

Draft Outline of Proposed MGA Regional Strategy for Commercial Deployment of Carbon Capture and Storage

Note: This is a working document that will be continuously expanded and updated as work is completed on the various components of the strategy identified and described below.

Background

In November 2007, Midwestern governors and the premier of Manitoba signed a regional Carbon Management Infrastructure Partnership resolution. Deliverable six of the resolution calls for development of a regional “commercial plan for CO₂ management” that incorporates the resolution deliverables and “emphasizes EOR as important steps toward deep saline aquifer CO₂ storage.”

The following outline lays out draft elements of a package proposal under development through the Midwestern Governors Association (MGA) that will be presented to Midwestern governors and the premier that can serve as the basis for such a commercial plan. It integrates discussions, recommendations and work products of the MGA’s Renewable Electricity, Advanced Coal with Carbon Capture and Storage (REACCCS) Advisory Group and aims to help jumpstart commercial scale deployment of carbon capture and storage (CCS) in the 2011-2015 time period. This corresponds with the regulatory and technology milestones for advanced coal and CCS endorsed by the governors and premier in the MGA Platform and with actual commercial projects expected to be operational and in need of an outlet for their captured CO₂.

Recommended Regional Approach to CO₂ Management Infrastructure Buildout

The REACCCS Advisory Group recommends a phased approach to Midwest development of a CO₂ management infrastructure:

- Phase I through 2015 features a two-pronged approach:
 - 1) Develop and deploy individual commercial scale capture projects with associated pipeline transport to reservoirs for CO₂ enhanced oil recovery (EOR) and storage in the jurisdictions of Kansas, Michigan, Manitoba and North Dakota that lie outside the Illinois Basin; and
 - 2) Site and build a major CO₂ trunk pipeline connecting a cluster of commercial capture projects in Illinois, Indiana, Kentucky and Ohio to the Gulf Coast for EOR and storage.
- Phase II from 2015-2025:
 - Continue expansion of CO₂ EOR storage and deep saline storage within the Midwest itself through pipeline network expansion enabled by Phase I development; and
 - Connect all Midwest jurisdictions to CO₂ trunk pipelines, so that commercial capture projects in Minnesota, Wisconsin and Iowa that currently lack suitable geologic reservoirs have access to viable CO₂ transport and storage options.

This strategy seeks to take early advantage of the Midwest’s largest single concentration of proposed commercial capture projects centered in the lower Midwest industrial states of Illinois, Indiana and Ohio. Ideally, for this cluster of projects to secure financing and move forward without delay, they will need a common CO₂ infrastructure solution in the 2011-2015 time period that the proposed Gulf Coast trunk pipeline would provide. This, in turn, would create a “network effect” and the opportunity during the Phase II time period to build off this common pipeline infrastructure to deploy more readily

and cost effectively additional plants and pipelines for EOR and deep saline storage in neighboring jurisdictions. The Illinois Basin geologic formation around which this Midwest project cluster is located provides a rich resource of suitable oil and gas reservoirs and deep saline aquifers to accommodate further project development and local CO₂ storage in Phase II.

Concurrently with development of a Midwest-Gulf Coast CO₂ pipeline, the REACCCS Advisory Group recommends that commercial capture and CO₂ EOR storage should be expanded during Phase I in MGA jurisdictions outside the Illinois Basin—notably Kansas, North Dakota, Manitoba and Michigan—starting with individual commercial projects that rely on local storage, but that are planned and developed with a view toward future integration into a larger Midwest-wide CO₂ pipeline infrastructure envisioned for Phase II.

While these jurisdictions outside the Illinois Basin have less opportunity in the near term to aggregate multiple commercial projects around a common large trunk pipeline infrastructure, they have excellent geologic storage potential, and some already have significant operational and regulatory experience with commercial scale CO₂ capture and EOR with storage (e.g. Dakota Gasification in North Dakota and Core Energy in Michigan).

Key Elements of Package

The following elements for the proposal were identified by participants at the Columbus meeting and have been discussed subsequently:

- **Target commercial projects in the Illinois Basin** that will need a CO₂ outlet in the 2011-2015 time period and that, taken together, provide a source of supply to justify a major inter-jurisdictional pipeline (helps meet MGA Platform commercialization milestones for advanced coal plants with CCS);
- **Characteristics and route of trunk CO₂ pipeline from Illinois Basin to Gulf Coast**, together with feeder lines to connect identified commercial projects (supports MGA Platform goal of siting and permitting an inter-jurisdictional CO₂ pipeline);
- **Characteristics and routing of potential pipelines to serve non-Illinois Basin jurisdictions with significant storage potential**, such as Kansas, Manitoba, Michigan and North Dakota;
- **Proposed CO₂ management utility**, established jurisdictionally or on geologic basin-wide basis (while retaining jurisdictional regulatory commission oversight), in order to provide common transport and storage services to target commercial projects providing CO₂ for the trunk pipeline;
- **Quantification of the basic Gulf Coast pipeline scenario, regional EOR analysis and pipeline network optimization modeling** to inform the core proposal and to help make a technical and economic case for it (building on work to be done on deliverables 1 and 5 of the CO₂ Management Infrastructure resolution); and a
- **Package of priority federal/state financial incentives and regulatory measures**, with the state policies harmonized to the extent feasible across jurisdictional boundaries through cooperative efforts within the MGA (drawing on the priority advanced coal and CCS policy recommendations of the REACCCS advisory group).

Target Projects

The following cluster of projects have been identified as all potentially benefiting from a common CO₂ outlet through a trunk pipeline to the Gulf Coast. This is the list of projects reviewed by the Advisory Group in a conference call last week for the purposes of one of the CCS quantification scenarios:

- Duke Edwardsport (IGCC) on-line in 2012, 630 MW;
- Cash Creek (Substitute Natural Gas (SNG)) on-line in 2012, includes 720 MW (nominal);
- Power Holdings (SNG) on-line in 2012, enables 677 MW;
- Kentucky NewGas (ConocoPhillips & Peabody) (SNG) on-line in 2015, enables 880 MW;

- Taylorville Energy Center (SNG) includes 630 MW;
- Secure Energy – Decatur (SNG) enables 325 MW; and
- Rockport, IN (SNG) –[details forthcoming].

Trunk and Feeder Pipeline Characteristics and Routes

The following characteristics of the Gulf Coast trunk pipeline have been identified and reviewed by Advisory Group participants for the purposes of quantification:

- Length: 450 mi;
- Diameter: 24 in;
- Capital cost: \$800 M;
- O&M: \$37.5 M/yr; and
- Capacity: 45,000 tons CO₂/day.

Actual routes for the trunk line and feeder lines, as well specific characteristics of the collection network of feeder lines will need to be determined later based on analysis and pipeline modeling (see below).

Projects and Pipelines Outside the Illinois Basin

Potential projects and pipeline options outside the Illinois Basin will be identified in a subsequent draft of this document.

CO₂ Management Utility

In order to foster certainty and reliability in deploying geologic storage at a system-wide scale, CO₂ could be stored through a public utility regulated by each jurisdiction's utility regulatory commission and operating on a geologic basin-wide basis. As with an entity like an electric distribution utility, this utility would be responsible for reliably receiving and distributing CO₂ to geologic storage sites, which it would also manage in perpetuity. For these services, the utility would recover its cost in rates, along with a reasonable rate of return. The development of such a utility, while not strictly necessary for deployment of a trunk and feeder pipelines supplying CO₂ for EOR purposes, would facilitate and likely accelerate the expansion of the core pipeline network beyond providing for storage of CO₂ in oil and gas formations to include deep saline aquifers.

REACCS participants and staff are moving forward with establishing a temporary work group to develop design recommendations for establishment of a CO₂ utility or utilities in the MGA region. This group will meet in April and present draft recommendations to the REACCS meeting in May.

For more on proposed utility, see Appendix B of the Draft MGA Draft Interim Toolkit for Advanced Coal with Carbon Capture and Storage.

Staff Quantification of the Basic Gulf Coast Pipeline Scenario, Regional EOR Analysis and Pipeline Network Optimization Modeling

Greg Powell's basic quantification of key elements of the Gulf Coast pipeline scenario should give us a preliminary look at the costs and CO₂ reductions to be achieved for the proposal.

Work with Advanced Resources International to adapt and expand on some of their work (per the first deliverable of the MGA carbon management infrastructure resolution to provide a report on EOR) should also provide a helpful and broader analytical context. Advisory Group staff have had an initial conversation with ARI staff about adapting and expanding on their EOR analysis for use by the Advisory Group generally and to support development of this proposal in particular. Staff will schedule further discussions this month to iron out details.

Phase one of the pipeline network optimization modeling by Jeff Bielecke of Harvard University is now underway. Funded by the Clean Air Task Force, phase one focuses on the same basic Gulf Coast EOR scenario in this proposal and in the quantification being done by Greg Powell, providing for an overall consistency. CATF will make Jeff's phase one results available to MGA, and they should provide a clearer picture of trunk and feeder line routes for the proposal summarized in this outline.

Finally, Advisory Group staff recently had a conference call with Jeff and CATF staff to discuss a phase two modeling effort, if time and funding allow. Phase two would build on this core proposal and show how new pipelines, both trunk and feeder, could emerge in the medium to long term from this initial commercial network to serve adjacent jurisdictions such as Iowa, Michigan, Minnesota and Wisconsin. Phase two modeling would seek to correlate proposed MGA commercialization milestones for advanced coal with CCS and broader regional GHG reduction targets with a corresponding stepwise buildout of a CO₂ pipeline infrastructure over the time period 2015 to 2030 (and possibly 2050). However, funding for this next modeling phase is uncertain at this time.

Priority Federal/State Financial Incentives and Regulatory Measures

Advisory group participants in Columbus emphasized the importance of the overall proposal including a package of priority financial incentives and regulatory measures. The package will draw on the following:

- Input received by Advisory Group staff interviews of project developers about their policy needs;
- Best practices for CO₂ ownership, liability and transport described in the draft MGA Toolkit and appendices;
- Recent discussions and work with Advisory Group participants in preparing proposed recommendations for a federal stimulus package; and
- Insights from the quantification work being done by Greg Powell.

Advisory group staff and participants will discuss a preliminary policy document at the March Traverse City meeting for eventual incorporation into this document.