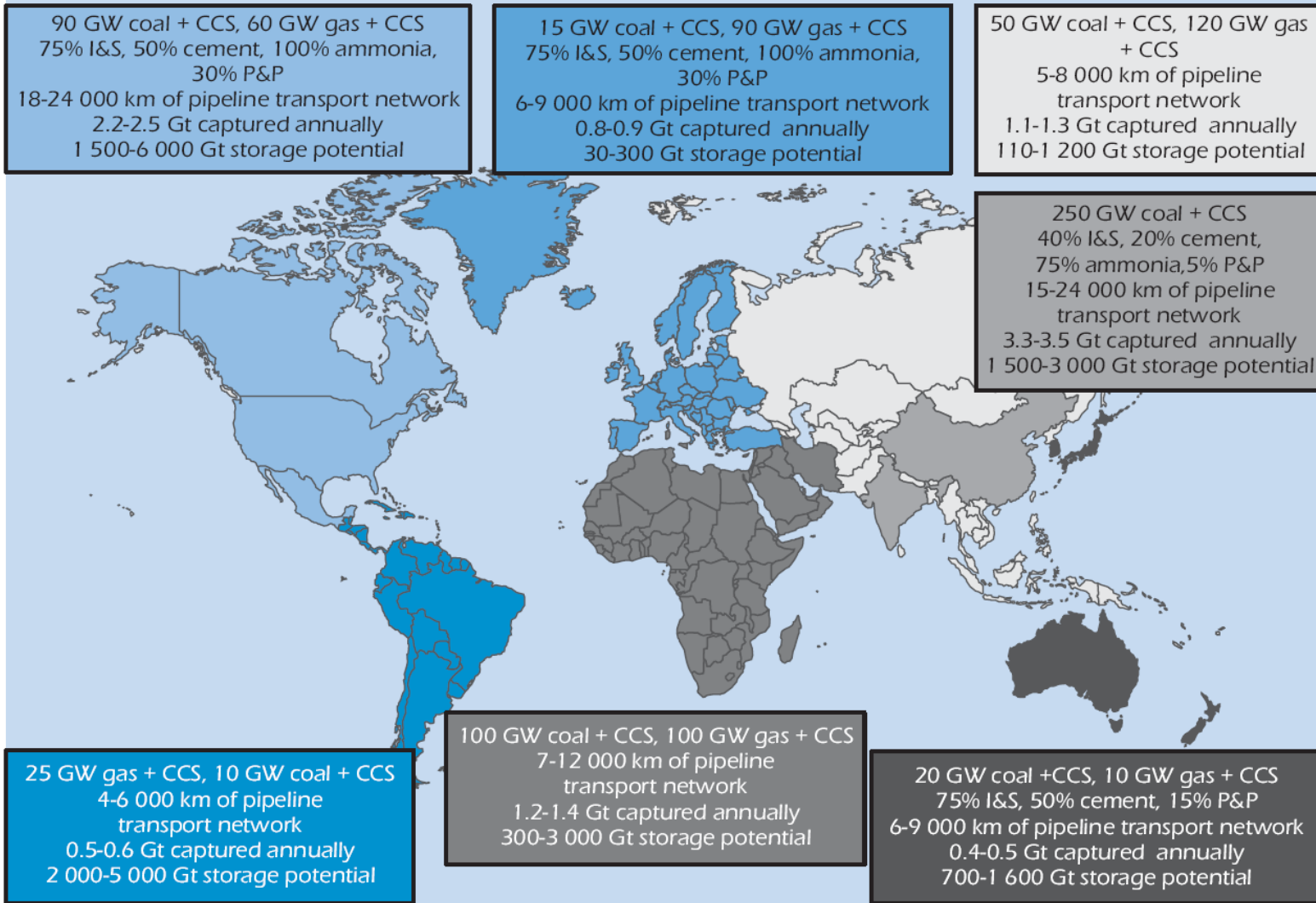
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One Vision for 2050



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