



## Introduction

Please note that these notes are intended to supplement the workshop presentation. Please refer to both materials for a more comprehensive overview of what this workshop covered. Presentation Slides are linked directly below (*in pdf format*) as well as in the corresponding sections lower in the notes.

## Presentation Slides

**California Air Resources Board:** *Matthew Botill, Division Chief, Industrial Strategies Division*

- [Overview: Carbon Sequestration: Carbon Capture, Removal, Utilization, and Storage Program \(SB 905, Caballero\)](#)

**Yolo County:** *Kristen Wraithwall, Sustainability Manager*

- [Update on Yolo County Climate Action and Adaptation Plan \(CAAP\) Carbon Sequestration Strategies](#)

**California Department of Water Resources:** *Tyler L. Anthony, PhD, Senior Environmental Specialist*

- [Sherman & Twitchell Island Subsidence Reversal & Carbon Sequestration](#)

**Sacramento - San Joaquin Delta Conservancy:** *Lauren Damon, Ecosystem Restoration and Climate Adaptation Projects Supervisor*

- [Carbon Efforts in the Delta](#)

## Workshop Notes

### [Basics of Carbon Capture and Storage \(CCS\)](#)

**Matthew Botill, California Air Resources Board**

- 2022 was a big legislative year with the passage of [AB-1279](#) and [SB-905](#)
  - Governor Newsom also called for 20 MMT CO<sub>2</sub>e removal by 2030, and 100 MMT CO<sub>2</sub> removal by 2045
- California's Climate Policy Framework includes GHG targets and goals (via legislation and executive orders) → CARB Scoping Plan, updated every 5 years → regulations and incentives to spur action → projects
- 2022 Scoping Plan Update
  - State strategy over the past decade has been to reduce the use of fossil fuels, a key source of GHG emissions
  - With carbon neutrality, need to also consider the feasibility of achieving a zero-emission future and if not, opportunities for carbon removal

- In-depth analysis of land-based strategies for carbon removal as a starting point before exploring other non-land-based strategies
- Need to start CCS projects today to deploy and scale efforts in this decade
  - Also need to consider changing climate – e.g., emissions resulting from refrigerants likely to increase as temperatures rise
  - Expecting significant reductions without CCS (e.g., 85% reduction in petroleum refining GHGs, but 94% reduction if combined with CCS strategies)
- Carbon Dioxide Removal (CDR) – i.e., pulling carbon out of the atmosphere - can address legacy emissions, and is supported by the science community and proven technologies
  - IRA provides [significant ongoing federal investments for CCS/CDR](#)
  - 2022 Scoping Plan showed need for CCS/CDR to achieve AB-1279 – nature-based solutions via natural and working lands and mechanical solutions via Direct Air Capture with Sequestration (DACs) and Bioenergy with CCS (BECCS) are both necessary
  - Role and scaling of CDR: GHG reductions +/- NWL (carbon storage opportunities but also recognizing that CA forests face risks due to wildfires, poor forest management, etc.) + CDR = carbon neutrality
- Concerns regarding heavy reliance on CCS/CDR leading to increased air pollution, but CARB focused on both emissions reduction and air quality
- Many strategies focused on demand-side reduction (not just reducing supply)

## Carbon Dioxide Capture Technologies & Incentives

### **Gavin Hoch, Matthew Botill, and Keiko Gee, California Air Resources Board**

- Various methods of CO<sub>2</sub> capture based on CO<sub>2</sub> concentration in stream (liquid absorption, solid absorption, calcium looping, membrane separation)
- Transportation options
  - CO<sub>2</sub> compressed to a supercritical fluid to reduce transport volumes – pipelines, trucks, rail, barge/ship
  - Distance between CO<sub>2</sub> sources and sequestration sites is the main determinant of transportation type
- Storage and utilization
  - Storage = in deep underground reservoirs (layer of porous rock where CO<sub>2</sub> can be stored); est. 149-843 Gt onshore storage potential in CA and est. 100 Gt offshore storage potential
  - Utilization, such as in cement and concrete, chemicals, fuels, materials
  - Enhanced oil recovery (EOR) - using CO<sub>2</sub> to create fuels - prohibited in CA
- **How much have we sequestered/stored underground in California to-date?** No projects in CA so far. But proof of concept with many projects injecting CO<sub>2</sub> underway across the U.S. and internationally. Additionally, many nascent carbon removal and sequestration technology research and pilot-scale testing underway.
- CCS costs
  - Capture typically the most expensive and variable cost with higher CO<sub>2</sub> concentrations being less expensive

- Energy costs associated with capture drives the cost of CCS, especially for direct air capture – need high penetration of renewables and significant expansion in renewable capacity
- CA incentives for CCS and CDR
  - [CARB - Low Carbon Fuel Standard program](#)
  - [CEC - Carbon Removal Innovation Support Program \(CRISP\)](#)
  - **How long does it take to get projects going?** Takes about 2 years to secure required permits (need Class VI permits for injection from EPA), which includes an assessment of potential storage sites and a suite of geological testing, injection modeling, etc. for the project-specific site. CA Geological Survey is also conducting a statewide study.
- Federal Incentives
  - IRS 45Q tax credits – originally enacted in 2008 and expanded by IRA in 2022
  - Cost estimated to be significantly higher than available tax incentives
  - [DOE Regional Direct Air Capture Hubs program](#)
    - Funding provided for 14 feasibility studies and 5 front-end engineering design studies, 4 of which are located in California
- **What does the injection process entail?** One to two injection wells where supercritical CO<sub>2</sub> is injected into the reservoir. Done in a way where pressure does not exceed fracturing (fractures can lead to potential conduits for leakage). Also requires computational modeling to assure that CO<sub>2</sub> is behaving in the expected manner; updates required every 5 years. Meters allow for constant tracking and monitoring of CO<sub>2</sub> flow, pressure, etc.
- **What can local governments do?** Need more renewable energy generation and local governments have local land use authority around electricity generation in their jurisdiction – also need transmission/distribution infrastructure, charging infrastructure (especially for heavy-duty vehicles).
  - [AB-2446](#) (low-carbon building materials strategy)
- **IOUs have been creating barriers – how can CARB help local governments install needed energy infrastructure?** Have been in discussion with CPUC on this (esp. Regarding 1-2 year delays for interconnections) and also working to identify additional incentives.

## Yolo County Climate Action & Adaptation Plan Carbon Sequestration Strategies

### **Kristen Wraithwall, County of Yolo**

- Carbon sequestration strategies primarily focused on lands-based strategies (85% of county's land use dedicated to agriculture)
- In 2020, County adopted a net negative by 2030 goal
- County's Climate Action & Adaptation Plan (CAAP) covers a suite of sectors with agriculture as a key sector for both mitigation and adaptation
  - Agriculture is a significant GHG source (in addition to transportation)
- Recognizing lengthy process of developing CAAP, already starting on early action project to accelerate pace and scale of carbon farm planning and implementation

- Going out to sites to conduct assessments, provide options, support planning, and connect growers to funding and financial incentives
  - Regional Conservation District has been a critical partner
- Intentional CAAP process to involve key stakeholders; all working lands sequestration strategies vetted by CAAP NWL Working Group and Yolo County Farm Bureau
  - 16 carbon farming strategies selected, each of which had co-benefits for producers (e.g., soil benefits)
  - Surveyed farmers and ranchers on 1) carbon farming strategies already being implemented, 2) strategies that could be feasibly implemented with support, and 3) support needed for implementation
- *Many great takeaways (see presentation)*
- ***What did the survey reveal as key barriers for farmers?*** Funding and technical assistance were the most common barriers (reflected in ~90% of responses). Many farmers didn't know that funding was available. Also heard from a farmer that, even with technical assistance, it took them 2 weeks full-time to write a grant application for \$30k that ultimately was not awarded. Often small, BIPOC, and/or new farmers face these barriers the greatest. A lot of trust building needed.
- ***Does the County aggregate form into a single healthy soils allocation, how ?*** Can apply for block grants to be distributors (possibly RCD as lead). Looking to
- ***Are you also working with California Community Alliance for Family Farmers and Kitchen Table Advisors?*** No formal partnership, but have been attending convenings, etc.
- ***On agricultural practices, State has been struggling to understand actual practices being implemented and quantifying benefits... what did you learn from your process?*** Farmers already have a lot of reporting and surveying they need to do (e.g., national ag survey), so a lot of data already being collected. The actual effectiveness of projects is so specific to the site (e.g., soil type, crops, etc.). This will be an ongoing process – planning to tweak the strategy list based on survey responses (e.g., to lean into/expand strategies of interest), roll out an incentive program, then continue adjusting based on future surveys, strategies of interest by farmers, etc.
- ***Any efforts on converting fossil carbon to soil carbon?*** Soil carbon amendments is one of the priority strategies (a bit of a catch-all for various types of amendments).
- Other resources/opportunities:
  - State getting \$35 million for regional food systems from feds
  - USDA streamlined reporting program
  - [CDFA Farm Equity Program](#)

### Sherman & Twitchell Island Subsidence Reversal & Carbon Sequestration

#### ***Tyler Anthony, California Department of Water Resources***

- Project part of West Delta Program to address SLR and subsidence issues threatening the State Water Project
- Sherman and Twitchell Island keeping water from San Francisco Bay out of the Delta – DWR purchased significant portions of land in the 1990s to reduce vulnerability of levee failure to maintain water supply as much of these islands are below sea level

- Undecomposed plant material make up much of the “soil,” which has high carbon content and leads to greater rates of soil accretion
- Delta Wetland Methodology created with 52,000 carbon credits already distributed over 5-year period
- Restoration efforts demonstrate that NWL play a key role in achieving carbon neutrality
- DWR projects are informing the potential of carbon sequestration in wetlands
- **What can local governments learn from this project?** If you have wetlands habitats in your jurisdictions, explore opportunities to pair restoration projects with research projects to deepen understanding of
- **What is the quantification methodology for this project and what tools are you using?** Used a state-of-the-art tool (expensive) but baseline is so large in the Delta that it would have paid for itself via CARB market. Advanced statistical analyses needed but rapidly becoming more accessible. In the future, opportunity to leverage reference sites with ecosystem monitoring already in place.
- **Have there been efforts to collaborate with similar watersheds?** Delta is a much warmer region than others and different levee systems have made direct international collaboration difficult.
- **How are recreational opportunities being considered?** Including recreation as a metric at DWR – most lands are privately owned, but could be publicly-facing in the future.
- **Currently, no wetland protocol on the cap-and-trade market, only voluntary market?** If CARB were to adopt wetlands protocol, it could have generated enough revenue to be profitable.

### Carbon Sequestration Efforts in the Delta

#### **Lauren Damon, Sacramento-San Joaquin Delta Conservancy**

- Delta used to be one large wetland, but lost much of this to agricultural purposes
- Delta is emitting 2 million metric tons of CO<sub>2</sub> each year
- Key solutions to subsidence – need to rewet soil:
  - Wet agriculture (e.g., rice cultivation - can stop subsidence but no soil accretion)
  - Create new wetlands (soil accretion, but costly with little revenue)
- Carbon Market Protocol Development
  - Voluntary Market Protocol (approved in 2017), but prices are not high enough to incentivize carbon farming
  - Working to have protocol under Cap-and-Trade compliance market to increase revenue
- [Nature-based Solutions: Wetland Restoration Grant Funding](#)
  - Awarded 4 projects - 6,500 acres for rice, 4,600 acres for wetlands
  - Over 2 decades of monitoring data
- Webb Tract Mosaic (~1,500 acres rice, ~3,500 acres wetlands) - exploring how much rice cultivation needed to be financially self-sustaining
  - Need to be actively draining water
- Staten Island - looking to replace corn with rice crops

- Land Acquisition on Bethel Island - John Muir Land Trust looking to purchase to convert to permanent wetlands
- *Are you engaging with counties/private landowners around the Williamson Act?* Staten Island has a Williamson Act contract.