California's Policy Approach to Develop Carbon Capture, Utilization and Sequestration as a Mitigation Technology

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INTRODUCTION

California (CA) contributes 7.5% of the total greenhouse gas (GHG) emissions in the U.S., or 1.8% of global emissions. A major barrier to commercialization of carbon capture, utilization and sequestration (CCUS) in the U.S. is attributed to the lack of federal climate legislation. In contrast, California has been aggressive in adopting climate change mitigation policies and in 2013 will start to put cap-and-trade into practice. Many studies have shown that CCUS is necessary to meet GHG reduction goals, but there has been little progress toward commercial-scale CCUS projects. This poster describes the history of California's CCUS projects and related policy with the aim of identifying barriers to CCUS adoption.

CALIFORNIA'S GHG REDUCTION POLICIES, METHODS & GOALS

2003

CA Energy Commission (CEC), with LBNL, wins a US DOE solicitation to form the West Coast Regional Carbon Sequestration Partnership (**WESTCARB**). 1st phase work identifies geologic and terrestrial CO_2 storage options in the western U.S. and Canada.

West Coast Regional Carbon Sequestration Partnership westcarb.org

2004

Governor's Executive Order S-3-05 sets GHG reduction goals:
- **Emissions to 1990 levels by 2020 (~25% reduction)**
- **Reduction to 80% below 1990 levels by 2050**

2005

WESTCARB initiates 2nd phase focus: pilot-scale demos of geologic and terrestrial storage, while continuing geologic characterization. But three successive industry partners withdrew from projects in CA.

CA Assembly Bill (AB) 32, the **Global Warming Solutions Act**, codifies Executive Order S-3-05 and directs Air Resources Board (CARB) to establish methods to meet 2020 reduction goal [1].

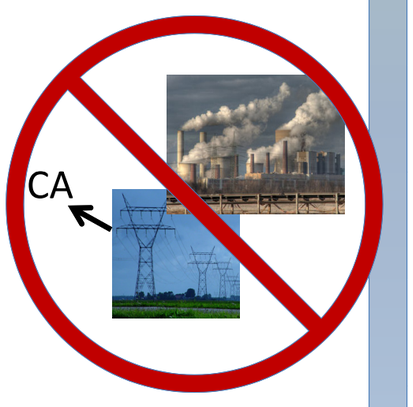
2006

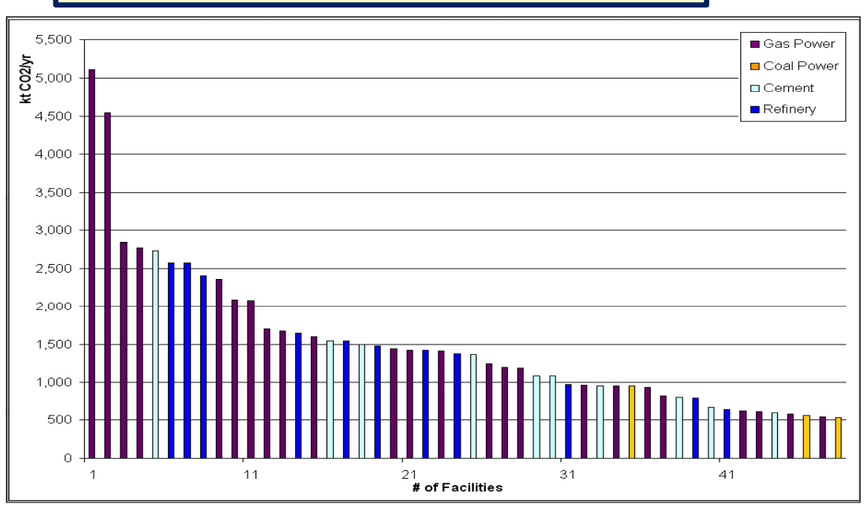
AB 705 is **not** passed. Would have given permitting and regulatory authority of CCS to the CA Division of Oil, Gas and Geothermal Resources (DOGGR, a division of the Department of Conservation).

AB 1925 requires the CEC and the CA Dept. of Conservation to make recommendations to facilitate adoption of CCS by industrial emitters.

CA Senate Bill (SB) 1368 prohibits utilities from signing long term power purchase agreements if generator emits >500 kg (1,100 pounds) of CO_2 per MWh (~ emissions of NGCC power plant).

WESTCARB and its partners begin producing a wealth of data about CCUS and CO_2 storage potential in the western U.S., e.g., see [2][3].





CO_2 emissions from California's 48 largest point sources: natural gas power plants, refineries and cement plants [4].

2007

WESTCARB starts 3rd phase to develop a commercial-scale CCS demo project in CA with Clean Energy Systems, with oxy-fuel combustion and saline storage. Later, project cancelled due to insufficient financing.

2008

Hydrogen Energy California (HECA), owned by BP and Rio Tinto, wins a DOE American Recovery and Reinvestment Act (ARRA) grant to build a 390 MW gross, 250 MW net, IGCC plant producing hydrogen, electricity, and CO_2 for EOR in Occidental's Elk Hills Oilfield in southern CA.

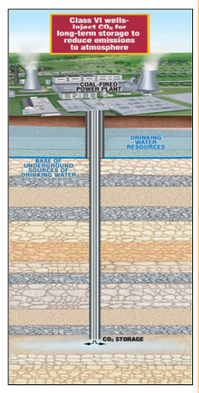
2009

C6 Resources, a subsidiary of Shell Oil Company, wins an ARRA grant to study a CCS project for sequestration of refinery emissions in northern CA. WESTCARB partners on the project. Later, C6 withdraws. Shell shifts focus to Quest CCS project in Alberta, Canada.

2010

U.S. President establishes the Interagency Task Force on CCS to develop a Federal plan to overcome barriers to CCS within 10 years and bring 5-10 commercial demo projects online by 2016.

U.S. Environmental Protection Agency issues Underground Injection Control (UIC Class VI) regulations for CO_2 injection and establishes the GHG Reporting Rule for annual reporting of industrial CO_2 emissions.

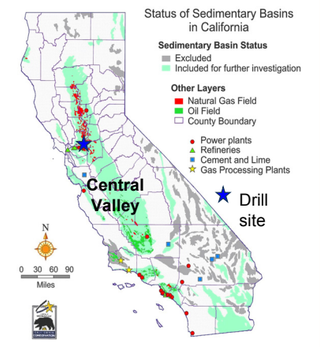


Three CA agencies (CEC, CPUC, CARB) establish the California CCS Review Panel to recommend ways to remove policy, regulatory and institutional barriers to CCS [5].

CARB approves the cap-and-trade program, which includes CCUS as an option to meet GHG emissions reductions.

2011

HECA project sold to SCS Energy. Modified design reforms coal/petcoke to produce hydrogen for electricity generation, and urea for fertilizers. Permitting is currently underway at the CEC.

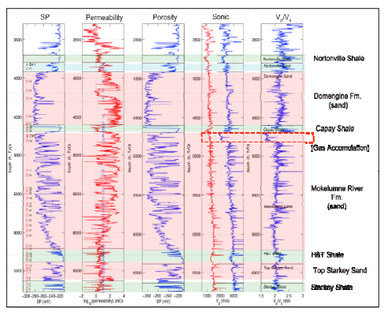


CEC study states that a commercial-scale, utility sector CCUS demonstration project is necessary in CA to show technical and fiscal feasibility, as well as functional regulatory and legal mechanisms [6].

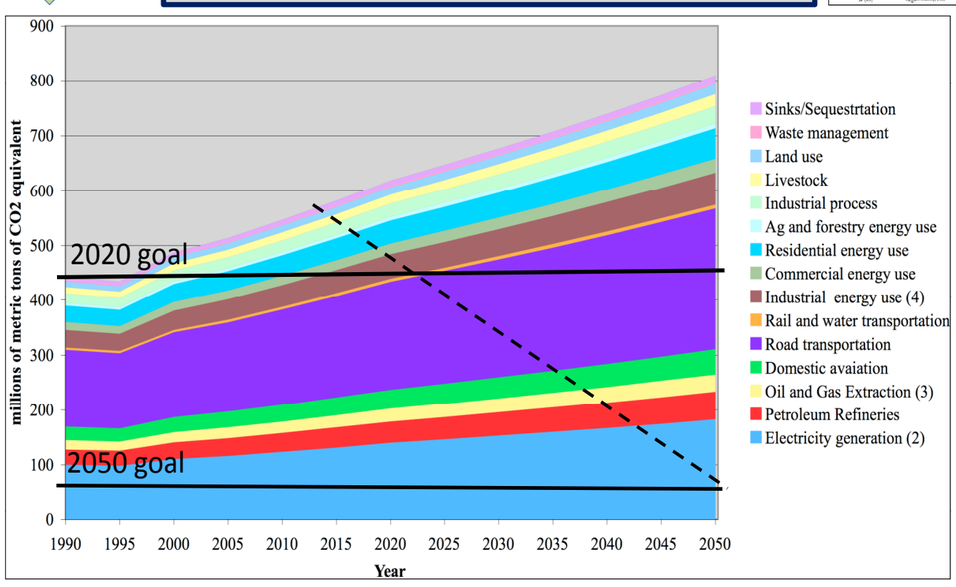
WESTCARB drills a geologic characterization well in the SW Sacramento Basin. LBNL begins analyzing samples and log data to determine storage potential.

2012

California Council on Science and Technology, after studying energy growth and CO_2 reduction technologies to meet the 2050 goal [7][8], says widespread adoption of CCUS is required.



SB 1139 is **not** passed. Would have given permitting and regulatory authority to DOGGR for CO_2 injection associated with EOR.



California's actual and projected GHG emissions 1990-2050 with 2020 and 2050 goals [9].

Dashed line shows the average removal rate of ~14 million tonnes of CO_2 equivalent (14 Mt CO_{2e}) per year needed to meet the 2050 goal.

2013

California begins to roll out cap-and-trade program.

2020 ? ..... 2050 ?

DISCUSSION & CONCLUSIONS

With California cap-and-trade caps to be set in 2013, the value of carbon emissions remains unknown. Without financial drivers and protocols, few industry stakeholders will invest in CCUS. Considering the necessity of CCUS to meet 2050 goals and the long lead time, additional issues must also be addressed to reduce uncertainty:

Policy Issues
- Cap-and-trade protocols for CCUS, to be developed in 2015-2016
- Legal and regulatory issues unique to CCUS, such as long-term liability, pore space ownership, accounting for stored CO_2, and streamlined permitting
- CCUS infrastructure costs to be included in utility rate base
- Approval of power purchase agreements for electricity generated with CCUS, necessary for financing (could be similar to incentives for renewables)
- Determine the relative status of CCUS as a compliance method compared to other low- or zero-carbon power technologies, such as renewables.

Investments
- R&D to reduce the cost of capture technologies
- State and Federal support for CO_2 pipeline infrastructure for EOR or sequestration
- A utility sector CCUS commercial demonstration project [6] to show technical and fiscal feasibility, as well as functional regulatory and legal mechanisms.

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