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Los Angeles and California: Environmental policy as a catalyst for cleantech ecosystems

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INTRODUCTION

In recent years, California has faced increasingly challenging climatological conditions, including drought and wildfires. Yet, it has also built on its reputation as a world leader in climate-related policymaking and in facilitating tech-based solutions to environmental problems. As a result, California offers a compelling and important story about climate change and technological innovation—a story that holds lessons for the rest of the United States and the world.

This paper is about economic geography. Specifically, it is about how California and one of its most important tech-innovation ecosystems, Los Angeles, have combated climate change and other environmental problems through innovation in both policymaking and technological invention and scaling.

Although this story is mostly one of success, the sustainability of California's model into the future is not a given. Both the state of California and city of Los Angeles face several significant challenges that could undermine their longstanding formulas.

Today, both California and Los Angeles rest upon a historical legacy that allowed them to become global leaders in environmental policymaking and experimentation. For over a century, voters, activists, businesses, and other actors in both California and Los Angeles have debated and fought over environmental issues ranging from land, water, wilderness, and ocean conservation to local air pollution mandates to energy and climate change policies. From the 1960s and 1970s onward, policymaking and experimentation have been enabled by powerful, if fluid, coalitions of stakeholders. These coalitions have included not just the groups that are most expected to push for stringent environmental protections—environmental and public health organizations and grassroots citizens' groups—but also powerful business interests, often including the tech sector. California's reputation as a first-in-the-nation (if not the world) environmental policymaker has had much to do with the public's longstanding desire to keep the state's beauty and livability intact. The public often has

The Atlantic Council Global Energy Center develops and promotes pragmatic and nonpartisan policy solutions designed to advance global energy security, enhance economic opportunity, and accelerate pathways to net-zero emissions.

found willing partners from within the state's many and diverse business interests, resulting in broad support for new policies.¹

In part because of this history, state and local policymakers today believe that advanced environmental policymaking and experimentation further the economy through boosting the indigenous tech sector. At the state level, California's policymakers are convinced that they have an important role to play in setting environmental standards that the state's private sector and its science and technology research institutions can meet through innovation. At the local level, leaders also believe that aggressive action on environmental challenges, including climate change, spurs local innovation and therefore the local economy. California is home to some of the most productive tech-innovation ecosystems in the world, including the Bay Area (Silicon Valley), Los Angeles, and San Diego.²

Tech-based innovation ranges from invention in the laboratory all the way through scaling new technologies in consumer markets. Numerous terms are used to describe advanced technologies that are designed to solve environmental problems, including cleantech, green tech, climate tech, agtech, blue tech, and

others. None of these terms captures the full range of technologies under consideration in this paper. (Box 1 provides a longer discussion of this terminological confusion.) However, the environmental technologies considered in this paper share several commonalities: they tend to use more sustainable materials, require less in the way of input resources (or use different types of input resources), are more efficient in operation, and have an overall smaller environmental footprint as compared with the technologies they are designed to replace.³ In general, these technologies are designed to deliver the same or better service to the consumer at a lower environmental cost. The list of such technologies is long, ranging from electric vehicles (EVs) to new foods such as meat substitutes to remote sensing technologies for Earth system analysis to biotechnologies and nanotechnologies that provide new materials for consumer goods. California is a global leader in tech development across all these areas.

This paper first assesses environmental and climate policymaking at the state level, actions that have been designed, in part, to spur tech-based innovation in California.

BOX 1: LABELS: CLEANTECH, GREENTECH, CLIMATE TECH, AND MORE

There is no consistent labeling of technologies that are developed to solve environmental problems. Rather, there are numerous terms describing these technologies, including “cleantech,” “green tech,” “climate tech,” “agtech” (technologies for agricultural purposes), “blue tech” (referring to marine technologies), and others. Although some of these terms clearly apply to specific types of technology, for example agtech and blue tech, the more sweeping terms such as cleantech, green tech, and climate tech are often used interchangeably. Cleantech, one of the most widely used terms, has been defined as any technology that dramatically improves the efficiency and productivity of natural resource inputs such as energy, water, and raw materials, while producing far less of pollutants such as carbon dioxide, and delivering results to consumers that are the same as or better than existing technologies.

The existence of so many tech labels has much to do with investment trends (after the 2008 financial crisis struck the sector hard, entrepreneurs rebranded their technologies through the use of new labels such as “climate tech”). However, more generally, the breadth of environmental challenges also explains much of this linguistic diversity. The planet's many ecosystems include its atmosphere, biosphere, oceans, forests, rivers, groundwater, lakes, glaciers, soils, wetlands, grasslands, and more. Human systems, including farms, ports, transportation networks, energy production systems, fisheries, and much more, intersect in important ways with these natural ecosystems. The world requires many different technologies to tackle the problems within, among, and across all these systems. Hence the proliferation of labels to describe this technological range.

Sources: Ben Hone, “What is blue tech? How these new, innovative technologies are improving our oceans,” Cool Down, November 25, 2022, <https://www.thecooldown.com/green-tech/what-is-blue-tech-oceans-water/>; Karn Manhas, “Why the agtech boom isn't your typical tech disruption,” World Economic Forum, February 25, 2019, <https://www.weforum.org/agenda/2019/02/why-the-agtech-boom-isn-t-your-typical-tech-disruption/>; Ted Dillon, “Climate tech vs. cleantech: What's the difference?” Clean Energy Ventures, January 20, 2021, <https://cleanenergyventures.com/clean-energy-venture-capital/climate-tech-is-cleantech-in-need-of-a-rebrand/>; “A brief history of cleantech,” Leonard, December 12, 2019, <https://leonard.vinci.com/en/a-brief-history-of-cleantech/>.

- 1 This is a central thesis in David Vogel, *California Greenin': How the Golden State Became an Environmental Leader* (Princeton, NJ: Princeton University Press, 2018).
- 2 “Silicon Valley” is often used as shorthand for the wider region around San Francisco Bay. The Bay Area's tech ecosystem includes Palo Alto and its environs, San Francisco, and Oakland plus adjacent communities.
- 3 Environmental technologies also can monitor, track, and safeguard the natural environment; for example, artificial intelligence and remote sensing technologies applied to wildlife conservation. See Trang Chiu Minh, “These new technologies could transform wildlife conservation,” *The Hill*, February 4, 2022, <https://thehill.com/changing-america/sustainability/environment/592820-these-new-technologies-could-transform-wildlife/>.

Then it shifts its analytical focus to Los Angeles, one of the most important tech-innovation ecosystems in the state, especially when it comes to environmental technologies. (Although Silicon Valley remains the world's most important tech-innovation ecosystem, California has others that are important producers of new technologies, including Los Angeles and San Diego; these ecosystems are under studied relative to Silicon Valley and worth exploring in their own right.) Disruptive technology is produced in dynamic places—often called tech-innovation “ecosystems”—that concentrate talent, money, scientific research, creativity, and visionary leadership. Los Angeles is one such place—even though it isn't as well-known for tech-based innovation as the Bay Area.

Finally, this paper assesses the significant risks to California's model and asks whether its tech ecosystems can transition to a fully decarbonized economy despite these risks.

CALIFORNIA: ENVIRONMENTAL POLICYMAKING AND TECH-BASED INNOVATION

California has long had an important place in American iconography. For decades, the Golden State has been equal parts cultural dream factory, wealth-creation machine, futuristic tech utopia, and stunning wilderness. Now, the state is attempting to rewrite this script to meet the needs of this century's unrelenting upheavals, including a rapidly changing climate that risks much of the California dream.

A remarkable feature of California's story is the coexistence of its economic dynamism and global dominance in tech-based innovation with the California state government's decades-long leadership in environmental policymaking. The state government has been at the forefront of environmental policymaking in the United States and often the world. That leadership extends back decades and, in the context of natural resource conservation, even longer.

Iconic periods in California's policymaking history include the 1960s and 1970s, which saw groundbreaking legislation focused on air quality, public health, and energy efficiency; and the 2000s up to the present, with policymaking focused primarily on climate change. The state's policy innovations also extended to powerful new institutions, which now count among the most important standards-setting bodies in the United States. A prime example

is the California Air Resources Board (CARB), founded in 1967 to combat air pollution. Among other innovations, CARB created the nation's first vehicular emissions standards for hydrocarbons, carbon monoxide, nitrogen oxides, diesel particulate matter, and greenhouse gas emissions.⁴

Today, climate-focused policymaking in California is associated primarily with the Democratic Party, which enjoys the governorship and a legislative supermajority in Sacramento. Yet historically, climate and environmental policymaking more often has been a bipartisan phenomenon in California. Republican governors Ronald Reagan and Arnold Schwarzenegger signed into law key climate and environmental legislation during the 1960s and 1970s, and the 2000s, respectively, as did Democratic governor Jerry Brown during the 1970s and 2010s (Brown served four terms as governor, from 1975 to 1983 and 2011 to 2019).⁵

This paper cannot do justice to the vast scope of California's environmental policies that have accrued over five-plus decades. However, a few policies are worth highlighting given their importance to the decarbonization of California's economy and their connection to the tech sector.

California has multiple policies focused directly on reducing greenhouse gas (GHG) emissions. Two of the most significant are the state's Renewables Portfolio Standard (RPS) and its GHG cap-and-trade-program. The RPS, passed in 2002 and updated as recently as 2018, requires that 60 percent of the state's retail electricity sales come from renewable sources by 2030, and all of it by 2045.⁶ The cap-and-trade program, signed into law in 2006 by Schwarzenegger, is the first and largest multi-sectoral emissions trading scheme (ETS) in the United States and fourth-largest in the world (after those in China, the European Union, and South Korea), covering large businesses such as utilities and large industrial plants accounting for roughly 85 percent of the state's total GHG emissions.⁷

Together, the RPS and ETS have driven much of the state's robust growth in the renewable energy sector. In 2022, wind and solar power accounted for more than a quarter of California's in-state electricity generation (19.9 percent for solar, 6.9 percent for wind), compared with 2009, when the shares were 0.04 percent for solar and 3 percent for wind. Growth in solar generation has been spectacular over that timeframe, from 850 gigawatt hours

4 “History,” California Air Resources Board, accessed May 16, 2024, <https://ww2.arb.ca.gov/about/history>.

5 Dan Farber, “Ronald Reagan – Environmentalist Governor,” *Legal Planet*, June 20, 2016, <https://legal-planet.org/2016/06/20/ronald-reagan-environmentalist-governor/>; “Protecting the Environment and Promoting Clean Energy,” Schwarzenegger.com, accessed May 16, 2024, <https://www.schwarzenegger.com/issues/milestone/protecting-the-environment-and-promoting-clean-energy>; Jeff Daniels, “From the 1970s to today, Jerry Brown defined modern California. What his legacy means depends on whom you ask,” CNBC, updated December 28, 2018, <https://www.cnbc.com/2018/12/18/ca-gov-jerry-browns-legacy-climate-leadership-but-too-cozy-to-oil.html>; Lauren Sommer, “Five Big Things Governor Brown Did on Climate Change,” KQED, January 3, 2019, <https://www.kqed.org/science/1936279/five-big-things-governor-brown-did-on-climate-change>.

6 “Renewables Portfolio Standard (RPS) Program,” California Public Utilities Commission, accessed May 16, 2024, <https://www.cpuc.ca.gov/rps/>.

7 “California Cap and Trade,” C2ES (Center for Climate and Energy Solutions), accessed May 16, 2024, <https://www.c2es.org/content/california-cap-and-trade/>.

(GWh) to 40,494 GWh.⁸ As shown in Table 1, California has among the highest renewable energy potential in the United States.⁹

Energy efficiency to avoid GHG emissions has also been an area of emphasis in California's policies. This approach stems from the early 1970s, when concerns about plans to permit hundreds of new power plants induced policymakers to consider demand-side management approaches. The California Energy Commission (CEC), created in 1974, established wide-ranging home appliance efficiency standards (for refrigerators, air conditioners, television sets, and dozens of other products) and efficiency standards for buildings.¹⁰ According to the CEC, the state's energy efficiency standards have saved consumers more than \$100 billion in electric utility bills over four decades.¹¹ The state's economy became more efficient at using energy as a result. Between 1975 and 2016, California's generation of fossil

fuel-based electricity decreased by 14 percent per capita and 62 percent per dollar of gross domestic product (GDP).¹² Even after 1990, when renewable energy from wind and solar sources began to grow rapidly in California, the state's efficiency programs continued to deliver massive energy savings. In 2016, efficiency savings amounted to an estimated 75 terawatt hours (TWh), more than eight times the estimated number from efficiency programs in 1990 and more than twice that from gains in renewable electricity generation over the same time period.¹³

California's approach emphasizes goals and standards as means for inducing technological innovation, based on the assumption that the private sector can meet such goals and standards if they are based on reasonable timetables.¹⁴ This logic extends back at least to the 1970s, if not even earlier, and the CEC's first energy efficiency standards for appliances.

Table 1: Total estimated technical potential for select renewable energy sources in California

| Energy source | US total estimated potential (GW) | Total estimated potential for California (GW) | California share of US total estimated potential (%) | California state rank (potential generation) |
|---|-----------------------------------|---|--|--|
| Urban utility-scale PV* | 1,218 | 111 | 9.1 | 2 |
| Rural utility-scale PV** | 152,974 | 4,010 | 2.6 | 11 |
| Rooftop PV | 665 | 76 | 11.4 | 1 |
| Concentrated solar power (CSP)/ solar thermal | 38,066 | 2,726 | 7.2 | 6 |
| Onshore wind | 10,955 | 34 | 0.3 | 20 |
| Offshore wind | 4,224 | 655 | 15.5 | 2 |
| Geothermal | 31 | 17 | 54.8 | 1 |

* Defined as a utility-scale photovoltaic (PV) installation placed within an urban area.

** Defined as a utility-scale PV installation placed outside an urban area.

Source: Lopez et al., U.S. Renewable Energy, figures 2–7.

8 Michael Nyberg, "2022 Total System Electric Generation," California Energy Commission, 2022, <https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2022-total-system-electric-generation>. The year 2009 is the baseline because CEC's data extends back to that year. See "Total System Electric Generation 2009-2022," California Energy Commission, accessed May 16, 2024, <https://www.energy.ca.gov/media/7311>.

9 Anthony Lopez et al., *U.S. Renewable Energy Technical Potentials: A GIS Based Analysis*, Technical Report NREL/TP-6A20-51946, National Renewable Energy Laboratory, July 2012, <https://www.nrel.gov/docs/fy12osti/51946.pdf>.

10 Vogel, *Greenin'*, chapter 7.

11 *Achieving Energy Efficiency*, California Energy Commission, January 2019, p. 1, <https://www.energy.ca.gov/sites/default/files/2019-06/EE-AchievingEnergyEfficiency.pdf>.

12 Charles Komanoff, Ralph Cavanagh, and Peter Miller, *California Stars: Lighting the Way to a Clean Energy Future*, Natural Resources Defense Council, 2019, pp. 9–12, <https://www.nrdc.org/sites/default/files/california-stars-clean-energy-future-report.pdf>.

13 Komanoff, Cavanagh, and Miller, *California Stars*, p. 10.

14 State officials interviewed by the author routinely made this claim.

California's zero-emission vehicle (ZEV) goal is a more recent example. In 2020, Gov. Gavin Newsom ordered CARB to plan for the transition to a ZEV future. CARB's rule, issued in August 2022, requires all new car sales in California to be ZEVs by 2035.¹⁵ California joined other governments (mostly European) having similarly aggressive goals.¹⁶ Its rule, however, is unique in that it mandates this transition, with fines levied on carmakers if they fall short.¹⁷

Undoubtedly, Newsom felt comfortable instituting such a rule given California's lead in ZEV design, manufacturing, and early consumer adoption is enormous. California is the largest EV market in the United States by far, comprising roughly a third of all battery electric vehicles sold nationwide.¹⁸ Five of California's cities—San Jose, San Francisco, Los Angeles, San Diego, and Sacramento—have the country's highest percentages of EV sales among major metro areas.¹⁹ Since 1970, the federal government has allowed the state to set stricter emissions rules than are required under the Clean Air Act, which shapes automakers' decisions for cars sold across the United States.²⁰ California's emissions standards are often adopted by other states; seven states have pledged to adopt California's ZEV rule and an additional eight are likely to do so.²¹

The state government's environmental policymaking intersects in important ways with California's economy, including its enormous tech sector, which employs an estimated 1.9 million people.²² California ranks first in the country for employment in the clean energy and clean transportation sectors, at over a half million jobs in 2021, which amount to 2.9 percent of the state's

entire workforce.²³ Some one hundred and fifteen thousand workers are employed in the solar electric power generation field in California, more than are employed in electric power generation from any other energy source by far, and a further two hundred and ninety thousand people work in fields related to energy efficiency.²⁴

There is no comprehensive data on employment across the full range of what might be called the green tech, cleantech, or similar environmental technology sectors in California. However, as with the tech sector in general, the state has the largest footprint in the United States in the development of advanced environmental technologies, as measured by the number of tech start-ups in these spaces (Table 2).

To support innovation in advanced environmental technologies, the state government invests considerable funds in the research and development (R&D) of such technologies and in their equitable adoption. For example, the cap-and-trade program funds California Climate Investments, which funds a wide range of environmental programs, including expansion of low-carbon technology markets and services (e.g., funding zero-emission equipment purchases by small businesses or expansion of transit services to low-income communities), climate monitoring and carbon sequestration programs, and pilot programs to support advanced ("pre-commercial") low-carbon technologies, among many others.²⁵ The California Infrastructure and Economic Development Bank has a Climate Catalyst Program that is designed to help early-stage start-ups find bridge financing for their nascent technologies and help later-stage firms scale their proven cli-

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- 15 Russ Mitchell, "California bans sales of new gas-powered cars by 2035. Now the real work begins," *Los Angeles Times*, August 25, 2022, <https://www.latimes.com/business/story/2022-08-25/california-ban-gasoline-mandate-zero-emission-2035>; "California Enacts World-Leading Plan to Achieve 100 Percent Zero-Emission Vehicles by 2035, Cut Pollution," Office of Governor Gavin Newsom, August 25, 2022, <https://www.gov.ca.gov/2022/08/25/california-enacts-world-leading-plan-to-achieve-100-percent-zero-emission-vehicles-by-2035-cut-pollution/>.
- 16 See summary in Dale Hall, *Supporting Governments with 100% ZEV Targets*, Workshop Report, ZEV Alliance, November 2021, <https://zevalliance.org/wp-content/uploads/2021/11/support-governments-zev-targets-nov21.pdf>.
- 17 Coral Davenport, Lisa Friedman, and Brad Plumer, "California to Ban the Sale of New Gasoline Cars," *New York Times*, August 24, 2022, <https://www.nytimes.com/2022/08/24/climate/california-gas-cars-emissions.html>.
- 18 Zachary Shahan, "California Rises to 21.4% BEV Market Share, 33.8% of US BEV Market," *CleanTechnica*, February 22, 2024, <https://cleantechnica.com/2024/02/22/california-rises-to-21-4-bev-market-share-33-8-of-us-bev-market/>.
- 19 For city rankings, see Nadja Popovich, "Where Electric Vehicles Are (and Aren't) Taking Off Across the U.S.," *New York Times*, March 6, 2024, <https://www.nytimes.com/interactive/2024/03/06/climate/hybrid-electric-vehicle-popular.html>.
- 20 In the 1960s, California was the first state to regulate automobile tailpipe emissions, presaging the federal Clean Air Act of 1970. See Peter Valdes-Dapena, "How California ended up in the zero-emissions driver's seat," CNN, September 6, 2022, <https://www.cnn.com/2022/09/06/business/california-emissions-regulations/index.html>.
- 21 Drew Hutchinson, "More states join California's push to phase out gas cars by 2035," Bloomberg Law, May 16, 2023, <https://news.bloomberglaw.com/environment-and-energy/more-states-join-californias-push-to-phase-out-gas-cars-by-2035>.
- 22 "High Tech," CA.gov, accessed May 16, 2024, <https://business.ca.gov/industries/high-tech>.
- 23 *Clean Jobs America 2022*, E2, August 3, 2022, Table 2, pp. 9–10, <https://e2.org/reports/clean-jobs-america-2022/>.
- 24 Gina Coplon-Newfield, David Keyser, and Hannah Schanzer, *United States Energy & Employment Report: Energy Employment by State 2022*, Office of Policy, Office of Energy Jobs, US Department of Energy, June 2022, Figures CA-2 and CA-8, pp. 30–33, https://www.energy.gov/sites/default/files/2022-06/USEER%202022%20State%20Report_0.pdf. Nationally, employment in solar and wind power generation also ranks first and second compared with employment from other power generation sources (e.g., coal, natural gas, or nuclear). See David Keyser et al., *United States Energy & Employment Report 2022*, Office of Policy, Office of Energy Jobs, US Department of Energy, June 2022, Figure 4, p. 12, https://www.energy.gov/sites/default/files/2022-06/USEER%202022%20National%20Report_1.pdf.
- 25 *2023 Annual Report: Cap-and-Trade Auction Proceeds*, California Climate Investments, April 2023, pp. 5–19, https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/cci_annual_report_2023.pdf. See also "Advanced Technology Demonstration and Pilot Projects," California Air Resources Board, California Climate Investments, accessed April 24, 2024, <https://www.caclimateinvestments.ca.gov/advanced-technology-freight-demonstration-projects>.

Table 2: Number and funding of start-ups producing advanced environmental technologies, by US state, utilizing Crunchbase data

| State | No. of companies |
|---------------|------------------|
| California | 1,907 |
| Texas | 774 |
| New York | 687 |
| Florida | 457 |
| Massachusetts | 400 |
| Colorado | 359 |
| Illinois | 260 |
| Pennsylvania | 199 |
| Washington | 196 |

Source: Analysis of Crunchbase data conducted August 2023 using Excel and R. Data included companies on Crunchbase with 1 to 100 employees, \$0 to \$50 million in revenue, no initial public offering, and self-identified within the following industries: agtech, battery, biofuel, biomass energy, clean energy, cleantech, electric vehicle, electrical distribution, energy efficiency, environmental consulting, environmental engineering, green building, green consumer goods, green tech, pollution control, power grid, recycling, renewable energy, solar, sustainability, waste management, water purification, or wind energy. The final dataset included 8,220 US-based start-ups.

mate technologies faster.²⁶ The Electric Program Investment Charge (EPIC), run by CEC, provides grants for clean energy tech development. EPIC's CalSEED program provides up to \$600,000 in grants to early-stage clean energy start-ups in California.²⁷

The state government appears intent on pushing even harder to decarbonize California's economy in the years to come. In December 2022, CARB's board approved a plan, supported by Newsom, to achieve carbon neutrality by 2045, in part through a 94 percent reduction in petroleum use and 85 percent reduction in fossil fuel use. In its press release announcing the plan, CARB noted that the plan will facilitate "high-road jobs tied to industries such as zero-emission car and truck manufacturing that position California as a major competitor in the global clean-energy marketplace."²⁸

LOS ANGELES TECH ECOSYSTEM

California has several of the world's most advanced tech-innovation ecosystems that are home to research and educational institutions, investment capital, entrepreneurs, talent, established tech firms, physical infrastructure, start-up incubators and accelerators, and more.

According to Startup Genome's Global Startup Ecosystem Report 2023, California places three areas in the global top twenty ecosystems—Silicon Valley (first), Los Angeles (fourth), and San Diego (sixteenth).²⁹ Other small but vibrant ecosystems such as Sacramento and Fresno are scattered around the state. AgStart, for example, is a leading agtech incubator in the Sacramento area that works closely with the University of California-Davis to develop climate-sensitive agricultural and food technologies.³⁰

26 "Climate Catalyst Program," California Infrastructure and Economic Development Bank, accessed May 16, 2024, <https://www.ibank.ca.gov/climate-financing/climate-catalyst-program>.

27 "Electric Program Investment Charge Program – EPIC," California Electric Commission, accessed May 16, 2024, <https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program>; "Investing in California's clean energy future," CalSEED, accessed May 16, 2024, <https://calseed.fund/>.

28 "CARB approves unprecedented climate action plan to shift world's 4th largest economy from fossil fuels to clean and renewable energy," California Air Resources Board, December 15, 2022, <https://www2.arb.ca.gov/news/carb-approves-unprecedented-climate-action-plan-shift-worlds-4th-largest-economy-fossil-fuels>. See also Daniel Sperling, "How California's ambitious new climate plan could help speed energy transformation around the world," *Conversation*, January 26, 2023, <https://theconversation.com/how-californias-ambitious-new-climate-plan-could-help-speed-energy-transformation-around-the-world-197094>.

29 *The Global Startup Ecosystem Report 2023*, Startup Genome, June 2023, p. 30, <https://startupgenome.com/report/gser2023>.

30 AgStart is a nonprofit incubator based in Woodland, twenty miles northwest of Sacramento: <https://www.agstart.org/>.

Albeit less well known than the Bay Area ecosystem, the tech footprint of the greater Los Angeles region nonetheless is a globally significant one. The Los Angeles metro area has thirteen million residents and an annual GDP greater than \$1 trillion.³¹ It boasts strengths in leading economic sectors, including aerospace, biosciences, manufacturing, transportation, electronics, and medicine, and possesses two of the largest ports in the United States—Los Angeles and Long Beach. The region has hundreds of science and technology-oriented research laboratories, including those at the California Institute of Technology, University of California Los Angeles, University of Southern California, Cedars-Sinai Medical Center, and the National Aeronautics and Space Administration’s Jet Propulsion Lab. It is also home to a thriving entrepreneurial culture, a large skilled workforce, and a massive and diverse consumer base including many

early tech adopters—for example, nearly one hundred thousand new ZEVs were registered in Los Angeles and Orange Counties alone in the second quarter of 2023.³²

Los Angeles is the center of the nation’s—if not the world’s—entertainment and gaming industries, which provide a constant supply of creative people from diverse backgrounds, a feature that is vital for all cutting-edge tech-innovation ecosystems.³³

A review of Crunchbase data shows that Los Angeles ranks among the top US ecosystems in advanced environmental technology innovation, as measured by the number of tech start-ups that produce these technologies (Table 3 and Figure 1). These findings are consistent with Startup Genome’s global cleantech



The Los Angeles metro area is home to leading research centers and companies across aerospace, bioscience, manufacturing, transportation, electronics, entertainment, and medical industries. Unsplash/Henning Witzel

31 This data covers the Census Bureau’s Los Angeles-Long Beach-Anaheim Metro Area, which is smaller than the greater Los Angeles region’s geographic footprint. See “Los Angeles-Long Beach-Anaheim, CA Metro Area,” Census Reporter, 2021, <https://censusreporter.org/profiles/31000US31080-los-angeles-long-beach-anaheim-ca-metro-area/>; “Total Gross Domestic Product for Los Angeles-Long Beach-Anaheim, CA (MSA),” FRED Economic Data, updated December 18, 2023, <https://fred.stlouisfed.org/series/NGMP31080>.

32 As reported in Emmet White, “25% Of California Passenger Vehicle Sales Are Now Electrified,” *Autoweek*, August 9, 2023, <https://www.autoweek.com/news/a44773527/california-ev-sales-record-2023/>.

33 On Los Angeles as a gaming center, see Allen Brown, “How Los Angeles Has Become the Gaming Capital of the United States,” *LA Guestlist*, July 8, 2020, <https://laguestlist.com/how-los-angeles-has-become-the-gaming-capital-of-the-united-states/>.

rankings, which place Silicon Valley first, Los Angeles fifth, and San Diego twenty-first in the world.³⁴

The region is a global leader in several advanced environmental technology sectors: It features dozens of tech companies focusing on the electrification of transportation, including EV design and manufacturing, EV charging infrastructure, e-mobility solutions, and related areas. Rivian, Fisker, EVgo, Canoo, and Bird are a few of the more notable start-ups that were founded or headquartered in the Los Angeles region. Companies in this space are attracted to the region for its automaking and auto supplier cluster, its high-quality R&D and abundant skilled workforce, and its large and growing EV consumer market.³⁵

Los Angeles benefits from specific attributes that facilitate innovation around environmental technologies. As an example, Los Angeles features world-leading blue tech and cleantech incubators. AltaSea is a “public-private ocean research institute” located at the Port of Los Angeles that mixes scientific research and public education with blue tech incubation. The Los Ange-

les Cleantech Incubator (LACI) is at the center of the region’s cleantech start-up economy and is one of the most highly regarded such incubators in the world.³⁶

As with the state government, the city of Los Angeles has facilitated the development of a vibrant local tech-innovation ecosystem that also includes environmental technologies. And as is true of state officials, city leaders view such innovation as positive for both environmental and economic reasons. An underlying reason why policymakers feel comfortable pushing for change is the broad popular support for public investments and policies designed to spur the development of advanced environmental technologies.

This support is partly the result of Los Angeles’s long experience fighting water and air pollution (especially smog, first observed in the city in 1943), and for fresh water supplies, protection of beaches, and more. Los Angeles, like California, has often been on the national and even global front lines of public dialogue and contestation over these issues since the 1940s.³⁷

Table 3: Number and funding of start-ups producing advanced environmental technologies, by US city-region, utilizing Crunchbase data

| City-region* | No. of companies |
|-------------------------|------------------|
| California’s Bay Area** | 851 |
| New York | 602 |
| Los Angeles | 495 |
| Boston | 378 |
| Houston | 278 |
| Boulder-Denver*** | 271 |
| Chicago | 210 |
| Washington, DC | 198 |
| Miami | 178 |

Source: Analysis of Crunchbase data conducted August 2023 using Excel and R, method as described in Table 2.

*Unless otherwise indicated, city-regions are defined by counties within the US Census Bureau’s Metropolitan Statistical Area.

**San Francisco, Santa Clara, Alameda, Contra Costa, Marin, and Santa Cruz Counties.

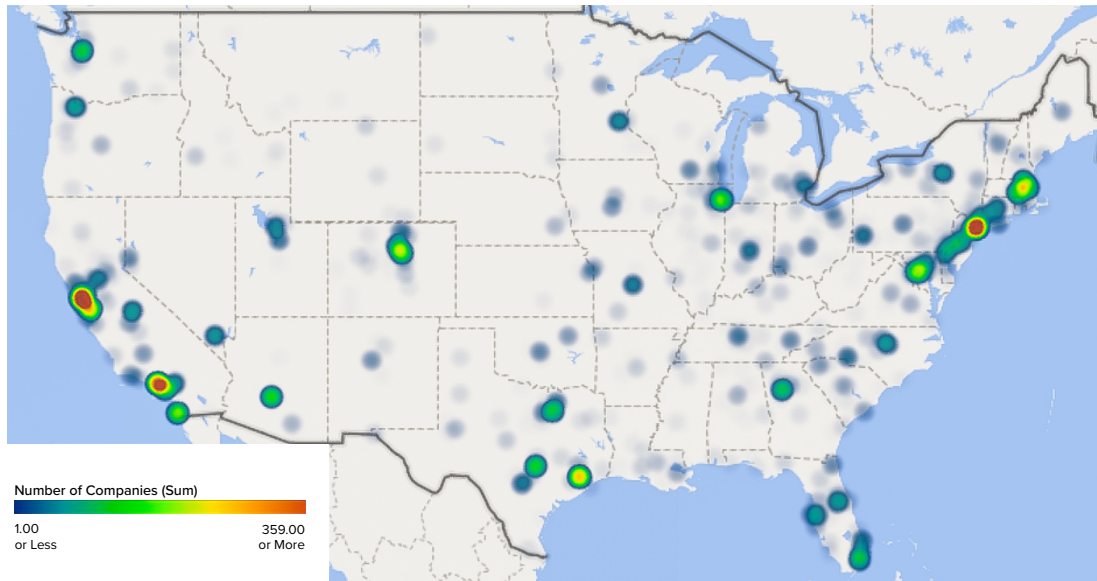
***Denver, Boulder, Jefferson, Arapahoe, Douglas, Broomfield, Adams Counties.

34 *The Global Startup Ecosystem Report: Cleantech Edition*, Startup Genome, January 24, 2022, p. 18, <https://startupgenome.com/reports/gser-cleantechedition>.

35 Jeff Collins, “Why Southern California Is the New EV Mecca,” *Transport Topics*, August 2, 2021, <https://www.ttnews.com/articles/why-southern-california-new-ev-mecca>.

36 “Vision + Mission,” AltaSea, accessed May 16, 2024, <https://altasea.org/our-vision/>; “What We Do,” AltaSea, accessed May 16, 2024, <https://altasea.org/what-we-do/>; “Our Strategy,” LACI, accessed May 16, 2024, <https://lacinubator.org/our-strategy/>.

37 A local government official made the general point in an interview with the author on July 17, 2023. On the history of smog specifically, see Sarah Gardner, “LA Smog: the battle against air pollution,” *Marketplace*, July 14, 2014, <https://www.marketplace.org/2014/07/14/la-smog-battle-against-air-pollution/>.

Figure 1: Number of firms producing advanced environmental technologies in the United States

Source: Analysis of Crunchbase data conducted August 2023 using Excel and R, method as described in Table 2.

The city's recent mayors have embraced this approach. LACI, for example, was created under then mayor Ramon Villaraigosa as a public-private partnership led by the Los Angeles Department of Water and Power, the goals of which were equally about supporting the region's burgeoning cleantech economy through urban redevelopment (LACI's La Kretz Innovation Campus is in the city's Arts District), facilitation of tech-based solutions to environmental problems, and inclusive economic development. Since LACI's founding in 2011, city, state, and federal officials have affirmed this role for the organization.³⁸

Eric Garcetti, who succeeded Villaraigosa as mayor of Los Angeles, put sustainable development—in the environmental and economic senses—at the center of his multiyear development plan starting in 2015. In asserting that the city's economic, social, and environmental development were linked, the plan called for an expansion of cleantech deployment, workforce upskilling for

“green industries,” and “use [of] LA's environmental leadership” to attract investment, firms, and business activity.³⁹ From early in his tenure, Garcetti was an enthusiastic advocate for the city's tech ecosystem, including innovation around advanced environmental technologies.⁴⁰ The city's current mayor, Karen Bass, has placed less emphasis on tech and more on equity compared to her predecessor. As with Newsom, Bass is placing much emphasis upon addressing the city's housing challenges.⁴¹

CONCLUSION: CALIFORNIA'S THREE RISKS

The California model, as successful as it has been for decades, is not immune to risk. If California and its tech-innovation ecosystems, including Los Angeles, are to sustain their global leadership positions, policymakers at the state and local levels will have to successfully navigate the following three sets of risks.

38 See Fred Walti, “Fostering the New Green Economy,” White House, President Barack Obama, August 16, 2011, <https://obamawhitehouse.archives.gov/blog/2011/08/16/fostering-new-green-economy>; “Speaker Pelosi visits LA Cleantech Incubator, touts Inflation Reduction Act,” Spectrum News 1, August 25, 2022, <https://spectrumnews1.com/ca/la-west/politics/2022/08/25/speaker-pelosi-visits-la--touts-inflation-reduction-act>; “Harris visits Cleantech incubator in Los Angeles to tout clean-energy economy,” ABC 7 News, April 18, 2023, <https://abc7.com/vice-president-kamala-harris-clean-energy-los-angeles-cleantech-incubator/13150987/>.

39 *pLAn: Transforming Los Angeles*, City of Los Angeles Office of the Mayor, 2015, pp. 60–65 (quotations from p. 65), <https://plan.mayor.lacity.gov/sites/g/files/wph2176/files/2022-12/the-plan.pdf>.

40 Sarah Favot, “Eric Garcetti's legacy as LA's first ‘High Tech Mayor,’” dot.LA, July 16, 2021, <https://dot.la/eric-garcetti-tech-2653797338.html>.

41 Elected in November 2022, Mayor Karen Bass campaigned on homelessness, crime, and housing. See Michael R. Blood, “In ailing LA, Mayor-elect Karen Bass promises unity, change,” AP, November 17, 2022, <https://apnews.com/article/2022-midterm-elections-los-angeles-karen-bass-government-and-politics-30a64a09b056984f65c1ab70a049e112>.

RISK 1: WILL CALIFORNIA RETAIN ITS COMPETITIVE EDGE?

California's economy is enormous, with a real GDP of around \$2.9 trillion (14.5 percent of total US GDP), ranking it first in the United States by a long measure (Texas is second at \$1.9 trillion, New York third at \$1.5 trillion) and (possibly) fourth or fifth in the world.⁴² A recent Los Angeles Area Chamber of Commerce report asserted that California's economy has the "largest number of employees and labor force, recipient of most of the nation's venture capital, most patents registered, and among the highest in per capita income" in the country.⁴³

Nonetheless, California's economy is at some risk of losing its luster given its longstanding reputation as a high-cost state for workers and business. For decades, that reputation harmed neither the state's economy nor its population, both of which expanded dramatically after World War II. California's glittering reputation as a sunbaked land of opportunity, driven in large part by a dynamic and diverse economy featuring manufacturing, entertainment, agriculture, technology, and more, far outweighed downside considerations. Recently, however, California has suffered through a population decline and is showing signs of business fatigue, which have been interpreted as warnings for the state and its highest-cost regions, including Southern California and Los Angeles.

Between 2020, when California's first absolute population decline in over a century was recorded, and 2022, the state's population fell by over half a million people. There were numerous causes, including a rapidly aging population, "a higher-than-normal death rate [during the COVID-19 pandemic], a falling birthrate, a drop in international migration and a flow of Californians moving to other states," according to a *New York Times* analysis.⁴⁴

The last cause, net out-migration, has been the source of much worry, as it speaks to the viability of California's business model. The debate in California revolves around how to interpret the migration data. Specifically, is recent out-migration temporary and not reflective of an otherwise strong state economy, or is it indicative of a more permanent trend that presages economic and demographic decline? The pandemic had some impact on out-migration, especially on tech sector workers who embraced remote work policies enabling them to move to lower-cost states elsewhere. In April 2024, the state released figures showing the downward population trend had reversed, with the state having gained sixty-seven thousand residents in 2023.⁴⁵ Despite this turnaround, however, a now-widespread view in California is that the state's high cost of living—in particular the high cost of housing—puts it at a disadvantage relative to other states like Texas.⁴⁶

Additionally, there is some risk that the state's business environment is eroding relative to other US states and regions. There are oft-cited concerns among the state's business leaders regarding California's heavy permitting and regulatory requirements, mandates, and higher taxation. Moreover, other states and regions are making themselves more competitive "in terms of industry composition, workforce opportunities, and amenities," according to the Los Angeles Area Chamber of Commerce.⁴⁷

Such critiques have been leveled against the state's business climate for decades, which only serves to reinforce a counterargument that the state's economy is resilient. There is quite a bit of merit in this counterargument. Over the short run, the risk specifically to the state's leading position as a tech innovator, including in environmental tech, should be low. This is because the size and density of California's tech sector is without peer anywhere in the world. The ongoing efforts by state and local officials to incentivize environmental tech innovation through aggressive public policies and incentives also should ensure

42 Data from the first quarter of 2023. See Bureau of Economic Analysis, US Department of Commerce, Gross Domestic Product by State and Personal Income by State, 1st Quarter 2023, news release, June 30, 2023, Table 1, <https://www.bea.gov/news/2023/gross-domestic-product-state-and-personal-income-state-1st-quarter-2023>. An October 2022 Bloomberg analysis concluded that California would overtake Germany as the world's number four economy by the end of 2023. See Matthew A. Winkler, "California poised to overtake Germany as world's no. 4 economy," Bloomberg, October 24, 2022, <https://www.bloomberg.com/opinion/articles/2022-10-24/california-poised-to-overtake-germany-as-world-s-no-4-economy>.

43 It found that only New York, Massachusetts, and Washington have a higher per capita GDP than California. See *California's Competitiveness: A Regional Approach*, Los Angeles Area Chamber of Commerce, June 2023, p. 7, https://lachamber.com/clientuploads/CACCompStudy/23_Competitiveness-Study.pdf.

44 Soumya Karlamangla, "The Population of California Declined, Again," *New York Times*, May 3, 2023, <https://www.nytimes.com/2023/05/03/us/california-population-decline.html>. See also Hans Johnson and Eric McGhee, "Who's Leaving California—and Who's Moving In?" Public Policy Institute of California, February 7, 2024, <https://www.ppic.org/blog/whos-leaving-california-and-whos-moving-in/>; Natalie Holmes and Evan White, "Pandemic Patterns: California is Seeing Fewer Entrances and More Exits (Corrected)," California Policy Lab, April 14, 2022, <https://www.capolicylab.org/pandemic-patterns-california-is-seeing-fewer-entrances-and-more-exits-april-2022-update/>.

45 Adam Beam, "California's population grew in 2023, halting 3 years of decline, state estimates," Associated Press, April 30, 2024, <https://apnews.com/article/california-population-growth-pandemic-decline-0d2bfc2c0a4ced0c3c2ad934207818bc>.

46 Researchers consistently point to decades-long undersupply of housing in California owing to restrictive zoning laws, fierce local opposition to new housing construction, and tax policies. See Noah Buhayar and Christopher Cannon, "How California became America's housing market nightmare," Bloomberg, November 6, 2019, <https://www.bloomberg.com/graphics/2019-california-housing-crisis/>; Jesse Bedayn, "Prop. 13 offers bigger tax breaks to homeowners in wealthy, white neighborhoods," *Cal Matters*, April 14, 2022, <https://calmatters.org/california-divide/2022/04/california-prop-13-neighborhoods/>. On housing costs as a driver of out-migration to Texas, see Swapna Venugopal Ramaswamy, "We kept getting outbid: Californians moving to Texas explain why they're changing states," *USA Today*, August 2, 2023, <https://www.usatoday.com/story/money/2023/08/02/californians-moving-to-texas/70488867007/>; William Fulton, "It seems like all of California is moving to Texas. Is that true?" Kinder Institute for Urban Research, Rice University, March 2, 2021, <https://kinder.rice.edu/urbanedge/it-seems-all-california-moving-texas-true>.

47 *California's Competitiveness*, p. 62.

that California remains one of the world's foremost innovators in environmental tech development.

Yet over the longer run even California's gigantic and dominant tech sector faces genuine risk. The state's high cost of living serves as a deterrent to attracting and keeping talented people, who have more choice than they ever have had before due to the expansion of remote work options within the United States and abroad to ply their trades. In addition, the Bay Area, Los Angeles, and San Diego may be at or near the very top of the world's tech ecosystems, but there are many others that are contenders for global leadership, including New York, Austin, Seattle, Boulder/Denver, Boston, Chicago, Shenzhen, Dubai, Singapore, Berlin, and London.⁴⁸ Each of these compete with California for talent.

As a result, California finds itself in a highly competitive global environment. In addition to addressing the high cost of living problem, the state and its ecosystems—Los Angeles included—will have to ensure that the longstanding advantages that enable California's tech-innovation dominance, for example, the state's many world-class research and educational institutions, continue to remain vibrant and well-funded.⁴⁹

Few in California underestimate the scale and magnitude of such challenges in the state. Policymakers are fully aware of them and have been searching for solutions. For example, affordable housing is a top priority for both Newsom and Bass.⁵⁰

RISK 2: WILL THE STATE'S ENVIRONMENTAL LEGACY STALL ITS DECARBONIZATION AMBITIONS?

California's monumental plans to combat climate change are at odds with other elements of the state's impressive environmental legacy. This tension has the potential to delay or derail the state's rapid decarbonization goals. There are important trade-offs between the state's climate ambitions on the one hand and other environmental policies on the other.

Chief among these trade-offs is how California can continue to protect its considerable natural assets while building out the infrastructure required for a fully decarbonized economy. The state's dramatic plans for expanding renewable energy production will require a massive expansion of onshore and offshore solar and wind infrastructure. There is a significant geographic mismatch between where the bulk of this renewable energy is expected to be produced and where it is consumed, requiring considerable new physical infrastructure (renewable energy generation plants, manufacturing and servicing facilities, storage facilities, and transmission infrastructure).⁵¹ The massive amount of construction needed to accomplish the state's renewable energy goals already has resulted in pushback from some groups that see threats to specific places, landscapes, and plant and animal species.⁵²

Much attention focuses on the California Environmental Quality Act (CEQA), which critics argue impedes the rapid buildout of utility-scale solar power in California's remote areas. CEQA, which was passed in 1970 and modeled after the federal National Environmental Policy Act, requires permitting agencies to undertake environmental impact reviews of major development projects, including large energy infrastructure projects. Because it also gives third parties, including the public, the right to file a lawsuit against these projects, CEQA has been a subject of intense debate for decades owing to accusations that the law unduly lengthens project approvals.⁵³ CEQA continues to have staunch defenders, who point out that the law has become a convenient (and unjustified) target for those who want faster permitting processes. They argue that CEQA remains necessary to prevent abuses from large-scale development of all types (not just energy projects), especially to protect vulnerable populations and communities.⁵⁴

There also is some risk that the state's plans, approved in August 2022 by the California Energy Commission, to create floating offshore wind farms for production of up to 25 gigawatts (GW) of power by 2045 (enough to power some twenty-five million

48 Robert A. Manning and Peter Engelke, *The global innovation sweepstakes: a quest to win the future*, Atlantic Council, June 2018, <https://www.atlanticcouncil.org/in-depth-research-reports/report/the-global-innovation-sweepstakes-a-quest-to-win-the-future-2/>.

49 Several of these challenges are addressed in Sean Randolph and Brian Brennan, *The Future of Advanced Technology and Basic Research: A California 100 Report on Policies and Future Scenarios*, California 100 Initiative, March 2022, pp. 30–35, <https://california100.org/app/uploads/2022/03/The-Future-of-Advanced-Technology-and-Basic-Research-ISSUE-REPORT-Single-pages-Round-3-2.pdf>.

50 Manuela Tobias, "Victorious in recall, Newsom refocuses on California housing crisis," *Cal Matters*, September 20, 2021, <https://calmatters.org/housing/2021/09/california-housing-crisis-newsom-signs-bills/>.

51 The primary controversies concern the siting of California's utility-scale solar photovoltaic (PV) infrastructure on public lands. There are many viable places for siting solar PV in California, including on rooftops and agricultural land, over canals and parking lots, and more. However, each has different siting challenges. See Vivian Yang, "Where is California going to site its new solar power?" Union of Concerned Scientists, April 27, 2023, <https://blog.ucsusa.org/vivian-yang/where-is-california-going-to-site-its-new-solar-power/>. See also Ryan Kennedy, "Retaining value for solar customers under California NEM 3.0 rule change," *pv magazine*, February 20, 2023, <https://pv-magazine-usa.com/2023/02/20/retaining-value-for-solar-customers-under-california-nem-3-0-rule-change/>.

52 See, for example, Julie Cart, "Wrangling over renewables: Counties push back on Newsom administration usurping local control," *Cal Matters*, August 4, 2022, <https://calmatters.org/environment/2022/08/renewable-energy-california-counties/>.

53 For an overview, see "CEQA Frequently Asked Questions," Planning and Conservation League, accessed May 17, 2024, <https://www.pcl.org/campaigns/ceqa/ceqa-faqs/>.

54 Julia Stein, "It's Not All CEQA's Fault," *Legal Planet*, March 14, 2022, <https://legal-planet.org/2022/03/14/its-not-all-ceqas-fault/>.

homes) will face similar lengthy delays owing to conflicting environmental protection goals.⁵⁵ The state sees the offshore wind plan as both a crucial piece of California's climate ambitions and as an economic development strategy that it hopes will turn California into the global center of the nascent floating offshore wind sector. (Offshore wind to date remains undeveloped on the US West Coast owing to the depth of the continental shelf and the need for floating turbines, which is an emerging technology.) The offshore wind plan will require building, storing, and transporting giant floating turbines as well as transmitting the resulting electricity onshore. The massive scale and technical hurdles of this endeavor have raised numerous flags regarding how the state's ports and port communities will be able to handle the turbines and their associated infrastructure, as well as how transmission lines and other infrastructure will affect critical marine habitats.⁵⁶

As with building out California's infrastructure on land, federal and state permitting processes could slow the build-out of the state's offshore wind infrastructure. There is much concern about and even outright opposition to California's ambitious offshore wind plans from local and tribal groups, environmental organizations, and commercial sectors, including fishing and shipping interests.⁵⁷

Permitting challenges for renewable energy projects are not unique to California; like CEQA, the federal National Environmental Policy Act throws up significant procedural roadblocks to renewable energy projects and related infrastructure around the country.⁵⁸

These challenges are real and consequential. Building an onshore and offshore renewable energy system at the scale needed to power the entire Californian economy represents a massive intervention in the state's physical landscapes and seascapes. Policymakers at state and local levels already are navigating policy alternatives. For example, in May 2023, Newsom proposed sweeping changes to CEQA, arguing that CEQA-created delays risk slowing the build-out of the state's renewable

energy infrastructure and the federal funding that is expected to pay for much of it (under the federal Inflation Reduction Act and the Infrastructure Investment and Jobs Act). The state legislature, reflecting the many political equities involved, narrowed the governor's package considerably, ensuring that CEQA reform is certain to remain a contested issue in 2024 and beyond.⁵⁹

RISK 3: WILL CLIMATE CHANGE OVERWHELM CALIFORNIA BEFORE IT DECARBONIZES?

A final and ironic risk to the California model is the possibility that climate change itself might derail decarbonization. For years, California has been on the front lines of climate-driven impacts, facing more frequent episodes of heat, drought, and even intense snow and rainfall. These impacts will make decarbonization more difficult by threatening critical infrastructure, making communities more vulnerable to catastrophe, and increasing the demand for renewable power in the state.

The western half of the United States has become hotter and drier over the past several years, resulting in reduced water supply and longer and more intense wildfire seasons in California and other states. Although California experienced record rain and snowfall in early 2023 and early 2024, thereby alleviating the state's multiyear drought, the long-term trend lines regarding drought in the American West, including California, nonetheless are worrying.

There are numerous consequences. One is the impact on communities. Producing enough affordable housing, already a problem for California, likely will become a bigger problem. California's wildfires now burn an estimated five times as much acreage annually than was the case a half century ago, directly threatening residential neighborhoods across the state.⁶⁰ In 2022 and 2023, two large insurers, State Farm and Allstate, announced they would no longer insure new residential and commercial properties in California. Both insurers cited growing wildfire risk as a central rationale, with State Farm announcing

55 "California sets big targets for offshore wind," Reuters, August 10, 2022, <https://www.reuters.com/business/environment/california-sets-big-targets-offshore-wind-2022-08-10/>.

56 Nadia Lopez and Josh Saul, "Clean Energy and Conservation Collide in California Coastal Waters," Bloomberg, February 9, 2024, <https://www.bloomberg.com/news/articles/2024-02-09/california-offshore-wind-power-goals-threatened-by-ocean-conservation-areas?sref=a9fBmPFG>; James Temple, "California's coming offshore wind boom faces big engineering hurdles," MIT Technology Review, December 5, 2022, <https://www.technologyreview.com/2022/12/05/1064243/californias-coming-wind-boom-faces-big-engineering-hurdles/>.

57 Katy Stech Ferek, "California Offshore Wind Projects Face Hurdles as Pressure Groups, Industry Interests Weigh In," *Wall Street Journal*, September 12, 2022, <https://www.wsj.com/articles/california-offshore-wind-projects-face-hurdles-as-pressure-groups-industry-interests-weigh-in-11662991200>.

58 See arguments advanced in Alec Stapp, "What many progressives misunderstand about fighting climate change," *Atlantic*, September 25, 2022, <https://www.theatlantic.com/ideas/archive/2022/09/capitalism-clean-energy-technology-permitting/671545/>.

59 Samuel-Bacal Graves and Amy Higuera, "California Infrastructure Plan Passes; Governor's CEQA and Species Reforms are Narrowed, but Signed into Law," JD Supra, July 13, 2023, <https://www.jdsupra.com/legalnews/california-infrastructure-plan-passes-9894823/>; Brooke Staggs, "Climate, business groups clash over Gov. Newsom's proposed environmental law reforms," *East Bay Times*, June 6, 2023, <https://www.eastbaytimes.com/2023/06/06/climate-business-groups-clash-over-newsoms-proposed-environmental-law-reforms/>; Ben Christopher et al., "Gavin Newsom wants to make it easier to build roads, dams and more. What's in his plan?" *Cal Matters*, May 19, 2023, <https://calmatters.org/environment/2023/05/gavin-newsom-ceqa-reform/>.

60 Marco Turco et al., "Anthropogenic climate change impacts exacerbate summer forest fires in California," PNAS, June 12, 2023, <https://doi.org/10.1073/pnas.22138151>.

that the company needed to limit its “rapidly growing catastrophe exposure” in California.⁶¹ (California is not alone here. Other states, including Florida, Louisiana, Colorado, and Oregon, likewise are being forced to manage climate-disrupted property insurance markets.)⁶²

Increased heat also will threaten California’s ability to produce all of its electricity from renewable sources. As coastal California enjoys ocean-moderated weather, the state has the highest percentage of households without air conditioning units in the United States. However, increasingly frequent heat waves will change this equation. More households using air conditioning more frequently in turn will require more electricity generation.⁶³ Not only will this mean that California will have to produce more electricity from renewable sources to meet demand, it also will threaten to reverse the state’s decades-long improvements in energy efficiency, measured as the energy needed per household or unit GDP.⁶⁴

State officials in Sacramento privately concede that this last risk is perhaps the greatest threat to California’s historical success using policy to drive a clean tech ecosystem. In the future, there might be no way for the state’s tech sector to innovate and implement fast enough to offset climate impacts in the form of heat, drought, fire, and flooding. In a worst-case scenario, it is plausible that climate impacts might be severe enough to drive tech sector investment and talent out of California altogether, in search of more benign environments in the United States and abroad.

For policymakers elsewhere, this concern should be eye opening. Climate impacts will not be confined to California or the West Coast of the United States. If the world’s tech leader becomes unable to adjust fast enough in the face of climate change, then other places likewise will be hard pressed to do so.

In both California and Los Angeles, policymakers are striving to avoid such an outcome, pushing to decarbonize as fast as possible through tech-centric innovation and otherwise preparing the state for a swiftly changing climate. Whether their efforts will be enough to succeed is the central question now facing them.

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61 See Michael R. Blood, “California insurance market rattled by withdrawal of major companies,” AP, June 5, 2023, <https://apnews.com/article/california-wildfire-insurance-e31bef0ed7eeddcde096a5b8f2c1768f>.

62 In August 2023, Allstate announced second-quarter losses from catastrophic insurance claims across the United States of \$2.7 billion, up from \$1.1 billion over the same period in 2022. See “Allstate posts bigger loss as catastrophe claims rise,” Reuters, August 1, 2023, <https://www.reuters.com/business/finance/allstate-posts-bigger-loss-catastrophe-claims-rise-2023-08-01/>.

63 Philip Bump, “Californians may no longer be able to avoid air conditioning,” *Washington Post*, September 7, 2022, <https://www.washingtonpost.com/politics/2022/09/07/californians-may-no-longer-be-able-avoid-air-conditioning/>; David Heacock, “U.S. Cities That Lack Air Conditioning,” Filterbuy, accessed May 17, 2024, <https://filterbuy.com/resources/across-the-nation/us-cities-that-lack-air-conditioning/>.

64 This last concern was expressed by a state of California official to the author during an interview on July 13, 2023.



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