Global ’18 Cleantech 100

A Barometer of the Changing Face of Global Cleantech Innovation
Acknowledgements

The list would not have been possible if it weren’t for the willingness of our 86 expert panelists (listed in Appendix 2) who gave up their time during the summer months to provide expert input and opinion. This is in addition to the many hundreds who made company nominations. Thank you all. We wish to acknowledge the support of the Chubb Group of Insurance Companies, the headline sponsor of the 2018 Global Cleantech 100 Program. We wish to thank them not only for their support of our activities, but also for the consistent and dedicated manner in which they are bringing to SMEs in our field much-needed advice and risk management expertise.

“What is most exciting to us, is the privilege of seeing and reading these viewpoints and interpreting them as part of our annual barometric read of the shifting sands within global sustainable innovation.”

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## The Global Cleantech 100 in Numbers

- **9** editions of the annual Global Cleantech 100 have been produced
- **12,300** distinct companies were nominated from **61** countries for this new edition
- **86** Expert Panelists reviewed **312** shortlisted companies
- **41** companies are new entrants to the list (Rising Stars), and **21** have never before been shortlisted
- **18** countries are represented with **48** companies headquartered in the US and **33** headquartered in Europe & Israel
- **40** companies are represented in Energy & Power, the largest showing of our **6** industrial groupings
- **15** Transportation & Mobility companies (more than in any previous report)
- **1** new entrant to the GCT100 Hall of Fame
Foreword

Strategic M&A is on the Rise?

For the ninth year running, Cleantech Group (CTG) is proud to present the annual Global Cleantech 100 list, our barometer reading of the global innovation community’s shifting views on which companies, and which types of companies, today seem most likely to make significant market impact within the next 5-10 years.

Every year there are surprises for us, and no doubt for everyone, about which companies have been included and/or which have been excluded. That is the nature of the beast.

The views we are trying to represent through our methodology are not mine, yours, or that of any one organization, but where “consensus sentiment” in our innovation ecosystem lies both in terms of which private companies active in sustainable innovation are in favor and are widely admired, and perhaps even more importantly for what kind of sub-sectoral areas and themes are in vogue.

This year’s list clearly shows how important the themes around Agriculture and Food and Transportation & Logistics have become over the last three years. Energy & Power remains the most represented industrial segment in the 100, but the other two are represented more and more, year on year, and these two are undoubtedly showing the strongest change dynamics right now.

The report explores such dynamics in detail, but a key takeaway for me from this year’s GCT100 exercise was the burst of M&A announcements across 10 days (October 24, 2017 to November 3, 2017) when we saw four of our new Global Cleantech 100 companies (and indeed one of our new Ones to Watch) ‘graduate’ between the month when the list is struck (September) and its publication date (January). This burst of strategic corporate activity fits into a wider picture for us, which speaks to a different market to 2009, the year of the first Global Cleantech 100.

In very particular areas, large companies (and more of them) indubitably see a different future fast arriving, most particularly in the autonomization and electrification of the transportation world, and a very different set of needs in terms of being a power provider. These were evident in that crazy 10 days:

- UK-based automotive supplier Delphi Automotive acquired Boston-based self-driving startup NuTonomy for $450 million, doubling the size of its self-driving operations. This was just the latest in what has been a series of mega deals in the sector over the last 12-24 months.

- Danish family company Danfoss acquired Visedo, a world-leading expert in electric solutions for the off-highway and marine markets, responding to the growing customer demand for electric solutions to reduce emissions and pollution and to increase productivity.

- On a different angle, but still concerning the future of automotive, Israel’s Argus Cyber Security, a specialist in security solutions for the automotive sector, was acquired by German car parts giant Continental, under the idea that only secure mobility is smart mobility.

- Enel, through its US subsidiary EnerNOC, acquired California-based advanced energy and e-mobility solutions company eMotorWerks, a major statement of how electric the Italian utility believes the future of transportation networks will be. This deal followed 2017 acquisitions made by other European energy giants, ENGIE (of EV-Box) and Shell (of NewMotion).

- Centrica acquired demand-side response aggregator REstore for £62 million, specialists in unlocking and monetizing industrial flexibility. This followed other acquisitions Centrica has been making to re-shape itself in line with the evolution of global electricity markets. In 2015, for example, it acquired another Global Cleantech 100 alumnus, the building sensor startup, Panoramic Power.

We hope you find our report thought-provoking and our read of the state of the market useful to you in planning the coming months. Congratulations to those who made the 2018 list and to the alumni who have successfully graduated over the last 12 months.

We look forward to following theirs and hundreds of other companies’ progress in the coming 12 months.

Richard Youngman, CEO, CTG
Is your insurance as advanced as your technology?

Chubb offers Clean Tech insurance solutions for today and tomorrow. Learn how Chubb helps nearly a third of the 2018 Global Cleantech 100* protect their future.

www.chubb.com

*According to the Cleantech Group.

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In Agriculture & Food, the fastest growing cleantech sector by deal count, alternative protein sources and plant-based substitutes to animal products are gaining momentum. Growing crops more efficiently has led to different approaches: vertical farming in controlled (and often urban) environments, increasing crops’ nutritional density via planet genomics, or by bringing analytics and actionable data to traditional farming through imaging, sensors, and drones. Read more about this sector on pages 15-18.

In Energy & Power, the move to capital-light software and service-based businesses continues. While some startups are focusing on energy access and bringing the now well established and mature renewables to emerging economies, the main innovation trends are focused on anchoring distributed energy sources into our power systems through efficient storage, aggregation, and management. Read more about this sector on pages 19-22.

In Industrial & Manufacturing, the deployment of wireless, low power, long range networks is enabling value creation downstream, and is accompanied by ever more powerful software algorithms for predictive maintenance and operational efficiency. Advanced manufacturing and 3D printing are also gaining momentum by combining innovation in robotics, material sciences and software. Read more about this sector on pages 23-26.

In Materials & Chemicals, industrial biotechnologies are battling with capital intensive commercialization and profitability over petroleum-based alternatives. Innovation is leaning towards retrofit solutions, low value waste utilization like CO2 sequestration, or shifting from commodity chemicals to higher value specialty products. Read more about this sector on pages 27-30.

In Resources & Environment, the market is leaning towards technologies solving the diverse wastewater challenges across industries, but here as well, the deployment of sensors for air quality, waste measurement and management, and ore extraction is a noticeable trend. Read more about this sector on pages 31-34.

In Transportation & Logistics, the fastest growing cleantech sector by dollars, Transportation-as-a-Service (TaaS) models such as car-sharing and ride-hailing platforms have been scaling at unprecedented pace and are well positioned to integrate autonomous vehicle technologies, which is driving a second stream of innovative startups. In the meantime, EV charging infrastructure is being deployed and increasingly intertwined with the grid and smart home systems. Read more about this sector on pages 35-38.

Innovations that didn’t even exist 10 years ago are quickly being adopted for cleantech-related industries. For example, this is the first year a blockchain company has broken into the Global Cleantech 100 (LO3 Energy). Increasing use of sensors – with the precision, control, and intelligence they afford all manner of industrial systems – is being matched with artificial intelligence solutions at a rate that could not be understood in 2007. Every sector covered in this report includes multiple examples of AI being leveraged to improve existing processes.

Here is a flavor of the trends revealed by this year’s Global Cleantech 100 across the different industrial segments.
While our Global Cleantech 100 list aims to identify companies set to make an impact over the next 5-10 years, many of these companies have already made positive gains around the world. We've highlighted a sampling of those impacts from this year’s list.
More in-depth profiles, additional stats and analysis, and the latest updates on the Global Cleantech 100 companies can be found at [https://i3connect.com/gct100/the-list](https://i3connect.com/gct100/the-list).

Key Stats:
- 41 companies are first timers on the Global Cleantech 100 list
- 59 companies have previously been on a GCT100 list of which:
  - 51 were on the list in 2017
  - 8 are returnees after being on the list in 2015 or earlier.

*Indicates that the company has been acquired since September 15, 2017 (the cut-off date at which point the new GCT100 was determined).
The Global Cleantech 100 by Sector

- Materials & Chemicals
- Resources & Environment
- Transportation & Logistics
- Agriculture & Food
- Energy & Power
- Industrial & Manufacturing
What is in marmite? Marmite contains the yeast that remains after being used to brew beer and is used to create a savory, dark spread. Marmite is not for everyone and is generally a very polarizing product – you either love it or you hate it! ‘Marmite’ companies are those that attract the strongest split of opinions across the Expert Panel.

In this edition of the Global Cleantech 100, we have looked to the 312-strong shortlist in an attempt to understand how the Expert Panel, and the various market signals we take in via our methodology, respond to companies and technologies. In doing so, we noticed that there are three main areas that split opinion most regularly: energy storage, solar, and transportation.

**ENERGY STORAGE**

<table>
<thead>
<tr>
<th>POSITIVE COMMENTS</th>
<th>NEGATIVE COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow batteries are a good competitor to other energy storage in large scale applications</td>
<td>Li-ion is not the future</td>
</tr>
<tr>
<td>The focus on renewables-to-hydrogen could be a viable alternative to battery energy storage; running pilots with a couple of utilities</td>
<td>Reliable recharging not yet proven for metal air technologies -</td>
</tr>
<tr>
<td>Simple saline solution based thermal storage, has potential to even out spikes in the grid with an inexpensive solution. Industrial refrigeration is significant in scale, so small improvements add up</td>
<td>Competition with Li-ion is too strong to see alternative battery solutions emerging</td>
</tr>
<tr>
<td>One of the few battery companies selling...</td>
<td>Very competitive market with strong leader in Li-ion</td>
</tr>
<tr>
<td>Good performance in pilot installations but still to be proven</td>
<td>Good performance in pilot installations but still to be proven</td>
</tr>
</tbody>
</table>

*Comments are not necessarily related to companies listed, but are to help illustrate split opinions across the sector.

**KEY TAKEAWAYS:** Investors are reluctant to engage with energy storage startups unless they have established and proven technology (e.g. Stem) or have a niche application that is not being served by alternative battery chemistries (e.g. Axiom Exergy). The competition that exists in the Li-ion market also causes concern about market share, with one Expert Panelist going so far as to suggest that Li-ion technology is ‘not the future.’ Experts are torn between contemplating alternative storage solutions and giving way to the new king on the Li-ion throne.

**SOLAR**

<table>
<thead>
<tr>
<th>POSITIVE COMMENTS</th>
<th>NEGATIVE COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unique positioning, validated by great commercial traction - albeit dependence on just one market segment</td>
<td>Market in disarray</td>
</tr>
<tr>
<td>The most promising organic thin film PV developer and producer – fingers crossed to scale up!</td>
<td>Cost reduction for solar mainly in production size now</td>
</tr>
<tr>
<td>Given the importance of solar in the future energy mix... flexibility, durability and efficiency will be required</td>
<td>No clear technological differentiation although the commercial need seems obvious</td>
</tr>
<tr>
<td>Organic solar films create new fields of application for energy production</td>
<td>OPV [organic photovoltaics] remains a challenge</td>
</tr>
<tr>
<td>Surprised they haven’t gone bankrupt yet... very difficult play</td>
<td></td>
</tr>
</tbody>
</table>

*Comments are not necessarily related to companies listed, but are to help illustrate split opinions across the sector.

**KEY TAKEAWAYS:** There is a great diversity of opinion about the solar companies that were included within the GCT100 process. This may reflect the diversity that naturally comes with a mature market. However, some of the more cutting-edge applications, such as thin-film and organic photovoltaics, are divisive for either being too challenging a technology to commercialize, or too expensive to reach necessary levels of deployment. It is also interesting to note that 1366 Technologies, a developer of manufacturing technology for silicon wafer production for solar cells, has been singled out this year for being a company that was on the GCT100 some years ago (in 2011 and 2012), and has been a permanent fixture on the shortlist ever since.
Marmite List – continued

TRANSPORTATION

<table>
<thead>
<tr>
<th>POSITIVE COMMENTS</th>
<th>NEGATIVE COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Despite challenges, customer acquisition is excellent</td>
<td>Need to fix culture</td>
</tr>
<tr>
<td>While Uber has more users, Lyft has won driver and customer hearts</td>
<td>For obvious reasons... A company on the Cleantech 100 list should operate responsibly</td>
</tr>
<tr>
<td>It has done this with a greater social mandate, providing improved worker conditions and rewards, such as tipping.</td>
<td>Difficulties in communication &amp; beyond</td>
</tr>
<tr>
<td>In a world where Uber gets all the press, this is the one really dominating the segment.</td>
<td></td>
</tr>
<tr>
<td>Great competitor of Uber; demonstrates the importance of localization of products</td>
<td></td>
</tr>
</tbody>
</table>

*Comments are not necessarily related to companies listed, but are to help illustrate split opinions across the sector.

KEY TAKEAWAYS: Due to the size of the market in which ride-sharing and mobility service providers are operating, it is no surprise to see strong Expert Panel opinion both in favor, and critical of, some of its market leaders. Some observers are quick to praise a company for success in this industry's main battle line: customer acquisition. This can sometimes be reflected as a desirable outcome if one company displays signs of monopoly, whereby another company making a ‘dent’ in the market leader is admirable. However, this does belie geographical bias. This bias is further touched on by another Expert Panelist, who praises the ‘localization’ of particular service offerings. Finally, and seemingly responsible for one of the more surprising omissions from the GCT100 this year, is the repeated criticism of corporate culture at Uber. It seems market dominance can be overlooked when a company’s reputation has been damaged.

OTHER MARMITE EXAMPLES

<table>
<thead>
<tr>
<th>POSITIVE COMMENTS</th>
<th>NEGATIVE COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The future of energy trading. While it’s still early, they have already demonstrated how blockchain will work.</td>
<td>Not a scalable model</td>
</tr>
<tr>
<td>Free heat who does not want to have that. Combining technology with an interesting business model</td>
<td>Not a new idea. Doesn’t really scale and is difficult to operate efficiently throughout the year</td>
</tr>
<tr>
<td>Extremely innovative and proven technology platform to create new clean energy for smart cities.</td>
<td>An interesting and well-marketed pilot without an underlying business model.</td>
</tr>
</tbody>
</table>

*Comments are not necessarily related to companies listed, but are to help illustrate split opinions across the sector.

KEY TAKEAWAYS: While there are many companies that we could have highlighted here, the three shown represent some interesting perspectives. On the one hand, there are those that see blockchain energy trading, free heating, and pavement-based electricity generation as ‘extremely innovative’ and ‘the future,’ whereas others have entirely different perspectives, seeing these technologies as un-commercial, un-scalable, not new, and difficult technology to apply or rely on. In these particular examples, there is a different set of criteria for evaluation. It is not about market capitalization, differentiated offering, or picking the winning technology as it is for the three other ‘marmite’ sectors, but whether there is a fundamental belief in the underlying innovation.
The GCT100 Hall of Fame was founded to recognize the achievement of the few companies whose sustained excellence over many years has meant that they have been on the GCT100 list an impressive seven times. To maintain the belief and support of a strong percentage of investors and technology scouts in the market year on year (from 2009 onwards) is no mean achievement.

Five companies had made it into the Hall of Fame so far, and now a sixth company is joining their ranks.

**Inducted January 2018**

Previously inducted:

Once inducted into the GCT100 Hall of Fame, companies will not feature on any future editions of the list, but we will keep a close eye on them, as we do all our alumni.

We hope to see great things from these companies in the future, and as such live out the promise of GCT100 companies as being set to make ‘significant impact in the next 5-10 years.’
2016-17 Graduates

Graduates is the term we use for Global Cleantech 100 companies (that have been on at least one past edition of the list) when they are no longer private and independent companies, and so cannot qualify for future editions of the Global Cleantech 100. That is to say, they have been acquired or have become a public company.

The following list shows all those who have graduated during the 12-month cycle between the determination of the 2017 Global Cleantech 100 (August 31, 2016) and the 2018 Global Cleantech 100 (September 15, 2017).

<table>
<thead>
<tr>
<th>GRADUATE</th>
<th>ACQUIRER</th>
<th>GCT100 YEAR</th>
<th>DEAL SIZE / TPIC *</th>
<th>DATE</th>
<th>DEAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue River</td>
<td>John Deere</td>
<td>2017</td>
<td>$305M $30.1M</td>
<td>September 2017</td>
<td>This acquisition price is roughly a 4x increase on Blue River’s valuation at their last funding round ($87 million in 2015), with $30 million in venture capital raised overall.</td>
</tr>
<tr>
<td>Digital Lumens</td>
<td>OSRAM</td>
<td>2010 → 2017</td>
<td>N/A $54.3M</td>
<td>August 2017</td>
<td>Financial details have not been disclosed, but sources suggest a mid-double-digit million-dollar sum. The acquisition of Digital Lumens will enable Osram to expand its business with digital lighting solutions and add to its expertise in software, sensors and connectivity.</td>
</tr>
<tr>
<td>Netafim</td>
<td>Mexichem</td>
<td>2017</td>
<td>$1.5B $604M</td>
<td>August 2017</td>
<td>Mexichem will pay some $1.5 billion, acquiring a 61% stake owned by private equity and buyout firm Permira, which bought into Netafim in 2011 before it roughly doubled in value.</td>
</tr>
<tr>
<td>Greensmith</td>
<td>Wärtsilä</td>
<td>2017</td>
<td>$170M $39.48M</td>
<td>July 2017</td>
<td>The acquisition of Greensmith will enable Wärtsilä to expand its footprint in the energy storage market and position itself as a leading global energy systems integrator.</td>
</tr>
<tr>
<td>Younicos</td>
<td>Aggreko</td>
<td>2014 → 2015</td>
<td>$52M $75.37M</td>
<td>July 2017</td>
<td>Younicos’ total portfolio of over 200 megawatts of installed storage systems will be used to lower the cost of energy for Aggreko’s customers.</td>
</tr>
<tr>
<td>SolarSpectrum</td>
<td>Northern Pacific Group</td>
<td>2013 → 2015</td>
<td>$50M $204.5M</td>
<td>April 2017</td>
<td>The merger of Sungevity’s subsidiary, Solar Spectrum, and Northern Pacific Group will provide homeowners and businesses across the US with solar solutions and technology.</td>
</tr>
<tr>
<td>Viridity Energy</td>
<td>Ormat</td>
<td>2012</td>
<td>$35M $38.5M</td>
<td>March 2017</td>
<td>Ormat will pay Viridity’s shareholders an initial consideration of $35 million at closing. Additional contingent consideration will be payable in two installments upon the achievement of certain performance milestones measured at the end of fiscal years 2017 and 2020.</td>
</tr>
</tbody>
</table>

* TPIC stands for total paid in capital.
<table>
<thead>
<tr>
<th>GRADUATE</th>
<th>ACQUIRER</th>
<th>GCT100 Year</th>
<th>Deal Size / TPIC</th>
<th>Date</th>
<th>DEAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-flexx energy boosting</td>
<td>MAHLE</td>
<td>2010, 2011, 2014</td>
<td>N/A $8.6M</td>
<td>February 2017</td>
<td>The MAHLE Group is expanding its expertise in the field of thermoelectrics by taking over Germany-based O-Flexx Technologies. The purchase price will not be disclosed.</td>
</tr>
<tr>
<td>LiquidLight</td>
<td>avantium</td>
<td>2014</td>
<td>N/A $32.52M</td>
<td>January 2017</td>
<td>This acquisition combines the technologies of both Liquid Light and Avantium to develop an electro-catalysis platform, and to commercialize new process technologies using CO2 as feedstock to produce sustainable chemicals and materials.</td>
</tr>
<tr>
<td>VIRENT</td>
<td>TESORO</td>
<td>2010</td>
<td>N/A $79.54M</td>
<td>September 2016</td>
<td>The acquisition will support the scale up and commercialization of Virent’s BioForming® technology for the production of low carbon bio-based fuels and chemicals. With the acquisition, Virent will become a wholly owned subsidiary of Tesoro.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>GRADUATE</th>
<th>GCT100 YEAR</th>
<th>Deal Size / TPIC</th>
<th>DATE</th>
<th>DEAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>avantium</td>
<td>2010 • 2017</td>
<td>$110.5M $138.3M</td>
<td>March 2017</td>
<td>Avantium successfully raised €103 million ($110 million) from its IPO on Euronext Amsterdam and Euronext Bruxelles, and was reportedly oversubscribed multiple times, according to European VC firm, Soffinova Partners. Avantium’s market capitalization has now reached €277 million.</td>
</tr>
<tr>
<td>Va-Q-tec</td>
<td>2013 • 2014</td>
<td>Undisclosed $19M</td>
<td>September 2017</td>
<td>The company’s IPO involved admitting a total of around 13 million shares to trading. The initial listing price was €14.00 and the issue price €12.30. The IPO was accompanied by Berenberg, equinet and MainFirst.</td>
</tr>
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<table>
<thead>
<tr>
<th>MERGER</th>
<th>GCT100 YEAR</th>
<th>DATE</th>
<th>DEAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EmeCy</td>
<td>RWL Water</td>
<td>2010 • 2014</td>
<td>March 2017 (as EmeCy)</td>
</tr>
</tbody>
</table>
The Agriculture & Food sector refers to innovation in agriculture, forestry, fisheries, and food production that is more efficient and sustainable. This encompasses many core areas, such as crop optimization, consumer food sourcing, and aspects of industrial biotech, which are all utilizing hardware and software solutions to reduce the resource strain on the growth, production, and supply of food products and other agricultural commodities.

**AGRICULTURE & FOOD COMPANIES BY SUB-SECTOR**

**Alternative Protein Sources**
- **Meat Alternatives**: Beyond Meat, Impossible Foods
- **Insect Farming**: AgriProtein, Ynsect
- **Dairy Alternatives**: Ripple Foods

**Plant Genomics**
- Benson Hill Biosystems
- Vestaron

**Data, Analytics & Digitalization**
- Farmers Business Network
- Farmers Edge
- Semios

**Vertical Farming**
- AeroFarms
- Plenty

12 2018 GCT100 companies

$694M raised by these companies so far

In this report, company names that are **orange** indicate a GCT100 company, while company names are that in **bold** indicate a Ones to Watch company.
INVESTMENT SNAPSHOT

_Agriculture & Food_ has been one of the fastest growing cleantech sectors in recent years, alongside _Transportation & Logistics_. In a 2009 CTG report on the future of _Agriculture & Food_, we surmised that ‘the smart money is getting ready,’ and it has turned out to be true. Venture capital in this sector has grown over ten years from $210 million (in 2008) to over $2 billion in 2017. The majority of this growth occurred within the last five years, as the sector has grown from biological pesticides and smart irrigation to the wide variety of software and hardware solutions represented by the 2018 GCT100 companies in this sector. Investment in _Agriculture & Food_ already surpassed 2016 totals in both count and amount before the end of the Q3 of 2017, and the sector is on track to reach just under $3 billion before the end of the year.

Innovation

As we can see from the relevant 2018 GCT100 companies, there are four main technologies that have been receiving investor attention recently. While these are not the only game-changing technologies in this sector, they serve as good examples of where we are seeing the most innovation.

**Alternative Protein Sources**

Alternative protein sources have accelerated their development over the past year, but it is important to understand the breadth of this industry. Earlier this year, CTG research broke it down into the following categories.

*Plant-based alternatives* fall into two groups. The first consists of well-established consumer choices such as tofu, seitan, Quorn, and others. The second group is at a much earlier stage of development, and consists of plant-based alternatives that attempt to be indistinguishable from animal products. Leaders in the field who made it into the GCT100 this year include **Beyond Meat** and **Impossible Foods**. Both companies once again received growth equity investments in 2017 ($75 million and $23.5 million respectively). While those two are developing meat replacements, **Ripple Foods** is developing a plant-based alternative to dairy products. The company received strong backing from GV, Prelude Ventures, and eight others in July 2016.

While there are no representatives in the GCT100 this year, **cultured products** is another category of alternative protein sources. These meats are animal protein-based products grown in a cell structure outside of the animal. Meat and other animal products such as leather are grown in bio-reactors. The process is similar to that used in regenerative medicine. **Modern Meadow**, now a developer of non-animal-based leather products, started out working towards a cultured meat product, and while they no longer continue to do so, other companies such as Memphis Meats are working towards the optimization of meat ‘growing’ without the need for the animal.

Insects have been a source of protein as long as animals and fish have been hungry. Insect use in the human food chain is, by our estimation, not about to take a great leap forward, but insect alternatives to animal and fish proteins used in animal feed and other industries is indeed going through a period of growth. **AgriProtein** and **Ynsect** rep-
resent leaders in this field, with both recently raising capital to begin development of commercial scale insect farms. One other company to watch in this space is Protix, a Dutch company that raised $50 million in June to develop insect products for aquaculture. It would seem set to make a mark on the GCT100’s radar in future.

**Vertical Farming**

Vertical farming is certainly an area with potential: resource efficient, nearer consumer demand, and better nutrition – all at competitive costs from current producers of high value leafy greens, herbs and other potential crops. Robotics, sensors, controlled environments, and lots of data combine to create a new level of food production that is a long way from traditional farming. Venture capital has been active in the past several years supporting commercialization of early-stage companies. AeroFarms raised $34 million in May 2017 (in addition to $20 million in December 2015 and $36 million in November 2014) and is currently on its 10th (or more) iteration of production facilities. Innovation in controlled-environment farming business models is also sprouting. BrightFarms’ use of long-term fixed price purchase agreements helped the company raise $30 million in September 2016, even though their approach is slightly less controlled due to lighting coming primarily from the sun instead of LEDs. Another urban agriculture company, Freight Farms recently increased customer focus on college and commercial campuses as the target for their shipping container-sized farms, following a $7 million raise in July 2017. These companies all have operating projects with customers.

**Plenty** claims that an essential element of the company’s differentiation comes from its proprietary technology and process, which it acquired from Bright Agrotech. Physically, one of the unique attributes of the technology are the 15-20-foot growing towers, an alternative to the trays often seen in other vertical growing operations. Like most others in this space, the software, use of machine learning, lighting, nutrient balance, and other technology are all proprietary. Monitoring of the continued growth of the overall market should focus on deployment of production facilities – the speed and number of cities, ideally with purchase agreements for the produce. Market saturation of locally grown produce from controlled environments is not an immediate concern; however, first to market in cities might make local expansion easier and create barriers for new entrants. To that end, we might also expect more capital coming into other companies that have demonstrated operating facilities and the need to expand quickly.

**Plant Genomics**

In spite of the much-covered legal battle over the intellectual property related to CRISPR-Cas9 gene editing technology, companies have been pushing forward, continuously innovating with new techniques and resulting tools for industry. One such example is Benson Hill Biosystems’ announcement of its new CRISPR 3.0 tool for agricultural applications, including increasing the nutritional density of crops and improving yield against stressors such as drought.

But perhaps the most exciting aspect of CRISPR and other plant genomics technology development lies in the computational advances and artificial intelligence (AI) that accompany the new biological tools. The transformation afoot is that – as DNA is understood as a numeric sequence that can be computationally mapped and manipulated – algorithmic tools can be introduced to speed further discoveries. A key aspect of Benson Hill’s announcement was the partnership model espoused, with the opening of the company’s “CropOS” AI technology to the industry – thereby giving access to its CRISPR 3.0 toolset to a wider set of possible innovators.

**Ginkgo Bioworks** and GreenLight Biosciences, both of which recently raised venture funding, are meanwhile pursuing similar techniques towards bio-industrial fermentation and pest control, respectively.

A final observation is that most business models in the space have shifted upstream, with innovators looking to be platform technology providers rather than producers. This is, perhaps, taking a lesson from the biofuel startup era in which build-operate models did not fare well.

**Data, Analytics, and Digitization**

The proliferation of cheap sensors for everything from in-situ soil conditions to crop growth calculations derived from aerial imagery is resulting in actionable data being available to a new generation of tech-savvy farmers. In this year’s edition there are three companies that are directly serving the needs of the digital age farmer. The first, **Farmers Edge**, brings together satellite imagery and various other data points to a farmer to enable better decision making and more precise farming methods. A fellow Canadian innovator, **Semios**, has a more grounded solution, taking accurate and localized measurements in order to pinpoint needs. This approach is being born out in higher value crops, such as fruit and grape farming, in which more intense and precise crop care can be afforded. The final innovator is **Farmers Business Network**, which serves as an overarching example of the power of digitization in the Agriculture & Food sector. The company has created an online membership platform for farmers to upload and share growing and input price data. The company’s proprietary analytics then take over, creating a treasure trove of agronomic intelligence and greater market transparency available to participating farmers.

**Market Dynamics**

As one can see from the investment summary at the beginning of this analysis, it would be difficult to attribute the rapid rise in venture capital investing in this sector to any one type, geography, or level of investor. There has been a widespread increase in investment with increasingly innovative solutions to invest in, despite this being the
second-oldest industry known to man. However, there are two particular causes of increased investment that are worth exploring. The first is the rise of the corporate investor. We have not only seen increasing investment from agriculture and food corporates themselves, but we are also seeing a wide array of corporates from a variety of industries participating in equity financing of agriculture and food startups.

Looking at the list of corporates and CVCs in this sector over the past year, there are some unsurprising faces. Monsanto Growth Ventures invested in two new companies, Newleaf Symbiotics and FarmLead, while Cargill invested in Descartes Labs, Memphis Meats, and Calysta – none of which is surprising. However, GV tops the list in the agriculture and food space with six separate investments: Bowery, Abundant Robotics, Soylent, Farmers Business Network, Clear Labs, and Ripple Foods. This accounts for two-thirds of the additions to GV’s cleantech portfolio since the middle of last year. While we are singling out GV as an example of non-sector-aligned corporates investing in Agriculture & Food, they are by no means alone, even as a web giant. Amazon’s purchase of Whole Foods for $13.7 billion in 2017 marked a significant departure, or attempt, to become a part of the ‘field to fork’ food chain.

The second reason for increasing investment is a number of regulatory changes that are starting to come into effect, and are poised to have a significant effect on the dynamics of protein systems, crop genomics, and more. To take the example of protein cycles, there are two major EU regulations in the pipeline. As of July 1, 2017, the use of insect-based proteins in fish feed will be allowed within the EU through a change to Annex IV of Regulation 999/2001. The regulation was introduced in the wake of the Mad Cow outbreak and Creutzfeld-Jacob diseases that swept through Europe years earlier, which led to heavy and broad restrictions on the contents of animal feed. This meant that the use of insects as a processed animal protein in animal feed was (most likely inadvertently) banned. The upcoming regulatory change will now clarify how and to what extent this requirement also applies to insect farming. Although the current regulatory change only affects the aquaculture feed sector, the use of insect-based protein in other forms of animal feed is expected to be legalized within the coming years. Furthermore, another upcoming piece of legislation is the Novel Foods Regulation (regulation 2015/2283), which will enter into force on January 1, 2018, clearing up the status of insect protein in animal and human food chains. However, it should be stated that in the US no such legislative certainty is on the horizon, and the future of insects in the human and livestock consumption chain remains under the guidance of the Department of Agriculture.

Challenges and Opportunities

Our Expert Panel is but one input into the selection process – an important one at that. Ultimately, the panel selected 12 Agriculture & Food innovators to this year’s GCT100, but even the most promising ventures have their challenges. Heard among our Expert Panel regarding this year’s Agriculture & Food companies:

Expert Panel Commentary

- Capital intense business model together with bio engineering setbacks are likely to hold this company back
- Real recycled feed...great circular economy.
- Big but low margin business
- The future answer of food crises.
- GMO is a no in the market
- Incredible growth, great product. Great team
- Too expensive
- Nice example of an integration play in the ag space where chemistry meets IOT meets sensors and data for sustainable, efficient and optimized farming practices
- Deal structure is not VC friendly
- Animal protein is pretty challenging long-term
- Building business model hits sustainability features across multiple value propositions; continuing to be recognized as market strategy innovators
- A leader in the wave of new protein development

Beyond the 100

In line with the soaring venture capital investment outlined at the start of this section, it is unsurprising to see that there are a good number of companies relevant to the Agriculture & Food sector beyond the GCT100. Looking at the 2017 Ones to Watch list, over 15 percent of the companies have some impact on this sector – specifically in agricultural biotech and IoT & software solutions.

In agricultural biotech, Caribou Biosciences, a developer of CRISPR techniques for gene editing, is providing a new framework in which genetic modification can be more targeted, safer, and clinical than ever before. Similarly, AgBiome and Ginkgo Bioworks are both developers of microbial solutions to plant health, as well as having applications in energy and medicine. Ginkgo Bioworks recently announced a well-funded joint venture with Bayer to further develop this work.

In the IoT & software realm, two Ones to Watch companies, Gama-ya and Plantix, are using high resolution imaging and software to increase crop yields and identify crop maintenance issues, whereas SoilScout, is developing sensor communications software and technology that could be a vital enabler for this process.
The **Energy & Power** sector refers to technologies and business models related to the generation, transmission, distribution, and end use or management of electric power and process heat. Historically representing the largest cross section of clean technology by new company formations and venture investment, the sector has more recently been eclipsed by the Transportation & Logistics and Agriculture & Food sectors, though it still accounts for a majority of this year’s GCT100. Also impacting this sector is the maturation of “cleantech 1.0” subsectors like solar PV and wind power, and the difficulty of innovators to manage sales and adoption cycles of electric & gas utilities.

## ENERGY & POWER COMPANIES BY SUB-SECTOR

### Efficient Devices

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<thead>
<tr>
<th>Aledia</th>
<th>Kinestral Technologies</th>
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<td>GaN Systems</td>
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### Energy Access

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<th>Azuri Technologies</th>
<th>M-KOPA Solar</th>
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<td>BBOXX</td>
<td>Off Grid Electric</td>
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### Energy Services

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<th>AutoGrid Systems</th>
<th>ONZO</th>
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<td>Awesense</td>
<td>Renovate America</td>
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<td>Carbon Lighthouse</td>
<td>REstore</td>
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<tr>
<td>Enbala Power Networks</td>
<td>Simple Energy</td>
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<td>FirstFuel Software</td>
<td>Sunverge Energy</td>
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<td>Mosaic</td>
<td>Thermondo</td>
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### Energy Storage

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<th>Primus Power</th>
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<td>Ferroamp</td>
<td>Skeleton Technologies</td>
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<td>FreeWire Technologies</td>
<td>Sonnen</td>
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<td>Geli</td>
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### Internet of Energy

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<th>Blue Pillar</th>
<th>Opus One Solution</th>
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<td>ecobee</td>
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### Transformative Technologies

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<tr>
<th>GlassPoint Solar</th>
<th>LO3 Energy</th>
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<td>Heliatek</td>
<td>sunfire</td>
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<tr>
<td>Hydrogenious Technologies</td>
<td>TAE Technologies</td>
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INVESTMENT SNAPSHOT

Looking at the historical trend over the last decade, we can see that investment in this sector reached a high of more than 560 deals and nearly $6 billion by 2011. However, capital-intensive businesses and hardware-based technology investing were less common thereafter, following the high-profile failures of companies like Solyndra and A123 Systems. 2012 and 2013 were years of persistently high deal volume but lower investment totals, as investors sought out capital-light software and service-based businesses. Since 2014, generalist and broad impact-focused investors have diverted much of their attention to the Transportation & Logistics and Agriculture & Food sectors, leading to a further decline of venture capital in Energy & Power. Notwithstanding the lower capital environment, this sector remains ripe for innovation and continues to account for a majority of the companies within the GCT100 list as investors and industry incumbents see high potential for impact among the new solutions being developed.

**Innovation**

Notwithstanding the relative maturity of existing renewable energy technologies like solar, wind, and biomass generation, several companies in the transformative technologies sub-sector are developing alternative generation technologies like organic photovoltaics (OPV), solar thermal generation of process heat, fuel cells & hydrogen, and nuclear fusion. In the energy access sub-sector, several companies are seeking to bring well established solar PV technologies to developing markets. The presence of Azuri Technologies, BBOXX, M-KOPA Solar, and Off Grid Electric on the 2018 GCT100, as well as SolarKiosk, SteamaCo, SunFunder, and SunCulture on the 2017 Ones to Watch list is a further vote of confidence in these business models’ capacities to drive great impact.

By the end of 2016, renewable energy (excluding large hydro power) reached about 9% of global electricity production, and almost 40% of the growth in global power generation. Denmark and Germany successfully managed peaks of 140% and 86.3% shares, respectively, of electricity generation from renewable sources during 2016. As renewables take a growing share of overall generation, many energy storage and energy services companies in the GCT100 are creating solutions for problems like intermittency and aggregation of distributed generation assets – turning non-carbon generation into a grid-friendly resource.

The internet of energy sub-sector of companies demonstrates the permeation of sensor and communications technologies into every corner of the clean technology ecosystem, and the belief that networked energy assets can provide for more intelligent management and efficient energy use. Admittedly, there is plenty of interplay between this and the energy services sub-sector of innovators, as many of the services being managed on behalf of the utility or the energy customer are predicated on such networking and connectivity.

Indeed, the proliferation of sensors and industrial Internet of Things technology is one of the main innovations driving the Energy & Power sector. It is creating greater transparency of, and influence over, both utility and end-user energy generation, management, and consump-
tion. And our 2018 GCT100 companies are not the only validation of this trend – early-stage investments raised in 2017 by companies like Home-IX, EnergiIP, Heimdall Power, SymPower, and Machfu suggest that this sub-sector is only likely to grow in future editions of the GCT100 list.

The second common innovation we see is that of business models based on services managed on behalf of a utility or their customer(s) (or both). By removing upfront capital costs and enabling access to technologies like solar power, building energy management systems, and energy storage, innovators – best embodied by our energy services sub-sector of companies – are reaching beyond first-adopters to drive the next wave of energy change.

One area worthy of acknowledgement is that of the technologies on the list that, if commercialized at scale, would represent truly transformative innovations in the current energy generation-consumption paradigm. Blockchain technology is one that, after an initial hype-cycle (some might argue we’re still in the midst of this cycle), is finding real applications in energy. LO3 Energy’s presence on the GCT100, that of Power Ledger on the 2017 Ones to Watch list, and early-stage investments raised by companies like Conjoule all lend credence to the technology’s potential impact.

Additional transformative innovations lie in efficient devices and several hardware companies on this 2018 GCT100. A common narrative says that the days of hard-tech investing in energy are gone because the capital-intensive nature and long technology development cycles of new hardware innovation are prohibitive to new businesses. Nevertheless, a select few companies in this sub-sector have filtered to the top of our selection process this year, demonstrating continued belief in the market that their wares can be adopted and that they can navigate the challenging paths to market. Nuclear fusion is one of those oft-cited areas of hard-tech, represented in this year’s GCT100 by TAE Technologies. The company inspired new confidence in 2017 with an important technical milestone – generating first plasma – and the revelation of a year-long partnership with Google to develop artificial intelligence to optimize reactor conditions.

**Market Dynamics**

A major driver – and sometimes hindrance – of innovation in the Energy & Power sector is government policy and the posturing of global leaders on climate change. The 2015 Paris Climate Agreement was a major milestone, even if only a long-sought indication of unified intent. Countries on the European continent have, perhaps, the strongest political bulwark against back-sliding, owing to a high degree of climate consciousness and belief in collective action among its voting populace. Nevertheless, Brexit proceedings are already having an impact. The continued financing of parts of the United Kingdom’s energy transition via infrastructure funds coordinated by the European Union, as well as cross-border energy markets and planned new grid interconnections between the British Isles and Europe, are now in question.

The Trump administration in the US, and the posturing of Rick Perry and Scott Pruitt, Trump’s Secretary of Energy and Environmental Protection Agency (EPA) administrator, are troubling but widely regarded by the industry as ultimately out of step with the sea change afoot, and likely to be ineffectual. Large energy companies see the longer-term trend toward decarbonization that has been set, and are adapting accordingly. Also, state-level policies like the passing of SB32 in California are still pushing a clean energy agenda, despite federal-level rule changes. The US, widely considered the laggard in global renewable energy adoption relative to its copious natural gas generation growth in recent years, is still forecast by the Department of Energy’s information and forecasting branch to go from roughly 7 quadrillion Btu equivalent of energy production from renewables to more than 11 quadrillion Btu equivalent by 2030.

Meanwhile, protectionist and isolationist trade policy moves the world over, perhaps most visibly led by President Trump, could prove a drag on the global economy overall, which would impact all sectors’ abilities to adopt new technology – especially from abroad.

Despite the political maneuverings, global electricity demand, even in developed economies, is still expected to increase across all three sectors – residential, commercial and industrial – though at slower rates. Demand in developing economies is expected to rapidly increase, but be met by a higher share of renewables from the start.

Perhaps the most important signals are coming out of developing markets like China and India. China’s current Five-Year Plan calls for at least $360 billion in renewable energy investment, and a 15% reduction in energy consumption per unit of GDP (which already dropped 70% between 1980 and 2010). Meanwhile, India is planning to install 225GW of renewables by 2022. New coal generation will not be phased out overnight, and indeed will continue to account for a large share of thermal energy generation in industries like steel, but the direction of the overall generation mix is clear. A final signal worth noting – this time in the Middle East – is the lowest ever price of USD 1.79 cents/kWh recorded at auction for a new utility-scale solar power project in Saudi Arabia in October.

**Notable Stakeholders**

Corporate strategic investors are playing an increasingly important role and are also more diverse than ever before. Looking at just 2017 venture deals, we see the expected utilities and power equipment companies, but we are also seeing other industries now represented.

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[1] https://www.ft.com/content/a106c468-3567-11e7-99bd-13beb903fa3
German automotive majors like Volkswagen/Porsche, Daimler, and BMW, perhaps in acknowledgement of the nexus of electrified transportation with power markets, have made investments in the sector. Similarly, oil majors like Schlumberger and Shell have invested in companies like Kite Power Systems and Innowatts in 2017, trending toward diversifying their energy businesses away from just petroleum.

Among traditional venture capital funds, we are seeing some interesting trends, too. Several funds active in the Energy & Power sector in 2017 have an impact focus implicit in their fund strategy. Obvious Ventures, with its “world positive” focus, is one such example, while Dutch fund SHIFT Invest similarly talks of creating environmental or health impact alongside financial return. Another common theme is the structuring of a VC fund specifically to connect Western technology with Eastern markets or vice versa. Funds such as Sangam Ventures and 1955 Capital are two such examples. Additionally, VCs like First Imagine! Ventures and Wildcat Venture Partners seem to be bringing a broader technological thesis, such as the proliferation of artificial intelligence or automation into the sector.

Finally, family offices and foundations are slowly becoming more public in their investments, and the 2017 Energy & Power sector deal list includes investors like the Wallenberg family, Fondation Ensemble, Impact Investment Exchange, Zoma Capital, PRIME Coalition, Madrone Capital Partners, Pritzker Group, and Investors Circle. Several of the GCT100 companies categorized in the Industrial & Manufacturing sector are important stakeholders in Energy & Power, too. We acknowledged previously that the broader industrial context of IoT, data, and automation is certainly being felt in energy. The offerings of 2018 GCT100 companies Actility, Airware, Cosmo Tech, OSIsoft, Sigfox, and SpaceTime Insight, in particular are noted for their commercial traction in the Energy & Power sector. The crossover of these technologies into the Energy & Power sector is pulling in strategic investors like Intel, Qualcomm, Verizon, Cisco, and LG – intertwining their corporate venturing strategies more closely with energy & power innovation.

### Challenges and Opportunities

Our Expert Panel is but one input into the selection process – an important one at that. Ultimately, the Panel selected these 40 Energy & Power innovators to this year’s GCT100, but even the most promising ventures have their challenges. Heard amongst our Expert Panel regarding this year’s Energy & Power companies:

**Expert Panel Commentary**

- **Good technology but time to market is very long**
- **Very tough to compete with lithium-ion in this market**

Beyond the 100

Looking beyond the GCT100, we see additional signals of tomorrow’s impactful innovations. Energiency and GeoDigital – both on the 2017 Ones to Watch list – lend credence to the idea that managed energy services are driving change in the sector. Energiency’s services demonstrate an increased niche market focus on industrial and manufacturing facilities, while GeoDigital’s offering suggests that big data services managed for the utility are seen as promising.

Cylance’s presence on the Ones to Watch list – and the traction of competitors like Mocana and Dragos – demonstrates the importance of cybersecurity with the proliferation of the industrial Internet of Things. Smarter and more connected energy assets will never bring the decarbonization and efficiency benefits promised if they are vulnerable to attack.

Finally, we thought Romo Wind’s selection as a One to Watch company was indicative of an important trend in a mature global wind industry that is more about rolled steel and fiberglass than data and software. Its offering, along with that of fellow One to Watch company Uptake, and other companies like Muir Data Systems and Power Factors, have the potential to dramatically improve asset management, turbine uptime, and reduce operations and maintenance costs.
The Industrial & Manufacturing sector refers to companies that provide efficiency gains for traditional industrial and manufacturing processes, laying the path towards 21st century industrial processes. There are a number of technologies enabling the emergence of a cleaner and more efficient industrial world. They are categorized under this sectoral label, ranging from innovations in wireless networking technologies to software algorithms and advanced manufacturing. Companies in this sector often have secondary applications in other sectors as well.

INDUSTRIAL & MANUFACTURING COMPANIES BY SUB-SECTOR

Advanced Manufacturing
- Airware
- Carbon

Software
- Cosmo Tech
- Maana
- OSIsoft
- SpaceTime Insight

Wireless Networking Technology
- Actility
- Sigfox

$993M
raised so far by these companies
The five-year historical investment trend for the Industrial & Manufacturing sector shows an exponential increase in venture investment, starting with an uptick in 2012. Before that, cleantech venture investments were still largely focused on sectors such as solar, wind, and biofuels. As the overall cleantech market began to evolve with the emergence of the Internet of Things (IoT) and other enabling technologies, as well as the adoption of cleantech-as-a-service business models, it has resulted in a new wave of venture investments. It is also worthwhile to note that many of the companies are developing technology that can be seen as “VC-friendly.” The innovations are often software-based and/or platform technologies, that are outside the traditional core cleantech ecosystem, but have crossovers into energy and industrial & manufacturing applications.

Innovation
The convergence of multiple technological innovations most accurately describes the various innovation streams in the Industrial & Manufacturing sector. Three main technology innovations have emerged within the GCT100: wireless networking technologies, software algorithms, and advanced manufacturing.

Wireless Networking Technology
A core technology that is part of the digitization theme is wireless networking technology. Specifically, innovation in wireless networking technology with characteristics suited for industrial and manufacturing processes, such as low power requirements and long-range communications, are at the forefront of wireless technology.

Actility, a co-creator of the LoRaWAN™ technology standard for LPWA (Low Power Wide Area Network) networks, provides a suite of infrastructure components and software products to enable IoT applications and management. The company raised a $75 million growth equity round in April 2017 that included multiple industrial investors, including Foxconn Technology Group and Robert Bosch Venture Capital. The company was praised by our Expert Panel for a strong management team and shared their confidence in the company’s future, especially following the latest funding round. Also, making the GCT100 again this year, Sigfox, an LPWA network provider, has raised more than $300 million and is recognized by our Expert Panel as a “pioneering IoT networking developer with expansions into 60 countries.”

Software/Predicative Maintenance/Operational Efficiency
The second innovation theme in the Industrial & Manufacturing sector is software solutions and platforms that provide value-add downstream applications. While wireless networking technologies provide the foundation, significant values are captured by analyzing the con-
connected assets’ newly generated data stream to develop solutions such as predictive maintenance and operation efficiency.

**OSisoft**, an industry veteran in developing data collection and processing platform, is the next value-add layer that sits between connected assets and software analytics. The company is recognized by our Expert Panel as a market leader for its open infrastructure platform, which allows further downstream application development. The next value-add layer is data analytics, with companies like **Cosmo Tech** developing software solutions that enable businesses to model and simulate complex systems for a number of industrial scale applications. Cosmo Tech has been able to deploy its technologies with several industrial customers, such as Alstom, EDF, and Veolia. **Maana** has also developed a platform using algorithms to analyze data models and provide operational insights, initially targeting the oil & gas market and since expanding to the more general industrial vertical.

It is worth noting that although the companies mentioned are categorized under the Industrial & Manufacturing sector, their respective enabling technologies extend into other sectors like Energy & Power, Transportation & Logistics, and Agriculture & Food.

**Advanced Manufacturing**

The third innovation theme is focused on advanced manufacturing processes that increase production efficiency while also reducing material input. **Carbon** has successfully raised more than $230 million for its 3D printing process that combines innovations in hardware, software, and material science that now allows manufacturers to produce functional prototypes and small volume parts at a significantly faster rate.

**Airware**, though strictly speaking it isn’t involved in the manufacturing process itself, can still be categorized as an innovation under the advanced manufacturing theme in this sector. The company’s commercial drone solutions can be used to monitor industrial sites in industries such as construction and waste management.

**Market Dynamics**

Given the cross-pollination of technologies that make up the Industrial & Manufacturing sector, the market dynamic is rather fluid and driven by multiple stakeholders across several industries.

First and foremost, the IoT movement is one of the primary drivers in the digitization of the Industrial & Manufacturing sector. The rapid decline of sensor costs has already enabled the connectedness of consumer devices, and industrial machines are in line to make up the next wave of connected assets. In addition, wireless networking technologies have also evolved to address the varying characteristics, for example, of data transfer rate, connectivity range, and power requirement. Given the vast amount of data that is generated from these sensors and transmitted through wireless networks in real-time, it has created a huge need for software solutions that are capable of translating these raw data streams to useful insights. Incumbents from the IT sector such as Intel and Cisco, and the industrial sector such as GE Ventures, Air Liquide, and ABB, as well as SoftBank from the telecoms sector, have all been active in the IoT space through strategic investments and/or partnerships.

Another emerging trend is the evolution of data analytics platforms that also include technologies like artificial intelligence (AI) and Machine-to-Machine (M2M). Parallel to the IoT movement, advances in computation power result in functionalities that extend beyond data collection and analysis as automated actions, which create value-add applications like predictive maintenance and process automation.

**Challenges and Opportunities**

There are several challenges facing the Industrial & Manufacturing sector across all three major innovation themes.

Although wireless networking technologies like **Actility** and **Sigfox** have created standardized industry protocols, companies further downstream are currently scattered in various segments of the value chain, and there isn’t a one-size-fits-all solution. This inherently makes it harder for potential industrial customers to implement such solutions, as the logistics to work through multiple vendors (e.g., hardware provider, networking provider, and data platform provider) is cumbersome.

Another major challenge that is on top of every venture investor’s mind is scalability. Given the complex nature of industrial processes, startup companies operating in this sector still rely on a consultative style sale, which results in long and costly sales cycles. As our Expert Panel has suggested, a key differentiator for successful startups is to move away from consultative sales to transaction-based ones, which will then allow companies to drive revenue growth at a much faster rate. We have highlighted Expert Panel commentary that pertain to the challenges in this sector:

**Expert Panel Commentary**

- **Crowded field, hard to say what sets them apart, need to know more about commercial progress and team**
- **Doing well in a crowded sector. Needs to get away from the consultative sale**
- **I think their approach and business model is (one stop shop) is capital intensive; though the tech per se sounds interesting**
Beyond the 100

Although there are only eight companies in the Industrial & Manufacturing sector in the GCT100 list, there are several other notable companies that are worth keeping an eye on from our Ones to Watch list. For example, Energiency is developing a SaaS platform for industrial manufacturers with real-time big data web energy analytics tools that monitor all industrial processes and provide real time energy monitoring and assessment. The company is still fairly young; however, it differs from other companies by focusing exclusively on industrial manufacturing, positioning itself as an expert in this particular vertical. On the other hand, Uptake has raised more than $260 million over the past four years and is targeting multiple industries like aviation, construction, energy, and mining.

One trend we have seen across sectors is the increasing role of artificial intelligence being leveraged to improve existing processes. SparkCognition’s AI-powered software uses machine learning technology to forecast equipment failures before they occur, adding another value proposition beyond baseline data analytics and visualization functionalities. Although the benefits of a digitized Industrial & Manufacturing sector are clear, it is also important not to discount the need for cybersecurity solutions to protect these assets. Cylance is getting increasing attention given the multiple cyber-attacks that have occurred in recent years. The company leverages artificial intelligence technology, but instead of a process/energy efficiency application, it focuses on predicting and preventing cyber-attacks for various mission critical industries.

Finally, Divergent 3D specializes in the development of a 3D-printing based automotive manufacturing platform. Not only does 3D printing technology reduce materials and production cost, the potential elimination of specialized production tools is another key value proposition for this sector. The company recently raised $65 million in its Series B round, with hints that more can be expected before the end of the year.
The Materials & Chemicals sector refers to the innovations in the sustainable production of materials and chemicals, as well as advanced materials with superior performance characteristics. There are several underlying themes in this sector, including industrial biotechnologies, carbon sequestration and reuse, and innovative new applications of existing materials.

**MATERIALS & CHEMICALS COMPANIES BY SUB-SECTOR**

**Advanced Materials**
- Bolt Threads
- E-Leather
- FRX Polymers
- Kebony
- NuMat Technologies

**Biochemicals & Biomaterials**
- Arzeda
- Enerkem
- Green Biologics
- Modern Meadow
- Terramera

**Carbon Capture & Sequestration**
- CarbonCure Technologies
- Newlight Technologies

$629M raised so far by companies in this sector

12 2018 GCT100 companies
INVESTMENT SNAPSHOT

The ten-year investment trend shows a very different investment dynamic in the 2010-2013 timeframe compared to recent years. Total dollars reached a high of more than $1.2 billion in 2011, while deal volume reached 153 deals in 2013. This peak can be attributed to the capital-intensive period of the biochemical subsector, with many companies pivoting from biofuels to biochemicals, but were still raising additional equity funding for scale-up and commercialization. Since 2012, dollar investments remained consistent while deal volume began to drop as investors shied away from capital intensive businesses. Another theory is that investors have also become more conservative in this sector, investing in fewer deals but at higher amounts in high-potential companies.

INNOVATION

Three main innovation themes have emerged through this year’s GCT100 list, namely in the areas of carbon-based products (CBP), industrial biotechnology and bio-based chemicals, and innovative applications and use cases of materials and chemicals.

Carbon Based Products (CBP)

Although carbon capture and sequestration technology is generally categorized under our Resources & Environment sector, we are highlighting innovations in the reuse aspect in this section as two GCT100 companies are not only capturing carbon dioxide (CO2), but using it as feedstock to produce value-added products. CarbonCure Technologies has developed a retrofit system for concrete manufacturing plants to sequester CO2 directly into the concrete production process. The ability to use waste CO2 for concrete production without compromising the concrete’s specification and safety is a key success factor, as indicated by our Expert Panel. Similar to CarbonCure Technologies, another GCT100 company focusing on the reuse of CO2 is Newlight Technologies. Instead of targeting the cement industry, the company has developed a polymerization technology to convert CO2 and other greenhouse gases to valuable biodegradable plastics. Our Expert Panel noted, however, that the performance of bioplastics when compared to oil-based plastics is an important factor to achieve commercialization.

Bio-based Products

The industrial biotech subsector has experienced its fair share of bumps, and witnessed a significant drop in venture investments over the past decade. One of the major challenges is the capital-intensive nature of the businesses, and many have questioned whether venture funding is the right financing mechanisms for these types of companies. Nevertheless, five companies under this theme made it into this year’s GCT100 list. Green Biologics, a long-time GCT100 company, has developed a biological conversion pathway to produce bio-butanol. To address the high-capital requirement to build a production plant, Green Biologics has adopted a strategy to retrofit existing ethanol plants to produce high-value bio-butanol. Enerkem, on the other hand, has developed a gasification and catalytic synthesis technology to convert biomass and wastes into biofuels and biochemicals. Our Expert Panel acknowledged the difficult nature of a catalytic conver-
sion process, but nevertheless expressed confidence in the company and its major commercial partnerships. The third industrial biotech company is Arzeda, a first-timer on the GCT100 list, that has developed a synthetic biology platform to design metabolic pathways. The company is not a material/chemical production company, but provides advanced tools for downstream companies to produce their target molecules.

In addition to chemical molecules, companies are developing biobased materials for specific markets. Terramera, for example, has developed plant-based biopesticides as a replacement for toxic conventional pesticides. Another company that is innovating at the intersection of biotechnology and advanced materials is Modern Meadow, which has developed a bio-based leather production system by using DNA manipulation to grow collagen materials without animals, and then turning them into leather. The company is currently focused on a leather substitute, and has the potential to expand into other markets, having previously pivoted from a meat-protein development technology.

**Advanced Materials**

The third innovation theme showcases a number of advanced material technologies that have been developed for various downstream applications. NuMat Technologies has developed a production platform that designs hardware systems for storage, separation, and purification systems. The company’s technology can be applied to a variety of industries that have atomic-level challenges, such as industrial gas purification and storage. Another material innovation comes from FRX Polymers, which has developed a non-halogen and non-burning family of transparent high flow thermoplastics in the global flame retardant plastics market. A long-time GCT100 company, FRX Polymers has capitalized on the value of its material innovation as a next generation replacement to existing flame retardants. Other material-based innovations include companies like Kebony, which manufactures sustainable hard wood by modifying sustainably sourced soft wood via a patented process. Kebony has gained significant traction over the years, and from a cleantech angle, it reduces deforestation and the demand for primary and hard wood. E-Leather, as the name suggests, produces engineered, composition leather, manufactured from recycled leather cut-offs via a patented process. The company has introduced alternative leathers to the aviation, rail, and automotive industries. Another company innovating traditional textiles, Bolt Threads, has developed an advanced silk production and textile fabrication technology to produce more sustainable silk to replace petroleum-based polymers. The company is gaining momentum with a major partnership to produce silk ties as its first commercial product, and has the potential to replace manufacturing materials in a number of other sectors as well.

**MARKET DYNAMICS**

Many companies in the Materials & Chemicals sector have failed to reach commercial scale for a number of reasons, such as the high cost and logistical challenges in feedstock supply, the capital requirement to build a commercial scale plant, and fundamental technical challenges to make cost-competitive products. It is therefore logical to see the evolution of companies in this sector using low-value wastes like CO2 to produce high-value products.

Another trend is the shift from producing commodity chemicals to specialty products that are higher in value, translating to higher margins for the companies, as products like flame retardants, hard wood, and silk do not have pricing pressures that commoditized products have. As a result, companies in this sector have also shifted further downstream to address specific end markets.

The third evolving trend is the focus on enabling technologies, as evidenced by Arzeda joining the GCT100 this year, that are only focused on creating biotech tools for downstream companies to produce their target molecules more efficiently. Because they are not focused on a particular molecule/material and market, companies in this subsector are industry-agnostic and have technology applicable to multiple industries, such as agriculture and food ingredients.

**CHALLENGES AND OPPORTUNITIES**

The biggest challenge facing the Materials & Chemicals sector is to reach cost-competitiveness against the petroleum-equivalent, while also meeting and/or exceeding performance characteristics. The profitability cushion from higher margin products can sustain the initial scale-up process, but that said, driving down costs is the critical factor to reach commercialization in this sector.

Another challenge related to commercialization is the capital-intensive nature of this sector, primarily due to the requirement of building production plants from the ground up. Furthermore, it was also widely recognized by the ecosystem that venture capital is not the most cost-effective financing vehicle to build production plants, so companies will need to find alternative strategies. As evidenced by the two capital-intensive companies on this year’s GCT100 list, Green Biologics and Enerkem have both taken alternative routes. Green Biologics has adopted a retrofit strategy to use existing corn ethanol plants for the production of its butanol. Meanwhile, Enerkem has formed a partnership with the City of Edmonton for the construction of its first commercial plant, and has since secured several strategic partnerships to co-develop additional plants.

Our Expert Panel has also shared their view on some of the challenges and opportunities facing this sector:
BEYOND THE 100

Looking beyond this year’s GCT100 list, there are similar themes emerging in our Ones to Watch list, which highlights emerging companies with significant potential impact. For example, **Gingko Bioworks** and **Caribou Biosciences** have both developed biological tools in strain optimization and genetic engineering, respectively, for markets such as materials, chemicals, and agriculture.

Carbon sequestration and reuse is also evident in this year’s O2W list, featuring **Econic Technologies**, which has developed catalysts that enable polycarbonate polyols and polymers using waste CO2.

Finally, **Autonomic Materials** has developed a self-healing chemistry technology for coating applications for a number of industries. The company’s value proposition in performance improvement over existing coating solutions addresses a significant unmet need in the market.

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**Expert Panel Commentary**

- Company is gradually scaling up and starting to make real impact
- I think their approach is wrong (one stop shop), as it is too capital intensive. Although the tech sounds interesting
- They have the tech working. Sort of. Now they need to make and sell the product...
- Potential game changer in synthetic biology
- Total space addressable by PHA is in the $ billions. Primarily targets the replacement of polypropylene, and positioned as a manufacturer of PHA opens up addressable market. So, large potential impact
- Potential for huge environmental gains and product quality improvements
- Recent commercial traction shows the value proposition landing in a sector with good potential to scale
The Resources & Environment sector contains technologies and new business models that seek to improve the environmental footprint in natural resource industries like mining, oil & gas, and water, as well as the reduction of airborne and waste-based pollutants through recycling, upcycling, and resource efficiency and optimization improvements.

RESOURCES & ENVIRONMENT COMPANIES BY SUB-SECTOR

**Clean Air**
- Aclima
- Bayeco

**Recycling & Waste**
- Black Bear Carbon
- Enevo
- Optoro
- Winnow

**Water & Wastewater**
- Axine Water Technologies
- Organica Water
- OxyMem
- Saltworks Technologies
- Voltea

**Extractive Industries**
- MineSense Technologies

**Earth Observation**
- Orbital Insight

$363M raised so far by these companies

13 2018 GCT100 companies
INVESTMENT SNAPSHOT

Investment in the Resources & Environment sector peaked in 2012 with $1.8 billion in total value, while deal volume peaked in 2013 with just under 300 venture deals. Since 2014, depressed oil prices have been one force driving lower investment in both upstream oil & gas extraction technologies and water treatment and recycling technologies, in particular. The market now seems to be stabilizing at 140-150 venture deals worth roughly $1 billion per year. Through the first three quarters of 2017 (this report was written during Q4), water and wastewater businesses accounted for 40% of the sector’s venture deals, recycling and waste for 31%, oil & gas and mining for 20%, and clean air technologies for 9%. While companies like Utonomy, Vericool, Pluto, and Molekule were able to raise early-stage funding in 2017, Resources & Environment related sectors are certainly seeing lower deal volumes these days.

INNOVATION

The 2018 GCT100 selections in Resources & Environment are evidence of the proliferation of sensor and communications technologies that have finally entered these industries. From air quality sensors and systems (Aclima, Bayeco) to sensors on garbage cans (Enevo, Winnow) to MineSense Technologies’ sensor-enhanced equipment that make low-grade ores easier to mine, it is clear the Internet of Things is finding promising applications in new verticals.

We think there are plenty of other innovations in water – from water quality monitoring to smart irrigation to behavioral change toward consumer-driven conservation – that promise big impact in the years to come. But the five companies in this year’s GCT100, as well as BioGill, Cambrian Innovation, and NVP Energy on the Ones to Watch list, are a clear signal that the market is most bullish on technologies that solve for diverse wastewater challenges across several industries.

Finally, Orbital Insight’s presence in the GCT100 for the first time is confirmation of an important signal we’ve been tracking in cleantech venturing. By leveraging existing or privately launched satellite networks, we can obtain transformative data and information on everything from deforestation to the effects of climate change and the environmental footprint of mines and oil & gas platforms. Other companies of note in this space include ICEYE, CloudEO, and Descartes Labs.

Elsewhere, we see confirmation of several trends within the GCT100. The promise of air quality monitoring technologies is supported by the naming of eLichens, a French developer of software solutions and miniaturized sensors to digitize air quality, on the Ones to Watch list.

Similarly, Pyrowave’s naming as a One to Watch company and Black Bear Carbon’s presence on the GCT100 suggest that, although digital/IoT solutions appear to be more in vogue in the waste subsector, hard-tech solutions that deal in waste-to-value transformations offer promise of great impact in the near term.

Finally, it’s worth acknowledging several GCT100 companies from
other sectors whose solutions cross into the Resources & Environment sector.

From Energy & Power:

**Powerhouse Dynamics**’ monitoring solution is employed in commercial kitchens to reduce food waste and might be seen as competitive with that of Winnow. **Renovate America**’s financing service for energy efficiency retrofits and solar installations is also offered to homeowners installing water conservation technologies. And **GlassPoint Solar**’s solar thermal technology clearly drives better environmental footprints in the oil & gas industry, which is otherwise generating steam for enhanced oil recovery by burning hydrocarbons.

From Materials & Chemicals:

**Newlight Technologies** and **CarbonCure Technologies**’ material innovations in thermoplastics and concrete, respectively, also inherently feature carbon capture from industry. **Modern Meadow**’s bio-printed leather, meanwhile, could reduce water use and methane emissions associated with dependence on livestock for traditional leather. Similarly, **E-Leather**’s materials created from leather waste in one stroke reduce industrial waste, and recycled previously valueless waste material, reducing demand for leather from livestock.

From Industrial & Manufacturing:

**OSIsoft**’s PI System is widely used in the oil & gas and water utility industries. **Airware**’s drone-based aerial surveying system is leveraged for operational efficiency in the mining industry, and **Maana**’s data analytics for physical asset optimization is already seeing strong traction in the oil & gas industry.

**MARKET DYNAMICS**

Commodity prices are a key driver in the Resources & Environment sector, clearly impacting the capacity of extractive industries like mining and oil & gas to adopt new technology, but also presenting the benchmark prices for recycled materials. After bottoming out around the start of 2016, commodities indices have rebounded slightly but remain suppressed. Copper and cobalt are an interesting counter example where higher demand and more limited supply is sending prices soaring, impacting the lithium-ion battery market in particular.

In the oil & gas industry, specifically, the suppressed oil price is clearly a driver. The professed intention for an IPO in 2018 of Saudi Aramco – which would be by far the world’s largest ever float of shares – will be closely watched, not least for the implications for super majors to adapt to higher market volatility with proven long-term profitability strategies (as opposed to national oil companies simply trying to control volume production).

US domestic policy has clearly taken a friendlier position with the industry than in recent years with the current ethos of rolling back environmental regulations, but most producers see the writing on the wall. Notwithstanding the pressure on investment brought by the low oil price, oil & gas companies are pursuing important environmental technology adoption like produced water treatment and reduced flaring of methane as much for cost reductions as a response to environmental regulations. Super majors are also closely watching the shift to electrified mobility and thinking seriously about regional and global peaks in demand in the foreseeable future.

The recycling industry is moving away from weight-based goals and toward things like emissions reduction. **Waste Management and Republic Services** made moves here starting in 2016. In addition to the price of fungible virgin commodities, a big driver for the recycling industry as of 2017 has been China’s reduced appetite for Western countries’ waste materials. Container ships returning to China have long been stuffed full of bales of waste plastics and recycled electronics destined to become tomorrow’s plastic and electronic goods. But the expanding middle class in China is now producing more of its own waste feedstock, meaning that Western recycling companies may find themselves increasingly without a buyer.

The water industry is facing diverse policy drivers. The Clean Water Act in the US, which turned 45 years old in October 2017, is under attack by President Trump via his EPA administrator Scott Pruitt, endangering pollution protections for streams and wetlands, and easing limits on toxins discharged from power plants and industry. China’s current Five-Year Plan, meanwhile, includes important initiatives like taking rural wastewater treatment from 10% to 70% service coverage. Such massive mandates by Beijing are sure to create a draw for the latest water technologies, already to the benefit of **Organica Water** and Fluence (formerly Emecfy, a GCT100 alumnus).

**Notable Stakeholders**

One driver for venture investment is the prominence of important strategic investors across multiple industries. In recycling and waste, we see not only large waste management services companies like Suez being active, but also big manufacturers like Foxconn (an investor in **Enevo**) and supply chain companies like UPS (**Optoro**). In oil & gas technologies, both equipment suppliers like General Electric and field services companies like Schlumberger have been active investors alongside the oil majors we’ve grown accustomed to seeing.

Oil majors are also important backers for wastewater treatment technologies that can also treat waste streams in other industries. Saudi Aramco’s recent investment in **OxyMem** is one such example.

Finally, the presence of Caterpillar in **MineSense Technologies**’ capital table is a natural strategic fit, while the same can be said of ITOCHU’s and CME Ventures’ investments in **Orbital Insight**.
CHALLENGES AND OPPORTUNITIES

Heard among the Expert Panel, regarding this year’s GCT100 companies in the Resources & Environment sector:

- dependent on...buyer and cities having to show they’re doing something about it
- All cities will have this type of air quality monitoring solution eventually as derivative of smart cities and urbanization
- Clever process but still some technical issues to be solved before introduction
- The challenge for...monitoring companies will be commoditization of sensor technology and the need to enhance the value proposition around the controls and acting on the data provided
- Could be squeezed between commodity virgin materials and recycled at equal cost with higher variability
- Promising technology and business model
- Technology is [a] solid...approach to wastewater treatment, but the volumes are very challenged
- This is a difficult and niche market. Likely to be bought in 1 -2 years
- Technology has the potential to be challenged in operating expenditures and capital expenditures

BEYOND THE 100

Taking a look at the GCT100 sister list, the 2017 Ones to Watch provides even more insight into the market leading companies in resource management and environmental protection and improvement. From this list, two main sectors are present: recycling and water.

In recycling, Ecor (formerly Noble Environmental Technologies) and Pyrowave made it into our 2017 Ones to Watch list. Ecor had appeared on this list once before in 2015 before the company rebranded around its main product, Ecor, which is a high performance green building material optimal for interiors, furniture, fixtures, and packaging. This waste-to-value manufacturing solution allows for the conversion of waste and recyclable resources into useful materials. Pyrowave approaches the waste-to-value solution from a different angle, focusing on plastic waste and emphasizing flexibility by designing smaller-scale machinery that can be deployed near the waste source itself, lowering the costs associated with transporting waste to a processing plant.

In water, four companies scored well enough in our GCT100 process to merit a place on the 2017 Ones to Watch list. Cambrian Innovation is working on a distributed wastewater treatment and resource recovery solution, which also generates electricity. BioGill is working to remove contaminants from water using biotechnology, where bioreactors improve water quality at low cost and low energy. NVP Energy’s solution offers revenue-generating, carbon-neutral, Low temperature Anaerobic Digestion (Lt-AD) technology to treat wastewater. Finally, Zero Mass Water is working at the solar-water nexus, developing equipment to produce potable water.
The Transportation & Logistics sector refers to the technologies, services, and related business models that enable the utilization of more sustainable and efficient transport options for people and goods. This includes electric vehicles, charging infrastructure, and software-as-a-service solutions for a variety of transportation and logistics applications.

TRANSPORTATION & LOGISTICS COMPANIES BY SUB-SECTOR

**Autonomous Vehicles**
- Nauto
- nuTonomy
- otonomo
- Peloton Technology

**EV Charging & Infrastructure**
- ChargePoint
- eMotorWerks

**TaaS Platforms**
- **Ride-hailing**
  - Didi Chuxing
  - Lyft
- **Multi-modal**
  - Moovit
- **Ride-sharing**
  - BlaBlaCar

**Vehicle Hardware**
- **Vehicle Components**
  - Visedo
- **Full Vehicle**
  - Gogoro
  - Lilium
  - NAYVA
  - Proterra

15 2018 GCT100 companies

$17.4B raised so far by these companies
INVESTMENT SNAPSHOT

Since 2007, transportation investment has transitioned from government-driven infrastructure finance and slow-moving incumbent vehicle OEMs focused on internal combustion engines (ICE), to private companies transforming vehicle and supply chain operations, facilitated by breakthroughs in cheap lithium-ion batteries, electric vehicle adoption, Transportation-as-a-Software (TaaS) platforms and multi-modal mobility solutions. The final two of these breakthroughs have been responsible for some of the largest single investments in cleantech in the past two years, and form an important part of the high investment totals we have recorded in the past two years. Taxi and ride-sharing applications are experiencing a global investment race to pay for customer acquisition, as instant access to transportation through smart phones becomes ubiquitous. The multi-modal mobility solution has so far manifested in strong investment in bike-sharing investments, especially in 2017, and is expected to incorporate a range of new transportation options in the coming years in technologies such as battery swapping, hyperloop, and autonomous purpose-built city transport solutions.

INNOVATION

The current lexical shift to ‘mobility’ as a synonym for the Transportation & Logistics sector reflects a wide range of changes that are occurring, technologically and in application. Several convergent innovation trends are driving the current sustained period of innovation, flux, and opportunity within this sector.

TaaS: Transportation-as-a-Service

Ownership is no longer a consistent feature in transportation, with transportation-as-a-service (TaaS) platforms disrupting both public and private transportation methods. Solutions such as ride-sharing and ride-hailing underpin this new paradigm, alongside other areas such as bike- and car-sharing services, from companies such as Mobike and BlaBlaCar. Multi-modality, in which users can move across a variety of TaaS providers, is also an emerging proposition, with companies such as Moovit moving towards an integrated transportation model.

While these TaaS models offer immediate benefits for users today, the platforms are also well placed to integrate into future technology within the Transportation & Logistics sector, namely fully autonomous vehicles and fleets. Autonomy-focused companies such as nuTonomy, onomomo and Nauto are primarily aimed at data gathering currently, but these companies’ inclusion into the GCT100 suggests that this sector represents significant future growth opportunities.

Business Model Innovation

The new service-based modality of transportation has enabled start-ups to scale at an unprecedented pace through innovative business models based on TaaS platforms. Companies such as Didi Chuxing and Lyft have raised significant capital, with Didi scaling at such a rate that it has invested in other TaaS platforms, including Careem, Taxify, Ola, Grab, and Ofo. While growth for some companies is happening rapidly, question marks remain over the differentiation or defensibil-
ity of these software-only offerings, beyond simply out-scaling and out-deploying competitors. To this end, a well-defined path to profitability is currently proving elusive for many TaaS startups.

**EVs, Charging & Infrastructure**

Beyond software platforms and mobility services, the last year has seen significant investment in hardware and scaling EV charging infrastructure. Companies such as ChargePoint have received large amounts of venture capital to grow charging networks globally, with the US leader now expanding into Europe. Due to the expensive nature of installing this extensive infrastructure, companies appear to remain focused on the long-term opportunities within the sector, with a strategy to secure future market share rather than short-term profitability and revenue growth.

Although ChargePoint is primarily focused upon charging hardware and infrastructure, there is also growing scope for an integrated hardware/software offering such that eMotorWerks offers. By integrating fast home charging and a demand management software platform, the company offers an integrated solution that will scale across the transportation sector, as well as across the smart grid and smart home. This type of vertical, full-stack business model allows for multiple avenues of application and engagement, and could also help capture future revenue with synergistic developments in areas such as smart home and smart grid integration.

**MARKET DYNAMICS**

Corporate participation in transportation rounds has increased, with Daimler participating in ten rounds focused on transportation sector companies (including ChargePoint’s $82 million funding round). Other vehicle OEMs who have invested include BMW i Ventures and GM Ventures.

As well as these traditionally transportation-focused CVCs, corporates from other areas of the market are also moving into transportation. For example, Intel Capital has invested in computer vision startup AEye, in addition to Intel’s bold statement of strategic intent through its acquisition of Mobileye. Tencent Technology has invested in Ola, Lilium, Go-Jek, Tesla and Mobike. However, the largest corporate investor in transportation – and in many other sectors – is SoftBank, which has swiftly deployed its $93 billion Vision Fund for companies such as Nauto, Brain Corp, OSIsoft, 99 Taxis, and Didi Chuxing (itself an investor in Go-Jek).

Traditional VC players are also increasingly active in this space. In 2017, New Enterprise Associates made six investments in the Transportation & Logistics sector, including ClearMetal, Drive.ai, and Echo- dyne. Accel Partners participated in five rounds, including DeepMap and Transit. DCM Ventures, Grishin Robotics, Andreessen Horowitz, Shunwei Capital Partners, and Sequoia all took part in four investment rounds. Sector-specific VCs are beginning to appear as well, such as Fontinalis Partners and Autotech Ventures in the US, Israel-based Maniv Mobility, and France-based NEoT Capital.

Another key trend is the growing presence of Chinese investors in the sector. For example, Hillhouse Capital, Didi Chuxing, and Shunwei Capital Partners all participated in multiple investment rounds throughout 2017, including investment in GCT100 alumni such as electric vehicle manufacturer, NIO. This growing momentum within this sector in the Asia Pacific region has played an important part in the overall rising APAC impact on venture investment, representing over 50% of all APAC deals in the third quarter of 2017, and 69% of total sectoral dollars invested.

**CHALLENGES AND OPPORTUNITIES**

One of the main challenges of the Transportation & Logistics sector are the risky, over-sized venture funding rounds aimed at helping companies scale at speed. Too much influx of venture capital can lead to equity dilution and unwieldy cap tables. In turn, this can lead to potential pitfalls at later stages of development for companies and investors aiming for an eventually profitable exit. Generally, companies with sky-high valuations and negative profit margins are taking a high-risk/high-reward growth strategy.

The opportunities in the sector revolve around several convergent technological trends reaching market. Autonomous fleets, driven by advances in AI and computer vision, will impact how consumers travel, as well as how travel is integrated into wider society. Many of these developments are applicable to other sectors, with synergies and intersections continuing to appear and create further value.

Some comment by our Expert Panelists include:

**Expert Panel Commentary**

- Does having a large network become increasingly valuable as adoption increases over the next 15 years? Although I am positive, this remains a long play...
- It’s a competitive product
- Difficult to combine with strong market traction and a very steep sales curve
- The management team is strong, which includes their capability to raise funds necessary to roll out infrastructure
- Is there a tangible first mover advantage in the EV charging market?
As EVs grow in number, the ability to allow utilities to effectively control when and how fast they charge can become a very big part of demand management.

As everyone else focuses on autonomous driving, this technology focuses on where the money is today, in making fleet vehicles safer, more efficient and cheaper to insure.

Massive GHG emission reductions; very large potential markets.

**BEYOND THE 100**

Beyond the GCT100 companies themselves, there are several trends that are growing in importance, and will likely have significant impact in the near future.

LiDAR and computer vision technologies look set to play an important part in autonomous vehicles, with companies such as Velodyne LiDAR leading the pack. Beyond transportation, 3D mobile mapping tools will be broadly applicable across other verticals, including monitoring of energy assets. Issues remain over LiDAR unit costs, but competition is being fomented by new entrants into the market such as JingChi, Algolux, and Strobe (which was recently acquired by GM-owned startup Cruise Automation). This should lead to the reduction of production cost in the next few years.

Smart city integration is an area of interest for both public municipalities and private investors, and startups collecting a range of data for it are well positioned for future growth. For example, StreetLight Data has developed a suite of tools for location analytics and transportation optimization on mobile applications, with an eye to expand into other verticals in the future. Other recently funded startups participating in the aggregation of transportation and city-level data integration include Vivacity Labs and Remix.

Lastly, freight and logistics has long been a sub-sector ripe for disruption via software platforms. In 2017, we have tracked over 30 deals related to freight logistics, with over $700 million invested. Flexport is a leader in this sub-sector, and with recent backing from DST Global to the tune of $110 million, further expansion is expected. Whereas many hardware players are looking to become more agile by integrating with software-based platforms, Flexport has the opportunity to leverage the freight experience of DST and transition from a pureplay route logistics company into a physical freight company. Other software-based logistics platforms of note include Guiyang, HuoCheBang, Convoy, Turvo, and InMotion Global.
Appendix 1: Global Cleantech 100 FAQs & Methodology

Who can qualify for the annual Global Cleantech 100 list?
Any independent, for-profit cleantech company that is not listed on any major stock exchange, or is not a majority-owned subsidiary of another company.

What is considered cleantech?
CTG uses more than 1000 unique identifiers to classify companies in important areas of innovation, organized by 6 industrial sectors, and by a further 18 primary technology categories. To see how our coverage is broken down, see below and please visit https://i3connect.com/tags

Who can nominate for this award?
Nominations are open to any market participant through the Global Cleantech 100 website https://i3connect.com/gct100/nominate and on www.i3connect.com. Those interested in taking part in the process are asked to nominate a minimum of three qualifying companies and a maximum of nine. Nominations must adhere to the ‘Lust List principle’ – meaning if you nominate your own company (or one you are part owner of) you must nominate at least two others that you admire (with which you have no association).

How can I increase my chances of being a Global Cleantech 100 company?
Cleantech Group, according to its methodology, pulls from a number of public sources and expert panel opinion. We encourage cleantech companies to create or update their profile on www.i3connect.com to ensure we have not missed any important public data. We pride ourselves on this list coming out of a robust system, and not a “popularity contest,” so getting all of your friends and family to nominate you will not give you better odds.

Where can I find more information about the Global Cleantech 100 companies?
More in-depth profiles, additional stats and analysis, and the latest updates on the Global Cleantech 100 companies can be found on https://i3connect.com/gct100/the-list

How does the list come together?
Cleantech Group has designed the Global Cleantech 100 to achieve two unique objectives that distinguish it from other lists: the list offers a fair representation of global innovation and private company creation, and it is not our editorial voice, but the collective opinion of hundreds of individuals within the wider global cleantech innovation community. The question we are seeking to answer is: According to the world’s cleantech community, which 100 of today’s private cleantech companies are the most likely to make the most significant market impact over the next 5-10 years? We answer this question in four phases, only allowing independent, for-profit, cleantech companies that are not listed on any major stock exchange to qualify for consideration.
PHASE I: NOMINATIONS

Nominations come from 4 sources:

1. Public nominations submitted by Cleantech Group’s network and other market participants.

2. Collection of nominations derived from 250+ third party awards and other rankings where expert assessment has already been applied.

3. Passive nominations from data in i3, based primarily on investment history (venture backing, grants, project financing, etc.) and significant commercial partnerships (e.g. channel partnerships, technology development partnerships, or pure customer/supplier relationships).

4. Nominations from the expert panel, adhering to the “lust list principle” before the voting process in Phase III. This means that if you nominate your own company (or one you are part owner of), you must nominate at least two others that you admire (with which you have no association).

This year, 12,300 companies were nominated, which was then filtered by a scoring system to a short list of 312 companies for consideration by our expert panel.
PHASE II: SCORING
The scoring system rewards companies that have multiple validations across multiple sources, to align with our objective to synthesize and represent collective opinion. Therefore, a company that has completed numerous market transactions (tracked through i3connect.com), been nominated by multiple people in the market—both publicly and within our expert panel—and appeared in third-party rankings, will tend to score better under our methodology than a hidden gem that few know about and vote for.

PHASE III: EXPERT PANEL VOTING
The 86 expert panelists evaluated the 312 shortlisted companies based on the following three criteria:
1. Innovation (the problem it solves; uniqueness; sustainability of advantage, etc.)
2. Market (accessibility, size, growth dynamics, barriers to entry, etc.)
3. Ability to execute (finances, team competencies, connections and networks, etc.)

The expert panel could vote positively OR negatively for up to 50 companies in the shortlist and were invited to provide commentary.

PHASE IV: THE FINAL 100
A combination of data from Phase I and Phase III are pooled together, and adjusted as much as possible for geographic or other biases. Companies with the greatest number of points overall made it to the final 100.
Appendix 2: Expert Panel

For individual biographies of our Expert Panelists, please see our website: https://i3connect.com/gct100/panelist

Laura Nereng, Sustainability and Business Development Leader, 3M
Grant Allen, Managing Director, ABB Technology Ventures
Rajesh Atluru, Managing Director, Activate Capital
Alex Betts, Managing Partner, Adaxia Capital Partners
Nathaniel Gorence, Technology-to-Market Advisor, ARPA-E
Greg Fleming, Investment Director, Air Liquide (ALIAD)
Kevin Eggers, Principal, Market Development, Anglo American Platinum
Fabio Lancellotti, Partner, Aster Capital
Nicola Büsse, Partnering & Venturing, Audi Business Innovation
Björn Heinz, Investment Manager, BASF Venture Capital
Tony Van Bommel, Senior Managing Partner, ICE Fund, BDC Capital
Christian Noske, Partner, BMW i Ventures
Yann Lagalaye, Head of Energy Transition Capital, BNP Paribas
Meghan Sharp, Managing Director, Americas, BP Ventures
Mark Austin, Venture Partner, Bright Capital
Danny Kennedy, Managing Director, CalCEF
Ludwig Goris, Investment Manager, Capricorn Venture Partners
David Aitken, Head of Incubation, Carbon Trust
Alla Jezmir, Vice President, CCM Energy
Christophe Defert, Innovation Director – Ventures, Centrica
Wal van Lierop, President & CEO, Chrysalix Venture Capital
Jamie Butterworth, Partner, Circularity Capital
Richard Youngman, CEO, Cleantech Group
Peter Kennedy, Managing Director, CLSA Capital Partners
Andrée-Lise Méthot, Founder and Managing Partner, Cycle Capital Management
Nancy Pfund, Managing Partner, DBL Partners
Benjamin Wainstain, Partner Innovation, Demeter Partners
Kathleen Jurman, Technology Scout, Corporate Ventures and New Business Development, Dow Chemical
Konrad Augustin, Head of E.ON SCI US, E.ON
Paul-Josef Patt, Managing Partner & CEO, eCAPITAL Entrepreneurial Partners
Sasha Brown, Principal, Ecosystem Integrity Fund
Luís Manuel, Board Member, EDP Inovação
Gina Domanig, Managing Partner, Emerald Technology Ventures
Glenn Bijvoets, Innovation Officer, Eneco Group
Giovanni Tula, Head of Innovation & Sustainability, Enel Green Power
Appendix 2: Expert Panel – continued

Jeff Clark, Managing Partner, **Energy Innovation Capital**
Wally Hunter, Managing Director, **EnerTech Capital**
Hendrik Van Asbroeck, Director, Venture Capital, **Engie**
Fabrice Bienfait, Partner, **ETF Partners**
Marty Reed, Chief Executive Officer, **Evok Innovations**
Lutz Stoeber, Investment Director, **Evonik Venture Capital**
Dirk de Boever, Head of Investments, **Finindus**
John Marrow, Partner, **First Imagine! Ventures**
Chris Thomas, Founder and Partner, **Fontinalis Partners**
Daniel Hullah, Managing Director, **GE Ventures**
Colin Le Duc, Partner, **Generation Investment Management**
Jason Nolte, Investment Manager, **GM Ventures**
Eric Wang, Managing Partner, **GRC SinoGreen Fund**
Jamie James, Managing Partner, **Greensoil Investments**
Zohar Yinon, CEO, **Hagihon Company Ltd**
Dotan Borenstein, Business Development Manager, **Hutchison Kinrot**
Diego Diaz Pilas, Head of New Ventures, **Iberdrola**
Nityen Lal, Managing Director, **Icos Capital**

Nicolas Chaudron, Partner, **Idinvest Partners**
Christian Ehrenborg, Managing Director, **IKEA GreenTech**
Matias Torrellas, Portfolio Manager, **InnoEnergy**
Ivo Nêmejc, Investment Director, **Inven Capital**
Robert Trezona, Head of Cleantech, **IP Cleantech**
Matthieu van der Elst, Venture Capital Director, **Michelin Group**
Kevin Kuhn, Vice President, General Manager Silicon Valley Branch, **Mitsubishi Corporation (Americas)**
Martin Kröner, Managing Partner, **Munich Venture Partners**
Gerd Goette, Director, **next47**
Andrew Beebe, Managing Director, **Obvious Ventures**
Keith Gillard, General Partner, **Pangaea Ventures**
Tarun Kapoor, Expert Product Manager, Emerging Technologies, **PG&E**
Gabriel Kra, Managing Director, **Prelude Ventures**
Stephan Dolezalek, Managing Partner, **Resourcint Capital Partners**
Stefan den Doelder, Investment Director, **Robeco**
Aruna Subramanian, Senior Portfolio Manager, **SABIC Ventures**
Karthik Chandrasekar, Founder & CEO, **Sangam Ventures**
Wouter Jonk, Managing Partner, **SET Ventures**

Matt Maloney, Head of Energy & Resource Innovation, **Silicon Valley Bank**
Thierry Piret, Global Investment Strategy, Solvay Ventures, **Solvay Group**
Mark Bonnar, Managing Director, **Southern Cross Venture Partners**
Kurt Faulhaber, Partner, **Stafford Capital Partners**
Gareth Burns, General Manager, **Statoil Energy Ventures**
Paul Austin, Regional Director, **Sustainable Development Technology Canada**
Andreas Stubelius, Portfolio Manager, **Swedish Energy Agency**
Astorre Modena, Managing Partner, **Terra Venture Partners**
Timothy Wang, Principal, **The Westly Group**
François Badoual, CEO, **TOTAL Energy Ventures**
Kelsey Lynn Skinner, Director Technology Ventures, **Touchstone Innovations**
Steve Kloos, Partner, **True North Venture Partners**
Yuan Fang, Partner, **Tsing Capital**
Peter Auner, Partner, **VNT Management**
Paul Straub, Managing Partner & Co-Founder, **Wireframe Ventures**
Samer Salty, Managing Partner, **Zouk Capital**
### Appendix 3: The Global Cleantech 100 mini-profiles

#### Agriculture & Food

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AeroFarms</td>
<td>(United States) is a developer of aeroponic systems to grow leafy greens at high yield densities in urban ‘vertical farms’</td>
</tr>
<tr>
<td>AgriProtein</td>
<td>(South Africa) is a developer of an alternative protein feed product from organic waste</td>
</tr>
<tr>
<td>Benson Hill Biosystems</td>
<td>(United States) is a developer of biotechnology solutions to increase crop yields</td>
</tr>
<tr>
<td>Beyond Meat</td>
<td>(United States) is a developer of plant-based protein meat substitutes</td>
</tr>
<tr>
<td>Farmers Business Network</td>
<td>(United States) is a developer of a membership website for farmers to upload data and share information</td>
</tr>
<tr>
<td>Farmers Edge</td>
<td>(Canada) is a provider of independent data management and precision agriculture solutions for farms</td>
</tr>
<tr>
<td>Impossible Foods</td>
<td>(United States) is a developer and researcher of plant-based substances for the creation of meat replacement products</td>
</tr>
<tr>
<td>Plenty</td>
<td>(United States) is a developer of vertical farms that use AI, data analytics and IoT sensors to create high-yield, low-space and water agricultural systems</td>
</tr>
<tr>
<td>Ripple Foods</td>
<td>(United States) is a developer of a dairy free, plant-based milk alternative</td>
</tr>
<tr>
<td>Semios</td>
<td>(Canada) is a developer of precision crop management systems</td>
</tr>
<tr>
<td>Vestaron</td>
<td>(United States) is a designer of next-generation biopesticides from naturally occurring peptides</td>
</tr>
<tr>
<td>Ynsect</td>
<td>(France) is a developer of bioconversion solutions of organic resources by insects for feed and non-food applications</td>
</tr>
</tbody>
</table>

#### Energy & Power

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Microgrid Solutions</td>
<td>(United States) is a developer of energy storage systems in buildings by providing financing, consulting and management services for advanced microgrid energy technologies</td>
</tr>
<tr>
<td>Aledia</td>
<td>(France) is developer of 3D LEDs based on microwire GaN-on-silicon technology</td>
</tr>
<tr>
<td>AutoGrid Systems</td>
<td>(United States) is a provider of software and cloud-based services for utilities, grid operators and end users</td>
</tr>
<tr>
<td>Awesense</td>
<td>(Canada) is a provider of a platform that enables real-time monitoring and loss reduction within the distribution grid</td>
</tr>
<tr>
<td>Azuri Technologies</td>
<td>(United Kingdom) is a developer of solar power technology bringing power at scale to off-grid customers in rural emerging markets</td>
</tr>
<tr>
<td>BBOXX</td>
<td>(United Kingdom) is a provider of plug &amp; play solar systems from 3W to 5kW for off-grid and on-grid solutions</td>
</tr>
<tr>
<td>Blue Pillar</td>
<td>(United States) is a provider of digital energy asset management products and services</td>
</tr>
<tr>
<td>Carbon Lighthouse</td>
<td>(United States) is a provider of an actively managed energy service that helps commercial building owners and stakeholders reduce energy consumption and leverage renewable power</td>
</tr>
<tr>
<td>ecobee</td>
<td>(Canada) is a developer of wifi-enabled smart thermostats for residential and commercial applications to maximize comfort and savings</td>
</tr>
<tr>
<td>Enbala Power Networks</td>
<td>(Canada) is a provider of demand side energy management services through continuously connected electricity supply and demand management</td>
</tr>
<tr>
<td>Company</td>
<td>Description</td>
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<tr>
<td>-------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Enlighted (United States)</td>
<td>A provider of lighting control systems for energy management applications</td>
</tr>
<tr>
<td>Ferroamp (Sweden)</td>
<td>A developer of a smart grid inverter integrating PV and storage in a local DC microgrid</td>
</tr>
<tr>
<td>FirstFuel Software (United States)</td>
<td>A provider of commercial customer intelligence software for energy providers</td>
</tr>
<tr>
<td>FreeWire Technologies (United States)</td>
<td>A developer of intelligent energy delivery systems from second-life electric vehicle batteries</td>
</tr>
<tr>
<td>GaN Systems (Canada)</td>
<td>A developer of gallium nitride (GaN) technologies</td>
</tr>
<tr>
<td>Geli (United States)</td>
<td>A provider of software and business solutions for the design, automation, and management of energy storage systems</td>
</tr>
<tr>
<td>GlassPoint Solar (United States)</td>
<td>A manufacturer of solar steam generators for the oil and gas industry</td>
</tr>
<tr>
<td>Heliatek (Germany)</td>
<td>A developer and producer of organic photovoltaic solar films</td>
</tr>
<tr>
<td>Hydrogenious Technologies (Germany)</td>
<td>A developer of efficient hydrogen storage for multi-MWh energy storage systems in the form of Liquid Organic Hydrogen Carriers (LOHC)</td>
</tr>
<tr>
<td>Kinestral Technologies (United States)</td>
<td>A developer of energy efficient glass for commercial, residential, and automotive applications</td>
</tr>
<tr>
<td>Kiwigrid (Germany)</td>
<td>A developer and operator of an energy IoT platform and provides energy management solutions for residential, industry and utility</td>
</tr>
<tr>
<td>LO3 Energy (United States)</td>
<td>A developer, project coordinator, and originator of blockchain-based solutions for distributed energy, utilities and the computation sharing economy</td>
</tr>
<tr>
<td>M-KOPA Solar (Kenya)</td>
<td>A provider of pay-per-use solar charging systems</td>
</tr>
<tr>
<td>Mosaic (United States)</td>
<td>A developer of an online marketplace for community solar financing projects</td>
</tr>
<tr>
<td>Off Grid Electric (Tanzania)</td>
<td>A provider of energy services to individuals and communities who have limited, unreliable, or no grid access</td>
</tr>
<tr>
<td>ONZO (United Kingdom)</td>
<td>A developer of big data analytics for utilities</td>
</tr>
<tr>
<td>Opus One Solutions (Canada)</td>
<td>A developer of real time control and optimization solutions for electric system energy resources, including generation, storage, and electric vehicle resources</td>
</tr>
<tr>
<td>Powerhouse Dynamics (United States)</td>
<td>A developer of a cloud-based enterprise energy and asset management solution for restaurants, retailers, convenience stores, and other small commercial facilities</td>
</tr>
<tr>
<td>Primus Power (United States)</td>
<td>A provider of low cost, long life, and long duration energy storage systems</td>
</tr>
<tr>
<td>Renovate America (United States)</td>
<td>A provider of financing solutions for the adoption of renewable energy sources in commercial and domestic buildings</td>
</tr>
<tr>
<td>REstore (Belgium)</td>
<td>A developer of automated demand response solutions to balance the electricity grid and decarbonize the energy market</td>
</tr>
<tr>
<td>Simple Energy (United States)</td>
<td>A developer of a SaaS that offers a digital customer engagement program that brings value to customers while driving positive, measurable business outcomes for utilities</td>
</tr>
</tbody>
</table>
### Energy & Power — continued

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>Skeleton Technologies</strong> (Germany)</td>
<td>a developer and manufacturer of graphene ultracapacitor-based energy storage</td>
</tr>
<tr>
<td><strong>Sonnen</strong> (Germany)</td>
<td>a developer of intelligent lithium-ion storage systems including energy management and integration into virtual power plants</td>
</tr>
<tr>
<td><strong>Stem</strong> (United States)</td>
<td>a provider of energy optimization services that combines big data, predictive analytics and energy storage to reduce electricity costs for businesses</td>
</tr>
<tr>
<td><strong>Sunfire</strong> (Germany)</td>
<td>a provider of energy conversion technologies, including solid oxide fuel cells and renewable synthetic fuels (diesel, jet-A, SNG) based on solid oxide electrolyzers</td>
</tr>
<tr>
<td><strong>Sunverge Energy</strong> (United States)</td>
<td>a provider of intelligent energy storage systems comprising batteries, power electronics and multiple energy inputs controlled by software running in the cloud</td>
</tr>
<tr>
<td><strong>tado</strong> (Germany)</td>
<td>a software service provider that allows users to control their home heating and cooling systems from their smart phones</td>
</tr>
<tr>
<td><strong>TAE Technologies</strong> (United States)</td>
<td>a developer of nuclear fusion technology which can be applied to radioactive waste destruction</td>
</tr>
<tr>
<td><strong>Thermondo</strong> (Germany)</td>
<td>a provider of heat solutions that digitizes the process of HVAC exchange</td>
</tr>
</tbody>
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### Industrial & Manufacturing

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Actility</strong> (France)</td>
<td>a provider of products and services for machine-to-machine (M2M) and smart grid applications</td>
</tr>
<tr>
<td><strong>Airware</strong> (United States)</td>
<td>a developer of hardware, software and cloud solutions for commercial Unmanned Aerial Vehicles</td>
</tr>
<tr>
<td><strong>Carbon</strong> (United States)</td>
<td>a manufacturer and developer of 3D printers utilizing photosensitive resins and an ultraviolet projector for a Continuous Liquid Interface Production (CLIP) process</td>
</tr>
<tr>
<td><strong>Cosmo Tech</strong> (France)</td>
<td>a provider of software solutions that enable businesses to anticipate complex systems behavior and impact through dynamic scenarios</td>
</tr>
<tr>
<td><strong>Maana</strong> (United States)</td>
<td>a developer of an advanced analytics platform that uses big data insights to help solve complex operational challenges</td>
</tr>
<tr>
<td><strong>OSIsoft</strong> (United States)</td>
<td>a provider of a real-time data and event management software platform with applications to many industries, including power, utilities, government, data centers and industrial facilities</td>
</tr>
<tr>
<td><strong>Sigfox</strong> (France)</td>
<td>a developer of ultra-narrow band technology for Machine-to-Machine (M2M) communications and Internet of Things (IoT) applications</td>
</tr>
<tr>
<td><strong>SpaceTime Insight</strong> (United States)</td>
<td>a developer of situational intelligence applications for faster decisionmaking, using real-time visual analytics software to provide actionable insight from Big Data and the Internet of Things</td>
</tr>
</tbody>
</table>
### Materials & Chemicals

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arzeda (United States)</td>
<td>A developer of proprietary technology to create cell factories capable of industry-scale chemical production</td>
</tr>
<tr>
<td>Bolt Threads (United States)</td>
<td>A developer of proprietary technologies for the fabrication of textiles and engineered silk fibers from proteins found in nature</td>
</tr>
<tr>
<td>CarbonCure Technologies (Canada)</td>
<td>A producer of carbon-sequestering equipment for precast concrete production</td>
</tr>
<tr>
<td>E-Leather (United Kingdom)</td>
<td>A producer of engineered materials based on leather waste from the traditional leather industry</td>
</tr>
<tr>
<td>Enerkem (Canada)</td>
<td>A producer of biofuels and chemicals from municipal solid waste via a proprietary thermochemical process</td>
</tr>
<tr>
<td>FRX Polymers (United States)</td>
<td>A developer of a patent-protected, non-halogen, non-burning family of transparent high flow thermoplastics</td>
</tr>
<tr>
<td>Green Biologics (United Kingdom)</td>
<td>A developer of microbial fermentation and process technology to turn readily available waste and agricultural by-products into high value chemicals and fuels</td>
</tr>
<tr>
<td>Kebony (Norway)</td>
<td>A developer and manufacturer of sustainable hard wood created by modifying sustainably sourced soft wood</td>
</tr>
<tr>
<td>Modern Meadow (United States)</td>
<td>A developer of bioprinting, a technology that uses 3D printing to make leather</td>
</tr>
<tr>
<td>Newlight Technologies (United States)</td>
<td>A developer of polymerization technology to convert greenhouse gases to valuable biodegradable plastics</td>
</tr>
<tr>
<td>NuMat Technologies (United States)</td>
<td>A designer and deployer of environmental sensor networks</td>
</tr>
<tr>
<td>Terramera (Canada)</td>
<td>A developer of plant-based biopesticides and fertilizers to replace conventional chemical pesticides</td>
</tr>
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### Resources & Environment

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Aclima (United States)</td>
<td>A designer and deployer of environmental sensor networks</td>
</tr>
<tr>
<td>Axine Water Technologies (Canada)</td>
<td>A developer of a low-cost, chemical-free solution for treating high concentrations of complex, toxic organics and ammonia in industrial wastewater</td>
</tr>
<tr>
<td>Bayeco (China)</td>
<td>A provider of industrial pollution control solutions for the oil &amp; gas and chemical industries</td>
</tr>
<tr>
<td>Black Bear Carbon (Netherlands)</td>
<td>A producer of upcycled carbon black from end-of-life tires for re-use in tires, technical rubber goods, plastics, and coatings, with renewable energy produced as a byproduct</td>
</tr>
<tr>
<td>Enevo (Finland)</td>
<td>A provider of waste logistics solutions for smart cities</td>
</tr>
<tr>
<td>Enerkem</td>
<td>A producer of biotechnology to turn readily available waste and agricultural by-products into high value chemicals and fuels</td>
</tr>
<tr>
<td>Enerkem</td>
<td>A provider of asset recovery solutions for returned and excess inventory of retailers</td>
</tr>
<tr>
<td>Enerkem</td>
<td>A developer of sensor technology designed to bring operational efficiency to the mining industry by consolidating low concentration ores and reducing energy, water, and chemical inputs</td>
</tr>
<tr>
<td>Optoro (United States)</td>
<td>A developer of advanced geospatial data analytics and processing softwares</td>
</tr>
<tr>
<td>Orbital Insight (United States)</td>
<td>A developer of advanced geospatial data analytics and processing softwares</td>
</tr>
</tbody>
</table>
### Resources & Environment — continued

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organica Water</td>
<td>(Hungary) is a provider of Fixed-Bed Biofilm Activated Sludge (FBAS) wastewater treatment plants in urban and residential population centers</td>
</tr>
<tr>
<td>OxyMem</td>
<td>(Ireland) is a developer of ‘drop in’ aeration technology known as the Membrane Aerated Biofilm reactor (MABR) that increases the efficiency of wastewater treatment</td>
</tr>
<tr>
<td>Saltworks Technologies</td>
<td>(Canada) is a provider of an advanced water treatment for desalination, brine management and chemical recovery applications</td>
</tr>
<tr>
<td>Voltea</td>
<td>(Netherlands) is a developer of a scalable water desalination technology using membrane capacitive deionization (CapDI)</td>
</tr>
<tr>
<td>Winnow</td>
<td>(United Kingdom) is a developer of a sensor system designed to track and reduce food waste in the kitchen</td>
</tr>
</tbody>
</table>

### Transportation & Logistics

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>BlaBlaCar</td>
<td>(France) is a provider of an online car-pooling marketplace</td>
</tr>
<tr>
<td>ChargePoint</td>
<td>(United States) is a provider of electric vehicle (EV) charging solutions</td>
</tr>
<tr>
<td>Didi Chuxing</td>
<td>(China) is a provider of taxi-hailing and ride-sharing services</td>
</tr>
<tr>
<td>eMotorWerks</td>
<td>(United States) is a developer of software and hardware solutions to turn EV chargers into networked nodes of a cloud-connected, grid service platform</td>
</tr>
<tr>
<td>Gogoro</td>
<td>(Taiwan) is a developer of electric scooters and the necessary battery swapping infrastructure for their use</td>
</tr>
<tr>
<td>Lilium</td>
<td>(Germany) is a developer of a battery-powered, fan-propelled vertical takeoff and landing commuter aircraft</td>
</tr>
</tbody>
</table>
Cleantech Group benefits from the advice and support of some of the most active and leading organizations in this innovation ecosystem. Advisory Board memberships are reserved for only certain types of organizations. In particular, they are reserved for: those who put capital to work or enable the financing of sustainable innovation; the most involved, committed and influential players in the world of clean technology innovation; and for those who wish to be visible as such on the international stage.

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