



Current status of CCS and EU activities

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Outline

- Introduction – context of climate change
- The role of CCS
- Economic framework
- CCS projects worldwide
- Situation in Europe (including official slides provided by the European Commission)
- Future of CCS
- Conclusions



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- **Introduction – context of climate change**
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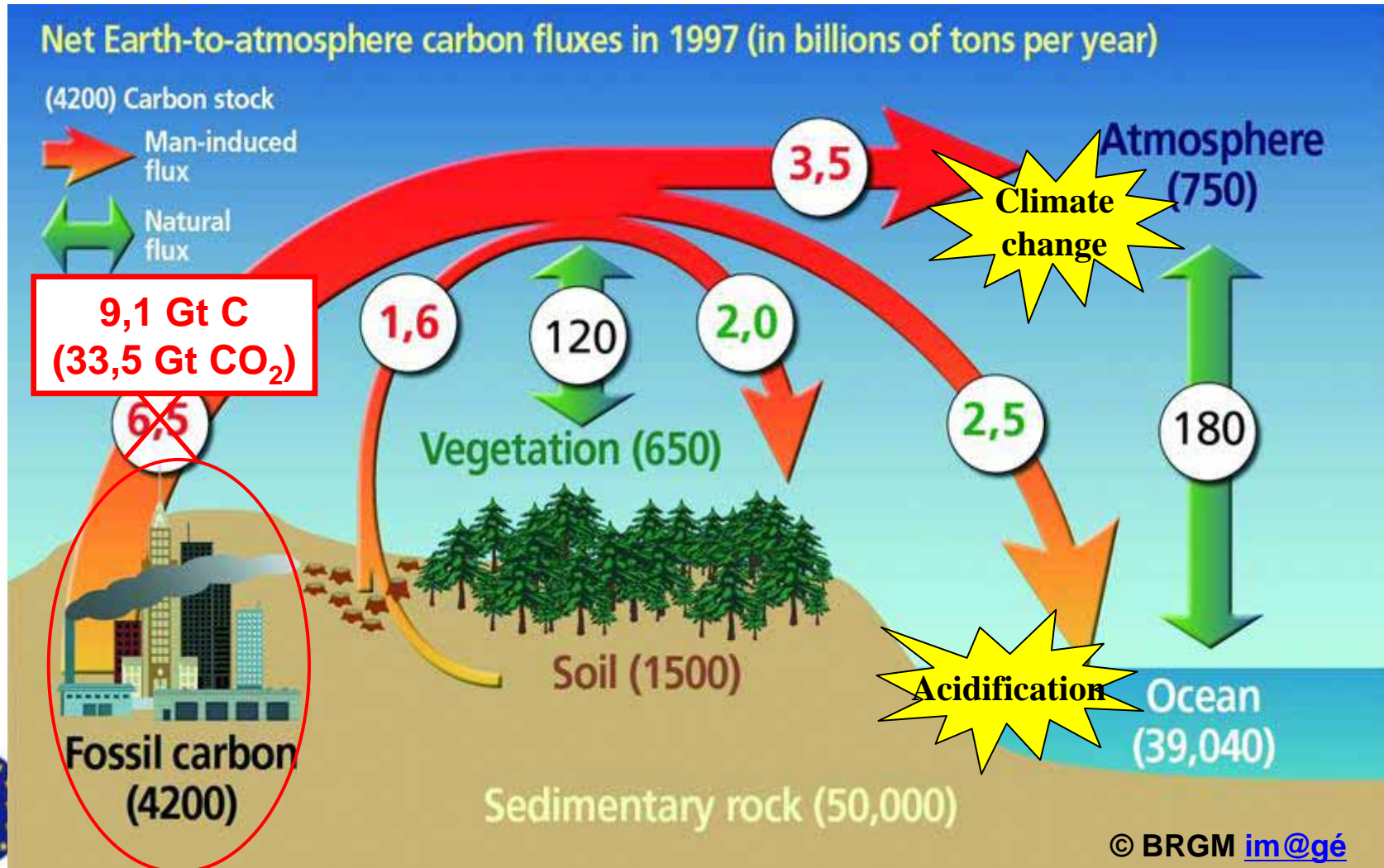


Context of climate change

- ➔ CCS is a climate-change mitigation option
 - Main goal = to reduce the emissions of CO₂ – a greenhouse gas contributing to global warming
- ➔ Basic preconditions:
 - Climate change is a fact
 - Man-made CO₂ emissions significantly contribute to climate change
 - We want to do something about it



CO₂ fluxes between the Earth and the atmosphere (in billion tons of carbon per year)



UNFCCC



United Nations
Framework Convention on
Climate Change

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NEGOTIATIONS

Meetings

Documents & Decisions

Bodies

PROCESS

Essential Background

Kyoto Protocol

Cooperation & Support

Adaptation

National Reports

GHG Data

Methods & Science

Parties & Observers

Press

Secretariat

KEY DOCUMENTS

The Convention

Kyoto Protocol

Bali Road Map

Cancun Agreements

Issues Quickfinder:

Please choose



Bonn Climate Change Conference - May 2012

The 36th sessions of the Subsidiary Body for Implementation (SBI) and of the Subsidiary Body for Scientific and Technological Advice (SBSTA), the fifteenth session of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA), the seventeenth session of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) and the first session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) takes place concurrently from 14 to 25 May. All sessions are held at the Maritim Hotel in Bonn.

- | | |
|---------------------------------------|--------------------------------------|
| Reports | Schedule of Meetings |
| Documents | Daily Programme |
| Logistics | ADP 1 |
| Press | SBI 36 |
| Webcasts | SBSTA 36 |
| Virtual participation | AWG-KP 17 |
| | AWG-LCA 15 |
| | Workshops |
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Latest Headlines

[UN leader seeks to head off Rio summit tragedy](#)
AFP

[Activists Call for Creation of High Commissioner for Future Generations at Rio+20](#)
IPS Tierramérica

[Climate Change 'Biggest Threat' to Food Security](#)
IPS

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Latest Documents

[FCCC/SB/2012/INF.1](#)
List of participants (SBSTA36) (SBI36) (ADP1) (AWG-KP17) (AWG-LCA15).
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[FCCC/2012/II/OD/11](#)
Daily programme for Friday, 25 May 2012 (SBI36) (SBSTA36) (ADP1) (AWG-KP17) (AWG-LCA15).
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[FCCC/SBSTA/2012/L.19](#)
Issues relating to agriculture. Draft conclusions proposed by the Chair.
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UNFCCC



United Nations
Framework Convention on
Climate Change

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UNFCCC is an international environmental **treaty** produced at the United Nations Conference on Environment and Development, informally known as the Earth Summit, held in Rio de Janeiro in 1992. The objective of the treaty is to **stabilize greenhouse gas concentrations in the atmosphere** at a level that would prevent dangerous anthropogenic interference with the climate system.

The treaty itself sets **no mandatory limits** on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. In that sense, the treaty is considered legally non-binding. Instead, the treaty provides for updates (called "protocols") that would set mandatory emission limits. The principal update is the **Kyoto Protocol**.

Bali Road Map

Cancun Agreements

Issues Quickfinder:

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Group on the Durban Platform for Enhanced Action (ADP) takes place concurrently from 14 to 25 May. All sessions are held at the Maritim Hotel in Bonn.

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FCCC/SBSTA/2012/L.19

Issues relating to agriculture. Draft conclusions proposed by the Chair.

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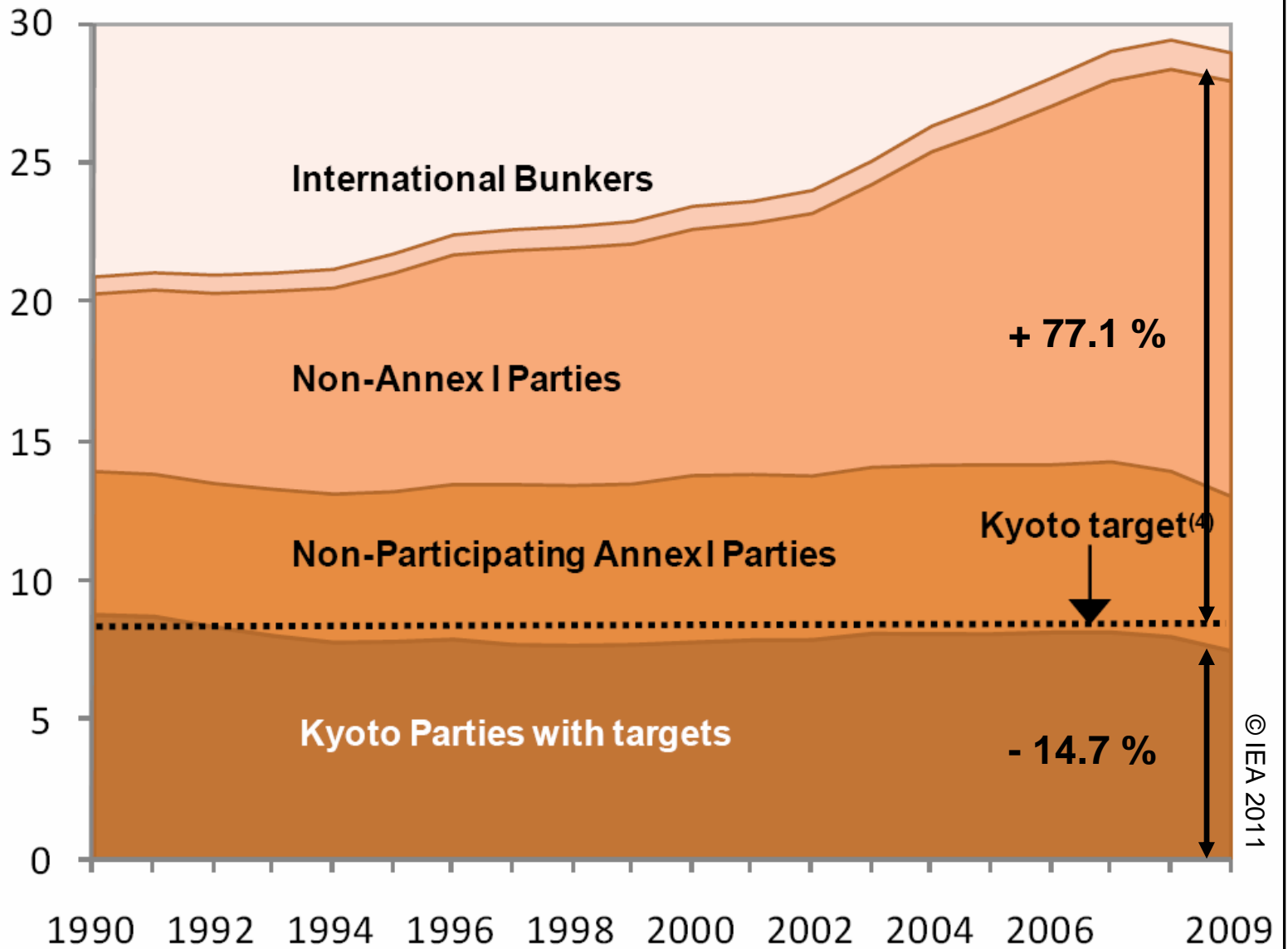
Kyoto Protocol

- protocol to the UNFCCC
- adopted 1997, entered into force in 2005
- ratified by 191 states
- sets GHG emission reduction targets for 37 developed countries in 2009-12, compared with base year (usually 1990); average reduction commitment 5.2%
- USA did not ratify the KP; Canada withdrew in 2011
- will not deliver global emissions reduction



Gt CO₂

Global emissions from fossil fuel combustion



© IEA 2011



Post-Kyoto

- ➔ Copenhagen accord 2009 (not binding):
 - "the scientific view that the increase in global temperature should be below 2 degrees Celsius" is recognized, in a context of sustainable development, to combat climate change
 - according to climate models, the 2 ° C target corresponds to atmospheric CO₂ concentration of 450 ppm (or less)
- Results of the UN Climate Change Conference in Durban (2011):
 - Kyoto protocol will continue after 31/12/2012 by its 2nd commitment period (only EU and a few other countries will be covered)
 - universal legal agreement on climate change will be prepared until 2015, valid from 2020



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Why do we Need CO₂ Capture and Storage?

- ▶ By 2050, global population will rise from 7 to 9 billion people
- ▶ World energy demand is expected to increase by 40% between 2009 and 2035*

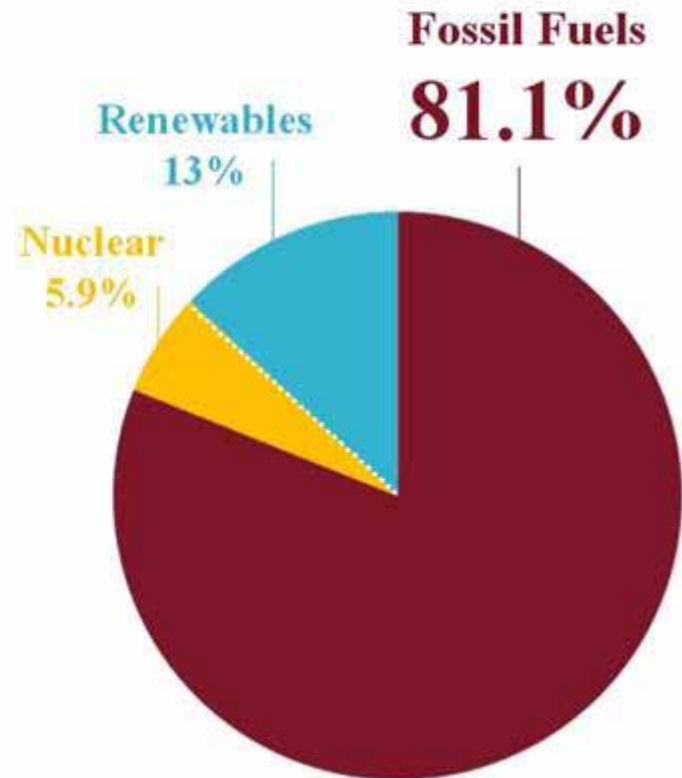


We Still Rely on Fossil Fuels

Today

- ▶ Fossil fuels (coal, gas and oil) represent **80%** of the global energy mix
- ▶ Renewables only account for 13% of our total energy supply

World total primary energy supply (2007)



... and will Continue to do so for Decades to Come

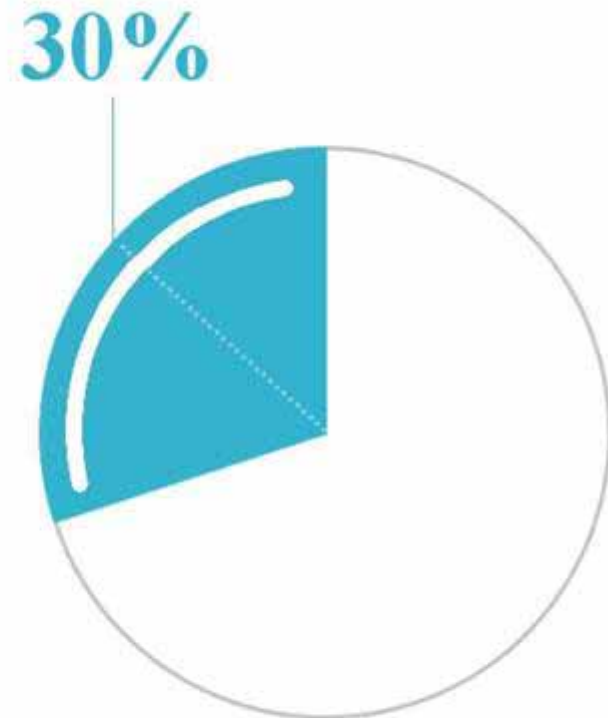
By 2030

- Renewables could make up 30% of the global energy mix*



But fossil fuels will remain our main source of energy for decades to come

Estimated share of renewables by 2030



*Average taken across multiple estimates: IEA WEO 2008; European Commission baseline scenario; German Ministry of Environment, EUROPROG

Fossil Fuels Power the Largest Emitters of

CO₂

- ▶ Fossil fuels power & heat plants, heavy industry and refineries account for **61%** of the world's CO₂ emissions*
(almost 18 billion tonnes CO₂ emissions in 2009)





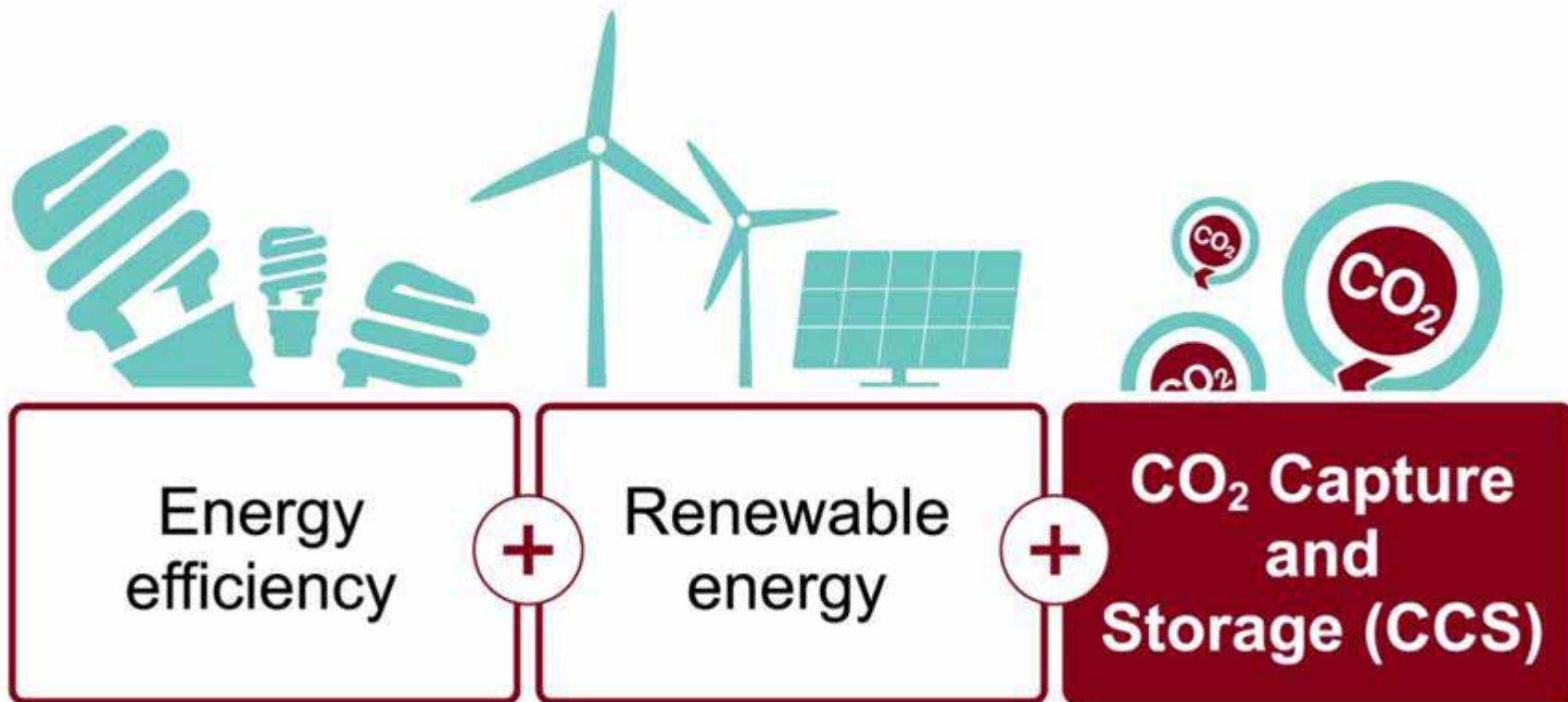
We need to cut
CO₂ emissions
fast...



... as energy
consumption continues
to **rise**

How do we Meet this Challenge?

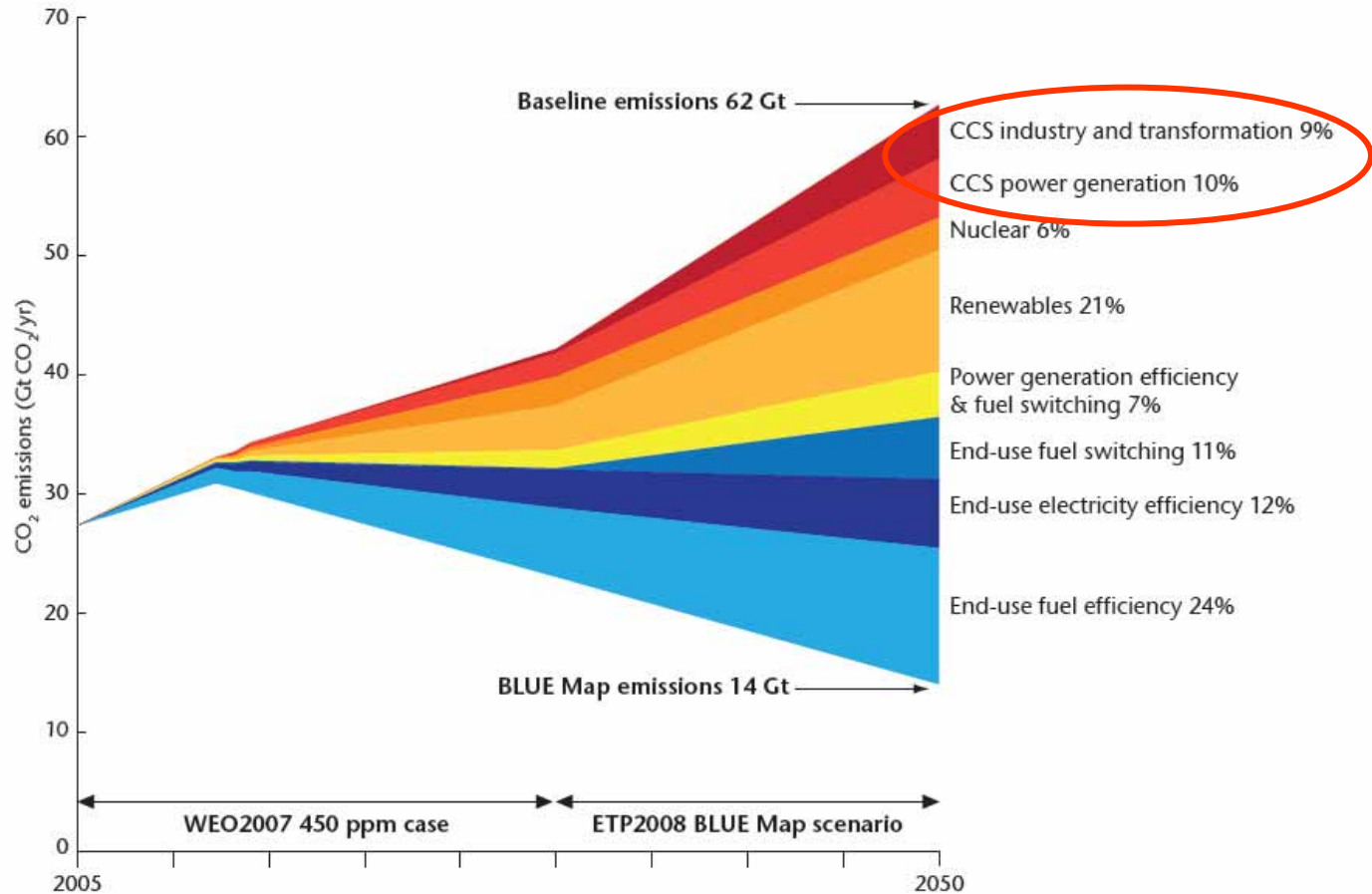
By using a portfolio of solutions:





CCS within the carbon abatement portfolio

Figure 1: CCS delivers one-fifth of the lowest-cost GHG reduction solution in 2050



Source: IEA, *Energy Technology Perspectives* (2008a).



KEY POINT: Without CCS, overall costs to halve CO₂ emissions levels by 2050 increase by 70%.

CCS is not only about power production

- ➔ Other technologies where CCS can be applied:
 - Iron & steel production
 - Cement industry
 - Paper & pulp production
 - Chemical technologies (e.g. ethanol & ammonia production)
 - Gasification plants (syngas)
 - Natural gas treatment (purification)

- ➔ And, last but not least:
 - **Biomass combustion with CCS produces negative CO₂ emissions!**

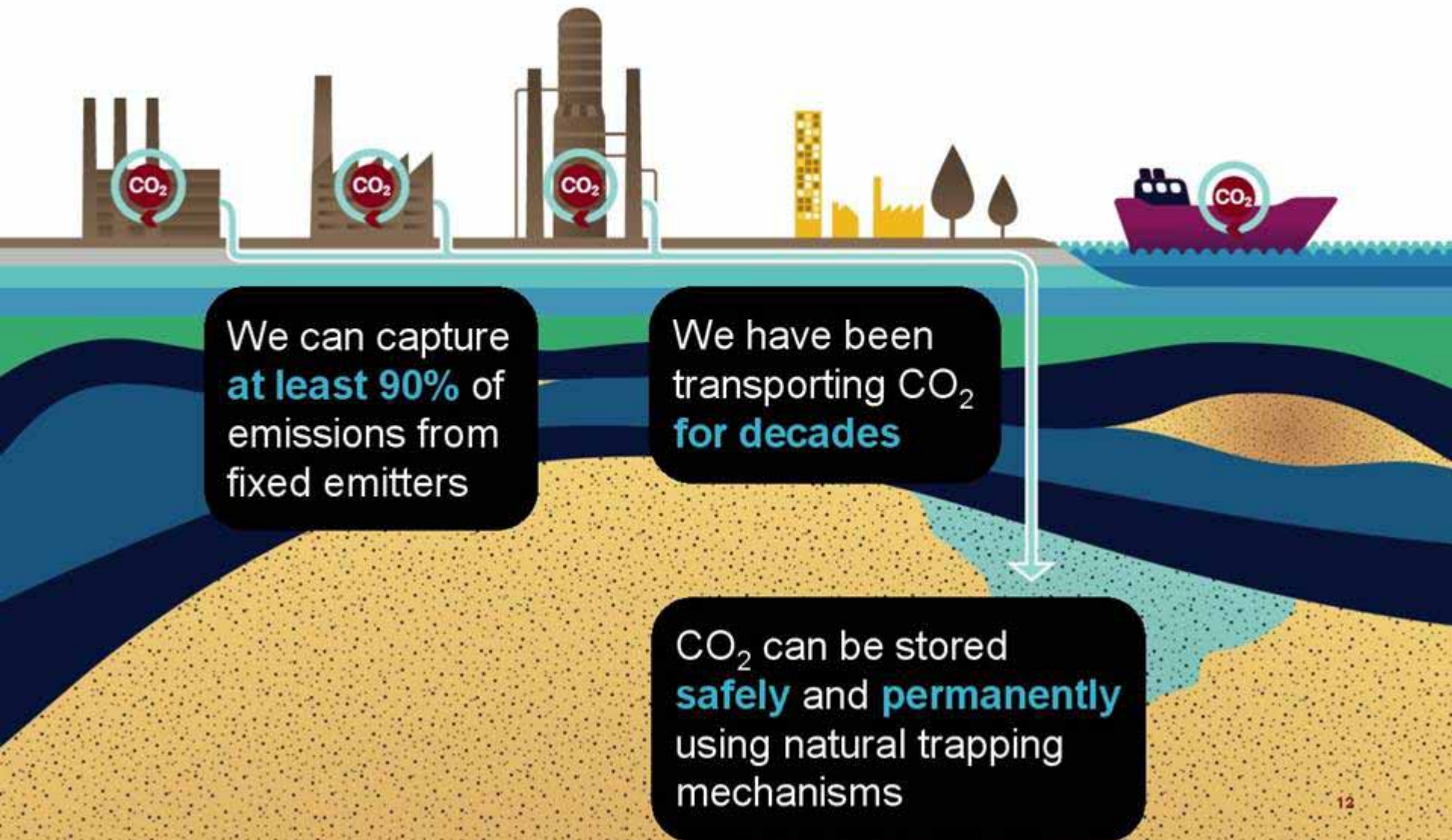


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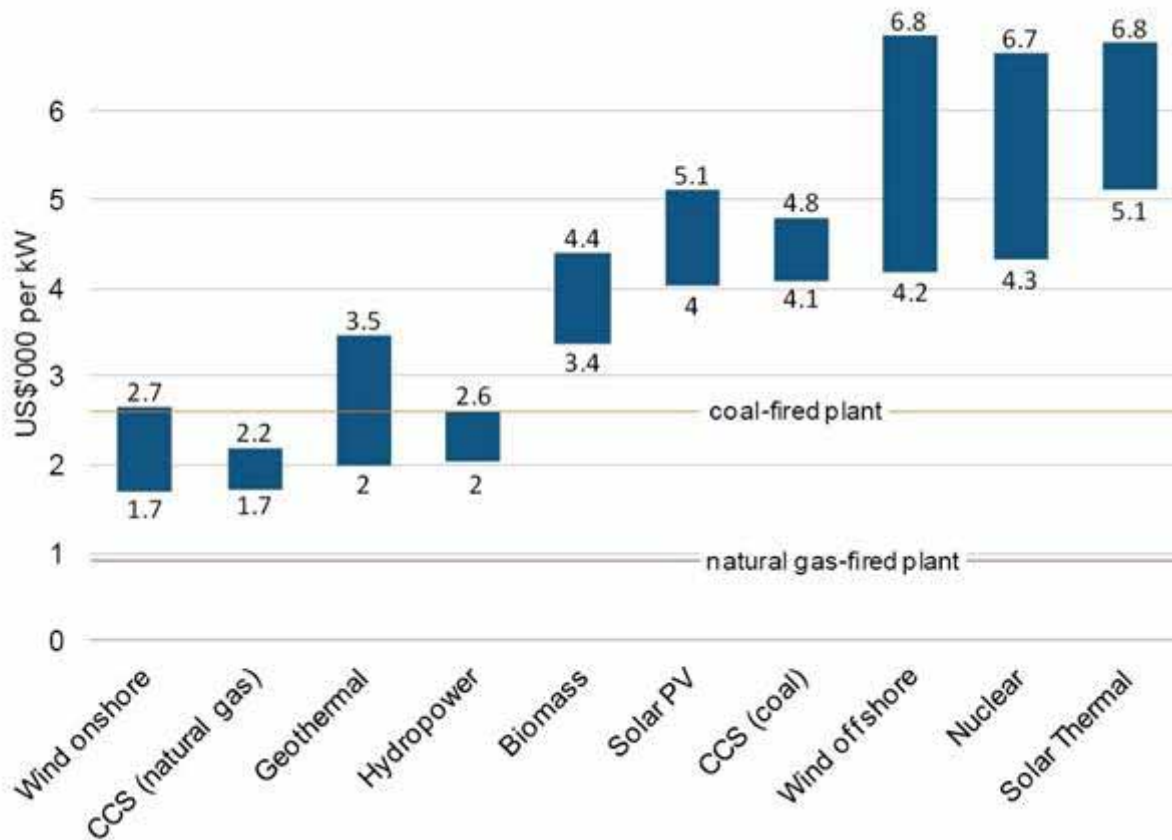


Principle of CCS



Capital cost of CCS

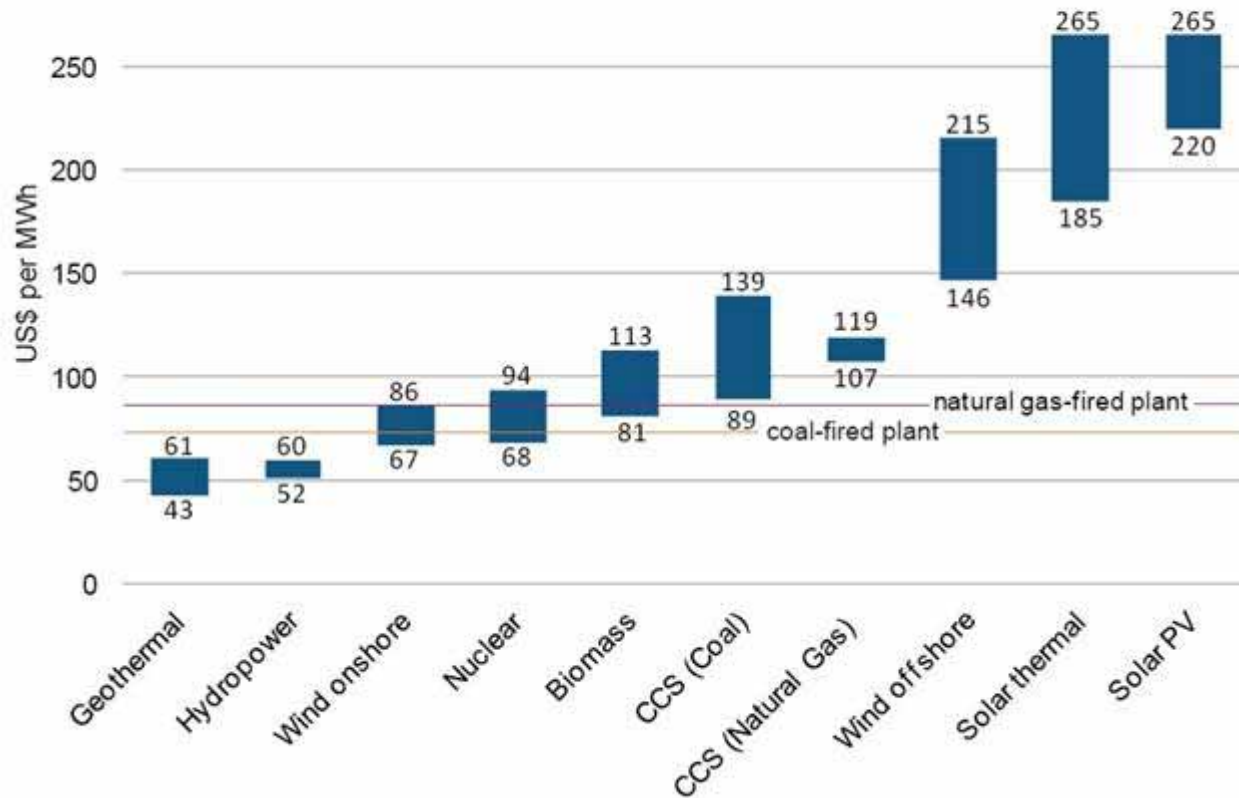
Installed capital cost of low-carbon technologies and conventional power generation



© Global CCS Institute, 2011

Cost of electricity

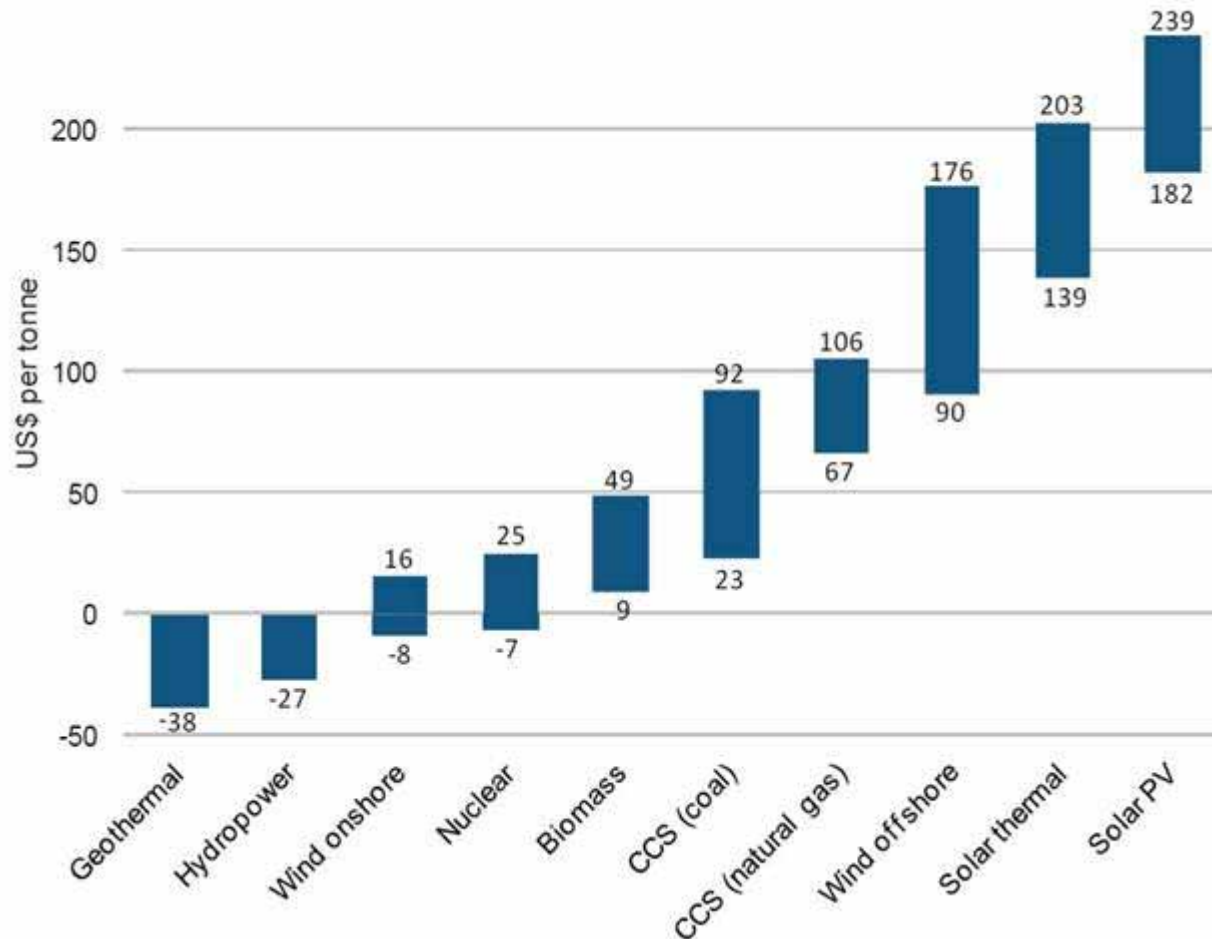
Levelised cost of electricity of low-carbon technologies and conventional power generation



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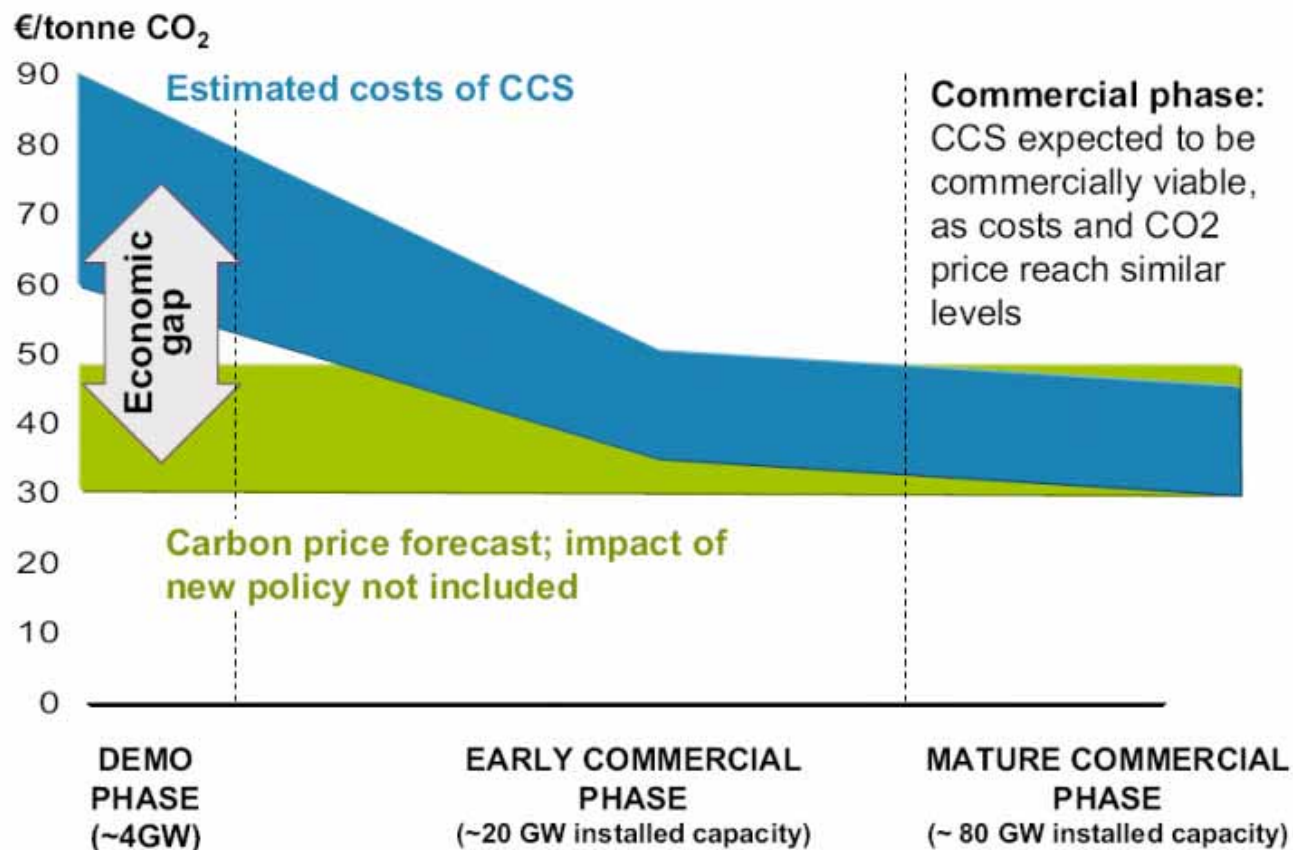
Cost of CO₂ avoided

Cost of CO₂ avoided¹



Demonstration phase needs co-financing

Demonstration phase:
CCS not economically viable. Public contribution necessary for some portion



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Large-scale CCS projects worldwide



- World
- North America
- Europe
- Africa
- South America
- Australia
- Asia

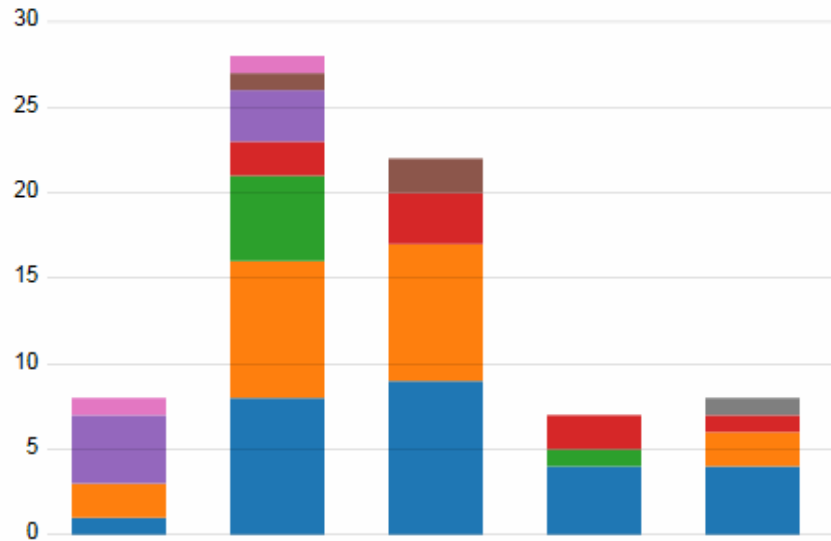
- Status
- Fuel
- Storage
- Source
- Capture
- Injection

- In Planning
- Cancelled or Dormant
- Pilot
- Operational
- Finished



Source: Scottish Carbon Capture and Storage - <http://www.scss.org.uk/map.html>

Large-scale CCS projects worldwide



	Identify	Evaluate	Define	Execute	Operate	Total
United States	1	8	9	4	4	26
Europe Area	2	8	8	0	2	20
Australia and New Zealand	0	5	0	1	0	6
Canada	0	2	3	2	1	8
China	4	3	0	0	0	7
Middle East	0	1	2	0	0	3
East Asia	1	1	0	0	0	2
Africa	0	0	0	0	1	1
Total	8	28	22	7	8	73

Large-scale CCS projects worldwide

Project name	Location	Capture type	Volume CO ₂ (Mtpa)	Storage type	Start date
In operation					
Val Verde Natural Gas Plants	United States	Pre-combustion (gas processing)	1.3	EOR	1972
Enid Fertilizer Plant	United States	Pre-combustion (fertiliser)	0.7	EOR	1982
Shute Creek Gas Processing Facility	United States	Pre-combustion (gas processing)	7	EOR	1986
Sleipner CO ₂ Injection	Norway	Pre-combustion (gas processing)	1 (+ 0.2 in construction)	Deep saline formation	1996
Great Plains Synfuels Plant and Weyburn-Midale	US/ Canada	Pre-combustion (synfuels)	3	EOR	2000
In Salah CO ₂ Storage	Algeria	Pre-combustion (gas processing)	1	Deep saline formation	2004
Snohvit CO ₂ Injection	Norway	Pre-combustion (gas processing)	0.7	Deep saline formation	2008
Century Plant	United States	Pre-combustion (gas processing)	5 (+ 3.5 in construction)	EOR	2010

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Pioneer large-scale projects



Sleipner, deep saline aquifer, Norway,
1 Mt CO₂/y since 1996



Weyburn-Midale, oil reservoir,
Canada, 1.8 Mt CO₂/y since 2000



In-Salah, gas reservoir, Algeria,
1 Mt CO₂/y since 2004



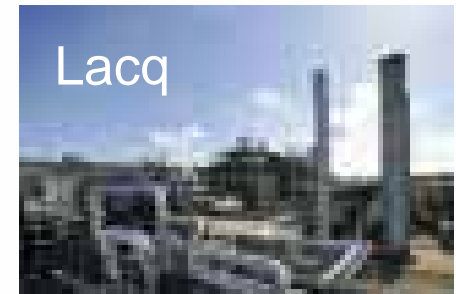
Snohvit, deep saline aquifer, Norway,
0.7 Mt CO₂/y since 2007



Courtesy CO2REMOVE, Statoil, PTRC



Laboratory-scale sites and pilots



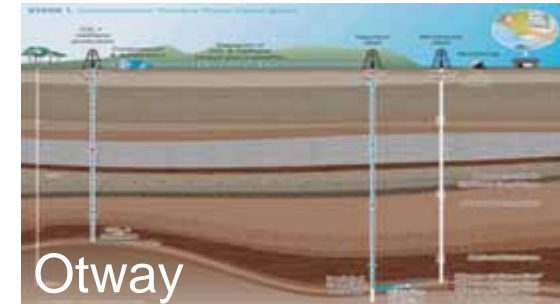
Lacq



Ketzin



Kaniow



Otway



K12-B



Frio



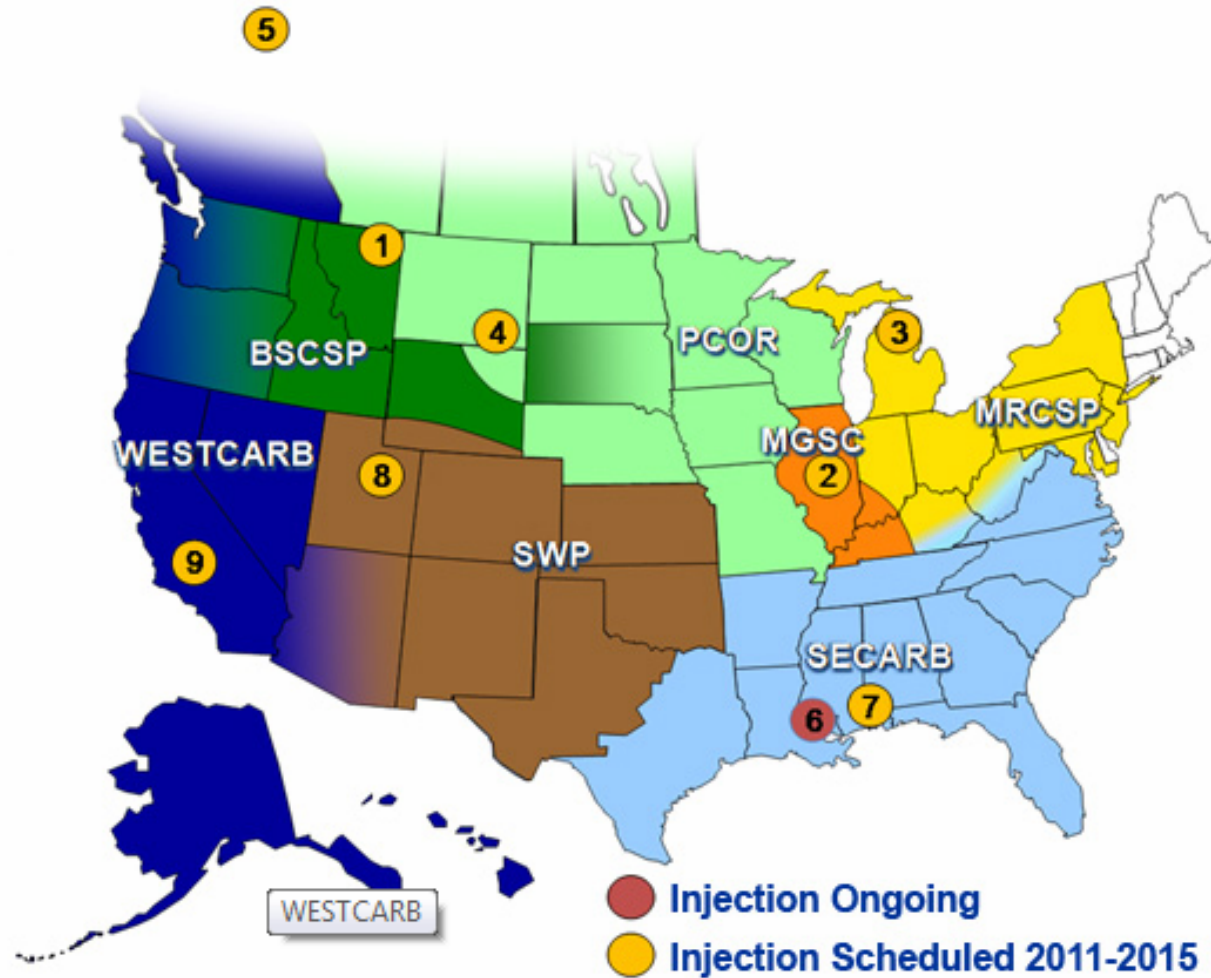
- the first Japanese pilot CO2 storage site in the Hayashima aquifer, Nagaoka, Japan

Nagaoka



Courtesy CO2REMOVE, GFZ, GDF, US-DoE, Total, RITE, CO2RC

U.S. Carbon Sequestration Partnerships



*Information current as of 2010. Some locations presented on map may differ from final injection location.



CO₂-EOR in the USA

- Commercial projects since 1972
- 114 projects in operation in 2010, additional oil production 280 th. barrels per day
- More than 5800 km pipelines for CO₂ transport
- Total CO₂ injection more than 600 Mt CO₂



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Ambitious EU emission reduction targets

➔ The „20-20-20“ target for 2020:

- reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency

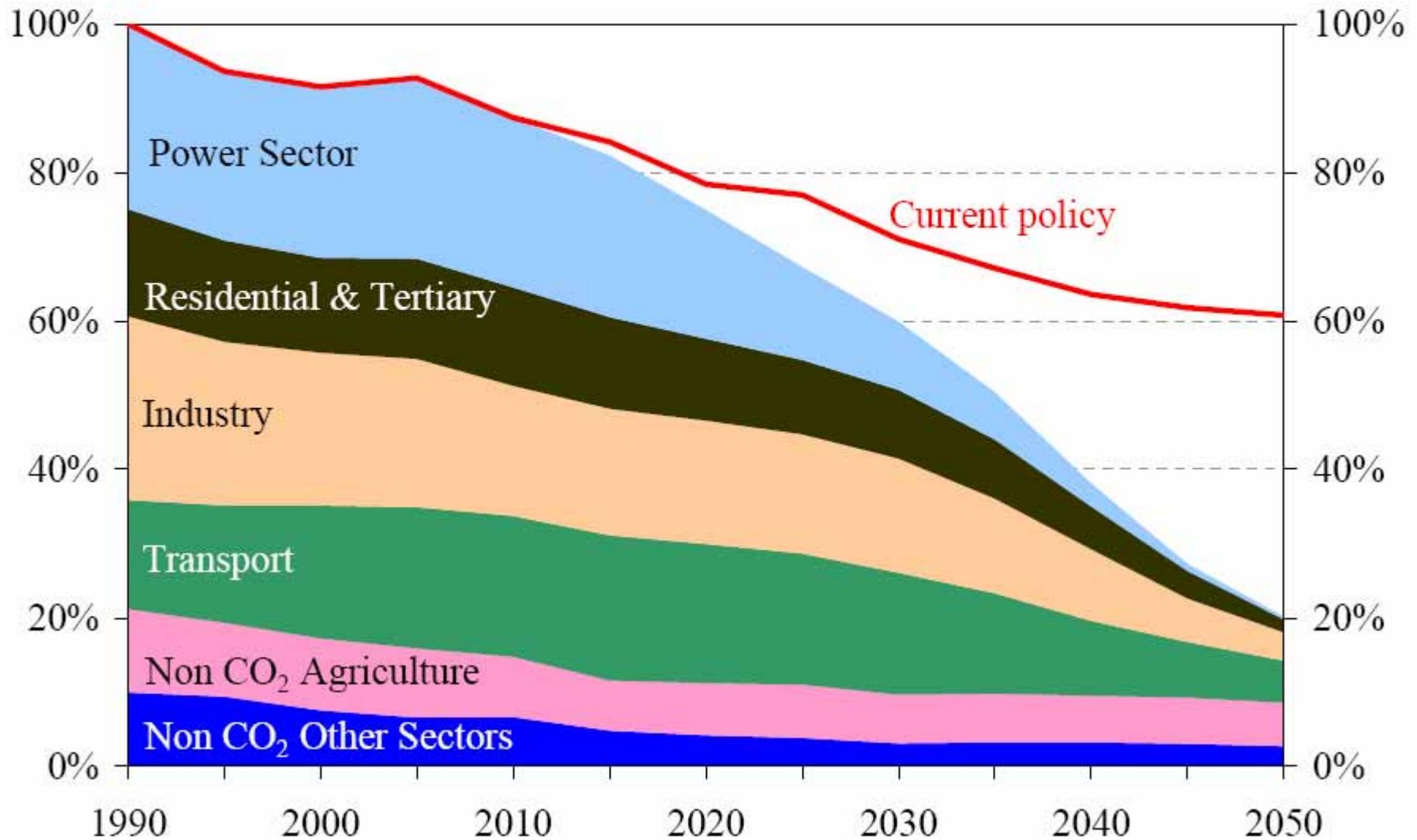
• Low-carbon economy in 2050

- „Roadmap for moving to a competitive low-carbon economy in 2050“ – EC communication of 2011 supported by Energy Roadmap 2050 + other roadmaps
- 80-95 % emission reduction in 2050



Ambitious EU emission reduction

EU GHG emissions towards an 80% domestic reduction (100% =1990)



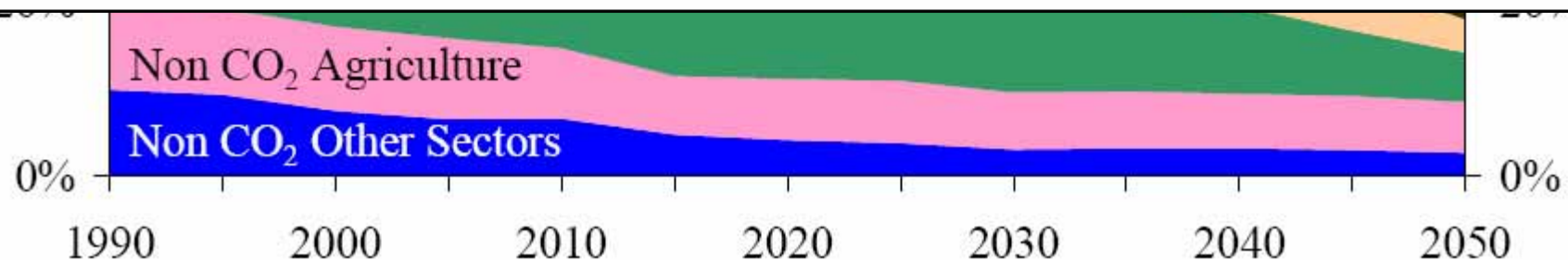
Ambitious EU Emission reduction

EU GHG emissions towards an 80% domestic reduction (100% =1990)



Sectoral reductions

GHG reductions compared to 1990	2005	2030	2050
Total	-7%	-40 to -44%	-79 to -82%
Sectors			
Power (CO ₂)	-7%	-54 to -68%	-93 to -99%
Industry (CO ₂)	-20%	-34 to -40%	-83 to -87%
Transport (incl. CO ₂ aviation, excl. maritime)	+30%	+20 to -9%	-54 to -67%
Residential and services (CO ₂)	-12%	-37 to -53%	-88 to -91%
Agriculture (non-CO ₂)	-20%	-36 to -37%	-42 to -49%
Other non-CO ₂ emissions	-30%	-72 to -73%	-70 to -78%



Current status of CCS in Europe

- Two large-scale CCS projects offshore Norway – Sleipner and Snohvit
- Integrated CCS pilot at Lacq (France)
- Capture pilots – Esbjerg, Schwarze Pumpe, Brindisi, Compostilla, Buggenum, Ferrybridge, Mongstad
- Storage pilots – Ketzin, K12b, Kaniów
- CO₂-EOR operations – Hungary, Turkey, Croatia (mostly using natural CO₂)
- Further pilot and demonstration projects under development
- Abundant R&D activities



EU support to CCS



- CCS is integral part of European Energy and Climate Change policy (e.g. the Strategic Energy Technology /SET/ Plan)
- Legislation enabling CCS (especially the Directive on the geological storage of carbon dioxide, adopted in December 2008, published in June 2009, now in final stage of implementation into national legislations)
- Allowing financial subsidies by Member States
- Support of R&D (7th Framework Programme)
- Integration in the Emission Trading Scheme from 2013 – stored CO₂ is considered not emitted
- Co-financing - EEP and NER300 mechanisms





Six EU demonstration projects financed by EEP

Start ~ 2015
1 billion €

SELECTED PROJECTS
CO₂ CAPTURE AND STORAGE



Hatfield (UK)

Pre-combustion

(IGCC Power plant)

Storage in **offshore gas field**

Project part of the Yorkshire Forward initiative that aims at developing a transport and storage infrastructure for the region

Rotterdam (NL)

Post-combustion

Storage in **offshore gas field**

Project part of the Rotterdam Climate initiative that aims at developing a transport and storage infrastructure for the region

Compostilla (Spain)

Oxy-combustion

Storage in **onshore saline aquifer**

Porto-Tolle (Italy)

Post-combustion

Storage in **offshore saline aquifer**

Belchatow (PL)

Post-combustion

Storage in **onshore saline aquifer**

Janschwalde (DE)

Oxy & Post-combustion

Storage in **onshore saline aquifer or gas field**

CANCELLED

NER 300



- 300 million CO₂ emission allowances from the New Entrants Reserve of the ETS will be sold on the market (200 mil. in the 1st round and 100 mil. in the 2nd round) to support CCS and innovative renewable energy demonstration projects
- First bunch of project proposals submitted by Member States in May 2011 (65 RES projects and 13 CCS demos from 7 Member States)
- Decision expected late 2012
- European Investment Bank is steering the project



Outline

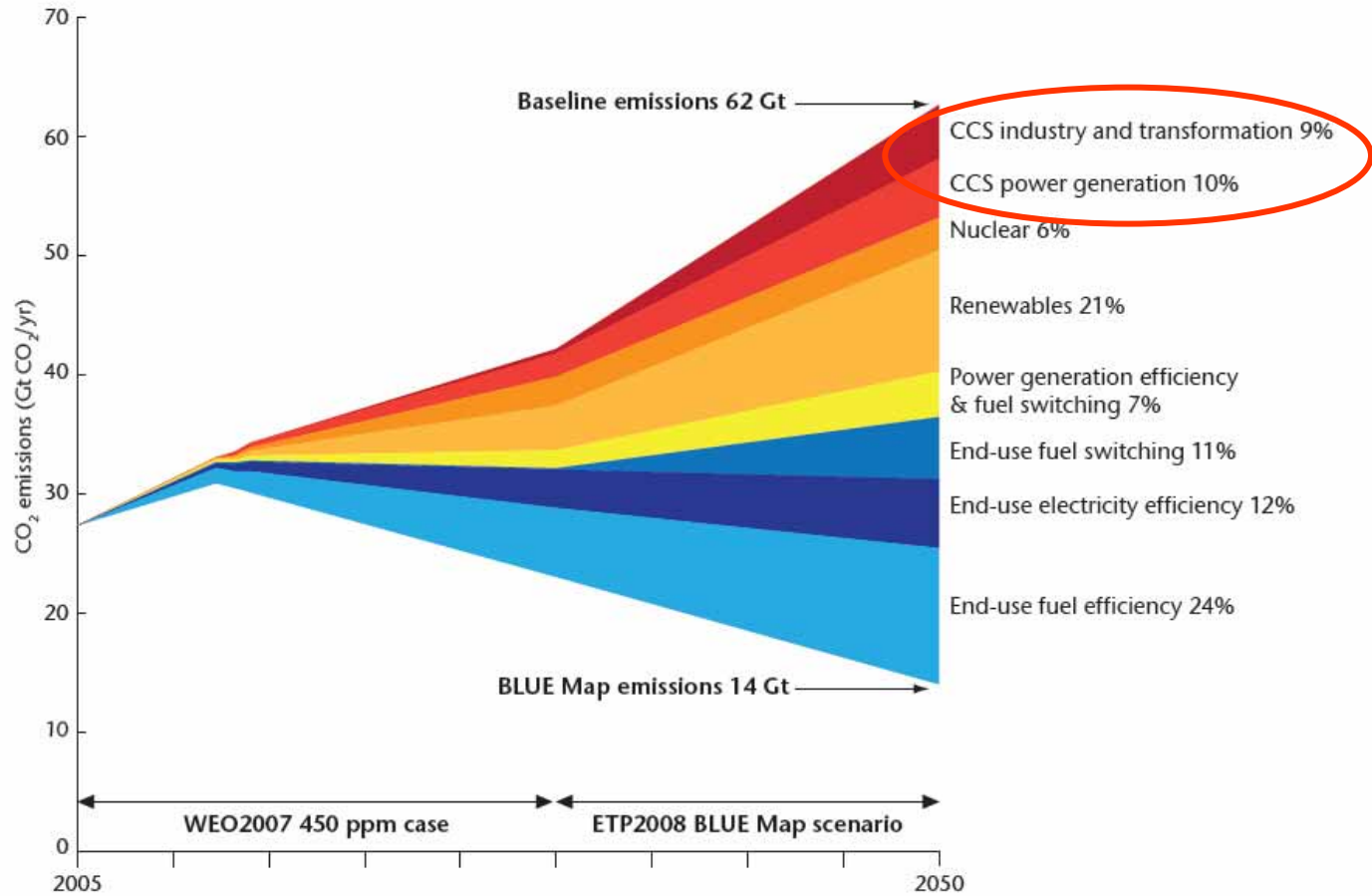
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CCS within the carbon abatement portfolio

Figure 1: CCS delivers one-fifth of the lowest-cost GHG reduction solution in 2050



Source: IEA, *Energy Technology Perspectives* (2008a).



KEY POINT: Without CCS, overall costs to halve CO₂ emissions levels by 2050 increase by 70%.

CCS roadmap milestones

2010

2020

2030

2040

2050

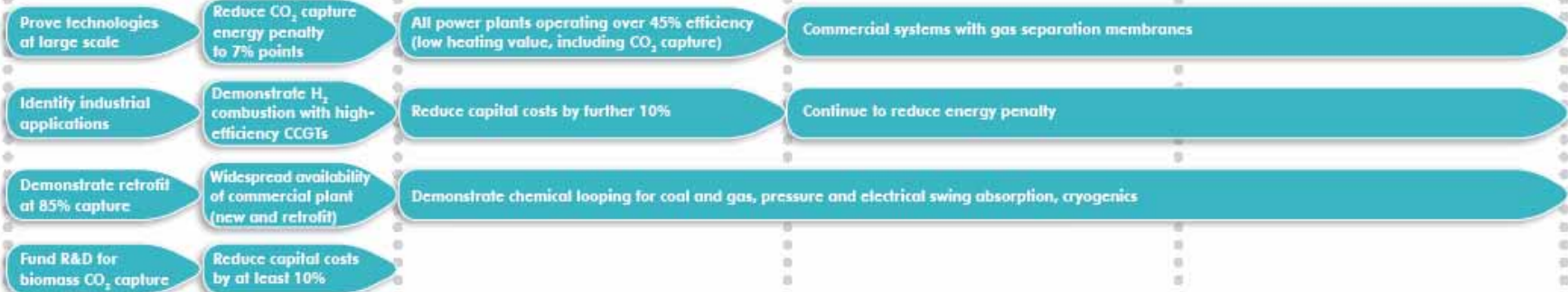
100 projects

850 projects

2 100 projects

3 400 projects

Technology



Regulatory



Finance



Public engagement



Large-scale CCS projects under construction

Project name	Location	Capture type	Volume CO ₂ (Mtpa)	Storage type	Start date
In construction					
Air Products Steam Methane Reformer EOR Project	United States	Pre-combustion (hydrogen production)	1	EOR	2012
Illinois Industrial Carbon Capture and Sequestration (ICCS)	United States	Industrial (ethanol production)	1	Deep saline formation	2013
Lost Cabin Gas Plant	United States	Pre-combustion (gas processing)	1	EOR	2013
Boundary Dam with CCS Demonstration	Canada	Post-combustion (power)	1	EOR	2014
Agrium CO ₂ Capture with ACTL	Canada	Pre-combustion (fertiliser)	0.6	EOR	2014
Kemper County IGCC Project	United States	Pre-combustion (power)	3.5	EOR	2014
Gorgon Carbon Dioxide Injection Project	Australia	Pre-combustion (gas processing)	3.4 - 4	Deep saline formation	2015

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In addition, 12 project are expecting the FID within a year

IEA: Tracking Progress in CCS

(April 2012)

Deployment rates for large-scale integrated projects are off pace



Not seeing the necessary rate of investment into full-scale demos



Business case lacking for deployment beyond demonstration

Global efforts ≠ significant emission reduction ambitions associated with CCS

What needs to be done?*

- Reduce the financial gap
- Find funding mechanisms for CCS in developing economies
- Develop legal and regulatory frameworks
- Amend marine treaties
- Share knowledge
- Investigate CO₂ storage
- Support CCS in industrial applications

More about the future of CCS in the final workshop presentation by Tore Torp



Recommendations from the IEA/GCCSI report „Tracking progress in Carbon Capture and Storage (April 2012)

Conclusions

- ➔ CCS is an important climate change mitigation option
- ➔ Technology and storage capacity are available
- ➔ There are implementation barriers delaying deployment:
 - lacking world-wide agreement on reducing GHG emissions (post-Kyoto) -> uncertain future carbon price
 - unclear financing of the demonstration and post-demonstration phases (economic crisis)
 - public resistance to onshore storage (NIMBY or NUMBY syndrome)

Nevertheless, without CCS the emission reduction targets cannot be achieved, or, if yes, the costs would be significantly higher





Acknowledgements

This presentation is a dissemination activity of CGS Europe – a coordination action co-funded by the European Commission within the Seventh Framework Programme of the European Community for research, technological development and demonstration activities.

The author is grateful to Peter Petrov (EC, DG Research & Innovation) and Eric Drosin (ETP ZEP) for providing slides and information for this presentation.

The CO₂GeoNet Association, ETP ZEP, Global CCS Institute, European Commission, IEA and Scottish Carbon Capture and Storage are acknowledged as sources of graphs, tables and pictures used in this presentation.