CCS: Driving Deployment and Reducing Costs

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Overview

• Cost Reduction Objectives

• Enhanced Oil Recovery

• US China Collaboration
CCS Costs Too Much, Today

Technology Cost Comparison
Real Levelized $/mWh, 2018 ISD, Merchant Financing

Notes:
1. These are US costs. Absolute costs will be much lower in China, as will be the “spread” among the different technologies.
2. For intermittent technologies such as wind, no penalty is added for lower value of non-dispatchable power, or additional capacity that needs to be built to provide back up power to offset unit intermittency.

Real levelized cost metric escalates from 2018 at 2.5% annually.
Phases of CCS Deployment

- **Pioneer Projects Phase**: 20 GW
- **Cost Reduction Phase**: 100 GW
- **Mature Industry Phase**: Full Deployment

Global Objectives
Deployment Will Drive Future Cost Savings

PCC Construction Costs Projected Drop: 30%*

*2014 cost estimate is for a scale “Nth” unit, not a first-of-a-kind demonstration project.
Reducing CCS Costs

GOALS

Cost Reduction

Deployment

TOOLS

Enhanced Oil Recovery

Collaborations with China
The EOR Opportunity

- 27-35 billion barrels = $3 to $4 trillion
- 9 – 11 billion tons = 50 to 61 GW of 90% CCS

Source: EIA, ARI 2010

With ROZs and Advanced flooding, demand could be as high as 19.5 billion tons of CO2
More CO2 is needed for future EOR
The CO$_2$-EOR barrel

3 tons CO$_2$ Injection

Source: EIA, ARF 2010
The CO$_2$-EOR barrel

Fed Tax revenue: $69 per ton of CO$_2$

CO$_2$ Revenue: $30 per ton

$29
EOR net income

$23
US Treasury

$10 for CO$_2$ ($30/ton)

$33
Cap&OpEx, Royalty Owners

$100

Source: ARI, NRDC
Potential Net Federal revenue from CCS-EOR

**Net Revenue Value of Federal Incentives for CCS-Enhanced Oil Recovery**
(Up to 100 million tons per year, average incentive level of $70/ton/10 yrs)

- CO$_2$ sequestered = 3 billion tons
- Oil produced = 9 billion barrels
- Total oil value = $1.05 Trillion

CCS incentives = $70 billion
EOR revenue = $180 billion
NPV (3.5% DR) = $40 billion

Source: EIA, ARI, NRDC 2011
The China Opportunity

**China**
- Low Cost PCC manufacturing
- Speed of Construction

**US**
- EOR depth
- Innovation strength

**Potential Benefits**
- Large CCS deployment in China where fossil growth is occurring
- Technical uncertainty eliminated.
- Lower CCS costs in West due to “Nth” plant
- Faster CCS deployment and innovation worldwide
China Opportunity: CCS-EOR is economic with little subsidy

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EOR value of CO\textsubscript{2} ($/ton)

CO\textsubscript{2} capture and compression costs from fossil-fueled power plant in $/ton
China’s CCS Innovation

Leveraging China’s market to accelerate US advances &
Capture and compression advances and innovation from China

*CCS project costs to be lowered in US and China*
Policy Goals

- Expand domestic oil production by 900 million barrels through EOR
- Establish CO2 capture from power plants as a mature technology through wide application
- Establish early saline injection projects

DESIGN STATE CCS POLICY AS A DRIVER FOR FEDERAL POLICY
Takeaways

• For EOR:
  • Near-term incentives (tax credits, rate recovery)
  • Can produce long term benefits (revenue, lower rates)

• US China Collaboration Benefits:
  • Accelerates US tech commercialization
  • Access to lower cost China innovation
  • China investment and learning on CO2 EOR/Sequestration