

CCS in the US

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US Drivers for CCS

- Economy slump-funding difficult to find
- Low cost of natural gas-no new coal in foreseeable future, plant closures, low coal dispatch
- Regulations
 - Non-CCS emissions being tightened
 - New coal plants regulation
 - Existing plant clean power plan
- Low cost of oil-even oil companies have a difficult time supplying funding for projects
- EOR companies resistant to reporting and monitoring requirements
- Saline reservoirs-significant R&D but no commercial locations

Demonstration Projects Overview



- While some U.S. CCS demonstrations have been reported as cancelled (e.g., FutureGen 2.0), several are under construction in pre-combustion capture / integrated gasification combined cycle (IGCC) and post-combustion capture (PCC) – Kemper and WA Parish, respectively
- Funding for many projects came from government grants (American Recovery and Reinvestment Act [ARRA] and the Clean Coal Power Initiative [CCPI]); Department of Energy (DOE) has also recently funded another set of projects for a new PCC pilot
- CCS demonstrations and pilots all involve coal flue gas; CCS on gas not thought to be needed for now
- While several CCS demonstrations in U.S. use enhanced oil recovery to improve economics, some involve geologic storage, which has less public concerns than in the European Union
- DOE focused on “transformational” CCS technologies, e.g., fuel cells, chemical looping, Brayton cycle
- More large-scale CCS demonstrations are needed to improve technologies and economics; from where will the new funding come?

U.S. CCS Demonstrations and Pilots

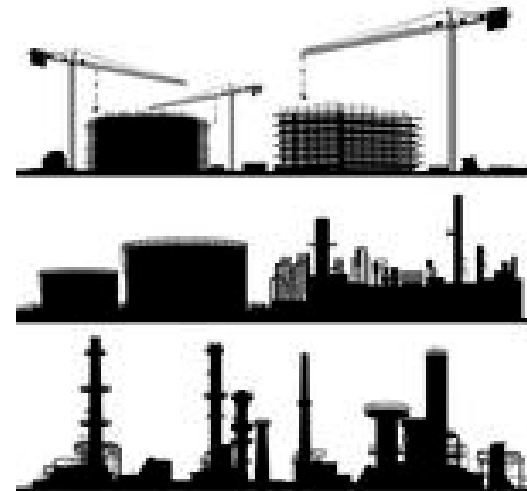
Project / Location	Owner	Size, Net MW	Capture Process / % Capture	Cost / Funding (Source)	Status / Date
FutureGen 2.0 / IL	FutureGen Alliance	99	Oxy-combustion / 98%*	\$1.65B / \$1B (ARRA)	Cancelled?
Hydrogen Energy California / CA	SCS Energy	288	IGCC / 90% (also producing urea)	\$3.9B / \$408M (CCPI)	Stalled
Kemper County / MI	Mississippi Power / Southern	524	IGCC / ~65% of total	\$6.4B / \$270M (CCPI)	Under construction / 2016 start
Mountaineer / WV	AEP	20	PCC (Alstom) / 75%*	? / (AEP, Alstom, and EPRI)	Completed / 2013 end
Plant Barry / AL	Alabama Power, Southern	25	PCC (MHI) / 90%*	? / (Southern, MHI, and EPRI for PCC; DOE, Southern, and EPRI for storage)	Operating / 2016 end
Texas Clean Energy Project / TX	Summit Power	200	IGCC / 90% (also producing urea)	\$2.9B / \$450M (CCPI)	Back on track?
WA Parish / TX	Petra Nova	240	PCC (MHI) / 90% (~35% of total)	\$1B** / \$167M (CCPI); NRG Energy and JX Nippon, \$300M each	Under construction / 2016 start

* Geologic storage

** PCC plant only

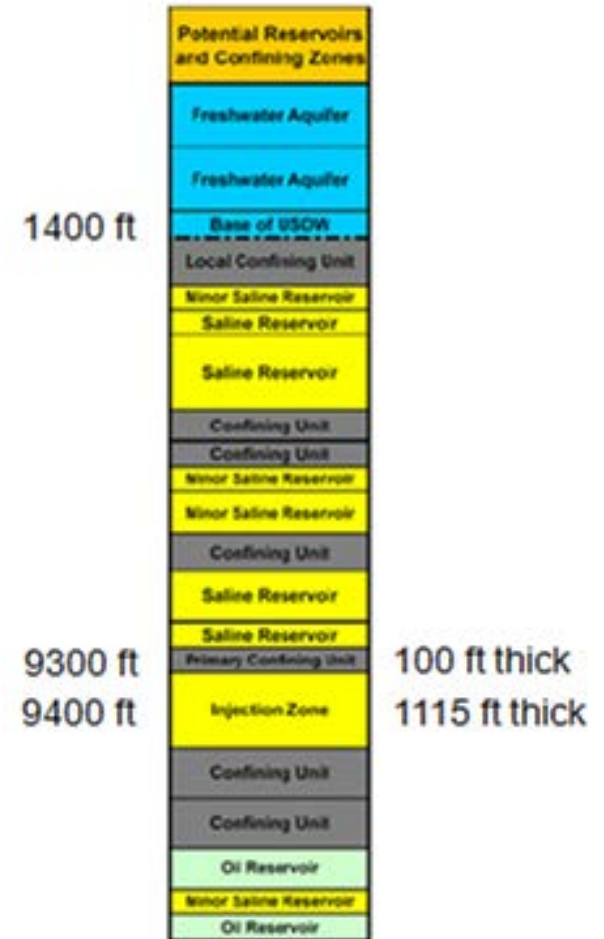
US CCS 2nd and 3rd Generation Status

- Question on how these will be progressed to commercialization to provide lower cost processes
- DOE is the main funder
 - Still have funding for lab and bench scale
 - Where will funds for large pilots (>10 MW) and demos come from
 - Where will cost share come from



CO₂ Storage

- Demos of large-scale injection
 - DOE Regional Carbon Storage Partnerships
- No commercial storage locations
 - May be significant up-front costs



National Coal Council Report

- The National Coal Council provides advice and recommendations to the Secretary of Energy on general policy matters relating to coal and the coal industry
- **Fossil Forward – Revitalizing CCS: Bringing Scale & Speed to CCC Deployment**
 - In order to achieve CCS at commercial scale, policy parity with other low/no carbon technologies is required.
 - Technology and funding Incentives must be significantly better coordinated to be effective.
 - DOE program goals need far greater clarity and alignment with commercial technology and funding approaches used by industry.
 - Funding for CCS RD&D is limited and must be enhanced and focused.
 - Public acceptance continues to be a major hurdle.
 - GHG control is an international issue in need of international initiatives.



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