

Economic Modeling of California's Scoping Plan

Macroeconomic Impacts of the Scoping Plan Scenario

2022 SCOPING PLAN WORKSHOP | OCTOBER 28, 2022

Impacts are measured in the context of a growing California economy

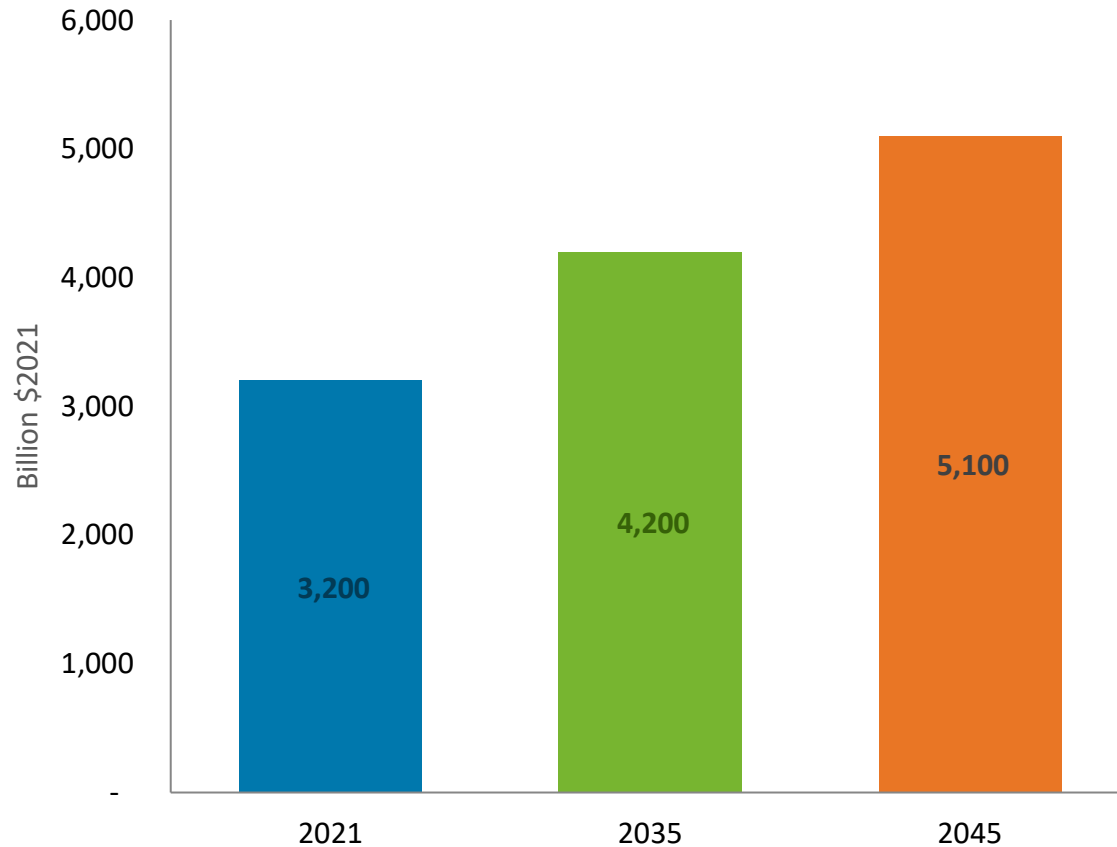
- The California Air Resources Board and the California Department of Finance forecast that the California economy and employment will continue to grow relative to today's levels
 - The California economy is anticipated to grow 2% each year, from \$3.2 trillion in 2021 to \$5.1 trillion in 2045
 - Employment in California is anticipated to grow 0.7% each year, from 23.5 million jobs in 2021 to 27.7 million jobs in 2045
- The impact on Gross State Product and employment are shown as negative impacts relative to a growing California economy in 2035 and 2045—which translates to a very minor slowing of California economic and job growth

Projections of California economic and job growth, 2035 and 2045

CARB projections based on Department of Finance forecasts

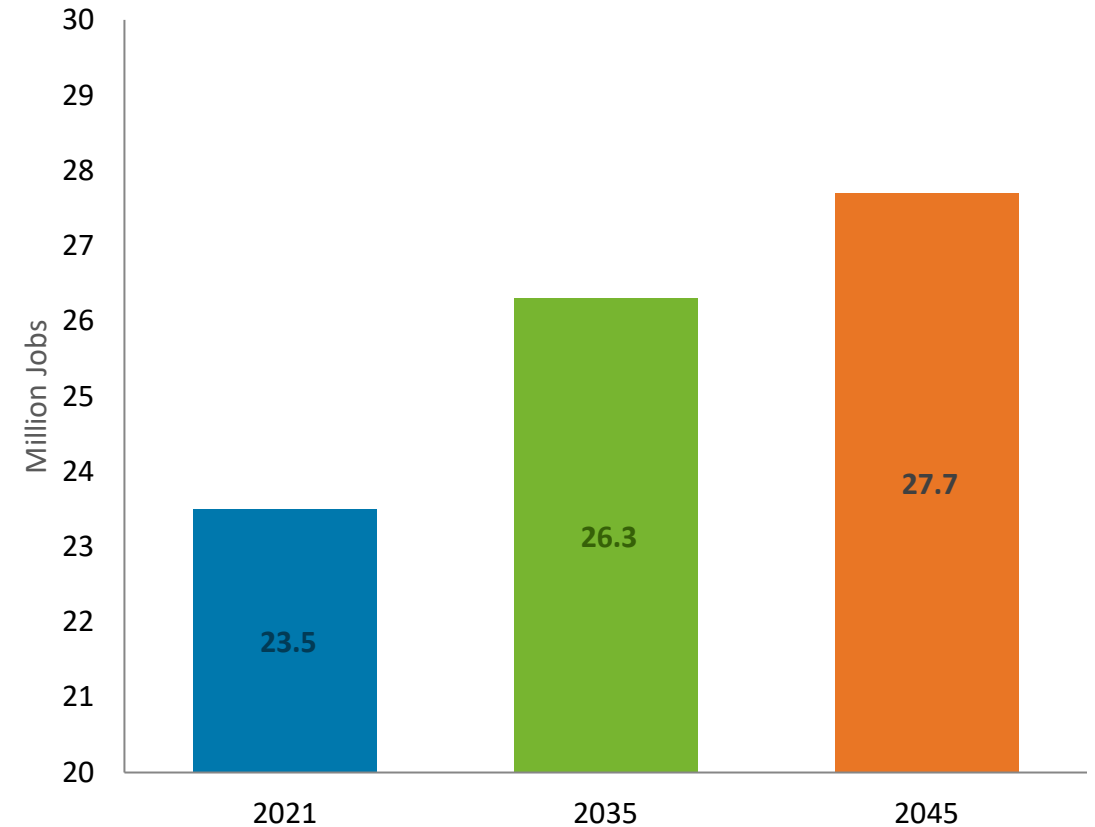
California Gross State Product Growth, 2035 and 2045

Billion \$2021, projections from CARB



California Employment Growth, 2035 and 2045

Billion \$2021, projections from CARB

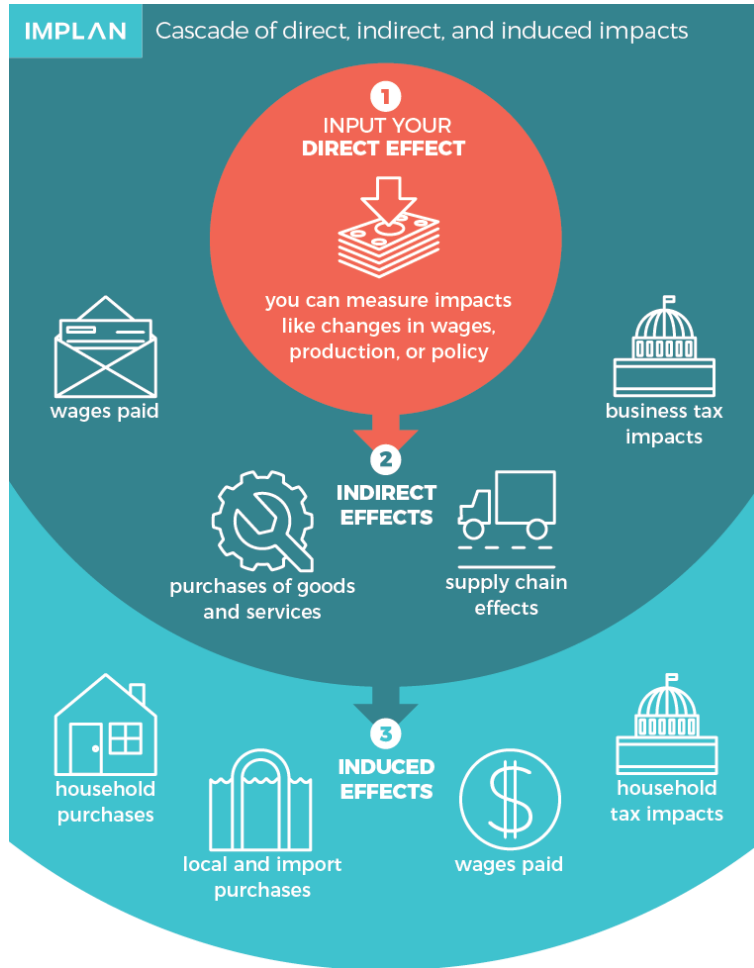


Source: California Air Resources Board

Macroeconomic impacts are estimated using IMPLAN

- IMPLAN is an input-output modeling system that uses annual, regional data to map economic relationships across industries, households, and governments in an economy
- The data contains 546 sectors representing private industries in the US classified by NAICS code
- Impacts can be assessed at the state and county level
- IMPLAN data updated annually from more than 90 sources including:
 - US Bureau of Economic Analysis (BEA)
 - US Department of Agriculture (USDA)
 - US Bureau of Labor Statistics (BLS)
 - US Census Bureau
 - National Center for Education Statistics (NCES)

IMPLAN estimates the economic impact to changes in an economy



Inputs

Costs and savings from PATHWAYS representing changes in spending by businesses and households

Outputs

Changes in spending and employment across the California economy, California businesses, households

Translation of PATHWAYS direct costs to IMPLAN

Rhodium sources all cost inputs from E3 PATHWAYS results

Direct Air Capture

- PATHWAYS direct costs for liquid solvent and solid sorbent DAC technologies powered by off-grid solar
- PATHWAYS costs are modeled by changing expenditures in the solar electricity industry
- The cost of DAC is passed through to consumers, reducing household spending

Stock costs

- Modeled as changes in commodity by subsector (residential lighting, light duty vehicles, commercial cooking, etc.)
- Changes in commercial ventilation from PATHWAYS are modeled as changes to air purification and ventilation equipment in IMPLAN
- The cost of stock is passed through to consumers, reducing household spending

Demand change measure costs

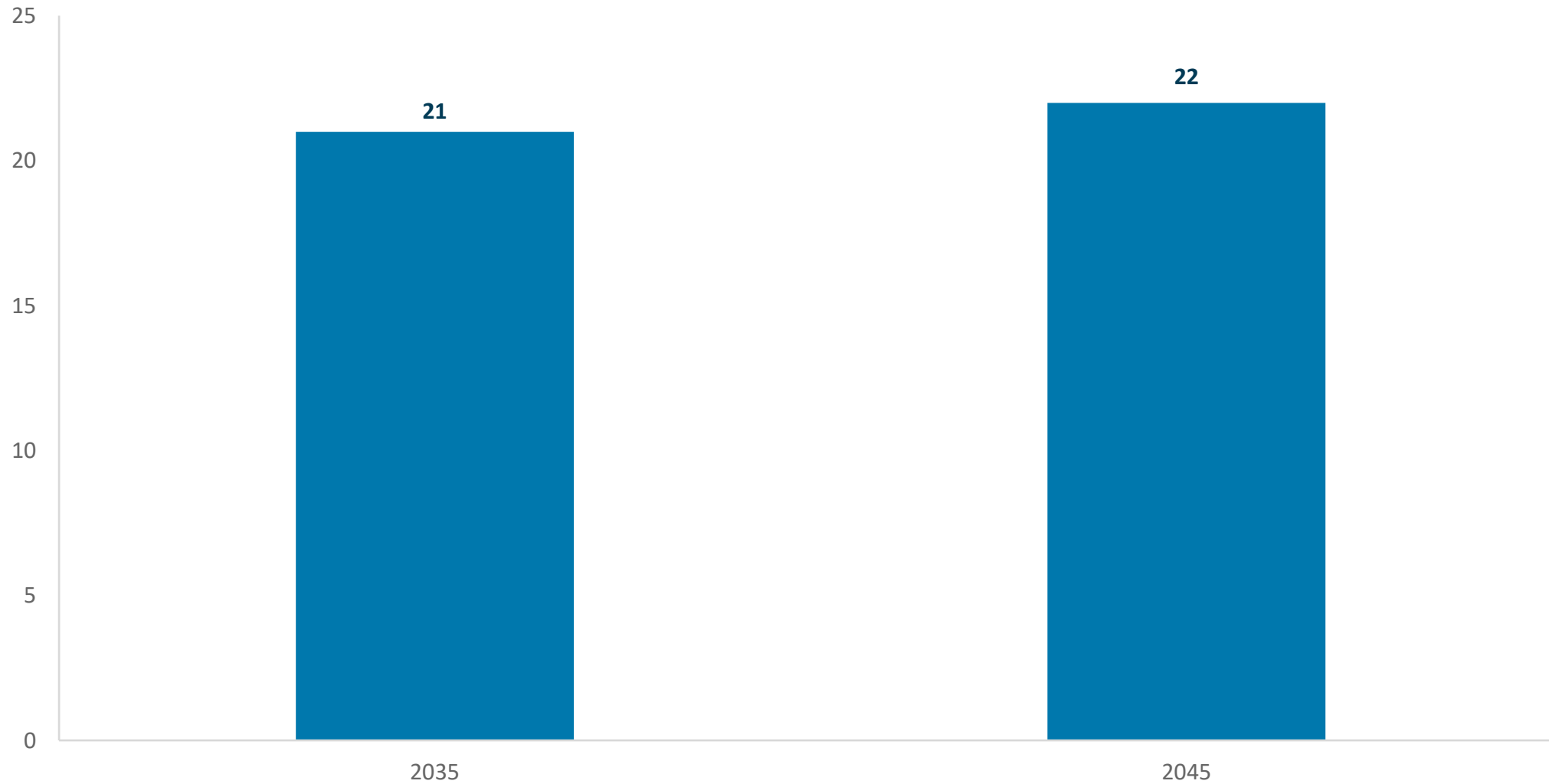
- Reflect energy efficiency across subsectors
- Modeled as changes in industry by subsector
- For example, a cost for a demand change in fabricated metal is modeled as a change in the output of fabricated metal
- The cost of the demand change is passed through to consumers, reducing household spending

Fuel costs

- Changes in expenditures across fuel and energy categories (electricity, gasoline, diesel, pipeline gas, etc.)
- The impact of a change in energy or fuel cost is modeled as a change in the industry that produces the fuel or energy
- A reduction in diesel costs in heavy duty trucking is modeled as a change in the petroleum refining industry in IMPLAN

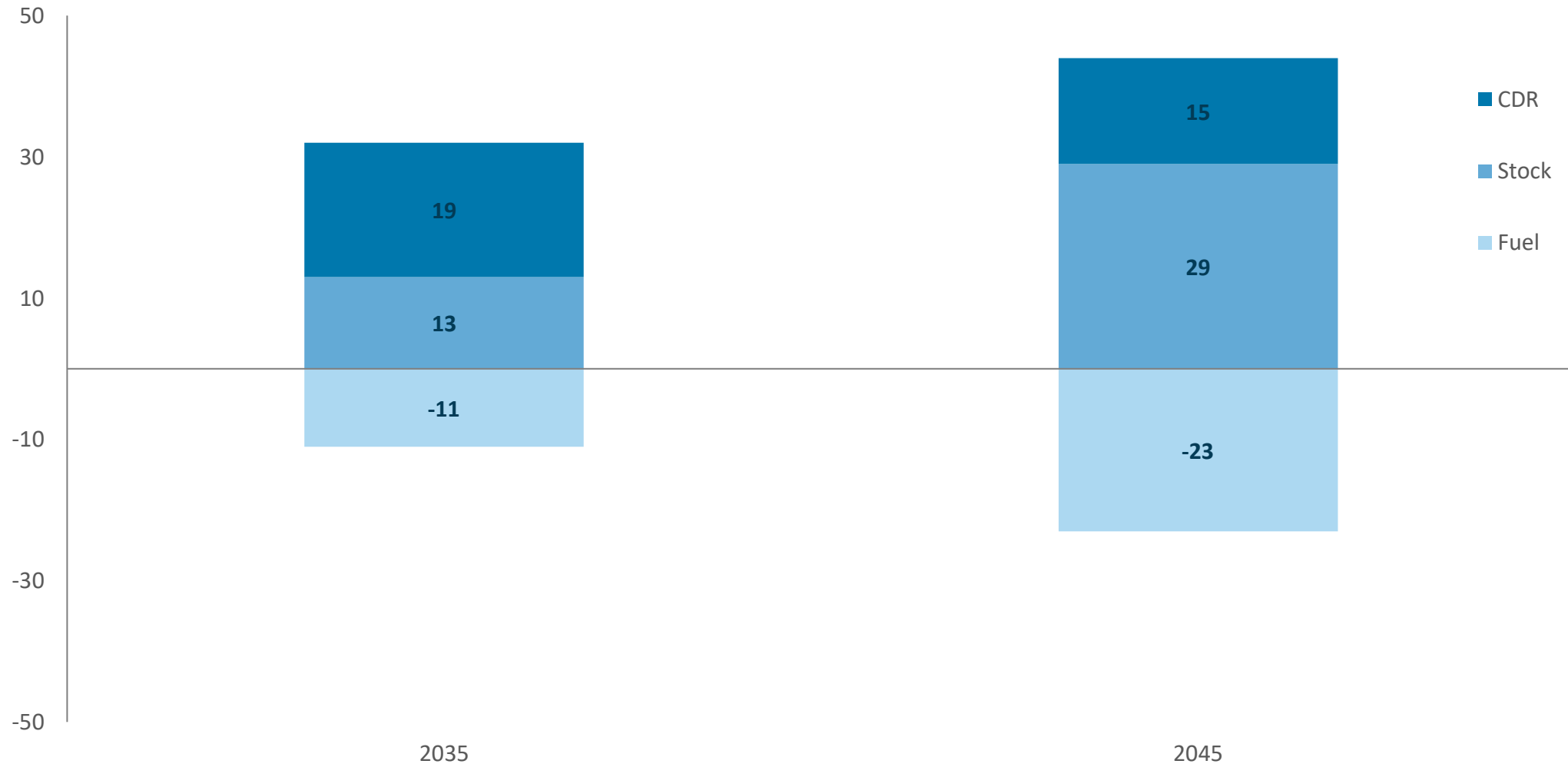
Direct cost of Scoping Plan scenario, 2035 and 2045

Billions \$2021, costs from PATHWAYS in a single year relative to the growing California economy



Direct cost and savings of Scoping Plan scenario, 2035 and 2045

Billions \$2021, costs from PATHWAYS in a single year relative to the growing California economy

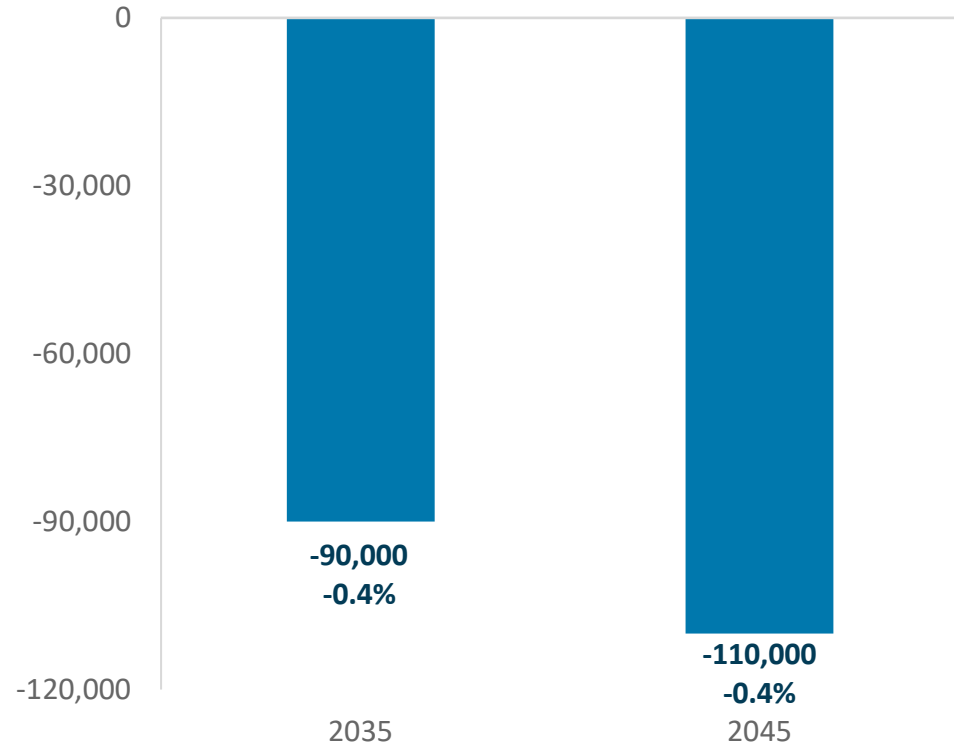


Employment Impacts

Impact from IMPLAN in a single year relative to California employment that grows from 23.5 million in 2021 to 27.7 million in 2045

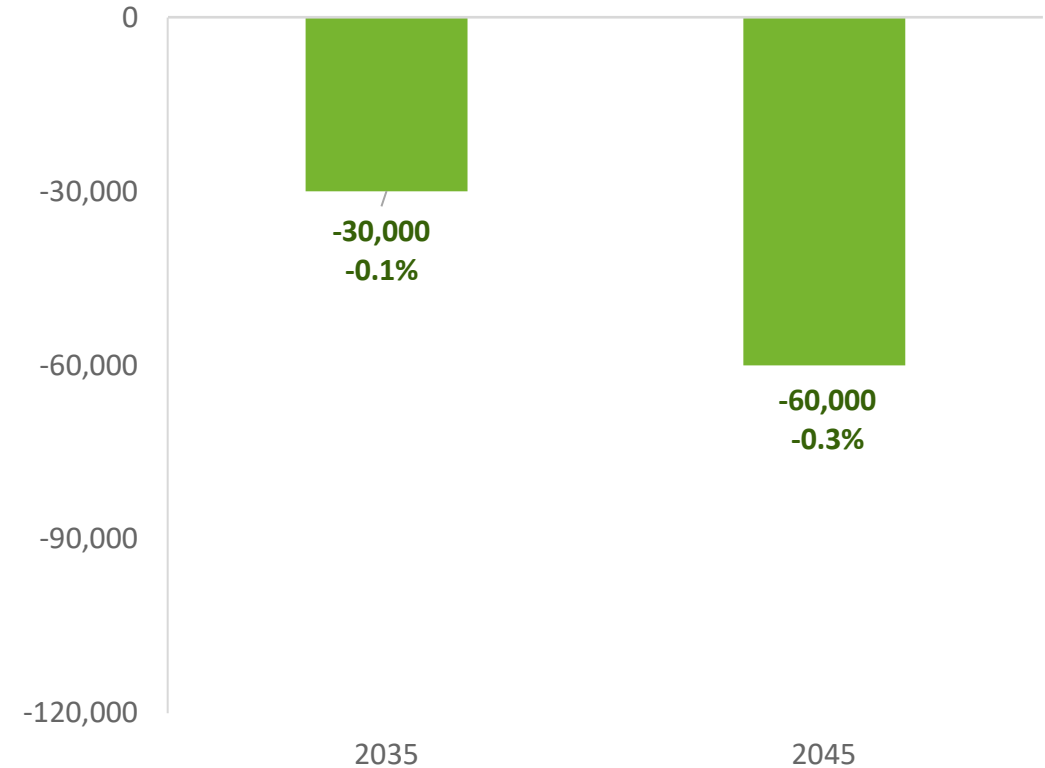
Scoping Plan scenario with CDR

Total Jobs



Scoping Plan scenario without CDR

Total Jobs



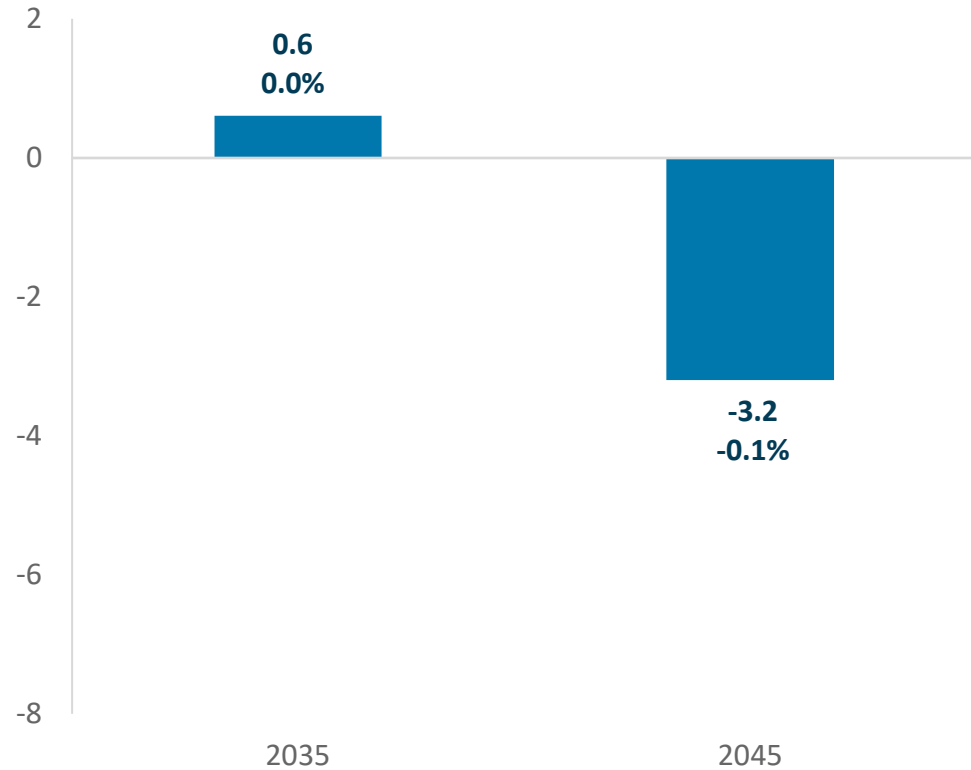
Note: Results from PATHWAYS costs assuming CDR is liquid solvent and solid sorbent DAC technologies powered by off-grid solar relative to BAU. Percentage change is relative to households in 2035 and 2045 based on California Department of Finance population forecasts. Without CDR, California will not achieve carbon neutrality in 2045. Jobs are defined in IMPLAN as an annual average that accounts for seasonality and follows the same definition used by the BLS and BEA. Percentage change is relative to CARB 2035 and 2045 employment forecasts.

Impact on Gross State Product of the Scoping Plan scenario with CDR

Impact from IMPLAN in a single year relative to the California economy that grows from \$3.2 trillion in 2021 to \$5.1 trillion in 2045

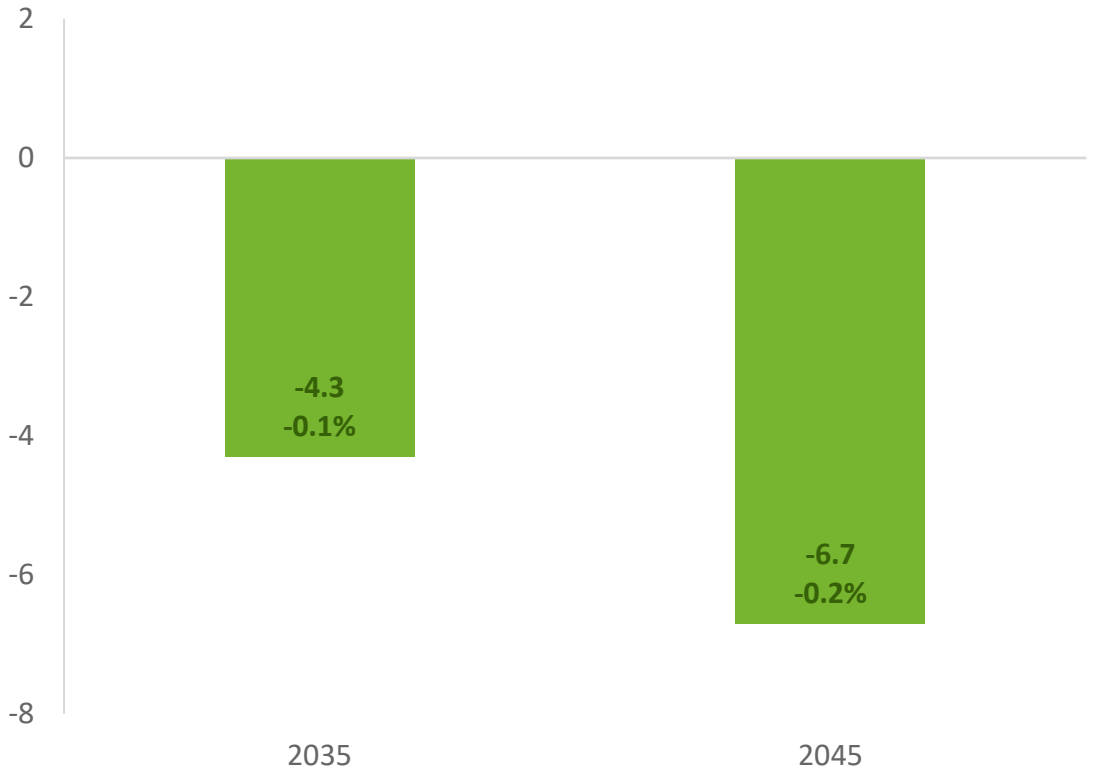
Scoping Plan scenario with CDR

Billion \$2021



Scoping Plan scenario without CDR

Billion \$2021



Note: Results from PATHWAYS costs assuming CDR is liquid solvent and solid sorbent DAC technologies powered by off-grid solar relative to BAU. IMPLAN reports value added which is equivalent to an industry's contribution to Gross State Product or GSP. Percentage change is relative to CARB 2035 and 2045 Gross State Product forecasts. Without CDR, California will not achieve carbon neutrality in 2045. IMPLAN reports value added which is equivalent to an industry's contribution to Gross State Product or GSP. Percentage change is relative to CARB 2035 and 2045 Gross State Product forecasts.

Data Observations

Macroeconomic impacts of the Scoping Plan scenario with and without CDR

Future Employment Growth

- The California workforce is forecast to grow from today's levels through 2045
- The Scoping Plan scenario with CDR slows the growth of employment, but the impact is small, resulting a 0.4% to 0.5% slowing of job growth relative to projected levels in 2035 and 2045
- The Scoping Plan scenario without CDR also slows the growth of employment, resulting in a 0.1% to 0.3% impact to job growth relative to projected levels in 2035 and 2045
- As modeled, Direct Air Capture in California can result in 15,000 direct jobs in California in 2035 and 12,000 direct jobs in 2045

Future California Economic Growth

- The Scoping Plan scenario has a relatively small impact on the California economy which is forecasted to grow from today's levels through 2045
- The impact of the Scoping Plan scenario with CDR is estimated to have no impact on economic growth in 2035 and to slow economic growth by 0.1% in 2045 (when CARB forecasts the economy to grow by 3.3% each year)
- The impact of the Scoping Plan scenario without CDR is estimated to slow economic growth by 0.1% in 2035 and 0.2% in 2045
- As modeled, Direct Air Capture in California can provide \$4.3 billion to the California economy in 2035 and \$3.5 billion in 2045

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