



# INTELLIGENTLY CONTROLLED ENERGY STORAGE SYSTEMS

## Smart grid and energy storage solutions from Younicos

Reliable grid operation fed 100 % by renewable energy sources is one of the key objectives of the energy transition. Younicos, a supplier of battery-based smart grid and energy storage solutions, has devoted itself to this goal. Besides battery technology, smart software and not least robust and modular control technology play a major role here.

Younicos has been supplying battery storage solutions to different sectors and application areas since 2005. Worldwide, 37 energy storage projects with outputs of 150 MW have been installed to date. »The aim of the founders of Younicos was to improve the technical and economic integration of renewables in the energy system by using storage systems,« says Ines Auweiler, head of Marketing and Communications. These pioneers, based in Adlershof, Germany, are repeatedly setting new standards here: In 2009, a megawatt battery was installed in European grids for the first time. A unique technology center was formed, in which the supply of grids with up to 100 % renewable energy at any location in the world was simulated and readjusted with actual current flows. In 2012, a battery was prequalified in Europe for the first time for the supply of control energy. Younicos subsequently designed and constructed Europe's first commercial battery park, as well as Europe's first multi-functional battery power station. A number of game-changing systems were also developed at the same time in America.

Today, Younicos is a leader in smart grid and energy storage solutions based on battery technology. Its customers include energy suppliers, independent electricity producers, industrial or commercial electricity consumers as well as is-

land grid operators. Since 2015, the company has focused on the commercial and industrial sector. Storage systems have really »grown up« and are not just of interest to grid suppliers or idealistic private users.

### The portfolio in detail

»Medium-sized plug-and-play systems offer several benefits, particularly for industrial or commercial users of electricity. These kinds of storage systems secure production by ensuring optimum supply quality. They also optimize energy consumption and thus save a lot of money. At the same time, the storage systems can be used in different markets, generating also additional income,« Auweiler explains. »Our storage systems can be used for different applications, even simultaneously, in line with this wide range of requirements.« She gives the following examples: absorbing load peaks, implementing an uninterruptible power supply, compensating reactive power etc. »These applications are implemented in the software and can be run together or individually,« Auweiler explains. The Younicos portfolio essentially comprises two solutions: the Y.Cube plug-and-play solution and the pre-engineered building solution Y.Station. The core of both solutions is the intelligent Y.Q. »Younicos Quotient controller software«, containing all our experience,« says Auweiler. All Younicos storage solutions consist

## Younicos

Younicos is the pioneer and market leader in smart grid and energy solutions based on battery storage. The company was founded in 2005 and has 130 employees at sites in Berlin, Germany, and Austin, Texas.

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



▲ A look inside the Notrees 36 MW battery park – the largest battery storage system in the USA connected to a wind farm.



▲ Test rig for lithium-ion batteries in the Younicos Technology Center in Berlin-Adlershof.

of different battery cells from different manufacturers enclosed in modules, which are then combined in a rack. They are controlled via a battery management system, the so-called ACBM (AC Battery Manager), for example, via CAN bus or Modbus. A Bachmann controller solution is used on this level: An M1 controls several racks and provides the connecting link to the converter. »The capability of the converter determines the number of battery racks that can be connected to it,« says Philipp Hundemer, requirements engineer. He further explains: »Several of these racks are used inside a power station, according to the combined output (MW output) required. Between 700 kW and 2 MW can be effectively used on average, depending on the converter.«

An air conditioning system and fire extinguishing system are some of the additional variables that are monitored and regulated within a system. »If necessary, we also use Bachmann controllers for the fire extinguishing systems. Air conditioning systems have their own controller, although they can be connected to the M1 via their integrated interface,« Hundemer explains. Bachmann's GMP module is also used, for example, to measure the grid frequency. The GMP232/x offers an outstanding measuring accuracy of 1 mHz, as is required in energy applications. »The data from the system worlds are routed via an IoT protocol, such as MQTT, to higher-level systems, such as the Battery Power Plant Manager (BPPM), or

the Web User Interface, such as Data Historian. In the stand-alone power station, the BPPM represents virtually the highest level on the software layer. It can route commands to the individual system components,« the software expert explains.

### Satisfied reference customers

The data can be visualized remotely in parallel. »The idea behind it is to completely prevent with our software the possibility of critical states developing in devices like the converter. This means that additional safety controllers on this level become unnecessary,« he continues. The BPPM can also be used to measure the energy content of batteries. Alternatively, if several strings are connected together in a power station, it is important to know the SOC of the individual components, otherwise the compensation currents may be too high in certain circumstances. »In such cases, we disconnect the appropriate batteries, and charge or discharge them in order to adjust them to the SOC of the

others,« Hundemer explains. The control options of the ACBM also enable different storage solutions to be run as hybrid systems. All information of the individual units, such as operating data, error states etc. are shown via the web interface. The 37 projects implemented so far worldwide includes the project at Wemag, headquartered in Schwerin, Germany. In the autumn of 2014, Europe's first commercial battery park for stabilizing short-term grid fluctuations was connected to the grid. The large-scale turnkey storage system implement-

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ed by Younicos in lithium ion technology helps to stabilize the grid frequency on the transmission network level and integrate wind and solar power safely into the existing grid. Coal-fired power stations, which previously performed this function, can be left out during good »energy weather«. Here too, the battery management was implemented with the M1 controller system from Bachmann. The control system for the converters and batteries was implemented on the MX220-CPU of the M1 automation system. It provides a standard interface to the BPPM at the same time. Younicos highlights the high CPU performance, as well as the ability to program in C++, as the benefits of the Bachmann solution. This also comes with the important interfaces and protocols, such as CAN, Profinet, IEC 61850 and IEC 60870-5-104, already on board. The high availability and EMC performance of the M1 system were other reasons for choosing Bachmann. Over a dozen M1 controllers have now been successfully controlling the battery management of the 5 MWh storage system at Wemag since the second half of 2014.

The latest and largest Younicos projects include the delivery of a 49 MW battery storage system at Centrica, the UK energy supplier. From the winter of 2018, the lithium ion system will respond in less than one second to fluctuations in current consumption in the UK grid. The installation is being built at the site of the former Roosecote coal-fired power station in Barrow-in-Furness in northwest England. The intelligent controller ensures here that the battery system meets the demanding requirements of the British transmission network operator, National Grid. Here too, the Bachmann solution stood out on account of its wide range of interfaces. The project was also a highlight for Bachmann: In all, 63 M1 controller systems are deployed here. »The M1 is a stable, certified hardware that is designed for industrial applications and long-term availability. Expansion modules can be connected quickly thanks to the modular design. It also offers software developers the benefits of a comprehensive software library,« says Hundemer.

### Conclusion and outlook

Energy storage systems can be used for a wide range of reasons. »For Wemag, the storage system was used for storing primary energy with which the company intends to earn money,« Auweiler explains. In other cases, such as on the Portuguese island of Graciosa, the project involved the replacement of the diesel units in place and the implementation of up to 100 % renewable energy usage. »In India, energy storage solutions are used to prevent pro-

duction breaks caused by unreliable grids,« she adds. However, many other scenarios are conceivable in future. Hundemer: »A fleet controller enables several of our Y.Cube container solutions to be connected together. This makes it possible to achieve a higher storage volume.« As one example, he states discount stores, wishing to offer charging facilities for electric cars in their parking lots around Germany and provide an energy storage solution for this task. »Each individual energy storage system is too small for primary control.

However, some interesting possibilities are created if several of these individual energy storage systems are combined together as a group. This is what we are working on at present,« says Hundemer. »This example also illustrates the potential of the commercial and industrial sector, which is only just beginning,« Auweiler explains. She expects this sector to grow quickly in the near future. »Customers have now realized what storage solutions involve. Four to five years ago, many still believed that energy storage systems were mainly deployed as a long-term storage system. We are now far away from this situation, so that larger industrial companies are asking about systems for the already described tasks increasingly more often,« says Auweiler optimistically about the future.

▼ What intelligent energy management looks like: architecture of the Y.Q software from Younicos.

