Global Corporate Venturing Leadership Society

Leif Capital

Corporate Venturing and the Future of Energy

Q4 2018

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Global Corporate Venturing Leadership Society

GCV Leadership Society mission:

The GCV Leadership Society is for corporate venturing leaders and aims to be the pre-eminent provider of data, information, events and other services for the global corporate venturing community. The Society helps develop the corporate venturing leaders of the future.

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* Non-corporate venturers will have more limited access to the GCV Leadership Society unless authorised by its board.

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Leif Capital

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Global Corporate Venturing - Leadership Society

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On November 8th and 9th, we convened over two hundred corporate and financial VCs, CTOs, and start-ups at the Venture Houston conference to debate issues and showcase innovation in energy digitisation, advanced mobility, low carbon, cyber, robotics, cloud and smart chemistry. What better place to reflect on what happened in energy corporate venture capital in 2018 and look ahead to what might happen in 2019 than Houston, the world's capital of energy. So, here are six predictions. Please join us at Venture Houston 2019 to see if were right.

1. Data is not the new oil. It's the new energy efficiency.

Energy CVCs will continue to co-invest in digitisation and 'datafication' tools, and in industrial IoT. This is where operational efficiencies can be gained, safety increased and costs reduced. GCV's award for 'Energy-tech Corporate Venture Capital Investment of the Year' went to Maana, which describes itself as a "knowledge platform that accelerates knowledge discovery to increase profitability for industrial and oil & gas companies." (See page 14 for more information on the award and the runners-up too).

We expect that more CVCs from a wider range of industries (not just traditional energy) will be investing in companies that are following Maana's lead.

2. Low carbon is back. Clean-tech is no longer a dirty word.

The largest energy corporate VCs will invest further in low carbon and renewables. US CVCs will follow Europe's low carbon lead, irrespective of the US federal government's coolness on climate change and warmth / nostalgia for coal. Indeed, historians may look back at Chevron's and American

Electric Power's November participation in Chargepoint's $280m Series H round as the point at which mainstream US oil & gas accepted that the future of mobility was electric. Asian CVCs too are keen to decarbonise, particularly in transport.

Investments in renewable energy, including solar, wind and tidal have become popular again over the last years, due, in part, to advancements in other technologies they depend on. (See energy venturing 2018 review from page 27 below for information).

The calibre of low carbon companies presenting in Houston was very high, the best we've ever seen. (See 'Low carbon venturing: This time it's different. Is it?' from page 11 below).

3. "Batteries suck" (which is why there will be more investment in batteries)

In the robotics conference session, Houston Mechatronics CTO Nick Radford was asked by a delegate whether batteries limit the development of robotics. He replied succinctly: "Batteries suck". Robotics is not the only industry craving superior battery performance (automotive, mobile phones and utilities are front of the queue), which is one of the reasons why we predict that CVC venture investing in battery technologies will continue to increase in 2019 and beyond. Nick's frustrations notwithstanding, battery and energy storage tech have seen considerable breakthroughs that have made them cheaper. Battery cost went down from $1000 to about $200 per Kw/h from 2010 to 2016 and thus, made intermittent renewables more viable, both operationally and commercially. Electric mobility's impressive growth is also down to batteries' improvement.

Volkwagen's $100m September 2018 Series E investment in QuantumScape, a spinout from Stanford University whose tagline is "Solid-state Batteries That Work", will not be the last major CVC investment in battery-tech for advanced mobility. (QuantumScape was a runner-up for 'Energy-tech Corporate Venture Capital Investment of the Year' - See more information from page 21).

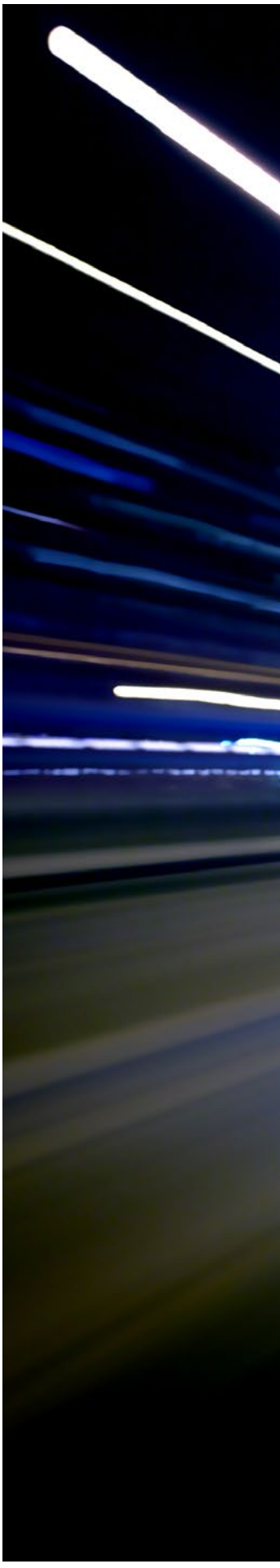
Callum Cyrus's excellent article on 'The challenge of battery tech investment' from page 16 sets out many of the challenges ahead.

4. Grid defection to revive venturing in modular generation

The growing trend of grid defection, which sees energy consumers (both industrial and domestic) use a combination of on-site renewables and storage to go off-grid, will not only increase battery venturing. It will also lead to an investment revival in new, cleaner (but still hydrocarbon-based) modular power generators.

EtaGen, a California-based "linear generator" raised $83m in January 2018 in a Series C round which included American Electric Power, Centrica Innovations and Statoil Energy Ventures. We believe that more such innovative generators will raise venture capital in 2019 and 2020.

The growing efficiency of storage (for example from Sonnen, the Germany-based 'virtual battery' which was shortlisted for 'Energy-tech Corporate Venture Capital Investment of the Year') is impressive. By supplying unwanted domestically-generated electricity to the grid as balancing power, it is becoming a virtual utility. But Sonnen and other energy storage systems have their limitations. Currently, only hydrocarbon-based dispatchable power can provide the back-up that consumers require. Generators like EtaGen that produce no or very little



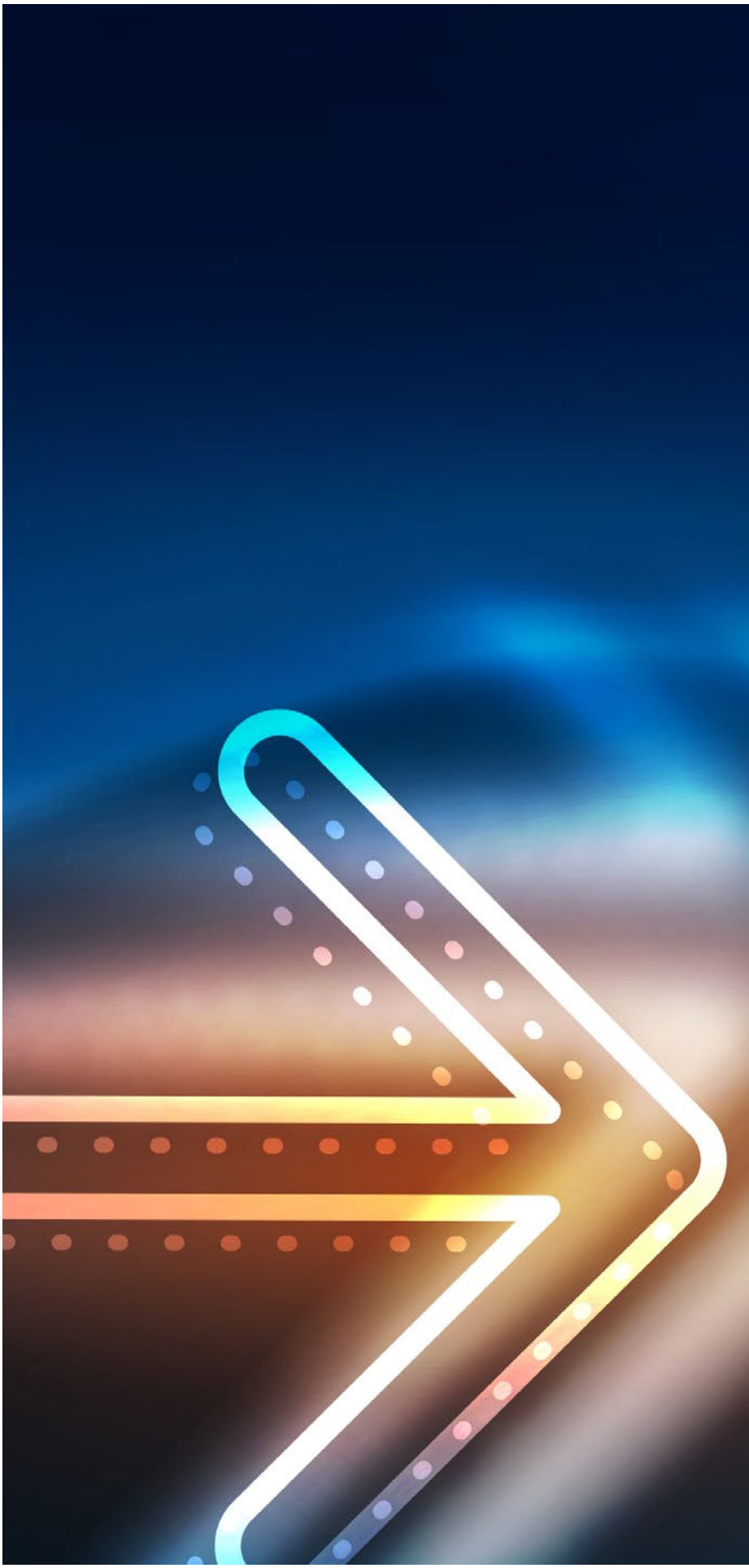
nitrous oxides, the pollutants increasingly targeted by cities authorities with mandates for clean air, will be at a premium.

5. Upstream European corporate venturing up creek without paddle?

One thing we barely spoke about at Venture Houston was drilling and other aspects of upstream innovation, which until recently dominated venturing at the oil & gas majors. Such is the desire among most of the energy CVCs to venture in low carbon, data / digitisation and advanced mobility, that upstream innovation in hardware is almost off their agendas. Upstream specialists in some corporate venturing teams are increasingly thin on the ground, crowded out by newly-recruited low carbon and electric vehicle colleagues. This creates an interesting vacuum that is being filled by financial VCs. We predict that upstream venturing will be increasingly led by specialist US financial VCs, who will be happy to see their CVC counterparts busy with other opportunities. Leaving them with some rich pickings perhaps.

6. Few exits, some internal collaborations

Energy CVCs are not expecting many exits in the near term, as they have increased their investment activity only recently (2017-18). Emerging energy businesses take more time to mature and the investment horizon in energy is longer than in, say, software. Rather than exits in 2019, we expect to see energy CVCs trying collaborations and joint ventures between their investments and their parent companies' new low carbon, advanced mobility and digital business units. Corporates will increasingly measure their venturing success according to the success of these collaborations. ■



Financial VC seeks more entrepreneurial challenge in corporate venturing.

Erin Hallock
BP Venturess

Erin Hallock, one of the founding members of the investor team at Business Growth Fund, a London-based private equity firm, has joined BP Ventures, becoming the eighteenth member of the ventures team (of whom ~40% is female). Erin was an external hire, having no prior employment with BP.

Far from seeing a move to a corporate VC as a conservative or 'corporate' career move, Erin is excited by the entrepreneurialism required in her new position and by the opportunity to create significant human and environmental impact. And having started her venture career in financial venture capital, she is well qualified to challenge the received wisdoms about corporate venture capital's oft-cited slowness in due diligence and deal execution.

1. How does it feel making the switch from a financially-focused investment company to a corporate VC?

It feels great. I was looking for a more entrepreneurial role and I've found it. My previous work in financial venture capital had become a little too institutionalised for my taste. The most exciting work for me to do today is being part of a growing team of incredibly smart people that are working with a global energy company to push into new frontiers and make sure that BP remains dynamic and relevant.

2. Some readers will be surprised to hear you say that corporate VC is more entrepreneurial than financial VC. Can you expand on this? What do you mean?

In my experience, corporate VC is faster, less dilutive and more strategic than financial VC. Myth number one is that corporates VCs are slower and less efficient in due diligence than financial VCs. They're not. At BP Ventures we have to engage with BP's business units to make investments. Unless they're supportive, we can't invest. This means that most due diligence is done in-house by deep technical, industry specialists. We don't need to employ external consultants, who know much less than our colleagues. This saves both time and money; money which would ultimately come from the portfolio company and would therefore be dilutive to the company founders.

3. But can you do deals faster than financial VCs?

Yes we can. Myth number two is that financial VCs are fast to execute deals and corporate VCs are slow and cumbersome. My experience is that it's quite the opposite. One deal I've been working on began in August and will close in early December – that's faster than anything I saw in private equity which took on average 12 months to complete. I think that is because we look at deals from two angles, financial and strategic, and when both are compelling the business units and ventures team really pull together in a way you don't see with a financial VC and external consultants.

Finally, I think the real differentiation is that corporate VCs can enable technology commercialisation in a way which is completely inaccessible to a financial VC. A recent example of this is Fulcrum BioEnergy, in which BP Ventures has invested, to support Fulcrum's drive to convert municipal solid waste into biojet fuel. The cost to commercialise this relatively nascent technology would likely outweigh the projected returns for many financial investors; however, by leveraging existing assets, skills and relationships through Air BP, the cost to commercialise Fulcrum is significantly lower than it would be for a financial VC.

4. What type of technology or solution are you looking forward to commercialising? What excites you most about the energy venturing opportunity?

My expertise is mostly commercial; in valuations, negotiations and in legal matters. I wouldn't describe myself as an energy specialist. But I am certainly excited by BP Ventures pushing the frontiers of new energy. All aspects of our investment strategy – from low carbon power to advanced mobility and digital – will have a lasting positive impact on our society and our future. The most exciting opportunity is to see new businesses really scale, to go beyond being interesting niche players, to become major new businesses.

5. Did you initially feel like an outsider at BP Ventures?

Not really. We are a team of people with pretty diverse skills and backgrounds and I find people recognise my commercial, private equity background. The BP Ventures team is highly collaborative and our relationship with the BP business units is dynamic. We're not in an ivory tower. The business units support both the origination of our deals and our due diligence. I really feel that venturing is increasingly part of the BP culture. Business units come to us as much as we go to them, to help access differentiated technologies and innovation. ■

Low carbon venturing
This time it's different. Is it?

Tom Whitehouse
Leif Capital

This time it's different – dangerous words. But the quality of the low/zero carbon technology start-ups on the agenda at 'Venture Houston' has got me excited.

I've not been excited about low carbon venturing for a while – about ten years to be exact. It was 2008 when the low carbon and clean-tech bubbles burst. I was there. We were going to change the world. Obscure oil-yielding laxative beans promised to undermine the oil and gas industry. That AIM-quoted clean-tech company whose CEO had a bad hair-cut and a part-time career as a film director had promised to end the internal combustion engine's reign of supremacy.

The legacy of irrational exuberance was a decade when low carbon technology all but ceased to be a venture proposition. Only a few die-hard specialist low carbon and clean-tech VCs survived. Corporate VCs dipped their toes in and out of low carbon waters. Impact investors were active on the fringes. The great improvements in the efficiency of solar and wind power were brought about mostly through manufacturing at scale (thank you China), not thanks to venturing.

Renewables have made great strides, but still have a long way to go if they are to start displacing hydrocarbons and do so soon enough to reduce greenhouse gas emissions. New technologies are required and venture capital is required for their fast commercialisation.

So, why am I excited now? What's changed? Looking at the Houston agenda and the companies that presented, I can see at least four reasons for rational excitement.

1. The CEOs of the low/zero carbon companies come from conventional energy industries as do their technologies.
2. They're working with large energy companies rather than against them.
3. The business models are aggressive but realistic.
4. No bad haircuts.

Here's a quick snapshot of just three of the venture-backed businesses who presented:

1. Inventys

Several carbon sequestration companies have failed. Vancouver-based Inventys could succeed because it is focused on costs. *"Inventys' technology can cause a step change in the economics of CO2 capture,"* says Dr. Pratima Rangarajan, CEO of OGCI Climate Investments, which announced its investment in Inventys in July this year. OGCI, a venture 'coalition' of energy companies that is backing low and zero carbon technologies, joins Chevron on the Inventys shareholder registry.

2. Szygy Plasmonics

Using recent advancements in physics and chemistry discovered at Rice University, Houston-based Syzygy is building a new type of chemical reactor. This reactor is powered by light instead of being powered by heat from burning fuel, which reduces GHG emissions. Their go-to-market reaction is low cost, low GHG hydrogen to help the fuel cell vehicle industry begin to compete with conventional vehicles.

3. Fervo Energy

San Francisco-based Fervo Energy intends to make geothermal power more accessible and lower cost by deploying technologies which were commercialised in the shale gas revolution. Fervo has raised money from Breakthrough Energy Ventures, an investment company set up by a coalition of the extremely wealthy, and is partnering with Schlumberger.

"We've gotten smarter about what it takes to be successful in this area."

Barbara Burger
Chevron

A fifth reason for excitement is simply that we're all ten years' older and, hopefully, therefore wiser. Technologies have advanced.

"We've watched this space for a long time and have played in some areas before," says Barbara Burger, President of Chevron Technology Ventures, who will give the Venture Houston opening keynote. *"That experience makes us better informed today. We've monitored the cost curves, the scaling opportunities and the impact of policies. So, it's not about us joining a new cycle. We simply believe that now is the right time to build on our*

Barbara Burger
Chevron

participation. And we've gotten smarter about what it takes to be successful in this area."

Chevron Technology Ventures recently announced a new 'Future Energy Fund'. *"It will be different than our earlier funds,"* says Barbara. *"It will be focused on technologies that enable emissions reduction in oil and gas operations as well as investments in technologies that may breakthrough or disrupt the energy vertical in the future."*

So much for the excitement. Here's one reason for scepticism: digital. The energy industry is still largely hydrocarbon and analogue. Huge efficiency gains are available from the great digital tweak set off by the collapse in oil prices. The oil and gas industry has taken another great stride forward in deploying technology – most of it digital – so that it can survive and prosper in a low oil price environment. Renewables must anticipate, and compete with, oil and gas at lower prices.

Ten years ago, a lot of venture investors lost a lot of money on magic beans and other dreams. But this time it's different. Is it? ■

Maana Wins GCV award

The winner of Global Corporate Venturing's inaugural award for 'Energy-tech Corporate Venture Capital (CVC) Investment of the Year' was announced at a gala dinner on November 8 during the Venture Houston conference. The winner of the award was Maana, a US-based company which describes itself as a "knowledge platform that accelerates knowledge discovery to increase profitability for industrial and oil & gas companies."

In February 2018, the company raised over $33.2m of series C funding in a deal which included corporate venturing divisions Intel Capital, GE Ventures, Chevron Technology Ventures, Saudi Aramco Energy Ventures, Shell Technology Ventures and Accenture Ventures, as well as China International Capital Corporation. Maana CEO Babur Ozen collected the award.

The award celebrates the role of CVC in furthering three crucial energy trends:

- widening the group of industries participating in the transformation of energy.
- extending the geographic reach of new energy-relevant technology.
- accelerating the uptake of new energy-relevant technology by large corporations.

The runners-up were (in alphabetical order):

QuantumScape

Founded in 2010 as a spinout from Stanford University, QuantumScape's tagline is "Solid-state Batteries That Work". The Company's batteries use solid electrolytes rather than liquid or polymer electrolytes utilised in the vast majority of batteries today, thereby potentially extending the range of electric vehicles and creating new opportunities in energy storage. In September 2018 the company received $100m of series E financing from Volkswagen.

Sarcos Robotics

Sarcos, which is based in Utah and was founded in 1983, is building dexterous robots using proprietary actuation, sensor, and control technology that can be used to help conduct tasks in remote or hazardous environments in the energy, aerospace, mining and maritime industries. In October 2018, the company raised $30m of series B venture funding in a deal which included Caterpillar Ventures, GE Ventures, Microsoft and Schlumberger Technology Investments.

Sonnen

Sonnen, previously known as Sonnenbatterie, is a Germany-based pioneer in solar-based energy storage system. In June 2018, the company raised €60m of series E funding in a deal which was led by Shell Ventures. Sonnen also counts GE Ventures and Inven Capital (the venture unit of the main Czech utility) among its corporate backers.

Xpansiv

Based in California and founded in 2016. Xpansiv has developed commodity digitisation platform which combines big data with distributed ledger technology to create 'Digital Feedstock', thereby enabling the demonstration and validation of commodities' provenance. In September 2018, the Company announced a series A round which included BP Ventures and S&P Global. The announcement followed Xpansiv's partnership with CBL Markets, a spot exchange for environmental commodities. ■

The future of energy: Different horses for different courses

Kaloyan Andonov
Global Corporate Venturing

Kaloyan Andonov of GCV spoke to Geert van de Wouw, vice-president at Shell Ventures, the venturing subsidiary of Anglo-Dutch oil and gas major Shell about the future of energy and how the rebranded venturing arm under his command tackles it.

A year ago, Tom Whitehouse and I interviewed Geert van de Wouw about Shell's venturing unit (back then still dubbed Shell Technology Ventures) and the technological challenges for the industry, in light of falling oil prices and damages from hurricane Harvey. In the interview, van de Wouw commented on the future of energy: *"The oil and gas industry does not need to be saved. Fossil fuels are here [to stay] for decades. Today, electricity accounts for only 20% of total energy demand. This will increase with the electrification of our societies, including auto-mobility, but still the fact is that hydrocarbons are a part of the future, whether people like it or not."*

That statement struck me as a rather bold one in a time when many only like to talk about a carbon-free future of the planet when in polite company. With the impending massification of electric vehicles and battery technologies becoming more efficient, I could not help but ask him if his position has changed. *"Well, I do not change my mind and my position so quickly and easily,"* he said and laughed.

"We have got emerging solutions in electric mobility, penetrating the customer segment, biofuels being increasingly commercialised and an ever more convincing case for hydrogen as

an energy carrier for long-term storage and long-haul trucking, along with developments in solar and wind energy. There is certainly going to be quite a mosaic of energy sources available and I think they will co-exist and be used each for a specific purpose. Different horses for different courses."

One thing that has changed, however, is the brand name of the venturing unit van de Wouw heads. *"The rebranding is quite easy to explain. We have been doing investing in business model innovation rather than strictly technologies, as the old name implied. People would just get very confused as our mandate expanded and the name implied a focus on technology only."*

Van de Wouw has also been expanding the team significantly since the beginning of 2017. Currently, Shell Ventures has six offices across different relevant geographies – three in the US (Houston, Boston and San Francisco) with teams of three to five people in each, in addition to the unit's offices in London, Shanghai and Amsterdam, where Van De Wouw himself is based, alongside his CFO Robert Linck.

"In terms of finding talent for our venturing unit, we doubled the size of the team since the beginning of 2017 and there has been no shortage of excellent professionals applying to work at Shell Ventures. Many of them come from outside the company [Shell], from corporate venturing units, financial VC's or private equity firms, bringing their unique external perspectives to Shell Ventures." Van de Wouw also added: *"I believe this is thanks to our reputation as a professional and faithful co-investor, which we have been building over the years. The combination between these seasoned VC professionals and the people in my team that know Shell from the inside has proven to be very effective."*

However, pressed by the need to diversify his team, he said: *"Diversity of thought is very important to any professional venture capital unit. Through challenging each other's deals, we avoid deal-bias and sharpen our decision making. While at Shell Ventures we already have diversity in terms of geographic and cultural backgrounds, we would like to do better in terms of gender diversity. However, what we found quite difficult in the recruitment process was finding experienced female talent in the Venture Capital ecosystem, which is – unfortunately – still very male-dominated. So, I would like to use your magazine as a platform and say that if there are women working in venture capital interested in working for Shell, they should contact me. With closing 22 deals last year, we are one of the most active and diversified corporate investors in the Energy industry and otherwise a very diverse and fun team to work in".*

Geert van de Wouw
Shell Ventures

Although most of the top 50 corporate venture investors have women in their senior investment ranks, there is still much work to be done to bolster diversity throughout the corporate venture capital community and beyond. Van de Wouw recognised it and added: *"I therefore fully embraced and supported the initiative taken by Wendell Brooks, President of Intel Capital during the 2018 GCVI Summit, when he called us out to hire and mentor the best and the brightest women and under-represented minorities as part of our growth plans".*

> *In many ways, China is at the forefront of electric and autonomous mobility, EV charging, battery swapping and new mobility concepts.*
>
> Geert van de Wouw
> Shell Ventures

When asked about China and the rising innovation scene there, Van De Wouw said: *"Shell Ventures sees investment opportunities in China in areas like the future of mobility and the scaling of new solar and battery technologies. In*

many ways, China is at the forefront of electric and autonomous mobility, EV charging, battery swapping and new mobility concepts. With Shell's downstream businesses, for example, we made a minority investment in HuiBao, an automotive e-commerce platform that links insurance companies with the insured, offering a range of aftermarket product and service from car maintenance, financing and auto parts."

This type of investments is obviously done strategically – to explore new sales channels, as China is one of Shell's largest growth markets for lubricants. And this is not the only such business model that Shell Ventures has invested in with the lubricants business: US-based online marketplace for auto services and repair Openbay is another investment of this kind and so is the UK-based WhoCanFixMyCar.com, a platform that helps customers compare prices and reputation of garages and mechanics, with over 8,500 repair shops registered.

Asia Pacific is undoubtedly one of the most interesting innovation regions for Shell Ventures. Aside from China, van de Wouw also speaks fondly of countries like India and Singapore: *"We have, for example, committed capital to Singapore-based solar power utility and retailer Sunseap."* Sunseap operates solar energy systems, providing renewable power to its clients through solar farms. The company is also working on an energy management platform and is looking into the use of batteries and floating solar.

Another country from the Asia Pacific region, the Philippines, will be the launching pad for one of Shell's soon-to-be-revealed logistics and supply chain spinoffs dubbed Connected Freight. *"The startup from our Digital Businesses unit uses Tiramizoo's software platform to remove inefficiency in the inner-city freight movement through the optimisation of goods delivery: allowing dispatchers and logistics companies to share loads, minimise paperwork and optimise their routes. The team is based in the region and is looking to bring expansion to Singapore, multiple cities in the Philippines and across Asia Pacific."*

With a global focus geographically, Shell Ventures and its investment thesis has undergone a notable transformation over the years. As van de Wouw put it: *"We relaunched Shell Ventures back in 2012 as concentrated primarily on core oil and gas technologies. Two years later we began looking at renewable energy technologies and in 2016 we started to include novel business models in the renewable power domain. In 2017, we further expanded our scope to include business models and technologies in the Future of Mobility space. A good example of that is our recent investment in Ample, a rapidly deployable EV battery charging solution proposition from California for operators of electric fleets, allowing slow charging and 24/7 availability of battery powered vehicles. To achieve this, Ample uses autonomous robotics and smart-battery technology."*

Ample is not the only commitment of Shell's in this space. NewMotion, a Netherlands-based EV charging station operator backed by vehicle distributor AutoBinck,

was acquired by Shell for an undisclosed amount. Founded in 2009, NewMotion enables EV owners to charge their cars at more than 80,000 charging points across several countries.

Shell Ventures support for providing more and cleaner energy has gone global. This includes investing on behalf of Shell's Energy Access business to back distributed power startups which bring renewable energy resources to under-served regions in Asia and Africa. A case in point is Husk Power Systems, a rural distributed utility company that installs and operates hybrid solar PV and biomass mini-grids in Tanzania and India.

Despite the broader investment mandate, Shell Ventures does not betray its core oil and gas realm. In March 2017, Shell spun out Salamander Solutions, a cable-based heater systems developer which can bring electric heat over very long distances exceeding 10km. For the oil and gas operations, it provides functions such as enhanced oil recovery of heavy oil wells or stopping the plugging of wells and flowlines that produce high amounts of wax, hydrates or other types of scaling. Van de Wouw described it as nothing less than *"the largest IP portfolio Shell has ever spun out"*.

The technology is essentially an enhancer of the viscosity in heavy oil wells, which has shown in test wells to improve 5 times the flow of oil. The solution also has applications in deep-water developments. Van de Wouw described it as *"reel-able and very easy to install through conventional methods"*. He also commented on investments and initiatives in the oil and gas realm in general as mainly geared to drive *"cost reduction and the environmental impact of reducing CO2 and methane emissions"*.

When it comes to new energy sources, van de Wouw said Shell Ventures is looking to back technologies and businesses models that would *"give Shell competitive edge on solar and offshore wind, whether in terms of technologies or business models". "This includes propositions on the customer side that can help Shell's power traders to reach more customers."* Indeed, there has been no shortage of investments. Earlier this year, Shell Solar acquired a stake US-based Silicon Ranch – a developer, owner, and operator of solar energy plants. Germany-based solar energy storage system developer Sonnen (formerly Sonnenbaterie) raised a €60m round that was led by Shell Ventures in May.

Another portfolio company, Innowatts, has built a software platform that uses data generated from more than 12 million smart meters to measure and analyse energy consumption, helping users optimise costs, forecast energy use patterns and create specialised energy products or services across the value chain.

Van de Wouw stressed that, despite being a strategic investor in SMEs, Shell Ventures runs very much like a financially-oriented one and seeks to help startups – and their VC backers – generate a financial return: *"We need to be very conscious that a profitable exit is the only way in which a financial VC makes money. This is an area where corporate VCs can struggle, as their investments tend to be more strategically motivated, where the value comes from deployment economics or an acquisition. With the ever-changing strategies at corporates, the relevance of a portfolio company may lessen and follow-on funding may stop, even when it should be warranted based on the startup's financial performance. The best way we, corporate VCs, can secure quality deal flow from our VC partners is by being 100% aligned with them on maximising exit proceeds and proving to be a predictable and consistent co-investor."*

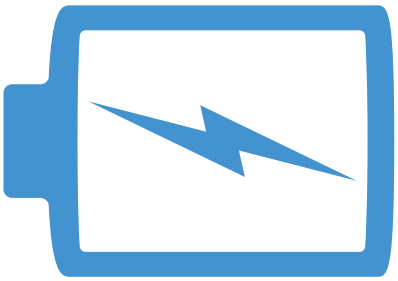
In addition to supplying startups with funding, van de Wouw explains how such startups get connected with the corporate

parents for business: *"We have implementation managers in our team, who help those new companies to connect with various divisions, projects and business units of Shell, which eventually helps them become our partners or suppliers."* This integration into the corporate parent's ecosystem also generates traction to attract other investors and enhance revenue prospects for the company. *"The new energy domain depends heavily on new technologies and business models for its growth. As this domain is growing, so is Shell's interest in these ideas as well. So, cooperating with those startups and making them part of our ecosystem is something quite natural."*

Does this mean some of those promising emerging companies are potential M&A targets, however? While not ruling out that possibility, van de Wouw spoke mostly of striking strategic partnerships and collaborating with them: *"We usually aim to help them go past the "valley of death" and become one of our suppliers or forge a relationship which can be a building block for growth in one of our businesses."* He also underscored that in cases of potential acquisitions by the corporate parent, Shell Ventures follows and fulfils strictly its fiduciary duties, properly separating company interests from Shell´s interests. *"Having proper information barriers in place, i.e "Chinese walls", is paramount. Access to Shell Ventures' IT systems, for example, is restricted to Shell Ventures personnel and separated from the rest of Shell in order to prevent leakage of competitively sensitive information. Furthermore, we separate board director roles from board observer roles. We regularly take both types of roles in a startup's board. While director roles are typically taken by Shell Ventures' personnel, we sometimes pick a Shell retiree or an independent domain expert to serve as board director on our behalf."*

With expanded mandate, Shell Ventures has also taken limited partnerships (LP) stakes in funds, currently holding eight such stakes: Autotech Ventures, specialising in early & growth-stage transport technology; Congruent Ventures, concentrating on early stage investments across hardware, software, enterprise, consumer, deep technology, fintech and business model innovation; Energy Ventures – specialising in growth-stage oil and gas companies; G2VP, focused on transport, manufacturing, energy, agriculture and logistics; GRC SinoGreen Fund III – a China-based fund focused on renewables and green technologies; SET Ventures – a Netherlands-based fund focused on renewables; ProVentures – a US/Norway-based fund; and Chrysalix, focused on high-growth energy companies. In addition, it also supports incubator program Greentown Labs in the US and Shell's own incubation program E4 in India. The E4 incubator was launched in October 2017 at Shell's research centre in Bangalore to attract the best Indian entrepreneurs from the energy domain.

Much like in other corporate VCs, Shell Ventures´ investments in new funds give it a great outlook on various innovations scenes: *"We are constantly looking to invest in new and interesting funds that would give us an extended view in a certain geography or industry or lead us to new co-investment opportunities."* It is hardly surprising that Shell Ventures has, in some cases, co-invested with the venture funds it holds an LP stake in. For example, it committed capital to Kespry – a data analysis tool for industrial drones, which was also backed by G2VP and it co-invested in Bluware with Energy Ventures. Shell Ventures will undoubtedly continue to make direct and indirect venture investments for the rising multifaceted future of energy. ■



The challenge of battery tech investment

Callum Cyrus
Global Corporate Venturing

A range of new materials and technologies could yield vastly improved batteries for purposes including electric vehicles and grid storage.

Improved battery technology has the potential to improve a range of applications, from the flexibility of our power grids, to the durability of consumer electronic devices and functionality of next-generation electric vehicles.

To understand the appeal, it is best to understand how today's batteries work. Most are constructed with an alkaline metal called lithium, favoured for its ability to store large quantities of electricity. Power is produced when a device is connected to the battery terminals – the cathode and the anode – allowing lithium ions to flow through a liquid electrolyte inside the battery. But electrolytes can also be a potential safety hazard – if too much heat is generated in the solution, the battery can ignite.

This has already caused problems for consumer electronics producer Samsung, which was forced to recall its Note7 smartphone after handsets began bursting into flames.

Safety, then, is a major driver for corporate venturing investment in new battery technologies, but there are others. Capacity is a concern as applications become more demanding. Consumers yearn for smartphones that last for weeks rather than hours, while electric vehicles must operate over distances similar to those of conventional vehicles if they are to secure widespread adoption.

The changing nature of the energy mix itself is also a factor, in addition to the need for

Keith Gillard
Pangea Ventures

better performance from grid storage units. Growing roles for intermittent renewable inputs such as wind and solar as well as electricity produced by households are big CVC drivers, in addition to the growing number of electricity customers globally.

The challenge

Depending on the application, a host of materials and innovations could fundamentally change how batteries are manufactured. These range from simple supercapacitors intended to sustain minute power requirements over longer periods, to paper-based designs offering a biodegradable option in challenging operational environments.

But some are sceptical such innovations can be translated into commercial success, and there is a sense that it has been a struggle to monetise new battery technologies.

According to GCV Analytics, the value of corporate-backed deals for battery-related technologies has varied year to year, slumping to $93m in 2016 from $415m in 2015 before recovering to $625m in 2017 and $288m so far in 2018.

Keith Gillard, general partner at advanced materials-focused and corporate-backed VC fund Pangea Ventures, said the battery segment remained a *"challenging space" associated with incremental gains and "less venture dollars".*

He added: *"Batteries are always a high percentage of our new dealflow every month but it would take a truly exceptional opportunity for us to invest in another battery company."*

Pangea Ventures is backed by an array of corporate investors, including oil company BP, chemicals conglomerate BASF and Samsung Venture Investment, a corporate venturing arm of the consumer electronics producer.

The fund, whose investment purview takes in advanced materials and chemicals, has now sold its position in three battery developers – electric car battery manufacturer Envia Systems, carbon nanotube producer Cnano Technology and performance additive developer Boulder Ionics.

Pangea had tried to compartmentalise its investments around different elements of battery design, according to Gillard. Envia and Boulder Ionics, for instance, offered insights into improving cathode or anode materials and electrolytes respectively.

Consumer electronics and electric vehicles

Consumer devices, such as smartphones and tablets, have proliferated, each new release arriving with more advanced processing specs that often drain the battery faster. Replacing or augmenting conventional battery technology is therefore a valuable proposition in the consumer space, and there is also clear CVC incentive for improvements which support the transition to electric vehicles.

While electric cars have increased in popularity in recent years for their ability to reduce greenhouse gas emissions, the limitations of current lithium-ion batteries frustrate their ability to supplant conventional automotive technology on a grander scale.

Electric vehicle batteries still do not offer enough mileage to satisfy the most demanding of motorists, and many are unlikely to accept recharging times causing disruption to a journey. Safety, again, is an absolute must, as is pricing, which must be affordable enough to lure users from petrol.

Gillard said the ideal battery for electric vehicle applications should possess strong energy-to-weight ratio and be capable of delivering multiple currents and voltages

without using a transformer, which steps voltages up and down between circuits.

One of the sector's most promising technologies involves replacing flammable liquid electrolytes with a solid material such as polymer or ceramic, in what is known as a solid-state battery (SSB).

The size of the prize means automotive firms are willing to plough resources into pursuing a solid-state breakthrough, either through venturing or through in-house R&D programs and industry partnerships.

Frank Blome, head of carmaker Volkswagen's centre for excellence for battery cells, said: "The solid-state-battery can be a real game-changer in the future of electric vehicles. The technology can provide higher performance with even more safety at lower cost."

In June, Volkswagen invested $100m in solid-state battery developer QuantumScape, which it first partnered in 2012, taking a board seat in an agreement aimed at deploying an SSB production line by 2025.

The QuantumScape agreement came after Ionic Materials drew $65m in series C capital in February this year from investors including Alliance Ventures, the collaborative VC fund of carmakers Renault, Nissan and Mitsubishi.

Another solid-state battery developer, Sakti3, was acquired by cleaning and climate management equipment maker Dyson for $90m in 2015. It had raised approximately $50m in venture and grant funding, with backers including Dyson, automotive manufacturing group General Motors and trading conglomerate Itochu.

In spite of these investments, a marketable solid-state battery remains elusive. There remain questions over how soon a viable solid electrolyte might be produced at commercial scale. Shinzuo Abe, head of carmaker Toyota's powertrain division, has reportedly conceded an SSB may not be ready for mass-production until at least 2030, rather than early in the coming decade as previously thought.

Toyota, which is exploring a battery tech tie-up with electronics producer Panasonic, now expects only to begin internal testing of its SSB technology by the early 2020s.

Sluggish progress on SSBs is reflected by modest corporate venturing inflows for the technology compared with developers working with conventional lithium-ion parameters – solid-state developers have raised $239m since 2015, against $572m for lithium-ion, according to GCV Analytics.

The same data indicates there have been 11 deals with corporate involvement since 2015 for SSB businesses, compared with a total of 24 for batteries based on lithium-ion, grid storage and other materials.

Blome said an improved battery solution for electric vehicles was likely to be found with time. Asked whether he was concerned about obstacles in delivering new battery technologies, he said: "I have no big concerns, but there is still a lot of hard work to do in order to shape the future. This business is still quite young in the realm of the high-scale automotive world and we still learn a lot every day.

"The long-term task is to develop a battery technology platform that delivers e-mobility for vehicles in all segments. That is to say, batteries going up to super-sportscars and down to the mass volume segment, always combining good technical performance with best costs."

Companies targeting electric vehicle applications with more conventional lithium-ion approaches include Proterra, which develops buses powered by electricity. The company's latest vehicles come equipped with a lithium-ion battery said to have fuelled a record 1,100 miles on a single charge.

Automotive manufacturer Daimler co-led Proterra's $155m round earlier this month, joining fellow carmakers BMW and General Motors in backing the company and illustrating the scope for performance gains from lithium-ion electric vehicle batteries.

Grid storage

The need for improved grid batteries is becoming clearer as developing countries connect more of their citizens to electricity, necessitating the development of vast networks of power plants and transmission lines.

Last month, multilateral financial institution World Bank was reported by the Financial Times to be lining up a $5bn funding initiative, including $4bn from external investors, to drive a fourfold expansion in the battery storage capacities of developing countries. Huge batteries are used by electricity grids to manage peak demand, offset congestion and ensure a consistent output of power.

Gillard said energy storage operators most appreciate battery technologies that offer downward pressure on costs, an advantage that helps upgrade existing grids effectively. Another consideration is the growing prevalence of renewable power plants, which require a robust storage solution to compete with the fossil-fuel facilities traditionally relied on for constant provision of a minimum level of power.

One material finding favour for energy storage purposes is sodium. Batteries made with sodium could supplant more precious compounds that drive up overheads for grid stores. CVC-backed sodium-ion battery developers include UK-based Faradion, which received $4m in funding from investors including catalyst technology supplier Haldor Topsoe in January 2017. While exploiting sodium for its batteries, Faradion also claims to have packed in enough energy density to target low-speed electric vehicle applications.

Pangea Ventures' interest in this space is an investment in US-based developer Energy Storage Systems (ESS), whose batteries employ an all-iron flow battery it claims can sustain 20,000 cycles of power.

ESS received $13m in series B capital in a December 2017 round led by chemicals producer BASF's Venture Capital division and backed by Pangea Ventures among others.

Software

CVCs are also taking an interest in software-led designs that enhance the performance of existing and future battery technologies. The data shows software developers, together with companies focused on auxiliary battery-related products, have taken a 32.9% share of corporate-backed funding in the battery sector since 2015.

Software-led designs benefit from faster applicability than models that alter the manufacture of batteries, something of a tonic for investors weary of slower progress in the hardware segment. One such emerging company is energy storage software developer Greensmith Energy, which was picked up by energy integration services provider Wärtsilä in July last year.

Greensmith had secured $18.3m in a two-tranche 2015 round featuring energy utilities Eon and American Electric Power, adding to $8.9m in equity previously disclosed in regulatory filings. The company claims its software is already installed in more than a third of US energy storage capacity.

Operating in a similar space to Greensmith is GreenSync, which last raised $8.7m in January 2017 from companies including Southern Cross Renewable Energy

Fund, backed by telecom and internet group SoftBank.

Software is also increasingly integral to battery performance in consumer electronics. Examples include diversified conglomerate Alphabet's latest Android operating system, which uses artificial intelligence to predict when and how smartphones are being used so that energy demands can be adjusted accordingly.

Android's market penetration means Alphabet's solution is likely to secure widespread adoption, and such is the scale of the opportunity for emerging software battery products in the consumer space.

Given Samsung's experience with faulty batteries, software intended to prevent battery overload and degradation is also likely to draw corporate venturing interest.

Power-charging software developer Qnovo is one CVC-backed developer in this field, having secured $8.6m of series B funding in 2015 from investors including Intel Capital, a corporate venturing arm of chipset maker Intel. Intel's involvement gave Qnovo the opportunity to install its software on mobile devices powered by the corporate's processing chips, a route to market share.

Energy CVCs are also ploughing cash into auxiliary products and services that augment batteries, such as upgraded power chargers that could help reduce downtime for consumers and motorists.

Oil producer BP, for instance, committed $20m to battery charging technology creator StoreDot in May 2018 through its strategic investment subsidiary, BP Ventures. StoreDot, which also counts Daimler, Samsung and cybersecurity technology provider Nation-E among its backers, has devised an "ultra-fast" charger and flash battery that offer vastly reduced charging times for both electric vehicles and consumer devices.

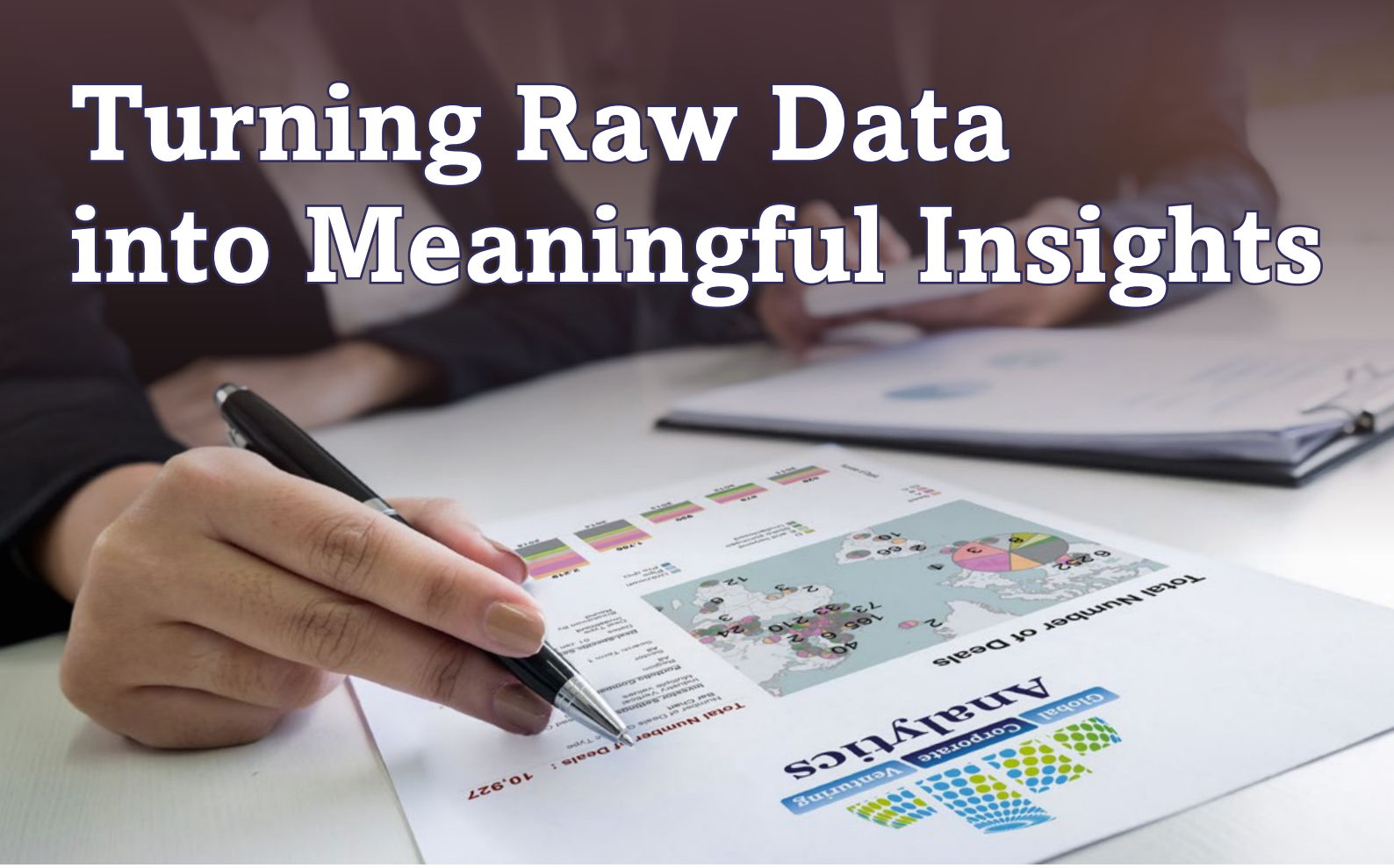
Conclusion

As Gillard noted, real barriers to investment exist for material-led battery technologies. Each of the array of materials vying for adoption brings its own unique challenges in development. But strategic capital is likely to continue following battery innovations – either tracking technologies with maximum potential over the longer term or those with advantages that can be implemented a faster.

The biggest question from an electric vehicle perspective remains how fast a solid-state solution can be commercialised. Manufacturers, which often buy electric vehicle batteries from China-based suppliers, will be anxious to avoid missing the opportunity to take the lead on manufacturing internally.

For this reason, solid-state manufacturers are likely to continue drawing high-value investments, though the number of deals may be smaller, perhaps due to a modest pool of strategic interest compared with other battery technologies. ■

Turning Raw Data into Meaningful Insights



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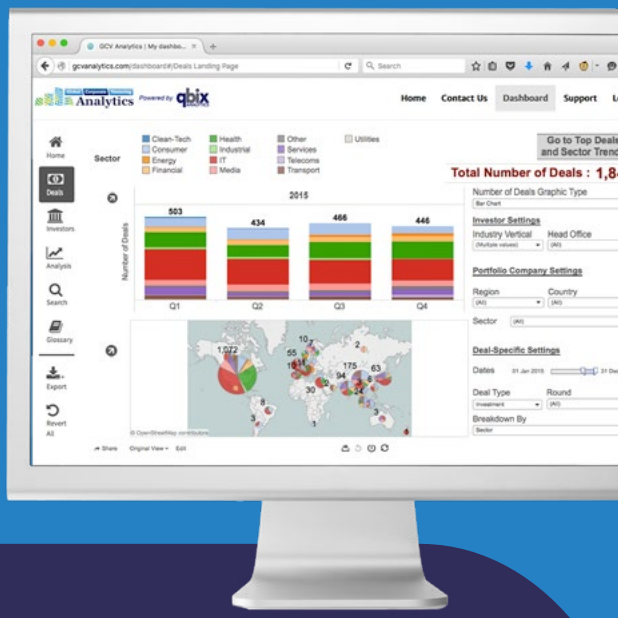

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Energy venturing 2018 review

Venturing in the third quarter of 2018

Kaloyan Andonov
GCV Analytics

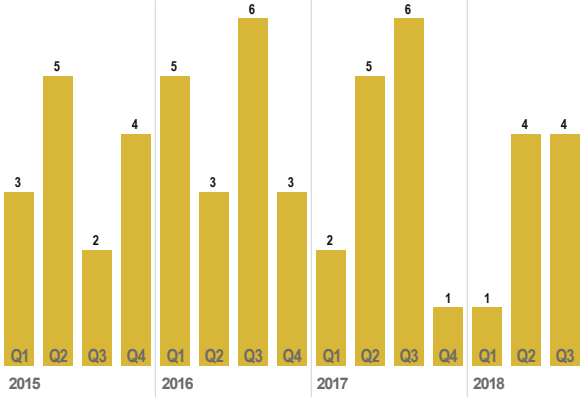
Over the past few years, GCV Analytics has observed a clear shift in focus of investments made by oil and gas corporate venturers, which is related to the emerging of an ever more diverse mix of energy sources.

There have been many investments in non-core areas, such as cleantech, IT and transport and mobility. The interest in transport and mobility technologies, undoubtedly, anticipates the foreseeable disruptive impact of electric vehicles, in addition to autonomous and connected vehicles. Commitments to cleantech companies are a precursor to the longer-term transition from fossil fuels or a medium-term world with a wider range of energy sources in which renewable energy plays a significant part.

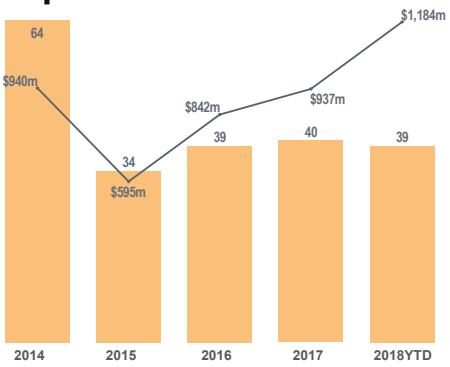
On the other hand, oil and gas corporate venturers continue to invest in core area technologies that bring efficiencies and cost reductions in their upstream and downstream businesses.

These major trends have been manifesting through the third quarter of 2018. In particular, there were new investments in cleantech, transport and mobility, IT as well as core oil and gas operation technologies.

Corporate-backed deals in oil & gas enterprises 2015-18



Investment activity of oil & gas corporate investors 2014-18



Investments by oil and gas corporates by the end of the quarter, at 39 rounds, had almost equalled the total for the whole of 2017 (40). Moreover, the estimated total capital deployed in such rounds by the end of the quarter was $1.18bn, up 26% from the $937m in 2017. This indicates that overall activity by the end of this year is likely to continue to grow.

The average size of deals in which oil and gas corporate venturers participated through the third quarter of 2018 was $35.56m, higher than 2017's $29.13m.

Most oil and gas corporate venturers focus on investing for a future ruled by renewable and sustainable energy or a future with a more diverse mix of energy sources, where mobility and transport are expected to go through significant changes – not only automotive but also air and other types of transport.

France-based oil and gas company Total has so far been leading in the number of cleantech investments along with Anglo-Dutch company Royal Dutch Shell. UK-based BP and Norway-based Statoil have also been active in that space, though their portfolios are somewhat more diversified. BP has also been active in biotech, as it prepares strategically for a carbon-free future.

There are likely to be more cleantech investments from oil and gas major Chevron in the future, particularly after it announced a $100m Future of Energy fund in the second quarter. Statoil has also placed bets on the cleantech space, but more so on oil and gas core operation technologies. Saudi Arabia-based Saudi Aramco has made direct commitments mostly to core energy operations and IT.

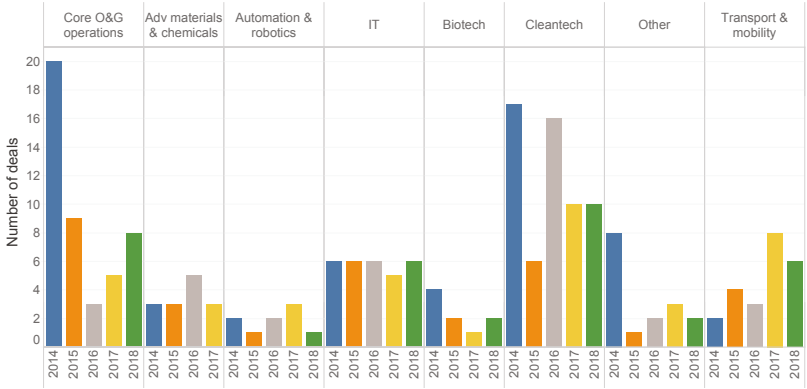
Deals

The oil and gas companies found among top corporate venture investors from the industrial and energy sectors were Shell, Chevron, Spain-based Repsol, Saudi Aramco, Total as well oil and gas services provider Schlumberger. In the third quarter of 2018, there were a number of notable deals involving oil and gas corporate venturers.

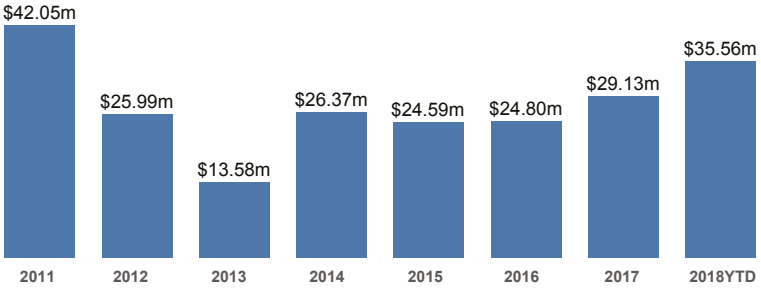
China-based industrial e-commerce platform Zhenkunhang raised $129m in a series C round, co-led by Legend Capital, the venture capital firm formed by conglomerate Legend Holdings, and Tiger Global Management. The round included Shell China, the local subsidiary of Shell, and Oriza Holdings, the investment arm of Suzhou Industrial Park, as well as Matrix Partners China and Eastern Bell Venture Capital. Founded in 1996, Zhenkunhang operates an e-commerce marketplace that sells industrial products such as tools and consumables for maintenance, repair and operation sourced from more than 5,000 suppliers.

US-based energy management technology developer Autogrid raised a $32m series D round, which featured Total Energy Ventures, a venturing subsidiary of Total, as well as Eon

Type of oil & gas venturing investments by year



Average size of deals backed by oil & gas CVCs 2011-18



Strategic Co-Investments, the venturing unit of utility company Eon. The funding will be used to develop capacity to manage large-scale and complex grid modernisation and digital transformation projects across the globe. Founded in 2011, AutoGrid provides software that enables utilities, electricity retailers, renewable energy power providers and energy service providers to manage the resources of a distributed grid to supply cleaner and more cost-effective energy.

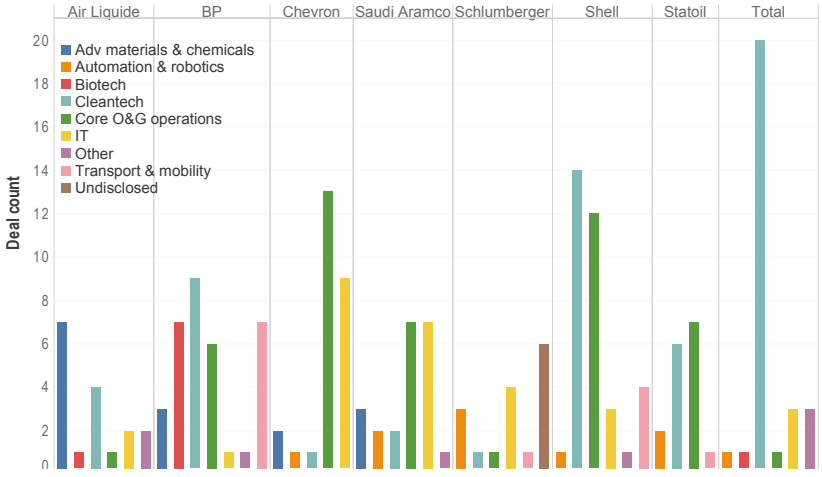
Shell Ventures, Shell's corporate venturing vehicle, led a $31m series A round for US-based electric vehicle charging technology developer Ample. Repsol Energy Ventures, Repsol's strategic investment arm, also participated in the round, as did venture capital fund Hemi Ventures, investment holding company Trirec and private investment firm Moore Strategic Ventures. Although it has not provided precise details on how its system will work, Ample claims to have developed a scalable and quickly deployable platform that uses autonomous robotics and smart battery technology.

US-based workplace robotics technology provider Sarcos Robotics received $30m in a series B round that included various corporates such as industrial equipment maker Caterpillar, power and industrial manufacturer General Electric, software company Microsoft and Schlumberger. Caterpillar and GE invested through Caterpillar Ventures and GE Ventures. Sarcos produces dexterous robots capable of traversing difficult spaces, which can be used to lift heavy items or in surveillance and inspection.

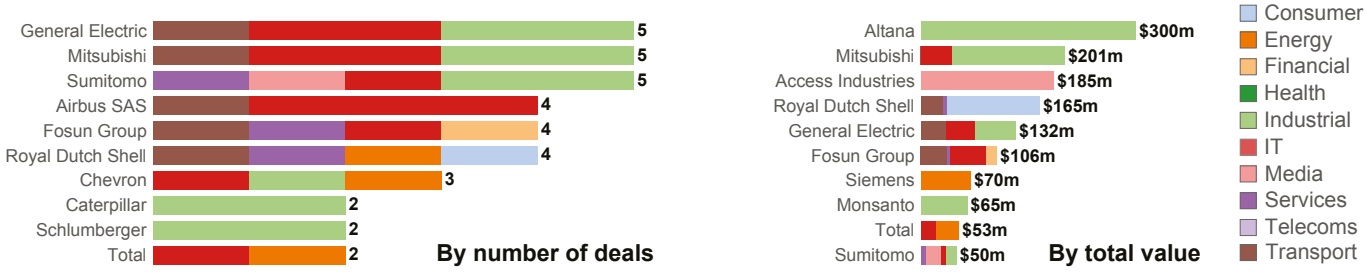
France and US-based software company Cosmo Tech closed a $21m series B round, featuring a number of corporate including Total Energy Ventures. The round was led by venture firm Inven Capital and featured Crédit Agricole Creation and BNP Paribas Developpement, subsidiaries of banks Crédit Argicole and BNP Paribas. Venture firms Cathay Innovation and Aster Capital – both backed by multiple corporate limited partners – also participated. Founded in 2010, Cosmo Tech develops a big data software solution suite which it claims is based on augmented reality intelligence, to help run simulations to optimise decision-making.

Seeq Corporation, a US-based developer of analytics software for the internet of things, received $23m in a series B round co-led by energy company Chevron and industrial equipment producer Siemens. Chevron Technology Ventures and Next47, respective venturing units of the corporates, were joined by oil and gas software-focused venture capital firm Altira Group, which led the round. Seeq has developed a software platform that enables customers in the manufacturing and industrial industries, including oil and gas, chemicals and pharmaceuticals, to obtain data from connected systems and share it quickly and easily.

Type of investment by company 2014-Q3 2018



Top energy and industrial investors Q3 2018

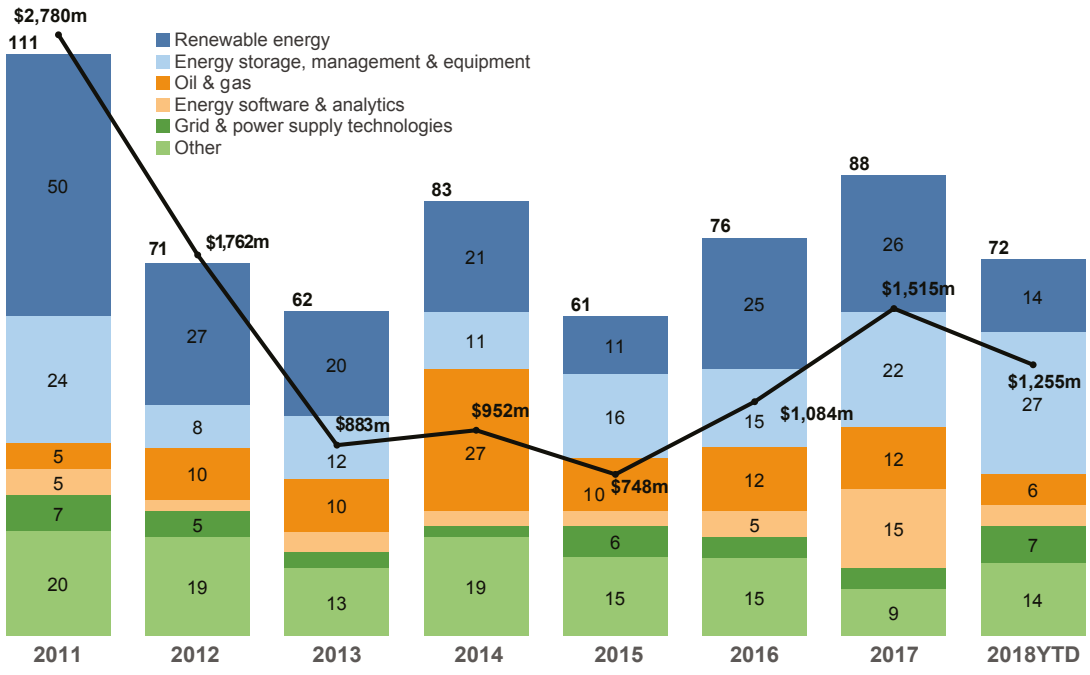


Canada-based carbon-capture technology developer Inventys Thermal Technologies closed a $11m first tranche of a series C round featuring oil and gas supplier Chevron, with an expected $21m close. The tranche was led by OGCI Climate Investments, a fund launched by the Oil and Gas Climate Initiative led by the CEOs of 10 global oil and gas companies, and also included Roda Group, while Chevron invested through Chevron Technology Ventures. Founded in 2007, Inventys is developing gas separation technology intended to separate carbon dioxide from industrial flue gas once it has been combusted. The capital will fund a pilot demonstration for the technology set to be launched in partnership with energy company Husky Energy early next year.

US-based industrial valve manufacturer Clarke Industrial Engineering closed a $10m series B round co-led by subsidiaries of oil and gas suppliers Saudi Aramco and Chevron. Saudi Aramco Energy Ventures (SAEV) and Chevron Technology Ventures invested alongside angel syndicate New World Angels. The funding followed a $3.1m series A round led by New World Angels that Clarke reportedly raised more than a year ago. Founded in 2011, Clarke produces industrial valves – mechanical devices used to control flow quality and pressure. Clarke's aerospace-inspired version of the technology, the "shutter valve", is intended to offer more precise flow control and reduce turbulence.

Canada-based greenhouse gas emissions monitor GHGSat received $10m in series A2 financing from investors including oil

Energy sector deals by subsector 2011-18



and gas services firm Schlumberger. OGCI Climate Investments led the round, which also featured Space Angels and Business Development Bank of Canada, and which doubled the company's overall funding to more than $20m. Its earlier backers include Canada's federal government and the government of the Canadian province of Alberta. Founded in 2011, GHGSat develops remote sensing technology for greenhouse gases, air quality, and trace gas emissions.

Spain-based electric scooter-sharing service Scutum secured €8.6m ($10m) from oil and gas supplier Repsol, Caixa Capital Risc, the venturing unit of financial services firm La Caixa, as well as the the Spanish government's Centre for the Development of Industrial Technology. All three participated in a $2.7m series A round in 2014. Founded in 2011, Scutum has developed a rechargeable scooter with a patented removable battery that is easy to charge and carry. The company's S02 model is aimed at businesses that rely heavily on scooters, including couriers, distributors and messaging companies.

Who Can Fix My Car, a UK-based operator of an online marketplace for vehicle repair services, raised £4m ($5.2m) from investors including Shell Ventures, venture firms Active Partners and Venrex Investment Management, and company chairman Trevor Chinn. Founded in 2011, Who Can Fix My Car runs an online platform and marketplace for car repairs, which provides customers with detailed estimates of the work they want done.

BP provided £1.5m for UK-based energy monitoring system developer Voltaware on as part of a £2.5m funding round. BP, which invested through corporate venturing vehicle BP Ventures, was joined by Imagine Ventures and Contrarian Ventures. The funds will be used to enhance the company's artificial intelligence and data science technology. Founded in 2014, Voltaware has developed a device that tracks energy consumption and manages electricity bills.

US-based software company Bluware raised an undisclosed amount in a round featuring Shell Ventures. The round was led by financial services firm EV Private Equity. Bluware is developing open software

Portfolio company	Round	Sector	Size	Venture investors
Zhenkunhang	C	Consumer	$129m	Eastern Bell Venture Capital | Legend Holdings | Matrix Partners | Oriza Holdings | Royal Dutch Shell | Tiger Global Management
Autogrid	D	Energy	$32m	ClearSky Power and Technology Fund | CLP Group | Energy Impact Partners | Envision Ventures | Eon | Foundation Capital | Ørsted | RWE Innogy | Tenaska | Total
Ample	A	Transport	$31m	Hemi Ventures | Moore Strategic Ventures | Repsol | Royal Dutch Shell | Trirec
Sarcos Robotics	B	Industrial	$30m	Caterpillar | Cottonwood Technology Fund | Dig Investments | General Electric | Microsoft | private investors | Raymond James | Schlumberger
Seeq Corporation	B	IT	$23m	Altira Group | Chevron | Next47 | Second Avenue Partners | undisclosed investors
Cosmo Tech	B	IT	$21m	Aster Capital | BNP Paribas | C Entrepreneurs | Cemag Invest | Cez | Credit Agricole | Sofimac Partners | Total
InventysThermal Technologies	C	Energy	$11m	Chevron | Oil and Gas Climate Initiative | Roda Group
GHGSat	A	Industrial	$10m	Business Development Bank of Canada | Oil and Gas Climate Initiative | Schlumberger | Space Angels Network
Scutum	A	Transport	$10m	Caixa Capital | Centre for the Development of Industrial Technology | Repsol
Who Can Fix My Car	–	Services	$5.2m	Active Venture Partners | private investors | Royal Dutch Shell | Venrex Investment Management
Clarke Valve	B	Industrial	$5m	Chevron | Oil and Gas Climate Initiative | Saudi Aramco
Voltaware	–	Energy	$3.3m	BP | Contrarian Ventures | Imagine Ventures
Bluware	–	Energy	–	Royal Dutch Shell
Well-Sense	–	Industrial	–	FrontRow Energy Technology Group | Saudi Aramco | undisclosed investors

platform Headwave, a digitisation solution for the oil and gas sector.

Well-Sense, a UK-based creator of data analysis tools for use in oil and gas extraction, secured an undisclosed level of funding from Saudi Aramco Energy Ventures as well as oil and gas services provider FrontRow Energy Technology Group and undisclosed members of its management team. Well-Sense, which was founded as a subsidiary of Front-Row, plans to capitalise on Saudi Aramco's investment and expand into the Middle East. Founded in 2015, Well-Sense provides engineering and consultancy services for quick response engineering and development of innovative and efficient product lines for the upstream oil and gas industry.

GCV Analytics also tracked deals by other companies related to the oil and gas industry or previously backed by oil and gas corporate venturers.

China-based business-to-business fuel-trading platform Zhaoyouwang secured $150m in a series C round co-led by logistics services provider GLP and private equity firm Rainbow Capital. SIG Asia Investments, a subsidiary of technology and trading firm Susquehanna International Group also took part, as did venture and financial services firms GGV Capital, DCM Ventures, Sky9 Capital, Yunqi Partners, Tide Capital and Oceanpine Capital. Founded in 2015 and also known as 51zhaoyou.com, Zhaoyouwang runs an online marketplace where enterprise customers can trade diesel, gasoline and kerosene. The platform also offers fuel-related logistics and financial services. The company is active in more tham 50 Chinese cities.

SkyX Systems, a Canada-based aerial data services provider that counts Chinese technology conglomerate Kuang-Chi as an investor, secured $9.5m of series B funding from Almond Tree/SkyX Limited Partnership, a vehicle led by family office Almond Tree Enterprise. The round boosted SkyX's overall funding to $15.8m, including a $4m investment by Kuang-Chi. Founded in 2015, SkyX develops aerial drones that monitor long-range assets such as oil and gas pipelines.

Equinor Technology Ventures, the corporate VC subsidiary of energy company Equinor formerly known as Statoil Technology Invest, invested an undisclosed sum in US-based gas detection system developer SeekOps. The technology developed by SeekOps, which was spun off from Nasa's Jet Propulsion Laboratory, supports emerging methane mitigation schemes being instituted by Equinor.

Funds

China-based oil, gas and chemicals supplier Sinopec has formed investment firm Sinopec Capital with RMB10bn ($1.48bn). Sinopec Capital will invest in emerging areas such as new energy, advanced materials, artificial intelligence and smart manufacturing and supply chain technologies. Although Sinopec has not stated directly that the vehicle will invest in startups, its activities will cover equity investments as well as project investments and asset management. The fund will get 49% of its capital from oil and gas refiner Sinopec Corp and the remaining 51% from parent company Sinopec Group.

BP has committed $10m to a dollar-denominated fund run by Nio Capital, the corporate venturing arm of China-based smart electric car developer Nio. Founded in 2016, Nio Capital invests in transport technologies such as electrification, autonomous driving software and shared mobility. It raised $500m for its first fund, which was launched in November 2017. BP's commitment comes two months after it formed a strategic partnership with Nio

Capital. The companies have not disclosed whether BP's investment will be channelled into a new or existing fund.

Saudi Aramco is considering the formation of a $1bn strategic investment fund. The fund would make multimillion-dollar investments in developers of technologies that would complement its parent's operations. The fund's formation could involve the opening of a US office, probably in Silicon Valley. Saudi Aramco already has its SAEV venturing unit, which was launched in 2012 to invest in technologies related to up and downstream oil and gas, water, petrochemicals, renewable energy and energy efficiency. Although it is unclear how the proposed fund would complement SAEV, news of its possible formation came weeks after reports that Saudi Aramco has dropped plans for an initial public offering expected to be in the multibillion-dollar range.

People

Susana Quintana-Plaza
National Grid Ventures

Cory Steffek left SAEV, where he was a managing director, to join private equity investment platform US-based Ara Partners as managing director. The firm focuses on lower middle-market investments in the energy, industrial and infrastructure industries. Steffek joined SAEV in 2012 and was based, like Ara Partners, in Houston, Texas.

Statkraft Ventures, the corporate venturing vehicle of Norway-based power producer Statkraft, hired entrepreneur Ammar Alkassar as a venture partner. Alkassar founded cybersecurity startup Sirrix in 2005 based on his research at the German Research Centre for Artificial Intelligence, and sold it to Germany-based peer Rohde and Schwarz in 2015, remaining as CEO for a further three years. Statkraft Ventures focuses on investments in Europe-based companies developing technologies disrupting the energy industry. It invests between €500,000 and €4m at a time.

Susana Quintana-Plaza left Next47, where she ran its London office as a partner. Quintana-Plaza joined Next47 in late 2016, having previously been senior vice-president of technology and innovation for energy utility Eon since 2014. She was Eon's vice-president of innovation scouting and co-investments for three years from 2011.

Swati Dasgupta left Siemens venturing unit Next47 to become a director at National Grid Ventures, the strategic investment arm of US and UK-based grid operator National Grid Group. National Grid Ventures oversees investments in technology startups, energy projects and partnerships on behalf of its parent. The unit is run by Lisa Lambert, who worked in venture capital activities for chipmaker Intel for 17 years. Before joining Next47 as a director in 2017, Dasgupta was a director of external innovation at Siemens' technology-to-business unit from 2013. ■

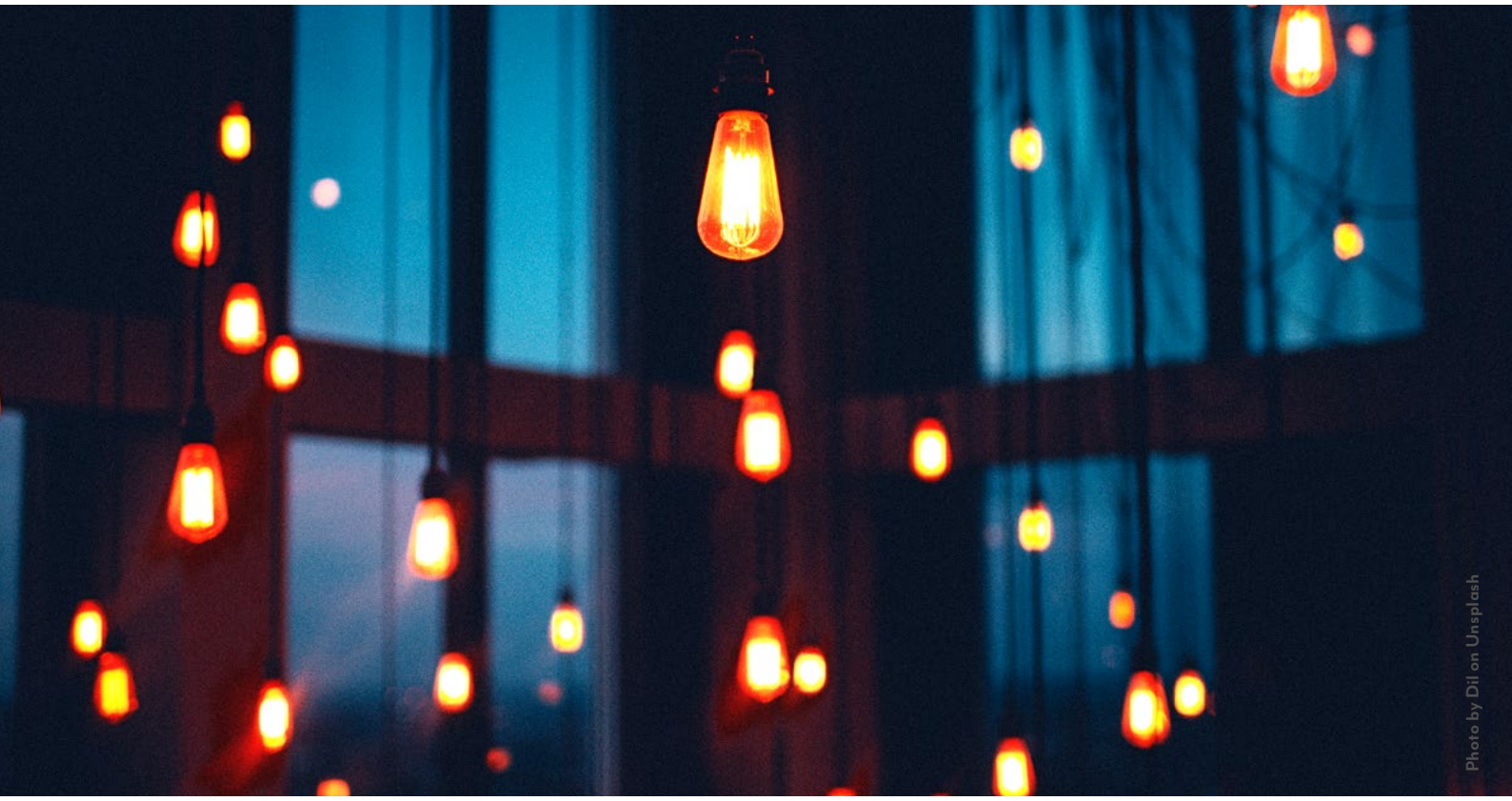


Photo by Dil on Unsplash

The energy sector grows again

Kaloyan Andonov
GCV Analytics

GCV Analytics' definition of the energy sector encompasses renewable energy technologies and providers, oil and gas technologies, energy storage, management and equipment along with grid and power supply technologies, energy software and analytics, energy utilities and other.

The energy sector is, by its nature, the driving fuel of virtually all economic activity, though almost always ridden with concerns about environmental impact. Thus, reducing impact and increasing efficiency are the two natural never-ceasing themes defining innovative aspirations in energy. At the current juncture, the sector is experiencing a profound change in the mix of energy sources – some of which much with much lower impact on the environment – and how they are managed more efficiently. Much of the growth opportunities lie in large emerging economies like China.

Renewable energy sources are continuing to gain importance around the globe. A report entitled "Global trends in renewable energy investment 2018" – prepared jointly by the UN Environment's Economy Division, the Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and Bloomberg New Energy Finance – ascertained that 157 gigawatts of renewable power were commissioned in 2017, far surpassing the 70GW of net fossil fuel generating capacity added. The report also stated: "Solar power rose to record prominence in 2017, as the world installed

98 gigawatts of new solar power projects, more than the net additions of coal, gas and nuclear plants put together." Overall investment in renewables globally stood at $279.8bn in 2017, up 2% on a year-on-year basis, representing a cumulative investment of $2.2 trillion since 2010.

Undoubtedly, this long-term growth has been due to decreasing capital and generating costs for renewables. The levelised cost of electricity (LCOE) for solar photovoltaics, onshore and offshore wind has been reduced over the past years, which has given a boost to the competitiveness of these energy sources versus traditional ones like coal and gas.

One geography in particular, China, was responsible for more than half of this growth: *"China accounted for just over half of that new global solar capacity in 2017, and it accounted for 45% of the $279.8 billion committed worldwide to all renewables."* The report also notes increases in renewables investments across other geographies like Australia, Mexico, the United Arab Emirates and Egypt. In the US, which remains a distant second behind China, capital commitments to renewable tech have stayed, according to the report, *"resilient in the face of policy uncertainties, although changing business strategies affected small-scale solar."*

The situation is somewhat similar also for water tech and water treatment technologies. The sub-sector is expected to grow globally and the growth will be fuelled mostly by developments in China, with a combination of a rising demand for potable water and increasing levels of pollution. The *"Water treatment systems market size, share and trends report 2018-2025"* by consulting firm Grand View Research forecasts the global water treatment systems market, estimated at $23.8bn, will register a compound annual growth rate of 7.1% by 2025.

The report summarises the drivers behind it: *"Asia Pacific is estimated to lead the global market over the forecast period. Economic performance is projected to rally in China in the coming years with large-scale investments in technology and research. China is undertaking massive changes in the water supply and sanitation scenario in the country to overcome numerous challenges including economic disparity between urban and rural population and increasing urbanisation."* It also points out that currently water treatment system manufacturers are focusing on systems and units that can function without constant electricity supply, so they can be employed in remote and rural areas.

One of the major challenges of many emerging technologies today, including electric vehicles and renewable power generation, lies in energy storage technologies. According to "Battery storage: The next disruptive technology in the power sector" – an analysis by consultancy firm McKinsey, prices of such technologies are going down and this has been largely driven by demand in consumer electronics and electric vehicles: battery-pack costs have decreased considerably to $230 per kilowatt-hour in 2016, down from $1,000 per kilowatt-hour in 2010. For more on burgeoning technologies in the batteries and energy storage space, please read Callum Cyrus' article in this issue of the GCV magazine.

With nearly zero-energy green buildings, smart cities and smart homes, it is unavoidable to touch on the topic of decarbonisation and the transition to a low-carbon energy world. While there have been notable advancements in consumer applications, the decarbonisation of heavy industry remains a rather complex technological challenge, which will likely create opportunities for tech developers. A 2018 McKinsey report, entitled *"Decarbonisation of industrial sectors: The*

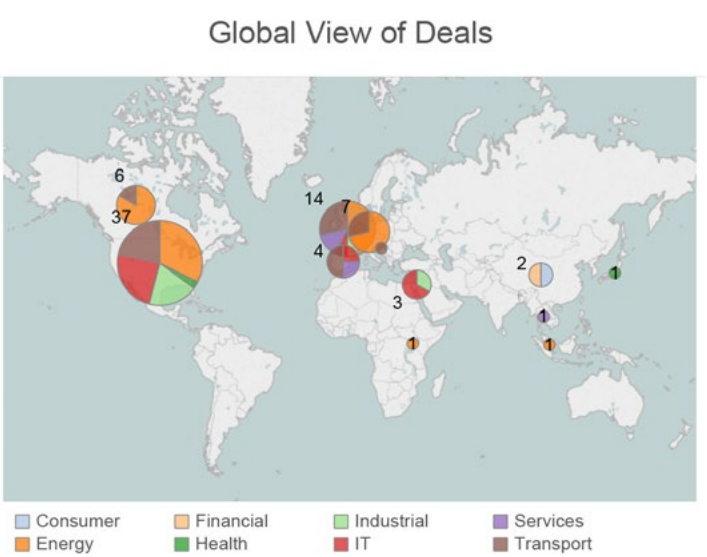
next frontier", found that ammonia, cement, ethylene, and steel companies can reduce their CO2 emissions to almost zero through efficiency improvements, electric production of heat, use of hydrogen and biomass as feedstock or fuel and carbon capture. However, the decarbonisation process is expected to cost between $11 trillion and $21 trillion by 2050 and would necessitate much higher levels of non-carbon generated electricity than presently available.

The oil and gas subsector of the energy industry still plays a crucial role in today´s world and susceptible to constant fluctuations in market conditions. After the recovery of oil prices and the increase in US oil production, the sector overall is currently swept with optimism. However, a report entitled "Oil and gas trends 2018-19", commissioned by auditing and consultancy firm PwC, states that the sector may "very well be moving headlong into a supply crunch" due to growing oil demand. Thus, the report recommends that oil and gas "maintain capital discipline and the focus on productivity improvements and applying new technology" and also reorient themselves towards a transition to a lower carbon energy world". This implies that, aside from rationalising oil-rich assets in terms of acquisition and divestments as well as streamlining operations to increase efficiencies, the oil and gas industry players would double down on digitisation, i.e. using advanced digital technologies to bring about operational efficiencies- from predictive maintenance and data analytics through drones inspecting offshore platforms to using robots to reduce workers' exposure to hazardous conditions. Our data on venturing deals corroborates the strategic interest such technologies constitute for oil and gas majors.

Corporates from the oil and gas ventures have, of course, been also seeking opportunities in low-carbon energy applications, spanning from renewables - like solar and wind energy – to infrastructure for electric vehicles. The PwC report notes, for example, how energy utility company Engie divested its upstream assets to refocus on power and renewables. The report also points out that switching focus to natural gas, which – as estimates suggest – constitutes a 10-15-year potential growth opportunity, may turn out to be a much-needed bridge to a low-carbon economy of the future.

Electric power utilities are facing an environment driven by a set of technological and regulatory forces. While the latter vary in each geography around the globe, the former exert impact across most regions. The "2018 outlook on power and utilities" report by Deloitte notes that, by the far, the most visible technological change in recent years has been the change of the fuel mix used for power generation. In the US, for example, generation from non-hydro renewable sources (i.e. mostly solar and wind) has doubled, while natural gas, due to its low prices, even surpassed the share of coal-generated power in 2016.

Not only is power generation becoming more diverse and cleaner but power distribution and consumptions are becoming smarter: *"Whether it is distributed generation, energy storage, microgrids, energy efficiency, electric vehicles, smart appliances, or demand response, residential and commercial electricity customers seem to increasingly see these products and services as a way to manage their energy use, save money, reduce their carbon footprint, and boost reliability and resilience."* The challenges that energy utility companies are facing in terms of the ever more diverse mix of energy sources presuppose investments in software and advanced analytics tool to modernise existing grids and make distribution more efficient, something particularly important

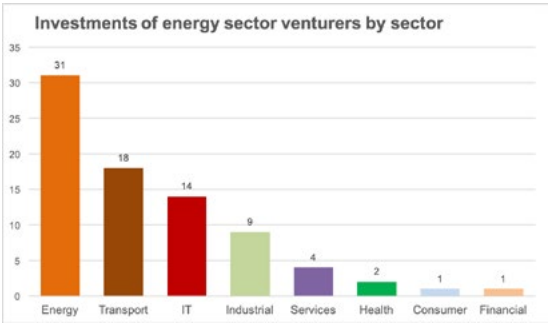


in times when falling costs of renewable energies encourage grid defection among customers.

For the period between September 2017 and August 2018, we reported 80 venturing rounds involving corporate investors from the energy sector. Nearly half of those (37) took place in the US, while 14 were hosted in the UK and seven in Germany.

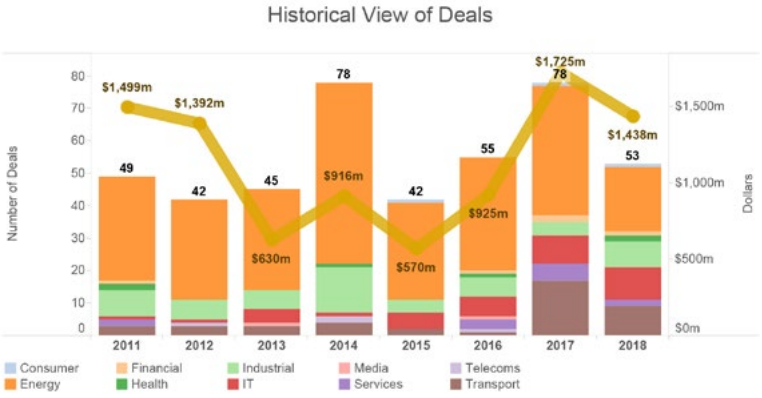
Many of those commitments (31) went to emerging enterprises from the same sector (mostly renewable energy and energy storage technologies along with core oil and gas applications) but also with the remainder going into companies developing other technologies favouring synergies with the energy sector: 18 deal in transport (mostly autotech innovations in electric vehicles as well as vehicle marketplaces), 14 in IT – mostly internet-of-things (IoT) applications, cybersecurity and data analytics) and nine in industrials (advanced materials, drones, robots and other industrial applications). Most notable, of course, is the interest in electric mobility, as it is a grand potential disruptor for oil and gas industry and its downstream fuel products.

The network diagram, which shows co-investments of energy corporates, illustrates the wide spectrum of investment interests of the sector's incumbents. The commitments range from charging stations for electric vehicles (Chargepoint) and lithium-based energy storage (Sonnen) through energy management systems (Sunverge), solar power producers (Sunseap), wind energy technology developers and providers (United Wind, Kite Power Systems), chemical products developers (Lux Assure) and even analytics software (Maana) and thermostat makers (Ecobee).

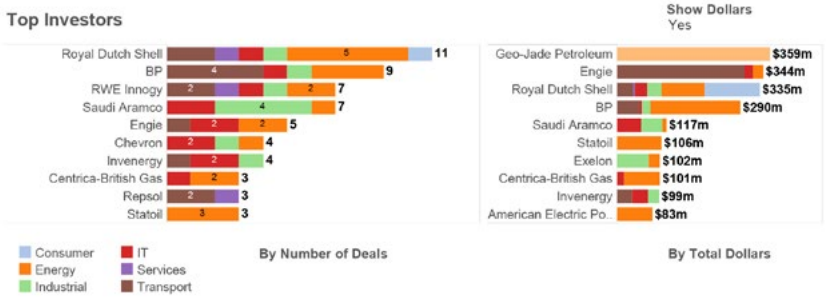


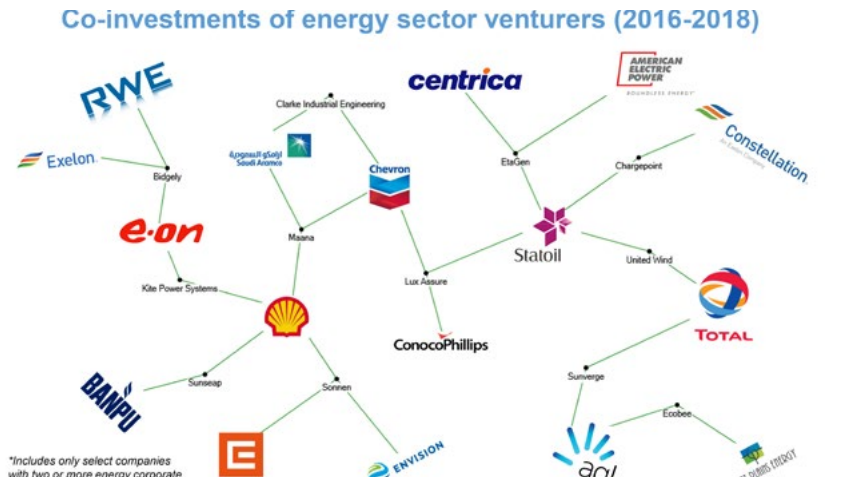
On a calendar year-on-year basis, total capital raised in corporate-backed rounds went significantly up from $925m in 2016 to $1.72bn in 2017, representing an 86% surge. The deal count also registered an 41% increase from 55 deals in 2016 to 78 tracked in 2017.

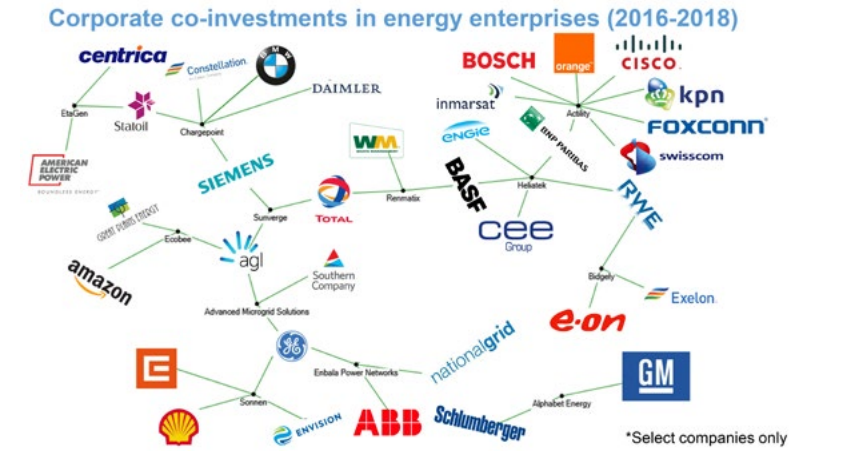
As outlined further in this article, the ten largest investments by corporate venturers from the energy sector were spread across various industries.

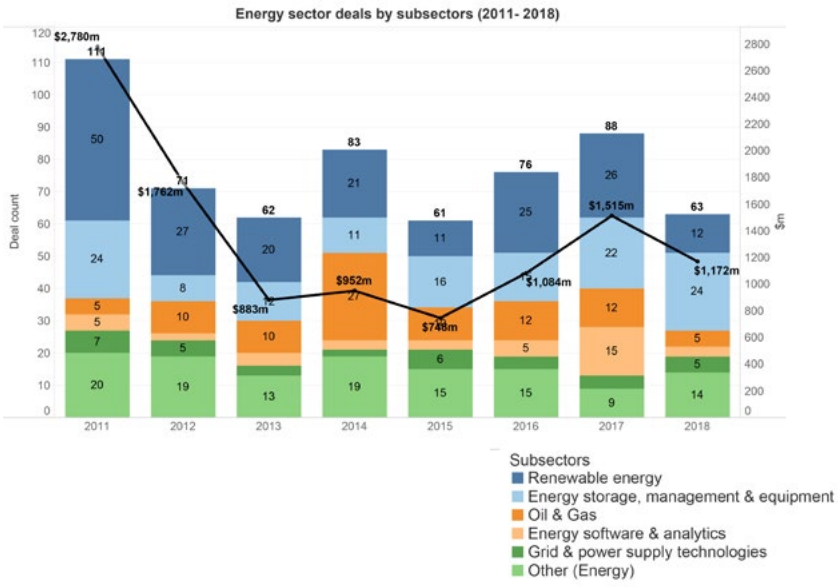


Top energy sector investors









The leading corporate investors from the oil and gas companies Royal Dutch Shell (Shell), BP and electricity and gas company RWE accounted for the largest number of deals. The list of energy corporates committing capital in the largest rounds was topped also by oil exploration and production firm Geo-Jade Petroleum, along with Shell and BP.

The most active corporate venture investors in the emerging energy companies was Free Electrons - an international energy-focused initiative backed by 10 energy utilities, along with Shell, chemical producer BASF and BP.

The rising energy businesses in the portfolios of corporate venturers were quite varied, encompassing anything from charging stations for electric vehicles (Chargepoint) and energy storage (Sonnen), smart grid applications (Actility), distributed energy management systems (Sunverge, Advanced Microgrid Solutions), solar photovoltaic technology (Heliatek) to biomass conversion technologies (Renmatix). This is illustrated by the network diagram of corporate co-investments in such companies.

Overall, corporate investments in emerging energy-focused enterprises went up slightly from 76 rounds in 2016 to 88 deals in 2017. Estimated total dollars also increased from $1.08bn to $1.51bn. This trend appears likely to continue, as we have reported 63 such transactions, worth and estimated $1.17bn, by the end of August this year.

Deals

Energy sector corporates invested in large multimillion-dollar rounds, raised by a range of enterprises – not only energy tech developers but also industrial, transport, consumer and financial services. None of the top ten rounds, however, stood above the $1bn mark.

Top 10 deals by energy corporate investors (Sep 2017 - Aug 2018)

Portfolio Company	Location	Sector	Round	Round size	Investors List
Caogen Touzi	China	Financial Services	D	$359m	Geo-Jade Petroleum | undisclosed investors
Gogoro	USA	Transport	C	$300m	Engie | Generation Investment Management | Panasonic | Samuel Yin | Sumitomo | Temasek
Lightsource	UK	Energy	Undisclosed	$200m	BP
Zhenkunhang	China	Consumer	C	$129m	Eastern Bell Venture Capital | Legend Holdings | Matrix Partners | Oriza Holdings | Royal Dutch Shell | Tiger Global Management
Ecobee	Canada	Energy	C	$97m	Amazon | Energy Impact Partners | Export Development Canada | Great Plains Energy | Northleaf Capital Partners | Ontario Capital Growth Corporation | Relay Ventures | Tech Capital | Thomvest Ventures | AGL Energy | Caisse de dépôt et placement du Québec | Business Development Bank of Canada (BDC)
EtaGen	USA	Energy	C	$83m	American Electric Power (AEP) | Centrica-British Gas | Independent | KCK Group | Khosla Ventures | Statoil
PrecisionHawk	USA	Industrial	Undisclosed	$75m	Comcast | DuPont | Exelon | Innovate Indiana Fund | Intel | Millennium Technology Value Partners | NTT Docomo | Senator Ventures | Syngenta | Third Point Ventures | USAA | Verizon | Yamaha
Sonnen	Germany	Energy	Undisclosed	$70m	Royal Dutch Shell | undisclosed investors
Sunseap	Singapore	Energy	C	$56m	Banpu
Commonwealth Fusion Systems	USA	Energy	Undisclosed	$50m	Eni

China-based fintech platform Caogen Touzi (CGTZ) secured RMB2.3bn ($359m) in series D funding from a consortium led by Geo-Jade Petroleum. The latter participated through an unnamed industrial fund and was joined by a range of undisclosed existing shareholders. Founded in 2013, CGTZ has developed a range of investment tools for private users and SMEs. Users can also apply for collateral loans backed by assets such as houses and vehicles, while the company also offers consumer instalment credit products in rural areas.

US-based electric scooter provider Gogoro closed a $300m series C round that included Engie, diversified conglomerate Sumitomo as well as consumer electronics producer Panasonic. The round reportedly valued Gogoro at more than $800m. Singaporean state-owned investment vehicle Temasek also participated. Founded in 2011, Gogoro has developed a smart electric scooter as well as a battery-swapping network for its customers, both of which were launched in Taipei, the capital of Taiwan, in 2015. The company has since sold 34,000 scooters and established more than 400 battery-swapping stations across Taiwan and Europe.

Oil and gas supplier BP invested $200m in UK-based solar power project developer and operator Lightsource over a three-year period as part of a strategic partnership. BP's investments will eventually give it a 43% stake in Lightsource, which will be renamed Lightsource BP, and two seats on its board of directors as part of the deal. The first $50m will be provided once the deal is closed. Founded in 2010, Lightsource develops and operates utility-scale solar projects. It has brought 290 solar photovoltaic projects online adding up to 1.3 GW of capacity in the UK and manages about 2 GW of energy through operations and maintenance agreements.

China-based industrial e-commerce platform Zhenkunhang raised $129m in a series C round co-led by Legend Capital, the venture capital firm formed by conglomerate Legend Holdings, and Tiger Global Management. The round included Shell China, the local subsidiary of Shell, and Oriza Holdings, the investment arm of Suzhou Industrial Park. Founded in 1996, Zhenkunhang operates an e-commerce marketplace that sells industrial products such as tools and consumables for maintenance, repair and operation that are sourced from more than 5,000 suppliers.

Canada-based smart thermostat producer Ecobee closed a $97m series C round after securing C$47m ($36m) in an extension that featured power company AGL Energy. It had initially raised $61m in the round, led by Energy Impact Partners, a private equity firm backed by AGL, and featuring Amazon Alexa Fund, an investment vehicle of e-commerce firm and cloud computing provider Amazon. Caisse de dépôt et placement du Québec (CDPQ) and Business Development Bank of Canada, both government-backed financial institutions, also joined the round. Founded in 2007, Ecobee has developed a smart thermostat that measures room temperature and detects how many people are in a room. The company has also introduced a smart light switch.

US-based electrical generator producer EtaGen completed an $83m series C round, which featured wind turbine services provider KCK Group and energy company American Electric Power, UK-listed energy utility Centrica as well as oil and gas company Statoil. Centrica and Statoil took part through their Centrica Innovations and Statoil Energy Ventures units. Founded in 2010, EtaGen provides linear generator systems to commercial business customers which produce electricity by combining air and fuel to push magnets through copper coils. The systems are scalable and come in 250 kW and 750 kW packages.

US-based drone technology producer PrecisionHawk raised $75m in funding in a round featuring a number of corporate venturers, including energy company Exelon. Mass media group Comcast, Exelon and semiconductor technology provider Intel invested through respective subsidiaries Comcast Ventures, Constellation Technology Ventures and Intel Capital. Agribusiness Syngenta, chemicals producer DuPont and telecoms firms Verizon and NTT Docomo meanwhile participated through their Syngenta Ventures, DuPont Ventures, Verizon Ventures and NTT Docomo Ventures units. Automotive manufacturer Yamaha Motor and insurance company USAA also chipped in. Founded in 2010, PrecisionHawk has created an enterprise software platform that can be used to control unmanned aerial vehicles and enable users to process, model and analyse data collected by the drones. The software also offers the ability to fly drones on autopilot.

Germany-based energy storage system developer Sonnen completed a €60m ($70m) funding round led by Shell Ventures, Shell's corporate venture capital arm. The identities of the other participants in the round were not confirmed, but Sonnen CEO Christoph Ostermann stated that it received backing from all its investors. Founded in 2010 as Sonnenbatterie, Sonnen has created a home energy storage and management system designed to work in tandem with solar panels. It also runs a community scheme where owners of its systems can share their surplus solar energy to save money.

Singapore-based cleantech developer Sunseap obtained S$75m ($56m) from energy company Banpu in a series C extension, bringing the round's total to at least $60.8m. Shell Ventures supplied an undisclosed sum as part of a partnership agreement to develop solar projects in the Asia Pacific region. Sunseap had raised a first $4.8m tranche from a consortium led by building maintenance company IsoTeam. Sunseap operates solar energy systems, providing renewable energy to its clients through solar farms. The company is also working on an energy management platform and is looking into the use of batteries.

Commonwealth Fusion Systems (CFS), a US-based fusion power technology developer emerging from Massachusetts Institute of Technology (MIT)'s The Engine accelerator,

Top investments in emerging energy enterprises (Sep 2017 - Aug 2018)

Portfolio Company	Location	Sector	Round	Round size	Investors List
Enerkem	Canada	Energy	Undisclosed	$224m	BlackRock | Braemar | Cycle Capital | Fondaction CSN | Fonds de solidarité FTQ | Investment Quebec | National Bank of Canada | Rho Canada Ventures | Sinobioway | Waste Management of Canada | Westly Group
Lightsource	UK	Energy	Undisclosed	$200m	BP
Zhaoyouwang	China	Energy	C	$150m	DCM | GGV Capital | Global Logistics Providers (GLP) | Oceanpine Capital | Rainbow Capital | Sky9 Capital | Susquehanna International Group | Tide Capital | Yunqui Partners
QuantumScape	USA	Energy	Undisclosed	$100m	Volkswagen
Ecobee	Canada	Energy	C	$97m	Amazon | Energy Impact Partners | Export Development Canada | Great Plains Energy | Northleaf Capital Partners | Ontario Capital Growth Corporation | Relay Ventures | Tech Capital | Thomvest Ventures | AGL Energy | Caisse de dépôt et placement du Québec | Business Development Bank of Canada (BDC)
EtaGen	USA	Energy	C	$83m	American Electric Power (AEP) | Centrica-British Gas | Independent | KCK Group | Khosla Ventures | Statoil
Sonnen	Germany	Energy	Undisclosed	$70m	Royal Dutch Shell | undisclosed investors
Sila Nanotechnologies	USA	Energy	D	$70m	Amperex Technology | Siemens | Sutter Hill Ventures
Forsee Power	France	Energy	Undisclosed	$65m	European Investment Bank (EIB) | Idinvest Partners | Mitsui
Sunseap	Singapore	Energy	C	$56m	Banpu

raised $50m in funding from energy supplier Eni. The company is hoping to attract additional investors, though a target size for the round was not revealed. CFS is working on fusion technology, which imitates the process by which the sun produces energy by smashing together light elements such as hydrogen to form heavier elements such as helium, harnessing the energy released in the process. The concept of fusion technology has existed for decades, but so far researchers have failed to create a workable approach at scale. Fusion power theoretically offers unlimited, carbon-free and safe energy.

There were other interesting deals in emerging energy-focused businesses that received financial backing from corporate investors from other sectors.

Enerkem, a Canada-based developer of a process that converts waste to biofuel, secured C$280m ($224m) from investors including waste management services provide Waste Management of Canada and industrial conglomerate Sinobioway. Financial services firm National Bank of Canada also took part in the round. Founded in 2000, Enerkem produces biofuels and chemicals such as methanol and ethanol from solid waste using a proprietary system it has developed. It operates out of a commercial facility in the province of Alberta.

China-based business-to-business fuel trading platform Zhaoyouwang secured $150m in a series C round co-led by logistics services provider GLP and private equity firm Rainbow Capital. SIG Asia Investments, a subsidiary of technology and trading firm Susquehanna International Group, also took part, among other investors. Founded in 2015 as 51zhaoyou.com, Zhaoyouwang runs an online marketplace where enterprise customers can trade diesel, gasoline and kerosene. The platform also offers fuel-related logistics and financial services. The company is currently active in more than 50 cities across China.

Automotive manufacturer Volkswagen committed $100m in US-based advanced battery developer QuantumScape as part of a strategic collaboration deal. Founded in 2010 as a spinout from Stanford University, QuantumScape is working on solid-state batteries that will use solid electrolytes, as opposed to the liquid or polymer electrolytes utilised in lithium batteries. The technology could potentially be used to create batteries with a higher energy density, equating to increased capacity, that are also more compact, safer to use and quicker to charge.

Industrial technology and appliance producer Siemens and lithium-ion battery manufacturer Amperex Technology both participated in a $70m series D round for

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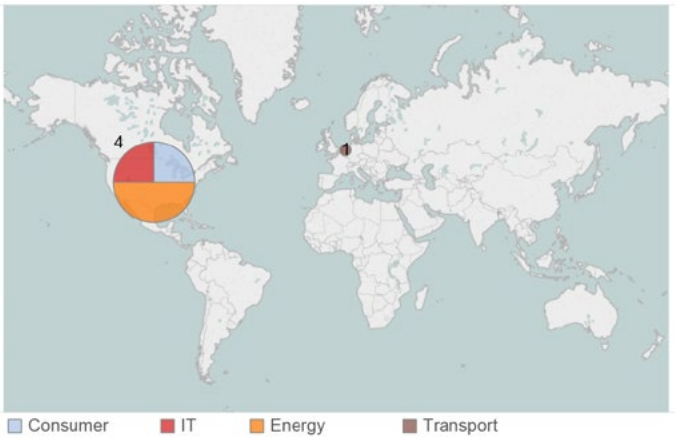
US-based advanced battery technology developer Sila Nanotechnologies. Siemens invested through its Next47 unit. Venture capital firm Sutter Hill Ventures led the round. Founded in 2011, Sila has developed silicon-dominant anode technology that can be inserted into existing battery manufacturing systems, replacing graphite and allowing for higher density in battery cells. The materials are intended for use in batteries serving the portable electronics, electric vehicle, grid-scale energy storage and, eventually, the battery-powered flight markets.

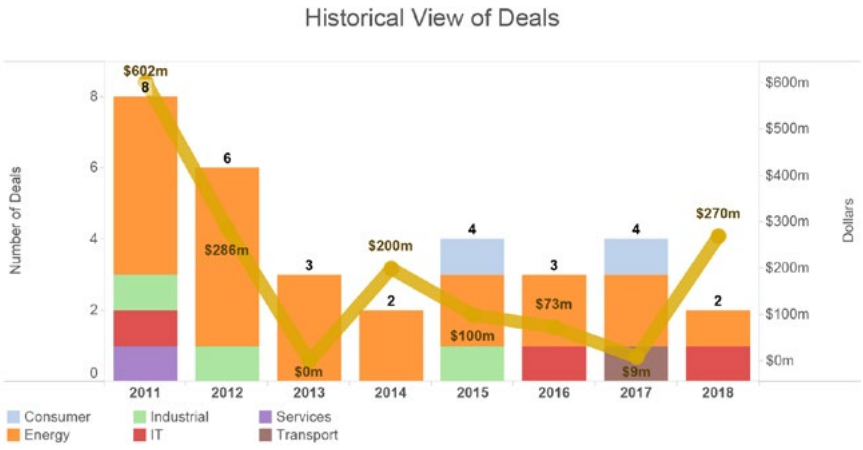
France-based battery technology developer Forsee Power raised €55m ($65.4m) in financing from diversified conglomerate Mitsui, private equity firm Idinvest Partners and the European Union-owned European Investment Bank. Forsee develops, builds, installs and maintains smart lithium-ion battery systems for electric transport, energy storage, and portable and mobile equipment producers. The company also provides leasing options through a partnership with Neot Capital.

Exits

Corporate venturers from the energy sector completed five exits between September last year and August this year, including four acquisitions and one initial public offerings (IPOs). On a calendar year-on-year basis, we reported four exits in 2017, the same number as we tracked in 2015. Given the limited number of exits with reported sizes, it is hard to draw a conclusion on trends in terms of the total estimated exited capital.

Bloom Energy, a US-based fuel cell energy system producer backed by energy utility Eon, raised $270m in its IPO on the New York Stock Exchange. The company issued 18 million shares priced at the top of its $13 to $15 range. Founded in 2001 as Ion America, Bloom Energy provides a stationary power generation device called the Bloom Energy Server, which can produce baseload power from flexible lithium-ion batteries at any time. The systems are usually used to supplement renewable energy systems at corporate buildings. Bloom often partners with utilities that purchase the systems to charge users directly for the electricity they generate.





Exits by energy corporate investors (Sep 2017 - Aug 2018)

Portfolio Company	Location	Sector	Exit Type	Acquirer	Exit size ($m)	Exiting investors
Bloom Energy	USA	Energy	IPO		$270m	Advanced Equities | Alberta Investment Management Corporation | Apex Venture Partners | Credit Suisse | DAG Ventures | Eon | Goldman Sachs | GSV Capital | Kleiner Perkins Caufield & Byers | Madrone Capital Partners | Mobius Venture Capital | Morgan Stanley | New Enterprise Associates | New Zealand Superannuation Fund | SunBridge | undisclosed investors
August Home	USA	Consumer	Acquisition	Assa Abloy		AGL Energy | Comcast | Creative Artists Agency (CAA) | KDDI | Liberty Mutual | Qualcomm | Sandisk | Singtel (Innov8)
Fenix International	USA	Energy	Acquisition	Engie		Engie | Orange | Schneider Electric
NewMotion	Netherlands	Transport	Acquisition	Royal Dutch Shell		Alliander | AutoBinck | DOEN Participaties | Egis Capital Partners | Entrepreneurs Fund | Tendris | Undisclosed strategic investors
Space-Time Insight	USA	IT	Acquisition	Nokia		ClearSky Power and Technology Fund | EnerTech Capital | Eon | NEC | Novus Energy Partners | Opus Capital | Start Up Farms International | Zouk Capital

Top exits from energy enterprises Sep 2017 - Aug 2018

Portfolio company	Location	Sector	Exit Type	Acquirer	Exit size	Exiting investors
Bloom Energy	USA	Energy	IPO		$270m	Advanced Equities | Alberta Investment Management Corporation | Apex Venture Partners | Credit Suisse | DAG Ventures | Eon | Goldman Sachs | GSV Capital | Kleiner Perkins Caufield & Byers | Madrone Capital Partners | Mobius Venture Capital | Morgan Stanley | New Enterprise Associates | New Zealand Superannuation Fund | SunBridge | undisclosed investors
PowerbyProxi	New Zealand	Energy	Acquisition	Apple	$100m	Samsung | TE Connectivity
Fenix International	USA	Energy	Acquisition	Engie		Engie | Orange | Schneider Electric
Chargemaster	UK	Energy	Acquisition	BP		Beringea | BMW | ProVen Growth | Qualcomm

Lock manufacturer Assa Abloy agreed to acquire US-based smart lock producer August Home for an undisclosed amount, enabling a number of corporates to exit. Those included energy supplier AGL, insurance firm Liberty Mutual, and Comcast Ventures and Qualcomm Ventures, respective subsidiaries of Comcast and chipmaker Qualcomm. SanDisk Ventures, CAA Ventures and SingTel Innov8, the corporate venturing units of data storage provider SanDisk, talent agency CAA and telecom groups SingTel and KDDI were other exiting investors. Founded in 2013, August Home provides smart locks that allow users to control access to their homes through their mobile devices. The company's products are compatible with Google Home, Amazon Alexa, Apple HomeKit and other smart home hubs.

KDDI agreed to acquire US-headquartered solar system provider and portfolio company Fenix International for an undisclosed amount, providing exits to industrial group Schneider Electric and telecoms firm Orange. Founded in 2009, Fenix provides small-scale solar energy systems to customers in developing nations that are not connected to the main electrical grid, enabling them to get the systems through a lease-to-buy scheme. The company mainly operates in Uganda, where it serves some 140,000 customers, but is also present in Zambia and intends to expand to other African nations.

NewMotion, a Netherlands-based electric vehicle (EV) charging station operator backed by vehicle distributor AutoBinck, was acquired by Shell for an undisclosed amount. AutoBinck previously contributed to a funding round of undisclosed size alongside energy distributor Alliander, sustainable technology holding company Tendris and Entrepreneurs Fund. Founded in 2009, NewMotion enables EV owners to charge their cars at more than 50,000 charging points across 22 countries. The stations draw their power primarily from renewable energy sources, and corporate clients can track the usage of each driver in their fleet through a cloud-based platform.

SpaceTime Insight, a US-based industrial IoT developer backed by Eon and IT services provider NEC, was acquired by communications technology producer Nokia for an undisclosed amount. Founded in 2008, SpaceTime Insight has developed a real-time visual analytics platform that relies on machine learning and industrial IoT applications to automate the optimisation of physical assets and predict asset failure across large networks. Nokia expects the acquisition to strengthen its IoT software and analytics offering and enable it to enter verticals such as energy, logistics, transportation and utilities.

Global Corporate Venturing also reported a few exits of emerging energy-related enterprises that involved corporate investors from other sectors.

Consumer electronics producer Samsung and sensor manufacturer TE Connectivity exited New Zealand-based wireless charging developer PowerbyProxi following its acquisition by computing company Apple, reportedly for at least $100m. While the exact figure was not confirmed, the deal's minimum value was confirmed

Top energy funding initiatives (Sep 2017 - Aug 2018)

Fund Name	Type	Funds Raised	Location	Backers	Focus
Sinopec Capital	CVC Unit	$1480m	China	Sinopec Engineering Group	Energy, IT, Industrial, Services
Cathay Smart Energy Fund	VC Fund	$239m	China	Cathay Capital | Total | Hubei High Technology Investment Guiding Fund Management	Energy
AP Ventures	CVC Unit	$200m	UK	Anglo American | Public Investment Corporation	Energy
Unnamed Westly Fund	VC Fund	$150m	USA	Westly Group | Duke Energy | RWE Innogy | CLP Group | American Electric Power (AEP) | Chubu Electric Power | Bridgestone Corporation	Energy
Unnamed SSC fund	VC Fund	$150m	Singapore	Spring Seeds Capital | Trendlines Medical-K2 Global |IMC Group | Heritas Capital | Armstrong Industrial	Energy, Industrial, Health
Inven Capital	VC Fund	$118m	Czech Republic	Čez | European Investment Bank (EIB)	Energy
Future Energy Fund	VC Fund	$100m	USA	Chevron	Energy
Navitas Capital II	VC Fund	$60m	USA	Navitas Capital | Equity Residential | Saint Gobain | Jones Lang LaSalle | Divco West Real Estate Services	Services, Industrial, Energy, Consumer
Capricorn Sustainable Chemistry	VC Fund	$60m	Belgium	Capricorn Venture Partners | Siam Cement Group (SCG)	Industrial, Energy
Unnamed Bharat Fund	VC Fund	$50m	India	Bharat Innovations Fund | Philips | ICICI Lombard | Bajaj Electricals | RBL Bank | Small Industries Development	Industrial, Financial, Energy

by New Zealand government agency Overseas Investment Office in a summary approval. Founded in 2007 as a spinout from University of Auckland, PowerbyProxi has been developing wireless charging technology for a range of battery powered devices including sensors, robotics and medical equipment.

BP agreed to acquire Chargemaster, the UK-based operator of a network of EV charging points, for an undisclosed amount allowing automotive manufacturer BMW to exit. Founded in 2008, Chargemaster designs, builds and installs EV chargers, and currently operates a 6,500-strong network of charging points across the UK spanning both public and in-home systems. It receives money through a mix of subscription and pay-as-you-go fees. BP made the acquisition to support the installation of charging points on its garage forecourts, allowing EVs to recharge alongside conventional vehicles that are buying fuel.

Funds

Between September 2017 and August 2018, corporate venturers and corporate-backed VC firms investing in the energy sector secured over $2.39bn in capital via 19 funding initiatives, which included 10 VC funds, five newly-launched venturing units, two accelerators, one incubator and one other initiative.

On a calendar year-to-year basis, funding initiatives registered a slight decrease in number– from 27 in 2016 down to 25 last year. Total estimated capital also went down from $3.86bn in 2016 to just $513m in 2017 but it seems to be rebounding in 2018 with $2.47bn raised by the end of August.

Please add chart from Energy funding initiatives.pdf and entitle “Energy funding initiatives 2011-2018”

China-based oil, gas and chemicals supplier Sinopec formed an investment firm called Sinopec Capital, equipped with RMB10bn ($1.48bn) of capital. Sinopec Capital will invest in emerging areas such as new energy, advanced materials, artificial intelligence and smart manufacturing and supply chain technologies. Although Sinopec did not state explicitly that the vehicle will invest in startups, its activities will cover equity investments and management as well as project investments and asset management. The fund will get 49% of its capital from oil and gas refiner Sinopec Corp and the remaining 51% from parent company Sinopec Group, which also produces a range of petroleum-related products.

Total Energy Ventures (TEV), the corporate venturing subsidiary of oil and gas company Total, agreed to form a RMB1.5bn ($239m) fund in partnership with two other investors - private equity firm Cathay Capital and Hubei High Technology Investment Guiding Fund

Management, a fund overseen by the local government in the Chinese province of Hubei. The two will provide RMB300m each for the fund. Cathay Smart Energy Fund, as it is dubbed, will target China's new energy sector and will invest in areas such as renewable energy, energy storage, distributed energy, smart energy, internet-connected energy and low-carbon technologies.

UK-based venture capital fund AP Ventures launched with $200m of capital, $100m of which came from Anglo American Platinum, the platinum-focused subsidiary of mining company Anglo American. The remaining $100m came from AP Ventures' other cornerstone investor, South African government-owned asset management firm Public Investment Corporation. AP Ventures will invest in companies developing technologies or products that make use of the platinum group metals (PGMs) that Anglo American Platinum sources, including systems that can help integrate renewable energy or mitigate the effects of population growth. Areas that could be covered by AP Ventures' brief include hydrogen infrastructure, energy storage, fuel cell-based electric mobility, water purification, medical devices, sensors and durable electronics. The fund will be based in London.

US-based venture capital firm The Westly Group raised $130m for its latest fund, with several corporates among the limited partners. Duke Energy and RWE Innogy were among the anchor investors, and the limited partners (LPs) included fellow energy utilities CLP Group, American Electric Power and Chubu Electric Power as well as tire manufacturer Bridgestone. Founded in 2007, Westly focuses on energy, transportation and smart building technology developers, and the latest fund will provide between $3m and $5m per investment.

Industrial equipment maker Armstrong Industrial Corporation was one of nine partners that have joined Spring Seeds Capital (SSC), the venture capital branch of government agency Spring Singapore, for a S$200m ($150m) co-investment scheme. Spring Singapore put up S$100m of capital for the initiative, which will provide funding for startups over an eight-year period. The partnership will look to invest in advanced manufacturing and engineering, health and biomedical sciences, and urban and sustainability technology developers.

Czech Republic-based energy utility ez and the European Union-owned European Investment Bank (EIB) agreed to each invest €50m ($59m) in Inven Capital, the venture capital fund formed by ez. The funding will be aimed at cleantech and smart energy developers, particularly small and medium-sized enterprises (SMEs) as well as midcaps – companies with a market capitalisation of $2bn to $10bn. Inven Capital generally provides between €3m to €20m per investment and targets technologies such as distributed power generation, energy efficiency, energy storage and flexible transmission, clean transport and smart cities.

Chevron Technology Ventures (CTV), the strategic investment arm of oil and gas producer Chevron, launched a $100m fund called Future Energy Fund to back energy transition technology. CTV was founded in 1999 and targets developers of technologies such as emerging materials, power systems, water management, IT and oil and gas production improvement. It also provides capital to strategically relevant venture capital funds. Future Energy Fund will concentrate on energy generation technologies that generate lower carbon emissions, or which can reduce emissions from oil and gas production. Read more in Tom Whitehouse's interview with the president of Chevron Technology

Ventures Barbara J. Burger in this issue of the magazine.

Navitas Capital, a US-based venture capital firm that focuses on the real estate and construction industries, closed its second fund at $60m fund, raising capital from several corporates. The LPs include construction materials supplier Saint-Gobain, real estate management and investment firms JLL and Divco West Real Estate Services as well as apartment owner and manager Equity Residential. Navitas targets companies in the space where energy and software meet in the construction and real estate sectors and invests up to $5m in developers of technologies such as smart systems, energy and heat efficiency, advanced materials and workflow management software.

India-based venture capital firm Bharat Innovation Fund (BIF) raised $50m from limited partners including electronics producer Philips, insurance provider ICICI Lombard and electrical equipment manufacturer Bajaj Electricals. Financial services firm RBL Bank and the Indian government-owned development financial institution Small Industries Development Bank of India also contributed capital, the latter through its Fund of Funds for Startups. BIF, an affiliate of Indian Institute of Management Ahmedabad's Centre for Innovation Incubation and Entrepreneurship, is targeting a $100m final close according to recent press reports, having initially been rumoured to be seeking $150m at the time of the fund's 2016 launch.

People

Cory Steffek left Saudi Aramco Energy Ventures (SAEV), the corporate venturing arm of petroleum producer Saudi Aramco, where he was a managing director, to join US-based private equity investment platform Ara Partners. Ara Partners focuses on lower middle market investments in the energy, industrial and infrastructure industries. Steffek had joined SAEV in 2012 and his role with the Saudi Arabia-headquartered unit had been based in Houston, Texas. SAEV generally concentrates on technologies that improve the identification and management of energy reserves and the efficiency of their use, but its North American branch has increasingly moved into more generalised enterprise software developers, such as Parsable, Maana and Foghorn.

Jonathan Tudor left BP, where he was managing director of its BP Ventures unit, to head a corporate venturing subsidiary of Centrica. Tudor had been venture director at Castrol InnoVentures, a division of BP, before its reorganisation into BP Ventures. Tudor had worked at lubricants provider Castrol and BP. Following three years at glass manufacturer Schott, Tudor's initial move into investing was as an investment director at government technology contractor Qinetiq's venture capital arm, Qinetiq Ventures, from 2002 to 2007, before its secondary buyout backed by Coller Capital led to the formation of CG Innovation Partners.

Girish Nadkarni, formerly president of Switzerland-based power and automation group ABB's corporate venturing unit, ABB Technology Ventures, has joined France-based Total to lead its corporate venturing subsidiary TEV. Nadarkani moved to Paris, France, to take the president position at TEV. Francois Badoual, former chief executive of TEV in France, moved to San Francisco to be president of Total New Energies Ventures USA. After Nadkarni's departure in October 2016, Grant Allen stepped up to head ABB Technology Ventures. Prior to setting up ABB Technology Ventures, Nadkarni was senior vice-president of ABB's robotics division. He also worked at venture capital firm View Group, and as an entrepreneur at startups VSimplify and Uniprise.

Lisa Lambert, former managing partner at venture capital firm Westly Group, rejoined the corporate venturing community as senior vice-president and chief technology and innovation officer at UK and US-listed energy utility National Grid. Before joining Westly two years ago, Lambert had worked at Intel Corporation for 19 years as vice-president and managing director of corporate venturing unit Intel Capital's software and services group. Lambert was also founder and managing director of Intel Capital's Diversity Fund, and she led global investments in more than 100 companies and produced top decile returns, including seven flotations and over 30 trade sales.

Imran Kizilbash left his position as vice-president and treasurer at US-based oil services provider Schlumberger. One of Kizilbash's former colleagues stated he would remain close to Schlumberger Technology Investments (STI) after his departure. STI had expanded into categories like renewables, software and the IoT under Kizilbash's leadership and its function essentially comes down to "being ready to transform if and when required."

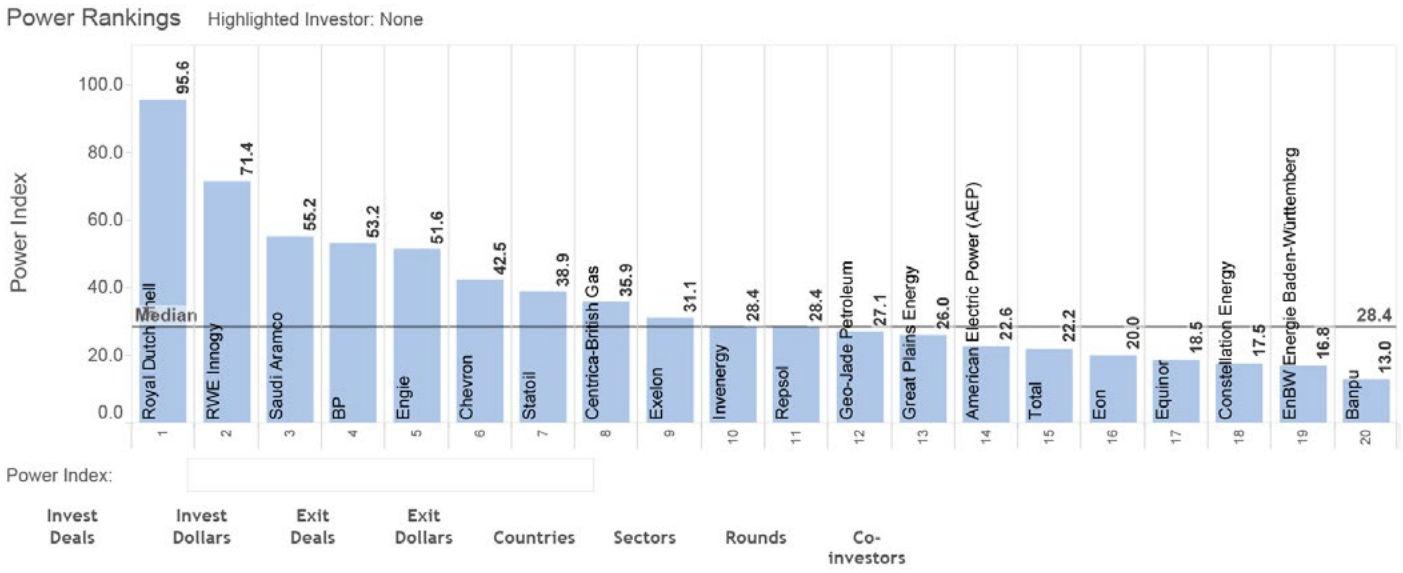
After four years as deputy director of corporate venture capital at Engie, Eric Vincent moved to a partner position at France-based venture capital firm Demeter Partners. Earlier this year the city of Paris had chosen Demeter to manage its €200m ($245m) Paris Green Fund (Paris Fonds Vert), making minority investments in six sectors – buildings, mobility, energy, air, waste and digital technologies – for sustainable cities. Vincent had been deputy director of Engie unit Engie New Ventures, investing in decentralised power generation, alternative fuels, energy management, smart grids, energy efficiency, home comfort, mobility and smart cities technologies.

Swati Dasgupta has left Next47, a subsidiary of industrial conglomerate Siemens, for a director position at National Grid Ventures, the strategic investment arm of National Grid Group. National Grid Ventures oversees investments in technology startups, energy projects and partnerships on behalf of its parent. Prior to joining corporate venturing vehicle Next47 as a director in 2017, Dasgupta had been a director of external innovation at Siemens' technology-to-business unit, TTB, from 2013. Dasgupta had previously spent nearly a decade as a partner at IBM Venture Capital Group, a corporate venture capital subsidiary of computing technology producer IBM.

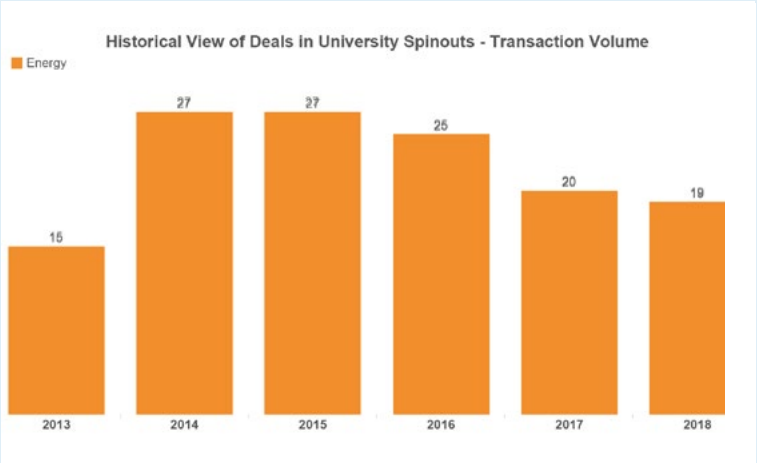
Mike Adams became a US-based director of corporate ventures at Germany-based air and water filter provider Mann+Hummel Group. Adams moved to Mann+Hummel after having previously been a principal for just over four years at 8 Rivers Capital, an energy, sustainability, transport and communications technology developer. Adams had previously been managing director of technology ventures at energy provider Constellation Energy as part of a nine-year stint at the company.

VC firm Aster Capital hired Jérome Joaug as a principal on its investment team to focus on the mobility, energy and industry sectors. Joaug is a serial entrepreneur who co-founded graphene producer Cambridge Nanosystems, a spinout from University of Cambridge, and IoT platform Nymbly. He is a graduate of both Cambridge and École Polytechnique. Aster Capital emerged out of Schneider Electric Ventures, the corporate venturing arm of industrial group Schneider Electric, becoming independent in 2010 and attracting equipment provider Alstom and chemicals company Solvay as limited partners.

Christina Karapataki left her venture principal position at Schlumberger Technology Investments, to join venture capital fund Breakthrough Energy Ventures



(BEV). BEV is an investor-led fund made up of members of the Breakthrough Energy Coalition, guided by scientific and technological expertise and committed to "investing patiently in developing new ways to live, eat, travel and build." The coalition's leadership is made up of entrepreneurial investors and scientists. The fund targets early-stage innovations in the emissions-free energy, agriculture and consumer goods sectors. Karapataki has took an investor role at BEV. While at Schlumberger, Karapataki was responsible for sourcing opportunities, technical evaluation and structuring joint development agreements, in addition to overseeing about half of Schlumberger's portfolio companies.

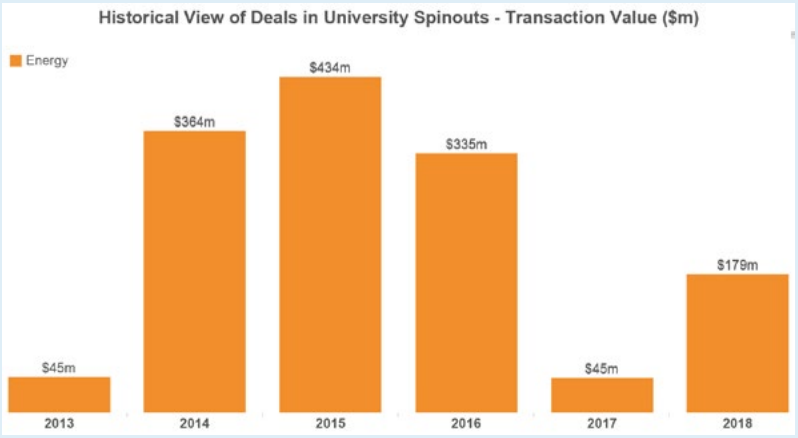


University and government backing for energy businesses

Over the past years, we reported various commitments to university spinouts in the energy sector through our sister publication, Global University Venturing. By the end of August this year, there were almost as many rounds raised by university spinouts (19) from this sector as in the entire 2017 (20). The level of estimated total capital deployed in those rounds stood at $179m, considerably higher than $45m in 2017.

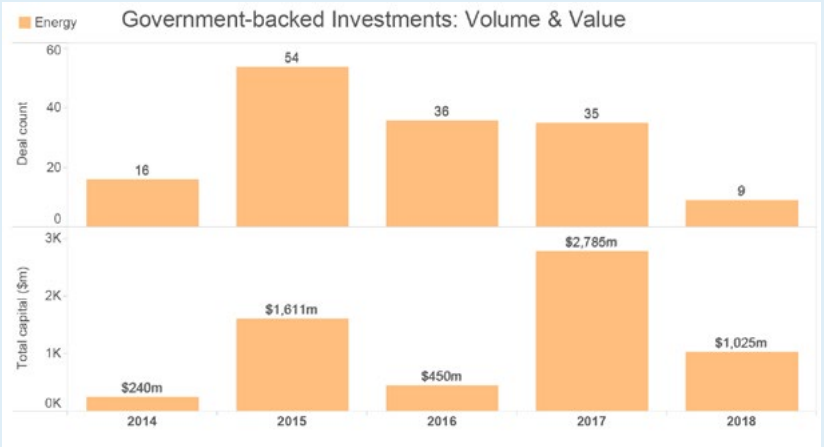
SolidEnergy Systems, a US-based lithium-metal battery technology developer spun out of MIT, closed a $34m series C round. The company did not disclose the participants in the round, which it said increased its overall funding to more than $50m since it was spun out of MIT in 2012. SolidEnergy is working on rechargeable semi-solid lithium-metal cells that could be produced using existing lithium-ion manufacturing technology. The company plans to employ the funds for expanding its manufacturing capability both internally and through cell manufacturing partners.

UK-based energy distribution management software developer Origami Energy closed an £18.6m ($26.3m) series B round with a



consortium featuring Cambridge Innovation Capital (CIC), the patient capital fund affiliated with University of Cambridge. The round also featured power production services provider Aggreko, as well as unspecified subsidiaries of shipping group Fred Olsen and investment firm Octopus Ventures. Founded in 2013, Origami Energy has developed technology to remotely monitor and control energy distribution flows in real-time. The system can facilitate the integration of renewable energy and batteries, while helping wholesalers spot opportunities during day-to-day market trading.

Government investments in energy enterprises, reported by our other publication, Global Government Venturing, had reached a peak at 54 rounds in 2015 but have since gone down to 36 and 35 in 2016 and 2017. However, the estimated total capital in such rounds reached $2.77bn last year and it appears to be on an upward path. In 2018, we have reported only nine government-backed rounds in emerging energy businesses but the estimated capital in them amounts to $1.02bn. Innovations in the energy sector are naturally attractive to government and related investors, as the sector is instrumental for future growth of virtually all other industries.



Clean energy technology developer Cypress Creek Renewables, a US-based clean energy technology company, received investment worth $200m from a group including Singaporean government agency Temasek. Founded in 2014, Cypress Creek Renewables develops solar energy facilities, using a data-driven approach and partners with landowners, communities, utility companies and other stakeholders to develop underutilized land on which it builds solar farms ranging from 2 to 20 megawatt (MW).

Canada Pension Plan Investment Board (CPPIB) agreed to pay $144m for a 6.3% stake in ReNew Power, an India-based renewable power producer. CPPIB, which manages funds on behalf of the government's Canada Pension Plan scheme, acquired the shares from the multilateral Asian Development Bank, which had invested $50m in ReNew as part of a $140m round in 2014. ReNew, which is also backed by corporate joint venture Jera, develops renewable energy projects and had built a 2 GW portfolio of wind farms, utility-scale solar plants and rooftop solar systems. ■