

# GLOBAL CLEANTECH 100

**From Chaos to Transformation:**

The Companies and Themes Delivering Sustainable Innovation



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# Acknowledgements

We firstly wish to express our gratitude for the ongoing support of Chubb, the world's largest publicly traded property and casualty insurance company. Chubb has been the headline sponsor of the annual Global Cleantech 100 program for eight consecutive years now.

The list would not have been possible without the 91 expert panelists (See pages 58-60) who gave up their time to provide input and opinion. This is in addition to the many hundreds who made company nominations.

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

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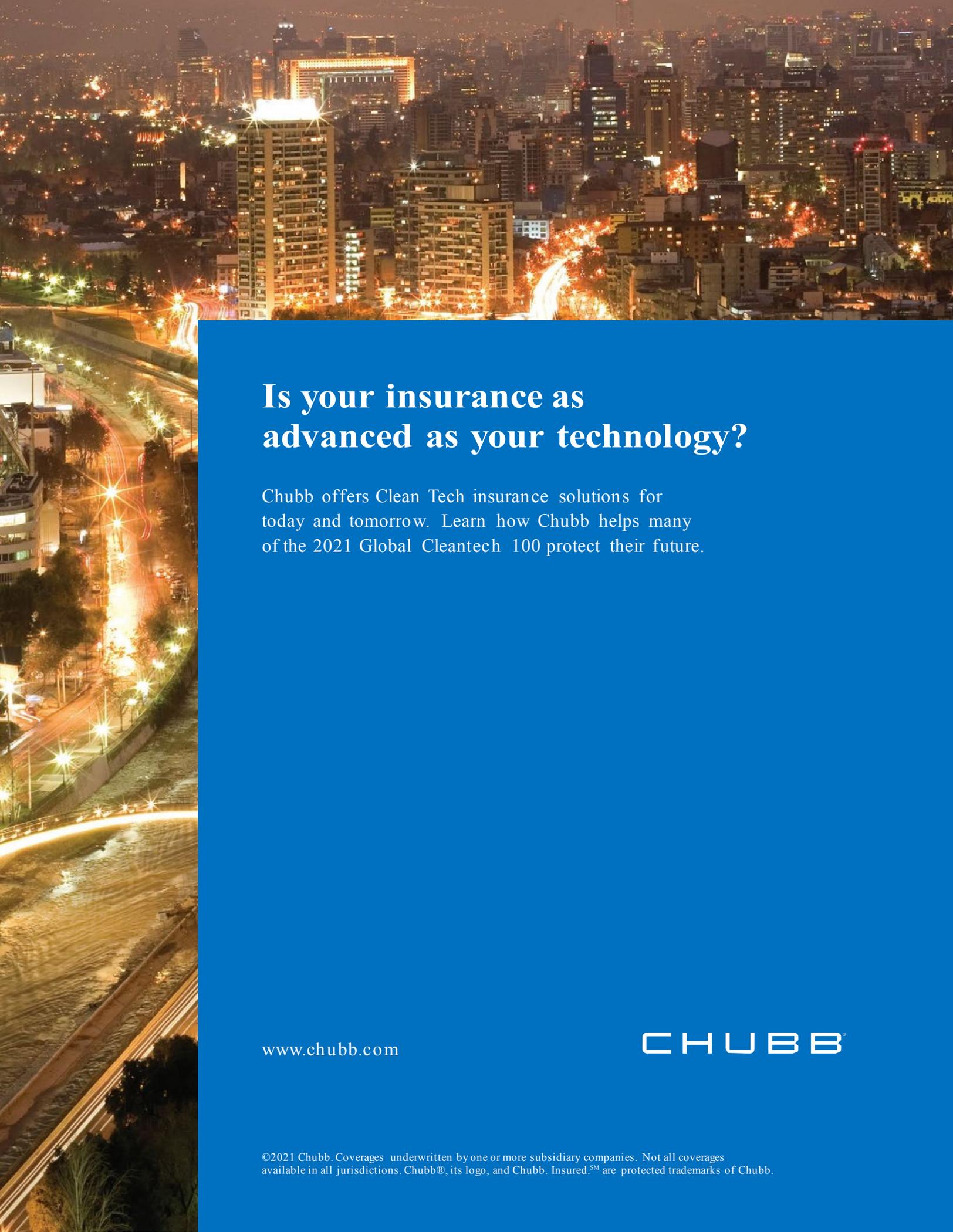
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# FOREWORD

From Chaos To Transformation:  
It's Truly Squeaky Bum Time Now

Richard Youngman  
CEO



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The negatives of 2020 and the pandemic are all too clear. It is easy and understandable to be overwhelmed by them. However, we, as a community, need to remain positive and believe we can still do this. After all, if entrepreneurs won't remain positive and focused on the longer-term game, then who will inspire us forward, from chaos to transformation?

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There were some silver linings to be picked out of the chaos of 2020, and these were a few of them:

CO<sub>2</sub> emissions have fallen for the first time since the 2015 Paris Climate Accord, and indeed by the kind of amounts needed every year until 2030 to reach that first halving of emissions (the only problem is that we blew \$16 trillion we could have used more productively on the climate crisis!).

The pandemic has created a focus on resilience and systemic risk. Without the Covid-19 test case showing us how Mother Nature can render our species small and powerless, would the global populace be as tuned into systemic life-threatening risks as it is right now? According to the Pew Research Center, citizens are as concerned right now with the climate crisis as they are with the pandemic.<sup>1</sup>

In what yet may prove a sliding door moment of history, the US will be back in the Paris Climate Accord and working collaboratively again in the international community on this global problem – just in the nick of time and at a very interesting moment with Japan, China and Europe having all recently increased their commitments to net zero.

We always said the 2020s would be chaotic, and that we should expect to have to work on solving the Climate Crisis through business unusual.<sup>2</sup> Maybe the worst of that chaos just happened? Maybe transformations could never have truly begun without industries, corporate and political leaders, institutional shareholders and consumers actually seeing and tasting a little bit of what extinction could look and feel like.

It certainly seems to have further increased the momentum of corporate announcements – from BP's Net Zero by 2050 to Microsoft's pledges to shift to 100% renewable energy supply by 2025 and to be carbon negative by 2030, from a raft of corporate commitments toward Regenerative Agriculture and Nature-based Solutions to Amazon's \$2 billion Climate Pledge fund. And so it might yet be the case that the chaos may have buried some of the better news items of the year. Their significance may only be appreciated in time, if and when their objectives are achieved.

Against this backdrop, we present the 2021 Global Cleantech list, this year's barometric read of the pulse out there, on the viewpoints of which types of companies and topics have higher likelihoods of making longer-term impact in the rest of the 2020s. What does it show?

- The 2021 list reflects the long-running mega-trends like digitization, electrification, resource efficiency and the ever-increasing volumes of deployed renewable energy.
- It shows that Covid-19 has had a marked impact on accelerating certain areas quite aggressively, albeit, of course, hurting others. Resilience is clearly at play in the increase in this year's list in automation and robotics-enabled solutions, in logistics and supply chain solutions and in the food chain to prevent, reduce and repurpose food waste.

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1. Fagan, Moira and Huang, Christine. 2020. "Many Globally are as Concerned about Climate Change as about the Spread of Infectious Diseases." Pew Research Center.  
 2. Youngman, Richard. 2019. "Welcome to the Chaos of the 2020s – Urgent Actions, Unusual Strategies and Unexpected Allies." Cleantech Group Insights.





“2020 may yet prove to be the year which created the conditions that brought us together and got us focused harder on achieving true transformations.”

- Carbon has never been so predominant in a Global Cleantech 100 – not just in the high number of CCUS companies, but in digital measurement solutions and indeed in regenerative agriculture and the potential for carbon sinks (like soil and cement) to give rise to new investment asset classes. Through the CO<sub>2</sub> lens, we also note the arrival of cultivated, lab-grown meat, following the recent wave of the plant-based solution providers we have seen in the latest Global Cleantech 100s.

2020 may yet prove to be the year which created the conditions that brought us together and got us focused harder on achieving true transformations. Transition has a sense for me of something too comfortable, smooth and neatly planned, something that is under control. It is not and business as usual was not going to get us there.

With nine years to the necessity of the 2030 halving goal, the climate crisis is truly in “squeaky bum time,” a phrase identified with Sir Alex Ferguson, the legendary Manchester United Football Team Manager, describing the last minutes of the match or a season, when it wasn’t clear who might win, only clear it would be ever so close and tense.

That’s where we are. Let’s get to work, tackling the climate crisis together.

*Richard Youngman*

CEO, Cleantech Group

# How we select the Global Cleantech 100

## 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:

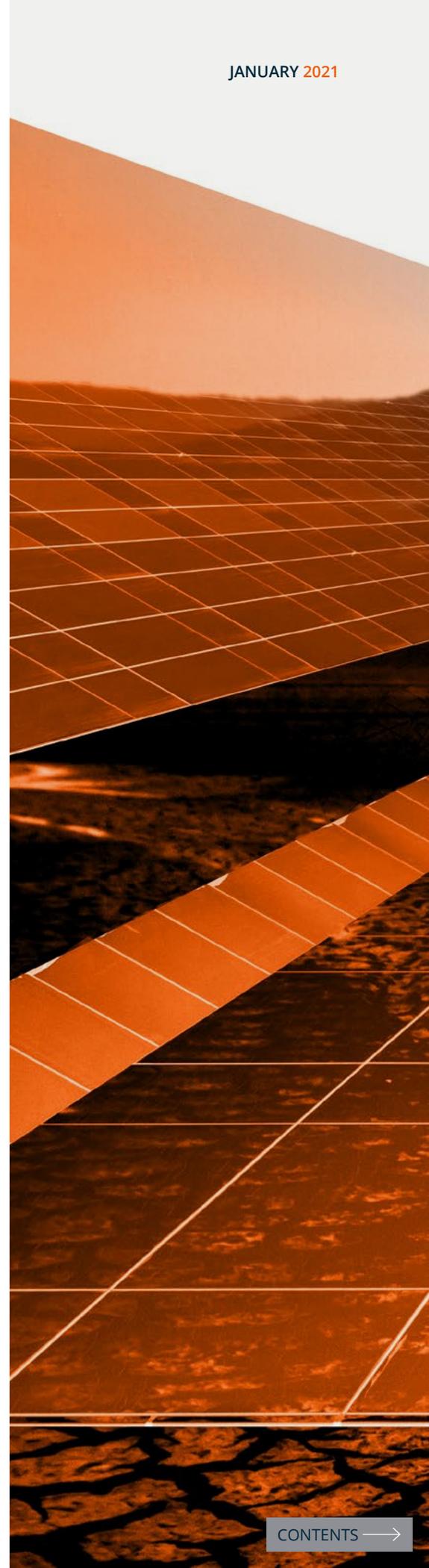
- The expert panel of 91 investor and multi-national corporation representatives
- Our i3 platform tracking the investment and partnership history of thousands of relevant companies
- Over 270 third-party awards where expert assessment has been applied
- Our sector analysts
- The global ecosystem \* ([i3connect.com/gct100/nominate](http://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 91 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 11,505 from over 75 countries. These companies were weighted and scored to create a short list of 321 companies that were reviewed by the 91 members of Cleantech Group's 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 Global Cleantech 100 in numbers

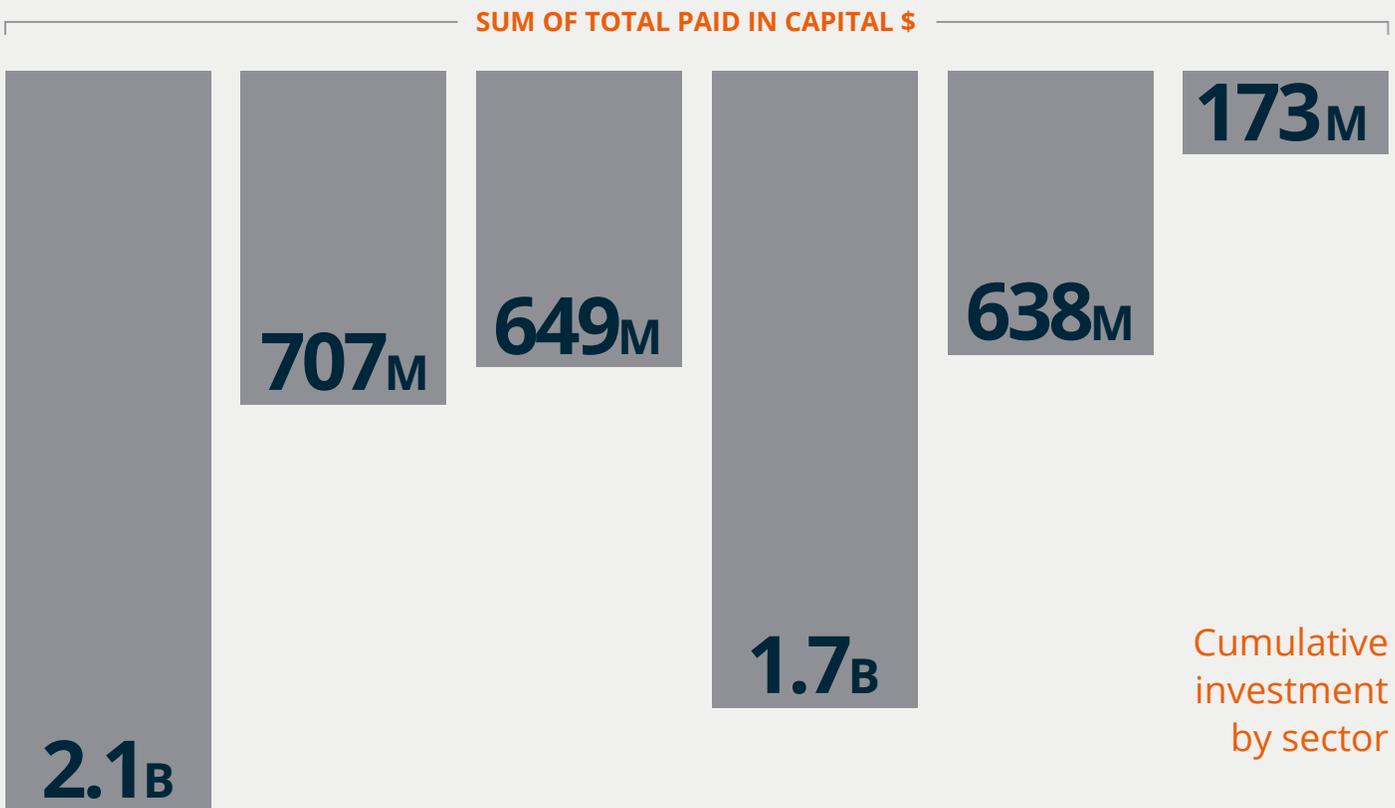
Uncover the story behind the companies included in the 2021 Global Cleantech 100. How much money have they collectively raised? How many investors have they attracted? Which sectors are leading the way?\*

The number of companies and level of investment by region



\*All investment figures based on data collected as of November 20, 2020. Source: Cleantech Group.





### Scale of total investment

Close to  
**\$5.9 B**

Raised by Global Cleantech 100 Companies since their founding

**\$170 M** BIGGEST EQUITY ROUND IN 2020 (INTO INFARM)

**\$37 M** AVERAGE EQUITY ROUND IN 2020

**631**  
INVESTORS

**40**  
COUNTRIES INVESTORS ARE FROM

**402**  
VENTURE INVESTMENT ROUNDS

Total money raised by the companies in the 2021 Global Cleantech 100 in Q1-Q3 2020

**\$1.3 B**





THE2021

# GLOBALCLEANTECH100

The 2021 Global Cleantech 100 companies  
listed in alphabetical order by sector





# Agriculture & Food

13 COMPANIES ↔

5 COUNTRIES ↓

Company	Description	Country
	Developer of mycoproteins for protein food products	United Kingdom
	Upcycler of organic waste using insects and technology to produce sustainable protein for animal and aquaculture feed	United Kingdom
	Developer of a synthetic biotechnology platform to develop new crops and food	United States
	Operator of a farm-to-table food delivery service focused on otherwise wasted produce	United States
	Developer of modular vertical farms to offer a local alternative food system	Germany
	Developer of modular robotic farming equipment and processes	United States
	Developer of a marketplace app that discounts and redistributes food waste to consumers	Sweden
	Developer of a way to produce real meat, poultry and seafood grown from animal cells	United States
	Developer of micro-organisms that improve plant health, promote early growth, and increase crop yield	United States
	Developer of microbe-powered technology to improve agriculture productivity	United States
	Developer of high-performing varieties of tropical crops using gene-editing technologies	United Kingdom
	Designer of next generation biopesticides using naturally-occurring peptides	United States
	Developer of bioconversion solutions using insects to produce feed, organic fertilizers and bioenergy	France

KEY: ↑ Increase on 2020 figures ↓ Decrease on 2020 figures ↔ Same as 2020 figures

 <h1 style="margin: 0;">Enabling Technologies</h1> <div style="float: right; text-align: right;"> <p>7 COMPANIES ↓</p> <p>2 COUNTRIES ↔</p> </div>		
Company	Description	Country
	Provider of large-scale data infrastructure and advanced analytics for R&D and manufacturing in the materials industry	United States
	Designer and developer of robots for street cleaning and logistics	China
	Developer of an industrial software analytics platform for asset-intensive industries	United States
	Developer of bio-fabrication processes and materials	United States
	Operator of a network of observation satellites to provide open-source information on Earth's changing climate	United States
	Developer of an AI platform aiming to prevent worker accidents and identify threats to infrastructure	United States
	Developer of robotic solutions for manufacturing and logistics	United States

KEY: † Increase on 2020 figures   ↓ Decrease on 2020 figures   ↔ Same as 2020 figures

**“ENABLING TECHNOLOGIES SUCH AS ROBOTICS, ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ARE ENABLING INDUSTRIAL EFFICIENCY AND DECARBONIZATION ACROSS MULTIPLE INDUSTRIES. IN THE COMING YEARS, KEEPING UP WITH AUTOMATION WILL BE CRUCIAL TO COMPETE.”**  
**NISA MIRZA, ANALYST, CLEANTECH GROUP**



# Energy & Power

39 COMPANIES ↓

8 COUNTRIES ↓

Company	Description	Country
 75F	Developer of a predictive building automation system that addresses HVAC, lighting and equipment control requirements	United States
 AKSELOS	Provider of real-time predictive digital twins for the management of large assets	Switzerland
 Alpha-ESS	Developer of advanced lithium-ion battery storage products	China
 Arcadia	Provider of a direct-to-consumer clean energy subscription platform	United States
 Bboxx	Developer of technologies and services to solve energy access needs in areas with no or unreliable electricity grids	United Kingdom
 BLOC POWER	Provider of data-enabled, financed heating and cooling retrofit services for multifamily buildings	United States
 CLOUD & HEAT	Provider of cloud-based computing services, with the waste heat produced by the servers also being used to heat buildings and water	Germany
 Commonwealth Fusion Systems	Developer of advanced fusion technology	United States
 Deepki	Provider of software for buildings using statistics and computer science to turn existing customer data into energy efficiency action plans	France
 ecobee	Developer of smart thermostats for residential and commercial applications to improve residents' comfort and energy savings	Canada
 Enapter	Manufacturer and integrator of modular anion exchange membrane electrolyzers to produce hydrogen	Germany
 energyworx	Developer of a platform analyzing energy data	Netherlands

KEY: † Increase on 2020 figures ↓ Decrease on 2020 figures ↔ Same as 2020 figures



## Energy & Power

Company	Description	Country
 envelio	Developer of a platform for grid operators to digitize energy planning and operation processes	Germany
 ESS INC	Developer of a flow battery technology that utilizes earth-abundant iron as its energy storage medium	United States
 FLEXIDAO	Provider of blockchain-based software to enable energy retailers, utilities and corporate buyers to manage and optimize data on their renewable energy	Netherlands
 form energy	Developer of low-cost, long-duration energy storage to replace existing baseload generation	United States
 FREEWIRE	Developer of battery-integrated EV charging and energy services	United States
 GaN Systems	Developer of gallium nitride (GaN) semiconductors	Canada
 hydrogenious LOHC TECHNOLOGIES	Developer of hydrogen storage in the form of Liquid Organic Hydrogen Carriers for multi-megawatt energy systems	Germany
 innowatts	Developer of real-time energy monitoring and prediction software for energy retailers and utilities	United States
 kWh analytics	Provider of data analytics for the solar financing community	United States
 leap.	Developer of a flexibility aggregation platform for distributed energy resources	United States
 Level10 Energy	Provider of transaction infrastructure for renewable energy buyers, advisors, sellers and financiers	United States
 METRON	Developer of energy management platform allowing industrial groups to optimize their energy performance and decarbonize their activities	France
 next	Operator of virtual power plants connecting decentralized renewable energy producers with large-scale power consumers	Germany
 opusone SOLUTIONS	Developer of real time control and optimization solutions for generation, storage and electric vehicle resources	Canada

	<h1>Energy &amp; Power</h1>	
Company	Description	Country
	Provider of AI solutions to optimize building operations	Canada
	Technology provider of deep-water offshore floating wind foundation systems	United States
	Developer of FastOx® waste gasification technology	United States
	Manufacturer of graphene-based ultracapacitor energy storage solutions for automotive, transportation, grid & renewables and industrial applications	Germany
	Provider of modular power flow control solutions for electric utilities and grid operators	United States
	Developer of all-solid-state rechargeable batteries for electric vehicles and mobile power markets	United States
	Developer of smart electrical panels and paired software to provide visibility and control at the edge-of-grid	United States
	Developer of a smart thermostat and SaaS platform allowing users to control their home heating and cooling systems from their smart phones	Germany
	Developer of an efficient electric motor system	United States
	Developer of predictive analytics software for batteries	Germany
	Provider of charging stations offering free charging to drivers and advertising space for brands and businesses	United States
	Developer of machine learning software aiming to solve EV-grid integration challenges for utilities	United States
	Provider of energy storage and solar solutions for remote energy access	Netherlands



# Materials & Chemicals

7 COMPANIES ↔

3 COUNTRIES ↑

Company	Description	Country
 BOSTON MATERIALS	Manufacturer of composite materials for light-weighting in transportation, aerospace, consumer electronics and industrial applications	United States
 BOSTON METAL	Developer of a molten oxide electrolysis technology for steel, alloys and other metals	United States
 Checkerspot	Developer and producer of bio-based performance materials leveraging advances in genomics, biology and materials science	United States
 RENITEC	Developer of a closed-loop chemical recycling technology that can turn cotton-rich textile waste into new fibers for the textile industry	Finland
 Lactips	Developer of cold water soluble bioplastic pellets made from caseins to replace conventional plastics or improve their recyclability	France
 MANGO MATERIALS	Developer of a process converting methane into PHA for applications in fashion and a wide range of other products	United States
 SOLIDIA	Manufacturer of sustainable cement and concrete	United States

KEY: ↑ Increase on 2020 figures ↓ Decrease on 2020 figures ↔ Same as 2020 figures

**“THE CHEMICALS INDUSTRY FACES TWO KEY CHALLENGES: ADDRESSING THE AVAILABILITY OF RAW MATERIALS, AND THE END-OF-LIFE IMPACTS OF PRODUCTS.”**  
**IAN HAYTON, LEAD ANALYST, MATERIALS & CHEMICALS**



# Resources & Environment

19 COMPANIES ↑  
5 COUNTRIES ↓

Company	Description	Country
 <b>AMP ROBOTICS</b>	Developer of robotic solutions to automate waste sorting	United States
 <b>axine</b> WATER TECHNOLOGIES	Developer of chemical-free solutions for treating toxic organics in pharmaceutical and other industrial wastewater	Canada
 <b>BreezoMeter</b>	Provider of location-based, real-time air quality data and pollen information solutions	United States
 <b>carbon clean</b> <small>TECHNOLOGY TO REMOVE NET ZERO</small>	Developer of CO <sub>2</sub> capture technology aiming to reduce the cost and environmental impact of CO <sub>2</sub> separation	United Kingdom
 <b>Carbon Engineering</b>	Developer of technologies for the capture of carbon dioxide from the atmosphere at industrial scale	Canada
 <b>CARBON CURE</b>	Manufacturer of a permanent carbon removal technology for concrete production	Canada
 <b>C-Capture</b>	Developer of materials for use in carbon capture and storage (CCS) applications	United Kingdom
 <b>climacell</b>	Developer of a technology that generates weather forecasts to predict the business impact of weather and improve operational efficiency	United States
 <b>climeworks</b>	Developer of direct air capture technology to remove carbon dioxide from the air	Switzerland
 <b>Descartes Labs</b>	Developer of an intelligence platform using geospatial analytics	United States
 <b>JUPITER</b>	Developer of climate-driven analysis for resiliency and disaster planning	United States
 <b>Li-Cycle</b>	Developer of battery recycling technologies to recover and supply lithium-ion battery materials	Canada
 <b>Lilac</b> solutions	Provider of lithium extraction services	United States

KEY: ↑ Increase on 2020 figures ↓ Decrease on 2020 figures ↔ Same as 2020 figures



## Resources & Environment

Company	Description	Country
	Developer of a low-waste shopping and delivery service with reusable packaging	United States
	Developer of sensor technology to bring operational efficiency to the mining industry	Canada
	Developer of energy- and capital-efficient technology for capturing carbon dioxide from industrial sources	Canada
	Developer and manufacturer of compostable packaging solutions for the food and fashion industries	Israel
	Developer of artificial intelligence tools to help chefs cut food waste	United Kingdom
	Developer of technology to quantify and verify environmental and social attributes of commodity production	United States

**“FROM A RESOURCE AND ENVIRONMENT PERSPECTIVE, USING OUR PLANET’S ASSETS IN A MORE RESPONSIBLE WAY MEANS REDUCING OUR DEPENDENCE ON PLASTICS, MANAGING WATER AND WASTE, AND PROTECTING OUR NATURAL ENVIRONMENT VIA RECYCLING, SHIFTING TO A CIRCULAR ECONOMY, AND LEVERAGING CCUS TECHNOLOGIES.”**

**HOLLY STOWER, LEAD ANALYST,  
RESOURCES & ENVIRONMENT**



# Transportation & Logistics

15 COMPANIES ↑

10 COUNTRIES ↑

Company	Description	Country
 <b>AMPLY</b> FLEET CHARGING SIMPLIFIED	Provider of electric fleet charging and energy services	United States
 <b>CargoX</b>	Provider of a platform to help companies securely transfer documents and connect shippers with carriers	Slovenia
 <b>DST 地上铁</b> 新能源运营服务平台	Provider of charging and management solutions for new energy vehicle fleets	China
 <b>effenco</b>	Developer of technologies for the electrification and connectivity of heavy-duty vocational vehicles	Canada
 <b>electriphi</b>	Provider of a fleet and energy management software platform for light, medium and heavy-duty commercial electric fleets	United States
 <b>ENEVATE</b>	Developer and licensor of silicon-dominant Lithium-ion battery technology for electric vehicles	United States
 <b>Momentum</b> Automated Wireless EV Charging	Developer of wireless charging systems for electric vehicles	United States
 <b>NORSEPOWER</b>	Developer of auxiliary wind propulsion systems for large ships	Finland
 <b>onTRUCK</b>	Developer of an on-demand platform to digitize freight logistics	Spain

KEY: ↑ Increase on 2020 figures ↓ Decrease on 2020 figures ↔ Same as 2020 figures



## Transportation & Logistics

Company	Description	Country
 SHIPPEO	Provider of a platform for predictive and real-time visibility into goods delivery	France
 STREETLIGHT DATA	Provider of a SaaS platform for transportation professionals to measure vehicle, bicycle and pedestrian activity	United States
 SUN MOBILITY	Manufacturer and operator of electric vehicle charging infrastructure with swappable batteries and swap stations	India
 Swiftly	Supplier of software applications to manage transit data in cities	United States
 TRITIUM	Designer and manufacturer of DC fast chargers for electric vehicles	Australia
 VIRICITI	Developer of fleet telematics solutions for electric and non-electric vehicles and chargers	Netherlands

**“THE COMPANIES ON THE LIST THIS YEAR ARE MAKING A REAL IMPACT ON EMISSIONS ACROSS VARIOUS SEGMENTS OF MOBILITY AND LOGISTICS, AND THEY’RE SOLVING KEY CHALLENGES IN MOVING TOWARDS AN ELECTRIC AND MORE EFFICIENT TRANSPORT SYSTEM.”**  
**CASSIDY SHELL, LEAD ANALYST, TRANSPORTATION & LOGISTICS**

# RESEARCH OUTLOOK

Five Major Macro Trends Driving Innovation

Chris Dawe  
Associate Director, Research



Cleantech Group helps corporates, investors and governments to better understand the key trends in innovation, with a focus on the sectors where the impact will be significant. Each year, we interview thousands of entrepreneurs, investors and corporate movers and shakers. These discussions help us identify market opportunities, successful business models and the early leaders.

This year, we followed five macro sustainability trends accelerating via innovation: resilience, circular economy, decarbonization, urbanization and digitalization. Each of these macro trends will have a long-term impact on the industrial landscape.

In addition to these macro trends, regulation and announced targets will also be a significant driver to a cleaner future. Announcements such as China's pledge to be carbon neutral by 2060, the EU's aim to be carbon free by 2050 and the US' expected return to the Paris Climate Accord will help sustain momentum and rising investment activity.

### 1. Resilience – Protecting People, Infrastructure and Supply Chains

Each year, disruptions to infrastructure cost households and corporates in low- and middle-income countries an estimated \$390 billion,<sup>1</sup> not including the indirect costs incurred to their communities, businesses and households. The global economy will be challenged to maintain steady growth due to climate change events such as extreme weather events and rising sea levels.

Currently, the scale and speed of weather risks outpace resources. The solution will be a combination of preparing for extreme weather and the adaptation of infrastructure. As noted in our recently published study; *Digital Grid Resilience: Natural event mitigation and reliability*, strategies are taking shape for grid operators with a focus on grid sensors, grid analytics and digital grid control.

After a solid first half of 2020, where many deals were already in development prior to the pandemic, the expected negative impact of Covid-19 hit

cleantech investment globally. Our data shows that the third quarter experienced a sharp decline of 23.6% in deal volume and a 23.5% drop in amounts invested. The Covid-19 supply chain disruption is driving agriculture chain operators to find ways to improve supply chain agility, flexibility and resilience. Leveraging technology to make agriculture more profitable and sustainable has become a priority for corporations, governments and investors.

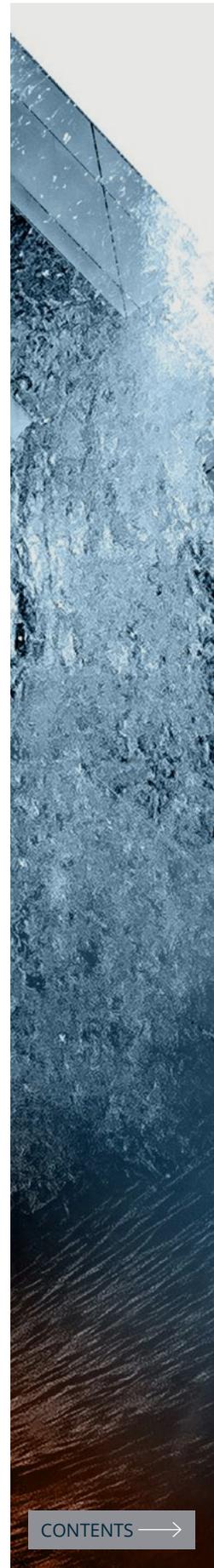
### 2. Circular Economy - Rethinking Business Models

In 2018, the World Bank announced that the current global waste production of 2 billion tons per year is predicted to increase by 70% by 2050 (barring urgent action).<sup>2</sup> Per the EPA, 45% of global emissions come from the way we make and utilize products,<sup>3</sup> making investment to drive circular economy strategies and development vital in the race to achieve UN SDGs and more ambitious targets. In designing for the future, collaboration to create joint value will be the key to drive innovation. Circularity will have a significant impact on traditional business. As highlighted in our September Cleantech Interactive event, *The Road to Circularity*, the pace of change will depend on the ability of the infrastructure to support it.

### 3. Decarbonization – Solutions + Regulation

Innovation toward a decarbonized economy must involve taking demand-side measures to reduce the need for fossil fuels and CO<sub>2</sub>-intensive products, as well as electrification, energy efficiency and carbon capture technologies to fill in the gaps on the way to this transition. Efficiency advancements, fossil fuel divestment, city and corporate targets and the increasing affordability of alternatives are driving decarbonization efforts on a larger scale.

1. World Bank. 2019.  
2. World Bank. 2018.  
3. EPA. 2018.



#### 4. Urbanization - Economic Mobility and Stability in Cities

Per the UN, around 55% of the world's population currently live in urban areas today, with this number expected to rise to nearly 68% by 2050.<sup>4</sup> While Covid-19 may slow this migration near term, the long-term outcome will be a focus on maintaining public safety and pre-empting potential disruptions to city life. Cities around the world are taking a wider view on what it means to be "smart", and increasingly embracing next-generation technologies to put distance between their daily operations and emerging risks to them.

According to the GI Hub,<sup>5</sup> global infrastructure investment is projected to reach \$79 trillion by 2040, while the actual global investment need is closer to \$97 trillion. To bridge this \$18 trillion gap, annual global infrastructure investment would need to increase by around 23%. Also, of critical need will be access to services and community. As highlighted in October's Cleantech Interactive event, Cities as a Resilience Lab, this movement will put a tremendous amount of pressure on existing (aging) infrastructure.

#### 5. Digitalization – Decentralization and Automation

By 2022, over 60% of global GDP will be digitized and an estimated 70% of new value created over the next decade will be based on digitally enabled platforms.<sup>6</sup> Sensors, real time analytics and processing enable efficiency and coordination. They will be rapidly deployed in addition to machine-to-machine communications and autonomy. Interoperability between new and existing systems will be essential.

Watch for these key macro trends to be reflected throughout this report as we do deeper dives into our focus sectors and highlight the companies gearing up to meet these challenges.



Associate Director,  
Cleantech Group

4. UN. 2018.  
5. GI Hub. 2019.  
6. WE Forum. 2019.





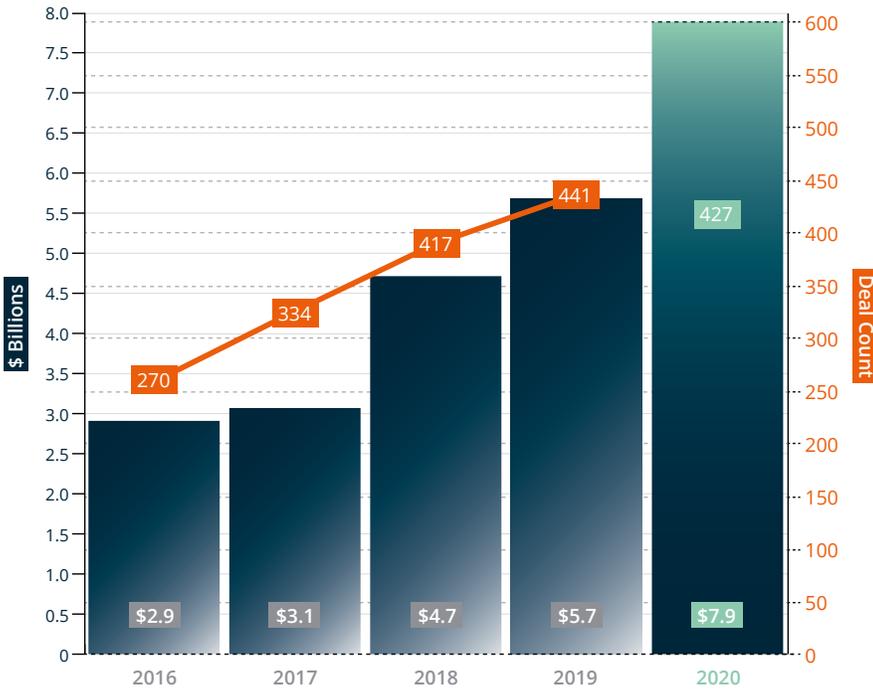
# Agriculture & Food

Chris Sworder, Lead Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

Fifty percent of the world's food supply is farmed outside of planetary boundaries.<sup>1</sup> How can the agrifood system support growing demand while remediating environmental damage?

### Venture and Growth Capital Investments



■ Total \$ amount ■ Total deal volume ■ 2020 does not include Q4 data

Note: Excludes outlier deals above \$350M

### Investment Snapshot

**Take away 1:** Investment in Agriculture & Food technologies increases following a three-year trend of growth in dollars invested and deal count.

**Take away 2:** Covid-19's short term impact created a spike in investment into new food logistics, ghost kitchens, and delivery technologies.

**Take away 3:** The EU and APAC are both increasing their share as 2020 is trending to be the first year with less than 50% of global Agriculture & Food investment taking place in North American-based companies.

**Take away 4:** Large Series B+ rounds for innovators working on biological crop inputs, alternative proteins, and food logistics technology contributed to a high dollar total, as the average size of these rounds rose from \$47 million in 2019 to \$63 million in 2020 (to Q3).

1. Gerten, D., Heck, V., Jägermeyr, J. et al. 2020. "Feeding ten billion people is possible within four terrestrial planetary boundaries." Nat Sustain 3, 200–208



### Overview

In 2020, innovation in agriculture and food benefited from a strong combination of drivers including maturing technologies, an increasing focus on circularity of resources in agriculture and a supply chain shock that focused attention on agility, resilience and transparency. Consumers expect more accountability for where their food comes from and there is an increased global desire for more nutritionally dense food that relies less on animals. As we see multiple enabling technologies including synthetic biotechnology, blockchain and AI converge to solve problems in this sector, we expect investment numbers to grow significantly over the next decade.

### Segment 1 Soil Health

**Definition:** This segment focuses on technology and business models to improve soil health by reducing or removing the need for chemical crop inputs.

### Market dynamics

Chemical agricultural inputs and pesticides are facing many headwinds. Farmers are noticing that pests are increasingly resilient to crop protections that have been in the market for a long time. Due to their impact on the environment and biodiversity, chemical pesticides are increasingly being regulated out of use by governments interested in promoting soil health, biodiversity and reducing the environmental harm caused from runoff. Conversely, biological alternatives are enjoying strong tailwinds.

A key challenge that bio-based alternatives need to overcome is the delivery system. One benefit of chemical inputs is that they are shelf stable, with widely known application methods and efficacy and a commoditized global trade. With biological fertilizers, key supporting technologies are being developed around encapsulation to improve in-field capabilities as well as on-site activation of the biological inputs to maximize potency at the time of application. Keep an eye on companies such as [Kaspersa](#) or [3Bar Biologics](#) for these types of solutions.

This market is growing in two ways. The first is the development of new modes of action for pesticides, or improved traits such as crop yield, hardiness, targeted pest control, nitrogen fixation, and more. The second is the use of AI-driven discovery platforms such as those used in drug discovery which sift through large databases of existing microbes to find specific functionality and traits. Combining these two could produce biological pathways to increase carbon content of soils, improve water quality and increase biodiversity, or any number of ecosystem services.

### Lessons from leaders

In 2018 [Vestaron](#), a developer of new modes of action for peptide-based pesticides, received regulatory approval for an entirely new pest control method. While this may sound like a technicality, this is a big deal in the industry for several reasons. First, it was only the 32nd mode of action in the entire history of the industry. Second, only 14 of those modes of action affect the nerve and muscular systems, which is by far the best way to kill a bug. This development represents both an industry landmark as well as a breakthrough in Vestaron's product landscape which may open more avenues for pest control working within the existing framework of chemical modes of action. The company is having its first commercial year and is looking to file its product in Europe in 2021.

In a briefing at Cleantech Forum San Francisco in early 2020, we were told by CEOs from leading biological crop input startups that scaling their businesses will be difficult, but that the blueprint already exists in the pharmaceutical industry.

New chemistry start-ups in agtech benefit from intellectual property (IP) protection but must enter a regulatory process that constricts access to market (a similar process occurs in pharmaceuticals). One possible route to scale could be traditional M&A of existing sales and marketing infrastructure instead of building out a sales force from scratch. However, there is currently more opportunity to build out commercial operations in-house, given the risks associated with working with agricultural incumbents in the near term.

### Keep an eye on

In the 2020 50 to Watch List, we named three companies contributing to improved soil health: [Nori](#), [Locus Agriculture Solutions](#) and [Soil Capital](#). As biological pathways for improving soil health grow, payments for delivering these ecosystem services, whether driven by regulated or voluntary markets, are also coming along. These three companies offer a good example of how to stitch this market together.



Nori is developing a marketplace for carbon removal certificates, but at its core it is designing the marketplace for ecosystem service payments that could include water quality, nutrient trading, increases in biodiversity and carbon sequestration.

Locus Agricultural Solutions, a developer of a biological product that increases root vigor, has partnered with Nori, a carbon marketplace developer, to provide certificates identifying where measurable soil carbon increases have occurred due to the use of Locus' product.

Soil Capital is developing a software-based model which analyzes a farm's data and gives a projection of future profit (or losses) if certain regenerative practices are installed on the farm. This model compares a farm's performance to neighboring farms in the region, making the potential gains more demonstrable for the farmer while exerting a certain element of peer pressure. Soil Capital is working with food and agriculture companies and cooperatives as a sales channel to offer their tool to their suppliers. Using another tool, Soil Capital Carbon, the company also enables businesses (in and out of food sectors) to pay farmers for actions to improve their climate impact.

## Segment 2 Local Food Networks

**Definition:** This segment focuses on technologies that are closing loops in the food system.

### Market dynamics

The statistic that thirty percent of all food grown goes to waste has been in circulation for nearly a decade. In that time, we have seen companies trying to reverse this trend directly with much emphasis put on local food networks, preventing waste and increasing supply chain resilience. In [Imperfect Foods](#) and [Karma](#), we see two innovators that are re-distributing food that would otherwise have been wasted.

In the U.S. alone, food loss is between 31%-40%<sup>2</sup> of overall food production, meaning Americans waste around \$160 billion<sup>3</sup> on food each year. This figure grows to \$218 billion when including farming, processing, transportation and disposal. This equates to 1.3% of GDP. Wasted food accounts for around 20% of consumption of fresh water, fertilizer, crop land and landfill. Food waste is the single largest category of material placed in municipal landfills<sup>3</sup> even while 37.2 million Americans are food insecure.<sup>4</sup> Globally, food insecurity is at 12.9%, or one-in-eight people on earth.<sup>5</sup>

However, if local food networks were just a logistics challenge then Amazon should be crushing start-ups. The task for companies in the new food system where consumers demand online, waste-free, local and nutritious foods is to provide a unique experience to the customer. Imperfect Foods understood this, hence the company's decision to control its own delivery network. Imperfect Foods gets two chances to interact with its customer – at sale and delivery – and so it has control over the experience in both situations. Covid-19 is an acid test for customer service as businesses push their delivery capacities to the maximum.

### Lessons from leaders

Imperfect Foods' delivery services for non-standard and excess food and Karma's 50% off on restaurant and retail food that is about to be taken off the shelves, are two examples of a broad range of waste-to-value business model innovation. These services have seen a surge in demand during Covid-19 as inflexible supply chains try to re-direct the food in their systems, and consumers look to online delivery services. Online grocery delivery services saw the equivalent of five years of growth occur in less than three months in 2020. This sales channel increased market share from 4% to 8% to over 15%, and as high as 30% in some markets with a majority of these market gains predicted to stick despite consumer desire to return to physical shops.<sup>6</sup>

### Keep an eye on

In the local food networks, brick-and-mortar retailers are looking for solutions to keep up with online-only providers as markets like the UK jump to +20% online grocery sales. US-based [Takeoff Technologies](#) offers an automated grocery fulfillment solution that lets retailers bolt direct-to-consumer order fulfillment centers onto an existing logistics infrastructure. Another German-based provider, [Fliit](#), specializes in a platform that connects fresh food shippers with transportation solutions all in one place.

For incumbents, increasing resilience in their supply chain is the priority. This will channel increased investment in warehousing innovations and capacity, cold chain logistics and other supply chain steps. Supply chain tracking, either through blockchain ([Ripe.IO](#)) or freshness monitoring ([Strella Biotechnology](#)), will be critical to understanding where supply chains are most vulnerable. This will require automation of the analogue parts of the food chain, such as quality inspection ([ImpactVision](#)), safety testing ([Clear Labs](#)) and many other steps. Because the processing stages of the food chain are often the most labor-intensive, increasing investment in automation tools is expected while social distancing and food safety concerns persist into the near future.

2. REFED. 2020. "Economic value per ton"

3. FDA. 2020. "Food Loss and Waste"

4. USDA. 2019. "Food Security Status of U.S. Households in 2019"

5. FAO. 2015. "The State of Food Insecurity in the World"

6. Nielsen. 2020. "Global New Shopper Normal Study"



### Segment 3 Indoor Farming

**Definition:** This segment focuses on innovation that is relocating fresh produce production closer to consumption.

#### Market dynamics

Indoor farming enables farmers to reduce risks associated with the weather and increase per acre productivity. It also uses fewer resources and produces more per square foot. The farms themselves can also be sited nearer to the market regardless of availability of suitable agricultural land. In a world where there is decreasing availability of arable land, this is a critical farming method. It is estimated an area twice the size of India will be required for new agriculture by 2050 even if increasing productivity follows the strong upward trend of the last fifty years.<sup>7</sup>

It is notable that there are no warehouse scale vertical indoor farms returning to this year's Global Cleantech 100. This reflects the market's sentiment that many of the warehouse-scale indoor farms are moving through the trough of disillusionment after completing nine-figure funding rounds in 2017. *Iron Ox's* place on this list is well-deserved as this market moves to autonomous robotic systems that can grow a variety of products in small, modular and automated farming systems.

*Infarm* illustrates a wider trend in the indoor farming market that is seeing smaller and more modular farming units rolled out closer to the point of consumption. This model works on the same premise that container farms have been selling for years: smaller footprint, lower food mileage, high-nutrition, high-value produce that is easier to brand. *Infarm* took this one step further by locating its growing units directly in the grocery aisle.

Small, modular and highly automated indoor farming systems are increasingly popular with industrial partners. Food logistics services see container farms as a good solution because they are fast to setup, use a limited footprint and are the cheapest (CAPEX) option available to build growing capacity onsite. Sodexo's recent investment in *Freight Farms* is a good example. Sodexo will roll out *Freight Farms'* system, called the Greenery, on university campuses where cost per acre is often high and there is a predictable consumption pattern. On-line retailers with large food distribution networks are looking to partner with vertical farming operations to fulfil the volume

of high quality produce they require. This was a factor in Ocado's decision to take a majority stake in *Jones Food Company*. This is the first time a retailer has taken a majority stake in a vertical farm developer, signaling the value of highly automated farm systems such as those provided by *Iron Ox*.

#### Keep an eye on

Companies such as *VoloAgri* are developing seeds and crops with traits that suit indoor growing conditions. As *Plenty's* recently announced partnership with Driscoll's<sup>8</sup> confirms, finding crops with unique selling points, such as Driscoll's proprietary strawberries, will increase the unit economics of indoor farming systems. A crop with a unique color, nutritional content, or some other trait can be differentiated from other leafy greens and berries, offering a branding and premium pricing opportunity for the grower.

### Segment 4 Alternative Proteins

**Definition:** This segment includes alternative protein developers. Business activities include new protein production methods, insect conversion of biomass for protein and other high value substances, and the development of ingredients for alternative protein products.

#### Market dynamics

Barclays estimates the alternative meat market will grow from 1% of the global market share in 2019 to 10% in 2029 worth \$140 billion. AT Kearney predicts up to 60% of meat could be alternative proteins by 2040, with cultivated meat comprising 35% and plant-based meat reaching 25%.

Multiple production methods are being funded, with a few types represented in this edition of the Global Cleantech 100. Once again, market signals have highlighted insect-based conversion of biomass as likely to have a significant commercial impact over the next ten years. *AgriProtein* is one of the leading companies working with *Black Soldier Fly (BSF)*, while *Ynsect's* differentiation lies in its use of mealworms. Both companies' target market is the replacement of wild-caught fishmeal for aquaculture feed, but the use of mealworms enables the extraction of more high-value proteins and chemicals for use in other industries. However, this restricts inputs to high-quality and consistent feedstocks, whereas *BSF*-based systems can operate on food waste streams.

7. World Resources Institute. 2019. "Creating a Sustainable Food Future"

8. Business Wire. 2020. "Driscoll's and Plenty Agree to Grow Strawberries Indoors"



The inclusion of [Memphis Meats](#) and [3F Bio](#) for the first time in the Global Cleantech 100 is reflective of the market forecasts outlined above; cultivated proteins will be the fastest growing new protein production method resulting in significant market share over the next ten years.

The in-vitro protein growth method used by Memphis Meat has been at the forefront of new protein production methods for a number of years, while 3F Bio represents a wave of precision fermentation-based protein production methods, in this case using mycelium fungus. This new method is further along the cost of production curve compared to in-vitro cultivation, but both methods require development before taste, texture, mouthfeel, nutrition and cost are comparative with conventional proteins.

The exclusion of plant-based companies for the first time in this year's Global Cleantech 100 is notable. After [Beyond Meat](#) and [Impossible Foods'](#) repeat appearances, the market has become a highly competitive space. The low cost of bringing a product to market has seen incumbent meat companies bringing their own products to market, while innovation has focused on optimizing ingredients rather than the end product. This explains [Benson Hill's](#) inclusion on this list. In 2019, the company announced its new focus on protein crops, and recently introduced a modified soybean with a high protein content that it is looking to sell to farmers in the next harvest cycle. For a genetic engineering company, the protein crop space offers significantly more opportunities and unexplored areas compared to cereal row crops. We expect to see more innovation coming through, with companies such as [Prolupin](#) and [Phytoform Labs](#) working on optimizing lupin as a protein crop.

### Keep an eye on

While there are opportunities to optimize the inputs to the plant-based system, a similar trend is occurring in the products themselves. There will be significant processing and personalization of the new food categories enabled by precision protein production methods. Design of flavors and ingredients, salts and sweeteners, will define the taste and texture of these products. Companies to watch include [Joywell Foods](#) and [Douxmatok](#), which are looking to develop a new range of natural salt and sweetener alternatives.

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9. Barclays. 2020. "Winds of change: the next environmental debate"

10. AT Kearney, 2020 "How Will Cultured Meat and Meat Alternatives Disrupt the Agricultural and Food Industry"



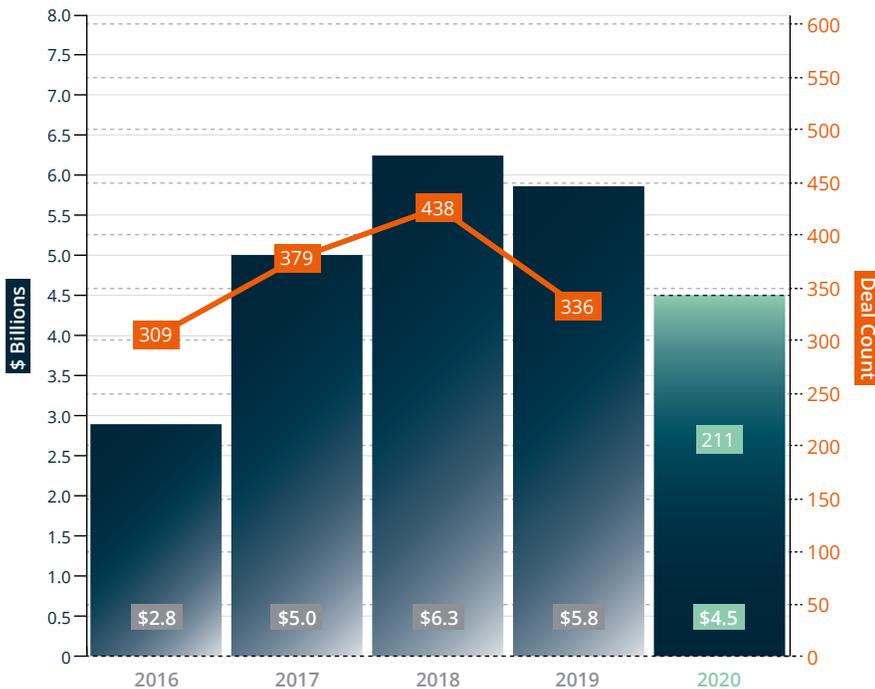
# Enabling Technologies

Nisa Mirza, Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

Innovation and investment in enabling technologies can help industries improve their performance, capabilities and environmental impact.

### Venture and Growth Capital Investments



■ Total \$ amount ■ Total deal volume ■ 2020 does not include Q4 data

Note: Excludes outlier deals above \$350M

### Investment Snapshot

**Take away 1:** Investment in an array of technologies continues in 2020 with a significant focus on edge computing as well as industrial process and supply chain optimization.

**Take away 2:** Overall, investment activity by volume is decreasing as average deal size increases for both early-stage and late-stage investments.

**Take away 3:** North America and Europe & Israel maintained their shares of total deal volume with North America taking the bulk share at 61%, while Asia Pacific's deal share is on a decline in 2020, possibly due to earlier effects of Covid-19.

**Take away 4:** Quarter-by-quarter comparison of 2020 by 2019 shows decreasing corporate participation in venture rounds, with an average decrease of 17% for the Q1 to Q3 period.



### Overview

As connectivity and processing capabilities improve, Enabling Technologies such as robotics, artificial intelligence and machine learning, sensors, big data and analytics, internet of things and other digital technologies find applications in multiple industries, enabling industrial efficiency as well as decarbonization. Corporates are increasingly at the forefront of piloting and adopting these technologies, and governments are setting up research clusters to drive innovation and standardization.

### Segment 1 Robotics

**Definition:** This segment focuses on the use of intelligent machines, both pre-programmed or autonomous, and increased operational efficiency and quality..

### Market dynamics

Stand-alone robotic arms, mobile robots and collaborative robots are driving automation in industries such as manufacturing, automotive and logistics. With the use of sensors, data analytics and artificial intelligence, robots are developing cognitive capabilities and can move around a factory and perform different tasks. This shift away from purely fixed, stationary mechanical robots has been made possible by advances in AI, years of safety optimization and increased collaboration between robots and humans. With advances in technology, robots are now priced approximately 40%<sup>1</sup> lower than a decade ago and can have ROIs of months rather than years.

Cloud support, for both data storage and processing capabilities, has boosted the scope and potential of robotics. Amazon Web Services launched a cloud robotics service in 2018 that streamlines the development of robotics by creating a simulation environment for testing and moving the operating system to the cloud. Similarly, the open-source cloud robotics platform launched by Google last year enables third-party innovation in robotics by providing critical infrastructure and standardized automation solutions. Such support infrastructure allows innovators to focus on their value proposition and scale accordingly.

In many industries, keeping up with automation has become crucial if companies are to remain competitive. For example, China's strategic Made in China 2025 policy aimed to increase its robot density to 150 units per 10,000 workers,<sup>2</sup> a target it has already exceeded. Tax benefits and R&D incentives for capital expenditure is also pushing the adoption of robotics.

The United States, through its National Robotics Initiative, continues to fund and support robotic technology. COVID-19 has also made the case for accelerated automation of industries, to ensure external impact is minimal on operations.

The robotics industry is already estimated to be worth close to \$50 billion and is expected to grow with a CAGR of 25.4% over the 2020 – 2024 period.<sup>3</sup>

Despite increasing engagement from multiple stakeholders, the robotics industry still needs to make its case in countries with sizeable cheap labor workforces and overcome consumer-perception hurdles in non-industrial applications. Overarching compliance standards are also trailing behind technological advancement, despite being essential to risk assessment and management.

### Lessons from leaders

**Vecna Robotics**, a new entrant in the Global Cleantech 100 list, is developing robotics solutions for the manufacturing and logistics industries. It offers a turnkey solution incorporating autonomous robots, intuitive user interface (UI) and a real-time process improvement engine. It started 2020 with a \$50 million Series B round in an effort to double its workforce. China-based **Cowarobot**, another new entrant, develops intelligent robots for street cleaning and logistics services. A pioneer in autonomous sanitation vehicles, expert panelists deemed this sustainable solution a convincing value proposition.

### Keep an eye on

The rise of robotics paves the way for other technologies, such as 3D printing, leading to more value in its applications. There is an upsurge of new business models offering robots-as-a-service and predictive maintenance-as-a-service, among others, to reduce capital-intensiveness and fill in the talent gap. The next hurdle to clear on the path to complete automation is ensuring that industries are cyber-proof.

1. PWC. 2018. "Robot-ready: Adopting a new generation of industrial robots"

2. China Daily. 2016. "Robots at center of China's big strategy"

3. Research and Markets, 2019. "Robotics Market – Growth, Trends and Forecast"



## Segment 2 Data Management and Analytics

**Definition:** This segment focuses on the acquisition, analysis, storage and protection of industry data to derive actionable insights and improve efficiency.

### Market dynamics

With a low technological barrier, data analytics involve frameworks and software that can be integrated and deployed with ease. Data streams of varying format, volume and velocity can be processed (in real time, in some instances) to monitor operations. The cost of technology such as drives for data storage and processors is decreasing as technology advances. Improvements in cloud computing have reduced the need for physical IT infrastructure, further reducing costs to organizations. Coupled with internet of things solutions, data can be captured from a variety of sources and collected for analysis. The availability of open-source, big data frameworks has enabled streamlined adoption of data analytics because they provide a structural basis for development for organizations.

The digitization of industries forms the basis for predictive maintenance and autonomous operations, marking a shift away from heuristic-based decision making. One example of using operational data is [Akselos](#) which has deployed a digital twin of Royal Dutch Shell's floating units in Bonga Field, Nigeria, to simulate the effects of external factors in real time thus reducing related risk and maintenance costs. Product development and supply chain optimization can also be fueled by leveraging consumer data, as FMCGs such as PepsiCo is doing using a proprietary analytics platform to detect trends. Amazon, for example, ventured into Whole Foods after its data analytics determined it an emerging trend.

Industries tend to collect and store data in regional clusters without processing for insights, a tendency largely due to past technological barriers. Now, with the rise in data sharing and cloud processing capabilities, industries such as agriculture and construction are utilizing both banked and real-time data.

### Lessons from leaders

Making the list for the second time is [Citrine Informatics](#), a provider of large-scale data infrastructure and advanced analytics for R&D and manufacturing in the materials industry. Its AI-based platform is being used by Panasonic and has been successful in the discovery of new materials for conductors. [Element Analytics](#) is also a second-time honoree and has developed an industrial data hub and analytics platform for asset-intensive industries including oil, gas, utilities and manufacturing. As these industries generate vast amounts of data, capturing and utilizing it can ensure increased efficiencies.

A new entrant to the Global Cleantech 100, [Urbint](#), has developed a risk mitigation platform utilizing data analytics and AI. Utilities are opting for Urbint's solution to reduce operating expenditure and extend asset lifetime. Some expert panelists praised the solution as capital light with a high scale-up potential.

### Keep an eye on

The next step in data analytics is data sharing across industry verticals. Societal and environmental impacts of business activities can only be accurately measured by tapping into a collated data ecosystem. Blockchain is another complementary technology to data analytics with increasing applications such as supply chain traceability. Just this year, Volvo invested in [Circular](#) to continue development of its blockchain-powered mineral tracing solution.



# Energy & Power

Louis Brasington, Lead Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

As we move into the next decade, integrating higher percentages of weather-dependent, volatile renewables becomes increasingly complex, requiring advanced solutions from innovators, incumbents and governments.

## Venture and Growth Capital Investments



■ Total \$ amount ■ Total deal volume ■ 2020 does not include Q4 data

Note: Excludes outlier deals above \$350M

## Investment Snapshot

**Take away 1:** Efforts to increase density, safety and costs of batteries, as well as to commercialize long-duration energy storage to integrate variable renewables meant energy storage investment leads with 37% of amounts invested as of Q3 2020, totalling \$2.87 billion, over 79 rounds.

**Take away 2:** Early-stage investments (seed + Series A) sit at a record high with 277 deals, while late stage (Series B+) activity has been slowing down, with only 94 deals. Innovators are increasingly accessing early-stage capital via accelerators and incubators.

**Take away 3:** Similar to other sectors, public listings via Special Purpose Acquisition Companies (SPACs) mergers are proving a popular route to public markets, especially for US-based CAPEX-heavy companies. US-based innovators [QuantumScape](#), [EOS](#), [Advent Technologies](#) and [Romeo Power](#) have announced plans to go public via SPACs.



**Overview**

Energy and Power investment has felt some of the inertia caused by shelter-in-place orders as a result of Covid-19. Compared to the same time in 2019, investment total is down by 25%. However, many deals, both follow-on and new, are continuing to close. Despite relatively smaller totals than seen in Transportation & Logistics and Agriculture & Food, the capital going into the sector is more strategic, purposeful and mission-focused than ever, given the goals outlined by oil and gas majors, utilities and industrial incumbents over the past few years. Energy technology is growing in complexity to answer difficult problems but remains an essential lever in the race to net zero. Smart building energy management, energy storage, hydrogen, fusion and energy flexibility are some of this year’s key investment themes.

2020 has witnessed some of the biggest private and public commitments for decarbonizing energy and power. From Germany’s \$10 billion hydrogen expansion strategy<sup>1</sup> to Amazon’s \$2 billion Climate Pledge Fund,<sup>2</sup> ambitions are being matched with hard dollars. In line with previous editions, and speaking to the level of innovation required, the energy and power sector features heavily in this year’s list, gathering 38 innovators. 2020 was a particularly strong year in three areas: renewable energy integration, residential services, and commercial and industrial energy. If 2050 climate targets are to be met, these innovators represent three major challenges: how to support a system based on volatility, how to help disengaged energy consumers and how to decarbonize the hardest to abate sectors.

**Segment 1** Enabling 100% Renewables

**Definition:** Technologies and business models that enable grids to operate using only renewable energy.

**Market dynamics**

In 2020, renewable energy has become a widely adopted, cost-competitive commodity. Over the past decade, costs have plummeted to the point where solar is the cheapest electricity in history.<sup>3</sup> Now, 26% of global of global electricity generation is renewable<sup>4</sup>, adoption is expected to expand 50% by 2024<sup>4</sup> and renewables were the only energy source that posted a growth in demand during Covid-19.<sup>5</sup> Commitments to zero out financed emissions from Blackrock’s Larry Fink<sup>6</sup> and HSBC,<sup>7</sup> show that renewables are an investment class to be taken seriously. In fact, in 2021 investment into renewables is projected to exceed that of fossil fuels, a world first.<sup>8</sup>

Globally, we are not ready for the disruptive impact renewables will have on the grid. Within the next decade, electricity grids with high renewable penetration will face unprecedented challenges with volatility, harmonization and system strain that could ultimately lead to severe power outages. Nations and grid operators are scrambling to prepare. Australia and California, while boasting record rates of residential solar, have frequent mismatches between renewable supply and demand, and are, as a result, having to commit billions into grid modernization hardware and software.

Without innovation to integrate volatile renewables, grids will struggle to surpass current rates, preventing countries from hitting their climate targets. To address this, innovators are introducing technologies and new services to help store energy for longer durations, smooth over generation spikes, and alleviate strains on grid infrastructure, ultimately looking to help support an energy system running on 100% renewable energy.

1. Reuters. 2020. "Germany earmarks \$10 billion for hydrogen expansion"  
 2. Amazon. 2020. "Climate Pledge Fund"  
 3. IEA. 2020. "World Energy Outlook"  
 4. IEA. 2019. "Renewables 2019"  
 5. IEA. 2020. "Global Energy Review 2020"  
 6. Blackrock. 2020. "CEO Letter"  
 7. HSBC. 2020. "Climate Ambition"  
 8. Business Insider. 2020. "Goldman Sachs Investment Projection"



### Lessons from leaders

Storage is one of the major enablers for a 100% green transition. For short-duration renewable energy balancing needs, Lithium-ion batteries are effective, with players such as [Alpha ESS](#) gaining momentum. But for 100% renewables, low-cost, adaptable, and carbon-free alternatives are needed for long duration balancing. For daily/weekly balancing, [ESS](#) and [Form Energy](#) have commercial pilots underway. For monthly balancing needs, green hydrogen is a strong contender for fossil fuel replacement. Innovators [Enapter](#) and [Hydrogenious LOHC Technologies](#) address the cost of producing green hydrogen, and the cost of hydrogen transportation, respectively.

Solution-by-solution due diligence is needed for effective planning and implementation of renewables. Traditional planning processes fail to consider the full breadth of technologies and services on offer and lack consideration of market incentives. In addition to providing DER management, innovators [Envelio](#) and [Opus One](#) offer integrated network planning tools to visualize and simulate grid scenarios, allowing for broad comparisons between storage, solar, EV charging, grid services or traditional grid investment.

Innovation in power lines is also vital to enabling increased renewable capacity and bidirectional renewable power flow. Global Cleantech 100 entrant [Smart Wires](#) has raised almost \$200 million in equity for their power control devices, altering power through transmission lines to increase network capacity.

Localized, real-time balancing of supply and demand is also essential to integrate renewables. Previously centred on commercial and industrial demand, innovators now need to aggregate, control and optimize assets across buildings, electric vehicles (EVs) and battery fleets. Multi-service load aggregator [Next Kraftwerke](#) returned to the list this year and now manages over 8GW of load across 10 European countries. EV charger load aggregator [WeaveGrid](#) is addressing EVs' potential as a flexibility resource. Lastly, to manage auctions in this pool of aggregated load, flexibility marketplaces are emerging as an important service layer. Players such as [Leap](#) service a significant share of flexibility providers in California, for example.

### Keep an eye on

Wind, solar and other forms of renewables are well-positioned to play a key role, but their volatile, weather-dependent nature means they are not well-suited to replace other large forms of fossil fuel baseload power. Fusion energy has the potential to complement intermittent renewables and battery storage as an always available, zero-emission solution, providing a baseline of utility-scale energy.

For many years, the narrative around fusion is that commercialization remains approximately 20-30 years away, however recent private sector activity is accelerating timelines. Backed by patient capital, a handful of companies are now aiming to demonstrate operational energy-gain by the mid-2020s and usable reactor designs by early 2030s. [Commonwealth Fusion Systems](#), for instance, is a Global Cleantech 100 entrant which has built a high-temperature superconductor to decrease the size and costs of tokamak fusion systems.

## Segment 2 Decarbonizing Home Energy

**Definition:** Technologies and business models reducing the carbon impact of domestic energy users.

### Market dynamics

Residential energy use accounts for 11%<sup>9</sup> of global energy consumption and has a considerable role to play to mitigate climate change. Driven by growing electricity use and a changing climate, the potential for residential decarbonization remains largely untapped due to widespread use of inefficient technologies, lack of effective policies and insufficient investment.

Differences in residential energy consumption patterns due to temperature variations are creating unique challenges. In Canada alone, where the residential sector accounts for 17% of secondary energy use, household energy consumption can differ by 200% between similar units.<sup>10</sup>

In 2020, consumers care more about how their energy is produced and how it is consumed. In deregulated energy markets such as the UK and Japan, customers can choose from over 70<sup>11</sup> and 200<sup>12</sup> energy retailers, respectively, with many offering green tariffs.

With no widespread action to improve energy efficiency in buildings, energy demand is predicted to rise globally by 50% by 2050.<sup>13</sup> To address this- and cater for a new class of conscientious consumers, innovators are introducing new avenues to tap into renewables, offering digital software to optimize energy and understand energy usage as well as new services to address underserved market segments.

Corporates are also looking to capitalize on the shift. Over the past few years, energy majors and upstream players have been pursuing vertically integrated offerings downstream, creating a direct interface with end consumers through innovative business models. Acquisition activity is also up in the residential energy market, with incumbents remaining competitive by acquiring advanced analytics.

9. OurWorldinData. 2020. "GHG Emissions"

10. BMC. 2018. "Household Energy Management"

11. The Guardian. 2019. "UK Energy Industry"

12. Cleantech Group. 2019. "Japan Energy Market"

13. Gibon, Thomas. 2015 "Building Energy Management Systems: Global Potentials and Environmental Implications of Deployment"



**Lessons from leaders**

In addition to tech giants opening up data gathering channels via voice assistants such as Google Home, Siri and Alexa, a diverse start-up ecosystem has emerged to engage customers with applications, panels and sensor-based offerings. Consumer facing interfaces to control energy streams are vital for enabling data visibility and engagement.

Smart thermostats, for example, are becoming a mature technology. Tado and Ecobee have returned to this year’s list, having enhanced their hardware offerings via technology partners including grid service DERMS/VPP innovator Enbala, now owned by Generac. Alongside thermostats, innovators are delivering solutions to optimize energy management holistically, enabling deeper grid service integration and insights into behind-the-meter distributed energy resources. SPAN is a new entrant on this year’s list, offering a smart electric panel for providing residential load visibility and control.

But benefits extend beyond consumers. Improved data disaggregation of home energy use is creating opportunities for increased consumer engagement for utilities. This year’s Global Cleantech 100 innovators Innowatts and Energyworx offer utilities opportunities to gather and capture value from otherwise lost consumer data, allowing generations of actionable insights to be seized by operators.

Engaged consumers are also exploring alternative avenues to connect with renewables directly. Global Cleantech 100 company, Arcadia is disrupting the North American utility market, offering a direct-to-consumer platform. Operating a nationwide digital utility, the company connects consumers to clean energy and energy efficiency choices, bringing transparency to power and reducing usage and costs. The company has also gained momentum in the community-solar market.

**Keep an eye on**

Multi-residential housing in urban areas remains one of the hardest markets to play into when it comes to energy efficiency. Building technology incumbents typically service the commercial and industrial building market through standardized building automation and control, but have failed to penetrate multi-residential buildings.

To penetrate this market, some innovators are bundling financing, technology, implementation and active energy saving management into a single offering with zero upfront cost. Canada-based Parity is on this year’s list and has developed an energy efficiency-as-service offering to multi-residential building owners and managers, guaranteeing 20-30% energy savings with two years return on investment. A second entrant this year, BlocPower, is also offering a zero upfront cost model, using software to save multi-residential customers 20-40% on their energy. By targeting building owners, innovators increase overall property value and net energy efficiency, and ultimately help serve communities in dense urban areas.

**Segment 3** Decarbonizing Commercial and Industrial Energy

**Definition:** Technologies and services to aid the decarbonization of the commercial and industrial sectors.

**Market dynamics**

The Commercial & Industrial (C&I) sectors consume two-thirds of global end use electricity.<sup>14</sup> From data centres to steel manufacturing, C&I decarbonization will be complex, diverse and expensive. Energy demand is continuing to rise, driven by increased economic activity, particularly in developing countries.

Commercial buildings remain energy intensive, particularly in hot climates where air conditioning accounts for a significant portion of the energy bill. Data centers are the economic workhorse of the 21st century and account for about 1% of global electricity demand.<sup>15</sup> Accounting for 24% of global energy use,<sup>16</sup> CO<sub>2</sub> emissions for industrial activities are extremely difficult to abate, due to the high amount of process integration, asset lifetime and commodity competitiveness. The total cost to decarbonize heavy industry could reach \$21 trillion through 2050.<sup>17</sup>

Despite the challenges ahead, progress is being made and businesses both large and small are starting to show signs of a desire to change. Over 260 corporates globally have made a commitment to go 100% renewable, on various timetables.<sup>18</sup>

14. IRENA. 2019. "Corporate Sourcing of Renewables: Market and Industry Trends"  
 15. IEA. 2020. "Data Centres and Data Transmission Networks"  
 16. OurWorldinData. 2020. "GHG emissions by sector"  
 17. McKinsey. 2018. "How industry can move toward a low-carbon future"  
 18. RE100. 2020. "Members"



Cement and steel corporations, for example, which account for 7%<sup>20</sup> and 8%<sup>21</sup> of global emissions respectively, are setting new goals and partnering with innovators for more ambitious action.

In 2020, large energy users are increasingly taking leadership roles in shaping the future of the grid, a mission that requires more than an additional 105GW of renewable energy to meet businesses' 2030 targets.<sup>22</sup> In support of these procurements, innovators are developing software to enable better access to renewables, enabling C&I-specific energy optimization, as well as exploring methods to directly and indirectly link industry with renewables.

### Lessons from leaders

Small and medium-sized companies committing to science-based targets lack sufficient contracts necessary to engage in power purchase agreements (PPAs). Global Cleantech 100 entrant **LevelTen** has recently made inroads in the European market, offering a C&I procurement marketplace and enabling buyers and sellers to pool resources into aggregated contracts. **FlexiDAO**, another company on the list, is also looking to support renewable procurement, offering a white label blockchain-enabled renewable tracking solution to utilities and energy retailers. This allows them to offer corporates a green tariff with the benefit of green energy certificates tracking, providing environmental insights.

For commercial buildings, innovators are utilizing artificial intelligence (AI) to enhance control, decrease energy bills and lower operating costs. Despite operating in a competitive market, **75F** offers building automation to make offices comfortable while cutting energy use by 30-50%. **Cloud&Heat Technologies** builds and operates data centres worldwide,

making efficient use of virtual servers at the cloud edge while capturing and using waste heat to lower energy consumption. Lastly, innovator **Deepki** on this year's list offers an AI platform to collect and analyze existing data, enabling large real estate owners to reduce their environmental footprint while also enhancing the value of their assets.

In the industrial segment, software-based energy efficiency improvement can also provide rapid energy savings. Working across a range of industrial segments, **METRON** has returned to this year's list with global momentum offering an AI-based digital twin optimization service for factory owners. Lastly, focused on upstream industry and offshore wind farm asset management, **Akselos** offers digital twin solutions, providing real-time operational simulation and predictive analytics using sensors, models and machine learning with momentum in Europe, the United States and South-East Asia.

### Keep an eye on

Motors remain one of the most important, and most inefficient, parts in industrial and commercial buildings. Over 47% of the world's electricity is consumed by analogue motors. A handful of innovators are worth watching in this space, including **Turntide Technologies**, which is developing a switched reluctance motor with smart motor control. The new implementation of an old motor design brings cost and weight savings, eliminates rare earth magnets and extends reliability. While the technology has potential in the transport market, the company has made inroads in the HVAC industry, as seen with the partnership with Amazon, with whom Turntide are piloting their motor technology in a number of buildings. The company also received investment from Amazon's \$2 billion Climate Pledge Fund.<sup>22</sup>

19. IEA. 2018. "Cement technology roadmap"

20. IEA. 2020. "Iron & Steel"

21. Bloomberg. 2020. "Corporate Clean Energy Buying"

22. Amazon. 2020. "Climate Pledge Fund"



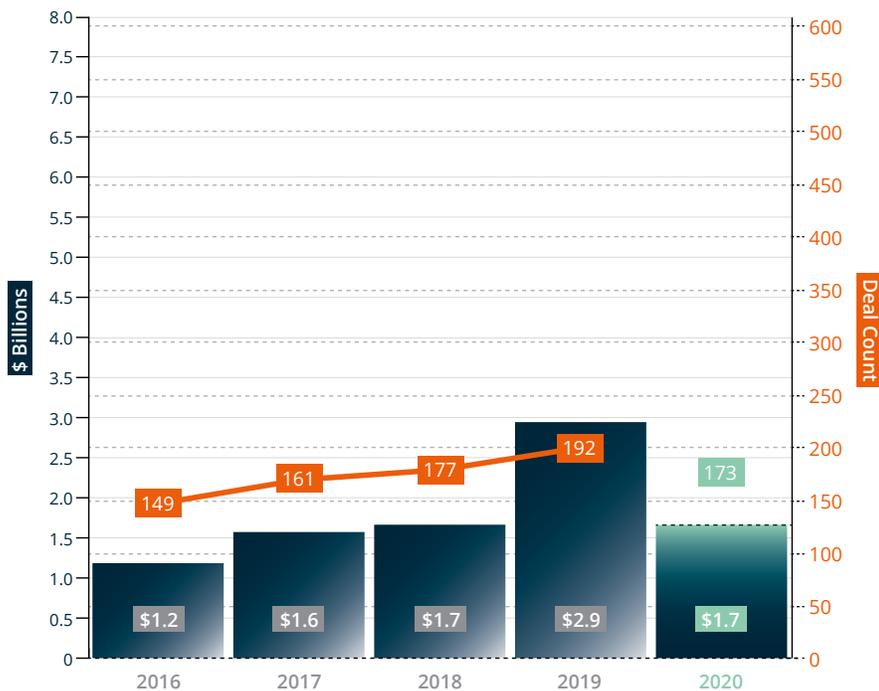
# Materials & Chemicals

Ian Hayton, Lead Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

The chemical industry faces a unique environmental challenge compared to other sectors. Improved energy efficiency and electrification are proven effective routes to address emissions, but the chemicals industry must also address availability of raw materials and end-of-life impact of products which are contributing to an increasingly dire plastics crisis.

### Venture and Growth Capital Investments



■ Total \$ amount ■ Total deal volume ■ 2020 does not include Q4 data

Note: Excludes outlier deals above \$350M

### Investment Snapshot

**Take away 1:** North American companies attracted the largest amount of investment, but also experienced a significant drop in comparison to last year. Europe & Israel were the only regions to see an increase in total investment amounts and deal volume.

**Take away 2:** Biofuels and Biochemicals experienced a large increase in both total investment amount and volume as venture capital and private equity continued to back synthetic biology and developers of new biobased polymers continued to scale up.

**Take away 3:** Investment amounts in Advanced Materials fell away from the highs of 2019 as manufacturing industries experienced decline due to the effects of Covid-19 with fewer large investments in new materials innovators.



## Overview

Venture investment in Biofuels and Biochemicals reached new highs in 2020, yet interest in drop-in replacements for road transportation fuels continued to ebb. Interest in the sector was driven by the potential for new fermentation-based pathways, including those leveraging advances in genomics and molecular biology. Plastic waste continues to be a critical issue, yet plastics remain costly to replace for many applications. As a result, biodegradable plastics are increasingly seen as an attractive solution. Challenges with costs have seen innovators target high-performance or high-value applications, either partnering with consumer brands or selling direct to consumers. Despite the drop in investment in Advanced Materials, new materials continue to support sustainable innovation across industries. The discovery of new materials is helping to lower environmental footprints, while new composite technologies are enabling stronger and lighter parts for energy and transport applications.

### Segment 1 Bio-based Plastics

**Definition:** Bio-derived or biodegradable alternatives to traditional petrochemical-based plastics, bioplastics are produced from post-consumer waste, greenhouse gases, extracts from biomass products or by-products such as algae, mycelium and lignin.

### Market dynamics

Plastics are everywhere - electronics, cars, household products, food packaging, drinks containers, our oceans, our food and our own bodies. Once deemed a miracle material, the associated problems are now familiar with consumers everywhere who are increasingly looking to avoid them. Governments are regulating their usage,<sup>1</sup> and manufacturers are seeking alternatives.

Bio-based plastics are deemed a potential alternative to conventional plastics. Utilization of biomass feedstock can help displace fossil fuel use, and biodegradability of some bio-based plastics could help address plastic waste. However, environmental credentials remain uncertain in many cases and production costs remain relatively high. Production levels of bio-based plastics remain low, representing less than 1% of plastics production in 2019.<sup>2</sup> Despite this, production is increasing with producers targeting the multi-billion-dollar plastics market more broadly.

Poly(lactic acid) (PLA), commonly used in food packaging, remains the most produced biobased plastic and production continues to increase. However, the use of food crops as feedstock is contentious and as PLA will not biodegrade under natural conditions, effectiveness of end-of-life collection and composting remains critical. There is now a renewed focus

on Polyhydroxyalkanoates (PHA) and similar molecules for which two groups of applications have become apparent. The first group targets biodegradable single-use plastics for which production capacity is increasing. **RWDC Industries** raised \$133 million for a new plant this year, while **Danimer Scientific** announced plans to go public via reverse merger and increase production capacity to 100,000 tons per annum by 2025.<sup>3</sup> The second group target high performance or high value applications produced from sustainable feedstocks. The market is relatively nascent, but one being tapped by Global Cleantech100 alumnus **Newlight Technologies**. The company opened a new commercial production facility and launched a fashion brand alongside a food-ware brand in September 2020.

### Lessons from leaders

Biodegradability of single-use plastics is widely considered as one of many contributing solutions to ocean plastic waste, yet most commercial production facilities utilize food crops as feedstocks. A new entrant to the Global Cleantech 100 aims to address both biodegradability and environmental footprint. **LACTIPS** has developed a cold-water soluble bioplastic manufactured from the excess of milk protein production with potential application in films, bags and even 3D printers. LACTIPS raised \$14 million in a Series B round led by BPIFrance earlier in 2020.

Sustainable bioplastic production pathways face challenges around cost. Global Cleantech 100 returnee **Mango Materials** addresses this challenge by producing PHA using methane from waste water treatment – a relatively low-cost feedstock. Mango is producing high-grade PHA suitable for use as textile fibers to replace polluting polyester in the fashion industry, while also formulating different grades for a variety of other applications, including caps, films, 3D printing and packaging.

1. PRI, 2019. "The Plastics Landscape : Regulations, Policies and Influencers"

2. European Bioplastics. 2019. "Bioplastics Market Data 2019"

3. Yahoo Finance. 2019. "Danimer Scientific, a Next Generation Bioplastics Company, to Become a Public Company"



### Keep an eye on

There are several alternative technical routes to address the environmental challenges faced by plastics. For instance, **Void Technologies** is developing plastic reduction technology based on adoption of a nano-voided structure into commodity and biopolymers. This results in up to 40% reduced material usage in polymer extrusion processes which can significantly reduce the environmental footprint of plastics used in packaging, industrial, agricultural and medical applications. The company recently raised \$7.3 million in a Series A round led by SABIC and supported by Capricorn Partners. The funding is being used for expansion of laboratory and technology development capabilities, and to establish manufacturing in both the US and Europe.

#### Segment 2 Materials and Chemicals Discovery

**Definition:** Discovery and development of new materials and chemicals and their production pathways.

### Market dynamics

New materials and chemical production pathways are key enablers across sectors. Synthetic biology remains the most common, or at least most invested in, route to discovery of new materials and production pathways. **Zymergen** raised a further \$300 million in this past year targeting commercial production of its Hyaline film. Beyond synthetic biology, discovery techniques continue to be optimized with applications for better energy storage, efficient separations and reduced environmental footprint of consumer products. Meanwhile, improved materials science and AI (or machine learning) combined with process automation will continue to shorten the time it takes to identify, produce and launch new materials.

### Lessons from leaders

Returning to the Global Cleantech 100, **Checkerspot** designs and manufactures high-performance materials for fermentation-based production. The company has actively partnered with corporates and start-ups to bring innovations to market. This past year, the company launched skis made from its newest material – Algal Cast. The new bio-based performance material replaces petroleum-derived acrylonitrile butadiene styrene (ABS) with enhanced physical properties, and near zero waste. The skis are produced using the company's Algal Core material – a high-density composite derived from microalgae polyol. Checkerspot raised \$36 million in a Series B round earlier this year.

### Keep an eye on

Companies looking beyond synthetic biology may well be the next focus area for new materials discovery. One example is **Kebotix**, which has a focus on developing AI tools to expedite the discovery of chemicals. The company raised \$11.5 million in 2020 which will be used for molecule discovery for electronic applications and then new polymers and alloys. Meanwhile, **NuMat Technologies** combines computationally-guided discovery, molecular design and precision engineering. The company has applied the technology for development and commercialization of Metal-organic Frameworks (MOFs) for gas storage and separation, with high potential for hydrogen storage – a key theme in Energy & Power.

#### Segment 3 Composites

**Definition:** This segment includes new materials made from two or more constituent materials with different properties. The resulting combination is a material with characteristics different from the individual components.

### Market dynamics

Composites have been developed and produced in some form for many decades and have been pivotal across traditional industries. For instance, in manufacturing and process industries, lighter, stronger and corrosion-resistant composites enable better production yields and longer-lasting equipment.

In more recent times, composites have played a pivotal role in multiple industries, leading to expectations of strong growth in a market expected to increase from \$88 billion in 2019 to \$160 billion by 2027.<sup>4</sup> In the automotive industry, a continuous drive to reduce the weight of vehicles, is favoring composites, creating parts with less material while extending their durability. This has become even more critical for electric vehicles where range remains one of the key barriers to adoption. Weight reduction can enable increased mileage. Composites are also used extensively in renewable energy applications, from wind turbines and solar panels to energy storage. Lightness combined with other properties make producing and storing energy increasingly cost-effective and more environmentally friendly.

4. Precedence Research. 2020. "Composites market size to hit around US\$ 160 Billion by 2027"

### Lessons from leaders

Despite the maturity of the composite industry, the development of a new generation of composites is under way. Innovators continue to look for ways to improve performance and functionality and bring down production costs. [Boston Materials](#), a new entrant to the Global Cleantech 100, is doing just that. The Massachusetts-based start-up manufactures a Carbon Supercomposite™ using a patented Z-axis reinforcement in a carbon fiber composite. This new composite enables the production of safe, durable and complex parts for lighter aircraft and stronger wind turbines. Availability of the product in pre-impregnated form (i.e., combined with a resin) removes process steps for manufacturers and enables the integration into existing manufacturing workflows and a cost savings.

### Keep an eye on

Although the environmental benefits of additive manufacturing are sometimes contested, its potential for decentralized production and printing of difficult-to-produce parts is increasingly recognized. Companies like [Arris Composites](#) and [Continuous Composites](#) are combining continuous composites with additive manufacturing, which has the potential to further widen the application range for these materials enabling an environmentally positive technology.

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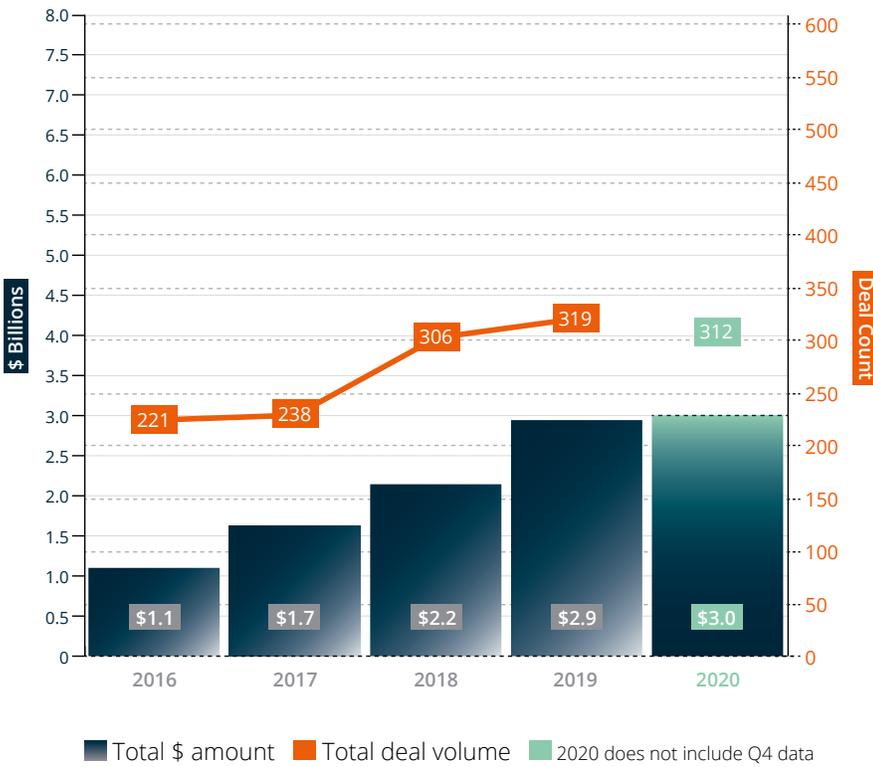
# Resources & Environment

Holly Stower, Lead Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

Using our planet's resources in a more responsible way means not just reducing our dependence on plastics and coming up with better ways of managing water and waste, but also starting to draw value from carbon capture and protecting our natural environment, upon which all economies are built.

## Venture and Growth Capital Investments



Note: Excludes outlier deals above \$350M

## Investment Snapshot

**Take away 1:** Venture Capital (VC) investments in the first half of this year saw record highs in both number and total investment amounts reaching \$1.4 billion and \$1.1 billion in Q1 and Q2, respectively. However, VC investment in Q3 2020 dropped to \$0.4 billion across 80 deals, which indicates the delayed but expected impact from Covid-19.

**Take away 2:** Much of the investment rise in Q2 2020 represents new industries integrating cleantech. For example, in the construction industry, Procore raised \$150 million in a growth equity, pre-IPO round; fashion companies like Vestiaire Collective raised \$63 million.

**Take away 3:** The geographical spread of deals was more varied in the last two quarters of this year than previous years. In Q2 and Q3, 46% of investment came from North America compared to over 80% in 1Q20; 42% of investment came from Europe & Israel, with start-ups from the UK contributing to 25% of deals.

**Take away 4:** Many large project financing rounds have occurred this year via corporate partnerships with innovators. Key sectors include commercial scale plants for chemical plastic recycling and Carbon Capture Usage and Storage (CCUS) infrastructure.

1. 2014 "Towards the circular economy: Accelerating the scale-up across global supply chains." The World Economic Forum & The Ellen MacArthur Foundation.



## Overview

Our first segment analysis looks at innovation and investment activity within recycling and waste, with a focus on plastics, digitized recycling and textiles. A shift to circular economy models represents a net materials cost savings opportunity projected at between \$340 billion and \$630 billion per annum.<sup>1</sup> The second segment looks at how wastewater treatment, water reuse and water harvesting technologies are developing to address an increasingly water scarce world. Lastly, our third segment analysis dives into Carbon Capture, Usage and Storage (CCUS) technologies and how CCUS presents a promising opportunity to reduce emissions without changing core business activities for hard-to-abate sectors.

### Segment 1 Carbon Capture, Utilization and Storage

**Definition:** For hard-to-abate sectors, Carbon Capture, Utilization and Storage (CCUS) presents a promising opportunity to capture emissions at source without changing their core business activities.

Industrial carbon capture clusters (ICCS) provide opportunities for shared infrastructure for capture, transport and utilization. Clusters also distribute the risk and cost for newer technologies, like CO<sub>2</sub>, to chemical technologies. In March, the UK government announced a further \$1 billion investment into ICCSs as it seeks to build two sites by 2030.<sup>3</sup> This followed the launch of Net Zero Teeside, a consortium led by BP with Eni, Equinor, Shell and Total which seeks to accelerate the ICCS at the Teeside site.

## Market dynamics

CCUS continues to draw attention from policymakers, large energy incumbents and some investors. The global carbon capture and storage market value surpassed \$3 billion in 2019, growing at a 5.4% CAGR, with 124 Mtpa Carbon capture capacity estimated by 2026.<sup>2</sup> Big industrial emitters such as the steel, concrete, oil and gas industries have made public commitments to reduce their carbon emissions, with many companies pledging to get to net-zero emissions by 2050. Corporates are looking to CCUS to reduce emissions from industrial plants. CCUS is also a source of carbon offsets, as illustrated by [Climeworks](#) and [CarbonCure Technologies](#) starting to sell their offsets this year. In August 2019, online transaction infrastructure provider, Stripe, announced its Negative Emissions Commitment, pledging at least \$1 million per year to pay, at any price, for the direct removal of carbon dioxide from the atmosphere and its sequestration in secure long-term storage. This year Stripe purchased its first batch of CCUS offsets, some from Direct Air Capture (DAC) developer [Climeworks](#).

Public funding for CCUS is also increasing. In September, the US Department of Energy awarded \$72 million in federal funding for the development and advancement of carbon capture. Similarly, the EU Innovative Climate Action \$10 billion fund is to develop innovation in CCUS, alongside renewable energy, storage and use.

Utilization applications can capitalize on waste-to-value business models and mitigate the cost of carbon capture by selling CO<sub>2</sub> utilized products like fuel or aggregates, compared to only capture or storage. Applications include CO<sub>2</sub> loading in polyols, CO<sub>2</sub> curing, CO<sub>2</sub> mineralization in aggregates and turning CO<sub>2</sub> into nutrients. [Carbon Engineering](#) is converting CO<sub>2</sub> from direct air capture into fuel. By deducting the sale of Carbon Engineering's fuel from the total capture cost, they estimate the cost of capture can reduce to below \$100 per ton of CO<sub>2</sub>. This can be compared to high value forestry offsets which cost between \$10-\$20 per ton of CO<sub>2</sub> stored.

## Lessons from leaders

Canada-based [Svante](#), a Global Cleantech 100 returnee previously known as [Inventys](#), has developed technology for capturing CO<sub>2</sub> directly from industrial sources, and is getting early-stage traction. In January 2020, the company announced a joint study with LafargeHolcim, Oxy Low Carbon Ventures and Total. The study aims to assess the viability and design of a commercial-scale carbon-capture facility at the Holcim Portland Cement Plant in Florence, Colorado. In February 2020, Chevron commissioned a study with Svante to evaluate the feasibility and design of a 10,000 ton-per-year carbon capture unit in one of Chevron's California facilities.

2. Gupta, Ankit. 2020. "Carbon Capture and Storage Market Size By Technology (Pre Combustion, Post Combustion, Oxy-Fuel Combustion), By Application (Oil and Gas, Chemical Processing, Power Generation, Others) Industry Analysis Report, Regional Outlook, Competitive Market Share & Forecast, 2020 - 2026." Global Market Insights.  
3. 2020. "UK to spend \$1bn on new CCS projects as key part of its zero-emissions strategy." Recharge News.



CarbonCure Technologies, the developer of CO<sub>2</sub> mineralization technology which transforms carbon into concrete via direct air capture, has made the list once again. In March, the company received a \$1.6 million grant from Natural Resources Canada to expand CarbonCure's suite of carbon utilization solutions for the concrete industry. In September, the company also raised a growth equity round led by Amazon with participation from Microsoft, amongst other investors. Amazon also announced it intended to use CarbonCure's concrete and technology in their buildings, including in their HQ2 building in Virginia.

**Carbon Clean** develops modular, point source carbon capture systems that aim to achieve +90% carbon capture rate. This year, they entered multiple development partnerships with GAIL, Marubeni, Unilever and Cemex.

### Keep an eye on

Nature-based carbon sequestration innovators continue to garner investment due to increased corporate commitments and the voluntary offset market enabling a fast route to market. **Project Vesta** captures CO<sub>2</sub> via a process called 'coastal enhanced weathering', which makes green-sand beaches out of olivine. Wave action grinds down the sand, capturing CO<sub>2</sub> from the atmosphere and ultimately storing it into rock. In April Project Vesta selected its pilot site and starts the pilot at the end of 2020. Other nature-based sequestration includes regenerative agriculture and forestry.

## Segment 2 Recycling and Waste

**Definition:** This segment looks at innovation and investment activity within the recycling and waste sector in 2020, with a focus on circular products, plastic reduction efforts, wasteless consumer goods and the fashion industry.

### Market dynamics

Increased consumer awareness of the impact of waste on our natural environment has led to a resurgence of conscious consumerism, particularly for plastic use. 2020 brought large investment rounds into e-commerce innovators with circular business models in reuse, rental and repair. For example, repaired electronics marketplace, **Back Market**, experienced traction and hired from the ranks of Amazon to keep growing. In May 2020, the company raised \$120 million in a Series B round to help increase its penetration in core markets, starting with the US, the UK and Germany. The global online resale market is expected to reach \$36 billion by 2021.<sup>4</sup>

Public and regulatory pressure is encouraging corporates to assume Extended Producer Responsibility (EPR) and act on plastic waste. Over the last few years, numerous consumer-facing brands have pledged to significantly reduce their plastic use or provide better end-of-life solutions for products. For example, in September 2019, UK supermarket Sainsbury's announced it would halve its plastic packaging due to consumer pressure.<sup>5</sup> However, consumer brands rarely meet their voluntary targets for plastics reduction, forcing governments to take greater action. The US's Break Free from Plastic Pollution Act debuted in February 2020, forcing EPR for plastic bottles and plastic packaging in the US. This follows similar bans on plastic from the EU (starting 2021), the UK (Environmental Bill) and China (starting in major cities in 2020 and then rolling out to cities and towns in 2022). There is also market pressure for change via consortiums aligning members across value chains. For example, the 500 signatories (including members such as PepsiCo and Unilever) of the Ellen MacArthur Foundation's New Plastics Economy Global Commitment represent 20% of all plastic packaging produced globally. However, the Foundation's 2020 Progress Report found limited progress on single-use plastics and that most actions were to scale recycling, when reuse and reduce actions are far more effective.<sup>6</sup>

The consumer focus on waste has helped attract investment for initiatives that mitigate plastic use. For example, **Transcend Packaging**, producer of plastic-free packaging recently raised \$14 million in a Series A round, while water fountain provider **Castalie** raised \$15 million in a Series A round.

Covid-19 has caused a boom of single-use plastic due to disposable PPE, panic buying and greater food delivery.<sup>7</sup> With China not accepting the world's plastic waste since 2018, the increase in waste has made bulk waste prices plummet, with more plastics ending up in landfill, incinerators and overloaded domestic recycling facilities. To quell this crisis, advanced domestic recycling solutions are being developed closer to home. This year saw many large project finance rounds and partnerships between chemical plastics recycling innovators and plastic manufacturers or FMCGs. In October, Nestlé entered a partnership with **Plastic Energy** to deploy the UK's first commercial-scale facility for chemical plastics recycling. In August, **Quantafuel** and Ramboll partnered to deliver a full-scale industrial chemical recycling plant for plastics in Denmark.

Circular fashion business models present an opportunity to retain the \$500 billion lost to fashion waste every year.<sup>8</sup> The 'quarantine of consumption' under Covid-19 will durably impact the industry, with the growing distaste for linear business models, while

4. 2020 "Sustainability and the Online Resale Market." IBISWorld.

5. 2019 "Sainsbury's to halve plastic packaging by 2025." Sainsbury's.

6. 2020 "The Global Commitment 2020 Progress Report." Ellen MacArthur Foundation.

7. "Sarkodie, Samuel. 2020. "Impact of COVID-19 pandemic on waste management." Environment, Development and Sustainability.

8. 2017 "A New Textiles Economy: Redesigning Fashion's Future." Ellen MacArthur Foundation.



highlighting the industry's exposure to market shocks. Consumer pressure, proposed regulations, social and environmental scandals are forcing brands to change and have opened up new markets for sustainable and circular business models. Marketplaces for second hand or repaired clothes have gained significant investment this year. For example, [Vestiaire Collective](#) raised \$63 million in a growth equity round; [Zadaa](#) and [Good Fair](#) respectively raised \$44 million and \$36 million in Series A rounds.

The systems by which we collect and sort waste have significant impact on the value of materials recycled. A single contaminated material can cause an entire batch of recyclables to be sent to landfill, and in the US, the average contamination rate is 25%.<sup>9</sup> Non-recyclable, mixed materials, or soiled items can damage machinery and cause downtime at Material Recovery Facilities. Innovators are responding to this challenge by creating optical sensors and software systems to autonomously sort materials. For example, [Recycleye](#) was selected for Microsoft's AI for Good accelerator program this year. Others are creating technologies which can separate contaminants from waste streams. This year, [PureCycle](#) raised \$11 million in two growth equity rounds, while also receiving \$250 million in structured debt to build a commercial plant.

#### Lessons from leaders:

[AMP Robotics](#), which develops machine learning and robotic technology for waste recycling, makes the Global Cleantech 100 for the second year. After raising a \$19.3 million in a seed and Series A round in 2019, the company received a \$1.8 million grant from the US Department of Energy and was selected to join the Plug and Play Spring 2020 cohort. AMP Robotics also entered a partnership with Canadian Fibers called the Clean Recycling Pilot, a program that provides feedback to residents on their building's waste-sorting behavior and helps them improve their recycling habits.

[TIPA](#), a developer of biodegradable and recyclable packaging solutions, is back in the Global Cleantech 100 this year. In October, they entered a vendor partnership with organic food retailer Abel & Cole to supply compostable zipper bags for herbs. This partnership will aim to replace 60,000 plastic bags with compostable alternatives.

2021 Global Cleantech 100 debutant, [Loop](#), entered multiple corporate partnerships this year to pilot its reusable packaging system. Launched in 2019 by parent company [TerraCycle](#), Loop has developed an e-commerce platform and reusable packaging delivery and collection service for waste-free shopping. In September, Loop partnered with McDonalds in the UK to trial a deposit return system for reusable hot

beverage cups. Loop also partnered with Suez in September to produce virgin quality, food-grade, 100% recycled, infinitely recyclable plastic and to build the first Infinite Loop recycling facility in Europe.

#### Keep an eye on

Data on how plastic waste travels through the value chain can inform more targeted corporate action on plastic reduction, while holding them to account for the waste their activities produce. Innovators are creating unique bar codes and invisible tags on packaging alongside optical scanners to track and map plastic waste. In February, Procter & Gamble announced plans to launch packaging with a digital watermark to track and trace where its plastic packaging ends up, to aid sorting in material recovery facilities and to potentially facilitate a take-back scheme.

### Segment 3 Water and Wastewater

**Definition:** This segment includes innovations in the municipal water and wastewater market for commercial, industrial and residential consumers.

#### Market dynamics

Population increases, pollution, growing incidence of drought and extreme weather events are all putting strain on the global water system. In response, technologies are being developed to manage scarcer and less reliable water sources, as well as to recycle and remediate water and harvest it from unconventional sources. Ageing wastewater infrastructure is overcoming increasing and variable loads with modular systems and operational software. The global water and wastewater treatment market is predicted to be valued at around \$211 billion globally by 2025 at a CAGR of 6.5% from 2019.<sup>10</sup> The majority of wastewater innovation is occurring in North America, followed by Europe. However, the rapidly developing Asia-Pacific and Middle Eastern regions are perceived as growth markets for water innovators. Supportive government schemes exist in these regions because water is becoming increasingly scarce and critical, yet water-intensive industries such as chemical manufacturing continue to expand. For such a large industry, VC investment remains in the early stages, with VCs reluctant to invest in capital-intensive hardware innovation. This is due to few big exits, slow returns on investment and long R&D periods for wastewater innovators.

9. Bell, Brent. 2018. "The Battle Against Recycling Contamination is Everyone's Battle" Waste Management."

10. 2020 "Water and Wastewater Treatment Market Worth \$211.3 Billion by 2025, Growing at a CAGR of 6.5% from 2019- Global Market Opportunity Analysis and Industry Forecasts by Meticulous Research." Meticulous Market Research Pvt.



Corporates in the sector have historically been risk averse and slow to adopt new technologies. However, the criticality of water in key sectors like fashion, construction and food and beverage, alongside the increasing scarcity and expense of water, have led some to look at investing in water technologies. In February 2020, drinks manufacturer and distributor ABInBev welcomed the second cohort of its 100+ accelerator which included six water innovators. In response, innovators are specializing their offerings for key sectors, like Aquacycl, which has developed a modular wastewater treatment system to treat high-organic content wastewater for the food and beverage industry efficiently.

In response to increasingly strict regulatory requirements, risk aversion and the high capital expenditure of traditional systems, innovators are creating modular water treatment systems and marketing them with treatment-as-a-service models. Their early target customers are industrials with reduced regulatory pressure. However, the water industry remains highly fragmented. Leading companies only have a maximum of ~3% market share, making economies of scale and regional expansion for innovators difficult to achieve.

Technologies like rainwater harvesting and desalination continue to attract investment, NGO and government support as water scarcity and population growth increases. Water pollution, water access and nutrient run off is causing eutrophication, which is further polluting critical water supplies, significantly impacting areas of natural beauty and threatening the collapse of ecosystems. As such, some governments have started to invest in remediation innovation, however funding is limited and usually only for areas which rely on tourism. For example, the US Environmental Protection Agency announced \$20 million for the Great Lakes Restoration Initiative to fund an action plan to address nutrient runoff.<sup>11</sup>

Industry-agnostic innovation in data collection, processing and storage has driven new software-based water services and business models. Water treatment operations and maintenance using operational software has increased the efficiency of existing infrastructure, enabled the monitoring of asset health and prevented unscheduled downtime. Efficient maintenance helps address rising process demands and limited expansion of treatment facilities, so asset owners can delay upgrading whole systems.

#### Lessons from leaders

**Axine Water Technologies**, provider of low-cost, chemical-free solutions for treating toxic organics in pharmaceutical and other industrial wastewater, made the Global Cleantech 100 yet again. Its continued inclusion in the list reflects a growing trend for systems reducing or omitting expensive chemical use.

#### Keep an eye on

Urban water systems and wastewater treatment facilities can require between 1%–3% of a country's total electricity output.<sup>12</sup> Asset owners are looking for more efficient solutions to reduce energy usage and related operating expenses. New wastewater treatment systems are more energy efficient and processing wastewater biologically or using electricity in more intelligent ways. A prime example is **Indra Water**, developer of a modular wastewater treatment system based on a patented physio-electrical process to remove pollutants (suspended and dissolved) and pathogens from water. Their process also produces hydrogen via electrolysis, which currently provides from 30%–40% of the system's electricity needs, and soon plans to be net-neutral.

11. 2020. EPA secures new Great Lakes funding, details nutrient runoff projects." Environmental Science & Engineering Magazine.

12. Capodaglio, Andrea. 2019. "Energy Issues in Sustainable Urban Wastewater Management: Use, Demand Reduction and Recovery in the Urban Water Cycle." MDPI.



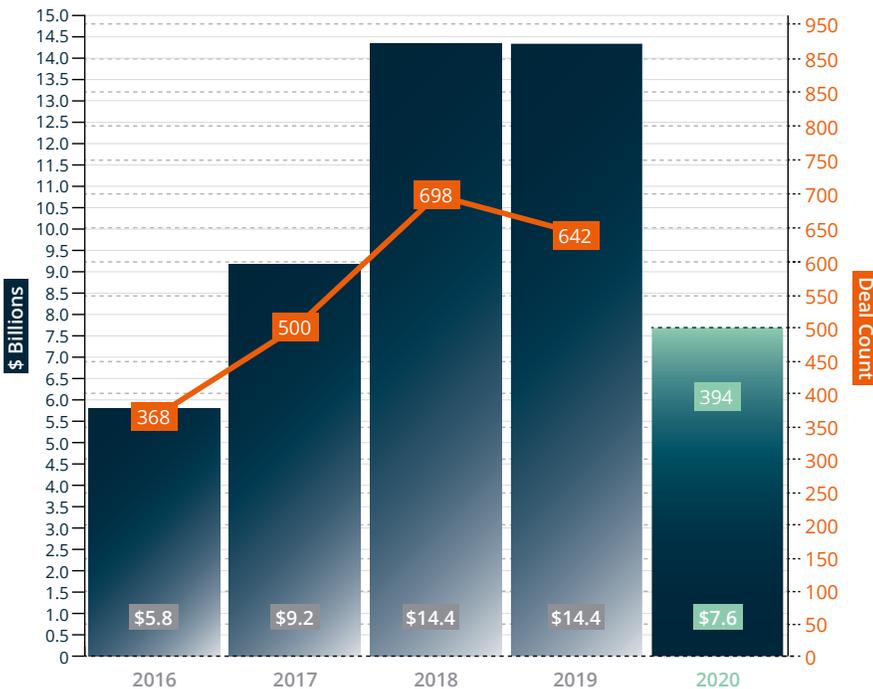
# Transportation & Logistics

Cassidy Shell, Lead Analyst, Cleantech Group

→ GLOBAL CHALLENGE:

The global pandemic has revealed a dire need for zero-emission, sustainable, flexible and safe methods of moving both people and goods. Mid-century net zero emissions targets announced by major economies have also put pressure on the transportation industry to decarbonize across all segments.

### Venture and Growth Capital Investments



■ Total \$ amount ■ Total deal volume ■ 2020 does not include Q4 data

Note: Excludes outlier deals above \$350M

### Investment Snapshot

**Take away 1:** This year, 44% of deals were in North America, 33% in Europe & Israel, 20% in the Asia Pacific region and less than 1% each in Central and South America, Africa and the Middle East.

**Take away 2:** Autonomous driving, electric vehicles, electric vehicle charging, logistics and mobility services were the major investment themes this year.

**Take away 3:** Overall, capital was increasingly deployed in larger rounds and at later-stage companies than seen in previous years. Investors, particularly automotive original equipment manufacturers (automotive OEMs or automakers) and corporates are making bigger bets on promising companies to accelerate the mobility transition.

**Take away 4:** Eight companies in the transportation sector have announced they would go public via SPAC acquisition this year, but few of these transactions are closed and trading and we are yet to see what impact this trend will have on the industry.



### Overview

The Covid-19 pandemic was the single most impactful event on the transportation sector this year. In the short term, global shelter-in-place orders forced automakers to halt production, grounded shared mobility and public transportation ridership to a halt and created chaos across supply chains. Increases in personal vehicle ownership and huge losses for automakers from manufacturing shutdowns seemed to spell disaster for the broader industry shift towards shared and electric transportation. However, economic recovery packages, particularly in Europe and Asia, are focusing on sustainability. The impact of movement restrictions such as cleaner air, more walking and biking and safer forms of transport, has revealed the benefits of a cleaner transportation system. Major economies and corporations are pushing even harder towards the next generation of transportation across all segments.

### Segment 1

### Electrification of Transport

**Definition:** This segment includes all battery-electric vehicles, including passenger vehicles, light vehicles (micro-mobility), heavy duty vehicles, aircraft, marine and associated charging infrastructure and technology. Business activities include the innovation and manufacturing capacity expansion of batteries, advancement in fuel cells, business model innovation in charging and expansion of charging networks and new solutions for electric fleets.

### Market dynamics

Electrification of transport is accelerating, largely driven by declining battery costs, increasing ranges and government emissions standards and regulations in major economies such as California, Europe and Asia, and emerging markets such as India and Africa. In 2019, electric cars accounted for 2.6% of global car sales,<sup>1</sup> a 40% year-over-year increase from 2018. Commitments such as mid-century climate targets, or the UK's recent announcement of the end of the sale of new petrol and diesel cars by 2030, are creating a market signal for OEMs to invest in electric vehicle (EV) manufacturing infrastructure.

Despite manufacturing shutdowns causing cash-flow shortages during the pandemic, increasing government regulation on transportation emissions is sustaining OEM commitment to EV development. Automotive OEMs across passenger, medium duty and heavy-duty segments are deepening commitments to battery and fuel cell-electric vehicles through partnerships, pilot projects, consortiums and expanding manufacturing capacity. To name a few examples, Tesla has two new factories

slated for Berlin and Texas, General Motors and Honda entered a partnership for a North American automotive alliance and Volkswagen and Ford formalized a partnership on commercial vehicles, electrification and autonomous vehicles. In the medium and heavy-duty segment, the Volvo LIGHTS project<sup>2</sup> in Southern California and UPS's 10,000 van order from Arrival epitomize this trend. However, limited battery range and higher costs for EVs remain major challenges. OEMs are investing heavily into battery manufacturing capacity and alternative energy storage technologies such as solid-state batteries and fuel cells, and they are testing new business models to overcome the high upfront cost of electric vehicles.

Fleets are strong initial target markets for electric vehicles due to the lower total cost of ownership and favorable government regulations, particularly in China and the EU. However, electrifying fleets, from corporate fleets to bus fleets, comes with operational challenges due to range limitations, battery health management and potentially expensive charging infrastructure. Many innovators are targeting this segment, developing solutions to manage battery health, minimize charging costs and maximize range.

### Lessons from leaders

Advances in lithium-ion battery materials have the potential to unlock long-range and low-cost electric vehicles. **Enevate**, a California-based developer and licensor of pure silicon-dominant lithium ion battery technology and **Solid Power**, a Colorado-based developer of solid-state batteries for electric vehicles, both made this year's Global Cleantech 100 list. The company's anodes and cells feature ultra-fast charging, high-energy density, low-temperature operation for cold climates, lower costs and safety advantages over graphite-based anodes.

1. IEA. 2020. "Global EV Outlook 2020."

2. Volvo LIGHTS. 2020.



**DiShangTie (DST)** is a Shenzhen-based provider of turnkey solutions for electric fleet management making its debut on the list this year. The company's solution includes EV procurement, charging infrastructure and a management and optimization platform. Backed by ITOCHU, Olympus Capital, Qiming Venture Partners and Idinvest, among many others, the company has raised over \$100 million since the beginning of 2019.

**Viriciti**, another Global Cleantech 100 debutant, has developed an energy management system to continuously monitor and adapt EV energy consumption to align vehicle range with predicted use. Recently, Viriciti unveiled a smart charging solution to be implemented for Heliox and ABB chargers and entered into a partnership with BAE Systems to automatically switch off engines in hybrid systems in geofenced areas.

**Electriphi** provides a software platform to control charging stations on a per-minute basis and optimize charging based on operations. The company's solution is unique in that it combines operations and smart charging, providing a new capability that was not necessary for fossil fuel-powered buses with no range limitations. Electriphi raised a \$3.5 million seed round in January 2020 to support scaling the customer base across more industry segments.

**AmPLY Power** has also made the list this year, thanks to the company's charging-as-a-service business model that simplifies electrification for fleets. The company raised a \$13 million Series A round in April this year and has secured partnerships with BYD and Logan Bus Company, among others.

Sectors outside of passenger transport, such as aircraft, marine, and medium and heavy-duty vehicles are seeing increased penetration of electric drivetrains, fuel cells and hybrid systems to reduce fuel use and comply with tightening emissions regulations, including the regulation approved by the California Air Resources Board (CARB) earlier this year to reduce NOx emissions in heavy duty vehicles.

**Effenco**, a developer of a hydraulic hybrid system for refuse trucks, made the Global Cleantech 100 list this year and recently raised a \$7.5 million seed round in addition to a grant from Sustainable Development Technology Canada. **Norsepower's** auxiliary wind propulsion systems for cargo vessels have earned them a spot on the list this year. Backed by OGCI Climate Investments, Norsepower has proven significant emissions reductions through the deployment of over three commercial systems, reaching between 5%-20% reduction in fuel consumption, on average, and a payback range of three-to-nine years.

The large-scale rollout of EV charging networks is a key enabler for EV uptake. Innovative business models and technology, such as fast charging, wireless charging and battery swapping, are supporting profitability of EV charging and enabling different use cases for electric vehicles. Although EV adoption is fragmented across geographies, charging networks need to be expanded even where adoption is low. Business model innovation is key here in order to be profitable and generate revenue even when throughput is low. Fast charging is also important to mitigate range anxiety and fill in the shortcomings of at-home charging.

**Volta Charging** has made the list for the third year in a row, thanks to their successful revenue model for public chargers. The business model leverages ad-supported charging stations in high-visibility locations, such as grocery stores and retail outlets, to generate additional revenue. **Tritium**, an Australia-based provider of DC fast-charging stations for electric vehicles, made the list for the first time this year. **Momentum Dynamics**, a leading developer of wireless charging systems, also made the list for the first time. Earlier this year, the company announced a partnership with Chinese automaker CEV to demonstrate high-power wireless charging with autonomous parking. Reliability and high-power charging remain a key concern with wireless charging, but pilot scale deployments and continued R&D are continuously improving the technology, and more capital is flowing into this space, including a recent \$34 million round raised by competitor **Witricity Corporation**.

#### Keep an eye on

Innovation and R&D around batteries will continue to be a key focus area for the industry in pursuit of the million-mile battery and breakthroughs in range and energy density. In addition to battery electric, different types of electric drivetrains are seeing accelerated development for deep decarbonization of transportation. Limits on range and payload capacity make battery electric largely unfeasible for sectors such as heavy-duty trucking, aircraft and maritime, at least for the foreseeable future. Other clean fuel sources, such as ammonia and hydrogen could provide solutions.

Outside of the battery, other parts of the electric vehicle will receive more attention for efficiency gains. Innovation around motors, power electronics, lightweight materials and electric vehicle platforms will continue to progress, all with the goal of maximizing range and efficiency of electric vehicles.



## Segment 2 Supply Chain and Logistics

**Definition:** This segment includes shipment of goods by truck, rail and ship and enabling technology platforms. Business activities include digital freight logistics platforms, asset tracking, supply chain visibility platforms and last-mile logistics solutions.

### Market dynamics

Supply chains are now more globalized and complex than ever. While this creates immense opportunities, it also exposes corporations and suppliers to heightened risk and makes emissions abatement much more challenging. In fact, supply chain emissions can be over five times greater<sup>3</sup> than a company's direct operations. Companies rely both on suppliers located around the globe (often with little visibility into their operations) and long-distance transportation by means of ships, rail, aircraft and trucks. Halted manufacturing operations and volatile demand due to the Covid-19 pandemic revealed a need for more flexible and resilient supply chains.

Decarbonization in the last mile has become increasingly important as well. Last mile delivery is the most inefficient piece of the supply chain and a projected 36%<sup>4</sup> rise in the number of delivery vehicles in cities around the world by 2030 will increase emissions from delivery traffic by 30%. Tightening regulations in cities around tailpipe emissions and congestion combined with increasing demand from consumers for real-time or near real-time delivery are forcing e-commerce logistics and last-mile delivery providers to adopt new form factors, lower-emission vehicles and distributed operational models. In 2019, 14% of retail sales<sup>5</sup> were conducted online, but this number is expected to jump to 22% in 2023. Traditional centralized order fulfillment models are no longer able to meet customer expectations for delivery speeds and the growing volume and complexities of e-commerce deliveries in urban areas.

### Lessons from leaders

**OnTruck** is a provider of an on-demand platform to digitize freight logistics and reduce the number of empty miles driven by carriers. The platform matches shippers to carriers, fully automating the load-matching process and assuring 100% capacity. OnTruck recently raised \$19.2 million in funding and will leverage the industry expertise of new investor OGCI Climate Investments' member corporations to accelerate growth. Similarly, **CargoX** provides a service that connects businesses with freight to ship with truckers who have excess capacity. Both companies are first-timers on the list this year.

**Shippeo** provides an AI-based platform for real-time and predictive visibility into supply chain operations. The company experienced 300% growth in 2019, driven by increased demand for visibility and flexibility across supply chains. In February, Shippeo raised a \$21.8 million Series B round from NGP Capital, ETF Partners, BPIFrance and Partech Ventures.

We did not have any companies from the last-mile or e-commerce logistics sectors on the list this year, but some of the leaders in this space are **Bond**, **Fabric**, **Arrival** and **Rivian**. Bond and Fabric provide delivery and distribution centers for e-commerce companies to move fulfillment closer to consumers and improve the unit economics of last-mile, on-demand delivery. Arrival and Rivian are developing electric delivery vans and have received large orders from major industry players such as UPS and Amazon.

### Keep an eye on

In order to increase efficiency and reduce operating costs of logistics and delivery operations, we can expect to see increasing numbers of new form factors, such as electric cargo bikes, and accelerated use of autonomous driving, especially in heavy-duty, long-haul trucking. In addition, asset tracking technologies and visibility platforms have become necessary for flexible, resilient supply chains and regulation compliance. We can also expect to see increasing penetration of these technologies in supply chains and buildout of complex capabilities.

## Segment 3 Urban Mobility and Smart Cities

**Definition:** This segment includes mobility service providers, including public transportation, car and ride-sharing, micro-mobility services and infrastructure. Business activities include technologies for intelligent traffic systems, AI-based analytics platforms for vehicle distribution, demand prediction and dynamic routing, curb management platforms and innovative infrastructure and business models for mobility services.

### Market dynamics

Historically, our urban transportation systems have been built around cars. As urban areas become denser, the way we move people and goods around is evolving. Technology advancements are enabling the use of new, smaller form factors and data-driven mobility and delivery services. In turn, these new methods of transportation are providing insight and data into how people really move around cities, informing public policy and turning the focus to moving people, not cars.

3. The Carbon Trust. 2019. "Global Supply Chain Report 2019."

4. Kraft, Ethan. 2020. "Last mile delivery push will worsen communities, hurt the environment", World Economic Forum says."

5. Oberlo. 2020. "Global eCommerce Sales (2017-2023)." Oberlo.



One key theme in the urban mobility and smart cities space is traffic management. Traffic lights are the main tool cities use to control traffic flows, but today's traffic lights were built to manage systems that consist of cars, trucks and various modes of public transit. Different forms of transportation, from walking to small-format vehicles to shared and autonomous mobility, promise to solve many of the pitfalls of the incumbent car-based traffic system, but the infrastructure used to manage these different modes of transportation must adapt to fully realize their potential.

Another key theme is curb management which is, in many ways, similar to traffic management, but is focused on managing what happens on the side of roads, rather than on them. As different actors fight for space on the curb, including last-mile delivery drivers, micro-mobility operators, private vehicles and, more recently, restaurants, cities are looking for solutions to better manage and prioritize curb space.

The challenges facing mobility and on-demand delivery services in the past have been inefficient operations and unprofitable business models. Historically, these companies have met growing demand by simply growing the number of drivers and couriers, leading to inefficient, oversized fleets. The next generation of mobility and delivery services will require more efficient use of smaller fleets in order to improve unit economics.

#### Lessons from leaders

**Swiftly** is a San Francisco-based provider of a purpose-built, data-driven enterprise software to manage transit data in cities. Features include real-time passenger information, real-time vehicle operation data and analytics of historical data. The company closed a Series A round last year and made it onto the Global Cleantech 100 list for the first time this year.

**Streetlight Data** is also a Global Cleantech 100 debutant and raised a \$15 million growth equity round in August 2020. The company's solution targets traffic data from streetlights and applies big data analytics for smart cities, traffic engineering and transportation planning applications.

#### Keep an eye on

The Covid-19 pandemic forced public transit ridership to near zero – eliminating ticket revenues and prompting increased government support for the service. This trend will likely continue as the pandemic persists due to the lack of space for social distancing on buses and trains. However, public transit operators will increasingly look to innovation to handle fluctuating demand and improve profitability of public transit services.

The micro-mobility sector witnessed a similar drop in ridership at the beginning of the pandemic, but its open-air and social distancing-friendly nature has brought ridership back to near pre-pandemic levels. Because of this, cities are more commonly seeing this form of mobility as an essential part of a sustainable and safe urban transportation system; they're expanding bike lanes, creating slow streets, rewriting policies and expanding pilot projects. However, micro-mobility still has profitability and safety problems, including high operating costs and free-floating vehicles being left haphazardly on streets. The future of this sector will see innovation in the areas of charging, docking and locking to truly make it work for cities.

# The 2020 Graduates

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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.

Below we record the graduation events since the previous edition of the Global Cleantech 100 was finalized.

Not every one of these acquisitions will have provided venture-grade returns, nevertheless investors into the macro cleantech theme should be encouraged that there is increasing openness to these new kinds of assets, from both larger incumbents and public market investors.

Each year we are now seeing over ten of these graduation events. These companies are illustrative of the general direction of travel for the industrial transitions we all need to see 2020-2050.

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# Mergers & Acquisitions

Company	Acquiror/ Exchange	Date	Deal Notes	Appearances on Global Cleantech 100
		October 2020	Fluence, owned by Siemens and AES, acquired AMS, developer of DER optimization software, on the back of a year-long partnership between the two companies.	2015, 2017, 2018, 2019
		October 2020	The deal solidified Generac's position in Smart Grid technologies, following recent acquisitions of Neuroio and Pika Energy.	2012, 2013, 2015, 2017, 2018, 2019, 2020
		August 2020	The \$5 billion acquisition expands AVEVA capabilities in industrial data services. OSIsoft was arguably the pioneer in proving out the power of big data as a critical industrial resource.	2012, 2013, 2014, 2015, 2017, 2018
		August 2020	The acquisition allowed Q CELLS to enter the US distributed energy market. As such, GELI has become part of Hanwha's product roadmap and corporate strategy in DER.	2015, 2017, 2018
		July 2020	The acquisition included strategic investment to continue Ostara's growth. Ostara, a nutrient recovery specialist, was the very first Hall of Fame company.	2009, 2010, 2011, 2012, 2013, 2014, 2015
		May 2020	The \$900 million acquisition enables Mobileye's strategy to offer a full mobility service. It speaks to the importance of mass transit, micro mobility and intelligent data systems for cities.	2015, 2018, 2019
		March 2020	The combined entity develops high-tech lithium batteries, charging solutions and new hybrid capacitors.	2011, 2012, 2013, 2014
		December 2019	The acquisition included an investment plan to expand EVgo's position as the U.S.'s largest public fast-charging network.	2020
		December 2019	The acquisition helps DuPont meet demand for wastewater treatment.	2015, 2017, 2018
		December 2019	Desalitech's reverse osmosis technology allows DuPont to further reduce the lifecycle cost of water purification.	2013, 2014

 <h1>Initial Public Offerings</h1>				
Company	Acquiror/ Exchange	Date	Deal Notes	Appearances on Global Cleantech 100
	Oslo Stock Exchange	September 2020	The company, a specialist in converting discarded plastic into new plastics and fuels, is currently trading at a market capitalization of around \$220 million, after raising more than \$50 million in venture capital.	2011, 2012, 2013
	Canadian Secondary Exchange	March 2020	Metamaterial Technologies, which makes synthetic materials that can alter the properties of lights, is currently trading at a market capitalization of around CAD 40 million, after raising more than \$15 million in venture capital.	2019

### SPACs in process

A number of Global Cleantech 100 companies and alumni are currently going public via acquisition by a Special Purpose Acquisition Company. None of these transactions are closed yet but watch this space in next year's report!

### Unicorns

We have a rule, whereby companies who have appeared on one of the publicly available unicorn lists, as having a valuation in excess of \$1 billion, can no longer qualify for the Global Cleantech 100. The following alumni companies have reached Unicorn status over the last 12 months, and so could not make the list this year, or in the future.

**“THE STRATEGIC M&A MARKET REMAINED ACTIVE AS ACQUIRORS CONTINUE TO RE-SHAPE THEMSELVES FOR THE MULTI-DECADE INDUSTRIAL TRANSFORMATIONS THAT ARE UNDERWAY.”**

**RICHARD YOUNGMAN, CEO, CLEANTECH GROUP**

		
	Company	Appearances on Global Cleantech 100
Unicorns		2015, 2017, 2018, 2019, 2020
		2018, 2019, 2020
		2019, 2020

# 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 people based in London, Paris and Boston.



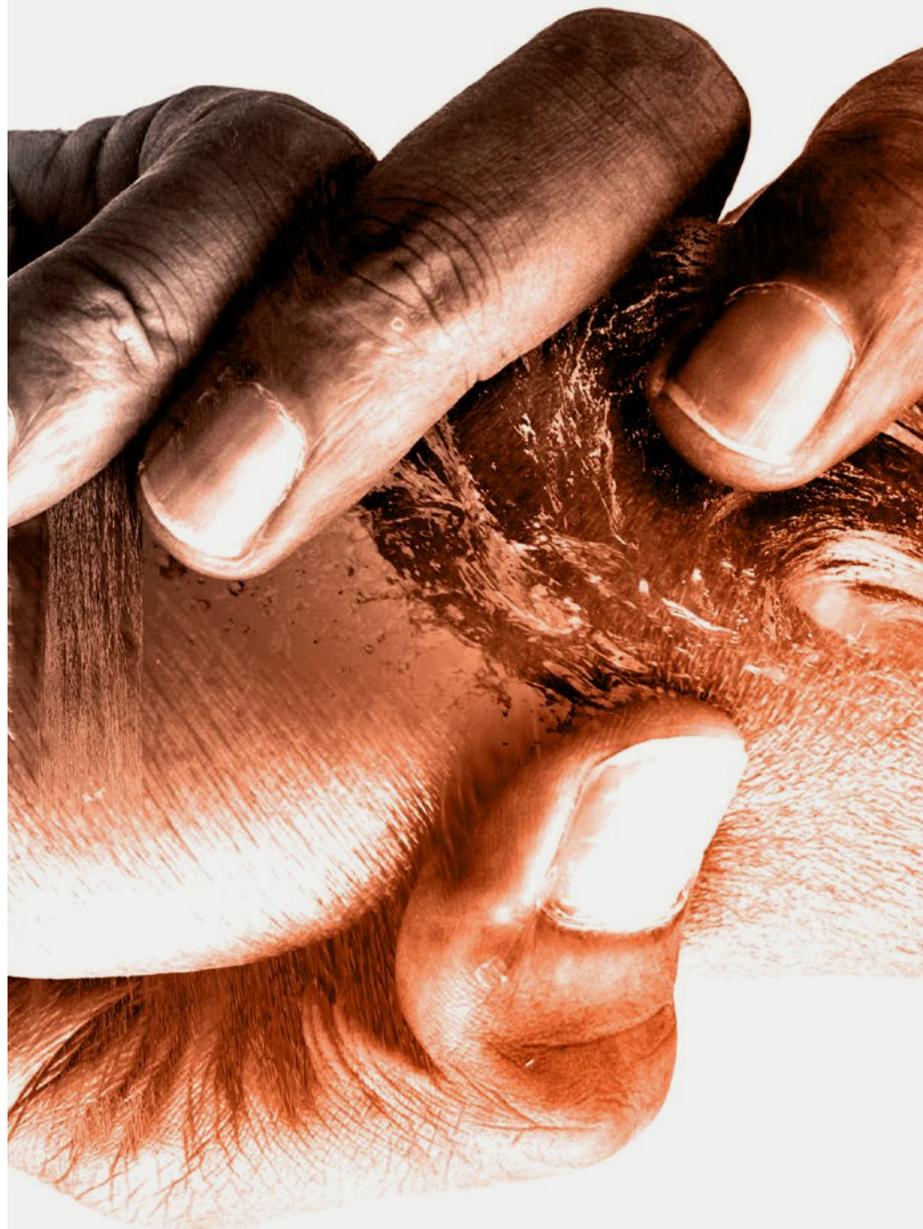
RESEARCH



CONSULTING



EVENTS



# Meet the experts

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

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