



WESTCARB Annual Business Meeting

WESTCARB Phase III Overview

Terry Surles (surles@hawaii.edu)
Researcher
University of Hawaii
surles@hawaii.edu


Anchorage, AK
October 2, 2008



Phase III WESTCARB Objectives – “Framing the Debate”

- Conduct a 10-year, commercial-scale CCS test (1 million tons CO₂)
 - Access the one of the best geologic target in California
 - Use results to refine capacity estimates and “qualify” the Vedder formation for commercial application
- Project will utilize an advanced, commercial “sequestration friendly” oxy-combustion technology – Clean Energy Systems (CES)
 - Technology development supported by DOE and CEC since 1998
 - First commercial-scale facility of its type in U.S.
- Demonstrate commercial-scale injection site characterization, operations, maintenance, risk assessment, and monitoring (Schlumberger)
- Conduct research advancing technologies in reservoir modeling/simulation and engineering, risk assessment, and measurement/monitoring (LBNL, LLNL, Stanford)
- **The goal of the project is to establish that emission-free fossil power is possible and geologic sequestration is safe**
 - **Address both regulatory and public perception issues**

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP



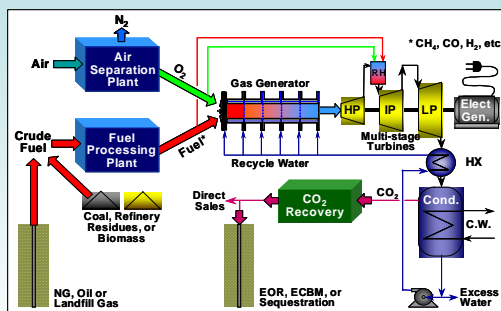
WESTCARB Phase III Complements California Environmental Goals and Business Initiatives

- AB 32 will require California utilities to reduce CO₂/MWh and increase the diversity of their carbon-neutral portfolios
- New generation with virtually no emissions eases the task of economy-wide GHG reductions and attainment of ozone ambient air quality standards (peak reserve margins are boosted as well)
- CES as a California technology developer will scale up from 5 MW_e to 50 MW_e with oxy-combustion technology
 - Saline formations provide storage medium, reduce the need for 50% cost share
- CO₂-EOR infrastructure development is now moving ahead in Kern County – see, for example, Michael Cox (Hydrogen Energy) presentation



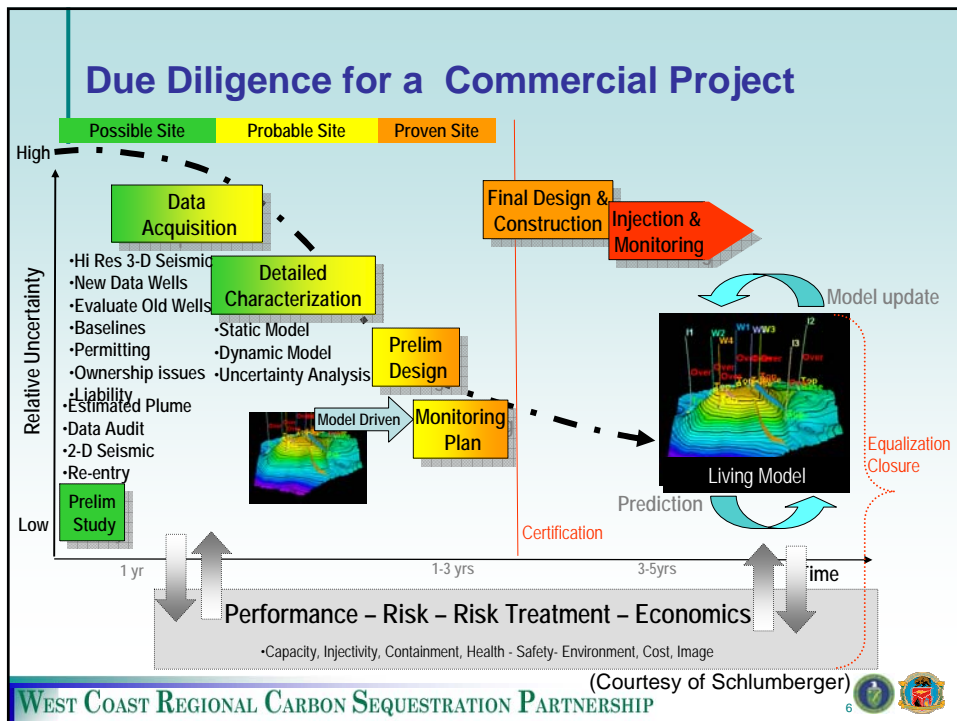
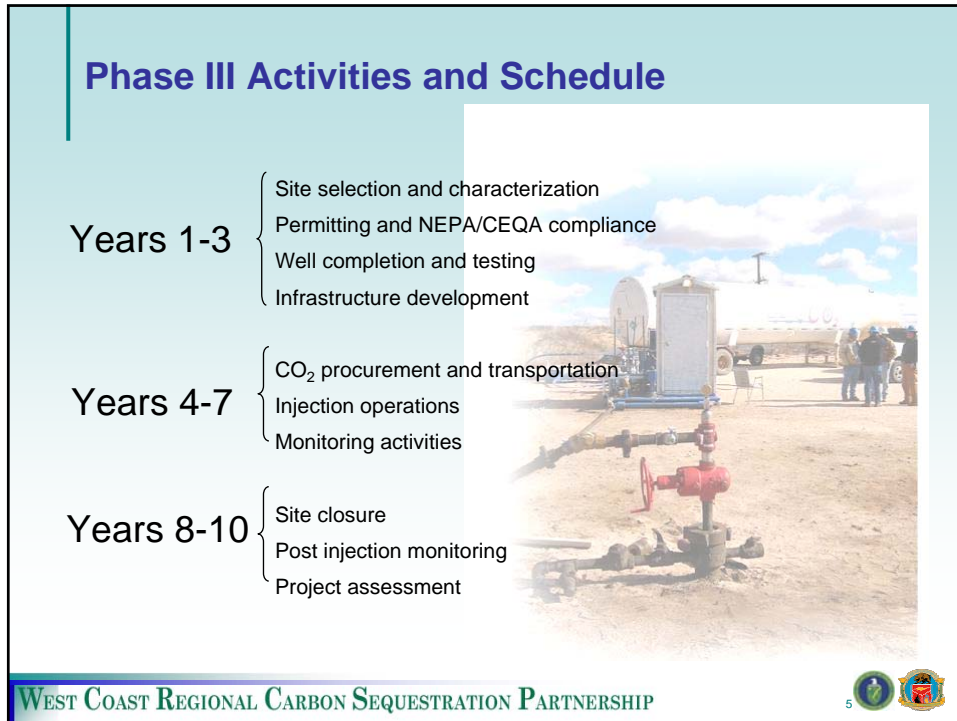
WESTCARB Phase III Test Was Developed From Phase II “Site Characterization” Pilot

- Lead industrial partners: Clean Energy Systems (CES), Schlumberger
- CES plans ~ 50 MW facility at Kimberlina, California (on CES property)
- Plant will provide ~250,000 tons of CO₂ per year for four years
- CO₂ injectivity testing 2010, full exhaust stream injection to begin in 2011
- Initial geologic modeling, reservoir simulation, and risk assessment under way
- Mineral rights and initial permitting issues seem workable; long-term liability for CO₂ unresolved



CES power generating system





Basic Requirements for Siting and Permitting Must First Be Met

- CEQA and other permit work to build and operate ~50 MW power plant is under way – CES/ENSR
- Drilling and other CEQA permits for injection of carbon dioxide is getting started
 - Terralog will develop materials for Underground Injection Control (UIC) permits, with support from the national laboratories
 - University of Hawaii, through an interagency agreement, will develop an RFP and contract for the surface injection facilities' CEQA permit
- Additional work to better characterize site for injection
- Subsurface ownership and other potential impact issues
- Address environmental justice issues as they emerge
 - Develop effective public outreach campaign



WESTCARB Phase III Project Provides Significant Regulatory Outreach Opportunity

- Likely early opportunity to apply forthcoming EPA Underground Injection Control (UIC) rule for large-scale CCS
- California Division of Oil, Gas, and Geothermal Resources (DOGGR) administers UIC permits for oil and gas wells; DOGGR could gain experience to petition for state primacy to administer CCS wells by “shadowing” WESTCARB application to U.S. EPA Region 9 for Kimberlina UIC permit
- Regulators from other WESTCARB states (and U.S. EPA Region 10) could be invited to participate



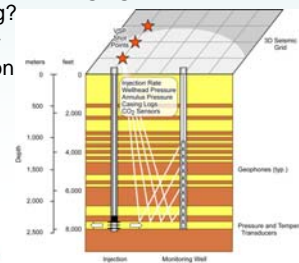
Managing Risk Is at the Core of Project Management and Milestones

- Risk assessment program
- Comprehensive site safety plan
- Careful site characterization
- Careful well construction and injection
- Prediction of plume behavior
- Comprehensive monitoring program
 - Surface and groundwater
 - Plume movement
 - Seismicity
- Mitigation plan
- Addressing regulatory, policy, outreach, financial risk issues



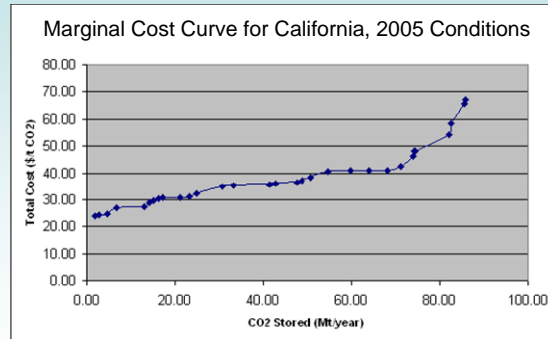
Phase III Monitoring Program Must Further DOE/FE and OS Research Goals, While Also Meeting All Practical Permitting Requirements

Pre-Operational Monitoring	Operational Monitoring	Post-Injection Monitoring
<ul style="list-style-type: none"> ▪ Well logs and cores ▪ Wellhead pressure ▪ Formation pressure ▪ Injection rate pressure ▪ Seismic surveys—3D and VSP ▪ Atmospheric CO₂ monitoring ▪ CO₂ flux monitoring? ▪ Pressure and water quality above the storage formation 	<ul style="list-style-type: none"> ▪ Well logs ▪ Wellhead pressure ▪ Formation pressure ▪ Annulus pressure ▪ Injection rate ▪ Seismic survey—VSP ▪ Atmospheric CO₂ monitoring ▪ CO₂ and O₂ flux monitoring? ▪ Pressure and water quality above the storage formation ▪ Distributed thermal perturbation sensor ▪ PSInSAR 	<ul style="list-style-type: none"> ▪ Well logs ▪ CO₂ and O₂ flux monitoring? ▪ Pressure and water quality above the storage formation ▪ Seismic survey—3D ▪ PSInSAR



Supply Curves for Geologic Storage Improve Cost Estimates

- CO₂ source characterization
- Capture cost estimation (about 80% of total cost) – oxy-combustion technology can reduce this cost
- CO₂ storage capacity estimation; AWWA concerns noted
- Transportation cost estimation – project is co-located with source and sink



Matching sources to sinks
(From H. Herzog, MIT)

Project Area Demographics and Outreach Strategy

- Oil and agriculture are predominant Kern County industries
- Local community and public officials familiar with drilling and injection (steamflood) operations
- Our industrial partners—Clean Energy Systems and Schlumberger—are well established in community
- Local institutions/industrial firms also involved in WESTCARB—California State University—Bakersfield, Occidental Petroleum, Western States Petroleum Association, others
- Although immediate neighbors to CES power plant (and injection site) are orchards and highways, environmental justice concerns are not being overlooked—local communication channels being developed

WESTCARB Phase III Project Provides Significant Public Outreach Opportunity

- Clean Energy Systems' oxy-combustion technology among lowest emitting fossil power systems; full exhaust stream being injected during WESTCARB project
- Easily accessed site; surrounded by orchards and fruit processing plants
- Rocket-engine origins of CES technology a draw for media
- Site may also host concentrating solar power demo, furthering clean energy image
- Plans for visitor center under discussion with Clean Energy Systems and its partners; excellent leverage opportunity for WESTCARB outreach



Summary of DOE Phase III Projects

- **Sources**
 - Natural gas processing facilities, including H₂S >40%
 - Ethanol plants
 - At least 2 post-combustion capture technologies
 - Oxy-combustion peaking power plant (WESTCARB)
 - IGCC power plant
 - Up to 3 Mt of CO₂ per year provided from each source
- **Geology**
 - 6 deep saline formations, carbonates and sandstones - from 3,000 to 13,000 feet deep
 - 1 depleted oil field (10,000 feet deep)
- **Comprehensive site characterization, modeling, monitoring, and risk assessment**

Administration Has Moved to “Deploy” Technologies

- Early, heavy pressure on DOE Office of Fossil Energy, based on misleading data and some self-serving interests, has been resolved in our favor
- Similar deployment initiatives seen in other program offices, such as Hawaii Clean Energy Initiative (EE) and Peak Demand Reduction projects (OE)
- Laws in new Congress and Administration may serve to accelerate CCS deployment; however, liability issue remains unresolved
- An insufficient number of late-stage demonstrations will serve to inhibit commercialization, due to non-acceptance by public and regulators – the “Yucca-lite syndrome”
 - Alternatively, a new Administration may push for more than the current seven demonstrations
- Both Presidential candidates pledge to put more funding into these efforts
 - Climate change issues
 - Petroleum dependency issues

WESTCARB Will Still Require Political Support

- Project activities and related technical and policy innovations are critical as new laws on carbon emissions are developed
- Technical leadership in new technologies and scientific advancement is in western U.S.
- Will serve as an alternative to renewable energy systems, end-use efficiency, and nuclear technologies, and allow for continued utilization of domestic energy resources
- **Need to remain vigilant and be prepared to obtain political support**