WESTCARB Regional Partnership

U.S. Geological Survey National Geologic Carbon Dioxide Sequestration Assessment Project

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USGS

Outline

- Overview of Legislation
- Geologic Model
- Work Plan & Products
- Data

Energy Independence and Security Act 2007
TITLE VII—CARBON CAPTURE AND SEQUESTRATION

Subtitle B—Carbon Capture and Sequestration Assessment and Framework

SEC. 711. CARBON DIOXIDE SEQUESTRATION CAPACITY ASSESSMENT.

(b) ***METHODOLOGY— …shall develop a methodology for conducting an assessment under subsection (f), taking into consideration—***

(1) the geographical extent of all potential sequestration formations in all States;

(2) the capacity of the potential sequestration formations;

(3) the injectivity of the potential sequestration formations;

(4) an estimate of potential volumes of oil and gas recoverable by injection and sequestration of industrial carbon dioxide in potential sequestration formations;

(5) the risk associated with the potential sequestration formations; and

(6) the work done to develop the Carbon Sequestration Atlas of the United States and Canada that was completed by DOE.

(c) ***COORDINATION—***

(1) Federal Coordination

(2) State Coordination

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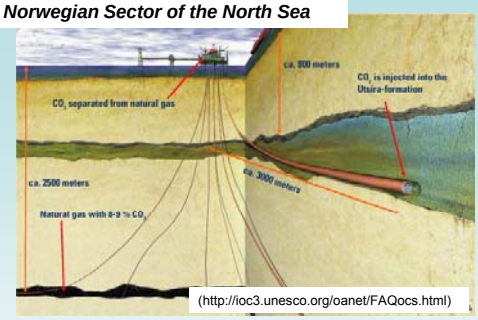
WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 3

Geological storage

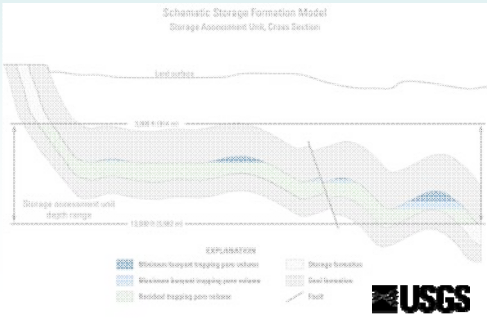
- USGS assessment focus on CO_2 injected at depths > 3,000 ft. (denser, supercritical CO_2)
- CO_2 is buoyant & displaces existing water, oil, or gas
- Storage formation must be sealed to retain buoyant CO_2
- >10,000 ppm TDS
- USGS assessment methodology addresses buoyant & residual trapping

Statoil's Sleipner Project in the Norwegian Sector of the North Sea



(http://ioc3.unesco.org/oanet/FAQocs.html)

- *Buoyant storage*
  - Basically, structural/stratigraphic traps
    - Petroleum production data to identify the known enclosures
    - USGS National Oil & Gas Assessment results to identify the undiscovered enclosures
    - Data gathered during CO_2 assessment research to estimate the non-petroleum filled enclosures



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WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP 4

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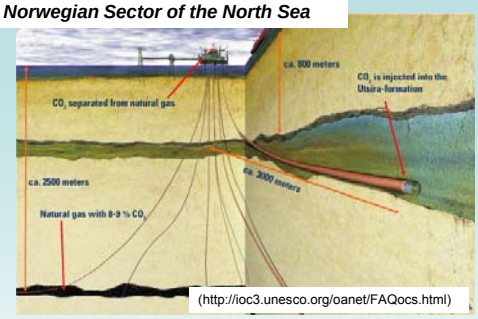

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- ***Buoyant storage***
  - Basically, resource contained by structural/stratigraphic traps
    - Petroleum production data to identify the known enclosures
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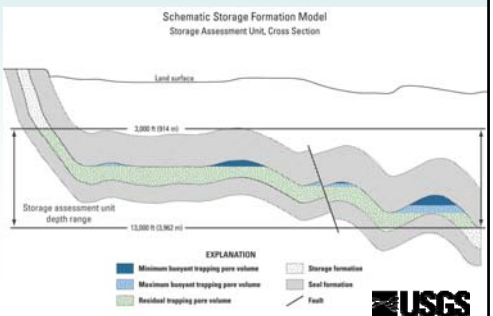

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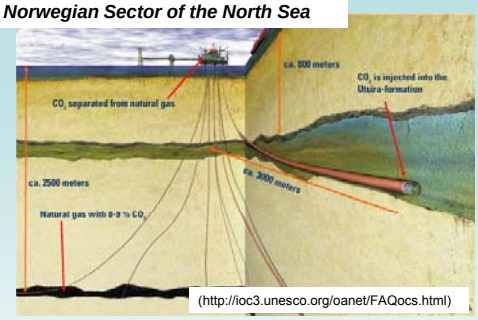

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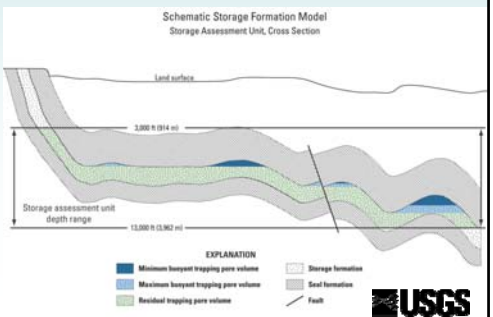
- ***Residual storage***
  - Remaining pore space within the Storage Formation not available for buoyant storage
  - The residual storage resource is divided into three classes based on variations in the permeability of the storage formation



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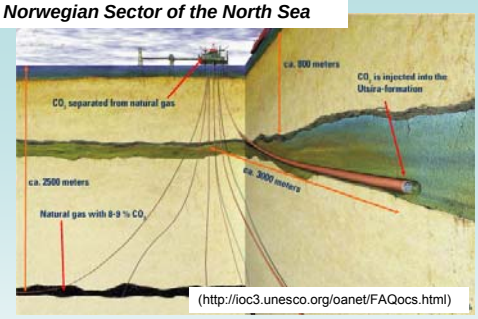

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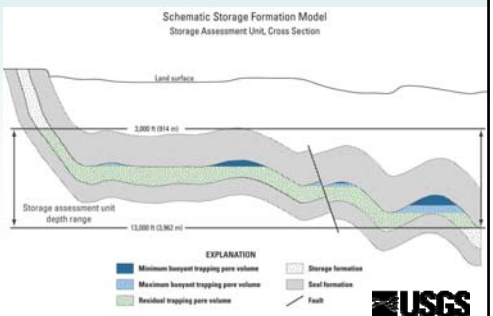
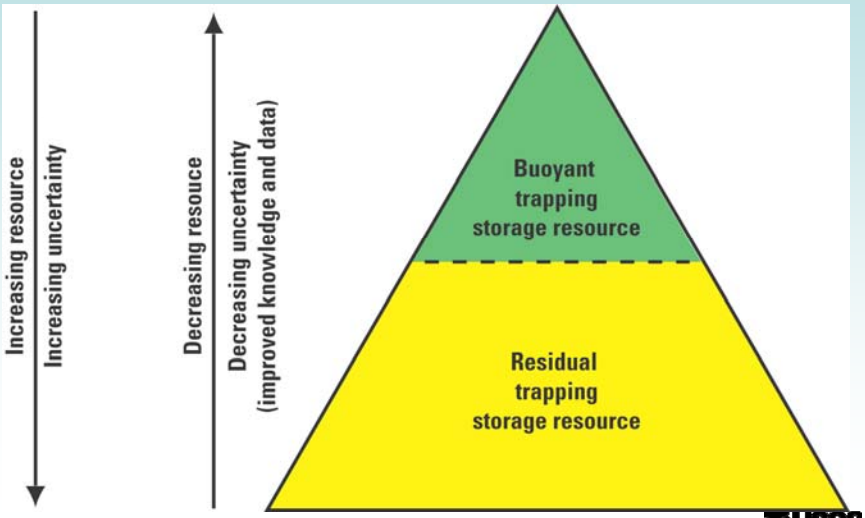


- Geologically based, statistically sound hypotheses for quantities of resource
- Comprehensive & consistent treatment (compatible/comparable to assessments in other areas)
- Transparent – methodology, assumptions
- Probabilistic – range of values to reflect uncertainty
- Not project site specific, estimates are regional (but geological models are developed for each region)
- External expert input

Hypothetical Resource Distribution

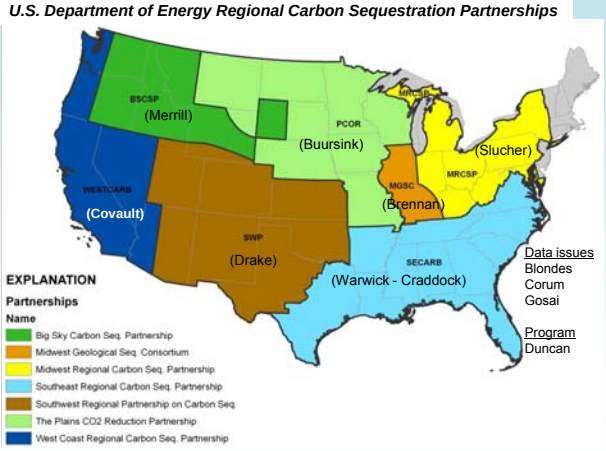
Technically accessible CO_2 storage resources



Work Plan

- CO_2 storage resource throughout the United States
  - ***USGS isolates SAU's within sedimentary basins***
  - ***USGS differentiates buoyant storage***
- 3-yr. term for resource estimates
- Assessment methodology generally applicable to global breadth of sedimentary basins

U.S. Department of Energy Regional Carbon Sequestration Partnerships



Modified from DOE NETL 2008 Carbon Sequestration Atlas II of the United States & Canada — Version 2
http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasII/

USGS

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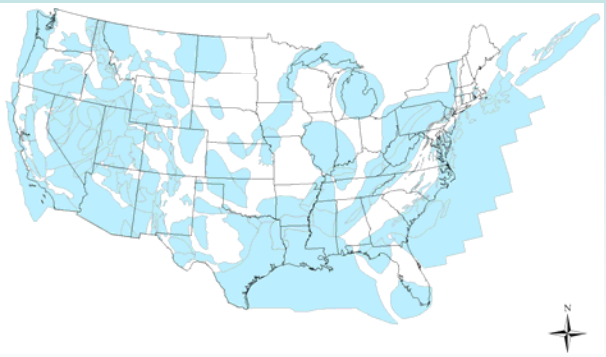
U.S. Sedimentary Basins of Lower 48 States



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Data

- USGS NOGA publications
  - Basic stratigraphic characterization
  - Cross sections
  - Depth to top contour maps
  - Isopach maps
  - Undiscovered oil & gas estimates are used in the buoyant trapping pore volume (B_{PV}) distribution
- Nehring Associates Database
  - Discovery well geology (depth, rock properties, pressure, etc.)
  - Field production information (B_{PV} distribution)
- IHS Production Database
  - Well & lease specific production & depth information, but limited rock properties.
- Literature for direct & analog applications

Products

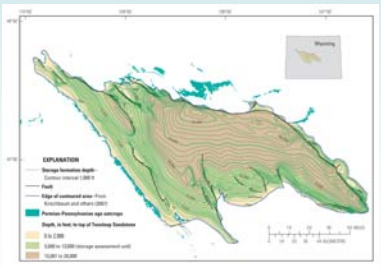
GIS Figures:

- Basin outline
- Formation outline – outcrop & subsurface extent of storage formation
- Storage Assessment Unit (SAU) outline – area within Formation outline that is assessed
- Formation thickness
- Formation top depth from surface
- Drill-hole penetration map by form. – quarter square mile cells

Text & figures:

- Location
- Basin stratigraphic chart
- Lithology (SAU) with sand/shale or limestone/shale percentages
- Formation top depth from surface
- Formation thickness
- Permeability/Porosity
- Formation water salinity & chemistry
- Top sealing unit extent, thickness & description
- Previous hydrocarbon production & drill penetrations
- References

Example of Penn. Tensleep Fm. of Wind River Basin



Thanks & data we need!

- Detailed stratigraphic/structural context
  - Character of sedimentary formations
    - Interpreted depositional environments & facies distributions
    - Grain size distributions
    - Porosity, permeability distributions
    - Thickness distributions
    - Areal extents of reservoir rocks & overlying seals
    - Depth to formation tops & structure maps
- Oil & gas production

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http://energy.usgs.gov

http://energy.er.usgs.gov/health_environment/co2_sequestration/

http://pubs.usgs.gov/of/2010/1127/

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13