

August 15, 2019

PATHWAYS TO 2050

Alternative Scenarios for Decarbonizing the U.S. Economy

California Air Resources Board



C2ES.ORG

- **Independent, nonpartisan, nonprofit organization.**
- **Mission: To forge practical solutions to reduce greenhouse gas emissions, expand clean energy, and strengthen resilience to climate impacts.**
- **A key objective is a national market-based program to reduce emissions cost-effectively.**
- **Brings city, state, and national policymakers together with businesses and other stakeholders.**
- **Ranks regularly among the top environmental think tanks in the world.**

Business Environmental Leadership Council (BELC)



AECOM



amazon.com



BHP



DTE



Goldman Sachs

HONDA
The Power of Dreams



IBM



JPMORGAN CHASE & CO.



nationalgrid



- **Climate Innovation 2050 brings together more than two dozen leading companies to examine potential pathways toward substantially decarbonizing the U.S. economy**
- **Principal outputs**
 - A policy brief, released in February 2019, outlining options for near-term federal action to address climate change;
 - A report, released in May 2019, culminating a year-long collaborative exercise that produced three alternative scenarios for reducing U.S. greenhouse gas emissions 80 percent by 2050; and
 - A comprehensive strategy, to be released in late 2019, outlining high-priority policies and business actions required over the coming decade to put the United States on the path to decarbonization.

- **What are scenarios?** - *“Descriptions of plausible future worlds”*
 - Plausible
 - Diverse
 - Relevant
- **Objective:**
 - Develop 3 U.S. decarbonization scenarios that each reach an 80 percent economy-wide emissions reduction
- **An actor driven approach:**
 - Many decarbonization analyses are technology driven
 - A focus on actors allows us to examine motivations and capacities of those with influence on decarbonization pathways

- **Scenarios integrated qualitative storylines with quantitative modeling**
- **Our initial set of scenarios failed**
 - Dependent on a single, dominant actor
 - Didn't achieve 80% reductions
- **Revised scenarios have actors working in concert with one another**
 - Everyone must act
 - Broad public support is required, but could manifest in a variety of ways

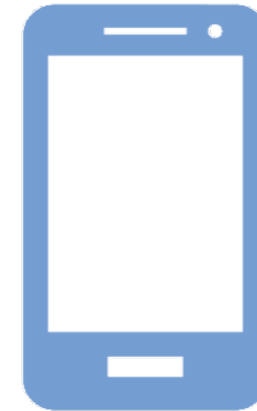
- International trade drives action
 - Carbon tariffs
 - Clean energy nationalism
 - Close collaboration between federal government and private sector
 - States play a complementary role
- Federal: Carbon price in 2024, aggressive vehicle GHG standards, strong RDD&D investment
- States: Clean energy standards, building codes, transportation policy
- Businesses: Focus on RDD&D collaboration and export opportunities
- Consumers: Support aggressive policy and are willing to pay more for domestically produced, low-carbon goods
- Technology: Nuclear, power sector CCS, grid-scale battery storage and cellulosic biofuels



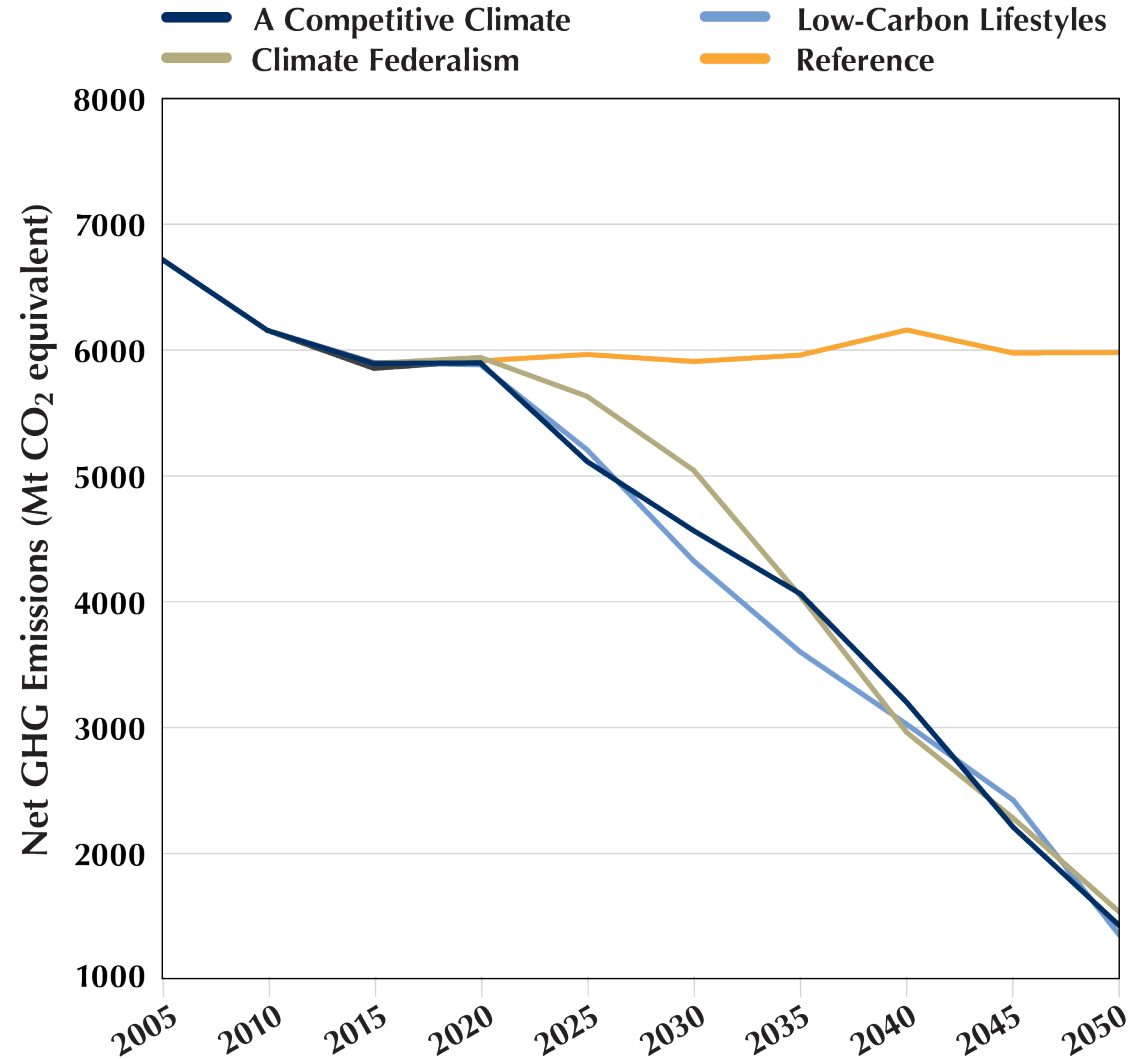
- Impacts and economic opportunity drive action
 - Increased climate impacts
 - Infrastructure turnover
 - Increasing economic opportunities
 - Private sector demands harmonization
- Federal: Carbon price in 2031, moderate vehicle GHG standards, moderate RDD&D investment
- States: Carbon markets expand and connect, post 2031: Clean energy standards, building codes, transportation policy
- Businesses: Facing investor pressure and fractured regulatory landscape, press for level playing field
- Consumers: Growing support for action through 2020s, rising preference for low-carbon products like electric vehicles
- Technology: Many renewables and electric vehicles are imported, domestic nuclear and hydrogen



- Urbanization, technology and markets drive change
 - Increased urban density offers efficiencies
 - Technological advances include autonomous vehicles and supply chain transparency
 - New business models, e.g., ridesharing, distributed energy
- Federal: Some RDD&D, but largely supportive, e.g., infrastructure
- States: Expanded and integrated carbon trading, many driven by urban centers
- Businesses: Utilities voluntary 90% reduction, low-carbon projects get low-cost finance
- Consumers: Can easily express low-carbon preferences, including dietary changes, walkable living
- Technology: Breakthroughs in software enable new business models and drive end-use efficiency

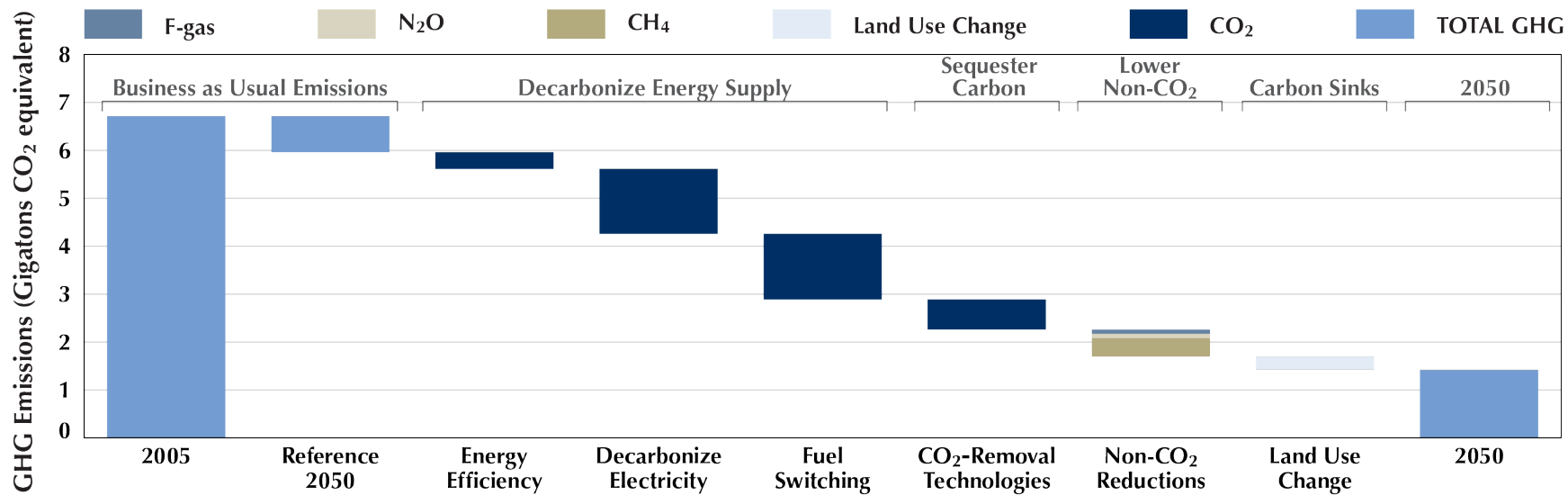


Net GHG Emissions (including LUC)

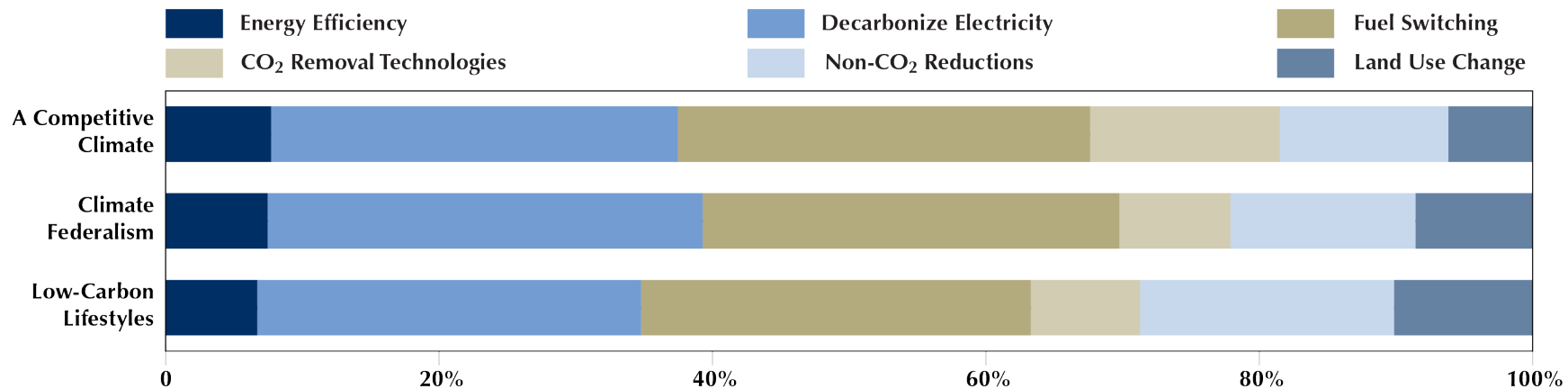


- **Decarbonizing the U.S. economy requires certain fundamental shifts in the ways we generate energy, produce goods, deliver services, and manage lands.**
- **These fundamental shifts can be achieved through a host of alternative pathways reflecting different drivers, contingencies, and societal choices.**

Key Elements of Decarbonization

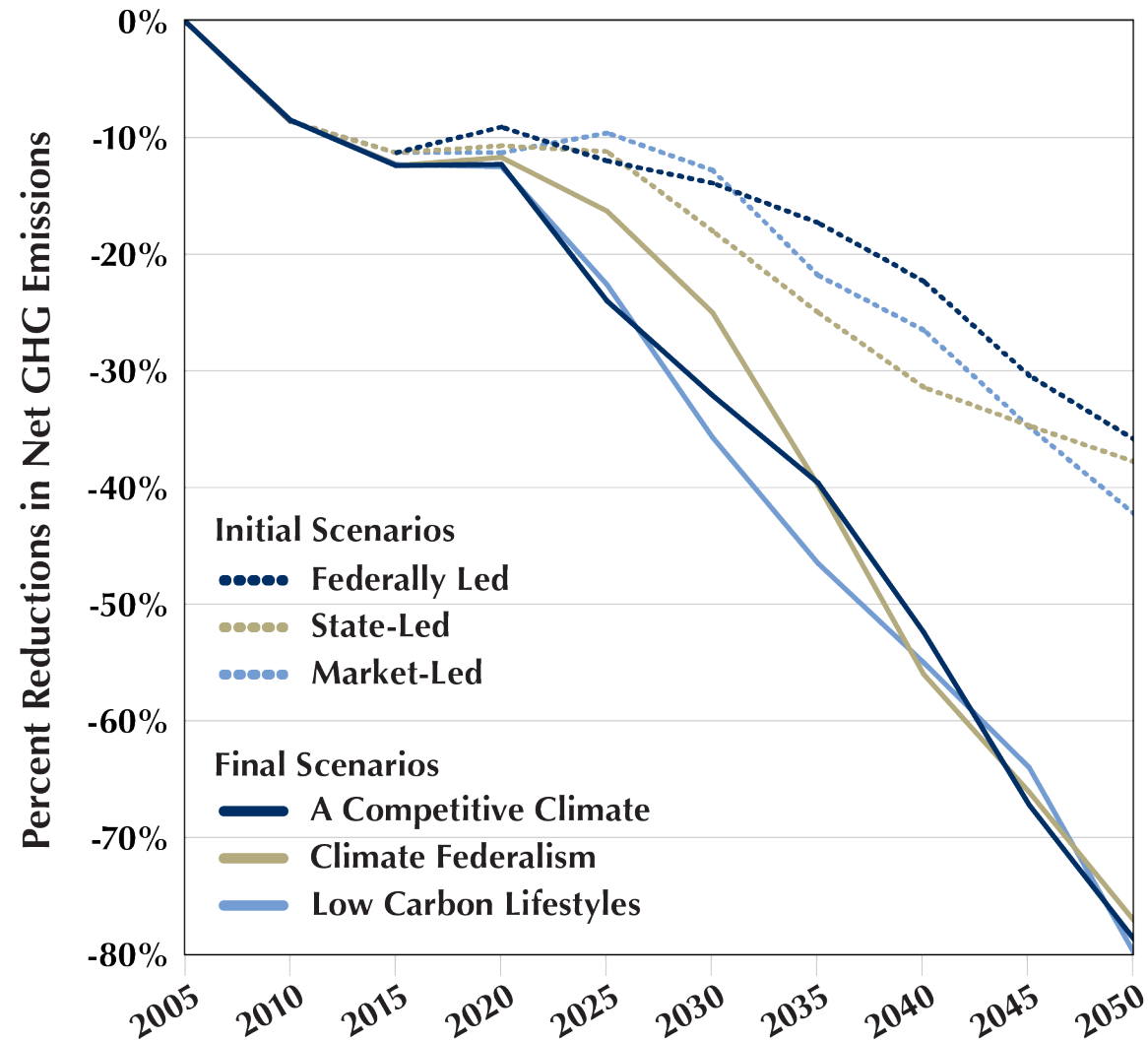


Scenario: A Competitive Climate



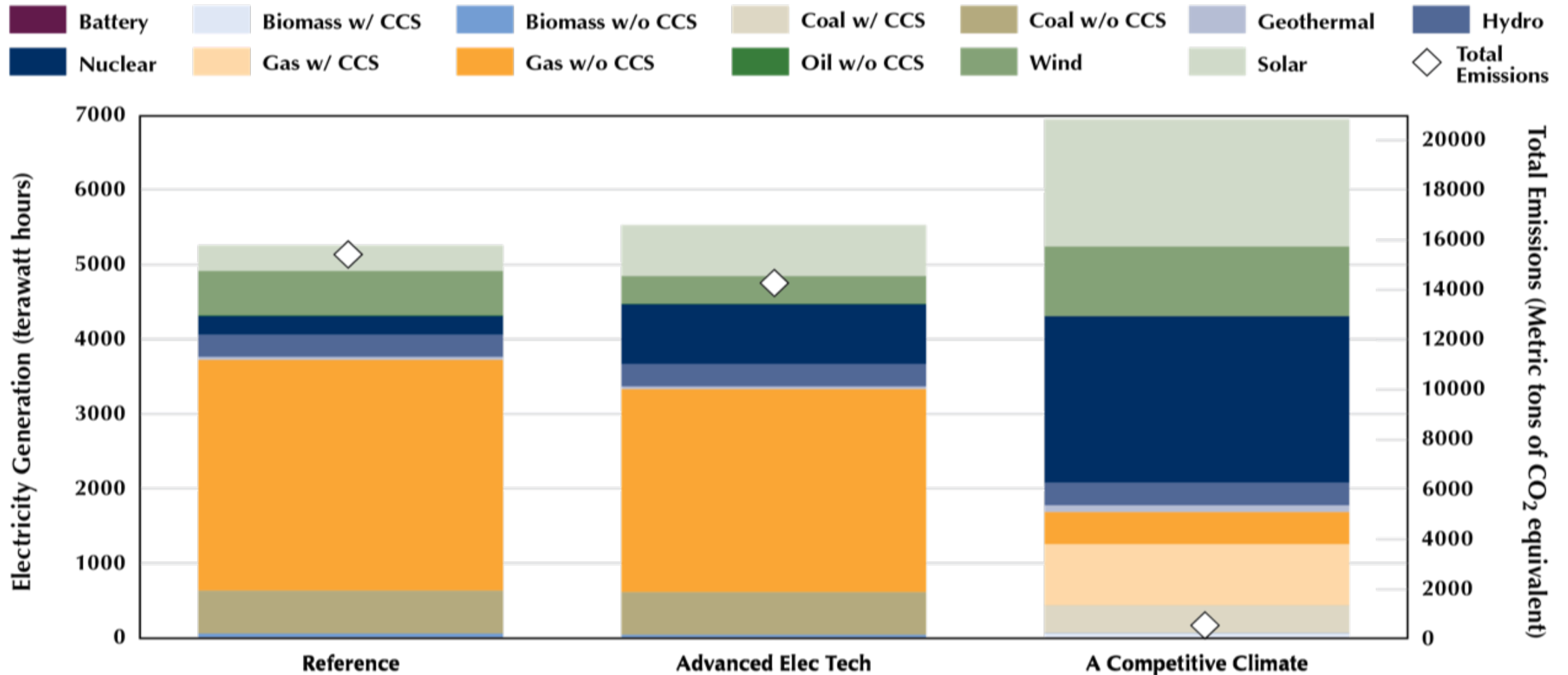
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- **Decarbonization requires that everyone plays their part—policy-makers at all levels, investors, entrepreneurs, consumers, voters, and companies across key sectors of the economy.**

Importance of Broad-Based Action



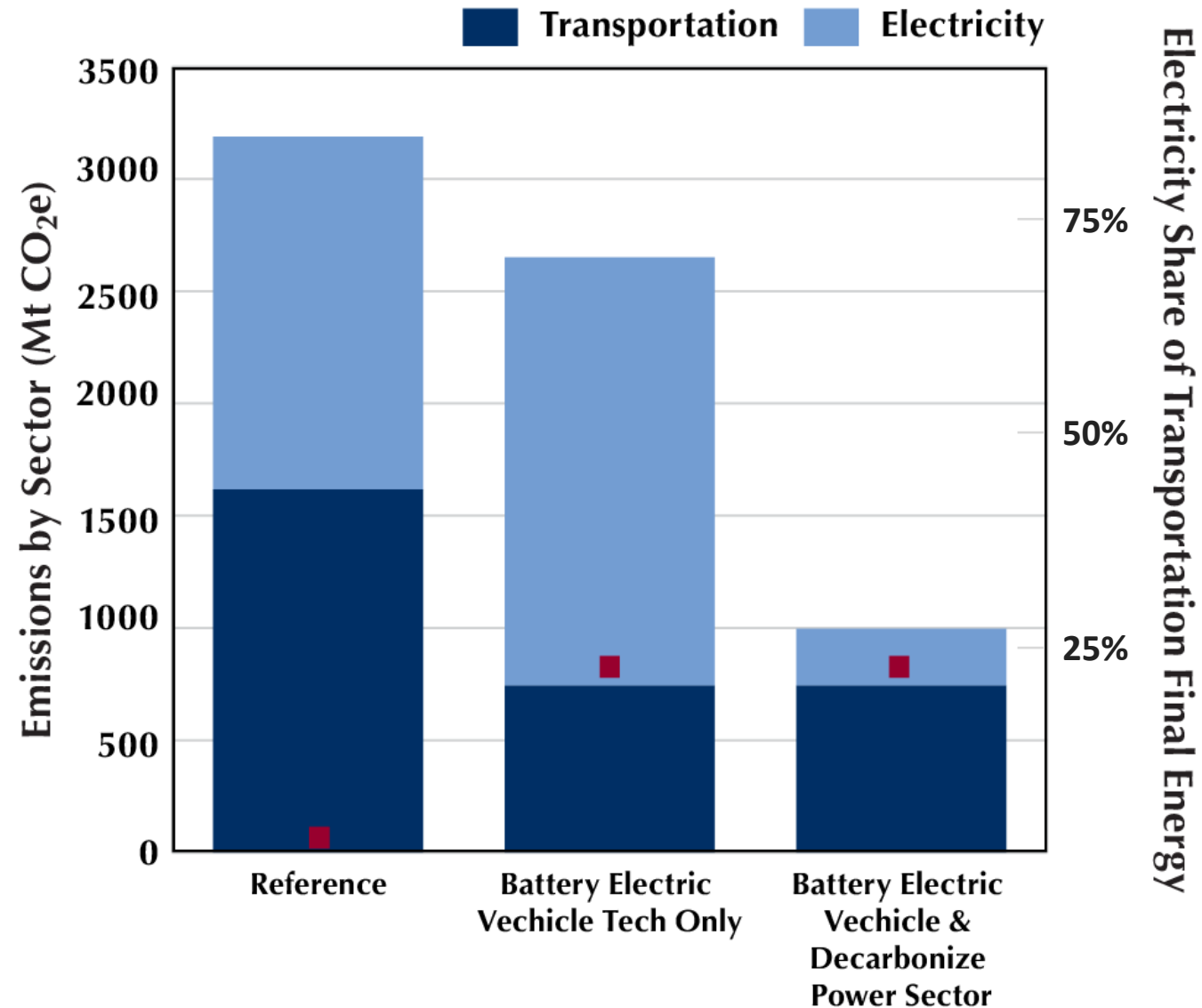
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- **Technological innovation can greatly facilitate decarbonization, but without adequate policy drivers, is not sufficient to achieve it.**

Role of Policy in Driving Technology Deployment



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- **Sectoral responses are highly interdependent—the pathway chosen by one sector may enhance or constrain the decarbonization options of others.**

Sectoral Responses are Highly Interdependent



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- These fundamental shifts can be achieved through a host of alternative pathways reflecting different drivers, different contingencies, and different societal choices.
- Decarbonization requires that everyone plays their part—policymakers at all levels, investors, entrepreneurs, consumers, voters, and companies across key sectors of the economy.
- **The success of any pathway hinges on high levels of public support, expressed through stronger demand for effective policies and/or low-carbon goods and services.**
- **Decarbonization requires a broad suite of policies that drive investment and action by setting goals, targeting resources, providing incentives, and ensuring a level playing field.**
- Technological innovation can greatly facilitate decarbonization but, without adequate policy drivers, is not sufficient to achieve it.
- **The private sector is an essential partner in any decarbonization pathway, and timely business leadership can help ensure choices that are beneficial for both companies and society as a whole.**
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FOR MORE INFORMATION

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Key elements of the Climate Innovation scenarios



	A Competitive Climate	Climate Federalism	Low-Carbon Lifestyles
Overarching Drivers of Change	<ul style="list-style-type: none"> Carbon tariffs Clean energy nationalism 	<ul style="list-style-type: none"> Increased climate impacts and economic opportunities Infrastructure turnover 	<ul style="list-style-type: none"> Increased urban density New business models, e.g., ridesharing, distributed energy
Federal Government	<ul style="list-style-type: none"> Carbon price in 2024, rigorous vehicle standards and strong RDD&D investment 	<ul style="list-style-type: none"> Carbon price in 2031 	<ul style="list-style-type: none"> Supportive, but plays no proactive leadership role
State and Local Governments	<ul style="list-style-type: none"> Ambitious complementary policies 	<ul style="list-style-type: none"> Carbon trading expands on east and west coasts through 2030 	<ul style="list-style-type: none"> Cities push for state level carbon trading expansion and implement aggressive policies
Businesses	<ul style="list-style-type: none"> Collaborate with federal RDD&D on clean technology, eyeing export opportunities 	<ul style="list-style-type: none"> Fractured landscape causes companies to push for level playing field 	<ul style="list-style-type: none"> New business models, voluntary reductions and low cost finance for low-carbon tech
Consumers	<ul style="list-style-type: none"> Willing to pay more for domestically produced low carbon products 	<ul style="list-style-type: none"> Consumer preference for electric vehicles increases 	<ul style="list-style-type: none"> Carbon transparency drives low-carbon preferences across sectors
Technology	<ul style="list-style-type: none"> Large, capital intensive and regulated industries thrive 	<ul style="list-style-type: none"> Many technologies imported 	<ul style="list-style-type: none"> Software drives new business models and efficiencies

Key quantitative elements of the Climate Innovation 2050 scenarios



	A Competitive Climate	Climate Federalism	Low-Carbon Lifestyles
Economy-wide Carbon Price	<ul style="list-style-type: none"> Strong International Pressure 	<ul style="list-style-type: none"> Starting in 2031: \$50/ton, escalating at 10%/year 	
Subnational Carbon Prices		<ul style="list-style-type: none"> CA and RGGI markets grow to 29 states and escalate through 2031 	<ul style="list-style-type: none"> CA and RGGI markets grow to 25 states and escalate through 2050
Land-Use Change Mitigation	<ul style="list-style-type: none"> Incentives = 15% of national price 	<ul style="list-style-type: none"> Incentives = 15% of national price 	<ul style="list-style-type: none"> Incentives = 25% of CA market price
Electric Power	<ul style="list-style-type: none"> All 50 states adopt a CES of 60% by 2050 or higher 	<ul style="list-style-type: none"> 8 non CA/RGGI market states adopt a CES of 80% by 2050 	<ul style="list-style-type: none"> Voluntary 90% utility reduction target
Buildings			<ul style="list-style-type: none"> Decrease in residential and commercial floor space
Industry			<ul style="list-style-type: none"> Face 12% of international carbon price
Transportation	<ul style="list-style-type: none"> CAFE (2050): LDV – 62.5 mpg Freight – 12.2 mpg 	<ul style="list-style-type: none"> CA standards through 2030 Post 2030 CAFE – 51/10.45 mpg 	<ul style="list-style-type: none"> CAFE (2050): 51/10.45 mpg Public transit subsidies ZEV fleet procurement

Negative Emissions by Sector

