2022 Scoping Plan Update

Costs, Health, and Economics

NATURAL AND WORKING LANDS

APRIL 20, 2022

Agenda

- NWL Scoping Plan Scenario/Results Review
- Wildfire Emissions
- Health Impacts
- Implementation Costs
- Economic Impacts
- EJ Advisory Committee Comments
- Public Comments

Photo courtesy of Adam Moreno

CARB Scoping Plan NWL Models

NWL Sub-Category	Model
Forests	RHESSys
Shrublands	RHESSys
Grasslands & Rangelands	RHESSys
Sacramento-San Joaquin Delta	SUBCALC/Literature
Urban Forests	CARB Urban Forest Carbon Model
Wildland Urban Interface	California Forest Observatory/CARB NWL Inventory
Annual Croplands	Daycent/LUCAS/Literature
Perennial Croplands	CARB Orchard Carbon Model/LUCAS
Deserts	CARB NWL Inventory/LUCAS

Photo courtesy of Adam Moreno

Natural and Working Lands Carbon Alternatives

- NWL Alternative 1: Prioritize maximizing short term carbon stock at 2045
- NWL Alternative 2: Balanced mix of strategies from current commitments/plans
- NWL Alternative 3: Prioritize restoration and climate resilience
- NWL Alternative 4: Prioritize forest wildfire and other fuel reduction efforts

Historical vs Contemporary Biomass

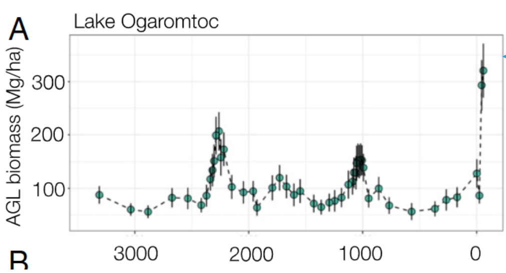
In the Sierras and Southern Cascades:

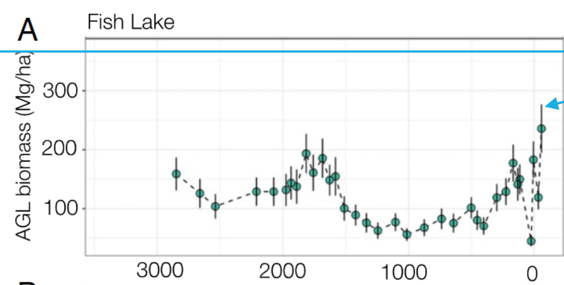
"Historical forest conditions … were generally characterized by low tree density, low live basal area, low biomass…"

"Based on [future projections], [The Sierras and Southern Cascades] may be unable to support aboveground biomass >40 Mg ha−1 by 2069, a value approximately 25% of current average biomass stocks"

In the Klamath:

"The study also illustrates the unprecedented level of contemporary forest biomass..." "…the contemporary biomass record is unstable in comparison to the long-term trend" (Figures Below).

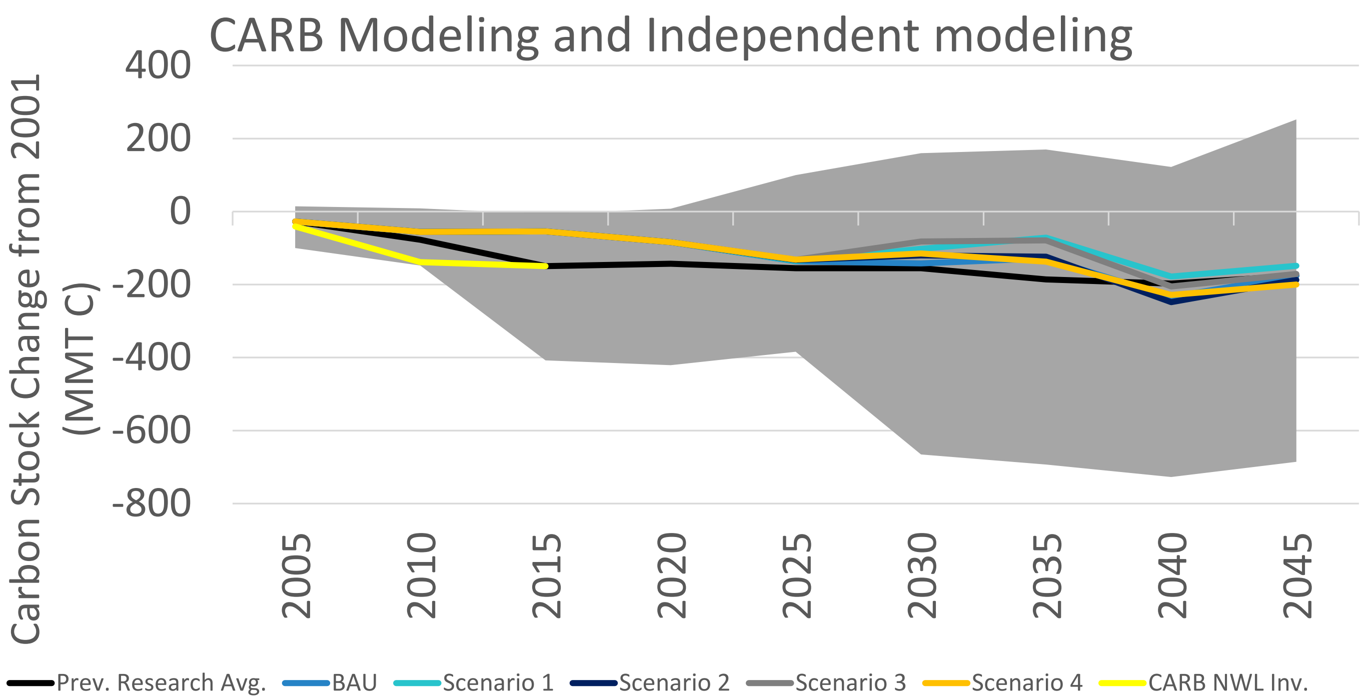




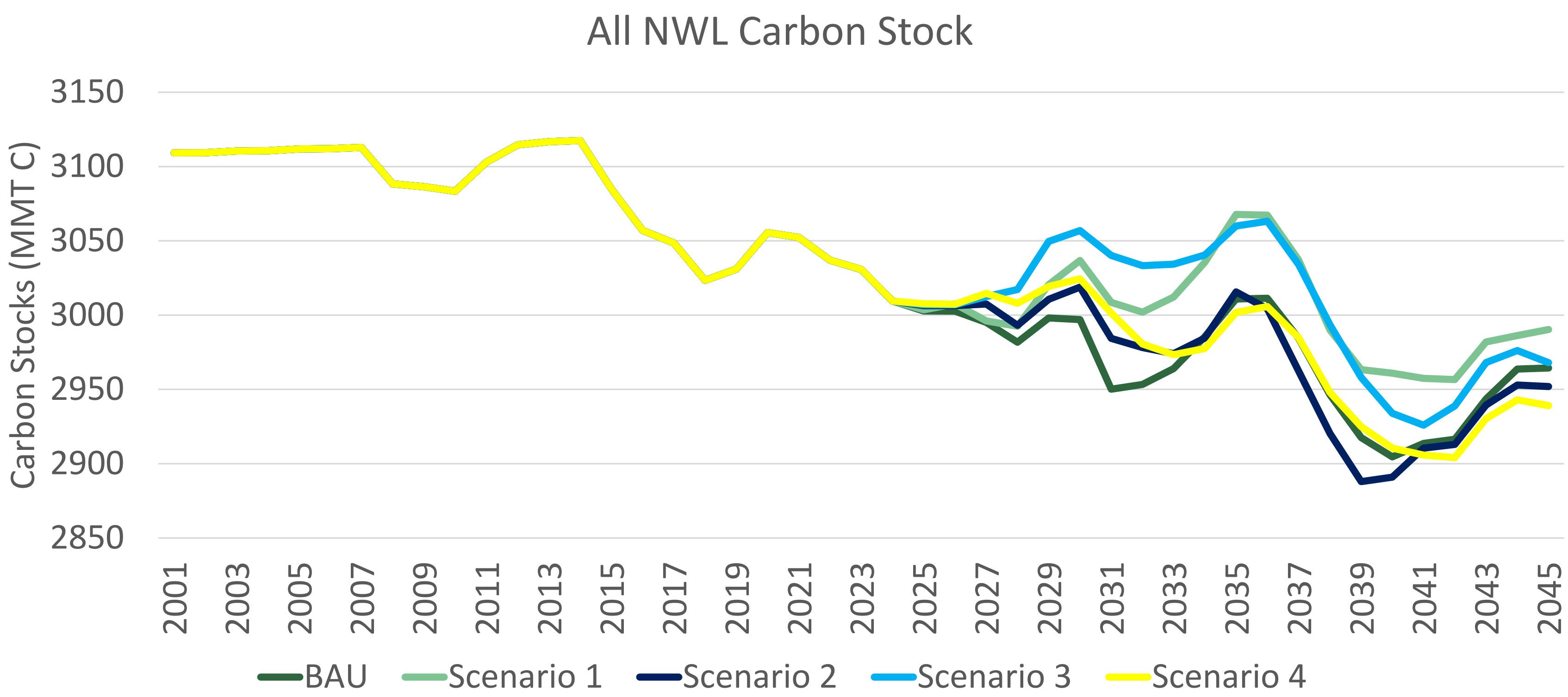
Current biomass is higher than at anytime in the last 3500 years.

- *Bernal, A.A., et al., 2022. Biomass stocks in California's fire-prone forests: mismatch in ecology and policy. Environmental Research Letters, 17(4), p.044047.*
- *Knight, C.A., et al., 2022. Land management explains major trends in forest structure and composition over the last millennium in California's Klamath Mountains. PNAS, 119(12), p.e2116264119.*

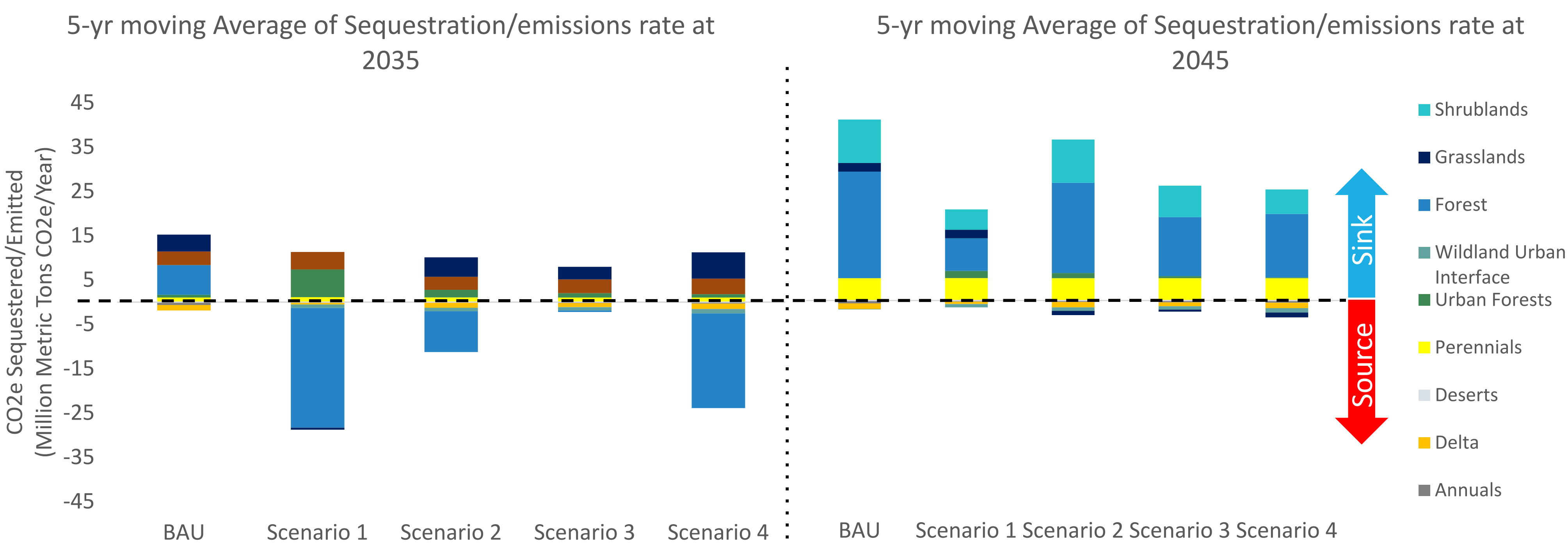
Overall Results



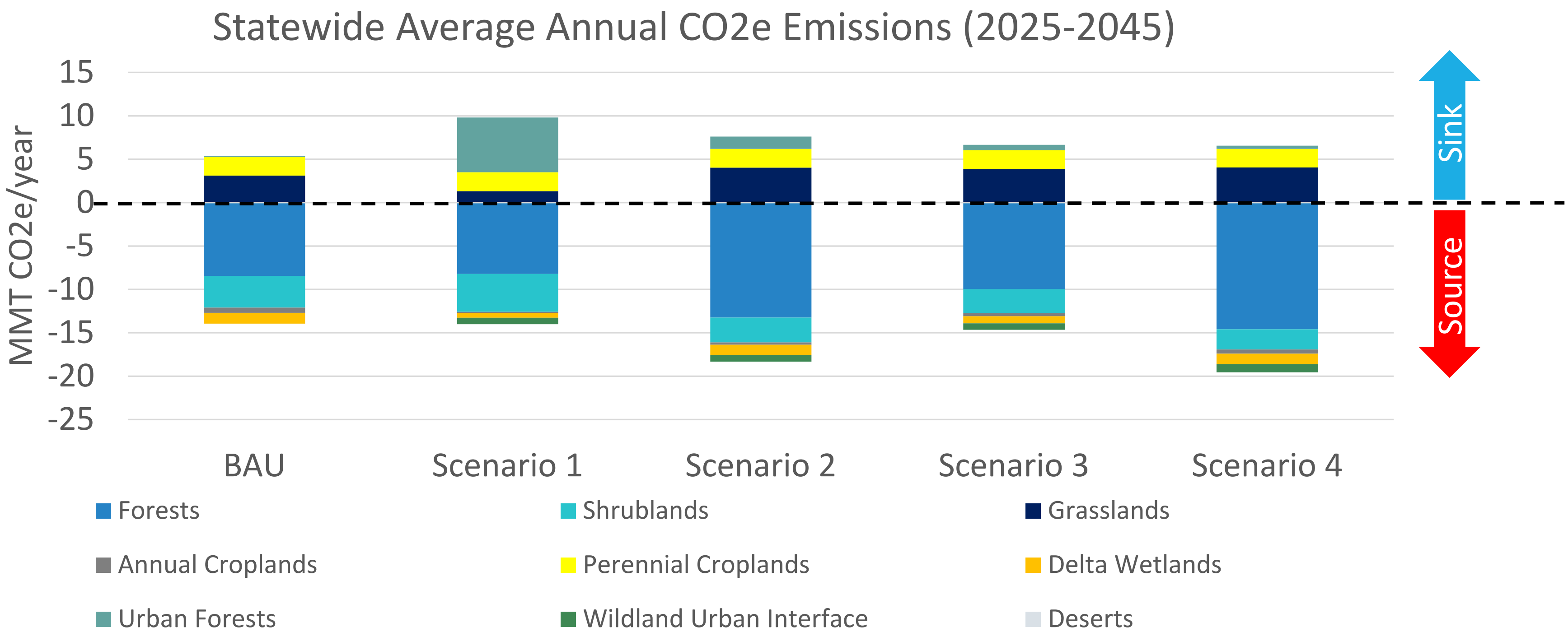
Overall Results



All NWL Sequestration/emissions Rate at a Given Year



All NWL sequestration/emissions rates through 2045



Summary of GHG Modeling

- Forests, shrublands, and grasslands dominate California's NWL contribution to carbon neutrality
- Our current forested biomass on the landscape is at historic highs
- The current trend from independent observations is that California's NWL are losing productivity
- Natural and Working Lands are projected to be a net source of emissions from 2025 to 2045
- Increasing actions on other lands can improve carbon storage and reduce emissions from this sector
- Expanding deployment of urban tree canopy, wetland restoration, healthy soils practices, and organic farming deliver carbon sequestration and reduced emissions.
- Natural variability exists - the ability for NWL to contribute to CN is dependent on future climate change and varies from year to year

Wildfire emissions modeling

Objective

- To quantify statewide annual wildfire PM2.5

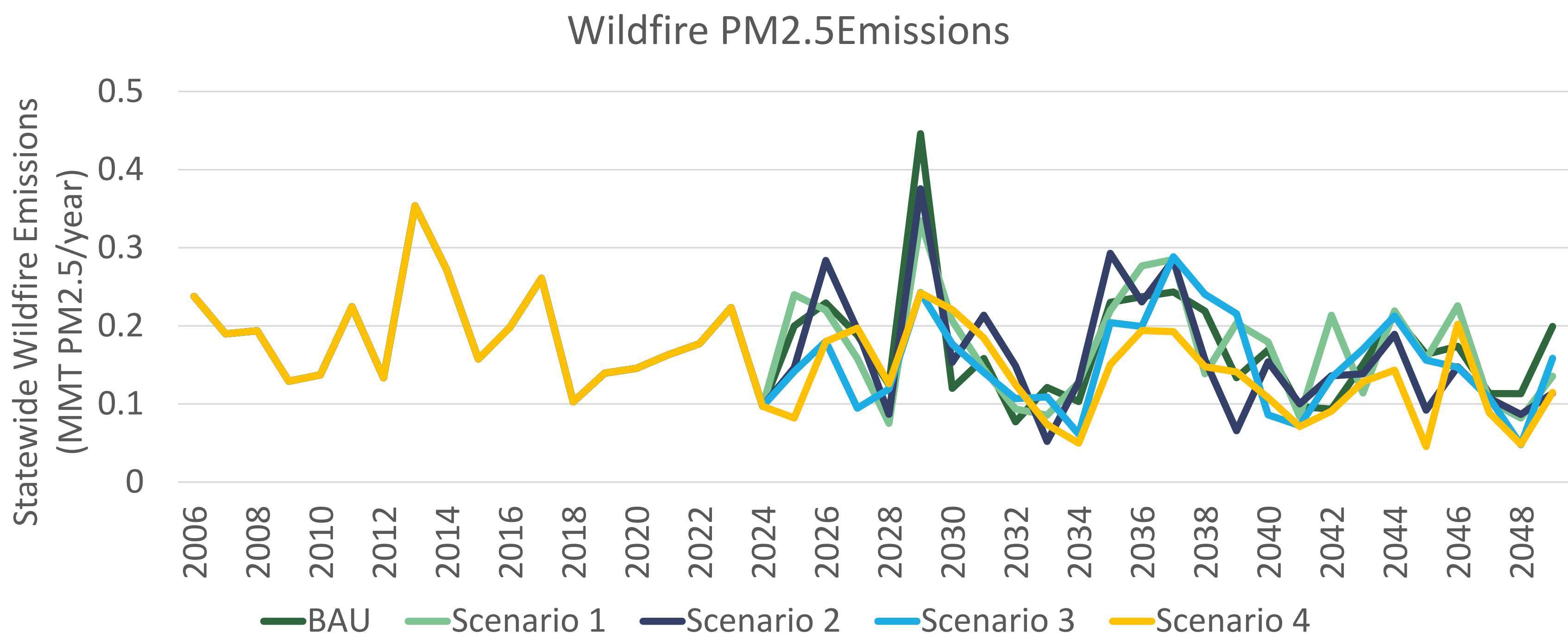
Methods

- RHESSys modeling provides estimates of biomass consumed each year by wildfire.
- Utilize Fire Inventory from NCAR (FINN) wildfire emissions factors
- Multiply annual biomass consumed by appropriate FINN emissions factor

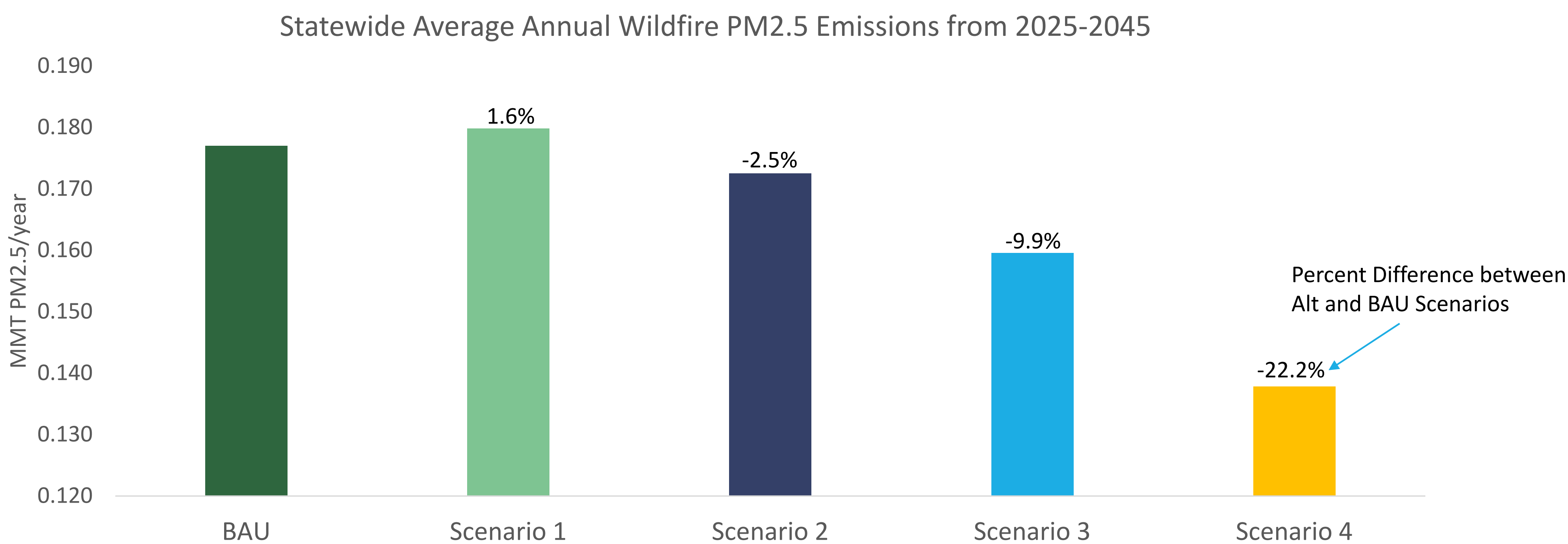
Limitations

- Only wildfire emissions
- Does not include direct impacts (e.g. lives lost, property destroyed, etc) from the fire itself
- Does not include more complex emissions speciation procedures

Annual Wildfire Emissions



Annual Wildfire Emissions



Data Observations

- Wildfire emissions vary from year to year because of natural variation
- Longer-term averages are needed to assess the effectiveness of scenarios
- Wildfire emissions will always exist in California, no matter what we do
- Wildfires are a natural part of California's ecosystems
- Modeling indicates that with increased fuels reduction treatments, emissions decrease
- Compared to BAU, wildfire emissions can decrease as much as 22%
- If no management is done from 2025 on, wildfire emissions increase compared to BAU

Wildfire Emissions Health Impacts

Objective

- To quantify the health impact associated with future statewide wildfire emissions

Methods

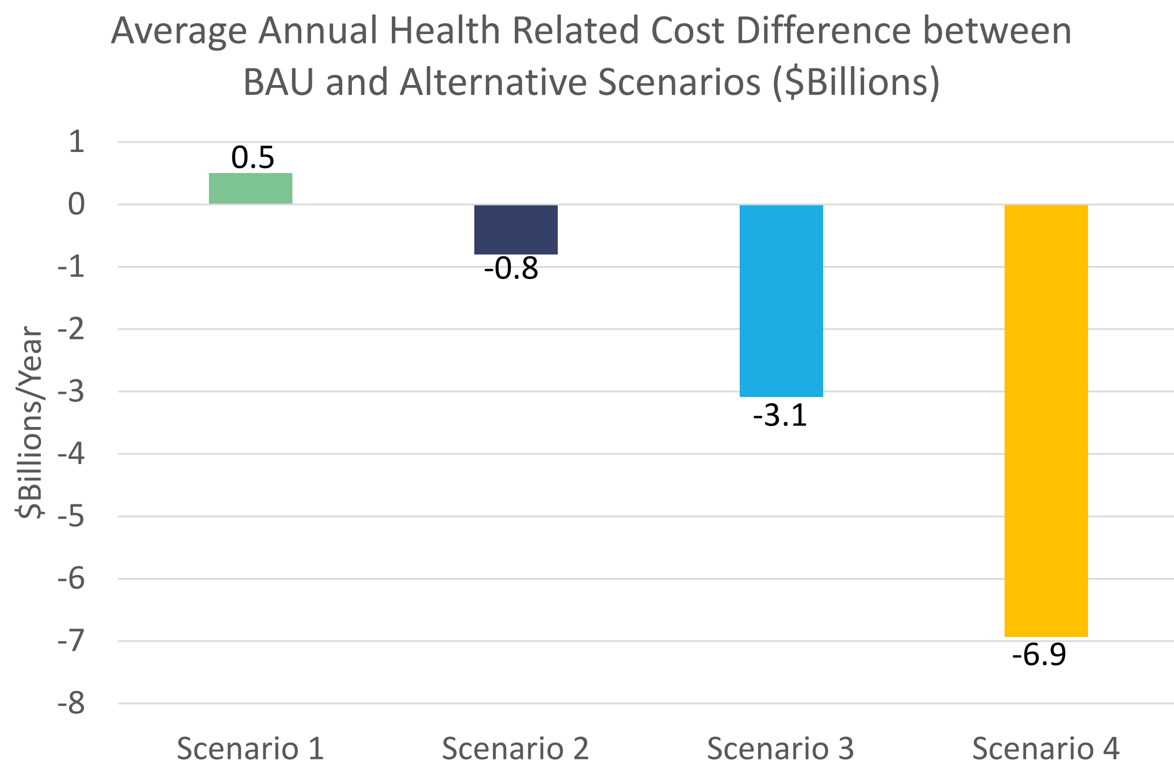
- In a non-spatial way, quantify annual statewide PM2.5 emissions from wildfires
- Similar to CARB's incidents-per-ton methodology
- Use historical estimates of health impacts to quantify a health impact/ton of wildfire PM2.5 multiplier
- This data came from new research from UCLA as part of a CARB contract
- Multiply projected annual emissions by health impact multiplier
- Given the randomness of wildfires, dispersion modeling on all future simulations is not feasible

Future Projected Health Impacts from Wildfire Emissions

Average annual difference in health effects in California from wildfire emissions compared to BAU from 2025-2045 (positive numbers are increases in incidents)

Health Endpoint	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Hospital admissions from asthma	3	-9	-16	-27
Hospital admissions from chronic obstructive pulmonary disease without asthma	3	-8	-14	-24
Hospital admissions from all respiratory outcomes	10	-26	-47	-79
Emergency room visits from asthma	25	-65	-115	-193
Emergency room visits from all respiratory outcomes	67	-176	-311	-523
Emergency room visits from all cardiovascular outcomes	25	-65	-116	-195
All cause mortality	63	-165	-292	-492

Annual Health Costs Associated with Wildfire Emissions



Note: Positive values indicate Increased health costs

Scientific agreement and knowledge gaps on the health benefits of organic/sustainable agriculture

Literature has general agreement that converting to organic/sustainable ag:

- Decreases pesticide exposure (residues and environment)
- Increases the nutritional value of food
- Reduces soil erosion
- Increases soil quality
- Reduces antimicrobial resistant pathogens
- Increases air & water quality
- Improves the mental health and wages of workers.

Knowledge gaps:

- Health benefits of conventional vs sustainable farming for communities living near fields or the general population
- Sensitive populations (children, elderly, etc.) and vulnerable populations (low income, etc.) are rarely included
- Limited number of studies on non-organic sustainable farming
- Only a handful of studies are from California and US or similar countries

Data Observations

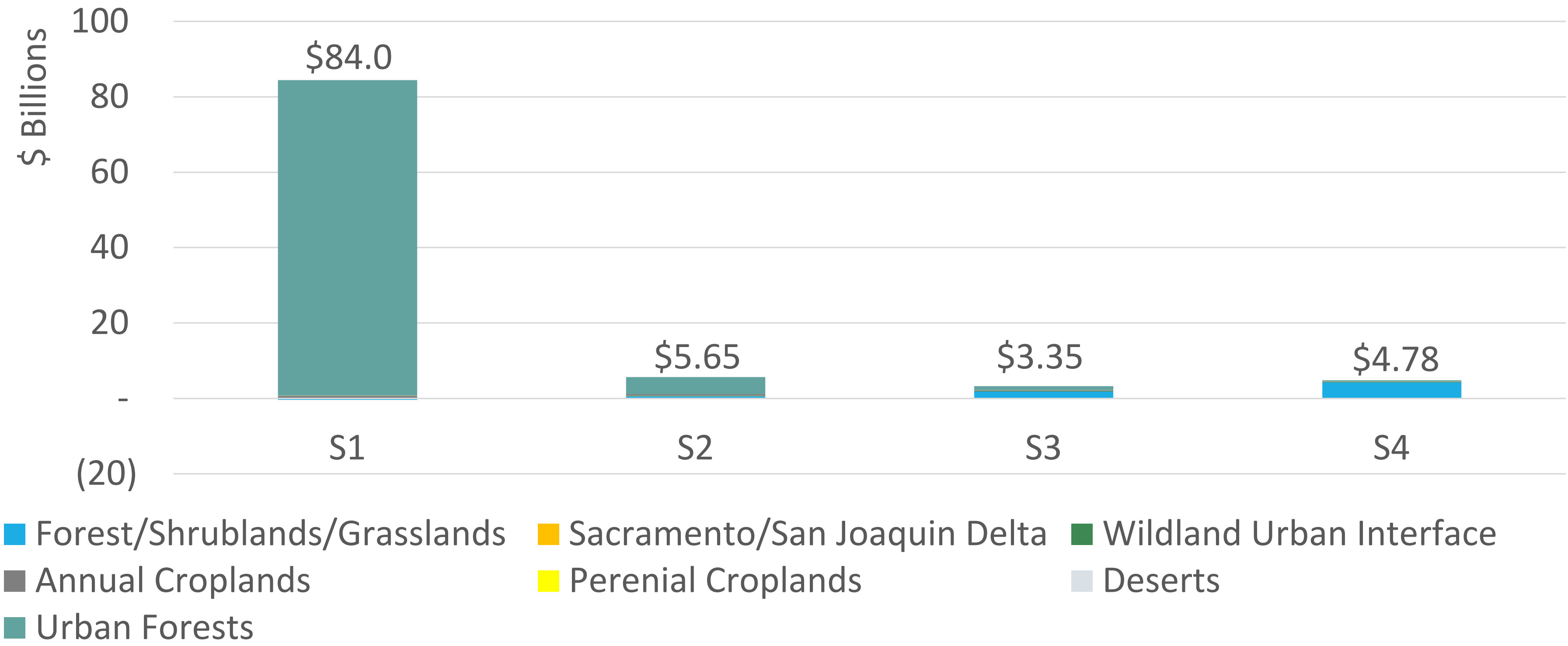
- Wildfire emissions have significant impacts on public health and substantial economic costs
- Public health greatly benefits from reduced wildfire emissions through increased fuels reduction
- Hundreds of lives can be saved each year through climate action to reduce wildfire emissions
- Compared to BAU, climate action can save up to nearly $7B annually in health related savings
- Reducing treatments on the land, has the opposite effect
- Many additional health benefits exist through climate action in all NWL land types
- We currently have a limited ability to quantify all of the public health benefits from all NWL

Economic Analysis of Natural and Working Lands Actions

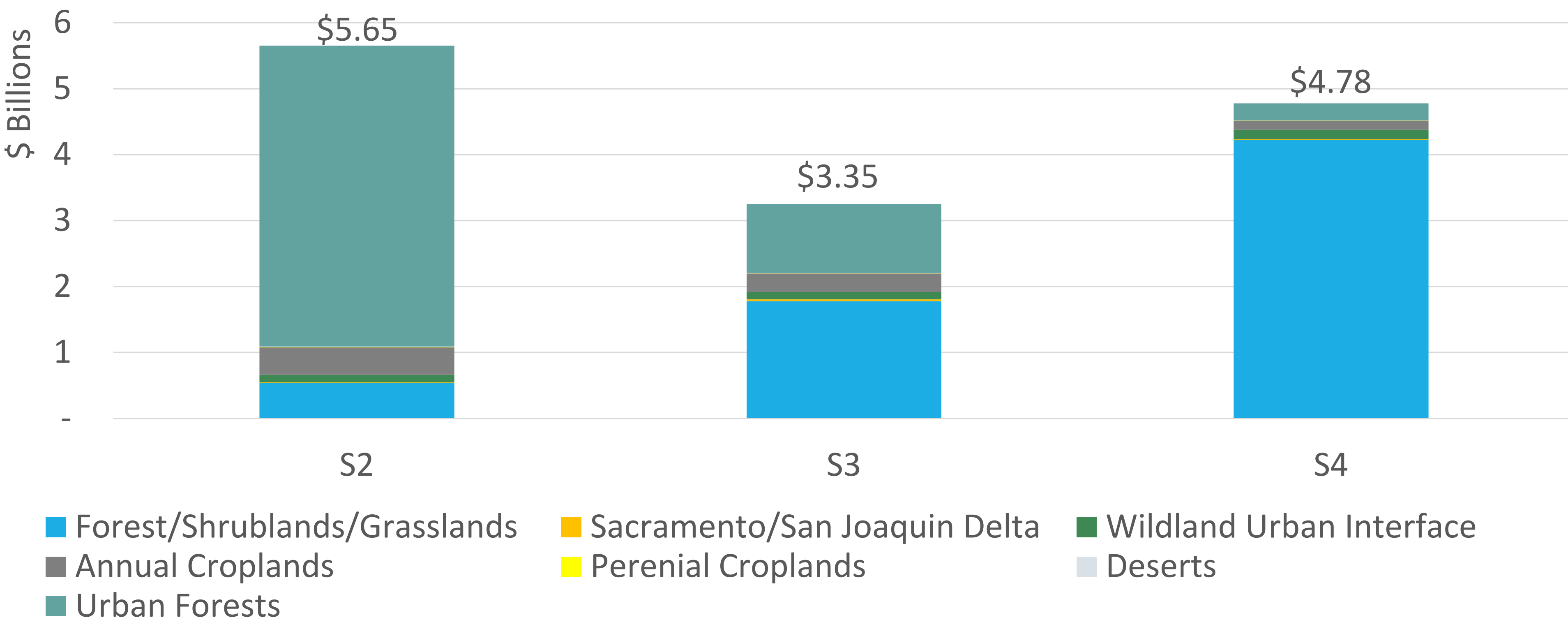
- Direct costs of each action were estimated on a per acre basis
- Costs were estimated using a combination of survey data, academic literature, and existing subsidy programs
- Estimates of Direct costs were used as inputs into a macro economic model (REMI PI+) to assess effects of each scenario on employment, income, and GSP in the state

Photo courtesy of Adam Moreno

Direct Annual Costs (All Scenarios)



Direct Annual Costs (Excl. Scenario 1)



Macro-Economic Modeling in REMI

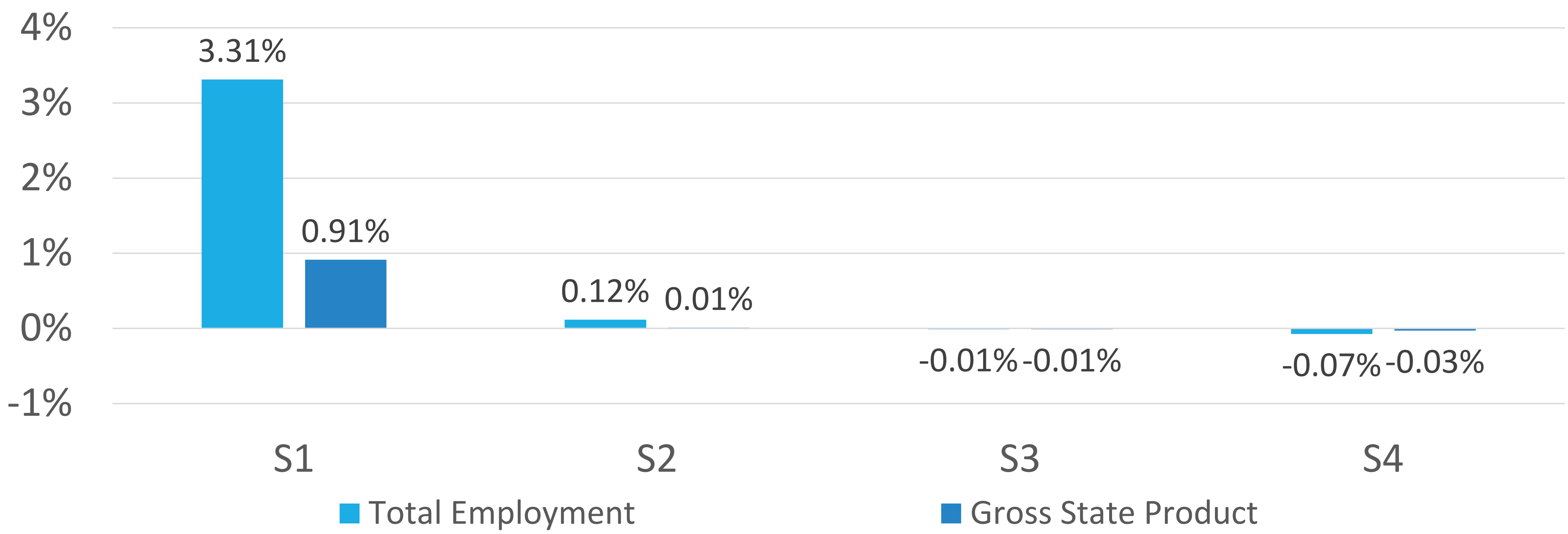
- REMI PI+ model is a structural economic forecasting and policy analysis model.
- It uses an Input/Output framework that represents relationships between industries
- It also integrates computable general equilibrium, econometric, and economic geography methodologies
- Structure of model consists of five major blocks:
  - Output and Demand
  - Labor and Capital Demand
  - Population and Labor Supply
  - Compensation, Prices, and Costs
  - Market Shares

Macro-Economic Modeling in REMI

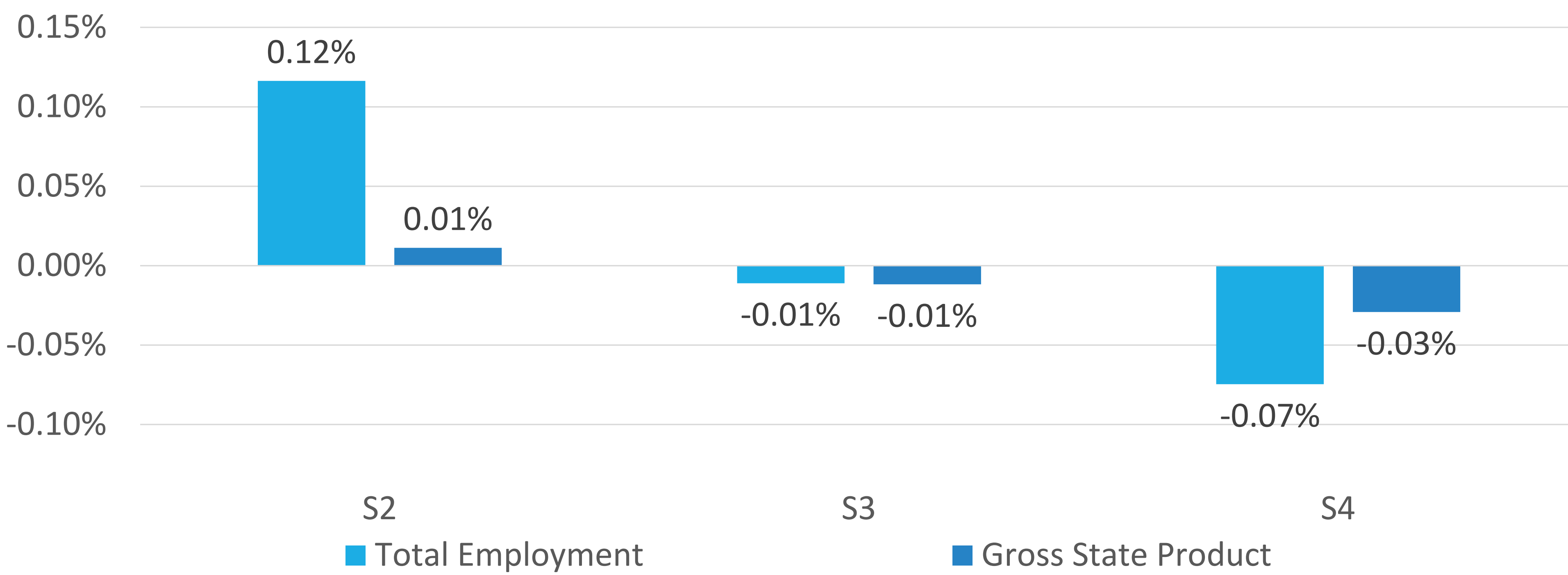
- Estimated direct costs of actions were used as inputs into a REMI PI +model
- Economic activity in target sectors is expanded in the model and macro economic effects are evaluated
- Funding for actions sourced from within state
  - Assumptions: funding sourced from state government spending, no increases in taxes
  - Urban forests costs came from a combination of private and government spending

Photo courtesy of Adam Moreno

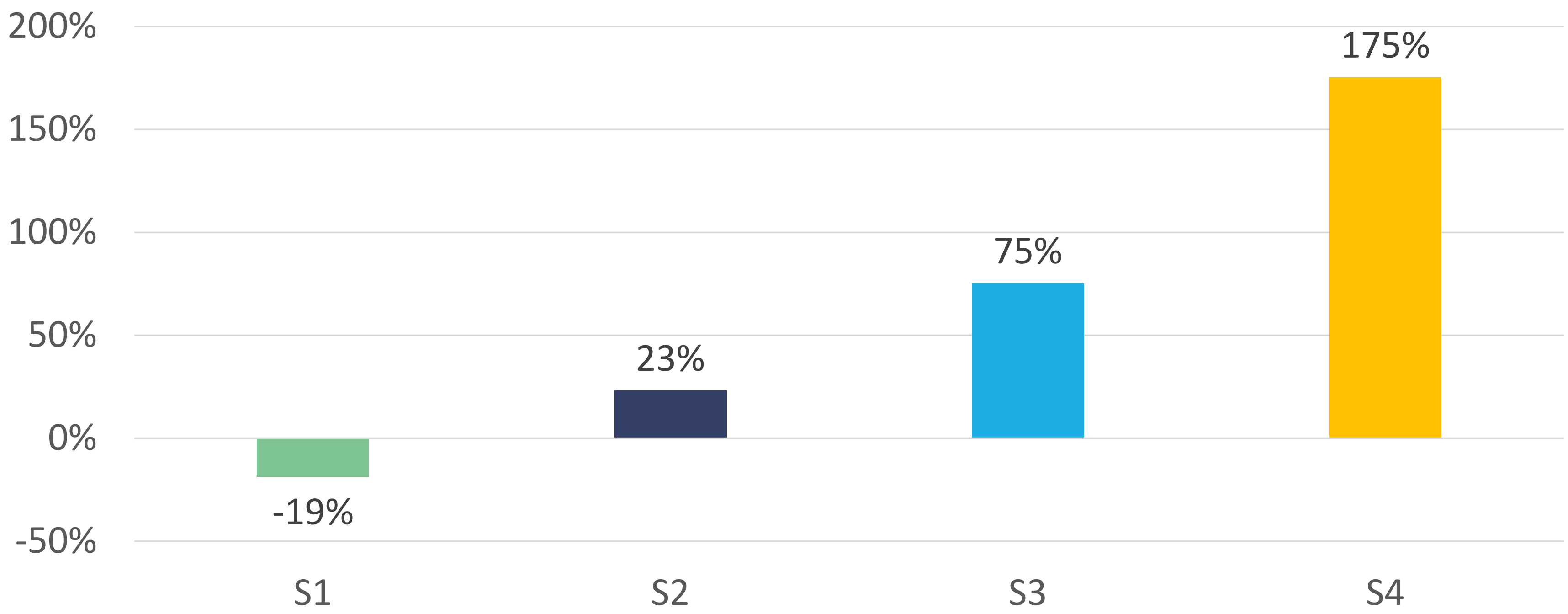
GSP and Employment (2045, All Scenarios)



GSP and Employment (2045, Excl. S1)



Employment (Forestry Sector)



Data Observations

- **Costs**
  - Scenario 1 is an order of magnitude more expensive due to urban forestry; other scenarios range from $3B to $5.5B annually
  - Forests and other natural land costs are the most expensive in scenarios 3 and 4
- **California Economy and Employment**
  - The California workforce is forecast to grow from today's levels through 2045 and the economy is forecasted to grow by 3.3% per year through 2045.
  - All scenarios have a small impact on CA economy in 2045. For Scenarios 2, 3, and 4, the impact is less than a 0.03% change in GSP in 2045.
  - Alternative 1 shows a positive impact in GSP and employment due to large reliance on urban forestry, which is labor intensive and also results in large declines in personal income.
  - Scenario 3 has smallest total impact on direct costs, jobs, and GSP.
  - To accomplish 1-5M acres annually in Scenarios 2, 3, and 4, the forestry sector employment needs to increase substantially

Summary of NWL Scenarios

Scenario	Avg. Annual Wildfire Emissions	Annual Wildfire Emissions Health Cost/Benefits (2021$)	Annual Cost (2021$)	Employment Relative to BAU in 2045	Description
1: Maximizing short term carbon stock at 2045	53 $MMTCO_2e$	~ -500 million (cost)	83 billion	+3%	Highest wildfire emissions Most health impacts Highest implementation cost Labor-intensive job increases
2: Balanced mix of strategies from current plans	51 $MMTCO_2e$	~800 million (benefit)	5.6 billion	+0.1%	Second highest implementation cost Modest health benefits
3: Prioritize restoration and climate resilience	48 $MMTCO_2e$	~ 3.1 billion (benefit)	3.2 billion	-.01%	Lowest implementation cost Second highest health benefits Moderate shift in jobs
4: Prioritize forest wildfire and other fuel reduction efforts	43 $MMTCO_2e$	~6.9 billion (benefit)	4.7 billion	-0.1%	Lowest wildfire emissions Most health benefits Significant shift in jobs to meet forestry needs