

# ESJ

# ENERGY STORAGE JOURNAL

## CHARGING THE FUTURE

ENERGY STORAGE,  
E-MOBILITY AND RENEWABLE  
ENERGY: A PERFECT FIT



CHALLENGES, OPPORTUNITIES: THE ROAD TO 2020  
EES AROUND THE WORLD: THE AMERICAS, INDIA  
THE CHANGING FACE OF DISTRIBUTED ENERGY  
ELECTROMOBILITY: THE NEXT PHASE ARRIVES

# THE ROAD TO 2020



Ahead of this year's industry meetings in Europe's largest exhibition for batteries and energy storage systems, the ees Europe in Munich, **Sara Verbruggen** reviews the latest developments across the continent. Germany, the Energiewende pioneer, continues to push ahead with energy storage deployments, while new markets from Sweden, to the UK, to Italy, are also forging their own path

## Next steps

A clear path for the future of renewable energy storage across Europe now looks assured. The route may still be a little sketchy at times but the direction is clear.

The reason is simple. The core question — whether mass adoption of renewable energy and storage across Europe will be the future for Europe's power needs — has been answered.

The answer is a resounding yes. And the one country that has done the most in providing that answer — Germany — looks set to lead the way.

Thanks to a continuation of the decision by the government, at the start of 2016, to rein-

state a subsidy for small-scale behind-the-meter energy storage systems, Germany's residential solar-plus-storage build-out is assured.

To date, over 40,000 systems have been installed, comprising units supported with the incentive paid by the state-controlled KfW bank, as well as systems installed without support. The solar-plus-storage systems installed, which encompass new installations as well as retrofit, exceed over 200MWh of energy storage capacity on the grid.

Germany's residential solar-plus-storage market is by far the biggest in the world and it is likely to stay that way for some time, even as new residential solar-plus-storage markets start to get underway this year in Australia, Italy, Sweden, the UK and some American states, including Hawaii and California.

Lithium ion battery technology is the chemistry of choice for most residential energy storage systems in Germany. Key players in the German energy storage market, which were out in force in the ees exhibition halls alongside / co-located with Intersolar Europe

2016 in Munich — and look set to do the same this June, include Sonnen Group. The firm, which has also expanded to the US, Australia and the UK, supplies about a third of domestic demand for residential storage systems.

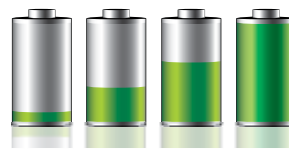
Solarwatt is another notable domestic energy storage player with global ambitions. Both companies have made most of their energy storage system sales to date through distribution partnerships with solar distribution and installation businesses.

In 2016, Solarwatt signed a deal with German utility Eon, which is distributing Solarwatt's energy storage system, branded as Aura.

"It is clear that the utilities have to find new business models. This process is still going on. As solar PV-plus-storage will be one of the most important components of the future electricity system it is a big opportunity for utilities. Their advantage is their large customer base," says Jörg Mayer, managing director of BSW Solar.

Though Sonnen has focused on a new business model that circumvents utilities by ▶

**“In Germany where peak demand prices are high for large energy users — companies consuming more than 10GWh in a year — these customers can reduce their grid charges by 80%-90%, by installing a battery.”**



allowing members to trade surplus electricity generated from solar-plus-storage and other small-scale distributed generation systems with other via its online platform Sonnen Community, the company's OEM partners include rival German utility RWE – lately rebranded to Innogy – which has been white-labelling Sonnen's battery storage systems and selling them since 2012.

In 2016, Germany's Daimler Group made a concerted move into energy storage announcing a new division, Mercedes-Benz Energy Storage, in June at ees Europe in Munich. Target markets include the UK, Netherlands and the US. The battery systems, which use the same technology as the automaker's electric cars, are compatible with SMA inverters.

Mercedes-Benz Energy Storage's solar partners span large, established German solar businesses, including Krannich and Baywa.re, as well as Segen, one of the UK's biggest distributors.

Daimler Group has also been working with partners to supply industrial grid-scale projects in Germany, providing services to Germany's primary power market, when fully connected.

By 2018, it is expected that solar-plus-storage systems will cross with socket prices for electricity, saving on energy from being able to self-consume as much as 80% solar generated power.

This is not due to retail electricity rates in Germany rising, as these should remain steady at around €0.29/kWh (\$0.32/kWh). Self-consumption is becoming more affordable due to the continuing price falls in lithium ion batteries.

By 2020 some estimates expect annual demand for home storage systems in Germany to be in the region of 50,000, driven by a growing number of residential electricity customers' desire to gain more grid independence, which explains the popularity of solar-plus-storage systems even while payback timeframes are at least 10 years, even when subsidized.

### Sweden, UK, Italy embrace residential solar-plus-storage

Residential solar-plus-storage has been one of the huge themes of 2016 and should continue to dominate many parts of this year's ees and Intersolar Europe exhibition area from May 31 to June 2 in Munich. Last year, for example, Mercedes-Benz energy had a

major booth that promoted the launch of its new home storage system.

Tax reductions on solar PV and solar-plus-storage systems over the first 10 years of operation, rising electricity rates as well as high levels of solar irradiation due to its southern European geography, has made Italy an attractive market for solar-plus-storage.

Energy bill savings combined with tax savings suggest on average home owners can expect payback between six and eight years, for a consumer installing a solar plus storage system in Italy in 2017.

This is one of the reasons why ABB has chosen Italy as the first country in which to launch the company's lithium ion battery

**“It is clear that the utilities have to find new business models. As solar PV plus storage will be one of the most important components of the future electricity system it is a big opportunity for utilities”**

storage system, called React, which is based on inverter technology developed at Power-One, when ABB acquired the company in 2013.

Other companies which have also started to roll out home storage products in Italy include Switzerland-headquartered Leclanché. ▶

## C&I energy storage poised for take-off in Germany, UK

Despite current legislative constrictions, which the EU's Winter Package (see box on next page) will ease, large-scale energy storage deployments, especially among commercial and industrial (C&I) energy consumers in Europe are expected to rise.

In Germany where peak demand prices are high for large energy users — companies consuming more than 10GWh in a year — these customers can reduce their grid charges by 80%-90%, by installing a battery.

Berlin-based energy storage software and turnkey systems provider Younicos is working on several projects with C&I customers in Europe and sees Germany and the UK as driving C&I demand for energy storage initially.

European utilities Eon and Centrica are also targeting C&I opportunities in Europe. In the UK, where the recent capacity market auctions rewarded several energy storage projects, some of these will be sited at customers' premises and will provide stacked services to ensure the investments are commercially viable. This will be by providing services that benefit the customer, like peak shaving and back-up, as well as earning revenues from the Capacity Market as well as other grid ancillary services markets potentially.

Yunicos' Y-Cube product, developed specifically for C&I applications, can pay for itself in under seven years by a combination of saving the company costs as well as generating revenues. The company can guarantee its battery systems for 10 years, which

helps assure customers that their investment will pay for itself.

As more projects have been developed, installed and operated with success, financiers are getting increasingly comfortable with energy storage technology.

“Bankability has improved dramatically, but regulatory uncertainty can still hurt. However, with the market shifting towards C&I applications, bankability is increasingly connected to the customers' credit rating, which in the case of German industry tends to be good,” says Philip Hiersemenzel, a spokesman for the company.

In Germany, engineering firm AEG Power Solutions is commercializing an innovative hybrid platform that combines electrical energy storage with power-to-heat equipment, reducing the capital expenditure of energy storage.

The company is targeting the platform at entities that use thermal processes in their facilities, such as local heat networks in combination with electrical distribution networks, as well as C&I customers with demand for power and processing heat, which could also earn revenues by providing frequency control.

By combining energy storage with a power-to-heat system the battery can operate at 100% state-of-charge, using all available capacity, so the battery capacity can be reduced. Any electricity the system absorbs from the grid goes straight to powering the heating/thermal system.

**By 2020 some estimates expect annual demand for home storage systems in Germany to be in the region of 50,000, driven by a growing number of residential electricity customers' desire to gain more grid independence**

The UK, which after Germany, has one of the highest amounts of installed residential solar PV capacity in Europe, is also pegged for solar-plus-storage growth from 2017 onwards. Many companies, including Sonnen, Solarwatt, Leclanché, Tesla, Mercedes-Benz Energy Storage, Samsung SDI, LG Chem and SMA, plus domestic player Moixa, having started marketing and supplying energy storage products in anticipation of increasing demand.

In the UK Moixa has installed over 650 of its smart batteries, equivalent to 1.3MWh, for storing solar and powering direct current loads, like LED lighting, flat panel televisions, laptops, smart phones and other computing equipment. All are deployed as part of an aggregation virtual power plant (VPP) platform — that manages clusters of batteries for utilities or aggregates for wider grid services.

The rapid maturing of the grid services ►

## Winter package clarifies roles for DSOs and energy storage

On November 30, 2016, the European Commission published its "Clean Energy For All Europeans" package, widely referred to as the "Winter Package".

The Winter Package consists of lots of legislative proposals, with three main aims of prioritizing energy efficiency, continued renewable energy development, and providing a fair deal for energy consumers. This topic is likely to prove to be a major discussion area for this year's forums at ees Europe exhibition and conference in Munich.

In the recast of the Electricity Directive, a key element of the Winter Package, the role of distribution system operators (DSOs) are

clarified in the new power market design proposals within the package.

The new power market design is expected to facilitate future electricity markets in Europe, where increasing amounts of variable and decentralized energy production will continue to be added, and there will be increased interdependence between individual electricity markets' systems across borders and growing opportunities for electricity consumers' participation in the market through demand-side response, distributed generation, smart metering and energy storage.

To ensure flexibility in the system, DSOs will be able to procure services from

decentralized resources, included distributed generation, demand-side response programmes and energy storage.

DSOs will also be assigned a role in the integration of electric transportation in the electricity network, by facilitating the connection of public and private grid-connected recharging points for electric vehicles. Rules on DSOs' ownership and operation of energy storage plants are also clarified in the Winter Package proposals.

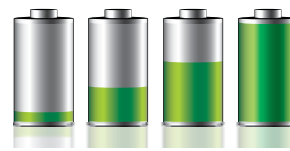
These new roles and associated tasks for DSOs will be based on the principle that DSOs are not allowed to develop charging and storage solutions, unless certain conditions are fulfilled. These conditions include the lack of interest by other parties. Where storage is concerned, the use of an energy storage system or facility is limited to securing the efficient, reliable and secure operation of the distribution system.

DSO ownership and operation of storage and charging facilities are subject to approval by the national energy regulator and must be in compliance with unbundling provisions in each national market. The potential interest of other market participants is reassessed at intervals.

The Winter Package will not take effect before the latter part of this decade but it is crucial for clarifying the position of DSOs in relation to energy storage and electric vehicle recharging infrastructure, which will help to unlock deployment of these technologies within the distribution network.



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market, which supports aggregators and other energy service providers, could see demand for behind-the-meter storage in the UK accelerate in the next few years.

Several players are targeting opportunities by partnering with solar installers that work with housing associations. Energy storage systems, coupled with solar PV, or standalone, can help electricity consumers on variable tariffs, to reduce their energy bills further by charging up the batteries in times of low demand when socket prices are cheapest, to provide power for households on tight incomes when demand and socket prices are highest.

In 2016, Leclanché was selected by UK solar installer North Star Solar to supply its TiBox home energy storage system, which uses lithium titanate cells, one of the highest cycling lithium battery chemistries available.

North Star has introduced a financing model which allows its customers to save on electricity costs with repayments coming directly from energy savings, with no upfront payments.

Utilities benefit because peak shaving services provided by aggregated batteries help to balance the grid and defer costly investments in upgrading and reinforcing parts of the network.

Taking a leaf out of Germany's book, towards the end of 2016, Sweden announced it was introducing a scheme to subsidize solar-plus-storage purchases by residential energy consumers.

Sweden wants to eliminate all fossil fuels used for electricity generation by 2040. The Swedish government hopes that much of the new generation capacity will come from solar PV, which already receives support, and that distributed energy storage systems will enable a smooth integration whilst enhancing the resiliency of Sweden's grid.

The new subsidy, which covers up to 60% of the cost to install a system, is scheduled to run until the end of 2019 that could support up to 25MWh of new energy storage capacity.

#### **Grid stabilizing and flexibility**

Battery storage systems, from utility-scale installations, to customer-sited deployments, to VPPs based on multiple distributed generation units are being rolled out across Germany. These show the technology's versatility — its use in

different configurations, sometimes for multiple use cases — is helping to stabilize Germany's power grid.

Last November one of the world's largest battery energy storage projects, for providing frequency control was inaugurated. Engineering multinational Nidec ASI supplied power producer Steag with six energy storage systems, installed across several of Steag's sites, totalling 90MW of capacity.

The systems combine Nidec ASI's power conversion equipment with LG Chem's lithium ion batteries.

A 15MWh system using around 3000 new electric vehicle battery packs is being built by Daimler, with its subsidiary Accumotive, and with a local utility in Herrenhausen, to provide frequency regulation services.

In 2016, Daimler also supplied one of the largest energy storage systems to reuse spent electric vehicle batteries in a stationary storage application. The 13MWh facility at a recycling plant in Lünen, actually fulfils three use cases; frequency regulation, electric bill management and energy time-shifting.

In Bavaria, a project has been running since 2015, to show how aggregated individual energy storage systems coupled to rooftop solar PV systems, operated within a VPP

“North Star has introduced a financing model which allows its customers to save on electricity costs with repayments coming directly from energy savings, with no upfront payments.”

platform, can provide frequency control services as well as enable the systems' household owners to benefit from high levels of self-consumption, reducing energy bills.

The energy storage 'swarm' pilot consists of 65 individual energy storage units, amounting to 1.3MW of capacity, supplied by German firm Caterva, working with Nuremberg community utility N-ergie.

In the UK, the transmission system operator (TSO), the National Grid, is also procuring more grid services using energy storage in response to a loss of inertia across the system due to the retiring of large thermal power generation units and increasing amounts of variable renewable energy generation. ▶

## Off-grid and smart concept grids

Off-grid energy storage opportunities are arising across Europe's islands. The most advanced of these to date is a renewables-powered microgrid on the island of Graciosa, which is using energy management technology from Younicos, coupled with battery technology from Leclanché to ensure wind and solar can be used for the majority of Graciosa's electricity production, relegating fossil fuel generation to a back-up role.

Through its extensive overseas territories, largely consisting of islands in various seas, France has pioneered cleaner island grids that deploy energy storage with renewable resources such as solar and wind. Projects include a 4.5MW system on the island of La Reunion.

Closer to home French battery maker Saft has

supplied two 1MWh lithium ion battery storage systems for renewables integration on the island of Corsica. The battery systems are each connected to a 1MW solar plant on the island.

On its mainland, France is also piloting energy storage. Saft has supplied battery systems for the Nice Grid project, which is testing a smart grid concept, with utility EDF, where batteries are being used to integrate solar PV from lots of rooftop systems in the region.

Recently EDF ordered a flywheel system from German supplier Stornetic for a concept grid smart grid test facility south of Paris, which has been set up to validate energy storage and other smart grid technologies, reducing their time to market, by seeing how they work in a real world environment.

**In 2016, Germany's Daimler Group made a concerted move into energy storage announcing a new division, Mercedes-Benz Energy Storage, in June at ees Europe in Munich.**

In the summer of 2016, the National Grid announced the successful bids for its first 200MW enhanced frequency response tender. All deploy battery storage. However, more storage opportunities are opening up due to the recent results of the TSO's Capacity Market tender, for reserve capacity in ti-

mes of peak demand, from 2020/2021.

Along with Germany the UK is expected to be one of the hottest markets for energy storage in Europe, for C&I and utility-scale deployments.

#### **Longer duration storage**

Grid stabilization applications, which require short duration energy storage, have helped drive demand for utility-scale storage so far in Europe.

However, longer duration energy storage applications are expected to become more popular from 2017 onwards, for applications such as renewables firming.

In Germany, where older wind farms are starting to emerge from their 20-year feed-in tariff contracts, operators are looking at how energy storage can be used to firm output to enable trading it in the power markets. Such applications are expected to become more commercially viable as negative pricing gaps widen.

Of course, Italy is one country familiar with deploying energy storage at scale for longer duration applications, to reduce curtailment of wind power, where it is mainly generated in the south.

But there is not the sufficient transmission lines and other infrastructure in place to get the power to the north of the country, where much of the demand lies. So, Italian TSO Terna has turned to energy storage, commissioning several energy storage projects over the past two years, which demonstrate a range of battery technology and storage characteristics, from lithium ion titanate chemistries to flow and sodium nickel chloride batteries.

One of the projects commissioned is a 450kW/1.4MWh vanadium redox flow battery supplied by Unienergy Technologies for a Terna substation in Ciminna, on Sicily. The system was installed as part of the first 16MW phase of Terna's energy storage programme and the TSO is now in the process of commissioning the second phase, which will lead to the installation of an additional 24MW of energy storage, based on the most promising technologies demonstrated in the first phase.

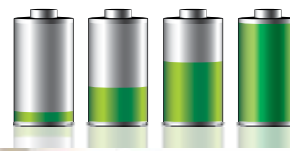
Terna is seeking energy storage technologies to help it address a range of use cases and services, including frequency regulation, transmission upgrade deferrals, due to wind, transmission support, voltage support and black start capability. ■



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**Lithium ion battery technology is the chemistry of choice for most residential energy storage systems in Germany. Key players in the global energy storage market, such as LG Chem, which was out in force in the ees Europe exhibition co-located with Intersolar 2016 in Munich —look set to do the same this June**



## Electrical energy storage in Brazil

In April 2016, the Brazilian National Regulatory Authority, better known as ANEEL, published the first draft of a three-year energy storage initiative in the context of its R&D programme for technological innovation in the power sector, which was launched in 2012. Project selection for the initiative should be concluded in 2017.

ANEEL's announcement is timely and shows an interest in pushing energy storage to be considered as a solution to Brazil's growing renewables capacity and urgent need to fill the transmission infrastructure gap.

## ees South America

ees South America is the new platform for storage technologies reshaping LATAM'S energy sector.

The ees (electrical energy storage) global exhibition series is the industry hotspot for suppliers, manufacturers, distributors and users of stationary and mobile electrical energy storage solutions.

ees is a special exhibition running within Intersolar South America 2017 and is dedicated to storage solutions for renewable energy, from domestic and commercial applications to large-scale storage systems for stabilizing the grids.

*This year it takes place between August 22 and 24 at the Expo Centre Norte in São Paulo.*

# Electrical energy storage in Latin America

South America offers one of the five highest solar potentials in the world. In the long term, a high share of solar energy in the region, together with other renewable energy sources such as hydro, wind and geothermal energy, will impose challenges on the power system.

These challenges will be addressed with storage technologies, smart transmission systems and demand side management (DSM). The high penetration of renewables that is

envisaged in future power systems of South America will increase the need for flexible operational measures and generation technologies, whose associated investment decisions have to be properly planned in the long term.

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

“South America offers one of the five highest solar potentials in the world.”



# US and California lead the charge



In 2015, the US energy storage market reached a record-setting number of installations, with an annual total of 221MW. That figure represented a 243% increase over 2014's installation total of 65MW. Looking ahead to the final figures for 2016, the market will continue to post impressive numbers:

GTM research forecasts the annual US energy storage market to cross the 1GW mark in 2019 and to reach 1.7GW by 2020.

The market will be worth \$2.5 billion by 2020. Additionally, the number of solar-plus-storage installations is expected to grow with the extension of the investment tax credit (ITC).

In the United States, the utility (front-of-meter) segment continues to be the bedrock of the market. In 2015, front-of-meter storage accounted for 85% of all deployments for the year. The residential and non-residential (behind-the-meter) market is much smaller but grew 405% in 2015.

But energy storage still faces significant hurdles.

Many systems are not yet cost competitive with conventional technologies. Cheap natural gas suppresses the market for peak-load shaving and ancillary services. And many US states lack the regulatory structures necessary to facilitate energy

storage deployment or reward utilities for their investments in storage projects.

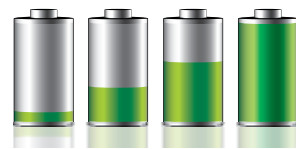
Despite these challenges, certain states have emerged as leaders in energy storage deployment. California is home to the country's largest energy storage market, and its policies and deployment practices serve as a model for other states. ■

#### For more information ...

You can download the GTM white paper at:  
[www.ees-northamerica.com/news-press/download-resources](http://www.ees-northamerica.com/news-press/download-resources)







# North America's ultimate hot spot for energy storage solutions

Covering the entire value chain of innovative battery and energy storage technologies, ees North America is the ideal platform for all stakeholders in the rapidly growing energy storage market. It takes place in the epicenter of the US storage market: California.

Co-located with Intersolar North America, North America's most-attended solar event, ees North America provides the best opportunity to explore

energy storage systems in combination with PV and beyond.

In 2016, more than 100 energy storage exhibitors and 18,244 visitors participated in the co-located events. ees North America is part of the ees global exhibition series. Together with ees Europe in Munich, and ees India in Mumbai, ees events are represented on three continents.



**“GTM research forecasts the annual US energy storage market to cross the 1GW mark in 2019 and to reach 1.7GW by 2020.”**

The United States is set to be the largest energy storage market worldwide, and California is the hub of technology innovation and policy development!

As more solar power comes online, storage technologies play a critical role in grid stabilization, electric transportation, demand management and beyond.



# Drivers for energy storage in India

The increased penetration of solar PV and wind installations is fundamentally altering the power sector across the world. The shift towards more and more distributed power generation and higher contribution of energy to the grid from power sources like solar and wind are creating new challenges in grid integration of renewables.

The seasonal fluctuations in solar power generation and the inherent unpredictability of energy from these sources have led to increased adaptation of energy storage systems.

India's renewable energy targets will massi-

vely add capacity to the grid over a very short period of time. Narendra Modi, the prime minister, has declared energy a top priority.

By 2022 the country aims to achieve an installed photovoltaic capacity of 100GW and 175GW renewable energy in total.

Many parts of the country face power cuts for up to 16 hours a day, and power is available only intermittently. This has prompted many households that can afford these storage systems to deploy them at their homes and use them during the long power outages.

Today almost none of these storage systems have so far been connected to a PV system and the energy stored in the system is the grid electricity. However, there are only a few storage systems either in the industrial or commercial sectors at the moment, mainly owing to the high cost of storage devices.

But the importance of energy storage systems

for India cannot be underestimated.

In a country where more than 400 million people do not have access to grid electricity and a similar number not having reliable and quality grid power, distributed and off-grid PV systems along with storage will be of great need.

And things are shifting dramatically.

India's electrical energy storage market is projected to reach \$200 million by 2018. The key drivers for this growth are the mandated replacement of decentralized generation (sets by solar for telecom towers, the expected growth of mini and micro grids, and the imminent need for grid stability arising out of growing solar and wind penetration.

Given the need for energy storage due to the increase in PV penetration, distributed power generation and power shortage in the country, Indian policy makers – both at the central and state level – can play a major role in devising policies to gain a major share in the PV storage market.

The Indian government is looking at ways to minimize the impact on the existing grid. Therefore, according to media reports, the Ministry of New and Renewable Energy is contemplating the launch of a National Energy Storage Mission. State policies will fire up energy storage and microgrid opportunities as well.

A possible energy storage policy would most likely be linked with the solar or wind energy policy. According to the Indian Storage Alliance (IESA) there are also policy drivers for storage with India's Central Electricity Regulatory Authority (CERC) mandating the scheduling of renewables farms and the Central Electricity Authority establishing a national task force for the integration of renewables, including the role required of storage technology. ■

## Where + when

**ees India takes place within Intersolar India 2017 from December 5-7, 2017 at the Bombay Exhibition Centre in Mumbai.**

“India's electrical storage market is projected to reach \$200 million by 2018.”



## Why ees?

Intersolar India is hosting and highlighting the special exhibition „ees India“ to extend and round up electrical energy storage innovations and programs.

The focus at ees is on energy storage solutions suited to energy systems with increasing amounts of renewable energy sources attracting investors, utilities, installers, manufacturers and project developers from all over the world.

The huge economic growth in India and the strong engagement

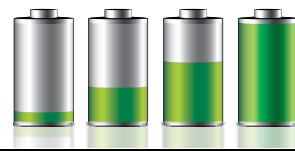
of the Indian government for energy security and renewable energy, the potential market for electrical energy storage in India is expected to be tremendous in the future.

The location of the exhibition and conference in Mumbai — the financial and commercial capital of India — means that ees India will attract international powerful buying power for electrical energy storage innovations.

In 2016, ees

India took place in parallel with Intersolar India. At the companies' booths, numerous visitors learned more about the energy storage sector. This event complements the exhibition perfectly — batteries are essential for India's journey to a renewable future.





# The changing face of distributed energy

ees Europe spoke to six industry leaders exhibiting in the Munich meetings from May 31 to June 2 for their perspectives on the present European marketplace

## Battery assets to provide multiple services and benefits

**Eliano Russo**, head of energy storage at Eon reckons that the industry is reaching a turning point



### Where has Eon positioned itself in the current market?

Following research in 2014 to 2015 to identify the most profitable applications across the different regions Eon operates in, we concluded that energy storage has value both in behind-the-meter deployments, in homes and on industrial premises, as well as for utility-scale in-front-of-the-meter applications, supporting transmission system operators and distribution system operators.

In the UK we have been selected as one of the successful bidders to provide services in the National Grid's new enhanced frequency response (EFR) market. However, this type of application, where the battery automatically responds to changes in frequency, is really the start.

### What do you mean, the start?

From now on we are looking at projects where battery assets can provide multiple services and benefits. This requires sophisticated software controls. Rather than having a battery that sits

on the grid, idle for many hours until it is called upon to provide one type of ancillary grid service, we are looking at projects where the battery is deployed first and foremost to provide peak shaving for the customer, but can also provide other services and benefits.

### What does this mean in geographical locations?

In Germany, where peak demand prices are high for large energy users — companies consuming more than 10GWh in a year — these customers can reduce their grid charges by 80%-90%, by installing a battery.

But in other countries in Europe, including the UK, similar opportunities are starting to emerge, especially if peak shaving can be complemented with other services or benefits such as improving power quality; for some manufacturing and processing businesses this is important, and back-up. Last but not least if the asset can also generate revenues from the National Grid's ancillary services, then pencilling out a business case for energy storage becomes possible.

### And what is your approach to this?

That's the direction the business is taking and it is why we are going to be focusing more on the intelligence — software — side. We made an investment in US energy storage software developer Greensmith in 2015, but we are also looking at other solutions on the market. These types of investments by European utilities in software developers have been occurring because they are mutually beneficial.

Utilities have access to customers and know about their lo-

ads, their usage patterns and billing, so can see how energy storage can be of service to customers, and how to monetize these assets. Software providers, which have the technology platforms to enable energy storage systems to perform intelligently, providing multiple functions and services, are able to gain access to the European market.

Energy storage should not be treated like a standard generation asset. But, the industry is still immature, though it has incredible potential. In Europe certainty in the regulatory framework — for grid operators and distribution system operators — around who can operate energy storage and who can use it is going to be needed. If we can set down some basic principles, it will provide investors with more certainty.

The EFR market, which is the first kind of grid ancillary service tailor-made for batteries, is going to be closely watched and monitored by other European transmission system operators.

Energy storage growth is comparable to the global solar PV market's evolution. For many years there was very little growth and then from 2009 to 2016 the market has boomed, going from 20GW to 300GW of installed global capacity. We are approaching that turning point with energy storage, I believe. ■

**“In Europe certainty in the regulatory framework, for grid operators and distribution system operators, around who can operate energy storage and who can use it is going to be needed”**

# The need for greater customer awareness

**Daniel Hannemann**, managing director of Tesvolt, reviews the current energy storage landscape



## What do you regard as the most significant change to the energy storage landscape — for your business — to have happened in 2016? Why?

Over the course of the last year, the industry has made major advances in the area of technology. As a result, storage systems are becoming increasingly competitive.

One of our own developments was among the most significant of these innovations in 2016: The active bidirectional battery management system (BMS). This monitors the condition of the cells and balances each individual cell, thus achieving greater efficiency in the battery system compared to existing methods — such as passive battery management.

**“Our new generation of products will have a lifespan of 30 years and a DOD of 100%.”**

It constantly tracks the temperature, voltage and state of charge of each individual cell. This award-winning system enabled our battery storage systems to have a lifespan of around 20 years and a depth of discharge (DoD) of 90%. Our new generation of products will have a lifespan of 30 years and a DOD of 100%.

## Could you name some things that you wish could happen for the energy storage industry for the year ahead?

Ideally, we would like to see a further fall in prices of battery storage systems driven by continued product development and improvement. The demand for storage solutions is there, but there needs to be an increase in customer awareness around the world that they can save money by using storage systems. We are planning to offer customised storage applications, most notably for the European market, and to continue to be involved in the area of off-grid.

## The uptake of energy storage is geographically disparate, with Germany and some parts of the US leading the way. In your opinion what would speed up adoption elsewhere? Cross-border subsidies? Harmonized international regulations?

The situation is this: Combining storage systems with renewable energy sources offers a favourable alternative to diesel. This is a strong argument, particularly in countries where the power grid remains underdeveloped — where up till now, the necessary power has been supplied by typically expensive and environmentally harmful diesel generators.

We need customers to be better informed and to put their trust in the technology. For the one part, bilateral agreements between countries and partnerships with other companies can contribute to the exchange of knowledge and help to pool strengths.

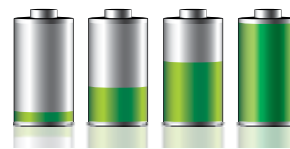
For us, it is particularly important to work with inverter manufacturers. But establishing uniform standards for manufacturers and international legal frameworks would also be an important step in increasing acceptance towards storage systems.

## Renewable energy is increasingly finding its way into everyone's lives through the grid to the home and factory but the transportation sector — electromobility is virtually untouched. Why do you think this is the case? What factors will drive this business sector forward?

Here, we face the same challenges as with stationary storage systems: It is difficult to win customers over if they cannot recognise the economic efficiency of storage devices. This is why we are looking to symbiosis between the use of stationary storage systems, renewable energy and e-mobility.

These areas must be more closely linked to ensure clear benefits for customers using e-mobility. E-mobility will only be a success if it is envisaged in connection with stationary storage systems. The domestic storage systems currently available are often much too small to supply a system including electric cars with enough energy at any given time.

For that reason, now that commercial storage systems for companies are well established, we are aiming to make commercial storage systems more attractive for the home as well. ■



# The joys of self-consumption

**Andreas Gutsch**, chief innovation officer of Solarwatt, discusses how his rapidly expanding company is positioned for the future.



## How do you see the current market situation for your firm?

Worldwide interest in our storage systems has been grown significantly. In 2017, we will start selling MyReserve in Australia, Italy, Spain, the Netherlands and France. This international market growth increases the sustainability of the market and thus enables us to develop even more powerful products.

## What concerns do you have about the present energy storage scene

### and what improvements would you suggest that would speed up adoption?

As for any innovation, safety is the most important issue.

In 2015 the lack of guidance on this topic became evident and the "recommendation policy for safety in Li-Ion home storage systems" was developed in cooperation with numerous Institutes and major players. My wish would be that this policy could be swiftly established globally. Because any accident in the sector would impact the whole sector.

In addition, the self-consumption of green solar energy from storage systems should be treated the same as tomatoes from your own garden and not taxed as is the case in Germany at the moment.

It would be desirable to raise public awareness for the cost/performance relation of the various storage systems. We truly do not believe in any kind of subsidies.

Solarwatt products pay off without financial

support from third parties.

Harmonized international regulations, especially in regard to safety of lithium ion batteries, would help a lot. At the moment we have a variety of regulations that differ from country to country even within the EU.

### And how does electromobility fit into this?

Solarwatt has a system approach around the concept of generating, managing and storing solar energy with clear focus on the self-consumption, among other, also the charging of electric vehicles. However, due to the small number of Electric vehicles sold so far, this concept has not yet fully penetrated into consumer consciousness.

In expectation that the trend to electric vehicles will increase, Solarwatt already today, offers a fully integrated product assortment ranging from long-life glass-glass solar modules, via energy management and storage, to the Wall-box for charging the EV. ■

# The rise and inevitable rise of electromobility



## Renewable energy is increasingly finding its way into everyone's lives through the grid to the home and factory but the transportation sector is virtually untouched. How do you see its future?

**Thomas Speidel**, general manager of ADS-TEC which makes high-performance battery systems for alternative energy sources, considers the growing market in e-vehicles.

Electric mobility will be a major driver of flexibility in the grid — especially in the distributed grid. This sector looks as if it is untouched at present but, as soon as the right products become available this is going to change.

In the future, the e-mobility market will look a little like this.

- Electric cars will have a reasonable price and have a decent driving range.
- More vendors than had been expected will offer e-cars. China will lead the field.
- The infrastructure for charging will be standardized and readily available. There will be no major hotel, restaurant, shopping mall or the like which would be wi-

thout charging infrastructure.

- Much of the core technology can be bought off the shelf, so sensors and software will be offered from companies such as Google similar to Android on mobile phones.
- Long development cycles can be shortened by using established components and functionality.
- Plug-in hybrids will become too expensive as they are neither an electrical nor a conventional car. Used plug-in cars will lose a lot in value.
- Cities will prohibit combustion engines in certain circumstances.
- Regulations such as parking will become preferential to electrical drivers. ■

# Long duration needs to lead demand

**Lars Möllenhoff**, CEO of Gildemeister Energy Storage believes that a worldwide reappraisal of renewable energy is underway



Our experience shows demand for long-duration storage will start to become more significant from 2017 onwards, both in developing and developed economies.

There is a worldwide change in energy goals and targets set by governments to

increase the usage of renewable energies and to expand rural electrification.

The Rural Electrification Agency in Uganda for example is planning to connect 100% of its inhabitants with electricity by 2035, including those living on remote islands and in rural areas, which would mean a connection of 1.4 million new customers.

Currently, Uganda's overall electrification rate is only 14%. Vanadium redox flow battery (VRFB) technology, a form of long-duration storage, can leap-frog lack of grid infrastructure and provide clean electricity.

Alongside East Africa, governments and project developers in India, Oceania and south-east Asia, such as Thailand, are interested in investing in microgrid solutions, which suggests plenty of growth market potential for VRFB technology in the upcoming years.

In developed markets we are seeing the demand for long-duration storage systems steadily increasing. This demand is mainly coming from the US, where customers are

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**A tendency towards DC-DC storage systems is underway, especially relevant is the growing interest in community solar-plus-storage projects**  
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asking for scalable storage solutions for four, six, or more, hours.

Recent political developments within the US considering a change in the energy policy by president-elect Trump have not had an effect so far. A huge impact in the long-run should be unlikely, as state law in many US states is in favour of renewables.

Besides these major trends, a tendency towards DC-DC storage systems is underway, especially relevant is the growing interest in community solar-plus-storage projects. ■

## Energy Storage 2.0

**Christoph Ostermann**, CEO and founder of Sonnen says the evolution of the energy storage market is far from over.



**What do you think will be the next stage in the development of energy storage this year?**

2017 is going to be about Energy Storage 2.0.

During the last five years we've seen many new companies with many different technical approaches for finding the most efficient,

the smartest, or the most economic way for storing energy.

This phase is not finished yet and we'll still see the entering of new players and the evolutionary improvement of storage systems.

But, in parallel the market has already entered a new phase. It is based on the assumption that the technical race will make storage systems more and more comparable in the future, in that products will become more commoditized, just like any other hi-tech industry.

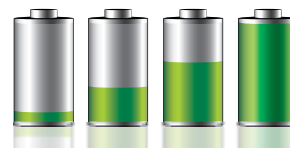
In addition, smart energy storage has a disruptive power that offers completely new applications beyond storage. So it will be not enough to just have the best or even the cheapest storage system on the market.

**So what do you think will happen in this next phase?**

That's why in the next phase we'll see the focus on establishing new services that are based on leveraging the full value of energy storage.

In addition to sharing platforms, additional services — such as those that offer a flat electricity rate, where energy storage systems provide grid services — mark the evolution of this disruptive industry. These additional services that are based on Internet of Things technology will become the unique selling point over the coming years and will help decide who will win the inevitable consolidation phase that the industry is moving towards. ■

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**In the next phase we'll see the focus on establishing new services that are based on leveraging the full value of energy storage**  
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# Battery assets to provide multiple services and benefits

A major component of the ees Europe conference (Munich, Germany, May 30-31) will be dedicated to the role of advanced batteries in automotive applications. We spoke to **Professor Werner Tillmetz**, a 30-year veteran of alternative battery technologies, a member of the ZSW Managing Board and head of the Electrochemical Energy Technologies division, member of the faculty of natural sciences at the University of Ulm and the key figure in arranging this part of the conference programme.



**“I speak with some 30 years of experience in the alternative automotive business and that is that change cannot happen without government interference or involvement.”**

## **EV and hybrid sales are climbing. How significant is this as a trend?**

EV growth is now moving into exponential territory. The market recently hit sales of two million and over the past five years we've seen annual growth rates of some 80% annually.

We're now seeing worldwide rates of growth doubling every year.

This isn't a trend that's going away and within a few years' time we should surely see EV sales occupying a sizeable chunk of the market. The recent diesel scandal has had a strong impact on the strategy of the OEMs, now pushing for EVs.

## **Where has EV penetration been greatest? And why?**

Worldwide the three areas that stand out are California, China and Norway.

The reason for this — and I speak with some 30 years of experience in the alternative automotive business — is that change cannot happen without government interference or involvement.

In California, for example, EV and hybrid growth has been fuelled by the state legislature's zero carbon emissions policy which is effectively a mandate to eventually make consumers drive electric.

In Europe we should expect to see a similar surge in EV and hybrid growth when the new, lower, European Union emissions come into force in 2020. Car manufacturers have to comply with these lower standards and will have to tailor their automotive sales accordingly.

In China the government has taken a similar policy approach to encourage EV sales — it's a bit more blunt: "... you want a licence plate for a car, you can have one but it has to be an electric one!"

In Norway, the emphasis is on providing subsidies for their citizens to buy EVs on preferential terms. Given the choice of buying a Golf or a Tesla at the same price — OK an exaggeration — which would you choose?

## **Obstacles to EVs tend to focus on the three areas — price, performance such as driving range, and popular reluctance to look at these cars. What's your take on them?**

Each generation of EV or hybrid cars is coming down in price quickly and performance, such as driving range, is increasing.

You only have to think of, for example, BMW's new i3, the latest Chevy Bolt or

the Tesla Model 3 where we're seeing the driving range extend up to the 300km to 400km mark. The cost range is dropping too, with prices of around €30,000.

Popular acceptance is something that is largely driven by the media for — but, however, this can be offset by the simple expedient of letting people sit in the cars and getting used to them. Something that, of course, will become more natural as time goes by.

## **Do you think there will be some kind of standard norm of electro-chemistry that will become the EV standard?**

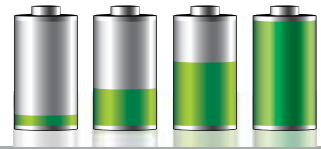
I see the immediate future being dominated by lithium ion batteries and fuel cells.

The two shouldn't be seen as being in competition with each other but as complementary — at its simplest it would be lithium for say, for example, city driving, but fuel cells for longer distance, city buses and logistics.

## **And how will this fit into your conference programme for Munich at the end of May?**

The emphasis of the sessions will be to focus on some of the remarkable developments in the technology that we're seeing in automotive batteries — the types of solutions that we're able to offer now in terms of yet better performance. ■

**“I see the immediate future being dominated by lithium ion batteries and fuel cells.”**



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