

Global Status of CCUS

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CCUS in EWSCA Member States

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What is IEAGHG?



- An international collaborative research programme
- We have been in existence since 1991.
- We are a part of IEA's Energy Technology Network
- Our remit is research the role technology can play in reducing greenhouse gas emissions
- Members pay into a common research fund
- Members are fully included in designing our technical work programme and our strategic plans
- We provide independent analyses to our membership
- We are policy relevant not policy prescriptive
- We aim to provide our members with value for money on the research money they invest with us.

What do we do?



- We cover all greenhouse gases but focus on CO₂
 - Watching brief on other gases, CH₄, N₂O, HFC's etc.,
- We cover all CO₂ abatement options but focus on CCS
 - Watching brief on other mitigation options: geo-engineering, mineralisation etc.,
- We research the full CCS chain and its components
- We are mostly technical but also research non technical issues like CCS social science research
- Our reports are freely accessible and widely cited
- We collaborate wherever we can with the IEA and outside
- Flag ship activities include:
 - Our technical research reports (over 250 to date)
 - Our international research networks (9 currently)
 - Our conferences, the GHGT series



EPRI

Schlumberger



ALSTOM

CIAB

EnBW

VATTENFALL

ExxonMobil



ieaghg



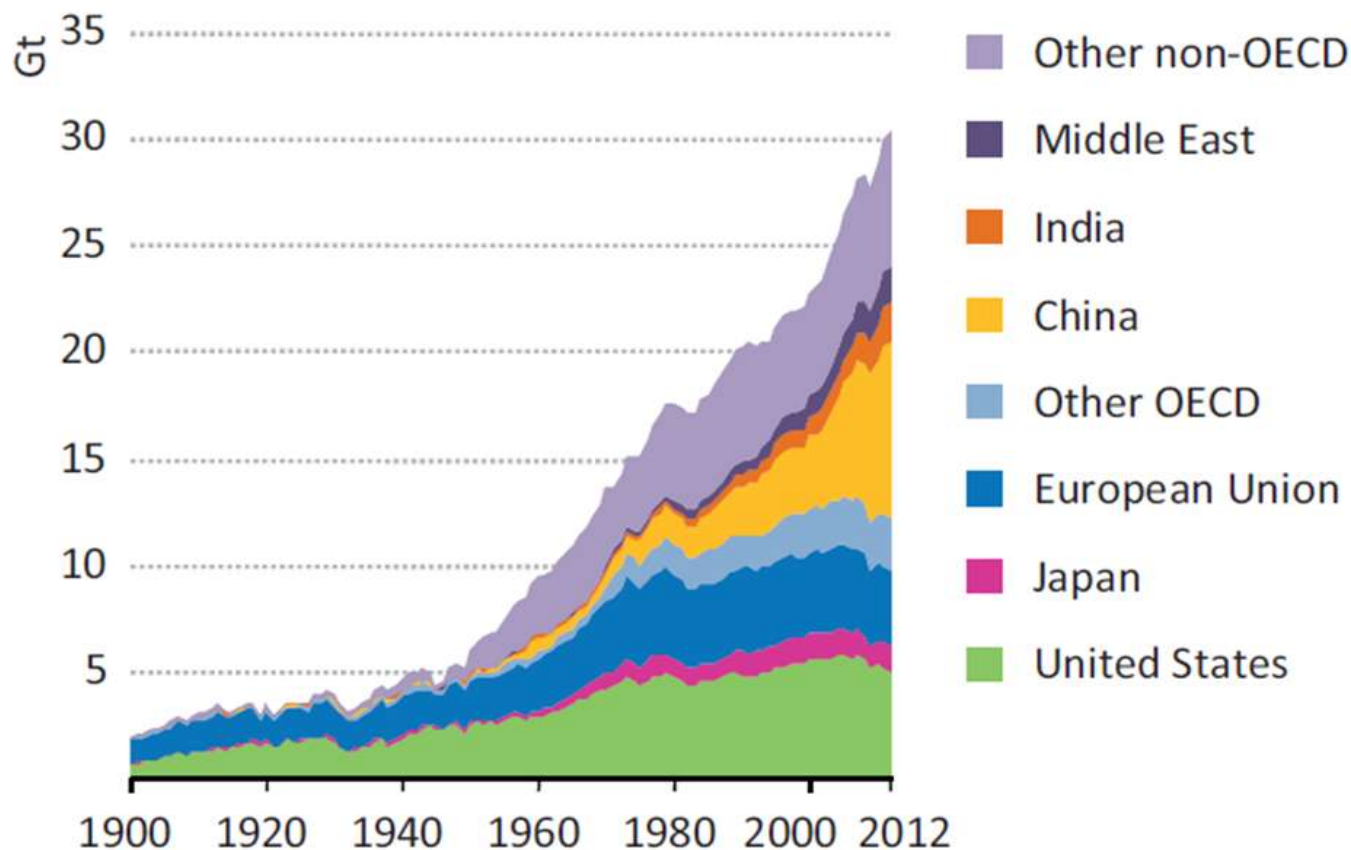
GLOBAL
CCS
INSTITUTE



Partner Organisations:



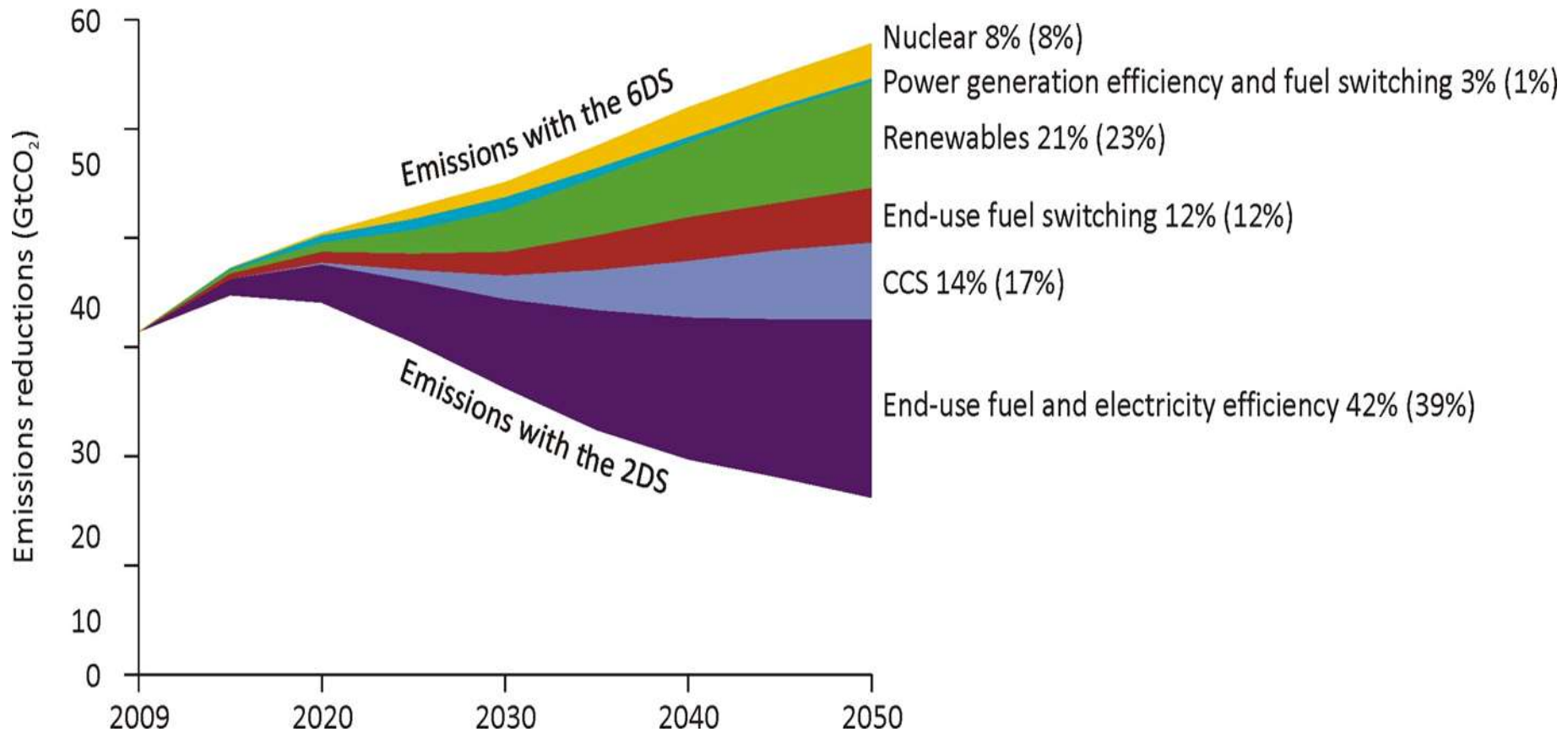
Why do we need CCS?



Sources: IEA databases and analysis; Boden *et al.*, (2013).

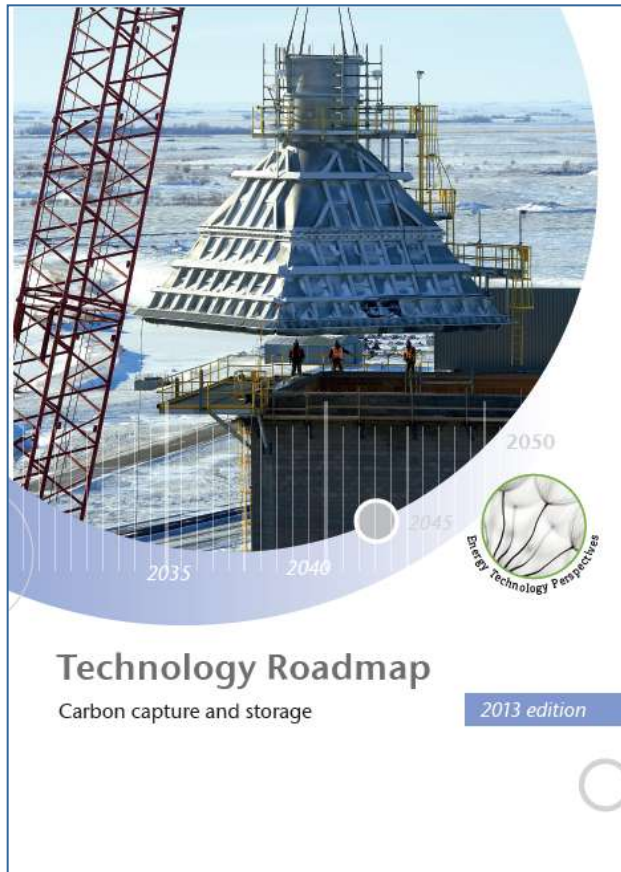
Annual CO₂ emissions reached record high **31,6 Gt** in 2012

Why do we need CCS?



Source: IEA 2013 Technology Roadmap for Carbon Capture and Storage

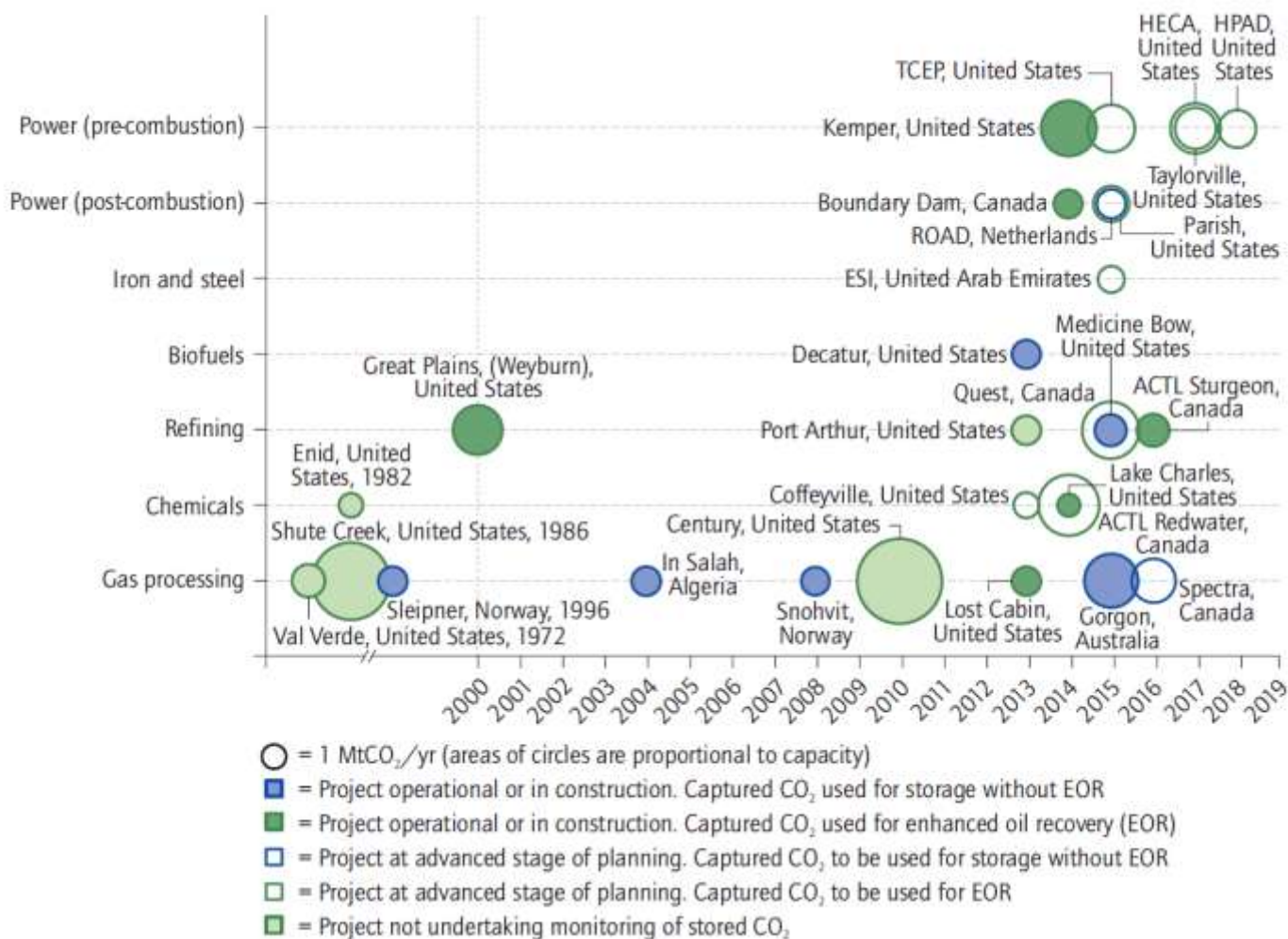
2013 CCS Roadmap: Key findings



- 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 CO₂ 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 CO₂ 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.



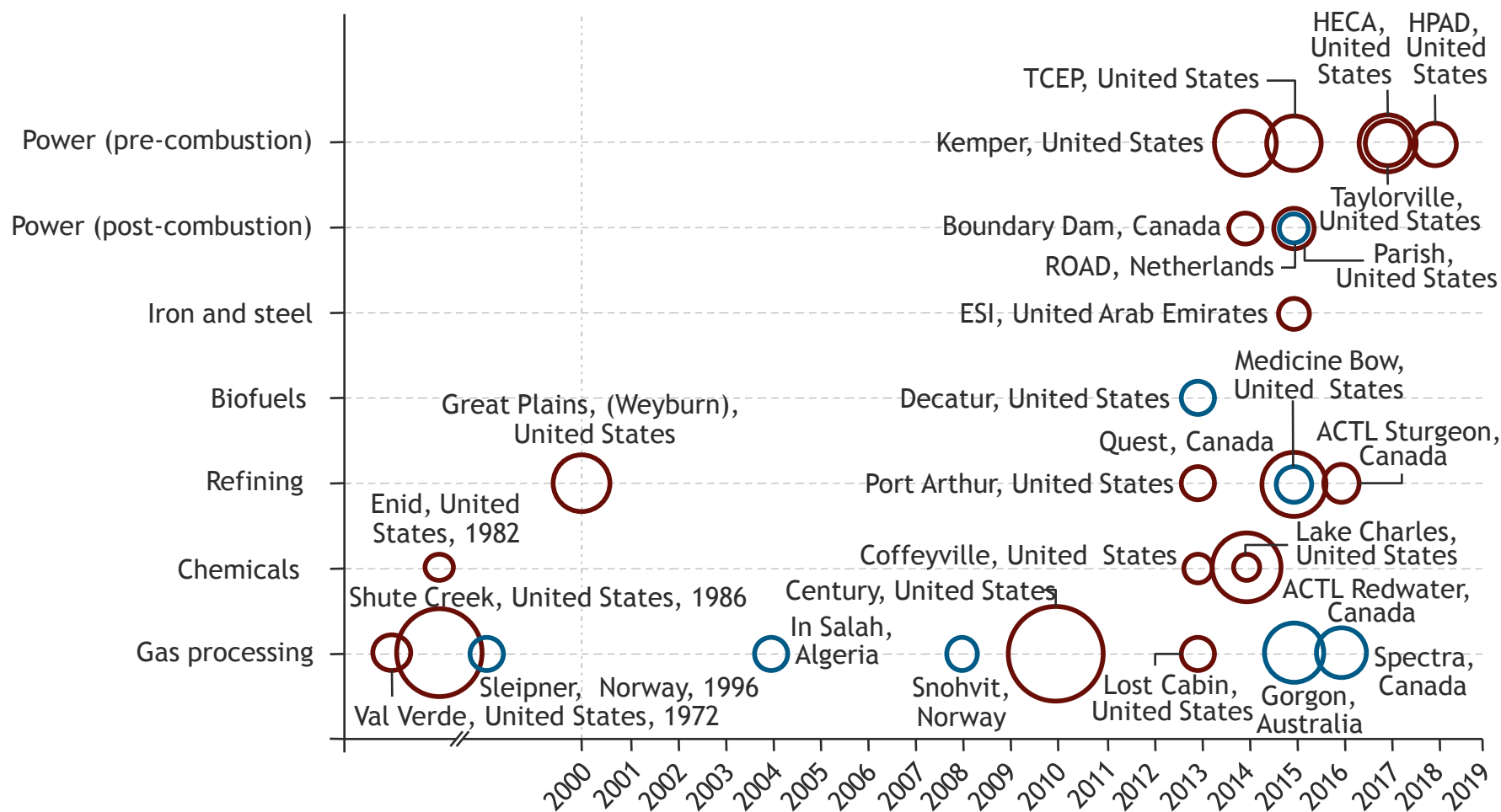
Progress with integrated projects



Source: Global CCS Institute data



Progress with large-scale capture projects



Source: IEA

Different Approaches by Region



Europe

- Portfolio of 12 demonstration projects (2007)
- 2009 CCS Directive launched
- Financial incentives provided
 - ETS (2005) /NER300 (2010)
- Demonstration funding set aside in EEPR (2009)
 - One project still operating
- Second NER300 call (2013)
 - One UK CCS project submitted
- No EC funded demonstration projects yet
 - UK, Netherlands and Norway going it alone

USA

- FutureGen Announced 2003
- Regional Carbon Sequestration Programme started (2003 to date)
 - 3 phase Regional Carbon Sequestration Programme (2010)
 - 4 X1 million tonne injections underway by 2013
- Energy Recovery Act 2009
 - 3 Industry demos – 1 started
 - 4 Power Gen demos
- FutureGen II Funded (2009)
- USEPA CO₂ injection rule announced 2010
 - No Class VI wells permitted yet



1 BSCSP Basalt	16 MGSC Sugar Creek EOR Phase II	31 SECARB - Stacked Storage Project Cranfield Phase II
2 Carbfix	17 MGSC Tanquary ECBM Phase II	32 SECARB - Mississippi Saline Reservoir Test Phase II
3 CarbonNet	18 Mountaineer	33 South West Hub (Collie South West Hub)
4 CIDA China	19 MRCSP Appalachian Basin (Burger) Phase II	34 Surat Basin CCS Project (Previously Wandoan)
5 CS Energy Callide Oxyfuel Project	20 MRCSP Cincinnati Arch (East Bend) Phase II	35 SWP San Juan Basin Phase II
6 CSEMP	21 MRCSP Michigan Basin Phase II	36 Teapot Dome, Wyoming
7 Fenn/Big Valley	22 Nagaoka Pilot CO2 Storage Project	37 Total Lacq
8 Frio, Texas	23 Otway I (Stage I)	38 West Pearl Queen
9 JCOP Yubari/Ishikari ECBM Project	24 Otway II Project (Stage 2A,B)	39 WESTCARB Arizona Pilot (Cholla)
10 K12B	25 PCOR Lignite	40 WESTCARB Northern California CO ₂ Reduction Project
11 Ketzin	26 PCOR Williston Basin -Phase II (NE McGregor Field)	41 WESTCARB Rosetta-Calpine test 1
12 Marshall County	27 PennWest Energy EOR Project	42 WESTCARB Rosetta-Calpine test 2
13 Masdar/ADCO Pilot project	28 Recopol	43 Western Kentucky
14 MGSC Ioudon Field EOR Phase II	29 SECARB - Black Warrior Basin Coal Seam Project	44 Zeron Project
15 MGSC Mumfords Hills EOR Phase II	30 SECARB - Central Appalachian Coal Seam Project	



The role of CCS pilots

- CO₂ injection pilots are currently the key to global implementation of CCS.
 - Building a science/knowledge base
 - Journals/Conference proceedings, AAPG/EGU/SPE etc.,
 - Key to developing public confidence
 - On site exhibitions/public interaction & social science research
 - Contributing to demonstration implementation
 - K12-B allowed the Storage permit for ROAD to be gained from EC
 - Develop expertise for future larger scale implementation
 - Skilled engineers, contractors, equipment suppliers



Changes in focus

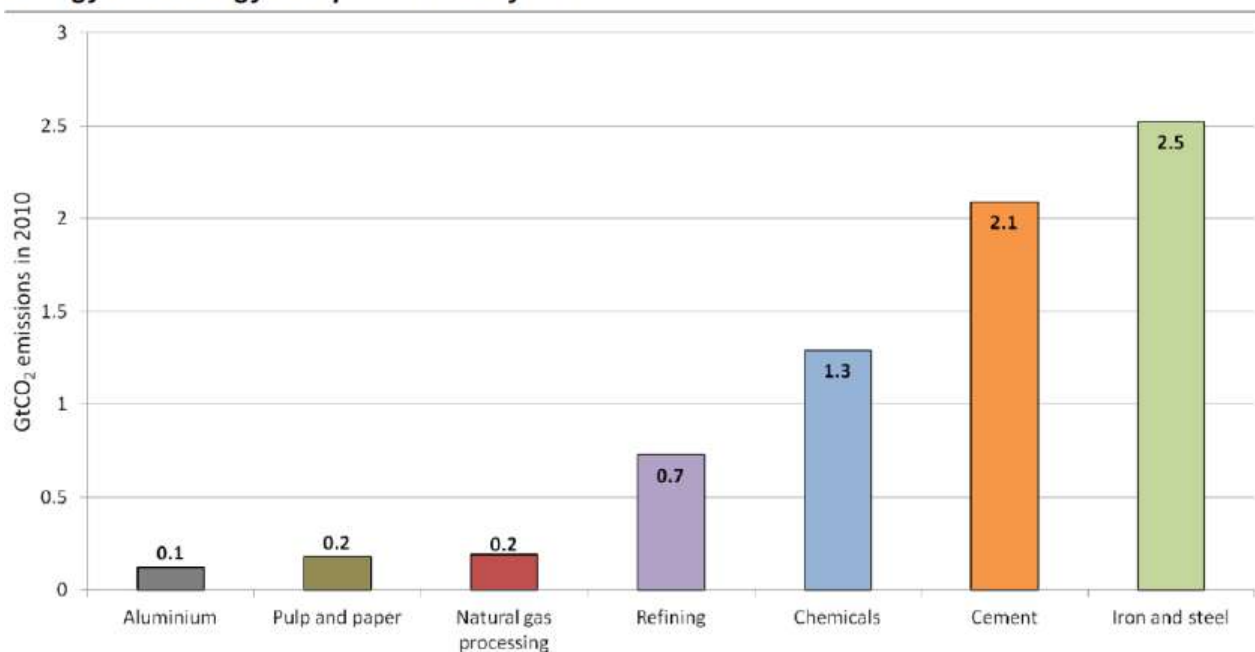
- CCS started off in gas supply industry
- Increasing interest in CCS on gas fired in Europe
 - USA – EPA regulations likely to mean only coal fired power plant will be fitted with CCS
- Norway formerly had most advanced plans for gas fired CCS
 - Mongstad full scale plant – FID deferred until 2020
- UK now stepping up its activity
 - ETI call for 5MW pilot plant
 - Peterhead gas fired CCS power plant selected in 2nd UK CCs competition



Rationale for CCS:

Only large-scale option for many industries

Figure 1. Global emissions from the seven most CO₂-intense industrial sectors in the IEA
Energy Technology Perspectives analysis



Tracking Clean energy Progress report 2013, industry-CCS annex

CCS is the only large-scale mitigation option for many industrial sectors.

Some Examples of CCS Research in Steel Industry



- ULCOS Project - Europe
 - Developing oxy blast furnace with top gas recycle and capture
- Japan - COURSE 50 Project
 - Demonstrate post combustion capture from blast furnace – 30tpd pilot scale
- Korea
 - Demonstrate ammonia scrubbing of blast furnace gas, 1st stage pilot testing

Developments in Industry CCS

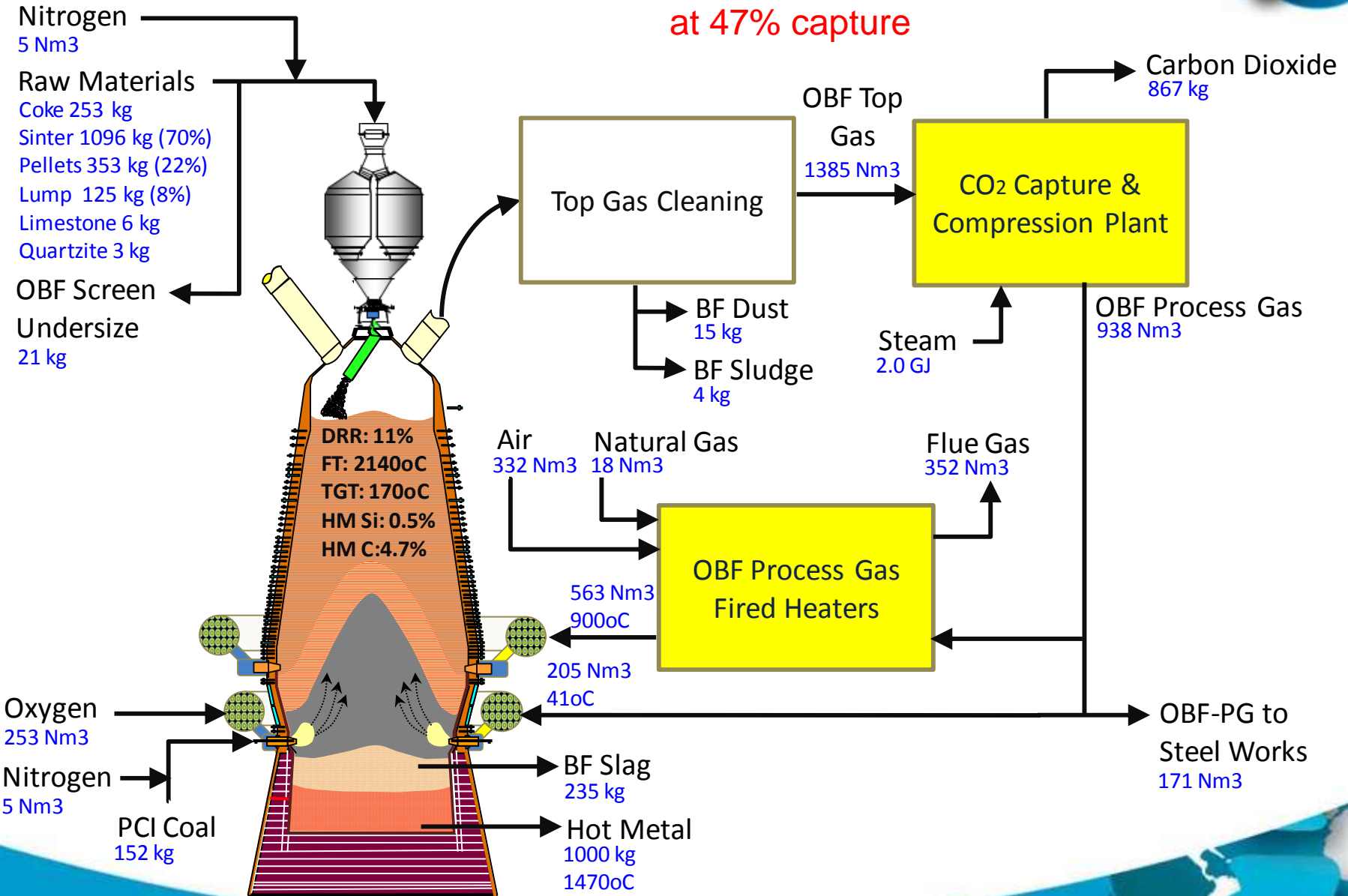


- Steel sector
 - IEAGHG with SWEREA MEFOS/Swedish Energy Agency first independent assessment of CCS integration in a reference steel plant
 - Breakthrough technology was ULCOS oxy blast furnace
 - Technical feasible to introduce CCS into steel plant, but challenging from an integration perspective
 - Non-technical issues of concern are global competitiveness of the industry

Oxy-Blast Furnace

(Picture of OBF courtesy of Tata Steel)

US57/t CO₂ avoided
at 47% capture



CCS Research in Cement Industry



- European Cement Research Association (ECRA)
 - Phased development project for pilot scale demonstration of oxy fuel firing of cement kiln in late 2013.
- NORCHEM/CLIMIT & ECRA
 - Pilot scale project for post combustion capture on cement kiln in 2013/14
- ITRI – Taiwan
 - 10 MW Calcium Looping pilot plant constructed in 2013



Where is CCS today?

- Taking a breather until first integrated demonstration plants come on line
 - Boundary Dam retrofit early 2014
- Once the demonstrations prove the technology in the power sector we can take the next step (5 to 10yrs)
- Industry development taking place in the same time frame, ready for demonstration in 5 to 10yrs from now.
- We are probably moving slower than the climate would like
- But not that slowly in terms of technology development
 - First coke blast furnace operated in 1709
 - First hot blast furnace was developed in 1829.

“It does not matter how slowly you go as long as you do not stop” Confucius

What can we expect and what do we need?

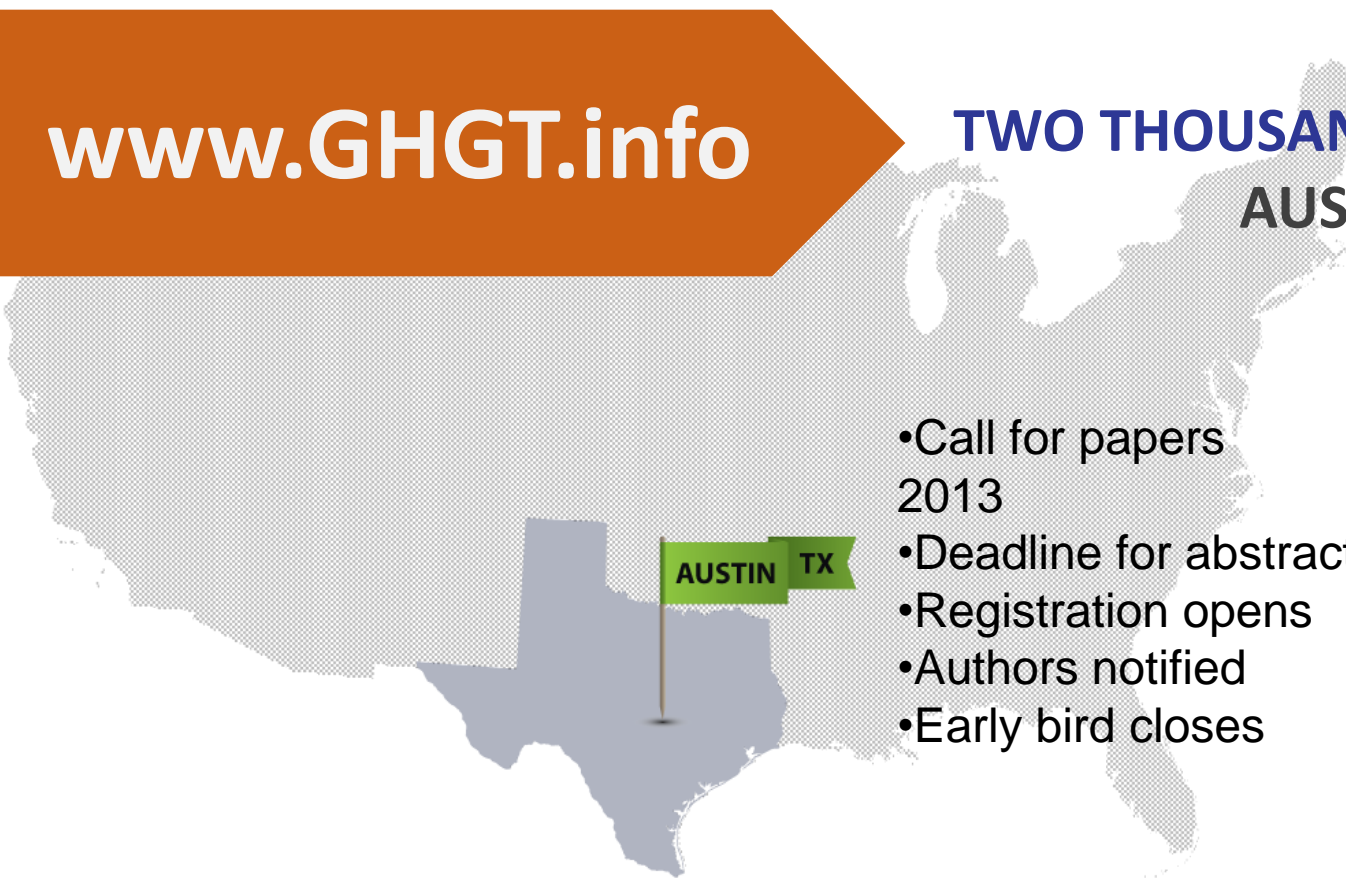


- Increased CCS pilot activity globally
- Will be some surprises along the way
- Demonstration activities in industrial sector building
 - Notably in China
- Need a lot more activity on basin scale evaluation of CO₂ storage capacity
 - This area of research is proceeding too slowly
- A realistic market price for CO₂.



www.GHGT.info

October 5 - 9
TWO THOUSAND FOURTEEN
AUSTIN, TX – USA

- 
- Call for papers 2013
 - Deadline for abstracts
 - Registration opens
 - Authors notified
 - Early bird closes

27th September

10th January 2014

7th March 2014

2nd May 2014

13th June 2014

Thank you, any Questions?

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LinkedIn: www.linkedin.com/groups/IEAGHG-4841998



Twitter: <https://twitter.com/IEAGHG>



Facebook: www.facebook.com/pages/IEA-Greenhouse-Gas-RD-Programme/112541615461568?ref=hl

International CCS Organisations



International

- IEAGHG: 1991- International research www.ieaghg.org
- Carbon Sequestration Leadership Forum (CSLF): 2003- Collaboration of governments <http://www.cslforum.net/>
- Global CCS Institute: 2009- Project deployment <http://www.globalccsinstitute.com/>
- IEA CCS Unit: 2009- Policy <http://www.iea.org/topics/ccs/>

Regional

















- EU ZEP: 2005- Stakeholder association <http://www.zeroemissionsplatform.eu/>
- CCSA: 2006- Trade association <http://www.ccsassociation.org/>

Other

- IPCC - <http://www.ipcc.ch/>
- UNFCCC - <http://unfccc.int/2860.php>

How do we compare?



Group	Policy Focus	CCS Focus	Technical Focus	Independent	Capacity Building	Fund R,D&D
CSLF			Technical Group			
IEA CCS UNIT						
GCCSI	Implementing		At Demo Level			
IEAGHG		Main but not sole focus	R,D&D	