The great European gigafactory
The fight to make it an economic reality

Paraclete Energy
The CEO, the joys of silicon, and the thrills of entrepreneurship

Argonne reveals all
Astonishing insights for lead offer make-over in the chemistry’s fortune

Meet Wally Rippel
The father of e-mobility is still pushing the EV goalposts forward

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PLUGGING EUROPE INTO THE FUTURE
Europe may need as many as 20 gigafactories to meet future lithium cell demand. Given its late moves into the sector, the big question is whether the region can stand on its own two feet or whether established players from Asia will walk away with the market. So is it better to be late than never?

EDITORIAL
No need for Europe to drag its feet

PEOPLE NEWS
Hoppecke hires ex-Johnson Controls director • Exide Technologies appoints new president and CEO • Centrica appoints Hookway as new business chief executive • Northvolt expands board of directors • SEPA welcomes new directors • Former White House official named as Highview’s chairman • Eguana Technologies hires two more Mercedes sales staff • Renewables expert appointed as chair of VPP firm Solo Energy • NEC Energy Solutions hires three senior staff • Second-life battery ESS firm announces first of key appointments • Flow battery firm ESS appoints new board chairman • EUROBAT appoints Gert Meylemans as head of PR • GE Power announces new chairman and CEO • Beuteschies becomes global VP sales for ENTEK • Clarkson University appoints Vu as assistant professor

NEWS • FINANCE NEWS • FLOW BATTERY NEWS • VPP NEWS
Our quarterly round-up of the most significant projects, technologies, regulations, events and happenings including a must-read round-up of industry activities

SPECIAL SUPPLEMENT — EES INTERNATIONAL EXHIBITION SERIES
Our comprehensive guide to the future events happening in the energy storage industry.

FEATURES
How a silicon materials start-up could change the Li-ion landscape
When it comes to entrepreneurs, the million dollar question is, are they made or are they born? In the case of Jeff Norris, CEO of Paraclete Energy, the answer is both. He talks about paper rounds, life lessons and silicon materials.

Improving lead battery performance through in situ electrochemical techniques
Real time charging and discharging analysis at Argonne National Laboratory’s is proving there’s a lot more life in the traditional battery chemistry

Carving out a new EV landscape
Wally Rippel’s enthusiasm for battery-electric cars goes back half a century to the Great Electric Car Race of 1968 but he’s been at the cutting edge of development from the pioneering by GM of EV-1 to the latest thinking with Tesla.

EVENT REVIEWS
ees/IBESA, Strasbourg, France: Making the case for energy storage opportunities in France
Future Resource, Birmingham, UK: Making the worlds of conservation and storage join up

EVENTS
Our comprehensive guide to the future events happening in the energy storage industry.

Paraclete’s Norris from paper rounds to silicon
The great and the good, assembles reviewed

PLUGGING EUROPE INTO THE FUTURE
Northvolt’s Campbell: the gigafactory rolls on...
How many pen-pushers does it take to change a light bulb?

The answer of course is 13. That’s 12 to write the feasibility study, check compliance with international ISO standards, conduct the performance analysis and devise a 10-point roadmap.

But just one to screw it into the kitchen tap.

Perhaps this is too easy a joke to make about the role of bureaucrats in reaching decisions but it makes a point.

Commercial decisions by the unelected, the unelectable and the unaccountable are rarely the wisest. And the trouble for Europe is that this lack of commercial coherence goes right to the heart of the institutions that govern it.

At the centre of the continent’s decision-making is the European Commission. It’s a huge sprawling organization of 32,000 civil servants working in a variety of locations and a multiplicity of languages — the ones in general circulation are English, French and German — but in all there are 24 official languages.

The job of the Commission is to create policy that the European Parliament will eventually vote on.

The Commission is the sole initiator of legislation. It drafts the policy to the finest crossing of the ‘t’ and dotting of the ‘i’. It is also under no external compulsion to show how it reaches its decisions.

As its many distractors will claim, there is no transparency in its internal discussions and very little explanation of its mechanisms. And accountability for its decisions, there is none.

A classic example of this happened just a few weeks ago,

In a meeting held in Brussels on October 25 a group known as the Reach 133 Committee met behind closed doors to decide — effectively at least — the fate of the European lead battery industry. No industry experts or technical representatives were allowed to be present at the meeting. Nor were the press permitted.

A decision was to be made on whether four lead compounds — lead monoxide, lead tetraoxide, tetralead trioxide sulfate and pentalead tetraoxide sulfate — would be banned for use in the European Union.

These lead compounds are indispensable in the manufacturing process of lead batteries, but do not themselves appear in the final battery — which is in any case completely sealed.

Without them no lead batteries could be made in the European Union. A whole industry could disappear at a stroke. The 298 million vehicles on Europe’s roads would have to go abroad to buy their batteries.

Although the European Union likes to portray itself as being ‘business friendly’ the reality is that these decisions are being made by people with no knowledge of business, be it friendly or otherwise!

Instead decision-making is heavily influenced by a vast array of lobbyists that hang round Brussels and the other areas where the Commission operates. The cost of lobbying as a whole for all the industries that want to push decisions their way is not just a multi-million euro industry but one measured in the hundreds of millions.

And decisions made by the Commission often lack any commercial sense at all.

When faced with opposition to an early practice of having the European Parliament meet in Brussels for most of the time but relocate to Strasbourg 450km away for four days every month, what did the Commission recommend?

It simply enshrined the tradition in a 1997 treaty binding all present and future EU member countries to the deal.

But it is this lack of commercial logic that is holding back energy storage in Europe. While other regions of the world have looked at the mass production of lithium cells — the so-called ‘gigafactories’ — Europe has been the clear laggard.
In China a huge wave of subsidies were introduced from the early 2010s on lithium battery applications and providing a huge boost to commercialization of cells in scale. South Korea, meanwhile, has invested heavily in cell manufacture and until the recent arrival of CATL, large scale cell manufacture was mostly the domain of firms such as Samsung, LG Chem or Japan’s Panasonic.

In the US, president Barrack Obama allocated some $3 billion of funding from its 2009 ARRA recovery money to promote the development of next generation energy storage products.

But although individual European nations — most particularly Germany — saw the future, the European Commission produced little but policy papers and statements of intent.

Or that was until this time last year when the EU suddenly saw that it was lagging behind the rest of the world. In 2016 it started to make some recognisable noises about the need for energy storage but this only took substance with the creation of the European Battery Alliance in October 2017.

And this showed how serious it saw the need for catch-up. “Europe has to move fast in the global race” the alliance said. The alliance being, in the management talk of the 1990s, presumably looking for last-mover advantage?

Predictably the answer was to throw a wall of money at the problem. No criticism there. It’s very much needed — even if it may well be too late.

So can Europe catch-up with the rest of the world? Expert opinion is divided. Most reckon that this flood of money will be needed to give Europe even a chance to compete in price with foreign entrants. Others say the race is lost.

But let’s not just blame civil servants.

A new generation of barmy politicians are setting out increasingly dreamy statements of intent that cannot be ever achieved in practice.

And these go far beyond the scope of the European Union.

Costa Rica, for example, announced this April that it intends to phase out the sale of all internal combustion engines by 2021. In this they are slightly behind Austria’s ambitious plan to phase out sales by 2020.

At the time of writing this is just 13 months away.

The movement toward clean cars at a city level has been in the international spotlight since 12 mayors signed the C40 Fossil-Fuel-Free Streets Declaration in October 2017, committing their cities to all-electric buses by 2025 and zero emissions in designated areas by 2030.

So citizens in London, Los Angeles, Madrid and Paris, for example, will shortly enjoy walking (and probably jogging too) in sunny emission-free cities, while outside, economic chaos reigns.

These are noble ambitions and worthy aspirations. Across Europe there is talk that emissions from diesel cars, in particular, are responsible for the early deaths of some 100,000 people a year.

But worthy aspirations clumsily designed and foolishly executed are still not worth the pledges made or finances allocated.
Northvolt expands board of directors

Swedish gigafactory developer Northvolt announced on October 30 it had appointed Tom Johnstone and Susanna Campbell as members of its board of directors. Johnstone is the chairman of motorcycle company Husqvarna, deputy chair at smart technologies firm Wärtsilä, and a board member of vehicle OEM Volvo Cars. Campbell is an independent investor and member of several boards including Norrsken Founders Fund, Swedish headquartered telecoms firm Telia Company and Swedish industrial group Indutrade. They have both previously been a part of Northvolt’s advisory board.

Exide Technologies appoints new president and CEO

Battery giant Exide Technologies announced on November 14 that Timothy Vargo had taken over as CEO and president from outgoing Victor Koelsch. The announcement said the change would be effective immediately, but that Koelsch would remain until December 31 as an adviser to Vargo. Vargo is on Exide’s board already, having joined Exide two years ago from Motor Car Parts of America, an automotive parts manufacturer and distributor. He has considerable experience in the auto industry, having previously worked for TruckPro, a heavy duty truck part distributor, and before that he sat on the board of directors at ATU, a German auto parts and service provider. Vargo was president and CEO at Kele, Inc, an independent distributor of building automation systems, before he joined Exide in June 2017.
“Having served on the board of Exide for two years and being very familiar with the company from my career in the automotive aftermarket, where I knew Exide as a supplier,” said Vargo.
“I’ve come into the CEO role with a good understanding of the company’s strengths and opportunities in the marketplace. The vision I have for Exide is to be the best partner for each of our customers as their needs evolve. “I see a huge opportunity for us to earn a greater share of their battery business by continuing to serve our customers at a high level in terms of quality and on-time delivery while also being an innovation leader in key categories.”

Centrica appoints Hookway as new business chief executive

Multinational energy company Centrica announced the appointment of Richard Hookway as its chief executive of Centrica Business on September 14. Hookway starts on December 1, when he will also join the Centrica board. The announcement follows the news that Mark Hanafin will retire at the end of March 2019. Hanafin will also step down from the board on November 30 after 10 years at the company.

Hoppecke hires ex-Johnson Controls director

Stationary and motive battery maker Hoppecke Industrial Batteries — the UK arm of Hoppecke Batterien — has appointed Jon Bailey as its managing director, the company announced on October 17. Bailey has around 38 years of battery and automotive related experience. He was national sales manager in the UK for VB Automotive Batteries before moving to Manbat in 2010. In 2013 he became regional director UK & Ireland for Johnson Controls until its merger/takeover by Ireland’s Tyco in September 2017. Hoppecke says Bailey will focus on delivering growth through strategic partnerships, including the UK’s energy storage marketplace and target development opportunities for new technologies. He will also assess the potential to introduce Hoppecke products into niche areas, especially the rail and reserve power sectors.

People News
SEPA welcomes new directors

Energy industry CEOs Gil Quiniones, of the state-owned power utility New York Power Authority, and Adrian Tuck, of energy management software company Tendril, have been elected to Smart Electric Power Alliance’s board of directors, the alliance announced on October 31.

Four people were also re-elected for another three-year term.

They were: Chris King, global policy officer, Siemens Digital Grid; Gary Rackliffe, vice president smart grids, ABB; Seth Frader-Thompson, president, EnergyHub; and Joe Hoagland, vice president of stakeholder relations, Tennessee Valley Authority.

“The election underlines the importance that SEPA’s membership places on having diverse voices on the board, from both the utility and technology sides,” said Cris Eugster, chair of SEPA’s board.

The SEPA board of directors consists of 17 members, including executives from utilities and technology firms, along with former policy makers.

Former White House official named as Highview’s chairman

Highview Power, the liquid air energy firm, named renewable energy and environmental leader David Sandalow as chairman of its US subsidiary Highview Power Inc on October 1.

Sandalow, a former senior White House, US State Department, and US Department of Energy official, had previously advised the company on how to develop and deploy utility-scale liquid air energy storage systems in North America.

Sandalow has been honorary chair of the US Energy Storage Association’s annual conference.

From 2009-2013, Sandalow has held senior positions in the US Department of Energy, where he helped oversee the department’s renewable energy, energy efficiency, fossil energy, nuclear energy and electricity delivery programs with an annual budget of more than $3.5 billion.

Javier Cavada, president and CEO of Highview Power, said Sandalow’s counsel would be valuable as they work with partners, utilities, grid operators, and government officials to deploy LAES on to the grid and enable wind and solar to penetrate their baseload power generation mix at increasing levels.

Eguana Technologies hires two more Mercedes sales staff

Residential and commercial energy storage system firm Eguana Technologies announced on October 15 it had appointed two high level Mercedes-Benz Energy sales members.

Marcus Brunner, former chief sales and marketing officer at Mercedes-Benz Energy, was named the Canadian firm’s new chief sales officer.

Andreas Rueckemann, the ex-head of sales Europe, will be Eguana’s new director of sales Europe.

The latest appointments bring the number of Mercedes-Benz Energy employees on Eguana’s books in the past few months to three.

They follow the appointment of Livio Filice as its director of residential sales in North America in June this year. Filice is the former energy storage business development manager at Mercedes.

Renewables expert appointed as chair of VPP firm Solo Energy

Virtual Power Plant firm Solo Energy announced on October 11 it had appointed Julia Lynch Williams as chair of its board.

The consultant in renewable energy, energy retail and energy services at Commodore Consulting and former RWE executive was appointed to develop investor relations and advise on commercial strategies.

The announcement follows the appointment of Ben Hill, former VP of Tesla EMEA, as its new commercial and technical adviser in September.

Hill is also the CEO of UK energy storage firm b3 New Energy, and founded and ran Tesla Energy across the EMEA region.
Musk ejected from chairman seat

Elon Musk resigned as chairman of electric vehicle and energy storage OEM Tesla on October 1 after the US Securities and Exchange Commission charged him with securities fraud following a series of tweets regarding plans to take the company private.

Musk, who will remain the company’s CEO, agreed to pay a $20 million fine — 50% of a fine levelled at Tesla, which was charged with failing to have required disclosure controls and procedures relating to Musk’s tweets.

According to the SEC’s complaint against him, Musk tweeted on August 7, 2018 that he could take Tesla private at $420 per share, that funding for the transaction had been secured, and that the only remaining uncertainty was a shareholder vote.

Musk knew that the potential transaction was uncertain and subject to numerous contingencies, the SEC’s complaint alleged.

According to the Commission’s complaint, Musk’s tweets caused Tesla’s stock price to jump by more than 6% on August 7, leading to significant market disruption.

CellCube appoints financier to board of directors

CellCube Energy Storage Systems announced on September 5 that international financier and real estate developer Bruno Arnold was to join its board of directors.

Second-life battery ESS firm announces first of key appointments

Connected Energy appointed Mark Bailey as its new chief commercial officer, the British energy storage technology developer announced on October 16.

The former Engie director led the company’s investment in Connected Energy, the second-life electric vehicle battery ESS maker, earlier in 2018.

Matthew Lumsden, CEO at Connected Energy, said: “Mark knows our business inside out, having worked with us whilst at Engie. We are entering a period of significant growth and this is the first of several appointments we will make over the next 18 months.”

Flow battery firm ESS appoints new board chairman

Flow battery manufacturer ESS announced on September 13 it had appointed Michael Niggli as its board chairman — two years after he first took a seat on the board.

The Oregon, US, firm also announced Tim Neville had joined the company as vice-president of operations.

Niggli and Neville will provide guidance as ESS develops relationships with utilities and ramps up manufacturing to meet growing demand for long-duration flow batteries, said company founder and CEO Craig Evans.

The appointment of Niggli has meant the departure of David Lazovsky, who had been chairman since February 2017.

NEC Energy Solutions hires three senior staff

Energy storage firm NEC Energy Solutions announced three senior appointments on October 22.

Erik Fogelberg becomes vice president of global sales; Roger Lin, vice president of marketing; and Jacques Goldenberg vice president of human resources.

Fogelberg was the former vice-president of commercial sales for the Americas at Tesla Energy. Before that he was the senior vice-president of commercial sales and storage solutions at Solar City, a Tesla subsidiary.

Lin was promoted from his role as senior director of product marketing at NEC. He had previously held jobs at lithium ion start-up A123 Systems.

From left to right: Erik Fogelberg, Jacques Goldenberg, Roger Lin

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IN BRIEF

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Cross-energy firm appoints COO

Cross-energy firm appointed Christopher Hounsfield as its new chief operating officer — the 32-year-old is leaving his current director role at Oxford Nanopore Technologies.

Hounsfield has worked with Hounslow Council and the University of Bath on projects and events.

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EUROBAT appoints Gert Meylemans as head of PR

EUROBAT, the European battery manufacturers’ association, announced in early September it had appointed Gert Meylemans as senior manager of communications.

Meylemans is former head of PR and corporate communications at the tyre company Bridgestone Europe.

Since leaving Bridgestone in 2016 Meylemans has worked as a communications consultant for CLEPA, the European automotive suppliers’ association, and before that Propel RC, a drone manufacturer that makes, among other machines, Star Wars battle drones.

“There’s a lot of legislative work ahead of us and lots of work to be done in the near future so I am going to be spreading the message, getting the industry on the map,” said Meylemans.

GE Power announces new chairman and CEO

GE Power, the energy company owned by General Electric, announced the appointment of Lawrence Culp as its new chairman and chief executive officer on October 1.

Culp succeeds John Flannery immediately following a unanimous vote of the GE board of directors.

The board also appointed Thomas Horton as lead director. Both people have been members of the board since April.

Culp said: “Tom and I will work with our board colleagues on opportunities for continued board renewal.”

Clarkson University appoints Vu as assistant professor

Clarkson University announced on October 11 it had appointed Tuyen Vu as assistant professor of electrical and computer engineering.

Vu had worked as a researcher for the Center for Advanced Power Systems in Florida for five years while also studying for his doctorate in electrical and electronics engineering.

Vu concentrates his research on smart grid, owner system dynamics, stability and control; energy management and optimization; and the integration of energy storage systems, renewable energy systems and electric vehicles into the distribution systems.
Negotiations begin for 1GWh of energy storage in Hawaii

Local utilities Hawaiian Electric, Maui Electric and Hawaii Electric Light announced on October 9 they are in contract negotiations with developers to build seven solar-plus-storage projects on three of the US state's islands.

If realized, the projects could produce long-term contracts for 855MWh of solar energy on Oahu, Maui and Hawaii islands.

The projects will also need to be approved by the Public Utilities Commission.

Working with the PUC, the companies tripled their original procurement scope for Hawaii Island to 60MW.

The seven projects include:
Oahu — three projects totalling 515MWh of storage;
Maui — two projects totalling 300MWh of storage;
Hawaii Island — two projects totalling 240MWh of storage.

The companies already have more than 500MW of renewable energy under contract in addition to nearly 80,000 private rooftop PV systems in operation.

Hawaiian Electric Company announced on May 2 it is planning to build a total of 120MW of lithium ion grid-scale energy storage to ensure its security of supply, allow for increased renewables penetration and reduce fossil fuel use on the Oahu electric grid.

At the start of the year, installations of PV plus battery systems had risen by 1,800% on Oahu, helped in part by falling prices.

Second-life partnership combines Nissan and EDF Energy technology

Nissan continues to push its second-life electric vehicle battery credentials and it announced a partnership on October 10 with EDF Energy to explore the UK utility’s demand side response platform, PowerShift.

The partnership will begin with a collaboration to explore how second-life Nissan LEAF electric vehicle batteries can support demand side management.

The joint project will explore the business case for using batteries from Nissan vehicles to store and release power back to the grid using PowerShift technology to react to demand side response.

The system will be trialled to see how it can support on-site generation, allow greater control and flexibility over energy use, and provide additional revenue streams.

The agreement also covers possible collaboration across smart charging, batteries, decentralized generation and grid integration.

Francisco Carranza, director of energy services, Nissan Europe, said: "We believe electric cars are just the start, and our second life programme ensures batteries from our cars continue to provide energy storage capacity in other applications – in houses, businesses, football stadiums even – long after their life in cars."

In July, ESJ reported that a 2.8MWh system, the largest of its type in a European commercial building, would combine Eaton’s power conversion units and the equivalent of 148 Nissan LEAF batteries at the famous Crujff Arena in the Netherlands.

In August, Nissan announced it had signed a memorandum of intent with Brazil’s Federal University of Santa Catarina to test its LEAF electric vehicle batteries in energy storage applications.

In April, Japanese firms Benex Corp and Sumitomo launched a project using second-life lithium ion batteries from 10 Nissan e-NV200 electric commercial vehicles to power Benex’s plant in Isahaya, Japan.

The project combines renewable energy, end-of-life batteries and electric vehicles to demonstrate a virtual power plant technology.

The project will use EV batteries to stabilize output from the rooftop solar panel system and for peak-shifting services to reduce the plant’s electricity costs.

Japan merger paves way for solid-state EV batteries

Japanese oil refiner Idemitsu Kosan looks set to move into all-solid-state lithium-ion batteries after a merger with Showa Shell Sekiyu, a Japanese subsidiary of Royal Dutch Shell group, the Nikkei Asian Review reported on October 1.

If the merger goes through next April, it will free up cash to commercialize the batteries, which are expected to be market ready in the 2020s.

Idemitsu has obtained patents and created a new unit to find ways of reusing the sulfur produced as a by-product during oil refining to make hydrogen sulphide.
Scottish cleantech company Nova Innovation announced on October 30 it had integrated a 500kWh Tesla Powerpack to its three 100kWh tidal turbines to form the world’s first grid-connected baseload tidal power station.

Nova’s Tidal Energy Storage System demonstrator in Shetland stores power generated by the six-hour cycle of the tide to deliver grid-scale services.

A Nova official said the system would provide general dispatch optimization and islanding with the power going into the Shetland grid.

The project was commissioned on October 12.

Sam Gardner, acting director of environmental charity WWF Scotland, said: “Predictable renewable power and smart storage working in harmony is the holy grail of the transition to a renewable electricity system. “It’s great that the Scottish government has backed this project and we hope it inspires politicians and others with the confidence to provide further support for ground-breaking technologies to cut climate pollution.”

Baseload capacity has traditionally been delivered by nuclear and coal, however with the transition to carbon-free energy Nova expects to be able to scale up their technology to hundreds of megawatts to deliver this continuous supply and displace traditional generation methods.

The project is set to be doubled to six tidal turbines.

Scotland has commissioned its first utility scale battery storage system with the launch of a 20MW facility in West Lothian, renewable energy firm RES announced on September 12.

The UK-based company built and will manage the Broxburn Energy Storage facility, owned by The Renewables Infrastructure Group (TRIG), which will provide grid services to system operator National Grid.

Those services include peak shifting and enhanced frequency response.

In the past decade, Scotland has grown its renewable generation to more than 60%, a success story the country is keen to build on in the next 10 years, its first minister Nicola Sturgeon MSP told the All Energy conference earlier this year.

Richard Crawford, director, Infrastructure at InfaRed Capital Partners, investment manager for TRIG, said: “As the installed base of renewables generation continues to increase, energy storage infrastructure projects like Broxburn are becoming increasingly important in balancing intermittent generation.”

The Livingston based NRS Group was the main civil contractor during the £1.5 million ($2 million) construction phase. The facility is managed 24 hours a day using RES’ RESolve operating system, from the company’s control centre in Glasgow.

The UK’s first subsidiary-free, municipal-run solar plus storage project was commissioned last month, German energy storage provider Tesvolt announced on October 31.

West Sussex County Council, the authority that commissioned the project, will sell power generated from the project on the electricity wholesale market for the next 25 years.

The ESS will access additional income from price arbitrage, frequency services and triad management/capacity market mechanisms adopted by the energy transmission system plus storage project was launched last month, Tesvolt’s 4.4MW system uses prismatic cells manufactured by Samsung SDI, and is connected to a 7.4MW solar park in Westhampnett, Sussex.

WSCC leader Louise Goldsmith said the project — the UK’s second subsidiary free solar farm and first to be combined with battery storage by a government authority — demonstrated that councils could have a role to play as leaders on energy.

Intelligent control of every single battery cell ensures the long service life of the storage system. This allows for optimal charging and discharging of the cells and for the prevention of errors or damage to the cells due to unequal states of charge.

(Triad is a UK charging mechanism adopted by power transmission company National Grid. The charge is calculated by taking three half-hour moments of highest demand between November and February, each being at least 10 days apart.)

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California pushes ahead with goal for 100% renewables

California has long led the US energy storage markets and could well be the leader at the forefront of renewable generation after the state’s governor Jerry Brown signed Senate Bill 100 on September 10, setting out a 100% clean energy goal by 2045.

The announcement was applauded by the US Energy Storage Association, which believes the law will send a strong investment signal for long-duration storage technologies, and accelerate investment and deployment of grid-scale storage.

An executive order has also been issued, establishing a target for the largest storage market in the US to achieve carbon neutrality in the same timeframe.

To do so, California will have to more than triple its in-state, non-CO₂ emitting generation to meet last year’s 206GWh of overall generated capacity, according to figures from the California Energy Commission.

A spokesperson from the commission said: “California has been actively pursuing power generation through clean energy resources for more than a decade. The state's first Renewables Portfolio Standard was established in 2002, and it has been constantly updated with even more ambitious targets.

California’s pioneering approach comes just over a year since president Donald Trump withdrew the US from the Paris Agreement, and follows a California Public Utility Commission target of more than 1GW of storage procurement by investor owned power utilities by 2024.

Governor Brown said: “This bill and the executive order put California on a path to meet the goals of Paris and beyond. It will not be easy. It will not be immediate. But it must be done.”

The bill's author, senator Kevin de León, said California had sent a message to the rest of the world that they were taking the future into their own hands.

The bill's ratification came two weeks after the state’s assembly passed SB 100, which establishes how much of the electricity system should be powered from renewable energy resources, half by 2025 and 60% by 2030.

The commission spokesman said: “Even though the deadline is nearly 30 years from today, utilities are already on the way to achieving the previous requirement of 50% renewables.”

The Energy Storage Association applauded the news, which it believes will position California as a leader in the US moving to 100% zero-carbon electricity by 2045.

ESA’s CEO Kelly Speakes-Backman said: “The innovation of California within the energy sector is welcomed by the storage industry as we stand on the precipice of realizing our own goal of 35GW of new storage deployed by 2023.

“As an enabling technology with many applications, the added flexibility storage provides to the grid will prove crucial to achieving the goals of SB100 in a cost-effective way and maintain reliability.

“Storage resources can be deployed to optimize existing renewable energy resources and to integrate additional ones, serving as a multiplier of the greenhouse gas reductions made possible by ambitious clean energy policies like California’s.

“Important to ESA members, SB 100 will also send a strong signal for long-duration storage technologies, further accelerating investment and deployment of reliable and cost-effective storage on the grid as a whole.”

Swedish firm buys secret 250MW storage-plus-solar project in US

Eolus, the Swedish management consulting firm, announced on September 10 that its wholly owned subsidiary, Eolus North America had bought its first solar-plus-storage project in America.

The project is in the early development phase, but the company says it has a planned capacity of 500MW solar PV and 250MW battery storage.

Further details such as the company the project was bought from (Eolus will not disclose the name) and the chemistry (not yet decided) are less forthcoming.

The company is somewhere in the western US, which means it is in a favourable region for renewable energy development, and has an interconnection queue position to deliver power to California.

Johan Hammarqvist, head of communications at Eolus, did tell ESJ that it was the company’s first solar and storage project, although they did have several wind projects in the US.

“We see a push in several western US states and their effort to reduce dependency on fossil-fired generation and instead increase their renewable energy production. For instance, with California making SB 100 law,” said Hammarqvist.

“SB 100 sets a target to arrive at zero emission electricity production by 2045. We believe other states in western US will follow, which makes it an interesting and important market when it comes to storage and production of renewables.”

Hans-Christian Schulze, Eolus’ North American country manager, said: “Energy storage is becoming increasingly important in enabling grid networks to match the supply and demand fluctuations of electricity and to increase grid stability.”
Victoria commissions first of two grid-scale storage systems

Less than a year since Australia switched on the world’s biggest lithium ion energy storage system in South Australia, its neighbouring state of Victoria has commissioned a 30MW/30MWh system, the Australian Renewable Energy Agency announced on October 23.

The system, in the city of Ballarat, is in the final testing phase before being connected to the grid in time for the country’s summer — December to February.

A consortium led by Downer Spotless has deployed the state’s first grid-scale system with batteries supplied by US firm Fluence.

It is owned by energy firm AusNet Services and operated by power generation and retail company EnergyAustralia.

The system will deliver grid stability and security-of-supply services — an area where the Tesla-delivered 100MW South Australian battery has excelled.

ARENA CEO Darren Miller said the battery would help to ease the constraints on transmission lines in Western Victoria that have in the past led to the curtailment of wind and solar generation.

He said: “As we have seen with the success of large-scale batteries in South Australia, grid-scale batteries have an important role to play in providing short-term energy storage and providing rapid response injections of power to help stabilize the grid.”

In March, on behalf of the Australian Government, ARENA committed A$25 million ($18 million) to two grid-connected batteries, which matched the A$23 million from the Victorian government as part of its A$50 million energy storage initiative.

ARENA has also funded a 25MW/50MWh battery system, co-located at the 60MW Gannawarra Solar Farm, in the state.

The Gannawarra system — which is being delivered and is also owned by Edify and Wirsol, with the storage system supplied by Tesla — was originally due to be commissioned in September.

EnergyAustralia will operate the Gannawarra battery under a long-term off-take agreement.

In March, South Australia’s departing premier Jay Weatherill announced the state would build a 120MW/140MW lithium ion battery.

The state government would assist the building of the project by Simec Zen Energy with a loan of A$10 million from the state’s Renewable Technology Fund.

Construction is to start this year at Port Augusta, and will support a 200MW solar farm installed for the Whyalla Steelworks.

Sodium ion replaces lithium batteries at Sydney sewage pumping station

An Australian project will replace lithium ion with sodium ion batteries to store renewable energy at Sydney Water’s Bondi sewage pumping station, the Australian Renewable Energy Agency announced on October 26.

The A$11 million ($7 million) system will feature 6kW of solar panels, an energy management system and a temporary lithium ion battery pack, which will be used for a year before transitioning to sodium ion as the first batteries are going to be received from a Chinese manufacturer.

Researchers from the University of Wollongong’s Institute for Superconducting and Electronic Materials are leading the project in collaboration with Sydney Water.

The system will generate around 8MWh of energy each year — more than the Bondi pumping station’s demand.

ISEM director Shi Xue Dou said: “Sodium ion batteries are a potential game-changer because the materials are much more abundant than those for traditional lithium ion batteries, reducing the cost of the raw materials as well as reducing reliance on scarce, expensive lithium.

“Critically, this project will deliver commercial-scale, ready-for-manufacture sodium ion battery technology that allows lower-cost distributed renewable energy supply to become a reality.”

Pioneering microgrid partnership to bring 100MW system to Micronesia

Engie EPS, the French microgrid and storage company, announced on October 12 it had deployed a 100MW hybrid microgrid project in the Republic of Palau, a Micronesian country in the Pacific.

Dubbed ARMONIA, the microgrid will consist of a 45MWh energy storage system, 35MW of solar energy generation and diesel generators to give the Palau grid system an overall installed power of more than 100MW.

Construction should begin by the end of 2018, with commissioning taking place before the end of 2019.

The solar component should deliver more than 45% of Palau’s total power demand and allow the country to meet its Paris agreement goal five years ahead of its original 2025 target.

The Republic of Palau signed a 30-year Power Purchase Agreement with Engie EPS.

“This 100MW microgrid will be one of the largest storage-enabled solar projects in the world and a pioneering showcase for the whole global energy sector,” said Carlalberto Guglielminiotti, CEO of Engie EPS.
Utility sets out 1GWh energy storage programme for South Africa

Eskom, the South African utility, has launched a two-phase 1.4GWh distributed battery storage programme to cover the country by the end of 2021.

The first phase, in the four provinces of Eastern, Western and Northern Cape and Kwa-Zulu Natal, will total 800MWh of battery storage and should be in place by the end of 2019. This will provide peak shaving, frequency support and ancillary services in the distribution network.

Eskom’s report, Environmental and Social Management Framework Summary, released in October, deals with the first phase.

It lists 47 projects for battery storage, with the following four chemistries considered: flow batteries, lithium ion, zinc bromine and lead acid.

“Eskom will not dictate chemistries. Offered solutions will be subject to evaluation according to set criteria,” said a spokesperson.

“Sites are chosen based on the technical need for battery storage to support the integration of renewable energy and the stability of the distribution network,” the report says.

“Sites targeted to be selected are mostly existing Eskom substation sites, power line servitudes, municipal land or where the project will have direct benefit to the community.”

The report says that just 0.1% of South Africa’s electricity is generated from solar and wind, with coal making up the greatest proportion, at 63% — although South Africa’s Department of Energy puts the figure at 77%.

“This is unlikely to change significantly in the next two decades owing to the relative lack of suitable alternatives to coal as an energy source,” the department says.

The second phase will include 600MWh of battery storage and 60MW of solar PV distribution.

“The systems will be containerized and installed primarily on already disturbed areas within existing electrical sub-stations, generating low environmental impacts,” the report says.

“Additionally, the operation and maintenance of the facilities will be mostly carried out remotely. Therefore, no potential indirect or long-term environmental impacts are expected from the project.”

Eskom says it supplies 95% of South Africa’s electricity.

Massachusetts commissions its biggest ESS

The US state of Massachusetts’ unveiled its largest energy storage system on September 25 almost a year after power firm Engie North America and utility Holyoke Gas & Electric first announced plans for the 3MW/6MWh lithium ion system.

Green Charge, an Engie NA subsidiary, will operate the system connected to the state’s largest community solar park situated opposite a former coal-fired station.

The system will be used to optimize solar power and reduce stress on the utility’s distribution system.

Massachusetts aims to generate 45% of its power from renewables by 2035.

The state’s second biggest ESS is a 3MW vanadium flow battery at Holy Name High School in Worcester.

The system was installed by Vionx, WPI, National Grid and US Department of Energy. It is the biggest of its kind in the US, only a 28MW zinc bromine flow battery in California is bigger.

German research group to test energy storage at power plant scale

German research organizations the Karlsruhe Institute of Technology, the German Aerospace Center and the University of Stuttgart will build an energy storage research facility, the companies announced on October 9.

The partnership will include building a research centre, called the National Demonstrator for Isentropic Energy Storage, to look at thermal storage technology.

The concept behind NA-DINE is to develop isentropic — a closed system process in which virtually no heat or matter is lost — storage in the form of Carnot batteries, known as power-to-heat-to-power storage.

The researchers will look at storing heat by converting power into heat with high-temperature heat pumps, which is then reconverted through a thermal power process.

The scientists aim to demonstrate that Carnot batteries can store electricity with an efficiency of up to 70%.

Plans also include a low-temperature and high-temperature laboratory in Stuttgart and a maximum-temperature laboratory in Karlsruhe, in which liquid metals can be studied at temperatures of more than 900°C.

The exact design of the research facility is being developed as part of an 18-month project, but the organizations have said they will explore a variety of technologies such as liquid metals for thermal storage.

The design project is funded by Germany’s Federal Ministry for Economic Affairs and Energy and the Ministry of Economic Affairs of the state of Baden-Württemberg.

The three research institutions signed the agreement in which they committed themselves to the construction of the research infrastructure in Karlsruhe and Stuttgart on October 8.

Duke Energy unveils 300MW storage master plan for the Carolinas

Duke Energy, the North Carolina-based power transmission operator, revealed plans on October 10 that will include deploying 300MW of energy storage and microgrid capacity across the Carolinas in the next 15 years.

The US firm outlined its $500 million investment plan to raise storage capacity in its Integrated Resource Plan.

According to the Department of Energy’s storage database, North Carolina has around 20MW — Duke Energy runs 4MW, 9MW and 5MW projects in the state — of storage and South Carolina has no projects.
Korea backs Australian firm to double energy density of VRFB

The Korean Institute of Energy Technology Evaluation and Planning announced on September 19 it had awarded Korid Energy—a subsidiary of Australian firm Protean — $2 million to support the trial of a 1MW/4MWh vanadium flow battery with the aim of doubling the energy density of the vanadium electrolyte.

Korid’s V-KOR stack technology will be integrated with another 1MW/4MWh vanadium redox flow battery.

It is part of a broader $7 million project to devise an industry-standard for vanadium batteries across South Korea.

Protean chair Bevan Tarratt said: “This will significantly reduce the physical footprint of the V-KOR battery solution, and enable us to execute further improvements, including scaling the technology.”

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DOE provides $148m in funding to spur energy storage research

The US Department of Energy announced a total of $142 million in funding for two initiatives aimed at driving research into energy storage technologies.

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The cash will be used to continue research on new materials that can improve the energy density of lithium ion batteries and devise new concepts for flow batteries.

During the first five years, the center has helped launch three start ups — lithium ion electrolyte firm Blue Current, advanced membrane company Sepion and long-duration sulphur–based battery firm Form Energy — and published more than 380 scientific papers.

A day later the DoE allocated $22 million in funding for 10 research firms developing technology that aims to increase the duration of energy storage systems up to 100 hours.

By extending the duration of an energy storage system, the DAYS (Duration Addition to electricity Storage) projects hope to enable a new set of applications for grid storage, including long-lasting backup power and greater integration of renewable energy resources.

Of those projects, three can be used for grid-scale applications: Primus Power was awarded $3.5 million to develop a long-duration storage system using a zinc-bromine flow battery. Unlike other flow batteries the system has no separator and uses a single tank to store the electrolytes.

Brayton Energy was awarded $2 million to develop an energy storage system that combines thermal energy storage with a gas turbine.

Echogen Power Systems was awarded $3 million for a system that uses a carbon dioxide heat pump cycle to convert power to thermal energy by heating a reservoir of low cost materials, such as sand or concrete.

Power-Blox is revolutionizing the off-grid energy market by opening up new ways and means for independent power generation.

The innovative principle not only allows for simple expansion of capacity and performance, but also applies intelligent swarm technology when connecting several units up to the Kilowatt range.

Each Power-Blox unit can be charged by photovoltaic modules, wind or other generators. Thanks to its design and user-friendliness, it is perfectly suitable for areas of application where flexibility and ease of use are essential Power wherever you are.

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Global electrochemical storage deployment grows 133% to 3.6GW

The UK installed almost half of all new global electrochemical energy storage capacity in the first half of the year, according to a China Energy Storage Alliance report released on September 14.

The CNESA Global Energy Storage Market Analysis – 2018 Q2 report stated that 697MW of electrochemical energy storage capacity was deployed globally up to June — an increase of 133% from the same period last year, and 24% since the end of 2017.

Lithium ion continues to take the lion’s share of market deployment with a total installed capacity of 690MW (99% of the total). Ancillary services saw the highest growth in new capacity at 354MW, an increase of 344% from the previous year.

It means that by the end of June operational electrochemical energy storage accounted for 3.6GW or 2% of the total capacity of all global energy storage technologies.

Regionally, the UK topped the list with 307MW (44%) of total installed capacity, an increase of 441% from the same period the previous year.

In comparison, China installed 100MW, up 127% from H1 last year and 26% since last December. By June, China’s total capacity, from all energy storage technologies, stood at 490MW (1.6%).

Jiangsu was the leading province, installing a quarter of all new capacity, an almost 100% increase since the end of 2017.

By application, grid-side energy storage held the largest portion of capacity at 43MW.

Mirroring the global trend, lithium ion was the number one choice of chemistry with 94MW of installed capacity — an increase of 172% compared to the same time the previous year.

BtM deployment shows strong growth as US storage capacity doubles YoY

Energy storage deployment surged in the US the year as second quarter capacity reached 62MW, according to the latest US Energy Storage Monitor report released on September 5 by Wood Mackenzie Power & Renewables (previously known as GTM Research).

Energy storage deployment rose 60% year-on-year and 42% quarter-on-quarter (from 44MW) in Q2, with behind-the-meter applications accounting for three quarters of the total, states the Q3 2018 Executive Summary.

The report said customers showed interest in ‘self-consumption and reliance’, and predicted storage deployment will accelerate from the overall 393MW to almost 1 GW during the next year, to quadruple by 2023.

The report stated: “A burst of newly announced FTM [front-of-the-meter] projects with target online dates of 2020 have accelerated our forecast, and we now see the market reaching over 2GW by 2020.

“BTM opportunities continue to expand, particularly as shifts to rate tariffs, NEM [net energy metering] policies and state programs allowing storage to provide grid services push the markets ahead.”
Meet the team

Mike Halls, editor
Mike, a former journalist with the UK newspaper the Financial Times, has been involved in journalism, publishing and print for three decades. “I’m particularly fond of writing about the energy storage industry,” he says. “It’s an unusual mixture of being fast-paced but slow to change — and friendly too. There’s always something more to learn.”

Karen Hampton, publisher
In her recent years of working within the energy storage business Karen has become a well known figure at conferences — not least as our social butterfly. “My job,” she says, “is to get the maximum benefit for our advertisers to make sure their name and brand is out there, while maintaining the integrity, fairness and excellence our publications are renowned for.”

Jade Beevor, Advertising Manager
Jade, who joined the team in early 2015, is already getting a feel for the industry. “This is an incredible business we’re in,” she says. “These people are literally changing the future of our lives — and the planet too!”

Wyn Jenkins, Supplements Editor
Don’t let his boyish charm deceive, Wyn’s been a journalist and respected editor on major financial titles for some 20 years. When not heading his own publications firm, Seren Global Media, he looks after our supplements.

Claire Ronnie, office manager and subscriptions
Claire’s our unflappable person — she’s the go-to girl for subscriptions or account enquiries. Go ahead and challenge her!

Antony Parselle, page designer
Better known in the office as ‘Ant’ he’s been working in magazine design and layout since the early 1990s. Not so good on showing his best side however!

June Moutrie, business development manager
She’s our accounting Wonderkind who deals with all things financial — a kind of mini Warren Buffett. But more fun!

Jan Darasz, cartoonist
Jan has won international fame as a cartoonist able to making anything — including an electrolyte! — funny. And as for LiFePO₄...

Kevin Desmond, historian
More than just a historian on energy storage and batteries as he’s written about many things. He’s the inspiration behind our Heroes of the Grid section.
Elcora completes graphite testing for lithium ion cells

Elcora, the graphite materials company, announced on October 10 that it had successfully completed tests of its product to ensure its suitability in commercial-grade 18650 lithium ion cells.

Tests included making one set of cells using the firm’s natural graphite anode powder, the other set used a cell manufacturer’s standard natural graphite anode material.

Results showed both sets of cells performed up to standard and that Elcora’s graphite anode powder is suitable for large-scale, commercial-quality lithium ion cell manufacturing.

The cells, which were made on the same day, used identical separators, cathodes, cell capacity, and electrolyte and were cycled at different rates and temperatures.

The graphite anode powder also passed quality control and safety tests that included exposure to a hot box at 130°C and a 2C overcharge safety test.

The company said more than 200 cycles had been completed to date, with the cells retaining >95% of their initial capacity.

Around 104,000 tonnes of anode material were required for the lithium ion battery market in 2016.

The global lithium ion market size is forecast to reach $46 billion by 2022 at a compounded annual growth rate of 11% between 2016 and 2022, according to market analysts Allied Market Research.

Pilot project utilizes best of three ESS technologies in one system

Three energy storage technologies are being combined in a pilot project by mechanical engineers Cockerill Maintenance & Ingénierie Groupe at its site in Seraing, Belgium, the company announced on October 26.

The installation, called MRIS (Micro Réseau Intégré Seraing), will combine vanadium redox, lithium ion and sodium sulfur batteries with 6,500 solar panels on the roofs of industrial halls and carports at the site in the province of Liège.

The energy storage system is supplied by: Sumitomo (500kW/1.7MWh vanadium redox flow battery); ViZn (1.2MW/1.3MWlithium ion); and NGK NAS (200kW/1.1MWh sodium sulfur).

“CMI uses different technologies to compare them and to use the best of each of them according to our customers’ needs or requests,” said a spokesperson.

The equipment is connected to an energy management system developed by the University of Liège in collaboration with CMI to manage the installation.

The power generated will either run CMI’s headquarters or feed into the distribution network.

UK opens dedicated innovation hub to promote fuel cell energy storage

A dedicated Fuel Cell Innovation Centre will begin researching hydrogen and fuel cell technology in the UK after it was opened at Manchester Metropolitan University on September 27.

The £4 million (£5 million) centre will offer training to businesses, particularly small and medium enterprises in how to utilize their technology and open up market opportunities.

Researchers at the centre will make advanced materials for fuel cells and next generation energy storage technology that uses nanomaterials and 3D printing.

Work in the field is already taking place at Manchester Metropolitan, including the 3D printing of graphene batteries for energy storage.

Researchers will share their expertise and £2.5 million of specialist, state-of-the-art equipment with businesses across Greater Manchester.

Malcolm Press, vice-chancellor of the university, said the centre would be a regional hub for research innovation and economic growth in the fuel cell technology sector.

Amer Gaffar, director of partnerships at the centre, said: “There is currently huge investment in hydrogen and fuel cell technology, both nationally and globally, and this will continue to grow.”

The centre was partly funded with £1.6 million from the European Regional Development Fund, with the University providing the rest of the funds.

Renault launches 60MWh ESS plans using second-life and new batteries

Vehicle OEM Groupe Renault announced plans on September 25 to develop energy storage systems totalling 60MWh using second-life and new electric vehicle battery packs.

Three initial systems will be between 1MWh-10MWh, depending on sites and existing electrical grid connectivity, with plans to extend the projects to meet the 60MWh target using 2,000 EV batteries, a Renault spokesman told ESJ.

The French firm’s Advanced Battery Storage stationary storage system will store second-life batteries and new packs for use in after-sales operations, but not in the same container.

The first facilities will be developed in early 2019 in Douai and Cléon, France, and at a former coal-fired plant in North Rhine-Westphalia, Germany.

The stationary storage system will be the largest of its kind in Europe to use EV batteries; the second largest is Daimler’s 30MW system.

A company official said: “The advanced battery storage will provide mainly frequency reserve services to the grid. However the system is designed for a multi-services approach, such as capacity market, backup services and voltage regulation, all aiming at a better integration of renewables energies in the grid.”

The systems will be used to balance supply and allow the integration of renewable energy sources.

“Our stationary storage solution aims to offset these differences: it delivers its reserves to a point of imbalance in the grid at a given time to reduce the effects,” said Nicolas Schottery, director of the Groupe Renault New Business Energy program.

“This unique assembly will give Advanced Battery Storage the capacity to generate or absorb instantaneously the 70MW power. This high power combined with high capacity of our solution will allow to us to react efficiently to all major grid solicitations.”

As part of the “Advanced Battery Storage” program, Groupe Renault has joined with La Banque des Territoires, the Mitsui Group, Demeter (via le Fonds de Modernisation Ecologique des Transports), and The Mobility House.
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Modelling software for ESS

Pason Power, the energy storage software subsidiary of Pason Systems, announced on October 18 it had developed a modelling tool that enables developers to assess a project’s feasibility during the planning stage.

The Storage Architect software allows developers to forecast a project’s economic value and determine which system configurations — solar PV and storage system sizes — optimize project economics.

Storage Architect is used before a deployment to reduce the risks to asset owners, installers, and financiers of overbuilding or underbuilding systems.

The technology gives developers a precise projection of how much storage a site will require, what the payback period will be, and what the net present value of the system is, said Bryce Evans, success manager at Pason Power.

A company official told ESJ: “For storage projects and solar+storage projects, the correct sizing of the storage system — taken together with the planned PV system, the building’s load, and the rate tariff — is critical to achieve the best outcomes.

“In terms of cost efficiency, it enables developers to not over-size their storage system by intuitively showing the user diminishing returns from over-sized systems.”

Brent Harris, CTO of energy storage manufacturer Eguana Technologies, said: “A major hurdle solar and storage installers face in project and proposal design is the inconsistency between the benefits that estimation tools predict customers will see from their renewable energy and storage projects, and how the completed systems actually perform in the field.”

California Energy Commission approves $8m in research to support storage

The California Energy Commission voted on September 21 to award nearly $5 million to the Electric Power Research Institute to demonstrate a standardized, renewable energy microgrid at the Naval Surface Warfare Center - Port Hueneme Division in California.

The data from the project will support commercial deployment of microgrids for military and non-military applications.

The grants come from the Electric Program Investment Charge program, which funds clean energy innovations, strategies and applications that help the state meet its energy and greenhouse gas emission reduction goals.

The same day, the commission voted to approve 18 grants totalling almost $3 million to design, develop or test the technical feasibility of energy storage, energy efficiency and renewables.

The grants, which are capped at $150,000, are funded through the California Sustainable Energy Entrepreneur Development Initiative, which supports entrepreneurs working on early-stage clean energy concepts.

Argonne’s Joint Center for Energy Storage Research renewed for five years

The US Department of Energy will provide $120 million over five years to allow the Joint Center for Energy Storage Research to continue its work, the organization announced on September 18.

The DoE Energy Innovation Hub is devoted to advancing battery science and technology, and is led by Argonne National Laboratory.

Undersecretary for science Paul Dabbar at DoE, said: “JCESR is one of our most important centres of discovery and innovation for electrical energy storage and will be critical in laying the scientific groundwork for the next generation of battery technology.”

Established in December 2012, the center worked on a new class of membranes for flow batteries; batteries based on magnesium instead of lithium; and screened more than 24,000 potential electrolyte and electrode compounds for new battery concepts and chemistries.

The centre has produced more than 380 peer-reviewed publications and over 100 inventions at various stages of the patent process.
Korea backs Australian firm to double energy density of VRFB

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The Perth-based firm linked its 25kW/100kWh battery to WA power operator Western Power in August.

Younicos trades as Aggreko after acquisition repositioning

Younicos, the German energy storage firm, announced on October 17 that it is now trading under the name Aggreko, the UK firm that bought it for £40 million ($52 million) in July 2017.

Younicos will sit within a new business unit, Aggreko Microgrid and Storage Solutions. This will be headed by Karim Wazni, Younicos’ previous managing director and head of Aggreko’s solar-hybrid energy business.

AMSS will be part of the Global Solutions business unit headed by Dan Ibbetson, group business development and strategy director.

Battery storage will be available in mobile and modular 1MW lithium ion units both as stand-alone systems and as sections of Aggreko’s microgrid-as-a-service offer.

Johnson Controls signs deal to bring battery tech to India

Johnson Controls and Amara Raja Batteries, owned by the Galla family, have signed an agreement to bring new lead-acid battery technologies to India, the firms announced on October 3.

The Galla family and Johnson Controls will each own 26% of the company’s equity.

The deal will see both companies share product design and manufacturing technologies for SLI, EFB and AGM batteries, a statement said.

No further details of the technologies were given, but under the deal, Amara Raja has licensed Johnson Controls’ PowerFrame grid technology, which JCI claims is critical for meeting requirements dictated by the ‘Bharat VI norms’, which will go into effect in 2020.

Andraca said: “This new agreement launches the next phase of a very successful 20-year collaboration. It provides both of our organizations with a powerful platform to introduce leading advanced lead-acid battery technologies and

These are emission control standards on fuel introduced in 2000 in India, based on European standards which limit the amount of sulfur in petrol and diesel to 10 parts per million.

Battery makers lock in lithium materials supply in latest deals

Tesla has signed a three-year deal with Chinese lithium-hydroxide materials firm Ganfeng, according to news agency Bloomberg on September 21.

Ganfeng will supply a fifth of its product to the vehicle maker, which in turn will designate its battery suppliers — namely Panasonic — to buy products from Ganfeng Lithium, said the report.

The agreement runs to 2020 and could be extended by three years, the Jiangxi-based company is reported as saying.

In August Ganfeng signed an agreement to supply 47,600 tonnes of materials to Korean battery maker LG Chem between 2019-2022.

It followed a similar deal in July, whereby LG Chem signed a five-year deal with Canada’s Nemaska Lithium.

Arensis and Schneider Electric launch smart microgrid partnership

Arensis, the US decentralized energy systems firm, and French microgrid development company Schneider Electric, announced on October 5 they had entered into joint development of a smart microgrid pilot program.

The pilot will include the development of a blockchain Application Programming Interface platform for Entrade IO, a company founded by the CEO of Arensis Julien Ulhig this year.

Mark Feasel, Schneider Electric VP Smart Grid North America Operations, said: “The system we are working on allows users to find information faster, reduce operator error and avoid machine downtime, with features such as giving users the ability to virtually open electrical cabinet doors and increase their overall efficiency.”
UK Power Reserve entrusts 120MW portfolio to Fluence

UK Power Reserve has awarded the second 60MW phase of its battery storage portfolio contracts to Fluence, the Siemens and AES company joint venture, the UK power gas-fired energy firm announced on October 4.

The expanded partnership for the full 120MW portfolio represents one of the largest global contracted energy storage portfolio transactions to date.

UK Power Reserve secured the portfolio of energy storage projects in the 2016 UK Capacity Market auction.

The sites are required to be online by the final quarter of 2020, but the entire portfolio is expected to be online by end of summer 2019, UK Power Reserve said.

In June, UK Power Reserve, which was bought for £216 million ($288 million) by Singaporean energy group Sembcorp Industries, signed a deal for three 20MW systems using Fluence’s Advancion technology platform.

The additional 60MW of projects will be built using Fluence’s Advancion platform.

Sam Wither, head of UK Power Reserve, said: “By splitting our portfolio into two 60MW sets of projects, we’ve had the opportunity to fully assess the market and took a nimble approach to keep up with this rapidly evolving space.”

Con Edison and Johnson Controls announce storage joint venture

Consolidated Edison Solutions, a Con Edison Clean Energy Businesses subsidiary, and Johnson Controls announced a joint venture on October 1 to take advantage of growth in both the behind-the-meter and front-of-meter markets.

Con Edison Solutions will be the majority owner and operating partner of the joint venture, while minority owner Johnson Controls will contribute the intellectual property.

Con Edison Solutions has been designated as the exclusive provider of battery energy storage to customers of Johnson Controls.

KACO new energy takes over storage provider Energy Depot

KACO New Energy, the German solar technology firm, has taken control of energy storage firm Energy Depot as part of an asset deal, the company announced on October 5.

Ralf Hofmann, chief executive of KACO New Energy, said they would integrate Energy Depot staff into its global research and development team.

Energy Depot’s Centurio 10 hybrid inverter, which combines a solar inverter and a battery inverter in a single device received the ees Award as the most innovative storage solution at Intersolar Europe 2017.

Bi-polar lead acid deal targets Chinese market

Lead acid battery firm FengFan and Advanced Battery Concepts have signed a memorandum of cooperation to develop bipolar lead batteries for the Chinese market.

The MoC was signed on September 25 when the two companies met at FengFan’s headquarters in Baoding, China.

Power supply merger given green light in the UK

UK power supply companies SSE Energy Services — a subsidiary of distribution network operator SEE (formerly Scottish and Southern Energy) — and npower, the British retail arm of Innogy, a subsidiary of German power firm RWE, will merge, the companies announced on October 10.

The Competition and Markets Authority confirmed the merger did not raise any competition concerns following an investigation.

Alistair Phillips-Davies, chief executive of SSE, said: “This is a complex transaction and there is still much work to do in the coming weeks and months. "However, we’ve always believed that the creation of a new, independent energy and services retailer has the potential to deliver real benefits for customers and the market as a whole and it is good to see that the CMA has cleared the transaction following what was a comprehensive and rigorous inquiry.”

US DoE selects Cabot Corporation as low cobalt technology partner

Cabot Corporation, the speciality chemicals and materials company, has been selected by the US Department of Energy to participate in advanced vehicle technologies research, the company announced on October 10.

Cabot will receive $3 million to research aerosol manufacturing technology for low-cobalt lithium ion battery cathodes for next-generation batteries.

The DoE is investing in 42 projects to support advanced vehicle technologies that can enable more affordable mobility, strengthen domestic energy security, reduce dependence on foreign sources of critical materials, and enhance US economic growth.

Of the combined $80 million investment, nearly $32 million has been allocated for battery and electrification initiatives.

BYD delivers grid-scale storage plus solar system as Poland enters ESS market

China battery giant BYD has tightened its grasp on the European energy storage market with the successful deployment of Poland’s first 1.3MW/2.5MWh lithium ion system, the company said on October 22.

The storage plus 1MW solar plant — also produced by BYD — began operations in September, and will be operated in partnership with Polish FV company ML System.

The project will enable grid-scale services including peak shaving.

Poland is adding around 1GW of power capacity a year to meet its EU carbon emissions targets, following the introduction of its ‘Energy Policy of Poland’ in November 2009.

The country aims to cut its coal generated power supply from 94% to 60%, through new nuclear power plants, renewable energy and natural gas.

BYD’s customers are in Germany, France, Japan, Switzerland, Italy, US, Canada, Australia and South Africa.
Netherlands to test EV-powered VPP to balance grid, aFRR

A pilot project to test the ability of electric vehicles organized into a virtual power plant to deliver secondary control reserve (aFRR — automatic frequency restoration reserve) in the Netherlands was announced on September 10 by virtual power plant operator Next Kraftwerke.

Transmission system operator TenneT selected fellow Netherlands-based firms Next Kraftwerke and electric vehicle aggregator and smart charging platform provider Jedlix for the pilot project.

TenneT aims to assess the ability of distributed energy resources, such as EVs, to deliver aFRR services as the country transitions from centralized and fossil fuel power generation. The project is set to begin next year and run for two years.

The aFRR service in the Netherlands is considered one of the most important services in balancing a TSO’s grid, says Next Kraftwerke’s business and product developer Carlos Dierckxsens.

The aFRR service supplier has to follow the system operator’s power setpoint, updated every four seconds, with their portfolio of generation and demand or storage assets. Those assets must deliver their maximum offered power contribution within 15 minutes.

The pilot will begin with several MWs or several hundred EVs. The aFRR bids will be submitted in 1MW resolutions, with no upper limit to the pool size. New EV owners can sign up throughout the pilot project.

Jedlix’s platform can receive charging preferences via a live connection with the EV. This data will inform whether the EV provides either positive (more production, or, less demand) or negative (less production, or, more demand) control reserves to restore the grid frequency.

Dierckxsens said: “We will not stress the battery beyond the normal. In fact, the battery is still just charged from its initial charge to full charge within the period requested by the car owner.

“The only difference is that we start/stop the charging process in additional accordance with the TSO’s needs. We continuously monitor the state of the EV batteries to know how much we can offer to the TSO.

“There is also no minimum or maximum battery capacity that we tap into. In fact, every car owner is remunerated in line with the energy that is to be flexibly charged. The more energy the EV needs to charge and the more charging can be shifted in time, the more benefits for the EV owner.”

Due to the high technical requirements, the aFRR service has typically sourced power from large fossil power plants that were available in the past.

“With the advent of renewables, fossil power plants are not always available or at least their availability now comes at a cost,” said Dierckxsens.

“At the same time, flexible and decentralized assets can together deliver a perfect aFRR service with even higher reliability than fossil plants, as already proven in Germany.

“In the Netherlands, the scaling of aFRR from several 10s of (centralized and fossil) units to thousands or millions of highly distributed units requires some technical adaptations on the TSO’s side.

“In this pilot we aim to both address these adaptations and test them in practice, as well as making decentralized asset owners comfortable with the product.”

Next Kraftwerke and Jedlix will pool the EVs with other assets such as greenhouses, lighting, wind, and solar plants, and biogas — as well as greenhouse CHPs.

Swiss firm SUSI invests in Australian VPP

Swiss sustainable investor SUSI has pledged A$12.5 million ($9 million) to fund Western Australia’s first virtual power plant in Dunsborough.

The Dunsborough Community Energy Project will begin as soon as the first 100 participants sign up and is expected to reach 6.5MW at peak times, around 9.5GWh a year.

Up to 1,000 solar and 9.6KWh lithium iron phosphate residential storage systems from UK firm Pylon Technologies will be installed in homes, then leased from the newly formed, not-for-profit group for a flat fee of A$35 per week.

Perth-based Redback Energy will provide the inverters, services and software to co-ordinate the project.

The project is the first 100% privately funded plant of its kind in Australia.
UK DER firm celebrates 19MW storage and VPP deals on same day

Distributed energy resource software firm Origami Energy announced on September 20 it had sold the rights to build and operate a total of 19MW of storage to Gore Street Energy Storage Fund, the world’s first publicly listed battery storage fund.

Gore Street Energy Storage Fund will oversee the construction of the projects — a 9MW behind the meter project and a 10MW front of the meter project — which are due to be operational in Q2 next year. Both projects have revenue streams attached to them, including two, six-month firm frequency response contracts that begin at the end of this month.

This will be followed by fulfilment of 12 and 15-year contracts secured in the UK’s T-4 Capacity Market auction.

Origami Energy’s technology will deliver real-time monitoring, control and operation of the batteries to enable access to multiple revenue streams for each asset, including the provision of grid balancing services.

The company announced on the same day it had signed a deal to supply its software platform to UK Distributed Network Operator Scottish and Southern Electric.

Origami Energy’s technology will support SSE’s delivery of its Virtual Power Plant services to allow its industrial and commercial customers flexible energy management services. SSE’s Virtual Power Plant knits together distributed energy resources including demand side response, storage, combined heat and power, generation and electric vehicles to offer capacity and flexibility to different markets.

SSE also plans to operate some of its own embedded generation assets through the platform.

Sonnen to build battery plant and develop VPP in Australia to meet BTM demand

Sonnen, the German micro-grid and residential energy storage firm, announced on September 9 it would build a battery manufacturing plant in Australia to meet demand for behind-the-metre applications.

The company aims to start manufacturing lithium cells this November in Adelaide, with the plan of producing 10,000 batteries a year for the domestic and Asia Pacific markets.

A sales and technical training facility in the South Australia capital will also be established with the hope of creating a training accreditation program to be run with TAFE (Technical and Further Education) SA.

The announcement came a day after the state’s government revealed a A$100 million ($72 million) Home Battery Scheme to assist households in buying Sonnen storage systems outright or over time with no upfront payment.

Sonnen also plans to create a virtual power plant in South Australia to support the state and national grid infrastructure after successfully running a similar project in Germany.

Sonnen founder and CEO Christoph Ostermann said: “We expect to contribute to increased grid reliability through the ability of the network of sonnenBatteries to store energy and act as a virtual power plant in a decentralised grid.”

In February, the South Australia government began trials of a virtual power plant using Tesla’s residential lithium ion Powerwall energy storage systems plus rooftop PV.

The VPP programme is initially supplying around 1,100 housing trust tenants across the state with 5kW solar panels plus 13.5kWh ESSs to test the technology’s capabilities.

The PV systems will convert solar and either feed it into the main electricity grid or store it in the ESS. The systems will remain operational for up to 20 years.

Utility unveils VPP and blockchain-led programs to cut emissions

Alectra Utilities and Sunverge, the virtual power plant firm, are expanding their business relationship with two new programs, the companies announced on September 24.

The Net Zero Energy Emissions program and a distribution level ancillary services market platform based on blockchain technology form part of Alectra’s strategy of decentralizing the grid through distributed energy resources.

The NZEE program consists of hybrid-heated homes fitted with Sunverge’s DER platform that will control and manage power demand and thermal load.

The Sunverge Dynamic VPP platform will control emissions through switching between gas and power through the real-time monitoring of data.

The second program is a blockchain-enabled energy platform designed and implemented by Alectra. It will facilitate contracting, compliance, and settlement of distribution level market services.

The objective is to validate how blockchain technology can support the energy sector by tracking renewable energy generation.

The Sunverge VPP platform will control residential solar PV, energy storage and EV chargers for localized demand response events.
**Saft completes India buy-out, pushes ahead with Russia deal**

Saft has completed the buy-out of its joint venture partner Amco with the purchase of its shares, the French battery subsidiary of oil giant Total, announced on September 21.

AmcoSaft will be renamed Saft India and continue to support the Indian government, the Made in India program and Indian industries, said Franck Cecchi, executive vice president, Industrial Standby Division and chairman of the board of Saft India.

Saft has been manufacturing nickel-based batteries in India since 2006 through the joint venture with Amco.

“We are looking to strengthen our leadership position in India with an increased focus on rail, telecom and infrastructure. That is why we are increasing our investment in our plant, in lithium ion and nickel technologies,” said Guy-Patrice de Broglie, general manager for Saft India.

Separately, on October 5, Saft and Hevel Group, the Russian solar module manufacturer and PV project developer, signed an agreement to develop megawatt-scale energy storage systems for solar power plants in the Altai Republic, a remote region in southern Siberia.

The projects will combine lithium ion batteries with solar to ensure a secure supply of power as well as a range of ancillary services to maintain the stability of the local power grids.

The deal is Saft’s first ever ESS deployment for a project in Russia.

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**EnerSys agrees to buy Alpha Technologies Group of companies**

EnerSys, the industrial energy solutions firm, announced on October 27 it had entered into an agreement to acquire all issued and outstanding shares and certain assets of select entities belonging to the Alpha Technologies group of companies.

Alpha offers commercial-grade energy solutions for broadband, telco, renewable, industrial and traffic customers.

The buy-out cost is $750 million, which consists of $650 million in cash, with the remaining in either cash or EnerSys shares, depending on the average share price prior to closing.

David Shaffer, CEO of EnerSys, said: “With Alpha, we hope to gain immediate scale, diversify our served end-markets and increase our exposure to industries.”

The transaction is predicted to close within 30-60 days of the announcement, subject to the satisfaction of customary closing conditions.

**Dyson solid-state battery ambitions continue despite writing off $60m**

Dyson, the UK vacuum cleaner company that has launched itself into the energy storage market, will continue developing solid-state lithium ion technology despite writing off £46 million (€60.5 million) on Sakti3, the US battery firm it bought for $90 million in 2015.

The cash was brushed off by a Dyson spokesman as ‘prudent accounting’ and as a reflection of the evolving nature of solid-state technology.

Dyson has pledged to continue work on solid-state batteries, but the company’s change in investment indicates the technology has evolved from what it originally bought.

The spokesman said: “Dyson’s investment in battery technology is growing, and this international research programme is quickly gaining momentum.

“The technology — both solid state and other forms — is advancing quickly and this [writing off of cash] represents nothing more than prudent accounting.”

In 2017 Dyson announced a £1 billion commitment to energy storage research and it now has multiple competing technologies in-house — including Sakti3, said a Dyson spokesman.

Dyson gave up the rights to Sakti3’s technology portfolio — which cost the company $200,000 a year from the University of Michigan, where Sakti3 spun out from — early last year.

On February 28, solid-state lithium ion firm Ionic Materials announced Dyson — as well as South Korean giant Samsung — had invested in the Massachusetts, US, start-up.

“The $65 million investment round included China’s A123 Systems, Japan’s Hitachi and vehicle OEM’s Renault, Nissan and Mitsubishi.

In April, Ionic announced that Total, the French power company that bought nickel-based and lithium ion battery maker Saft for $1 billion in 2016, had also invested an undisclosed amount in the firm.

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**Key Equipment Finance invests $100m in fuel cell technology**

Key Equipment Finance, a bank-held equipment finance company, announced on September 27 it would provide $100 million in project financing to fuel cell firm Bloom Energy.

The investment will provide lease financing for around 10MW-15MW of fuel cell deployment, and should enable shorter-term deal structures that cater to customers that are constrained or inhibited from signing long-term contracts.

Key has invested more than $300 million for lease financing and $30 million in Bloom’s Power Purchase Agreement program.

The company began its commercial relationship with Bloom Energy in 2014 with a $100 million commitment for lease financing.

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**Monbat backs out of lead acid buy out of Tunisian battery firm**

Bulgarian battery manufacturer Monbat announced on September 26 it was withdrawing from the buy-out of fellow lead battery firm L’Accumulateur Tunisien Assad.

In August last year Monbat confirmed its intention to buy a majority stake in Tunisian lead storage battery manufacturer Assad.

A Monbat statement said: “In the course of the final stage of the due diligence of L’accumulateur Tunisien Assad there were subsequent matters disclosed which are challenging the originally expected value creation and are increasing Monbat’s level of enterprise risk.

“In light of securing the already committed investment parameters and acting as a guardian to the interests of its bondholders and shareholders, Monbat AD will sustain its investment selectivity and focus on those business projects in the current pipeline, which provide the best match between return and operational risk.”

Monbat operates four lead acid manufacturing and recycling plants.

Assad has two factories specializing in manufacturing, distributing and recycling lead storage batteries and two production factories, all in Tunisia.
World Bank pledges $1bn to ramp up global battery deployment

A billion dollar pledge to finance 17.5GWh of energy storage deployment in developing and middle-income countries was made by the World Bank on September 26.

The global program aims to accelerate investment in battery storage, which in turn will allow countries to increase their use of renewable generated power, improve security of supply and increase access to power.

The “Accelerating Battery Storage for Development” program aims to triple the amount of installed battery storage in all developing countries in the next seven years.

World Bank Group president Jim Yong Kim said the program could be a game changer for developing countries, allowing them to set the stage for cleaner, more stable, energy systems.

The program will finance and de-risk investments such as utility-scale solar parks with battery storage, off-grid systems – including mini-grids – and stand-alone batteries.

The program will also support large-scale demonstration projects for storage technologies that are long lasting, resilient to harsh conditions and that present minimal environmental risks.

The World Bank will raise another $1 billion in concessional climate funds through channels such as the Climate Investment Funds’ Clean Technology Fund. The program should raise an additional $3 billion from public and private funds and investors.

The new program will also assemble a global think-tank on battery storage, bringing together national laboratories, research institutions, development agencies and philanthropies to develop and adapt new storage solutions.

Billionaires back energy storage start-ups

Breakthrough Energy Ventures, a fund that boasts billionaire investors including Microsoft founder Bill Gates and Amazon founder Jeff Bezos, is investing in seven energy start-ups, the fund announced on October 1.

The commitment will be made to companies aiming to cut carbon emissions and harness renewable resources more efficiently.

The companies benefiting from the cash are: QuantumScape (solid-state batteries), Commonwealth Fusion Systems (Fusion gas), Fervo Energy (geothermal).

In June, BEV committed $15 million to two battery storage start-ups: long-duration ESS firm Form Energy and pumped hydro company Quidnet Energy.

The fund is also supported by LinkedIn’s founder, Reid Hoffman; Alibaba’s CEO, Jack Ma; and David Rubenstein, the executive chairman of the private-equity giant Carlyle Group.

PV firm buys 75% stake in lithium ion ESS company

SolarEdge Technologies, the Israel-headquartered PV technology firm, announced on October 11 it had entered into a definitive agreement to buy a major stake in South Korean energy storage firm Kokam.

The global PV firm will buy around three quarters of Kokam’s outstanding equity shares, which reflects an aggregate investment of around $88 million, including related transaction expenses.

SolarEdge says it intends to eventually buy the remaining outstanding equity shares, resulting in Kokam becoming its wholly-owned subsidiary.

Kokam supplies lithium ion cells, batteries and storage for the energy storage system, UPS and electric vehicle markets.

The transaction should close in the coming weeks.

Rolls-Royce Power System strengthens microgrid hopes with investment

Rolls-Royce Power Systems, a wholly owned subsidiary of Rolls Royce, is investing an undisclosed sum in German energy storage and control systems firm Qinous.

The firm — which manufacturers aircraft engines, marine propulsion systems, and power-generation systems — will work in partnership with the Berlin-based start-up, which builds NCM/LCO lithium ion residential storage up to 335kW.

A Rolls-Royce official told ESJ: “Financial details of the individual investment by Rolls-Royce are not being disclosed. Investment made is below control level under company law.

“This investment is a strategic investment in order to support Rolls-Royce’s ambitions to strengthen its microgrid activities.”

The aim is to set up a partnership to develop innovative energy storage solutions as the firm expands activities in this business segment, said Marcus Wassenberg, CFO and labour director at Rolls-Royce Power Systems.

Qinous has integrated its batteries and energy systems in more than 30 microgrids projects worldwide and has already integrated MTU Onsite Energy systems from Rolls-Royce in projects.

In addition to the diesel and gas gensets supplied by MTU Onsite Energy, Rolls-Royce will now offer battery containers, include renewable power generation plants combined with intelligent control.

Hecate Energy, InfraRed Capital Partners launch energy storage firm

Hecate Energy and InfraRed Capital Partners announced on October 16 they had formed an energy storage company called Hecate Grid to develop, build, own, and operate utility-scale energy storage projects in North America.

Hecate has contributed its 126MWh portfolio of operating and contracted assets, and 600MWh of pipeline projects.

InfraRed has committed to fund the new company’s growth, which will be headquartered in Chicago, Illinois.

Dan Walker has been named CEO of the new firm.

Thomas Buss, investment director and transaction lead for InfraRed, said: “We believe the time is now to invest in the North American energy storage markets.”

Metals firm moves deeper into battery material supply chain

Metal company Terrafame will start to produce nickel and cobalt sulphates for electric vehicle battery makers at its current site in Sotkamo, Finland, following an investment package announced by its board of directors on October 24.

The company will invest around €240 million ($271 million).

The company aims to complete the plant by the end of 2020, with commercial production beginning at the start of the following year.
There’s a hint of desperation in the air. Or is that optimism too?

Just a couple of weeks ago, TerraE — a consortium of 17 European firms seeking to create the continent’s first home-grown gigafactory — appeared to give up the ghost. Consortium insiders talked about a reluctance within the group to commit the huge sums of money that would be needed. Was it really true that lithium ion gigafactories would soon be dead, some of them were unofficially reported as saying, as soon as solid state lithium batteries entered the market?

And then came the bombshell on November 15. BMZ Group, a European leader in lithium products, announced it was taking over the shares of the entire consortium — leaving the original members with a small stake — and was ploughing ahead with the project.

Germany was about to get its first lithium cell gigafactory and it looked set to be based in Karlstein, near Frankfurt, in the geographic centre of the country.

It was as if, all of a sudden, Europe’s investment into its energy future had gone beyond words to something tangible.

Shifting sands

Just a week before, Peter Altmaier, Germany’s federal minister for economic affairs and energy, announced that his government realized the urgency of the need for a domestic capability to make lithium cells in huge volumes. He said it had set aside €1 billion ($1.2 billion) to build lithium ion gigafactories and related research facilities.

Now, more than likely with the TerraE take-over and Altmaier’s announcement, the funding has found a destination. Confirmation of this should be given by early December.

Irrespective of any possible connection, Altmaier’s concern over a European domestic need to enter into lithium cell manufacturing is very real. There is a huge catch-up that needs to take place.

European manufacturing of lithium battery cells is at least four years behind where commercial rivals — and their related experience and expertise — from South Korea, Japan and China are positioned.

So far the first mover in Europe is South Korea’s LG Chem, where production began in the first quarter of 2018 in a plant that the firm has built in Poland.

Europe may need as many as 20 gigafactories to meet future lithium cell demand. Given its late moves into the sector, the big question is whether the region can stand on its own two feet or whether established players will walk away with the market. So is it better to be late than never?
Intercontinental moves

The trouble for Europe is that other countries and regions saw the future impact of lithium batteries far earlier.

In the US in 2009, then president Barack Obama introduced the American Recovery and Reinvestment Act. Part of the $27 billion devoted to energy efficiency was aimed at giving the country a foothold into the expanding world of lithium batteries.

Nevertheless, with the exception of Tesla’s operations in the US (partnered with Panasonic), there are few signs that battery manufacturers can compete against the commercial inroads that firms such as Samsung, Panasonic, CATL, BYD and LG Chem have made in advancing the future of the business.

Europe may have been slow to come to the party, but oddly enough it has been at the heart of a great deal of discussion over the future direction of the industry.

It occupies a strange no-man’s-land of predicting huge numbers for the world’s demand for energy storage and electric vehicle markets while doing little — apart from talking — in advancing the manufacture of the batteries that will power these developments.

Altmaier wants cell production to begin by 2021. This is a timeline that verges on the practical but it is unlikely that it can develop the volumes that European automakers, in particular, say they may need.

Bosch, the industrial chemical and engineering giant, predicted that the cost of any manufacturing plant to match that of Tesla’s facility in Nevada would be in the region of $20 billion.

It’s a strange territory, too, in which Europe’s leaders continue to talk the talk … but walking the walk?

“Batteries are at the heart of the industrial revolution and I am convinced that Europe has what it takes to become the world’s leader in innovation, decarbonization and digitization.”

These are powerful words from the vice-president of the European Battery Alliance Maros Sefcovic. Sefcovic is also a vice president of the European Commission and was once positioned as its next president.

The intention is unambiguous. But as one observer later said, “then again he would say that, wouldn’t he?”

Another said, “I asked him where he saw the future of lead batteries in Europe’s future. He couldn’t answer the question. He didn’t know. The Battery Alliance that he trumpeted so much last year hasn’t contemplated doing anything except focus on lithium.

“The approach by the European Commission has been slow and blinkered. There’s too much talk but not enough action.”

Advancing policy

In its defence, the EC can point to numerous studies and policy documents drawn up from 2015 onwards, but solid action has not been forthcoming.

That said Sefcovic is no fool. And his judgment is spot on: “Europe needs to invest in a competitive and sustainable battery manufacturing framework that includes access to materials and innovation if it is to nurture its electric vehicle and energy storage markets in any kind of meaningful and autonomous way”.

The rapid deployment and planning around lithium ion battery megafactories, dubbed gigafactories due to annual outputs of at least a gigawatt, is a story that begins with electric vehicles and continues today with the exponential growth in energy storage systems — from 5kWh residential packs to 100+MW, record-breaking grid-scale projects.

While Sefcovic reckons Europe can nurture a lithium battery industry from scratch, the fact is the region is playing catch-up with the rest of the world.

“The objective is to create a competitive, innovative and sustainable value chain in Europe with sustainable battery cells at its core. To prevent technological dependence on our competitors and capitalize on the jobs, growth and investment potential of batteries.”

– Anca Paduraru, European Commission
COVER STORY: EUROPE’S GIGAFACTORIES

WILD CARDS IN THE OFFING

One known unknown is the rapid advance of battery technology. Talk that lithium solid state batteries, which have a greater energy density and thermal stability, would not appear until the 2020s seems to be wrong.

Qing Tao Energy Development in Kunshan, East China says it is now manufacturing the first lithium solid state battery on a commercial scale.

If it is to wrestle any kind of share of the market from Asia’s first mover advantage — given Chinese and South Korean firms are bankrolling more than half of the planned European gigafactories — it has to act fast.

Only a few years ago there were three gigafactories run by Tesla/Panasonic in the US, and LG Chem and Foxconn in China. Today there are at least 26 planned. If possible start-ups’ plans are to be considered seriously there could be as many as 45 projects under way worldwide next year.

Within five years, 26 companies will have bumped worldwide capacity up to 658GWh via established factories, the expansion of existing plants or planned projects, according to industry analysts Benchmark Minerals. By 2028 the global supply of lithium batteries could top 1,102GWh.

HOW EUROPE COMPARES WITH CHINA

<table>
<thead>
<tr>
<th>Company</th>
<th>Capacity (GWh)</th>
</tr>
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<tbody>
<tr>
<td>CATL</td>
<td>88GWh by 2020</td>
</tr>
<tr>
<td>BYD</td>
<td>60GWh by 2019</td>
</tr>
<tr>
<td>Funeng Technology</td>
<td>10GWh in 2018</td>
</tr>
<tr>
<td>Eve Energy</td>
<td>9GWh in 2018</td>
</tr>
<tr>
<td>Guoxuan High-Tech</td>
<td>4GWh in 2018</td>
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To put that in context, last year that number was 144GWh and in 2015 overall capacity was 37GWh.

China has led the way in investment and capacity, and remains the dominant force. Firms such as CATL, with its operations south of Shanghai in Ningde and a long relationship with OEMs such as BMW, are already world-class firms. CATL said last year that it already makes more lithium cells and batteries than any other operation in the world.

Maturity

The question now is whether Europe’s battery potential can reach a level of maturity where it will manage its own battery supply chain with almost a quarter of all planned global capacity produced in the region.

Forecasts suggest that Europe’s supply chain could handle a rise from the 7GWh last year to 39GWh by 2023 and 207GWh just five years later.

To put this in perspective, pre-2017 there was only one planned gigafactory in Europe: LG Chem’s 4GWh plant in Poland. The ground was broken on that plant in October 2016 and the first cells are now reaching the market. The initial output level of being able to produce batteries that can power around 100,000 pure EVs is being upgraded to 300,000.

Almnaier’s desire for cell production to begin by 2021 is do-able once the issues of finance, design and project management are in place.

Today there could be as many as 14 gigafactories in construction, planned or at the rumoured stage of development, in Europe (see facing page).

These include Samsung SDI 2.5GWh (late 2018) and SK Innovations 7.5GWh (early 2020), both in Hungary; and vehicle OEM Daimler (unknown capacity by 2019). Northvolt — run in part by former Tesla employees Peter Carlsson, ex-supply chain head who founded the company; and executive Paolo Cerruti as its chief operating officer — plans a 32GWh (by 2020) plant in Sweden.

The appetite for these plants’ creation seems at first to be there — mostly perhaps because of the realization that Europe’s automotive industry is looking increasingly vulnerable to Asian competition.

If the electric vehicle revolution predicted to happen does materialize then the key component of the cars — the lithium ion battery — will mostly be made in Asia or Asian subsidiaries in Europe.

Anca Paduraru, spokesperson for health, food safety and energy union projects at the European Commission, said that to cover the EU demand alone, Europe requires a conservative estimate of at least 20 gigafactories.

“The scale and speed of the necessary investment requires a combined effort to address this industrial challenge,” she said.

Issues of size

None of the European plants is as big as Tesla’s US gigafactory, which is projected to reach 50GWh (in August it was running at around 20GWh) at the end of the year, and could top 150GWh on completion.

Interestingly, even at 20GWh the US electric vehicle and residential storage OEM had to source cells from South Korea at the end of 2017 to fulfil its promise to build a record-breaking 100MWh/129MWh project in South Australia.
At the time, a Tesla spokesman confirmed the powerpacks for the project were being manufactured at the gigafactory in Sparks, Nevada, using cells produced by Samsung SDI. It was the first time the gigafactory had not been able to meet demand with cells from their manufacturing lines.

This case of demand outstripping supply is a strong argument for Europe needing to build a supply chain as the EV and storage markets grow.

The biggest concern facing the industry is whether the supply chain can grow in parallel with demand.

“We’ve never seen such demand,” said Yayoi Sekine, a New York-based analyst at Bloomberg New Energy Finance. “But the supply is struggling to keep up.”

To understand the growth rates of the market, take a quick look at Volkswagen. It plans to build three million EVs a year by 2025; today there are around four million EVs globally.

Or have a glance at the numbers coming from South Korea. A Bloomberg New Energy Finance report in September said the country was aiming for almost 4GWh of storage by the end of this year; 697MW of electrochemical energy storage capacity was deployed globally in Q2 this year, according to China Energy Storage Alliance’s Global Energy Storage Market Analysis – 2018 Q2 report.

Too little, too late?

Many industry commentators believe plans to build European gigafactories by new European ventures into the sector are too little, too late.

However, as batteries become as essential to the automotive industry of the 21st century as the combustion engine was in the 20th, second or even third-mover advantage may be better than none at all.

If the EU is to maintain any leadership in the automotive sector and in clean energy systems, it has to have independent capacity to develop and produce batteries.

As Germany alone closes in on the 600MWh installed capacity mark, and with 10 European countries announcing the ban on internal combustion engine vehicle sales — starting with Austria in 2020 — demand for cells will spiral upwards.

According to some forecasts of market uptake, the battery market could be worth €2.50 billion ($281 billion) a year from 2025.

One firm hoping to plug the supply gap is Northvolt, which changed its name from SGF Energy in March 2017. The company aims to raise $4 billion for its 32GWh factory in Sweden. It will target four primary markets: automotive, grid, industrial and portable.

Jesper Wigardt, Northvolt’s public affairs director, said he believed Europe was clearly behind, but it was not too late to catch up.

“If you look at what has happened in Europe during the past year it is clear that there is a willingness from the political leadership and industry to create a comprehensive, European-wide, supply chain for battery manufacturing,” he says. “This is crucial for the European industry.”

But foreign firms have already circled the region.

South Korean firm LG Chem is in
vesting an estimated $1.63 billion in a plant in Wrocław, Poland. The company started exploring lithium ion batteries in 1995 and began developing EV batteries five years later. Its European plant will form a corner of its global cell manufacturing reach, which includes Ochang in South Korea; Nanjing in China; and Holland in the US state of Michigan.

But having a plant is one thing, having the cell technology another.

**Increasing range**

Third generation battery packs using high nickel content chemistries will offer a high EV driving range of 500km-600km.

In terms of investment, Wiegardt believes it is a good thing that both Asian and European firms are establishing manufacturing hubs in the region.

“Asian manufacturers are establishing themselves in Europe but there are several European projects, such as Northvolt, starting up,” he says.

“We are going to need companies from outside Europe and local companies to create a comprehensive supply chain and the ecosystem surrounding it.”

One advantage of arriving at the battery party late should be that lessons learnt from previous facilities can be incorporated into the new plants. But that’s only if they’re public knowledge.

LG Chem is reluctant to discuss what these lessons might be — and clearly have no need to give away any commercial and manufacturing secrets. WonJae Yoo, a specialist from LG Chem’s communications team, said details of the plant were confidential but the company had developed know-how on yield rates and the management of workers through trial and error.

Know-how was also generated from building its gigafactory in Nanjing, China, and in the construction of its second in the area, a 32GWh facility set to be completed in 2023 at a cost of €1.5 billion.

“Every year an existing player refines their in-house manufacturing techniques is another year gained over their rivals,” says a commentator.

**CATL moves into Germany**

BMW, the German car giant, announced in June it had struck a deal with Chinese battery cell manufacturer CATL (Contemporary Amperex Technology Ltd) to buy battery cells over the next five years, for €4 billion (€4.7 billion) in total.

The deal was made in connection with a CATL decision to build a high-volume battery cell factory at Erfurt, a city in the German state of Thuringia.

CATL has already made the battery cells for BMW's early range of electric vehicles. It is the largest lithium cell maker in the world.

Thuringia's economy minister, Wolfgang Tiefensee, said the factory would be “one of the most important of the past decade”, and could create up to 1,000 jobs. The German metalworkers’ union also welcomed the announcement.

The deal was presented just four and a half months after Bosch, a German firm that includes a mobility solutions division, announced it would cancel plans to build a battery cell factory, and would discontinue its massive, years-long battery cell technology research and development (R&D) programme.

BMW has said it may eventually get into battery cell production, but only once a future generation of improved battery technologies is ready for implementation.

It will continue to investigate making complete battery packs for its cars using CATL lithium ion cells as their key components.

The cells that will be produced in CATL's Erfurt factory are for BMW's new iNext model, a fully electric, self-driving vehicle the company reckons will come to market in 2021.

Daimler, the company that produces Mercedes Benz cars, has also hinted it will become a client of CATL as it too gears up production of electric vehicles.

Some suggest that German companies such as BMW and Bosch have opted out from opportunities to build battery cell production factories — despite spending many years on cell R&D — as they don’t believe battery cell production will be profitable — or not profitable enough.

Like auto manufacturers in the US there is the perception that once lithium cells become a commodity product, made in the millions by a variety of manufacturers, the profit margins will be low but the problems of supply will not be an issue.

**They long to be … close to you**

Car manufacturers need the cells for their battery packs to be made close to their car assembly plants.

In terms of cost, shipping a complete EV battery pack from, for example, China is expensive. Pack sizes of up to 750kg in bulk are expensive.
to meet demand as the region slowly bans sales of ICE vehicles and adopts renewables and energy storage.

Where it is not the purpose of the European Battery Alliance to usurp other markets, it does aim to build on its role in the automotive and clean energy system sectors while having independent capacity to develop and produce batteries.

“The objective is to create a competitive, innovative and sustainable value chain in Europe with sustainable battery cells at its core,” says Paduraru at the European Commission. “To prevent technological dependence on our competitors and capitalize on the jobs, growth and investment potential of batteries.”

To light the fuse under the explosion of Europe’s battery making facilities, the European Commission has started with the rapid implementation of the Strategic Action Plan for Batteries.

Subjects of its key actions include: regulatory framework; raw materials, including building refining capacity; interregional partnerships on batteries to accelerate towards scale-up and commercialization activities; research — €114 million from the EU research and innovation programme Horizon 2020 next January, and €70 million in 2020 for battery-related topics; and skills.

Proximity
From an environmental and economic point of view it makes sense to European OEMs to have production close to their production facilities, rather than ship batteries across the globe, says Wigardt.

This was a concern for LG Chem, which considers the establishment of a secure supply of cells key to growth. “We already have a lot of customers on the Germany side,” says Yoo. “To ensure the security of our product supply, we made our EU plant in Poland, which shares borders with Germany.”

With the huge growth of the EV and ESS markets, the scale of economy is another attraction for establishing manufacturing facilities in Europe.

“The price of batteries will continue to become cheaper and cheaper,” says Yoo.

Northvolt is seeing demand from consumers and manufacturers as well as legislators. And demand is increasing faster than anyone had expected.

Wigardt said Northvolt sees the automotive (including EVs), portable products, industrial solutions and ESS markets growing quickly over the coming years.

LG Chem’s decision to build a facility in Poland follows big commercial demand from its European vehicle OEM customer base that includes VW, Audi, and Renault.

While it is clear the market is maturing rapidly, there is the not-so-trivial question of materials supply. While the plants are being built, the question of materials supply meeting demand is still writ large above all facilities around the globe (see following page).

Finance and technology
Northvolt is making the necessary preparations to be able to take the next step in terms of technology once the timing is right.

To prepare for the introduction of new battery chemistries, Northvolt began construction of its Northvolt Labs in April. Construction is due to be completed in Västerås, 100 kilometres west of Stockholm, within the next two years.

The research facility will be used to develop, test and industrialize lithium ion battery cells before large-scale production. The 19,000 square meter facility will have an annual capacity of 125MWh once completed next year.

Wigardt says: “We will do our research and development there. It will also be used to qualify and industrialize products and processes together with our customers.”

The facility is being supported by a grant of up to Skr146 million from the Swedish Energy Agency to build Northvolt’s demonstration line. In February, the board of directors of the European Investment Bank approved a loan for Northvolt of up to €52 million.

The financing is to be supported by InnovFin — the EU Finance for Innovators’ Energy Demonstration Projects facility — with the financial backing of the European Union under Horizon 2020.

At the beginning of the year Scania, the Swedish commercial vehicle OEM, announced it was to invest €10 million in Northvolt’s demonstration line and research facility to develop and commercialize cells for heavy commercial vehicles.

Northvolt is also taking recycling into consideration.

“It is key that we manage to industrialize large-scale recycling of lithium-ion batteries for this transition to be truly sustainable,” says Wigardt.

The pessimistic corners of the battery manufacturing industry might scoff at the thought of Europe becoming a global cell-making hub, but investors, OEMs and entrepreneurs are more optimistic.

With more than 70GWh of capacity planned for the region, it might not hit the heights of Asia, but within a decade Europe might possibly boast its own supply chain to meet demand from EV and ESS markets.

But it’s not just a one-way ticket of Asian firms muscling into Europe. Dutch energy storage and battery company Lithium Werks announced on October 16 it had signed a framework agreement with Chinese Zhejiang Jiashan Economic and Technological Development Zone Industry Corporation to build a lithium ion gigafactory in China.

The planned gigafactory in the Yangtze river Delta will cover 60 hectares, cost an estimated €1.6 billion ($1.8 billion) and have installed production capacity of 500GWh a year by 2030, said Lithium Werks.

The Lithium Werks factory and related facilities will produce cells for lithium-ion batteries.

The agreement was signed in the presence of the Chinese premier Li Keqiang and Dutch prime minister Mark Rutte.

Lithium Werks plans to build multiple gigafactories across the world as part of a 15 to 20-year programme. The company expects its revenue to top $1 billion by 2020 as it grows its share of the energy storage market.
Security of supply

Casper Rawles, an analyst at Benchmark Minerals, says that in terms of raw material demand there will be enough lithium and cobalt material in the coming years, but as the industry enters the early-mid 2020s the markets will go into under supply.

“There is certainly concern around supply meeting demand from around 2023 onwards,” Rawles says.

“Alongside cobalt reduction another important factor will be recycling, something which is starting to happen in meaningful volumes in China, but there is still a considerable way to go for recycling to help meet the volumes needed in the future.”

To date, apart from the recycling of cobalt in those lithium ion batteries that contain the metal, all recycling is a cost rather than an asset. It is the complete opposite of lead battery recycling, where the price of lead is sufficient to merit the recycling and smelting process. Lithium ion batteries are also a hazardous waste product and not suitable for landfill.

“Speaking specifically about cobalt, with the growth in production that is expected to come online/ramp up in the coming years, there will be enough supply to meet demand and in fact in the nearer term the intermediates market is likely to go into oversupply,” Rawles says.

The key cobalt projects are all in the Democratic Republic of Congo: Glencore’s Katanga (restarted in Q1 2018 but now facing delays); Eurasian Resources Group’s Roan Tailings Reclamation project (production starting now); and Chemaf’s Mutoshi project.

A lot of research is happening within the industry to reduce cobalt use in cathodes, primarily around nickel cobalt manganese cathode types. The industry has moved from NCM 111 (one part nickel, one cobalt, one manganese) to NCM 523 and 622, which are now being used commercially.

Rawles says the ultimate goal was to reach NCM 811.

“This has engineering challenges associated with it and is still some years away from having an impact on the materials supply chain.”

Even with this reduction, cobalt use in batteries is expected to grow five-fold in the next decade. This is a challenge, considering cobalt’s by-product nature, and shows that volume of sales will far outweigh any reduction of cobalt use in the cathode.

“So for raw material supply to meet demand there will be a combination of factors that go into helping plug the gap, but without more investment in mining and new projects actually making it into production the cobalt crunch is still very much on the horizon,” says Rawles.

To ensure a steady stream of raw materials, companies such as LG Chem are signing deals with raw material suppliers. For example, the company has signed a cathode-producing Joint Venture with Huayou Cobalt (China Cobalt producer).

LG Chem’s plan includes extending its total capacity for EV batteries to 34GWh by the end of this year based on its four battery plant spots. It also plans to extend its capacity to 90GWh by 2020 to meet customer demand.

But cobalt supply is going to prove problematic in terms of the uncertainty that will continue to surround the issue — particularly over the price.

“Most of us grew up in extraordinary times when the word ‘shortage’ meant ‘it will cost more but you can still get all you want if your wallet is deep enough,’” says John Petersen, a corporate lawyer with a lifetime of experience in the battery and energy industry.

“With each passing day, I’m increasingly convinced that the cobalt cliff will teach all of us that the word ‘shortage’ means ‘not available in sufficient quantities at any price’.”

International mining firm Glencore announced in late October that exports of cobalt hydroxide from its Katanga copper-cobalt mine in the DRC have been halted due to high levels of uranium.

Prices that had spiked earlier this year at around $80,000 a tonne — but had drifted downwards to around $50,000/t — will soar back to those levels in 2019. Although production will be stockpiled, the $25m ion-exchange plant to remove the radioactivity won’t be completed until next summer and it will take much longer before the backlog of mined cobalt is processed.

Glencore idled Katanga in 2015 for an extensive refurbishment and only restarted operations earlier this year. To date, Glencore has produced 25,700 tonnes from its DRC mines. In July, Glencore said it expected to achieve an annual rate of production of 40,000 tonnes by the end of the first quarter next year. That said, its previous target represents a third of total global output.

One way of mitigating the need to secure a raw materials supply is to use less of the material and LG Chem is developing batteries that use less cobalt.

For now its main product for EV batteries is NCM622 (nickel 60%, cobalt 20% manganese 20%), but the company is developing NCM 712, which it aims to start producing from 2020.

“We are also developing NCMA batteries by 2022. The NCMA battery will have almost 90% nickel on the cathode, and the amount of cobalt should be under 10%,” said Woo.

“We’re focusing on every type of battery so we are prepared for the future, but non-cobalt and sodium ion batteries are so far in the future story it is not appropriate to talk about these batteries at this moment. We’re focusing on 2020, with the present type batteries like an NCM-type lithium ion battery.”

Wigardt says battery chemistries are constantly developing, and believes the newer chemistries will be less dependent on cobalt.
INDIA’S RENEWABLES, STORAGE AND EV MARKETS ARE ROARING INTO ACTION
SOUTH AMERICA’S RENEWABLES MARKET IS PRIMED FOR EXPONENTIAL GROWTH
FIRST MOVER CALIFORNIA PAVING THE WAY FOR MASS ESS AND EV ADOPTION
EUROPE SET TO BECOME WORLD’S MOST IMPORTANT ENERGY STORAGE MARKET
INDIA'S RENEWABLES, STORAGE AND EV MARKETS ARE ROARING INTO ACTION

LAST YEAR INTERSOLAR INDIA WELCOMED A TOTAL OF AROUND 13,000 BUSINESS PROFESSIONALS FROM 55 COUNTRIES. THE POSITIVE ATMOSPHERE OF THE EXHIBITION REFLECTED THE STRONG STATE OF INDIA'S RENEWABLES MARKET.

An old Indian proverb says: "We can’t change the direction of the wind, but we can adjust the sails." With more than a billion people in need of power, the Indian government is showing strong leadership in changing the country’s energy landscape as it decarbonizes its power and transport infrastructure.

In terms of market growth, India is ahead of both North America and Europe in deploying solar capacity.

Last year the country added 9.6GW of capacity, a gigawatt more than third placed North America, but 40GW below China.

That growth was backed up this year with around 1MW of PV capacity being installed every hour during the first half of 2018. As of July 2018, the country’s installed renewable power generation stood at 117GW, around a third of the total installed capacity, reported the India Brand Equity Foundation.

Solar deployment growth followed the Ministry of New and Renewable Energy’s introduction of custom and excise duty benefits to all 100KW-plus rooftop solar projects in April last year. The move cut the cost of both generation and project deployment.

But with the potential to triple capacity, and with government policies focused on the renewable energy sector, the country’s potential is clear. So much so that forecasters predict that at its current rate of growth, by 2040 half of the country’s power needs will be met by renewable energy.

Solar+storage is anticipated to become a viable solution for off grid as well as for managing peak loads within 18 months, fuelling exponential growth for storage.

Rahul Walawalkar, executive director India Energy Storage Alliance, said India had the potential to deploy more than 300GWh of energy storage in the next four years.

“We anticipate this to focus on three areas: electric vehicles, behind the meter energy storage and grid scale energy storage. Key applications include meeting the targets set by national wind and solar missions as well as meeting the energy access goals set up by the prime minister.

“While we are waiting for deployment of grid scale energy storage, the distributed advanced storage deployment has already crossed over 1GWh in the last two years thanks to uses in telecom and related sectors.”

TACKLING POLLUTION

With some of the world’s most polluted cities, India’s government is anxious to swap fossil fuels for clean energy.

As well as renewable energy, the country is adopting EVs as a means to curb pollution, especially as the population becomes centred in and around cities.

Every day almost 50,000 new EVs (two, three and four wheels)
With the rapid adoption of solar energy in India, there is a strong need for exploring the role of energy storage for facilitating solar integration.

Dr Rahul Walawalkar, executive director India Energy Storage Alliance

are registered in India, a success story for the government’s Faster Adoption & Manufacturing of Hybrid and Electric Vehicle (FAME I) program, which aimed to promote the adoption of EVs, from scooters to buses.

Launched in 2015, it was extended three times before the second phase of the initiative was rolled out in April. Incentives will be provided on the purchase of all full EVs including taxis and buses used in public transport.

Two-wheel vehicles are eligible for incentives ranging between Rs1,800 ($25) to Rs29,000, while in three-wheelers it is between Rs3,300 and Rs61,000. However, strong hybrid vehicles are no longer entitled to the subsidies.

While the government is pushing EV adoption, the state of Karnataka wants to grab first mover advantage to attract investments worth around $5 billion and make the city India’s EV capital.

There are around 70 million registered vehicles in the state’s capital Bengaluru (also called Bangalore), with the vast majority being two wheeled. By 2030 the city wants all vehicles, from scooters to rickshaws and buses, to be 100% electric.

To achieve this, the state launched its Electric Vehicle and Energy Storage Policy 2017, the first state in the country to introduce an EV and energy storage policy.

The program’s strategy includes initiatives to designate parks/zones for EV manufacturing facilities, cultivate a charging infrastructure and support research and development as well as skills development.

It will also offer incentives and concessions to attract companies to the city in EV and lithium ion battery manufacturing as well as charging equipment makers.

To back up the program the government is set to buy 640 EVs under the FAME initiative.

In February 2018, the Maharashtra state government adopted its Electric Vehicle Policy 2018. Initiatives to encourage EV adoption include road tax and registration charge exemptions.

But, when it comes to storage policies, the biggest challenge is making a decision.

Walawalkar said: “We are spending too much

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INTERVIEW

EES INTERSOLAR INTERVIEW DR RAHUL WALAWALKAR

Dr Rahul Walawalkar is executive director India Energy Storage Alliance and a member of the ees/Intersolar India program committee. Here he discusses this year’s solar+storage workshop in Bangalore, on December 12, 2018.

Can you explain what delegates can expect from the solar + storage workshop planned for Intersolar/EES India?

With the rapid adoption of solar energy in India, there is a strong need for exploring the role of energy storage for facilitating solar integration. This workshop will address the underlying techno-commercial trends in energy storage as well as provide insights into changing regulatory and business models that are creating a unique opportunity. The IESA team and experts will share their experiences from around the globe and discuss its relevance for India.

The workshop and the event is very timely, as the Ministry of New and Renewable Energy is launching a National Energy Storage Mission for addressing needs for energy storage at transmission level for ultra-mega solar parks at distribution level to increase the adoption of roof top solar and campus microgrids as well as off grid systems for energy access. Various solar and energy storage tenders have been floated in India in the last two years. Around the globe solar + storage solutions are growing in popularity and for the first time, the US is also expected to have more energy storage behind the meter in 2018-19.

You are on the Program Committee. What were the challenges of putting together a program that unites EVs, solar and storage, or are they just part of the same decarbonization goal?

Energy Storage is the enabling link that ties both EVs and Solar. So it was thrilling to put together the program to unite EVs, Solar and Storage. The India Energy Storage Alliance has been working towards accelerating the adoption of energy storage, microgrids and EVs since 2012. So we understand the requirements of the evolving industry and are happy to leverage the event as a platform to bring all key stakeholders together.
time in just discussions and debating various options, rather than implementing projects that should be built. We also need removal of barriers such as higher GST (18% for batteries versus 5% for solar) and import duties for kick starting the market for advanced energy storage in India.”

E-MOBILITY

With around one in four people owning a vehicle, it’s unsurprising that India’s oil import bill is expected to reach $105 billion this year, or that 14 of the 15 most polluted cities reported by the World Health Organization are in India.

Moving to a wider EV penetration allows the country to reduce emissions by a gigaton, the cherry on a fiscal cake that could see $330 billion saved from oil imports, all by 2030.

Sales of EVs in India are expected to witness high double digit growth rates annually in the next two years, according to a study done by ASSOCHAM, an Indian Business Chamber. What kind of EV is up for discussion. While electric car sales dropped 40% year-on-year in 2017 compared to 2016, two-wheel sales grew 138%.

To curb air pollution concerns from around 210 million cars, motorcycles, trikes and trucks on India’s roads, the country’s government is supporting the EV industry with various programs. Schemes such as the country-wide FAME II and Karnataka’s EVESP is set to increase the EV market of the world’s fifth largest vehicle maker to 40% of all sales within 12 years.

Adoption is expected to quicken as EV costs fall with the continued drop in the price of key components, and could become cost competitive to ICE vehicles even on the upfront capital cost.

Depending on how the charging infrastructure is created and associated policies are developed, this may or may not require substantial new generation capacity.

Energy Storage is a key component of this and there are a number of ways in which EV adoption could be transformative for the grid. Walawalkar said: “With better tariff structures and use of right storage technologies in EVs, we could also use EVs as distributed storage and provide grid balancing services.”

Solar deployment growth followed the Ministry of New and Renewable Energy’s introduction of custom and excise duty benefits in April last year. The move cut the cost of both generation and project deployment.

With the potential to triple capacity, and with governmental policies focused on the renewable energy sector, the country’s potential is clear.

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SOUTH AMERICA'S RENEWABLES MARKET IS PRIMED FOR EXPONENTIAL GROWTH

LATIN AMERICA IS AN EMERGING RENEWABLES AND ENERGY STORAGE MARKET. DURING 2016 INVESTMENT IN THE REGION’S ENERGY STORAGE MARKET TOTALLED $9 BILLION, WITH THE BULK TAKING PLACE IN BRAZIL, CHILE AND MEXICO.

It’s predicted that more than 1.4GW of energy storage will be installed in Central and South America by 2025 to ensure security of supply to around six million households, as well as industrial and commercial applications.

The region’s markets are growing, but they still have some way to go: off-grid capacity grew from 256MW in 2008 to 456MW last year. In parallel, solar capacity jumped six-fold to 90MW in the five years up to 2017, partly driven by deployment of solar powered mini-grids, micro-grids and standalone systems.

While certainly an emerging market, the uptake of storage in Chile, for example, is in line with the sudden explosion in renewable energy, said Christopher Lenton, senior manager of research and analysis at BN America. However, he says that while regulation surrounding storage is lacking, Chile is becoming the most influential storage market in the region at the moment.

Chile’s power producer and distributer AES Gener — a part of AES Corporation — has a few small utility-scale battery storage options. These are augmented with a pumped-hydro storage project and a CSP plant in Chile.

“One thing is certain, storage is becoming a very big deal in numerous countries in the region as serious renewable power capacity comes online,” said Lenton.

One thing is for sure, with big deposits of lithium in Chile, Argentina and Bolivia the region is set to spur the global uptake of lithium battery technologies, both in terms of battery manufacturing, and maybe delivering cheaper energy storage systems to the region.

It is clear, irrelevant of the region, a high penetration of renewables will significantly increase the need for storage.

INTER SOLAR SOUTH AMERICA

The smarter E South America
LATAM’s innovation hub for the new energy world

With three parallel energy exhibitions, The smarter E South America is LATAM’s innovation hub for the new energy world. It takes a comprehensive approach to the topics of the energy transition by presenting cross-sector energy solutions and technologies and by highlighting the need for intelligent interaction between energy generation, storage, distribution and consumption. The smarter E South America creates opportunities to address all the key areas along the value chain, making it the most important industry platform for the energy future in South America.

The smarter E South America will take place at the Expo Center Norte in São Paulo, Brazil, on August 27-29, 2019, bringing together the following events:

- Intersolar South America - The Largest Exhibition and Conference for the South American Solar Industry
- ees South America - South America’s New Hot Spot for Batteries & Energy Storage Systems
- Eletrotec + EM-Power - The Premier Exhibition for Electrical Infrastructure and Energy Management

https://www.thesmartere.com.br
“One thing is certain, storage is becoming a very big deal in numerous countries in the region as serious renewable power capacity comes online.”
Christopher Lenton, BN America

MICROGRIDS
Despite the region’s storage growth potential in the next ten years — Colombia (480MW), Mexico (2.3GW), Brazil (5.6GW) — microgrids are a big driver of the market, according to Navigant Research’s Microgrid Deployment Tracker 2018.

The tracker noted that although Asia Pacific and North America accounted for almost three quarters of all microgrid capacity, Latin America boasted the largest addition of microgrid capacity with 364MW in Q2.

SOLAR POWERHOUSE
For now, Latin America’s power infrastructure is still based around hydropower (around half of its supply), but South America offers one of the five highest solar potentials in the world, especially the Atacama Desert, where plans are underway to create a system to supply 30% of Latin America’s power by 2035.

The challenges of harnessing a high amount of renewables — including solar, hydro, wind, and geothermal energy — will be met with storage, transmission systems and demand side management technologies.

Chile’s market experienced a boom in its solar PV market between 2013 and 2015, with investment rising from $300 million to $3 billion before declining to $800 million in 2016.

Falling wholesale power prices, which made solar PV projects without auction backing a less appealing investment prospect, possibly drove this decline.

It is clear, irrelevant of the region, a high penetration of renewables will significantly increase the need for storage that can offer a range of grid-scale services.

In Chile for example the power sector is already deploying battery storage as a spinning reserve. In the residential, commercial and industrial segments, the industry players are looking for market-ready energy storage solutions.

The key will be the proper long-term planning and investment in the flexible operational measures and generation technologies available to the region.

It will be part of three exhibitions: The smarter E South America, ees South America and will include the special exhibition Power2Drive South America.

This special exhibition will highlight the need for electric mobility solutions in order to shape a sustainable new energy world.

It will focuses on mobile energy storage solutions, electric vehicles and charging infrastructure technologies.

Held in parallel to Intersolar South America, ees South America takes place at the Expo Center Norte in São Paulo, Brazil, on August 27-29, 2019.
FIRST MOVER CALIFORNIA PAVING THE WAY FOR MASS ESS AND EV ADOPTION

AFTER SECURING ITS FIRST MOVER ADVANTAGE, CALIFORNIA, HOME OF EES/INTERSOLAR NORTH AMERICA NEXT JULY, CONTINUES TO PUSH BOUNDARIES IN ITS DRIVE TO BE THE TRAILBLAZER AT THE FOREFRONT OF RENEWABLE GENERATION, ENERGY STORAGE DEPLOYMENT AND ELECTRIC VEHICLE ADOPTION.

On September 10, California’s governor Jerry Brown signed Senate Bill 100. The new law set out a decarbonized energy goal that will see the state meet 100% of demand from clean power by 2045, with supply milestones of half by 2025 and 60% by 2030.

To achieve carbon neutrality, California will have to more than triple its in-state, non-CO₂ emitting generation, which is expected to accelerate investment and deployment of grid-scale storage.

The Energy Storage Association’s CEO Kelly Speakes-Backman has said that the added flexibility that storage provides, as well as its multitude of applications to the electric grid, will prove crucial to achieving the 100% goal.

Governor Brown also signed SB 700 into law, which will extend the state’s Self-Generation Incentive Program (SGIP) to 2025. The program allocates around $166 million per year in incentives, which could see 3GW of behind-the-meter storage deployed in the state by 2026 — up from 176MW of grid-connected BtM storage today.

The goal is to create a mainstream market for energy storage, similar to what California did for solar PV, said Bernadette Del Chiaro, executive director of the California Solar & Storage Association, the bill’s chief proponent in Sacramento.

Since Q1 2017, residential storage has grown at 61% per quarter, with the US Energy Storage Monitor showing that 62MW/157MWh of energy storage was deployed in Q2 this year.

The US states of California and Hawaii lead the residential market, accounting for 72% of all installations. However, Massachusetts and Arizona are beginning to close the gap.

On August 9, Massachusetts governor Charlie Baker signed an Act to Advance Clean Energy (H.4857) into law. Within the bill are regulations that require utilities to provide a minimum percentage of clean power to cover peak demand.

In addition, the bill calls for the creation of an energy storage target to reach 1GW by the end of 2025 and to revise its renewable portfolio standard to reach 50% by 2030.

Having already deployed a 3MWh vanadium flow battery, the biggest ESS of its type in the US, the state continued its mission in October with a 3MW/6MWh lithium ion system connected to the state’s largest community solar park.

**VCs Continue Investing in Batteries**

The flip side of the all-electric coin is the electrification of transport. Sales of electric and plug-in hybrid vehicles hit the four million-passenger vehicle milestone in August. Bloomberg New Energy Finance predicts the market will grow to 11 million within seven years, and 30 million by 2030.

China is expected to lead this shift, accounting for almost half of the global EV market in 2025, dropping to 39% five years later. Europe will be next at 14%, followed by the US at 11%.

But for now, the US is second only to China in terms of sales, and accounts for around a quarter of the global market. Last year 280,000 EV cars were sold in the country with industry experts estimating a further 190,000 had been delivered to US customers up to the end of August 2018.

The growth in the EV industry is running parallel with the need to make cheaper and better performing batteries, to make EVs both more affordable (the pack is around half of the cost) and quashing range anxiety.

Amid this growth, venture capital and private equity firms have begun upping their interest in the market, with more than $1billion invested in energy storage technologies in 2018, according to energy research firm Wood Mackenzie.
EV sales grow to detriment of hybrid

California is embracing electric and plug-in hybrid vehicles with a 29% (32,000 sales) and 40% (30,000 sales) rise in sales respectively from the previous year.

But this increase has come at the cost of hybrid vehicles, which saw sales in California fall 14% to 40,000 through to June this year, according to analysts.

And while electric, hybrid and plug-in hybrid sales accounted for a combined 10% market share, internal combustion engines — diesel and petrol — still make up 85% of the state’s vehicle market share.

US states will spend big on EV charging plans

California is undoubtedly a leader in new energy vehicle uptake in North America, but on the east coast the states of New York and New Jersey are boosting their efforts to encourage EV adoption.

The three states have announced investments totalling $1.3 billion to increase their charging infrastructure, which remains a major barrier to mass EV adoption in the US.

California’s Public Utilities Commission has approved up to $738 million worth of projects over the next five years. These will include charging infrastructures built at around 1,500 locations throughout the state via investments from Southern California Edison ($343 million) and the Pacific Gas and Electric Company ($258 million), which includes 234 DC fast-charging stations.

New York has pledged up to $250 million through its EVolve NY initiative. The state will work with the private sector to install 200 DC fast chargers every 30 miles along key interstate corridors and two major airports by 2025.

New Jersey’s biggest utility owner Public Service Enterprise Group will invest $300 million to build 50,000 charging stations along highways, in residential areas, and at workplaces.

But with an estimated 80% of EV charging happening at home, California power utility San Diego Gas and Electric will spend up to $137 million on its Residential Charging Program, which will offer up to 60,000 customers rebates if they install Level 2 chargers in their homes.

Find out more about the booming U.S. energy storage and e-mobility industries and join us in San Francisco from July 9-11, 2019 at ees North America (www.ees-northamerica.com) and its special exhibit P2D North America (www.powertodrive.us)
EUROPE WAS ONE OF THE MOST IMPORTANT GLOBAL SALES REGIONS FOR ENERGY STORAGE SYSTEMS IN 2017, WITH SALES TRIPLING OVER THE PREVIOUS TWO YEARS. THE NEXT 24 MONTHS WILL BE A KEY TIME FOR BATTERY AND ESS MANUFACTURERS.

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Philipp Schröder, managing director of sonnen

The overall European market for behind-the-meter (residential, commercial and industrial) as well as front-of-meter, grid-scale installations rose last year to close to 589MWh, up almost 50% compared with the previous year.

And, while at the start of 2017 more than every second storage system in Germany required funding, by the close of the year only a fifth of new home storage systems were being subsidized by Germany’s KfW Bank.

Year-on-year growth in BtM, C&I and residential storage is expected to grow by a further 45% this year, and within a year will break the 1 GWh milestone. Italy and Germany have led the way.

Poll results published by the research firm Delta-EE, with the European Association for Storage of Energy, noted that almost half of contributors found that lack of clear and robust policy, grid regulations and network codes and cost were the biggest issues preventing faster growth in the grid-scale energy storage market.

MARKET LEADERS

In Germany, that growth in BtM applications during 2017 came as almost half of all PV systems below 30 kWp were installed with storage. By August this year, Germany boasted around 100,000 decentralized solar+storage systems (37,000 fitted last year), giving the country access to around 600MWh of capacity connected to its low-voltage grids.

The country’s energy transition — called Energiewende — is well under way.

The next milestone to aim for, according to BSW Solar’s (Germany Solar Industry Association) managing director Carsten Körnig, is to double solar+storage installations within the next two years.

GROWTH MARKETS

Experts from market analysts Macrom say Germany’s rapid trajectory has made it the largest domestic market for home storage in Europe, which makes it, one of the most, if not the most, important markets worldwide. However, arguably, another very interesting market is Italy, where dynamic year-on-year instalment grew 70% between 2016-2017.

In part, this could be because of policy. The Italian Revenue Agency has said homeowners fitting a residential ESS and rooftop PV system can take up to 50% (up to €96,000) off their personal income tax. The deduction includes the purchase of a storage system if installed simultaneously or after the PV system is installed.

According to the Italian renewable energy association ANIE Rinnovabili, 20 kW or smaller systems still dominate the residential market, with around 68
MW of newly installed capacity last year.

Analysts identified capacity size as a significant difference within the European markets. This, according to analysts, could be related to the sizes of private PV systems.

In Italy this is certainly true, with incentives put in place for storage projects connected with PV installations up to 20 kW.

**UK A GROWTH MARKET**

Policy support is key, but scenario drivers are happening outside of legislation to push the UK up to 8 GWs of installed capacity within three years, up from 60 MW today.

Capacity markets, such as the Enhanced Frequency Tender (152 MW), and the addition of large-scale storage to renewable generation, will drive the market.

A report by the UK Renewable Energy Association and an All-Party Parliamentary Group on Energy Storage stated that to reach the 8 GW target, 40% of solar and 25% of wind power generation would have to be connected to storage systems.

Across the Irish Sea, the first round of Ireland’s Enduring Connection Policy – 1 (ECP-1), introduced at the start of the year, has resulted in solar PV and battery storage outcompeting various forms of gas-fired generation, biomass and wind energy.

In real-world terms, Irish grid operator Eirgrid Group has approved 252 MW of solar farms, 842 MW of solar systems, and 351 MW of storage capacity under its ECP-1 capacity application process.

The policy was designed to create a new system for issuing connection offers for new generation and storage capacity.

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“ees Europe is the most important date in the exhibition calendar because it opens up great opportunities for business and its excellent marketing attracts a first-class international customer base.”

Daniel Hannemann, managing director at Tesvolt GmbH

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**ABOUT EES 2019**

ees Europe is the continent’s largest and most visited exhibition for the battery and energy storage industry, bringing together manufacturers, distributors, users and suppliers of energy storage systems. The annual event in Munich, Germany, will see 450+ exhibitors (including all energy storage exhibitors at The Smarter E Europe) benefiting from a 20% increased exhibition surface this year.

Part of a global exhibition series, the event is dedicated to renewable energy storage solutions, ranging from residential and commercial applications to large-scale storage systems for grid stabilizing.

Areas of focus include products and solutions for smart renewable energy, energy management and uninterruptible power supply.

The ees exhibitions and accompanying ees conferences are co-organized with Intersolar, the leading exhibition for the solar industry, and ees Europe in Munich is part of The Smarter E Europe event series.

More than 70% of the increased exhibition space has already been booked, and more than 50,000 visitors are expected to attend ees Europe in 2019.

**ees Europe takes place in Munich, Germany on May 15-17, 2019.**
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FOLLOW US
When it comes to entrepreneurs, the million dollar question is, are they made or are they born? In the case of Jeff Norris, CEO of Paraclete Energy, the answer is both. He talks to Paul Crompton about paper rounds, life lessons and silicon materials.

**How a silicon materials start-up could change the Li-ion landscape**

Behind every household name from McDonald’s to Apple is an entrepreneur. Someone who has the vision to take a concept and fulfil its promise, whether it’s making burgers faster or putting a computer on every desk. All have failed at some time, all have kept going, and all have maintained a belief in themselves.

Jeff Norris is one of those people. He has made a career from building or fixing companies. Something that he admits has always been ‘in my blood’.

He is the architect behind Affinity Technology Group (banking and automated statistical decision processing system) and Paraclete Corporation (a thin film renewable energy and material science company) both of which he built from concept to exit.

His latest venture is Paraclete Energy, a nanoparticle surface modified silicon and silicon nanoparticle composites materials firm focused on the lithium ion battery industry.

But for Norris the story begins much much earlier than his days at Affinity. It started with his first job as an eight-year-old delivering magazines, such as the *New York Post* and *Grit Magazine* door-to-door.

When you’re an entrepreneur, one paper round is not enough.

“By the time I was 12-years-old I had the biggest paper round in Delaware,” he remembers. “Delivering hand-to-hand from my base in New Castle, I actually had four people working with me. At that age I had to deal with weekly payroll.”

And he has always been busy. He recounts the time when he was looking at home movies from the 60s and 70s his parents had transferred from 8mm films to CDs.

“When they showed them I noticed I was always in the background working; they might be filming my parents at the kitchen table, and you could see me through the window cutting the grass, or when around the breakfast table I was washing up. Or at Christ-
“Since over 90% of the cost of the anode is graphite and the customer can now use lower priced graphite with Paraclete’s SM-Silicon, the overall cost of the battery will decrease as well. Thereby achieving, higher capacity, a long life between charging and a lower cost.”
SM-SILICON: THE ENABLING TECHNOLOGY

This surface modifier functions as an artificial solid electrolyte interphase that negates the negative effects of electrolyte interaction and enables very high loadings of silicon well beyond the approximate 8% limit of silicon oxide. SiOx is limited to putting in less than 9% of 1,550mAh/g due to its high initial capacity loss, of 25%-35% that the oxide causes. Therefore, the resulting composite will be about 430mAh/g — far short of elemental SM-Silicon of 3,590mAh/g. The SM also acts to create a covalently bonded network between the binder and carbon and other systems within the anode, and thereby the electrode is more capable enduring the stress associated with silicon.

Paraclete’s SM-Silicon is based on high capacity 3,590mAh/g, 99.5% silicon metal and not 1,550mAh/g SiOx. Like graphite, Paraclete’s SM-Silicon has a tap density of 0.8g/cm³ and an ICL of only 8%.

SM-Silicon can be added to anode slurries and is used in current industry processes. It is compatible in either aqueous or non-aqueous slurry systems.

Paraclete also offers services for customization and making cycle stable, high capacity SM-Silicon based batteries so that customers can test and prototype their next generation products. The industry is currently using a silicon graphite composite whereby the ratio of silicon to graphite is fixed at ~5% silicon and ~95% graphite by the supplier. The highest capacity offered is presently 450 mAh/g.

were made with functional groups covalently bonded to the silicon surface to allow a much wider optical spectrum band gap for higher photonic sensitivity.

This ability to produce low-cost silicon nanoparticles at room temperature with almost all organic or inorganic material covalently bonded to the surface of the silicon was beneficial in overcoming the typical problems of working with nanoparticle silicon with lithium ion batteries.

Paraclete manufactures tonnes of many types of nanoparticle silicon metal, but its premier silicon product is SM-Silicon. The SM stands for surface modified.

The company’s business model is two pronged: selling materials to the cell maker and anode materials suppliers, or licensing the technology. Currently there are three providers where commercial cell makers are only able to buy their graphite/silicon composite at a fixed ratio. Paraclete wants to disrupt that chain.

Paraclete now manufactures 50 tonnes and next year aims to expand that by another 600 tonnes of the material, but Norris said demand is 10 times that based on current availability of high capacity anode materials.

Thereafter during 2020 they will be making 2,600 tonnes, so they are building the capacity to market that growth in the industry.

He said: “Our business model is to get cell makers in Asia, Europe and the US to buy materials from us in bulk so if they want higher capacity anodes they just add more with Paraclete’s SM-Silicon.

“You can use the cheapest graphite out there, but when you add it with our silicon it boosts performance.

Paraclete’s SM-Silicon is embedded in a multi-layered carbon matrix thereby shielding the SM-Silicon with an artificial SEI from the electrolyte.

“Allowing the customer to determine the silicon to graphite ratio and use the graphite that is their baseline is something the industry wants to achieve.

The other prong of the company’s business model involves licensing their IP with major players who prefer to make the material themselves.

That growth from primarily EVs but also energy storage is growing at compound annual rate of around 32% which is projected to be a $14 billion industry by 2021, and well over $100 billion by 2025.

“But there’s nothing quite like the EV industry and there is a great deal of vertical integration in the market,” said Norris.

“Mercedes, for example, is building its own battery plant while Tesla is buying from mines. We are working with industry whereby they are advance purchasing 50% of our manufacturing capacity.”

“We decided to focus on lithium ion because, although from a cost point it was extremely expensive when we started, I could see the potential to where it was going, which it is where it’s at now.”
The ability of lead battery researchers to use the Argonne National Laboratory’s synchrotron to look into the depths of a lead acid battery — in real time — is opening up a world of opportunity of converting research into reality, as this recent presentation shows. It was this same facility that, a few years ago, opened up the world of lithium batteries.

**Improving lead battery performance through *in situ* electrochemical techniques**

This is an extract of a presentation written by Tim Ellis, president of RSR Technologies and his chief researcher on the project Matthew Raiford that was given at 16ELBC in Vienna this September. The full title of the paper is *Microalloyed control of lead battery active materials and resulting improvements in battery performance through in situ electrochemical techniques* — but the results are truly exciting.

Cycle life is the most vital concern in renewable energy storage and grid backup, and indicates how long the service life will be for the battery. Operational failure modes such as over-sulfation in the negative electrode and paste shedding and grid corrosion in the positive electrode must be inhibited as much as possible to improve cycle life.

Another way to look at failure modes is to think of failure to be caused by accumulated damage, and that managing damage is paramount to extending the working life of a lead acid battery.

Sulfation, the formation of PbSO$_4$, is a necessary step in the chemical and electrochemical processes governing LABs. The slow dissolution of PbSO$_4$ is the underlying reason for poor charging performance of LABs under partial-state-of-charge (PSOC) operation.

Dissolution of PbSO$_4$ crystals occurs at different rates based on orientation, crystal plane termination, surface free energy, available surface area, and presence of crystal modifiers. Understanding how to control the dissolution will open new avenues to improve LAB performance.

Many scientists have studied the effect of various trace elements on gassing in LABs, but there is no understanding of how these same elements affect the crystallization and dissolution processes of PbSO$_4$, Pb, and PbO$_2$ phases in LABs.

Based on work done on electrochemical systems, like electrocatalysts and the influence LAB additives have on crystal structure, certain elements could help control and benefit crystallization and dissolution process occurring in LABs.

Our approach to improving LAB performance focuses on monitoring electrochemical and materials behavior at the same time. Studying elemental effects on not only electrochemical characteristics but the fundamental crystal processes is important to uncovering new pathways for performance enhancements.

**Product performance**

SUPERSOFT-HYCYCLE is a secondary soft lead alloy developed to im-

Many scientists have studied the effect of various trace elements on gassing in LABs, but there is no understanding of how these same elements affect the crystallization and dissolution processes of PbSO$_4$, Pb, and PbO$_2$ phases in LABs.

![Figure 2. (left) SEM image of typical leady oxide (control) after MHT cycling showing PbSO$_4$ covering the surface. (right) SEM image of SUPERSOFT-HYCYCLE oxide after MHT cycling. PbSO$_4$ crystals occur less frequently and are smaller in particle dimensions.](image)

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prove the active material of lead acid batteries. The alloying elements greatly improve the ability of the PbSO₄ to dissolve, resulting in higher cycle life, especially in PSOC applications.

Micro-hybrid cycling testing of SUPERSOFT-HYCYCLE in 2V test cells, when compared to typical leady oxide, showed a significant increase in performance. Furthermore, analysis of samples with SUPERSOFT-HYCYCLE and samples with typical leady oxide showed that the PbSO₄ formed in the SUPERSOFT-HYCYCLE active material was smaller in quantity and size.

Figure 3 shows the MHT performance of SUPERSOFT-HYCYCLE compared to typical leady oxide (control) and an ultra-pure secondary soft lead (SUPERSOFT-ULTRA).

Further testing of SUPERSOFT-HYCYCLE in different DOD cycling tests indicated further improvement. Table 1 shows a performance summary of SUPERSOFT-HYCYCLE in various cycling categories and in EN DCA (full run-in) testing.

![Figure 3. MHT comparison of control (typical leady oxide), SUPERSOFT-ULTRA (ultra pure secondary lead), and SUPERSOFT-HYCYCLE.](image)

<table>
<thead>
<tr>
<th>Product</th>
<th>One Hour Capacity (mA-Hrs/mg)</th>
<th>MHT Cycle Life (Cycles)</th>
<th>Dynamic Charge Acceptance (A/A*hr)</th>
<th>DoD 17.5% Cycles</th>
<th>DoD 50% Cycles</th>
<th>DoD 100% Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>74</td>
<td>8,000</td>
<td>0.21</td>
<td>3,000</td>
<td>810</td>
<td>765</td>
</tr>
<tr>
<td>SUPERSOFT-HYCYCLE® Patent 20170317351</td>
<td>84</td>
<td>42,000</td>
<td>0.49</td>
<td>4170</td>
<td>1140</td>
<td>990</td>
</tr>
<tr>
<td>Test Method</td>
<td>BCI</td>
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</tr>
<tr>
<td>Improvement</td>
<td>13.5%</td>
<td>x5</td>
<td>x2</td>
<td>39.0%</td>
<td>40.7%</td>
<td>40.1%</td>
</tr>
</tbody>
</table>

In conjunction with SUPERSOFT-HYCYCLE, failure mode inhibition and accumulated damage management has been approached from the grid alloy perspective. SUPERSOFT-HYCYCLE inhibits over-sulfation and increases particle cohesion, helping with positive paste shedding issues, but positive grid corrosion issues were addressed by the development of new grid alloys. The grid alloy, 009, uses barium and silver to greatly improve corrosion resistance and high temperature durability in positive grids.

Willard Battery was an early adopter of SUPERSOFT-HYCYCLE, and DOD 17.5% testing of Willard AGM batteries with SUPERSOFT-HYCYCLE and 009 grid alloy shows the benefit of improving the active material/grid interface.

Willard batteries achieve exceptionally high cycling performance with SUPERSOFT-HYCYCLE and 009, especially at higher temperatures.

Dissolution of PbSO₄ crystals occurs at different rates based on orientation, crystal plane termination, surface free energy, available surface area, and presence of crystal modifiers. Understanding how to control the dissolution will open new avenues to improve LAB performance.
Synchrotron experiments at the Advanced Photon Source in Argonne National Laboratory were planned and performed to better understand the difference in crystallization habit and dissolution of PbSO₄ in SUPERSOFT-HYCYLE containing electrodes. X-ray diffraction was performed on SUPERSOFT-HYCYLE electrodes and control electrodes during PbSO₄ growth over many discharge/charge cycles.

The results in Figure 5 indicate that SUPERSOFT-HYCYLE grows more homogenously than typical leady oxide.

The control lead measurements indicated that two distinct crystal habits ((311)/(212) and (140)/(231)) preferentially formed, resulting in PbSO₄ crystals that grow quickly on certain crystal areas. Over the life of the battery this would translate to large PbSO₄ crystals that are less easily dissolved PbSO₄ crystals over the operational life.

SUPERSOFT-HYCYLE, on the other hand, forms PbSO₄ crystals that have a much weaker preference with resulting growth occurring in a more homogenous, controlled mode.

We have utilized a combination of internal instrumentation, as well as techniques, methods, and instrumentation at Argonne National Laboratory, to deeply study the changes in PbO₂, Pb, and PbSO₄ crystals in LABs during operation.
Essential reading - Batteries International magazine

WARNING
MAY BE ADDICTIVE

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The ees & IBESA Summit France in Strasbourg on October 24 turned out to be a lively affair with some 135 energy professionals attending the one-day event.

The morning session looked at how the integration of renewables and energy storage was progressing in France — the frank answer was not very well — and then looked at the broader picture, across Europe as a region and wider. Over the course of the day the focus shifted to major business and technology trends in place across the industry.

The French situation is interesting in that the country was one of the first to see the economic advantages of solar+storage when in most parts of the world interest was confined to technical studies and trial projects. In France, however, an immediate application was found for deployment on its overseas territorial departments. As early ago as 2012 solar farm projects were being developed on the Pacific island of Réunion and there was talk of several hundreds of megawatts of electrical storage that would be planned.

The first concrete projects including involvement with major players such as Saft emerged the year afterwards.

The economic cases for these projects — essentially that solar+storage is far cheaper than the use of diesel to power gensets — turned out better than expected. For a while France was a leader in early experiments of micro-islanding.

By contrast, as the summit clearly showed, the growth of renewables+storage was as one of the first speakers pointed out, at best, “stable” in mainland France.

The reason for this could be summed up in two words — nuclear power.

Some 75% of France’s electrical power comes from its 58 nuclear reactors dotted across the country. The price of electricity is a fraction of what it costs in Germany, for example, making the drive to combining renewables and storage as an expensive alternative.

(And oddly enough, despite the huge decommissioning that Germany has achieved of its nuclear plants in the north of the country, France has four MW1300 plants next to the German border in Cattenom in the Moselle.)

Once renewables+storage reached a price point similar to that achieved by nuclear power then, the summit heard, could renewables+storage take off.

French government policy is also vague on the role of nuclear power in the future, meaning that opportunities could be forthcoming sooner rather than later.

Nicolas Hulot, the country’s environment minister, announced in 2017 that the country “could” close up to 17 nuclear reactors by 2025. This would reduce the country’s energy dependence on nuclear power to around 50%.

Hulot has since resigned but there is a lively debate going on whether a new generation of nuclear plants is to be built. (The average plant is around 30 years old with a planned lifespan of 40 years.)

Irrespective of the decision, the conference heard there was still the potential for growth in some more specialized areas such as C&I (commercial and industrial). The principle of micro-islanding, first explored in Réunion and Martinique, for example, could be extended to mainland France at a much smaller scale for schools or factories for reasons of self-sufficiency or security.

One impediment to a speed-up in the numbers of PV installations...
has also been due to the fact that insurance for French solar installers has been unavailable from local insurers. This is a situation that could change, however.

But the growth of energy storage in France was seen as inevitable in the longer term given the larger worldwide context of our need for yet greater amounts of energy — mostly sparked by the drive to electric vehicles.

France is committed to banning the sale of petrol or diesel cars by 2040 — as promised by its president Emmanuel Macron — but there is also a plan to only allow emission-free vehicles to drive in Paris by 2030.

Perhaps the most interesting of the discussions was led by Pablo Ralon, an associate programme officer for IRENA (International Renewable Energy Agency). He said that Europe’s power mix which presently consisted of 24% from renewable sources and 76% from others was set to flip to around 85% from renewables by 2050.

Ralon said that he saw V2G — vehicle to grid — technology as being “hugely important” in the way that the world’s energy mix will balance itself. This was a view that was echoed by other speakers during the summit.

IRENA anticipates that by 2050 there will be some 965 million EVs on the world’s roads and 57 million electric buses.

Ralon also said that he saw no business case for V2GAS at present and that the technology was at a trial stage but could become important for longer term storage. The lack of a business case may soon be changing following the UK government’s recent announcement that it planned to use hydrogen fuelled trains in some parts of the country.

Interestingly enough for an audience of mostly lithium ion battery enthusiasts, he said that storage would be so essential that other chemistries and technologies would have to form part of the mix.

He reckoned that lead batteries, flow batteries and high temperature sodium batteries would all contribute to this energy mix, as would other combinations.

“Mostly they will be application specific but we anticipate that lithium batteries will be dominant by an order of a magnitude,” he said.

Other topics that dominated discussions in this highly useful set of talks and presentations included the latest thinking on virtual power plants and the creation of the so-called digital utility.

The role of the existing utility, France’s energy giant EDF, was discussed. Unlike most other European countries, which have a number of independent utilities, almost all electricity in France comes through EDF.

“The situation for utilities could change enormously,” said Kerstin Pienisch, manager for international business development at Next Kraftwerke. “In a virtual power plant the new utility doesn’t own the assets but manages them. The shift for the industry is the move towards production to consumption. It’s a radical way to organize things.”

Perhaps the liveliest discussions came after Christophe Bourgueil, in charge of energy storage business development at Eaton, gave a presentation entitled Building the Case for Behind the Meter Energy Storage.

Most of the audience are aware that to date recycling large scale lithium car batteries is a cost rather than a source of revenue, so business cases for second life batteries were of great interest.

This was the first country summit led by ees and IBESA and proved a day well spent. Although the technical and business case was high, as you’d expect from these two organizations, the networking opportunities proved excellent and this reviewer looks forward to seeing further summits for other countries.

Mike Halls, Energy Storage Journal
Resource management may not sound the sexiest of subjects but issues such as conservation are just as important as energy storage and generation. So a revamp of the conference previously named Resource and Waste Management into Future Resource — the Event for Water and Energy Efficiency makes a lot of sense.

This year’s conference was a rebranding and relaunch of the UK’s largest recycling and waste management expo. It proved a remarkable success, some 500 market-leading brands were exhibitors and there were 350 seminars led by pioneering professionals across the waste industry.

Attendance figures were high — 12,500 visitors passed through the hall’s doors — with a wide and very diverse background of attendees ranging from executives involved in the energy business, recycling and waste management, as well as senior figures from local authorities.

Alongside the huge range of exhibitors, the seminar schedule proved to be hugely popular with the Keynote Theatre packing out for the majority of the event. RWM also made good on its promise to facilitate business growth opportunities through its Business Growth Theatre and the local authority audience, who are key to improving communities.

The next Future Resource conference and exhibition will be held on September 11-12, 2019 at the NEC, Birmingham, England.
This is India’s most pioneering exhibition and conference for the solar industry.

Solar developments in India grew exponentially in 2017. Further announcements and new market opportunities in the energy storage and electric mobility sector strengthen India to become an interesting and very promising market in the future.

The state of Karnataka is one of the most flourishing Indian solar markets and the first Indian state to launch a specific EV policy.

Intersolar India, the most pioneering exhibition and conference for the solar industry is celebrating its 10th edition in Bangalore, the capital city of the top solar market.

The event will focus on the solar, energy storage and electric mobility industries and will welcome more than 17,000 industry professionals and 300 exhibitors.

In addition, Intersolar India will continue to connect solar businesses in Mumbai at the Bombay Exhibition Centre (BEC) on April 4-5, 2019 with a focus on financing and India’s western solar markets.

Contact
Brijesh Nair
Tel: +91 22 4255-4707
www.intersolar.in
Power-Gen International
Orlando, Florida, USA
December 4-6

As the World’s Largest Power Generation Event, POWER-GEN International is the industry leader in providing comprehensive coverage of the trends, technologies and issues facing the generation sector.

Displaying a wide variety of products and services, POWER-GEN International represents a horizontal look at the industry with key emphasis on new solutions and innovations for the future.

Contact
PennWell Corporation
Tel: +1 918 831 9160 (direct)
+1 888 299 9016 (toll free)
Email: registration@pennwell.com
www.power-gen.com

Energy Storage Summit 2018
San Francisco, California, USA
December 11-12

Now in its fourth year, the Energy Storage Summit will bring together utilities, financiers, regulators, technology innovators, and storage practitioners for two full days of data-intensive presentations, analyst-led panel sessions with industry leaders, and extensive, high-level networking. This year, we’re expanding our traditional U.S. event to cover the global market.

Contact
GTM Events
Email: info@greentechmedia.com
www.greentechmedia.com/events/live/energy-storage-summit

Battery India
Goa, India
January 5-7

Battery India will focus on growth and usage of lithium batteries for India and neighbouring countries. The conference is expected to raise the standards of participatory interaction among stakeholders, regulatory authorities from various countries, user industries, researchers, technologists and equipment manufacturers.

Battery India 2019 will ensure a direct opportunity towards international co-operation and business promotion by ensuring quality lectures by eminent specialists and researchers, buyer and seller meetings.

Contact:
Battery and Recycling Foundation International
Ajoy Raychaudhuri
Email: info@bfi.org.in
Tel: +91 11 2955 2649
www.bfi.org.in/index.htm

Energy Storage India
New Delhi, India
January 9-11, 2019

Energy Storage India conference and exhibition brings together industry professionals and speakers from more than 20 countries.

Powered by India’s leading Energy Storage Alliance “India Energy Storage Alliance (IESA), attending will give you a platform to meet all Energy storage & EV Tender Authorities, State & central Regulators, Policy Makers and Government Bodies.

Contact
Messe Düsseldorf India Amruta Dhumal
Tel: +91 11 4855 0059
Email: DhumalA@md-india.com
www.esiexpo.in

World Future Energy Summit-WFES
Abu Dhabi, UAE
January 14-17

WFES (World Future Energy Summit) is a global industry platform connecting business and innovation in energy, clean technology and efficiency for a sustainable future.

WFES Expo hosts over 850 exhibiting companies from more than 40 countries; The Future Summit; the unique WFES Forums, covering everything from disruptive technologies to future cities; a set of ground-breaking WFES Initiatives; and WFES Hosted Events, where individual growth markets come under the spotlight.

Contact
Rajveer Singh
Tel: +971 2409 0444
Email: rajveer.singh@reedexpo.ae
www_wfes.ae

Advanced Automotive Battery Conference Europe (AABC Europe)
Strasbourg, France
January 27-31

Make plans to participate in the 9th International AABC Europe, where chief battery technologists from major European automakers will present their development trends as well as projected battery needs, and key suppliers will share their latest offerings and roadmaps for the future.

Each year, AABC Europe brings together a global audience of battery technologists and their key suppliers for a must-attend week of development trends, breakthrough technologies and predictions of the market for years to come.
As more European nations and international automotive OEMs make their own commitment to vehicle electrification, we are excited to carry that momentum forward for 2019. Our program continues to expand coverage of the research and development of the chemistries and materials supporting the next generation of electric vehicle batteries, while maintaining our core focus on applied technologies needed for hybrid and electric cars and specialty vehicles.

Contact
Tel: +1 781 972 5400
Email: ce@cambridgeenertech.com
www.advancedautoatb.com/europe/

**Solar Power Northeast**
**Boston, Massachusetts USA**
**February 5-6**

Solar Power Northeast is the largest forum in the Northeast for the solar and energy storage industries to come together and learn about the trends and legislation impacting grid resilience and reliability in the region.

This event will feature multiple tracks of education that include business and market insights, technology, policy, energy storage, innovation, and more-plus, extensive networking opportunities. Attendees can also expect over 80 exhibitors, 1,500 attendees, and expanded energy storage business opportunities on and off the show floor.

Contact
SEIA & SEPA
Tim Morris
Email: tmorris@sets.solar
www.events.solar/northeast/

**Hydrogen & Fuel Cells Energy Summit**
**Madrid, Spain**
**February 6-7**

The two day event will bring together key industry stakeholders from all facets of the hydrogen industry to discuss the required economical and infrastructural innovations for a sustainable future energy carrier. The key discussions will involve monetisation, latest technologies implementations, material optimisation, production and transportation.

Contact
ACI
Rob Cheeseman
Tel: +44 203 141 0625
Email: rcheeseman@acieu.net

**5th Annual Energy Storage Policy Forum**
**Washington DC, USA**
**February 13**

Featuring nationally recognized policymakers and energy thought-leaders, the ESA Annual Policy Forum convenes a select audience of stakeholders from across the energy ecosystem — including state and federal regulators, policymakers, storage industry members, utility decision makers, and power sector stakeholders.

The 2019 Policy Forum promises to build on exciting developments to help guide one of the most interesting and important conversations in the electric sector today.

Who should attend?
- State and federal regulators
- Policymakers
- Storage industry members
- Utility decision makers
- Power sector stakeholders

The 2019 Policy Forum will return to the prestigious National Press Club in Washington DC.

Contact
Energy Storage Association
Justin Aquilante
Email: sales@energystorage.org.
www.pf.energystorage-events.org

**Lithium Mine to Market, Australia 2019**
**Perth, Australia**
**February 21-22**

The Western Australian lithium industry is dynamic and undergoing a period of change, in that it is transforming its traditional mining output into lithium,
International Conference & Expo on Batteries, Charging Infrastructure, Recycling

Battery India - 2019
Goa Marriott Resort, Panjim Goa, India January 5th - 7th, 2019

BLOCK YOUR DATES
Battery India - 2019
JANUARY 5th - 7th

Hot discussion topics:
- EVs & Batteries for EVs, E-Rickshaws, Energy Storage Systems, Solar, Telecom
- GIGA Factory Concept
- Charging Infrastructure Systems, Testing Systems, Battery Management Systems,
- Advances in Battery technology, Battery Chemistry, Additives, Separator Technology, Appropriate Technology for Battery recycling / Circular Economy
- Batteries Sourcing (LA & LIB )

Battery India - 2019
- Exhibition
- Conference
- Business Promotion
- Networking
- Technology Transfer

Battery & Recycling Foundation International
Web: www.bfi.org.in
Email: info@bfi.org.in | info@ewm.org.in

Contact:
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Tel.: +91-11- 29552649
Email : info@ewm.org.in
Email : info@bfi.org.in
chemical production.

New government policies are being discussed to develop the lithium downstream industry even further. This could represent a momentous shift for the industry, with Western Australia potentially incentivized to become a source of materials for the manufacturers of batteries and beyond that-cell and pack manufacturing.

Roskill’s inaugural Lithium Mine to Market, Australia 2019 Conference offers you the opportunity to discover what is really happening in the lithium supply chain.

The conference will bring together a high profile list of expert speakers to offer insights and supply and market outlooks for the current situation in Australia and further afield. It will also give you the chance to meet and network with key decision makers across the entire lithium supply chain.

Contact
Roskill Information Services
Tel: +44 20 8417 0087
www.roskill.com/event/lithium-mine-to-market-australia-2019

9th International Smart Grid Expo
Tokyo, Japan
February 27-March 1, 2019

Japan’s largest international exhibition showcasing various cutting-edge technologies and products related to smart grid and smart communities.

Reed Exhibitions Japan strive to provide the most effective platform for exhibitors showcasing the latest technologies, products and services to meet professionals from around the world who seek such exhibits.

Contact
Reed Exhibitions
Tel: +81 3 3349 8576
Email: visitor-eng.wsew@reedexpo.co.jp
www.smartgridexpo.jp

21st International Conference on Lithium Batteries —ICLB
Miami, Florida, USA
March 11-12

The ICLB 2019: 21st International Conference on Lithium Batteries aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results about all aspects of lithium batteries.

It also provides the premier interdisciplinary forum for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns, practical challenges encountered and the solutions adopted in the field of lithium batteries.

The conference solicits contributions of abstracts, papers and e-posters that address themes and topics of the conference, including figures, tables and references of novel research materials.

Contact
World Academy of Science, Engineering and Technology
www.waset.org/conference/2019/03/miami/ICLB/keynotes

10th Annual NAATBatt Meeting and Conference
Phoenix, Arizona, USA
March 11-14

This year’s NAATBatt 2019 program will focus on the markets for advanced battery technology in North America. As in past years, NAATBatt will invite the leading market analysts in the world to report on trends in the markets for electric vehicle, stationary energy storage, industrial, military and consumer batteries in North America.

The impact of recently enacted US tariffs on the battery market and on domestic battery manufacturing will be covered. NAATBatt’s chief science officer and chief technology officer will make their much anticipated annual addresses predicting how changes in the technology of batteries are likely to impact the business of selling stored electrical energy.

Contact:
National Alliance for Advanced Technology Batteries (NAATBatt)
James Greenberger
Tel: +1 312 588 0477
Email: jgreenberger@naatbatt.org
www.naatbatt.org/2019-annual/

Energy Storage Europe
Düsseldorf, Germany
March 12-14, 2019

Those who would like to get to know the entire world of energy storage, its leading technologies and key-figures, for those there is only one destination: Energy Storage Europe in Düsseldorf.

The unrivalled focus on the topic of energy storage can only be found here in Düsseldorf. Only here the entire range of technologies in all its diversity can be discovered: Electrical, thermal, chemical and mechanical solutions. Only here the energy storage of future energy systems can already be experienced today.

Contact
Messe Düsseldorf
Caroline Markowski
Tel: +49 211 4560 7281
Email: markowskic@messe-dusseldorf.de
www.energy-storage-online.com
FORTHCOMING EVENTS

Solar Pakistan, Electricity Pakistan
Lahore, Pakistan
March 15-17

The 8th edition of Solar Pakistan will attract key industry leaders, governments, manufacturers, suppliers, traders, contractors and partners from across the globe.

It will highlight the latest innovations in the solar and sustainable energy field by offering a unique platform to forge partnerships between public and private sectors to develop innovative solutions.

Running concurrently is Electricity Pakistan which will become Pakistan’s premier exhibition for the energy, storage and power industries. It is a dedicated platform for manufacturers, suppliers, distributors, users and energy storage solutions providers.

Participants from governments, utilities, independent energy producers, energy storage products manufacturers, consulting companies, associate as well as other related sectors are invited to discuss applications, opportunities and challenges for energy, storage and power sector.

Contact
FAKT Exhibitors
Tel: +92 21 35810637 39
www.solarfairpakistan.com

36th International Battery Seminar
Fort Lauderdale, Florida, US
March 25-28

Founded in 1983, the International Battery Seminar & Exhibit has established itself as the premier event showcasing the state of the art of worldwide energy storage technology developments for consumer, automotive, military, and industrial applications.

Contact
Cambridge EnerTech
Tel: +1 781 972 5400
Email: ce@cambridgeenetech.com
www.internationalbatteryseminar.com

The Solar Show Africa — Featuring The Energy Storage Show
Johannesburg, South Africa
March 26-27

As Africa’s largest energy conference and exhibition, The Solar Show Africa brings together government ministries, utilities, power producers, municipalities, regulators, large energy users, project developers, investors and solution providers to allow new business opportunities and valuable connections to be made.

Our mission is to bring together the entire energy sector in Africa to learn, be inspired and exchange ideas.

The conference brings together the brightest and most innovative minds that are shaping the way we generate energy and meet growing demand across Africa!

For 22 years, delegates have flocked to the conference to gain first-hand knowledge on upcoming projects, investment opportunities and innovations across the continent that will help utilities deliver energy.

Contact
Terrapin
Roshnie Govender
Tel: +27 11 516 4076
Email: roshnie.govender@terrapinn.com

2019 SEPA Utility Conference
San Diego, California, USA
April 8-10

Teaching utilities how to implement clean energy and grid modernization technology — that’s what the SEPA Utility Conference is all about.

In 2018 attendees had opportunities to connect and learn with other utilities from across the nation during 54+ hours of networking and education. Sessions and events ranged from EVs to DERS and from storage as a utility asset to low-income solar.

If there has been an incredible utility innovation somewhere in the US, you’ll learn about it at Utility Conference.

Whether your utility is tackling electrified transportation, grid resilience, DER integration, regulatory innovation or new utility business models, the Utility Conference will give you the tools you need to be the hero for your utility and your customers.

Join us in the resort city of Coronado in San Diego to learn lessons that will help you further your utility’s grid modernization, clean energy, and distributed energy technology efforts.

Contact
Smart Electric Power Alliance
Kevin McGrath
Email: kmcgrath@sepapower.org

IDTechEx Show!
Berlin, Germany
April 10-11

The IDTechEx Show! presents the latest emerging technologies at one event, with eight concurrent technologies and a single exhibition covering 3D printing, electric vehicles, energy storage, graphene, the Internet...
of Things, printed electronics, and sensors & wearable technology. Due to the strong overlap across these topics, attendees and exhibitors are exposed to the full relevant supply chains and customer and supplier bases, saving you time and money from attending separate events.

The IDTechEx Show! is devised by analysts covering these topics — bringing together the most significant developments in each of these areas.

**Contact**
IDTechEx
Tel: +4 1273 916 300
Email: info@IDTechEx.com
www.idtechex.com/europe2019/show/en/

### 29th Annual Energy Storage Association Conference & Expo
**Phoenix, Arizona, USA**
**April 16-18**

The 29th Annual Conference and Expo is the industry’s premiere conference and networking event. It is the most influential gathering of market leaders, customers, decision makers, and technology innovators.

Attending will provide you with new strategies, new connections and innovative ideas that will move your organization forward.

**Contact**
Energy Storage Association
Tel: +1 202 293 0537
Email: events@energystorage.org
www.esacon.energystorage-events.org

### The Battery Show Europe 2019
**Stuttgart, Germany**
**May 7-9**

The Battery Show Europe, co-located with Electric & Hybrid Vehicle Technology Expo Europe, is the industry's largest and fastest-growing trade fair for advanced battery and H/EV technology.

With 400+ suppliers from across the battery supply chain, such as A123 Systems, CATL, Leclanché, Voltabox and Bosch Rexroth will display thousands of design, production and manufacturing solutions, including battery management systems, battery pack assemblers/integrators, materials, components, research, testing and recycling. This free trade fair is an opportunity to source the latest energy storage solutions to reduce costs and improve the performance of battery applications.

**Contact**
Smarter Shows
Tel: +44 1273 916 300
Email: info@thebatteryshow.eu
www.thebatteryshow.eu

### Energy Storage International Conference and Expo (ESIE)
**Beijing, China**
**May 14-16**

Since its inception in 2012, ESIE has become the leading annual event for energy storage in China, bringing together nearly 6,000 attendees including government representatives, academic experts, and private industry leaders both domestic and international.

The three-day event includes over 100 speakers covering the latest topics and trends in the energy storage industry, as well as over 60 exhibitors showcasing innovative energy storage technologies, applications, and services.

ESIE 2019 will also feature the 3rd Energy Storage Innovations Competition, honouring the year’s best energy storage technologies and applications.

Other exciting events include industry leader salons, site tours, networking opportunities, new product releases, and more. For those eager to learn first hand about energy storage in one of the industry’s fastest growing markets, ESIE is the can’t-miss event of the year.

**Contact**
SNEC
Tel: +86 21 33685117-888
Email: info@iesh.org.cn
www.iesh.us

### The ARPA-E Energy Innovation Summit
**Denver, Colorado, USA**
**July 8-10**

The ARPA-E Energy Innovation Summit is an annual conference and technology showcase that brings together experts from different technical disciplines and professional communities to think about America’s energy challenges in new and innovative ways.

Now in its 10th year, the summit offers a unique, three-day program aimed at moving transformational energy technologies out of the lab and into the market. ARPA-E is the US Department of Energy’s advanced research projects agency. ARPA-E advances high-potential, high-impact energy technologies that are too high-risk for private-sector investment.

**Contact**
ARPA-E & US Department of Energy
Email: arpa-e-commss@hq.doe.gov
www.arpa-e-summit.com/
Wally Rippel’s enthusiasm for battery-electric cars goes back half a century to the Great Electric Car Race of 1968 but he’s been at the cutting edge of development from the pioneering by GM of EV-1 to the latest thinking with Tesla.

The present enthusiasm for eMobility — the seamless integration of renewable energy, battery storage and the smart grids of the future — would never have advanced so quickly without one man, Wally Ewald Rippel. Rippel was one of a select few leaders of the first generation of EV pioneers in the 1960s. Without his knowledge of battery technology and electronics it’s arguable that EV-1 — General Motors’ first mainstream electric vehicle — would have emerged in the form it did. Or as early as it did.

Wally Ewald Rippel was born in southern Los Angeles, California on October 21, 1944. His father was a sound engineer at NBC radio and was a formative force in the development of Rippel as an inventor and an engineer.

Young Rippel went to LeConte Junior High and Hollywood High where he recalls that physics and engineering were inspirational subjects to him while chemistry left his cold. “It’s a shame as this is one of the key disciplines for energy storage,” he says.

“In recent years, I have come to realize that truly understanding catalysis is a missing element. When we do, we will be able to design batteries and fuel cells far superior to anything under development. The science of catalysis has yet to be born.”

Rippel became interested in electric vehicle technology in the late 1960s while studying physics for a degree at Caltech. It was a time of great change in US society as parts of the counterculture started to enter mainstream thinking.

For Rippel it was the mix of science and social responsibility.

“The smog in the Los Angeles area was terrible. In our history class we talked about the roles of the government and private enterprise. We debated whether the government should be responsible for developing new technologies or if this is the private sector’s responsibility.”

“One smart, but quiet guy in the class spoke up and said, ‘the ‘they’ we’re talking about? That’s us!’ That got to me – and it made me think.”

Road race

This led to Rippel’s converting a 20hp 1958 VW microbus to electric drive using lead-cobalt batteries. The lead cobalt battery was the product of Electric Fuel Propulsion of Ferndale, Michigan. “This was basically a lead acid battery with cobalt ions added which supposedly increased the charge acceptance,” he says. “But I never saw technical data which confirmed the claim. I used the batteries because I had access to them.”

The 24-year-old graduate challenged MIT to a cross-country electric car race.

“The contact with MIT was the result of a letter which I drafted and was rewritten by Caltech’s dean of en-
WALLY RIPPEL: THE FATHER OF E-MOBILITY

Wally Rippl’s career at Caltech and MIT primarily centered on the development of electric vehicles and power electronics. His work at Caltech, initiated with the “Great Electric Car Race” in 1968, set the stage for significant advancements in electric vehicle technology. The race featured cars from MIT and Caltech, each using different approaches to propulsion.

At MIT, Rippl worked on projects such as the development of thyristors and the application of power electronics to electric motors. He also collaborated with the Electromechanical Center of MIT, which was involved in the development of spacecraft propulsion. His work at Caltech included the development of a thyristor-controlled power device and the application of power electronics to electric motors.

Rippl’s collaboration with AeroVironment was a turning point in his career. He co-developed the “Electrospirit” electric vehicle with Eric Cocconi and other engineers. This vehicle was a significant step towards the development of practical electric vehicles. Rippl and his team worked diligently on the Electrospirit, and they were unperturbed by detours that led to failures, as they believed in the potential of electric vehicles.

In a personal statement, Rippl reflects on the importance of nature and his commitment to environmental stewardship. He mentions that his passion for environmental issues stems from a desire to play a role in encouraging Christians to become environmental supporters. Rippl states, “I like nature and care strongly about the environment. As a Christian, one of my passions is to play a role in encouraging Christians to become environmental supporters. In far too many cases, they are on the opposite side of the fence.”

In conclusion, Wally Rippl’s contributions to the development of electric vehicles and power electronics have had a lasting impact on the field. His perseverance and dedication to innovative technologies have undoubtedly contributed to the advancement of electric vehicle technology.
route to Cambridge, Massachusetts

August 1968 and the all-electric converted 1958 Volkswagen bus is en route to Cambridge, Massachusetts

drive systems that powered the Pathfinder and Helios solar airplanes. This featured specially developed 40 pole permanent magnet motors with integrated power electronics. In August 2001, the Helios set an airplane altitude record of 96,863 feet (29,524m).

In 1992, with Alain Cocconi, Wally Rippel co-founded AC Propulsion at San Dimas in Greater Los Angeles, to develop and manufacture those high-performance induction motor drives for GM.

In the 2003 film, “Who Killed The Electric Car?” Rippel was one of the participants in the mock funeral for the EV1 as General Motors prepared to collect the last few for crushing. Rippel believes the film was a real problem for GM as it proved an embarrassment but also a spur to other car manufacturers.

While promoting the film, Rippel met Martin Eberhard, co-founder of Tesla. “He wanted me to work for him. At first, I showed no interest in leaving AeroVironment,” he says. “Finally, I gave a list of requirements for me to join Tesla, — thinking the list would not be met — but Martin agreed and so I joined Tesla in September 2006.”

As Tesla’s principal power electronics engineer, Rippel was able to continue his lifelong work on the battery electric car. Tesla inherited the drive system developed by AC Propulsion. This was not adequate for the Roadster which was heavier than AC Propulsion’s T-0.

As a result, Tesla undertook development of a two-speed automatic transmission — an effort, however, that failed. But the firm itself was changing. Martin Eberhard, the co-founder was asked to leave in August 2007 and ultimately left in January the following year. Rippel was then also asked to leave. “When I left, I felt that Tesla had little chance of surviving,” he says. “How wrong I was!”

The Mini-E

Wally Rippel was almost 70 years old, but he continued to work from AC Propulsion at San Dimas, California, providing electric drive trains for an initial run of 500 Minis automobiles. Dubbed the Mini-E these fully-electric cars were soon deployed on the streets of Southern California, New York, and New Jersey.

By this time he had been joined by his son Eric Rippel, forming a start-up to develop their patented induction motor with transverse liquid-cooled rotor and stator. “Eric and I are working in the development of electric motors and magnetic components which have very high power to mass ratios; greater than 10 kW/kg for motors and greater than 100 kW/kg for magnetic components). Rippel is still hard at it. He is working with Brian Jensen, also formerly with AeroVironment and Michael Gould on their venture, Whisper Energy Systems based in Sherman Oaks, California.

The firm has developed a portable energy and power processing device that can be embodied in backpack, waist-pack, or other portable form. The portable power unit includes a battery and a bidirectional power inverter.

Rippel heard about the work Whisper was doing with 36V DC packs designed to power electric leaf blowers, mowers and other equipment. The packs were being used by several commercial landscape maintenance companies in the Los Angeles and San Joaquin areas to reduce mobile source emissions and noise pollution.

Rippel suggested the packs should supply 120V AC instead of DC so that any appliance could plug in and this led to the partnership. His design approach led to a light weight and low cost solution for the packs.

Rippel, aged 73, now based in Altadena, Florida, now holds 27 US patents with two more on the way. His number one passion remains environmental protection. In the 1960s Wally was a prophet crying out in the wilderness. Now half a century later, the campaign is well advanced.

“I like nature and care strongly about the environment,” he says. “As a Christian, one of my passions is to play a role in encouraging Christians to become environmental supporters. In far too many cases, they are on the opposite side.

“If one believes in a creator, as do I, then it should follow that you would want to value and protect the creation. Yet, now we have an administration that is trying to roll back everything environmental. Washington’s current energy policy is strongly pro-carbon.”

But he also holds hope for the future. “Combined with the progress in solar and wind energy, people see EVs as making better sense than ever What has had the greatest effect, I believe, is the technical progress in batteries and drive systems. Indeed, we may be approaching a tipping point for both EV’s and renewable energy as costs continue to drop.”

As Tesla’s principal power electronics engineer, Rippel was able to continue his lifelong work on the battery electric car. Tesla inherited the drive system developed by AC Propulsion
The definitive guide to battery energy storage conferences and meetings for the year ahead

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jade@energystoragejournal.com
Maccor Test Systems perform virtually every type of test on any type of energy storage device (i.e. batteries, capacitors, fuel cells, etc.).

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- Medical
- Cells | Modules | Packs
- Military
- Channels over 1200V | nanoAmps to thousands of Amps
- Quality & Standards Testing
- Mobile Devices
- Aerospace
- Cell Balancing
- CAN | SMB | I^2C

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