New approach for energy storage
Solutions for power-to-gas
New approach for energy storage
Power-to-gas plants offer a compelling approach to what is currently the greatest challenge of the energy transition – the storage of energy from renewable sources. For these purposes, Siemens develops reliable and safe automation systems and has already equipped the first plants – including the world’s largest power-to-gas plant in Werlte in Northern Germany
The world’s demand for energy is enormous and is expected to increase by about 60% over the next 30 years. Meanwhile, energy prices are rising. In Germany, for example, industrial electricity costs are currently 50% higher than they were 20 years ago, and gas prices have more than doubled.

Energy efficiency has therefore become a more and more important issue for energy-intensive process industries in particular. In this edition of process news, we want to show you how companies can use energy more intelligently and thereby increase their competitive edge. Generally, industrial enterprises can choose between two options to cut their energy costs: they can either produce power for themselves – perhaps by using residual heat or waste products, or with wind power or photovoltaic systems – or they can reduce their energy consumption.

Any power generated from renewable sources that is not fed into the power grid must be stored reliably, as the amount will fluctuate severely. Siemens has developed a storage system that converts electricity into hydrogen, methane, or methanol, which can be stored locally. These substances can be reconverted into electricity when needed or can be used in chemical processes. Our cover story explains how this works. Siemens products and systems can also help companies use their production waste as a self-sufficient power supply, as you can see in the case of SÜDLEDER, a company in Germany. We also help our clients reduce their energy consumption by working together to analyze processes and identify potential savings before proposing and implementing energy-saving solutions. This effort often pays off very quickly – as it did for Merck Serono, a biopharmaceutical company in Switzerland.

I hope these and other stories in process news will inspire you to take brave new steps toward an energy-rich future. Enjoy the read!

Yours,

Siegfried Russwurm
CEO, Industry Sector
Siemens AG
By the year 2050 – this is the country’s ambitious goal – 80% of Germany’s energy supply should be provided by renewable energy sources. However, one prerequisite for this is the availability of sufficient storage capacity for energy from renewable sources, according to Michael Doll, head of electrical engineering at ETOGAS. He says, “Everybody knows the problem, which is that, at certain times, more energy is produced from wind and the sun than is consumed. Our plants can chemically store this excess energy.” The first step in this process involves water being split into hydrogen and oxygen via electrolysis. In the second step, the hydrogen is then converted with carbon dioxide (CO$_2$) to methane (CH$_4$), which is directly fed into the natural gas network and can also be stored in the existing infrastructure for natural gas storage.

**From idea to application**

The general feasibility of the process was successfully proven on a kilowatt scale in 2009 at a demon-
stration plant at the Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg (ZSW, Center for Solar Energy and Hydrogen Research Baden-Württemberg), ETOGAS’s research and development partner. Already back in October 2012, ZSW inaugurated a research plant with a connected electrical load of 250 kW.

This plant consists of an alkaline pressure electrolyzer, a methanation unit, and a process control system for control and regulation, which is already state of the art for future large-scale industrial plants. “Of course electrolysis is not a new process; however, the challenges were not to be underestimated,” reports Doll. “We are one of the first companies making this classic method of electrolysis and methanation switchable and thus providing it with a load capacity. After all, this is one of the basic requirements for suitability as an energy storage medium.” The research plant with a capacity of 250 kW can flexibly respond to a changing energy supply from wind power and photovoltaic systems as well as sudden power generation blackouts.

**Safe process control**

As this is a chemical process, power-to-gas plants are operated and also automated like regular process plants. ETOGAS uses the Simatic PCS 7 process control system, which has proven itself in the process industry. For ETOGAS, the scalability of the system is a particular advantage of PCS 7. Because this plant – like many other power-to-gas projects – started out as a pilot system, the experience gained there can be transferred quickly and smoothly to the large-scale system. “Maybe we could have automated the research plant in a different manner, but having the first plant already equipped with PCS 7 paid off. This made the switch from the pilot to the production system much easier,” emphasizes Doll.

And the step to the production system was seamless. In Werlte in Northern Germany, the world’s largest power-to-gas plant has been developed, constructed, and put into operation. The plant has a connected electrical load capacity of 6 MW and converts excess renewable energy into hydrogen and methane. The plant will produce an average of 3 million m³ of synthetic methane per year. The same automation technology components, based on Simatic PCS 7, were used as in the 250 kW plant. Siemens also supplied the switch cabinets and provided engineering services such as some of the programming and the electrotechnical project management as well as the electrotechnical connection of the approximately 1,000 I/O devices.

Following successful tests of the new renewable energy storage technology, this first industrial-scale plant was successfully put into operation in the fall of 2013. The experience and results obtained in the research operation now benefit the new system. The synthetic methane generated with the help of renewable energy, called e-gas by Audi, is intended for customers of the new A3 g-tron. Using this fuel, drivers can drive almost CO₂ neutrally, with a CO₂ balance of 20 g/km. The amount of gas from Werlte is sufficient to supply 1,500 A3 g-trons with an annual mileage of 15,000 km each – for a total of 22.5 million km.

**Insights for the future**

Despite the large dimensions of the plant in Werlte, this is still a research project. And that means a two-year research phase will follow the initial operation. The remote access option offered by the Simatic PCS 7 automation system is therefore helpful not only in diagnosing possible errors but also in regard to the optimization of the entire process, as the data from the operation are analyzed by ZSW to optimize the plant still further.

There is no lack of interest in this innovative process. Wind farm operators as well as network operators and the fuel industry are currently looking into alternative possibilities for energy storage. What is crucial here is that the dynamics of the process enable a flexible response to the changing supply of solar and wind energy – which is the reason why ETOGAS and Siemens are continuously developing their solutions for the storage of renewable energy.
“The energy transition will happen”

The storage of electrical energy from renewable resources is one of the central issues in the discussion of the energy transition. Experts estimate that the demand for storage capacity in Germany will increase to 14 GW by 2020. Currently, energy storage in Germany takes the form of pumped storage power plants and compressed air energy storage, with a capacity of approximately 7 GW. We spoke with Professor Eicke Weber about how this “storage gap” for renewable energy sources could be intelligently closed.

Professor Weber, what role do energy storage systems play in the energy transition?

Eicke Weber: The energy transition is based on four pillars: energy efficiency, renewable energy sources, network expansion, and energy storage. At the moment, most industry players are focusing to a great extent on the expansion of renewable energies – and are consequently creating challenges for network expansion and storage. The sources of renewable energy, especially the sun and the wind, fluctuate, so networks and energy storage systems must be able to buffer these fluctuations and store excess energy.

One approach to long-term storage is power-to-gas technology. What role can these systems play in energy storage and use in the future, and what challenges must be overcome to do this?

Eicke Weber: Power-to-gas plants are actually well suited to recovering excess energy, that is, electricity that is produced surplus to demand. The most energy-efficient way to do this is to produce hydrogen via electrolysis, which is then either used as a feedstock for chemical processes or else can be fed into the natural gas network. What is not generally known is that even today, hydrogen can easily and safely be fed into the natural gas grid up to a content of 5%. High-capacity infrastructure is available for storage in the form of caverns, which can also be used for renewable energy this way.

The issue of economic efficiency has a high profile in the debate about the reasonable use of renewable energy. What about the economic efficiency of power-to-gas processes? When will such plants become profitable?

Eicke Weber: Electrolysis itself is still in its infancy as a technology, and I am convinced that we will see enormous progress within the next couple of years, and that will also have an effect on the cost of power-to-gas processes. Currently, we clearly...
must say that the conversion of the generated hydrogen back into electricity is not yet profitable – but in 10 or 15 years that certainly will be different. What is already profitable today is the use of hydrogen as fuel for vehicles and as a base chemical for the chemical industry.

Mentioning the chemical industry, there is a great deal of interest from large companies in the chemical industry and in the production of technical gases that are to some extent involved in the development of power-to-gas plants. What advantages are these companies expecting from it?

Eicke Weber: Hydrogen is a valuable base chemical for the industry and can be directly fed into chemical synthesis. So far, hydrogen has been generated from hydrocarbons, but now new possibilities are emerging for creating new synthesis routes from hydrogen and carbon dioxide. This leads to new possibilities for the chemical industry.

What role do companies like Siemens play in the development of storage technologies? What can they contribute and what do you expect from these companies?

Eicke Weber: In my opinion, Siemens can provide and optimize an overall solution for power-to-gas, certainly achieving better results than would be possible by optimizing individual components. Process optimization is critical for the efficient chemical storage of renewable energies. Technology providers must therefore address these challenges, because one thing is clear: the global energy transition will happen. Companies should not miss these opportunities.

Professor Weber, thank you for the interview.
The advantages of chemical storage of electricity in the form of hydrogen are its high energy densities as well as the various ways in which hydrogen, and the methane produced from it, can be used directly for mobility, energy, and industry purposes. In power-to-gas plants, electrolysis is used to produce hydrogen from water. The energy required to do so is provided by the excess power generated from photovoltaic systems and wind turbines. In another step, the hydrogen can be used as is or converted to methane using carbon dioxide.

A combination of many aspects

The automation of a power-to-gas plant is a multidimensional challenge: shareholders expect profitability; plant operators expect quality, flexibility, and adherence to schedules; and public agencies expect compliance with the applicable legislation, especially where environmental matters are concerned. Furthermore, the availability of the plant must be maximized and – particularly in areas of the plant exposed to explosion hazards – safety risks minimized.

The integration of all the plant components, including the central package units, in a consistent information and control architecture enables plant operators to meet all these requirements. All subsystems and field devices are integrated into the system. The resulting data transparency allows the plant to be operated efficiently throughout its entire lifecycle. This efficiency is also supported by the numerous diagnostic functions of Simatic PCS 7. Many planned projects in the power-to-gas field begin with a pilot plant; in this respect, the scalability of Simatic PCS 7 offers the advantage of being able to quickly and easily transfer the knowledge gained in the pilot plant to a large-scale plant. The open architecture of Simatic PCS 7 enables the smooth integration of subsystems supplied by machine and plant manufacturers. All plant data and documents are stored in a central engineering database that can be used in a consistent manner by the subsystem suppliers. Planning and commissioning timelines are thus significantly shortened, thanks in part to the numerous preconfigured modules.

Clear structure, powerful communication

Power-to-gas plants are typically divided into two major units: electrolysis and process technology including process utilities. Depending on the type of process, methanation may be the third section of the plant.

The electrolysis unit controls all the electrolyzers operated in the plant and associated auxiliaries. Field devices are integrated via I/O groups, even in areas with risk of explosion. A compressor station with its own controls, if required, can be integrated via a Profibus link. All the other plant components that are coupled either directly through ex-proof I/O groups or using their own controls via a Profibus link are part of the process technology / backup system unit. Profibus-enabled devices, such as gas analyzers, can also be directly connected. Safety engineering can be integrated into the individual controllers for each package unit, so there is no need for an additional safety controller.

For large plants with several electrolyzers and reactors, providing a clear overview is critical. Such plants consist of several individual package units, comprising an electrolyzer and reactor as well as process technology and auxiliary systems, for example. Each of these units has its own controller.
Its own network. Each controller can be individually adapted to the requirements of each unit.

**Instrumentation and analytics**

Besides the actual process control, Siemens also supports the efficient and safe operation of power-to-gas plants with an extensive portfolio of equipment and systems for process instrumentation and analytics. Reliable and accurate temperature, pressure, and flow rate data can therefore be continuously collected. Thanks to modern diagnostic and maintenance features, these process instruments contribute to increased availability and significantly reduced downtime. Special versions of these devices are also available for power-to-gas plants, for example, with special coatings on the pressure gauge cell to minimize the diffusion of hydrogen. The devices can be integrated quickly and easily into the Simatic PCS 7 process management system using the Simatic PDM process device manager. Siemens provides a complete range of products for the field of process analytics, from individual analysis devices to customized system solutions – from the MicroSAM or MicroSAM CV online process gas chromatograph for post-electrolysis quality control (trace measurement of oxygen and nitrogen in ultrapure hydrogen) to the Sitrans CV analyzer for gas quality measurement at the point of feed-in to the natural gas grid. Other synthesis steps, such as the methanation of hydrogen, can also be monitored by the powerful Ultramat and Oxymat 6 gas analyzers. All the equipment is available in explosion-proof design.

**Expertise for the optimal solution**

Selecting the right instrumentation is essential for the efficiency of a plant. Since the different methods used for measuring may vary significantly in their results, expertise in application and instrumentation should be integrated in an early stage of the process. The same is true for process analysis, for which Siemens has developed a special solution for power-to-gas plants. Two fully automatic analysis lines are operated with different carrier gases (helium and argon), thus allowing the separation of a total of 14 components, including the ascertainment of helium in hydrogen. This makes it possible to determine the energy content of the gas with extremely high accuracy. Calibratable measurement ranges are approved for all 14 components, with the measurement range for hydrogen extended up to 25% in preparation for future developments in the admixture of hydrogen.

**Energy alternative with potential**

Compared to established storage procedures, power-to-gas technology offers significant benefits in terms of its storage capacity and the diverse ways it can be applied. It has the potential to make a significant contribution to a safe and clean power supply in the future. Building pilot plants to carry out advance testing of the procedure and using the appropriate automation technology already in this phase is therefore worthwhile. Using Simatic PCS 7, this automation can grow in step with the plants, enabling safe and efficient operation in each phase.

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Green hydrogen

With the Silyzer electrolysis system based on PEM (proton exchange membrane) technology, electricity can be converted to hydrogen to capture and then store large amounts of energy from renewable sources.

There can be significant fluctuations in electricity production from renewable sources. Storage solutions for this kind of power must therefore react very quickly and reliably to fluctuations in the generation of electricity, so that the power can be used efficiently and a contribution can also be made to the stability of the grid. To this end, Siemens has developed electrolytic technology that offers the following benefits as compared to the conventional alkaline technology: the PEM electrolyzers are suitable for high current densities and can respond to major fluctuations in electricity production from wind and solar facilities within milliseconds.

Dynamic and efficient

In addition to this highly dynamic response, the advantage of the new electrolyzers is that they do not need to be maintained at a certain operating temperature but can be switched off completely and do not require a preheating phase before being switched on. This eliminates the operational costs accrued in standby mode and allows for efficient and reliable operation without residues such as potassium hydroxide. In addition, the PEM electrolyzers supply the hydrogen at a pressure of at least 35 bar. This means that for many applications, the gas does not first need to be compressed in order to be processed or stored. The elimination of compressors reduces costs.

First projects

The PEM technology developed by Siemens is now so advanced as to be used in practice, such as in the CO2RRECT project executed together with Bayer, RWE, and 10 other partners from the scientific community. The research objective of the project was the conversion of fluctuating energy sources (wind) to polymers as a basis for further chemical synthesis processes. Reactants used included hydrogen from the Siemens PEM electrolyzer and carbon dioxide from a conventional power plant. The next milestone is the delivery of a Silyzer electrolyzer for the project “Mainz Energy Park – hydrogen electrolysis as energy storage and vector.” The main aim of this research project is to develop an energy storage system on a scale that is suitable for decentralized management of network bottlenecks. The system should have a peak performance of up to 6 MW and is therefore an important step for today’s small (100 kW) electrolysis systems on the path toward future large (100 MW) units.

INFO
siemens.com/hydrogen-electrolyzer
A solid case for going green

The Merck Serono site in Aubonne, Switzerland, has always been very eco-minded. With a strong local GoGreen initiative, both staff and management were committed to improving energy and resource efficiency in operations and utilities. This mind-set, combined with energy assessment services from Siemens, helped shape several business cases that will support Aubonne in making a significant contribution to Merck’s corporate Edison program, which aims to reduce CO₂ emissions throughout the company’s production sites.
The challenge was to put reliable figures behind 2020, based on 2006 figures. To help facilities systems, leading to substantial energy and cost savings improvement in both utilities and building technology Siemens, the company has identified several areas of through an energy assessment performed together with Merck Serono is the biopharmaceutical division of Merck. How- ever, the Edison program launched by the Merck Group gave us an excellent opportunity to put additional effort behind our own programs. The Edison project aims to cut carbon dioxide (CO₂) emissions throughout Merck facilities by a total of 20% by 2020, based on 2006 figures. To help facilities around the world achieve this ambitious goal, Merck has provided dedicated funding for suitable efficiency projects for all sites.

Figures make the case

“The challenge was to put reliable figures behind some of the potential projects where we could achieve further energy savings,” says Huguelet. “Our own teams and experts had already identified some areas, but what we were lacking were the analyses and the numbers on how much energy we could save and how much the corrective measures would cost us.” This was when Merck Serono approached Siemens for support. “The main motivation behind bringing in an external partner to perform an energy assessment was that we wanted to get objective, detailed analyses of the savings potential in the various areas and identify projects that would fit into the Edison program both in terms of CO₂ savings and in terms of return on investment. This is where we saw that our own teams often lacked the time to do this in their daily work,” adds Stefano Siviero, director of engineering and technology for global manufacturing and supply at Merck Serono. Siviero was responsible for the energy assessment at the Aubonne site for Merck Serono.

Bringing Siemens into the project was an almost natural choice, says Siviero: “We had already been working with Siemens on other projects, so they were already familiar with our site and our systems. Because we needed someone to perform the assessment in a very efficient and effective manner, this a priori knowledge that Siemens had was a big asset. After all, we dedicated staff for one week for the assessment, and we wanted to get the optimum result from this effort. But much more important was the fact that Siemens has established an excellently structured energy assessment process and a strong team of knowledgeable people with the right expertise and mind-set who could work closely with us. With Siemens, we have identified a partner who is there not just for the execution of the assessment itself but also in the implementation of the corrective measures afterward. In short, we see Siemens as a partner who is with us throughout our entire energy-improvement journey.”

One week of intensive analysis

The assessment itself took one week and was performed in the first half of March 2013. “Of course, we thoroughly prepared the facts from our side,” says Huguelet. The Merck Serono team had compiled all the information that was already available, complete with a site layout and details such as a list of major loads. “Both the collaboration and the preparation by Merck Serono were really outstanding,” says Walter Huewels, project leader for Siemens. “This excellent teamwork was absolutely critical to the good results we got from this assessment. You need the expertise and knowledge of the customer’s own staff, as they are working with the systems every day and have insights into the whys and hows of certain situations that you need as an external party to make the best
“Siemens has established an excellent energy assessment process and a strong team of knowledgeable people with the right expertise and mind-set. Plus Siemens is a partner who is with us throughout our entire energy-improvement journey.”

Stefano Siviero, Director of Engineering and Technology for Global Manufacturing and Supply, Merck Serono

> proposal.” In just five days, Huewels’s team and the Merck experts performed a technical analysis on-site to identify the first energy efficiency measures and to assess the general condition of the plant in terms of energy efficiency. The assessment team analyzed and assessed all energy forms, the energy supply and distribution, and the energy data collection and archiving as well as the output (e.g., waste heat). The results of this step provided an overview of suitable energy efficiency measures and optimization potential as well as a first estimate of the potential energy savings and the necessary investment for each energy efficiency measure, complete with a return-on-investment business case and a report summarizing the outcome of the analysis.

**Triggering changes, reducing costs**

What was presented to site management at Aubonne was indeed a very strong business case for making improvements, as Huguelet confirms: “We finally had the figures we needed to be able to point to a situa-
We finally had the figures we needed to be able to pinpoint and quantify energy losses and build business cases for improving the situation."

Bertrand Huguelet, Technical Services and Project Management Office Director, Merck Serono, Aubonne

Next assessment on track

"It was no small feat to choose a week in which we could set aside a team to work with Siemens, but the results really justified this effort – and we received positive feedback from our staff, who saw the assessment as an opportunity to really deal with the situation. This is probably another benefit of bringing in an external partner such as Siemens: they come to the site, and then you have no excuses such as daily work you need to see to – you have a plan you need to stick to!" says Siviero. Thanks to the dedication of the team, the results in Aubonne were so impressive that other sites will use this assessment as a best practice case. Siviero continues: "Aubonne was our pilot site, and the results we achieved here will set the standard for the next assessments. Let’s see what they can do."

Standing in front of the Aubonne office building, Huguelet and Siviero address another aspect of the assessment that relates to the beautiful surroundings of the site: "We believe that we need to make a contribution to a sustainable society, not just here at work but also in our private environment. Energy efficiency is not just about capital expenditures. It’s a mind-set – something that our staff can take home as well. So this energy assessment has impacts that reach beyond the site in Aubonne."

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MORE INFORMATION ON SIEMENS ENERGY EFFICIENCY SERVICES:
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Even the most modern energy management system suffers from an especially persistent chronic illness: the data overflow. Companies need efficient tools to achieve better transparency with regard to energy consumption data and to quickly perform conclusive evaluations of consumption and demand.

**Energy data management leads to transparency**

Simatic B.Data energy data management provides a series of efficient functions that help companies analyze the exact amounts of energy consumed. Specific implications for individual production sites can also be assessed using the system. The user can select from different visualization possibilities, for example, energy dashboards, which quickly provide all the important data.

In addition to typical applications such as the display of important key performance indicators – for example, consumption or costs – even the effect of climatic conditions such as temperature or humidity can be taken into account. Simatic B.Data can carry out the scaling automatically. Beyond giving a general consumption overview on all levels, Simatic B.Data identifies energy guzzlers and even detects hidden savings potential in the operation of already optimized plants.

**Purchase energy cost-effectively**

In addition to increasing efficiency, Simatic B.Data helps the user reduce purchase prices with better predictability and also select the appropriate tariff based on the company’s consumption.

A powerful energy management system helps decrease energy costs through improved controlling and more efficient procurement and operational processes.
Energy management has become a must for any company, and transparency is the basis for this. It is a proven fact that simply showing the amount of consumption leads to a change in behavior. If other supporting functions such as controlling and projection are available, energy management turns into a key factor for success.

**Summary**

Energy management has become a must for any company, and transparency is the basis for this. It is a proven fact that simply showing the amount of consumption leads to a change in behavior. If other supporting functions such as controlling and projection are available, energy management turns into a key factor for success.

**Simple and clear: Simatic B.Data supports the user through various features in routine energy procurement and accounting tasks as well as with consumption optimization.**

profile. This is made possible via the projection of energy consumption and the load profile for one or more sites, individual loads, production areas, or buildings.

The greatest financial advantage is achieved by minimizing the difference between expected and actual consumption within a defined period and by transferring activity to times during which power supply is cheaper or the company can use its own power sources such as a photovoltaic plant, for example.

Simatic B.Data offers three different projection methods for this: first, regression analysis, which analyzes daily production quantities and the corresponding consumption data; second, the exact analytical assessment of a reference period of reference days and shift models; and third, the calculation of energy consumption based on the production plan. Users whose consumption profiles are determined by batch or material quantities can thus predict their energy requirements.

Various interfaces

There are many possibilities to create reports easily and quickly already during configuration. Simatic B.Data supports users with automatically generated reports — for example, cost center reports, which show the respective consumption for all units involved as well as the incurred costs.

Simatic B.Data features a great variety of interfaces for reading consumption data. In addition to the user-friendly WinCC channel for Simatic WinCC and PCS 7, other interfaces such as OLE for Process Control (OPC) or ASCII are available that enable Simatic B.Data to record the consumption and production data of different sources at the same time.

In the case of a low data load, it is possible to install Simatic B.Data on existing PC stations. But it can also be installed on a separate individual PC or, in the case of higher data volumes or distributed sites, on several PCs. What is more, the scalability of Simatic B.Data provides the user with the opportunity to start with a single site and/or low-quantity structure and expand the system later.

To enable a simple and cost-effective system structure, Simatic B.Data also supports the connection of web clients so that users can continue to use their individually customized views for monitoring, controlling, or projection and remain mobile thanks to the support for several browsers.

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An energized future
The municipal energy transition in Rehau, Germany, is well under way. This can be seen most clearly at SÜDLEDER GmbH & Co. KG, which supplies all its tannery’s electricity and heating requirements with its own organic waste. The plant was designed and implemented by Plauen-based REHAU Energy Solutions GmbH, which chose an integrated automation and instrumentation solution based on Siemens technology.

Traveling along the road to Rehau in the district of Hof in Northern Bavaria is like taking a journey through time. “Here and now you can already see much of what the future is going to bring with it in terms of the energy transition, and how many things are going to change,” explains mayor Michael Abraham enthusiastically. Just outside the city limits is a construction site, which the city is incredibly proud of. Rehau is even attracting attention from abroad with this unprecedented project: On the site, a bioenergy center for the municipality is steadily taking shape. The first step, a bioenergy plant (BEP), was completed a few months ago. The next step is to expand the center into a biowaste fermentation plant (BFP). Of course, many municipalities are doing this; however, it is clear that something more is going on in Rehau. According to federal government plans, energy from renewable sources will reach 35% of overall electricity consumption by 2020, but in Rehau it will already have reached 40% by 2014, a first for an industrial center that consumes 80,000 MWh of electricity each year. This extraordinary target can only be pursued thanks to the vision of local businesses such as SÜDLEDER and REHAU AG, as well as the state, the city, and the public authorities. With 240 employees, SÜDLEDER is one of Europe’s leading leather manufacturers, so it is no surprise that its tannery, where the company manufactures top-quality leather, also produces around 70,000 t of organic waste every year, which in the past had to be disposed of as hazardous waste but can now be used to generate energy.

“The plant ensures ideal fermentation of the organic content of glue stock and wastewater. This has made the SÜDLEDER GmbH & Co. KG tannery virtually energy-self-sufficient.”

Eric Priller, REHAU Energy Solutions GmbH, Plauen
which will generate around 1.4 MW of electricity and 1.6 MW of heat. This makes SÜDLEDER a virtually energy-self-sufficient business and a pioneer in this field.

This reorganization could only be achieved in such a relatively short period of time because of REHAU Energy Solutions GmbH from Plauen and Siemens experts from Berlin and Leipzig. REHAU Energy Solutions used Siemens technology to develop a patented process to convert former substrates in biogas (TanERGY) for the leather processing industry, thus making a significant contribution to reducing waste.

Electrical engineering for the plant used the latest expertise and equipment and Siemens technology. At the heart of the automation solution is a Simatic PCS 7 stand-alone system with a high-performance AS414 automation system built by Borna-based solution partner AllTec. A total of around 200 process objects have been implemented within the system. Process signals are integrated via Profibus, including the independent controls of each of the three cogeneration units and the heating unit, plus the processing data from the tannery’s wastewater recycling. In total, 13 Sinamics G120 frequency inverters ensure that the plant’s agitators and pumps are driven in an energy-efficient way. Most of the 68 sensors are connected to the plant via Profibus as well: 15 Sitrans P300, P Compact, and P210 pressure switches to measure pressure; 11 CLS200 and LVL200 level gauges to measure levels in shafts and containers; a Sitrans MAG 3100 flowmeter to detect the precipitate in the feed tank; and several Sitrans T temperature sensors and temperature transmitters.

Because of the stringent measurement requirements, the filling level is monitored by several Sitrans LR 200 and LR 250 radar transmitters. The composition of both clean and raw gas will be analyzed and evaluated by an Ultramat 23 in the SetBGA complete analytics system.

In addition to on-site control, SÜDLEDER production personnel can monitor the plant by secure remote access via a Scalance S security module. There are also future plans for an Industrial Ethernet connection to the planned Hochfranken BFP.

With the establishment of Energy Solutions GmbH, the REHAU group became a specialist in the market for renewable energy at an early stage. In the German town of Rehau, the focus is not on wind power or solar energy but, first and foremost, on energy from waste. Energy Solutions has developed specific processes to realize this, and they are already catching on all over Europe:

- **TanERGY®**: This process, the first of its kind in the world, generates power from production waste – which in Rehau means residues from the tannery, which deliver up to 76% of the facilities’ power requirements. Fermentation produces electricity and heat.

- **WastERGY®**: With this newly developed process, from now on municipal biowaste can be used for a fermentation method that extracts energy from piles of compost.

- **NetERGY®**: In the future, a higher-level, self-learning control system will make it possible to record and regulate every aspect of a municipality’s own energy supply from biowaste. In addition to weather factors such as wind, solar power, and outdoor temperature, the system also studies the behavior of the power producers and consumers.
Clean gas and raw gas composition is analyzed and evaluated by a SetBGA complete analytics system.

Reduced emissions and costs

Since the biogas plant was commissioned, it has played a major role in the drastic reduction in carbon dioxide production, as a result of savings on heat energy, from producing electricity from on-site waste, and from the reduced associated disposal costs. “That’s at least another 5,500 t,” explains Peter Pöppel, the managing director of SÜDLEDER. Heat production itself is another separate process. The tannery’s emergency power supply is therefore guaranteed using on-site resources as well. “The revenue from electricity production and the savings resulting from the heat supply and glue stock disposal mean that the investment will be paid off in just a few years,” says Eric Priller of REHAU Energy Solutions GmbH. The company also benefits from a high level of investment security, thanks to future-proof technology, as well as a reduced total cost of ownership.

Moving toward an energy transition

All this represents a big step closer to making the Hochfranken Bioenergy Center a reality. The town of Rehau is making a statement with this energy transition. Further site development will be geared toward demonstrating the use of renewable energy. It is an ambitious undertaking that is proving successful. While Rehau produced only 3,700 MWh of electricity from renewable sources in 2010, this year it will produce more than 65,000 MWh. A BFP is currently being planned, and if it goes ahead, REHAU Energy Solutions GmbH and Siemens will rejoin the team as project partners.

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Municipal utilities face the major challenge of reliably meeting the energy demand of private households and industrial enterprises at all times and without problems. At the same time, these companies must continue to operate economically despite rising costs. This was also the case at Stadtwerke Hannover AG (enercity), the municipal utility and service provider. The company operates the Linden joint power plant, among others, a plant that went into operation 1962 and has been modernized several times since then. In 1998, the first gas and steam turbine plant was commissioned, consisting of a gas turbine and an old steam turbine dating back to the year 1962. An additional gas turbine was installed in 2011, and the steam turbine was replaced by a significantly larger joint steam turbine. With this change, 210,000 t of CO₂ were saved in a single year.

With the use of modern technology, such as these types of highly productive gas and steam turbines, the data volume to be managed within the power plant increases. For this reason, enercity decided to invest in an electronic plant and document management system. “We were not looking for a mere data management system but an intelligent data management system that we could use to digitally map the

At the Linden joint power plant, the Comos software solution provides the right person with the right information at exactly the right time, thus supporting flexible and efficient plant operation.
plant quickly and easily and that would allow further planning,” explains David Röbbing, system administrator at the Linden heat and power plant.

Uniform and always up-to-date

After intensive analysis of several software products, enercity decided in favor of the Comos software solution. This software is based on a uniform data platform and takes an object-oriented approach. It provides a seamless, consistent, and navigable database for mapping the existing and the expanded plant (starting with the new gas turbine). Today, the complete power plant can be mapped digitally 1:1 in its current state. The KKS is used in the database as a higher-level plant designation system. Before starting the data implementation of the plant documentation at the Linden power plant, the responsible employees came together to develop a plan for the new document management system. They defined a basic structure to which the standard software solution would be adapted in a customer-specific manner. “A huge advantage of Comos is that the software is flexibly adapted to the existing work processes, and not the other way around, as is usual with other software products,” Röbbing comments the software adaptation. After defining the database structure, the team collected and entered the data, and implemented the documents. The Berlin-based engineering office Thielert supported the power plant operator with the definition of the database structure, the development of tabs, data import, and document migration.

Block diagrams, process charts, piping and instrumentation diagrams (P&ID), site maps, activation plans, single line diagrams, control diagrams, the fire alarm system, data from units, and diverse other documents were implemented in the database. In this way, for example, 400 A4 folders with approximately 300,000 documents were integrated for the new gas and steam turbine plant alone. Despite the huge data volume, working with the data is quick and easy thanks to the powerful software. “We have the guarantee at all times that the available data and documents reflect the as-built state of the power plant,” Röbbing describes an additional benefit of the software solution.

Integrated solution

In addition to being used as a data management system, Comos is also used for project and plant planning, with the advantage that employees only need to work with one system, thus reducing training and system maintenance requirements. In addition, the power plant operator started implementing a specific information system for the employees at the Linden power plant several years ago. Now, this so-called electronic shift book contains more than 145,000 entries, which the employees can access by means of a free text search. The information system is also linked to the software solution via an interface. In this way, employees can call up additional information on objects or plant devices stored in Comos when necessary, which makes for faster and better decision making.

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Sunshine Sugar, Australia

Sweet success

“AC or DC?” was the question on everyone’s mind when Sunshine Sugar decided to replace its aging centrifugal drive system. After considering all the options, the company chose a Siemens AC drive-motor combination. The unique solution has helped the company reduce energy consumption by 40%.

The decision to replace the 298 kW DC centrifugal drive system with a 184 kW AC motor-drive combination was not an easy one, but Siemens was determined to prove the value of its unique solution. Plant manager Stephen King explained how Siemens supported the company in its decision making, which ultimately led to the upgrade of the centrifugal drive system on time and even under budget. “Siemens drew on their 1,200 worldwide reference sites with successful centrifuges operated by AC drives. They also provided detailed analysis of their success with reducing the size of motors and drives by controlling the switching rate of the insulated-gate bipolar transistor (IGBT). And they even sent out a global expert on drives from their Sugar Competence Center in Germany to reassure us that this was the right solution,” said King.
Brian Jackson, Sunshine Sugar’s senior electrical superintendent, was also impressed: “We were convinced by the 184 kW drive system when we learned about the Active Front End technology, which is a standard feature in Sinamics drive systems. This allows us to reduce the size of the motor and drive without losing power, achieve harmonics of less than 1%, and consequently reduce our energy costs significantly.”

Choosing the right technology

AC drives are particularly well suited for centrifuges, as they can provide the performance required. The device to interface to the existing Bailey distributed control system for bidirectional communication.

Substantial savings

Since the commissioning of the new drive, Sunshine Sugar has achieved a substantial reduction in power consumption. “Power recordings have confirmed a reduction from 1.7 to 1.0 kWh per ton of massecuite, despite the recording being made prior to optimizing the drive. So we’re planning to undertake further analysis soon to determine the final savings,” says Jackson. Due to the success of this solution, Sunshine Sugar has placed a second order with Siemens to upgrade the drive and motor of a second centrifuge.

Active Front End

The technology used as a standard feature in the converters of centrifugal drives provides several important benefits:

- Self-commutated converters with IGBTs and a clean power filter in the input
- Sinusoidal currents and voltages with no mains-typical harmonics and thus absolute minimum mains pollution on the line side; thus, compensation and filter circuits are no longer needed and the overall power factor is cos φ = 1
- No conduction-through with fuse tripping in response to mains undervoltage or failure in generator mode, thanks to active tripping; this makes the solution especially suitable for weak or unstable systems
- Compensation of mains undervoltages by voltage step-up mode
- Exceptional dynamic response
- No mains voltage distortion due to commutating voltage dips
- No effects on mains voltage caused by mains system resonance due to harmonics

The new AC motor-drive solution for Sunshine Sugar’s centrifuge has saved the sugar manufacturer more than 40% in energy consumption.

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So-called tunnel feed equipment made by Eggersmann Anlagenbau (in this photo inside a fermentation tunnel for biogas extraction) will also supply the new composting tunnels with shredded organic and green waste.

The Eggersmann Group in Marienfeld, Germany, specializes in innovative plants for converting organic waste products into high-quality compost products and, increasingly, biogas. It is a family-run group of four separate companies – Bauwesen, Anlagenbau, Kompotec, and Objektmanagement – that both develop and manufacture plants as well as act as long-term operators. One example is the Kompopark Gütersloh, which was recently expanded to include an innovative biogas production plant with a cogeneration unit and a second composting line. Eggersmann’s plants and processes have long been in global demand as well, which is another major reason to work with Siemens, as Holger Iderhoff, head of automation technology at Eggersmann Anlagenbau in Bad Oeynhausen, emphasizes: “Siemens’ control, drive, and visualization systems are known all over the world and can be obtained quickly. Also, virtually anywhere you go you will find professionals who know how to use them.”

Efficient ventilation

Composting is a tough job that, for the most part, is performed automatically in batches. In this process, the material flows must be conveyed, mixed, shredded, moistened, tempered, and more – but, above all, ventilated. At the Kompopark Gütersloh, that last
Drive technology | process news 1/2014

process is performed by a series of large fans in two composting halls or eight new composting tunnels that have just been added. The approximately 30 fans are speed-controlled to individually and flexibly adjust the required air volume to the given biological processes. As part of the Kompopark’s expansion, the fans were equipped with Sinamics G120P distributed inverters, plus the controls and inverters for the ventilation units in the composting halls were also brought up-to-date.

These inverters, built in IP55 (UL Type 12) degree of protection, are dustproof, fully protected from external access, and water-jet-proof, which is why they can be installed distributed over the plant without additional control boxes. This saves time and money, not least because only the short piece of power cable between the inverter and the motor needs to be shielded. To operate and monitor an inverter directly, Eggersmann always uses the Sinamics BOP-2 Basic Operator Panel with a two-line display and menu navigation.

Profibus and Profinet communication incorporates all data from the extensive plant into several Simatic S7-300 controls – in fail-safe versions where required. To operate and monitor all the parts of the plant from a central point, Kompopark uses Simatic WinCC.

Continuous remote diagnostics

This integrated solution from Siemens enables efficient yet secure remote diagnostics right down to the drive. The integrated functions of the Drive ES Basic drive engineering system can be used for targeted diagnostics as well. It is also possible to quickly and cost-effectively assign new parameters to a replacement Sinamics G120P inverter, upload the software, and reactivate the drive from a remote location, as Iderhoff explains: “The operator makes a quick call, the connection is established, and errors are quickly fixed – so that further increases the availability of our plants. What’s more, the entire automation project is easy to summarize and document.” Documentation is supported and accelerated by ready-made PDF files, some of which are already supplied by the manufacturer on the visualization system. This also speeds up troubleshooting and provides for high availability.

Everything from a single source

The plant operator also benefits from this reliable, integrated automation and drive solution. “It makes sure we remain in the familiar, safe, secure, and comfortable position when fermenting green waste and extracting methane gas as well as during the transfer to our own cogeneration unit, which will generate power and heat from the raw and clean biogas,” says Sebastian Böhme, operations manager. The plant will feed around 5.7 million kWh into the Gütersloh municipal network every year. The plant’s own demand will be met by about 15% of the power generated.

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The beer brewing industry is intensely competitive. Many companies, including Karmeliten Brauerei in Straubing, Southern Germany, are turning to energy-efficiency initiatives in order to survive in the market. Karmeliten Brauerei has teamed up with Ziemann International GmbH and Siemens to achieve energy-efficient production over the next five years.

“It is particularly important for us as a medium-sized business to have the most energy-efficient production possible. We need this to compete with the large players in the industry and secure our competitiveness in the long term.”

Christoph Kämpf, Managing Director, Karmeliten Brauerei Karl Sturm GmbH & Co. KG
Christoph Kämpf is the managing director of Karmeliten Brauerei Karl Sturm GmbH & Co. KG and is a pioneer in his industry. His vision is to brew his craft beer independently of any external power source. This move comes in the context of rising energy and production costs and increasing cost pressures. “When I looked at the accounts each month, it quickly became apparent that we must take action,” Kämpf says. Energy expenditures increased by around 20% in 2012–2013 alone. When energy consumption includes more than 650,000 kWh of electricity and more than 2 million kWh of gas, such an increase adds up very quickly.

**Detailed planning from the start**

Plant engineering firms Ziemann and Siemens are responding to the brewery’s long-term plans with a wide range of solutions and services to optimize the energy engineering aspects of the processes, machinery, and installations – starting with proactive planning. The brewhouse – the part of the brewery where the wort is produced – accounts for approximately 43% of the brewery’s heat energy demand. The brewery has invested about €2 million to completely renovate the brewhouse, which began operating in 1980.

The implementation of IT solutions in existing breweries will have a decisive impact on optimizing operating processes, saving energy, and increasing output from the same, or even reduced, capacity. By introducing manufacturing execution system (MES) applications such as Simatic IT, the managers of the brewery will be able to use the data gathered to evaluate and continually optimize processes. This information can be turned into tangible economic benefits. For example, the average volume of water that is used to produce 1 l of beer has been cut from around 10 l to 3.5 l over the past two decades.

Newer automation solutions mean that not only can more data be processed, but individual process steps can also be better integrated and systems can be centrally controlled from a control room. The advantages for breweries: production is more flexible, the primary beer-making processes fluctuate less severely, and secondary processes can be controlled more accurately.

**Transparency creates efficiency**

These automation solutions are part of a wide-ranging energy efficiency program that Siemens offers its clients across many different industries. The aim is to continually improve the productivity of energy used in the beverage industry – from designing the plant, to production planning and engineering, to the actual operations and the relevant services.

Increasing the transparency of processes and energy demand leads to a significant improvement in energy efficiency. The Simatic B.Data energy data management system enables the recording of important key figures such as energy demand in proportion to production volume or in proportion to consumables. At the same time, Siemens also assists users with specialized services to identify specific energy efficiency measures and to evaluate the plant’s overall energy efficiency status. One of these is the machinery and line energy analysis performed on-site by experts using mobile measurement devices to identify hidden energy-savings potential.

The analysis results in a series of energy efficiency measures and a customized implementation plan. For example, the measures could include introducing an energy data management system, installing a heat recovery system, or modernizing existing equipment with Simatic controls or Simotics motors.

**An excellent energy plan**

In Straubing, this investment in energy-self-sufficient production has already started to pay off. Karmeliten Brauerei won the 2013 "Federal Award for Outstanding Innovative Achievement in a Trade" for its plan for an energy-self-sufficient brewery with optimal raw material usage. The jury members said they were particularly impressed by the energy efficiency of this custom-designed concept. “The resource-saving master plan at Karmeliten Brauerei Karl Sturm GmbH uses the innovative Cascade brewhouse design by Ziemann and thereby achieves energy savings of around 30%, as well as an approximately 12% reduction in demand for electrical power, while simultaneously saving up to 20% of drinking water,” the jury said.

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Hygienic production, in a nutshell, is about taking measures to avoid the contamination of products by germs or toxic metabolites of certain bacteria or fungi. Originating in the food and beverage industry, the cleaning in place (CIP) and sterilization in place (SIP) methods are commonplace as they are cost-effective in operation.

Both production plants and individual components have to meet several important criteria in order to be considered as hygienically designed: easy cleanability, prevention of germ growth, no impact on the product and absolute durability cleaning processes. These requirements naturally influence the choice of materials, surface quality, construction, and connection design. In particular, this means that gaps, dents, constructional dead spaces, and flow-free areas are avoided, since they are prone to residue deposits or the forming of biofilms.

Using measuring technology usually implies an intervention in the process system, which increases the risk of contamination. To minimize this risk, process connections should possess small sealing geometries and, if possible, edges and protrusions should be eliminated. The seals themselves should be self-centering and allow for as little thermal expansion as possible, and the expansion should always take place to the side facing away from the process. Additionally, the connections need to allow for CIP and SIP cleaning and should use only sealing materials approved by the US Food and Drug Administration (FDA).

Hygienic design in practice

The Sitrans P300 pressure transmitter is available in a design that is compliant with European Hygienic Engineering and Design Group (EHEDG) standards.
and is especially suited for applications in the sterile production of pharmaceuticals, the safe manufacture of food, and biological production of active substances. Its stainless steel housing with laser-printed nameplate and IP69K degree of protection (high-pressure cleaning) allow for optimal cleaning. In addition to offering nearly 100 connection versions, the pressure transducer can also be integrated into the process according to DIN 11864-1, -2, or -3, using aseptic techniques. The measuring cells are designed in such a way that the process does not require further sealing: the measuring cell membranes are welded directly to the process connection, also in EHEDG-compliant design, of course.

Equipped with the same features, the Sitrans FC430 flowmeter excels among Coriolis flowmeters. In addition to the EHEDG and 3A hygienic approvals, this flowmeter system is also FDA and NAMUR compliant. The Sitrans FC430 flowmeter is suited for CIP and SIP and was already certified according to hygienic design guidelines during product development.

Another approach to hygienic design is provided by so-called clamp-on products. These sensors are mounted on the outside of product-carrying pipes. In addition to ultrasonic flowmeters, resistance thermometers, for example, are also available in clamp-on versions. In contrast to inline measuring, this method has no direct media contact and thus guarantees measurement free of sealing, welding seams, dead spaces, and turbulence.

**Disposable sensors coming soon**

New hygienic design requirements are emerging in response to so-called single-use sensors or disposable sensors. They are for one-time use in bioreactors and are disposed of together with the reactor after the reaction is complete and the product has been pulled off. This calls for cost-effective and rugged sensor technology with high measuring accuracy. At the moment, mostly optical sensors are used for this, but because of their light-sensitive measuring principle they cannot be used for all applications. Furthermore, measured values such as temperature, pH value, and oxygen content, for example, cannot be collected precisely in an optoelectronic way. This is where radio-frequency identification (RFID) technology could offer valuable new approaches. Nonetheless, it will be some time before single-use sensors can compete with the measuring accuracy and flexibility of their hygienically designed colleagues doing continuous duty.

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Video about gas analytics

Gas analytics reduce emissions

Siemens gas analytics have enabled Nitto Europe to not only reduce its carbon dioxide emissions by around 9,000 t per year but to decrease its manufacturing costs as well. For quite some time now, a specially configured gas chromatograph has been monitoring the recovery of solvents that accumulate during sticky-tape production. In the past, Nitto Europe had to thermally oxidize the charged air in afterburners, until the company approached Siemens. “We picked Siemens as our supplier because it was the only registered company that could help us with our specifications. Siemens drew on the company’s analytics expertise and designed a gas chromatograph that was ideally suited to our application,” explains Paul Clusters, utilities specialist at Nitto Europe. To precisely meet the client’s very specific needs and provide the best possible analytics solution for the job, Siemens performed a front-end engineering and design study. The result was a gas chromatograph with an exceptionally short cycle time and a very low detection threshold for the specified contaminants. Nitto is highly satisfied with the solution.

Biogas references from Austria

“Green energy” times three

Exclusively in process news online: Thöni Industriebetriebe GmbH, based in Telfs, Austria, opted for Siemens as a partner a total of three times when it came to equipping its biogas plants in Italy and Great Britain.

In these projects, Siemens took over planning and engineering, assembly, and installation as well as commissioning, including the necessary training and documentation of measuring and control technology. A central Simatic S7-300 controller controls the plant. Powerful and efficient Sinamics or Micromaster drives are used, and process data are collected with Sitrans and Pointec devices.

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Sipat special

Integrated quality

Process Analytical Technology (PAT) is a decisive approach to help companies in the pharmaceutical industry get their processes in shape – for greater competitiveness, higher efficiency, and better quality, in particular. A special feature in process news online illustrates the PAT solutions Siemens offers and how companies can profit from these solutions.

Read more at sie.ag/1lvfmGx or scan the QR-Code
Focus on Brazil

Boom at Sugar Loaf Mountain: Driven by the prospering commodities markets and huge investments in industry and infrastructure, Brazil has become one of the largest national economies in the world in recent years. As Brazil hosts two major international events – the FIFA World Cup and the Olympic Games – the country will also be drawn to the very center of global news coverage.

At the same time, like anywhere else in the world, businesses in Brazil are gearing up for the challenges that lie ahead: to grow sustainably, to handle natural resources more responsibly, and, in particular, to use energy more efficiently.

Siemens has been a trusted partner to companies in Brazil for more than 100 years – on projects ranging from infrastructure modernization to healthcare to industrial automation and drive solutions. Find out more about current projects, and the specific challenges that businesses in Brazil are facing, in the next issue of process news.

Number 2/2014 of process news will be published in June.
The increasing scarcity of resources, rising energy costs, and ever-stricter environmental regulations are intensifying pressure on industry to use energy more efficiently than in the past. And there is enormous potential in this area. As much as 70 percent of the energy used in industrial plants is consumed by electric drives and motors alone. We offer an extensive portfolio of energy-efficient products and solutions during the entire production process – from modern energy-saving motors to innovative software applications – along with comprehensive energy consulting. You can thus quickly achieve lasting gains in efficiency that will continue to benefit you, day in and day out.

Profits aren’t optimized over night.
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You too can realize the potential of energy-efficient solutions

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Answers for industry.