Siting Geologic Sequestration Projects for Commercial Power Plants

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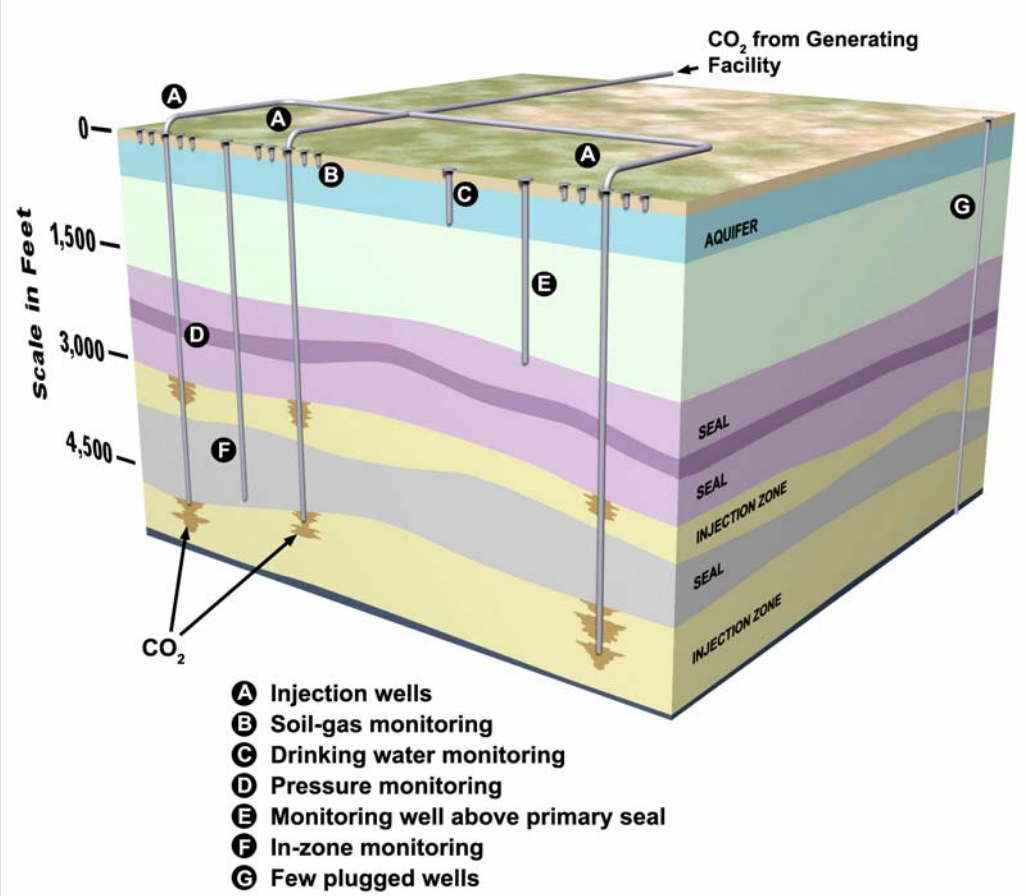
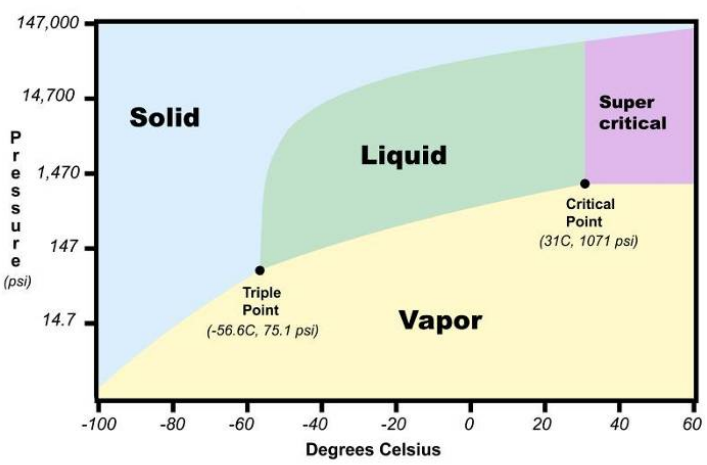
Axioms

- There is no “mainstream” process for siting geologic sequestration projects tied to commercial power plants
- Legal and liability issues are as important as technical issues
- Many of the critical tools needed to design and evaluate a sequestration project reside with research institutes and will remain that way for the near future

Generic Picture of Sequestration System



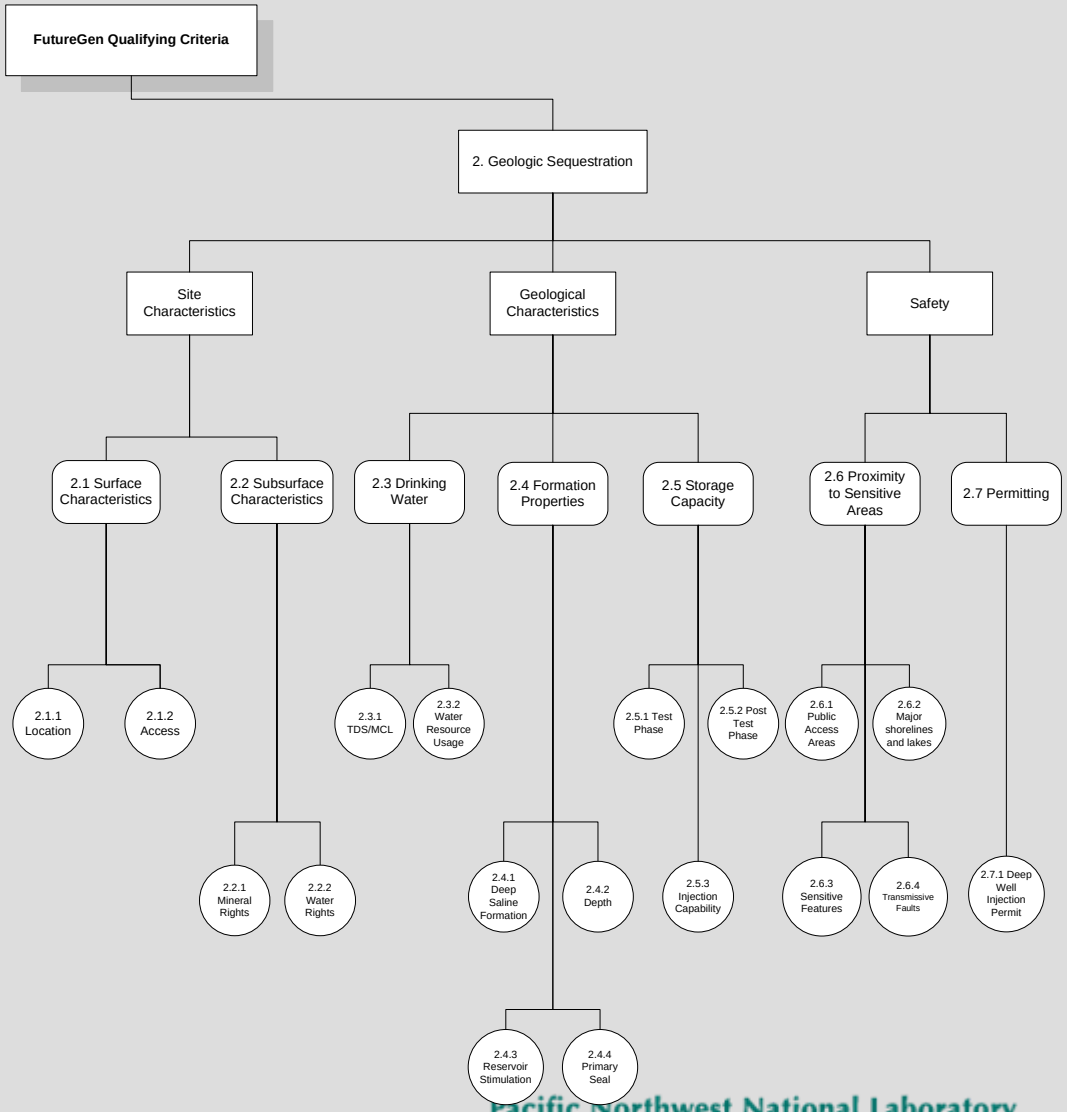


The FutureGen Experience

- 275 MWe IGCC power plant
  - 90% CO_2 capture target
  - Integrated with geologic sequestration site
  - Design to support surface and subsurface research
- Nationwide site selection process
- Very aggressive “can’t be done” timeline
  - Site downselection in 7 months
  - NEPA process completed in 16 months*

Siting Approach

- Two-tiered system
  - Qualifying Criteria (18)
  - Scoring Criteria
  - Criteria evaluated against a fixed CO_2 mass of 50 MMT
- Qualifying criteria covered a broad range of characteristics critical to maintaining schedule and limiting risks to the project
- Criteria were developed and vetted with an international expert panel
- Despite having published qualifying criteria, 4 of 12 proposals received were disqualified



Qualifying Criteria

- Site Characteristics - Surface
  - "The proposed geologic formation(s) must be located within the United States with no risk of subsurface migration of CO_2 outside the territory of the United States."
  - "At least 60 percent of the land above the proposed target formation(s) must be physically accessible for installation of surface and subsurface monitoring equipment."
- Site Characteristics – Legal
  - This category of criteria is designed to ensure the free and unencumbered rights of the proposer to use the proposed target formation(s) for injection and storage of CO_2 and conduct a monitoring program.
  - Mineral and water rights
  - Land access rights/permits

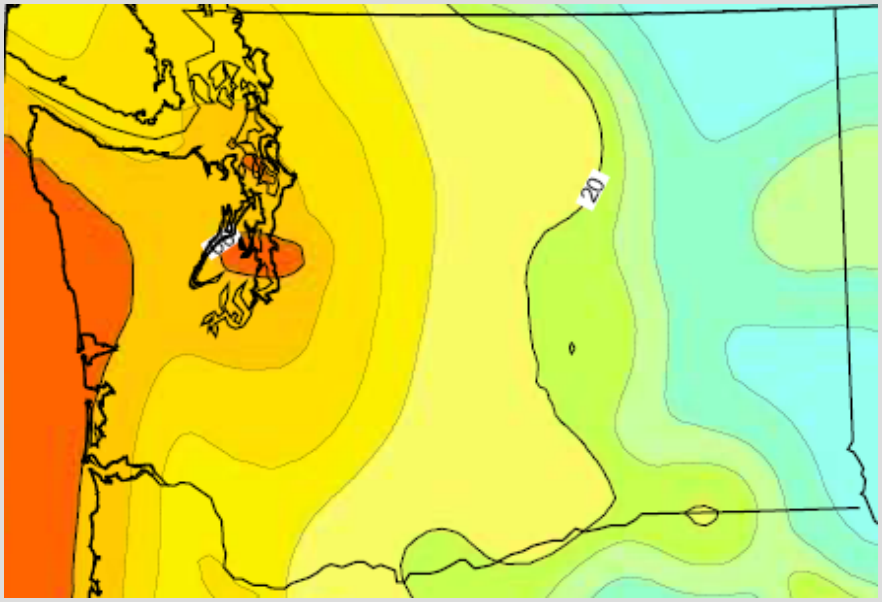
Qualifying Criteria, cont.

- Geological Characteristics
  - "Proposed target formation(s) must not be a current underground source of drinking water."
  - Provide evidence that the proposed target formation(s) is unlikely to be used to meet local water usage needs for the next 10 years.
  - "…the target formation(s) must have in situ hydrostatic pressure and temperature conditions above the CO_2 critical point."
  - "The proposed target formation(s) must have sufficient capacity to meet injection requirements without dependence on large scale physical or chemical stimulation techniques."
  - "The proposed target formation(s) must have caprock capable of long-term containment of the injected CO_2."

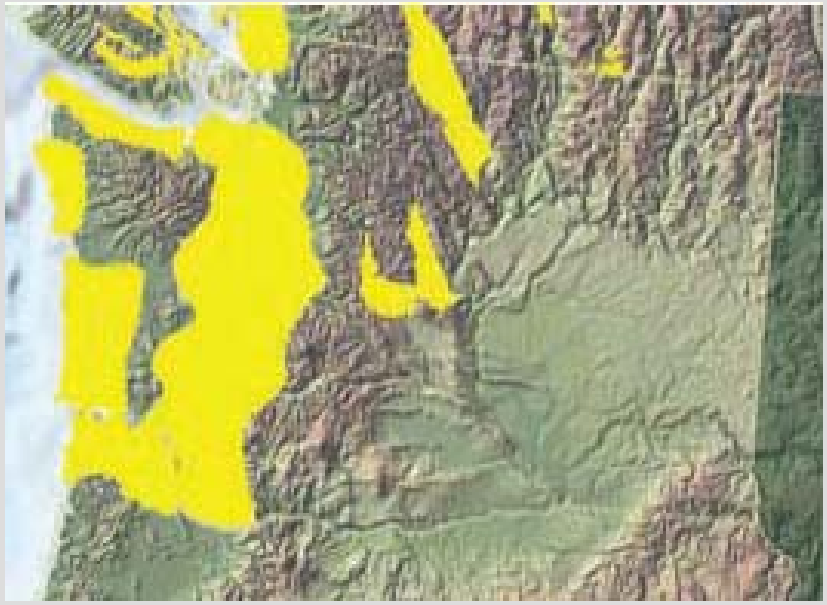
Qualifying Criteria, cont.

- Safety and Security
  - The plume area projected above the proposed target formation(s) must not intersect:
    - PAA. PAA's include national park or preserve, national monument, national seashore, national lakeshore, national wildlife refuge, designated wilderness area, designated wild and scenic river, or study area for any of the preceding designations.
    - marine shoreline
    - large dam, hazardous materials storage facility, Class 1 injection well, or other sensitive feature.
  - The site must have low risk from significant seismic events demonstrating peak ground acceleration less than 30 percent g, with a 2 percent chance of exceedance in 50 years, or a site-specific seismic analysis demonstrating equivalent ground motion hazard.
  - *The proposed site must have low potential for flood damage and flood-induced interference with site monitoring. At least 60 percent of the plume area projected above the proposed target formation(s) plant site must be above the 100-year floodplain.*

Seismic Hazard and DSFs in Washington



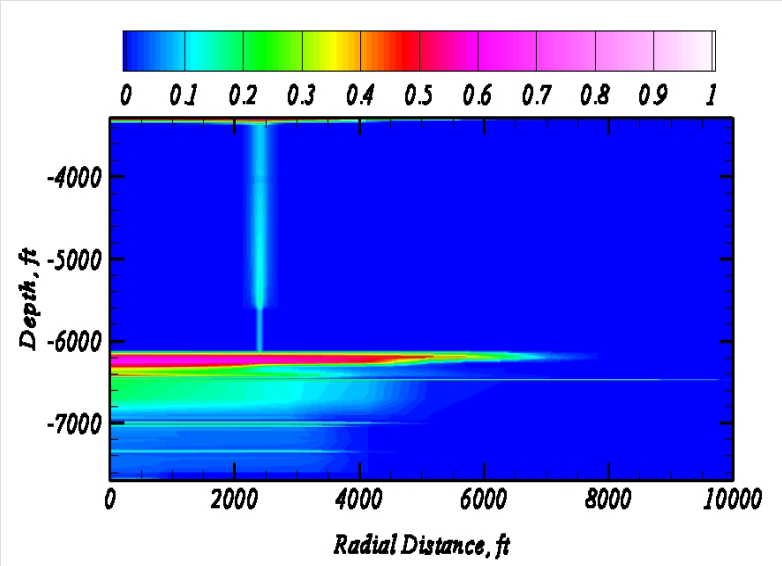
Adapted from USGS Seismic Hazard Map

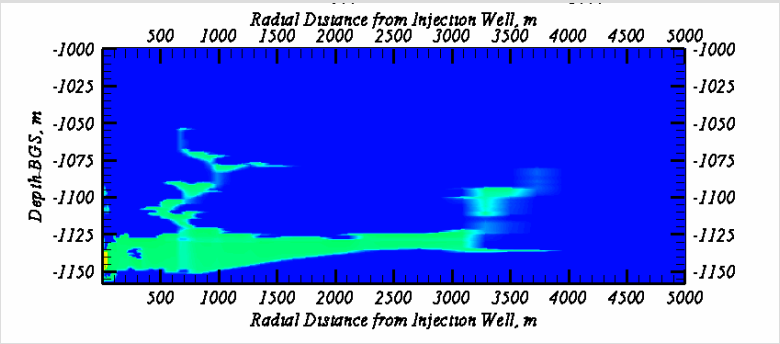


"Geological carbon sequestration options in WA", September 13, 2007, NRDC

Other Considerations

- What level of site characterization data is required, how close to the site, and when?
  - Illinois
    - Handful of wells drilled into Mt. Simon
    - No site specific seismic data
    - Nearest well approximately 50 miles away
  - Texas
    - No site specific seismic data or held in proprietary status
    - Lots of wells but most are either shallow water wells or deeper to access oil & gas plays
- CO_2 Purity
  - CO_2 produced from coal gasification or combustion contains low levels of a variety of other compounds
  - Pipeline regulations vary widely for H_2S
    - 20 ppm K-M Central Basin system
    - 200 ppm Petrosource
    - 10,000 ppm Weyburn
- What constitutes a leak?





Other Considerations, cont.

- Maintenance and off-normal events
  - Require backup well(s)?
  - Control systems
    - Well shut-in for plant outages
    - Thresholds for injection system shutdown?
    - How long to operate and vent before plant shutdown required?
    - Ties to regional emergency networks?
- MMV Plan & Reporting
  - Required before operating
  - Updated how often? How are new technologies incorporated?
  - Part of a periodic permit renewal?

Conclusions

- The FutureGen project provides some guidance on minimal criteria for a project to be considered under EFSEC
- The permitting process for non-EOR CCS projects is far from mainstream and is unfolding across the country in different ways for different projects
- The necessary tools are available to design sequestration systems that meet the special needs for integration with a commercial power plant
  - Enlist the aid of organizations skilled in the technology *early*
  - Develop and conduct a site characterization plan in concert with plant design