

▲ Genuine power flows over a total length of 14 km: The medium-voltage distribution network in the Younicos Technology Center in Berlin-Adlershof, Germany.



# FOSSIL-FREE AND INTELLIGENT

Grid connection of the 5 MW battery park in autumn 2014

The core expertise of Berlin-based Younicos AG is the management of energy storage systems for a stable power supply – based on up to 100 percent renewable energy. They are currently building Europe's largest commercial battery park for balancing short-term grid fluctuations for the green energy supplier WEMAG, based in Schwerin, Germany. The battery management was implemented with the M1 controller system and MX220-CPU's.

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**S**un and wind can cover the entire energy demand of the planet. However, several technical and economic challenges have to be overcome before a successful transition to renewable energy is possible. The most important of these is the adaption of the power supply to the energy demand at any time. The sun, after all, does not shine all the time and the wind does not blow continuously. Today central thermal power stations, mostly fired with fossil-based energy carriers, are used to compensate these fluctua-

tions: They regulate the difference between the supply and the demand – and keep the electricity voltage and frequency within safe limits.

### **The search for the ideal energy storage system**

In order to do so, the slow response of thermal power stations means that they usually have to operate at 60 % and often up to 90 % capacity. Only a small proportion of this, around 4 %, is used for stabilizing the grid. ►►



Younicos AG based in Berlin, Germany, was founded in 2005. Together with partners, they develop, build and operate up to 100 percent renewable energy systems which are today more economically viable than fossil-based systems.

► [www.younicos.com](http://www.younicos.com)



▲ Intelligent closed-loop control: Younicos-CTO Clemens Triebel explains to the WEMAG board member Thomas Pätzold the power plant management of the Younicos battery park.

►► However, according to the experience of Younicos, the so-called must-run capacity limits the share of renewables in the energy mix to an annual maximum of 15 percent. Efficient energy storage systems offer one way out of this misery. “It was already clear to us in 2005 that storage systems and an innovative grid management are the key to a power supply of up to 100 percent wind and solar power,” Udo Berninger, head of software development at Younicos, describes the basic reasons that led to the founding of the company. “However, it was not clear how quickly and consistently the regulatory requirements would be adapted to the

» We are making batteries intelligent. «

*Udo Berninger,  
Head of software  
development at Younicos*

technical demands of a fossil-free power supply,” Udo Berninger continues. Younicos therefore intentionally pursued a number of different approaches and has also examined the 27 most promising storage technologies – particular in regard to durability, reliability, safety and commercial viability.

**Hybrid solution increases commercial viability**

The choice ultimately fell on electrochemical storage systems, i.e. batteries. “We are currently working with three technologies,” explains Udo Berninger, “lithium-ion, sodium sulphur and vanadium redox flow.” They have

a particularly fast response and are therefore highly suitable for balancing fluctuating energy generation from wind and sun with millisecond precision: Lithium-ion batteries with their high power to energy ratio are suitable as a short-time storage system for minutes or hours, whilst sodium sulphur high energy batteries are suitable for compensating daily fluctuations due to their very high storage capacity.

Vanadium redox-flow batteries have virtually no self discharging: “The energy carrier has virtually no signs of aging or wear and is therefore very well suited to storing energy over long periods and seasons,” Berninger explains. If necessary, the different technologies are combined in a hybrid battery. This type of battery is as yet unique. “This makes it possible to combine all their benefits. Because storage systems



»For us availability and EMC performance is what counts. With the M1 we made the right choice.«

*Udo Berninger,  
Head of software development at Younicos*

are normally the largest cost factor, this considerably increases the profitability of our solutions,” Udo Berninger stresses.

### Integration of batteries in the grid

Besides the availability provided by the best battery technologies, their connection to typical AC grids presents a further challenge: All generation and storage units must work together decentrally and without requiring constant human intervention. Due to their many years of experience in the cell chemistry of batteries, Younicos became experts in battery management. “We make batteries intelligent and communication-enabled,” Udo Berninger states with a smile and explains: “Only in coordination with the power inverters we have developed can the batteries respond automatically to changes in power supply and demand.”

### Management and communication

The intelligent battery power plant management system developed by Younicos ensures that this takes place smoothly. Younicos storage systems are the first in the world that can communicate with other grid stations, such as power plants in accordance with the internationally accepted IEC61850 standard. The company has been using Bachmann technology for this in their battery power plants for the past four years: “We have implemented the

control of the inverters and batteries on the MX220-CPU of the M1 automation system,” explains Udo Berninger. “This also gives us a standard interface for battery power plant management (BPPM) at the same time. We also appreciate the performance: The CPU’s high performance enables us to program in C++ and comes with the most

important interfaces and protocols for us – CAN, Profinet, IEC61850 and IEC60870-5-104 – already on board.” As the Younicos plants are connected to the grid round the clock, particular importance was placed on the availability and EMC performance of the M1 system. This was summed up by Udo Berninger in one word: “Robust”. ▶▶



◀ With 5 MWh capacity: Europe’s first commercially used battery park is being built in Schwerin, Mecklenburg-Vorpommern, Germany.





▲ **Modules above head height:** Battery storage systems based on lithium-ion technology, as used in the WEMAG battery park in Schwerin.

►► **Capacity:**  
**five megawatt hours**

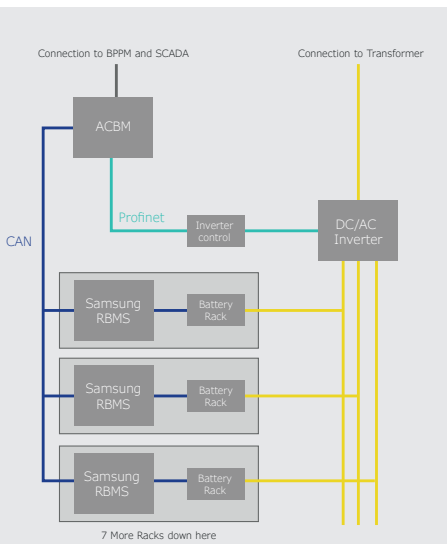
From the second half of 2014, more than a dozen M1 controllers will regulate the battery management of the WEMAG 5 megawatt hour storage system. The turn-key storage system based on lithium-ion technology with an output of 5 megawatts will help to stabilize the grid frequency on the transmission level and safely integrate wind and solar energy into the existing grid.

More than 800 megawatts of connected power from regenerative sources are already currently installed in the grid at WEMAG, arithmetically around 80 percent of the power consumed today is already generated from renewable energy. The battery storage system is specially designed to balance out fluctuations arising from the volatile feed-in of energy. The battery power plant is cleverly located: Installed directly at a 110 kV transformer station, it can be integrated easily into the

regional distribution grid and connected to a nearby 380 kV high voltage grid.

**Paying for itself**

Over 25,000 lithium-ion batteries are being installed in Schwerin. Younicos is convinced: Powerful storage systems that stabilize short-term fluctuations offer a decisive lever for the economical integration of more renewable energy. "Each megawatt of installed battery capacity replaces ten times the amount of conventional power station capacity required for a stable power supply," Udo Berninger calculates. "This reduces the load on our grids and saves costs. The installation in Schwerin will once more enable us to demonstrate that these kinds of storage systems are already worthwhile."



▲ **AC battery management:** An AC battery is a logical unit consisting of battery (DC) and inverter. The battery management is implemented on the MX220 from Bachmann. This controls and monitors batteries as well as inverters and offers a standard interface based on IEC61850 or IEC60870-5-104 for controlling power plants.