An Update on Market Mechanisms for CO2: Issues and Opportunities

SECA 2008

Michael E. Moore
VP External Affairs
and Business Development CCS

Pittsburgh, PA

August 5, 2008

BlueSource™

CO_2 Markets

BlueSource™

Two Markets for Same Molecule

Commodity CO_2 for use in Enhanced Oil Recovery in the US and Globally

Sequestered CO_2 or Greenhouse Gas and resulting tradable offsets

Carbon Capture Storage (CCS) can readily optimize values from both markets

BlueSource™

CO_2 EOR

Use of CO_2 for third step or tertiary recovery of oil in mature fields

Ongoing in West Texas last 35 yrs-well understood
1 billionth bbl produced this way December 2006

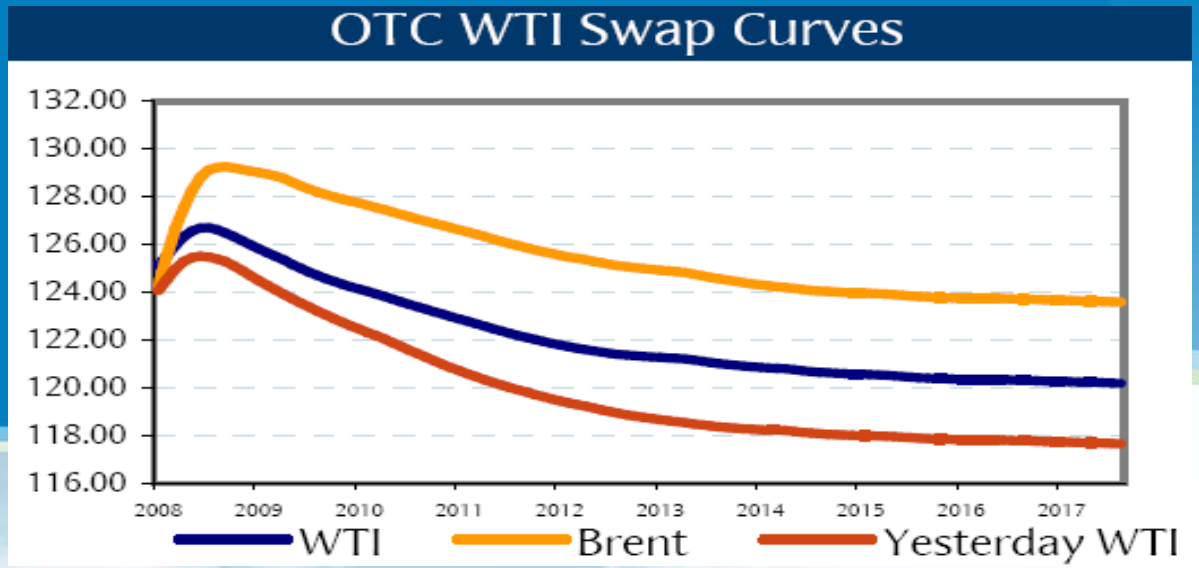
Exxon, Kinder Morgan, Chevron, Marathon, Apache, Anadarko, BP, Conoco-Phillips, EnCana, Oxy, Shell, Sandridge, Trinity, Ranger, CORE Energy and Chaparral all engaged in addition to Denbury

- North America currently produces ~250,000 bbl/d this way
- 89 billion bbls identified as potentially recoverable in US alone
- Current shortage of CO_2 makes expansion problematic and $120/bbl oil makes CO_2 valuable
- Hence massive commercial value today

BlueSource™

Brent and WTI forward Swap/Price Curve

August 1, 2008 Barclays daily market report



10 year WTI/Brent Oil price ~$122.00/bbl. Value of CO_2 created by oil price.
In US rule of thumb: 1000 cubic ft of CO_2 is valued as 2.0% of bbl of oil value.
(Note: Rising EPC costs are lowering % rule of thumb)

$122. X 2.0% = 2.44/mcf, hence
Implied value delivered to wellhead: 19.3 X 2.44 = $47.10/US ton.

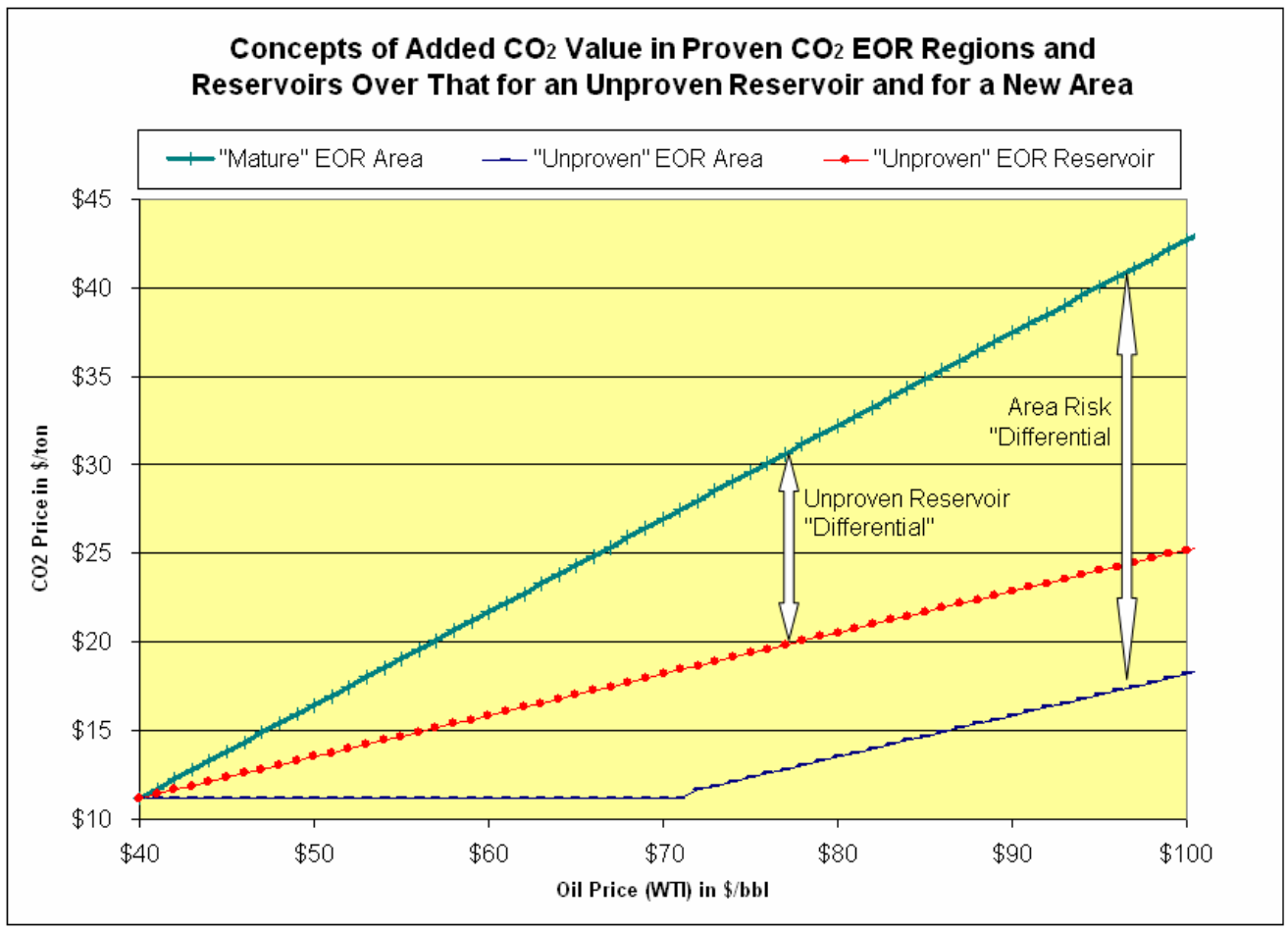
One US ton (19,300 cubic feet) will produce ~2.5 bbls of oil

Crude oil quality, field characteristics, distance to/from markets and EPA definition will influence ultimate CO_2 value

Blue Source™

Physical CO_2 Pricing Matrix

Source: Steve Melzer-Melzer Consulting



BlueSource™

DOE-ARI US Oil Basin Assessments

OUTLOOK FOR CO_2-EOR

Recently completed "basin studies" of applying "state-of-the-art" CO_2-EOR in the U.S. indicate:

- Nearly 89 billion barrels of technically recoverable resource,
- From 4 to 47 billion barrels of economically recoverable resource.

Results are based on applying streamline reservoir simulation to 1,581 large oil reservoirs (two thirds of U.S. oil production).

Available on the U.S. DOE web site.
http://www.fe.doe.gov/programs/oilgas/eor/Ten_Basin-Oriented_CO2-EOR_Assessments.html

Advanced Resources International

BlueSource™

Geologic Sequestration

Expected to manage massive amounts of CO_2 output starting next decade

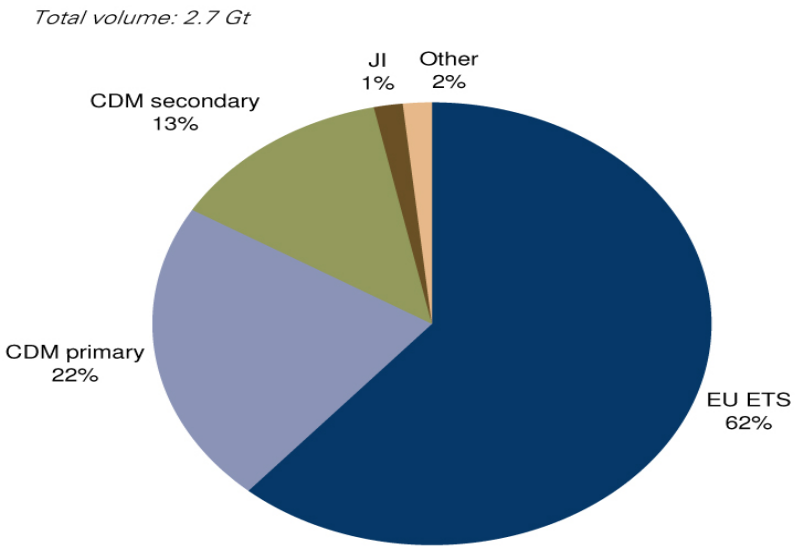
- **Massive research work underway**
- **Most oil fields overlay target/desirable storage medium-brine aquifers**
- **No commercial value to date**

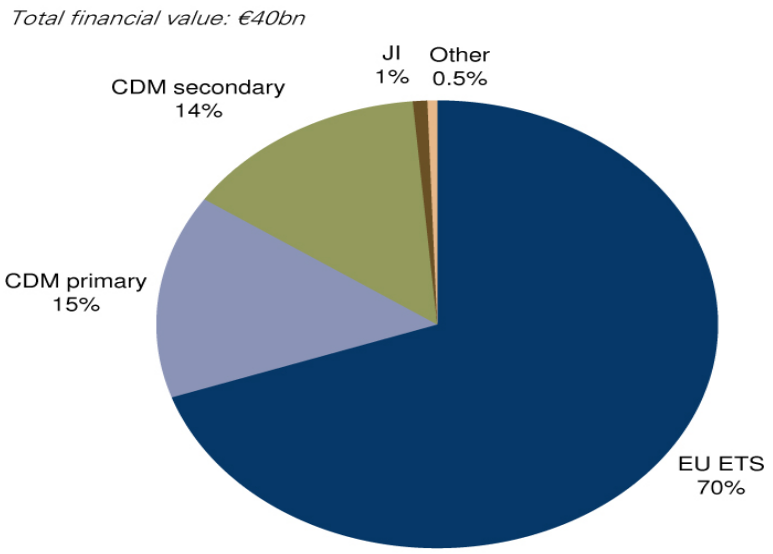
BlueSource™

Kyoto Market Size 2007 40 bln euros

Still dominated by the EU ETS

Distribution of 2007 traded volume (left) and financial value (right) across the main market segments.





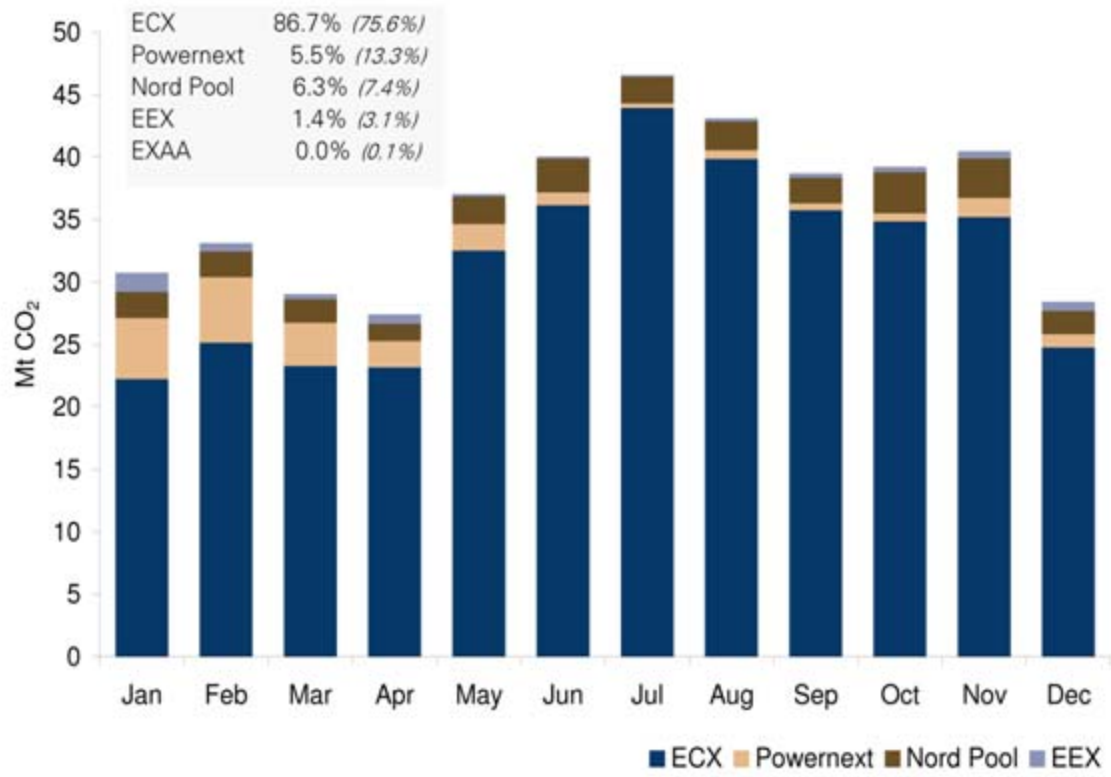
PointCarbon™

Source: *Carbon 2008*, "Post-2012 is now": Figure 2.2, page 4, 11 March 2008

BlueSource™

European Exchanges 2007

Monthly EUA volumes transacted on exchanges. Last year's figures in parentheses.



PointCarbon

Source: *Carbon 2008*, "Post-2012 is now": Figure 2.4, page 6, 11 March 2008

BlueSource™

GHG Credits: EUA vs. US CCX 2008 values $33.20/tn vs. $3.90/tn

Intl CERs-$27.19/tn vs. US VERs $5-8/tn

Source: August 1, 2008 Point Carbon (www.pointcarbon.com) and August 2008 Chicago Climate Exchange
Note: August 1 Euro/Dollar rate 1.5567

Point Carbon EUA OTC assessment (EUR/t)

01 Aug 08
DEC 2008
€21.33 -0.67

Last 30 days

Methodology »
Historic prices »
Carbon Market Daily »

Point Carbon Secondary CER OTC assessment

	Date	Low	High
DEC 2008	01 Aug 08	17.30	17.40

Carbon Financial Instruments - Aug 2008*

Product	Vintage	High	Low	Close	Change	Volume
CFI	2003	$3.95	$3.90	$3.90	-0.05	1,500
CFI	2004	$3.95	$3.90	$3.90	-0.05	6,000
CFI	2005	$3.95	$3.85	$3.85	-0.10	4,100
CFI	2006	$3.95	$3.85	$3.95	0.05	8,600
CFI	2007	$3.85	$3.85	$3.85	-0.10	100
CFI	2008	-	-	$3.90	-0.05	0
CFI	2009	-	-	$3.95	-	0
CFI	2010	-	-	$3.95	-	0
Total Electronically Traded Volume						20,300

Price Units: Per metric ton of CO_2
Volume: Electronically traded volume reported in metric tons CO_2
Change based on previous month's closing price

* - This report is based on trading through08/01/2008

http://www.chicagoclimatex.com/market/data/monthly.jsf

BlueSource™

Western Climate Initiative: Post 2012

http://www.westernclimateinitiative.org/index.cfm

The Western Climate Initiative is a collaboration which was launched in February 2007 by the Governors of Arizona, California, New Mexico, Oregon and Washington to develop regional strategies to address climate change. WCI is identifying, evaluating and implementing collective and cooperative ways to reduce greenhouse gases in the region. In the spring of 2007, the Governor of Utah and the Premiers of British Columbia and Manitoba joined the Initiative. Montana joined in January, 2008 and Quebec moved from Observer to Partner status in April, 2008. Other US and Mexican states and Canadian provinces have joined as observers.

July 23, 2008 WCI announces Draft Design Recommendations and Draft Essential Requirements for Reporting.

BlueSource™

Cross Commodity Pricing

In Europe: Coal, fuel oil, gasoline, jet fuel, electricity and natural gas all have carbon figured into their valuations.

In the US only recently has the expected impact of carbon pricing begun to show up in energy pricing

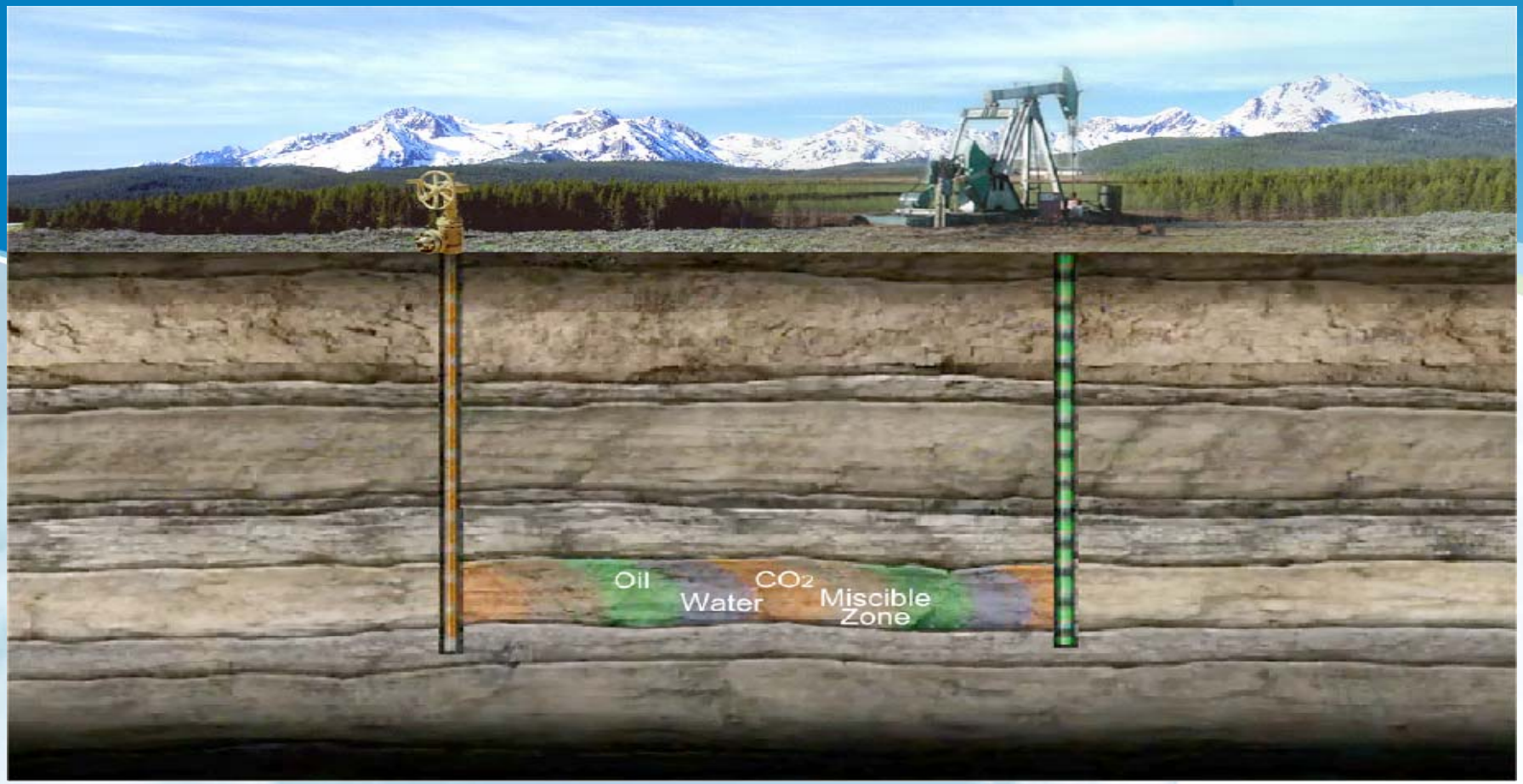
This impacts expected project economics and has had massive Implications in the US

BlueSource™

Mediums

Blue Source™

CO_2-Enhanced Oil Recover (EOR)



Graphic courtesy of
USDOE National Energy
Technology Laboratory

BlueSource™

CO_2 Overview

- **Well understood-but complex**
- **Heavy capitalization**
- **CO_2 shortage hampers increased utilization**
- **Many undeveloped opportunities**
- **Legal and Regulatory issues well covered in states where already implemented—less so in developing areas**
- **Optimizes remaining oil in mature fields**
- **Creates shareholder, local, state and federal wealth**
- **Supports infrastructure costs/builds for sequestration**

BlueSource™

Carbon Dioxide Sequestration in Deep Brine Aquifers

Geologic sequestration in brine aquifers most likely route

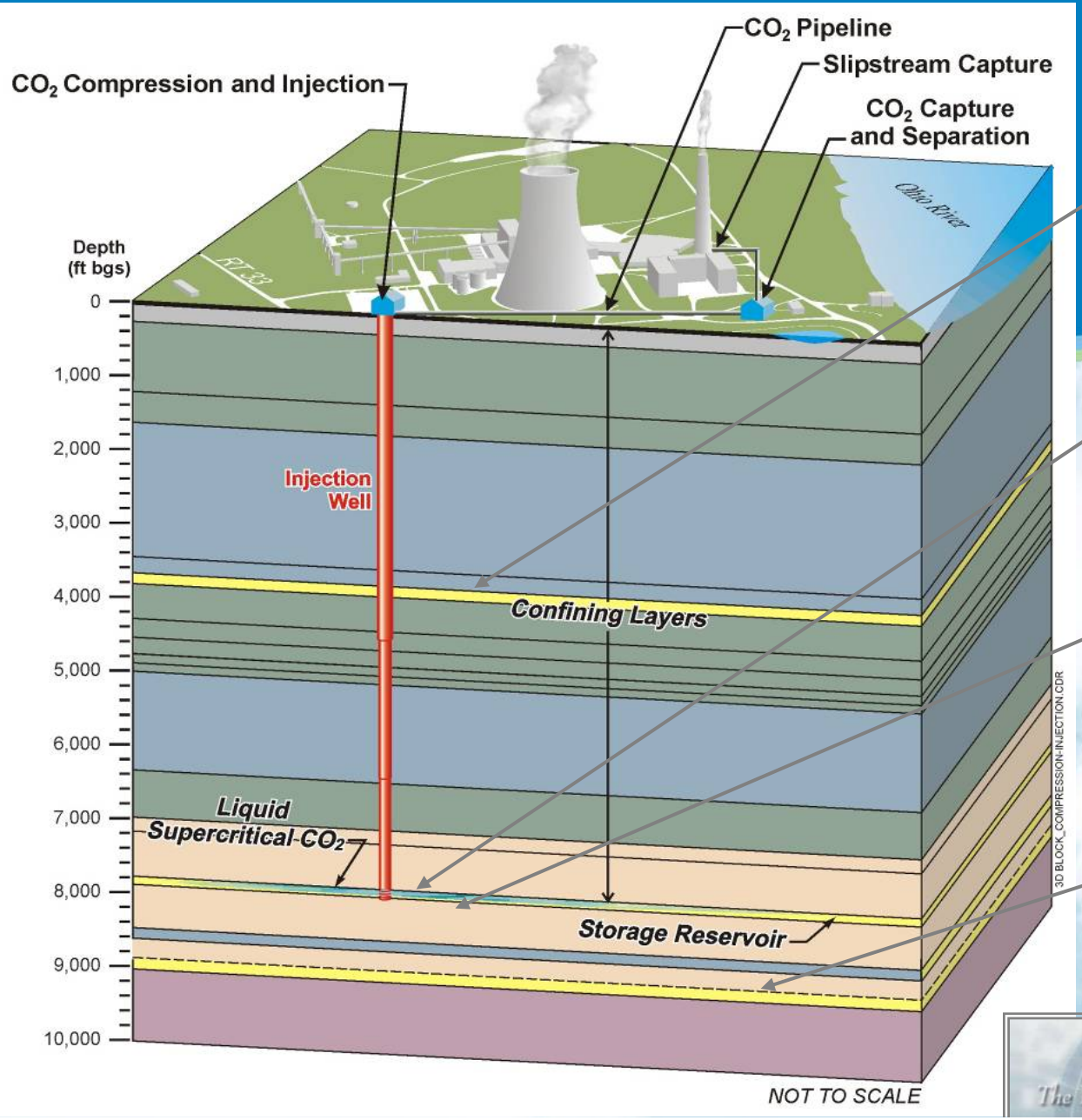
Massive carrying capacity

Research underway globally – nominal commercial development

- **Scope of subsurface impacted areas substantial**
- **Ownership issues of pore space diverse or undefined**
- **Ownership in turn defines short and long term costs, obligations and liabilities**
- **Public acceptance problematic**
- **Regulatory process nascent**

BlueSource™

CO_2 Injectivity at Mountaineer



CO_2 injection should also be possible in shallower sandstone and carbonate layers in the region

Rose Run Sandstone (~7800 feet) is a regional candidate zone in Appalachian Basin

A high permeability zone called the “B zone” within Copper Ridge Dolomite has been identified as a new injection zone in the region

Mount Simon Sandstone/Basal Sand - the most prominent reservoir in most of the Midwest but not desirable beneath Mountaineer site

BlueSource™

Battelle
The Business of Innovation

Additional Mediums

Unminable Coal Seams and ECBM

Depleted Natural Gas Reservoirs and EGR

Mineralization and Carbonization

Deep Sea Sediments

Feedstock for Added Value Products

BlueSource™

NETL Seven Regional Partnerships

http://www.netl.doe.gov/technologies/carbon_seq/partnerships/links.html

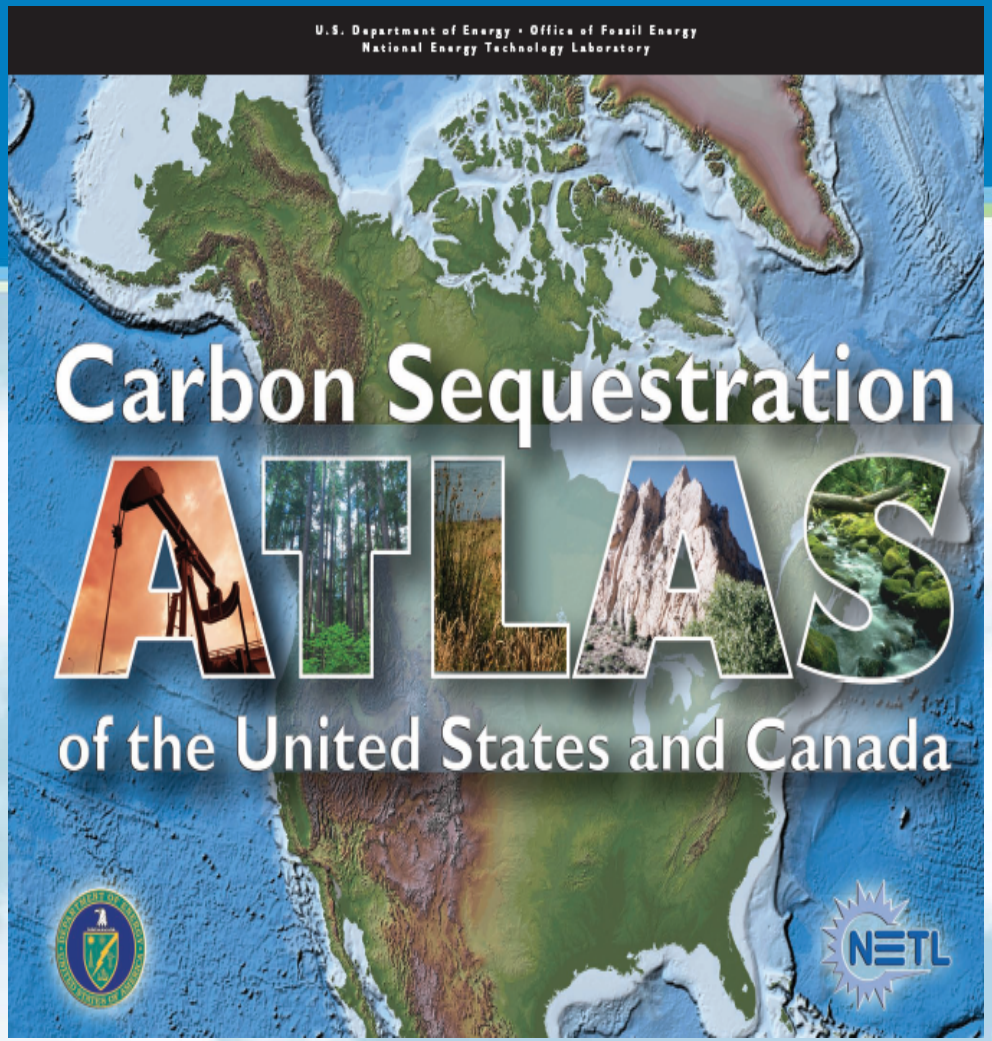
BIGSKYCARBON SEQUESTRATION PARTNERSHIP	**Montana State University** http://www.bigskyCO2.org/
MGSC	**University of Illinois,** **Illinois State Geological Survey** http://www.sequestration.org/
MRCSP MIDWEST REGIONAL CARBON SEQUESTRATION PARTNERSHIP	**Battelle Memorial Institute** http://www.mrcsp.org
The Plains CO2 Reduction Partnership PCOR	**University of North Dakota,** **Energy & Environmental Research Center** http://www.undeerc.org/pcor/

Southeast Regional Carbon Sequestration Partnership	**Southern States Energy Board** http://www.secarbon.org/
SWP SOUTHWEST PARTNERSHIP CO2 SEQUESTRATION	**New Mexico Institute of** **Mining and Technology** http://www.southwestcarbonpartnership.org/
WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP westcarb.org	**California Energy Commission** http://www.westcarb.org/

BlueSource™

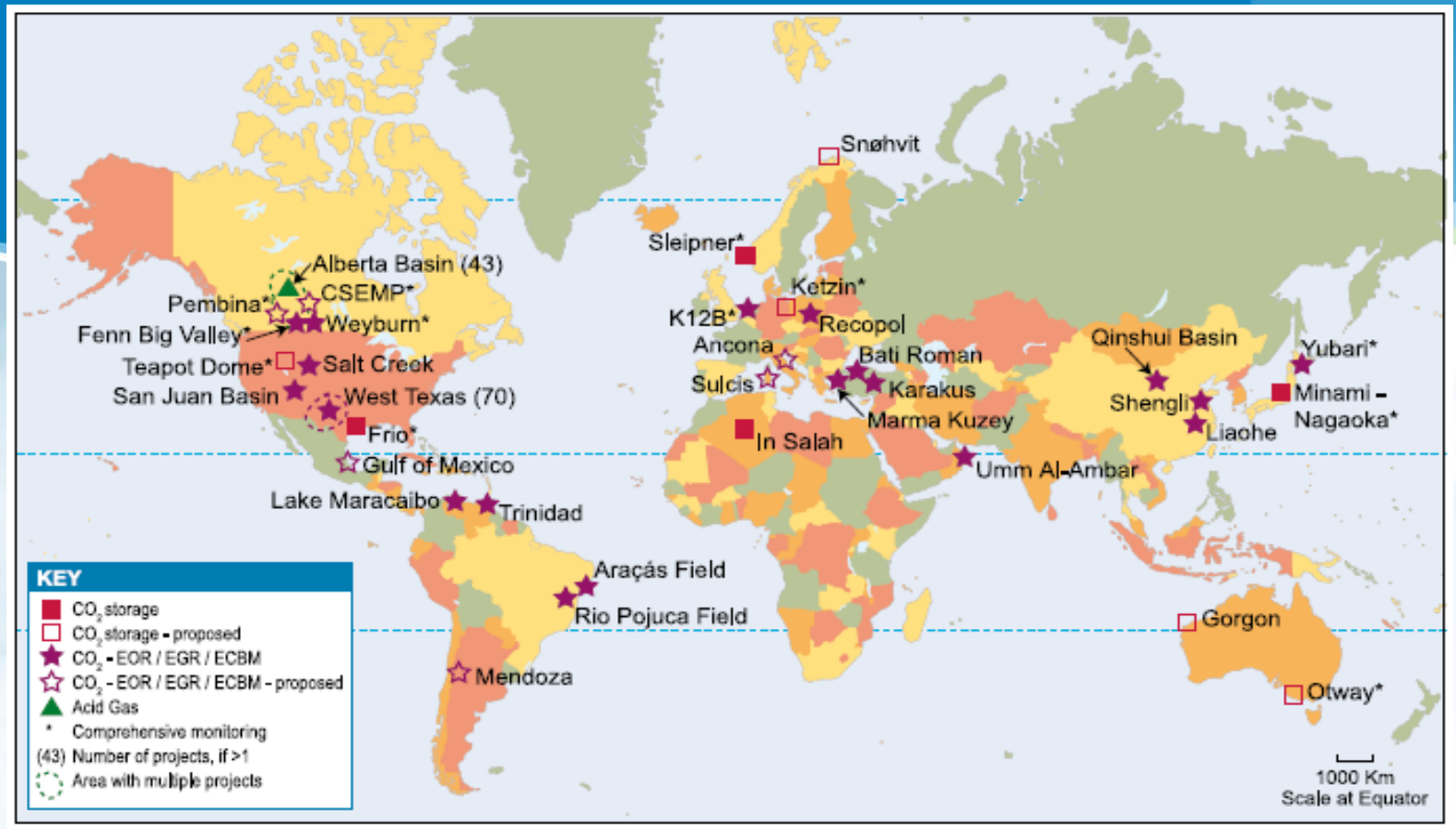
DOE National Sequestration “Atlas” Released 2007

http://www.netl.doe.gov/publications/carbon_seq/atlas/index.html



Blue Source™

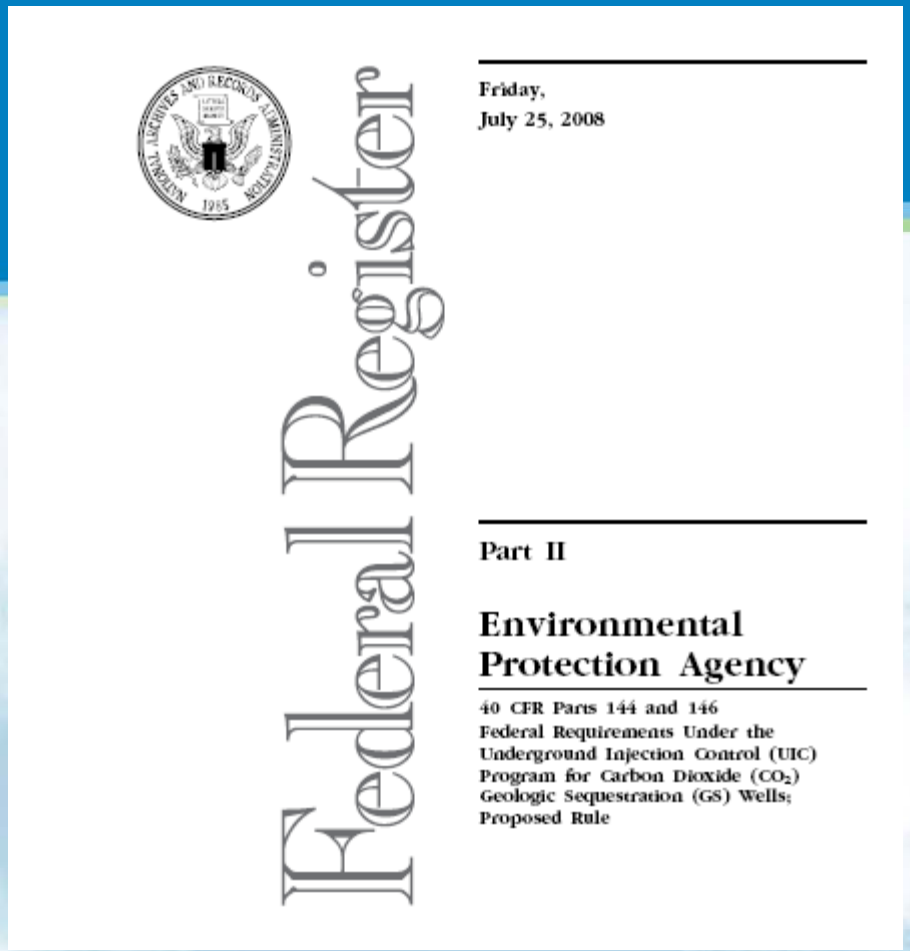
Global CCS-Geologic Sequestration Efforts Extensive



Special Report on Carbon Dioxide Capture and Storage pge 198 fig. 5.1
http://www.ipcc.ch/activity/srccs/SRCCS_Chapter5.pdf

Blue Source™

EPA Geologic Sequestration Guidelines



Federal Register

Friday,
July 25, 2008

Part II

Environmental Protection Agency

40 CFR Parts 144 and 146
Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells; Proposed Rule

BlueSource™

NRDC "Win – Win" CO_2 EOR and Geologic Sequestration

EnergyFacts

Tapping into Stranded Domestic Oil: Enhanced Oil Recovery with Carbon Dioxide Is a Win-Win-Win

Americans are demanding measures that will relieve the pain they are feeling at the pump today. The country has a significant, untapped win-win-win opportunity to stimulate our economy and reduce our dependence on imported oil while actually helping to protect wild places and reduce global warming pollution: a process known as carbon dioxide enhanced oil recovery (CO_2-EOR). According to industry research CO_2-EOR would give America access to large, domestic oil resources—potentially more than four times the proven U.S. reserves, or up to 10 full years of our total national consumption. But without the stimulus of climate protection legislation, CO_2 for oil recovery is likely to remain in short supply and most of this domestic oil resource will stay in the ground.

For more information, please contact
George Peridas at
(415) 875-6181.

NRDC

www.nrdc.org/policy

July 2008

CO_2-EOR Can Produce More Oil Right Now

Enhanced oil recovery using carbon dioxide offers an immediate- to medium-term opportunity to produce more oil right here at home, from mature fields that have already been drilled and have much of the needed infrastructure already in place. CO_2 injection can increase oil production in as little as a few months to two years—a fraction of the time needed to discover, further explore, and develop a viable new oil field. And in the EOR process, large quantities of CO_2 from industrial sources can be sequestered underground rather than emitted to the atmosphere, reducing global warming pollution.

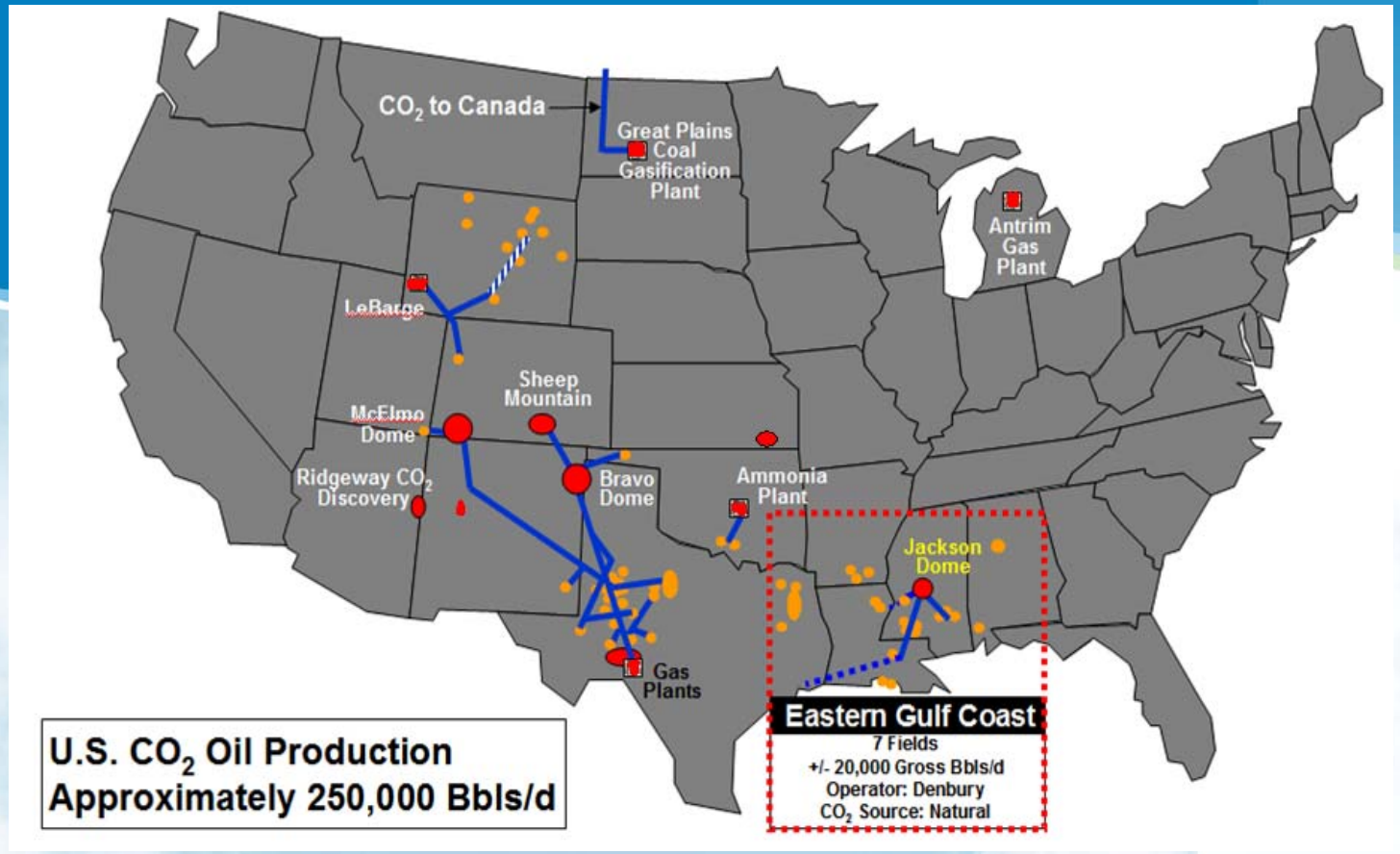
"Stranded oil" is oil that is left in the reservoir after conventional recovery techniques have been completed. Injecting CO_2 mobilizes the stranded oil, driving it to the wellbore and making it recoverable. This CO_2 "flooding" used for enhanced oil recovery can result in a recovery of up to 20 percent more of the original oil in place. Nationally, a massive 400 billion barrels of oil remains stranded, of which 85 billion barrels could be technically recoverable according to oil and gas industry research and consulting firm Advanced Resources International.[1] As much as 45 billion barrels of "stranded oil" from just over 1,000 existing fields would be economical to produce at a price equal to $70 per barrel.

BlueSource™

Locations

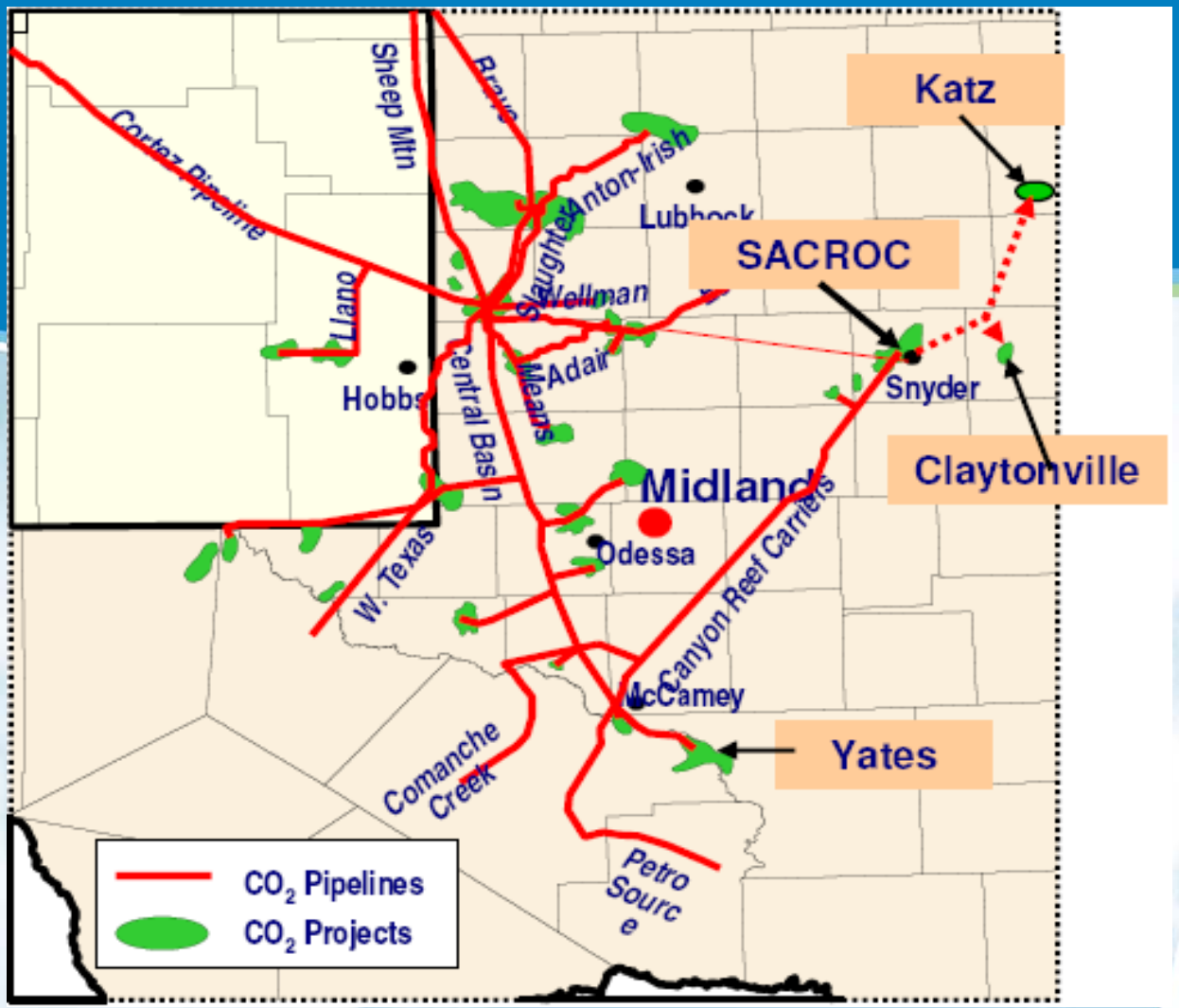
Blue Source™

US CO_2 Systems



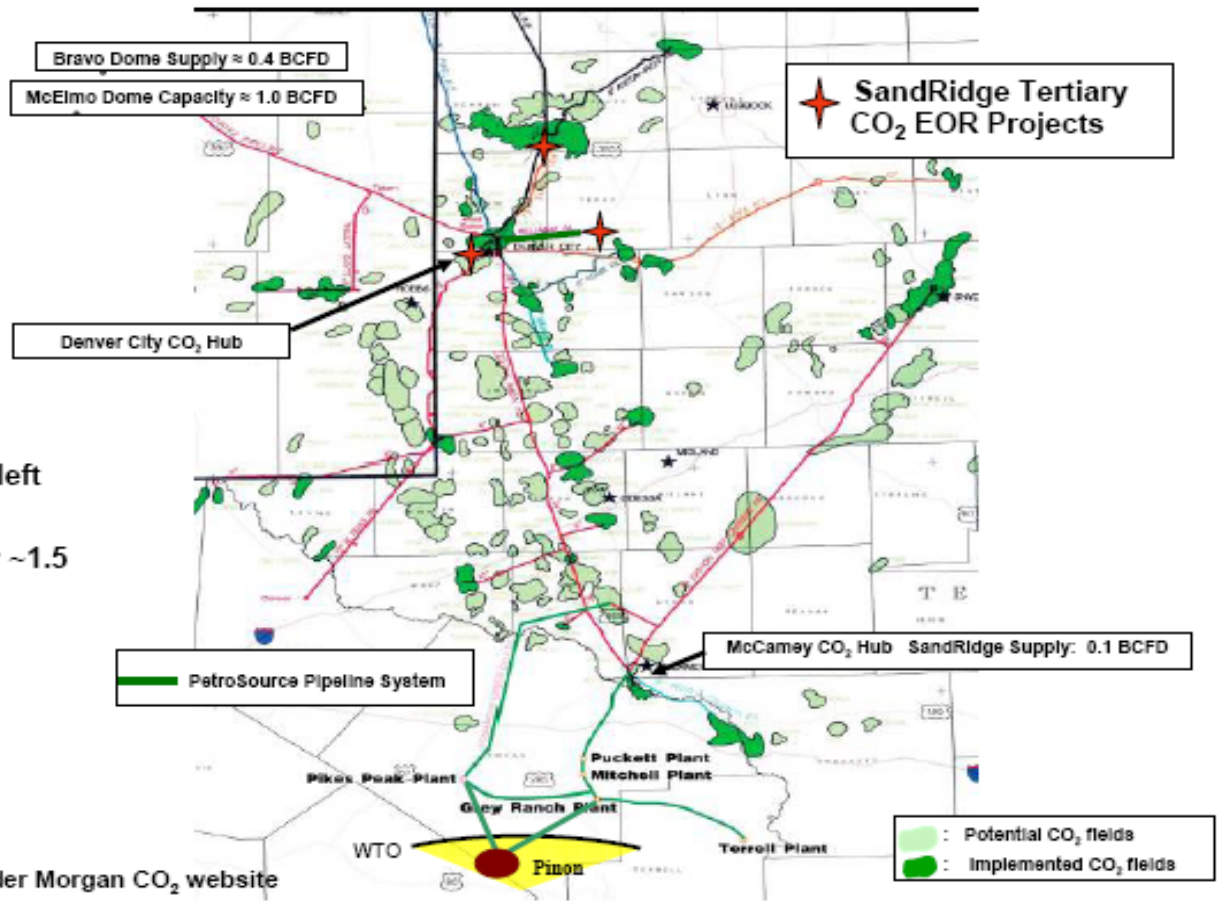
BlueSource™

Permian Expansion



Blue Source™

PERMIAN BASIN CO_2 INFRASTRUCTURE



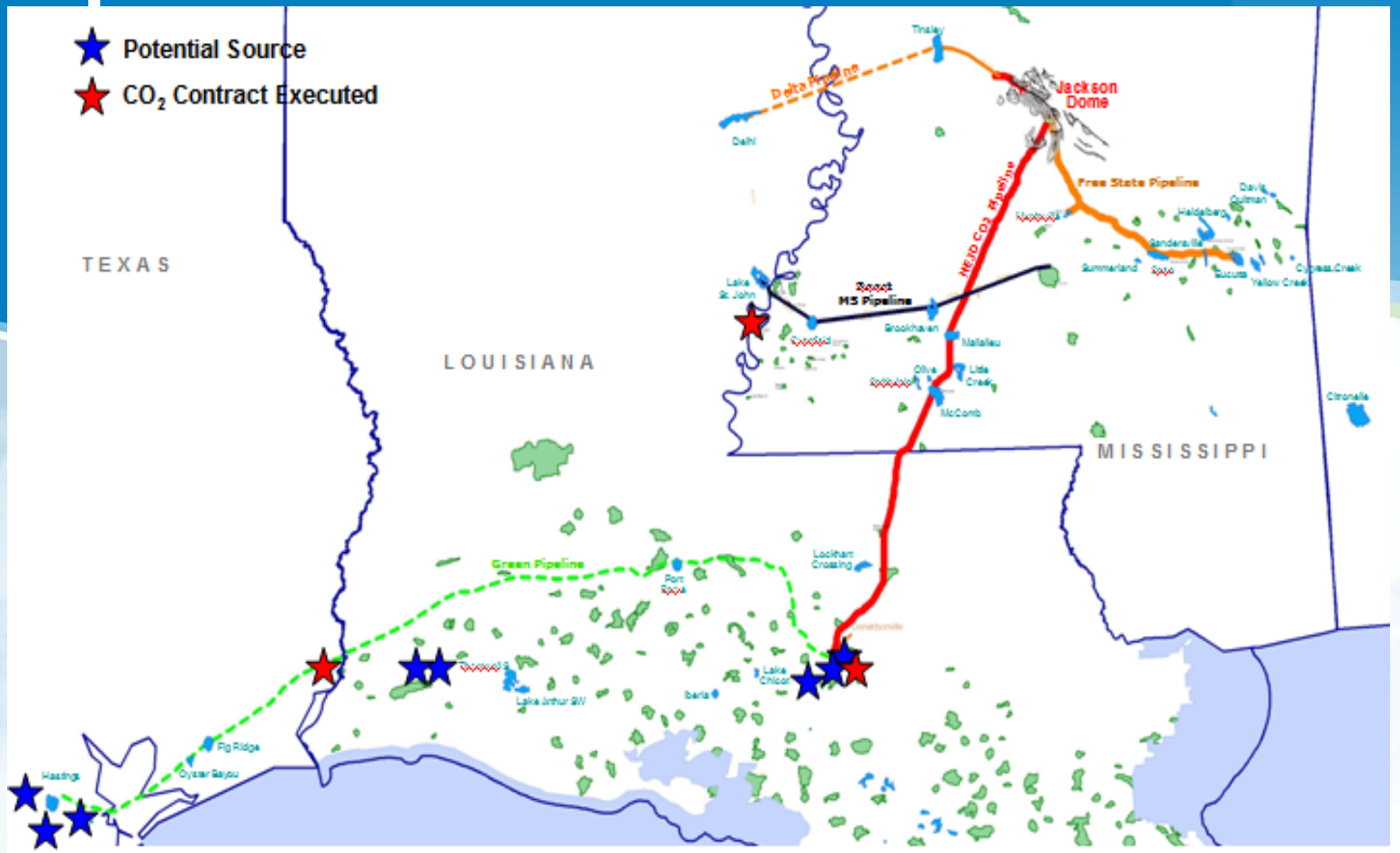
Key Considerations:

- Significant EOR projects left to implement
- Current CO_2 deliverability ~1.5 Bcfepd

* Kinder Morgan CO_2 website

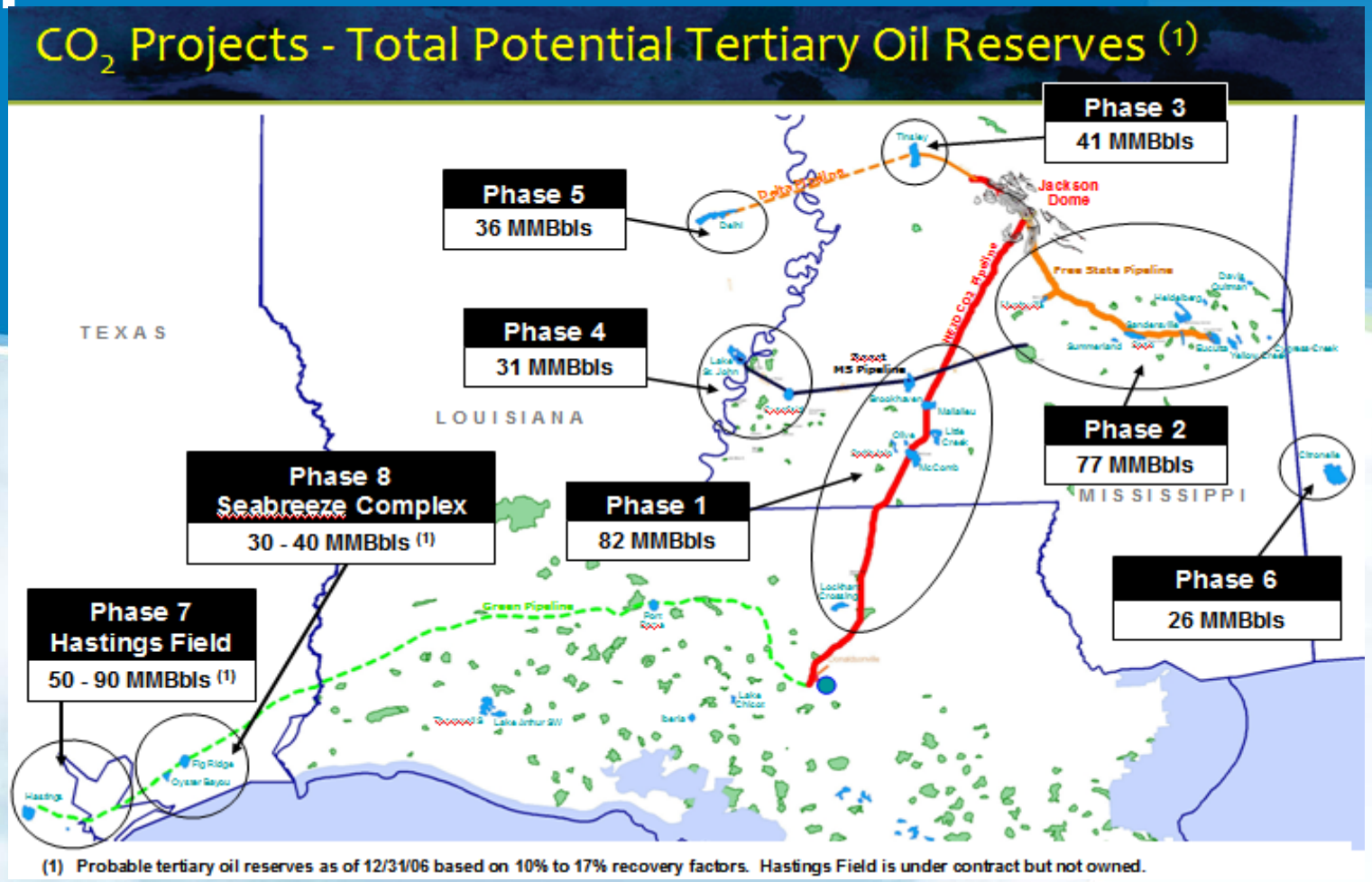
BlueSource™

New CO_2 Source: Denbury's Perspective



BlueSource™

CO_2 EOR-Sequestration: Denbury's Perspective



(1) Probable tertiary oil reserves as of 12/31/06 based on 10% to 17% recovery factors. Hastings Field is under contract but not owned.

BlueSource™

Texas

Western- Permian Basin-well developed

Eastern - currently being "explored" for CO_2 -EOR options and opportunities ie: Exxon-Mobil and Eastman Chemicals

Gulf Coast - currently being "explored" for CO_2 -EOR options and opportunities ie: Denbury's "GreenLine" to Hastings, DOW-Hunton at Freeport, Kinder Morgan, NRG and Eastman Chemicals

BlueSource™

CO_2 Market Analogs

Exxon CO_2 sales to Anadarko etc +250mmcfd – ongoing

PetroSource CO_2 Sandridge + OXY participation

Coffeyville CO_2 sales to Kansas and Oklahoma EOR operators + 2000 tpd – in negotiations

Basin Electric/Dakota Gasification CO_2 sales to Encana +225 mmcfd

- **Illinois – Tenaska - in negotiations, Power Holdings - Kinder Morgan**
- **Kentucky – Cash Creek - ?**
- **Michigan – DTE-CORE Energy – ongoing local Michigan CO_2 EOR**
- **Indiana – Duke's Edwardsport– CO_2 in negotiations**
- **California – Hydrogen Energy CO_2 to be utilized by OXY at Elk Hills**
- **Oklahoma – AEP– SemGroup's "SemGreen" contracted for CO_2**

- **Enhance Energy to build Alberta pipeline loop --in development**

- **Spectra Pipelines working on CO_2 pipeline feasibility in BC**
- **Atmos Energy and El Paso working on CO_2 pipeline-EOR options**

BlueSource™

Texas's Interest In CO_2-EOR

1973 Texas Produced 3,444,000 bbl/d

2006 Texas Produced 934,000 bbl/day

2007 Texas By CO_2-EOR ~200,000 bbl/day

BlueSource™

Texas HB 3732

CCS Incentives and Legislation: The State of Texas has since 1989 had in place an *EOR Severance Tax Incentive* scheme ensuring a reduced tax rate (2.3% on the market value of oil) for the first 10 years of CO_2 -EOR production. This is one-half of the standard rate. Recently the Legislature also adopted an *Advanced Clean Energy and EOR Tax Reduction* Bill (effective from September 1, 2007) which reduced the effective tax rate for use of anthropogenic CO_2 to 1.15% for the first 7 years of CO_2 -EOR production.

- The HB 3732 includes, i) recognition of CCS with EOR as a "qualifier" for Clean Energy, ii) provides severance tax reductions for anthropogenic CO_2-EOR projects, and iii) provides Ad Valorem Tax Abatement for CO_2 capture (see also HB 1967 – covering open access through CO_2 pipelines).
- Furthermore, to encourage the development of advanced clean energy projects in an environmentally protective manner the *State Energy Conservation Office (SECO)* is charged with making grant awards and loan guarantees totaling $20 and $10 million respectively on a bi-annual basis through to 2020. The SECO can finance up to 50% of the total amount invested by industry.
- Finally, the Texas FutureGen consortium led by the *Bureau of Economic Geology* and the *Texas Railroad Commission* has set a precedence that the State may take on longer-term ownership and liability of the CO_2, independent of future EPA rulings possibly defining CO_2 as pollutant.

BlueSource™

The Texas Carbon Capture and Storage Association ("TxCCSA")

is a non-profit industry association advocating for policies that support the development of a commercial CCS industry in Texas and promoting energy security through increasing environmentally responsible fuel production in Texas. We seek the growth and commercialization of the CCS industry through market-based policies and incentives that support private sector investment.

Goals

- **Promote market-based policies that recognize the practical and economic benefits of CCS.**
- **Educate state and local stakeholders regarding the CCS industry, including CO_2 for enhanced oil recovery (EOR) and its national security and environmental benefits.**
- **Promote practices, programs and policies that position Texas in the forefront of clean energy and energy security efforts.**
- **Promote the development of CO_2 storage and injection methods that contribute to recovering oil in place from existing oil and gas reservoirs.**
- **Recognize geological storage of CO_2 as an acceptable emissions reductions methodology that has national security (as related to energy independence) as well as environmental benefits.**
- **Work to endorse CO_2 for EOR as a CCS activity under existing and future regulatory protocols.**
- **Identify business spin-offs and promote policies that attract foreign and new market-based CCS business opportunities to Texas.**
- **Inform members about policy, legal, regulatory and technical developments related to CCS through information sharing and analysis.**
- **Work closely with sources and users of coal, chemical companies, refineries, manufacturing, and producers, transporters and users of CO_2, to develop CCS technology and practices.**
- **Work closely with legislators, state agencies and state officials on policies that promote CCS and energy independence.**
- **Develop and promote adoption of a voluntary CCS certification and permitting program through the Texas Railroad Commission and Texas Commission on Environmental Quality.**

- ***www.txccsa.org***

BlueSource™

North American Carbon Capture Storage Association (NACCSA)

Carbon Capture and Storage (CCS) is driven by growing interest in managing carbon dioxide emissions, and to date it is considered to be one of the most important options in a portfolio of technologies that could be used in CO_2 management. The NACCSA and its members will work to educate stakeholders in the United States and Canada about the technological readiness of CCS with the goal of helping to create a framework that supports the development of a CCS industry, including CO_2-EOR where those opportunities exist. The association will also work closely with its members to inform them about policy, legal, regulatory and technical developments related to CCS through information sharing and analysis.

- **"The NACCSA will fill a critical need for cross-industry information and policy in the on-going Carbon Capture and Storage discussion," said Elizabeth "Libby" Cheney who serves as the NACCSA Chairperson from Shell Oil Company.**
- **"We have a strong commitment to the development of a commercial CCS industry from each of the current members and we welcome new companies to join us in our efforts," said John Tombari association Vice-Chairperson, from Schlumberger.**
- **About the North American Carbon Capture & Storage Association**
  Founded in September 2007, the non-profit North American Carbon Capture & Storage Association ("NACCSA") supports the development of a commercial CCS industry in the United States and Canada.

- **On October 24, 2007, the North American Carbon Capture & Storage Association was launched. Alston & Bird has the privilege of serving as counsel to the Association.**

BlueSource™

Blue Source Overview

Blue Source™

Blue Source Market Position

Overview

The company's senior management developed, constructed and/or operated 5 of the last 6 anthropogenic CO_2 pipelines built in North America in the last 20 years.

Blue Source owns the largest portfolio of Greenhouse Gas (GHG) verified emission reduction credits, or "VERs" in North America.

Blue Source is owned 50/50 by its founders/senior management and First Reserve Corporation - the leading private equity firm specializing in energy.

Blue Source has $1+ billion (equity/debt) investment sources for project development in GHG ERs and CO_2 infrastructure projects.

The company has two primary business segments: a physical CO_2 asset development group and a GHG VER portfolio development group

Blue Source™

Blue Source CO_2 Activities

Develop Infrastructure Linking Sources & Sinks

Sources: Gas treating plants, ethanol plants, gasification projects, including CTL and IGCC power plants, hydrogen plants, cement plants, fertilizer plants and power plants (incl. retrofits)

Sinks: EOR, deep saline aquifers, depleted oil & gas fields, depleted CO_2 reservoirs, and ECBM

Acquisitions – Pipelines and CO_2 producing or storage assets

In service Today – LaVeta gas processing

Focus Project: Coffeyville Resources

~38,000 Mcf (2,000 tonnes/day) of anthropogenic CO_2

Proven, reliable source (PetCoke advantage) since 2003

Project scope includes compression and pipeline(s) to EOR markets

Sequestration alternatives considered

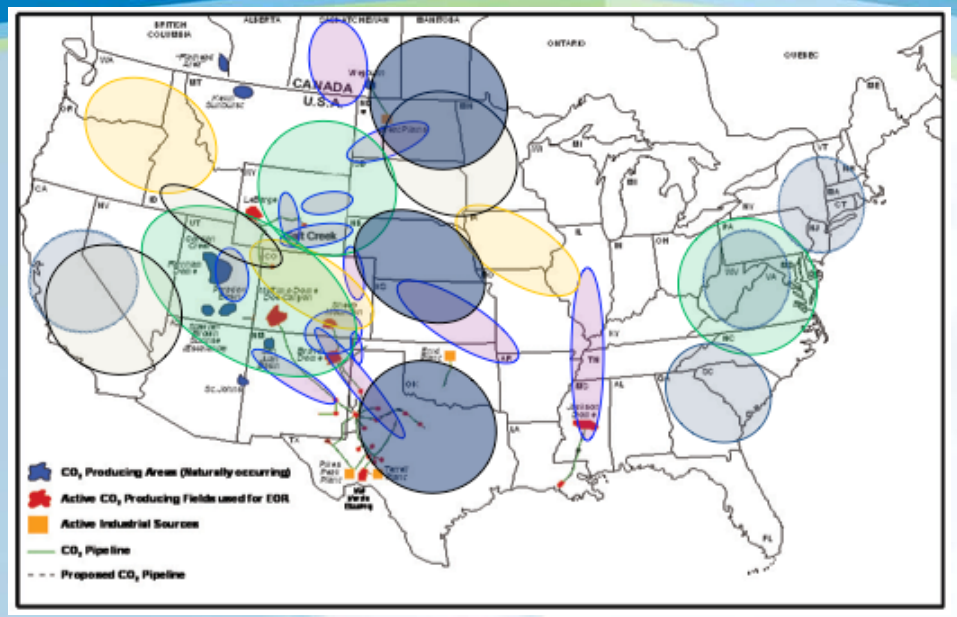
Blue Source is marketing CO_2 and VERs

Blue Source™

Carbon Credit Portfolio

Blue Source's Verified Emission Reduction (VER) portfolio is the largest in North America, with project pipeline including:

- Carbon capture and storage
- Fuel switching
- Industrial gases (N2O, etc.)
- Renewable energy
- Energy efficiency
- Transportation
- Landfill gas
- Coal mine methane
- Wastewater treatment
- Biomass
- Agriculture/Forestry



Blue Source™

CO_2 Pipeline Knowledge & Experience

Pipeline Design Experience

- Land & Underwater
- Critical Specifications (for gas contaminants)

Compression Selection & Specifications

Construction Management Experience

- Worked with pipeline contractors having both land and underwater experience, i.e. Gulf Interstate Pipeline and Antares Offshore

BlueSource™

Contact Information

Michael E. Moore

VP External Affairs and Business Development CCS
Blue Source LLC

VP and member Board of Directors Texas Carbon Capture Storage Association

Member North American Carbon Capture Storage Association

Houston

mem@ghgworks

Tel: 281-668-8475

www.ghgworks.com

Blue Source™