NATIONAL ENERGY TECHNOLOGY LABORATORY

Water and Carbon Storage Related Research at DOE/NETL

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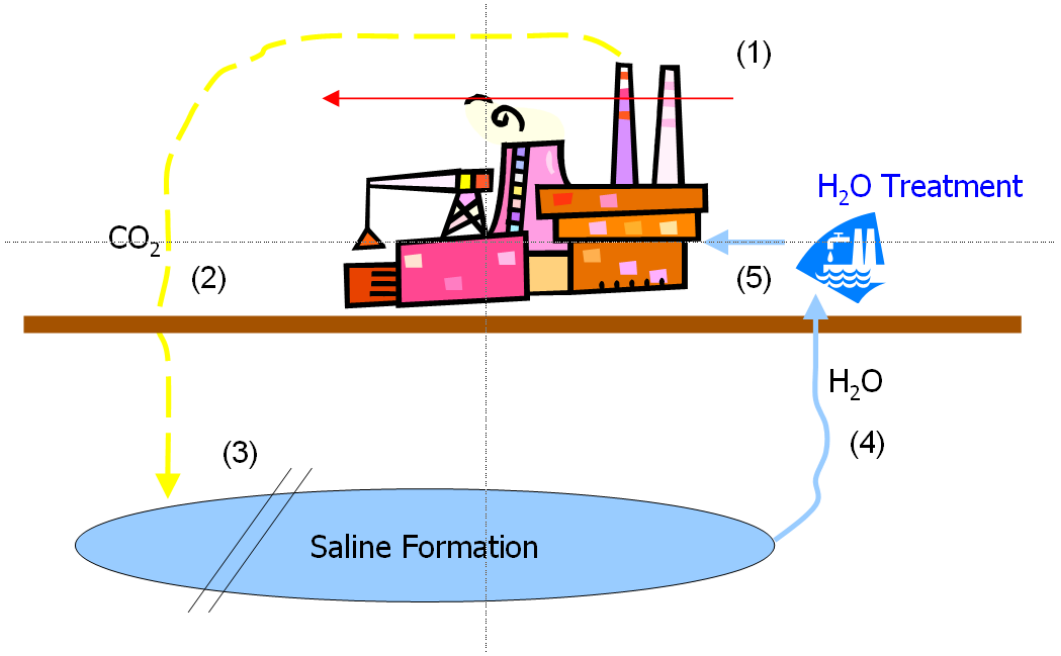
U.S. DEPARTMENT OF ENERGY

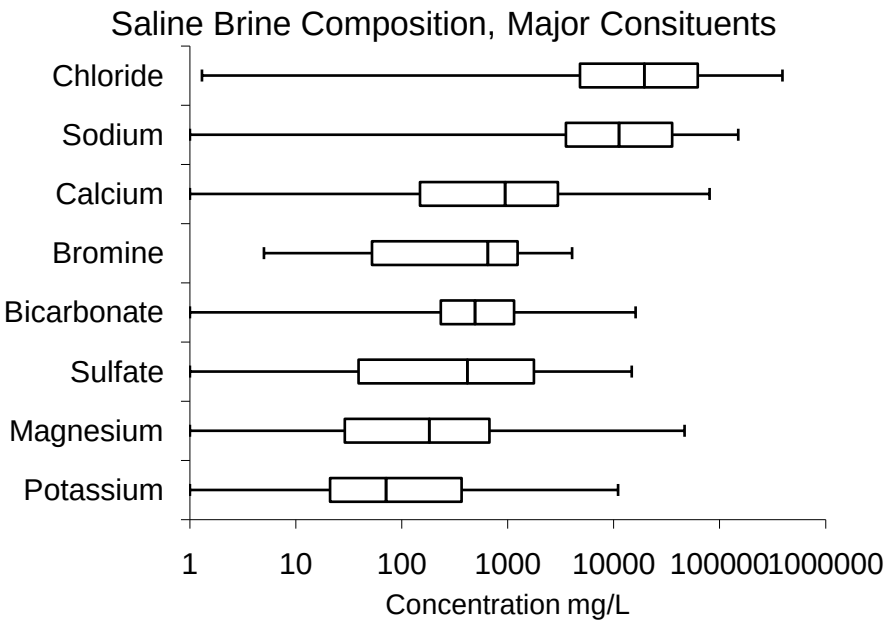
Sandia National Laboratory Project



- **Developing a model examining advantages and challenges of integrated system**

- **Model addresses relevant areas of CO_2:capture, transportation, and storage; water: extraction and treatment for reuse by power plants**
- **Model contains available data and calculations but allows for user corrections to data and assumptions**

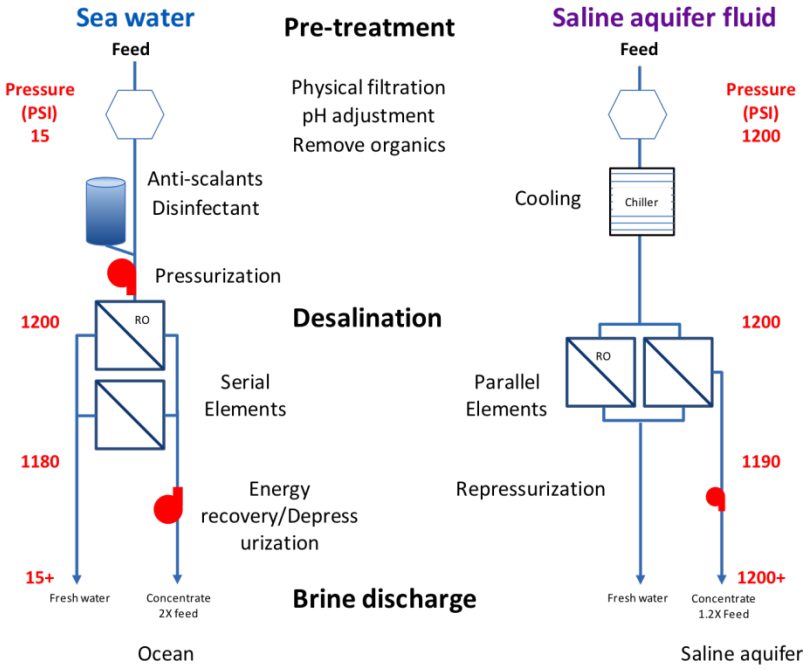
Argonne National Laboratory Project



- **Assessing:**
  - Extracted water management options
  - Industries or sectors that can reuse water of lesser or different quality
  - Investigate innovate use of components of formation water

- **Ongoing efforts will build off of the assessment and will use a life cycle assessment approach to assess the environmental costs and benefits of the previously identified options**

Lawrence Livermore National Laboratory Project



- **Brine pressurized by CO_2 storage as feedstock for desalination and water treatment**

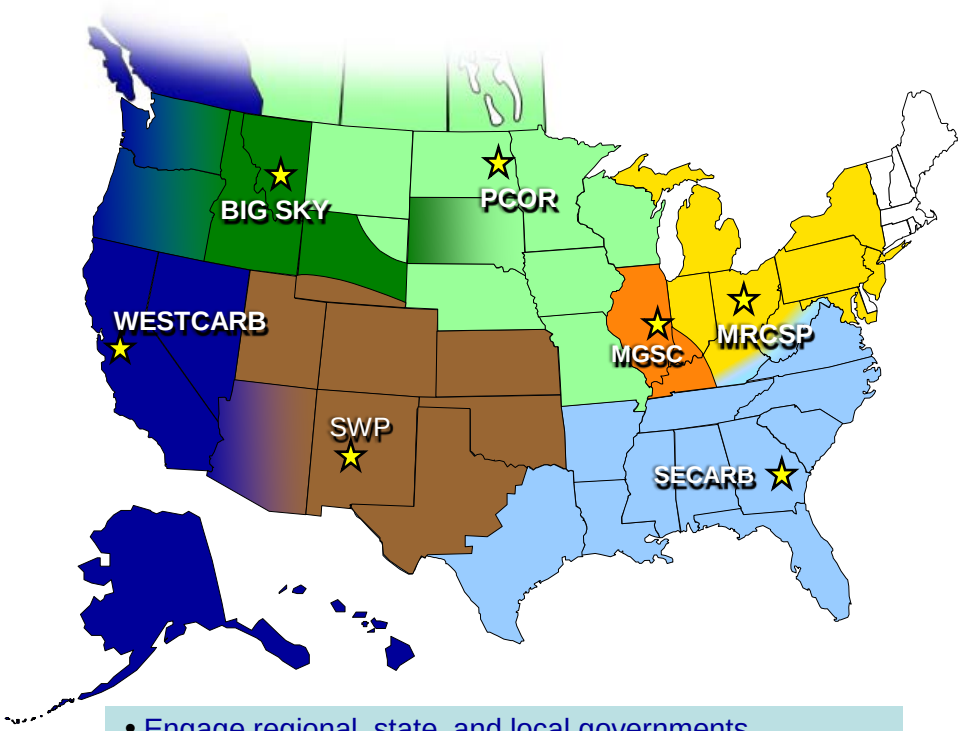
- **Two pronged approach:**
  - Evaluating membrane treatment methods
  - Modeling effects of saline extraction on CO_2 plume, pressure front, trapping mechanisms, and seal integrity

Regional Carbon Sequestration Partnerships

Developing the Infrastructure for Wide Scale Deployment

Seven Regional Partnerships

400+ distinct organizations, 43 states, 4 Canadian Provinces



- Engage regional, state, and local governments
- Determine regional sequestration benefits
- Baseline region for sources and sinks
- Establish monitoring and verification protocols
- Address regulatory, environmental, and outreach issues
- Validate sequestration technology and infrastructure

Characterization Phase (2003-2005)

Search of potential storage locations and CO_2 sources	Found potential for 100's of years of storage

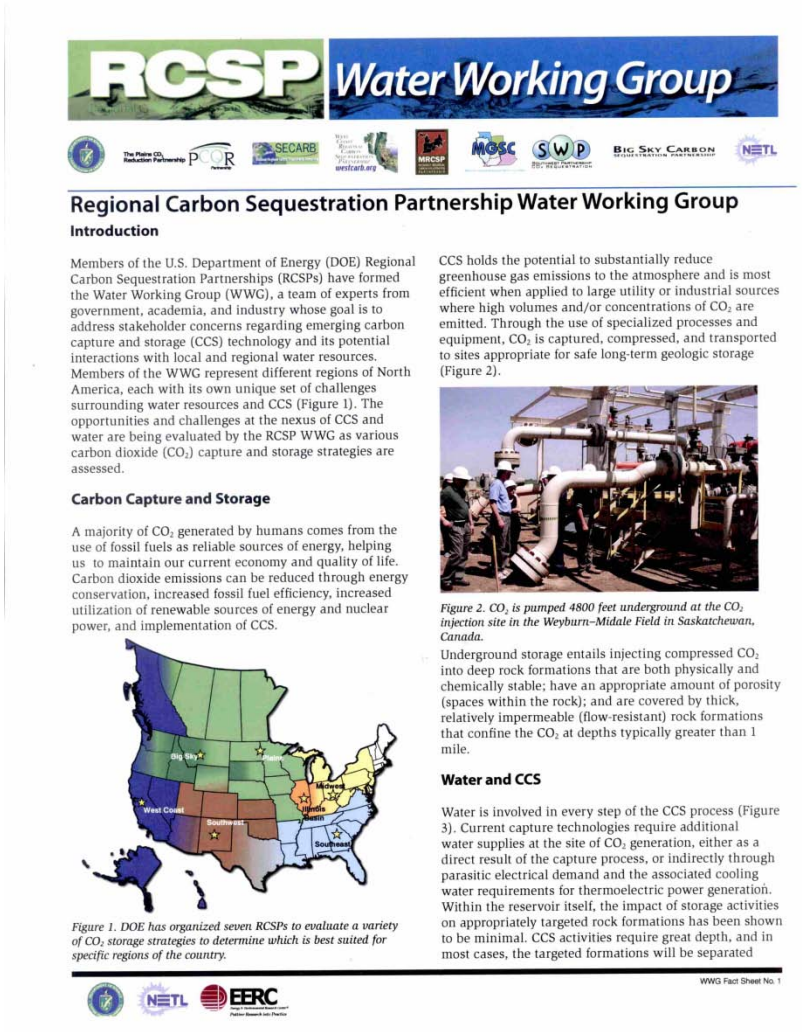
Validation Phase (2005-2011)

20 injection tests in saline formations, depleted oil, unmineable coal seams, and basalt

Development Phase (2008-2017+)

9 large scale injections (over 1 million tons each)	Commercial scale understanding	Regulatory, liability, ownership issues

RCSP Water Working Group



RCSP Water Working Group

Regional Carbon Sequestration Partnership Water Working Group

Introduction

Members of the U.S. Department of Energy (DOE) Regional Carbon Sequestration Partnerships (RCSPs) have formed the Water Working Group (WWG), a team of experts from government, academia, and industry whose goal is to address stakeholder concerns regarding emerging carbon capture and storage (CCS) technology and its potential interactions with local and regional water resources. Members of the WWG represent different regions of North America, each with its own unique set of challenges surrounding water resources and CCS (Figure 1). The opportunities and challenges at the nexus of CCS and water are being evaluated by the RCSP WWG as various carbon dioxide (CO_2) capture and storage strategies are assessed.

Carbon Capture and Storage

A majority of CO_2 generated by humans comes from the use of fossil fuels as reliable sources of energy, helping us to maintain our current economy and quality of life. Carbon dioxide emissions can be reduced through energy conservation, increased fossil fuel efficiency, increased utilization of renewable sources of energy and nuclear power, and implementation of CCS.

Figure 1. DOE has organized seven RCSPs to evaluate a variety of CO_2 storage strategies to determine which is best suited for specific regions of the country.

CCS holds the potential to substantially reduce greenhouse gas emissions to the atmosphere and is most efficient when applied to large utility or industrial sources where high volumes and/or concentrations of CO_2 are emitted. Through the use of specialized processes and equipment, CO_2 is captured, compressed, and transported to sites appropriate for safe long-term geologic storage (Figure 2).

Figure 2. CO_2 is pumped 4800 feet underground at the CO_2 injection site in the Weyburn–Midale Field in Saskatchewan, Canada.

Underground storage entails injecting compressed CO_2 into deep rock formations that are both physically and chemically stable; have an appropriate amount of porosity (spaces within the rock); and are covered by thick, relatively impermeable (flow-resistant) rock formations that confine the CO_2 at depths typically greater than 1 mile.

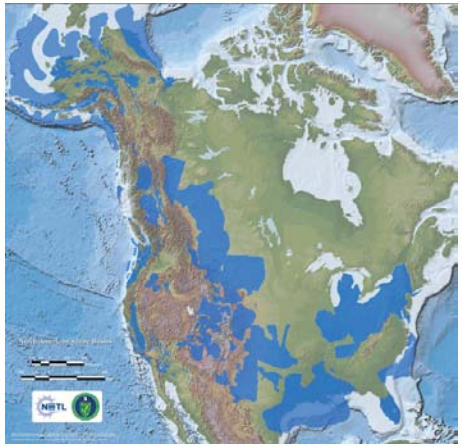
Water and CCS

Water is involved in every step of the CCS process (Figure 3). Current capture technologies require additional water supplies at the site of CO_2 generation, either as a direct result of the capture process, or indirectly through parasitic electrical demand and the associated cooling water requirements for thermoelectric power generation. Within the reservoir itself, the impact of storage activities on appropriately targeted rock formations has been shown to be minimal. CCS activities require great depth, and in most cases, the targeted formations will be separated

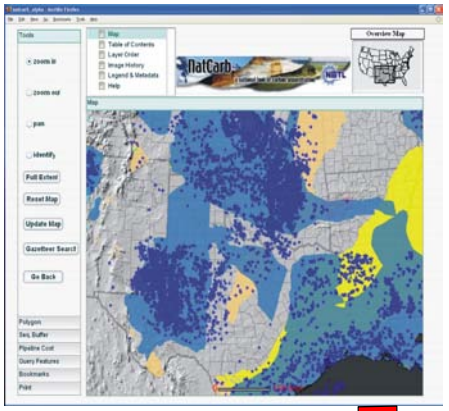
WWG Fact Sheet No. 1

- **Capture experiences related to CCS & water**
- **To provide a forum for brainstorming and communication on issues and opportunities**
- **Each RCSP has crosscutting challenges and opportunities but also many unique regional experiences**

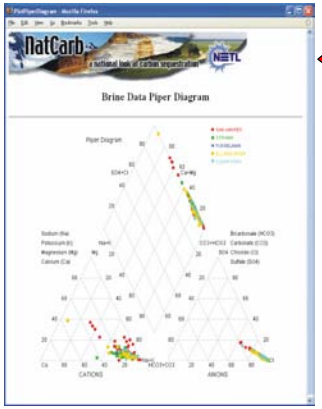
National Carbon Sequestration Database and Geographical Information System (NATCARB)



- **Relational database and geographic information system (GIS)**
- **Integrates data from the RCSPs and various other sources**
- **Provides a National view of the carbon sequestration potential in the U.S. and Canada**



National View of Saline Formations and Coal Basins



Brine Data from Selected Texas Formation

CO_2 Sequestration Site