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WEST COAST REGIONAL  
CARBON SEQUESTRATION  
PARTNERSHIP

# Developing Sequestration Options for the West Coast

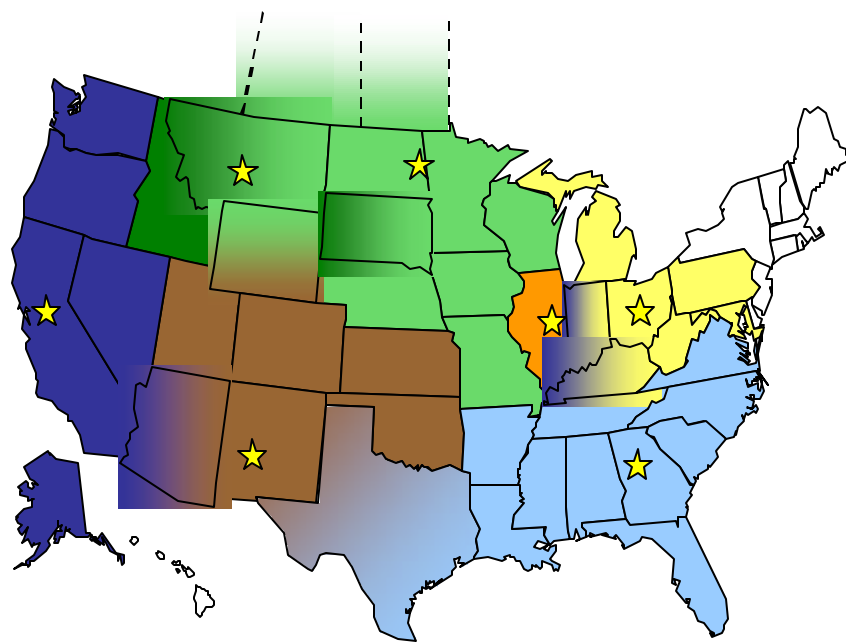
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**University of California Office of the President  
California Institute for Energy and Environment**



# WESTCARB Is One of Seven in DOE Program

- Partnership is evaluating terrestrial and geologic options for CO<sub>2</sub> sequestration in the region
- Partnership has broad stakeholder representation
- California Energy Commission is lead organization for WESTCARB



# WESTCARB Has Engaged A Strong Multi-Sectoral Team

- **Policy and Coordination** (**Western Governor's Association**)
- **State Resource Management, Environmental Protection, and Regulation** (CA Dept. of Forestry and Fire Protection, CA Dept. of Oil, Gas and Geothermal Resources, CA Geologic Survey, CAL EPA, **OR Dept. of Forestry**, Nevada Bureau of Mines and Geology, Region 9 EPA, **WA Dept. of Natural Resources**)
- **Oil and Gas Companies** (AERA, BP, Chevron Texaco, ConocoPhillips, Occidental Petroleum, Shell)
- **NGO's** (**Pacific Forest Trust**)
- **Utilities** (**Pacific Corp.**, Salt River Project, Sierra Pacific Resources, **TransAlta**)
- **National Lab and Research Institutions** (Electricity Innovation Institute, Kearney Foundation, LBNL, LLNL, MIT, Stanford-GCEP, Winrock)
- **Engineering Companies** (Advanced Resources International, Clean Energy Systems, **Golder Associates**, KinderMorgan, Nexant, SFA Pacific, Terralog)
- **Public Outreach/Education** (American Petroleum Institute, Cal State Bakersfield, Cal Poly, SF Dept. of Environment, Science Strategies, Western State Petroleum Association)

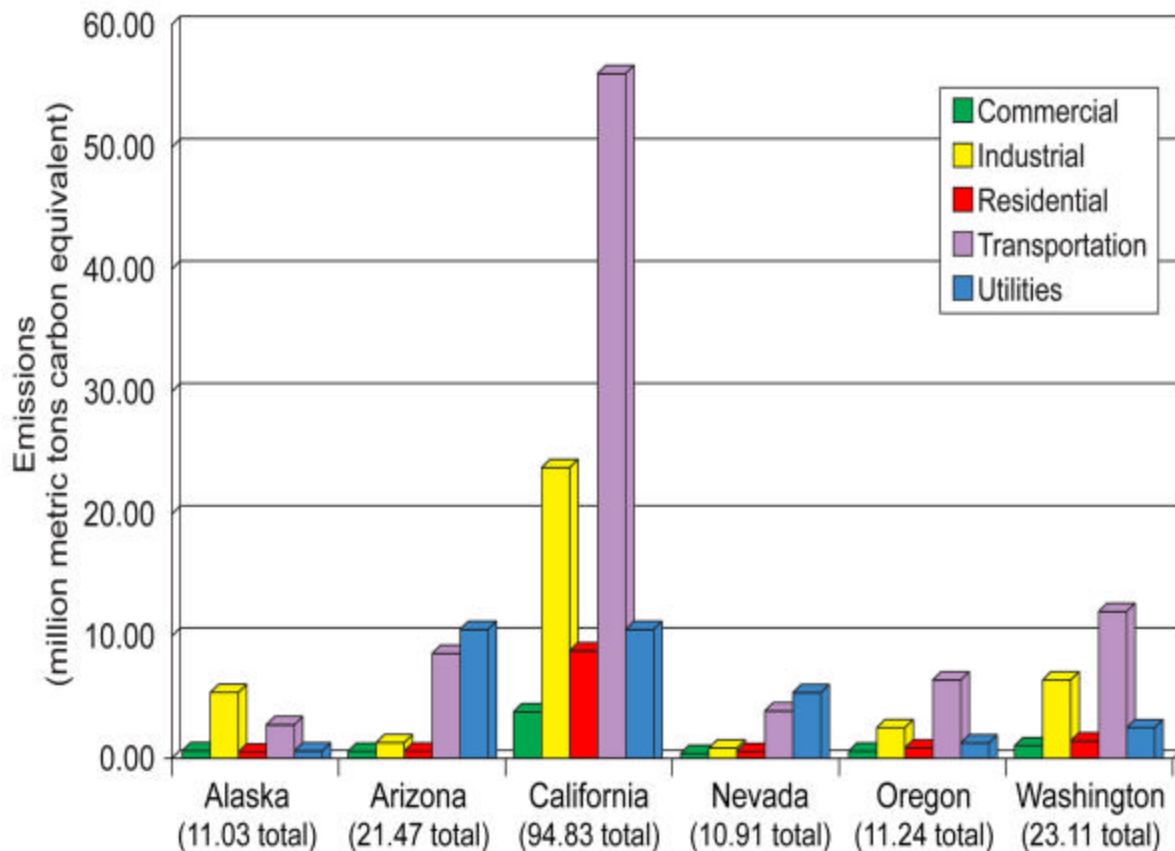
# WESTCARB Is Addressing 4 Major Questions in a Two-Phase Program

- Where are the sources of CO<sub>2</sub> and how much is there?
  - Where can it be stored?
  - How much will it cost?
  - Will it be safe?
- 
- Phase I will address these at the regional level while Phase II will address them at the local level

Where are the CO<sub>2</sub> sources and how much is there?

# WESTCARB States Account for 11% of U.S. CO<sub>2</sub> Emissions

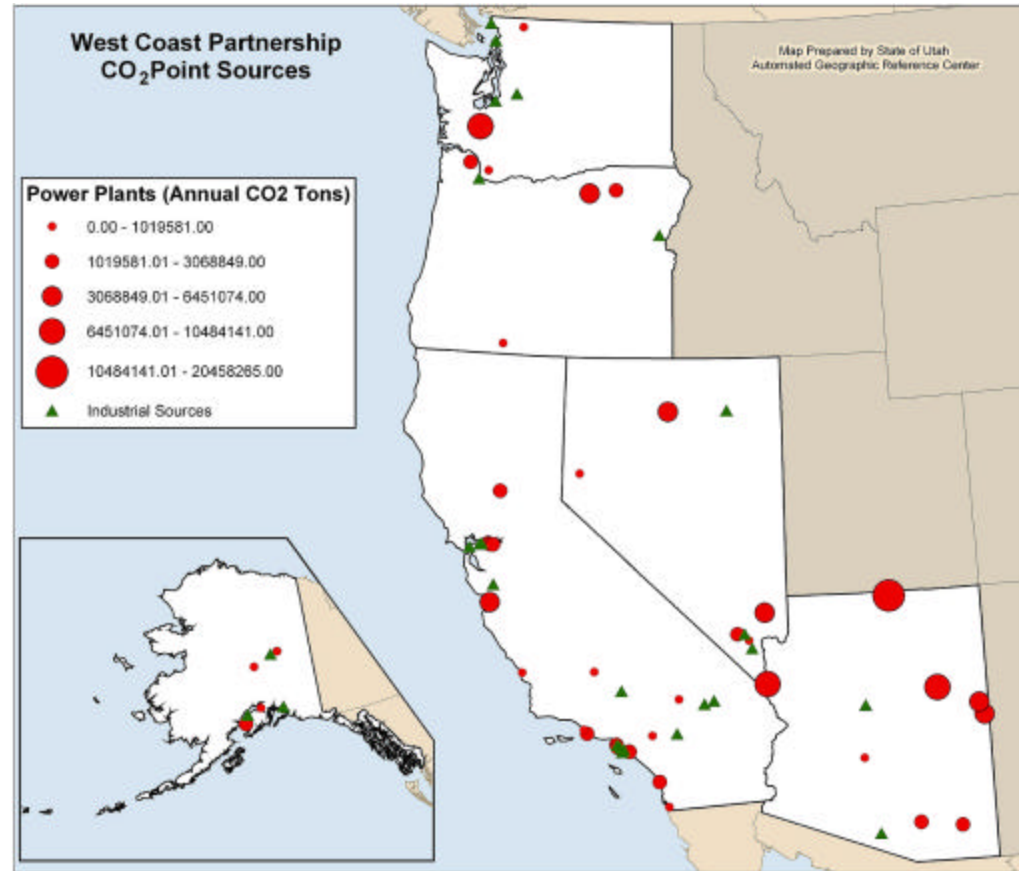
- Within WESTCARB, transportation accounts for 53%, utilities 13%, and industry 23% emissions
- Largest point sources are power plants, oil and gas producing field operations, oil refineries, and cement plants



Data Source: EPA CO<sub>2</sub> emission inventories for 1999 fossil fuel combustion

# Major Point Sources of CO<sub>2</sub> Have Been Identified for Study in WESTCARB

- Sources account for about 80% of total industrial and utility sector emissions
- CO<sub>2</sub> emissions and plant operating data are being collected
- Information is stored in a Geographic Information System (GIS) format

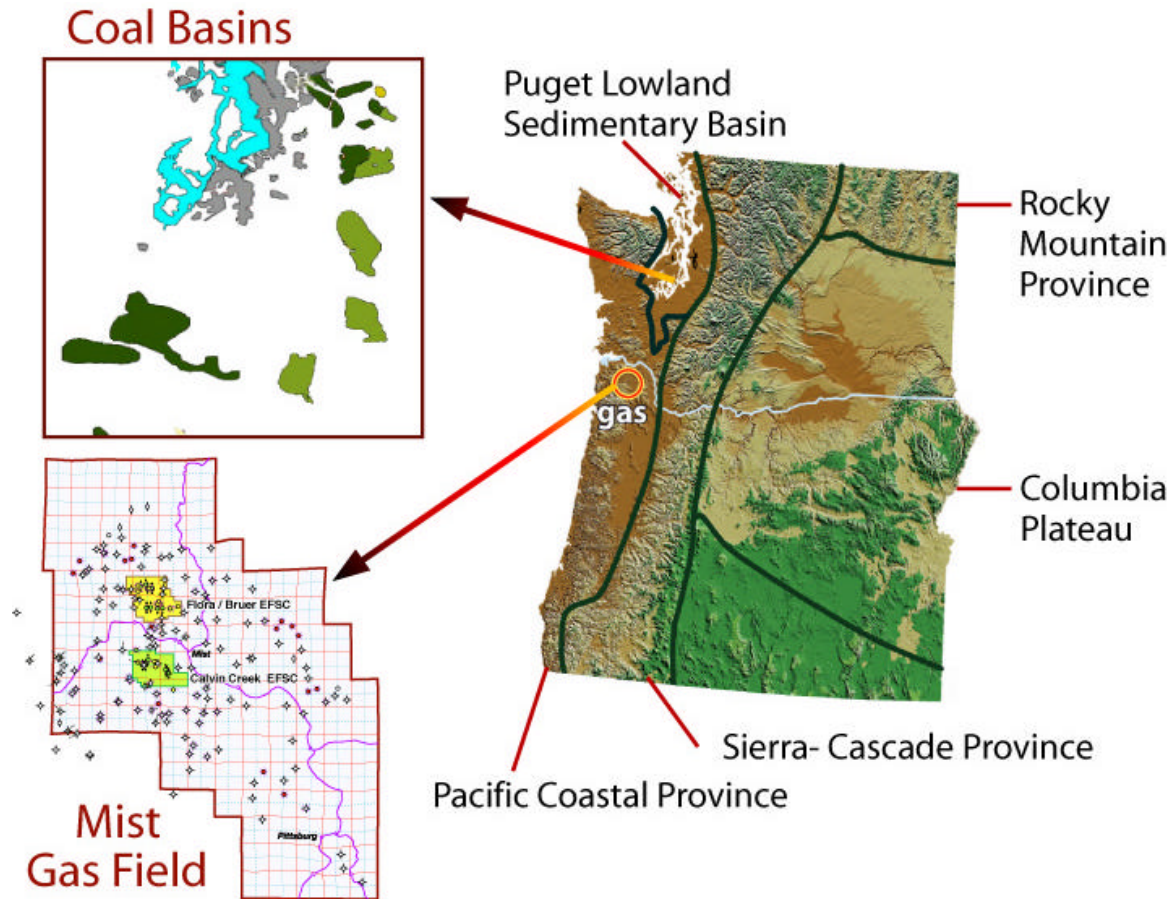


Where can the CO<sub>2</sub>  
be stored?



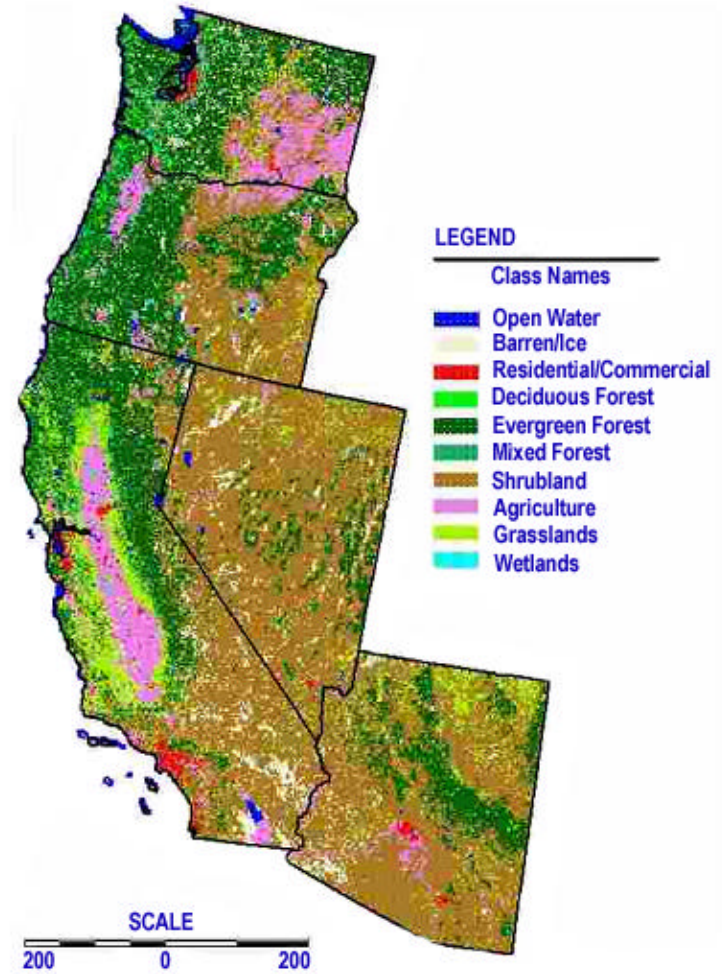
# Large Sedimentary Basins Offer the Best Geologic Storage Sites

Potential for offsetting costs if gas fields or coal beds are used



# WESTCARB Offers Major Terrestrial Storage Opportunities

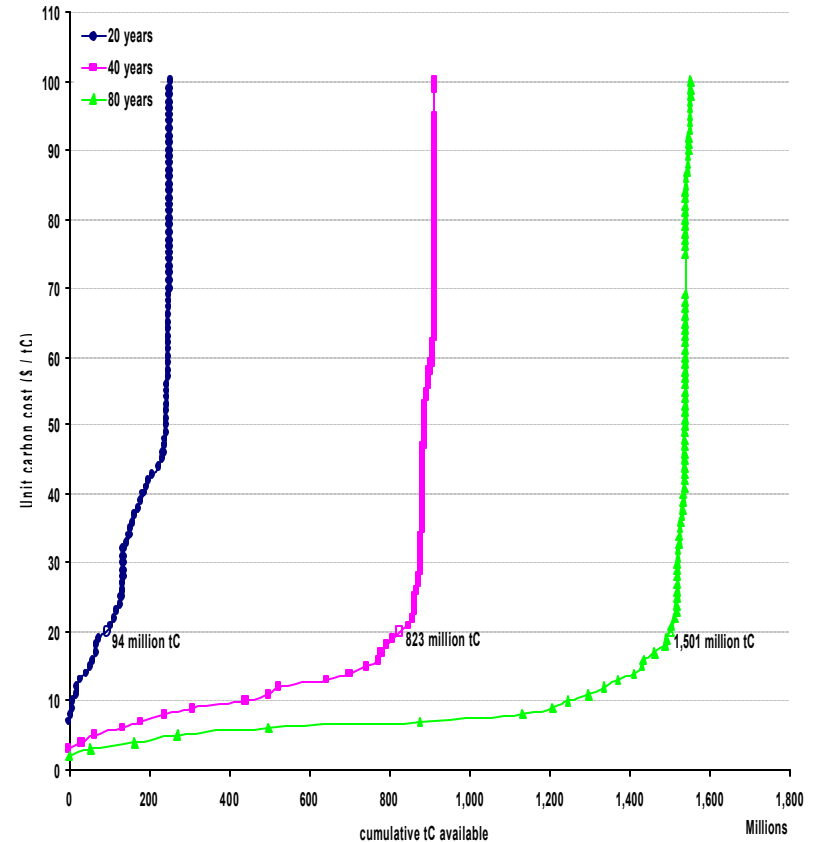
- Region diverse in forests, rangelands, and agricultural lands
- Forest sequestration options include riparian management, conversion of rangeland/marginal land, enhancement of large wood, fire management
- Baseline analyses define carbon emissions and/or sequestration for forest, rangeland, and agricultural sectors



How much will it cost to  
store the CO<sub>2</sub>?

# Supply Curves Quantify Major Terrestrial Storage Options

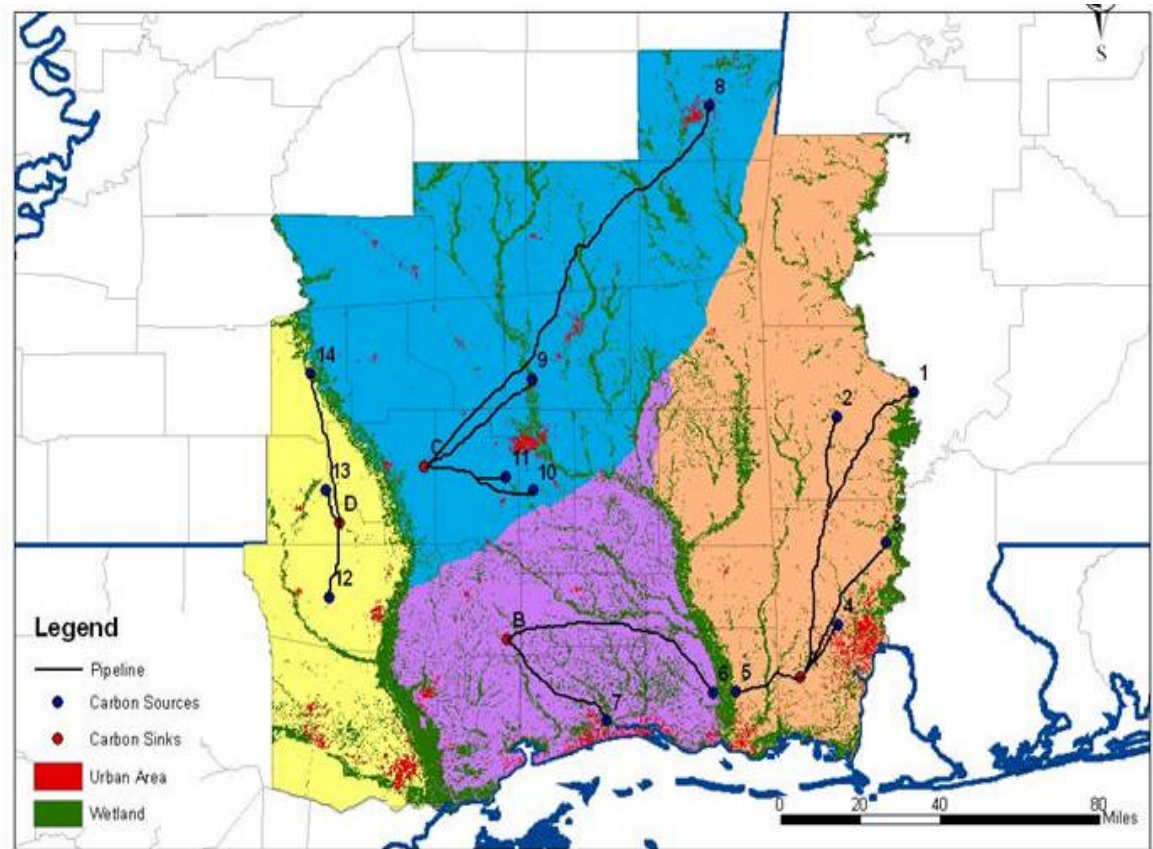
- Identify areas of current use
- Determine areas suitable for change
- Estimate additional carbon stored
- Include risk, other externalities
- Estimate opportunity, conversion, MMV costs
- Field check carbon storage estimates



Carbon supply curves for afforestation activities on candidate rangelands at 20, 40 and 80 years.

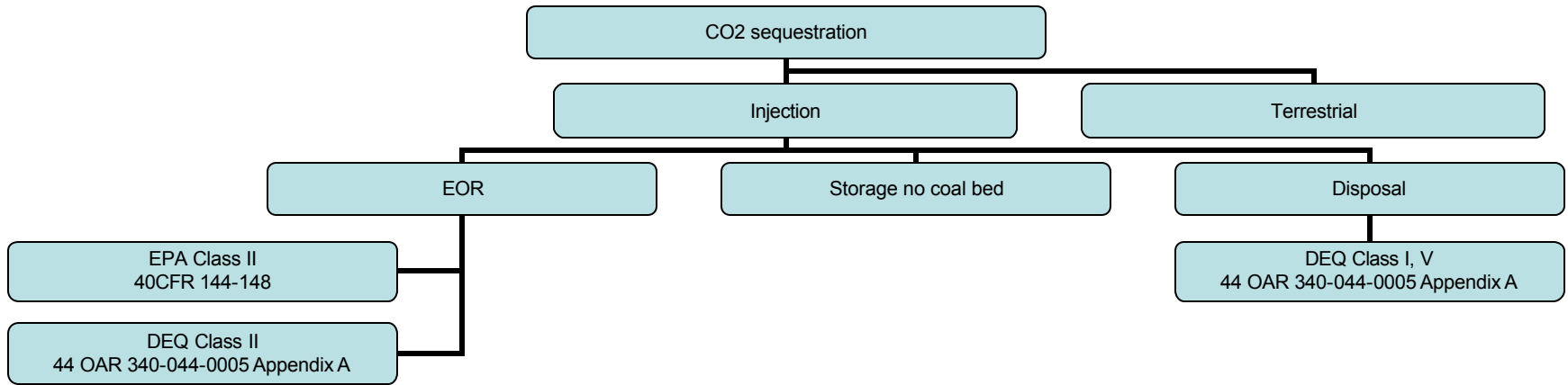
# Costs are Calculated for Point Source-Geologic Site Combinations

- Costs include capture and separation, compression, pipeline transportation, injection
- Cost offsets for additional oil or gas production taken if feasible
- Analyses carried out using GIS-based system



Example of source-sink matching using GIS system

# Regulatory and Permitting Requirements Are Compiled and Assessed



# Is CO<sub>2</sub> storage safe?

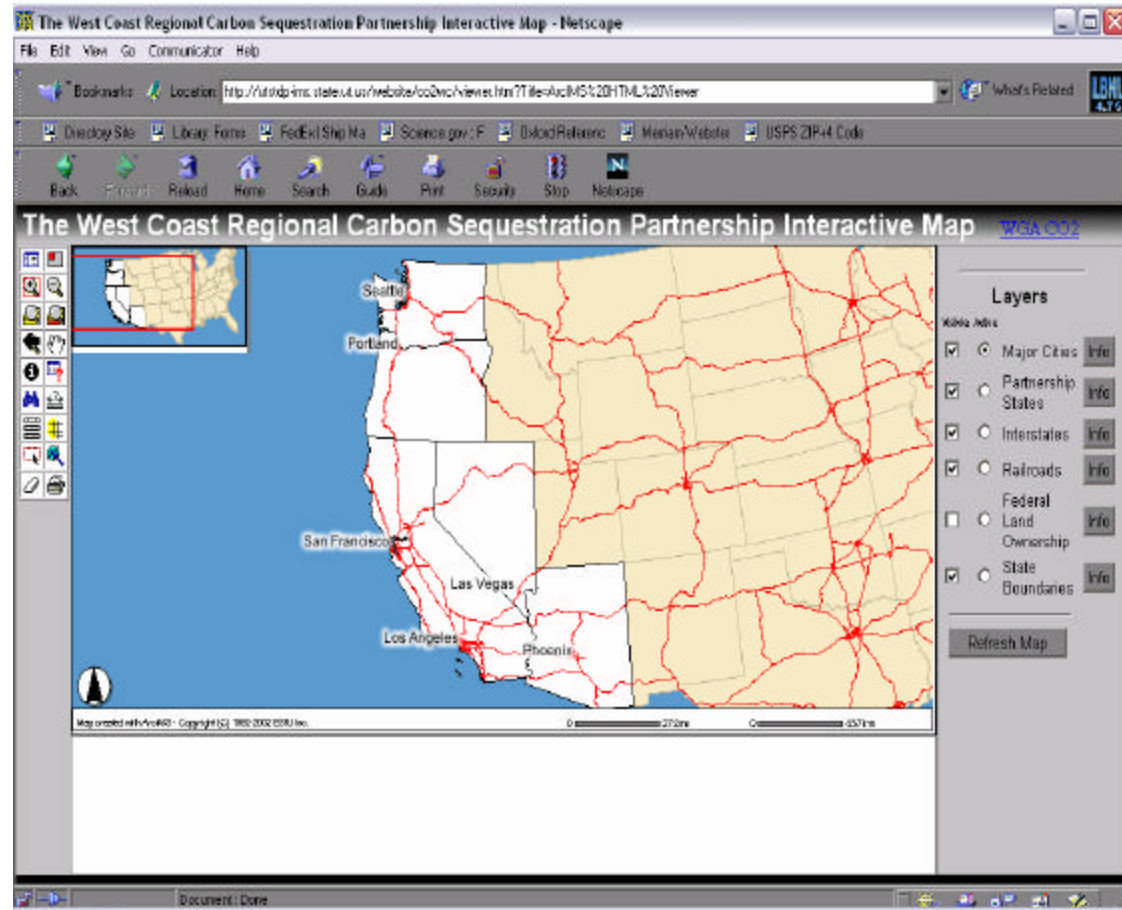
# Security Against Leakage Is an Important Factor in Geologic Site Selection

- Geologic sites are screened for adequate depth; isolation from potable water; multiple, continuous seals (e.g., shale layers); distance from active faults
- Spreadsheet model for scoring possible health, safety and environmental risks help in screening
- Evaluation of available monitoring technology being carried out for example geologic site locations in WESTCARB



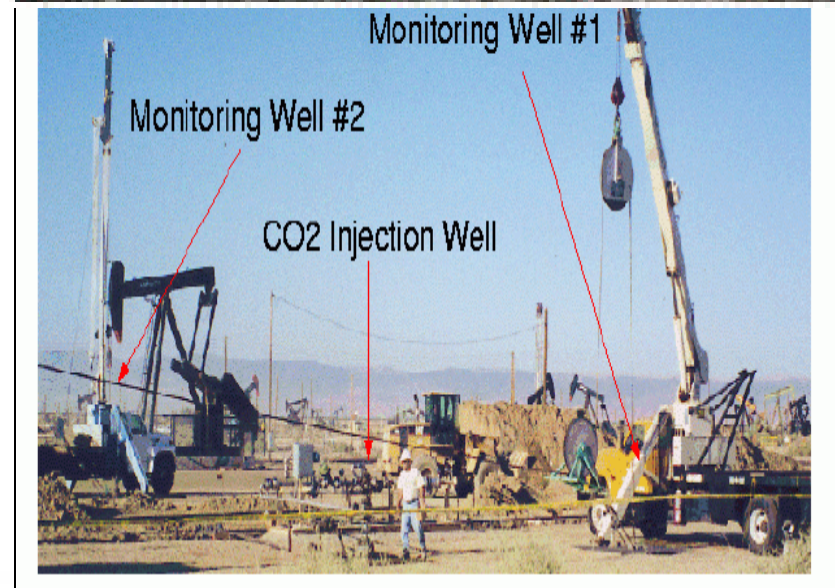
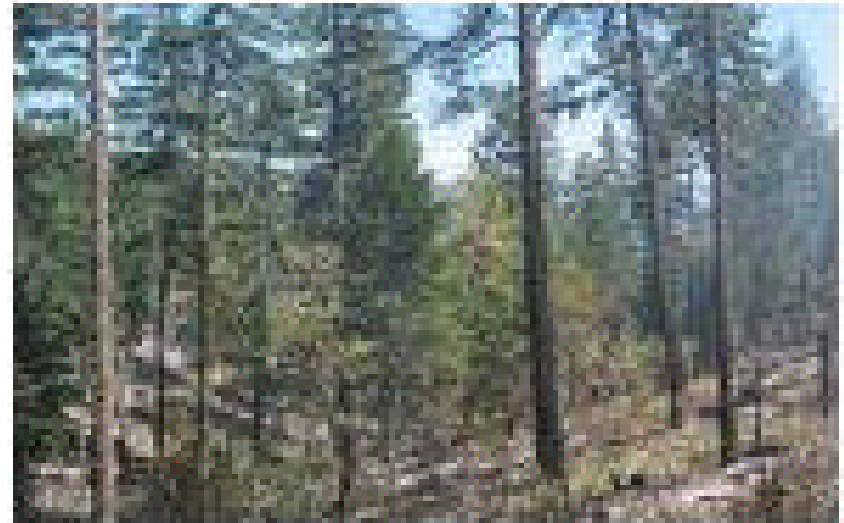
# Transparency Is Essential

- Broad stakeholder participation
- Public meetings, education materials
- Public access to information through web site and Internet Mapping Site at Utah AGRC (go to [WESTCARB.org](http://WESTCARB.org) and click on “carbon atlas”)



# Field Pilot Demonstrations Will Be Proposed for Phase II

- Pilots will be representative of best sequestration options, unique technologies and approaches, in region
- At least one terrestrial and one geologic pilot will be proposed for a five year study
- Pilots involve site-specific focus for
  - Testing technologies
  - Defining costs
  - Testing regulatory requirements
  - Validating monitoring methods
  - Assessing leakage risks
  - Gauging public acceptance



# Conclusions

- WESTCARB has been designed to advance the practical application of carbon sequestration
- Regional source/sink information is an important basis for decision-making at state and national level
- Phase I work is about half finished; new participants are still welcome
- Phase II field pilots are being developed – suggestions are welcome