PitchBook

EMERGING TECH RESEARCH

Climate Tech

Q3 2021 VC update

Contents

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Published on October 26, 2021

This report serves as a quarterly snapshot of the climate tech vertical in Q3 2021. For a comprehensive, detailed introduction to the climate tech industry, please see **Introduction to Climate Tech: A Taxonomy Overview.**

Vertical overview

The climate technology vertical consists of solutions across various industries that seek to help countries and businesses reduce carbon emissions. In alignment with the Paris Agreement, 59 countries—representing 54% of global GHG emissions—have set a net-zero carbon emission target before 2050.[1] This worldwide effort to limit global temperature increases to 1.5°C relative to pre-industrial levels is likely to drive sustained focus on the climate tech industry. In addition to the environmental importance of this initiative, we believe it is also spurring significant opportunities for startups to create novel solutions to help signatories achieve their Paris Agreement goals.

Emerging climate tech startups are targeting a broad range of industries as they seek to decarbonize the economy, including the energy sector, transportation, building, food systems, and industrial processes. This represents an important shift from the ill-fated Clean Tech 1.0 trend between 2006 and 2011, which focused primarily on the energy sector and ultimately caused investors to lose nearly 50% of the roughly $25 billion of venture capital invested. This time around, startups are focused on the broader global climate change emergency in an effort to decarbonize across all sectors of the economy to reduce greenhouse gas emissions (GHGs).

Given this new approach to the problem, it is not surprising that the climate tech vertical is highly fragmented and encompasses a diverse ecosystem of disparate providers at different stages of technological maturity. The industry encompasses technologies focused on reducing GHG emissions created by energy generation and storage, sustainable transport, the built environment, industrial processes, food systems, land use, and carbon technologies. It is estimated that existing technologies can reduce up to 65% of emissions needed to reach net zero by 2050, but the remaining 35% will require new technological breakthroughs that could provide opportunities for enormous growth. We estimate climate tech will provide investors with an investment opportunity between $100 trillion and $150 trillion over the next 30 years, equivalent to roughly $3 trillion–$5 trillion annually.[2]

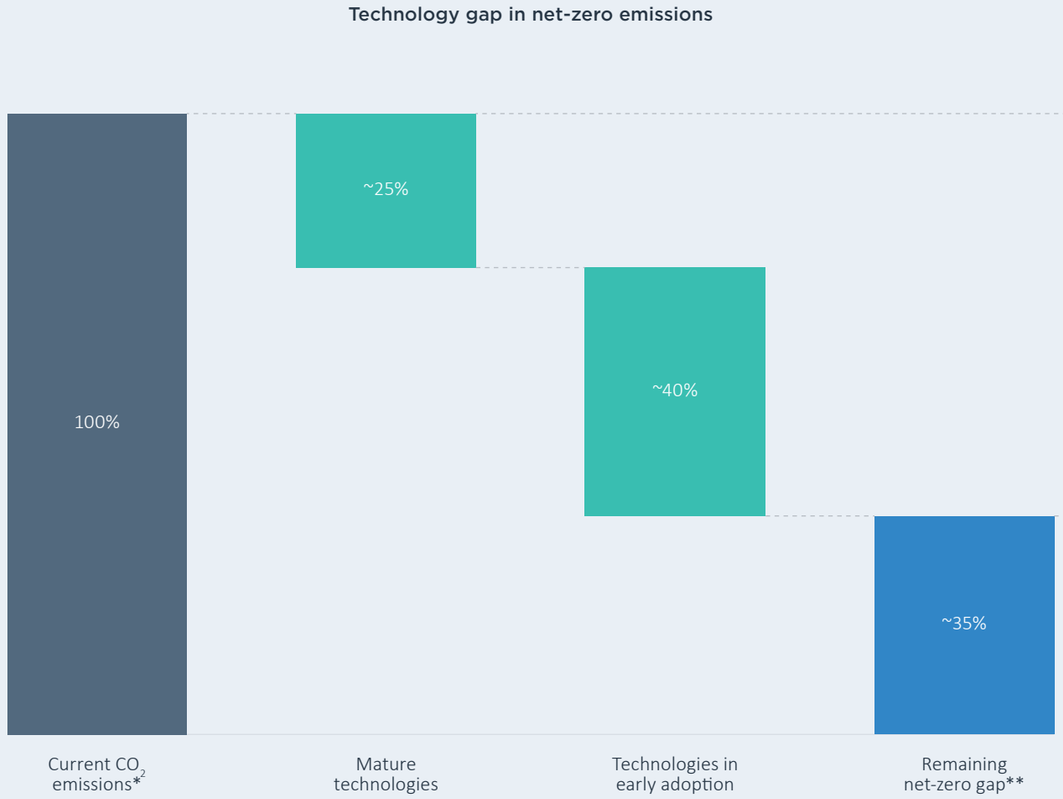
The growth has already begun. Between 2013-2019, capital deployed in climate tech grew at 5x the venture capital overall growth rate,[3] even though climate tech only made up 6% of the total venture capital invested in 2020. The current fragmentation of the investor landscape is likely to diminish as more climate-tech focused funds are launched.

1: “Net Zero Targets: Which Countries Have Them and How They Stack Up,” World Resources Institute, June 2, 2021.
2: “The Time for Climate Change Is Now,” BCG, April 2021.
3: “Climate Tech Investment Grows at Five Times the Venture Capital Market Rate over Seven Years,” PwC, September 23, 2020.

VERTICAL OVERVIEW

Figure 1.

Existing technologies can reduce up to 65% of emissions needed for net-zero goal



Opportunity: estimated ~$100-150T investment needed over next 30 years to reach net-zero globally ($3-5T/year)

New business models and changes in policy can maximize available net-zero technologies to achieve 60-70% of progress towards net-zero

e.g., mature technologies include renewable energy technologies, efficiency improvements in operations; early adoption includes carbon capture, utilization, and storage (CCUS) technologies

Remaining gap in technologies to achieve net-zero by 2050

e.g., technologies not yet commercially scalable such as hydrogen electrolysis from seawater or alternative-fuel/battery-powered aircrafts

Source: BCG

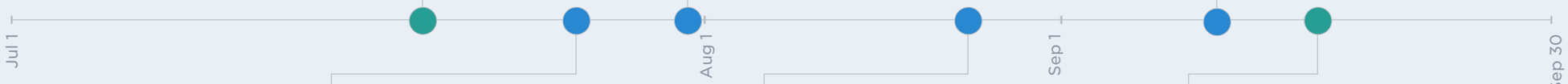
* Excludes other GHG emissions (e.g., methane, nitrous oxide). 2. Includes technologies in demonstration and large prototype as well as technologies still in development. Source: IEA Sep 2020: Global energy sector CO2 emissions reductions by current technology maturity category in the Sustainable Development Scenario relative to the Stated Policies Scenario, 2019-2070, GFMA; BCG analysis.

Q3 2021 timeline

July 16 — VC EXIT
Clean hydrogen mobility company **Hyzon** (NASDAQ: HYZN) goes public via a special purpose acquisition company (SPAC) reverse merger, valuing the company at $2.7 billion.

July 30 — VC DEAL
Lithium-ion battery manufacturer **SVOLT** raises a $1.59 billion Series B led by BOCGI Zheshang Capital, valuing the company at $5.6 billion—a 3.46x step-up.

September 9 — VC DEAL
Clean chemical producer **Solugen** raises a $357 million Series C led by Baillie Gifford, valuing the company at $1.86 billion—a 6.0 x step-up.



July 23 — VC DEAL
Electric vehicle (EV) manufacturer **Rivian** raises a $2.5 billion late-stage round led by Amazon, D1 Capital, and T. Rowe Price, making it the largest deal in Q3.

August 24 — VC DEAL
Sodium-based energy storage developer **Form Energy** raises a $240 million Series D led by ArcelorMittal, valuing the company at $1.2 billion—a 2.98x step-up.

September 15 — VC EXIT
Renewable natural gas producer **Archaea Energy** (NYSE: LFG) goes public via a SPAC reverse merger, valuing the company, which is expected to become the largest producer of renewable natural gas in the US, at $1.15 billion.

Q3 VC DEAL ACTIVITY

203
total deals

$12.9B
total raised

YTD VC DEAL ACTIVITY

783
total deals

$30.8B
total raised

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.

CLIMATE TECH VC ECOSYSTEM MARKET MAP

Food systems

Alternative protein

IMPOSSIBLE · motif · ripple · NotCo · Perfect Day · Thought Machine · LIVEKINDLY · BOLT THREADS · v2food

Indoor farming

AeroFarms · infarm · f'fth season · Oishii · CropOne · plenty

Alternative farming methods

invaio sciences · local bounti · VESTARON · SOLINFTEC · BIOWISH · iunu · SunCulture · LIVING GREENS FARM · Epitome Energy

Ag biotech

BENSON HILL · indigo · Yield10 BIOSCIENCE · Clara Foods · DUCTOR · PolyGenomX · GreenOnyx · CB Therapeutics

Cultured meat

CALYSTA · BlueNalu · MEATABLE · Shiok Meats · WILDTYPE · WILD EARTH · NOVONUTRIENTS · MeaTech · MISSION BARNS · UMITRON

Robotics

ecorobotix · farmshelf · Greenfield ROBOTIC · grownetics · growcer · CITYCROP · URBAN HARVEST · Vitalgia · agbotic

Energy transition - grid tech

Energy storage

stem · CARBON NEUTRAL ENERGY · ENERGY VAULT · Nanotech Energy · Highview Power · PRIMUS POWER

Grid management

generalfusion · REDAPTIVE · Mainspring · inspire · SUNVERGE · GaN Systems · MODERN ENERGY · voltus

Analytics

brighte · swell · Gridwiz · SOLFACIL · sparkfund · powerhive · Wildcat Discovery Technologies · nexamp

Battery technology

FREYR · ENOVIX · 24m · Factorial · Cadenza INNOVATION · moixa · Ambri · amprius

Hydrogen

FE FUEL · H2PRO · ELECTRIC HYDROGEN · Lhyfe · jol · Pragma Industries · CPH2 · PROTIUM · EODev · Z·E·G · MONOLITH

Land use

Fertilizer alternatives

PIVOT BIO · Terramera · Sound · concentric · CSS

Land use management

COLLECTIVE CRUNCH · (Rainforest Connection) · BIOME MAKERS · GUARDIAN AGRICULTURE

Forest carbon tech

dronenseed silvaseed · Terraformation · dendra SYSTEMS · Flash Forest · Pachama · NCX

Climate/Earth data

planet. · Orbital Insight · one concern · semios · Gro Intelligence · Climavision · CIBO · Cervest · BYE AEROSPACE · tomorrow.io · ORORA TECHNOLOGIES

Industry

Lithium battery recycling

REDWOOD MATERIALS · Li-Cycle · GDT · Lithion

Fuel alternatives

Fulcrum BIOENERGY · Edeniq · Fiberight · sunfire · POWERTAP HYDROGEN · Lycia | Xiaozao Tech · AIREX · WRT · steeper ENERGY · SUPERBREWED FOOD · RENEWLOGY

Chemicals

METGEN · Starfire Energy · SEPPURE · 45-8 Energy · GEN3BIO · Solugen · GreenEarth Institute · TRILLIUM · KHEPRA

Mining tech

GoldSpot DISCOVERIES INC. · Cornish Lithium · Lilac · SUMMIT NANOTECH · EARTH AI · novamera · TIMINING · scarab · emesent · GRYPHON DIGITAL MINING

Manufacturing

achatesPOWER · BOSTON METAL · H2green steel · KAIROS AEROSPACE · Blue World · Upstart Power · MetOx · THEVA · LeadingEdge

Built environment

Heating/cooling

HALIO · NIRVANA · QARNOT · TREAU · ambion · SkyCool Systems · AIREX · ADVANCED DATA COOLING TECHNOLOGIES · MODERN ELECTRON

Energy efficiency

BluePath · VERDIGRIS · 75F · CLEANFUND · AEROSEAL · heliotrope · Pearl · PassiveLogic · pooled energy · Brite · HEATWORKS

Construction tech

NEXII · MIGHTY BUILDINGS · plant PREFAB · SENSORFLOW · IDEAL MODULAR HOMES · hygge power · MIRU

Water

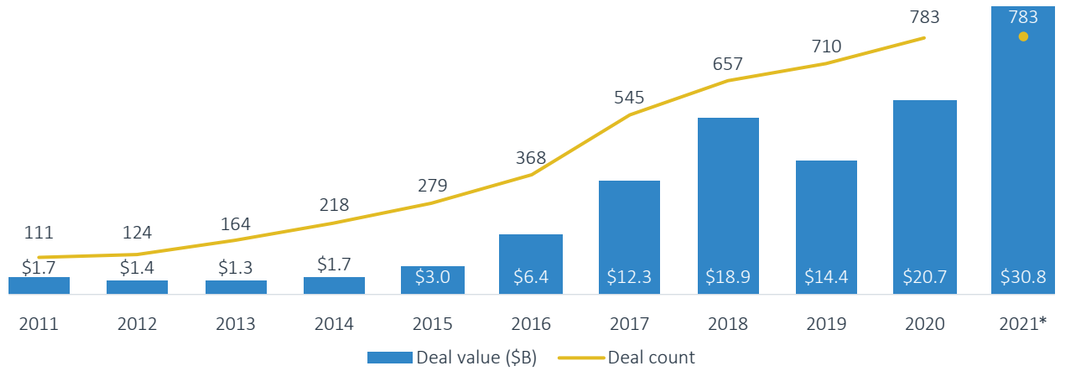
Intellihot · Conservation Labs · PowerX

VC activity

The deployment of VC into climate tech continued to increase in Q3 2021. Climate tech startups raised $12.9 billion in VC investment across 203 deals in Q3, up 49.2% QoQ and 38.3% YoY. As in previous quarters, electric transportation companies received most of the investment as VCs targeted sustainable transport. Notable VC deals in the quarter include a $776.6 million Series C round raised by the sustainable battery recycling company **Redwood Materials** and led by T. Rowe Price, bringing the post-money valuation to $3.8 billion, with a 13.83 x step-up. **Pivot Bio**, a producer of microbial nitrogen fertilizers, raised a $430 million Series D round led by Temasek Holdings and joined by investors including Breakthrough Energy Ventures, Bunge Ventures, CGC Ventures and new investors such as G2VP and Rockefeller Capital Management, among others. Foam Energy, a developer of sodium-based energy storage, raised a $240 million Series D led by ArcelorMittals, which valued the company at $1.2 billion—a 2.98x step-up. **SVOLT**, a developer and manufacturer of electric batteries, raised $1.6 billion in a Series B round, which brings its post-money valuation to $5.6 billion, with a 3.46x step-up.

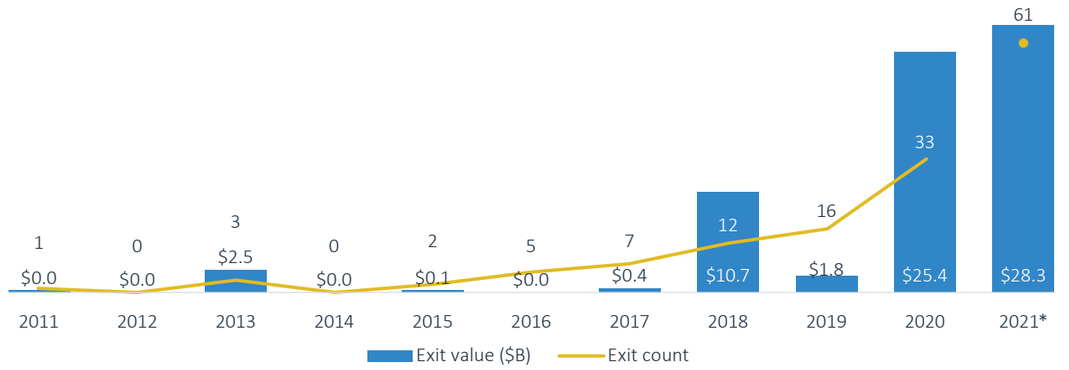
Valuations for early- and late-stage climate tech startups increased in Q3. While the median pre-money valuation for angel & seed climate tech startups decreased 6.5% YoY to $6.5 million, the median pre-money valuation for early-stage climate tech startups increased by 105% YoY to $41 million. Late-stage valuations saw less growth as the median pre-money valuation increased by 32.2% YoY to $79.3 million. The drastic increase in early-stage valuations was largely driven by investments in battery tech, electric mobility, and alternative proteins.

Figure 2. CLIMATE TECH VC DEAL ACTIVITY



Source: PitchBook | Geography: Global | *As of September 30, 2021

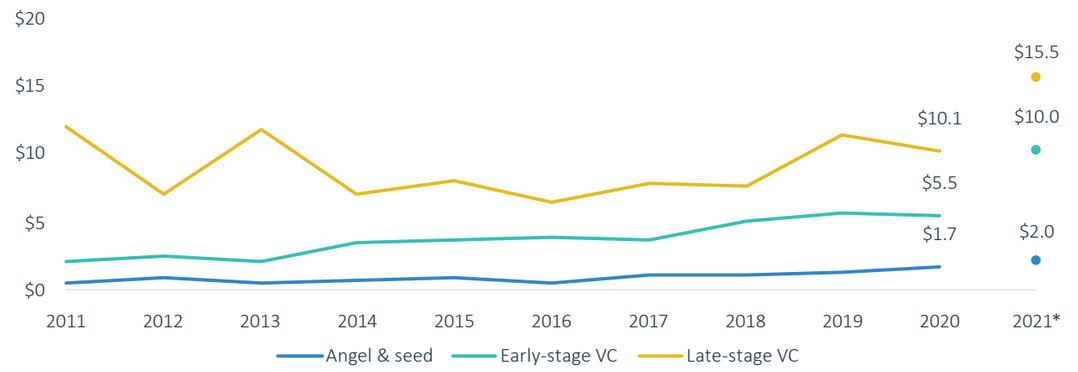
Figure 3. CLIMATE TECH VC EXIT ACTIVITY



Source: PitchBook | Geography: Global | *As of September 30, 2021

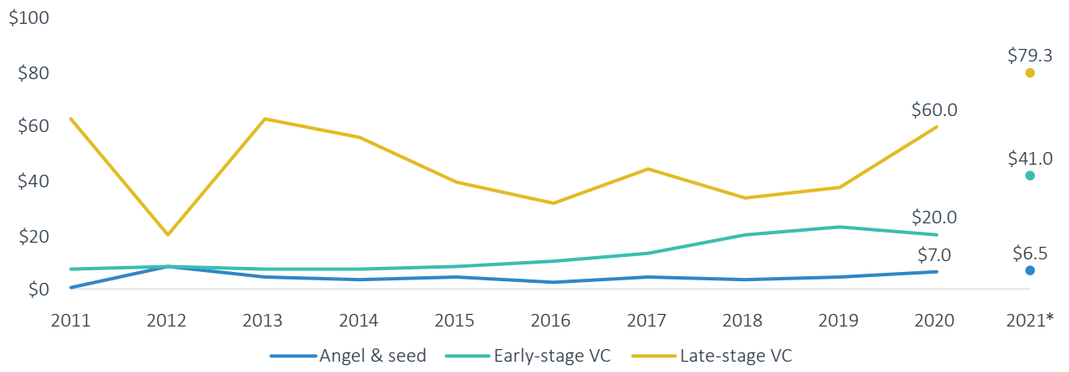
VC ACTIVITY

Figure 4. MEDIAN CLIMATE TECH VC DEAL SIZE ($M) BY STAGE



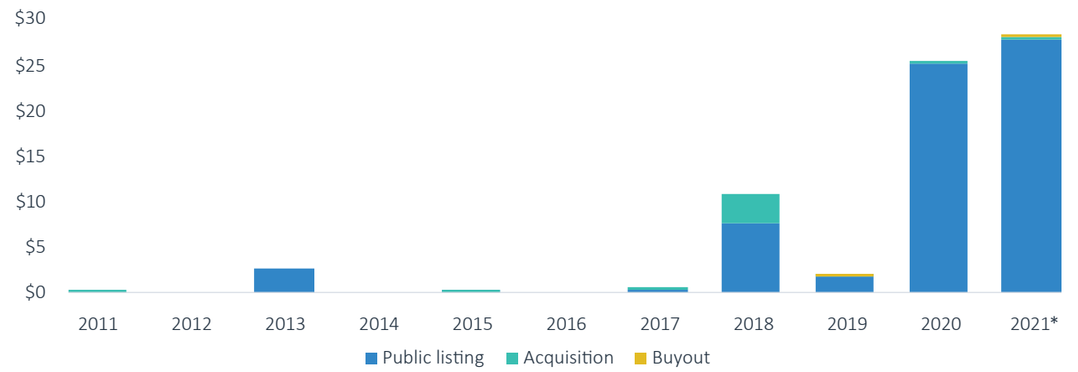
Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 5. MEDIAN CLIMATE TECH VC PRE-MONEY VALUATION ($M) BY STAGE



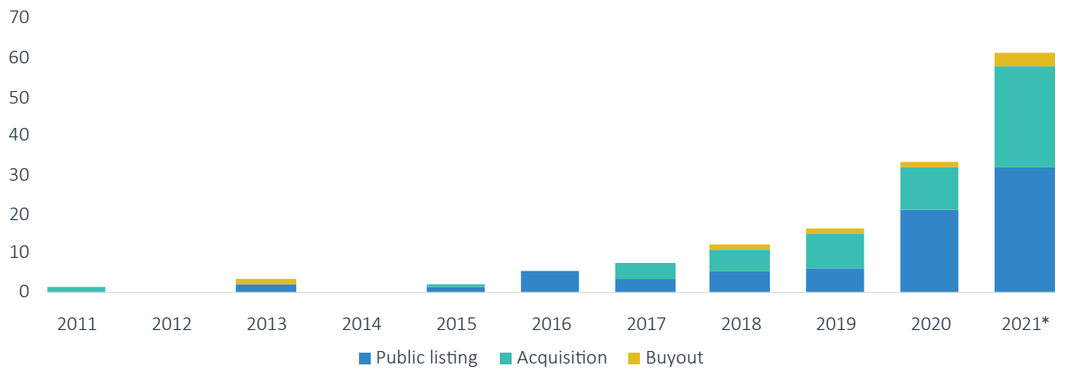
Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 6. CLIMATE TECH VC EXIT VALUE ($B) BY TYPE



Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 7. CLIMATE TECH VC EXIT COUNT BY TYPE



Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 8.

Key climate tech early-stage VC deals

COMPANY	CLOSE DATE	SEGMENT	DEAL SIZE ($M)	SERIES	LEAD INVESTOR(S)	VALUATION STEP-UP*
SVOLT	July 30, 2021	Electric transportation	$1,586.1	Series B	BOCGI Zheshang Capital	N/A
Verkor	July 6, 2021	Electric transportation	$119.8	Series B	Groupe Renault (France), EQT Ventures	N/A
v2food	August 5, 2021	Food systems	$110.2	Series B	Astanor Ventures	N/A
Aleph Farms	July 7, 2021	Food systems	$105.0	Series B	DisruptAD, L Catterton	N/A
Prometheus Fuels	September 23, 2021	Industry	$100.0	Series B	N/A	8.1x
TurtleTree	July 6, 2021	Food systems	$80.0	Series A	VERSO Capital (Switzerland)	N/A
Lhyfe	September 30, 2021	Energy transition - grid tech	$58.9	N/A	N/A	N/A
Heart Aerospace	July 13, 2021	Electric transportation	$35.0	Series A	United Airlines Ventures, Breakthrough Energy Ventures, Mesa Air Group	N/A
Nexii	September 8, 2021	Built environment	$34.1	N/A	Honeywell	4.8x
Easy charger	July 19, 2021	Electric transportation	$29.7	N/A	N/A	N/A

Source: PitchBook | Geography: Global | *As of September 30, 2021

VC ACTIVITY

Figure 9.

Key climate tech late-stage VC deals

COMPANY	CLOSE DATE	SEGMENT	DEAL SIZE ($M)	SERIES	LEAD INVESTOR(S)	VALUATION STEP-UP*
Rivian	July 23, 2021	Electric transportation	$2,500.0	N/A	T. Rowe Price, Amazon.com, D1 Capital Partners, Ford Motor Company Fund	N/A
Redwood Materials	August 18, 2021	Industry	$776.6	Series C	T. Rowe Price	13.8x
Caocao Mobility	September 7, 2021	Mobility solutions	$586.2	Series B	N/A	6.1x
Pivot Bio	July 19, 2021	Land use	$430.0	Series D	Temasek Holdings	3.1x
Solugen	September 9, 2021	Industry	$357.0	Series C1	Gulf Investment Corporation, Baillie Gifford	6.0x
Perfect Day	September 29, 2021	Food systems	$350.0	Series D1	Canada Pension Plan Investment Board, Temasek Holdings	1.5x
Bowery	August 13, 2021	Food systems	$320.7	Series C	Fidelity Management & Research	4.0x
Eat Just	September 20, 2021	Food systems	$267.0	Series F	N/A	N/A
Form Energy	August 24, 2021	Energy transition - grid tech	$240.0	Series D	ArcelorMittal	3.0x
Nexamp	August 17, 2021	Energy transition - grid tech	$240.0	N/A	Generate	N/A

Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 10.

Key climate tech VC exits

COMPANY	CLOSE DATE	SEGMENT	EXIT SIZE ($M)	EXIT TYPE	ACQUIRER(S)/INDEX	POST-MONEY VALUATION ($M)
Arrival	March 24, 2021	Electric transportation	$5,000.0	Public listing	CIIG Merger	$5,660.0
REE Automotive	July 22, 2021	Mobility solutions	$3,600.0	Public listing	10X Capital Venture Acquisition	$3,600.0
Faraday Future	July 22, 2021	Electric transportation	$3,170.0	Public listing	Property Solutions Acquisition	$3,400.0
Lilium	September 14, 2021	Electric transportation	$2,470.0	Public listing	Qell Acquisition	$3,300.0
Xos Trucks	August 24, 2021	Electric transportation	$2,000.0	Public listing	NextGen Acquisition	$2,000.0
ChargePoint	February 26, 2021	Electric transportation	$1,907.0	Public listing	Switchback Energy Acquisition	$2,400.0
Hyzon	July 16, 2021	Mobility solutions	$1,750.0	Public listing	Decarbonization Plus Acquisition	$2,700.0
Benson Hill	September 29, 2021	Food systems	$1,597.0	Public listing	Star Peak Corp II	$2,000.0
FREYR	July 8, 2021	Energy transition - grid tech	$1,400.0	Public listing	Alussa Energy Acquisition	$1,400.0
Proterra	February 25, 2021	Electric transportation	$1,322.0	Public listing	ArcLight Clean Transition	$1,600.0

Source: PitchBook | Geography: Global | *As of September 30, 2021

VC ACTIVITY

Figure 11.

Top VC investors in climate tech companies since 2018

INVESTOR	DEAL COUNT*
SOSV	64
CPT Capital	44
Unovis Asset Management	43
Prelude Ventures	39
Khosla Ventures	39
Blue Horizon Corporation	34
Stray Dog Capital	34
Kleiner Perkins	34
TotalEnergies Ventures	34
Alumni Ventures Group	33

Source: PitchBook | Geography: Global | *As of September 30, 2021

Figure 12.

Top VC-backed climate tech companies by total VC raised to date

INVESTOR	VC RAISED TO DATE ($M)
Rivian	$8,951.3
Northvolt	$4,410.1
Weltmeister	$3,915.5
Hello Inc.	$3,879.9
SVOLT	$2,268.9
BAIC BJEV	$2,112.2
Enovate Motors	$1,409.9
Impossible Foods	$1,362.5

Source: PitchBook | Geography: Global | *As of September 30, 2021

Emerging opportunities

Forest carbon tech

Buyers seeking transparent and accountable carbon markets

Turquoise hydrogen

Generating energy while producing solid carbon

Clean crypto mining tech

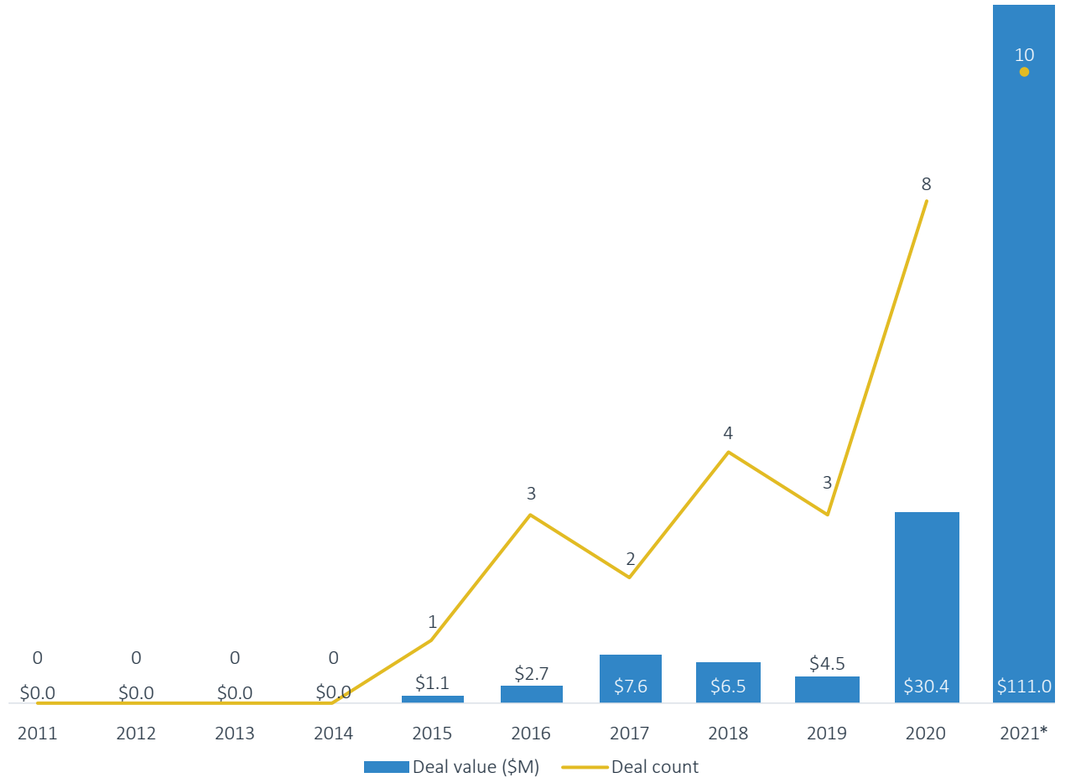
Making bitcoin mining climate friendly

Forest carbon tech

More and more, carbon markets are becoming an essential focus—not just for governments but also for corporations. Hence, in addition to compliance carbon markets, voluntary carbon markets are playing an increasingly important role. Voluntary carbon markets were formed to drive corporate finance into projects that reduce GHG emissions, and to date, more than 200 companies have voluntarily agreed to honor Climate Pledge commitments to reach net zero by 2040 (10 years earlier than anticipated by the United Nations). In an analyst note released in August, the current most liquid carbon credit exchange, **Xpansiv** CBL, shared a number that makes it clear: In comparison to last year, carbon volumes are up 393%, with total transactions of 25.8 million tons of carbon traded in Q2 2021. .[4]

Supplying markets with carbon credits through nature-based carbon solutions will require advances in technology that can ensure transparency, integrity, and accountability. Quantifying carbon sequestration has traditionally been done manually and can take years; hence emerging-technology-based approaches will have an enormous multiplier effect for forest analysis. The idea behind forest-based climate strategies is that forests decrease the free carbon in the air by increasing the amount of carbon in trees, presenting the fastest and cheapest way to sequester carbon as of now. It is expected that the demand for carbon credits will outpace the supply as soon as 2024,[5] which makes it essential to secure a high-quality carbon credit supply early on. Startups that work on solving these issues are integrating machine learning models, light detection and ranging (LiDAR) technology, and advanced native mass reforestation to create carbon sinks and significantly improve forest growth models.

Figure 13. FOREST CARBON TECH VC DEAL ACTIVITY



Source: PitchBook | Geography: Global | *As of September 30, 2021

4: "Xpansiv Market CBL Sets Quarterly Record, Trading More than 25M Tons of Carbon and 66B Litres of Water," Xpansiv, July 1, 2021.
5: "The Time for Climate Change is Now," BCG, April 2021.

FOREST CARBON TECH

Two promising startups seek to address the opportunity with end-to-end solutions that span from seed technology to using artificial intelligence (AI) to validate carbon sequestration. **Terraformation** seeks to restore 3 billion acres of exclusively native forest ecosystems globally through mass reforestation. Unlike other tech-enabled solutions that focus on the monitoring aspect of carbon markets, **Terraformation** addresses the main bottlenecks to successful large-scale forest restoration, which include land availability, fresh water, and seeds. The company claims to achieve a forestry restoration work rate that's 5x the average. At the heart of the operation are off-grid seed banks that come fully equipped in shipping containers, along with low energy desalination plants to provide seedlings with fresh water in arid ecosystems. In June 2021, the former Reddit CEO and founder of **Terraformation** raised $30 million of Series A funding in a deal led by the Apollo Project, elevating the company's post-money valuation to $105 million, a valuation step-up of 4.98x. Brent Goldman, along with 9 other Angel investors, also participated in the round.

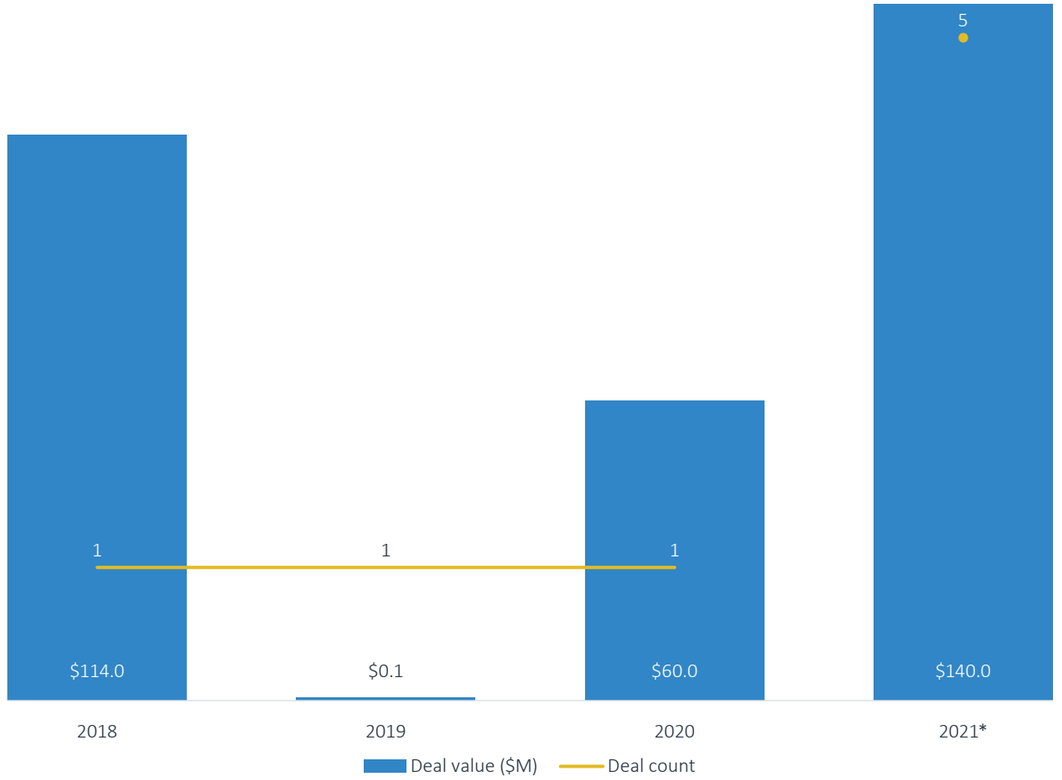
Pachama, a US based startup with partners in Latin America, uses satellite images and AI to validate carbon sequestration projects. **Pachama** uses up to six data layers—one of them employs LiDAR to create 3-D representations of a forest—and merges those layers through geospatial data fusion. The machine learning model is then used to predict the total biomass and is precise enough to reach up to 90% confidence across 300,000 field plots. This technology is extremely promising and will make monitoring of forest carbon projects—a key requirement for scaling voluntary carbon markets—more reliable, accountable, and transparent. In April 2021, **Pachama** raised $15 million through a combination of Series A1 and A2 venture funding in a deal led by Bill Gates' Breakthrough Energy Ventures. This last funding round put the company's pre-money valuation at $65 million. LowerCarbon Capital and Saltwater Capital also participated in the round—two more big names in the climate tech arena.

Turquoise hydrogen

While green hydrogen—water electrolysis through renewable electricity[6]—continues to dominate the clean hydrogen space, the lesser-known turquoise hydrogen represents another opportunity to offer energy-efficient solutions in areas such as industrial heating, long-haul heavy transportation, and long-duration energy storage. Hydrogen-based energy could benefit from recent government funding initiatives in the US—specifically, the Infrastructure Investment & Jobs Act, which allocates $8 billion to create four regional hydrogen hubs and further R&D to accelerate clean hydrogen technologies.[7]

The disruptive technology behind turquoise hydrogen, also known as methane pyrolysis or methane cracking, is to break down methane into hydrogen gas and carbon under extremely high temperatures and is in direct competition with blue hydrogen (hydrogen from steam methane reforming).[8] The unique advantage of methane pyrolysis is its ability to capture the entire carbon amount in methane (solid carbon), thus eliminating carbon dioxide emissions while requiring only half the energy needed to produce the same amount of hydrogen via blue hydrogen techniques. Three kg of solid carbon (carbon black) are produced per kg of methane as a by-product with a market value of around $1/kg—an additional revenue stream.[9]

Figure 14. GLOBAL TURQUOISE HYDROGEN VC DEAL ACTIVITY BY YEAR



Source: PitchBook | Geography: Global | *As of September 30, 2021

6: "Green Hydrogen: A Guide to Policy Making," IRENA, 2020.
7: "Scientists Just Laid Out a Game Plan for Building a Clean Hydrogen Economy," SingularityHub, Edd Gent, August 16, 2021.
8: "Green Hydrogen: A Guide to Policy Making," IRENA, 2020.
9: "R&D Opportunities for Development of Natural Gas Conversion Technologies for Co-Production of Hydrogen and Value-Added Solid Carbon Products," U.S. Department of Energy Office of Scientific and Technical Information, November 2017.

TURQUOISE HYDROGEN

To date, methane pyrolysis has mainly been directed by corporations, but the venture landscape is changing with several startups scaling technologies that were originally developed at research centers. The clean hydrogen market is expected to grow at a CAGR of over 14% during the period 2020-2026, generating revenue of $2.1 billion in 2026.[10] Factors that will drive supply growth include steady cost reductions and supportive government policies. We forecast clean hydrogen demand to be 100x–200x current levels by 2050.

Several emerging startups are focused on this growing opportunity. **Monolith Materials**, a key player in plasma methane pyrolysis, has announced that its solid carbon byproducts are being used in tires and industrial rubber products, plastics, coatings, and petroleum refining applications. In June 2021, **Monolith Materials** raised a $120 million Series C from Azimuth Capital Investment, Cornell Capital, NextEra Energy, Perry Creek Capital, SK Group, and Warburg Pincus.

In January 2021, **C-Zero**, a Santa Barbara-based startup that uses catalytic methane pyrolysis to convert natural gas to solid carbon and hydrogen, secured a $11.5 million Series A round. The round was led by Breakthrough Energy Ventures, Bill Gates' fund focused on climate tech, and Eni Next, the venture investing division of Italian oil company Eni. Other funders were AP Ventures and Mitsubishi Heavy Industries. The company is planning to commission a pilot project capable of producing 250 kg of hydrogen daily by the end of 2022.

Ekona Power, a Vancouver-based thermal methane pyrolysis startup, won the Breakthrough Energy Solutions Canada initiative with Natural Resources Canada (NRCan). The startup is collaborating with NRCan to develop new materials for clean hydrogen production and has raised $3 million in an early-stage round led by the Canadian firm BDC Capital.[11] **Ekona Power** is reportedly seeking an undisclosed amount of Series A venture funding, expected in December 2021.

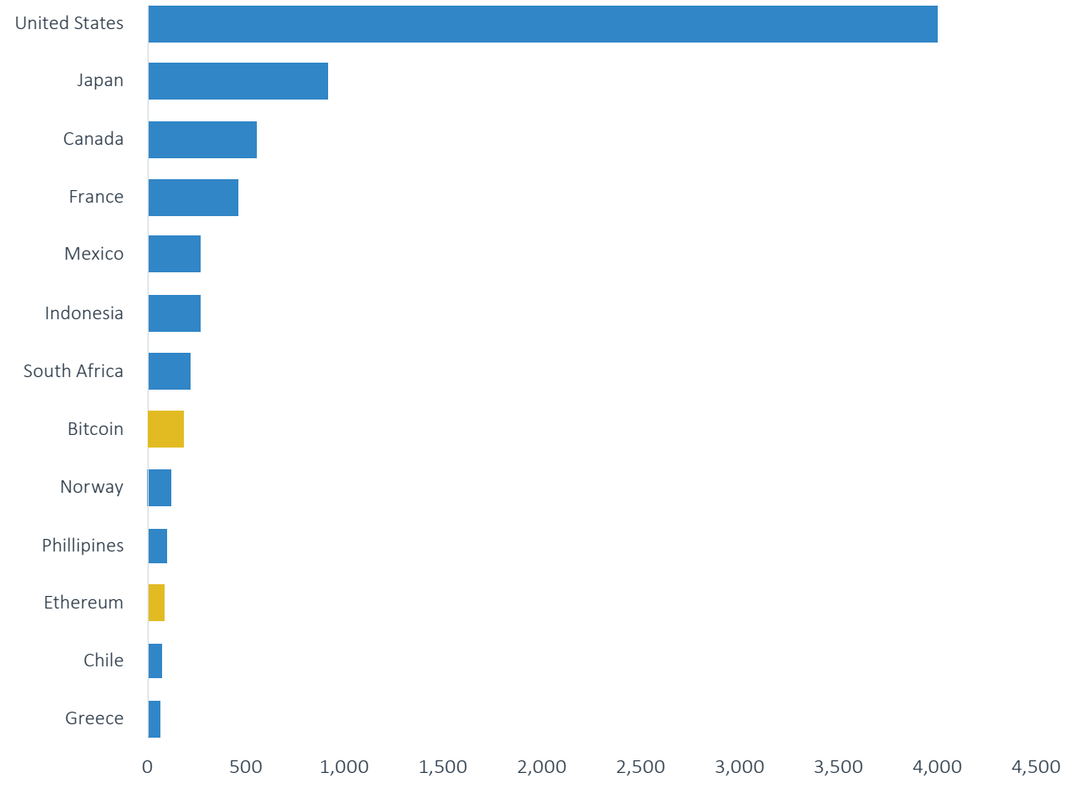
10: "Global Clean Hydrogen Market Outlook and Forecast 2021-2026: Supportive Government Policies to Enable Market Growth," CISION, June 24, 2021.
11: "Ekona Power Raises $3.0 Million from BDC Capital to Accelerate the Development of Its Novel Technology for Low-Cost, Clean Hydrogen," Markets Insider, January 19, 2021.

Clean crypto mining tech

The mainstreaming of cryptocurrencies has shone a light on the potential environmental downsides of decentralized blockchains, whose energy requirements are estimated to add 40 million tons of carbon dioxide to the atmosphere each year. The issue drew widespread attention earlier in 2021 when Tesla temporarily announced it wouldn't accept Bitcoin payments, pointing to research indicating that by 2024, bitcoin mining could be responsible for 130 million tons of carbon emissions annually. Already, bitcoin mining is responsible for more than 5.4% of China's domestic emissions generated from electricity, according to the China Emissions Accounts and Datasets platform (CEAD).[12] The Crypto Climate Accord was subsequently launched in April 2021,[13] advocating for the total decarbonization of all cryptocurrencies by 2040. The ongoing opportunity to accomplish this goal is driving investment opportunities for startups seeking ways to reduce crypto's carbon footprint, giving rise to the "green bitcoin" economy.

Crusoe Energy Systems, which mines bitcoin using the flare gas from oil drilling, raised a $128 million Series B in late April 2021 with a post-money valuation of $448 million and valuation step-up of 3.20x. The deal was led by Valor Equity Partners and joined by Coinbase Ventures, Lowercarbon Capital, Polychain Capital and others. **Crusoe Energy Systems** uses methane emissions, which trap more heat than their carbon dioxide counterparts and dissipate more quickly. The main contributor of methane emissions is the oil and gas industry. The US alone flares roughly 1.4 billion cubic feet of natural gas every day.

Figure 15. ANNUAL ELECTRICITY CONSUMPTION IN COMPARISON (TWH)



Source: Cambridge Centre for Alternative Finance, PitchBook | Geography: Global
*As of September 30, 2021

12 "Bitcoin Could Churn Out 130 Million Tons Of Carbon, Undermining Climate Action. Here's One Way To Tackle That," Onlinemarketingscoops.com, David Vetter, February 9, 2021.
13: "Make Crypto Green," Crypto Climate Accord, April 2021.

CLEAN CRYPTO MINING TECH

Stronghold Digital Mining employs breakthrough crypto mining techniques to remediate the impacts of 19th- and 20th-century coal mining by converting coal refuse into power that is used to mine Bitcoin. **Stronghold Digital Mining** is based in Pennsylvania and raised $105 million through Series A and B in April and May. The startup has since filed preliminary papers to go public with an expected offering amount of $127.06 million.

Startup **Gryphon Digital Mining** raised a $16 million Series A, led by Alpha Sigma Capital, to become the first vertically integrated crypto miner with a fully owned mining operation with a 100% renewable energy supply and a zero-carbon footprint. **Gryphon Digital Mining** provides reliable, low-cost hydro-electric powered mining with plans to expand to other renewables such as nuclear, wind, and solar power to lower mining's impact on the environment. The startup exited through a reverse merger in June 2021 led by Sphere 3D Corp.

Select company highlights

SELECT COMPANY HIGHLIGHT | FORM ENERGY

Founded
2017

142 employees

Total VC raised
$366M

Last financing valuation
$1.2B

Last financing
$240M

Last financing lead investor
ArcelorMittal

Overview

The founders of **Form Energy**, industry experts from Tesla, Aquion, and A123, don't consider their startup to be a battery company but rather a "bidirectional power plant" that produces renewable energy and delivers it tailored to demand. The company's sodium-based energy storage system substitutes fossil baseload generation with renewable energy and provides businesses with cost-effective and multi-day energy storage alternatives.[14] Through the long storage capacity technology, renewable energy can be supplied throughout the year to replace mid-range and baseload power plants, which use fossil fuels to supply the grid. Efficient, long-duration energy storage is one of the main bottlenecks in climate tech and is desperately needed to make decarbonization cheaper. The grid added 987 megawatts of energy storage in 2017, another 3.5 gigawatts in 2020, and expected to increase to add an additional 10.2 gigawatts in 2023.[15] A leading energy researcher at MIT found that large-scale energy storage can potentially lower electricity prices in a decarbonized grid by up to 40%.[16] Hence, long-duration energy storage solutions will play a key role in the global energy transition away from conventional battery storage systems.

Form Energy's technology goes beyond a novel energy storage solution and includes the grid management analytical software Formware™ to capture the dynamics of decarbonizing grids and the drivers of multi-day storage value. The idea behind this optimization model is to combine high penetration renewables at a system level to predict how storage can be combined with available renewable energy. **Form Energy**'s technology promises to secure renewables during any weather event, optimize transmission without new wires, increase reliability without thermal generation, and provide resilience during multi-day grid events.

Leadership

Mateo Jaramillo CEO
Ted Wiley Chief Operating Officer
William Woodford Chief Technology Officer
Yet-Ming Chiang Chief Science Officer

Financing history

In August 2021, **Form Energy** raised $240 million of Series D funding in a deal led by the steel company Arcelor Mittal, which put the company's pre-money valuation at an estimated $960 million. Breakthrough Energy Ventures participated in the round as well. The company's valuation step up is 2.98x.

14: "Inside Form Energy, the Star-Studded Startup Tackling the Toughest Problem in Energy Storage," GTM, Julian Spector, June 18, 2018.
15: "'Big Storage' Is the Next Big Technology in the Climate Fight," Bloomberg, Eric Roston, March 30, 2021.
16: "Powering the Energy Transition with Better Storage," MIT News, Leda Zimmerman, March 29, 2021.

SELECT COMPANY HIGHLIGHT | AVALO

Founded
2020

2 employees

Total VC raised
$3.1M

Last financing valuation
$7.9M

Last financing
$2.9M

Last financing lead investor
Better Ventures

Overview

Avalo addresses one of the most concerning issues in climate ag tech: dry and temperature variability resiliency plants. Half of all plant species are at risk in biodiversity hotspots,[17] while yields of vegetables could decrease 35%[18] and staple food crops by up to 10.6%[19] because the climate is changing faster than plants can adapt. Seed tech companies have been working to improve the major crop varieties to manage pests for a long time, but genome sequencing has a steep price tag and takes up to two years. With rising temperatures and extended droughts, climate change has a growing impact on agriculture, and speedier ways to adapt crops to changing weather patterns are needed. **Avalo** is an ag biotech startup working on novel technologies to alter crops' gene expression more quickly and at lower cost. Through AI-powered genome analysis, **Avalo**'s technology allows for gene identification so advanced that even highly complex traits and under-studied crops can be sequenced in just four months.

According to Avalos Co-Founder Brendan Collins, **Avalo**'s mission is to accelerate biological production and crop development. The company uses machine learning to facilitate gene discovery and diagnostic forecasting, enabling researchers to assist with crop quality, validation, and prediction. The issue of food security is especially concerning in the global South, where a large proportion of food is produced by vulnerable smallholder farmers. We expect AI-driven seed tech targeted at climate change to become increasingly important among major food companies and investors looking to diversify their portfolios. As food demand is expected to grow between 59% and 98% by 2050,[20] food insecurity and reduced agricultural production will put pressure on both governments and private markets. In response, investing in technologies to provide resilient crops will become a high priority.

Leadership

Mariano Alvarez, Ph.D. Co-Founder
Brendan Collins Co-Founder

Financing history

In July 2021, **Avalo** raised $2.9 million of seed funding in a deal co-led by Better Ventures and Giant Ventures, which put the company's pre-money valuation at an estimated $5 million. SOSV and Climate Capital also participated in the round. The company plans to use the funds to expand its operation and to continue its work at greater scale.

17: "Half of Plant and Animal Species at Risk from Climate Change," World Wildlife Fund, March 14, 2018.
18: "Effect of Environmental Changes on Vegetable and Legume Yields and Nutritional Quality," PNAS, Pauline F.D. Sheelbeek, et al., June 26, 2018.
19: "Emergent Constraint on Crop Yield Response to Warmer Temperature from Field Experiments," Nature Sustainability, Xuhui Wang, et al., June 29, 2020.
20: "The Future of Food Demand: Understanding Differences in Global Economic Models," Current Protocols, Hugo Valin, et al., December 10, 2013.

SELECT COMPANY HIGHLIGHT | NEXII

NEXII

Founded
2018

350 employees

Total VC raised to date
$133.2M

Last financing valuation
$1.2B

Last financing
$34.1M

Last financing lead investor
Honeywell

Overview

Nexii is the youngest Canadian unicorn in climate tech and is dedicated to reinventing buildings and construction, which are responsible for 39% of global greenhouse gas emissions. The startup uses a cement-like material to construct incredibly energy-efficient buildings and offers an environmentally friendly alternative to the use of carbon-intensive concrete in conventional construction. In addition to its lower carbon footprint, the material developed by **Nexii** also promises resilience to fire and earthquakes as well as mildew and mold. The technology allows lower labor intensity throughout the construction period, and buildings built with **Nexii**'s technology only require a fraction of the energy typically required throughout a building's lifecycle. As of now, the unicorn has successfully implemented projects for Starbucks, Popeye's, and Marriott Courtyards.

Leadership

Stephen Sidwell CEO
Gregor Robertson Executive Vice President of Strategy and Partnerships
Ben Dombowsky Co-Founder, Co-Inventor, and Senior Vice President of Product Development
Michael Dombowsky Co-Founder, Co-Inventor, and Senior Vice President of Building Technology

Financing history

In September 2021, **Nexii** raised $34 million in its fourth round of early-stage VC, led by Honeywell and joined by Trane Technologies. The startup reached unicorn status in fewer than three years with a $1.23 billion post-money valuation.

About PitchBook Emerging Tech Research

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