



WHY CARBON NEUTRALITY?

According to the UN Intergovernmental Panel on Climate Change (IPCC), in order to limit warming to 2°C (the increase at which the most severe impacts of a changing climate will be felt) annual global emissions must peak by the year 2020, and be reduced steeply thereafter.

CALIFORNIA'S CHARGE TO REACH CARBON NEUTRALITY AND OTHER EMISSIONS TARGETS

On September 10, 2018 Governor Brown issued **Executive Order B-55-18** which declares a new statewide goal to achieve **carbon neutrality** as soon as possible, and no later than **2045**, and to achieve and maintain net negative emissions thereafter.

- **EO B-55-18** directs State agencies to engage the **support, participation, and partnership** of **universities, businesses, investors, and communities**, as appropriate to achieve the goals contained in this order.

*'The achievement of carbon neutrality will require both significant **reductions** in carbon pollution and **removal** of carbon dioxide from the atmosphere, including sequestration in forests, soils, and other natural landscapes.'*

- **SB 100** (De Leon, 2018) calls for renewable energy resources and zero-carbon resources to supply 100% of retail sales of electricity to California end-use customers and 100% of electricity procured to serve all state agencies by 2045.
- **SB 32** (Pavley, 2017) requires the California Air Resources Board (CARB) to ensure that statewide greenhouse gas (GHG) emissions are reduced to 40% below 1990 levels by 2030.

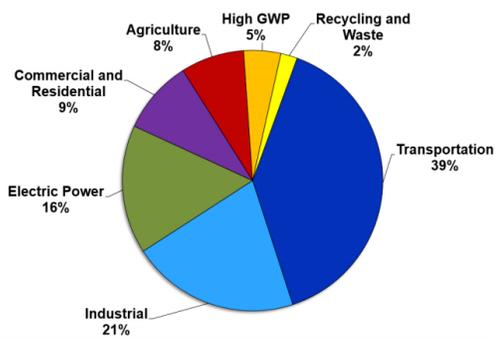


FIGURE 1: GHG Emissions by Economic Sector

California's annual statewide GHG emission inventory establishes historical emission trends, tracks California's progress in reducing GHGs, and demonstrates the state's progress in achieving statewide GHG targets.

This chart shows the breakdown of GHG emissions by economic sector

Figure sourced/adapted from Air Resources Board

DEFINITIONS

- **CARBON SEQUESTRATION:** the process of capturing and storing atmospheric carbon dioxide in oceans, soils, vegetation (especially forests), and geologic formations, aka carbon dioxide removal or negative emissions
- **BIOFUEL:** a fuel derived directly from living matter
- **BIOMASS:** waste material from plants or animals that is not used for food or feed; it can be waste from farming (like wheat stalks) or horticulture (yard waste), food processing (like corn cobs), animal farming (manure), or human waste from sewage plants
- **AJAX:** Alpha Jet Atmospheric eXperiment; NASA Ames Research Center based science measurement flights that perform regular missions to measure ozone, formaldehyde, carbon dioxide (CO₂), methane (CH₄) and meteorological data over California and Nevada
- **JOINT BIOENERGY INSTITUTE:** One of three Department of Energy Bioenergy Research Centers established in 2007 to accelerate fundamental research in biofuels, and to make such technology cost-effective and widely available

SELECT EXPERTS

The following researchers and practitioners can advise and share insights on Climate Research in California.

Laura Iraci PhD

AJAX Principal Investigator
Atmospheric Science Branch
NASA Ames Research Center
laura.t.iraci@nasa.gov
Office: (650) 604-0129

Expertise: airborne measurements of atmospheric gases related to pollution and climate change

Jennifer Pett-Ridge PhD

Sr. Staff Scientist and Group Leader
Lawrence Livermore National Lab
pettridge2@llnl.gov
Office: (925) 424-2882

Expertise: biotic interactions and energy flow in microbial communities critical to soil nutrient cycling and sustainable biofuel production

Blake Simmons PhD

Chief Scientist & Technology Officer, Vice President for Deconstruction
Joint BioEnergy Institute
Lawrence Berkeley National Lab
basimmons@lbl.gov
Office: (415) 235-3170

Expertise: advanced biofuels, renewable chemicals, biomanufacturing, biomass pretreatment, enzyme engineering, and biofuel cells

Moderated by Rob Oglesby

CCST Council Member
Executive Director, Retired, California Energy Commission 2011-2017; Former Legislative Director, Air Resources Board
roboglesby614@gmail.com

Expertise: energy policy; major issues affecting air pollution and global warming; Low and Zero Emission Vehicle standards, adoption of reformulated gasoline and diesel fuel requirements; AB 32 and other landmark climate legislation

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EMISSIONS: INVENTORY AND MONITORING

In order to become carbon neutral, we need to first measure the carbon footprint (emissions) of all sources.

- Under California's Regulation for the Mandatory Reporting of Greenhouse Gas Emissions (MRR), industrial sources, fuel suppliers, and electricity importers must report their annual GHG emissions to CARB. Agricultural emissions, high global warming potential gases, emissions from landfills and composting, and select fugitive emissions are **not** captured under the MRR program.
- **Agricultural emissions:** The rural San Joaquin Valley is a significant source of methane from livestock and agriculture. Alpha Jet Atmospheric eXperiment (AJAX) measurements within the San Joaquin Valley boundary layer observe spatial variability in methane, highlighting local *hot spots*. Combined airborne measurements and modeled data allows for model verification and can identify methane emissions.
- **Wildfires:** Certain factors are contributing to the recent wildfires in California, such as fuel accumulation due to historic aggressive fire repression; tree mortality from fires, droughts, and insects; drought causing extremely low live fuel moistures; and extreme temperatures. AJAX has been sampling emissions from wildfires in California since the 2013 Yosemite Rim fire. In total AJAX has sampled emissions from 13 different fires, with some fires sampled more than once, with a total of 17 AJAX flights targeting emissions from fires.

CARBON SOIL SEQUESTRATION

Current research is addressing issues that include the following:

- Impacts of land use and land management on soil carbon sequestration and ways to increase the storage time of carbon in the soil.
- The underlying mechanisms controlling soil structure and the storage of carbon. These include various chemical, physical, biological, mineralogical, and ecological processes.
- The relationships between biodiversity, atmospheric CO₂ levels, and increased nitrogen deposition in carbon storage.

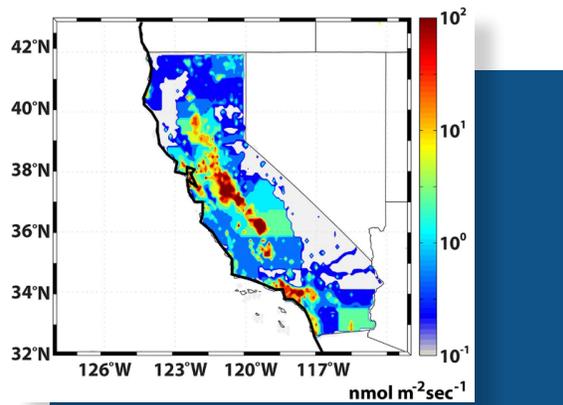


FIGURE 2: Modeled methane emissions refined using AJAX trace gas measurements over the San Joaquin Valley

Figure from Johnson et al., 2016, *Journal of Geophysical Research: Atmospheres* doi: 10.1002/2016JD025157

BIOFUEL

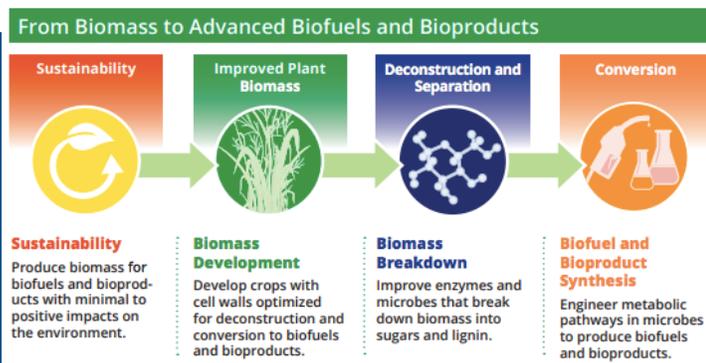
- Plant cell walls are naturally resistant to deconstruction. This represents one of the greatest challenges to attaining a viable, cost-effective biofuels and bioproducts industry.
- Lifecycle analysis shows that biofuels provide significant carbon benefits compared to gasoline. These benefits have increased, as biofuels have become less energy-intensive to produce while oil/gas has become more energy-intensive to extract and produce.

JOINT BIOENERGY INSTITUTE

- The vision of JBEL is that bioenergy crops be converted into economically-viable, carbon-neutral, biofuels and other bioproducts that cannot be efficiently produced from petroleum.
- JBEL's mission is to establish the scientific knowledge and new technologies in feedstock development, deconstruction and separation, and conversion needed to transform the maximum amount of carbon available in bioenergy crops into biofuels and bioproducts.

FIGURE 3: Innovation stemming from advanced biotechnology-based research is key to accelerating needed improvements in the sustainable production of lignocellulosic biomass, its deconstruction into sugars and lignin, and conversion

Figure sourced/adapted from U.S. DOE. 2018. U.S. Department of Energy Bioenergy Research Centers, DOE/SC-0191. U.S. Department of Energy Office of Science (genomicscience.energy.gov/centers/brcbrochure.pdf).



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