PitchBook

VERTICAL
SNAPSHOT

Climate Tech

2020

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Executive summary

The climate tech sector has gained significant momentum in the past decade, with global urgency and technological breakthroughs suggesting that now may be the time for investors to confidently commit to the climate investments that will shape the future. Although the COVID-19 pandemic has temporarily redirected resources toward finding a vaccine and weathering economic shutdowns, it has also reminded nations about the value of international collaboration in solving problems of such immense magnitude and complexity. In the past six months, a number of governments have committed to act on climate change. The Prime Minister of Japan vowed to be carbon neutral by 2050, Xi Jinping pledged to make China carbon neutral by 2060, and once in office, the newly elected Biden administration within the US plans to invest trillions into a clean-energy transition targeting net-zero emissions by 2050.

Climate tech represents a vast and sprawling opportunity that currently amounts to a $2.5 trillion market encompassing energy, transportation, agriculture, buildings, industry, climate adaptation, and materials & resources. In terms of startup investment, the energy sector leads the way with $7.2 billion of capital invested YTD. Developments in this sector are powering innovation across the ecosystem, as participants in the transportation, industrial, and agriculture sectors develop electrified products and processes that are helping decarbonize the planet. This report delves into innovation and disruption across each of these sectors and provides a visual exploration of the key emerging technologies that will enable countries and corporations to meet their net-zero targets.

1,800+
companies

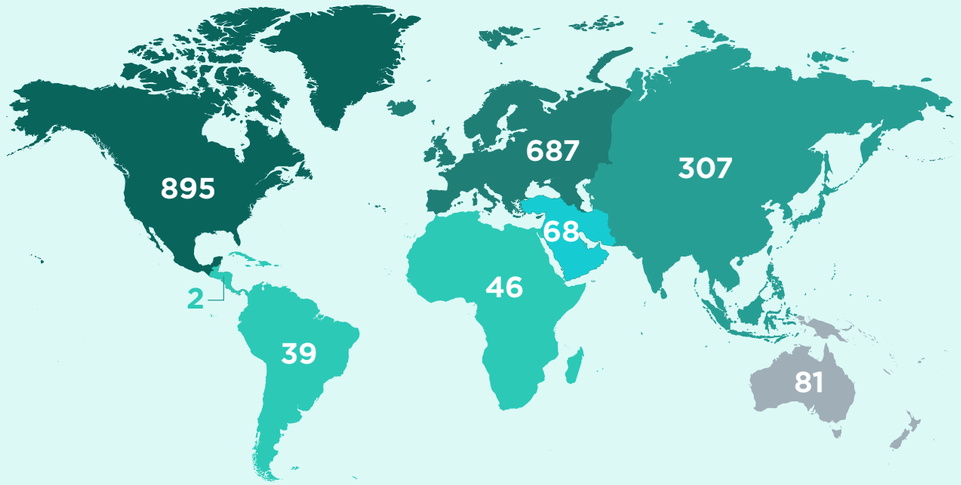
$286.0B
of capital invested since 2011

5,400+
investors

24
emerging spaces

6,700+
deals

Company count breakdown by geography



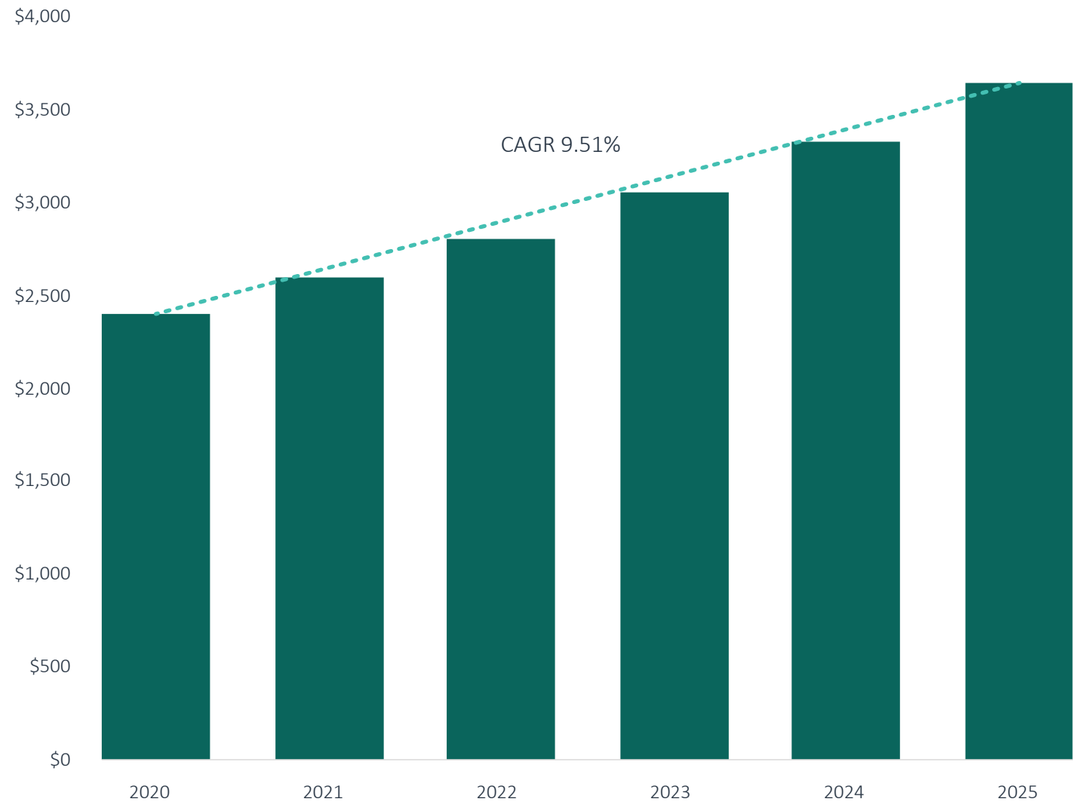
Market size

Figure 1.
Climate tech market size ($B) by sector

	2020	2021	2022	2023	2024	2025	CAGR
Climate tech total	$2,404.9	$2,595.0	$2,809.0	$3,051.1	$3,326.9	$3,643.2	**9.51%**
Energy	$1,922.2	$2,036.7	$2,159.7	$2,292.1	$2,434.9	$2,589.1	**6.34%**
Agriculture	$33.6	$36.8	$40.4	$44.3	$48.6	$53.3	**9.68%**
Buildings	$29.6	$33.0	$36.8	$41.0	$45.7	$51.0	**11.50%**
Transportation	$382.8	$445.4	$521.3	$613.7	$726.4	$864.7	**19.04%**
Industry	$3.6	$4.0	$4.5	$5.1	$5.8	$6.5	**12.81%**
Materials & resources	$15.4	$18.4	$22.1	$26.7	$32.5	$39.9	**22.82%**
Adaptation	$17.7	$20.7	$24.2	$28.3	$33.1	$38.6	**16.90%**

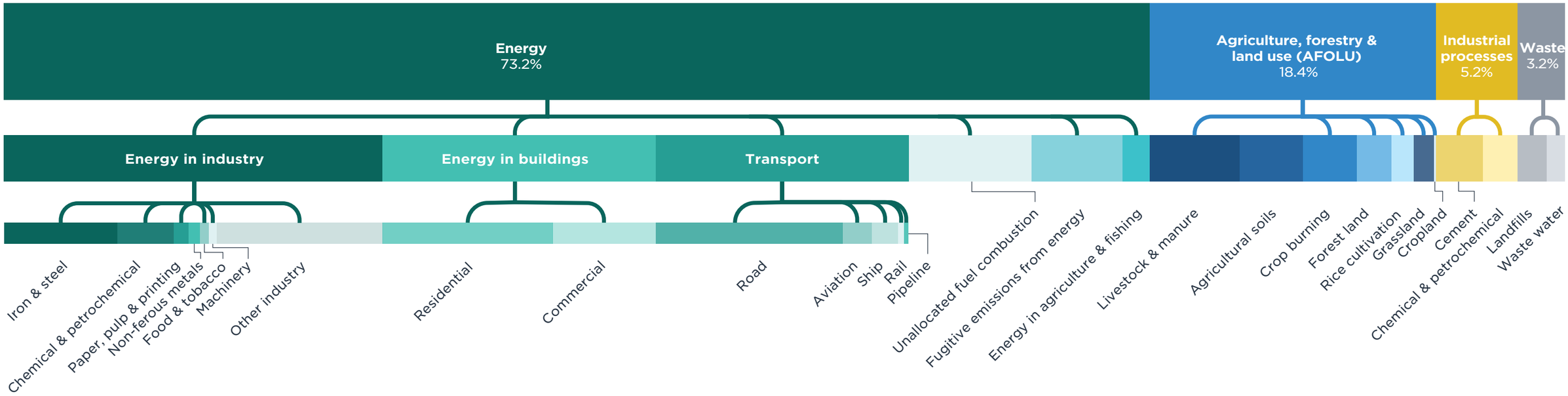
Source: PitchBook | Geography: Global

Figure 2. CLIMATE TECH MARKET SIZE ($B)



Source: PitchBook | Geography: Global

Global greenhouse gas emissions by sector



Market drivers

A rapidly changing climate has compelled immediate action. The last decade recorded eight of the top 10 warmest years in history, leading to more droughts, wildfires, and hurricanes. The frequency and severity of storms have increased over the past decade. 2019 marked the ninth consecutive year with eight or more billion-dollar disasters in the US.[1] By 2040, it is estimated that almost one in four children globally will live in areas of extremely high water stress, with severe weather events and changing water-cycle patterns making it more difficult to gain access to safe drinking water.[2] International organizations such as the World Bank and the United Nations, through its Green Climate Fund, have both upped their investments into climate-vulnerable nations. The World Bank in particular is targeting $200.0 billion in support from 2021 to 2025 to support climate adaptation.[3] Whether it be water scarcity or flash flooding, people around the world are feeling the effects of climate change more viscerally, putting their plight in greater focus and spurring governments to take the issue more seriously.

Governments worldwide have adopted climate change initiatives. In urgent response to these crises, many countries have made carbon reduction a central pillar of domestic policy. Japan has pledged to be carbon neutral by 2050 and China by 2060, while the European Union's 2030 Climate Target Plan aims to reduce greenhouse gas emissions to 55% below their 1990 levels, with full carbon neutrality expected by 2050. Although the US controversially left the Paris agreement in 2017, the country's newly elected administration aims to spend $2.0 trillion over four years to escalate the use of clean energy, with a goal to also reach net-zero emissions by 2050.

Younger consumers are more mindful of sustainability, driving corporations to develop carbon-neutral products and practices. For Generation Z and millennials, climate awareness and advocacy are key issues that define their policy perspectives and politics. The climate activism of Greta Thunberg has been embraced by her peers around the world, and her organization Fridays for Future supports climate strikes, typically led by youth, as a way to pressure governments into policy action. Her influence resulted in a global climate strike in September of 2019, before which Amnesty International wrote to 30,000 schools to encourage them to allow their students to take part in the demonstrations without penalty.[4] According to the Yale Program on Climate Change Communication, 62% of individuals in the US who are millennials or younger strongly or at least somewhat supported climate activism in 2019.[5] A 2018 Gallup survey found that 70% of Americans aged 18 to 35 worried a great deal or a fair amount about climate change.[6] All this amounts to companies considering climate change in their marketing and product development. This has been of particular note in Big Tech, where companies such as Apple, Microsoft, Google, Amazon, and Facebook have all promised carbon neutrality from their operations by 2030.

The COVID-19 pandemic has provided a template for international cooperation. Although the pandemic has undeniably caused significant suffering and hardship for many, it may have also been the spark necessary to demonstrate how international collaboration can help to solve a problem as complex as climate change. Global warming and COVID-19 share a number of similarities, including the need for significant investment and coordination to overcome their effects, the greater ability of wealthier countries to drive solutions, and the

1: "Weather Disasters and Costs," Office for Coastal Management, NOAA.
2: "Water and the Global Climate Crisis: 10 Things You Should Know," UNICEF, March 20, 2020.
3: "World Bank Group Announces $200 Billion Over Five Years for Climate Action" The World Bank, December 3, 2018.
4: "Amnesty Chief Urges Schools to Let Children Take Part in Climate Strikes," Amnesty International, September 11, 2019.
5: "Young Adults, Across Party Lines, Are More Willing to Take Climate Action," Yale Program on Climate Change Communication, April 28, 2020.
6: "Global Warming Age Gap: Younger Americans Most Worried," R.J. Reinhart, Gallup, May 11, 2018.

disproportionately negative impact they have on poorer countries that lack resources. Laying the groundwork for a coordinated international response to this health crisis may help foster cooperation in setting aggressive targets in a multilateral fashion and subsidizing nations and technological development to benefit all nations.

Solar power offers a compelling roadmap for other nascent climate technologies. As many investors learned during the first cleantech investment craze of the early 2000s, climate-oriented technologies will fail unless they achieve economies of scale and reach pricing parity with traditional sources of energy such as coal, oil, and natural gas. Solar power offers a promising scenario. Between 1980 and 2012, the cost of solar modules fell by 97%, largely due to government subsidies, efficiencies from economies of scale, and improvements such as solar cell efficiency.[7] We expect a similar path for other emerging climate technologies and believe increased private investment, expanded government commitments, and steady technological progress will help drive profitable models.

Advances in "deep tech" are propelling climate tech breakthroughs. Technologies ranging in diversity from artificial intelligence (AI) to the internet of things (IoT) to robotics are enabling new possibilities in a host of climate tech subsectors. AI & machine learning (ML) leads the pack from an adoption standpoint, largely due to its overall maturity, with deployment in areas such as grid optimization and climate risk modeling. Companies are using these technologies to reduce costs and increase efficiencies for climate tech solutions, leveraging the advances and investments already made in the portfolio of deep technologies.

Investor interest is expanding, with more capital available. In addition to a rising number of investors and funds dedicated to climate change in the past decade, numerous generalist investors are exploring allocating capital to climate tech projects. PwC found that climate tech has gained interest from investors faster than any other sector over the past three years, including AI.[8] This PitchBook Vertical Snapshot uncovered over 30 investors focused on climate change in addition to hundreds more generalist ones, some of which are considering investment into climate tech for the first time.

7: "Evaluating the Causes of Cost Reduction in Photovoltaic Modules," Energy Policy, Volume 123, Goksin Kavlak, James McNerney, and Jessika E. Trancik, 2018.

8: "The State of Climate Tech 2020," PwC, Celine Herweijer and Azeem Azar, September 9, 2020.

Outlook

Rising demand for renewable energy technologies will drive explosive growth in the metals, minerals & mining sector. In particular, technologies such as wind turbines, solar panels, and batteries for energy storage will necessitate a significant increase in resource yields to be deployed at the scale projected to meet Paris Climate Agreement targets. A World Bank Group report estimates that the production of minerals such as graphite, lithium, and cobalt alone could increase nearly 500% by 2050 to meet growing demand for climate-friendly technologies.[9]

Battery technology is primed for a central role in the decarbonization playbook. Substantial innovations in battery technology will be vital to help spur the adoption of climate-saving technologies within transportation and energy generation, two of the largest carbon-emitting sectors. Although sharing some overlapping challenges, batteries for long-duration energy storage face fundamentally different obstacles than those of their vehicular counterparts, primarily due to the need to scale for grid storage. In the automobile sector, batteries must both charge faster and hold their charge longer if consumers are expected to pivot away from combustion-powered cars. Technological advances aside, governments are already setting aggressive targets, with both California and the UK aiming to phase out gas-powered cars by the 2030s.

An uptick in renewable power generation, combined with electrification, will diminish carbon emissions in many nonenergy sectors. Electrification developments such as battery-powered cars and planes, the growing of food through indoor farming and cellular agriculture, and the utilization of electrolysis to develop green hydrogen all seem to hold great promise for reducing carbon output. But while electrification is an important first step, the electricity feeding into these processes must also be derived from renewable sources to fully reach the goal of decarbonization. Declining prices in solar and wind, technological improvements, and government policies are all contributing to an expansion in renewable sources of power. The International Renewable Energy Agency reported that renewable power accounted for 72% of all power expansion in 2019, outpacing fossil-fuel growth by a factor of 2.6x.[10]

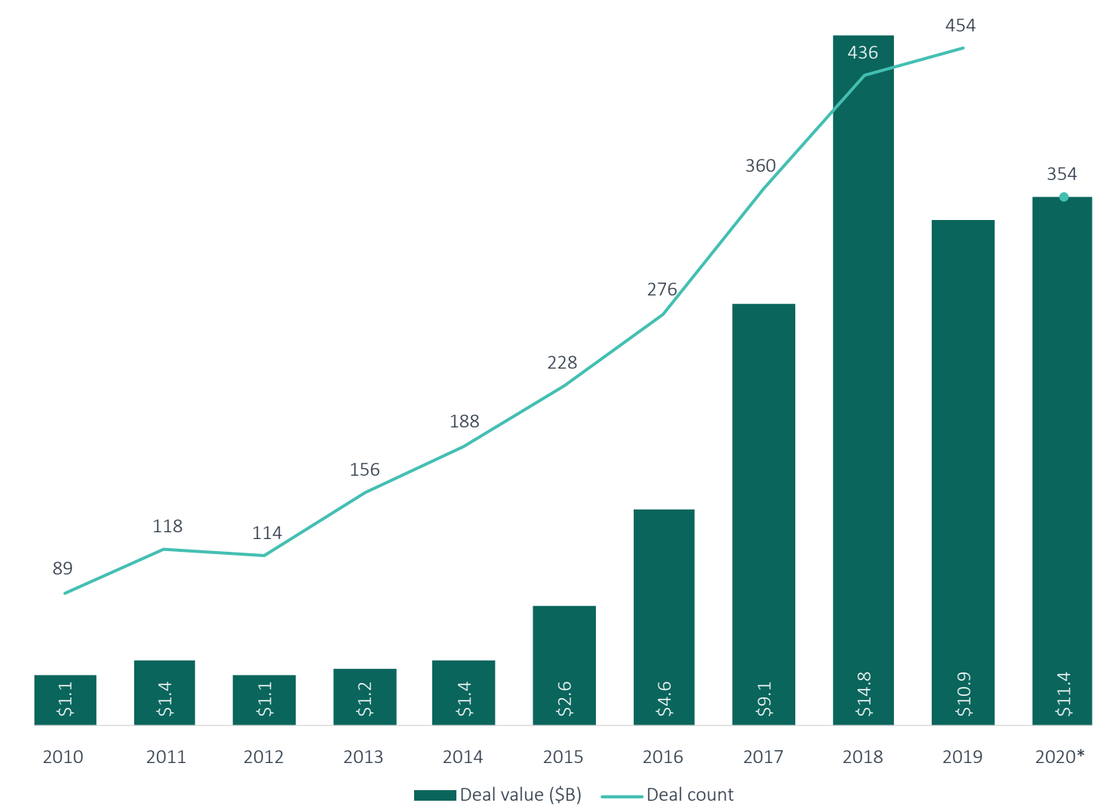
Hydrogen will emerge as a major source of energy later in the century, but near-term obstacles remain. Hydrogen has long been pointed to as a "future fuel" by energy entrepreneurs, who note that it is light, storable, energy-dense, and produces no direct emissions or greenhouse gases when burned. Moreover, interest in hydrogen has steadily increased, with demand for hydrogen surging more than threefold since 1975, and it continues to rise.[11] Hydrogen offers the opportunity for decarbonization across many sectors, including long-haul transport, chemicals, iron and steel manufacturing, and consumer transportation. Unfortunately, producing hydrogen from low-carbon energy sources is currently very expensive, with the vast majority of hydrogen produced today coming from natural gas. Substantial investment and/or government incentives will be needed to expand hydrogen production, storage, and transportation infrastructure, as well as investment into pilot projects that can validate the applications of green hydrogen to industries such as steel manufacturing.

9: "Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition," World Bank Group, 2020.

10: "Renewables Account for Almost Three Quarters of New Capacity in 2019," IRENA, April 6, 2020.
11: "The Future of Hydrogen," IEA, June 2019.

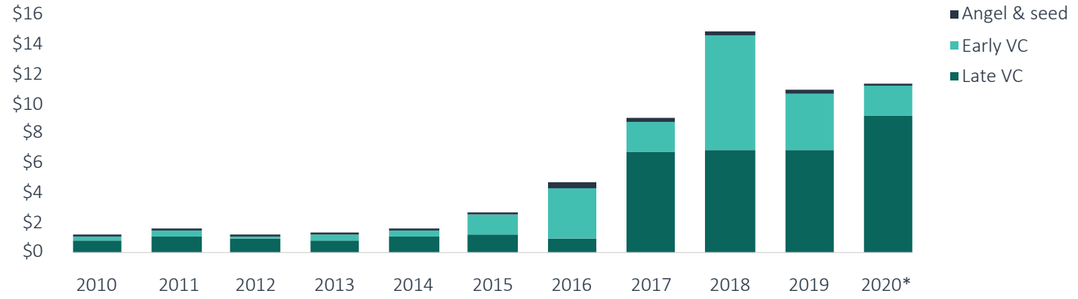
VC activity

Figure 3. CLIMATE TECH VC DEAL ACTIVITY



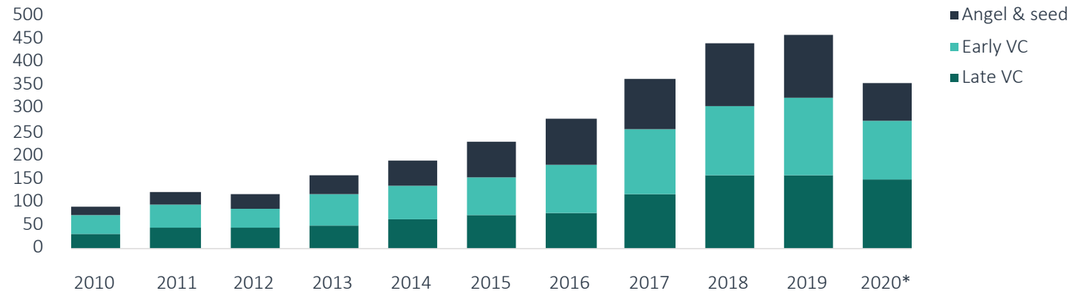
Source: PitchBook | Geography: Global | *As of October 30, 2020

Figure 4. CLIMATE TECH VC DEALS ($B) BY STAGE



Source: PitchBook | Geography: Global | *As of October 30, 2020

Figure 5. CLIMATE TECH VC DEALS (#) BY STAGE



Source: PitchBook | Geography: Global | *As of October 30, 2020

Figure 6.

Notable climate tech VC deals

COMPANY	DEAL STAGE	DEAL SIZE ($M)	CLOSE DATE	REGION	SUBSEGMENT
WiTricity	Late-stage VC	$34.0	October 29, 2020	North America	Electric vehicle charging
Northvolt	Early-stage VC	$600.0	September 29, 2020	Europe	Batteries
Riversimple	Late-stage VC	$193.5	Not yet closed	Europe	Hydrogen
QuantumScape	Series F	$200.0	June 16, 2020	North America	Batteries
Form Energy	Series C	$75.0	September 11, 2020	North America	Energy storage
Hozon	Series C	$425.9	Not yet closed	Asia	Electric vehicles
Cleantech Solar	Debt	$75.0	June 23, 2020	Asia	Renewable energy generation
Enovate Motors	Series B	$735.9	October 13, 2020	Asia	Electric vehicles
Arrival	Late-stage VC	$118.0	October 13, 2020	Europe	Public transportation
Climeworks	Late-stage VC	$107.0	August 1, 2020	Europe	Carbon capture
Plenty	Series D	$140.0	October 14, 2020	North America	Indoor farming

Source: PitchBook

Climate tech VC ecosystem market map

Click to view interactive market map on the PitchBook platform

Market map is a representative overview of venture-backed or growth-stage providers in each segment. Companies listed have received VC or other notable private investments.

Transportation

Micro-mobility

(Hellobike) Lime Bird gogoro BOUNCE voi. ninebot

Biofuels

Enerkem Edeniq SGB sunfire

Electric vehicle platforms

BYTON (Hozon)

Electric flight

JOBY Lilium VOLOCOPTER XTI

Urban air mobility

Skyryse LINEAR air (Dash Systems) ASCENT VIMANA

Transportation (cont.)

Electric vehicle charging stations

chargepoint (TELD New Energy) volta TRITIUM (Infraprime Logistics Technologies)

Energy

Long duration energy storage

ESS MALTA

Next-generation battery technology

northvolt QuantumScape SILA enovix StoreDot amprius nexeon

Smart grid

Origami powerhive moixa thinxtra INVENIA LITION innowatts

Renewable energy generation

generalfusion GlassPoint NUSCALE

Materials & resources

Mining tech

TIMINING scrab EARTH AI einsite emesent NEXT ORE

Lithium extraction technology

Adionics SUMMIT NANOTECH

Smart waste management

RUBICON enevo COMPOLOGY OLIO ENWAY SEaB

Forestry

KOMAZA SATELLIGENCE Flash Forest

Lithium-ion battery recycling

REDWOOD MATERIALS Li-Cycle RENEWANCE

$26.1B
Total raised in transportation

$7.2B
Total raised in energy

$739.6M
Total raised in materials & resources

Climate tech VC ecosystem market map

Click to view interactive market map on the PitchBook platform

Market map is a representative overview of venture-backed or growth-stage providers in each segment. Companies listed have received venture capital or other notable private investments.

Industry

Carbon capture

FORTERA · climeworks · Carbon Engineering · Svante · AIREX

Industrial decarbonization processes

SOLIDIA · ECOncrete · CARBON CURE · CarbiCrete · EcoCarbon · Carbon Upcycling

Green hydrogen

Lhyfe · ION-MR · BOMAX · HiiROC

Agriculture

Regenerative agriculture

indigo · COOKS VENTURE · NOBI

Cellular agriculture

Perfect Day · Spiber · BOLT THREADS · MEMPHIS MEATS · GELTOR · mosa meat

Indoor farming

plenty · infarm · AeroFarms · BOWERY · fifth season · FREIGHT FARMS · OISHII

Adaptation

Water scarcity

APANA · HydroPoint · BANYAN WATER · KETOS · SOURCE · GRADIANT

Natural disaster preparedness & response

RAPIDSOS · one concern · TRACTABLE · AlertMedia · EDGYBEES · JUDY · COMPANY SIX

Climate modeling as a service

JUPITER · Cervest · TCS · ClimateAI · ClimateView · overstory

Behavior

.planetly · deedster · Changers · CarbonCloud · evocco · Ducky · klima.metrix

Buildings

Commercial

CARBON LIGHTHOUSE · sparkfund · EnOcean · CLEANFUND · 75F · ThoughtWire · Intellihot

Residential

inspire · HEATWORKS · PowerScout · swell · SMARTECH · SPAN · plant

$915.1M
Total raised in industry

$4.1B
Total raised in agriculture

$632.5M
Total raised in buildings

$608.8M
Total raised in adaptation

Climate tech market definitions

Transportation

Micro-mobility encompasses transportation solutions that target the "last mile" problem, whereby users have difficulty traveling from their current destination to a major transportation hub such as a bus or railway station, or vice versa. Distances covered by these solutions typically average less than six miles, with bicycles and scooters being the most prevalent form of transportation used to bridge this distance.

Electric vehicle charging stations includes companies building electric vehicle charging infrastructure to support the electrification of the mobility sector. The number of charging outlets has significantly expanded as awareness and adoption of electric vehicles has increased, and this trend is expected to continue and accelerate as large automakers such as GM continue to make investments into electric vehicle development.

Biofuel companies are producing an array of fuels generated from renewable biomass.

Electric vehicle platforms are companies developing and manufacturing electric vehicles, powertrains, and platforms. Though electric vehicles accounted for a minuscule percentage of automobile sales in 2019, significant growth in the industry is expected as battery technology improves and decarbonization becomes a stronger policy priority. Moreover, adoption of electric vehicles is expected to increase as charging infrastructure expands, major OEMs increase investments into the tech, and autonomy providers lean toward electric vehicles for their computing advantages.

Electric flight companies are developing hybrid or all-electric powertrains for electrified aerial transportation. Due to the lower energy density of existing lithium-ion battery technology, startups in electric flight are constrained to short-to-medium distance applications. Despite this limitation, electric flight is viewed as an important research area to help decarbonize overall air transportation, with primary applications in logistics and passenger transportation.

Urban air mobility refers to the use of vertical-take-off-and-landing (VTOL) aircraft in aerial transportation, generally best suited for urban environments. Companies in this space include both air taxi service providers as well as eVTOL manufacturers. Air taxis offer congested urban environments a new mode of transportation that seeks to find the optimal balance between cost and convenience. Additionally, aircraft in this space are almost entirely all-electric, reducing potential concerns over noise and pollution.

Energy

Long-duration energy storage technologies aim to improve the ability to store energy from the grid for use on demand, especially as sources of energy expand into renewables. Approaches in this category include flow batteries, compressed air, gravity storage, and thermal techniques.

Next-generation battery technology refers to the development of improvements or alternatives to the lithium-ion battery. These improvements and alternatives often involve new materials using advances in chemistry and materials sciences. Improved battery life is expected to enable advances in electric vehicle range, the performance and convenience of consumer electronics, and better storage options for renewable energy.

Smart grid refers to technology that allows for two-way communication between power utilities and their customers, enabling the more efficient transmission of electricity.

Renewable energy generation refers to the creation of electricity from sources that produce no carbon emissions. Energy sources in this category include hydrogen, fusion, solar, wind, tidal and wave power, geothermal, and nuclear.

Materials & resources

Mining tech includes companies developing technology to assist with the automation, expedition, and yield of mining processes. As the demand for consumer technologies and renewable energy in particular skyrockets, the need for more resources will put greater demands on mining production. The solutions in this space lean on robotics, AI, and digital twins among others to help mining companies meet this demand.

Lithium extraction technology includes companies developing novel solutions to mine lithium. With demand for lithium expected to triple by 2025, historical approaches to mining it have been deemed inadequate for modern needs due to slow process times and unsustainable use of water. Newer solutions propose to mine greater yields with less water, often in areas previously considered inaccessible for lithium mining development.

Smart waste management companies are developing technologies to improve the efficiency and effectiveness of traditional waste management. These solutions include waste bins equipped with sensors, data-base management and logistics platforms, and even robots and computer vision systems that can easily sort trash and recycling.

Reforestation startups in this space are focused on developing technologies and providing services related to reforestation and forestry management. The acceleration of both climate change and biodiversity loss has propelled governments and private actors to respond quickly, in this case by restoring and maintaining trees across the world in areas where they once thrived, enabling more species to flourish and carbon to be captured at greater rates. Types of companies in this space include drone-based replanting, satellite and AI-supplemented imaging, and carbon offset programs.

Lithium-ion battery recycling startups are designing technology and processes to recycle lithium-ion batteries more efficiently, especially those that are used in electric vehicles. Due to a combination of economic and technical factors, fewer than 5% of lithium-ion batteries are recycled today. However, these batteries, which are already fairly ubiquitous in consumer tech, are expected to scale up even more as the electric vehicle market expands, potentially creating both a sustainability and economic opportunity for their recycling.

Industry

Carbon capture startups are using a diverse array of technologies to capture, store, and/or remove carbon from industrial processes and the environment more broadly. Carbon capture & removal refers to the process of actively capturing carbon atoms and removing them from the atmosphere via storage or utilization in other forms. Carbon capture & removal is one of a series of technologies that investors are pursuing in order to mitigate the effects of climate change. Technologies in this category include afforestation, biochar, carbon sequestration, and direct air capture.

Industrial decarbonization processes includes companies developing techniques, methods, and technologies that enable fewer carbon emissions from common industrial outputs such as steel, concrete, and chemical production. Companies in this space are developing industrial process improvements that produce similar outputs with far fewer or no carbon emissions. Industrial processes are big carbon emitters, but adapting to new processes is very expensive.

Green hydrogen refers to the production of hydrogen as a fuel through renewable means. The majority of hydrogen today is produced from fossil fuels, largely due to cost and energy efficiency reasons. Companies in this space are developing technologies to bring down the costs of producing hydrogen at scale in a carbon-neutral manner.

Agriculture

Regenerative agriculture companies are adopting farming and grazing practices that help to reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity, in addition to other benefits. Companies in this space primarily develop programs for encouraging farmers, generally through carbon payment systems, to institute regenerative agricultural practices. This space is seeing increased attention as pressure on the agricultural sector grows to reduce its carbon-intensive processes.

Cellular agriculture focuses on the production of agricultural products from cell cultures using a combination of biotechnology, tissue engineering, molecular biology, and synthetic biology to create and design new methods of producing proteins, fats, and tissues that would otherwise come from traditional agriculture. Most of the industry is focused on animal products such as meat, milk, and eggs, produced in cell culture rather than raising and slaughtering farmed livestock. The most well-known cellular agriculture concept is cultured meat.

Indoor farming refers to the growing of crops or plants in a facility enclosed from the environment, usually on a large scale, using technologies such as hydroponics and artificial light. Indoor farming offers the advantage of using a controlled environment that enables year-round growth and produce to be stacked vertically to maximize output in a confined space. Companies within indoor farming include the growers and facilities, the equipment inside, and the software to manage them.

Adaptation

Water scarcity startups are developing solutions to help improve access to and cleanliness of fresh water in drought-prone regions. Climate change, accompanied by increasing deforestation and desertification, is expected to worsen the issue of water scarcity around the world.

Natural disaster preparedness & response companies are developing technologies to assist individuals and businesses vulnerable to natural disasters. With severe weather events growing more frequent due to climate change, these companies offer proactive and reactive measures to help minimize loss of life and property during a disaster. Technologies in this space include AI, drones, and communication platforms, and extend to applications such as wildfires, floods, earthquakes, and severe storms.

Climate modeling as a service describes companies analyzing climate data with the intention of providing risk assessments to enterprises. As increased global temperatures make weather patterns more unpredictable, these startups aim to provide more stability to businesses risk modeling. Often leveraging AI, applications in this space include flood risk assessment, real estate valuations, and agricultural production.

Behavior companies are developing tools that help individuals and businesses adopt climate-friendly lifestyles or practices. For example, by stating on a food label how much carbon was used to produce it, consumers may be more conscious of buying products with less carbon emissions.

Buildings

Buildings includes companies advancing technologies that help to monitor and optimize energy usage in commercial and residential buildings.

Key players

Figure 7.
Key VC-backed climate tech companies

COMPANY	SEGMENT	GROWTH THEME	PRODUCT FOCUS	TOTAL VC RAISED ($M)*	LAST FINANCING DATE
Faraday Future	Transportation	Electrification	Electric vehicle platforms	$4,361.0	October 14, 2020
Hellobike	Transportation	Micro-mobility	Bike sharing	$3,510.0	December 31, 2019
Chargepoint	Transportation	Electrification	Electric vehicle charging stations	$955.6	September 24, 2020
Joby Aviation	Transportation	Electrification, urban mobility	Air taxis	$728.3	January 15, 2020
Northvolt	Energy	Next-generation battery technology	Lithium-ion battery manufacturing	$3,670.0	September 29, 2020
ET Solar	Energy	Renewable energy generation	Solar power	$1,650.0	February 1, 2015
Energy Vault	Energy	Long-duration energy storage	Gravity storage	$110.0	January 1, 2020
TerraPower	Energy	Renewable energy generation	Nuclear energy	$178.0	September 13, 2019
Malta	Energy	Long-duration energy storage	Thermal energy storage	$26.0	December 19, 2018
Indigo Agriculture	Agriculture	Regenerative agriculture	Soil carbon enrichment	$1,120.0	June 22, 2020
Perfect Day	Agriculture	Cellular agriculture	Dairy products	$368.5	July 8, 2020
Memphis Meats	Agriculture	Cellular agriculture	Cultured meat	$208.3	April 10, 2020

Source: PitchBook | *As of September 30, 2020

Figure 8.

Key VC-backed climate tech companies (cont.)

COMPANY	SEGMENT	GROWTH THEME	PRODUCT FOCUS	TOTAL VC RAISED ($M)	LAST FINANCING DATE
Plenty	Agriculture	Indoor farming	Indoor farming	$541.0	October 14, 2020
MineSense	Materials & resources	Mining technology	Ore sorting technology	$95.6	March 12, 2020
Lilac Solutions	Materials & resources	Materials for renewables	Lithium extraction tech	$23.6	February 20, 2020
Redwood Materials	Materials & resources	Electrification	Lithium-ion battery recycling	$44.9	July 8, 2020
Carbon Lighthouse	Buildings	Commercial building energy efficiency	Real estate AI	$137.2	April 27, 2020
Inspire	Buildings	Residential building clean energy	Clean energy for home	$189.3	February 27, 2020
One Concern	Adaptation	Natural disaster preparedness & response	AI modeling	$74.1	June 2, 2020
Source	Adaptation	Water scarcity	Drinking water from solar panels	$103.0	June 17, 2020
Jupiter Intelligence	Adaptation	Climate risk modeling	AI modeling	$43.0	July 29, 2020
Climeworks	Industry	Carbon capture	Direct air capture	$159.3	August 1, 2020
Solidia	Industry	Low-carbon industrial processes	Cement & concrete	$118.2	July 31, 2018
Lhyfe	Industry	Green hydrogen	Renewable hydrogen generation	$12.3	January 17, 2020

Source: PitchBook | *As of September 30, 2020

Figure 9.

Key climate tech incumbents

COMPANY	SEGMENT	SUBSEGMENT	COMMENTARY	MARKET CAP ($M)*	NOTABLE ACQUISITIONS
Tesla	Transportation	Electric vehicles, battery technology, energy storage	Tesla is a major player in the clean energy space, most notable for its presence in the electric vehicle space. Its products include electric vehicles, battery energy storage, and solar products.	$407,549.0	Blanco Minerals, SolarCity, Redwood Materials (Inv)
NextEra Energy Partners	Energy	Renewable energy generation, wind & solar assets	NextEra Energy Partners is a limited partnership formed by NextEra Energy, intended to acquire, manage, and own contracted clean energy projects. The majority of its portfolio focuses on promising wind and solar opportunities.	$4,817.0	Aventino Solar, Nitrogen Renewables, Jericho Wind Energy Center
Sunnova Energy	Energy	Solar power	Sunnova Energy provides residential solar and energy storage services across the US. Sunnova's products are also focused on optimizing energy use in the home, using predictive analytics to estimate energy use over time.	$3,107.0	Sunlayar
Plug Power	Energy	Hydrogen power	Plug Power develops hydrogen fuel cells and hydrogen energy infrastructure. Its primary focus is on developing a platform of modular fuel cell engines to empower OEMs and system integrators to adopt fuel cell technology.	$7,576.0	Giner Elx, United Hydrogen, Energyor, American Fuel Cell, HyPulsion
Kalera	Agriculture	Indoor farming	Kalera is a smart horticulture company that develops and operates urban vertical farms. Its vertical hydroponic farms use cleanroom technology, IoT, AI, and Big Data analytics to create the conditions necessary to grow a variety of greens year-round.	N/A	N/A
Renewable Energy Group	Transportation	Biofuel	Renewable Energy Group is the largest producer of biomass-based diesel in the US and also develops renewable chemicals.	$2,107.0	Imperium Renewables, Dynamic Fuels, LS9
Suzlon Energy	Energy	Wind power	Suzlon Energy is an international manufacturer of wind turbine technology, with an installed capacity of over 17,000 MW in 18 countries.	$24,580.0	Mostly just assets
Ballard Power Systems	Energy	Fuel cells, marine	Ballard Power Systems develops fuel cells for use in the automotive transportation, trains, mining trucks, and marine markets.	$5,309.0	Automotive Fuel Cell Cooperation, Protonex Technology, Weichai Ballard Hy-Energy Technology, H2 PowerTech
Neo Lithium	Materials & resources	Lithium extraction, materials & resources for energy transition	Neo Lithium is developing an upcoming lithium-extraction project based in Argentina. The project aims to minimize carbon footprint and freshwater consumption.	$135.0	N/A
Aker Carbon Capture	Industry	Carbon capture	Aker Carbon Capture outfits industrial plants with carbon capture and sequestration technology. Its proprietary process uses a mixture of water and organic solvents to absorb CO2. The process can be applied to emissions from gas, coal, cement, refineries, waste-to-energy, and hydrogen production.	$4,811.0	N/A

Source: PitchBook | *As of October 30, 2020

KEY PLAYERS

Figure 10.

Key VC investors in climate tech from 2018 to 2020*

INVESTOR NAME	DEAL COUNT
SOSV	21
Breakthrough Energy Ventures	20
CPT Capital	16
EIT Innoenergy	13
Contrarian Ventures	7
Urban Us	7
Total Carbon Neutrality Ventures	7
Spark Capital	7
Starlight Ventures	6
Cycle Capital Management	6

Source: PitchBook | *As of October 30, 2020

Emerging technologies

Climate tech emerging technology landscape

1 **Hydrogen energy**

Companies in this space are developing methods, machines, and materials to harness the power of hydrogen to generate energy. Key technologies represented here include the design and manufacture of hydrogen fuel cells, new methods of hydrogen production, hydrogen energy storage, hydrogen fuel infrastructure, and hydrogen-powered mobility solutions. Due to its zero-emission output and high energy density, hydrogen emerges as a promising energy source. However, companies must find a way to reduce the cost of hydrogen production to make this method competitive with other forms of energy generation.

Highlighted company: Ardica

2 **Small modular reactors**

Small modular reactors (SMRs) are defined by the World Nuclear Association as "nuclear reactors generally 300 megawatt electrical (MWe) equivalent or less, designed with modular technology using module factory fabrication, and pursuing economies of series production and short construction times." The small size of these reactors makes them easy to construct, safe, and deployable to remote areas that still have dire energy needs.

Highlighted company: NUSCALE

CLIMATE TECH EMERGING TECHNOLOGY LANDSCAPE

3 **Renewable ocean energy**
Renewable ocean energy describes the effort to generate electricity via the ocean, most commonly via tides, waves, salination, and water temperature fluctuations. Ocean movement offers a vast, untapped source of kinetic energy that companies in this category aim to capture. Currently, renewables such as wind and solar are cheaper to build and operate but are less available. Innovators in this space are testing competing iterations of technologies, ultimately working to lower costs of ocean-sourced power to be more competitive with wind and solar.

Highlighted company: Minesto

4 **Waste to energy**
Companies in this space are developing techniques to convert both organic and inorganic waste into usable energy such as hydrogen, biofuels, and synthesis gas. These companies are developing technologies that aim to improve upon traditional incineration, which expends excessive energy and creates pollutants. Separate from the circular economy, entrepreneurs in this space believe that waste is a serious carbon emitter that will endure without significant efforts and technologies concentrated on waste removal.

Highlighted company: SIERRA ENERGY

5 **Concentrated solar power**
Concentrated solar power (CSP) harnesses solar thermal energy using mirrors to heat a specific focal point, which collects and stores the heat energy to power a turbine, thereby generating electricity. CSP projects are often used in utility scale scenarios, with the goal of providing power directly to the electrical grid, though applications could be expanded to power generators for localized energy use. Current research focuses on improving unit economics by reducing manufacturing costs, developing new storage technologies, and increasing automation of operations.

Highlighted company: Heliogen

6 **Smart grid**
A smart grid refers to digital technology that allows for two-way communication between power utilities and their customers, thereby enabling a more efficient transmission of electricity.

Highlighted company: stem

7 **Long-duration energy storage**
Energy storage technologies aim to improve our ability to store energy for use on demand, especially as sources of energy expand into renewables. Companies in this space are using a variety of approaches such as batteries, thermal, pumped hydropower, and other mechanical storage methods.

Highlighted company: form energy

8 **Fusion energy**
Fusion energy is a proposed form of power generation that would generate electricity by using heat from nuclear fusion reactions. Fusion has the potential to eliminate dependence on fossil fuels, as it would be emission-free, safe, and economically viable globally. However, the core technology is still theoretical, and many of these startups are focused on finding pragmatic applications of the underlying theory.

Highlighted company: Commonwealth Fusion Systems

9 **Next-generation battery technology**
Alternative battery tech refers to the development of improvements or alternatives to the lithium-ion battery. These improvements and alternatives often involve new materials using advances in chemistry and materials sciences. Improved battery life is expected to enable advances in electric vehicle range, the performance and convenience of consumer electronics, and better storage options for renewable energy.

Highlighted company: QuantumScape

10 **Electric vehicle platforms**
Companies in this space are developing and manufacturing electric vehicles, powertrains, and platforms. Though electric vehicles accounted for a minuscule percentage of automobile sales in 2019, significant growth in the industry is expected as battery technology improves and decarbonization becomes a stronger policy priority. Moreover, adoption of electric vehicles is expected to increase as charging infrastructure expands, major OEMs increase investments into the tech, and autonomy providers lean toward electric vehicles for their computing advantages.

Highlighted company: LUCID

11 **Electric vehicle charging infrastructure**
This space includes companies building electric vehicle charging infrastructure to support the electrification of the mobility sector. The number of charging outlets has significantly expanded as awareness and adoption of electric vehicles has increased, and this trend is expected to continue and accelerate as large automakers such as GM continue to make investments into electric vehicle development.

Highlighted company: chargepoint

CLIMATE TECH EMERGING TECHNOLOGY LANDSCAPE

12 **Urban air mobility**
Air taxis refers to transportation in vertical-take-off-and-landing (VTOL) aircraft across short distances, generally best suited for urban environments. Companies in this space include both air taxi service providers as well as eVTOL manufacturers. Air taxis offer congested urban environments a new mode of transportation that seeks to find the optimal balance between cost and convenience. Additionally, aircraft in this space are almost entirely all-electric, reducing potential concerns over noise and pollution.

Highlighted company: LILIUM

13 **Electric flight**
Electric flight companies are developing hybrid or all-electric powertrains for electrified aerial transportation. Due to the lower energy density of existing lithium-ion battery technology, startups in electric flight are constrained to short-to-medium distance applications. Despite this limitation, electric flight is viewed as an important research area to help decarbonize overall air transportation, with primary applications in logistics and passenger transportation.

Highlighted company: EVIATION

14 **Regenerative agriculture**
Regenerative agriculture companies are adopting farming and grazing practices that help to reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity, in addition to other benefits. Companies in this space primarily develop programs for encouraging farmers, generally through carbon payment systems, to institute regenerative agricultural practices. This space is seeing increased attention as pressure on the agricultural sector grows to reduce its carbon intensive processes.

Highlighted company: COOKS VENTURE

15 **Cellular agriculture**
Cellular agriculture focuses on the production of agriculture products from cell cultures using a combination of biotechnology, tissue engineering, molecular biology, and synthetic biology to create and design new methods of producing proteins, fats, and tissues that would otherwise come from traditional agriculture. Most of the industry is focused on animal products such as meat, milk, and eggs, produced in cell culture rather than from farmed livestock. The most well-known cellular agriculture concept is cultured meat.

Highlighted company: Perfect Day

16 **Indoor farming**
Indoor farming refers to the growing of crops or plants in a facility enclosed from the environment, usually on a large scale, using technologies such as hydroponics and artificial light. Indoor farming offers the advantage of using a controlled environment such that growing can happen year-round, whereby produce can be stacked vertically to maximize output in a confined space. Companies within indoor farming include the growers and facilities, the equipment inside, and the software to manage them.

Highlighted company: plenty

17 **Mining tech**
The mining tech space includes companies developing technology to assist with the automation, expediting, and yield of mining processes. As the demand for consumer technologies and renewable energy in particular skyrockets, the need for more resources will put greater demands on mining production. The solutions in this space lean on robotics, AI, and digital twins, among others, in order to help mining companies meet increased demand on resources.

Highlighted company: minesense

18 **Lithium extraction technology**
The lithium extraction technology space focuses on companies developing novel solutions to mine lithium. With demand for lithium expected to triple by 2025, historical approaches to mining it have been deemed inadequate for modern needs due to slow process times and unsustainable use of water. Newer solutions propose to mine greater yields with less water, often in areas that were previously considered inaccessible for lithium mining development.

Highlighted company: Lilac

19 **Lithium-Ion battery recycling**
Companies in this space are designing technology and processes to more efficiently recycle lithium-ion batteries, especially those that are used in electric vehicles. These batteries, which are already fairly ubiquitous in consumer tech, are expected to scale up even more as the electric vehicle market expands, potentially creating both a sustainability and economic opportunity for their recycling.

Highlighted company: Lithion

CLIMATE TECH EMERGING TECHNOLOGY LANDSCAPE

20 **Smart waste management**
Smart waste management companies are developing technology-oriented solutions to improve the efficiency and effectiveness of traditional waste management. These solutions include waste bins equipped with sensors, data-base management and logistics platforms, and even robots and computer vision systems that can easily sort trash and recycling.

Highlighted company: RUBICON

21 **Reforestation**
Startups in this space are focused on developing technologies and providing services related to reforestation and forestry management. The acceleration of both climate change and biodiversity loss has propelled governments and private actors to respond quickly, in this case by restoring and maintaining trees across the world in areas where they once thrived, enabling more species to flourish and carbon to be captured at greater rates. Types of companies in this space include drone-based replanting, satellite and AI-supplemented imaging, and carbon offset programs.

Highlighted company: dendra SYSTEMS

22 **Carbon capture**
Carbon capture & removal refers to the process of actively capturing carbon atoms and removing them from the atmosphere via storage or utilization in other forms. Carbon capture & removal is one of a series of technologies that investors are pursuing to mitigate the effects of climate change. Technologies in this category include afforestation, biochar, carbon sequestration, and direct air capture.

Highlighted company: Carbon Engineering

23 **Natural disaster preparedness & response**
Companies in this space are developing technologies to assist individuals and businesses vulnerable to natural disasters. With severe weather events growing more frequent due to climate change, these companies offer proactive and reactive measures to help minimize loss of life and property during a disaster. Technologies in this space include AI, drones, and communication platforms, and extend to applications such as wildfires, floods, earthquakes, and severe storms.

Highlighted company: one concern

24 **Climate risk modeling as a service**
Climate risk modeling as a service describes companies analyzing climate data with the intention of providing risk assessments to enterprises. As increased global temperatures make weather patterns more unpredictable, these startups aim to provide more stability to businesses' risk modeling. Often leveraging AI, applications in this space include flood risk assessment, real estate valuations, and agricultural production, among others.

Highlighted company: JUPITER