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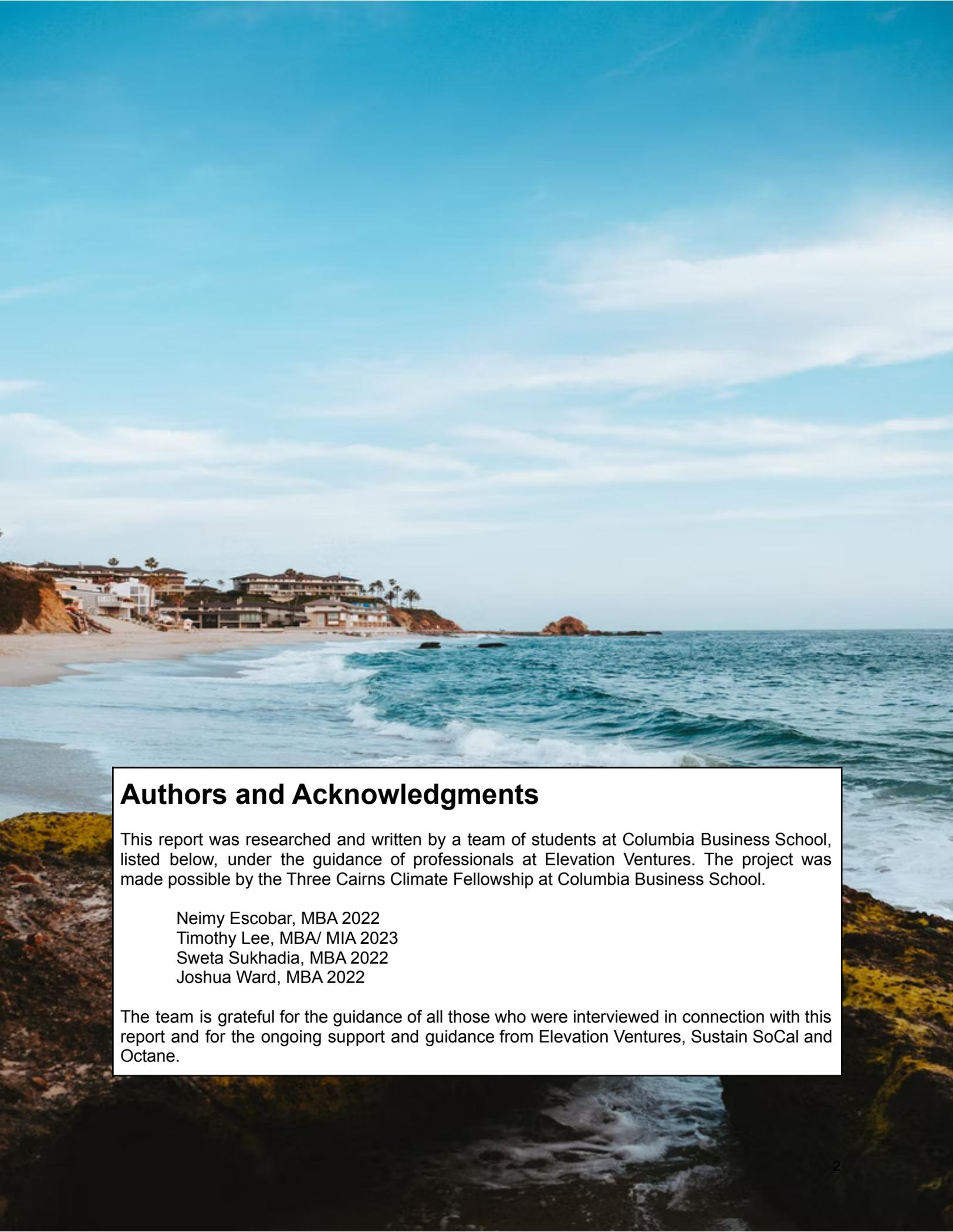
 **Columbia  
Business  
School**

# **Southern California Climate Tech Ecosystem**

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**An Emerging Innovation Hub  
For Decarbonization and Sustainability Solutions**

**April 2022**



## Authors and Acknowledgments

This report was researched and written by a team of students at Columbia Business School, listed below, under the guidance of professionals at Elevation Ventures. The project was made possible by the Three Cairns Climate Fellowship at Columbia Business School.

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# EXECUTIVE SUMMARY

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## **Key Differentiators of the Southern California Climate Tech Ecosystem**

### **(1) Human Capital & Expert Talent**

One of the most significant pillars of an innovation ecosystem is human capital - the supply, development, and retention of top talent. Southern California is a center for academic excellence with an expansive higher education system and eight universities in the region consistently being ranked in the top 50 of university rankings. In both scale and quality, Southern California's network of academic institutions differentiates the potential of its climate tech ecosystem.

Components of this pillar include the availability of management and technical talent, as well as optimistic job availability and competitive pay. The top U.S. county with the most degrees awarded in engineering is Los Angeles County with nearly 7,000 graduates per year. Specifically in the Electric Vehicle sector, we can also assert that the average pay is higher than the average of all other jobs in the region.

### **(2) Community Awareness & Commitment**

With a wide range of institutions, organizations, investors and individuals, the community of Southern California is committed to creating a more sustainable future. Setting net-zero emissions targets has become the norm for companies, driven largely by community interest and pressure. Communities are driving real impact in the state and region, as can be seen by the implementation of a CCE, community choice energy. Strong community involvement like this continues to be a driving force for the SoCal climate-tech ecosystem.

### **(3) Government Support & Local Infrastructure**

There are many overlapping governmental programs aimed at developing, incentivizing and adopting climate tech solutions in SoCal, which combine to create a highly supportive public sector environment for the ecosystem. The confluence of all levels of government involvement – for example, a high level of federal funding (e.g., federal spending on EV charging infrastructure), state level commitments and standards (e.g., CA's Zero Emission Vehicle 2035 strategy), and local pilot programs and institutions (e.g., CARB's newly opened Riverside campus) – set SoCal apart from any other climate tech hub in the country and beyond.

In addition to the fertile climate tech environment supported by robust government sponsorship, SoCal benefits from a world class and nation-leading logistics network, composed of the largest port in the United States, the third largest warehousing segment in the US, several commercial airports across the region, and a dense network of freight rail and highway routes. This logistics leadership supports the emergence and success of climate tech players across the value chain.

## **Areas for Growth to Accelerate Ecosystem Development**

### **(1) Connections between Los Angeles and Orange County**

Within Southern California, economic activity is concentrated in Los Angeles County, Orange County, and San Diego County. Despite their relative proximity, the climate tech communities in Los Angeles and Orange County are relatively self-contained in their operations. We believe there is an opportunity for stakeholders in Los Angeles County and Orange County to collaborate and share knowledge or resources to a greater degree than they currently do. Both have strong communities of academic institutions, incumbent corporations, startups, and accelerators. More linkages between these two areas would contribute to a larger, more robust ecosystem. According to PwC, climate tech companies headquartered in Los Angeles saw the 10th highest level of VC investment of any city in the world between 2020 and 2021 thanks to the mobility theme. We believe that Orange County startups could reach similar levels of activity and that there is significant opportunity to grow more nascent climate technologies with greater emissions reduction potential. As the two counties move forward with their own climate-related initiatives—such the proposed Angeles Link green hydrogen project—new opportunities to collaborate on the launch new industries will emerge.

### **(2) Development of a “Center of Gravity”**

Successful innovation ecosystems, such as the vibrant MedTech ecosystem in SoCal, develop around and with the institutional support of large incumbent players in a given industry (e.g., Edwards Lifesciences in MedTech). Such a “center of gravity” for the ecosystem is important due to its role as an innovation originator, a strategic investor in entrepreneurs, a human capital training and development hub, and a potential supplier and/or customer of a startup’s product.

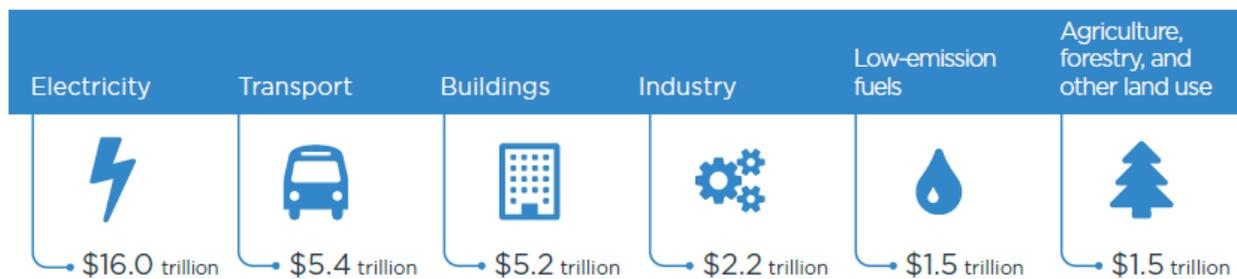
The Climate Tech Ecosystem in Southern California does not yet have an incumbent “center of gravity” like other successful innovation ecosystems in California and beyond. However, there are several industries with major players that are filling these gaps – notably, the automotive OEMs in the region (both conventional and EV) and the power and utilities sector. In order to accelerate the emergence of SoCal as a world leading climate tech hub, outreach to and collaboration with these incumbent corporate players should be pursued by all members of the ecosystem in order to maximize the benefit that these established firms can play in fostering continued education and development of climate tech solutions.

### **(3) Connections between Technical and Managerial Talent**

While large numbers of technical and managerial talent exist in Southern California, we believe there can be greater communication and collaboration between the two groups. From our conversations and interviews, we heard several accounts of startups with robust technical talent lacking a general manager, or vice versa. Accelerators and incubators like LACI and the Cove@UCI are resources founders and builders can leverage to connect with like-minded changemakers.

## WHAT IS CLIMATE TECH?

Climate change is the defining challenge of our time and cross-industry decarbonization will reshape our entire economy. Avoiding climate catastrophe will require us to put society on a path to a net zero that will reinvent daily life and cut across sectors. Climate tech, an emerging category of companies, encompasses the solutions and technologies that aim to achieve this. The cost to achieve net zero is substantial—\$125 trillion dollars, including \$32 trillion over the next 10 years. This implies a significant market opportunity for climate tech companies. A summary of the investment needed in this decade is presented below by sector, as estimated by the Race to Zero Campaign.



Source: PitchBook

Climate tech companies are already active in all of these areas. In this report we group these firms into six themes, described below with various subthemes. There is some variation in how climate tech is defined among investors and operators, but all of these definitions are connected to decarbonization.

- (1) **Mobility:** This segment of climate tech comprises the electrification or other decarbonization of transport as well as vehicle technologies that support broader decarbonization—such as “vehicle-to-X” charging, which allows EVs to serve as energy storage for the grid or other sources of demand. By our definition, it also includes sustainable fuels. Mobility has thus far seen the greatest level of investment among climate tech themes. Relevant subthemes include:
- *Passenger vehicles:* This subtheme involves alternatives to the internal combustion engine for consumer travel by road, which is the most significant source of mobility carbon emissions.
  - *Commercial vehicles:* Similar to passenger vehicles but for heavier duty to trucking, buses, and fleet vehicles.
  - *Aviation:* Electrification of air travel or use of sustainable fuels or green hydrogen to power aviation.
  - *Maritime:* Alternatives to the use of diesel in sea freight.
  - *Infrastructure:* Electric vehicle charging and software.

- *Batteries*: Advanced battery chemistry and technology to improve the range and performance of electric vehicles as well as make the use of batteries more sustainable through recycling.
  - *Mobility services and solutions*: Technologies and platforms that are synergistic to the decarbonization of mobility, though not necessarily themselves low-carbon technologies. Includes sharing economy and artificial intelligence for cars or urban infrastructure.
- (2) **AgTech**: Companies and technologies focused on making agriculture and the food supply chain more efficient and sustainable.
- *Food Systems*: Alternative proteins, alternative or indoor farming methods, and biotechnology.
  - *Land use*: Forestry, data analytics, and alternative fertilizers. Tangent to carbon markets in that land can be used for carbon sinks.
- (3) **Electricity**: The broad range of technologies and solutions that support the transition of the energy system towards clean energy.
- *Low-carbon energy generation*: Includes companies focused on technologies that generate renewable, low-carbon or zero-emission energy. Technologies includes solar, wind, nuclear, waste-to-energy, ocean and hydro, and geothermal. Of these, solar and wind have seen the most VC investment in recent years, with approximately \$1.9B invested in 2021.
  - *Sustainable and smart grid technology*: This includes technologies that can store energy and optimize the grid to make it more resilient and efficient such as demand response aggregation or smart appliances. Green hydrogen may fall into this category, to the extent that it is being used as a form of storage. Utility-scale batteries and the related software may also fall into this category, as well as recycling operations.
- (4) **Built Environment**: Buildings are connected to carbon emissions both through construction and in their operations.
- *Energy efficiency*: Lowering the energy intensity of buildings to reduce their load impact, reduce emissions, and improve grid resiliency.
  - *Construction tech*: Improve the efficiency of construction such that it is more efficient in its use of materials.
  - *Heating and cooling*: Reduction of building emissions by replacement of gas heating through heat pumps and combined heat and power.
- (5) **Heavy Industry**: Solutions for hard-to-abate sectors of the economy.
- *Chemicals*: Replacement of carbon-emitting feedstocks for the petrochemicals industry.
  - *Mining*: Smarter mining practices to provide the supply of metals and minerals needed for the transition to renewable energy.

- *Manufacturing*: Increasing the efficiency and reducing the carbon-intensity of manufacturing operations, particularly for goods such as steel.

**(6) Carbon Capture, Storage, and Utilization:** Includes carbon capture and sequestration or utilization (eg. direct air capture, soil sequestration, carbon negative cement), carbon measurement and accounting, and financial technologies to fund these efforts through consumer financial products.

### *This Time is Different*

The current movement towards investing in climate tech was preceded by a venture capital boom focused on “clean tech” energy companies during the mid-to-late 2000s that saw \$25 billion in investment. More than half of this investment principal was lost as some of these nascent technologies failed to deliver short-term returns, unfavorable dynamics in the supply and cost of natural gas emerged (ie. fracking), and competition from Chinese manufacturers accelerated. While the current cycle builds upon the work that was done during the clean tech boom, VC investors have largely avoided the space since about 2008. However, there are several important factors that differentiate climate tech and the current environment from the last time around.

In the past two decades, the urgency surrounding the issue of climate change has grown significantly, as extreme weather events become more frequent and cause tangible economic impact. Publications such as the IPCC’s AR6 report have been widely read, helping to add momentum towards meaningful action. This sense of importance cuts across the public and private sector as companies and governments alike announce their intentions to transition to net zero. Climate tech is appropriately broader in its focus than cleantech, which focused only on energy and matches the sweeping effects of climate change. In the energy sector, for example, advances in some key technologies have reduced costs substantially. Lithium-ion batteries are now 97% less expensive than they were in the mid-nineties. During this time, climate policy has also advanced broadly and progressed to be conducted at a global level, as with COP 26. This has been mirrored by a massive push towards Environmental, Social, and Governance (ESG) in both public and private market investing and the private sector was also a critical participant at COP 26. According to PitchBook, \$31.5 billion of venture capital was poured into climate tech startups in 2021, exceeding the past cycle in a single year.

## WHY SOUTHERN CALIFORNIA?

California has historically been a bellwether for the rest of the country on environmental and sustainability issues. The extreme weather and environmental stress experienced by Californians—such as droughts, wildfires, and storm surges—makes climate change particularly tangible. But these problems drive innovation and the state has been a leader on climate policy and an early mover in the development of key industries that contribute to decarbonization, such as solar. There is a strong community of environmental activists and a robust public research university system to guide climate initiatives and provide human capital to execute them.

We focus our analysis on the entire region from Los Angeles to San Diego, with particular emphasis on Orange County and Long Beach. This area has several unique characteristics that we consider favorable for business activity. The proximity of the Ports of Long Beach and Los Angeles, which serve as a major hub for trade between the U.S. and Asia, makes this area easily accessible for the transport of goods. Orange County has a highly technology-driven business environment and is already a leader in mobility and renewable energy with 60,000 people employed in these sectors according to the Orange County Business Council. There are 13 Fortune 500 companies that are headquartered in or around Los Angeles and Long Beach plus three in San Diego. These firms are listed below, most of which have net zero targets.

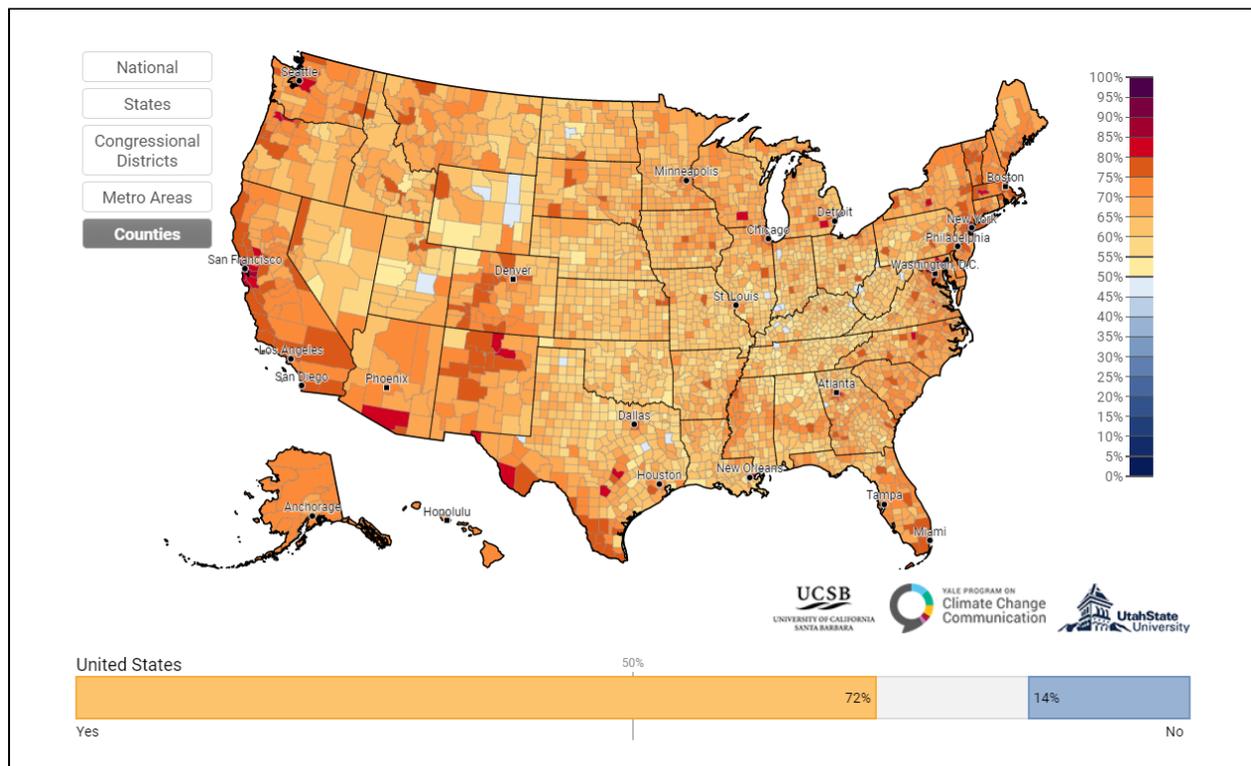
| Company                  | Ticker | Industry           | Headquarters   | Net Zero Target |
|--------------------------|--------|--------------------|----------------|-----------------|
| A-Mark Precious Metals   | AMRK   | Metals Trading     | El Segundo     | N/A             |
| Activision Blizzard      | ATVI   | Entertainment      | Santa Monica   | 2050            |
| AECOM                    | ACM    | Engineering        | Los Angeles    | 2050            |
| Amgen                    | AMGN   | Healthcare/Pharma  | Thousand Oaks  | 2027            |
| Avery Dennison           | AVY    | Packaging          | Glendale       | 2050            |
| CBRE Group               | CBRE   | Real Estate        | Los Angeles    | 2040            |
| Chipotle                 | CMG    | Food & Beverage    | Newport Beach  | 2030            |
| Edison International     | EIX    | Utilities          | Rosemead       | 2045            |
| Farmer's Insurance       | N/A    | Insurance          | Woodland Hills | N/A             |
| First American Financial | FAF    | Insurance          | Santa Ana      | N/A             |
| Molina Healthcare        | MOH    | Healthcare/Pharma  | Long Beach     | N/A             |
| LPL Financial            | LPLA   | Financial Services | San Diego      | N/A             |
| Pacific Life             | N/A    | Insurance          | Newport Beach  | N/A             |
| Qualcomm                 | QCOM   | Semiconductors     | San Diego      | 2040            |
| Sempra Energy            | SRE    | Utilities          | San Diego      | 2050            |
| Walt Disney              | DIS    | Entertainment      | Burbank        | 2030            |

# AWARENESS OF THE CLIMATE CRISIS

One essential characteristic of the Climate Tech Ecosystem in SoCal is the broad societal awareness of climate change and climate related issues among the residents of the region. Due in part to the history of climate change-related disasters in Southern California in recent years, including devastating wildfires and droughts, residents of the region have a level of awareness and concern related to climate change significantly higher than the national average.

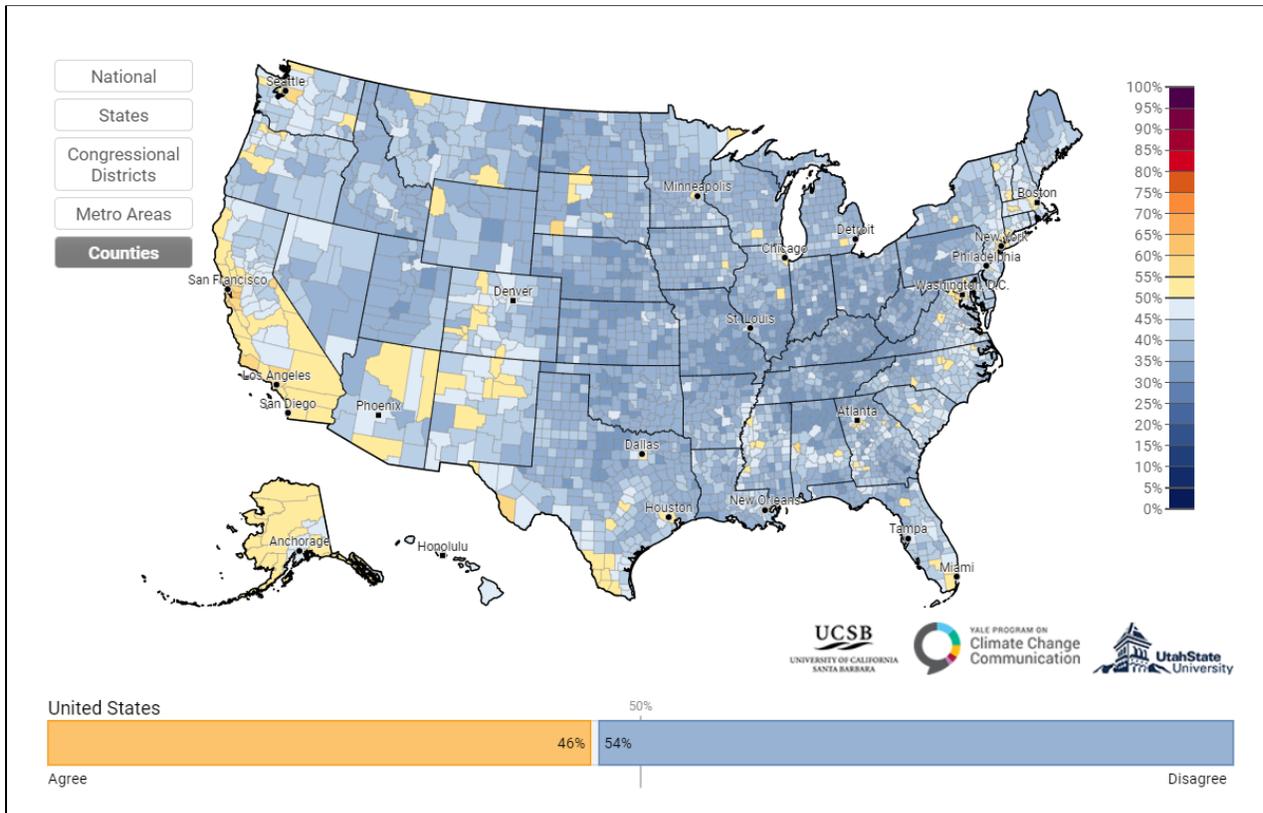
As shown in the Yale Climate Opinion data from 2021 below, residents of 76% and 74% of Los Angeles County and Orange County, respectively, believe “global warming is happening”:

## Estimated % of adults who think global warming is happening (nat'l avg. 72%), 2021



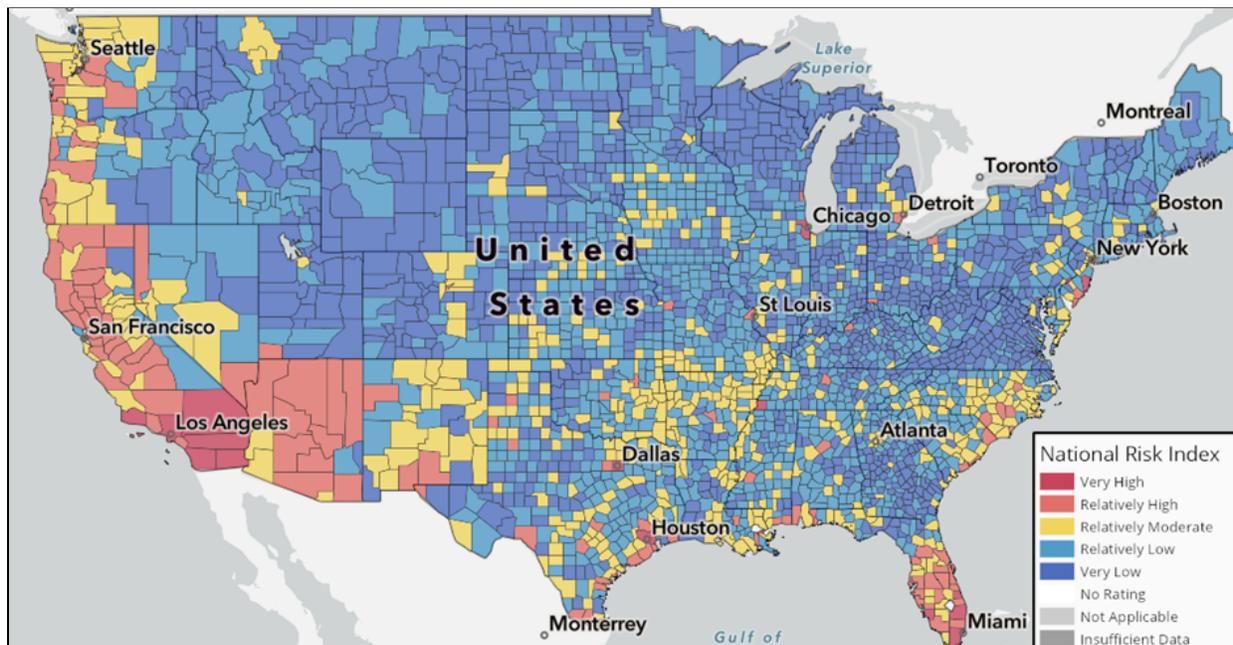
Additionally, residents of Southern California are more likely to have personal experience with the climate crisis. As shown below, residents of Los Angeles County and Orange County are 9 and 6 percentage points, respectively, more likely to have personally experienced the effects of global warming than the national average.

**Estimated % of adults who have personally experienced the effects of global warming (nat'l avg. 46%), 2021**



As these data suggest, the effects of climate change and related concerns are ever present in Southern California, and climate and sustainability issues are top of mind for many in the region. One potential explanation for the heightened awareness and concern for climate change can be found in the FEMA National Risk Index (NRI) data represented in the map below. The FEMA NRI is a blended index of 18 natural risks (e.g., heat waves, wildfires, flooding, hurricanes, tornadoes, etc.) which shows the overall risk facing communities across the country from extreme weather events related to climate change. As the map below shows, the counties in and around Southern California (and California as a whole) have NRI scores of “very high” and “relatively high”, which are the two highest categories in the FEMA NRI data. This implies that the counties in SoCal have among the highest combined risk related to extreme weather impacts, as many in the region have experienced in recent years.

**FEMA National Risk Index  
(Risk Index of 18 Climate-Related Natural Disasters), 2022**



This heightened awareness of and vulnerability to the *threats* of climate change that are found in Southern California are accompanied by increased awareness and willingness to adopt key *solutions* to the climate crisis. As a result of Southern California’s heightened awareness of climate change and its unique cultural and economic characteristics, communities in the region are early adopters of innovating Climate tech solutions – especially B2C solutions such as electric vehicles and mobility solutions.

For example, the importance of cars as the dominant mode of transportation in Southern California not only exposes drivers to fluctuations in gasoline prices increasing the relative attractiveness of Electric Vehicles over Internal Combustion Engine Vehicles, but also makes the region a large and fast growing market for EVs. California is currently the largest EV market in the United States, with Electric Vehicles making up over 12% of car sales in California in 2021, exceeding the nationwide (4%) and global figures (8.6%) during the same period.<sup>1</sup>

As this example shows, the awareness of climate change in Southern California, and the specific economic and cultural conditions, make the region an emerging leader in Climate Technology, and a key hub for innovation, investment and consumption of solutions to the climate crisis.

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<sup>1</sup> [New ZEV Sales in California](#)

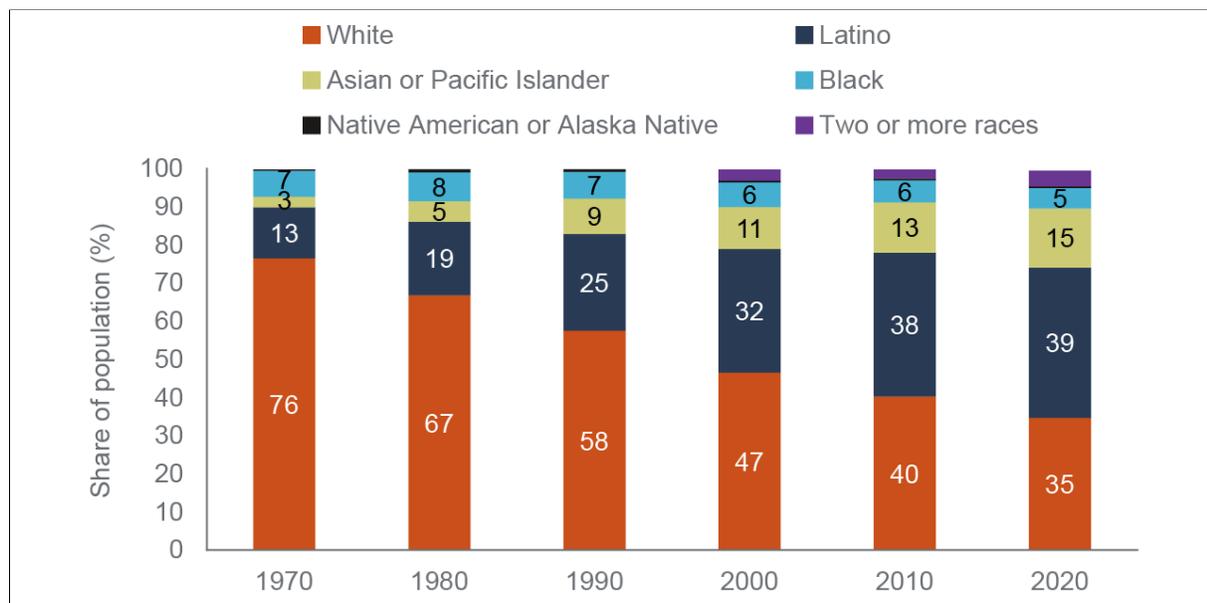
## MACRO OVERVIEW

While not officially defined, the widest definition of Southern California includes the following counties: San Luis Obispo, Kern, San Bernardino, Santa Barbara, Ventura, Los Angeles, Orange, Riverside, San Diego and Imperial. The bulk of this report zeros in on the innovation hubs of Los Angeles County and Orange County, but this macro portion will broaden scope to include all counties.

With a whopping GDP of \$1.6 trillion, Southern California has one of the largest economies in the world. Much of the economic activity is concentrated in three counties – Los Angeles County, Orange County and San Diego county, which respectively have GDP's of \$815B, \$272B and \$256B. Top industries include Entertainment, Aerospace and Tourism. In particular, Los Angeles was considered the locus of aerospace research and manufacturing during WW2, given its cheap land. Today, that industry is being replaced with the automation industry. Real GDP for South California continues to grow at a faster rate than the nation's over the past two decades. The Inland Empire (Riverside and San Bernardino counties) is forecasted to grow at a higher rate because of a continued influx of residents drawn by lower costs of living and the warehousing sector. These population gains will put pressure on existing systems like public infrastructure, educational facilities, water systems and roads and transportation networks.



### Demographic Shifts in California State 1970-2020



Demographic shifts that have been ongoing for decades will also continue. California's transition from a majority white state to a majority-minority state is largely led by the Southern California region. Today, less than half of the state's population is white—the majority is made up mostly of Latinos and sizable proportions of Asians, African Americans, and multiracial Californians. Despite the ethnic diversity in SoCal, the innovation and venture communities remain largely white, and there remains work to be done for these communities to reflect the diversity of the region.

Some additional economic shifts in the region include:

- **Job growth in service and construction industries, while manufacturing will stagnate**
  - The service, construction and service industries are seeing the highest rates of job growth, while manufacturing trends downward. According to a recent study, there will be no net-new manufacturing jobs in 2026.
- **Labor force participation is at its lowest levels**
  - Although unemployment is at historic lows, labor force participation is as well, and has trended downwards since 2000. This trend can be attributed to an aging population and long-term exists arising from the COVID-19 pandemic.
- **Lack of affordable housing can hinder economic growth**
  - High housing costs have left many with less money to save or spend. The lack of affordable housing may make it more difficult for employers to retain talent.
- **Incomes have improved, but the gap in incomes has also widened**
  - The wealth gap is widening. Top income families earn 50-60% more today than in 1980, but middle-income families only earn about 25% more than 1980

## WHAT IS AN ECOSYSTEM?

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*An innovation ecosystem is the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors.<sup>2</sup>*



Although there is no single, widely agreed-upon definition for an entrepreneurial ecosystem, the most common definitions refer to a system with a series of complex relationships that are formed between actors or entities whose functional goal is to enable business and technology development as well as innovation. Ecosystems are dynamic and include resources (both financial and non-financial), human capital (students, faculty, staff, industry researchers, mentors), and institutions (universities, business schools, research institutes, state or local economic development, funding agencies, and policymakers).

We referenced several reports to understand components of innovation and startup ecosystems from Japan, Houston, the Bay Area, and Florida. Interviewees were asked what components made up the Southern California innovation ecosystem to confirm or revise our list of components accordingly. This enabled us to conduct a gap analysis using both industry-standard benchmarks and localized components of importance.

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<sup>2</sup> *Innovation ecosystems: A conceptual review and a new definition*, <https://doi.org/10.1016/j.technovation.2019.102098>

A gap analysis for the components of Government, Corporations, Academic Institutions, Startups, Funders, and Ecosystem Enablers (e.g. accelerators and incubators) was conducted. Each component is detailed in the *SoCal Landscape* section of the report.

### Southern California Ecosystem Overview:

| Ecosystem Area                      | Key Gaps   | Key Strengths  |
|-------------------------------------|--|--|
| <b>Government</b>                   | <ul style="list-style-type: none"> <li>Disparate sources of funding and involvement in climate solutions and a lack of a consolidated platform or taskforce to help navigate governmental resources</li> </ul>                                       | <ul style="list-style-type: none"> <li>Range of federal, state and local programs including grants, subsidies, standards, etc.</li> <li>These programs provide ample opportunities for climate tech ecosystem participants to receive public sector support, on both the supply and demand side, accelerating the development of the ecosystem as a whole</li> </ul>           |
| <b>Logistics &amp; Supply Chain</b> | <ul style="list-style-type: none"> <li>Currently a very carbon-intensive sector. However, significant progress and ambitious net zero targets have been made at the state and local levels</li> </ul>  | <ul style="list-style-type: none"> <li>World class and nation-leading network of logistics infrastructure, including San Pedro Bay Port complex, extensive networks of freight rail and highway arteries, several commercial airports, and extensive warehousing capacity</li> </ul>   |
| <b>Corporations</b>                 | <ul style="list-style-type: none"> <li>Lack of a clear incumbent firm serving the role of a “center of gravity” for the climate tech ecosystem</li> </ul>  | <ul style="list-style-type: none"> <li>There are several industries represented in the industry (especially automotive OEMs and firms in the energy sector) with significant involvement in climate tech</li> <li>The incumbent firms in these industries play an important role in financing startups, attracting talent and incubating and deploying technologies</li> </ul> |
| <b>Academic Institutions</b>        | <ul style="list-style-type: none"> <li>Integration of innovation and design content in traditional engineering curriculum</li> <li>Greater regional effort initiatives that improve tech transfer knowledge across institutions</li> </ul>           | <ul style="list-style-type: none"> <li>Largest, and among the most diverse, system of higher education in U.S.</li> <li>Highest number of engineering graduates in the country</li> <li>Pre-existing tech transfer infrastructure</li> </ul>   |
| <b>Human Capital</b>                | <ul style="list-style-type: none"> <li>Continuous need for events and spaces to encourage organic collaboration</li> </ul>   | <ul style="list-style-type: none"> <li>Optimistic industry projections for human capital supply and demand indicators</li> <li>Centers focused on supporting and stimulating this area (e.g. COVE, Sustain SOCAL, LACI)</li> </ul>   |
| <b>Startups</b>                     | <ul style="list-style-type: none"> <li>Over-indexed on mobility startups</li> <li>Limited capital and support to cross several “valleys of death” faced by climate tech startups resulting in fewer startups and investable opportunities</li> </ul> | <ul style="list-style-type: none"> <li>Strong presence of electric vehicle startups and surrounding ecosystem components can support other climate tech innovation</li> <li>Number of startups is growing</li> </ul>   |
| <b>Funders</b>                      | <ul style="list-style-type: none"> <li>Few funds exclusively focused on climate-tech</li> <li>Greater investment needed in areas of building and agriculture</li> </ul>  | <ul style="list-style-type: none"> <li>Sources of capital at multiple stages (early-stage VC, growth equity, PE)</li> <li>Growth in # of investments and climate-tech deal activity</li> </ul>   |

While this list is not exhaustive, it provides an overview of the most commonly cited themes from interviews, field research, and secondary research. Interviewees were also asked what levers could accelerate the development of or further strengthen Southern California’s innovation ecosystem to develop action areas for each ecosystem.

### **Government**

The SoCal climate tech ecosystem benefits from a wide range of government programs at the federal, state and local level: from restrictions on high emissions activities, to supply side incentives for renewable energy and other climate solutions, to demand side subsidies for businesses and consumers. SoCal has access to a patchwork of governmental policies and organizations supporting many aspects of the climate solutions.

### **Corporations**

Although there is no single corporate incumbent that forms a “center of gravity” for the innovation ecosystem, there are several key industries – namely, the automotive sector and energy industry in Southern California each play important roles in the development of the ecosystem. These corporate players benefit the ecosystem by providing (1) talent development and retention, (2) corporate venture and capital allocation, and (3) technology incubation and deployment support.

While the existing corporate participation in the emerging climate tech ecosystem provides valuable support, increased outreach to and engagement with these incumbent corporate players would accelerate the development of the innovation ecosystem in Southern California.

### **Supply Chain & Logistics**

Southern California’s climate tech ecosystem benefits from the region’s world class and nation-leading network of logistics infrastructure, including San Pedro Bay Port complex, extensive networks of freight rail and highway arteries, several commercial airports, and extensive warehousing capacity. This logistics and supply chain leadership provides an opportunity for ecosystem participants to accelerate the development of technologies and access inputs and markets that would not be possible to the same extent in any other climate tech hub in the United States.

### **Academic Institutions**

A key lever for academic institutions to push forward in an innovation ecosystem is the convening of intellectual communities. By partnering with academic institutions in geographic clusters (Priority Groups 1 and 2), the ecosystem can benefit from pooled resources, knowledge, and organic collaborations. Leveraging the high population of engineering graduates and caliber of the universities in the area, Southern California is poised to enable a robust innovation climate.

## **Human Capital**

Even beyond university settings, human capital in the region is fostered by the potential of talent and development supplied by corporations. Jobs, specifically in the EV sector, pay more than the average in Southern California and are forecasted to grow at a higher rate than the average job growth rate. We are confident that good talent is found in the Southern California region and connections continue to be fostered by organizations like The Cove, Sustain SOCAL, and LACI.

## **Startups**

The Southern California ecosystem is over-indexed on mobility startups with other areas of climate tech representing untapped potential. To foster growth in these other areas, the ecosystem must support technology transfer (eg. from universities to startups), formation of founding teams with an appropriate mix of technical vs. managerial talent, mentorship for new startups, and dialogue with incumbent industry players. Because climate tech companies face significant challenges at each stage of their lifecycle, the ecosystem must involve constituents from various groups to support these startups.

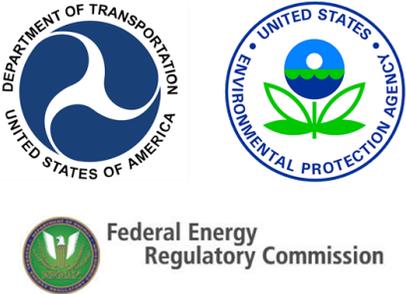
## **Funders**

The growth of climate-tech innovation in Southern California requires capital from early-stage investors. Early-stage investors that pump in the funds to enable scaling of new approaches and technologies to tackling climate change will be key to transforming sectors to a net-zero future. In Southern California, there are few early-stage investors that are dedicated funds. We believe there is a need for more investors to focus exclusively on climate solutions and for investors at all levels of the growth cycle. In addition to continuing investment in electric mobility, funders should look to deploy more capital to adjacent climate-tech verticals like agriculture and the built environment.

## SOCAL ECOSYSTEM LANDSCAPE

### Government

Public sector commitments to addressing climate change have grown at every level in recent years. Today, Southern California benefits from robust federal, state and local programs designed to abate Green House Gas emissions and to incentivize the development and adoption of climate solutions. These government programs range from *restrictions* on high emissions activities, to *supply* side incentives for renewable energy and other climate solutions, to *demand* side subsidies for businesses and consumers. SoCal has access to a patchwork of governmental policies and organizations supporting many aspects of the climate solutions, and agencies with active programs in SoCal benefitting the climate tech ecosystem include:

| <u>Federal</u>   | <u>State</u>   | <u>Local</u>   |
|--|--|--|
|  |  |  |

This wide range of programs led by all levels of government – supported by the broad public recognition of the threats and challenges posed by climate change discussed above – Southern California is a leader in the fight against climate change and among the most attractive jurisdictions in the nation to develop and invest in climate tech due to the immense governmental support.

In addition to the direct involvement of public sector organizations in the climate tech ecosystem, there are also numerous industry organizations and lobbying associations for the major industries represented in Southern California. These industry associations play a crucial role in aligning governmental outreach within each major industry and serving as a communication hub between the industries and the different layers of governmental involvement in climate-related sectors. For example, the California Farm Bureau (with local branches including the OC Farm Bureau & Los Angeles County Farm Bureau) is deeply engaged in developing education programs on AgTech for CA agriculture companies and is active in

lobbying for AgTech policy at the state and local level. The Alliance for Automotive Innovation is a national organization with an office in Sacramento, and its members include the major conventional SoCal automotive OEMs. This association has a significant focus on government affairs work related to EVs and other technological developments in the automotive sector.

Below is a sample overview of various governmental programs available in Southern California. This is a representative sample intended to demonstrate the breadth of institutions and programs available to climate tech ecosystem participants in Southern California:

| Program  | Description   |
|--|---|
| <b>State Programs</b>  |   |
| California Climate Investments                                 | <ul style="list-style-type: none"> <li>·State investments funded by Cap-and-Trade proceeds</li> <li>·\$15 billion invested in California to date</li> <li>·Key segments: EVs, Transit, Clean Energy, Waste Diversion</li> </ul>   |
| CalEPA: Climate Action Team (CAT)                              | <ul style="list-style-type: none"> <li>·Comprised of 22 state agency members, develops, evaluates, and implements climate change emission reduction strategies in accordance with the California Global Warming Solutions Act of 2006</li> </ul>  |
| California Hybrid and Zero-Emission Voucher Incentive Project  | <ul style="list-style-type: none"> <li>·Up to \$315,000 for fuel cell zero-emission trucks and buses</li> <li>·Up to \$175,000 for zero-emission buses</li> <li>·Up to \$40,000 for trucks and buses with engines meeting low NOx standard</li> </ul>   |
| Volkswagen Environmental (VW) Mitigation Trust                 | <ul style="list-style-type: none"> <li>·\$423 million for California to mitigate the excess nitrogen oxide (NOx) emissions caused by VW's use of illegal emissions testing</li> <li>·Funding is available for four categories of vehicles and equipment</li> </ul>  |
| Zero-Emission by 2035 Executive Order (N-79-20) & ZEV Strategy | <ul style="list-style-type: none"> <li>·Executive Order calls for elimination of new internal combustion passenger vehicles by 2035</li> <li>·CA Government action plan including several funding sources and incentives to achieve ZEV goals</li> </ul>  |
| California Air Resources Board                                 | <ul style="list-style-type: none"> <li>·Organization charged with protecting CA air quality</li> <li>·Responsible organization for several of the CA ZEV incentives and grants</li> <li>·Recently opened a new HQ in SoCal (Mary D. Nichols Campus, Riverside CA)</li> </ul>  |
| <b>Federal Programs</b>  |   |
| USDA National Institute of Food and Agriculture Grants         | <ul style="list-style-type: none"> <li>·\$124m NIFA grants to CA in 2020 alone</li> <li>·Several grants available for AgTech and other climate solutions in the Southern California Agriculture industry</li> </ul>   |
| Clydebank Declaration  | <ul style="list-style-type: none"> <li>·19 country multilateral agreement re: curbing emissions in shipping (COP26)</li> <li>·Initiatives at Port of LA and Port of Long Beach expected to be rolled out as a continuation of ongoing efforts</li> </ul>  |
| Bipartisan Infrastructure Bill                                 | <ul style="list-style-type: none"> <li>·Under the Infrastructure Investment and Jobs Act, California would expect to receive \$384 million over five years to support the expansion of an EV charging network in the state</li> <li>·California will also have the opportunity to apply for the \$2.5 billion in grant funding dedicated to EV charging in the bill.</li> </ul> |

### *Initiative Spotlight: California ZEV 2035 Strategy*

In September 2020, Governor Gavin Newsom signed an executive order requiring all sales of new passenger vehicles in California to be zero-emissions vehicles (EVs or green hydrogen Fuel Cells) by 2035.<sup>3</sup> This goal will result in a reduction of more than 35% of the GHG emissions from cars statewide.

|   |  |
|---|--|
|  | <p><b>California Air Resources Board, Riverside Campus</b></p> <ul style="list-style-type: none"><li>• In November 2021, California Air Resources Board opened a new campus in Riverside, California</li><li>• The new campus – the Mary D. Nichols Campus – consists of a 19-acre and 402,000 square foot facility</li><li>• The facility is <b>the largest Zero-Net Energy (ZNE) building in the United States</b>, and integrated innovative sustainable design techniques and technologies throughout</li><li>• The campus brings CARB’s expertise in standard setting and technology testing to SoCal, where it will continue to play a crucial role in California’s climate tech industries – specifically related to <b>CARB’s ZEV Strategy Goals</b></li></ul> |
|---|--|

The executive order and associated state-level strategy team enlists the support of several state entities, such as the California EPA and the Governor's Office of Business & Economic Development. Most notably, the order instructs the California Air Resources Board (CARB) to craft regulations and set vehicle standards supporting the ZEV 2035 goal. The executive order also tasks CARB with ensuring that medium- and heavy-duty vehicles are 100% zero emission by 2045 in the state.

### *Business Environment Implications*

Despite the high level of incentives and focus on climate solutions from all levels of government in Southern California, the level of governmental involvement in private sector activities and associated regulatory and tax burden lead some to consider California a challenging environment for starting and scaling a business. California has among the highest state corporate income tax rates in the country – flat rate of 8.84% in 2021.

The high tax rates in California lead some groups to identify California as among the most inhospitable states for businesses in the country.<sup>4</sup> Recent high-profile announcements, such as Tesla’s relocation of its corporate headquarters to Texas, lend credence to this claim that mature businesses face unique burdens in CA that they do not elsewhere in the country. However, other observers with a broader set of criteria identify other factors that support a vibrant business community in California, and SoCal specifically. For example, U.S. News & World Report ranks California as the second most attractive business environment in the nation, due to the high patent creation rate, ample early-stage financing, and high new business creation rate.

<sup>3</sup> [ZEV Strategy | California Governor’s Office of Business and Economic Development](#)

<sup>4</sup> [Up For Grabs: The Best & Worst States For Business 2021 \(chiefexecutive.net\)](#)

## Logistics & Supply Chain

As discussed above, Southern California is one of the most economically productive regions in the United States and the world. One of the fundamental attributes that has allowed SoCal's economy to prosper – and simultaneously set the foundation for a vibrant climate tech ecosystem – is the world-class logistics and supply chain capabilities in the region.

California as a whole boasts impressive and world class logistics infrastructure and freight capabilities, including:<sup>5</sup>



**1 private and 11 public** deep-sea ports plus numerous private port and terminal facilities



**12** airports with major cargo operations



**2 Class 1** railroads that are the largest in the nation, and 26 short-line railroads operating over 6,500 miles of track



**5,800** commercial miles of high traffic volume Interstate and State highways



**3 existing and 1 future** commercial land border ports of entry with Mexico

The logistics and supply chain advantage in California is particularly pronounced in Southern California, which is the hub of the state's logistics network. There are three main areas in which Southern California's supply chain advantage is readily apparent:

### (1) Ports

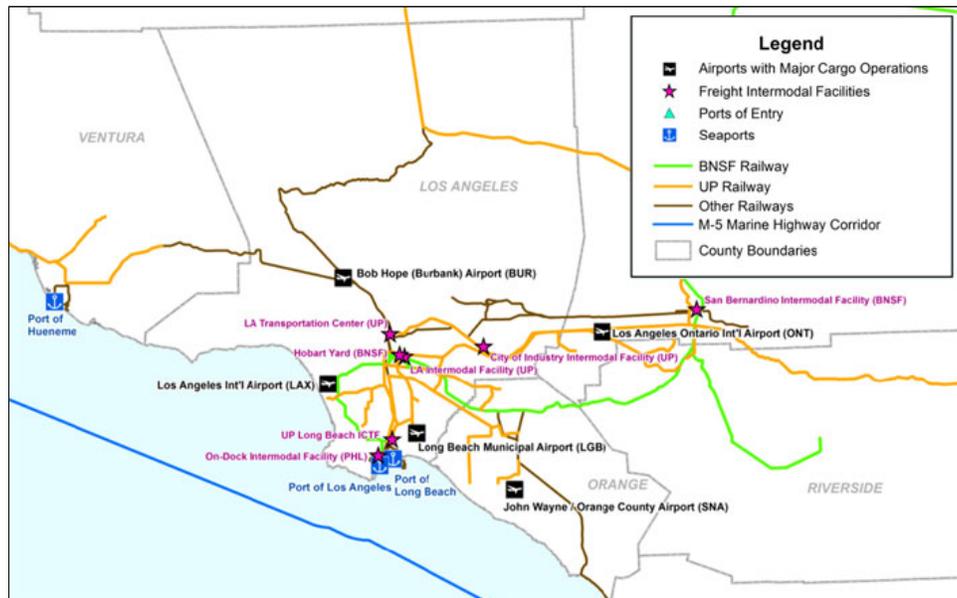
The San Pedro Bay Port Complex, comprising the neighboring ports of LA and Long Beach, is the largest port in the United States and the ninth largest port in the world. As of 2020, the San Pedro Bay Port Complex has an annual capacity of over 18 million twenty-foot equivalent units (TEU). The port also employs nearly 200,000 people in LA and Long Beach, and is indirectly responsible for over 950,000 jobs in the five-county region in Southern California. This port complex makes up 74% of the port market share on the Western United States, and 31% of the market share of the country as a whole (measured in TEU).

<sup>5</sup> [Logistics & Infrastructure \(ca.gov\)](https://www.ca.gov/logistics)

## (2) Freight Infrastructure

Extending from the San Pedro Bay Port Complex is an extensive freight rail network consisting of two class 1 railroad (United Pacific and BNSF Railway) as well as several local and regional freight networks. As depicted below, this extensive freight rail network also intersects with several interstate and state-wide highway corridors connecting the transit hubs with nationwide logistics networks.

In addition to the rail and highway networks, there are several major airports in Southern California connecting the region with suppliers, customers and communities across the US and beyond. These airports include Los Angeles International Airport, John Wayne International Airport in Orange County, LA/Ontario International Airport, Long Beach Airport, Bob Hope Airport in Burbank, Chino Airport and March Air Force Base. As shown in the map below, these airports are spread out across the region and intersect with the other shipping and freight modalities discussed above.<sup>6</sup>

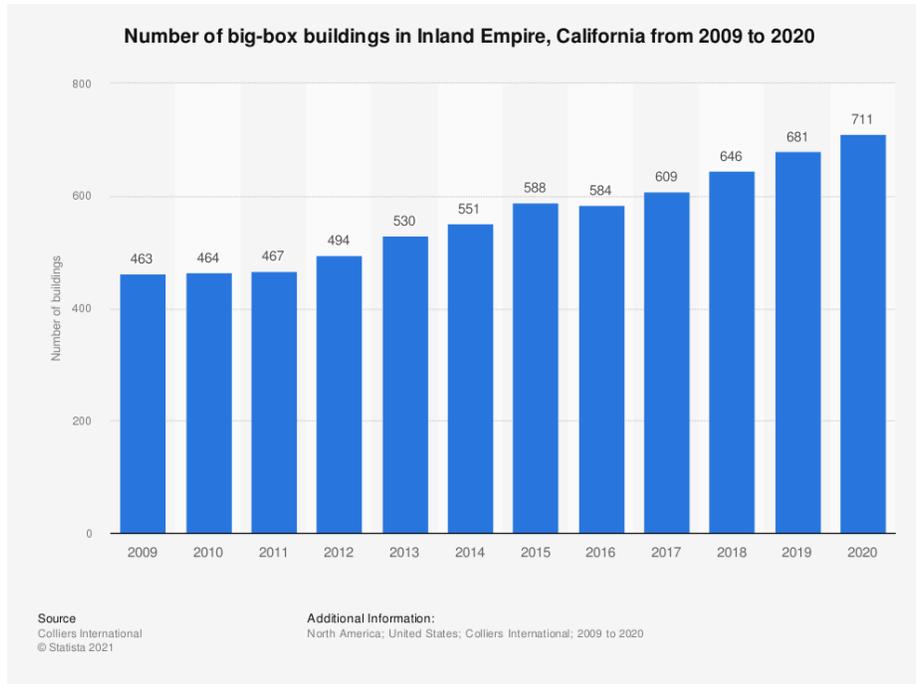


## (3) Warehousing

Another key advantage of SoCal's logistics capabilities is a large and growing warehousing capacity, concentrated primarily in Inland Empire, CA, a region adjacent to the coastal counties of Southern California. In 2021, Inland Empire was third in the United States for commercial warehouse leases of more than 1 million square feet. This warehouse leadership is steadily growing, as shown in the table below, with the total number of big-box building in Inland Empire growing from 463 in 2009 to 711 in 2020, and this growth shows no signs of slowing in coming years as commercial real estate prices remain high across the region.<sup>7</sup>

<sup>6</sup> [Los Angeles Freight Economy Roundtable | Federal Highway Administration \(dot.gov\)](#)

<sup>7</sup> [Inland Empire No. 3 In U.S. For Large Warehouse Leases \(therealdeal.com\)](#)



Taken together, this confluence of supply chain and logistics advantages in Southern California amplifies the benefits of the local business environment to the SoCal climate tech ecosystem. Entrepreneurs, startups, investors, innovation centers and other ecosystem participants have access to world class supply chain support which serves to accelerate the innovative potential of the local ecosystem. This system improves local access to technology inputs (e.g., advanced manufactured components) on the supply side, and efficient distribution to potential customers worldwide on the demand side.

In addition to these direct benefits to ecosystem participants provided by the region’s logistics advantage, the immense logistics industry also provides an important catalyst for new innovations and presents an opportunity for ongoing climate tech investment to improve the sustainability of these logistics industries. For example, in 2015 then governor Edmund Brown signed Executive Order B-32-15 which set out the state’s sustainable freight strategy. This order sets targets for zero emissions freight and develops pathways for further research into climate solutions and technologies that will allow California’s logistics industry achieve these net zero goals. These state-level goals, along with other initiatives such as the Clydebank Declaration committing the global emissions-free shipping by 2050 and the state’s ZEV strategy, have accelerated the potential for SoCal’s supply chain sectors to be crucial centers for innovation and development in the climate tech ecosystem going forward.<sup>8</sup>

<sup>8</sup> [Sustainable Freight Pathways to Zero and Near-Zero Emissions Discussion Document \(ca.gov\)](#)

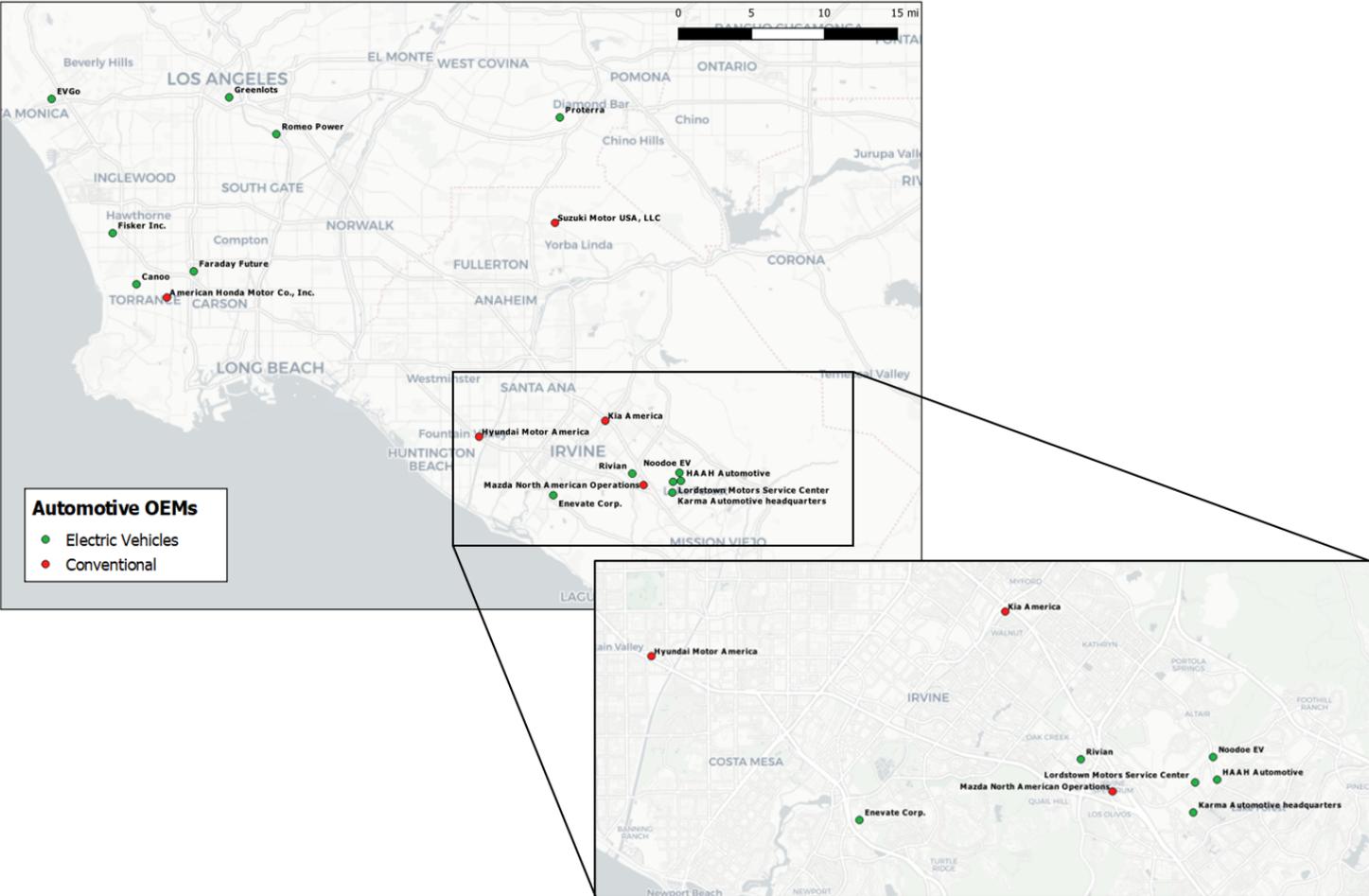
# Corporate

As discussed above, Southern California is an economic powerhouse, producing \$1.6 trillion in GDP in 2021 alone – approximately 7% of annual US GDP. This economic activity is anchored by several large and mature industries, including agriculture, entertainment, tourism, life sciences, and advanced manufacturing, among others. Every industry in SoCal plays an instrumental role in attracting and developing talent and capital in the region, which play a foundational role in supporting a robust climate tech ecosystem. However, there are two industries in particular which play an outsized role in supporting climate tech in SoCal: the automotive sector and the energy sector.

## Industry Highlights

The automotive sector plays a unique role in Southern California’s climate tech ecosystem, and the competitive advantage that the region has compared with other climate tech hubs around the world. Southern California’s automotive industry spans a range of OEMs and technologies. As shown in the map below, the region is home to the US headquarters of several industry leading conventional OEMs like Honda, Kia, Hyundai, as well as the headquarters of a new generation of rapidly growing electric vehicle OEMs, including Rivian (NASDAQ: RIVN), Canoo, Fisker, Faraday Future and more.

**Automotive OEM Headquarters in Southern California, by OEM Type**

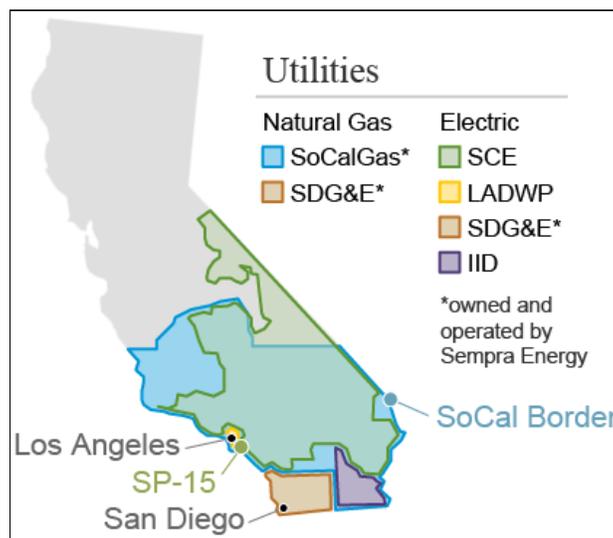


As leaders in the transition to a Zero Emissions Vehicle future, these automotive companies are essential components of the SoCal climate tech ecosystem in their own right. The conventional vehicle OEMs represented in the region are early movers in hybrid and electric vehicles among the conventional auto OEMs, while the EV startups in SoCal are among the most commercially successful EV companies in the world.

However, the impact that these auto companies play in the climate tech ecosystem goes beyond their direct role as developers and manufacturers of climate tech solutions. For example, according to the US Bureau of Labor Statistics, California’s motor vehicle manufacturing industry employed ~25,000 employees in 2021, approximately 10% of the total 250,000 motor vehicle manufacturing jobs in the country as a whole. These 25,000 workers are highly trained Californians with skills that will be essential to the growing climate tech ecosystem in the state. The auto OEMs in Southern California specifically attract talent from within the state and from around the country and contribute meaningfully to the development of skills and human capital in the regional workforce. Even those auto workers who are not currently employed by OEMs with EVs will ultimately play a crucial role given their expertise in the sector, and will be able to fill the demand for skilled workers as EV companies continue to scale and conventional OEMs transition to a ZEV future.

In addition to their role as a talent hub and investment center in the SoCal climate tech ecosystem, the automotive OEMs also play an important role as the hub in a growing network of ancillary services for electric vehicles – most notably EV charging infrastructure and other electric mobility solutions adjacent to the robust EV industry in SoCal. In this lens, the automotive companies that are concentrated in SoCal represent a built in demand center and opportunity for piloting and ultimately deploying emerging EV-adjacent technologies. Startups in EV-adjacent products or services would find a robust user base and opportunities for regional partnerships and synergies in the region, leading to an essential overlapping characteristic of the e-mobility segment of the SoCal climate tech ecosystem.

### Natural Gas & Electric Utility Coverage Areas, Southern California, 2020



Another key industry engaged in the development of the SoCal Climate Tech Ecosystem is the power and utilities sector in the region – specifically, the electric and gas utility companies responsible for providing energy to residents and businesses across the region. As depicted in the map above, there are several utility companies with overlapping service areas serving Southern California, all of which have different levels of engagement and investment in climate solutions but will each play an important role in the continued development of the ecosystem in the region. As the primary providers of energy to residents and companies in the region, these utility companies in the region play a central role in the financing, incubation, and deployment of climate tech solutions. The massive scale of these utility companies provides a built in user base for new technologies, and an innovative product or service that meets a need for a utility company can be rolled out across the region efficiently and at a scale that a startup climate tech firm would not otherwise be able to access.

Additionally, the utilities also play a role in rolling out their own climate tech solutions at scale. One example of this role as developer of climate tech solutions can be seen in SoCalGas' renewable natural gas (so-called, Power-to-Gas) strategy. The Southern California Gas utility has a commitment in place to deliver 20 percent renewable natural gas (RNG) by 2030 as part of its Net Zero plan. This provision of RNG will make SoCalGas an industry leader in this new product and the investment in talent, equipment and technology to meet this goal will have positive externalities in the broader SoCal climate tech ecosystem.

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While the firms operating in these sectors are involved in climate tech in differing degrees through their primary operations (i.e., manufacturing electric vehicles, developing renewable energy generation assets), these industries also contribute to the climate tech ecosystem structurally in three primary ways:

### **(1) Talent development and retention**

The first mechanism through which Southern California's mature corporate players help to foster a vibrant climate tech ecosystem is through the attraction and training of human capital to the region. As discussed below (see "Academic Institutions"), California is home to world-class higher education institutions, which attract students from around the country and the world. Many of the students who pass through these institutions, as well as thousands of other individuals with wide-ranging skills and education levels, enter the Southern California workforce each year.

The automotive and energy sectors attract many employees with skills and interests relevant to climate tech, and invest in the ongoing development of these talent pools both within their institutional boundaries and beyond, through fellowships and partnerships with other local organizations. By attracting investing in key talent with targeted skill sets, the incumbent firms in the automotive and energy sectors play an instrumental role in developing a talent pool in the climate tech ecosystem to propagate and support future startups and other ecosystem participants in the dominant sectors.

## **(2) Corporate venture and capital allocation**

Another direct mechanism through which corporate incumbents contribute to the climate tech ecosystem in Southern California is through their corporate development and venture investing activities. Many of the automotive OEMs and firms in the energy sector have active corporate venture arms which serve as capital allocators for startups as well as information gathering tools for the incumbents. These corporate development activities serve as a source of funding and information sharing across the ecosystem, as well as a framework for founders and climate tech VCs to make connections across the industry value chains in which they operate.

Corporate venture capital investing also supports traditional climate tech VC investors by providing additional opportunities to syndicate investment rounds and access operating expertise for portfolio companies that may not otherwise be possible without the involvement of incumbent industry operators.

## **(3) Technology incubation and deployment support**

The final structural mechanism through which corporate incumbents support the climate tech ecosystem in Southern California is through the operational synergies that these companies can provide. The mature firms operating in the automotive and energy industries offer scaled platforms for startups and new technologies to be applied in Southern California, as well as an installed user base for ancillary services. For example, the incumbent auto OEMs producing and marketing EVs offer a large and growing user base for EV charging infrastructure startups and related services.

The operational support provided by mature firms can either take the form of direct partnerships for piloting technologies or entering procurement agreements or through organic market-making benefits as in the EV example noted above. This important function deepens the network of beneficial commercial relationships within the climate tech ecosystem, which not only supports existing firms and entrepreneurs but further improves the profile of the climate tech ecosystem in SoCal, attracting new capital and encouraging new entrepreneurs to start businesses in the space.

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Ultimately, the role of incumbent corporate players in climate tech-adjacent sectors is an essential component in developing, growing and sustaining the ecosystem in SoCal. Through talent development, capital deployment and operational synergies, the corporate sector ensures that the ecosystem flywheel continues to turn and accelerate the growth of the ecosystem.

## Academic Institutions

California's higher education system is the largest, and among the most diverse, in the nation.<sup>9</sup> California has a three-tiered system of state-financed universities and colleges:

- University of California (UC)**  
 The UC educates more than 280,000 undergraduate and graduate students and employs about 228,000 faculty and staff. It is the state's primary awarder of doctoral and professional degrees.
- California State University (CSU)**  
 The California State University is the largest university system in the nation. CSU provides undergraduate and graduate instruction to approximately 474,600 students on its 23 campuses and employs about 50,000 faculty and staff.
- California Community College (CCC)**  
 The California Community Colleges are the nation's largest higher education system. The state's community colleges enroll 2.1 million students (about 900,000 on a full-time-equivalent basis) at 114 colleges that are organized into 72 districts.

In addition to California's public systems, there are over 80 independent or private colleges in California. Southern California has 19 universities registered with higher education agencies, eight of which are ranked in U.S. News Ranking of the 2022 Best National Universities. In both scale and quality, Southern California's network of academic institutions differentiates the potential of its climate tech ecosystem.<sup>10</sup>

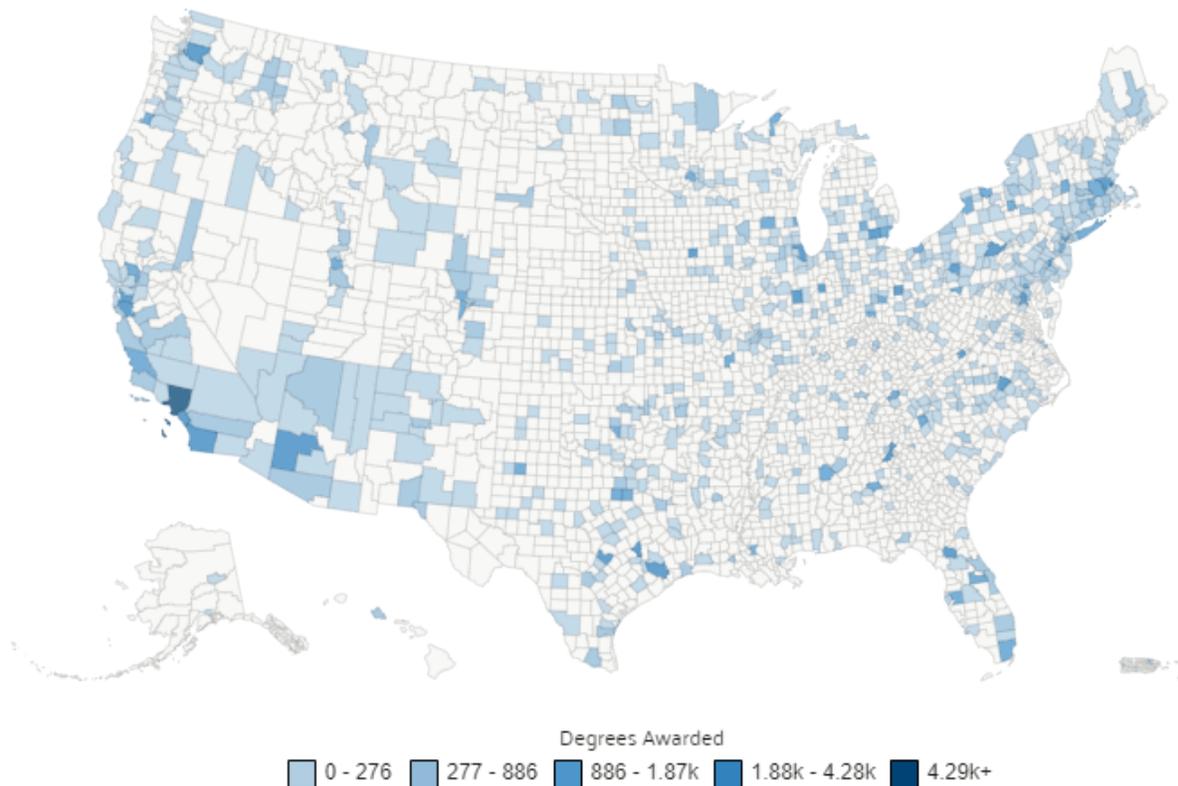
| University                              | Alias            | Ranking | Type    | Enrollment | Zip   |
|---|------------------|---------|---------|------------|-------|
| California Institute of Technology      | CalTech          | 10      | private | 979        | 91125 |
| University of California--Los Angeles   | UCLA             | 21      | public  | 30,873     | 90095 |
| University of Southern California       | USC              | 21      | private | 18,794     | 90089 |
| University of California--Santa Barbara | UC Santa Barbara | 37      | public  | 21,574     | 93106 |
| University of California--Irvine        | UC Irvine        | 42      | public  | 27,331     | 92697 |
| University of California--San Diego     | UC San Diego     | 42      | public  | 28,127     | 92093 |
| Pepperdine University                   | Pepperdine       | 46      | private | 3,542      | 90263 |

<sup>9</sup> *California's Higher Education System*, PPIC Higher Education Center, <https://www.ppic.org/wp-content/uploads/higher-education-in-california-californias-higher-education-system-october-2019.pdf>

<sup>10</sup> *Best National University Rankings*, U.S. News & World Report, <https://www.usnews.com/best-colleges/rankings/national-universities>

A second differentiator relates specifically to the number of engineering students available in the Southern California region. The top U.S. county with the most degrees awarded in engineering is Los Angeles County with nearly 7,000 engineering graduates per year. Santa Clara County, in Northern California, is the second with slightly less than 4,000 graduates per year. Data from the Integrated Postsecondary Education Data System (IPEDS) Completions shows the counties in the United States colored by the highest number of degrees awarded in Engineering (2019). A clear advantage for Southern California exists as multiple counties grant over 1,000 degrees per year.<sup>11</sup>

### Engineering Degrees Awarded by County in the U.S., 2009



Source: DataUSA

The quality of higher education institutions and the number of graduates in engineering was referenced multiple times in stakeholder interviews. Despite this unique quality, three challenges to the innovation ecosystem were highlighted that pertained to academic institutions:

- **Distance**  
Universities place a heavy emphasis on networking and in-person interactions. This creates a greater challenge for collaboration between universities and other climate tech innovation ecosystem stakeholders.

<sup>11</sup> *Data USA: Engineering*, Deloitte, Datawheel, and MIT Media Lab, <https://datausa.io/profile/cip/engineering#:~:text=Georgia%20Institute%20of%20Technology%2DMain%20Campus%20has%20the%20most%20Engineering,3%2C559%20degrees%20awarded%20in%202019.>

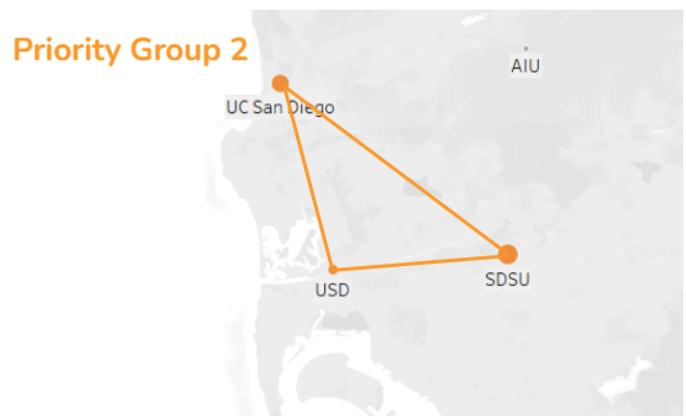
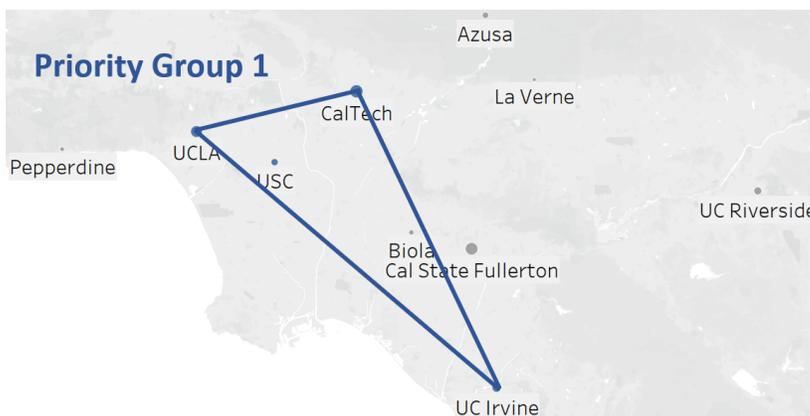
- *Innovation Curriculum*

While many engineering graduates are available, interviewees cited greater opportunities to integrate innovation and design content in the traditional engineering curriculum. This also leads to opportunities for greater interaction and cross-pollination between engineers and other concentrations.

- *Tech Transfer*

While some universities have dedicated tech transfer sites, there is variation in the amount and types of resources they offer. Organizations like the University Technology Licensing Program (UTLP) aims to standardize some of these offerings by providing widespread, convenient, and efficient access to valuable inventions owned by 15 universities across the country - including UCLA, Caltech, and USC.

To further stimulate a climate tech innovation ecosystem in Southern California, action areas should address these challenges by promoting more frequent interactions between students, faculty, researchers, funders, and employers. To create a targeted approach, a focus should be placed on two priority groups when building relationships with academic institutions. The first priority group, based on ranking, number of graduates, and geographic concentration, should include UCLA, Caltech, USC, and UC Irvine. Priority group 1 contains four out of the five highest ranking institutions in SoCal totaling nearly 80,000 students. The second priority group is further south and includes UC San Diego, USD, and SDSU totaling just under 65,000 students.

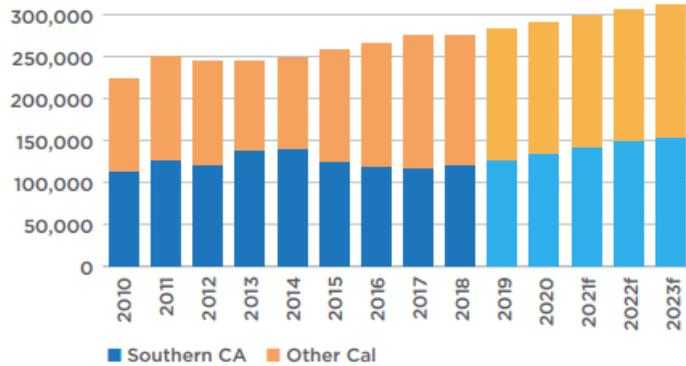


Any programming with academic institutions focused on these priority groups will help tackle the challenges presented by distance and allow for complementary innovation and design programming even if universities don't have the resources. Three out of the four universities in Priority Group 1 are also members of the UTLP, naturally providing an ability to compare how membership impacts tech transfer in comparison to Priority Group 2, while also allowing key insights to be shared.

## Human Capital

Southern California is both a center for academic excellence and an attractive hub for top talent. These factors set the foundation for human capital, consistently ranked as a pivotal ecosystem pillar.<sup>12</sup> Components of this pillar include the availability of management and technical talent, as well as optimistic job availability and competitive pay.

### California EV Employment Forecast, 2010-2023

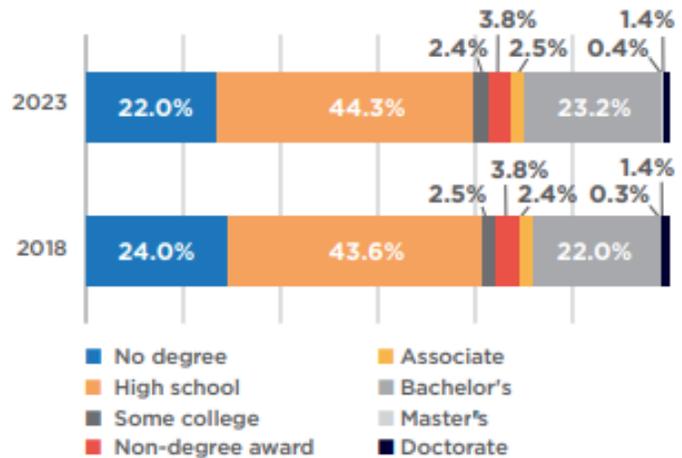


Focusing specifically on the Electric Vehicle sector, the Los Angeles County Economic Development Corporation (LAEDC) published a jobs report highlighting the promising trajectory for workers employed in the industry. EV jobs in SoCal both pay better and are forecasted to grow robustly in the coming years. In 2018, EV jobs in SoCal on average paid \$80,900 annually while other jobs in the region on average paid

\$54,900 annually. They are also projected to have a higher annual growth rate of 2.9% than the average annual growth rate of 1.7% which reflects all sectors. As a result, SoCal is projected to maintain nearly 50% of all EV employment for the state.

### EV Employment by Education, 2018 and 2023

It is also important to note the trend in the greater EV ecosystem is toward greater education for entry-level employment, which uniquely positions Southern California to benefit. Between 2018 and 2023, EV-related work requiring at least a high school diploma is estimated to grow by 0.7% and requiring at least a bachelor's degree by 1.2%. Coupling the demand for nearly 30% of the workforce to have some level of higher education and the local supply of high-tier colleges, Southern California's human capital is poised to be tapped into for a climate tech innovation ecosystem.<sup>13</sup>



<sup>12</sup> *The Relative Importance of Entrepreneurial Ecosystem Pillars to Entrepreneurs*, World Economic Forum,

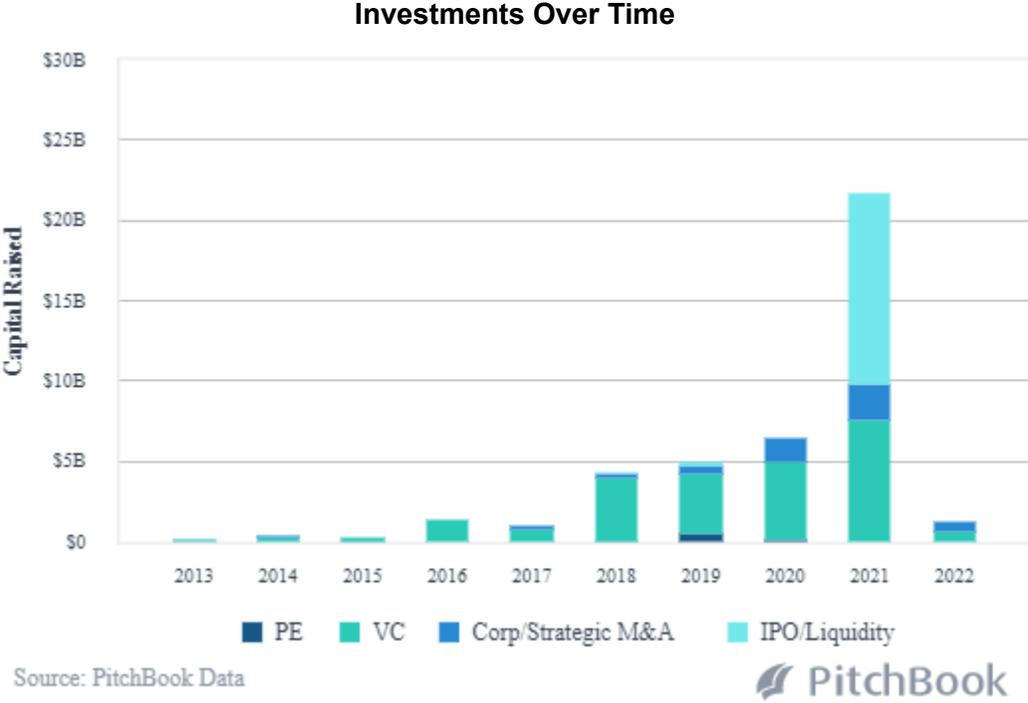
<https://reports.weforum.org/entrepreneurial-ecosystems-around-the-globe-and-early-stage-company-growth-dynamics/section-3-the-relative-importance-of-entrepreneurial-ecosystem-pillars-to-entrepreneurs-the-big-three-of-accessible-markets-human-capitalworkforce-and-funding-finance/>

<sup>13</sup> *Energizing an Ecosystem: The Electric Mobility Revolution in Southern California*, LAEDC, <https://laedc.org/2020/03/01/laedc-ev-industry-report/>

# Startups

The landscape of climate tech startups in Southern California is presently dominated by companies in the mobility space but includes firms focusing on AgTech, the energy system, and other themes. There is significant variation in the maturity of the various sectors in climate tech in general, with some decarbonization solutions (mobility, electrification) receiving more attention and resources than others. This holds true in Southern California and is represented in the distribution of startups. Unicorns have emerged and IPO'd in certain sectors in Southern California, such as Rivian and Beyond Meat, while many other startups are still in the early stages of demonstrating commercial viability. Many startups in the space are applying mainstream solutions from other use cases to decarbonization, such as artificial intelligence, and others are developing new proprietary tech. Despite the large increase in capital availability and interest in the space, adequacy of financing—particularly early-stage capital to fund prototypes and demonstration projects in certain climate tech subsectors—remains a challenge.

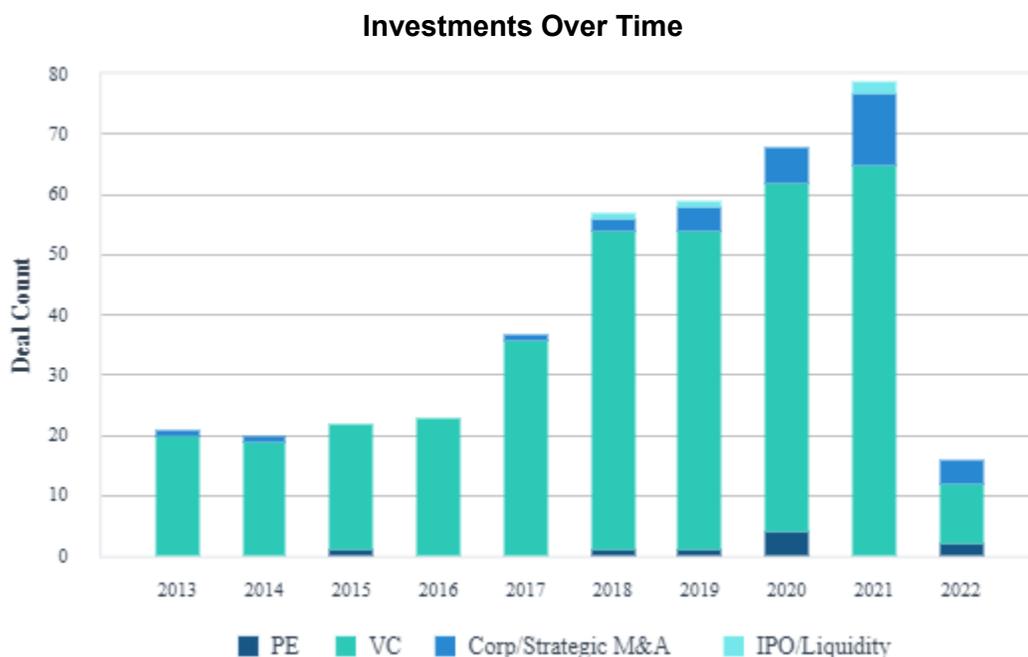
On the PitchBook data intelligence platform, there are 159 climate tech startups with a presence in Southern California area codes. While not an exhaustive list, this report considers this dataset an illustrative sample. In 2021, 55 of these companies raised nearly \$7.6 billion of venture capital, the highest level in 10 years. Average deal size has also increased to \$117 million in 2021 from \$83 million in 2020. The capital raised by these firms during this time is shown in the chart below.



Last year, the following sectors led in Southern California climate tech deals:

- **Mobility:** Mobility companies raised \$5.5 billion in 2021. By far the largest transactions in 2021 in mobility were Rivian's \$2.7 billion Series F in January and subsequent \$2.5 billion raise in July. Investors included Amazon, Third Point Ventures, Fidelity, Ford, and 412 Venture Fund. Rivian later IPO'd in November, raising nearly \$12 billion. Other mobility companies raising capital included Bird Rides (\$208 million), Volta Charging (\$125 million), and FirstElement Fuel (\$105 million).
- **Electricity:** Startups in electricity raised the bulk of the remaining VC funds directed towards climate tech in 2021. The largest raise in this sector was TAE Technologies, a nuclear fusion company that raised a total of \$410 million in January and April from investors including Alphabet. Other notable transactions included a \$240 million late-stage VC round raised by Nexamp and Energy Vault's \$165 million Series C.
- Outside of the above categories, sustainable FinTech platform Aspiration raised a \$135 million Series C, AgTech company Semios raised \$79 million, and plant-based protein producer Daring Foods closed \$65 million. Israeli AgTech firm NRGene Technologies, which also has offices in Southern California, IPO'd on the Tel Aviv Stock Exchange 2021, raising US\$31 million. In January 2022, indoor farming company Plenty raised a \$400 million Series E.

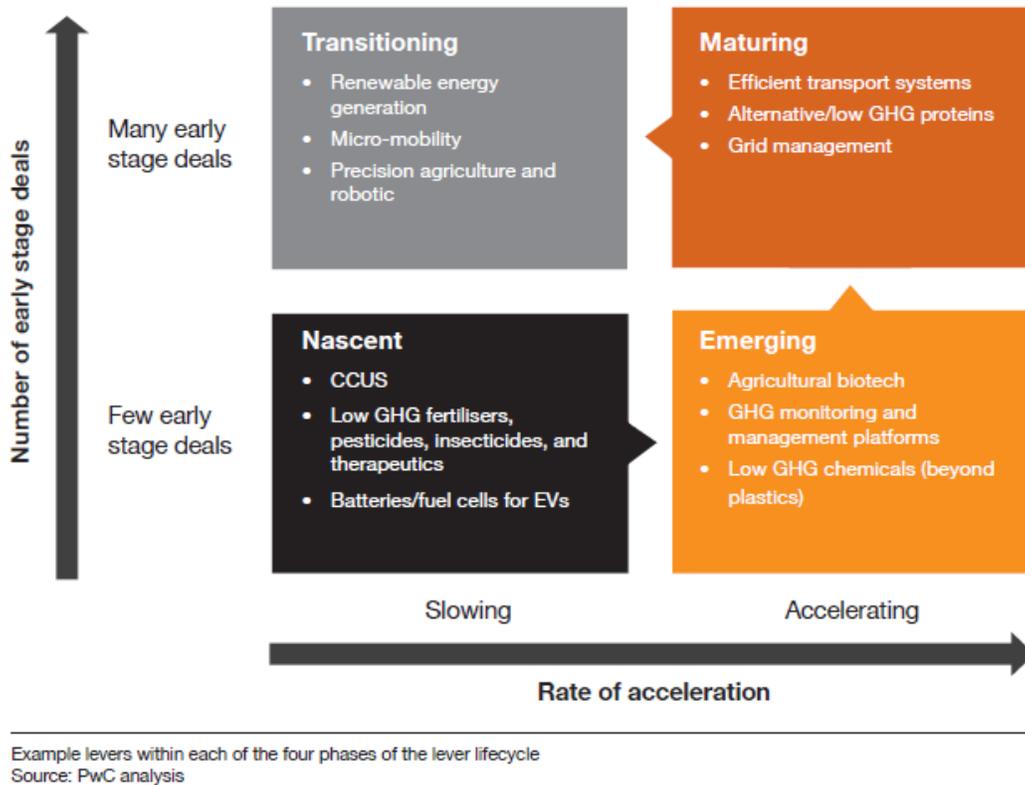
The deal volume of this universe of companies is shown below.



Source: PitchBook Data



The most active climate tech hub in Southern California has been Los Angeles, which ranked #10 on PwC’s list of most active investment hubs based on VC funding raised by startups headquartered there for 2021 and #4 for 2020. This is largely due to investment in mobility and transport companies. When excluding this focus area from the ranking, no city in Southern California is ranked in the top 10. However, three of the U.S. cities that are ranked are included due to funding raised by a single startup, implying that non-mobility and transport sectors are also relatively nascent elsewhere. A visual representation of PwC’s lifecycle framework for levers of decarbonization (ie. climate tech themes) is below.



The large amount of capital directed towards mobility reflects a national trend in climate tech investment in which electric vehicles have received the most attention. Nationally, light-duty battery EVs have received 60% of total investment funding from 2013 to the first half of 2021 according to PwC’s State of Climate Tech 2021 report. However, PwC further estimates that this focus area represents only 3% of the total potential emissions reduction of climate tech by 2050. This implies that significantly more capital is needed to target other more nascent areas of climate tech with significant emissions reduction potential. A graphic depicting select technologies against PwC’s total funding against emissions reduction potential is included in the appendix.

A market map of this sample of Southern California climate tech startups, grouped by focus, is included on the following page with the total funding raised to date. Electric transportation has raised \$35.1 billion, 9x the capital raised by the next largest category.

# SoCal Climate Tech

Showing 133 of 159 Companies | Segmentation Method: Custom

Created on 04-24-2022 | Source: PitchBook

### Electric Transportation Total Raised: \$35.1B

- Road Consumer Total Raised: \$33.1B**
  - RIVIAN, FISHER, Paradox Future, PROTERRA
  - K.A.R.M.A., WHEELS, Eli Electric Vehicles, AMPERE, NOVVE, URB-E
- Road Industry Total Raised: \$721.5M**
  - XOS, SEA, XLFleet, OSMO
- EV Infrastructure Total Raised: \$868.7M**
  - volta, LOCALMILES, EverCharge, eMotorWerks, EV PASS PORT
  - Power Pass, EVmatch, driivz, greenlots, LIBERTY ACCESS TECHNOLOGIES
  - GO TO-U, NeoCharge
- EV Battery Tech Total Raised: \$468.3M**
  - ENEVATE, EVELO, COMPACT

### Energy Transition - Grid Tech Total Raised: \$2.7B

- Energy Storage Total Raised: \$867.6M**
  - ENERGY, Navitas, eVOLTA, TransPower, eBiosPlus, eBIOFLEX
- Grid Management Total Raised: \$209.7M**
  - inspire, MITTECH, EKO/WATT, DELTA, CSE
- Analytics Total Raised: \$1.3B**
  - swell, Local Carbon Footprints, nexamp, ECORITHM, ELECTRUM, better
  - NEXT, HST, gti
- Battery Technology Total Raised: \$12.2M**
  - POWER GLOBAL, BigBattery.com
- Hydrogen Total Raised: \$240.8M**
  - RE FUEL, PURE TECHNOLOGIES

### Mobility Solutions Total Raised: \$373.8M

- Shared Mobility Total Raised: \$98.2M**
  - veo, hopp, Road Ready Rider
- Green Hydrogen Total Raised: \$13.9M**
  - OC GROUP
- Micro Mobility Total Raised: \$252.5M**
  - revel, #200RHO, WAVE, LASTMILE, Rydable
- Smart Infrastructure Total Raised: \$9.3M**
  - AI, HILLTOP

### Land Use Total Raised: \$224.7M

- Climate/Earth Data Total Raised: \$224.7M**
  - semios, HYDRUSAI, harbor

### Food Systems Total Raised: \$3.9B

- Alternative Protein Total Raised: \$1.5B**
  - LIVEKINDLY, BEYONHEAT, CALIFIA FARMS, daring, fazenda futuro, alpha FOODS
  - Outstanding, ABBOT'S, eclipse, akua, PRECIOUS, Protein
  - HELP'S TROOP, THIS SAVES LIVES, HILL COOPERATIVE, ZEN BURGER, abounded
  - Hilbert, PERENNIAL, NATIVE STATE, PLANT POWER, BRAMI
  - Honeyville, Abbot's Pie, MOKU
- Indoor Farming Total Raised: \$941.0M**
  - Plenty
- Alternative Farming Methods Total Raised: \$95.9M**
  - runu, zelp
- Ag BioTech Total Raised: \$32.5M**
  - CB, cellibre
- Cultured Meat Total Raised: \$1.4B**
  - Bluehou, TALENT, Pristine Pet Food, illumina
- Robotics Total Raised: \$0.1M**
  - LOCAL ROOTS

### Energy Transition - Clean Energy G... Total ... : \$1.6B

- Solar Total Raised: \$382.9M**
  - mPower, AION, SIGORA SOLAR, GlassPoint, Solar, narmaste solar
  - Hellogen, pi energy, RENOVY
- Nuclear Total Raised: \$1.1B**
  - tae
- Ocean & Hydro Total Raised: \$85.2M**
  - Eavor, SEATREC

### Built Environment Total Raised: \$61.1M

- Construction Tech Total Raised: \$61.1M**
  - plant, CarbonBuilt, Pacific Works

### Industry Total Raised: \$222.9M

- Fuel Alternatives Total Raised: \$83.1M**
  - POWERSTAR, GREENSTAR

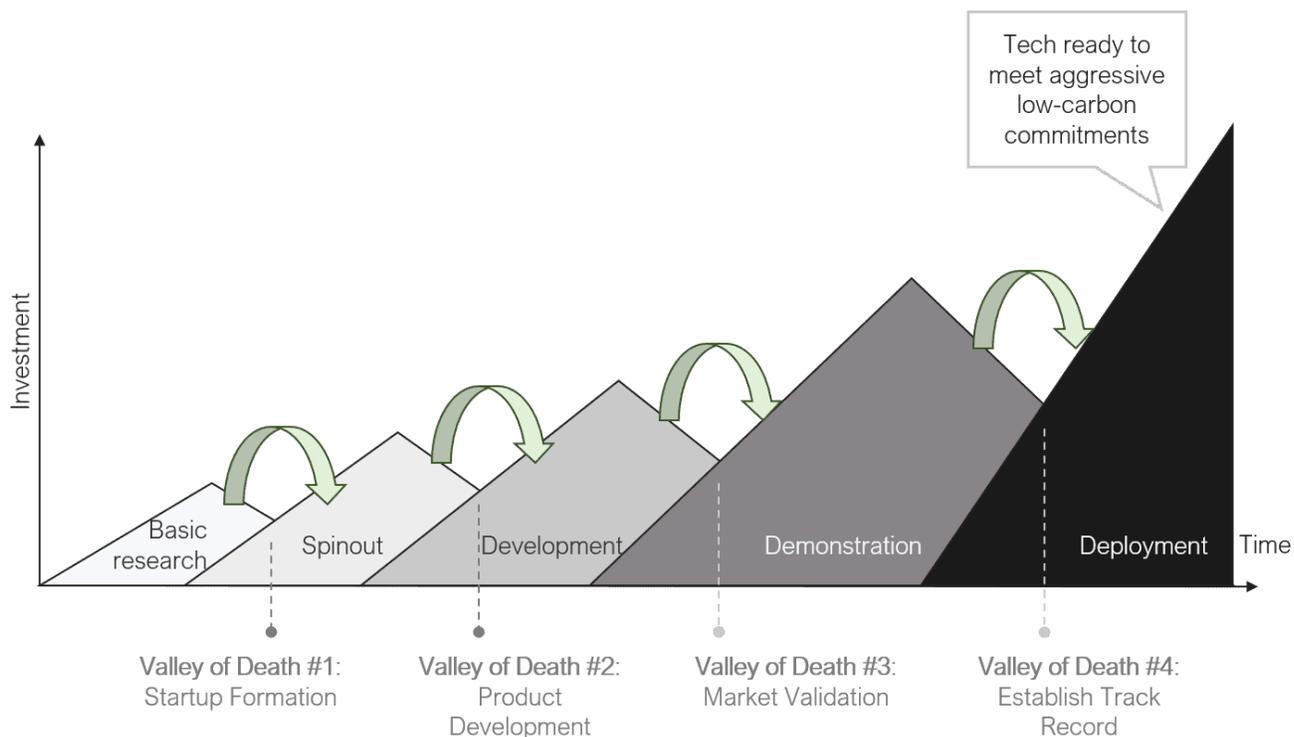
### Carbon Tech Total Raised: \$757.0M

- Carbon Fintech Total Raised: \$461.2M**
  - Aspiration, Good Money
- Carbon Capture & Storage Total Raised: \$43.6M**
  - Carbon Capture, VERIN FIVE
- Carbon Sequestration Total Raised: \$169.6M**
  - Carbon

As an asset class, climate tech is rapidly maturing and many firms having moved beyond proof of concept as the value of decarbonization has become more widely accepted. This will likely be further validated by future implementation of broad carbon pricing. However, many climate tech companies have notable differences compared to other sectors in which venture capital investors have been active, such as software, that pose challenges. These may include:

- Lengthy research and development process
- Longer product development cycle
- Heavily entrenched status quo and incumbent players with biases against change
- Specialized technical, commercial and regulatory expertise needed
- High capital intensity throughout

These issues may present unique considerations for VC investors as they evaluate how to best invest in and support their climate tech portfolio companies. Specifically, these challenges mean that climate tech startups face more existential hurdles at various stages of their development, or multiple “valleys of death”. While other industries may face a single valley of death, climate tech startups could face four, according to Third Derivative, and require specific supports at each stage. An ecosystem approach is essential to providing these.



Source: Third Derivative

**Valley #1:** The key challenge at the earliest stage of a climate tech startup's life is the transfer of technology to a startup. At this early stage, seed capital is a significant constraint due to the challenge and intensity of due diligence at this stage for a small investment. In Orange County, we have seen significant intellectual capital at universities such as UCI, but relatively limited precedent for its transfer to startups.

**Valley #2:** Once a startup has raised seed funding, they must navigate finding product-market fit, producing an MVP that will integrate into existing industries and displace existing solutions. Here, access is a challenge and founding teams will require mentorship and connections that will allow them to understand and iterate upon incumbent technologies and processes as well as the regulations and other complexities involved. Incubators and accelerators in Orange County play a critical role at this stage.

**Valley #3:** After finding product-market fit, startups face the challenge of sourcing a demonstration project for their product. At this stage, the entrenched industry incumbents and solutions that have held the status quo present significant barriers. Often, incumbents resist change. Startups must choose an arduous process of convincing their first incumbent customer or the vastly capital-intensive option of constructing a parallel value chain. Involving representatives from incumbent industry players in an ecosystem, such as the one that is forming in Orange County, is essential.

**Valley #4:** The stage of scaling and achieving stable profitability is also highly capital-intensive and requires institutional capital to flow into established financial structures. For this to happen, late-stage investors must be ecosystem participants and must become comfortable with climate tech companies.

### *Incubators and Accelerators*

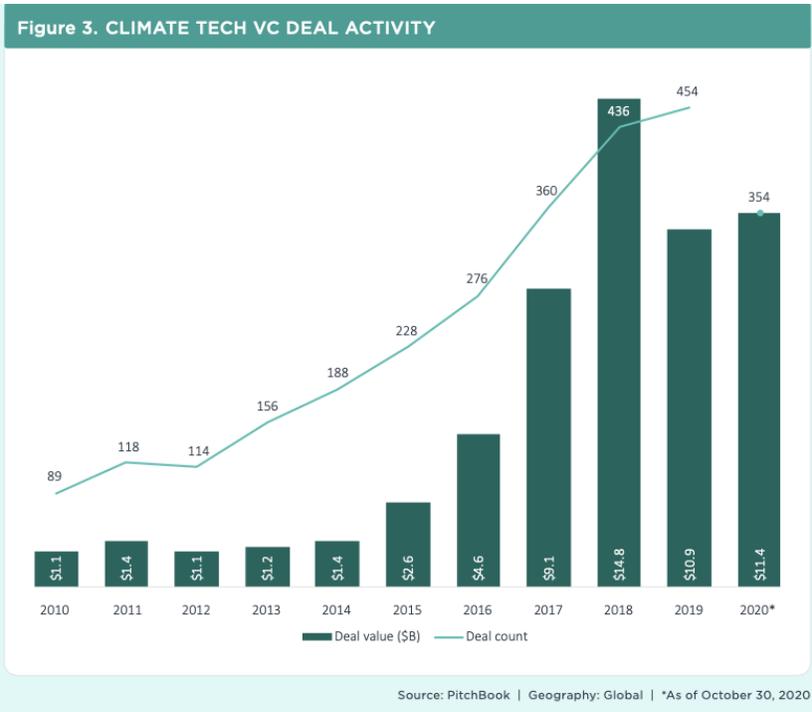
Incubators and accelerators play a key role in supporting startups as they navigate critical challenges during each stage of their lifecycle by acting as a hub for resources and knowledge. Below is a snapshot of four key organizations in Southern California that help startups avoid the valleys of death and drive forward the innovation economy.

|  |  |  |  |
|--|--|--|--|
|   |   |    |   |
| <p>LACI is unlocking innovation through startups, transforming markets with partnerships and enhancing community inside our campus and out in our neighborhoods.</p> | <p>An epicenter for innovation and entrepreneurship in Orange County. Built to create opportunities for connection, sharing, and growth, it provides the UCI campus and surrounding community an innovative ecosystem with access to resources, tools, exposure and collaborative partners and advisors.</p> | <p>Octane convenes and enables the Southern California tech and medtech business ecosystem by connecting people, resources, and capital. Octane impacts their community through LaunchPad SBDC, a top-performing accelerator, Capital &amp; Growth, a platform to provide companies capital and growth resources, Ignite Series, providing leading content, and Octane Foundation for Innovation, focused on furthering their mission while advancing diversity and inclusiveness.</p> | <p>Sustain Southern California (Sustain SoCal) accelerates cleantech economic growth and sustainability initiatives through innovation, collaboration and education.</p> |

In considering what is possible for climate tech, the medtech ecosystem is often cited as an example. As with climate tech, medtech is capital-intensive, targets regulated markets, and requires startups to navigate a landscape with entrenched incumbents which control customer distribution channels. Medtech ecosystem participants have developed a well-established pathway for startups to work with and be supported by corporate incumbents and VCs to commercialize innovative technologies. Such an ecosystem exists for medtech in Southern California and accelerator programs such as those at Octane and Sustain SoCal were critical in organizing the community, human capital, capital and other resources there.

# Venture Capital

Global urgency and technological breakthroughs have caused a surge of investment into climate-tech. In partnership with government support and LP pressure, investors have been increasingly pouring capital into the climate tech sphere. In fact, in the past year, investment in climate tech has outpaced the overall venture market 5 to 1, and has attracted a diverse set of investors. The interest in climate tech has been a resurgence of the cleantech era between 2009-2011, which, unfortunately, was an investment bust. Investors lost roughly half of their investment which deterred investors for the decade. However, recent innovations in technology, growing consumer demand and government support has once again, rightly, propelled capital into the space.



The investment opportunity speaks for itself. Last year, Amazon committed to launching their Climate Pledge Fund, a \$2B fund aimed at clean energy ventures. Microsoft also announced a \$1B Climate Innovation Fund, and Unilever pledged to \$1B in a new dedicated Climate & Nature fund. In addition to this, generalist VCs including Sequoia Capital, Founders Fund and Khosla Ventures announced they are now seeking out climate-tech opportunities. Areas with the most funding are Mobility and Transport, followed by Built

Environment, and Food, Agriculture and Land Use.

The below SoCal based funds are investing in various areas and stages of climate-tech, ranging from energy and infrastructure to fintech and government.

| Fund                | Investment Focus                             |
|---------------------|--|
| Fifth Wall Ventures | Climate Tech, Real Estate Tech, Retail       |
| Blue Bear Capital   | Energy, Infrastructure, Climate              |
| Elevation Ventures  | Sustainability                               |
| Angeleno Group      | Clean Energy, Climate, Infrastructure        |
| Overture VC         | Climate and Government                       |
| 2045                | Climate-Tech                                 |
| Keiki Capital       | Decarbonization, Adaptation, Climate Fintech |
| Full Cycle          | Climate Infrastructure Technology            |

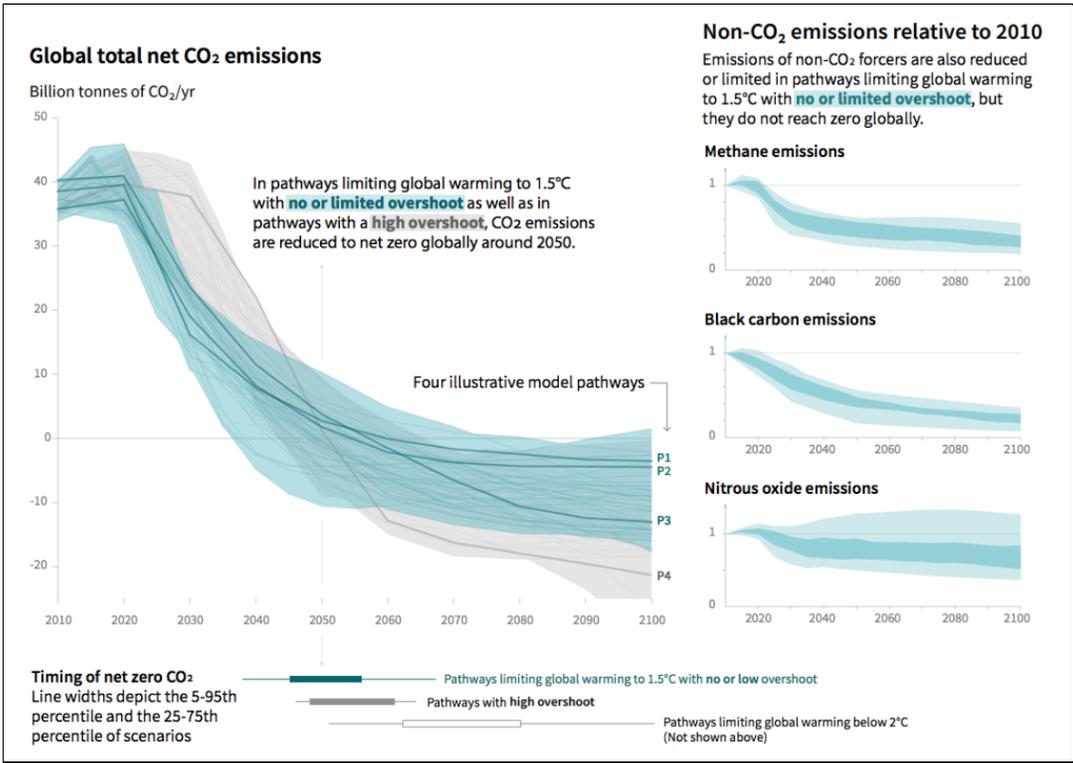
The most active VC investors in the startup data set by deal count include Kleiner Perkins, Tao Capital Partners, Mission Ventures, GM Ventures, and Fidelity; none of which are based locally in Orange County. Despite the staggering growth in the sector, climate tech investment only represents 6% of global venture capital activity.

Investing in climate-tech is not only a necessity, it is also smart. Between government backing, advancements in sustainable technology and unique geographic positioning, the SoCal region is brewing in innovation that is ripe for early-stage investment.

# CONCLUSION

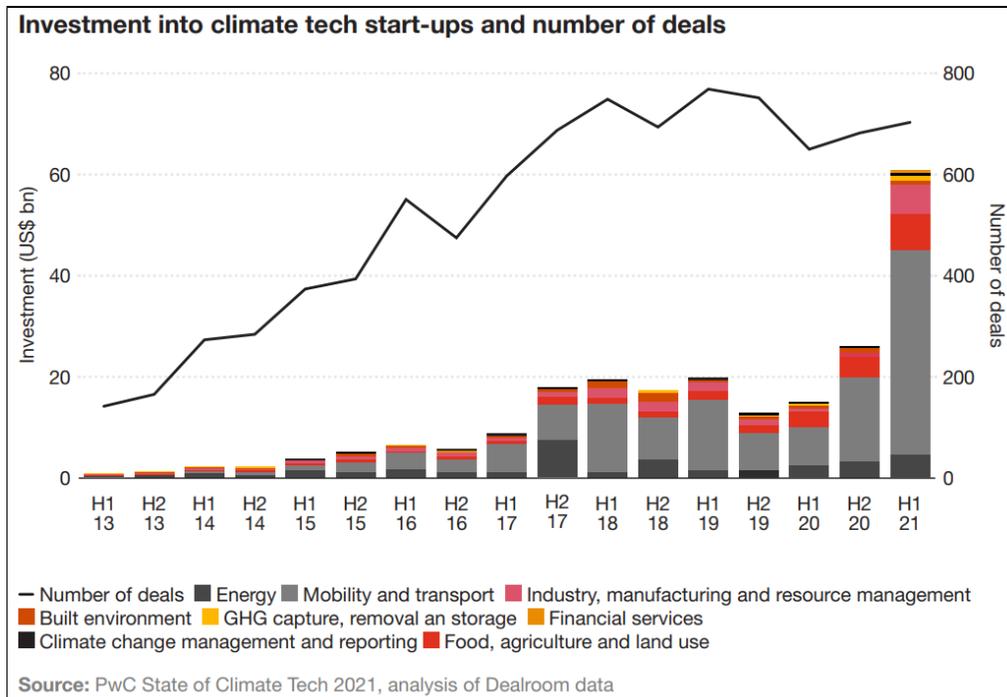
Global focus on innovation and early stage investment in climate tech solutions is more essential than ever. As illustrated in the graph below, a significant reduction in emissions is needed over the coming decades in order to meet net zero targets and to maintain pathways to remain below warming limits (e.g., 1.5° or 2° C warming).

The speed of decarbonization and development of economy-wide sustainability practices required to track these net zero pathways will require new technologies, business models and entrepreneurial actors engaged in solving this pressing issue worldwide. In short, a robust climate tech economy will continue to be an essential component of the global approach to tackling this age-defining challenge.



Source: IPCC

Investment in climate tech start-ups across a range of sectors has continued to grow in recent years. As shown in the chart below, a substantial proportion of the investment in recent years has been driven by investment in electric mobility solutions. Given the pressing planetary needs and the increased focus on climate change from a range of actors, this trend will continue to accelerate in regions and economies across the globe.



As demonstrated by the already vibrant electric vehicle ecosystem in Southern California, there is great opportunity to develop a hub for climate tech in this region that includes a more diverse range of decarbonization solutions. There is a confluence of favorable elements in Southern California including government climate initiatives, decarbonization efforts announced by industry incumbents, and an existing innovation community that can support this ecosystem’s development.

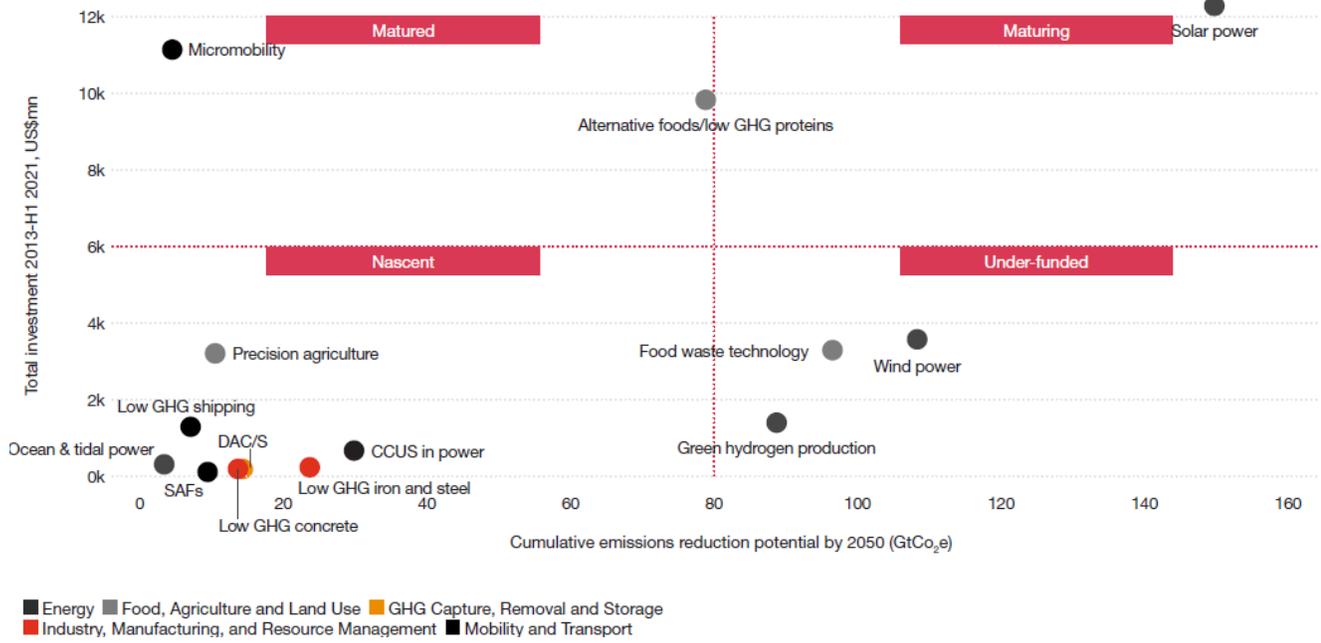
Southern California has an outsized potential to become the next hub for climate innovation. The ecosystem is highly concentrated in mobility startups, reflecting a broader national trend in which this sub-theme has attracted the most funding. As a result, there is a need for a transversal connector of resources to act as “center of gravity.” The need for an institutional partner was cited as instrumental by various stakeholders in the ecosystem to continuously evaluate the ongoing needs and address gaps of the ecosystem.

One ongoing gap is the few funds and investor capital exclusively focused on climate-tech. There is a greater need for dedicated funds based in Southern California given the potential of nascent startups in the sciences that leverage SoCal’s stellar caliber of human capital. Coupling targeted funding with regional effort initiatives to improve tech transfer knowledge across institutions sets a prime foundation for new to market disruptive solutions.

Lastly, a key lever can be flipped for SoCal given the existing government support and local infrastructure through the creation of a consolidated platform or taskforce to help navigate governmental resources. This will both incentivize the ecosystem and centralize the disparate sources of funding available for climate solutions.

# APPENDIX

Total funding against emissions reduction potential by climate technology (2013-H1 2021)



Source: PwC State of Climate Tech 2021

## Additional Sources:

- 2021 Introduction to Climate Tech: A Taxonomy Overview (Pitchbook)
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