

Future of Climate tech

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INTRODUCTION

SILICON VALLEY GOING GREEN

We are at the beginning of a fast and deep transformation of our societies – deep decarbonization. Like most disruptions, this is being driven by the convergence of several key technologies. This era will closely parallel the digital disruption of information technology. Just as computers and the Internet enabled countless new business models that collectively have had a transformative impact upon the global economy, so too will this ‘green’ transformation create unmatched opportunities for innovation and entrepreneurship.

The climate tech ecosystem in Silicon Valley are key partners in getting to zero.

Combatting climate change will require significant transformative thinking, and that is what the Silicon Valley mind-set is associated with. Aiming big and pursuing innovative technologies. The stories of how Silicon Valley entrepreneurs have disrupted entire industries are well-documented and relevant to understand in order to see how The Future of Climate Tech can unfold in Silicon Valley.

Within the past few years, climate tech has taken off in the ecosystem across world-class research institutions, investors, startups and BigCorp. Some observations about current developments and trends;

LARGE AMOUNTS ARE INVESTED INTO TECH FOCUSING ON REDUCING EMISSIONS AND RESOURCE INTENSITY.

➤ Within climate tech investments, mega-rounds, unicorn births in 2021, and (the increasingly popular) SPAC investment vehicles are especially related to renewable

energy, energy storage, and the electrification of transportation and operations.

INVESTORS ARE INCREASINGLY PLACING BETS ON CARBON REMOVAL.

➤ Annual funding to startups in the carbon removal / carbon capture, utilization, and storage (CCUS) space in 2021 is at a record high and more than double funding raised in 2020.

THE SMART, GREEN GRID

➤ Grid tech and renewable energy management start-ups are attracting investment as utilities work to upgrade both hardware and software in their efforts to decarbonize the grid.

ANNUAL ENERGY STORAGE FUNDING AND DEALS HAVE ALREADY REACHED A NEW PEAK IN 2021.

➤ So far in 2021, mega-rounds related to energy storage companies have increased, and investors are eager to fund expanding research into manufacturing and recycling of batteries. »»



✧ The offices of Innovation Centre Denmark Silicon Valley

» **CIRCULAR ECONOMY MOMENTUM IS BUILDING AS COMPANIES LOOK TO REDUCE THEIR RESOURCE USE.**

➤ Companies are doubling down on innovating circular materials and tech to help them recycle, which helps them reduce their resource intensity – leading to start-ups’ raising mega-rounds.

DIGITALIZED EMISSIONS TRACKING AND MANAGEMENT

➤ As corporations increasingly commit to carbon neutrality goals, they are investing in start-ups that can help them capture, store, and manage their emissions – as well as better collect and track

i ICDK SILICON VALLEY

ICDK Silicon Valley is here to help you connect. While Denmark is a green frontrunner in Europe, the State of California is a green frontrunner in the US and drives an ambitious climate action transition. For this reason, Denmark and California are working together on key climate challenges; from offshore wind, energy efficiency and water technology to energy storage, conversion and carbon removal as well as sustainability within food and agriculture.

their operational data across businesses, which can lead to lower energy usage and reduced emissions. ✕

A photograph of the Golden Gate Bridge in San Francisco, California, taken during sunset. The bridge's iconic red-orange towers and suspension cables are silhouetted against a soft, pinkish-orange sky. The bridge spans across a body of water, with a rocky island visible on the left. The overall mood is serene and iconic.

CALIFORNIA: A GLOBAL GREEN FRONTRUNNER

California is a noticeable green frontrunner. While federal policies and priorities have shifted with changes in government, California has consistently been taking the lead in the green transition.

The state has set some of the most ambitious mid-century climate goals in the world and drives the green transition wielding a unique political, economic, technological, and innovation toolbox. California has a lot to offer Danish stakeholders looking for green business opportunities, research, and innovative, strategic partnerships.

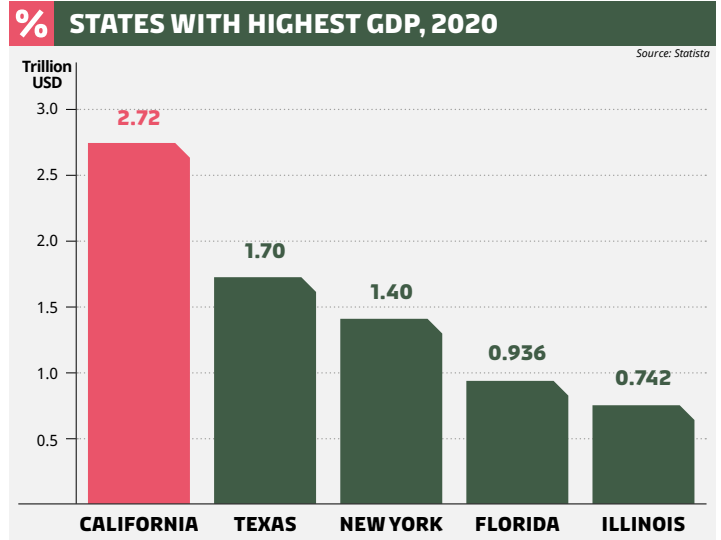
Climate Action Progressing on the State Level

The United States is the second-largest emitter of carbon in the world and the highest producer of greenhouse gasses per capita. Climate change splits public opinion in the US, and the dominant political parties differ markedly in their views on energy and the environment. An example is the Trump administration’s decision to withdraw from the Paris Agreement, which sets out a global framework for limiting global warming and reducing carbon emissions. President Biden has signed the executive order to rejoin the Paris Agreement and has put forward plans for investing 1.7 trillion USD in low-carbon technology that would put the US on a path to net-zero emissions no later than 2050. Irrespective of policies on the federal stage, climate action at the state level has been moving ahead. Twenty-five US states have independently joined the United States Climate Alliance, committing to reduce emissions consistent with the Paris Agreement. Many climate and energy policies are being developed and implemented at the state level.

California is at the forefront of the efforts to decarbonize the economy. As the largest state in the US—with 40 million inhabitants (and consumers)—and the fifth-largest economy in the world, California wields significant influence. Moreover, laws, regulations, consumer trends, and business models emanating from California often signal change and drive for action elsewhere. This is apparent in the digital sphere, where Google, Apple, and Facebook - now Meta - have made their mark globally. Still, California also takes the lead when it comes to the energy and environmental sphere.

Ambitious Goals

California has set some of the most ambitious climate targets in the world.



Even despite the pandemic, California remains the wealthiest state in America with 59% higher GDP than the second runner up, Texas

A LONGSTANDING ENVIRONMENTAL LEADER

California has a long history of prioritizing environmental policy. In 1884, an epic anti-dumping ruling in the aftermath of the gold rush put California on this environmentally-friendly path. California was the first state to introduce tailpipe emissions standards in 1966 and led the way on air pollution control with the establishment in 1967 of the California Air Resources Board by then Governor Ronald Reagan.

California was also the first state to implement energy efficiency standards in 1974. The first American law to place a cap on greenhouse emissions, the Global Warming Solutions Act in 2006, was passed under Republican Governor Arnold Schwarzenegger. Historically, the law demonstrates that Californian climate efforts have been bi-partisan, with political support from both Republican and Democratic administrations. Recent polls (PPIC) suggest that a majority of voters believe it is very important that California remains a world leader in fighting climate change.

The current goal is to have 100 % clean electricity and a 100 % carbon neutral economy by 2045, with net negative emissions after 2045. That is, not just reducing existing emissions but removing carbon from the air. As an intermediate goal, the state aims for 60 % of delivered power to come from renewable sources in 2030.

For the transportation sector, which is responsible for approximately 40 % of emissions in the state, California has a political goal of having 5 million zero-emission vehicles on the road by 2030. In 2020, Governor Newsom issued an order requiring all cars and passenger trucks sold in 2035 to be zero-emission vehicles. Subsequently, the automobile manufacturer General Motors announced it would follow California’s »

» lead and commit to manufacturing only zero-emission vehicles by 2035.

California prioritizes energy efficiency as a key component of its energy policies and has committed to doubling energy efficiency savings by 2030 compared to 2015. In 2020, Governor Newsom added a new element to the Californian decarbonization efforts by issuing an executive order pledging to conserve 30 % of land and coastal water by 2030 to protect biodiversity and harness natural-based solutions to remove and store carbon from the atmosphere.

California exerts its political influence outside the state in the US Climate Alliance and by spearheading the Under2Coalition – a group of more than 200 sub-national jurisdictions, which combined encompass 1.3 billion people and 43 % of the world economy – have pledged to ambitious climate action in line with the Paris Agreement.

Tools of change moving California towards climate drawdown

California's strategies for achieving its ambitious goals encompass a suite of sector-specific standards and incentive programs as well as overarching climate policies aiming to reduce emissions.

CAP AND TRADE PROGRAMME

» Among the centerpiece climate policies is the Cap and Trade Programme, the fourth largest emissions trading system in the world, introduced in 2013. Businesses responsible for approximately 85 % of state emissions are required to comply. Emissions allowances are traded at auctions, having generated more than 12 billion USD in revenues deposited in the state Greenhouse Gas Reduction Fund. As of 2020, projects for more than 5 billion USD have been implemented, with the majority of funding allocated to transportation and sustainable agriculture.

LOW CARBON FUEL STANDARD (LCFS)

» Another key component in California's decarbonization efforts is the Low Carbon Fuel Standard (LCFS), implemented in 2011, designed to reduce the carbon intensity of transportation fuel pool by 20 % by 2030 and increase the range of lower-carbon, alternative fuels. Carbon Capture and Sequestration projects are included in the LCFS credit program, which

i CALIFORNIA'S CLIMATE AMBITIONS



By 2030:

- Reduce the **GHG emissions by 40 %** (compared to 1990 levels)
- Have **5 million zero-emission vehicles** (ZEVs) on the roads in California
- Doubling of **energy efficiency** (compared to 2015)



By 2035:

- **Ban sale of new gasoline vehicles**, both cars and passenger trucks



By 2040:

- Reach **carbon neutrality** and maintain net **negative emissions thereafter**
- **Run entirely on clean energy** sources for electricity

“California has long prided itself on being a leader in terms of low-carbon green growth goals. But they are inadequate. The most significant thing we can do is accelerate our goals.”

Californian Governor **Gavin Newsom**, 23 September 2020 - upon issuing an executive order to ban sales of fossil-fueled cars and passenger trucks by 2035.

in 2018 resulted in a 6 % reduction in fuel carbon intensity and created a market for LCFS credits exceeding 2 billion USD. Other programs, such as the Low Carbon Fuel Production Program and the Clean Transportation Program, further aim to accelerate the deployment of clean vehicle technologies and improve access to clean transportation by leveraging public and private investments.

RENEWABLE PORTFOLIO STANDARD

» California's ambitious targets on green electricity are supported by, e.g., the Renewable Portfolio Standard setting out renewable energy procurement targets for electricity providers. The Electric Program Investment Charge (EPIC) is another important program, investing more than 130 million USD annually in clean energy research and demonstration projects to accelerate the transformation of the electricity sector. EPIC also supports the California Energy Innovation Ecosystem, where clean energy entrepreneurs get access to networking, funding opportunities, mentoring, facilities, and expertise.

ENERGY EFFICIENCY PROGRAMS

» California is also a pioneer in energy efficiency and e.g., has legislation »»



» requiring utilities to gradually increase shares of renewable energy and improve customers' energy efficiency and extensive, green building codes. There are extensive efforts to boost energy-efficient retrofitting to decarbonize the entire building stock in the building sector, accounting for roughly 25% of the state's GHG emissions. Programs such as EPIC and financial incentives from the utilities are crucial stimuli to reduce carbon emissions and increase energy efficiency in buildings. In 2017, California spent approximately 1.5 billion USD on energy efficiency programs.

CLIMATE INVESTMENT FRAMEWORK

➤ Acknowledging the state's role as a major employer and asset manager, Governor Newsom in 2020 introduced a new Climate Investment Framework, setting out to integrate climate risk strategies of the state's three largest pension funds into a statewide approach to develop common climate risk disclosure standards. The pension funds were also directed to increase allocations to low-carbon indexes and increase investment in sustainable technologies. With 700 billion USD in assets under manage-

ment - more than double Denmark's GDP - the potential in aligning investments with climate goals is significant.

The Innovative Power of California

Policymakers in California are paving the road to carbon neutrality with ambitious climate goals, policies, incentive programs, and R&D activities. At the same time, California is home to some of the best universities in the world, innovative entrepreneurs from all over the globe, large amounts of capital, and a plethora of risk-willing investors. The unique ecosystem of Silicon Valley has spun out world-changing technologies and business models and thrives on a general belief that technology can and will change the world for the better. Leveraging all these substantial assets, California is well-positioned to advance towards the finishing line of the Paris Agreement in time— and inspire others along the way.

Building Bridges between California and Denmark

Similar to California, Denmark has ambitious climate goals (70 % reduction of emissions by 2030, compared to 1990 levels), world-class research, green

technology, and know-how. With a new comprehensive national research strategy, the Danish government has, for instance, set a long-term direction for green research, highlighting four areas of strategic concern: 1) Carbon capture storage and utilization (CCSU), 2) Green fuels for transportation and industry, 3) Climate and environment-friendly agriculture and food production, and 4) Recycling and reduction of plastic waste.

The Danish Representation in Silicon Valley promotes political, research, innovation, and commercial collaboration with California. Denmark is already exchanging expertise with California in the journey towards carbon neutrality while paving the way to export green technologies in renewable energy, water technology, and energy efficiency. Furthermore, the Representation facilitates research collaboration, technology insights, and corporate innovation and links innovative ecosystems for climate startups to test, grow and scale their technologies. The opportunities for collaborating on enhancing knowledge, developing technology, and growing green businesses are significant while contributing to achieving joint, global climate goals. ☒

BRIDGING THE VALLEY OF DEATH FOR CLIMATE STARTUPS

We need to better understand how we can support deep tech climate start-ups crossing the Valleys of Death from research to market. Which challenges do they face? And how can an ecosystem support the bridging of the gap? In this article, we take a deep dive into how the start-up Fervo Energy manages to cross the Valley of Death with support from the Silicon Valley ecosystem.



Tim Latimer
Founder, Fervo Energy

The most well-known stories from Silicon Valley are often about tech entrepreneurs launching and rapidly growing digital VC-backed start-ups to become the next unicorns. However, in recent years, prominent profiles of the climate ecosystem in Silicon Valley have emerged, turning the attention to supporting a new generation of climate deep-tech start-ups.

Unlike a digital start-up, which – as the saying goes – is possible to build with just a computer and a good internet connection, deep-tech start-ups, on the other hand, require a long-term commitment from research to implementation and large investments for hardware development which carries higher uncertainty of success and discourage most investors. This phenomenon is named ‘valleys of death’. The deep tech climate founders must translate promising new research into a working product to cross the first valley of death. Then, they must cross the second valley of death to find a way to scale their product and bring it to market.

This troubled path results in many promising start-ups never getting off the ground and eventually leads to the chicken-and-egg problem, where lack of success stories and funding discourages climate-tech researchers to take on the enormous risk of being a start-up entrepreneur.

Luckily, the network of Silicon Valley offers all the right components to support the challenging journey a hard-tech climate entrepreneur may face. With a new wave of investors, accelerators, and fellowship programs, there is more help to make them succeed.

The valley of death is anything but theoretical. Every start-up will face the challenges differently, and they will need to find their own way to navigate through. One of the start-ups from the new generation of climate deep-tech start-ups is the renewable geothermal energy company [Fervo Energy](#).

Fervo Energy managed to navigate startup challenges with help and support from various programs and stakeholders in the Silicon Valley ecosystem. »»

» Fervo Energy was founded by Tim Latimer and Jack Norbeck, who wanted to create a new type of horizontal geothermal drilling to support a 100 percent clean energy future. Tim came from a career as a drilling engineer in the oil industry and was inspired to transition his career into renewables.

“I was working as a drilling engineer poking big holes in the ground for oil companies, and I wanted to put that know-how into developing a climate-friendly energy source instead,” he explains.

Tim and Jack met during their graduate studies at Stanford. Tim was pursuing an M.B.A. and an M.S. in Environment and Resources at Stanford when he crossed paths with Jack, who was doing his Ph.D. in Energy Resources Engineering from Stanford University. Combined, they had the technical experience and business insight needed, and the question was how to make it across the valleys of death and build a successful start-up.

In the fall of 2017, while still at Stanford, Fervo Energy received a 50,000 USD grant from the Stanford TomKat program (read more about the program below) to validate the technical concept and test its commercial potential. Being a part of the TomKat family was a good stepping-stone to proving to TomKat’s phenomenal network in Silicon Valley that Fervo Energy was on to something.

While at TomKat, Fervo Energy was simultaneously developing their next big break: applying to the Fellowship Program Cyclotron Road and talking to investors at Breakthrough Energy Ventures. According to Tim, deep-tech and research and development, intensive start-ups are constantly developing their next opportunity.

“The linear model of commercializing innovation where you go from public funding to venture funding does not fit. Instead, you are constantly pursuing every lead available, using public funding to test new technology applications and private funding to get more mature technology to market,” he says.

In 2018, Fervo Energy won a spot in the highly competitive Cyclotron Road Fellowship Program. The program offers comprehensive support tailor-made for scientists to translate promising research into working prototypes and attract funding. The program provides fellows with a basic salary as well as access to laboratory

i STANFORD UNIVERSITY

TomKat Center for Sustainable Energy

The TomKat Center supports faculty, staff, and students in the process of commercializing breakthrough technologies in sustainability through a series of programs both educational and transfer to market. Such as the [Innovation Transfer Program](#), which provides grants and mentors for the development of prototypes, business plans, and market research to solutions impact.

facilities at the Lawrence Berkeley National Lab. To help fellows with the business side of their start-ups, the program also involves a curriculum for entrepreneurial scientists and introduces them to a vast network of companies, partners, and investors in the Silicon Valley ecosystem.

“The team really knows the failure modes of entrepreneurial scientists – how you as a scientist prefer to stay in the lab, not engage with customers, just publish – they know all of that! They help you break your habits and push you outside your comfort zone, which enable you to successfully build your company,” Tim explains.

At the same time in 2018, Fervo Energy announced their seed funding from Breakthrough Energy Ventures (BEV), leading a group of investors. BEV stands out among investors in Silicon Valley for its commitment to ‘patient capital.’ In contrast to other venture funds that typically need a return on their investment within a few years, BEV invests with longer time horizons (up to 20 years) to better fit the needs of R&D heavy and capital-cost intensive energy start-ups like Fervo Energy.

For Fervo Energy, patient capital is only half of the equation. Just as important is the unique understanding of how to help start-ups find a successful business model:

“Even with a longer time horizon, you still need to make a very high return on your start-up once you are market-ready. Achieving that requires a solid under- »

i CYCLOTRON ROAD

Cyclotron Road supports leading entrepreneurial scientists and engineers as they advance technology projects with the potential for global impact and bringing it to scale. The program provides them with funding, access to world-class Berkeley Lab, mentorship support, and an entrance to the network of the entrepreneurial ecosystem.



» standing of your market and how your business works, and BEV has been really helpful in pushing Fervo Energy forward,” Tim says.

Tim initially met David Danielson, the managing director at BEV, and adjunct professor, Precourt Energy Scholar, at Stanford University. Tim took the class Energy Ventures (now renamed Stanford Climate Ventures) at Stanford. This early connection proved to become invaluable, giving David a unique insight into the journey of Fervo Energy.

Fervo Energy is on a continuous journey, working towards launching its breakthrough technology. Like many other hard-tech climate entrepreneurs, they have experienced the valleys of death, but managed to navigate through the challenges with great support from the ecosystem and network. With the quick succession between Stanford TomKat, Cyclotron Road, and Breakthrough Energy Ventures all speak to the strength of the Silicon Valley ecosystem: These programs are just three of many, showing the strength and the availability of world-class universities, national laboratories, investors, and other important partners and the importance of networking in Silicon Valley.

As Tim puts it: “Silicon Valley is one of the easiest places to pursue these parallel paths of developing your tech, securing government grants for new R&D, and getting venture investment. Everything is nearby.”

Bridging the gap from university to market is crucial to reaching Denmark’s and the world’s ambitious climate goals. To do so, we need to support the deep tech climate entrepreneurs. Looking at the Bay Area, we might find inspiration for supporting ideas getting off the ground with programs. ❌

i BREAKTHROUGH ENERGY VENTURES

Breakthrough Energy Ventures is an investor-led fund focused on building new, cutting-edge companies that have the potential to significantly reduce greenhouse gas emissions. BEV focuses on supporting companies to scale which is already scientifically feasible and has a potential for at least half a gigaton of greenhouse gasses per year. Solutions with such potential can take decades to develop, and therefore, BEV takes a long-term investment approach to assessing opportunities, future needs and markets.

WORLD-CLASS UNIVERSITIES WITH BIG BUDGETS

California has the highest amount of R&D funding within the energy and climate tech sectors in the US. Top-class universities in California are working on ground-breaking research and developments in the fight against climate change.

The universities' game-changing developments provide valuable knowledge and technologies essential for Californian – and global – efforts to reach ambitious climate goals. This research stronghold makes California an important knowledge hub and exciting location for Danish researchers to collaborate on renewable energy and sustainability research.

California is home to some of the world's best universities, making it an outstanding place for research and development within renewable energy and climate tech. Some of the most renowned universities in the area, Stanford University, UC Berkeley, and Caltech, have developed revolutionary discoveries over the years. Stanford University has won 34 Nobel Prizes and is currently home to 20 living Nobel laureates, UC Berkeley has won 71 prizes and currently hosts 10 laureates, while Caltech has won 46 prizes. This high number of Nobel Prizes is evidence of the innovative character and quality of the research conducted in California. ❏

i OVERVIEW

World-class universities with big budgets:

STANFORD UNIVERSITY: Ranked #2 in the world* with an annual budget of 6.6 billion USD.

CALTECH: Ranked #4 in the world with an annual budget of 3.4 billion USD.

UC BERKELEY: Ranked #7 in the world with an annual budget of 3 billion USD.

*Times Higher Education World University Ranking

BILLIONS IN SUPPORT OF RESEARCH

California has a very high level of private and public support for Research and Development (R&D). The political leadership in California has continuously prioritized green research, with most state-sponsored energy research being focused on demonstration projects and bringing technology to market.

FEDERAL R&D BUDGET

> In December 2020, the US Congress adopted the most comprehensive bipartisan energy and climate legislation in the past decade, providing the Department of Energy with 39.62 billion USD. Parts are dedicated to the department's National Nuclear Security Agency, but major funds are also allocated to developing various clean energy technologies, including wind, solar, energy storage, energy efficiency, carbon capture utilization, and storage (CCUS) / carbon removal, and nuclear energy.

FEDERAL FUNDS ALLOCATED TO STATES

> Federal funds are also allocated to states, and the Department of Energy is estimated to spend more than 3 billion USD of R&D funding in California annually. They have designed a very effective institutional structure of national laboratories and energy innovation hubs. DOE's national laboratories cover both basic research and translating basic science to applied research. They partner with universities, research institutions, and industry to do basic science and share it with private partners to spur technological breakthroughs.

R&D BUDGET IN THE STATE OF CALIFORNIA

> The total public state R&D budget in California was 534 million USD in 2020, with 257 million USD, 46 million USD, and 41 million USD awarded to respectively energy, environmental and natural resources, and transportation. >>>



»» At the university level, Stanford University, UC Berkeley, and Caltech work with immense budgets, attracting global talent and conducting important basic research in fields such as dark matter, quantum physics, and theoretical economy, enabling new transformative discoveries.

Not all of the university research funding is public. Many universities in the US are private, with Stanford as a prime example. These universities are conglomerates in themselves and fund much of their research. Private universities are still eligible for public funding for specific projects. Stanford reports that the federal government sponsors approximately 75 % of their externally funded projects.

While the state government partly funds public universities like UC Berkeley, they also fund research activities through tuition, research funding, philanthropy, and other sources.

There is also a development towards more privately sponsored research by the industry, also within the energy sector. One example is BP funding projects at UC Berkeley and in partnership creating The Energy & Biosciences Institute. For the universities, this is a way of funding new research exciting projects while the sponsoring companies gain access to hardware and intellectual capacity, enabling them to do research that they themselves could not perform. These new partnerships and funding structures enable more research and help close the gap between science and industry, ensuring that findings make their way to the market. However, such partnerships also create some concerns about the impartiality of science. The interests of the industry are not necessarily aligned with the public interest. While the industry cannot dictate research results, they can influence which themes are being researched by their investments. ❌

LEADING RESEARCH ON RENEWABLE ENERGY AND SUSTAINABILITY

Caltech, Stanford, and UC Berkeley are home to leading research communities within renewable energy and climate tech.

Caltech (The California Institute of Technology) houses the Resnick Sustainability Institute which is a hub for energy and sustainability research. With a new donation of 750 million USD, the institute has the backing to do sustainability research in four core initiatives: sunlight to everything, climate science, water resources, ecology and biosphere engineering. Moreover, the university also hosts JCAP (Joint Center for Artificial Photosynthesis), one of DOE's Energy Innovation Hubs, and the nation's largest effort focused on artificial photosynthesis.

University of California consists of nine campuses; UC Berkeley, UC Davis, UC Irvine, UCLA, UC Merced, UC Riverside, UC San Diego, UC San Francisco, UC Santa Barbara, and UC Santa Cruz. Several campuses have their own institutes and centers focusing on energy research. As mentioned above, UC Berkeley is also host to Lawrence Berkeley National Laboratory – a national laboratory funded by DOE. The laboratory – also known as Berkeley Lab – focuses on e.g. physical sciences, energy sciences, and energy technologies.

At **Stanford University**, the Precourt Institute for Energy is one of Stanford's five cross-campus research institutes and the focal point of energy research. Research efforts span across renewables, storage and grid, policy and market, end-use, transportation, nuclear and environmental impact, and the institute unite more

than 200 researchers working across different centers and disciplines. Stanford University is furthermore launching a new interdisciplinary school focused on climate and sustainability in 2022.

Two important **DOE national laboratories** are located in California: The Lawrence Berkeley National Laboratory hosted by UC Berkeley and the SLAC National Accelerator Laboratory located at Stanford University. Moreover, one of the five innovation hubs JCAP (Joint Center for Artificial Photosynthesis), is located at Caltech. The Energy Innovation Hubs are multi-institutional research teams with partners from national laboratories, universities, and industry. They are advancing energy science from early-stage research to the point of commercialization.

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The Danish Government's green research strategy has identified Power2X as a prioritized subject, and the Precourt Institute does important work on this agenda. For instance, the SUNCAT Center for Interface Science and Catalysis explores the atomic-scale design of catalysts critical to future energy technologies. The center is a partnership between the Stanford School of Engineering and SLAC National Accelerator Laboratory. According to Professor Bo Brummerstedt Iversen, SUNCAT is a natural anchor for research on electrocatalysis.

Iversen is a Professor in Chemistry at Aarhus University, and he spent the

The SUNCAT center at Stanford University is a natural anchor for research into Power2X"

Bo Brummerstedt Iversen, Professor in Chemistry at Aarhus University

fall of 2019 at SUNCAT doing a research stay facilitated by Innovation Centre Denmark. He highlights Stanford's focus on application and informs that there have been concrete results of his research stay:

"I came home from Stanford with new ideas about how to link my basic research to application, and formed a new group on this basis", Bo Brummerstedt Iversen, Professor in Chemistry at Aarhus University.

In a scenario where technological breakthroughs and entrepreneurial spirit and vision are requisite to achieving global climate goals, the ecosystem in Silicon Valley holds the ingredients to success. Currently, there are several research projects and industry programs in Silicon Valley looking into solutions that can move forward the green transition, which could be relevant for Danish research institutions and companies looking for strategic research collaboration. At Innovation Centre Denmark Silicon Valley, we stay updated and facilitate contact with strategic partners at Stanford University and UC Berkeley, among other research institutions. ✕

CURRENT RESEARCH AGENDAS THAT COULD CHANGE THE WORLD

Universities and research are a big part of what drives innovation in Silicon Valley. Universities provide the educational background and foundation of many scientists and specialists in the tech giants' R&D departments, and university alumni often start their own businesses.

Research is also the source of many ground-breaking discoveries that entrepreneurs, investors, and companies subsequently take and mature into ready-to-market solutions that can help us solve some of today's biggest challenges. What if quantum computing could solve problems that would be impossible to solve with classic computers and help us develop improved batteries and new clean energy devices? And can artificial photosynthesis help us to provide a renewable energy source? These are all questions that are being answered right now at some of the top Californian universities.

Here you can read more about some of the current research in Silicon Valley, which could perhaps be the next game-changers of the fight against climate change.

QUANTUM COMPUTING

> Big Science to go green

What if we, alongside finding the next innovative green technologies, could also change the entire way of doing research? Quantum computing can revolutionize how we do research by solving problems that would appear impossible with classic computers. Silicon Valley is poised to become the world center for research in quantum computing. As part of the federal government's effort to speed up the development of quantum computers, the National Science Foundation (NSF) has awarded 25 million USD to UC Berkeley to establish a multi-university institute focused on advancing quantum

science and engineering, situating the new research center near the heart of the computer industry in Silicon Valley.

The potential for innovation is endless. As Eric Hudson, UCLA professor of physics and co-director of the new institute frames it: "Scientific problems that would take the age of the universe to solve on a standard computer potentially could take only a few minutes on a quantum computer." For example, quantum computers could help us better simulate the properties of molecules, thus improving our understanding of how the world works. In turn, this might enable us to develop improved batteries and new clean energy devices and even help us find cheaper and more readily available catalysts for carbon capture. If we are looking for technologies that could change the game of climate research, quantum computing is undoubtedly a clear candidate.

UNCONVENTIONAL SUPERCONDUCTIVITY

> High-temperature superconductivity

High-temperature superconductivity was discovered in 1986, and despite almost thirty years of intense research, the underlying physics of these materials is still not understood. However, scientists at the top Californian universities are trying to unlock the mysteries of superconductivity, with huge potential for the green transition. 90 % of the generated electricity is lost in a normal conductor, but superconductors are materials »»



» that let electricity flow without losing energy. Practical superconductors would make power grids and many devices, including new computers, faster and more energy-efficient. Recently, scientists at the Department of Energy's SLAC National Accelerator Laboratory and Stanford University made a new class of material (nickel oxide) that shows clear signs of superconductivity. This is the first in a potential new family of unconventional superconductors—and while the research is still at a very early stage, it could revitalize the research on superconductors and enable us to create faster and ultra-efficient electronics.

ARTIFICIAL PHOTOSYNTHESIS

» Copying Nature's green talent

In the current quest for alternatives to fossil fuels, scientists suggest that we can harness the power of the sun in the same way that plants do: photosynthesis. Researchers attempt to copy the same process with simpler nanostructures, which has only recently been possible due to breakthroughs in nanotechnology in imaging and manipulation. At the Stanford SUNCAT Center, researchers currently investigate how to use this process to provide a renewable

energy source. Furthermore, artificial photosynthesis on a large industrial scale has the potential to reverse global warming since the process consumes carbon dioxide and releases oxygen.

NEW GENERATIONS OF BATTERIES

» Improving existing innovations

Sometimes, trailblazing innovation can come from improving existing items that we use daily and have a massive impact. Battery research falls into this category, as it could improve one of our existing energy storage technologies. Berkeley Lab has deep expertise in materials research, materials design, and energy storage technologies. They are currently working on better battery alternatives from cobalt-and nickel-free batteries to smaller, more powerful multi-valent batteries. At Stanford University, scientists have just discovered an entirely new approach to making lithium-ion batteries lighter, safer, and more efficient by reengineering one of the heaviest battery components, so they weigh 80% less and immediately quench any fires that flare up. This new type of battery can extend the driving range of electric vehicles and reduce the danger that laptops, cell phones, and other devices will burst into flames. ❌



HOW UNIVERSITIES ARE SPINNING OUT CLIMATE SOLUTIONS

Universities in California are among the best in the world at transferring knowledge and technologies from universities to start-ups and corporations. An entrepreneurial culture, close collaboration with industry, and a host of supportive structures are vital elements in paving the way from idea to impact at scale. And climate solutions are on the agenda.

Universities play a key role in the green transition. Their research constitutes an important knowledge base for understanding the environmental challenges we face — and the potential solutions. Nonetheless, there are acknowledged gaps in the journey from university research to its commercialization, metaphorically known as valleys of death (as mentioned, this refers to the fact that many promising discoveries never get out of the lab and into the market, and consequently a lot of potential goes unfulfilled).

In California, universities have successfully worked on bridging these gaps. They have created an efficient infrastructure and collaboration with their surrounding ecosystem, which results in

“The purpose of the university is to generate knowledge and applications to better the human condition.”

Marc Tessier-Lavigne

President of Stanford University, speaking at the conference Accelerating Climate Solutions for a World that works.

an impressive track record of spinning out companies. Among the ingredients in the system are the nurturing of an entrepreneurial mindset and access to a comprehensive ecosystem that supports students and researchers who wish to transform their ideas into something that has an impact at scale. ☒



FOSTERING GREEN ENTREPRENEURSHIP IN EDUCATION

Californian universities recognize their important role in installing an entrepreneurial mindset in their students. As a result, they offer programs in close collaboration with the industry in Silicon Valley.

The focus on entrepreneurship and university-industry collaboration is a feature of the ecosystem in Silicon Valley, and it is also present when it comes to climate solutions. Below are some examples of how Stanford University, UC Berkeley, and UC Davis take a collaborative approach to climate challenges:

Stanford Climate Ventures is a program where multi-disciplinary teams learn how to bring their promising new ideas in energy and climate technology to market – e.g. the founders of Fervo Energy, featured in this publication, met through this program. Through cross-disciplinary courses in close collaboration with industries, investors, and accelerators, the program has delivered an impressive number of spin-out companies.

At **UC Berkeley's Sutardja Center for Entrepreneurship**, they work with an approach called 'Future of X' or 'X-Labs', where the 'X' refers to new technolo-

gies and emerging industries that can change the world. The center, for example, hosts the **Alt: Meat Lab**, which is a hub connecting students, entrepreneurs, venture capitalists, and industry leaders interested in creating the plant-based food of the future.

The **Innovation Institute for Food and Health** at UC Davis addresses global food and health challenges by connecting faculty and student researchers with investors and industry experts. For example, a recent call asked for cutting-edge projects to improve energy efficiency across the food system. ❌

i DID YOU KNOW THAT...

These entrepreneurship programs have proven to spike interest in entrepreneurship among the participants. A comprehensive Stanford Innovation Survey from 2011 shows that 60 % of start-up founders who received venture investment within three years of graduating had participated in an entrepreneurship course at Stanford.

SUSTAINABLE STARTUPS CONNECTED TO THE UNIVERSITIES IN BAY AREA



TESLA



IMPOSSIBLE FOODS



QUANTUMSCAPE



RIPPLE FOODS



REAL GOODS SOLAR



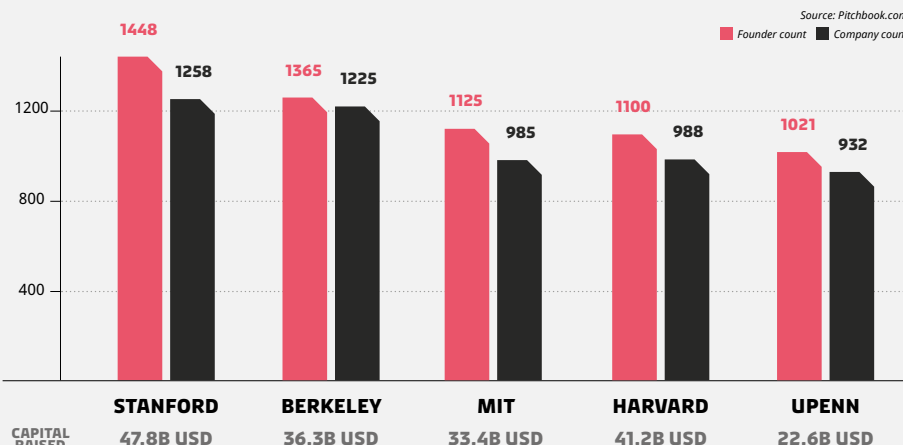
TRANSFERRING RESEARCH TO THE MARKET

Education in climate entrepreneurship is a great way to create a mutual understanding and build the next generation of climate entrepreneurs.

The latest World’s Most Innovative University ranking by Reuters (2019) named Stanford the most innovative university in the world– and UC San Francisco, UC Davis, and UC Berkeley all rank among the top 30 universities in the United States for R&D expenditures. However, for innovation to be successful, it needs to be implemented. The universities in California have various programs that support green startups to ensure that new ideas and projects take off.

Tech-transfer offices deliver expertise on matters like intellectual property rights and conduct marketing of technologies to relevant companies. For instance, Stanford’s Office of Technology Licensing has also developed a framework to allow researchers to work as consultants in startups. Acknowledging that many professors with innovative technologies may not be interested in leaving the university to find a company, they can instead consult, while others bring the technology to market. ❏

UNDERGRADUATE PROGRAMS PRODUCING THE MOST ENTREPRENEURS



⤴ Based on companies that received a first round of venture funding between January 1, 2006, and August 31, 2020.

INNOVATION TURNING INTO COMPANIES

According to PitchBook’s 2020 university rankings, Stanford University was number one in the world with 1,258 start-up companies and 47.8 billion USD in capital raised. UC Berkeley is the runner-up with 1,225 start-up companies and 36.3 billion USD raised.

Among the spin-outs are notable green companies such as Tesla and Impossible Foods founded by Stanford alumni. These companies are often established while the founders are students, and consequently, the companies are often headquartered in the same area – reinforcing the well-educated workforce and innovation ecosystem in the Bay Area.

Since climate tech start-ups have different needs than other startups, the universities have developed specialized programs. Climate tech solutions often rely on deep-tech, which may take longer to develop and require larger investments. Moreover, they often require large-scale implementation or even a

system transformation, making such solutions challenging to test and implement. The specialized programs address these challenges by providing students access to grants, labs, mentorship, and crucial networks of start-ups, investors, and industry.

For instance, the TomKat Center’s Innovation Transfer Program supports Stanford University faculty, staff, and students in commercializing breakthrough technologies and innovations in sustainability. The program offers grants, mentors, guidance, and a strong entrepreneurial network and helps to determine when new technologies are ready for external investment.

Another example with federal funding is Cyclotron Road. Lawrence Berkeley National Laboratory created this fellowship program in conjunction with the US Department of Energy, and the program is now run by the non-profit organization *Activate*. The program addresses the gap between federal grants dollars for research and traditional early-stage ❧❧❧

» investment by allowing early-stage hardware innovators the time and resources to de-risk their technologies while determining a pathway to market to attract more traditional forms of capital. Once accepted, fellows are granted access to Lawrence Berkeley National Lab and UC Berkeley facilities for two years while receiving a generous stipend, extensive mentorship, entrepreneurial training, and networking opportunities.

i LEARN MORE

Learn more about Cyclotron Road and read about Chris Graves' move from Denmark to California through the Cyclotron Road fellowship program in the interview on page 22-23.

Finally, the universities also have programs in place that support the commercialization of emerging technologies. For instance, the Berkeley Hass School of Business hosts the program Cleantech to Market (C2M), which matches startups that are already part of programs such as TomKat or Cyclotron Road with graduate students that can help them accelerate the commercialization of their leading cleantech solutions. ✕

i R&D – A CORNERSTONE IN THE FIGHT AGAINST CLIMATE CHANGE



The Danish Government has launched a new strategy, 'The Green Solutions of the Future' (DK: 'Den Grønne Forskningsstrategi'), boosting investments in green research, technology, and innovation. A key part of the strategy focuses on building strong collaboration with industry and supporting climate research from university to market. The R&D and tech transfer capacity of Silicon Valley has had a significant impact on the digitalization of our economies. Harnessing the successful model of entrepreneurial education, ecosystem collaboration, and tech transfer agencies in the fight against climate change could prove transformational. At Innovation Centre Denmark Silicon Valley, we create gateways to learning, networks, and partnerships with Californian universities to bridge the green valleys of death.

CYCLOTRON ROAD: HOW TO GET NEW ENERGY TECHNOLOGY FROM THE LABORATORY INTO THE MARKET

Entrepreneurial scientists can get stuck in the early phase of maturing their technology (a 'valley of death'). Chris Graves experienced it in Denmark in 2018 and decided to apply for the Cyclotron Road fellowship program in the San Francisco Bay Area to get the necessary support. Learn how Cyclotron Road creates a pathway for technology to go from the lab into the market.

In a laboratory inside the Technical University of Denmark, far away from the Bay Area, Chris Graves worked on groundbreaking technology. He was coming up with a new way to create ultra-low-cost flow batteries that enable long-duration energy storage. And surely, he did.

Chris Graves developed a new type of flow battery in Denmark a few years ago as an associate professor and senior scientist at DTU, and this was to become the building blocks of Noon Energy. If the research project was successful, the batteries would create continual, stable access to energy from renewable sources like solar and wind – even when the wind does not blow, and the sun does not shine. The question and next challenge were how to mature the new technology and get it into the market, to be of use for the energy industry. At the time, Chris could not get his new startup off the ground in Denmark because of restrictions around founding companies with a researcher visa.

Therefore, Chris decided to move back to California: "After almost 10 years living and working in Denmark,

"From the outset, funding seemed a really important part of the fellowship. What surprised me were the other resources: how they teach scientists the ropes of business, the enormous network in Silicon Valley I was introduced to, and the invaluable community of other founders in the program."

Chris Graves, Founder and CEO of Noon Energy and a fellow with Cyclotron Road

in 2018 we decided to move our family to California to build the startup with the help of Cyclotron Road and the unique ecosystem in Silicon Valley. Noon would have been started in Denmark if I had been able to access some of the same resources – and if it were legal at the time." Chris explains. Furthermore, the support to commercialize the technology was not readily available in Denmark. ✕

THE VALLEY OF DEATH

Cyclotron Road is a program of Lawrence Berkeley National Laboratory (LBNL) in partnership with Activate, an independent nonprofit. It was designed for entrepreneurial scientists like Chris, who was accepted into the 2018 cohort of Cyclotron Road fellows.

Unlike the many accelerators and entrepreneurship programs in Silicon Valley, Cyclotron Road does not take any equity stakes in participants' startups, and it is aimed especially at researchers who need help getting their research across the first valley of death, the early phase of maturing the technology, developing a proof-of-concept and making an initial prototype. For deep tech coming out of laboratories, this requires considerable investment and time. However, without that prototype, the required funding is difficult to secure, creating a chicken-and-egg problem. As the term 'valley of death' implies, many promising technologies do not make it to the other side, where they might have achieved broad societal impact.

The two-year Cyclotron Road fellowship offers entrepreneurs a pathway to translate promising research results to initial product through comprehensive support including a living stipend, access to state-of-the-art laboratory facilities at LBNL, networking opportunities, and business resources.

The program also helps scientists learn the business side of a technology startup

"Denmark is already one of the most progressive countries in the world for energy, with high consumer support for transitioning away from carbon. The opportunity for Denmark to build an even more impactful ecosystem for clean energy is huge."

Chris Graves, Founder and CEO of Noon Energy and a fellow with Cyclotron Road

with an entrepreneurship curriculum and mentorship from Cyclotron Road's team of full-time advisors. Fellows are also introduced early on to the sizable venture capital community and corporates present in Silicon Valley to build relationships that might lead to support down the road in the form of funding, advisors, and future customers. "From the outset, funding seemed a really important part of the fellowship. What surprised me were the other resources: how they teach scientists the ropes of business, the enormous

network in Silicon Valley I was introduced to, and the invaluable community of other founders in the program," says Chris.

The network and the proximity to Silicon Valley is an important reason why Cyclotron Road successfully supports startups.

Since being founded nearly five years ago, nearly 18M USD has been invested in 56 fellows, who have generated 150 million USD in funding to support their ventures. The success of Cyclotron Road prompted Activate to launch a similar program in Boston, in collaboration with MIT Lincoln Laboratory. Recently, a new program in New York with NYSERDA (The New York State Energy Research and Development Authority) was also announced. These are the first programs of what Activate hope will be several new programs in the US and around the world. ✕



Chris Graves
Founder and CEO of Noon Energy and a fellow with Cyclotron Road

A DANISH MODEL FOR SUCCESS?

The challenging path for reaching the Danish goals of 70 % carbon emissions reduction in 2030, and ultimately achieving a carbon-neutral society in 2050, emphasizes the need for developing and scaling commercially viable new technologies.

But as analyses show, although we have a robust public funding system for innovation, there are few funds for early-stage research, and especially venture capital can be hard to come by for deeptech startups. At the same time, the potential is there: Denmark has made important progress on decarbonizing its economy, is home to leading research and competencies in climate tech.

This summer, Chris Graves will graduate from Cyclotron Road, equipped with the tools to grow Noon Energy and get his new battery to market within a couple of years. As his story shows, supporting startups with the right resources and plugging them into an ecosystem of peers, labs, business expertise, and capital can bring cleantech across the challenging valleys of death and further down the path to success. For Denmark, collaboration with international ecosystems, leveraging comparative advantages could be a way to increase the likelihood that tomorrow's energy solutions to global climate challenges have a Danish footprint.

Innovation Centre Denmark Silicon Valley is working to build bridges into the ecosystem in the Bay Area, creating access to inspiration, best practices, and

partnerships that can assist in maturing the Danish cleantech ecosystem. ✕

i QUICK FACTS

ABOUT THE CYCLOTRON ROAD FELLOWSHIP PROGRAM

- **Two years of funding:** Fellows receive a living stipend on par with a typical salary.
- **World-class research labs:** Startups have access to the lab facilities at LBNL and UC Berkeley as well as an additional 100,000 USD for project expenses to be spent at the lab.
- **Rigorous mentorship:** Fellows get one-on-one mentorship and guidance from the experienced team of Cyclotron Road staff.
- **Startup curriculum:** To become entrepreneurs, fellows receive tailor-made weekly sessions on business and product development to develop skills.
- **An unrivaled network:** Cyclotron Road has a broad network of industry executives, investors, entrepreneurs, philanthropists who can serve as advisors and partners.

Cyclotron Road is located in the California Bay Area and run by the non-profit organization Activate in partnership with the Lawrence Berkeley National Laboratory.



ACCELERATING CLIMATE TECH

Accelerators are a key component of the innovative Silicon Valley ecosystem, known for its ability to spin out ground-breaking technologies, transformative business models, and unicorns. Decarbonizing the global economy requires new green solutions to scale – fast. So are Silicon Valley accelerators taking on the climate challenge? And how is this relevant for Danish climate tech entrepreneurs?

Silicon Valley is known for its thriving ecosystem of research institutions, corporates, start-ups, investors, and accelerators. This ecosystem has created the most unicorns in the world and some of the world's most valuable and innovative companies. A key component of this ecosystem is the accelerators, helping start-ups develop their initial products and business model, identify customer segments, secure resources, and offer networking oppor-

“Accelerators are the spiders in the web of start-up ecosystems”.

Ryan Kushner, New Energy Nexus, Accelerate This!

tunities. Renowned US accelerators like Y Combinator and Techstars have assisted in the successes of tech companies such as Airbnb, Dropbox, and Stripe. ✕

CLIMATE TECH ACCELERATING IN CALIFORNIA

With increasing climate awareness and demand, several specialized climate tech accelerators have emerged for startups working to decarbonize global economies. Their mission is to nurture and connect green start-ups to business mentors, market intelligence, and venture capital.

Importantly for climate tech start-ups, they also connect companies with corporate off-takers aiming to scale the businesses' solutions as fast as possible. CEO of New Energy Nexus, Danny Kennedy explains the growing climate tech focus;

"The giant economic opportunity of climate tech is becoming understood in the Golden State. California – as the world's leading innovation economy – wants to own that future. Already, electric vehicles are our largest export by value - larger than Apple, larger than agriculture, larger than wine, dope, Google or Facebook". He continues;

"Accelerators are where the risk is now taken, as VCs have moved away from the early stage and want their bets to be de-risked. Without accelerators, government grant programs like the one we administer – the CalSEED.fund – there would be no deal flow sufficient to the scale and speed of this market. Disruption is upon us, and the Californian community – from the Governor, the legislators, to the regulators and local cities – want it and their communities to ride the wave. The engine of invention and ingenuity has only just begun to take on this opportunity." ✕



THE WORLD'S LARGEST PLATFORM FOR CLEAN ENERGY ENTREPRENEURSHIP

*As a global green frontrunner, the state of California has long been supporting climate tech entrepreneurship. A key example is the accelerator **New Energy Nexus**, established in 2004 under the name California Clean Energy Fund (CalCEF).*

The fund pioneered a new model of investing indirectly in companies through partnerships with VC firms, with Tesla among the indirect start-up investments. Over the years, New Energy Nexus has grown in scope; CEO Danny Kennedy explains;

“We’re basically the world’s largest platform for clean energy entrepreneurship and financial innovation. We build ecosystems of support for startups to advance the energy transition. So, unlike many accelerators that are putting the power of entrepreneurs into the market, we are supporting the mavens that make the accelerators happen as well. Think of New Energy Nexus as Vestas - not necessarily building all the wind farms in the world but supplying all the wind farmers with the tools and know-how to harvest that potential. We have nearly 80 staff in 10 countries supporting hundreds of startups directly and will soon

“We are intent on saving the world by spreading clean energy companies everywhere”

Danny Kennedy
CEO of New Energy Nexus

have tens of thousands of clean energy entrepreneurs in our orbit. Just last year, we backed 200 companies, dilligenced 2000, and welcomed 2700 into our slack community, NEX Network.”

New Energy Nexus works closely with other accelerators and partners globally. Among the newest joint venture initiatives is **Third Derivative**, a global, virtual accelerator focusing on climate tech, addressing commercialization challenges, getting to scale, and achieving funding that is especially difficult for deep-tech startups. »

» Third Derivative is established in a partnership with the private research organization Rocky Mountain Institute, providing access to more than 250 experts to guide the entrepreneurs. In 2020, Third Derivative launched with its first cohort of almost 50 climate tech startups – named ‘Cohort 417’ after this year’s peak atmospheric carbon dioxide concentration of 417.1 ppm (recorded in May 2020) – working across verticals of electricity, industry, transportation, agtech & land use and more. The competitive program and the inherent vetting process de-risk investments from strategic investors, such as Microsoft and BP. The program can also foster partnerships with corporates for startups to validate their climate tech solutions. ❌

i UTILITIES ARE INVOLVED IN SCALING CLIMATE TECH

The Incubatenergy Network was established by the non-profit independent research institution EPRI, the U.S. Department of Energy, and the National Renewable Energy Laboratory (NREL). EPRI hosts the annual program [Incubatenergy Labs](#) that connects start-ups with utilities for paid demonstration projects in targeted areas. Successful applicants will spend four weeks scoping projects, 12 weeks executing them, and finally showcasing the results at a Demo Day event with participation by some of the largest utilities in the US.

Other key green accelerators in California are the Cleantech Open and the [Los Angeles Cleantech Incubator \(LACI\)](#), founded by the City of LA and its Department of Water & Power and [Cleantech Open](#). Cleantech Open is the world’s largest cleantech accelerator and has trained more than 1,800 early-stage start-ups that have raised more than 2 billion USD since 2005. The focus areas of LACI are zero-emission transportation, clean energy, and smart cities, including water solutions, as transportation and water are large challenges of the Los Angeles area. LACI runs programs for companies across all stages of duration from 10 weeks to 2 years.

The LACI program is physically co-located with the Los Angeles Department of Water & Power at their large La Kretz Innovation Campus, which also houses the Advanced Prototyping Center (APC), enabling entrepreneurs to design, build, test, and validate new product solutions fast.

Specific accelerator programs have also emerged, focusing on sustainable water challenges, e.g. [Imagine H2O](#) in San Francisco and [Valley Ventures](#), a program within the WET Center (the Water, Energy, and Technology Center) at the university Fresno State in California’s Central Valley region.

CLIMATE TECH ACCELERATORS AND INVESTORS

Private accelerators have also realized the demand and business potential in scaling up climate solutions and are seeking to address the particular needs of cleantech startups. Among the for-profit privately funded accelerators with a green innovation platform is e.g. Plug and Play.

Plug and Play has an in-house venture fund investing in around 150 early-stage startups every year. In less than 10 years, Plug and Play has grown to 500+ staff members, 55 accelerator programs, and 500+ corporate partners spread across 35 locations globally. The first cohort of the Energy program started in 2017 in Silicon Valley, focusing on energy transition solutions for a decarbonized and digitized energy sector.

Asked about the main challenges for cleantech startups, Wade Bitaraf, the Founder of Energy & Sustainability program, points to the lengthy process of acquiring corporate customers for prod-

“There has never been a better time to be an entrepreneur in this space”

Wade Bitaraf

Founder of Energy & Sustainability at Plug and Play

uct validation or go-to-market strategic partnerships.

“Through our programs at Plug and Play, we provide a free and non-equity requirement opportunity for the startups to land some of the largest corporations as their clients, far more expedient for all parties involved,” he adds, before continuing. »»



»» “We were able to generate nearly 20 confirmed corporate-startup pilot projects only through our partnership with the Alliance to End Plastic Waste in 2020. We’re incredibly excited to join our corporate partners in their refreshed sustainability efforts to accelerate the adoption of new technologies and build a world together that is more just, liveable, and sustainable.”

Plug and Play is not alone in the green accelerator space. Another key stakeholder in the SF Bay Area green ecosystem is the Oakland-based accelerator Powerhouse. The related Powerhouse Ventures invests in seed-stage start-ups working on digital technology and software in

the clean energy space. Powerhouse hosts several events that connect the ecosystem - from the annual hackathon SunCode to hosting summer parties for the climate tech community and hosting the podcast Watt it Takes.

Elemental Excelerator is an example of a private, non-profit accelerator in the San Francisco area (born out of Hawaii). Elemental Excelerator focuses primarily on energy, water, agriculture, and transportation. The annual cohort uptake of the start-up program is between 15-20 companies, each company receiving up to 1 million USD. Elemental Excelerator has awarded more than 41 million USD to about 110 portfolio companies in only seven years. ❌



SCALING TOGETHER – OPPORTUNITIES FOR DANISH GREEN ENTREPRENEURS

The climate tech accelerators in California can prove valuable for Danish startups looking for opportunities to scale, expand globally and get access to capital. Corporate strategic investors looking for new climate tech solutions may also find what they are looking for.

The thriving Danish climate tech ecosystem will find abundant opportunities for knowledge sharing and collaboration by plugging into networks with Californian counterparts. Danny Kennedy agrees that the potential for collaboration between Denmark and California is great;

“Where to start? Offshore wind is going to be huge in California. It is a great complement to solar, and we have strong

resources. But we need an industry! All the grid edge realities and software needs that we both are dealing with due to increasing variable, renewable input are a space for rich collaboration.” Furthermore, he adds:

“Another area is finance innovation broadly and digital fintech more specifically. We can have a common focus on the enabling tech platforms for modern financing of distributed renewables the

world over. All of this and much more will be necessary to meet our climate commitments, which will only ratchet up in time to come. We are interested in collaborating with private and public sector partners, who want to create the muscle in our communities that helps us stay on the cutting edge and keep moving the energy transition faster to 100 % clean energy for 100 % of the population as soon as possible!” ✕



NORTH AMERICA

NEW ENERGY NEXUS

AUSTRALIA

AFRICA

EUROPE

ASIA

WILL VENTURE CAPITAL FINANCE A GREENER FUTURE?

The investor landscape in Silicon Valley is adapting to the increased demand for climate action, and an ecosystem is emerging, attuned to the needs of climate entrepreneurs. This creates great opportunities for climate tech start-ups in Silicon Valley — an innovation hub with an impressive track record of delivering transformational technologies globally.

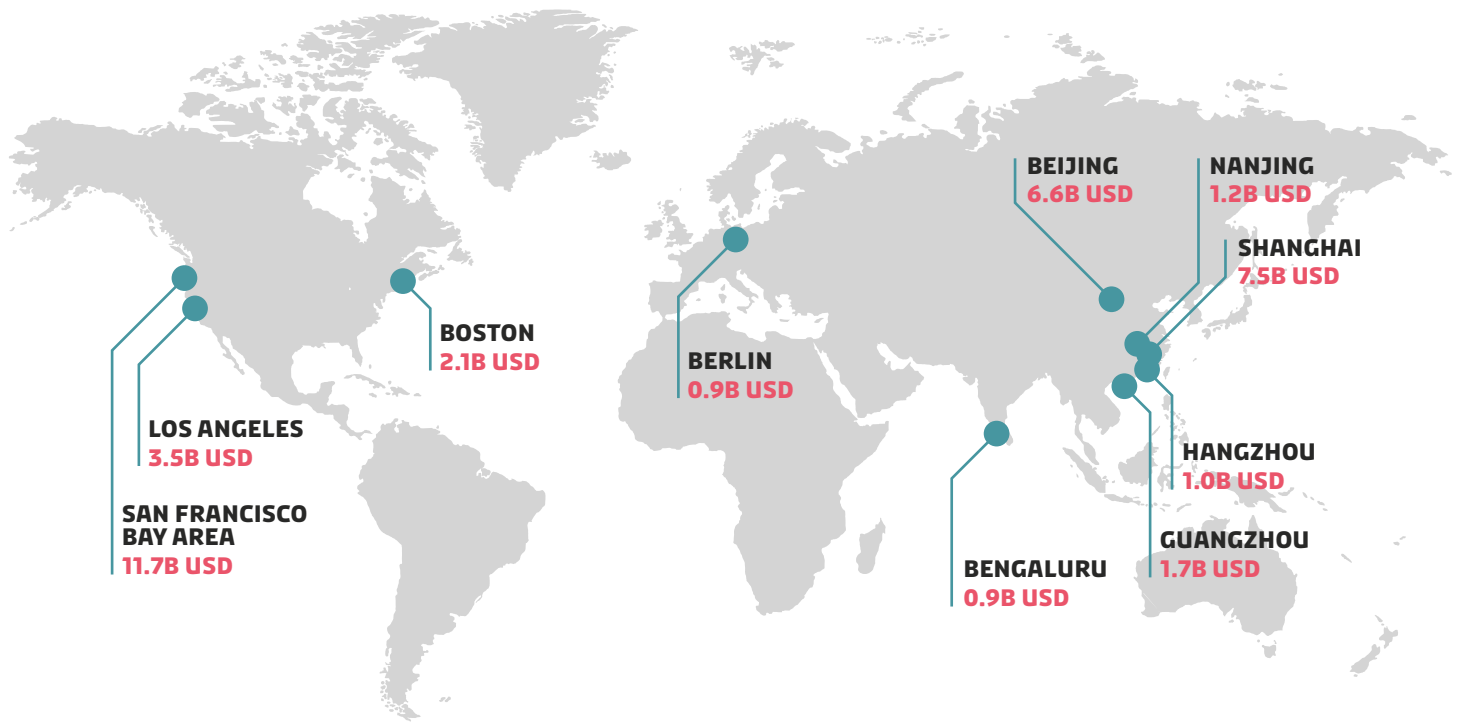
Silicon Valley is almost synonymous with world-changing technologies and big tech companies with global impact on industries and societies. At the heart of Silicon Valley is the venture capital industry, which invests around 50 billion USD annually in innovative start-ups — about 80 times more than Denmark.

The venture capital model that is often associated with Silicon Valley rests on a large appetite for risk. Investments typically have a 10-year horizon, and VC firms are prepared to let a majority of their investments fail, banking on one to three out of ten investments being successful enough to cover the losses. Venture capitalists often bet large to support ‘hyper growth’ or ‘blitzscaling’ to create companies valued above 1 billion USD—the so-called ‘unicorns.’ The model has proven successful in software, internet, and communication sectors, where scale can be achieved with less upfront capital investment.

So how is Silicon Valley relevant when it comes to addressing climate challenges? Silicon Valley has changed the way we consume, work, and interact. Can its innovative capacity also be harnessed to transform our societies into a carbon-neutral future? ❌

“For perspective, this research shows that in 2013 the early-stage venture funding for climate tech companies was about 418 million USD. In 2019, total venture funding increased to 16.1 billion USD, a more than 3750 % increase.”

Source: PwC: The State of Climate Tech 2020. The next frontier for venture capital



📍 The World's largest Climate Tech Hubs: VC funding raised by climate tech startups headquartered in the following cities from 2013-2019
Source: PwC, Dealroom

THE BOOM AND BUST OF CLEANTECH IN SILICON VALLEY

The collapse of the cleantech sector in Silicon Valley some 10 years ago is key to understanding VC engagement with climate start-ups. In 2007, John Doerr from Kleiner Perkins, one of the most renowned VC firms in Silicon Valley, pronounced cleantech to be the business opportunity of the century, saying that “Going green is bigger than the internet.”

From 2006 to 2011, VC firms invested more than 25 billion USD in cleantech start-ups. However, many of these investments failed. Nearly 150 renewable energy companies in Silicon Valley shut down, and VCs are estimated to have lost more than half of their money, causing what has been coined the ‘burst of the cleantech bubble.’ With their fingers burnt, many VCs lost interest in cleantech.

Observers have pointed out that traditional VC investments are not well-suited

to cleantech. Cleantech start-ups often need longer time horizons to develop their solutions and significantly more capital to scale. They also operate in a market dominated by risk-averse legacy companies, on whom they often depend on bringing their solutions to market. VCs in Silicon Valley also point to the fact that while investors have considerable expertise in growing software and biotech companies, cleantech requires a skill-set and technical know-how that was not widely available at the time. ❌

A SECOND GREEN WAVE – ENTER CLIMATE TECH?

But times are changing – again. The sense of urgency of the climate crisis has also been registered in Silicon Valley, where “climate tech” has entered the investment vocabulary. While ‘cleantech’ is still in use, the climate tech moniker covers technologies specifically aiming to reduce greenhouse gas emissions or address global warming impacts.

Nancy Pfund, founder of [DBL Partners](#), when recently asked in a Greenbiz webinar of the differences between the first cleantech wave and now, pointed out that:

“Today, there is such a high level of focus, commitment, and knowledge on the part of both the entrepreneurs and the investors. The economics of clean technologies are extraordinarily compelling today. There has been a stunning cost reduction over the past decade, which brings in mainstream investors and asset owners who are making dollar and cent decisions without wearing a climate banner. Also, the re-entrance of corporate investors is for real this time.”

Many of the larger VCs are still choosing to focus on what they know best, digital technologies. However, signals are pointing towards both well-established generalist venture capital firms and

newer specialist funds zooming in on the business opportunities in climate change. Some of the large companies populating the Midas list of the world’s best venture capital investors have made statements in this regard:

- Sequoia Capital has recently called out for startups in the green space.
- Kleiner Perkins has spun out a separate Green Growth Fund, G2VP, focusing on digital technology companies that modernize traditional industries. They specifically focus on agriculture, energy, logistics, manufacturing, and transportation sectors.
- Khosla Ventures has continued in the climate tech space, focusing on food, efficiency, power, and energy storage. You can read more about Khosla Ventures [here](#). ❌

i KHOSLA VENTURES

khosla ventures

[Khosla Ventures](#) was established in 2004 by the founder of Sun Microsystems, Vinod Khosla. The company is one of the re-

nowned Sand Hill Road VCs that have traditionally made up the backbone of Silicon Valley. It has made more than 900 investments, many of them in clean technologies.

Vinod Khosla is considered a role model for investing in climate solutions. He espouses the idea of transformative change being led by “instigators” that cause others to follow their lead. Whether these early driven entrepreneurs are successful or fail, they will affect change by changing conventional wisdom and making the seemingly impossible possible in areas critical to climate and sustainability. Khosla Ventures invests in both early- and late-stage startups and is willing to take risks. Their investments are diverse and include battery technology, materials, and fusion energy.

VC FUNDS LOOKING FOR IMPACT

Seeking to debunk the myth that there is a trade-off between impact and returns, venture capital funds like [DBL Partners](#) specialize in investments with big impact. They have been investing in clean technologies for decades with rates of return that outperform traditional investments. Others like [Obvious Ventures](#) and [Congruent Ventures](#) do not define themselves as impact investors but invest in early-stage startups that aim to positively impact energy and resource consumption. You can read more about Obvious Ventures here. ✕

i OBVIOUS VENTURES



San Francisco-based Obvious Ventures was co-founded by ex-Twitter CEO Evan Williams. The firm believes it can outperform traditional venture funds by focusing on “world positive” companies that create new solutions to big world problems in a profitable and scalable way. In an interview with VentureBeat, Williams frames the business philosophy like this; “We’re not doing philanthropy. We’re not doing social impact investing. We’re doing an early-stage venture. Our thesis is that the best

returns are going to come from these world positive companies.”

Obvious Ventures is a certified B Corp; a for-profit company verified for its positive impact on all stakeholders, including people and planet. Combining purpose and profit, Obvious Ventures focuses on early-stage start-ups in energy, mobility, and food and closed its first fund of 123,456,789 USD in 2015. Obvious Ventures is one of the largest shareholders in [Beyond Meat](#), a plant-based meat substitute that had its IPO in 2019.

A NEW TYPE OF PATIENT INVESTORS

Taking up the distinct challenges surrounding the financing of climate tech start-ups, especially with hardware/deep tech solutions, a more patient type of venture capital investor has emerged. [Breakthrough Energy Ventures](#) works with a 20-year timeline, focusing on funding solutions to the world’s large decarbonization challenges and measuring the impact in gigatons of greenhouse gas emissions mitigated. De-risking of climate tech is also provided by philanthropic funds, which can provide much-needed catalytic capital. While donations to mitigate climate change still only account for 2% of total philanthropic giving in the US, donations almost doubled over the last five years to 5-9 billion USD, according to the

i PRIME COALITION



Making Philanthropic Investments in Green Start-ups Less Risky

PRIME Coalition mobilizes philanthropic funding and acts as a non-profit investment syndicate to de-risk early-stage companies addressing climate change. PRIME’s novel approach lies in leveraging charitable funds from private foundations, which must donate 5% of assets annually following the US tax code. It uses vehicles such as program-related investments (PRIs), which have not traditionally been used for science and engineering innovation. The fund’s focus is to grant needed catalytic capi-

tal – patient and risk-tolerant - to technologies with the potential to mitigate gigaton-scale CO₂-equivalent emissions. The early capital enables start-ups to build their technical proofs of concept, which help de-risk their business by validating key proof-points necessary for later commercial investment rounds.

Since 2015, PRIME Coalition has mobilized 48.8 million USD and supported eleven companies, ranging from grid-scale energy storage to electric airplanes. In June 2020, the Prime Impact Fund closed 50 million USD for a new seed fund to invest in breakthrough climate tech. Celebrities Will Smith and Jada Pinkett Smith are some of the backers of Prime.

ClimateWorks Foundation. Prime Coalition represents an interesting new trend in philanthropy using incentives inherent

in the US tax code to leverage funding from endowments and rich people for innovative ventures. ✕



CORPORATE VENTURE CAPITAL IS TAKING OFF

For climate tech startups, especially hardware startups that struggle to overcome technical, commercial, and regulatory challenges while competing in a market dominated by large incumbents, corporate venture capital adds much-needed financing opportunities. It also provides possibilities for market validation and access to knowledge, customers, and distribution channels.

Corporate venture capital (CVC) has played a role in the investor landscape for many years. But for the first time, in 2018, CVC investment in the US overtook venture capital funds with 71 billion USD invested, according to CB Insights. This is equal to 52 percent of all VC investments.

Among the most active CVCs are tech giants such as GV (Google Ventures) and Salesforce, but CVCs with a primary focus on identifying and scaling the climate tech solutions that will transform their industries are on the rise. The incumbents have joined the game.

In 2018 and 2019, the top 5 oil and gas CVCs participated in deals worth more than 1 billion USD. Shell Technology Ventures is the most active, followed by Saudi Aramco, Total, BP, and Chevron.

i GREEN FUNDING FROM THE OIL AND GAS COMPANIES



New alliances and partnering models are also entering the VC market. The Oil and Gas Climate Initiative (OGCI) is an example of oil and gas companies gathering in a consortium to accelerate industry response to climate change. The initiative has a 1 billion USD fund investing in decarbonizing oil and gas, industrials, and commercial

transport. An example of recent investment is in the Mountain View-based company Kairos Aerospace that utilizes airborne and spaceborne sensors to detect methane leaks. Furthermore, OGCI is among the active investors in carbon removal projects, having funded projects both in the US and globally. Energy Impact Ventures, built around an alliance of utilities, represents an interesting corporate venture model.

i BRINGING VC, UTILITIES, AND START-UPS TOGETHER



Energy Impact Partners (EIP) is a collaborative strategic investment firm working with 14 utilities to back cutting-edge energy technology companies at the growth stage. The fund raised 681 million USD in its first fund and is aiming for 750 mio. USD for its second fund. EIP invests globally and has three offices in the US (incl. San Francisco) and three in Europe.

EIP is also establishing itself in Norway by partnering with Nysnø, a sovereign climate investment company administered by the Norwegian Ministry of Trade, Industry, and

Fisheries. EIP approaches strategic venture investing by bringing incumbents, investors, and entrepreneurs together. Utility partners benefit from insights on emerging technologies and business models to help them prepare for the future. Portfolio companies benefit from unique access to a broad group of global customers that accelerate their growth, making them more successful. This reduces risk in the investments and maximizes return for investors. EIP's portfolio includes microgrid, EV charging infrastructure, grid storage technologies, automation and analytics platforms.

Driving their investments is the potential of discovering new low-carbon fuels, renewable energy sources, and other envi-

ronmentally friendly technologies, which match their current business or present opportunities for diversification. ❌

AN ECOSYSTEM THAT IS MATURING

Scaling and deploying the solutions needed to mitigate climate change requires diverse actors and funding models. A cornerstone of Silicon Valley's ecosystem is this plethora of experienced VC funds with a proven track record in scaling startups. Even if the 'traditional' Silicon Valley is still predominantly about IT and digital solutions, parts of the VC community are jumping on board the climate bandwagon. This development is likely to experience only more tailwinds with the younger generation of investors entering VC. There are signals of a more comprehensive ecosystem developing, which can accommodate the diverse funding needs of innovative climate tech companies on their perilous journey from idea to transformational solution. And with digital technologies being part and parcel of a carbon-neutral future, Silicon Valley remains center stage as part of the green transition. ✕

HOW DANISH START-UPS CAN BENEFIT

Denmark has key business strongholds in climate tech, world-class researchers, and entrepreneurs. With ambitious climate goals, strong policy drivers, green investments, and innovative public-private climate partnerships, the Danish ecosystem for green technologies is growing and offers many benefits to startups needing to test their solutions in a smaller setting. However, for startups entering the growth and scaling phase and needing more paths to risk-willing capital and international strategic partners, the heightened focus on climate tech and the maturing green ecosystem in Silicon Valley is good news. Danish corporates looking for green technologies to achieve sustainability goals may also find what they are looking for in Silicon Valley. ✕



ARE THE **TECH GIANTS** LEADING THE WAY?

Big tech in Silicon Valley run businesses that demand many resources, especially energy consumption, as digital growth means a continuing need for more data centers. In their ambitious pledges to reduce emissions, they clean up their supply chains and invest in green technologies.

Tech giants have huge climate footprints. As a result, they have increased the focus on corporate responsibility for the past few years. Thus, the green transition is a part of the largest corporates' agenda, as they are actively looking for ways to reduce emissions in their entire supply chains, and some are also actively removing carbon.

In the past two decades, a great amount of the world's wealth has been accumulated by a small handful of companies present in Silicon Valley. Meta, Apple, Microsoft, Google, and Amazon, also known as 'Big Tech' or 'GAMMA',

have a combined market cap of around 7.3 trillion USD. Roughly speaking, that is equivalent to 43 "Novo Nordisk" companies - Denmark's most valuable company to date. If the five GAMMA companies decided to form a nation, it would be the 3rd largest economy in the world.

With these tech companies being some of the largest economic powerhouses in the world, their success also brings with it large energy demands due to the massive growth in hyper scale datacenters that a global increasing data demand spurs. The impact of how these tech giants act and how fast they drive their

transition is considerable – both regarding their emissions, their supply chains, and their position as industry leaders. ❌

i FACTS

Amazon emitted 51.17 million metric tons of carbon dioxide in 2019*. By comparison, the City of Copenhagen emitted 1.55 million metric tons of carbon dioxide in 2018*.

Thus, the carbon footprint of Amazon compares to 33 times the City of Copenhagen.

* <https://www.environmentalleader.com/2020/02/facebook-ranks-1-on-list-of-top-10-large-energy-buyers-in-the-us/>

BIG TECH ARE GREENING THEIR SUPPLY CHAINS

Corporate emissions are often classified into three scopes, following the GHG Protocol Corporate Standard. Scope 1 covers direct emissions from owned or controlled sources, scope 2 covers indirect emissions from the generation of purchased energy, and scope 3 includes all other indirect emissions that occur in a company's entire value chain.

GAMMA have already made considerable efforts to lower both their **scope 1 and 2 emissions**.

In 2019, Meta, Google, Microsoft, and Amazon bought 3.76 gigawatts (GW) of renewable energy in the US alone – and in 2020, Amazon alone bought 3.16 GW, becoming the top energy buyer in the US followed by Google with their 1.04 GW procurement¹. Apple also invests in renewable energy, e.g. seen by Apple’s investment in building two of the world’s largest onshore wind turbines in Esbjerg, Denmark².

In the past years, GAMMA have also begun to look beyond their internal business. One of the latest and most consequential trends in GAMMA’s sustainability commitments is their new focus on the indirect emissions from their entire supply and value chain – the so-called **scope 3 emissions**.

Focusing on scope 3 emissions is an important step as Microsoft alone expects to emit 16 million metric tons of carbon in 2020. Of these 16 million metric tons, 12 will come indirectly from their supply and value chain³. The shift towards focusing on the entire supply chain could thus be impactful on the business world at large.

Greening big tech’s long supply chains is a huge challenge. Apple, for instance, has more than 200 suppliers and over 800 production facilities, and their supply chain includes everything from mining rare earth minerals and cobber in South America to manufacturing facilities in Asia⁴. Especially the mining operations could be hard to decarbonize by 2030. But it would create a large impact if they are successful in doing so. At the moment, Apple has commitments from more than 70 suppliers to use 100 % renewable energy for producing components for Apple devices, incentivizing them to restructure their businesses to become sustainable.

“Apple can help the industry transform by modeling and taking a risk on new technologies and ways of doing businesses and quickly scaling them. Our real strength is that when we find something that we really love, we can scale it right away. Not only to do it first – but do it bigger and leave behind a supply chain that is open and ready for other business to use with proof that »

1. <https://rebuyers.org/blog/reba-announces-top-10-u-s-large-energy-buyers-in-2020-2/>
 2. <https://www.apple.com/newsroom/2020/09/apple-expands-renewable-energy-footprint-in-europe/>
 3. <https://blogs.microsoft.com/blog/2020/01/16/microsoft-will-be-carbon-negative-by-2030/>
 4. <https://www.apple.com/supplier-responsibility/pdf/Apple-Supplier-List.pdf>

» there is a demand and that it does work,” – Lisa Jackson, Vice President, Environment, Policy, and Social Initiatives at Apple.

The five tech giants also appear to influence each other. In January 2020, Microsoft announced that they would cut their emissions in half by 2030 – not just their direct emission but also those across their entire supply and value chain. In July 2020, Apple raised the stakes by announcing that their entire business would be completely carbon neutral by 2030 and that they would only work with suppliers that aim to reach carbon neutrality by its 2030 timeline⁵. These pledges could thus create business opportunities for Danish companies looking to become part of a greener supply chain. ❌

i

CARBON-FREE ALUMINUM – PART OF APPLE’S 2030 CARBON NEUTRALITY EFFORTS

Apple plans to become carbon neutral across its entire business, manufacturing supply chain, and product life cycle by 2030. For instance, aluminum is an area of interest for Apple as Steve Jobs, the late founder of Apple, made aluminum fashionable, with almost all of Apple’s products having an aluminum layer.

As aluminum extraction and processing is very carbon-heavy, Apple has partnered with the Canadian aluminum giant Alcoa Corporation and Rio Tinto Aluminum, and the Governments of Canada and Quebec to help innovate the aluminum smelting process, make it carbon-free, and scale it for commercialization. The partnership has co-invested 144 million USD in future research and development.

The new process, called Elysis, has already been used to produce a batch of 16-inch MacBook Pros and is expected to be commercialized for larger scale by 2024, making the carbon-free technology accessible for other companies.

Nevertheless, even with the new process, Apple cannot call the aluminum they use ‘carbon-free’ since the mining process itself is energy-intensive. This is a challenge that Apple will continue to face working with aluminum.

5. <https://www.apple.com/newsroom/2020/07/apple-commits-to-be-100-percent-carbon-neutral-for-its-supply-chain-and-products-by-2030/>





THE TECH GIANTS ARE INVESTING IN NEW TECHNOLOGIES

True to the Silicon Valley mindset, the tech giants have realized that part of the solution to climate change cannot be found in today's world but lies in tomorrow's innovation. Consequently, they invest in green innovation and promising start-ups and step in as first buyers for innovative startups.

While these new technologies will support big tech in reaching their carbon goals and corporate sustainability ambitions, the companies have also realized that green business can be good business. In other words, besides following the movement of increasing green preferences among consumers, they are also in it for business gains.

In June 2020, Amazon announced a Climate Pledge Fund with 2 billion USD in funding. These news were followed by Google, who two months later issued 5.75

billion USD in sustainability bonds. Earlier in 2020, Microsoft had established a 1 billion USD 'Climate Innovation Fund' focused on accelerating the global development of carbon reduction, capture, and removal technologies. The fund has a global scope and is also actively looking for investments outside the US:

"We want our money to make a difference ... when it comes to technology and innovation, it doesn't know boundaries, it doesn't know specific countries" – Brad Smith, Microsoft Corp. President, and Chief Legal Officer. »»



» The tech companies support startups via investments and act as first buyers of their technologies, which is critical to help startups survive the valleys of death, especially in the early stage and scaling up.

For instance, Amazon has bought 100,000 electric delivery vans from the start-up Rivian known for its electric pickup truck. While greening the Amazon fleet of delivery vehicles, it also

creates tailwinds for a startup. Another example of such a partnership is the Danish startup Tomorrow that supplies Google with renewable forecasting data, which helps Google in the mission to make all of the data centers run on renewable energy 24/7 by 2030¹. In 2020, Google had reached 67% round-the-clock carbon-free energy across all its data centers². ❌

1. <https://www.greenbiz.com/article/google-redefines-what-it-means-be-100-renewable>
2. <https://cloud.google.com/blog/topics/sustainability/google-releases-carbon-free-energy-percentage-for-2020>

CLIMATE TECH INVESTMENTS

EXAMPLES

GAMMA's investments signal to the rest of the industry that green technologies are the future – here are some examples of the capital running into the space:



**The Chan Zuckerberg Initiative (CZI),
October 2021:**

10 million USD in funding to the Breakthrough Energy Fellows program

23 million USD invested in a small portfolio of organizations focusing on building the field of carbon dioxide removal (CDR), as well as investing in CDR technologies.



**Restore Fund, April 2021:
(200 million USD)**

The fund, launched with Conservation International and Goldman Sachs, aims to remove at least 1 million metric tons of CO₂ annually by investing in forestry projects that generate a financial return for investors.



**Issued sustainability
bonds, August 2020:
(5.75 billion USD)**



**Climate Pledge Fund,
June 2020
(2 billion USD)**



**Climate Innovation Fund,
January 2020**

(1 billion USD)

The purpose of the fund is to accelerate the global development of carbon reduction, capture, and removal technologies (CDR).



TECH COMPANIES PLAYED AN ESSENTIAL ROLE IN THE RISE OF A CARBON REMOVAL MARKET

Another big tech company Stripe, a successful fintech company, was a first-mover when they in 2019 announced that they would invest 1 million USD a year in carbon removal startups.

Since then, Stripe has invested an even higher amount annually. At the same time, the company has set up the investment program Stripe Climate, where their customers can contribute with further investments.

At the Carbon Virtual Summit 2021, Peter Reinhardt, Co-founder of Carbon In-

dustrial, an innovative and successful US carbon removal startup, emphasized the key role of buyers like Stripe in creating a market for carbon removal. There was no market, no investments, and limited awareness in the carbon removal space until two to three years ago. But this has changed dramatically in the last few years with increased revenue streams »»



» from new buyers who ensure that future capacity is built.

“These sophisticated buyers – such as Stripe, Shopify and Microsoft, and others – are now buying and locking in capacity to make sure they have a supply of high-quality engineered carbon removal in the future, through 2025-2030.” Peter Reinhardt, Co-founder of Charm Industrial.

This development is a large contrast to just a few years back when deep tech entrepreneurs in the carbon removal space struggled to create demand – now, there is more demand than supply for carbon removals.

If you are interested in watching the Carbon Virtual Summit 2021, co-hosted by Innovation Centre Denmark Silicon Valley and State of Green together with US partners AirMiners and Carbon 180, find it [here](#).

With their ambitious goals and investments, companies such as Stripe and Microsoft are helping to drive the demand for new technologies that will support companies in achieving their goal of carbon neutrality. ❌

i MICROSOFT AIMS TO BECOME CARBON-NEGATIVE BY 2030

Microsoft has a goal of being carbon-negative by 2030. The goal applies to Microsoft’s own business and the underlying value chain of suppliers – and by 2050, the tech giant aims to have eliminated all its historical emissions through investments in carbon removal.

Thus, Microsoft is betting big on carbon removal and capture technologies, e.g. Direct Air Capture where machines draw carbon out of the air and transform it into non-dangerous gasses and solids. The technology already exists but is expensive and has high energy consumption. Microsoft believes that costs can be reduced drastically with the right investments – like a range of other players within carbon removal.

Microsoft plans to finance those investments through their climate innovation fund and an internal carbon tax. Since 2012, Microsoft has charged themselves 15 USD a metric ton of carbon emitted and used the money to finance sustainability improvements. In 2020, Microsoft expanded the carbon tax to include scope 3 emissions, increasing subsequent investments in the Direct Air Capture market.



THE ROLE AS GREEN INDUSTRY LEADERS

When the tech giants make a move, all eyes are upon them. As industry leaders, big tech also has a large impact on the journey towards net-zero. The companies can set an example, create climate-friendly forums and maybe even affect global policies.

If we can do this at our scale and complexity, we want to see if we can inspire others to come along with us and inspire them to advance their goals. It wasn't about reinventing a new pledge or a new way of communication. But more about bringing the unusual suspects together to do this. We will figure it out together - we have to. We don't have a choice," – Kara Hurst, Head of Worldwide Sustainability at Amazon.

Amazon has co-founded The Climate Pledge, where 11 large corporations have signed on to reach net-zero 10 years before the Paris Climate Accord. Microsoft and nine other corporations, including

Danish A.P. Moller-Maersk, have founded the cross-sector initiative 'Transform to Net Zero'. The initiative aims to "deliver guidance and business plans to enable a transformation to net-zero emissions, as well as research, advocacy, and best practices"¹.

"Organizations are starting to realize that they are operating within an ecosystem, and what they do affect other parts of that ecosystem. They are not just operating in a vacuum with a simple balance sheet where 'I do this and therefore that'. If we do not have system change, then the world will not be a place where you can operate successfully in a time frame greater than 10 years," – Lucas Joppa, chief environmental officer at Microsoft². ❌

1. <https://transformtonetzero.org/>
2. At the GreenBiz webcast: Aligning Action with Ambition: How Leadership Companies Approach Audacious Sustainability Goals



FROM SILICON VALLEY TO WASHINGTON D.C.

GAMMA is also taking the sustainability agenda to Washington. The five companies are all a part of the trade association Advanced Energy Economy, whose goal is to influence public policy and highlight the economic opportunities advanced energy and tech can bring to the US.

A few years back, the CEOs from all five big tech companies also publicly advocated for the US not to leave the Paris Climate Accord¹. Zuckerberg's Facebook post on the matter received 317,000 en-

gagements alone, showing the reach that GAMMA have in today's world and their impact on the climate agenda. However, the money spent on advocating for climate change is still only a small part of the companies' lobbying budgets². Amazon has also faced critique from its employees for funding almost 70 members of the US congress who persistently voted against climate legislation³. ❌

1. <https://www.theguardian.com/technology/2017/jun/02/shortsighted-wrong-apple-facebook-among-tech-giants-to-reject-paris-pullout>
 2. <https://www.washingtonpost.com/technology/2020/01/22/amazon-facebook-google-lobbying-2019/>
 3. <https://www.vox.com/recode/2019/9/20/20874497/amazon-climate-change-walkout-google-microsoft-strike-tech-activism>



FROM DIGITAL IMPACT TO GREEN IMPACT


While GAMMA has pledged to reduce emissions and be frontrunners in the green transition, the companies have also been condemned for their large emissions and continued work with the fossil fuel industry.

For instance, the public and their employees have criticized Amazon, Google, and Microsoft for selling AI and Cloud computing services to oil and gas companies. However, Google has taken steps to rectify this, and in May 2020, they announced that they would no longer build custom AI tools for the fossil fuel industry¹. Microsoft has chosen a different approach by highlighting the areas where their software supports the fossil industry in becoming more sustainable².

While the tech giants are corporations with a large carbon footprint globally, the green transition is also part of their agenda. They are actively looking for ways to reduce their emissions and remove carbon from the atmosphere. Big tech drive demand for green technologies that could create opportunities for Danish climate tech companies as green suppliers or investment prospects. Please reach out to Innovation Centre Denmark Silicon Valley to explore opportunities to connect with relevant stakeholders in the Silicon Valley climate tech ecosystem. ❌

1. <https://www.forbes.com/sites/rachelsandler/2020/05/19/google-halts-ai-tools-for-oil-industry-after-greenpeace-report/#30f28bca69ae>
 2. <https://www.greenbiz.com/article/amazon-google-microsoft-and-climate-cloud>

CLIMATE TECH DEEP DIVES



In the chapters above, we have covered the Silicon Valley ecosystem across universities, accelerators, investors, and corporates. As these chapters illustrate, climate tech is taking off across various sectors. In this last chapter, we dive into three specific themes that show the innovative power of the Bay Area climate tech ecosystem: Carbon removal, electric vehicles, and alternative proteins.

New technologies assist us in saving the climate by capturing CO₂ from the air, storing and reusing it – an essential element in the efforts to reach the climate goals of the Paris Agreement. California is once again at the forefront of carbon removal and CarbonTech (products utilizing captured CO₂) – an innovative carbon removal ecosystem is emerging.

To reverse climate change, there is a need to start removing carbon from the environment and permanently store it since reducing future emissions is not enough. For California, carbon removal (CDR; Carbon Dioxide Removal) is a part of the plan towards carbon neutrality: A push for new innovative technologies is emerging.

California has set the goal of achieving carbon neutrality by 2045. However, as not all emissions can be eliminated by that time, California aims to reduce greenhouse gas emissions by 80% by 2050 compared to 1990 levels. This means that carbon removal solutions will have to be a part of the plan to reach neutrality by 2045.

Being a front runner on climate action, negative emissions are not only crucial for California's climate goal but is considered a part of the key to preventing the global temperature from increasing more than 1.5 degrees Celsius, as set out in the Paris Climate Agreement. To achieve that, the International Panel on Climate Change recommends large-scale carbon removal – that is, negative emissions, which means pulling already emitted carbon out of the air. ❌

A NEED TO REMOVE 125 MILLION TONS OF CARBON PER YEAR IN CALIFORNIA

A study from Lawrence Livermore National Laboratory, 'Getting to neutral – Options for Negative Carbon Emissions in California' reveals that California would need to remove 125 million tons of carbon per year to reach the goal of carbon neutrality by 2045.

One of the study's key findings is that to achieve the desired amount of negative emissions within this timeframe – and affordably – there is a need to look at high-

tech solutions for direct air capture and do so in combination with the restoration of natural ecosystems. The study points to a combination of three focus areas for optimal results; the first best »»



» is to support natural and working land until capacity is reached, the second best would be the conversion of waste biomass into fuel, and the third-best would be the removal of CO₂ through direct air capture technology.

A report from Stanford University moreover concludes that capturing and storing CO₂ can become one of the largest single contributors to California's green transition. California will be able to reduce its CO₂ emissions by as much as 15 percent in a relatively short time if they proceed with a targeted CO₂ capture at just 76 of the largest CO₂ industrial plants and power plants. The accumulated CO₂ could, if necessary, be stored in the subsoil. Like Denmark, California has

a huge underground storage capacity, large enough to accommodate the entire California electricity sector's CO₂ emissions in 2017 for 1000 years.

In this way, there is a potential for point-source capture in California. However, the range of carbon removal technologies and possibilities is much broader than only point-source capture, which has also been the main focus in Denmark. The carbon removal ecosystem in California and the US more broadly has a lot to offer in terms of inspiration on other technologies, from engineered solutions (such as Direct Air Capture) to nature-based solutions (land-based as well as ocean-based technologies). ❌



COMPANIES ENTER THE RACE FOR REALIZING CARBON REMOVAL

One approach to negative emissions is to convert waste biomass into biochar, which can then be used to improve the soil. Biochar reduces waste, improves the soil, substitutes chemical fertilizer, and retains water while providing soil structure. It is therefore not only carbon-capturing but also beneficial for regenerative agriculture.

An example of a startup in the carbon removal and biochar space is CarboCulture, which has been part of the Stanford incubator Start-X. They capture carbon by converting waste biomass (e.g. leftover walnut shells from production, which are often burned) into biochar. The biochar is then used to improve cities through green roofs, stormwater management, urban trees, etc.

Moreover, another range of important technological leaps is seen in the development of technologies that capture carbon directly from the atmosphere (Direct Air

Capture) and permanently stores it. These high-tech solutions have an advantage because their capacity to capture carbon is almost unlimited – compared to other solutions, which, for instance, are restricted to the total amount of biomass waste.

These solutions have not yet had a breakthrough for a while as they are much more expensive, require a large amount of energy (which needs to be low-carbon-sourced), and are considered far from market scale. However, this is starting to change as new companies are starting to pop up, and even though they are still early stage, recent investments

show an interest in this developing field.

For instance, Climateworks has launched the plant Orca, the world's first and largest climate-positive direct air capture and storage plant. Furthermore, CarbonEngineering in Canada is noticeable in the space, as they believe they can scale their technology and capture CO₂ for less than 100 USD per ton. With investments of 68 million USD from Bill Gates and Chevron Technology Ventures, among others, they are in the process of establishing the largest facility in the world, which will be able to capture 1 million tons of CO₂ directly from the air. ❌



CORPORATES AND FOUNDATIONS STEP UP TO KICK-START CARBON REMOVAL VENTURES

Other companies worth noting are a range of startups whose business was kick-started by investments from the major online payments platform Stripe. Stripe became a first mover when they pledged to pay 1M USD per year for carbon removal and long-term storage strategies in 2019. Since then, they have only increased the investments in the space.

In the process, Stripe compared 24 technologies and chose to support four of those technologies. Out of the companies invested in so far, two are in Silicon Valley:

- **Project Vesta** wants to capture and store CO₂ by creating a process that makes calcium bind to CO₂. This can be done with a green mineral, Olivine, added to the ocean, and the motion of the ocean waves support the process. The project is still early-stage, and more lab experiments and pilot beach projects must be

conducted, including testing safety and viability.

- The other company is **Charm Industrial** which focuses on carbon storage by a new way of preparing and injecting bio-oil into geologic storage. The carbon is removed by converting waste biomass into bio-oil and storing it permanently in deep underground rock formations used to store crude oil.

Another example of new money flowing into the carbon removal space is the recent awards from Amazon CEO

Jeff Bezos' Earth Fund (10 billion USD in total), which supported a range of nature-based solutions for binding CO₂. Among the recipients of this year's 791 million USD award are organizations such as The Natural Resources Defense Council, which received funding to restore carbon-binding ecosystems. The Salk Institute received funding for its 'Harnessing Plants Initiative', which seeks to bind CO₂ in the roots of crops. WWF also received grants to protect mangrove forests and to develop the market for seaweed, which, among other things, contributes to the absorption of CO₂. ❌

NEW CDR TECHNOLOGIES ARE EMERGING FROM CALIFORNIA'S STRONG RESEARCH INSTITUTIONS

California's world-leading universities also deliver a steady stream of news related to CDR-relevant research findings and new inventions.

For example, researchers from the Lawrence Berkeley National Laboratory at UC Berkeley have developed a new technique for capturing CO₂ from natural gas plants. The technique utilizes a highly porous organometallic material to collect 90 percent of the emitted CO₂. The method is estimated to be six times as efficient as other known technology.

Another example is BioMADE, a new public-private partnership between the US Department of Defense and 80 private companies that will invest DKK 1.7 billion over the next seven years in developing the US bio-industrial manufacturing sector. BioMADE will be involved in developing technologies that are necessary for using genetically modified bacteria and yeast cells on an industrial scale to produce enzymes that can convert CO₂ into green chemicals.

Furthermore, The SUNCAT energy research center at Stanford University has the same focus. Here researchers also work on finding new ways of converting CO₂ into green chemicals and fuels, focusing on 'electrochemical CO₂ conversion'. The goal is to develop technologies that use renewable energy technologies to convert CO₂ from industrial emissions to CO₂-based products.

The strong research community within carbon removal also includes current Stanford Professor Alfred Spormann. From early 2022, he will be leading the new 100 million USD international research center, The Novo Nordisk Foundation CO₂ Research Center, based at Aarhus University with six satellite institutions abroad. ✕

CARBON TO VALUE

According to the non-profit organization, Carbon180, the global market consists of almost 6 trillion USD with the greatest opportunities in fuels, building materials, and plastic products.

Production of fuels with low or no CO2 content will reduce emissions from the transport sector, especially in aviation and shipping, which are difficult to electrify.

One of the important companies in this area is the Chicago-based Lanzatech (initially founded in New Zealand), which recycles CO2 to produce sustainable fuel, including the use of a microbe that can convert CO2 to, for example, ethanol. Silicon Valley investor, Vinod Khosla, was among Lanzatech's first major investors in 2007. The visionary Khosla described Lanzatech as a 'black swan' at the time – rare but of particularly high value.

Additionally, an interesting and innovative solution is seen in concrete production, the most abundant man-made material. The company CarbonCure adds a dose of CO2 in the production process, which makes the cement stronger and simultaneously binds CO2 permanently in the product. The Canadian-based company has received funding from

the Bill Gates-backed investment fund Breakthrough Energy Ventures and is also part of the Bay Area-Hawaii based cleantech-focused startup accelerator, Elemental Exccelerator. Another company revolutionizing the traditional making of concrete is CarbonBuilt, a startup spun of UCLA, whose technology reduces the emissions from cement production and decreases the operating costs considerably. Other startups are looking into how carbon removal and cement production can be combined, e.g., with a more decentralized production model of cement.

There are thus several examples of how new technologies can help to convert CO2 into sustainable materials. ✕



**i A 'CARBON ECONOMY'
ON THE RISE**

As the climate goals of the Paris Agreement will be unattainable without negative emissions, the ball is in the court of governments, researchers, entrepreneurs, investors, and companies.

The research and development stage of carbon capture is still early-stage, technologies are high-risk, and entrepreneurs having launched new companies successfully are not abundant. A robust startup ecosystem of carbon removal ventures is on the rise. It is supported by organizations such as non-profits AirMiners and Carbon180 and several corporates stepping in to accelerate carbon removal.

**i OUTRO
RELEVANCE FOR DK**

California is, as usual, among the frontrunners when it comes to carbon removal due to its significant innovation capacity. Innovation Centre Denmark Silicon Valley actively engages with the US carbon removal network of stakeholders across the value chain and ecosystem and can help Danish stakeholders gain inspiration and knowledge and create access to networks and markets as they mature.

DRIVING ELECTRIC: THE ROAD TO A SUSTAINABLE FUTURE

California is leading the electric vehicle revolution. Ambitious state regulation combined with an extensive charging infrastructure make California and the Bay Area ideal for switching from gasoline to zero-emission cars. As Denmark is looking to accelerate its adoption of electric vehicles, there may be inspiration to draw from California.

With more than 800,000 electric vehicles (zero-emission vehicles; ZEVs) in California, they are hard to miss when driving through the landscape on highway 1 or any other routes through the Golden State. Over the past decades, California

has become the leader in electric vehicles adoption and innovation, and ZEVs are now California's second-largest global export market. As Denmark also has ambitions to increase the number of EVs by incentivizing drivers to switch out the old fuel cars, California can be a good place to look for inspiration to optimize the consumer journey.

In California, consumers are already enjoying the benefits of driving electric. In 2014, the then Governor Brown set the goal of having at least 1 million ZEV and near-ZEVs on the road in California by January 1st, 2023. Since then, California has experienced a fast uptake of these »»



» green vehicles that help Californians get cleaner air. The State of California has set a goal to have 5 million ZEVs on the roads by 2030 - and just this summer, the state goal related to charging infrastructure was increased to 1 million EV charging stations by 2030.

To boost California's climate action even further, Governor Gavin Newsom recently signed an order to ban sales of new gasoline cars by 2035. To date, the most ambitious and aggressive clean air policy in the United States. But what is it like to be an EV driver in California, the state with the highest percentage of EVs in the US at more than 5 percent? ❌

AN EV DRIVER'S JOURNEY

Like every other weekday, Emma Jane wakes up to the penetrating sound of her alarm clock at 5:30 AM. Emma has a 1.5-hour drive from her townhouse in San Francisco to her workplace in Sunnyvale. Emma is one of the 800,000+ people in California who own an electric vehicle, a Peugeot e-208 to be exact, which she bought last year. She decided to buy a smart and environmentally friendly car a year ago and was extremely surprised by the wide range of EVs to choose from. Luckily, a friend recommended the app MyGreenCar which uses her driving data to choose the best model.

(*Emma Jane is a fictional character used to showcase the life of an EV driver in California and the tools available for EV drivers)



🚩 Henrik Fisker, chairman and CEO of U.S. startup Fisker Inc.

Source: Getty Images

A GROWING SELECTION OF ELECTRIC VEHICLES FOR EVERY CONSUMER'S NEEDS

Consumers who want to trade in their traditional internal combustion engine (ICE) vehicle for an electric model now have a lot more cars to choose from. Automakers launched 143 new EVs in 2019 alone.

And even though most of the traditional car giants have entered the EV market, and new innovative players are popping up frequently, it is almost impossible to talk about the EV industry without mentioning the Silicon Valley giant Tesla. The EV frontrunner Tesla was founded in 2003 and launched its IPO in 2010. Only ten years later, Tesla replaced Toyota as the world's most valuable automaker, estimated to be worth more than both Ford and GM combined.

Today, there is an electric vehicle for every consumer's needs. The newest gamechanger is thought to be the launch of

electric SUVs. EV manufacturers, among others Rivian and Tesla, both based in the Bay Area, have recently presented larger vehicle models with the Cybertruck and R1T truck.

The growing selection of EVs inspired the Lawrence Berkeley National Lab to develop an app to make it easier for consumers to find the EV model that best fits their needs. The consumers just have to download the app, MyGreenCar, and then drive their normal routes. After a while, the app will present the driver with a couple of EV models that best fit their needs based on their unique driving data. ❌

i FISKER

Fisker Inc is a luxury EV car brand that aims to have the world's most sustainable car with its newest Fisker Ocean SUV model, launching in 2022. Following the notion that what's inside counts, the Ocean model's interior is created from recycled, abandoned fishing nets and plastics from the ocean. The Ocean model is supposed to take you between 400-480 kilometers per full charge, and you get the option to add a full-length solar roof to the car.

The California-based manufacturer has a strong Danish connection; Fisker was co-founded by the Danish-American automotive designer and entrepreneur Henrik Fisker.



🔥 Rivian R1T and Tesla Cybertruck.
Source: Rivian and Tesla

SOME CITIES LEAD THE ELECTRIC VEHICLE TRANSITION

In 2018, Palo Alto topped the list of cities at the forefront of EV adoption, with almost every third sale of a new car being an electric vehicle – while the number was between 11 and 24 pct. for the nearby cities.

Outside the San Francisco Bay Area, especially cities like Los Angeles and San Diego have also seen a great uptake in electric vehicles. In the second quarter of 2020, the total market share of plugin hybrids and battery electric vehicles was around eight pct. in California. ❌

AN EV DRIVER'S JOURNEY

Somewhere on Highway 101 between San Francisco and Sunnyvale, Emma realizes that she should probably fast charge her car. A free parking spot right in front of her house was too tempting last night, so she did not park at the designated EV parking spot on the neighboring street. Living in a greater city, finding overnight charging spots can be difficult at times, but Emma is not too worried because she knows that there are charging stations throughout her entire route to work. She quickly opens an app to find the nearest available charging station.

THE IMPORTANCE OF A WELL-DEVELOPED INFRASTRUCTURE

The lack of charging points is one of the key reasons customers do not switch to an electric car. Matching the charging infrastructure and EV adoption is a classic chicken and the egg challenge, which is also highly debated in Denmark: Consumers will only invest in an EV if there is sufficient charging infrastructure.

However, the infrastructure providers do not have the incentive to build more chargers until there are enough EVs on the road to make it a viable business case.

How much and which infrastructure is needed for it to be sufficient depends on the available range of vehicles on the market – that is, how far can the average EV drive per charge. In the past years, the vehicle range has improved, especially due to increased battery performance. The Bay Area-based EV manufacturer Lucid Motors recently announced a new EV with a range of 835 kilometers (520 miles) per charging. For comparison, the drive from the northernmost point of Denmark, Skagen, to the German border is 394 kilometers. Although the daily needs for most Danes are far less – only about 50 kilometers – EVs with longer ranges are likely to be a game-changer as it removes any 'range anxiety'.

To ensure that the needed infrastructure is available to deliver 'range confidence' for EV drivers, it has been a key priority for the California Energy Commission (CEC) and the California Air Resources Board (CARB) to ensure that infrastructure of charging points was built out across California. Support is found in various incentive schemes both at the state level and the local level. For instance, the West Coast Electric Highway was initiated across California, Washington, and Oregon. This green electric

highway has DC fast charging points for every 40 to 80 kilometers along the central highway route from the Canadian to the Mexican border. The project is funded by private-public partnerships as well as vehicle registration services and fuel fees. ❌

i PLUGSHARE

The California-based app Plugshare is one of the most popular apps for EV owners in America. The app makes it easy for EV owners to always find the nearest charging station on their route, provides navigation, and lets you pay through the app. Plugshare is community-based and not only finds the closest but also the best charging station based on more than 2,500,000 user reviews. The app offers live availability data so that you do not drive to a station in vain, and it also alerts users when new public charging stations are installed nearby.

AN EV DRIVER'S JOURNEY

The Plugshare app navigates Emma off the exit at San Mateo, where she quickly finds a neat charging station close to her. It's outside a middle-sized office building, and four of the employees' cars are already plugged into the standard Level 2 chargers for a charge while they are working. Luckily, an additional fast charger is available, so Emma can still fast-charge her car for 5 minutes due to smart charging technology. When she is done charging, Emma's app automatically pays for the fast-charge service.

INNOVATING CHARGING SYSTEMS

While fast charging is convenient, it is expensive and can challenge the electric grid in many areas. To meet the latter challenge, FreeWire recently launched its Boost Charger charging point with an integrated battery that can act as a buffer to take the stress off the grid when needed.

This solution enables fast chargers to be installed in places that would not otherwise have the opportunity to meet the fast charging high-power demand.

Another area with an abundance of innovation is within 'smart charging' to optimize the way charging stations consume electricity while also benefiting the consumers. Alameda County near San Francisco added more than 100 charging station ports to the infrastructure without

major upgrades to its electrical infrastructure through smart charging. They implemented a smart charging program where chargers control energy use and reduce expensive spikes by optimizing how a building's chargers communicate. The fast charger overrides the 'fleet Level 2' chargers aka 'leaving my car charging while working' chargers. It prolongs the charging time for Level 2 chargers just a little while, creating a spot for cars that need to charge immediately. ❌

i VOLTA

The San Francisco-based company Volta Charging has created a unique business model to ensure not only more charging stations but also free-of-charge charging stations. Volta collaborates with real estate and business owners to install EV chargers in high-traffic areas and provides free power to drivers through the revenue from outdoor advertising on the chargers. By the end of July 2020, Volta had already provided American EV drivers with more than 75 million free miles through their 1,260 chargers.

AN EV DRIVER'S JOURNEY

Emma drives back onto the highway after her quick detour. It's 7:45 AM now, and the traffic is getting denser. Emma swings out to the outer carpool lane to pass the worse traffic. The carpool lane is exclusive to EV drivers and people carpooling (2+ passengers) to decrease the number of traditional cars on the road polluting the air. Just one of the many advantages Emma gets in California for being an EV driver.



REGULATING FOR CHANGE – THE MANY INCENTIVES TO DRIVE AN ELECTRIC VEHICLE IN CALIFORNIA

California is backing up its ambitious EV goals with incentive structures. First of all, there are several financial incentives to buy an EV. A federal tax credit of up to 7,500 USD is available for newly purchased qualified all-electric and plug-in hybrid cars.

The State of California also provides a rebate of 1,000 USD to 4,500 USD for the purchase or lease of new qualified EVs, and some low-income households may receive an additional 2,500 USD rebate as well. There are also programs at the local level. For example, the Bay Area Air Quality Management District's Clean Cars for All program provides incentives of up to 9,500 USD for low-income Bay Area residents to replace their old cars with a hybrid or an EV.

Besides financial incentives, California has made an effort to improve the everyday life of EV owners. In San Francisco, all public and private parking lots and garages with more than 100 parking spaces must install charging stations in at least 10 pct. of their spaces by 2023. It is just one of the few ways California is securing the first-rate infrastructure for EVs – also in

the bigger cities – helping California reach its goal of having 5 million zero-emission vehicles on the road by 2030. ✕

i A THRIVING ECOSYSTEM

The Silicon Valley ecosystem of green mobility is thriving with its world-class research into new technologies, entrepreneurs focused on challenges across energy and mobility, investors with venture capital to invest, and the traditional car manufacturers' innovation centers such as Ford Greenfield Labs and Volkswagen's Innovation Center.

i OUTRO – RELEVANCE FOR DK

Innovation Centre Denmark Silicon Valley shares insights from California and can create value for your company or organization via connections to innovation stakeholders or potential future partners.

HOW MEAT ALTERNATIVES ARE MODERNIZING THE FOOD INDUSTRY

Meat is among the most resource-intensive foods, but plant-based and cultivated meat enables society to meet growing food demands sustainably. California is the hub for the fast-growing and disruptive industry, and the demand for research, innovation, and capital in the field is projected to increase in the coming years.

Globally, meat consumption is at the highest it has ever been. According to the UN, global meat production is projected to double by 2050. Yet, a contrary trend is also visible. According to the market research company Euromonitor, the global meat substitutes sector is worth 20.7 billion USD and is set to grow to 23.2 billion USD by 2024. This trend is spurred on by a growing and diverse consumer base consisting of strictly vegans to carnivores attempting to limit their meat consumption. While these consumers are motivated by various reasons, from animal welfare to food security, more and more consumers are

also attempting to mitigate the environmental impact of their food intake.

Animal-based foods are typically more resource-intensive and environmentally impactful to produce than plant-based foods. By making meat alternatives from plants and cultivating meat from cells, meat production is undergoing a modernization. It is a faster process that enables more flexibility in production with a significantly lower emission rate. Three different processes and technologies mainly enable this modernization: plant-based protein, fermentation, and cultivated meat, and these three processes make up the new and growing field of alternative proteins. ❌



CALLS FOR PUBLIC FUNDING FOR RESEARCH

California is at the center for both academic research and industry innovation in the field of alternative proteins. In 2020, The National Science Foundation (NSF) awarded around 3.5 million USD to fund a cultivated-meat consortium at the UC Davis in California.

Cultivated meat is a way of re-designing meat. It is grown directly from animal cells and produced in bioreactors and tastes like regular meat (because it is regular meat) but without environmental impact. Cultivated meat is still in its infancy, but in December 2020, the first cultivated chicken was produced by California-based Eat Just.

And the grant to NSF represents the US government's biggest investments in open-access alternative protein research so far. UC Davis also hosts a chapter of the Good Food Institute-financed project, the 'Alternative Protein Project', which attempt to build an education pipeline for the alternative proteins industry by designing educational offerings and driving innovative research.

UC Berkeley also focus on research and education in the field of alternative proteins. They have formed the UC Berkeley Alternative Meats Lab, connecting students, entrepreneurs, venture capitalists, and industry leaders.

While Californian universities are

making progress in alternative proteins research, public funding for research is still relatively low. Instead, most investments in research are made in and by private companies competing for market share, meaning that the findings often end up patented. The famous political analyst, Ezra Klein, brought this debate to wider public attention when he published an impassioned opinion piece in the New York Times calling for larger public investments into alternative protein research. According to Klein, conventional meat has had decades of subsidies and publicly funded research, and the time has now come for alternative proteins to receive the same.

Ezra Klein is not alone. The NGO Good Food Institute recently led a coalition of 61 companies, non-profits, research »»

"Let's Launch a Moonshot for Meatless Meat"

Ezra Klein in The New York Times

» institutions, and trade associations, calling Congress for federal funding toward alternative protein research in the FY22 budget. Among the 61 signatories to the appropriations letter were large multinational companies such as Unilever, Merck, and Kraft Heinz. According to GFI research funding coordinator James Dale, “private funding tends to focus on applied science and commercialization, seeking a short timeline for a return on investment for a small group of shareholders. On the other hand, public investments can fund long-term basic research and often lead to unanticipated advances on decades-long time scales.”

Some politicians seem to be listening to these calls. At a USDA subcommittee hearing, Chair of the House Appropriations Committee Rosa DeLauro also called for parity in research funding for alternative proteins, saying that these technologies “play an important role in combatting climate change and adding resiliency to our food system”.

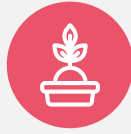
“Alternative proteins play an important role in combatting climate change and adding resiliency to our food system”

Rosa DeLauro

Chair of the House Appropriations Committee

Researchers are discovering how technology can be applied to modernize our food production, and the examples above signal increasing attention and investments in alternative proteins. As a result, there is a demand for more research and innovation in this field. This provides an opportunity for Danish researchers and companies already working in this field. Moreover, many of these technologies – protein research, fermentation, and tissue engineering – are already being used in other research areas such as medicine. Yet, their potential for modernizing food production is just being discovered. This also creates an opportunity for researchers already working with these technologies to apply their knowledge to the upcoming field of alternative proteins. ❌

i THE THREE PILLARS OF ALTERNATIVE PROTEINS



PLANT-BASED



FERMENTATION



CULTIVATED



CALIFORNIA: AN INDUSTRY HUB

According to GFI, a thriving alternative protein ecosystem requires investors, talent (usually from universities), local demand (flexitarians), a supportive government, a business community, access to resources, and infrastructure. California is beginning to develop such an ecosystem, and it has consequently developed into a hub for innovative companies working in the alternative proteins industry.

The two giants in the alternative proteins industry, Impossible Foods, and Beyond Meats, are both based in California. Through 2019, Impossible Foods have raised 672MM USD and Beyond Meats 482.75MM USD, making them undisputed leaders when it comes to producing plant-based meats. Plant-based proteins are made from plants since they have a similar biochemical composition to meat consisting of fat, protein, water, vitamins, and minerals. Traditionally these products and innovations were directed towards vegetarians, but with a growing consumer base, the challenge is now to develop plant-based meats that closely mimic conventional meats' properties. Impossible Foods has struck a deal with fast-food chain Burger King which has released the Impossible Whopper made from their plant-based meat. According to analyses made by Barclays and CNBC, Burger King stores saw an overall increase in foot traffic and a 3.5% sales increase in its U.S. stores as a result.

Perfect Day is another big Bay Area company that uses fermentation to create plant-based dairy. Fermentation is an effective way to produce lots of protein and has already given us alcohol and yogurt. Efficiency attracts money, and by July 2020, companies developing and

deploying technologies that enables the process have raised 435 million USD in funding. A life cycle assessment of Perfect Day's protein production through fermentation shows that it reduces greenhouse gas emissions by at least 85% and up to 97%, compared to conventional production methods. As fermentation is one of Denmark's strong points, there might be interesting opportunities for companies and researchers in this area.

All of these companies are part of a relatively new but rapidly growing industry. According to The Good Food Institute, a record 3.1 billion USD was invested in plant-based food companies in 2020 – a figure that is three times higher than the amount raised in 2019. The demand for research, innovation, and capital in the field is projected to increase in the coming years. ✕

i COLLABORATION OPPORTUNITIES?

California is among the frontrunners for alternative proteins due to its significant innovation capacity. There are currently several research projects and industry programs in California that could be relevant for Danish companies and research institutions looking for strategic research collaboration. At Innovation Centre Denmark Silicon Valley, we stay updated on the latest developments and facilitate contact with strategic partners.



**INNOVATION
CENTRE
DENMARK**