Carbon Dioxide Capture and Storage: A Status Report

McIlvaine Company Hot Topic Hour

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CCS Today

- All major components of a carbon capture and sequestration system are commercially available today.
  - Capture and compression
  - Transport
  - Injection
  - Monitoring
- However, there is no CCS industry – even though the technological components of CCS are all in use somewhere in the economy, they do not currently function together in the way imagined as a pathway for reducing carbon emissions.

CO_2 Injection Projects Million Tonne per Year Scale

Project	Leader	Location	CO_2 Source	CO_2 Sink
Sleipner (1996)	Statoil	North Sea Norway	Gas Processing	Deep Brine Formation
Weyburn (2000)	Pan Canadian	Saskatchewan Canada	Coal Gasification	EOR
In Salah (2004)	BP	Algeria	Gas Processing	Depleted Gas Reservoir
Snovit (2008)	Statoil	Barents Sea Norway	Gas Processing	Deep Brine Formation

The Scale-up Challenge
From Megatonnes to Gigatonnes

- We have yet to build a large-scale (>1Mt CO_2/yr) power plant CCS demonstration
- In order to have a significant impact on climate change, we need to operate at the billion tonne (Gt) per year level
- This implies that 100s of power plants will need to capture and store their CO_2

Challenges for Scale-up

- Costs
- Infrastructure
- Subsurface Uncertainty
  - Capacity
  - Long-term Integrity
- Regulatory Framework
- Long-term Liability
- Public Acceptance

Proposed US Demonstrations (with government support)

Company	Location	DOE Support (million $)	Size	Technology	Fate
FutureGen	Meredosia, IL	1000	200 MW >1 $MtCO_2$/yr	Oxy-Combustion	Saline Formation
Basin Electric	Beulah, ND	100	120 MW 1 $MtCO_2$/yr	PCC HTC PurEnergy	EOR
Hydrogen Energy	Kern County, CA	308	390 MW 2 $MtCO_2$/yr	IGCC Coal/PetCoke	EOR
AEP	New Haven, WV	334	235 MW 1.5 Mt CO_2/yr	PCC Chilled NH_3	Saline Formation
NRG Energy	Parish, TX	167	60 MW 0.4 Mt CO_2/yr	PCC Fluor	EOR
Summit Energy	Midland-Odessa, TX	350	400 MW 2.7 $MtCO_2$/yr	IGCC	EOR
Southern	Kemper County, MS	293	524 MW 3.4 $MtCO_2$/yr	IGCC Transport Reactor	EOR

Proposed US Industrial Demonstrations (with government support)

Company	Location	DOE Support (million $)	Size	Source	Fate
Leucadia Energy	Lake Charles. LA	260	4.5 $MtCO_2$/yr	New Methanol Plant	EOR
Air Products & Chemicals	Port Arthur, TX	253	1 $MtCO_2$/yr	Existing Steam Methane Reformers	EOR
Archer Daniels Midland	Dacatur, IL	99	1 $MtCO_2$/yr	Existing Ethanol Plant	Saline Formation

Mountaineer AEP/Alstom

- West Virginia
- 100,000 tpy (30 MW_{th})
- Chilled Ammonia
- Storage in a saline formation

FutureGen

- 275 MW_e IGCC coal plant with CCS
- Matton, IL
- Projected cost over $2 billion
- Storage in saline formation

FutureGen 2.0

- 200 MW_e oxy-combustion coal plant with CCS (Ameren Energy Resources)
- New boiler, air separation unit, CO_2 purification and compression unit (Babcock & Wilcox, Air Liquide)
- Meredosia, IL
- Establish a regional CO_2 storage site in ???
- Establish and a CO_2 pipeline network from Meredosia to ??? (1 Mt/yr CO_2)

Southern Company Barry Steam Plant

- Feb 22, 2010
  - Dropping CCPI project
  - Will proceed with smaller tests
- Tight deadline
  - DOE wanted firm commitment by Feb 19
  - Not “sufficient time” to understand “financial ramifications”

Moving CCS Forward

- In the near-term, the government needs to play a big role in technology push – this is relatively cheap and can be done immediately – matter of $ - either direct subsidies or policies to encourage private investments
- Ultimately, climate policy and/or regulation must create markets for low-C technologies
  - CCS uneconomic in today's markets – costs money
  - CCS may be a least cost supplier in low-C markets – saves money
- All 5 "Challenges for Large-Scale Deployment" are critical – any one can defeat large-scale deployment. However, getting the right combination of "technology-push" and "market-pull" is going to be the real driver

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