WESTCARB: 2012

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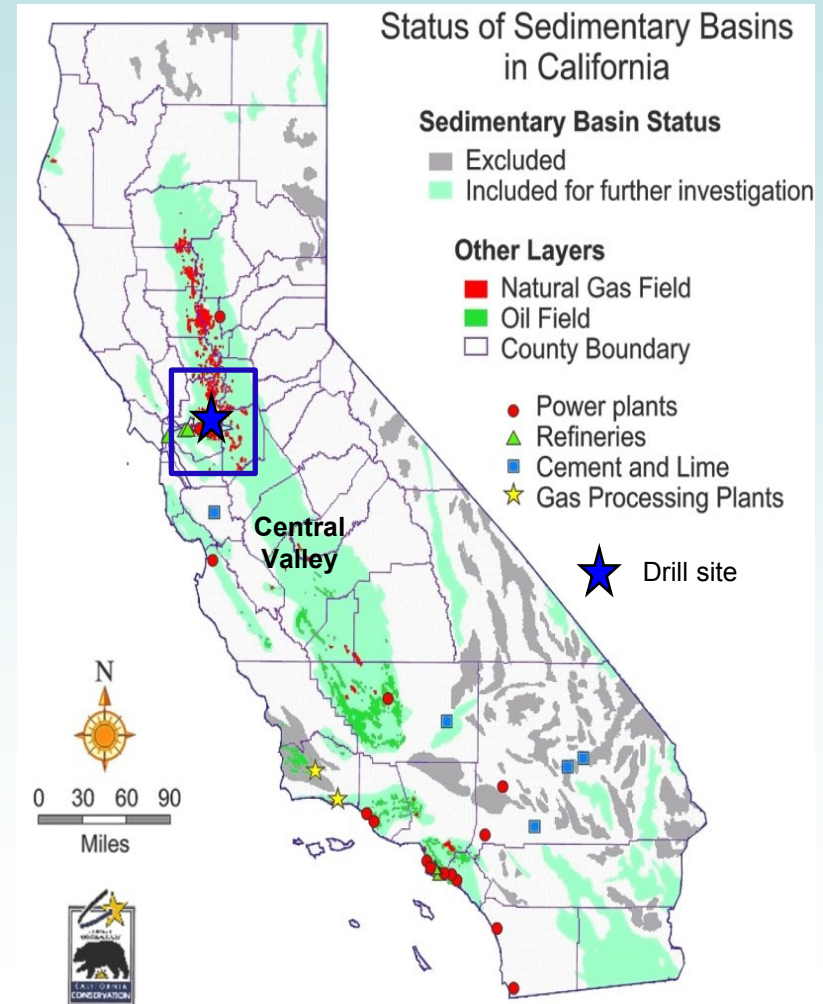*eburton@lbl.gov*
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Presentation Outline

- 2012 in review

- Retrospective—last 10 years

- Why do we really need CCUS?

- Next steps

# Characterizing CCUS Potential of Northern California's Central Valley

- California Geological Survey –

  Central Valley is most promising on-shore CO_2 storage resource in WESTCARB territory with estimated resource of 75-300 Gt in saline formations and natural gas and oil-bearing formations

- The Citizen Green #1 Well Technical Team is performing multi-scale studies to assess storage potential of key formations

Status of Sedimentary Basins in California

Sedimentary Basin Status
- ■ Excluded
- ■ Included for further investigation

Other Layers
- ■ Natural Gas Field
- ■ Oil Field
- □ County Boundary

- ● Power plants
- ▲ Refineries
- ■ Cement and Lime
- ★ Gas Processing Plants

★ Drill site

Central Valley

N

0 30 60 90
Miles

Citizen Green Well team, budget and timeline

- The Citizen Green #1 Well Technical Team
  - BKi
  - California Institute for Energy and Environment, University of California-Berkeley
  - Lawrence Berkeley National Laboratory
  - Lawrence Livermore National Laboratory
  - Princeton Natural Gas, LLC
  - Schlumberger Carbon Services
  - Sandia Technologies
  - Service providers (Stratigraphic, Paul Graham Drilling, Tom Fazio and many others)
  - Collaborators from two FERCs, Sandia National Lab, TBEG, UC Berkeley, CSU Bakersfield, and other universities
- < Six months from permit to well completion
- ~ $3 million dollars

www.westcarb.org
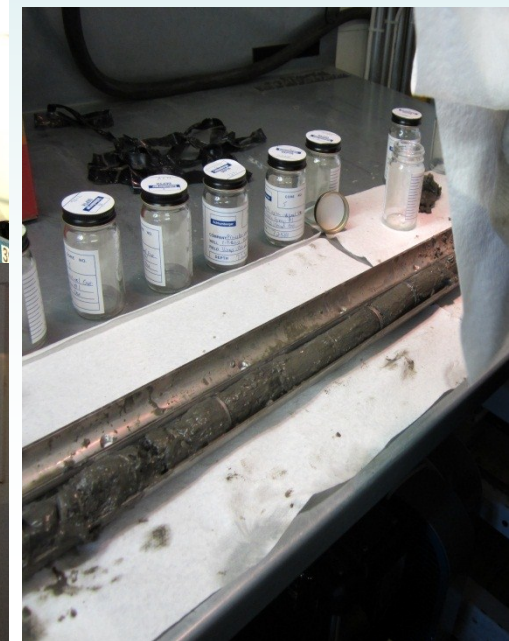
Assessment of CCUS for Natural Gas Combined Cycle Power Plants

- Includes engineering, economic and geologic assessments

- Technical Team
  - Bki
  - Lawrence Livermore National Laboratory
  - Shaw Group
  - Industry Partners (PG&E, SoCal Gas, SCE, SMUD, Clean Energy Systems)
  - Visage Energy

- ~50% of state's electricity generated with natural gas from young plants that operate at high capacity factors.

- Many plants located above or near potential CO_2 resource, including oil fields suitable for CO_2-EOR.

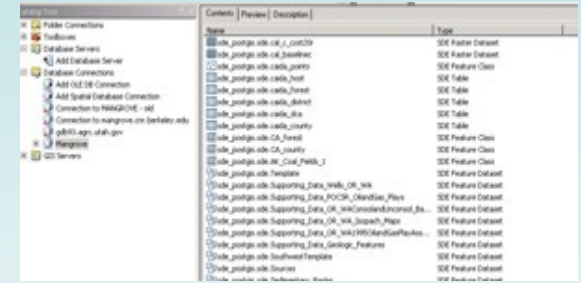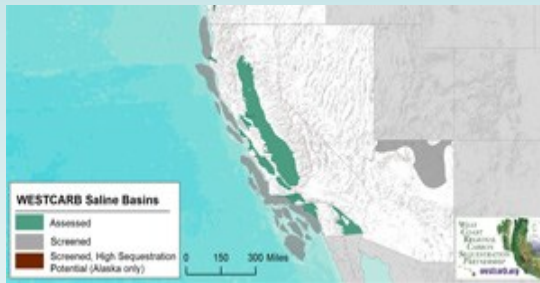WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP
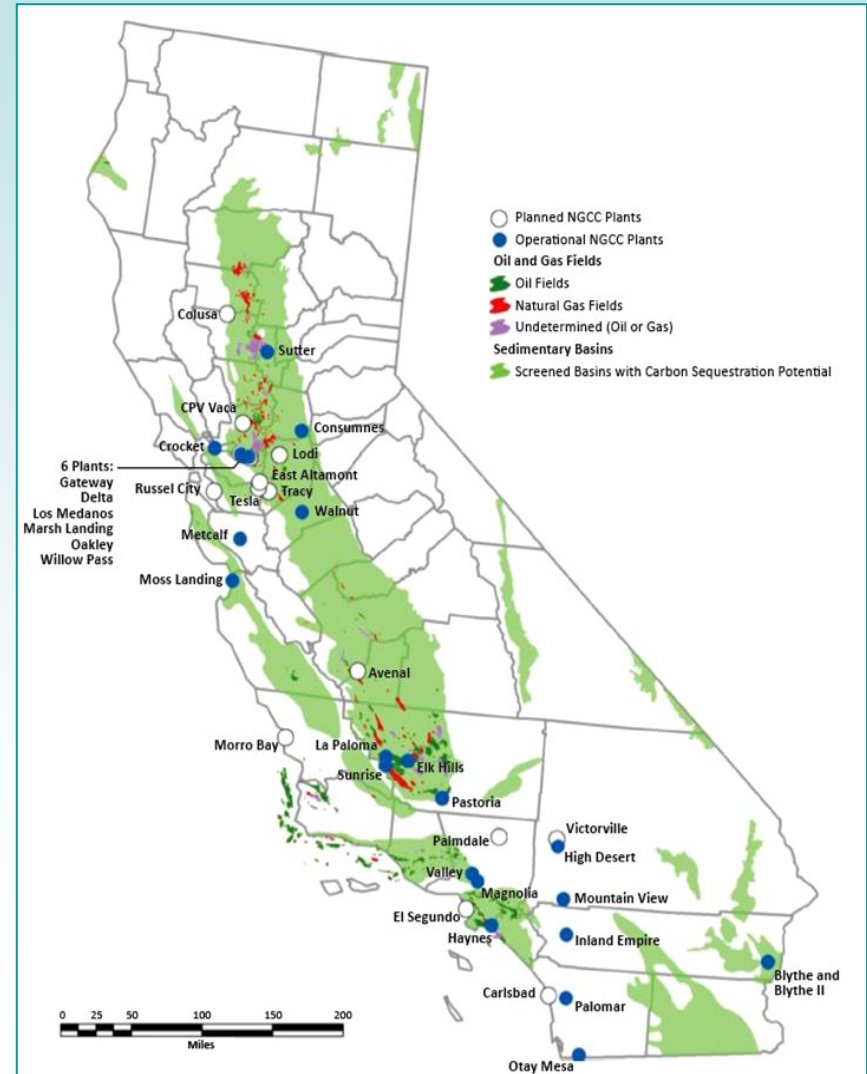
Regional characterization in Arizona

- Mapping and capacity estimates for Paleozoic and Tertiary Basins—Arizona Geological Survey
- Plans for acquisition & reprocessing of existing seismic data and new seismic surveys—Schlumberger
- Characterization well—EPRI
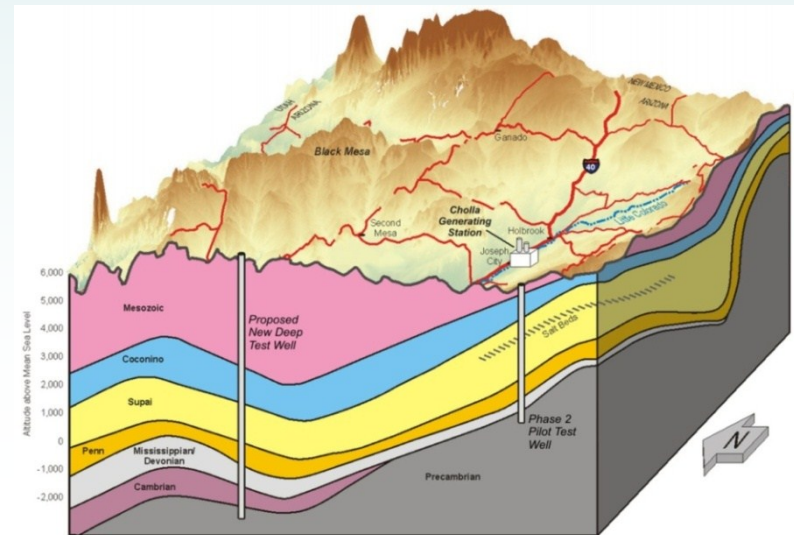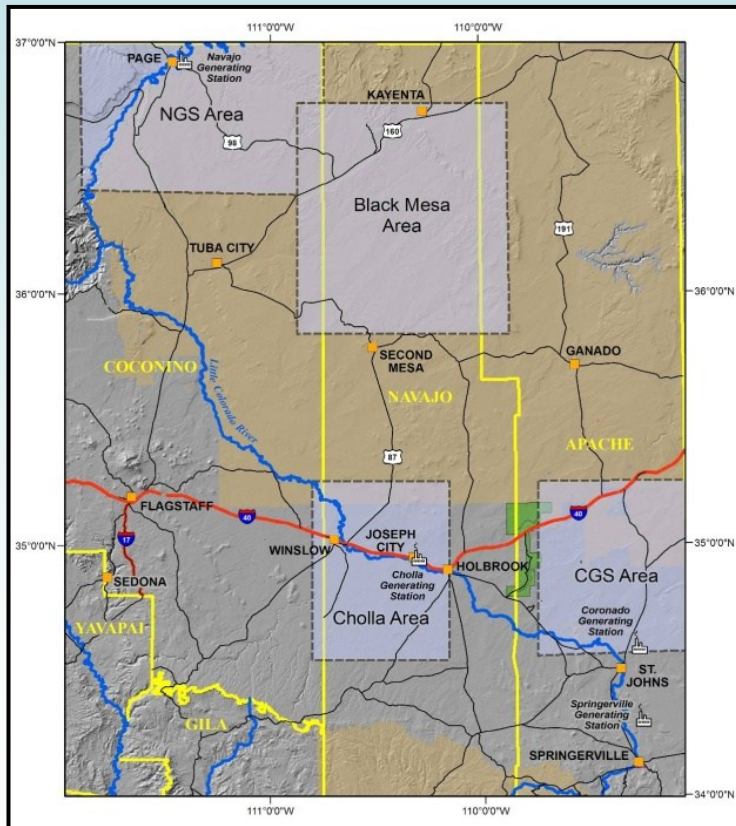
WESTCARB Carbon Atlas

Map gallery
View and download maps highlighting Westcarb data in pdf or jpeg formats

Data explorer
Launch interactive web maps to explore and download Westcarb data

Data access
Download Westcarb data in a variety of formats including gis files and arcgis web services

Maintained by UC Berkeley's Geospatial Innovation Facility (gif@berkeley. edu)

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

Ten Years of CCS Activities

- 2003 WESTCARB begins characterizing CCS (geologic and terrestrial) potential in the western U.S. and British Columbia

- 2005-2006 California sets climate change goals and requires CARB to determine methods to meet the 2020 goal (AB32); Washington state adopts CCS regulatory framework; AB 1925 requires CCS report in CA; AB 704…

- 2009 WESTCARB drills a CO2 characterization well in AZ; HECA and C6 Resources receive ARRA grants to pursue CCS projects in California; Terralog characterizes Wilmington Basin….

- 2010-2011 C6 Resources exits, BP-Rio Tinto exit HECA, SCS Energy steps up; CES turbine testing; California CCS Review Panel; WESTCARB drills a well in CA; SB669, SB 1139 …

CCUS Activity in WESTCARB region
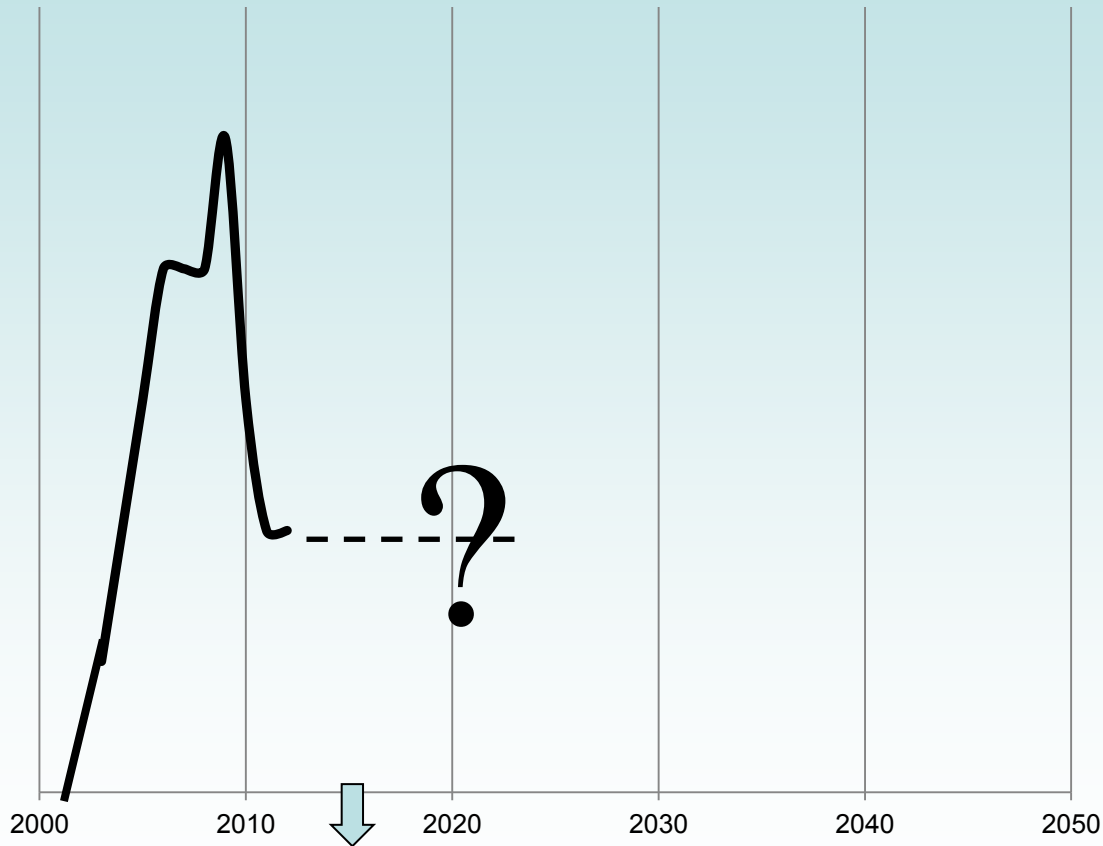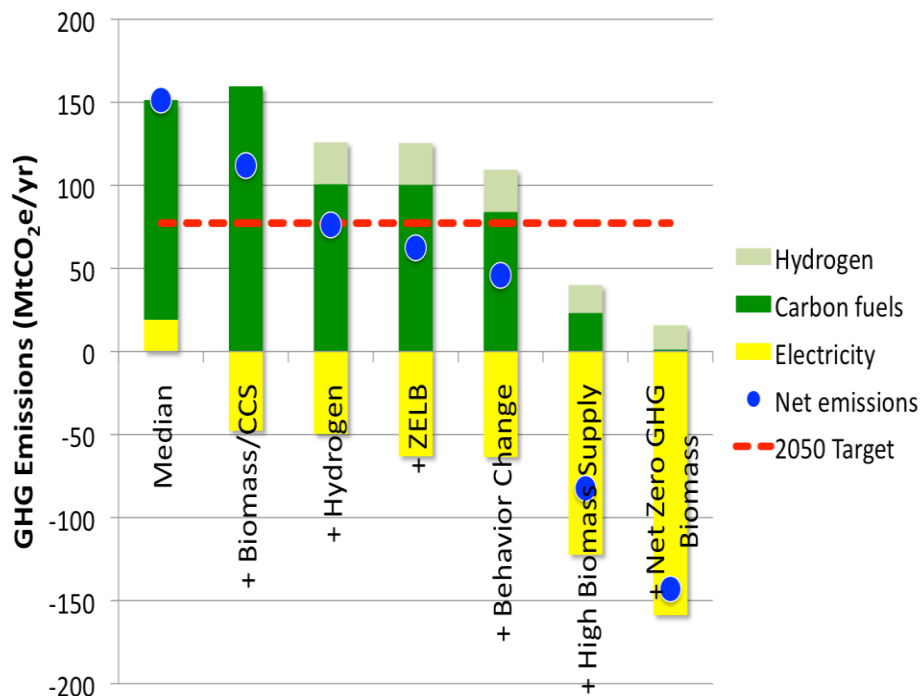

CARB to develop CCS
protocols 2015-2016

The path to the 2050 goal gets steeper with delay in adopting GHG mitigation technologies

From Schiller, 2007, CIEE
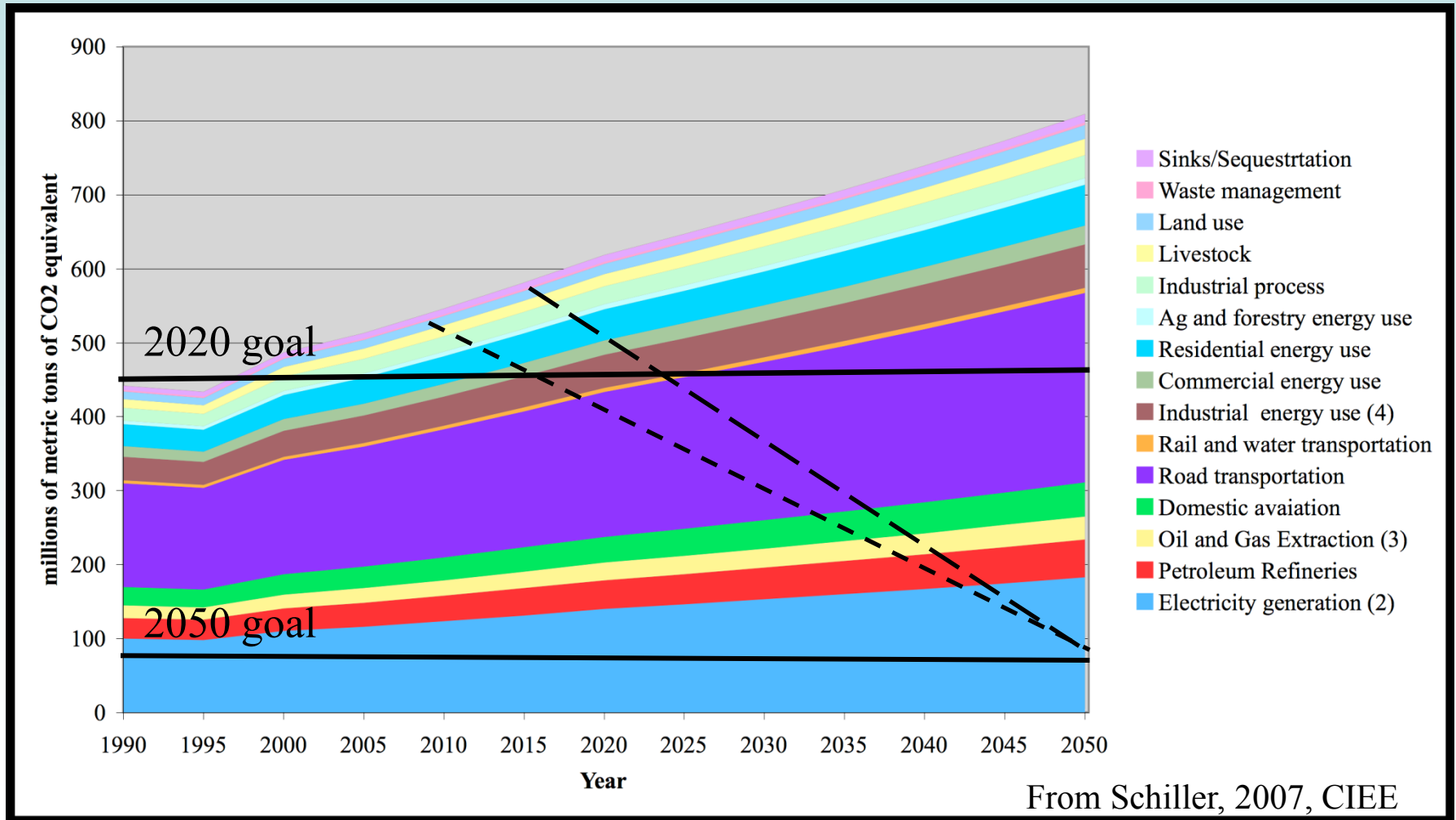
Studies consistently show CCUS required to meet 2050 goals

Getting to 80%: Example of Multiple Strategies

Y-axis: GHG Emissions (MtCO$_2$e/yr), ranging from -200 to 200

X-axis categories: Median, + Biomass/CCS, + Hydrogen, + ZELB, + Behavior Change, + High Biomass Supply, + Net Zero GHG Biomass

Legend:
- Hydrogen
- Carbon fuels
- Electricity
- Net emissions
- 2050 Target

California Council on Science and Technology

CCS lowers the total societal cost of addressing climate change by approximately 30%. [1] This does not mean that CCS lowers electricity prices. It means without CCS, more costly methods are needed to meet carbon dioxide reduction targets, which could add trillions of dollars. *Clean Air Task Force*

As we look to our energy future, California will need to commercialize and improve CCS technology now in order for it to be a viable option for reducing greenhouse gas emissions on a large scale beyond 2020. *Energy and Environmental Economics, Inc. (E3)*

http://www.ccst.us/publications/2011/2011energy.php

Conclusions

- CCUS technology development lags hoped for rates of progress

- Nevertheless, there are successes and a lot of tenacity by CCUS technology and project developers

- CCUS is a necessary part of the GHG emissions reduction toolbox

- While CCUS will be expensive, the cost of not meeting reduction goals will be greater (est. $60 billion/year in U.S.):
  - Crop heat stress and drought--$18 billion/year
  - Additional cooling--$11 billion/year
  - Coastal damage from sea level rise--$7 billion/year

Acknowledgments, Disclaimers

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