

Contributions of CCS to the Energy Transition

***EPRG & CEEPR European
Energy Policy Conference***

London

July 9-10, 2015

Outline

- The Crossroads
- CCS Demonstration Projects
- Markets for CCS
- BECCS

The Crossroads

- CCS Technology Development has made great strides in the past 25 years
- The technology is ready for commercial scale demonstration and deployment
- However, the necessary markets have not developed due to lack of strong climate policy

Said Another Way

Every Saturday night

I felt the fever grow

Do ya know what it's like

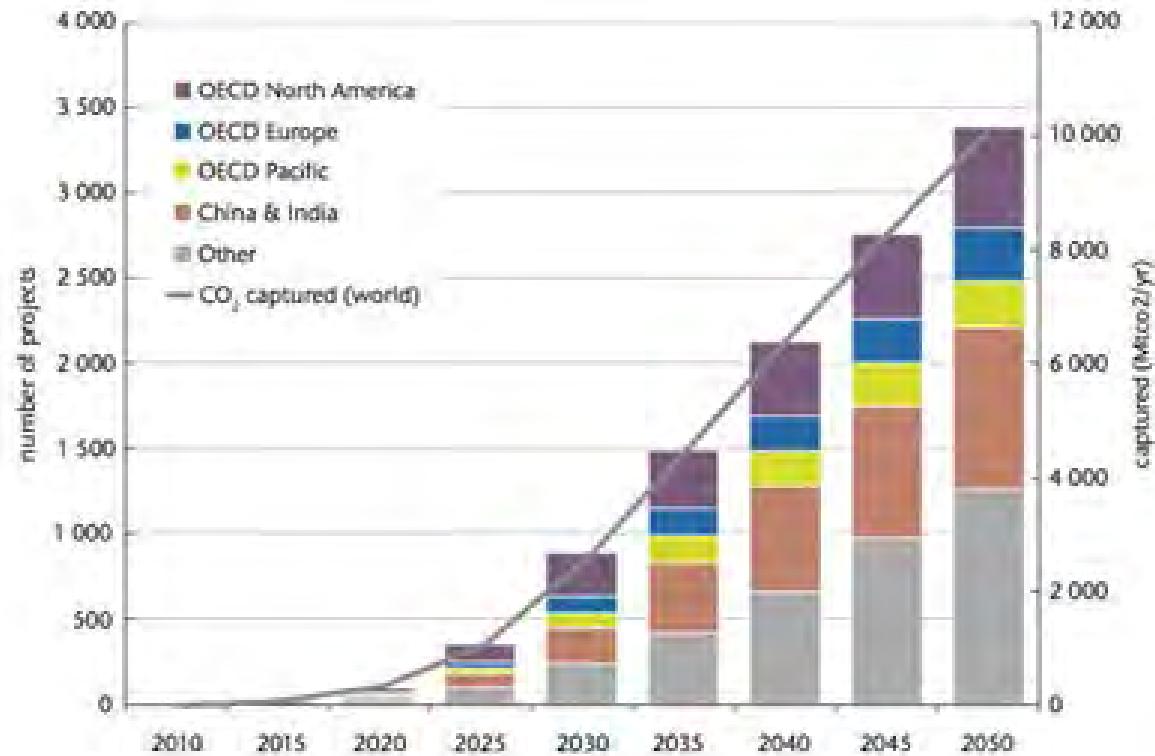
All revved up with no place to go

- Meatloaf (1977)

The View from 2009

- Climate change in 2009
 - Cap and Trade bills in Congress
 - Obama in White House
 - New international agreement in Copenhagen
- CCS in 2009
 - There will be about 20 large-scale CCS demonstrations worldwide by 2020
 - Commercial projects will be feasible by 2020; We will see 100s built by 2050

IEA CCS roadmap (2009)



From 2020-2050

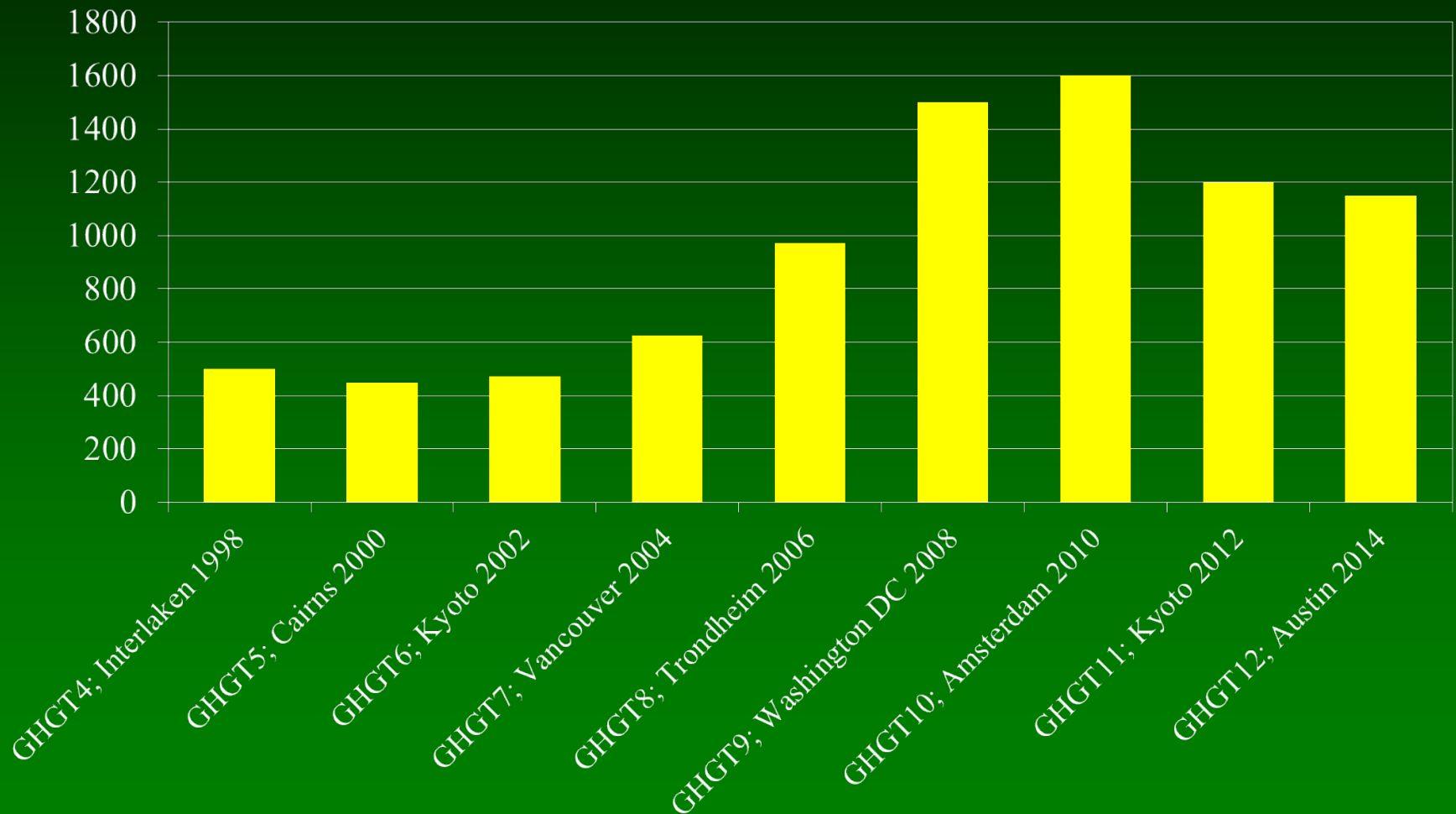
- ~100 new projects/year
- ~300 Mt/yr growth in storage rate

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The View from 2015

- Climate Change
 - Snowballs in the Senate
 - Low expectations for Paris
- CCS
 - Large-scale CCS demonstrations have proven difficult to finance.
 - Commercial markets for CCS will not develop by 2020; even 2030 seems very optimistic

GHGT Participant Numbers



Making CCS a Major Player in the Energy Transition

- Two major requirements
 - Technology Development
 - » R&D Programs
 - » Demonstration Programs
 - Establishing Markets
 - » Climate Policy

Major Demonstration Projects

Phase 1

- Pioneer Projects (little/no gov't money)
 - Natural Gas Processing (4) – Sleipner (Statoil), In Salah (BP), Snovit (Statoil), Gorgon (Chevron)
 - Synfuels - Weyborn (Dakota Gasification), EOR driven
 - Major Pilots - Schwarze Pumpe (Vattenfall), capture, no storage

Sleipner (North Sea, Norway)



Major Demonstration Projects

Phase 2

- CCS RD&D Programs
 - Power Plants
 - » Operating – Boundary Dam (Canada)
 - » Under Constuction – Kemper (US), Petra Nova (US)
 - » Planning – TCEP (US), HECA (US), White Rose (UK), Peterhead (UK)
 - Industrial Facilities
 - » Operating - Air Products (US, Methane Reformer), ADM (US, Ethanol)
 - » Under Construction – Quest (Canada, Methane Reformer), Alberta Trunk Line (Canada, pipeline between refinery and fertilizer plants to EOR)
 - Major Pilots – Mongstad (Norway), capture, no storage

Major Demonstration Projects

Role of EOR

- Phase 2 – CCS RD&D Programs
 - Power Plants
 - » Operating – Boundary Dam (Canada)
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Boundary Dam

World's first CCS Power Plant



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Major Demonstration Projects

Phase 3

- No definitive policies in place
 - Technology Push (RD&D programs)
 - Market Pull (Climate Policy)
- US proposed
 - Investment Tax Credit
 - Tax Credit for CO₂ stored
- UK – “Delivering CCS”
- EU has no credibility in my book

Establishing Markets

- US
 - New Source Performance Standards
 - Clean Power Plan
- UK
 - Contract for differences
- Canada
 - CCS requirements for coal
- EU
 - ETS

IPCC Working Group 3

Summary for Policy Makers

- April, 2014
- CCS mentioned 35 times
- Key points:
 - CCS reduces costs of meeting key stabilization targets (i.e., 450 and 550 ppm)
 - Strong call by IPCC for negative emissions by BECCS (bio-CCS)
 - Without CCS, certain targets cannot be met (due in part to CCS role in negative emissions)

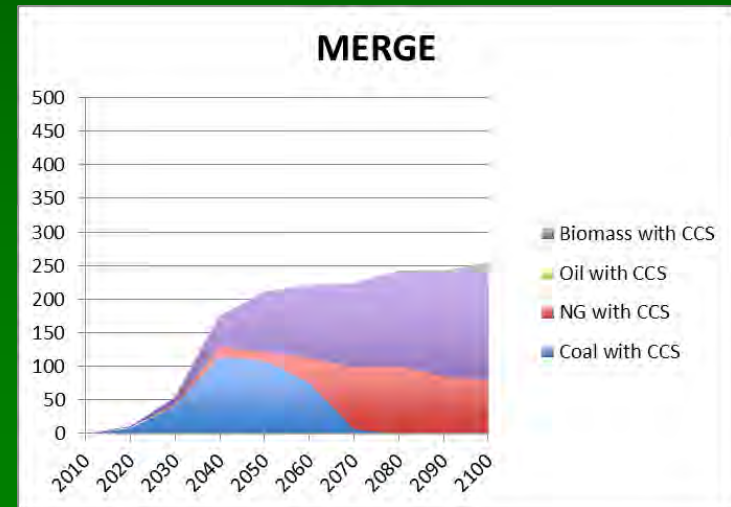
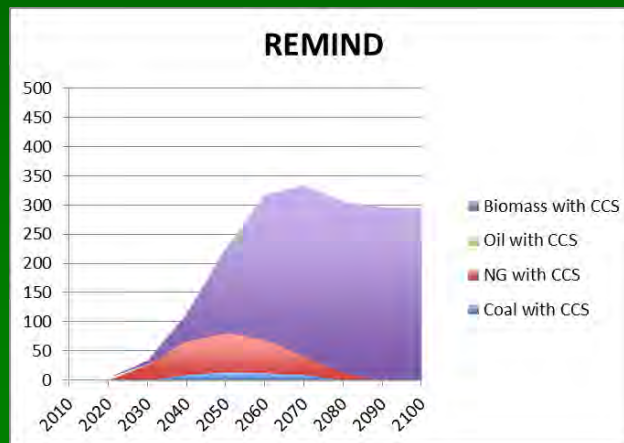
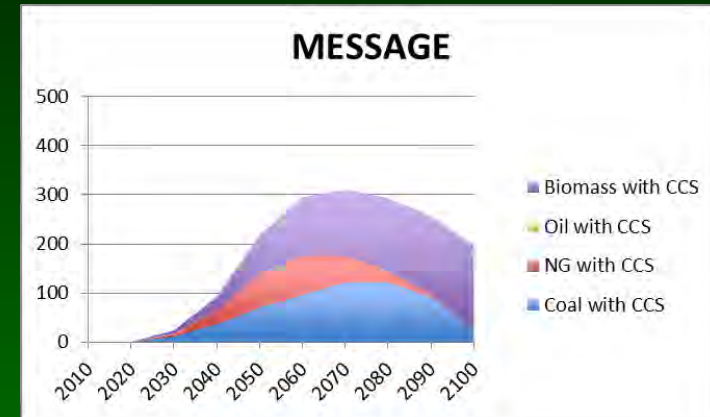
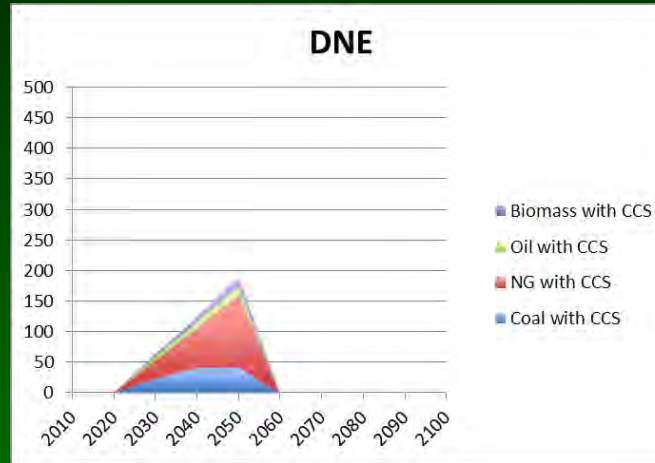
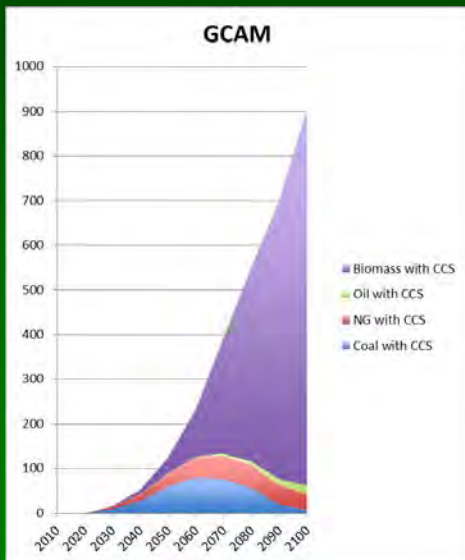
Nature

May 7, 2015, pp. 27-28

- “Climate advisors must maintain integrity”
by Oliver Geden
 - “Each year, mitigation scenarios that explore policy options for transforming the global economy are more optimistic - and less plausible. Advisers once assumed that the global emissions peak would have to be reached before 2020 and that annual emissions-reduction rates of more than 3% were not feasible. Those assumptions keep changing.”
 - “In both cases, climate economists got around past ‘make-or-break’ points for the 2 °C target by adding ‘negative emissions’ ”

BECCS – Ampere Study

450 ppm case



BECCS

- Without CCS, there will be no BECCS
 - Cost of BECCS > CCS
 - » At high enough C price, may reverse
 - Issues with storage are identical
- Why did IPCC highlight BECCS
 - Without negative emissions, 450 ppm (2 degree C) scenarios are hard to justify
 - BECCS is basically an accounting trick to keep the 2 degree C aspirations alive

Final Thought

- CCS has ability to be a major player in the energy transition
- Current policies are inadequate to develop markets for CCS
 - Not only does this marginalize CCS's role in the energy transition, it threatens the energy transition itself (at least the goal of stabilizing CO₂ emissions at a reasonable level)

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