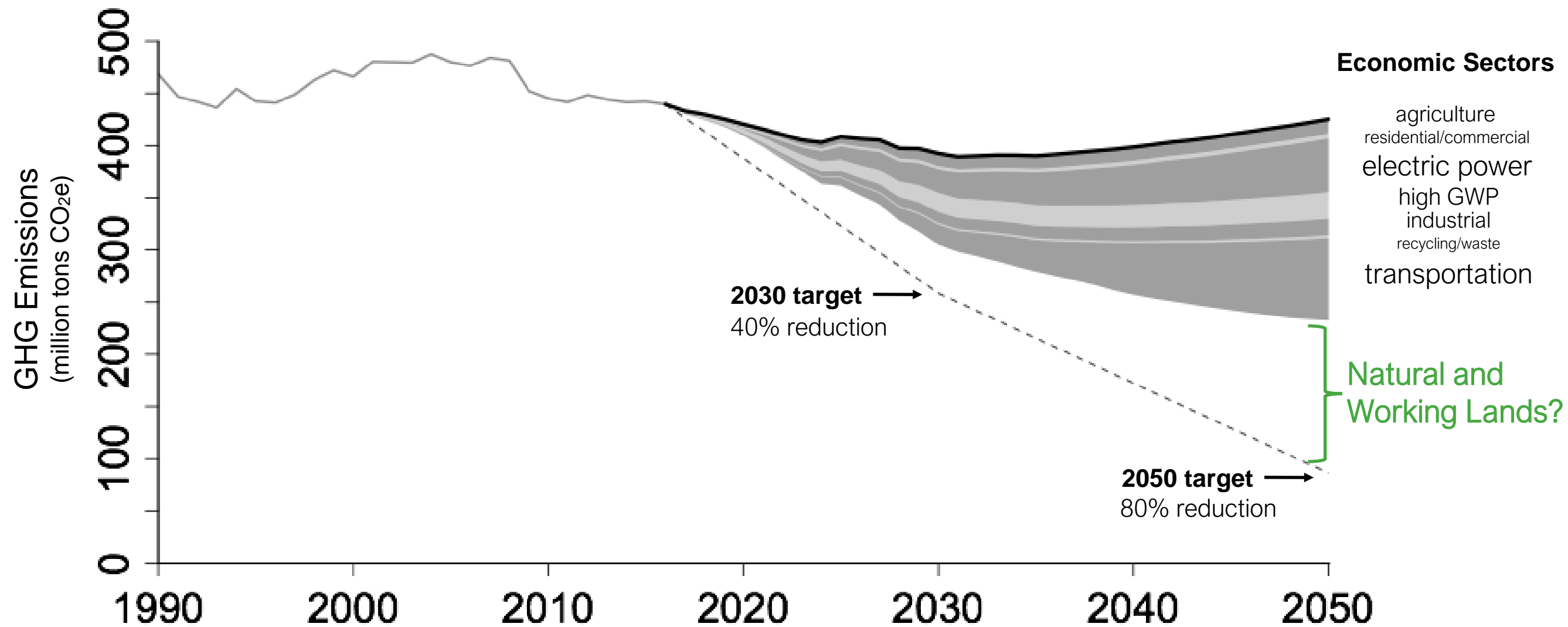


Analytical approaches to align climate mitigation with social and ecological co-benefits in California

Low Emissions Solutions Conference
September 11, 2018

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Dave Marvin, Climate Change Ecologist
California Chapter, The Nature Conservancy

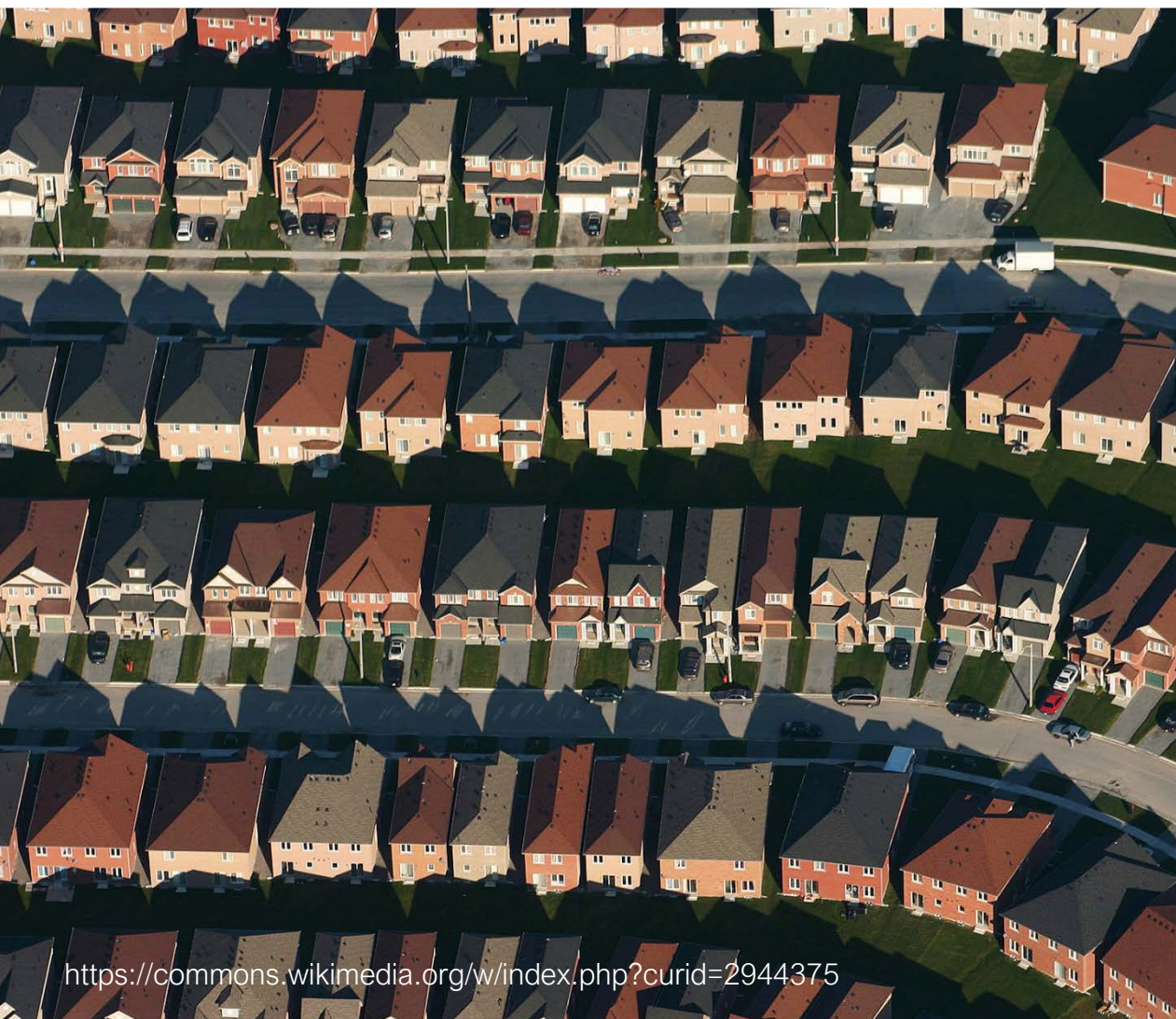
How can ecosystem reductions contribute?



Source: 2030 Scoping plan



Scott Warren



<https://commons.wikimedia.org/w/index.php?curid=2944375>



Andrew Peacock

Ecosystem management and land conservation can substantially contribute to California's climate mitigation goals

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Modeling efforts focused on future greenhouse gas (GHG) emissions from energy and other sectors in California have shown varying capacities to meet the emissions reduction targets established by the state. These efforts have not included potential reductions from changes in ecosystem management, restoration, and conservation. We examine the scale of contributions from selected activities in natural and agricultural lands and assess the degree to which these actions could help the state achieve its 2030 and 2050 climate mitigation goals under alternative implementation scenarios. By 2030, an Ambitious implementation scenario could contribute as much as 147 MMTCO₂e or 17.4% of the cumulative reductions needed to meet the state's 2030 goal, greater than the individual projected contributions of four other economic sectors, including those from the industrial and agricultural sectors. On an annual basis, the Ambitious scenario could result in reductions as high as 17.9 MMTCO₂e⁻¹ or 13.4% of the state's 2030 reduction goal. Most reductions come from changes in forest management (61% of 2030 projected cumulative reductions under the Ambitious scenario), followed by reforestation (14%), avoided conversion (11%), compost amendments to grasslands (9%), and wetland and grassland restoration (5%). Implementation of a range of land-based emissions reduction targets materially contribute to one of the most ambitious mitigation targets globally. This study provides a flexible, dynamic framework for estimating the reductions achievable through land conservation, ecological restoration, and changes in management regimes.

land use change | avoided conversion | carbon sequestration | natural lands | agriculture

Over the past two decades, climate science and policy have increasingly recognized the role that forests and other terrestrial ecosystems could play in climate change mitigation. About 30% of global anthropogenic carbon dioxide emissions are absorbed through carbon sequestration from plant growth and associated ecological processes (1). However, clearing and degradation of ecosystems, particularly forests, represents an emissions source roughly equivalent to 9% of total emissions, or about half of the carbon dioxide released globally from the combustion of natural gas (1). Land conservation and changes in ecosystem management can reduce emissions that might otherwise occur from conversion to more intensive uses, land degradation, or natural disturbance, such as fire. In many cases, they can also promote increased sequestration (2, 3). Such interventions may enhance the resilience and adaptive capacity of species and ecosystems and serve to maintain the provision of ecosystem services in the face of accelerating environmental change (4–6).

Globally, many government jurisdictions have committed to reducing emissions [including the sequestration of more greenhouse gases (GHGs)] across natural and agricultural lands as part of their climate change targets under the Paris Agreement. As of 2016, 83% of Intended Nationally Determined Contributions submitted to the United Nations Framework Convention on Climate Change reference land use, land use change, and forestry as key parts of their mitigation contributions (7). However, there is

little consistent analysis of the mitigation potential across multiple land-based activities to help governments prioritize investments to reduce net emissions [though see Griscom et al. (8)], particularly at a subnational level where activities and funding can be more specifically directed and aligned.

Subnational jurisdiction commitments have become more common over the last decade as efforts to achieve binding multinational GHG goals languished. California is one such subnational jurisdiction that has been a leader in climate change policy through its early adoption of ambitious GHG reduction goals, as defined in the Global Warming Solutions Act of 2006, commonly known as Assembly Bill (AB) 32. More recently, California has adopted more aggressive GHG reduction goals for 2030 and maintains commitments to reduce emissions in the energy and transportation sectors have the state on track to meet its 2020 goal (emissions equal to the 1990 level), but earlier studies have shown that additional reductions are needed beyond existing policies to meet the 2030 and 2050 targets (9, 10). California has recognized the need to reduce emissions through the management and conservation of its “natural and working lands” (i.e., open space, wetlands, urban forests, agricultural lands, and forest lands) (11). To effectively include this sector to help meet the state's long-term climate goals, an assessment of the GHG reduction potential of the state's natural and agricultural lands is needed.

Significance

Combating climate change will require using all available tools, especially those that contribute to other societal and economic goals, such as natural resource protection and energy security. Conserving and managing natural and agricultural lands to retain and absorb greenhouse gases (GHGs) are tools that have not been widely integrated into climate policy. Our analysis provides a quantification of potential climate benefits from multiple land-based activities for a jurisdiction with an emissions reduction target (up to 13.3% of the cumulative reductions needed to meet the 2030 target, or nearly three-fourths of a billion metric tons of GHGs). This approach provides a model that other jurisdictions can use to evaluate emissions reductions that might be achieved from conserving and restoring natural lands.

Author contributions: D.R.C., D.C.M., J.M.R., and M.C.P. designed research; D.R.C., D.C.M., and J.M.R. performed research; D.R.C., D.C.M., and J.M.R. analyzed data; and D.R.C., D.C.M., J.M.R., and M.C.P. wrote the paper.

The authors declare no conflict of interest.

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Data deposition: All data and simulation sourcecode are available for download through the Open Science Framework repository (<https://osf.io/UH1CP>).

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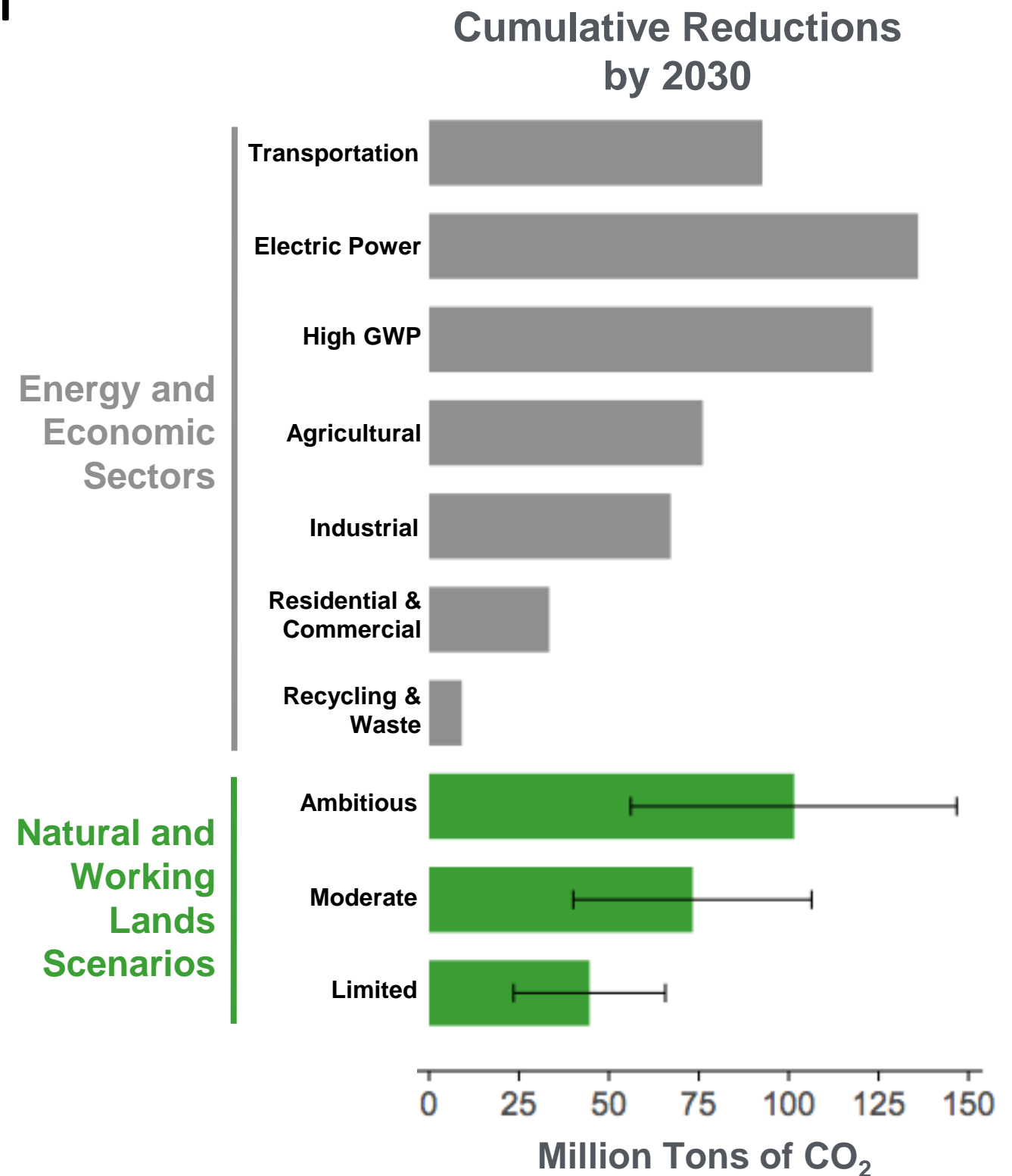
PNAS Early Edition | 1 of 6

www.pnas.org/cgi/doi/10.1073/pnas.1707811114

- 14 activities under 3 policy scenarios, focused on natural ecosystems
- 2030 and 2050 cumulative and annual mitigation

Sectoral comparison

Max of **17.4%** of cumulative reductions to meet the 2030 goal (147 MMTCO₂e)



What about.....

“Baseline” trends under plausible futures?

Climate effect on reduction potential?










Cost to achieve mitigation?

Land Use Carbon Scenario Simulator (LUCAS)

Environmental Research Letters

LETTER • OPEN ACCESS

Effects of contemporary land-use and land-cover change on the carbon balance of terrestrial ecosystems in the United States

Benjamin M Sleeter^{1,8} , Jinxun Liu² , Colin Daniel^{3,4} , Bronwyn Rayfield³ , Jason Sherba² ,
Todd J Hawbaker⁵ , Zhiliang Zhu⁶ , Paul C Selmanns²  and Thomas R Loveland⁷ 

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[Environmental Research Letters](#), Volume 13, Number 4

[Focus on Carbon Monitoring Systems Research and Applications](#)

Initial Conditions Carbon Stocks

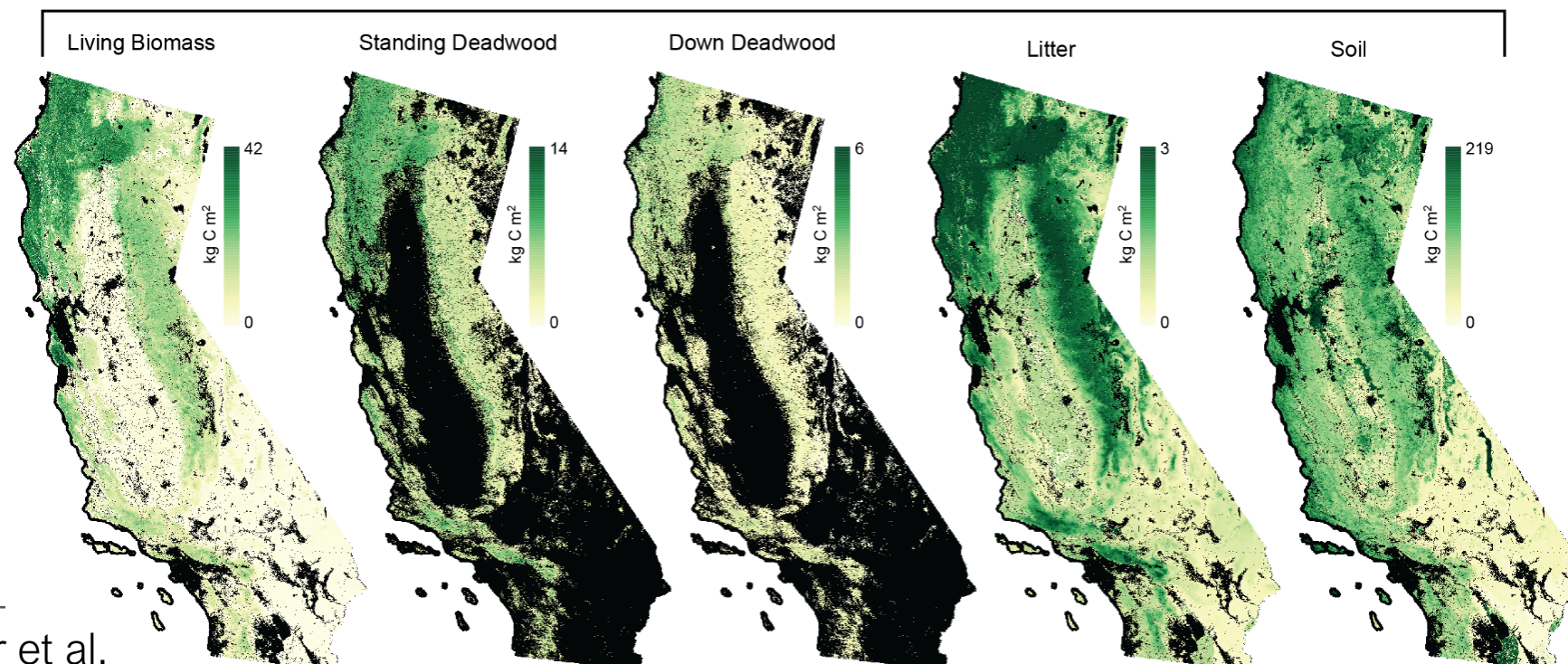
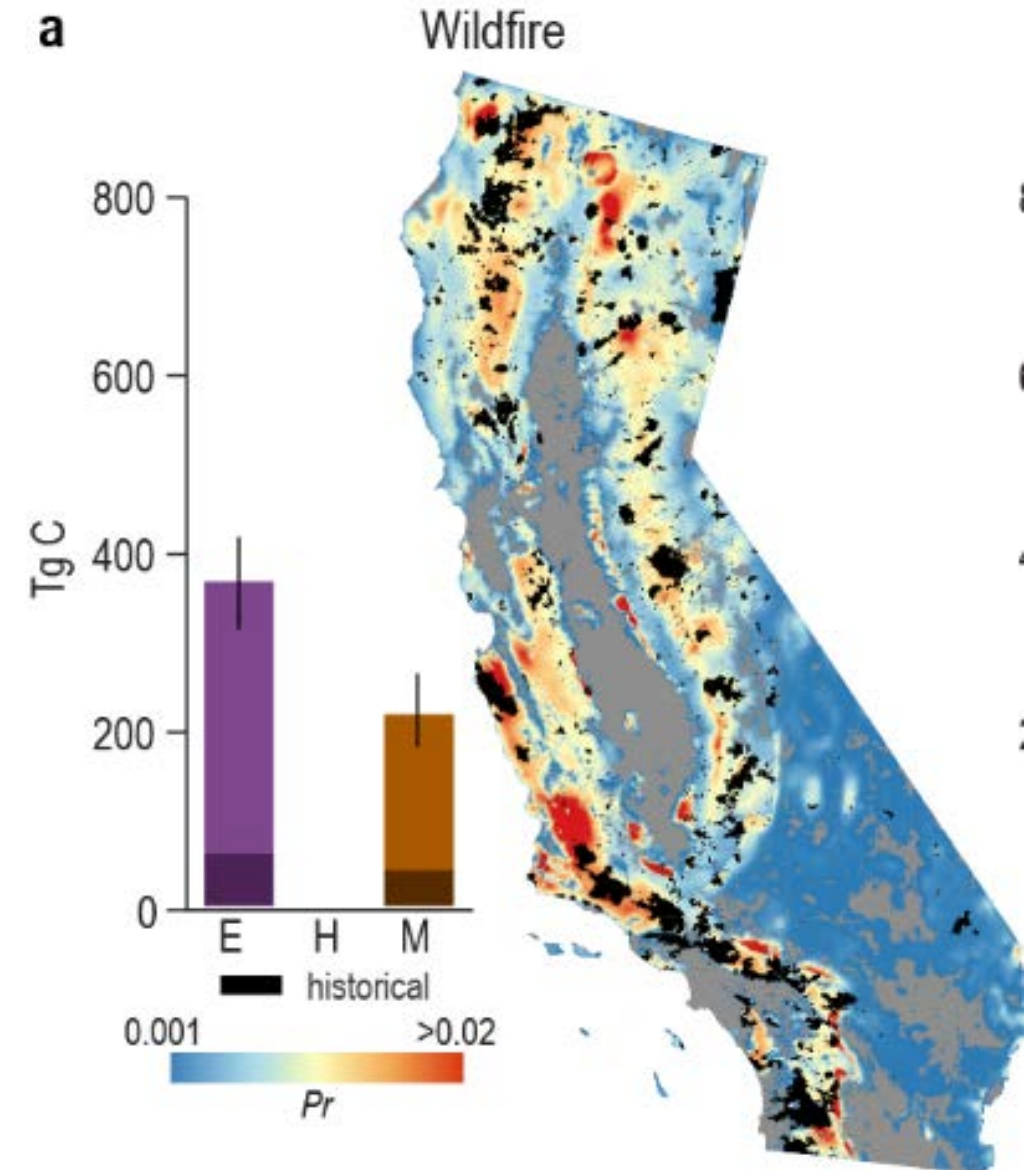
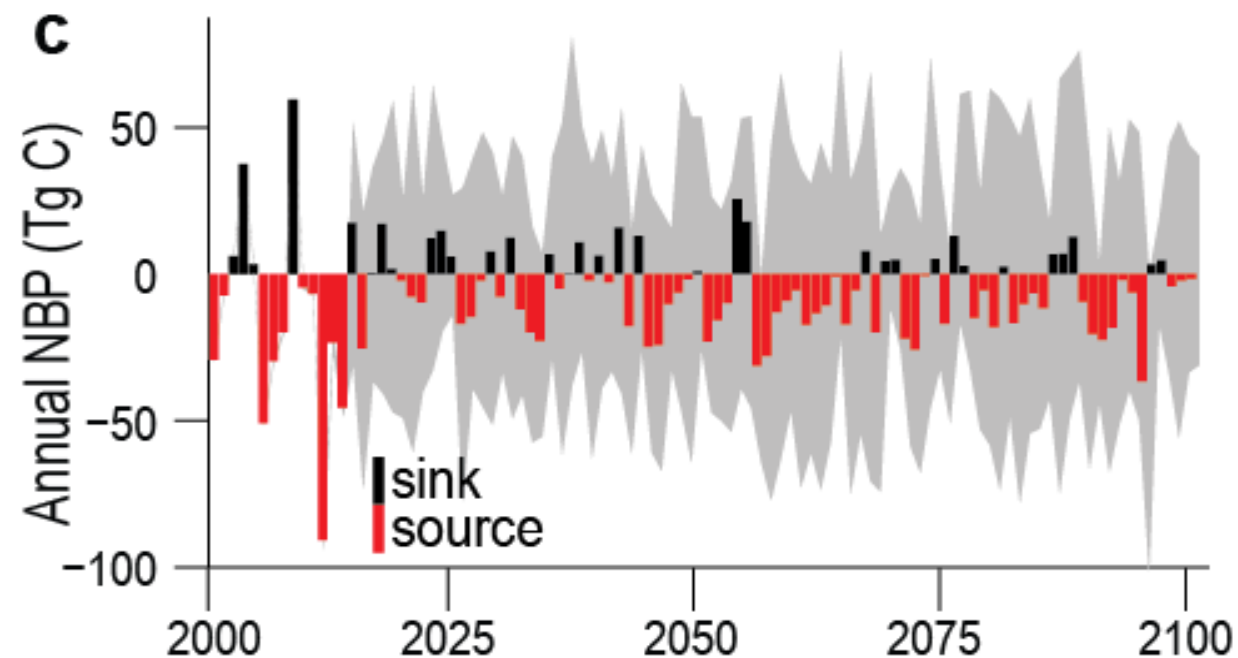
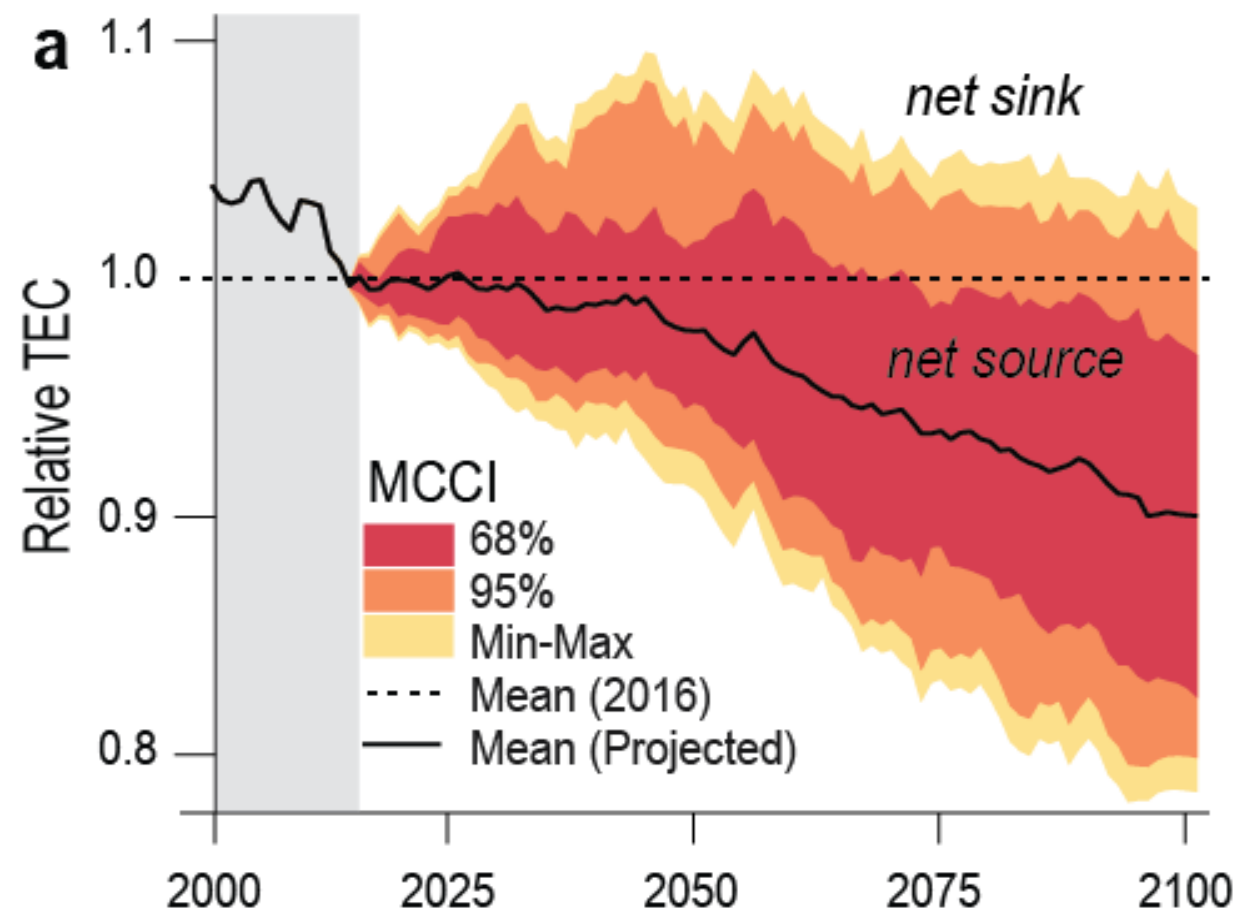


Figure from Sleeter et al.
In prep., Figures are Draft

Carbon dynamics of California's lands



32 futures (GCM/RCP/LUC)

TEC: Total Ecosystem Carbon
NBP: Net Biome Productivity

Direct and
opportunity costs of
intervention

Costs

Social cost of carbon/nitrogen
Avoided fire suppression costs
Avoided conversion benefits to
cropland
Avoided flood damages
Avoided fire damages?

Benefits

Changes to forest
management

Hardwood forest
restoration

Riparian forest
restoration

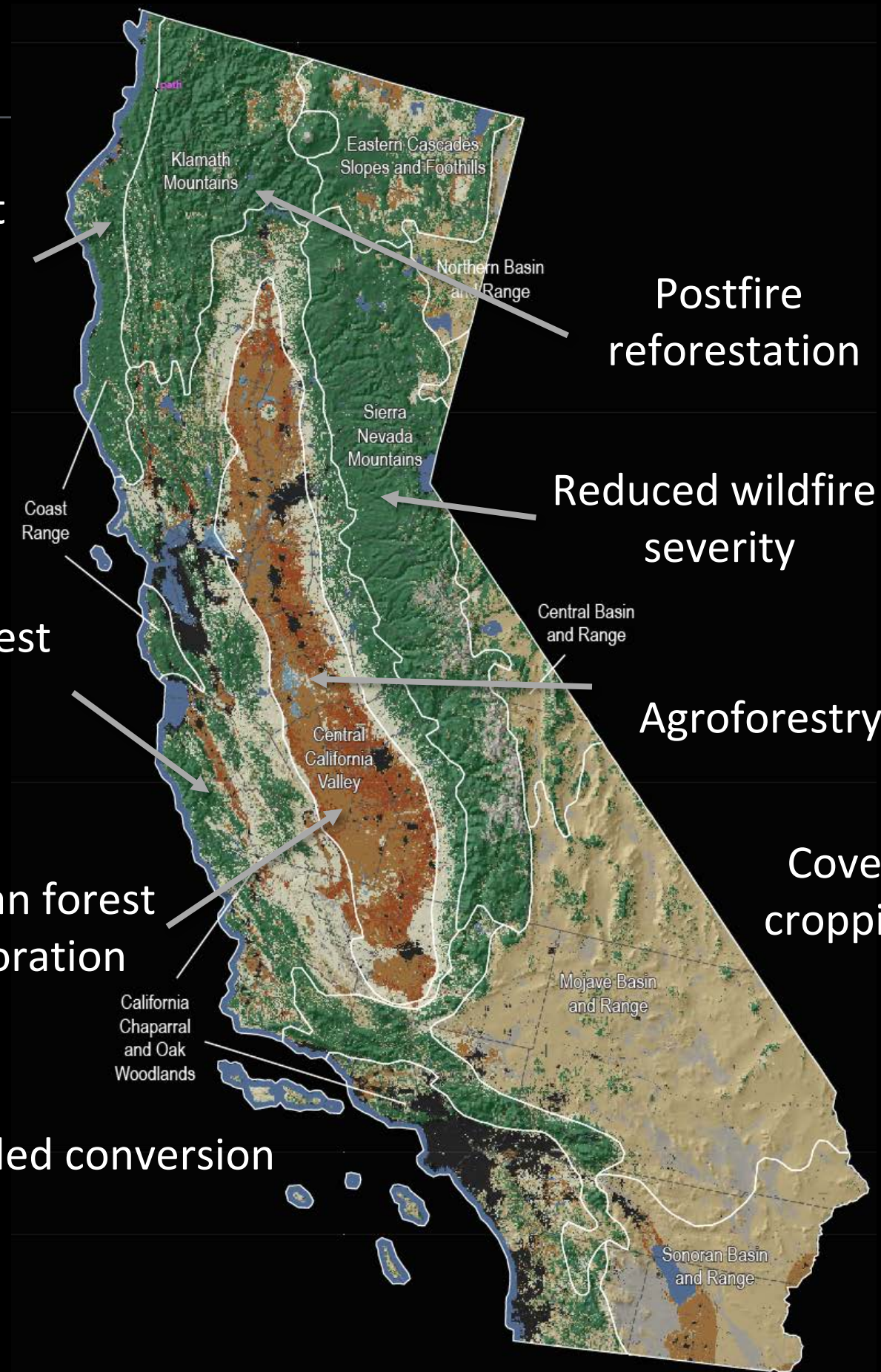
Avoided conversion

Postfire
reforestation

Reduced wildfire
severity

Agroforestry

Cover
cropping

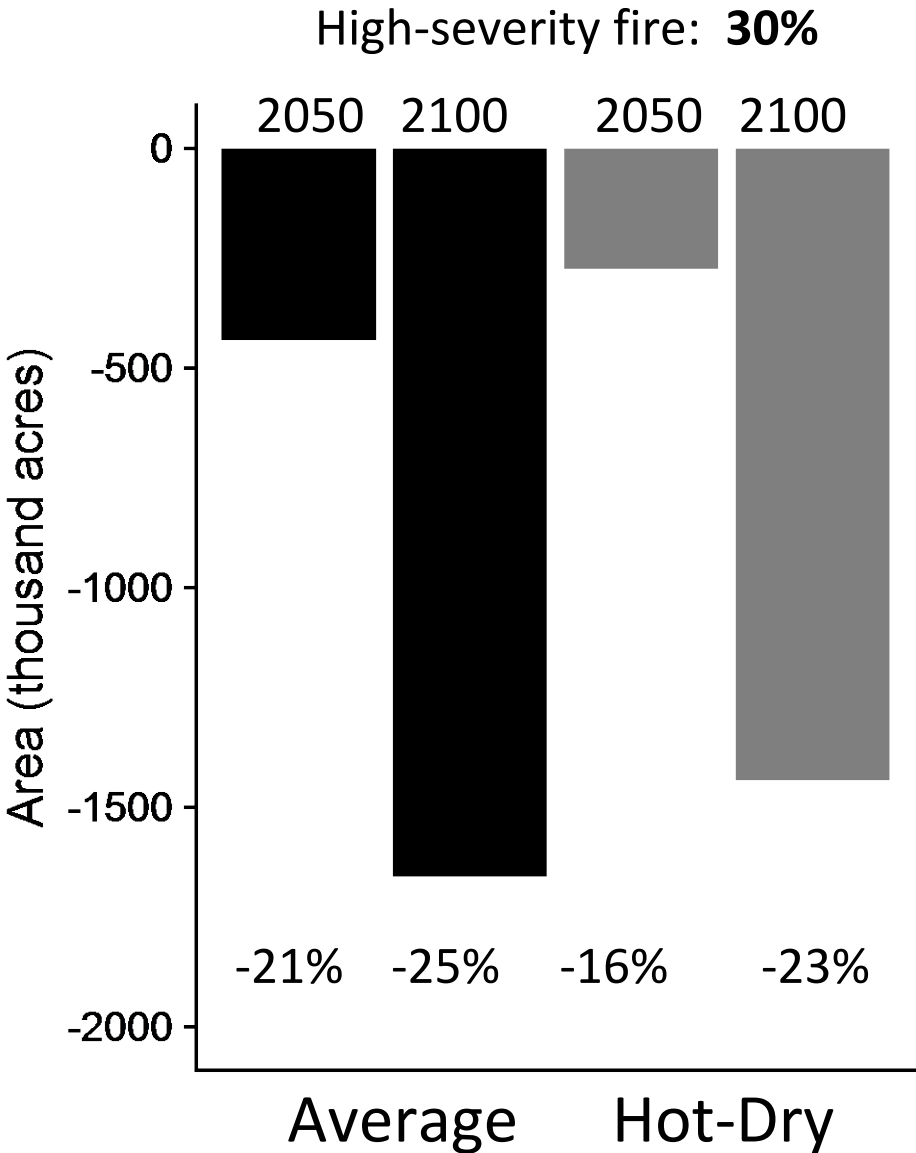




Reduced Wildfire Severity

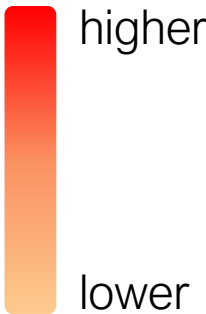
310,000 ac thinning/yr

120,000 ac Rx burning/yr



- Forest Thinning
- GAP 1 & 2 Restriction

Avg. Annual Wildfire Probability



Westerling: CA 4th assessment

Draft Results

Summary

- Evidence of strategies to achieve material GHG reductions and generate co-benefits is emerging
- Analytical approaches exist at multiple levels of complexity
- Taking a scenario-based approach to explore trade-offs will support more robust policies