WESTCARB Annual Business Meeting

Geologic Carbon Sequestration Strategies for California
AB 1925 Report to the Legislature

Working Group Members:

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AB 1925 part of California's strategy to address climate change

Executive Order S-3-05 established three target reduction levels for GHG emissions in California

- 2000 levels by 2010
- 1990 levels by 2020
- 80% below 1990 levels by 2050

AB 32 requires Air Resources Board to adopt regulations to report and verify greenhouse gas emissions and adopt limits at 1990 levels to be achieved by 2020

SB 1368 sets an emission standard (1100 lb-CO_2/MWh) and prohibits long-term power purchase agreements for baseload power with emissions greater than that standard

AB 705 (now a 2-year bill)

AB 1925 requires an assessment of California's readiness for geologic carbon sequestration

- Introduced by Sam Blakeslee
- Bill passed unanimously in August 2006
- Requires the Energy Commission, with the Dept of Conservation, to prepare a report containing:

  …recommendations for how the state can develop parameters to accelerate the adoption of cost-effective geologic sequestration strategies for the long-term management of industrial carbon dioxide.

- Report is part of 2007 Integrated Energy Policy Report

AB 1925 was followed by AB 705

- Requires DOGGR, with CalEPA and the Geological Survey, to adopt, by January 1, 2011, standards and regulations for geologic carbon sequestration.
- Requires DOGGR and CalEPA enter MOU with the US EPA to establish appropriate jurisdiction under USEPA's Underground Injection Control Program.
- Requires DOGGR, in collaboration with CalEPA and the Resources Agency, to:
  - Take reasonable efforts to follow the recommendations of the CEC's AB 1925 report and explain deviations from the CEC's recommendations.
  - Develop regulations that provide for reporting and public disclosure of information and data to maximize transparency and accountability

AB 705 met strong opposition from EJ community in Committee hearings—now a 2-year bill

Meanwhile, CEC made case for phased approach for AB 1925 report

- Data needed to inform AB 1925 report not yet available
  - WESTCARB Phase II studies and pilots
  - Other RCSP studies
  - R&D component of bill
- 2007 report will be first of two reports
  http://www.energy.ca.gov/2007publications/CEC-500-2007-100/CEC-500-2007-100-SF
- Second report due to legislature in 2010

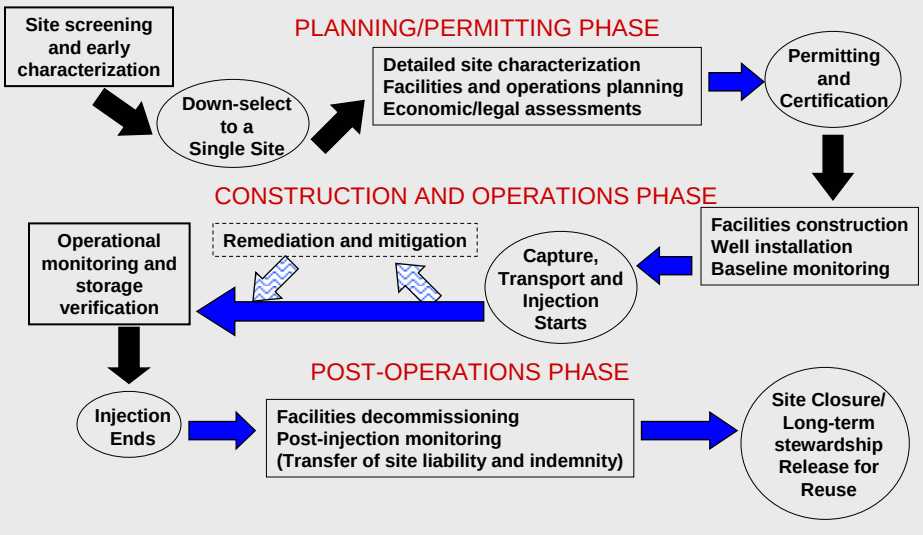
Report process engaged experts, agencies, stakeholders and the public

- Multidisciplinary team of experts provided foundational white papers for core chapters
- Two workshops held
- Engaged other state agencies
- Received input from various stakeholder groups

AB 1925 Report Schedule

Milestone	Target Date
Posting of final first report	November 21, 2007
Adoption by the Energy Commission	**December 5, 2007**
Report to be submitted to Legislature	**December 2007**
Second report	**November 2010**

Parameters must address all phases of a CCS project



Contents of the report

1. Role of CCS in California
2. Key Implementation Issues
3. California's sequestration capacity
4. Capture technologies
5. Site characterization and certification
6. Monitoring and verification
7. Risks and risk management
8. Remediation and mitigation
9. Economics
10. Statutory and regulatory frameworks
11. Recommendations

existing technology supports moving forward, but need proof-of-concept

It's (too?) expensive

Ambiguous and messy

Recommendations

- Developed iteratively
- Limited to actions, etc. over next 3 years to inform the second report
- Had to pass the policy "stink-bomb" test

- Discussion session—
  - Does this recommendation lead to promoting commercial CCS adoption?
  - What specific actions can be taken?

Recommendations in first report address next steps:

1. Over the next three years, any state planning and other analyses involving energy or greenhouse gas emissions reduction strategies, as appropriate, should include consideration of carbon capture and sequestration options.

   Better cost estimates should be developed and policy makers at all levels of government should consider them an appropriate proxy for the long-term value of CO_2 reduction.

CCS is relevant to many California studies focused on GHG management

- Market Advisory Committee to ARB: Recommendations for design of a cap-and-trade system
- CEC's scenario analysis of California's electricity system—impact on GHG emissions
- Cost of electricity generation studies
- Technologies to consider in broad economic assessments of effects of GHG mitigation policies (e.g., ETAAC)

Economics presently do not appear to support a business case for CCS

	per metric ton
– Capture	
• Pulverized coal	$55
• IGCC	$47
• NGCC	$76
• "Pure" CO_2 industrial emissions	$10
• Small industrial sources	$80–100
– Transport (>10 MMT/yr) (per 100 km)	$0.50
– Injection and Storage	$0.5–$8
– Monitoring	$0.1–$0.3
– Less EOR	-$20

CCS costs much higher than existing carbon pricing estimates

Some issues to consider

- How is CCS best presented to demonstrate its relevance and role in climate change mitigation options (esp. in a state like CA without big coal plants)?
- How do we fairly assess CCS value/economics relative to other options (e.g., considering baseload, opportunities for net negative emissions when combined with biomass feed stocks)?

Recommendations in first report address next steps:

2. Further examination is needed of the scenarios for carbon capture and sequestration adoption identified in this report as early opportunities, based on potentially close-to-favorable business cases. These opportunities may have greater value than as niche applications and may facilitate creation of an in-state market for CO_2 by demonstrating enhanced oil and gas production.

Significant potential to take advantage of EOR opportunities

Types of Oil Field Storage Reservoirs	Number of Fields	Estimated Total Storage Capacity (MMT CO_2)
Oil fields with CO_2 storage potential	176	3,563
Oil fields with miscible CO_2-EOR potential	121	3,186
Oil fields with immiscible CO_2-EOR potential	18	178
Oil fields with CO_2 storage capacity but no EOR potential (fields lacking API data also included)	37	199

80% of large emissions sources are within 50 km of a potential EOR site

Early economic opportunities in alternative fuels

- Ethanol
  - Only a few large plants currently in California, more planned
  - About 2500 metric tons CO_2/1 million gallons of ethanol produced
  - Emissions are essentially pure CO_2 so avoids separation costs
- Hydrogen
  - CO_2 capture integrated into syngas and hydrogen production by pre-combustion process

Some issues to consider

- What specific parameters affect the business case for these opportunities (e.g., infrastructure, value of CO_2 for EOR)?
- How do you extrapolate importance of "niche" opportunities?
  - in context of carbon emissions pricing vs. technology cost
  - growth of niche emissions

Recommendations in first report address next steps

3. Demonstration projects in the United States and around the world over the next three years will provide key data to set carbon capture and sequestration policy. They should be facilitated and carefully studied, and may provide early insight into public and property owner concerns about risks.

WESTCARB has a role in providing data and analysis

- Refined CCS potential studies (Phase II)
- Small-scale demonstrations (Phase II)
- Large-scale demonstrations (Phase III)

Discrepancy between early economic opportunities and demonstration projects?

- Early opportunities are
  - "pure" CO_2 industrial emissions
  - CCS-EOR
- Demonstration project focus on saline formations

2007 report removes distinction—depleted hydrocarbon reservoirs are treated as a subset of saline

Some issues to consider

- How do we assure that demonstration projects are designed to provide core information applicable to a range of CCS options?
- How can (RCSP) demonstration project data intercomparisons be facilitated or optimized?

Recommendations in first report address next steps

4. California's power imports encourage consideration of carbon capture and sequestration in a regional context. Coordinated investigations of carbon capture and sequestration for power plants should take place involving other states in the Western Electricity Coordinating Council region. This should be done in the context of recognizing the connection between regional climate change and electricity generation objectives and involve consideration of how carbon responsibility should "flow" with electricity.

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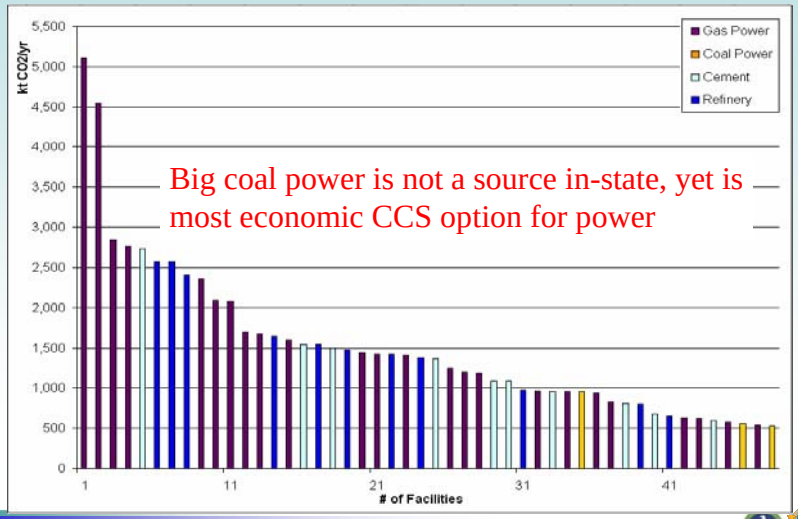
A closer look at California's point sources



CCS for coal implies a focus for California on imported power

- Imported power generates about 60 MMT CO_2/yr (compare to 48 MMT CO_2/yr in-state)
- SB 1368 sets an emission standard (1100 lbs CO_2/MWh) and prohibits long-term power purchase agreements for baseload power with emissions greater than that standard

Some issues to consider

- How does addition of CCS affect ranking of coal plants in loading orders, GHG emissions scenarios, and in costs of power?
- How could carbon "flow" with electricity?

Recommendations in first report address next steps

5. Regulatory and statutory ambiguities and barriers identified in this report must be addressed, potentially through efforts that cut across the agencies that will ultimately be involved in regulating carbon capture and sequestration, from surface facilities through injection to sequestration and verification of climate change mitigation. These efforts would include evaluating the need for protocols and, as applicable, drafting them. This would include protocols for site characterization, monitoring and verification, and contingency plans for remediating leakage.

Various agencies may have jurisdiction over aspects of CCS

- CA Dept of Conservation (DOGGR) – underground injection
- CA Air Resources Board—climate
- Office of the State Fire Marshal--pipelines
- EPA Region 9—underground injection
- Energy Commission—power plant siting (CEQA)
- Local agencies, etc….

Some issues to consider

- CCS project life-cycle period—
  - What constitutes “permanent” storage?
  - What limitations on liability period are reasonable from a business perspective?
  - What happens to carbon credits if liability for carbon is transferred?
  - Mineral lease terms for CCS-EOR?
- How to streamline/coordinate among agencies?
  - How to tackle creating protocols?