

# GLOBAL CLEANTECH 100

From Commitments to Actions:  
The Sprint to Net Zero is On



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# ACKNOWLEDGEMENTS

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The list would not have been possible without the 81 expert panelists (See pages 54 -55) who gave their time to provide their input and opinions. This is in addition to the many hundreds who made company nominations.

We also wish to acknowledge the support we receive all year from members of our international Advisory Boards, all of whom are leading players in this innovation ecosystem.

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# FOREWORD

We start 2023 with a series of headwinds and challenges to navigate—a war in Europe with impacts on global energy markets, on supply chains, and on geopolitical collaboration and trust levels that cannot be overestimated; a recessionary economic environment, underpinned by rising costs of accessing energy and other critical enablers of the global industrial economy; and a COP that did little to keep the 1.5 degrees mitigation dream alive.

This is hardly the 2022 we all expected as we left Glasgow in 2021, buoyed by the show of support from across the private sector, believing that it was only a matter of time before there would be explicit support in the text for phasing out not only fossil fuels, but coal, too.

**Nevertheless, these are the cards we have currently been dealt.**

The journey to net-zero by 2050 was never going to be a straight line of progress. It was always likely to be chaotic and last minute, given the sheer size of the incumbent global economy, and by implication, the enormity of transformation implicit in decarbonizing it over the next 28 years.

This is the backdrop against which we proudly present the 2023 Global Cleantech 100, our 14th annual edition. We salute not only these 100 companies, but all the thousands beyond, who are fighting the good fight.

**And it's not all doom and gloom.**

This Global Cleantech 100 edition is remarkable for the number of businesses in it who represent solutions for some of the hardest of decarbonization challenges (e.g., cement, steel, aviation, and shipping) and those who are working on some of the critical materials issues coming our way, real soon.

Investment appetite has grown for these areas of late, and there is still a lot of dry powder around for clean technology companies. That said, we expect to see valuations have a bit of a reset and a drag effect on deal volumes in 2023, in certain themes and for certain stages of companies, for sure.

It may well be the case that CO<sub>2</sub> emissions grew far less quickly in 2022 than some people feared. That was certainly the conclusion of the International Energy Agency (IEA) in October, when it reported record deployment of renewables and EVs, leading to the CO<sub>2</sub> intensity of the world's energy supply improving again, after a worsening in 2021.

**WE SALUTE NOT ONLY THESE 100 COMPANIES, BUT ALL THE THOUSANDS BEYOND, WHO ARE FIGHTING THE GOOD FIGHT**

If so, that would suggest that Russia's aggressions may well have jolted more actions faster, towards renewables and low carbon power, and a greater focus on energy efficiency, in the name of national energy security.

The U.S. Inflation Reduction Act's provisions for climate-positive capital expenditures of \$369B in the coming years looks set to propel the U.S., and many of the key decarbonization technologies, up their deployment curves, and down their cost curves. The question that remains: is there an early (weak) case for being able to look back at 2022 as a year in which national security threats were put so front and center that suddenly there were stronger imperatives beyond "just" climate concerns, for moving faster towards decarbonizing strategies?

**Why and how we get there, is not as important as getting there.**



WRITTEN BY  
RICHARD YOUNGMAN  
CEO

# HOW WE SELECT THE GLOBALCLEANTECH100

## The question we seek to answer:

According to the world’s cleantech community, which 100 private companies today are most likely to make significant market impact over the next five to ten years? We answer this question in three phases:

### Phase 1 Nominations

Nominations come from five sources:

- The expert panel of 81 investor and multi-national corporation representatives.
- Our i3 platform tracking the investment and partnership history of thousands of relevant companies.
- Over 70 third-party awards where expert assessment has been applied.
- Our sector analysts.
- The global ecosystem\* ([i3connect.com/gct100/nominate](https://i3connect.com/gct100/nominate)).

### Phase 2 Evaluation

Since our aim is to objectively synthesize and represent consensus, nominations are scored in a system rewarding companies that have multiple validations from our nomination sources. From this, a shortlist is created and sent to our panel of 81 industry experts comprised of investor and multi-national corporation representatives. The panel votes positively or negatively based on their knowledge of the company’s innovation, market and ability to execute.

### Phase 3 The Final 100

A combination of data from Phase I and Phase 2 are pooled and adjusted for geographic or other biases. Companies with the highest points overall make it to the final 100.

## Exploring the depth and breadth of the cleantech community

The total number of nominations from the public, our expert panel, i3, awards and Cleantech Group totaled 15,752 from over 93 countries. This was a 44% increase from the 2022 nomination process. These companies were weighted and scored to create a short list of 330 companies that were reviewed by the 81 members of the Global Cleantech 100 expert panel.

The list offers a fair representation of global innovation and private company creation. It is not Cleantech Group’s editorial voice, but the collective opinion of hundreds of individuals within the wider global cleantech innovation community.

\*To be valid, nominations of your own company (or one you are part owner of), be they made by the expert panel or the open call to the ecosystem, must be accompanied by nominations of at least two other companies you admire and with which you have no commercial association.

Any independent, private, for-profit cleantech company can qualify for the Global Cleantech 100. These companies must have a knowledge-based offering that embodies doing more with less (provides superior performance at lower costs, greatly reduces or eliminates negative ecological impact and improves the productive and responsible use of natural resources). We exclude those who we know to have reached Unicorn status and/or those who have been in the list seven times before.

The list was struck on 1 October 2022.



2023  
**GLOBALCLEANTECH100**  
 2023 Global Cleantech 100 Companies



Listed in alphabetical order by sector



AGRICULTURE & FOOD

DATA STATS

12 COMPANIES ↔ 7 COUNTRIES ↔

COMPANY	DESCRIPTION	COUNTRY
<b>BeeHero</b> Pollinate & Prosper	A beehive technology platform that promotes pollination to maximize crop yields	Israel
	Biotech company focused on distributive manufacturing of fat and muscle cells for cultivated meat	Israel
<b>CH4 GLOBAL</b> Sending the climate curve—negative™	A seaweed-derived livestock feed supplement that reduces enteric methane emissions	United States
<b>hazel technologies, inc.</b>	Packaging inserts that preserve freshness of agricultural produce, eliminating food waste and shrinkage for distributors	United States
<b>INNOVAFEED</b>	Tech-enabled insect farming company using genetic science to select optimal strains of black soldier fly for the animal feed industry	France
<b>mori</b>	An edible, silk-derived biomaterial coating that extends shelf life of perishable foods	United States
<b>Mosa Meat</b>	Pioneering cultivated meat company that produced the world's first 'lab-grown' beef burger back in 2013	Netherlands
<b>SOLAR FOODS</b>	Protein product manufactured using carbon dioxide, water, nitrogen, and renewable electricity	Finland
<b>Too Good To Go</b>	An app that connects users with unsold food from shops and restaurants to reduce waste	Denmark
<b>TRACE GENOMICS</b>	Soil health analytics using genomics and machine learning	United States
<b>v2 food™</b>	Producer of consumer-focused plant-based meat products including sausages, patties, schnitzel, and ready-to-cook meals	Australia
<b>VESTARON™</b> THE POWER OF PEPTIDES	Biopesticides using naturally-occurring peptides to replace conventional agrochemicals	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures





ENERGY & POWER

1/3

DATA STATS

37 COMPANIES ↓ 9 COUNTRIES ↓

COMPANY	DESCRIPTION	COUNTRY
1KOMMA5°	Software-enabled distributed energy resources (DER) installation and deployment services	Germany
AEROSEAL	Process that seals the central heating/cooling and ventilation ductwork within residential homes and commercial buildings	United States
AMOGY	Carbon-free energy storage system using ammonia as fuel	United States
ANTORA	A low-cost thermal battery for grid-scale energy storage	United States
Bboxx	Technologies and services to solve energy access needs in areas with no or unreliable electricity grids	United Kingdom
BLOC POWER	Data-enabled, financed heating and cooling retrofit services for multifamily buildings	United States
cove.tool	Automated building performance solutions that enable Architectural Engineering and Construction (AEC) to optimize	United States
deepki	Software for buildings using statistics and computer science to turn existing customer data into energy efficiency action plans	France
Eavor™	Closed-loop, conduction-only geothermal energy solutions	Canada
EKONA	A production process for industrial-scale hydrogen, clean power and pure CO <sub>2</sub>	Canada
ELECTRIC HYDROGEN	A novel electrolysis-based hydrogen production technology for industrial-scale applications	United States
element	An industrial software analytics platform for asset-intensive industries	United States
enervee®	A comprehensive SaaS-based energy consumption comparison platform	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures



ENERGY & POWER

2/3

DATA STATS

37 COMPANIES ↓ 9 COUNTRIES ↓

COMPANY	DESCRIPTION	COUNTRY
 eZINC	Zinc reactor technology which stores electricity in zinc metal for large-scale energy storage	Canada
 FERVO ENERGY	A technology for power generation using enhanced geothermal systems	United States
 FLEXIDAO	Blockchain-based software to enable energy retailers, utilities and corporate buyers to manage and optimize data on their renewable energy	Netherlands
 HUSK Powering Possibilities	Distributed mini-grids which utilize solar PV, biomass gasification and batteries	India
 Hydrogenious LOHC	Hydrogen storage in the form of 'Liquid Organic Hydrogen Carriers' for multi-megawatt energy systems	Germany
 HYDROSTOR ADVANCED COMPRESSED AIR ENERGY STORAGE	An underwater adiabatic compressed air energy storage system	Canada
 instagrid	Portable power packs for professionals with various applications including construction, small businesses, and event organizers	Germany
 Kairos Power	A novel advanced reactor technology for nuclear fission, leveraging tristructural-isotropic (TRISO) fuel and using molten fluoride as a coolant instead of water	United States
 leap	A flexibility aggregation platform for distributed energy resources	United States
 Mainspring	A linear generator technology capable of producing energy from a variety of fuels	United States
 moment energy	Recycler of retired electric vehicle batteries into clean, affordable energy storage	Canada
 menolith	A plasma pyrolysis technology that transforms natural gas into turquoise hydrogen and produces carbon black	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures



ENERGY & POWER











3/3

DATA STATS

37 COMPANIES ↓ 9 COUNTRIES ↓

COMPANY	DESCRIPTION	COUNTRY
OhmConnect	A system that pays users to reduce electricity at specific times of high grid stress	United States
OMNIDIAN	Protection plans for investments in residential solar energy systems	United States
one	High-density lithium iron phosphate or lithium ferro-phosphate (LFP) batteries in a structural cell-to-pack form	United States
piclo®	A B2B flexibility auction marketplace that facilitates flexible contracts and an energy management platform for efficient and reliable energy grids	United Kingdom
RONDO	A battery technology that stores wind and solar power to support industrial decarbonization	United States
SPAN	Smart electrical panels and paired software to provide visibility and control at the edge-of-grid	United States
sun king.	Solar-powered off-grid homes in Africa and Asia	United States
tibber	Smart home devices encouraging renewable energy consumption through a digital management platform	Norway
TWAICE	Predictive analytics software for battery management	Germany
WeaveGrid	Machine learning software which solves EV-grid integration challenges for utilities	United States
X1 WIND	Floating wind platforms for offshore wind energy	Spain
YOTTA ENERGY	A modular solar energy storage solution	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures

		DATA STATS		
		21 COMPANIES ↑	7 COUNTRIES ↓	
		COMPANY	DESCRIPTION	COUNTRY
 <b>MATERIALS &amp; CHEMICALS</b> 1/2		Microwave plasma technology for the production of battery materials and additive manufacturing powders	United States	
	<b>ADDIONICS</b>	3D-based electrodes for rechargeable batteries	United Kingdom	
		A molten oxide electrolysis technology for steel making, and production of other metals and alloys	United States	
	 <b>BRIMSTONE</b>	A technology to produce carbon-neutral portland cement and supplementary cementitious materials	United States	
	 <b>Checkerspot</b>	Bio-based performance materials formulated by leveraging advances in genomics, biology and materials science	United States	
	 <b>Coppriint</b>	Conductive Nano Copper inks for additive copper printing	Israel	
	 <b>ECONIC</b> <small>TURNING CO<sub>2</sub> INTO ENDLESS POTENTIAL</small>	Catalysts that enable production of polycarbonates, polyols and polymers from CO <sub>2</sub>	United Kingdom	
	 <b>Electrochaeca</b>	A power-to-gas energy storage technology that converts excess electricity from wind and solar into renewable gas (SNG)	Germany	
	 <b>EnginZyme</b>	A cell-free synthetic biology platform for production of alternatives to plastics, nylons and rubbers	Sweden	
	 <b>GaN Systems</b>	Gallium nitride (GaN) semiconductors for more efficient electronics	Canada	

**KEY:** ↑ Increase on 2022 figures   ↓ Decrease on 2022 figures   ↔ Same as 2022 figures



MATERIALS & CHEMICALS

2/2

DATA STATS

21 COMPANIES ↑ 7 COUNTRIES ↓

COMPANY	DESCRIPTION	COUNTRY
GROUP14	Tuneable, drop-in, micronized silicon-carbon powder for high capacity lithium-ion battery cells	United States
H2green steel	Large-scale, integrated, digitalized and automated steel plants with lower carbon impact	Sweden
INFINIUM	CO <sub>2</sub> utilization technology to produce transportation fuels using renewable power and CO <sub>2</sub> emissions	United States
INNOVATIONS	Durable anion-exchange membrane for fuel cells, fuel production and metal recovery	Canada
MANGROVE LITHIUM <small>Unlocking a battery-powered future</small>	A modular platform for the cost-effective production of battery-grade lithium hydroxide	Canada
MYCOMBIOS	Leather grown from mycelium and agricultural byproducts in a carbon-negative process	United States
NFW <small>NATURAL FIBER WELDING™</small>	Plant-based textile fiber alternatives	United States
PAPTIC®	A new material to replace plastic and paper bags	Finland
SYZYGYS <small>PLASMONICS</small>	A photocatalyst technology for chemical conversions to produce low-cost, low-emission hydrogen	United States
VIA SEPARATIONS	Energy-efficient membrane filtration solutions for industrial separations	United States
Xampla	Bio-based biodegradable material, made entirely from plant protein	United Kingdom

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures



DATA STATS

23 COMPANIES ↑ 7 COUNTRIES ↔

RESOURCES & ENVIRONMENT

1/2

COMPANY	DESCRIPTION	COUNTRY
AMP ROBOTICS	Waste sorting AI-guided robotics, computer vision, and deep learning to transform the economics of recycling	United States
ASCEND ELEMENTS	Lithium-ion battery recycling services	United States
carbon clean TECHNOLOGY TO ACHIEVE NET ZERO	CO <sub>2</sub> capture technology that significantly reduces the costs and environmental impacts of CO <sub>2</sub> separation	United Kingdom
carbon upcycling	Technology for sequestering CO <sub>2</sub> gas into a solid form within concretes, plastics and coatings	Canada
Circular	Traceability software for materials in industrial supply chains, including e-waste, battery materials, and plastic	United Kingdom
climeworks	Direct air capture technology that safely and permanently removes carbon dioxide from the air	Switzerland
GHGSAT	Satellite-based remote sensing technology for detection of greenhouse gas emissions from industrial facilities	Canada
GRADIANT	Water treatment services including desalination, water reuse and zero liquid discharge	Singapore
InfiniteCooling	Technology to enhance cooling tower efficiency, including real-time monitoring and maintenance for energy efficiency, and plume abatement system for water capture and reuse	United States
INOPSYS SIDE STREAM SOLUTIONS	On-site wastewater treatment solutions for toxic, non-biodegradable compounds in water	Belgium
KoBold Metals	Digital mineral exploration software to discover new ethical sources of cobalt	United States
Lilac solutions	Ion exchange technology to extract lithium from brines	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures














DATA STATS

23 COMPANIES ↑ 7 COUNTRIES ↔

RESOURCES & ENVIRONMENT

2/2

COMPANY	DESCRIPTION	COUNTRY
 measurabl	Sustainability reporting software for real estate	United States
 Pachama	Satellite and LiDAR-based carbon storage estimation solutions	United States
 pani	AI-powered water treatment operations and management software	Canada
 Patch	API and marketplace to monitor spending-based emissions and offsets	United States
 PERSEFONI	Carbon footprint management and reporting platform for businesses	United States
 planA	Carbon reduction software to help businesses calculate, monitor and reduce their carbon footprint through mitigation and offsetting actions	Germany
 SORTERA ALLOYS	Scrap metal autonomous sorting technology using AI to optimize recycling	United States
 Svante	Energy-efficient technology for capturing carbon dioxide from industrial sources	Canada
 twelve	An electrochemical process that recycles carbon dioxide into synthesis gas for chemicals and fuels	United States
 VERDOX	Technology for direct air carbon capture which is based on electro-swing adsorption	United States
 Xpansiv	Global marketplace for ESG-inclusive commodities and other green finance products	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures



TRANSPORT & LOGISTICS

DATA STATS

7 COMPANIES ↓

5 COUNTRIES ↓

COMPANY	DESCRIPTION	COUNTRY
Dance	An electric bike subscription service	Germany
deepsea	An AI-based software platform for monitoring and optimizing shipping	Greece
DST 地上铁 <small>New Energy Logistical Vehicles Digital Platform</small>	Charging and management solutions for new energy vehicle fleets	China
ev.energy	An AI-powered platform to optimize electric vehicle charging	United Kingdom
FREEWIRE	Battery-integrated EV charging and energy services	United States
Gatik	Autonomous vehicles for short-haul and last-mile logistics	United States
ZEROAVIA	A hydrogen-based powertrain to enable zero-emission aviation	United States

KEY: ↑ Increase on 2022 figures ↓ Decrease on 2022 figures ↔ Same as 2022 figures

**ENERGY CORPORATES, AUTOMOTIVE COMPANIES, AND OIL AND GAS PLAYERS, ARE SEIZING THE OPPORTUNITY TO INVEST AND PARTNER WITH INNOVATORS ACROSS THE CHARGING VALUE CHAIN, INCLUDING BOTH CHARGING AND ENERGY STORAGE SOLUTIONS**  
**ZAINAB GILANI, RESEARCH ANALYST**  
**CLEANTECH GROUP**



## TREND WATCH 2023

**A Supply Shock Shakes the World Awake**

No story has held more prominence in the news cycle this year than the war in Ukraine. Beyond the immediate humanitarian and civil crises resulting from the war, the resulting shift away from Russian gas and that shift's associated energy price implications have rippled throughout the world.

Indeed, despite lower aggregate venture investment numbers in cleantech this past year, energy and power innovators blew past a record year of fundraising seen in 2021, bolstered especially by investments in Europe and Asia-Pacific (see page 23 for Energy & Power analysis).

Energy & Power investments have been most apparent in the continued investor willingness to back alternative fuels - hydrogen saw 2022 with investments outpacing a record year in 2021. Biogas and waste-to-fuels technologies were infused with cash, from the highest tech point source carbon capture- to-fuels methods to new drop-in / bolt-on technologies to push anaerobic digestion infrastructure into hyperdrive.

Global Cleantech 100 companies [Ekona Power](#), [Electrochaea](#), and [Twelve](#) are examples of the future fuels bet that investors are becoming more willing to make.

**ENERGY AND POWER INNOVATORS BLEW PAST A RECORD YEAR OF FUNDRAISING SEEN IN 2021**

[Mainspring Energy](#) offers a case in downstream usage to decarbonize industrial operations but also hedge against fossil fuel volatility.

Novel chemical conversion processes to create synthetic aviation fuels and long-distance shipping energy vectors (i.e., hydrogen and ammonia) may be the next areas to experience a pull-through effect from demand for alternative fuels. These areas have seen investment trends come in fits and starts due to their distance from price parity with fossil fuels, but companies [Amogy](#) and [Infinium](#) on the Global Cleantech 100 list are examples of investor confidence in the coming demand pull.

Expect to see the ripple effects of fuels anxieties reach not only wide across industries, but deep through the innovation value chain, down to renewed interest in constituent components for chemical processes like is being done at [Syzygy Plasmonics](#).



WRITTEN BY  
ANTHONY DEORSEY  
RESEARCH MANAGER



### The Disappearing Line – Mobility and Power are Converging Faster than Ever

Drawing down energy demand has a new urgency among energy users, and the jump in financing of energy services and network technology is evidence of consumer desire to engage technology that will ease the pain of energy price volatility.

For years, solar and storage have operated as one product set, with home or building energy management software entering the mix as a complement (as well as grid participation software, where market design allows it). However, as electric vehicles continue to roll out en masse, expectations of consumers are rising to expect comprehensive systems that manage their “energy portfolio”, i.e., the energy consumed in a home or building, harnessed via solar/storage, and used with an electric vehicle (or traded back into a home or building).

Bifacial charging is quickly becoming a table-stakes offering for EV charging, and Ford actively markets the home power back-up capabilities of the new F-150 Lightning. Our conversations with innovators providing consumer energy management and EV charging products over the past few months have surfaced a sentiment that consumers’ trust in energy companies and utilities is eroding, and many believe better foresight could have prevented the current pricing pain.

Expect to see consumers look not only for systems that manage their energy portfolio and bring down total cost of ownership of resources (solar, storage, EVs), but that represent them in transactions with the grid. Indeed, Global Cleantech 100 companies [Weavegrid](#) and [1Komma5°](#) offer instructive cases of energy management with EVs as a central point of optimization.

### The Cleantech Aperture Widens as Adaptation Comes into the Frame

A key headline coming out of COP27 this past November was the somewhat somber victory of commitment to a “loss and damage” fund that will eventually compensate developing world nations for disasters that result from climate change. As most of the world emerges out of the COVID-19 crisis, we expect to see more countries and multinational companies with a lower appetite for surprise, and more willingness to acknowledge the need for long-term planning against disasters.

Adaptation- and resilience-themed venture funds may very well be the next cleantech financing frontier - in 2022 we noted the launch of more adaptation-focused venture funds, including [Climate Adaptive Infrastructure](#), a fund putting over \$1B into adaptation and resilience technologies, and [Convective Capital](#), a venture fund dedicated specifically to wildfire prevention and control technologies.

In 2021, Cleantech Group’s research team undertook the massive effort of revisiting our cleantech taxonomy, the categorization of cleantech sectors and subsectors that comprise our view of the world. The taxonomy was re-launched in mid-2022 to reflect a significantly changed world, but beyond changes in definitions and sector tree organization, we changed our approach to make it a ‘living taxonomy’ that reflects innovators’ pursuit of moving targets in real time.

The uncertainty of the 2020’s shows no sign of abating. In 2023, expect to see innovators take risks to make business models more nimble (horizontal mergers, as-a-service for everything, pay-as-you-save, etc.) to turn the crises of 2022 from a challenge to manage to an opportunity to be leveraged.

## IN 2023, WE SEE INNOVATORS TAKING RISKS TO TURN THE CHALLENGES OF LAST YEAR INTO OPPORTUNITIES



SECTOR ANALYSIS

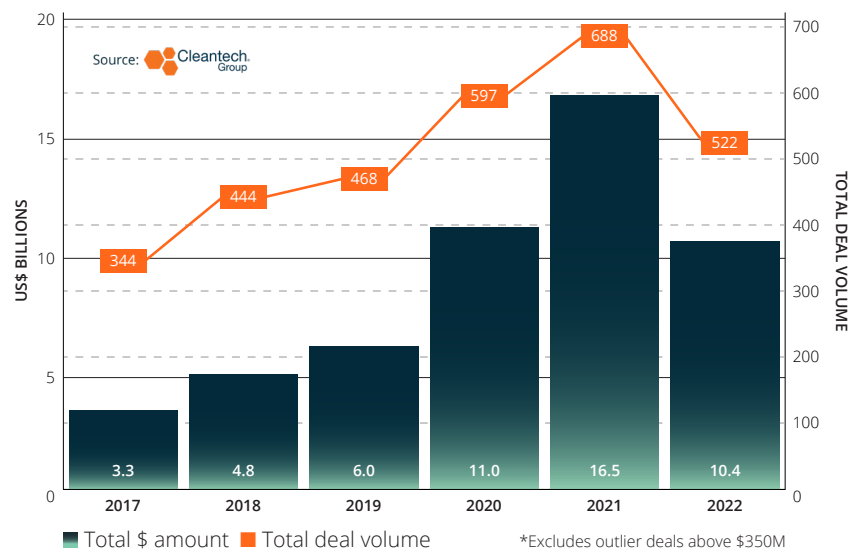
# AGRICULTURE & FOOD



Written by  
Jack Ellis,  
Senior Associate

The global Agriculture & Food ecosystem is estimated to be responsible for as much as a third of all greenhouse gas emissions. The Global Cleantech 100 companies include start-ups that are working to address this: several are reducing our reliance on livestock by building alternative proteins from plants or growing meat from cells; others are making more sustainable agricultural inputs, and using biotechnology to enhance the health of our soils. In the year ahead, it will be worth keeping an eye on developing regulation around cell-cultured meat and soil carbon trading which will be crucial for the decarbonization potential of these fields to be realized.

### AGRICULTURE & FOOD VENTURE INVESTMENT 2017-2022



## AGRICULTURE & FOOD SEES DROP IN FUNDING

Agriculture & Food witnessed a drop in venture funding in 2022 following the all-time highs hit in 2021.

Looking at the number of deals, 2022 was the slowest year since 2019, with 522 transactions compared to 688 in 2021. The \$10.4B raised by Agriculture & Food start-ups is the third-highest annual total for the sector after 2021's \$16.5B bonanza, and \$11B in 2020.

While sharing in the exuberance seen across venture funding in recent years, Agriculture & Food's 2021 plateau was also marked by increased interest on the part of investors and consumers around questions of food security and its relationship with climate change and environmental sustainability.

The COVID-19 pandemic and its continuing effects have brought sharp focus on existing weaknesses in the global food supply chain. Lockdowns, labor shortages, and movement restrictions saw good food left to rot in fields or in shipping containers. Major commodity-producing countries such as India and Indonesia imposed export bans in an effort to secure local supply.

Meanwhile, climate and weather events have exacerbated these problems. Over the past three years, La Niña has contributed to drought and dry conditions in key crop-growing regions such as Brazil and the U.S., as well as flooding and excessive precipitation in other regions, like Australia.

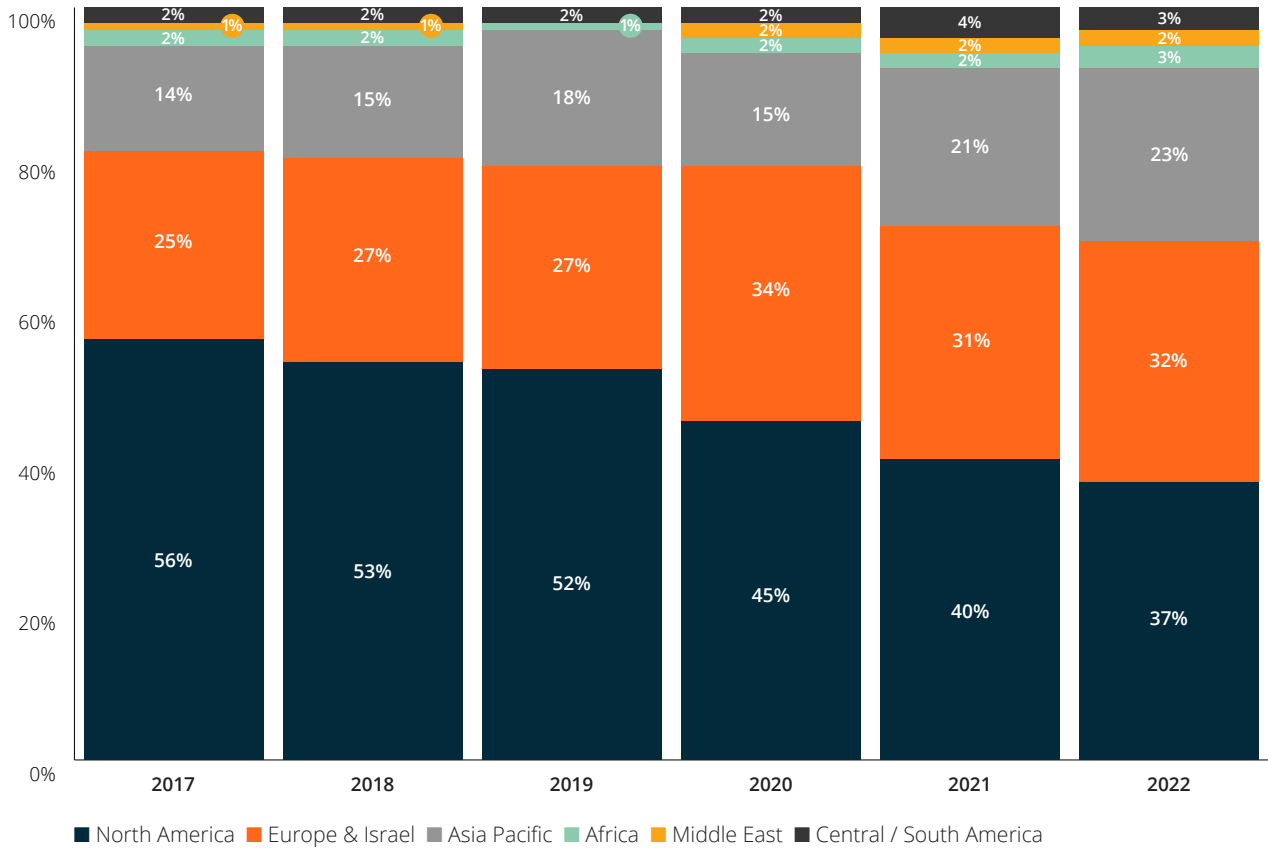
And more recently, the war in Eastern Europe has had a dramatic impact on both the grain trade and fertilizer production, making farming and food production an ever more expensive business.

All these factors are lending to the sense of urgency in Agriculture & Food tech investment.



AGRICULTURE & FOOD VC INVESTMENT SHARE BY REGION 2017-2022

Source: Cleantech Group



ASIA, AFRICA INCREASE SHARE

In dollar terms, North America saw its investment amount halve between 2021 and 2022.

Asia-Pacific fared somewhat better, with investment amount dropping around a third between 2021 and 2022.

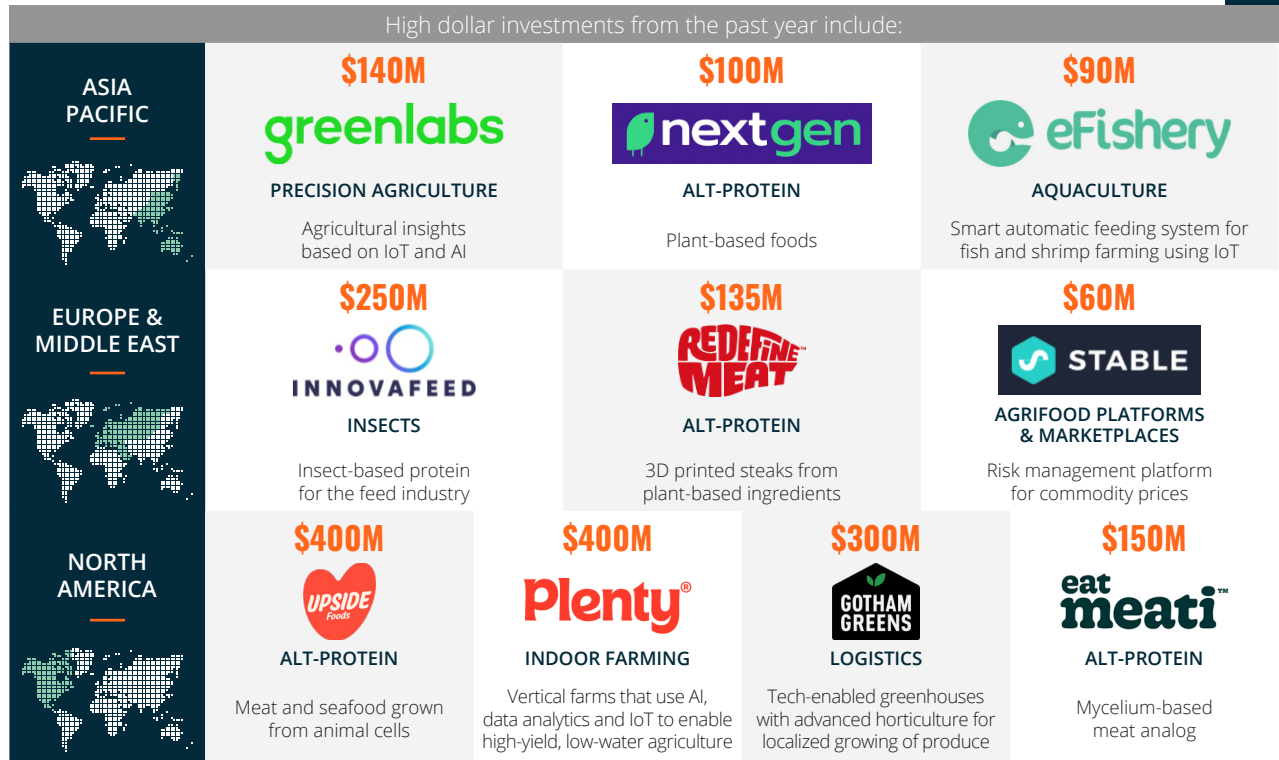
Moreover, 2022 saw Asia-Pacific claim its largest share of Agriculture & Food venture funding to date. The region accounted for 23% of global Agriculture & Food funding in 2022, up from 21% a year earlier (and leaping from just 14% in 2017).

This encouraging trend suggests that Asia-Pacific's Agriculture & Food innovation ecosystem is reaching a level of maturity comparable to the more established North American and European markets, representing new opportunities for entrepreneurs and investors alike.

**ASIA-PACIFIC ACCOUNTED FOR 23% OF GLOBAL AGRICULTURE & FOOD FUNDING IN 2022**



MAJOR DEALS BY REGION



Source: Cleantech Group

**ALT-PROTEIN STILL DOMINATES, BUT THEMES ARE SHIFTING**

Alternative protein remains the single largest subsector in terms of dollars invested in Agriculture & Food innovation. Start-ups in this subsector raised \$2.1B in 2022 – half the whopping \$4.2B secured in 2021, though still an impressive haul given the wider slowdown.

The Intergovernmental Panel on Climate Change estimates that as much as one-fifth of all anthropogenic greenhouse gas emissions come from animal agriculture – that is, the raising of livestock for the meat, dairy, and eggs that supply critical protein to the human diet.

Alt-protein innovators focus their efforts on developing novel protein products from plants and fungi – as well as from animal cell cultures – that can bypass livestock farming and its massive carbon footprint.

There were fewer mega-deals in alt-protein in 2022 than in previous years. While consumer-focused product innovators scored some big checks – for example, **Upside Food's** \$400M round, and **Meati Food's** \$150M Series C – the year notably saw several smaller, earlier-stage deals targeted farther upstream. These involved B2B start-ups offering ingredients and production technologies for the emerging plant-based and cultivated meat industries. Innovators are realizing that, to meet consumer expectations around taste and texture, it may be more sensible to focus on one part of the supply chain

**ALT-PROTEIN START-UPS RAISED \$2.1B IN 2022**

rather than vertical integration; for example, by providing animal-free fats that enhance flavor as a B2B product.

Also related to the theme of reducing livestock production emissions, animal agtech start-ups scored a total of \$816M in funding in 2022. In particular, insect farming start-ups notched up big-ticket financings. These models offer more sustainable, circular sources of feed for livestock, utilizing agrifood waste to raise insects that provide feed for poultry and aquatic animals as well as fertilizer as a byproduct.



AGRICULTURE & FOOD – SELECT CORPORATE INVESTMENTS & ACQUISITIONS 2022

VENTURE INVESTMENTS						ACQUISITIONS		
VENTURE INVESTMENTS	TOYOTA	→	Nori	Q1 2022				
	Olam	→						
	LDC. <small>Louis Dreyfus Company</small>	→	ProfilePrint™ <small>DIGITAL FOOD FINGERPRINT</small>					
	Cargill	→						
	Ⓣ Tyson	→	MYCO TECHNOLOGY™	Q2 2022	BioPhero	←	FMC <small>An Agricultural Sciences Company</small>	
	Cargill	→	UPSIDE Foods		RESSON   AgTech	←	McCain	
	Givaudan <sup>o</sup>	→						
	JOHN DEERE	→	hello-tractor		Eruvaka	←	nutreco	
	JOHN DEERE	→	INNERPLANT	CoverCress	←	BAYER		
	ADM	→	INNOVAFEED	VENCE	←	MERCK		
	Cargill	→						
	novo holdings	→	FROSLIN Technologies					
novo holdings	→							
WILBUR-ELLIS	→	VESTARON™ <small>THE POWER OF PEPTIDES</small>	Q4 2022					
Syngenta Group	→							

Source: Cleantech Group

CORPORATE ACTIVITY

Agribusiness major Cargill invested in food supply chain start-up [ProfilePrint](#); it also participated in insect farm operator [Innovafeed](#)'s \$250M Series E round, in which it was joined by fellow grain handler, ADM.

The venture arms of Syngenta, Wilbur-Ellis, and Novo Holdings invested in biopesticide innovator [Vestaron](#)'s Series C round.

John Deere backed African farm equipment marketplace [Hello Tractor](#) and plant biotech innovator [Innerplant](#).

Merck Animal Health acquired [Vence](#), developer of a 'virtual fencing' system enabling sustainable livestock management in the animal subsector.

SECTOR ANALYSIS

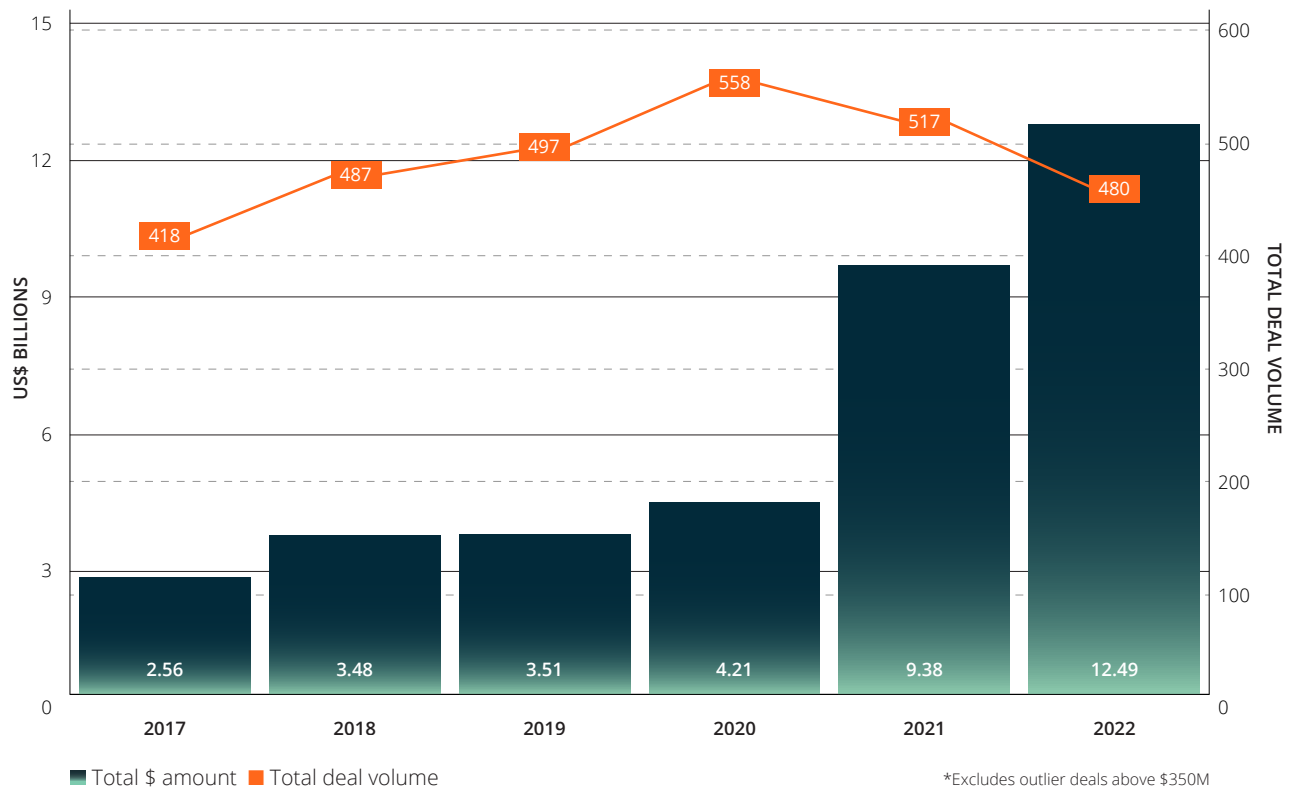
# ENERGY & POWER



Written by  
Anthony DeOrsey,  
Research Manager

### ENERGY & POWER VENTURE INVESTMENT 2017-2022

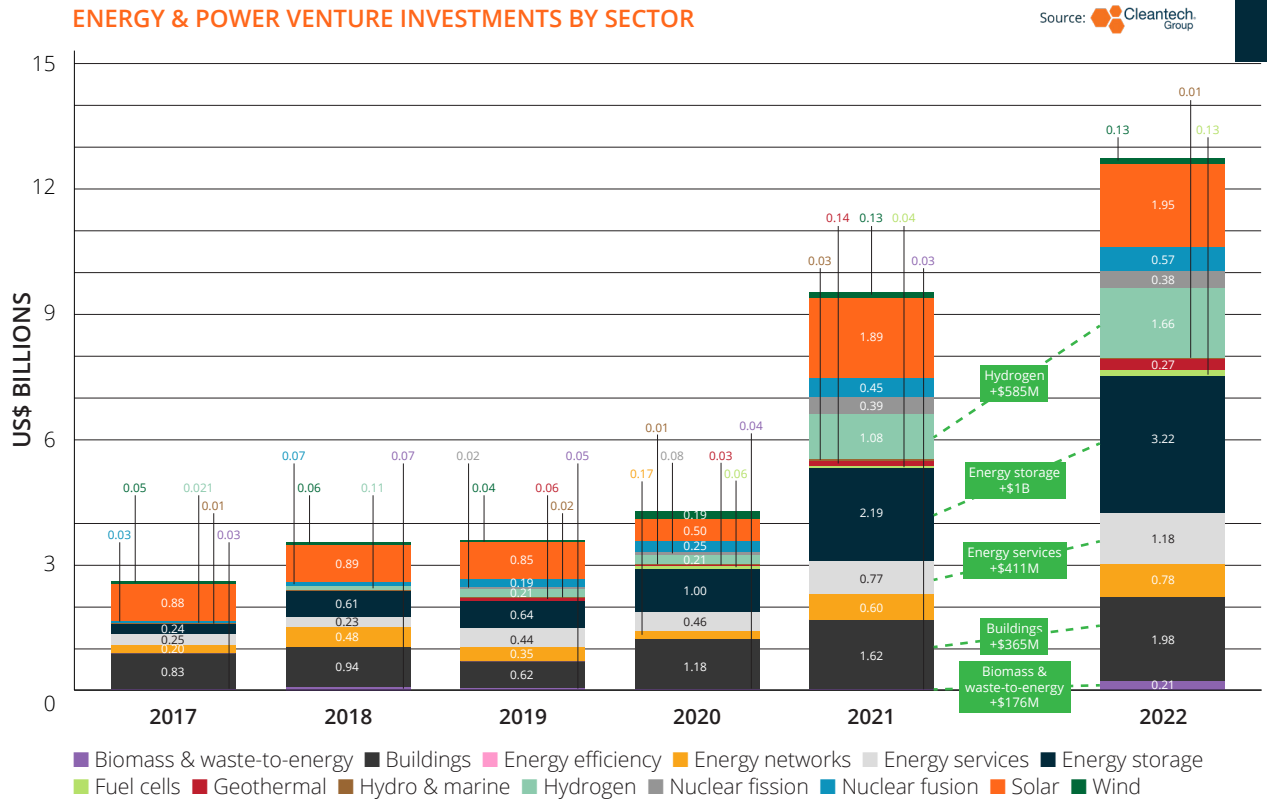
Source: Cleantech Group



## ENERGY & POWER INVESTMENT ON THE RISE

While downturns in cleantech venture investments were seen across multiple sectors this past year, Energy & Power have shown signs of increased growth – this year there have been larger rounds invested in a more concentrated group of companies.

Investors are putting money toward follow-on financing to help portfolio companies outlast competitors through a predicted economic downturn. There have also been unique Energy & Power opportunities during this past year, as global energy price volatility has strengthened enthusiasm for alternative energy sources and energy users (e.g., commercial and industrial or residential customers), embracing energy-saving technologies at a faster clip.



The incremental growth in Energy & Power investments (i.e., improvements on 2021 numbers) can be seen in three general categories:

**New baseload power:**

- After a landmark year in 2021, investments in nuclear fusion continued to rise in 2022.
- Geothermal, a traditionally quiet area of venture investment, doubled in 2022.

**Energy use reduction + renewables integration:**

- Energy & Power technologies for buildings are typically a reliable area of venture investment, but had an especially strong 2022, as more low-cost and easy deployment technologies helped building managers adjust quickly to rising energy prices.

- Energy services and energy networks, mostly underpinned by digital technologies and delivered to end users as energy optimization or grid flexibility products, grew significantly in 2022. These technologies are enhancing the operational and economic efficiency of distributed energy assets (e.g., solar, energy storage, and electric vehicles) and can be expected to be a magnet of corporate attention and investment in the coming years, as competition for access to devices accelerates.

**Alternative fuels:**

- Hydrogen investment saw a significant jump last year but 2022 proved to be an even more eventful year with venture investments increasing by 54%. Large hydrogen investment rounds were seen at the production stage (e.g., electrolyzers) through compression and transport and to end-use technologies. Fuel cell investments nearly tripled since 2021.

- Out of one of the sleeper corners of venture investments emerged a new motivation for investors to support biomass and waste-to-energy. Anaerobic digestion and other long-standing technologies for biogas production are being enhanced by high-tech improvements to the systems and novel sector coupling approaches. Not surprisingly, technologies and processes that can produce renewable natural gas are being accelerated as a means to avoid future uncertainty from gas prices, as has been experienced in 2022.

**GEOTHERMAL INVESTMENTS DOUBLED IN 2022**



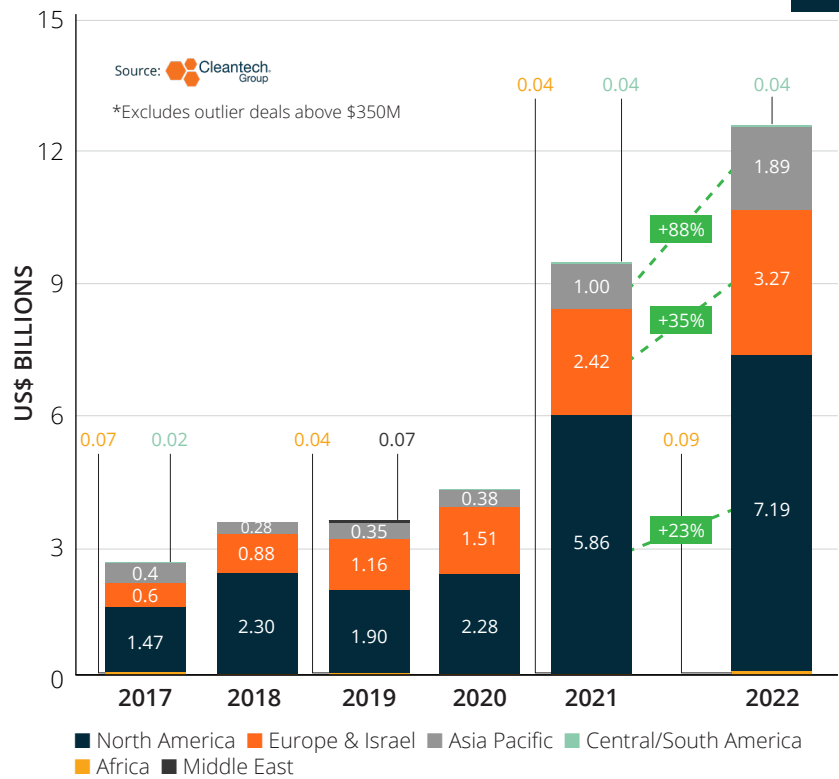
In recent years, we have uncovered a trend of Europe and Asia-Pacific comprising a larger percentage of cleantech innovation investments. This year that trend continued, and Europe and Asia-Pacific can be credited with most of the incremental improvement in 2021 Energy & Power investments.

In Europe, anxiety over energy prices has undoubtedly generated demand pull for technologies to optimize energy use and reduce inefficiencies. A series of blockbuster deals in European energy networks and services made those sectors the highest growth area of European investments in 2022. Not surprisingly, Europe was a hotbed of hydrogen activity this past year as well, as the need for availability of renewable fuels became more pressing.

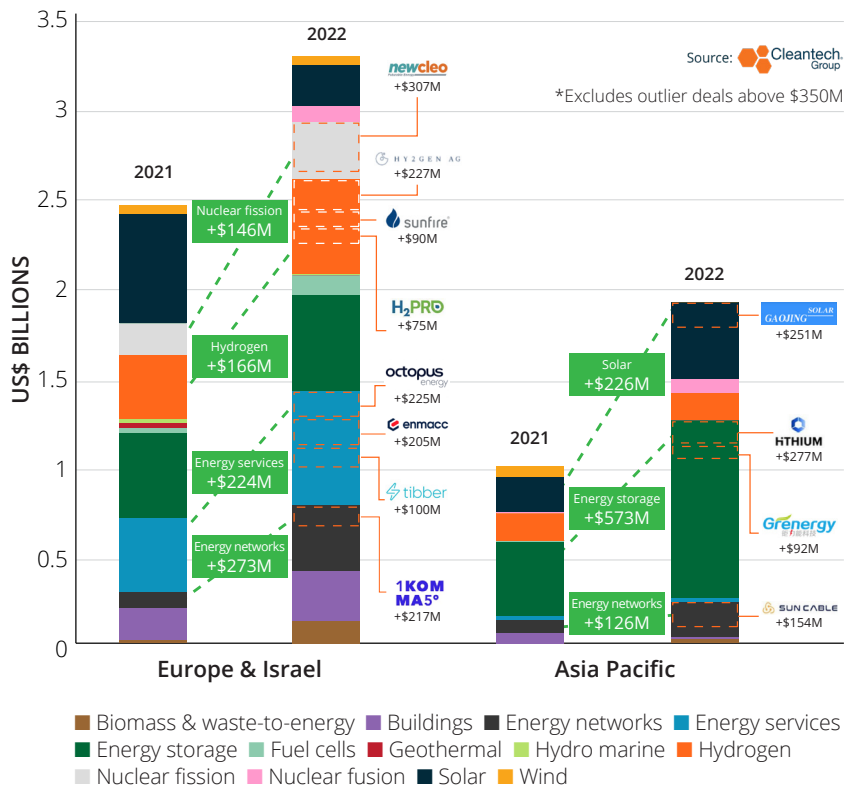
In Asia-Pacific, a jump in solar investment can be attributed primarily to **Gaojing Solar**, a producer of high-efficiency and low-cost solar wafers, but solar in Asia is not stopping at production. Australia's largest solar farm will soon be supplying energy to Singapore via **Sun Cable**, a combination of undersea high voltage direct current (HVDC) cables and energy storage on either side of the cable. This case may prove to be a template for long-distance transmission of renewable energy without a fuel conversion intermediary.

**NOT SURPRISINGLY, EUROPE WAS A HOTBED OF HYDROGEN ACTIVITY**

ENERGY & POWER VC INVESTMENT SHARE BY REGION 2017-2022

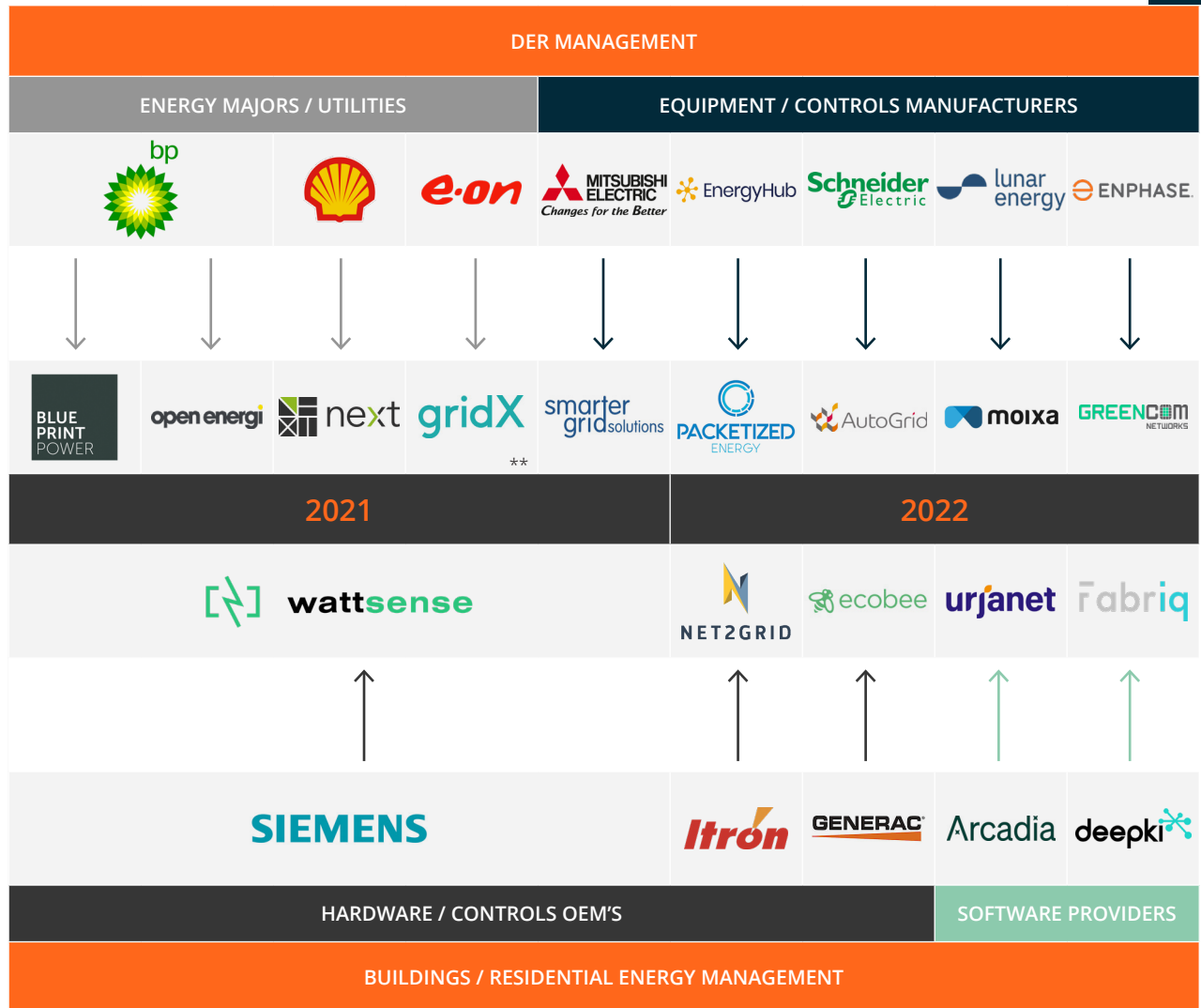


ENERGY & POWER VENTURE INVESTMENTS, EUROPE & ASIA PACIFIC 2021-2022





ENERGY USE AND DER MANAGEMENT MERGERS & ACQUISITIONS\*



\*Excludes outlier deals above \$350M \*\*Germany

Source: Cleantech Group

**“BATTLE FOR THE BRAIN”:  
COMPETITION TO  
CONTROL OPTIMIZATION  
OF BUILDINGS AND HOMES**

As discussed throughout this year’s reports, reducing energy consumption is a priority from residential consumers out to CSOs and COOs of global corporations, driving an accelerated interest in energy management tools. An important complement to energy efficiency, distributed energy resources (DERs), continue to roll out at breakneck speeds and technologies to monitor, control, and coordinate them are becoming a key focus area. The outstanding question in both of these areas is where the “brain” of a building or home will reside – innovators are competing across the value chain to be the center of optimization decision-making and corporates are engaging to broaden access to end users.



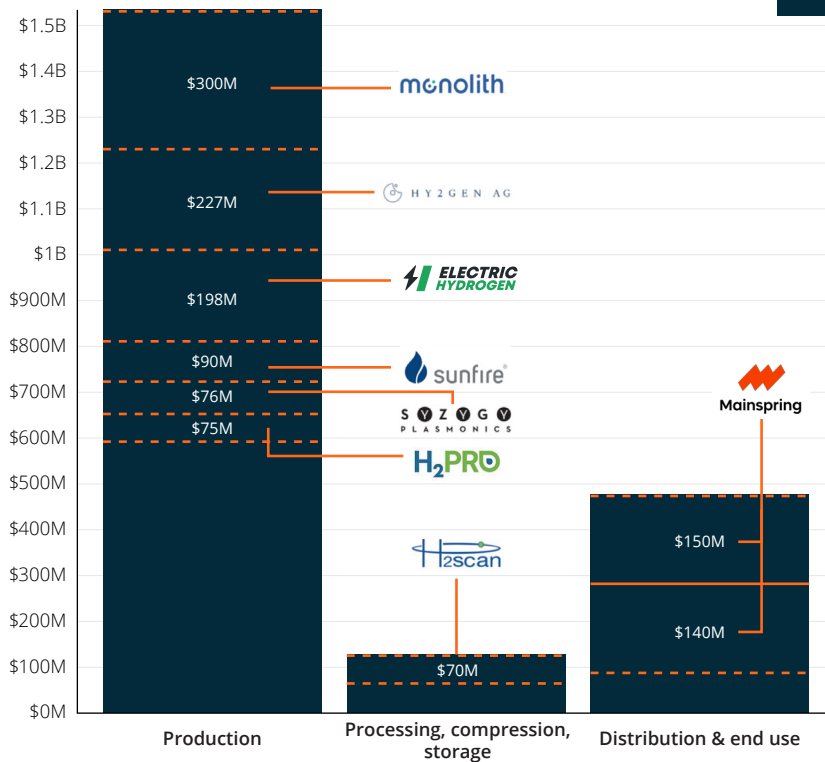
## HYDROGEN – FOCUS SHIFTS UPSTREAM FOR LONG-TERM VALUE CAPTURE

Venture investment in upstream hydrogen – production via electrolysis, reforming or other methods – doubled in 2022 to around \$1.6B from \$638M in 2021. This is an indication that there are more market signals for future offtake of green hydrogen, increasing investor appetite to finance the technologies to produce renewable hydrogen versus focusing primarily on the safer bets of tech that uses any type of hydrogen downstream. Corporate net-zero targets and multilateral compacts like the H2Zero Hydrogen Pledge are becoming more mainstream, incentivizing development of green hydrogen production technologies today, to meet demand in the coming decades.

## NUCLEAR FUSION SHOWS ITS STAYING POWER IN 2022

Fusion shows no sign of slowing down, after a landmark year in 2021 which saw significant capital raises and breakthrough demonstrations of fusion processes. As reactor producers and their offtakers begin to lay out plans for operational rollout in the 2030's, it is clear that the appetite to support high-CAPEX developments is starting to pick up, and investors in key rounds from 2021 are doubling-down on their fusion portfolio companies.

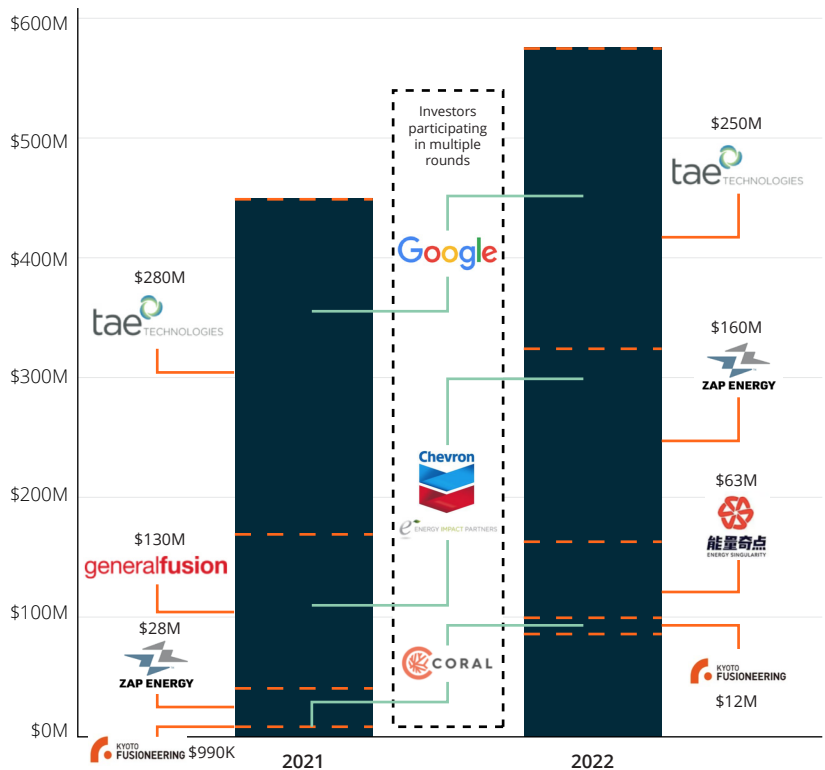
### LARGEST HYDROGEN VENTURE DEALS 2022



\*Excludes outlier deals above \$350M

Source: Cleantech Group

### NUCLEAR FUSION VENTURE INVESTMENTS 2021-2022



\*Note – this data set considers single investments over \$350 million to be outliers, so a \$1.8 billion investment in Commonwealth Fusion is not pictured in the chart

Source: Cleantech Group



WASTE-TO-ENERGY, BIOMASS, BIOGAS PRODUCTION  
KEY DEVELOPMENTS 2021-2022



Source: Cleantech Group

BIOFUELS

In 2021 there was a cohort of biogas production and anaerobic digestion IPOs. Throughout 2022, the action shifted to corporate acquisitions of biogas companies, and increasing involvement in funding rounds by corporates and blue-chip investors, undoubtedly influenced by the global anxieties around natural gas supply.

Looking forward, expect more early-stage technologies to enhance anaerobic digestion (e.g., microbial electrolysis, biotech for feedstock preparation) and optimize wastewater treatment (e.g., bioelectrochemical treatment) to experience uptake from industrial corporates with on-site waste remediation and biogas use needs.

SECTOR ANALYSIS

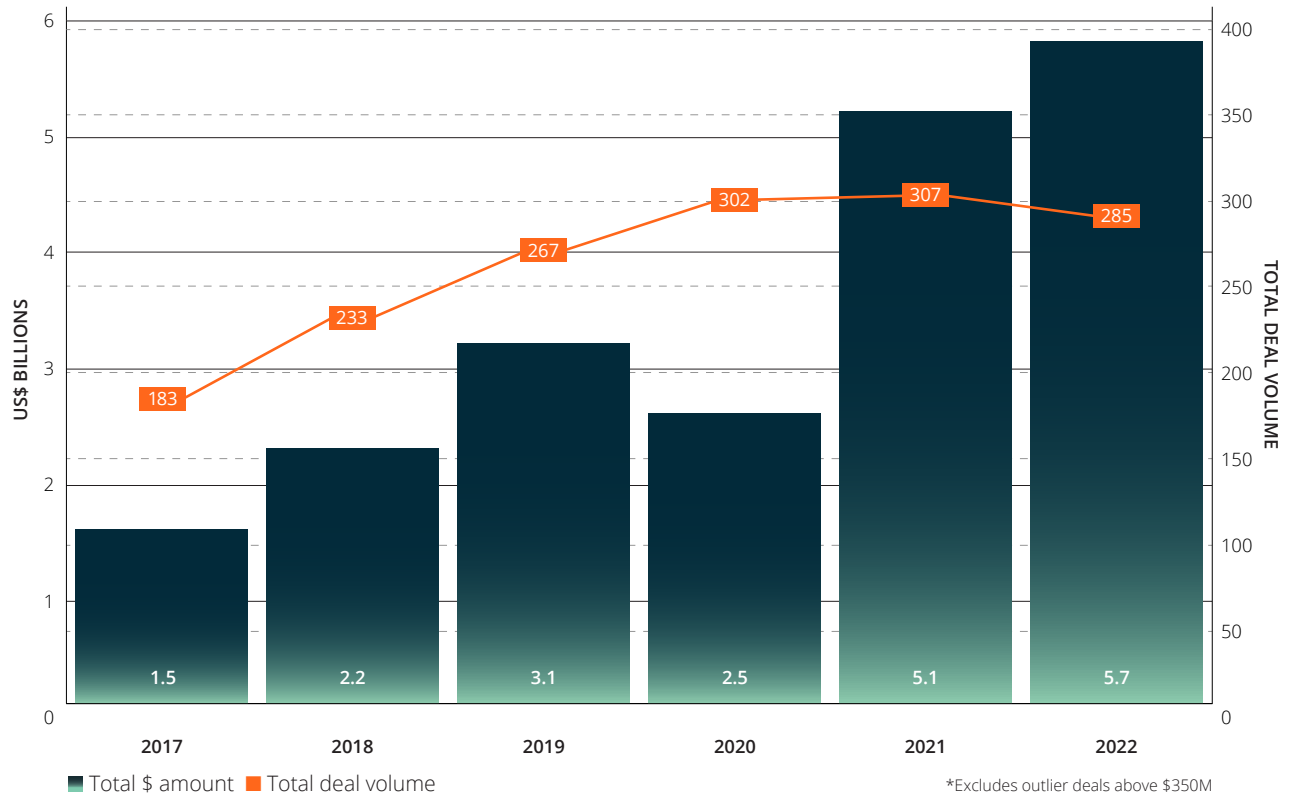
# MATERIALS & CHEMICALS



Written by  
Ian Hayton,  
Senior Associate

MATERIALS & CHEMICALS VENTURE INVESTMENT 2017-2022

Source: Cleantech Group



## MATERIALS & CHEMICALS FUNDING REMAINS STRONG

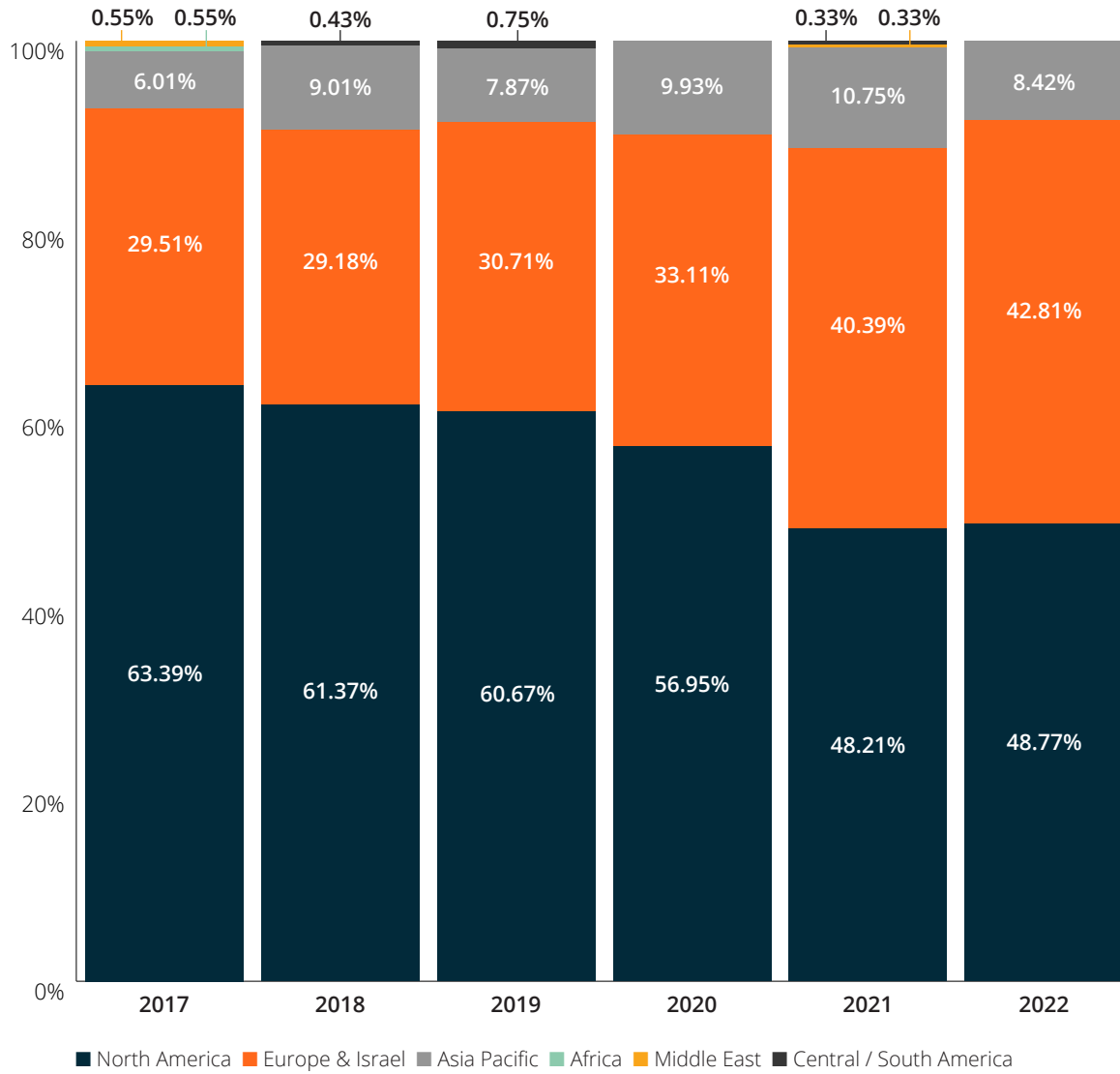
Venture funding to Materials & Chemicals innovators remained strong in 2022 with large investments flowing into technologies which address emissions of industrial processes – such as steel, cement, and chemicals – as well as textiles and packaging.

Going forward, Materials & Chemicals sectors are likely to benefit from policy tailwinds, such as the U.S. Inflation Reduction Act and pending introduction of the EU’s Carbon Border Adjustment Mechanism as part of the Emissions Trading Scheme. Further, we will also continue to see a positive effect of consumer pressure, e.g., negative views on flights with single use plastics, which will encourage industry change and stimulate demand for innovation.



MATERIALS & CHEMICALS VC INVESTMENT SHARE BY REGION 2017-2022

Source: Cleantech Group



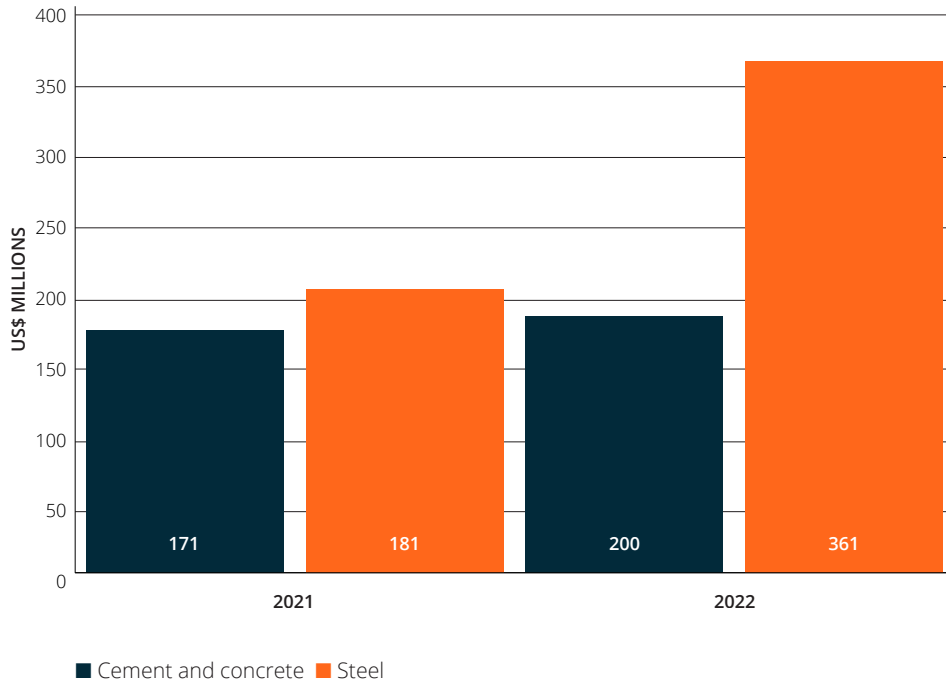
**SMALL SHIFTS IN DEAL FINANCING BY GEOGRAPHY**

The slight decrease in venture funding to Asia Pacific innovators gave way to an increase in investments to European companies. This was driven in part by large investment into energy materials innovators with growing interest in battery technologies.



VENTURE INVESTMENT IN INDUSTRIAL MATERIALS

Source: Cleantech Group



**DEALS INCLUDE:**

**2021**

CEMENT AND CONCRETE:

STEEL:

**2022**

CEMENT AND CONCRETE:

STEEL:

INDUSTRIALS ARE TASKED WITH REDUCING EMISSIONS

Steel and cement production are responsible for around 15% of global emissions, and demand for these products is set to increase with population and as part of a green transformation. Unfortunately, heavy industries face unique challenges when it comes to reducing emissions. New production processes with lower emissions tend to have higher production costs; while margins for producers are too slim to absorb these costs. In addition, heavy industry facilities are long-lived and capital-intensive, locking in emissions inertia.

The past two years have seen sustained investment in these industries. For iron processing, start-ups such as **H2 Green Steel** and **GravitHy** have raised capital to build commercial-scale plants based on direct reduction

of iron ore using hydrogen, while **Boston Metal** and **Electra Steel** have raised funds to electrify production, enabling the direct use of electricity as well as decentralized production.

For cement, there has been a continued interest in reducing clinker ratios by increasing the use of supplementary cementitious materials (SCM). However, supply of conventional SCMs such as fly ash and granulated blast furnace slag may become increasingly constrained with the phaseout of coal and transformation of the steel industry, so innovators such as **TerraCO<sub>2</sub>** and **Brimstone Energy** are raising funds to scale production of alternative SCMs and novel cements. Biocement (or bioconcrete), under development by **bioMASON** and others, is increasingly attracting funding.

STEEL AND CEMENT PRODUCTION ARE RESPONSIBLE FOR AROUND 15% OF GLOBAL EMISSIONS



## THE DEPLOYMENT OF LIQUID FUELS WITH LOWER CARBON INTENSITY IS LIKELY TO ACCELERATE OVER THE COMING YEARS WITH CORPORATES LOOKING TOWARDS TECHNICAL SOLUTIONS

### INDUSTRIES WITH RELIANCE ON FUELS MAKE SLOW PROGRESS

The aviation and shipping industries remain heavy emitters and the technical constraints of electrochemical storage solutions mean that both will largely continue to rely on liquid fuels, at least in the near-term and for long distances. Further, the deployment of liquid fuels with lower carbon intensity is likely to accelerate over the coming years with corporates looking towards technical solutions instead of offsets, and legislators set to introduce blending quotas (e.g., ReFuelEU) or incentives (e.g., U.S. Inflation Reduction Act). Unfortunately, lower emissions typically come with higher production costs, while feedstocks are likely to become constrained.

**Enerkem** raised funding to deploy technology to produce methanol from non-recyclable solid waste. **Syzygy Plasmonics** raised growth equity funding to support the development and delivery of all electric reactor systems that use light to energize their chemical reactions for hydrogen, methanol, and fuel production. Other approaches and technologies which use alternative feedstocks, and/or improve efficiencies will be in demand.

### BIO-BASED CHEMICALS AND THEIR NOVEL APPROACHES

Bio-based approaches to chemical manufacturing can help increase circularity, lower emissions, and introduce functionality. Historically these production approaches have faced technical and economic challenges and have largely failed to reach economic competitiveness with conventional approaches. However, novel approaches leveraging synthetic biology and artificial intelligence are helping to address these challenges.

The year 2022 saw a continued interest in bio-based chemicals, and particularly biomanufacturing. **Solugen** raised funding to break ground on another 'Bioforge' facility and to start working on another three. Meanwhile, **Mojia Biotech** received funding to commercialize animal-feed additives and to scale up manufacturing capacity for bio-based materials. **Arzeda** raised funding to advance its product portfolio development which includes better detergents and sustainably-produced food ingredients.





## THE PLASTICS CRISIS CONTINUES WITH INNOVATORS TAKING AIM

Plastics are responsible for up to 4% of the world's total greenhouse gas emissions - that's around twice as much as the aviation industry produces. To put it into perspective, 300M tonnes of plastic are produced every year, with 14M tonnes ending up in the ocean each year killing animals and destroying natural habitats.

Bio-based plastics and plastic alternatives remain a key cleantech investment theme. PHA production continues to scale with [Bluepha](#) raising funds to advance construction of a plant for the biodegradable material PHA. Meanwhile [TIPA](#) raised funding for scaling of compositable packaging material. Early-stage innovators such as [Xampla](#) are raising funds to develop and commercialize alternatives to plastics made from proteins.

## THE LONG ROAD FOR BATTERY TECHNOLOGIES

The electric vehicle (EV) revolution remains unflagging as road transportation moves away from fossil fuels - even the U.S. hit the "tipping point" in 2022 of 5% of all vehicles sold being electric. However, challenges remain. EVs continue to cost more than their internal combustion engine (ICE) counterparts. Meanwhile, performance of EVs, especially in terms of range, remains a barrier for adoption, especially in areas with limited charging structure.

With batteries remaining both a significant cost driver and constraint on performance, 2022 has seen [Group 14](#), [Nexeon](#), and others raising growth equity to commercialize silicon anode materials, while [6K](#) is scaling up low-cost cathode processing technology. Early-stage innovation in technologies which address materials constraints such as solid-state sodium ion batteries are under development by [LiNA](#) or [Mitra Chem](#).

**NEW BATTERY TECHNOLOGIES WILL HELP DRIVE THE UPTAKE OF ELECTRIC VEHICLES, WITH LOWER COSTS AND IMPROVED PERFORMANCE**

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SECTOR ANALYSIS

# RESOURCES & ENVIRONMENT



Written by  
Holly Stower,  
Senior Associate

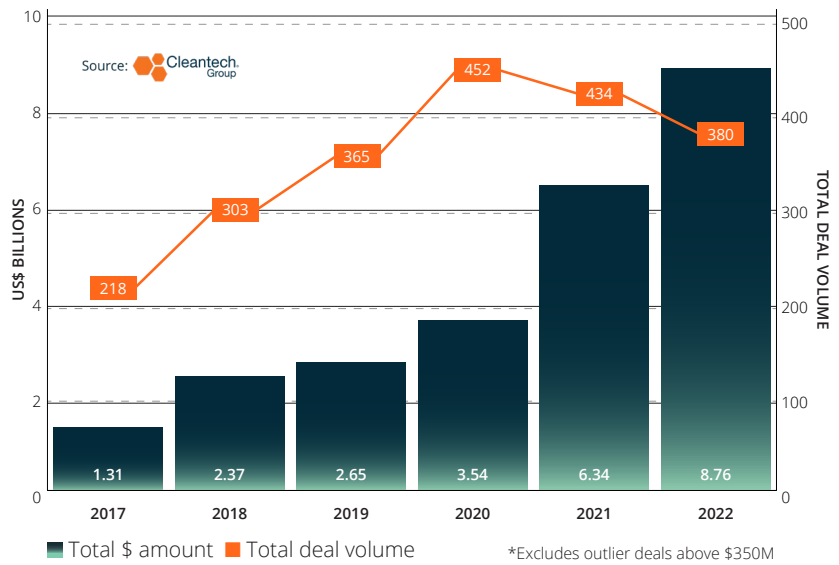
## RESOURCES & ENVIRONMENT DEALS INCREASE

The Resources & Environment sector has seen a healthy rise in investment since 2017. Following the 2021 boom seen across all sectors, Resources & Environment remain on an upwards trajectory in deal amount.

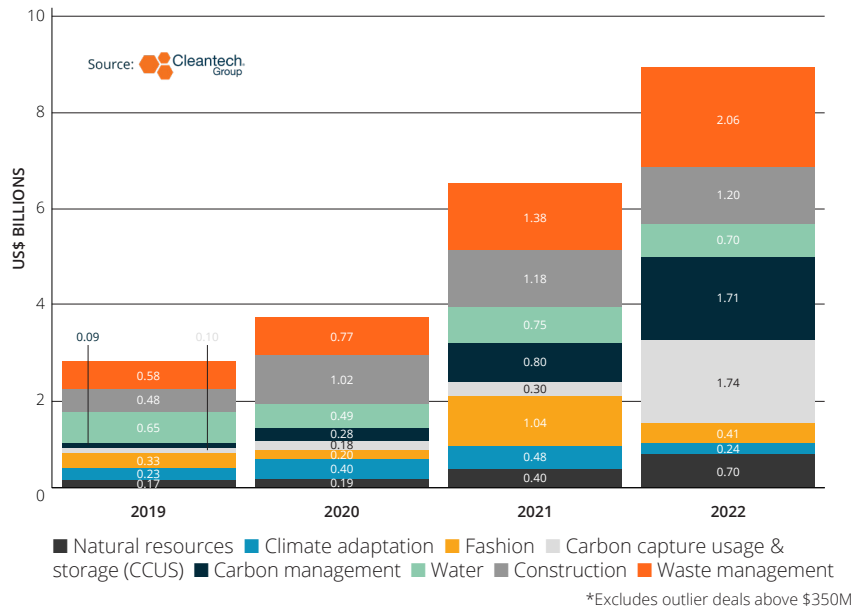
The investment by sector comparison (bottom chart) shows the key sectors including plastic recycling (waste management), CCUS and carbon offsets (in carbon management) and mining (natural resources).

**THE RESOURCES & ENVIRONMENT SECTOR HAS SEEN A HEALTHY RISE IN INVESTMENT SINCE 2017**

RESOURCES & ENVIRONMENT VENTURE INVESTMENT 2017-2022



VENTURE INVESTMENT BY SECTOR 2019-2022





## CARBON CAPTURE USAGE AND STORAGE

One billion tonnes of CO<sub>2</sub> removal is needed by 2025 if the Paris target is to be achieved. As a result, governments (mostly the U.S., Canada, and UK) are ramping up investment into Carbon Capture Usage and Storage (CCUS), providing R&D grants, funding feasibility studies and developing national clusters.

- The U.S. Department of Energy (DOE) awarded \$14M to five FEED (Front End Engineering Design) studies to scale direct air capture, including projects with [Climeworks](#).
- The UK government launched a \$24.9M competition for next generation CCUS, to reduce costs and increase TRL (Technology Readiness Levels). Funding was awarded to [C-Capture](#).

Corporate partnerships and investments are also helping technologies to scale, particularly with heavy emitters like oil and gas companies or airlines. Chevron invested in [Carbon Clean](#) to provide funding for a pilot.

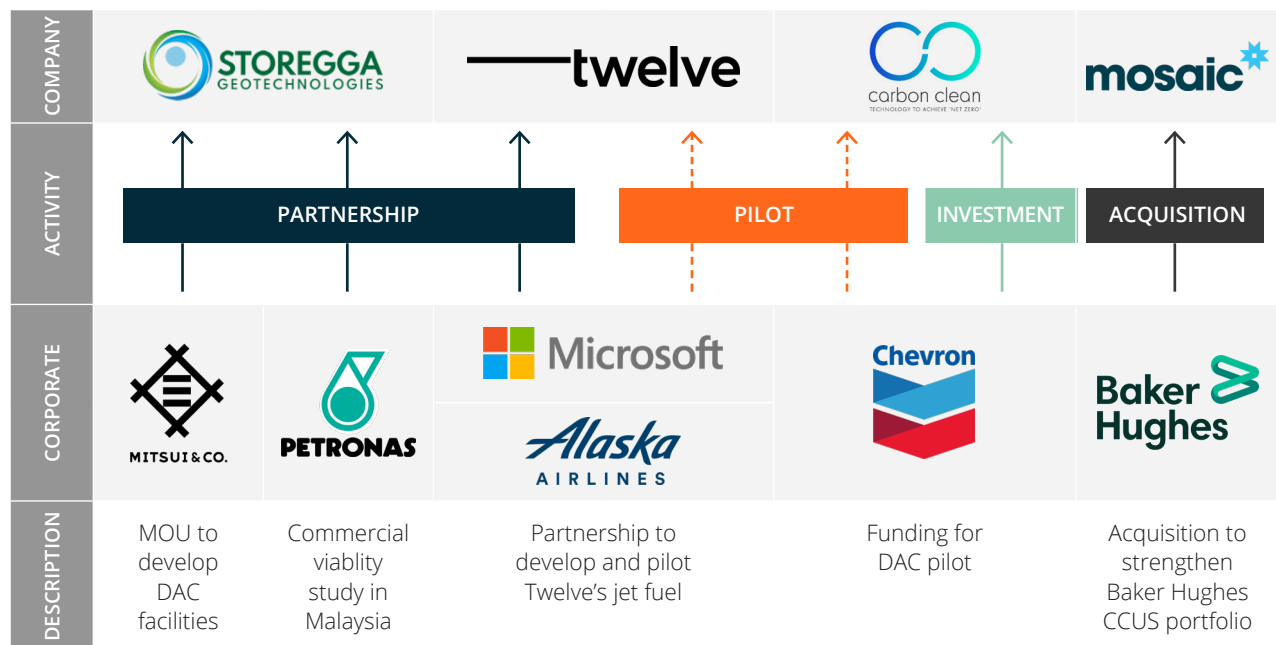
Direct air capture (DAC) carbon capture technologies saw considerable investment in the past year, including large growth equity rounds for scaling DAC and many smaller funding rounds for early-stage, more efficient capture technologies such as metal-organic frameworks (MOFs) and lower cost DAC. [MOF Technologies](#), manufacturer of nanoparticles which can be used to capture CO<sub>2</sub>, raised \$5M in a Series A round from investors Clean Growth Capital and Barclays, while developer of low-cost DAC, [Mission Zero Technologies](#), also raised \$5M. Risks remain with business models, however, that are largely dependent

on the price of carbon rising. Additionally, DAC's high energy requirements (80% heat, 20% electricity) will require considerable new and dedicated renewable energy capacity.

Innovators continue to sell CCUS project carbon offset credits on the voluntary carbon market (VCM). DAC developer, Climeworks, raised \$650M in Q2 to scale its facilities to multi-million-tonne carbon removal capacities. Although these credits are expensive, high corporate demand for offsets and the high quality of these credits have counterbalanced high costs. The certification bodies Verra and The American Carbon Registry, who create the methodology for carbon offsets, are developing methodologies for CCUS alongside the CCUS industry, which will further unlock CCUS carbon offsets. We expect the CCUS market to develop along with the growing VCM and compliance carbon markets.

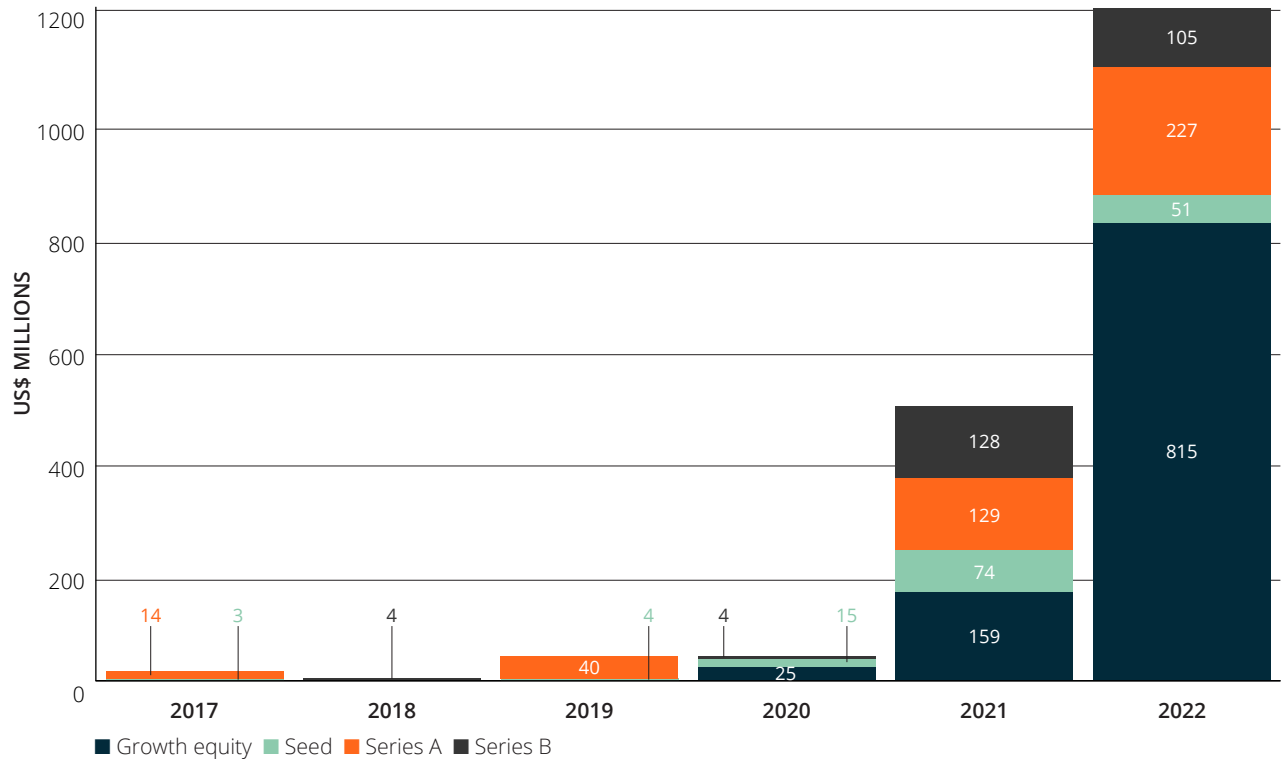
### INVESTMENT SNAPSHOT: PAST 15 MONTHS

Source: Cleantech Group



CARBON OFFSETS & MARKETS VENTURE INVESTMENT BY TYPE 2017-2022

Source:  Cleantech Group



OFFSETS

Carbon offsets are not material reductions in emissions; they compensate for emissions emitted elsewhere or historically. Corporates are under pressure from regulators, investors and customers to both disclose and act on their emissions. Carbon offsets present a fast and affordable way to ‘reduce’ their net emissions. As such, the voluntary carbon market has seen a resurgence. Due to the magnitude of challenges that remain in this market, and which were partially to blame for its downfall in the 2010’s, technology which can solve these challenges has seen significant investment.

These can be split into three distinct technology types:

- Project production.
- Monitoring and verification.
- Marketplaces and trading.

**THE HIGH DEMAND FOR OFFSET CREDITS COMBINED WITH THE MAGNITUDE OF MARKET CHALLENGES IS SEEING INNOVATORS FLOCK TO SOLVE THEM**

As more corporates are under pressure to reduce and remove emissions, especially with mandatory disclosures on the horizon, expect the offset market to continue its upward trajectory. However, trading and marketplaces are particularly crowded so expect most growth in project production, especially nature-based offsets, e.g., forestry.



CRITICAL METAL MINING

The transition to a clean energy system requires a significant increase in the use of critical minerals to manufacture clean and renewable energy technologies (i.e., wind turbines, wiring, solar panels, EV batteries). Total demand for battery metals is projected to triple from over 5.5M metric tonnes this year to 17M tonnes by 2030. Demand projections currently outpace existing mineral availability. As such, there is pressure for mineral producers to improve efficiency, and also for battery and EV producers to secure supplies of battery materials in supply chains.

Innovations to meet this demand for materials include:

- Exploration via underground mapping, asset visualization and mineral characterization which improve the efficiency of extraction and mining operations, e.g., **Kobold Metals**, raised \$192M in Series B funding this year.
- Extraction & Refining, including more efficient refining technologies. Some technologies improve lithium recovery from less than 50% to more than 90%, while also reducing water use, e.g., **Mangrove Lithium**.
- Recycling, comprised of technologies and business models to extract and upcycle critical metals from products and infrastructure, e.g., **Ascend Elements**.

**TOTAL DEMAND FOR BATTERY METALS IS PROJECTED TO TRIPLE BY 2030**

These minerals are essential to building the low carbon economy, so expect continued private and public investment.

CRITICAL METALS: VALUE CHAIN WITH BUSINESS ACTIVITIES AND EXAMPLES





## BATTERY RECYCLING HAS SEEN SIGNIFICANT ACTIVITY IN INVESTMENT AND PARTNERSHIPS

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### CIRCULAR BATTERY MATERIALS

Battery recycling has seen a significant amount of activity in the past two years in both investment and corporate partnerships with automotive OEMs. The ecosystem developing around EV battery recycling is one of the strongest circular business models in cleantech, benefitting from the circularity success trifecta of the:

- High cost of materials recycled.
- Limited supply of materials.
- High demand for materials.

Innovators are now raising large growth equity rounds and partnering with large corporate recyclers or automotive OEMs to scale recycling facilities while securing supply and demand:

- Lithium-ion battery recycler, [Lithion](#), raised \$125M in a Series A round. The funding will support construction of Lithion's first lithium-ion battery recycling plant and technology development centre in Quebec, Canada.
- Lithium-ion battery recycler, [Primobius](#), entered a technology partnership with Mercedes-Benz to build a CO<sub>2</sub>-neutral recycling facility.
- Volvo partnered with [Redwood Materials](#) to create a recycling network for Volkswagen and Audi EV batteries in the U.S.

As the EV and battery storage markets continue to scale, while being conscious of their sustainability footprint, expect continued private and public investment to scale facilities and to build circular loops in the U.S. and Europe.



## PLASTICS

The OECD predicts that global plastic waste will triple by 2060, with around half being landfilled and less than 1/5 recycled. This scenario assumes demand isn't curbed, and waste management and recyclability aren't 'radically' improved. Almost 500,000 tonnes of food-grade rPET (recycled Polyethylene Terephthalate) will be needed to meet the demand for voluntary and regulatory mandated commitments in the next decade.

This will require up to three times as much as the 150,000 tonnes of bottle-grade rPET that was produced in 2017. Demand owners and product manufacturers are looking for suppliers of high quality rPET to avoid regulatory fines and bad PR. Technologies which have the potential to 'radically' improve the efficiency and economics of plastic recycling include:

- **Chemical Recycling:** Uses chemicals and/or heat to break down plastics into raw materials for new plastics, fuels, or other useful chemicals.

- **Biological Recycling:** Uses cultured microorganisms to break down mixed plastics via enzymatic depolymerization.

Chemical plastics recycling innovators continue to scale up and commercialize, raising large late-stage and project finance rounds. **Mura**, developer of chemical recycling for plastic and rubber waste, raised \$100M in growth equity from investor KBR. Mura also partnered with Dow Chemicals this year to construct multiple world-scale 120,000-metric-tonne-capacity advanced recycling facilities in the U.S. and Europe.

External pressure for heavy polluters to act on plastics and the growing demand for recycled plastic and plastic alternatives will drive corporate engagement with innovators and incumbent's diversification into advanced recycling. Dutch-based **Ioniqa** and UK-based, polyester producer **Koch Technology Solutions (KTS)**, the technology licensing arm of KTS, announced in September 2022 that they have entered a partnership to scale up and commercialize Ioniqa's advanced PET recycle technology in the plastics industry.

As part of this collaboration, KTS has also committed to investing €30M in Ioniqa.

This year saw a significant uptick in investment and partnerships with biological plastic recycling (enzymatic recycling and depolymerization) innovators. **Epoch Biodesign**, developer of enzyme-based solutions to break down plastics, raised \$11M in seed funding. PET fibre biological recycler, **Carbios**, signed critical agreements with On, Patagonia, Puma and Salomon to develop and gather data on fiber-to-fiber recycling models following their successful trial producing 100% enzymatic recycled white PET fiber from colored textile waste.

Enzymatic recycling technologies allow for mixed, low quality and contaminated plastics, in particular PET, to be recycled without becoming degraded, as would occur through mechanical processes and some chemical recycling processes. Recyclers can in-theory generate higher returns by converting low quality, coloured, and contaminated plastics that would typically only have low quality downstream solutions, into high quality, clear and food-grade resins that are much more profitable.

### ENZYMATIC PLASTICS RECYCLING COMPANIES

Source: Cleantech Group

COMPANY	DESCRIPTION	INVESTMENT
<b>SAMSARA</b>	Enzymatic technology that recycles plastics.	\$40M
<b>PROTEIN EVOLUTION</b>	Enzymatic recycling technology to depolymerize textile and mixed plastic scrap and supportive AI processes.	\$20M
<b>EPOCH BIODESIGN</b>	Enzyme based solution to break down plastics.	\$11M



## ADAPTATION AND CLIMATE RISK

Increasingly frequent, destructive, and longer lasting natural disasters are bringing into focus the vulnerabilities of economies, businesses, and communities. In response, governments are starting to front cash for adaptation. COP27 focused on who would pay for the worst impacts of climate change and closed with agreements to:

- Provide loss and damage funding for vulnerable countries.
- Commit \$3.1B to provide early warning systems by 2027.
- Launch ‘Global Shield,’ a partnership between G7 and V20 countries to provide financial support during climate disasters. Initial contributors include Germany (€170M) and other countries (€40M).

The EU has also approved nearly €720M in the [EU Solidarity Fund](#) for several countries following natural disasters.

Cleantech can help companies and governments understand, act, and implement resilience measures to reduce the impact of climate risk. The way Cleantech Group sees the adaptation technology gap being met by innovators is as follows:

- **Climate Risk Analytics:** Satellite, sensor, and software technologies to help companies and nations understand their vulnerability to climate change via climate risk analytics. Innovators have had a specific focus on the financial services sector. Geospatial climate risk analytics provider [Descartes Labs](#) was acquired by Antarctica Capital to grow its space-based data portfolio.

- **Early Warning Systems:** Peril-specific warning systems via sensors and software have seen an uptick in investment this year. Mountaintop camera forest fire warning system [Pano](#) raised \$20M in Series A funding.
- **Climate Insurance:** Parametric insurance products continue to scale, enabling instant pay-outs and immediate resilience actions to be funded and taken. These technologies and business model innovations are shifting the role of the insurer from reactive to proactive in response to risks. Parametric flooding insurance MGA [FloodFlash](#) raised a \$15M Series A from MunichRe and Sony Financial Ventures.
- **Resilient Infrastructure:** This collection of technologies can be wide ranging covering drought resilient crops to sea defences. One technology group we see gaining more attention is water harvesting technologies, e.g., desalination or atmospheric water harvesting, in the face of increasing water scarcity. Solar atmospheric water harvester, [SOURCE](#), raised \$130M in a growth equity round.

### ADAPTATION COMPANIES

Source: Cleantech Group

THEME	COMPANY	DESCRIPTION	INVESTMENT
Climate Risk Analytics	JUPITER	Climate-driven analysis for resiliency and disaster planning.	\$87M
Early Warning Systems	DRYAD	IoT network for early fire detection in forests.	\$12M
Climate Insurance	kettle	Micro reinsurance strategies using swarm intelligence machine learning to calculate future climate-related risk exposure.	\$29M
Resilient Infrastructure	ECONCRETE	Ecologically positive concrete sea defenses to prevent coastal flooding while fostering biodiversity.	\$13M

As the worst effects of climate change have generally been felt by poorer countries, funding hasn't been available for those who need it most. COP27 commitments could see a redirection in funding, while risk assessment technologies should make corporate supply chain vulnerabilities clear, which in-turn could see more corporate interest and investment into adaptation.



SECTOR ANALYSIS

# TRANSPORTATION & LOGISTICS



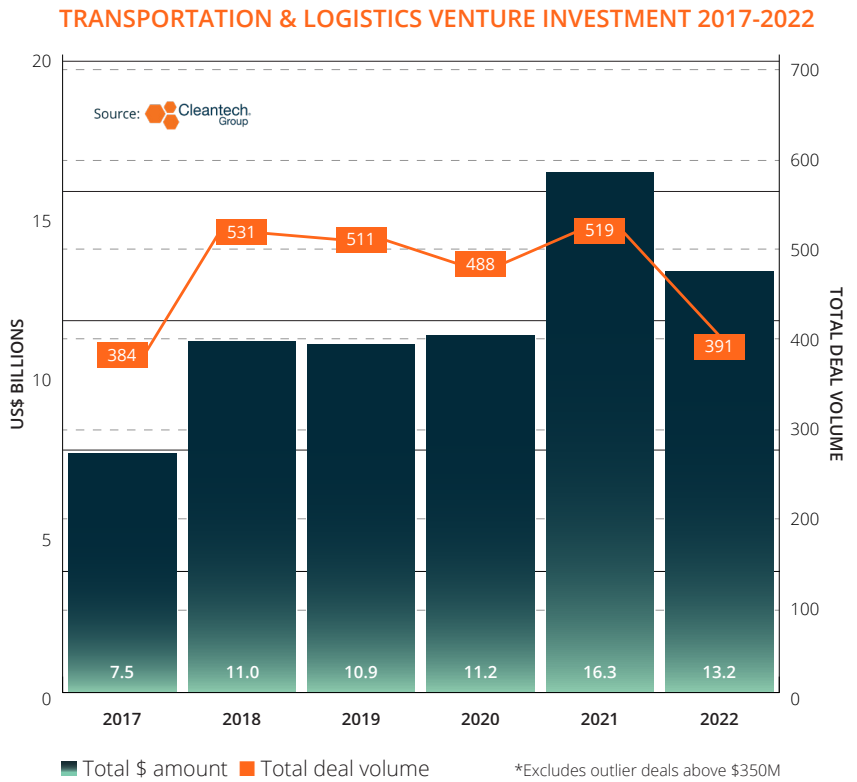
Written by  
Nicole Cerulli &  
Zainab Gilani,  
Research Analysts

## TRANSPORTATION & LOGISTICS DEALS DECREASE

Supply logistics have seen a noticeable increase in investment from the past year as well as on-road vehicle electrification and EV charging which have both been bolstered by the continued commitments from corporate players to go all electric and from regional regulations prohibiting the sale of new internal combustion engine vehicles.

2022 has seen an 25% decrease in deal count and 19% drop in total investment from last year. While deal number dropped significantly compared to 2021, key sectors maintained an overall investment amount above pre-2021 levels. Notable deals included electric ride sharing platform Bolt's \$713M round, Terawatt Infrastructure's \$1B raise for EV charging, and Rimac Automobili's \$536M in growth equity for EVs and components.

Geographic diversity across Transportation & Logistics investments continues to be in line with previous years: North America drew approximately 40% of the overall deal count, while Europe (33%) and Asia-Pacific (23%) also attracted large shares.

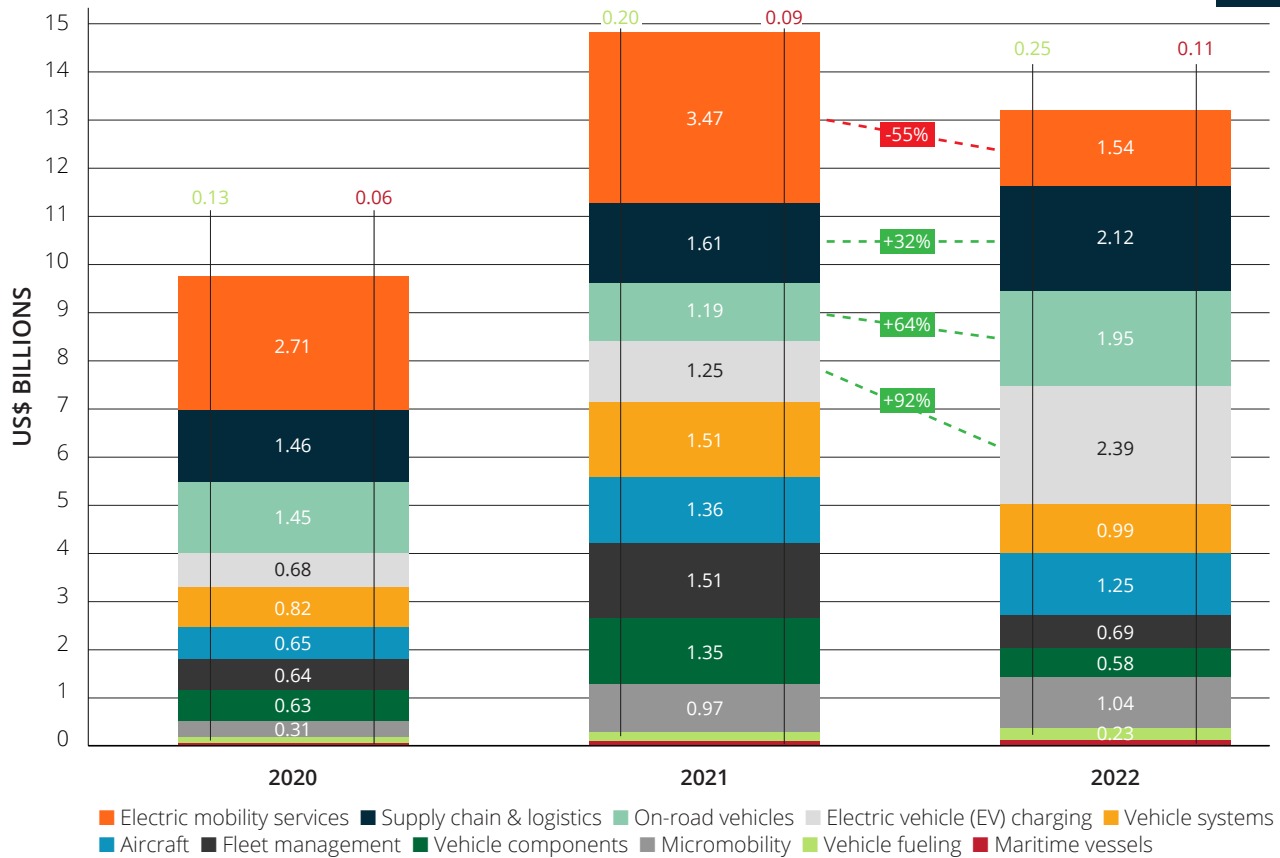


Although investment numbers across Transportation & Logistics were down as a whole compared to last year, subsectors like supply chain and logistics, EV charging, and on road vehicles saw substantial increases in investment. Meanwhile, there was a noticeable decline in electric mobility services, micromobility, vehicle components and aircraft systems.

**ELECTRIC VEHICLE CHARGING RECEIVED STRONG CORPORATE SUPPORT AS REGIONAL REGULATIONS BAN COMBUSTION VEHICLES IN THE NEAR FUTURE**

TRANSPORT & LOGISTICS INVESTMENTS BY SECTOR

Source: Cleantech Group



**ON ROAD PASSENGER ELECTRIC VEHICLES ARE UP BY 64% FROM LAST YEAR**

Electrification of on road passenger vehicles continued as a key trend in 2022. Both electric vehicle innovators and electric vehicle component manufacturers have secured critical equity investments and debt financing. This is true especially for the Chinese market where electric vehicle manufacturer **Xpeng** secured a loan of \$1.14B to support their growth in China and establish a battery subsidiary with \$700M in capital to support the manufacturing of their own batteries and **Farizon Auto** raising over \$300M in their Pre-A funding round. Similarly in Europe, **Hozon Automobile** closed their latest funding round of over \$400M to support the expansion of their manufacturing facilities. **Turntide Technologies**, a U.S. smart electric motor manufacturer, raised \$80M in equity this year putting their total equity investment raised at \$485M. This made their valuation over \$1B giving them unicorn status.

**ENERGY CORPORATES, AUTOMOTIVE COMPANIES, AND OIL AND GAS PLAYERS, ARE SEIZING THE OPPORTUNITY TO INVEST AND PARTNER WITH INNOVATORS ACROSS THE CHARGING VALUE CHAIN, INCLUDING BOTH CHARGING INFRASTRUCTURE AND ENERGY STORAGE SOLUTIONS**



**EV CHARGING INVESTMENTS DOMINATE THE SECTOR AND ARE UP BY 61% FROM LAST YEAR**

Investment in EV charging technologies and infrastructure has increased to support the growing demand and number of EVs on the road. EV charging innovators and companies that received significant investments to expand their electric vehicle network include *DST* who raised \$200M, and *Electrify America* who closed \$450M with corporate investors Siemens and Volkswagen. Other key players include *Atom Power* which raised \$100M, *ZePlug* which raised \$240M and *PowerDot* which raised \$158M.

Q3 especially saw a significant increase, with EV charging accounting for over 40% of overall Transportation & Logistics investment.

2022 also saw significant regulatory announcements, including an EU commitment to ban the sale of new combustion engine passenger vehicles by 2035. In the U.S., California has announced a similar ban, with more states likely to follow suit.

The surge in EV charging deals reflects mounting pressure to develop adequate infrastructure and charging solutions for the rising number of EVs on the road. EV production is at an all-time high with many major automakers announcing significant electrification plans.

Among them, GM, Cadillac, Volvo, Jaguar, and Volkswagen pledge to go all-electric by 2030 or 2035.

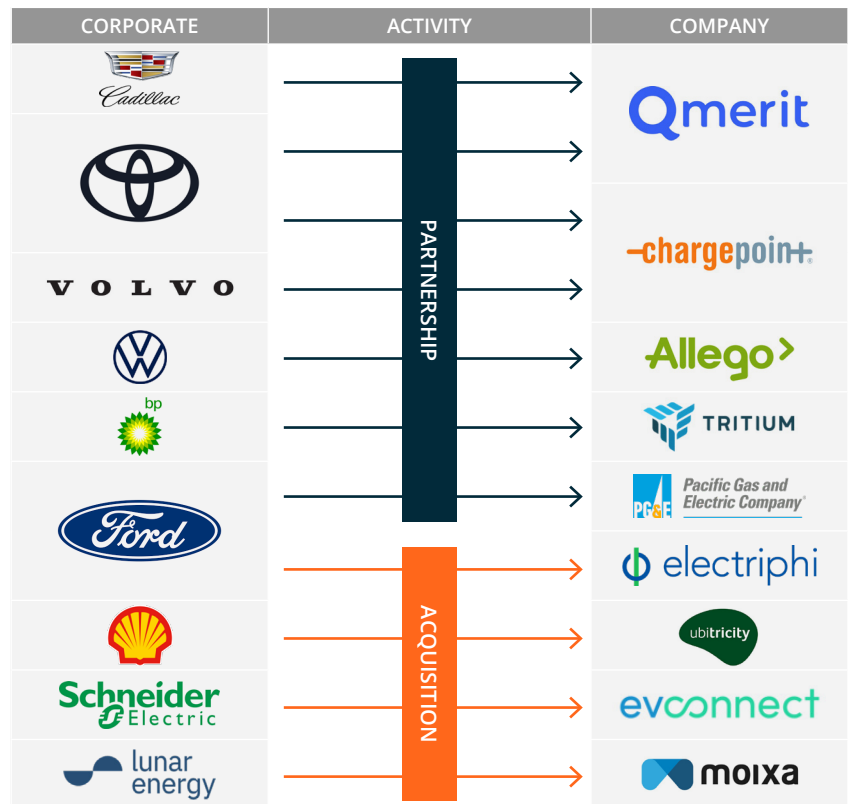
Energy corporates, automotive companies, and oil and gas players, are seizing the opportunity to invest and partner with innovators across the charging value chain, including both charging infrastructure and energy storage solutions. Both Volvo and Ford partnered with battery recycling innovator *Redwood Materials* while Volvo also announced a partnership with EV charging solutions provider *ChargePoint* and Ford established a bi-directional EV charging partnership with PG&E.

**OFF-ROAD AND COMMERCIAL VEHICLE ELECTRIFICATION**

From commercial to off-road vehicles, electrification innovators attracted large investments from both venture capitalists and corporates. For off-road vehicles, *Cummins* partnered with *Komatsu* to develop zero-emission mining trucks. In regard to commercial vehicles, *Volta Trucks* received over \$320M to accelerate the production line of their electric trucks from 14,000 in 2024 to 27,000 trucks on road by 2025. Similarly, *DeepWay* raised \$67M in Series A funding to develop smart electric trucks and enhance their autonomous capabilities.

**CORPORATES ENGAGING EV CHARGING INNOVATORS**

Source: Cleantech Group





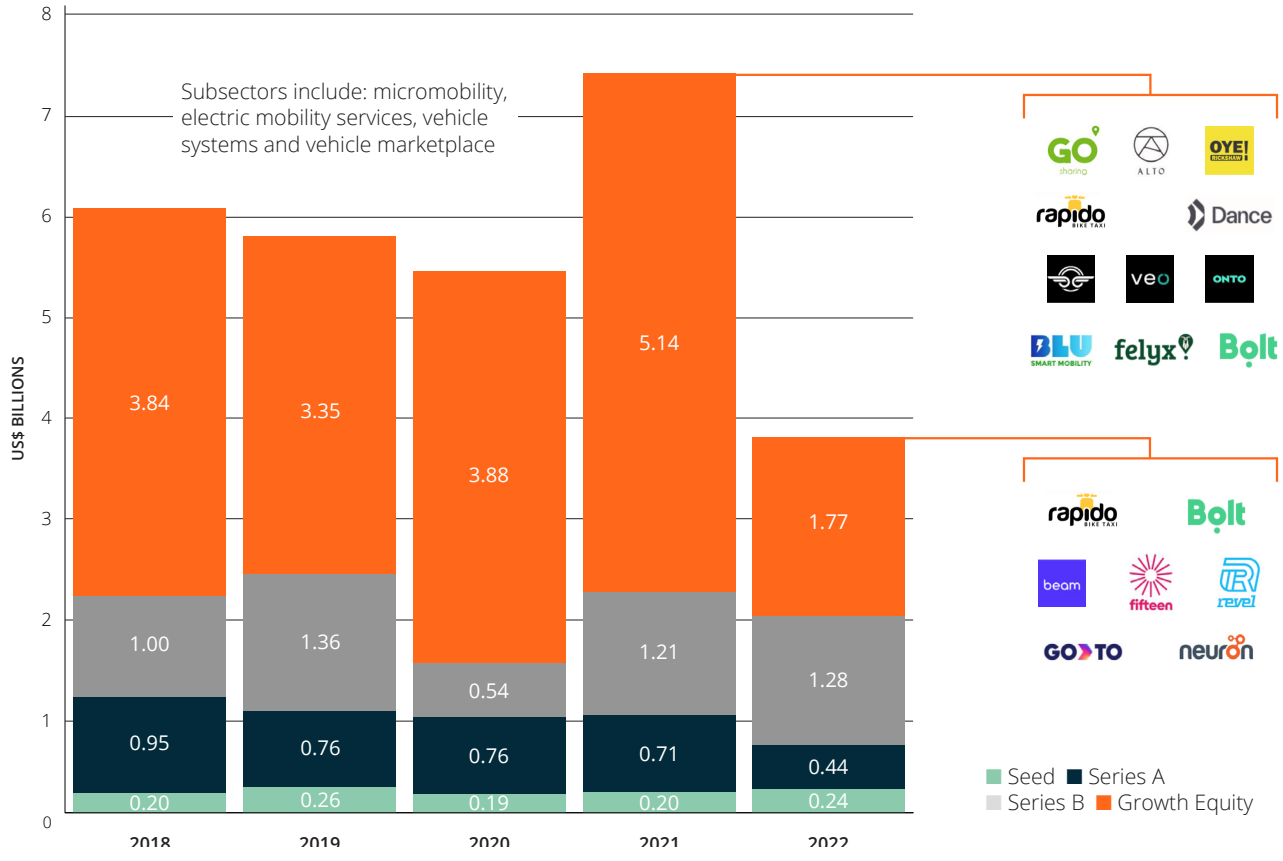
**KEY ELECTRIC MOBILITY SERVICES RECEIVE FUNDING**

Another key trend of 2022, electric mobility services saw significant investment and an expansion of service offerings from innovators, along with engagement from incumbents and OEMs. While overall numbers remained low, dropping EV prices, increasing options, and improving ranges are driving mobility service providers to electrify. Fleet electrification services and electric micromobility emerged as particularly attractive spaces for investment and incumbent engagement.

Innovators are establishing novel business models and providing new service offerings related to batteries and charging services. Electric scooter developers **Yulu** and **Ather Energy** received \$82M and \$50M, respectively, while micromobility service provider **Superpedestrian** raised \$125M. Incumbents in mobility services are actively engaging innovation to improve their emobility offerings, exemplified by Lyft's acquisition of **PBSC Urban Solutions** and **Stellantis** acquiring **Share Now**. **Revel** received over \$120M in their Series B round to expand to seven new cities in the U.S. and received over \$50M from Blackrock in debt to continue their expansion in 2023 and provide all electric mobility services and charging services. Overall mobility services have seen a 50% change from last year.

**MOBILITY SERVICES VENTURE INVESTMENT 2018-2022**

Source: Cleantech Group



SECTOR ANALYSIS

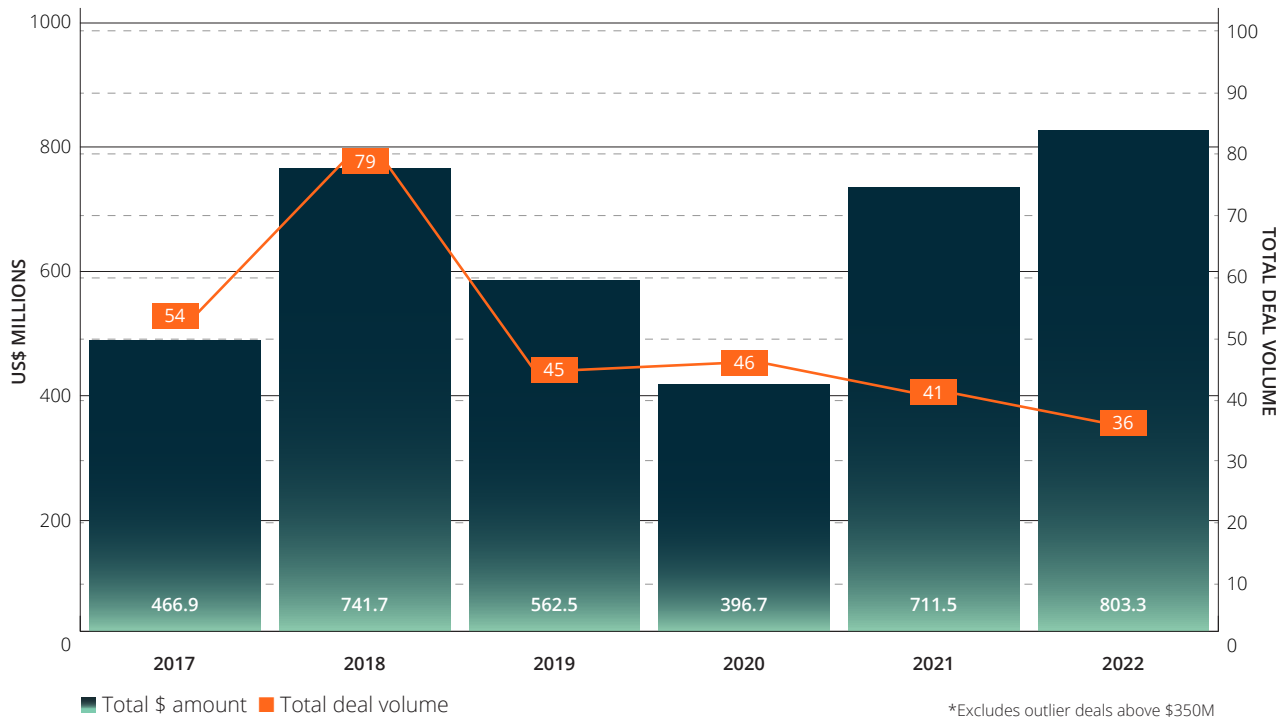
# ENABLING TECHNOLOGIES



Written by  
Alex Crutchfield,  
Research Analyst

## ENABLING TECHNOLOGIES VENTURE INVESTMENT 2017-2022

Source: Cleantech Group



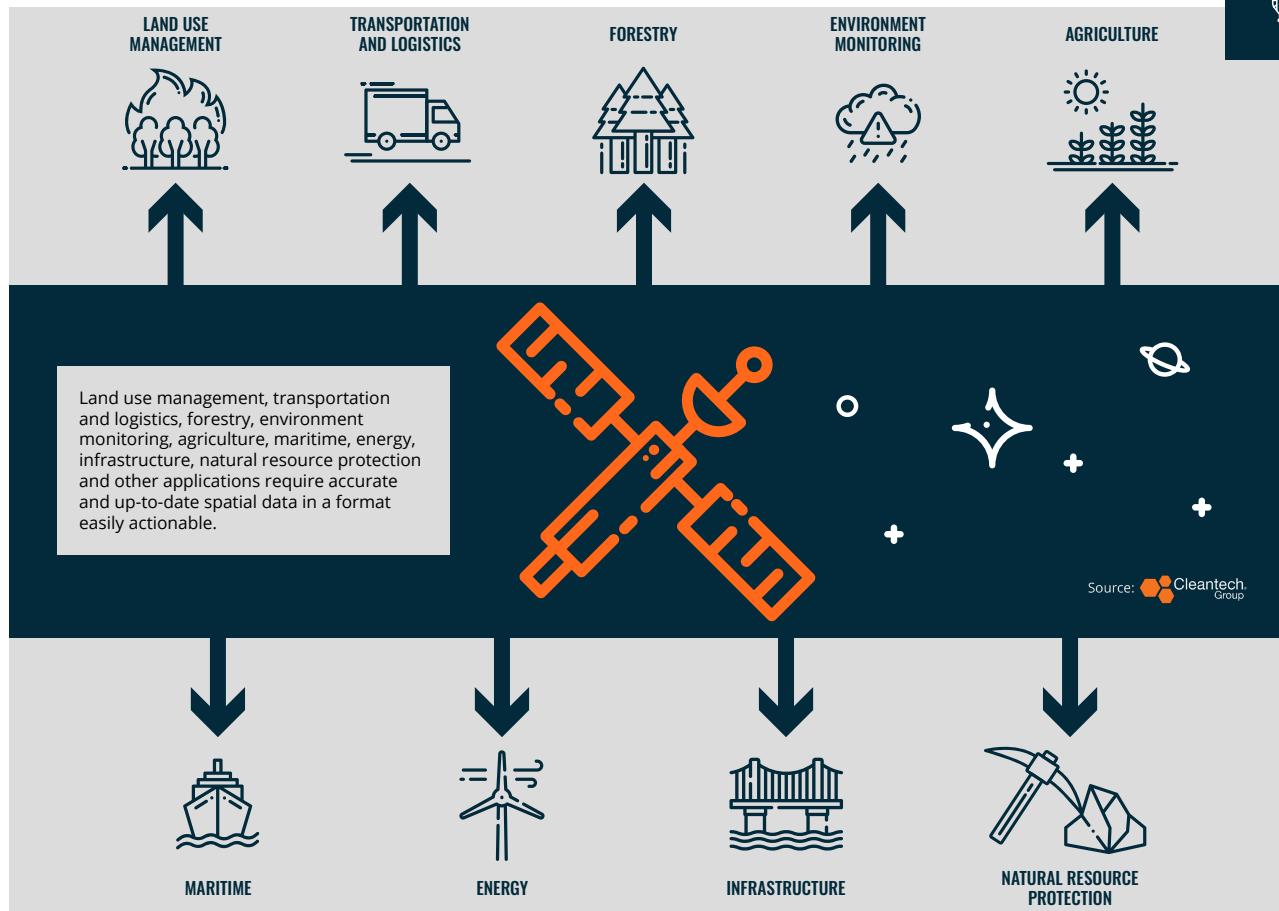
\*Excludes outlier deals above \$350M

## REVERTING BACK TO PLANET EARTH

Enabling technologies in 2022 offered turnkey solutions for supply chain management and new business models using geospatial imaging.

In 2021, innovators explored blockchain, augmented reality, and the Internet of Things (IoT), searching for ways to improve industrial efficiency from the comfort of our homes while the world adapted to the 'new normal'. In response to our hyperconnectivity in the cyber sphere, industries sought to protect their assets and data in 2022.

Market demand for data risk analysis software and cybersecurity showed a compound annual growth rate (CAGR) of 13.4%. Corporates established strategic partnerships with innovators in quantum computing to boost security, either directly or through their venture arms. Where are enabling technologies going in 2023 and beyond? From the metaverse back to planet Earth.



## CREATING A CLEARER PICTURE OF OUR WORLD

Satellite data and analysis are becoming increasingly accessible as they have decreased costs due to major progress in geospatial imagery analysis, combined with the implementation of AI and big data, and the privatization of the space industry. Concurrently, mapping and imaging is producing more granular capture of earth-level data and enabling more micro analysis for geographic information systems (GIS).

This, in turn, is opening a plethora of new business models including climate risk analytics, measurement, reporting and verification, and planning software. Major incumbents are highly collaborative in the field with key players such as **Esri India** announcing GeoInnovation 2022, an acceleration platform in partnership with **AGNii (Invest India)**. This is a boon for innovators seeking new opportunities and in turn, creating a more dynamic playing field.

However, with greater access to satellite data, analytics software providers are now part of a crowded competitive market. Those that have seen great success are those that have strategic partnerships, like **EarthDaily Analytics** with Airbus, who will supply 10 satellite buses to advance their mission to develop super-spectral imagery

constellation. Others have a unique specialism such as **AiDash**, developer of AI-powered satellite analytics solutions for utility vegetation management or **NCX**, developer of forestry carbon monitoring software to maximize the carbon storage capacity of forests.

Finally, the shift towards the satellite-as-a-service model has made imagery a cost-effective choice for applications such as the selection of construction sites, infrastructural projects, and 3D modeling of excavation sites. One key deal that reflects this trend involves **4M Analytics**, developer of a subsurface infrastructure mapping dashboard, that closed a \$45M Series A round to map the United States' underground infrastructure. It will build this map from a "digital repository" of comprehensive utility data.



## MAKING LOGISTICS 4.0 MORE AGILE

The digitalization of logistics has become synonymous with the Fourth Industrial Revolution. But there are key areas where the sector is heading toward the future: robotics and digital project development tools. Project development software streamlines operational methods, mitigates risk, and increases resource efficiency, particularly in the construction and manufacturing industries. Intelligent flexible factory instruments are able to optimize supply chain workflows.

Additionally, these technologies have enabled advancements in cleantech such as in precision agriculture and electric mobility. For example, [Xpeng Motors](#), a major Chinese player in the electric vehicle industry spun out [Xpeng Robotics](#) and poured in \$100M along with IDG Capital to improve its R&D competitiveness. Furthermore, the robotic farming sector between the 2nd half of 2021 to now has almost quadrupled the total investment of prior years. And interest does not appear to be waning. American meat behemoths Tyson Foods and Johnsonville invested \$26M in [Soft Robotics](#) to accelerate the commercial deployment of its robotic picking technology. Also, [Farmwise](#) raised \$45M in Series B funding to expand the production capacity of its precision weeding robots.

What does this mean for the future? Innovation in cleantech will walk hand-in-hand with advancements in robotics and digital project development tools. It will open the door for more diverse opportunities for market growth. We are already seeing it play out on the policy level with regulatory incentives like the UK Farming Investment Fund offering grants for investment in new technologies or the Inflation Reduction Act incentivizing optimized fertilizer, pesticide, and herbicide use via robots.

**INNOVATION IN  
CLEANTECH WILL  
WALK HAND-IN-HAND  
WITH ADVANCEMENTS  
IN ROBOTICS AND  
DIGITAL PROJECT  
DEVELOPMENT TOOLS**

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# THE 2022 GLOBALCLEANTECH100 GRADUATES

Global Cleantech 100 Graduates are companies who have been included in the Global Cleantech 100 at least once, since the first edition in 2009, and then go on to be acquired or become a public company.

A company by the name of **Tesla** was in the first graduating class when it went public in June 2010, having been on the inaugural 2009 Global Cleantech 100 as a private company. Had we the foresight to buy \$10K of stock at that time on a long hold, that would have been worth more than \$2M at one point.

If we are truly to transform the global industrialized economy in the next 25 years, we have every reason to believe that there will be more such super-returns to be had, among Global Cleantech 100 graduates—past, present, and future.

Below we record the graduation events since the previous edition of the Global Cleantech 100 up to the cut-off date of September 30, 2022.

## SPACs

Companies which announced a definitive agreement to go public via a Special Purpose Acquisition Company (SPAC) before the cut-off date (September 30, 2022) were ineligible for consideration for the 2023 Global Cleantech 100, even though, we acknowledge, the odd one might not complete in the end. As an example, this prevented **tado** (which announced a SPAC in January) from consideration. We subsequently learned in October that their listing - via that SPAC, at least - will not happen and so it remains a private and independent company.

Only those which have fully completed and are trading as a public company are included in our roll call of graduates below. **LanzaTech**, for example, an alumnus of many of the early

Global Cleantech 100 lists, announced a \$2B transaction with a SPAC in March 2022. **LanzaTech**'s listing, via a SPAC, was still pending at the start of 2023.

## Unicorns

We have a rule, whereby companies who have appeared on one of the credible, publicly available unicorn lists (as having a valuation in excess of \$1B), can no longer qualify for the Global Cleantech 100. With valuations of recent times, this has meant more leading private companies each year who might otherwise have made the Global Cleantech 100, are no longer able to do so.

The last 12 months of relevance (prior to October 1, 2022) has seen record numbers joining such Unicorn lists:

- Nine of last year's Global Cleantech 100 were among them – **Arcadia**, **Aurora Solar**, **Commonwealth Fusion Systems**, **Enpal**, **Form Energy**, **Nature's Fynd**, **Pivot Bio**, **Turntide Technologies**, and **Watershed**.
- We counted a further 13 cleantech relevant companies, some of which are Global Cleantech 100 alumni, too – including **Einride**, **InFarm**, **Spark Cognition**, **Upside Foods**, and **Volocopter**.

We expect the pace of such "Unicornization" to slow down and catch a breath in 2023—most particularly in other investment themes beyond cleantech (where most Unicorns are, anyway), but also in cleantech. Valuations will surely go through some kind of re-set in 2023, though this may have less of an impact on the very best and brightest start-ups.





OCTOBER 1, 2021 - SEPTEMBER 30, 2022

GLOBAL CLEANTECH 100 GRADUATES VIA IPO

GLOBAL CLEANTECH 100 ALUMNUS COMPANY	IPO TYPE	IPO DATE	DESCRIPTION	YEARS ON THE GLOBAL CLEANTECH 100
 ESS INC	Via SPAC	October 2021	A flow battery technology that utilizes earth-abundant iron as its energy storage medium	2017, 2020-2021
 Solid Power	Via SPAC	December 2021	All-solid-state rechargeable batteries for electric vehicles and mobile power markets	2021
 planet.	Via SPAC	December 2021	A network of observation satellites to provide open-source information on Earth's changing climate	2015, 2017-2021
 TRITIUM	Via SPAC	January 2022	DC fast chargers for electric vehicles	2021
 gogoro.	Via SPAC	April 2022	Electric scooters and battery swapping infrastructure	2018-2020
 NUSCALE	Via SPAC	May 2022	A modular, scalable 45 megawatt electric light water reactor nuclear power plant	2022
 amprius	Via SPAC	September 2022	Advanced lithium-ion batteries for consumer electronics and automotive applications	2011-2012



GLOBAL CLEANTECH 100 GRADUATES VIA M&A

OCTOBER 1, 2021 - SEPTEMBER 30, 2022				
GLOBAL CLEANTECH 100 ALUMNUS COMPANY	ACQUIRER	DATE	NOTES FROM THE ANNOUNCEMENTS	YEARS ON THE GLOBAL CLEANTECH 100
	Generac Power Systems	November 2021	The acquisition was motivated to complement Generac's residential energy technology portfolio	2017-2021
	GE Digital	December 2021	The combined technology portfolio will enable broader and more rapid adoption of renewables and DER, and will help utilities forecast, manage, optimize, and trade renewables coming onto the electric grid	2018-2022
	E.ON	December 2021	The acquisition is part of E.ON's ambition to provide an open digital energy ecosystem. envelio will remain an independent company and continue to evolve its Intelligent Grid Platform	2020-2021
	bp	December 2021	This acquisition was motivated to accelerate bp's fleet electrification activities, whereby AMPLY Power's fleet charging and energy management services will be offered to bp's global customers	2020-2022
	Intellihub Group	April 2022	This acquisition brings together Intellihub's advanced smart metering platform with GreenSync's cloud-based DER interoperability software	2019-2020
	Schneider Electric	May 2022	This acquisition was intended to support Schneider's activity in DER integration into the grid	2013-2020
	Schneider Electric	June 2022	Schneider Electric acquired EV Connect to expand its capabilities in electrification and digitization, and to support EV Connect's growth	2022



GLOBAL CLEANTECH 100 GRADUATES VIA M&A

OCTOBER 1, 2021 - SEPTEMBER 30, 2022

GLOBAL CLEANTECH 100 ALUMNUS COMPANY	ACQUIRER	DATE	NOTES FROM THE ANNOUNCEMENTS	YEARS ON THE GLOBAL CLEANTECH 100
	Enphase Energy	August 2022	This acquisition was intended to accelerate Enphase's European expansion and to provide software and staff resources to support growth	2020
	Lunar Energy	August 2022	Lunar Energy acquired Moixa's Gridshare software asset to integrate Lunar's hardware with it, to deploy across 35,000 homes to support charging services	2019-2020
	Terex	August 2022	Terex Materials Processing acquired the assets of ZenRobotics, a provider of robots that sort recyclables using proprietary artificial intelligence (AI) software	2014
	Antarctica Capital	August 2022	PE firm Antarctica Capital acquired geospatial analytics provider Descartes Labs to support its growing space-based data portfolio	2019, 2021
	Henkel	September 2022	Henkel acquired NBD Nano to expand and strengthen its position in adhesive technologies with NBD's expertise on coatings	2015
	Google	September 2022	BreezoMeter's air quality and forecasting data is expected to be incorporated into Google products such as Environmental Insights Explorer, Earth Engine and Air View	2017, 2019-2022
	Misfits Market	September 2022	Misfits Market acquired Imperfect Foods, a fellow secondary marketplace for food items aimed at waste avoidance, to create a combined business set to surpass \$1B in sales next year	2021

# GLOBAL CLEANTECH 100 HALL OF FAME

The Global Cleantech 100 Hall of Fame was created to recognize the achievements of the few companies whose sustained excellence over many years resulted in being on the Global Cleantech 100 list an impressive seven times. To maintain the support of a strong percentage of investors and technology scouts in the market year over year (from 2009 onwards) is a great achievement.

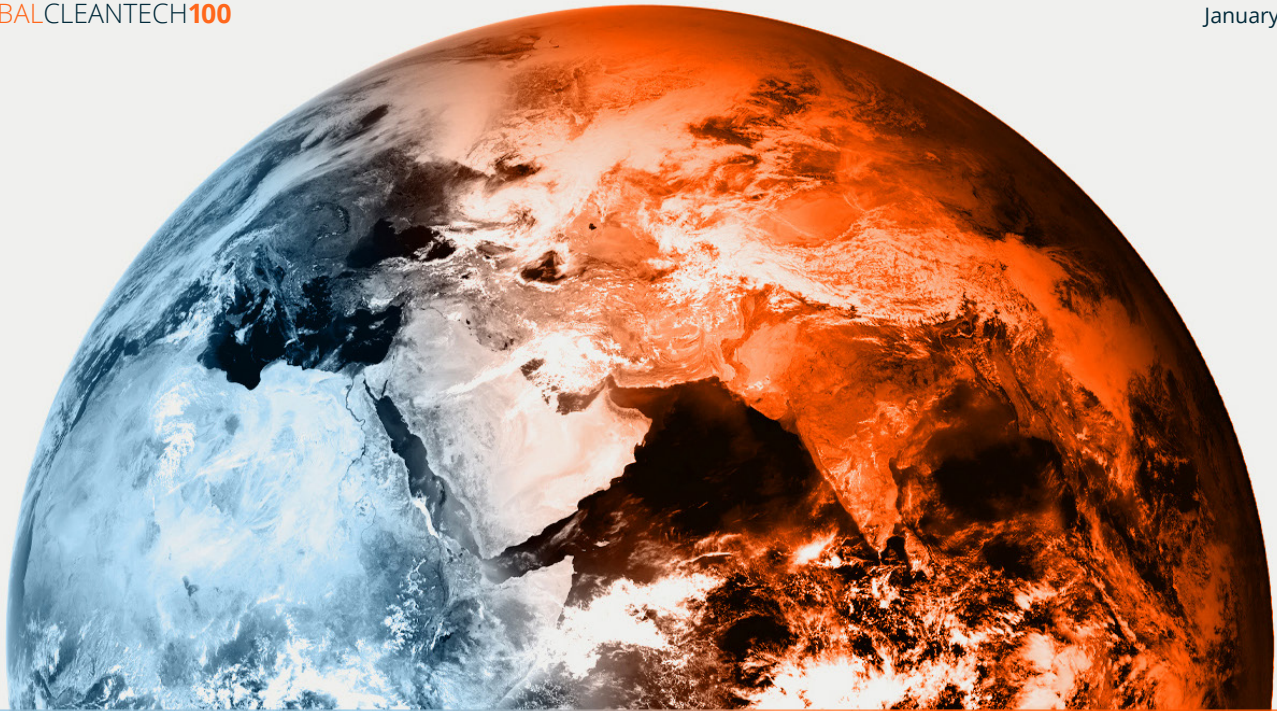
Once inducted into the Hall of Fame, companies will not be featured on any future editions of the list. We will, of course, continue to keep a close eye on them, as we do all our alumni.

We hope to see great things from Hall of Fame companies in the future, delivering on the promise of Global Cleantech 100 companies poised to make significant impact in the next five-to-ten years.

This year, one company, GaN Systems, a global leader in gallium nitride power semiconductors, has reached that milestone and is accordingly inducted into the Global Cleantech 100 Hall of Fame.

**WE EXPECT FEWER HALL OF FAME COMPANIES IN THE FUTURE. THIS IS A POSITIVE SIGN, WHEREBY A 2020'S CLEANTECH COMPANY'S DEVELOPMENT CYCLE IS SPEEDING UP**  
**RICHARD YOUNGMAN, CEO**

	<b>INDUCTED JANUARY 2023</b>				<small>Source:  Cleantech Group</small>
	<b>HALL OF FAME</b>	<b>PREVIOUSLY INDUCTED</b>			
					
					
					
					



ABOUT  
CLEANTECH GROUP

At Cleantech Group, we provide research, consulting and events to catalyze opportunities for sustainable growth powered by innovation. We bring clients access to the trends, companies and people shaping the future and the customized advice and support businesses need to engage external innovation.

Industries are undergoing definitive transitions toward a more digitized, de-carbonized and resource-efficient industrial future. At every stage from initial strategy to final deals, our services bring corporate change makers, investors, governments and stakeholders from across the ecosystem, the support they need to thrive in this fast-arriving and uncertain future.

The company was established in 2002 and is headquartered in San Francisco with offices in North America, Europe, and Asia.



RESEARCH



CONSULTING



EVENTS

# MEET THE EXPERTS

The expert panel plays an important role in shaping the final list. Their knowledge and insight add weight to the evaluation process. For biographies of our expert panel visit our [website](#).

**Christian Hernandez**  
Partner  
2150

**Laura Nereng**  
Business Development  
Director  
3M (Left as of  
December 2022)

**Patrick Sagisi**  
Investment Partner  
Acario Innovation (Left  
as of December 2022)

**Paul Jordan**  
Principal  
Activate Capital Partners

**Greg Fleming**  
Investment Director  
Air Liquide Venture  
Capital – ALIAD

**Bastien Gambini**  
Managing Director  
Alantra Partners

**Stefan Söderling**  
Fund Manager & CEO  
Almi Invest GreenTech

**Michelle Robson**  
Associate  
AP Ventures

**Cory Steffek**  
Partner  
Ara Partners

**Hendrik Van Asbroeck**  
Managing Partner  
Astanor Ventures

**Fabio Lancelotti**  
Partner  
Aster Capital

**Susan Rohac**  
Vice President,  
Cleantech Practice  
BDC Capital

**Rhea Hamilton**  
Managing Director  
Beyond Net Zero

**Ernst Sack**  
Partner  
Blue Bear Capital

**Shaun Healey**  
Principal  
BP Ventures

**Ludwig Goris**  
Partner  
Capricorn Partners

**David Aitken**  
Director, Innovation  
Carbon Trust

**Matthieu van der Elst**  
Chief Impact Officer  
Cathay Capital

**Wal van Lierop**  
Founding Partner &  
Executive Chairman  
Chrysalix Venture Capital

**Jamie Butterworth**  
Partner  
Circularity Capital

**Richard Youngman**  
CEO  
Cleantech Group

**Danielle Joseph**  
Managing Director  
Closed Loop Partners

**Will Guzick**  
General Partner  
Coatue

**Christina O'Connor**  
Partner  
Congruent Ventures

**Shounok Sinha**  
Principal, Venture  
Investments  
Constellation  
Technology Ventures

**Caitlin Walsh**  
Managing Director,  
Growth Equity  
CPPIB

**Andrée-Lise Methot**  
Founder and  
Managing Partner  
Cycle Capital Management

**Nancy Pfund**  
Managing Partner  
DBL Partners

**Olivier Bordelanne**  
Partner  
Demeter

**Kathleen Jurman**  
Technology Scout  
Corporate Ventures  
Dow

**Patrick Elftmann**  
Partner  
E.ON Future  
Energy Ventures

**Dr. Paul-Josef Patt**  
Managing Partner  
and CEO  
eCAPITAL  
Entrepreneurial Partners

**Sasha Brown**  
Partner  
Ecosystem Integrity Fund

**Luis Manuel**  
Executive Director  
EDP Ventures

**Gina Domanig**  
Managing Partner  
Emerald Technology  
Ventures

**Glenn Bijvoets**  
Innovation Manager  
Eneco

**Tomohisa Hirano**  
Scientist  
ENEOS

**John Tough**  
Managing Partner  
Energize Ventures

**Wally Hunter**  
Managing Director  
EnerTech Capital

**Johann Boukhors**  
Managing Director  
ENGIE New Ventures

**Fabrice Bienfait**  
Partner  
ETF Partners

**Lutz Stoeber**  
Investment Director  
Evonik Venture Capital

**Dirk De Boever**  
Head of Investments  
Finindus

**Colin Le Duc**  
Founding Partner  
Generation Investment  
Management

**Stefon Crawford**  
Principal  
GM Ventures

**Eric Wang**  
Managing Partner  
GRC SinoGreen Fund

**Jamie James**  
Managing Partner  
Greensoil Building  
Innovation Fund

**Robert Liu**  
CEO  
Huaneng Invesco  
WLR (Beijing)

**Sukhwan Yun**  
Senior Manager,  
CVC Team  
Hyundai Motor Company

**Diego Diaz Pilas**  
Head of New Ventures  
& Technology Prospects  
Iberdrola

**Matias Torellas**  
Portfolio Manager  
InnoEnergy

**Ivo Němejč**  
Investment Director  
Inven Capital

**Ali Sharifi**  
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Kerogen Capital

**Robert Trezona**  
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Kiko Ventures

**Ryosuke Sakai**  
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Munich Venture Partners

**Gert Wrigge**  
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Prelude Ventures

**Eric Kosmowski**  
Managing Partner  
Princeville Capital

**Michael Claes**  
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Manager  
SABIC Ventures

**Karthik Chandrasekar**  
CEO  
Sangam Ventures

**Arindam Bhattacharya**  
Managing Director  
Schlumberger Ventures

**Grant Allen**  
General Partner  
SE Ventures

**Markus Hökfelt**  
Head of SEB Greentech VC  
SEB

**Wouter Jonk**  
Managing Partner  
SET Ventures

**Jermaine Saaltink**  
Principal  
Shell Ventures

**Dan Baldi**  
Market Manager  
Silicon Valley Bank

**Hee S. Jung**  
Head of Investment  
SK Gas

**Mark Bonnar**  
Managing Partner  
Southern Cross  
Venture Partners

**Kurt Faulhaber**  
Partner  
Stafford Capital Partners

**Jacques de T'Serclaes**  
Investment Manager  
Telos Impact

**Astorre Modena**  
Managing Partner  
Terra Venture Partners

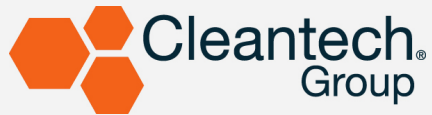
**Peter Kennedy**  
Managing Director  
The Meloy Fund

**Steve Kloos**  
Partner  
True North  
Venture Partners

**Qi Lu**  
Partner  
Tsing Capital

**Peter Auner**  
Partner  
VNT Management

**Chris Kane**  
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