Creating a Carbon Capture and Storage Business in a Carbon Unconstrained World

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Agenda

• Kinder Morgan
• Industry
  – Where have we been?
  – Where are we know?
  – Where might we be going?
Kinder Morgan

Largest pipeline MLP
Largest CO₂ transporter
Largest independent owner/operator of terminals and products pipelines
The Past


**CO₂ Sources**

- **CO₂ from natural underground sources**
- **CO₂ from anthropogenic (man-made) sources**

Technology has provided the means for two distinct sources of CO₂ for EOR use.

**CO₂n**

Leading to significant regional market development.

**CO₂a**

Limited to those specific industrial processes where economic.
While CO$_2$a is important in some markets, CO$_2$n is THE baseload upon which most EOR relies.
Permian Basin

- 2006 was record year (~27 million tonnes)
- Permian Basin Demand expected to increase

Domestic EOR

- Industry CO2 EOR activity is increasing
- CO2n sources are being expanded to ultimate capacity
- CO2a sources supplied 7 million tonnes in 2005
- Additional supplies exist:
  - Gasification, Ethylene, Ethylene Oxide, Steam-Methane Reformer, Ammonia & Ethanol facilities
- Several regions have potential including:
  - Gulf Coast, California, Mid-continent, Canada

1000 MMcf/d ~ 19 million tonnes/yr

Sources: KM estimates, Oil and Gas Journal, EIA, XOM, Dakota Gasification, DRI
CO₂ – Cumulative Energy Impact

CUMULATIVE PERMIAN BASIN AND U.S. CO₂ EOR PRODUCTION - FROM ONSET (1974) TO JAN '06

In 2006 236,000 BOPD of CO₂ EOR were produced in the U.S.
The Present
How to Create a CCS Company Today

• Assuming you have decided not to become a not-for-profit entity:
  – 1) Find a fair size oil field with residual oil
  – 2) Find an inexpensive CO$_2$ source
    • Generally an underground natural source of high CO$_2$ content natural gas (although could be a gasifier)
  – 3) Connect them with a pipeline

• Without sufficient tax incentives or carbon constraints and a regulatory framework there is not a profitable CCS business model that includes actually injecting the CO$_2$ into the ground (other than activities already underway)
Economic CO₂ Price

• The economic CO₂ price is whatever price makes the project economic
• For 25 years, that price has been 3% - 4% of oil price, i.e.
  – If the oil price is $100/bbl, then the delivered price of CO₂ must be less than $3 - $4 per mcf ($58 – $77 per tonne)
• All the capital and expense costs have scaled with oil price over this period.
• Oil producers will only contract for CO₂ at prices less than 3% - 4% of their perceived long term oil price
• Today CO₂ prices need to be below $29 – $38 per tonne (based on $50 per bbl)
CCS is not impossible, but why would a Power Company Commit the Capital?

Comparison of CO₂ Capture Costs to Economic CO₂ Price Targets

Since the cost estimates were prepared, many cost factors doubled.

The capture costs do not include transportation which could add $10 per tonne (or more).

Capture costs based on IPCC Special Report on CO₂ Capture and Storage. The cost estimates were prepared between 2003 – 2005. '07 Target based on $50/BO. '03 – '05 Target based on historic oil prices.
Transportation Costs

- Pipeline costs decrease with larger volumes

- Pipeline costs increase above these values in heavily populated areas and areas with obstacles like mountains, rivers, or freeways

- Critical Issue: Impurities. The addition of H$_2$S above 200 ppm would increase costs and introduce safety concerns

After Figure 4.5 IPCC Special Report on Carbon Dioxide Capture and Storage
Will we try to chase our tail?

- We tend to make cost estimates for CO$_2$ capture with one set of energy and capital cost expectations and try to apply them to a different cost environment.
- Higher energy prices increase the demand for CO$_2$, but also increase the cost to supply it.
- We may need greater government action than we think.
- Government action is probably coming – but when and to what extent?
- Let’s assume it comes and is effective, what next.
The Future
The Future

1. Depleted Oil and Gas Reservoirs
2. Use of CO$_2$ in enhanced oil recovery (EOR) and enhanced natural gas recovery (ENGR) – revenue opportunities
3. Deep saline formations
   a. offshore  b. onshore
4. Use of CO$_2$ in enhanced coal bed methane recovery – revenue opportunity

Direct storage in ocean also an option, but politically problematic

Source: IPPC (2005)
Step 1: Get it.

Step 2: Move it.

Step 3: Store/Use it

Step 4: Control it

CCS Dynamics

Carbon Capture

Transportation Infrastructure

Storage

EOR Site

Storage Site

Meter/ Monitor & Measure

Political/Policy

Economic

Legal

Environment

Health Safety

Commercial
KM CO₂ Opportunities

KM CO₂ core competencies are of value in a carbon constrained environment. KM CO₂ has and can have position in each of 3 major segments in the CO₂ Value Chain.

- Producing/ handling CO₂
- P/L construction & operation
- CO₂ distribution/ logistics
- CO₂ systems
- EOR: injection, wellhead, field management

**Upstream Services**
- CO₂ marketing and sales
- Compression services
- Emissions Credit reporting

**Pipeline & Logistics Services**
- Construct pipelines
- Develop other necessary infrastructure
- Distribution management

**Injection/ Field Management**
- Handle all field injection and overall field management for storage only.
- Provide verification
- Manage EC transactions
CO₂’s Impact on the Environment: Seven Slices of the Stabilization Wedge

Each Wedge is 25 Gt C avoided
Total is 175 Gt C avoided

Efficiency
Fuel Switching
CO₂ Sequestration
Nuclear
Wind
Solar
Natural Sinks

After Socolow 2003
Permian Basin/North Sea Comparison

~ 1000 KM

Colorado
New Mexico
Texas
Mexico

Cortez PL
Bravo PL
CRC PL
CBPL PL

Norway
Scotland
Denmark
England
Germany
North Sea
The Future?

Existing and new CO2 infrastructure serving CO₂ EOR and storage needs.

- Significant EOR potential
- 2 - 3 bcf/d
  (40 – 60 million metric tonnes per year)

All politics is local.
Thank You

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