A REGIONAL CONCEPT FOR A CO2 PIPELINE NETWORK

A MIDWEST PROPOSAL AND SOLUTION FROM A STATE VIEW

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“Our Energy Policies have succeeded beyond our expectations”
WHAT WOULD ENABLE A VITABLE MIDWESTERN MARKET

- Multiple plants in multiple states
- Federal, State, and Local incentives
- Defining common objectives
  - i. EPAct 05 Military Fuel Perspective
  - ii. Carbon Sources for Gasification
  - iii. Carbon Credits

A MIDWESTERN STATES MOU (building on the MWGA GHG platform)
Operating & Publicly Announced Gasification Plants in North America

Planned Plants - 67
Operating Plants - 19

Canada 6, 1

SOURCE: NETL
POTENTIAL

• NOT ONLY GASIFICATION BUT ALSO EXISTING ELECTRICITY PRODUCTION INFRASTRUCTURE AS WELL AS NEW PLANTS

• PLUS, ETHANOL PLANTS
“MEN READ MAPS BETTER THAN WOMEN BECAUSE ONLY MEN UNDERSTAND THAT AN INCH CAN EQUAL A HUNDRED MILES”

ROSEANNE BARR
Existing CO2 Pipelines in Relation to Gasification Projects
Extensions and Existing CO2 Pipelines in Relation to Gasification Projects

- Gasification Projects
- Existing CO2 Pipelines
- Extension of Existing CO2 Pipelines
STAGES WHICH WILL LEAD TO SEQUESTRATION FOR CENTURIES

a) EOR – pipeline infrastructure
b) Finish deep injection R&D
   i. Shale
   ii. Coal Seams
   iii. Saline Formations
   iv. Basalt
Extensions and Existing CO2 Pipelines in Relation to Gasification Projects & CO2 EOR Sinks
Extensions and Existing CO2 Pipelines in Relation to Gasification Projects & Basalt/Shale CO2 Sinks
Extensions and Existing CO2 Pipelines in Relation to Gasification Projects & CO2 ECBM Sinks
Extensions and Existing CO2 Pipelines in Relation to Gasification Projects & Saline Aquifer CO2 Sinks
More stages

• Local wells

• Supported by state and federal regulatory framework
Geologic Sequestration Research in Ohio

2000-2003 MIDCARB – Created first regional Internet accessible GIS – maps of prospective “sinks and seals”

2003-2005 – MRCSP Phase I – regional mapping of potential reservoir units and caprocks, including preliminary capacity calculations

2005-2009 – MRCSP Phase II – small scale CO2 injection tests; continuing geologic unit characterization; EOR assessment

2005-2006 – Ohio FutureGen Task Force – great help in focusing Ohio’s need to prepare for a “carbon economy”

2007 – Drilled Ohio CO2 Stratigraphic Test #1 – Tuscarawas County

2007-?? – Assisting industry with sequestration issues

2008-2017 – MRCSP Phase III – large scale, long term, CO2 injection projects; continuing geologic unit characterization
Data was gathered and analyzed from over 85,000 wells (left) to create regional CO2 capacity maps, per formation. To the right is the capacity grid for the Mount Simon Sandstone.

Left – a 3-D view showing saline formations that meet the criteria of 3,000 feet or greater depth and at least 50 feet thick.
Basal Sand Thickness
CO₂ Enhanced Oil Recovery Operations in the U.S.

- **Rockies**
  - 5 Fields – Additional 2 Proposed (Anadarko)
  - 19,520 Gross Bbls/d
  - Operators: Exxon/ Chevron/ Merit
  - CO₂ Source: Natural/ Manufacturing

- **Mid-Continent**
  - 4 Fields
  - 9,800 Gross Bbls/d
  - Operators: Exxon/ Anadarko/ Chaparral
  - CO₂ Source: Manufacturing

- **Permian Basin**
  - 42 Fields
  - 155,000 Gross Bbls/d
  - Operator: Multiple (16)
  - CO₂ Source: Natural

- **Eastern Gulf Coast**
  - 3 Fields
  - 8,500 Gross Bbls/d
  - Operator: Denbury
  - CO₂ Source: Natural

Source: Denbury Resources, Inc., 2004
Geologic Sequestration Trapping Mechanisms

- **Hydrodynamic Trapping:** carbon dioxide can be trapped as a gas under low-permeability cap rock (much like natural gas is stored in gas reservoirs).

- **Solubility trapping:** carbon dioxide can be dissolved into a liquid – water and/or oil

- **Mineral Carbonation:** carbon dioxide can react with the minerals, fluids, and organic matter in the geologic formation to forms stable compounds/minerals; largely calcium, iron, and magnesium carbonates
Major Classes of Geologic CO₂ Storage Reservoirs

1. Deep Saline Formations
2. Enhanced Oil Recovery
3. Unminable Coal Beds

(IEA Greenhouse R&D Programme, 2001)
Synergies are a big factor in planning our energy future
Proposed Biofuel and Coal Gasification Plant Locations

Capacity (millions of gallons)
- Biodiesel plants:
  - 13 - 30
  - 31 - 54
  - 55 - 60
  - 61 - 110
- Ethanol plants:
  - 13 - 30

Power (megawatts)
- Coal Gasification:
  - 300 - 500
  - 501 - 900
  - 901 - 1200
- Denotes plant currently under construction
Landfills are a largely untapped resource in Ohio. Most are simply venting methane and CO2 to the atmosphere.

Locating planned ethanol plants near landfills and using the methane for the boilers is one synergy that could be developed in the near term.
Class 1 Injection Wells w/10 Mile Radius

Future CO2 injection in the same strata must stay far away from these existing large injection operations.

Class I Injection w/10 Mile Radius

Oil Fields
Existing power plants, Class 1 wells and planned fuel and power plants.
Potential CO2 sources and candidate oil & gas field “sinks” (greater than 2,500 feet deep)
Ohio Power Siting Board

East Canton Consolidated and Morrow Consolidated Oil Fields – First up?

Results

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<tr>
<th>Description</th>
<th>Value</th>
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<td>Construction Cost (Million $)</td>
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<td>Total Cost ($/t/Year)</td>
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Pipelines developed to “leapfrog” from one EOR field to the next can eventually be tied together with a line to feed into a large regional gathering system.
“WHAT HAPPENS TO A DREAM DEFERRED?

DOES IT DRY UP LIKE A RAISIN IN THE SUN?...”

LANGSTON HUGHES
WHAT WILL IT TAKE

• Political Will

• Industry Determination

• State and Local support

• Wall Street – Investor Community buy-in and support
THE QUESTION OF LIABILITY

- IT IS PART OF THE PRODUCERS BUSINESS OBLIGATION

- STATES NEED TO DETERMINE A THRESHOLD LEVEL OF FISCAL CONSEQUENCES AT WHICH THE STATE WILL SERVE AS AN INSURANCE AGENT

- FOR CATASTROPHIC (UNLIKELY) INCIDENTS THE FEDERAL GOVERNMENT NEEDS TO PROVIDE INSURANCE PROTECTION; JUST LIKE THE RE-INSURANCE INDUSTRY
Ohio Power Siting Board

OHIO HOUSE BILL 487

Another take on the subject of liability

H.B. 487 contains among other provisions a new section addressing CO2 and CCR. New proposed section 1572.03 (F) states that…..

“the ownership of the storage facility shall transfer to this state….

upon transfer of ownership, the storage operator, and any generator of carbon dioxide that was injected into the storage facility by the storage operator, shall be released from liability with respect to the storage facility and that any long term monitoring or remediation of any leakage at the storage facility shall become the responsibility of this state’’
SITING

• Just look at Ohio
  The ability to work with other political jurisdictions

Bonding ability for projects and the promise for regional co-ordination
SITING 2

- Route selection and certification in the larger (regional) picture is possible and advisable.

- Common interest by high sulfur States can lead to a real solution.
Even if you’re on the right track, you’ll get run over if you just sit there.

—Will Rogers (1879–1935)
END MARKETS

• Immediate markets are dictated by the availability of sinks in the vast oil production arena

• Future sequestration will be more localized as the long term compliment to current availabilities
SO?

• We need to work as partners to get this implemented in the near term in order for it to be not an untraveled road but a vibrant energy highway.