THE POWER OF MANY
Case Studies from our Virtual Power Plant
A VIRTUAL POWER PLANT

All together now

THE POWER OF MANY - this is more than a slogan, it is the basis of our Virtual Power Plant. In the Next Pool, we network thousands of power producers, power consumers, and storage units. This way, we bundle a capacity that is now equivalent to several conventional power plants.

Together with our participants, we’re shaping a new energy world in which distributed energy resources are building the backbone of our energy supply. This way, the operators not only help replacing conventional power plants. Networked in the Virtual Power Plant, they can also increase their revenues by participating on various energy markets. On the following pages, we present some of the participants from our Next Pool. We look forward to welcoming you as well in this strong network of ours.

Hendrik Sämisc and Jochen Schwill
Founders & CEOs
Team Renewables

The networked assets of our Virtual Power Plant create a strong team of perfectly-harmonized players: If wind or PV production is low on a given day, we ramp up production from flexible sources in our Next Pool, such as bioenergy or CHP plants. If wind or PV feed-in exceeds forecasted levels, the same flexible plants can scale back in production. Alternatively, our networked power consumers, battery storage units, or electrolyzers can increase their power consumption. There is no doubt that this well-choreographed dance provides larger benefits to the entire energy system: We stabilize the power grid by aligning generation and consumption with actual demand. By using the Next Pool to also provide balancing energy, we add even more stability to the grid. Of course, participating in the Next Pool also pays off for the networked operators and consumers. The revenue they generate on the electricity markets stems directly from their participation in the Virtual Power Plant.
A LANDFILL TURNING PROBLEMS INTO ENERGY

Karl-Heinz Zurhold, graduate engineer and veteran of the energy transition sums up the self-image of his region: “When it comes to the expansion of renewable energies in the Münsterland region, there will be no competition between us - we help each other.” Zurhold, who began building wind turbines in 2000 and thereby producing electricity from renewable energies, has since implemented many small and large projects not only in an advisory but also in an executive function.

“Everything is represented - from a few to many dozen wind turbines, biogas plants, and photovoltaics. We are very well networked in the Münsterland region, we know and help each other with projects,” explains the convinced energy entrepreneur and networker. “We recognized early on that pooling our plants offers us many advantages - the step into a Virtual Power Plant is only logical. When I sit down at the negotiating table with 5 MW instead of 500 kW, it makes a completely different impression, even with the renewables trader.” The current project of the bustling Münsterlander, which started green energy trading with Next Kraftwerke in March 2017, is a 2,058 kWp photovoltaic plant on a backfilled and sealed former waste dump. A total of 8,760 PV modules produce clean electricity on site, which the electricity traders, analysts and control system technicians from Cologne-based Next Kraftwerke then sell on the spot market of the power exchange. However, the PV modules are not the only energy sources hidden in the former problem area. “In addition to the converted landfill area for photovoltaics, which is subsidized, we also use the landfill gas to generate energy,” is how Zurhold explains the comprehensive approach of his project. “Together with a biogas plant in which the landfill gas is mixed with bio methane and then converted into electricity, we are making good use of this brownfield. In addition, we installed two wind turbines - we exploit every possibility to generate renewable energy on our landfill site,” the energy entrepreneur says happily, and concludes by describing a win-win situation between humans and animals: “Sheep can graze between the PV modules - and now they can seek shade in summer.” The integration of Zurhold's PV system into the Next Pool of the Virtual Power Plant went absolutely without a hitch - even though the authorities took longer than originally expected to approve the construction. Zurhold had been trying to obtain approval for his plant since 2011 - now he is happy that it has been finally launched six years later. He considers the cooperation with Next Kraftwerke, which he already knows from three joint projects with his Energielandwerker colleague Thomas Voß, to be very good: “What I find particularly positive is that you don’t have to put a lot of effort into the whole trading issue anymore. I don’t have to report every small malfunction of my power plants, and if I do, I can do it via the app or the website.”

Looking to the future, however, a few dark clouds are gathering above the sky of Münsterland. “After Fukushima, there was a real spirit of optimism not only among us, but also in politics - we wanted renewable energies, and policymakers also wanted them. Now we have planned the projects with long lead times - and the politicians turn their back,” Karl-Heinz Zurhold criticizes the lack of support of the federal and state governments regarding the expansion of renewable energy. “In addition, the 1,500 meter distance rule for wind power plants to residential areas and many other small laws and regulations, which are constantly changing and which we have to implement daily, do not make life easier for us.”

Nevertheless, Zurhold remains optimistic, his confidence comes from his strong network of many committed supporters, “We are a genuine ‘we’ team. We are not in competition with each other, but live the cooperative idea every day by helping, supporting and advising each other on projects.” The cooperation with Next Kraftwerke fits perfectly into this concept: “Helping each other, finding solutions and working towards enabling renewables - that is the common goal.”
Applied products
› Spot market trading of electricity from photovoltaics

Facts & figures
› 2,058 kWp
› 365 strings á 24 modules = 8,760
Hubert Banaszkiewicz, Director
PV Project Polska at Renesola

Applied products
- Power trading

Facts & figures
- Capacity: 1 MW
coal, solar power has one advantage: It generates power when demand and thus prices are highest. This structural advantage helps Renesola to gain additional benefits above its awarded bid in the auction – especially in summer time, when conventional generators have troubles to run on full capacity due to the lack of cooling water. While Next Kraftwerke assumes all forecasting and trading risks like imbalance costs, it passes on the benefits resulting from the positive profile of PV generation in Poland to Renesola. For its services, Next Kraftwerke receives a fixed fee per managed MWh.

In order to minimize costly forecast deviations, Renesola and Next Kraftwerke have opted to use a SCADA connection to transmit live data from all of the contracted PV parks to the central control system of the Virtual Power Plant Next Pool. This way, day ahead forecasts based on meteorological and historical data continuously and automatically get updated with live information on current infeed from the PV sites. Subsequently, trading of a volatile energy source like solar power becomes less adventurous and more reliable. Renesola receives its monthly billing with the earnings of power trading via the online customer portal “My Power Plant”. Next Kraftwerke also assumes the task of communicating infeed data to Polish Settlement Manager ZR S.A. to ensure the prompt and correct calculation of negative balance payments through the feed-in premium scheme. “We feel like we are in good hands with our PV farms and hope the very smooth cooperation between the two companies will go on further,” Hubert Banaszkiewicz adds.

Renesola is one of the very first PV developers and operators whose bids were awarded in the Polish auction system for the installation of PV capacity. Today they run the largest PV portfolio in the country. The auction system was introduced in 2015 to kick off the transition towards renewables. Hubert Banaszkiewicz, Director PV Project Polska at Renesola, explains the intricacies of the new auction system: “We decided to build the first PV parks all at a capacity just below 1 MW and needed to find an energy trader that would take our PV power into their balancing group and then manage it. Since the auction system does not allow for the sale of green certificates like its predecessor, the trading scheme had to be adapted to take into account the negative balance which basically is the difference between the baseload price on the spot market and the successful bid in the auction. We looked at a variety of trading houses, but only Next Kraftwerke was able to provide us with a transparent and pragmatic contract which also allows us to profit from the positive profile of our PV plants.”

Since the baseload price on the Polish spot market is still dominated by baseload conventional generators like coal, solar power has one advantage: It generates power when demand and thus prices are highest. This structural advantage helps Renesola to gain additional benefits above its awarded bid in the auction – especially in summer time, when conventional generators have troubles to run on full capacity due to the lack of cooling water. While Next Kraftwerke assumes all forecasting and trading risks like imbalance costs, it passes on the benefits resulting from the positive profile of PV generation in Poland to Renesola. For its services, Next Kraftwerke receives a fixed fee per managed MWh.

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While part of the energy is sold at an annual price on the futures market, another part is sold at a fixed quarterly price. However, at least 25 percent of the energy produced is sold by Next Kraftwerke traders on short-term spot markets. “While we decide on the macro strategy, Next Kraftwerke has complete control of the actual trading of our generated power. The assets are connected to the Virtual Power Plant and the energy is placed by the traders on the short-term spot markets.” Many different trading strategies and elaborate forecasts help the customer to get the best price. When market prices are negative, the wind turbines can easily be curtailed with a simple command from Next Kraftwerke headquarters in Cologne.

For Windkraft Simonsfeld, connecting to the Virtual Power Plant does not require a dedicated Next Box. “Communication with our assets is conducted over a protocol interface. Linking the systems went off without a hitch. Next Kraftwerke’s technicians were in touch with our IT department and the link was up and running after a quick software update,” adds Winter. Proof of origin is providing an additional source of income from the assets. Part of the power generated by Simonsfeld facilities is sold directly to consumers who have indicated a preference for verified green energy from ecological installations. Another case in point to why Windkraft Simonsfeld is not only a pioneer in generating power from renewable sources, but also a leading example of how green energy is commercially viable without subsidies.
Markus Winter, Chief Technical Officer of Windkraft Simonsfeld

**Applied products**
- PPA based trading concept

**Facts & figures**
- Capacity: 18 MW
Thomas Voß, Energy Cooperative of the Energielandwerker

Applied products
› Power trading of wind, solar, and biogas

Facts & figures
› Number of networked assets: 155
› Capacity: >270 MW
“Back there, we see the Lingen nuclear power plant,” says Thomas Voß, pointing north across the undulating Münsterland. “And there is the Ibbenburen coal-fired power station,” he continues, now pointing east. “In between, we have spread out.” We, that is the energy cooperative of the Energielandwerker, which has grown into a strong association of operators of the other, more sustainable power plant types in the northern Münsterland. To date, around 155 renewable energy plants have joined forces in order to operate as a cooperative on the market. The cooperative’s generation capacity is more than 270 megawatts, ranging from wind power to bioenergy and photovoltaics. Some loners between the omnipresent fossil power plants? With this renewable energy capacity, they are more likely a major regional player in the new energy world.

“Originally, we joined forces as a purchasing group,” explains Thomas Voß, an industrial engineer. “However, the topic of electricity trading soon arose, primarily with regard to the German scheme of so-called direct marketing of electricity from renewable energies, but also with regard to alternative marketing channels.” Since May 2016, Next Kraftwerke has been placing the electricity of the Energielandwerker from the Münsterland region on various marketplaces. “A whole series of points were important to us when selecting our trading partner. That’s why we took a close look around the market. First, of course, the conditions had to be right. Secondly, we also paid close attention to expertise in aggregating and dispatching flexibility, as bioenergy CHP plants are also part of our portfolio. Thirdly, the structure of the company had to suit us. The solvency and the personal involvement of the managing directors at Next Kraftwerke are positive criteria. Some of the electricity generated by the Energielandwerker is supplied by Next Kraftwerke to a municipal utility in the region to enable a regional electricity product for end consumers. The remaining quantities are traded on one of Europe’s spot market power exchanges called EPEX SPOT. In addition, the dispatchable plants of the Energielandwerker supply the transmission grid operators with reserves that can be activated at short notice in order to support the electricity grid frequency: Balancing energy. “It is important for us to always retain control over the choice of marketing options. We want to be able to decide which paths our electricity takes,” explains Voß.

Basically, a small Virtual Power Plant was created within the international Next Pool of Next Kraftwerke. “The cooperation with Next Kraftwerke already ran smoothly in the first phase of the cooperation. This concerned both the joint design of our trading concept and the individual contract design. The technical connection and monthly billing procedures also work very well, and if there are any open questions or problems, we have personal customer service managers who have always reacted quickly,” says Voß, reviewing the cooperation to this day. For the future, the expansion of the cooperative through the further inclusion of new plants is planned - so that the history of nuclear power plants and coal-fired power plants in the region will soon come to an end.
“When our biogas power plant was under construction, people wondered why we were installing 4 MW CHPs but only kept the motors running for a few hours a day,” says Onno Wilberts while pointing at the three combined heat and power (CHP) units at the biogas power plant he operates with his business partner Guido Koch. “We had to do a lot of explaining and convincing.” Back in 2011, Wilberts and Koch were indeed pioneers in the German biogas industry. Their objective: A highly flexible biogas power plant that helps stabilize grid frequency and follows a peak-load operation schedule which is tied to the current power price on spot markets.

“To put our plan into action, we needed a reliable market partner who could place the flexibility of our power plant on the electricity market,” Koch recalls. “Next Kraftwerke offered the competence we were looking for. We especially value the close cooperation and excellent support they provide.” Today, the power plant is controlled via a remote control unit, and its power production is shifted up and down as often as 20 times a day. The power plant can be controlled in 15-minute increments based on current prices on the spot market.

But also the transmission grid operators benefit from valuable control reserve which the biogas unit provides through Next Kraftwerke’s Virtual Power Plant. The power plant runs on an average electric capacity of 1.2 MW, while the installed capacity is nearly 4 MW. Additionally, the power plant’s storage encompasses 14,000 m³. With this immense flexibility, it can help compensate fluctuations in the national power grid, caused by volatile PV and wind infeed, sudden changes in electricity consumption, or even unplanned downtimes of conventional power plants.

The input material is just as versatile as the power production itself: Wilberts and Koch use a mixture of manure, chaff, and corn. The power plant also adjusts to seasonal conditions by producing more or less power based on the amount of silage. “Through an operation that is tied to the power price, and the flexibility of the power plant itself, we can achieve the highest profits. We decide how much power to produce based on the electricity prices and the substrate prices.” In addition to the price-led power production, the flexibility of the power plant is an advantage when it comes to repair or maintenance work. Inavoidable downtime is compensated later without impacting earnings. “This argument has also been accepted by the financing bank, since deductions are usually calculated for non-availability of a biogas plant,” stresses Onno Wilberts.

Despite the flexibility of the system at various levels, Onno Wilberts and Guido Koch consider it important that system operation and earnings remain predictable and stable. They have therefore agreed with Next Kraftwerke on a flat-rate remuneration for the flexibility of their plant. This remuneration is based on the availability of each individual flexible kilowatt of the unit. Could this be a model for the entire industry?
Guido Koch & Onno Wilberts, Plant Operators of the biogas plant in Beverstedt

**Applied products**
- Power trading / peak load operation
- Balancing energy

**Facts & figures**
- Capacity in kW: 1,560 / 1,560 / 800
- Gas storage capacity: 14,000 m³
Stefan Kienz, Product Developer at the Energielenker

**Applied products**
- Power trading / peak load operation
- Balancing energy

**Facts & figures**
- Capacity: 250 kW
- Total capacity Energielenker: 5 MW
- Heat supply: 1.5 GWh
When it comes to decentralized energy production, flexible electricity generation and heat production seem to be mutually exclusive, especially in the case of biomethane CHP plants. The Energielenker from Greven in the Münsterland region show that this is not necessarily the case. Their biomethane CHP plant in tranquil Gronau is an example of this approach - one out of the ten plants currently operated by the Energielenker, which together have a capacity of around five megawatts.

The biomethane plant promoted by the German Renewable Energy Act (EEG) supplies the adjoining facility for people with disabilities and the associated workshops and school as well as other local heat consumers, such as a swimming pool, with about 1.5 GWh of heat per year - a major location advantage for biomethane CHP plants. Since they only require a connection to the gas network, they can also operate without problems in densely populated areas. The required gas - balance-sheet traded biomethane - is obtained by the natural gas network. Despite the heat supply obligations, they operate the plant not exclusively heat-led, but achieve lucrative additional revenues via a demand-oriented electricity feed-in at the electricity exchange, as Stefan Kienz, product developer at the Energielenker, reports: “The demand-oriented feed-in works smoothly. We forecast the heating demand for the upcoming days on a daily basis and use this as a basis to optimize the CHP schedules. These schedules are sent daily to Next Kraftwerke and the control system of their VPP then remotely ramps our unit up and down according to the schedules.” In addition to providing local heat, the plant, like all other plants in the portfolio of the Energielenker, ensures the stabilization of the German electricity grid by providing balancing energy via the Virtual Power Plant of Next Kraftwerke. Similar to demand-oriented feed-in, Stefan Kienz’s restrictions on heat supply obligations in this market segment are not as far-reaching as it is often assumed. “All our plants have more or less large buffer storage facilities. These facilities enable longer balancing energy activations without any problems. We have already completed one-hour deliveries without any losses in heat supply,” Kienz notes. “In the case of very short activations, we don’t even have to resort to buffer storage, as heat is a rather inert medium and short-term fluctuations in electricity production are not directly noticeable in heat production.” The biomethane plants of the Energielenker offer their capacity primarily in the negative secondary reserve (aFRR), but also providing positive secondary reserve is interesting for the Energielenker and will be implemented in the near future.

In this context, Stefan Kienz would like to see more support from the industry on the regulatory and legislative side. “It would certainly have been helpful if the legislator had given the industry clear signals as to how electricity production can be adjusted to the electricity demand in the future electricity mix consisting of a considerable proportion of fluctuating feed-in from wind and sun. At this point, the easily adjustable generation of electricity from combined heat and power plays out its full potential - regardless of whether it is operated with natural gas or biomethane. Especially in the current Renewable Energies Act (EEG), dispatchable bioenergy unfortunately does not receive the appreciation it deserves in the German electricity mix.” Fortunately, this does not change the fact that bio methane CHP plants, like those of the Energielenker, are already an important cornerstone of the energy system transformation.
The diffuse white light of the greenhouse makes the color of the plants, which are waiting for their delivery to retail, appear even more intense. The new greenhouses of the Hartmann GmbH & Co. KG in Schwarzach am Main cover almost 2.9 hectares. Heat and electricity for the greenhouse, which runs almost fully automatically, come from the CHP plant next door. The plant was built by the planning office PRO>>OPT GmbH and is also serviced by them. The electricity from the combined heat and power plant, which was connected to the grid in November 2018, is marketed in accordance with the 2017 Act on Combined Heat and Power Generation, short KWKG-2017. Robert Hackl, planner at PRO>>OPT, explains: “When we started planning the plant, the KWKG-2017 had not yet been finally adopted. Of course, for such an endeavor, you need a little bit of courage and trust in the legislature. But in our case, it has paid off and the plant is one of the first plants operating according to KWKG-2017.”

Today, the plant consists of a CHP plant with 530 kW output. A further CHP plant with the same capacity is already in the works and will be installed next to it. “At the moment, our plant delivers about 650 kW thermal energy per hour. But overall, we need about 3000 kW of thermal energy in peak times. We have got this gap well covered with our thermal storage system.” The storage system of the CHP, which is already designed for both CHP units, comprises one million liters. “This gives us a lot of flexibility,” explains Robert Hackl. “I can pause power generation for a few days if the electricity prices are unappealing or if I already made use of very good prices at the energy exchange in the beginning of the week. This leads to roughly EUR 3,000 more revenues each month as compared to just running it heat-controlled,” Hackl states further.

A particularly important tool for Hackl and the Hartmann GmbH & Co. KG is the scheduling tool of the Next Kraftwerke user portal “My Power Plant“, which allows users to transmit plant operation schedules online. A traffic light symbol shows the hours in which Next Kraftwerke’s analysts predict profitable prices, and in which hours the operation of the plant is not as lucrative. Schedules can be either transmitted daily or weekly. “The customer portal makes our work much easier. For example, while I was on holiday with my son, I scheduled the plant’s operation from the caravan. Every morning, when we came home from sheatfish fishing, he used his mobile phone to connect my laptop to the internet via tethering and while we had breakfast, I set the plant’s operation schedule based on the electricity price forecasts displayed in the portal. That was extremely convenient,” says Hackl.

Even though the plant currently makes its revenues solely at the spot market of the energy exchange, it could theoretically also provide balancing reserves to the national grid. “Of course, the plant is also prequalified for balancing reserve. Unfortunately, however, prices at the balancing reserve market were unappealing in recent years. And because the revenues from the peak-load optimized operation were so profitable, we did not see a reason to change anything about it. If the prices at the balancing reserve market increase again and we have completed our second CHP unit, this option is also somewhat more attractive again,” explains Robert Hackl. The CHP plant of the Hartmann GmbH is not the only plant marketed through PRO>>OPT GmbH by Next Kraftwerke. “I have been in contact with Next Kraftwerke for a long time and appreciate the individual expert advice very much. The cooperation works smoothly and I get answers to my questions quickly. That is what you really want from a business partner,” says Hackl in summary.
Robert Hackl, Planer PRO>>OPT GmbH

Applied products
› Power trading
› Schedule optimization

Facts & figures
› Capacity: 530 kWel
› Volume heat storage: 1 mio litres
Julian Weiß, Project Manager Ökowind GmbH

Applied products
- Power trading
- Balancing energy

Facts & figures
- Capacity: 1,100 kW
- Types of balancing energy: secondary & tertiary reserve
At first glance, one does not suspect how important the terrain in the Austrian Erlauf valley is in terms of industrial history. The valley in lower Austria is part of the so-called Eisenwurzen - the birthplace of the Austrian small iron industry. In Neubruck, in the 1820s, the industrialist Andreas Toepper, pioneer of Austrian ironmaking and inventor of the rolled sheet process, built the first imperially and royally privileged iron, steel, and rolled sheet factory. Even today, the Toepper Castle testifies to this heritage and its importance for the region. Hydropower played an important role in both the iron mill and the paper mill, which was later built on the same site. Until a few years ago, the old drainage channel of the paper mill and a wooden weir were still landmarks of regional industrial history.

In the middle of the 2000s, Ökowind GmbH from St. Pölten took over the weir - with the aim of constructing a new hydropower plant on the Erlauf. Ökowind GmbH, which until then had only operated wind farms in Austria, converted the weir into a hydropower plant with an output of 1100 kW and an average drop height of 8.7 meters.

“When planning the plant, we opted for an investment subsidy instead of feed-in subsidies,” says Julian Weiß, project manager at Ökowind GmbH. “This decision also meant that we had to sell our electricity on the free market right from the start. So it was important to us that we could rely on different trading options in order to achieve the best possible price for our electricity production. This is particularly important when you consider the falling prices on the electricity exchanges. We therefore quickly opted for Next Kraftwerke, as the company was the first provider in Austria to network decentralized plants with the aim of both enabling electricity trading on the spot market and providing control reserve to the Transmission System Operator. The option to participate in different markets allows us to diversify our marketing risk.”

The Neubruck hydropower plant markets electricity both on the spot market and on the control reserve market. Almost the entire output can be used to stabilize the electricity grid in the event of frequency fluctuations. “If required, the hydropower plant can be ramped down to 100 kW,” explains Weiß. The hydropower plant is able to offer both tertiary and secondary reserve capacity. “The balancing energy activations last from a few seconds to a period of several minutes - often several times a day. The revenues from these deliveries of control reserve are an important aspect for us in marketing via Next Kraftwerke. This is financially very lucrative for us, even if it doesn’t seem intuitive at first glance to get money for shutting down your plant,” says Weiß. But in this way, the hydropower plant makes an important contribution to stabilizing the Austrian electricity grid. Thus it takes up the path of the industrial revolution in this region again and leads it into the 21st century: with the digitization of the decentralized energy revolution.
A small, winding road leads from Ludwigshafen at Lake Constance through a dense deciduous forest to Sipplingen Berg. Its plateau, with a wide view over the Swabian Sea to the Alps, is covered by the huge and yet almost invisibly embedded treatment plant of the Zweckverband Bodensee Wasserversorgung, the largest regional water supplier. Together with the Süßenmühle lake pumping station, which pumps raw water from Lake Constance 310 meters below up to the mountain top, the plant is the largest waterworks in Germany.

Christoph Drusenbaum, engineer in the production and treatment plant, is responsible for energy procurement at the Swabian water supplier. The electricity he purchases feeds the total of 54 megawatts of installed pumping capacity at the Sipplingen site, which produces an average of 356,000 cubic metres of untreated water per day from Lake Constance. After treatment with microfilters, ozonation and a sand filter system, the Lake Constance water reaches the storage tanks of the waterworks and from there the consumers in Stuttgart and the whole of Baden-Württemberg.

With an annual consumption of 150 gigawatt hours of electricity, mainly for pumping, energy procurement plays a special role. As an engineer with a focus on renewable energies, Christoph Drusenbaum is therefore continuously looking for ways to improve energy and cost efficiency and has found these in the flexible electricity tariffs at Next Kraftwerke. Since 2016, Next Kraftwerke has been offering a variable electricity supply contract with the product “Best of 96”, which makes the price fluctuations on the electricity exchange directly usable for industrial and commercial customers. They can shift their consumption processes from expensive to cheaper time zones of the day to the nearest quarter of an hour.

“We can save a six-digit amount of electricity costs annually through these optimizations in electricity procurement,” Christoph Drusenbaum is pleased to report, but emphasizes: “With electricity procurement costs totaling roughly 20 million euros per year, this is of course only a single-digit percentage share. However, we are quite satisfied with the results of our cooperation.” To adjust consumption, the four 8 MW pumps and the two 11 MW pumps can be switched on or off. “It should of course be noted that the number of switching operations is limited. To start a pump, the centrifugal masses of several tons from the pumps must be set in motion,” explains Christoph Drusenbaum. The engineer appreciates the trouble-free communication with the specialists at Next Kraftwerke: “I find the atmosphere very pleasant and pragmatic – not least because of the balanced contract design with the profit share model of the time-of-use tariff. Also the support in the technical design and setup of the communication via the REST-API interface was very helpful.” Next Kraftwerke transmits the electricity prices to the waterworks via the REST-API, while the waterworks sends its schedule back to the Virtual Power Plant via the same route.

Thus not only the engineer but also the water supplier is content: Lower electricity procurement costs mean more money for infrastructure and the expansion of the renewable power supply of the pumping station for four million water consumers in Baden-Württemberg.
Christoph Drusenbaum, Engineer at Zweckverband Bodensee-Wasserversorgung

Applied products
- Tariff Best of 96

Facts & figures
- Installed capacity of the Süßenmühle pumping station: 55 MW / flexibility provided: 32 MW
- Average power consumption of pumps per year: 150,000 MWh
- Pipe length: more than 1,700 km
Norbert Zösch, Managing Director of the local utility Stadtwerk Haßfurt

Applied products
- Balancing energy

Facts & figures
- Installed capacity of the electrolyzer: 1.25 MW
- Hydrogen production capacity: 220³/h
- Annual production of hydrogen gas: approx. 1 GWh
- Customers supplied (by Greenpeace Energy): ca. 20,000
FROM WIND TO HYDROGEN

In Haßfurt, a small town in the middle of Mainfranken, a Bavarian region in Southern Germany, on a clear, windy May day around 2 p.m.: The electrolyzer starts booming and hydrogen is being produced from wind power. The gas tank behind the hall fills up. Norbert Zösch, Managing Director of the local utility Stadtwerk Haßfurt, smiles, “On a day like this, we can produce gas very cheaply thanks to excess renewables.” Then he opens the roller shutter of the tidy, rather inconspicuous hall on the outskirts of the town, filled with power lines, pipes, and electronics.

Norbert Zösch and his team achieved a great pioneering work: They built one of the first larger plants to generate hydrogen from a surplus of renewables through electrolysis. This makes the utility not only a cleantech forerunner, but also one of digitization: The control of the whole power-to-gas plant is split between controls on site and the control center of Next Kraftwerke’s Virtual Power Plant in Cologne, some 360 km away. But Next Kraftwerke’s involvement in Haßfurt does not only extend to aggregating and selling ancillary services from the electrolyzer: The VPP also delivers forecasts of local wind generation and the load on the local natural gas network. This way, the control center does not only supervise and control the flexibility potential of the hydrogen production but also the local energy landscape in order to schedule the optimal dispatch of the electrolyzer.

Since the end of 2016, the plant has been able to generate 220 m³ of hydrogen per hour through an electrolyzer with an installed capacity of 1.2 megawatts at an efficiency of around 70 percent. The product - combustible hydrogen gas - is then fed into Haßfurt’s natural gas network in a five-percent admixture. Gas customers who opt for the more climate-friendly wind gas tariff by project partner Greenpeace Energy can then burn the mixture of natural gas and hydrogen in their gas heaters without any upgrades in their homes. With Greenpeace Energy and Next Kraftwerke, the Stadtwerk Haßfurt has deliberately opted for companies in the energy sector that prefer achieving pioneer work to fast profits. Norbert Zösch explains the situation, “Due to the obligation of paying a surcharge on the utilized green electricity, the plant does not create much profit, but it covers its costs.” Every 15 minutes, Next Kraftwerke delivers forecast data to the electrolyzer on PV and wind feed-in, gas, and electricity consumption in Haßfurt and the gas consumption of the nearby malting plant. The receiving interface converts this data directly into control commands for the electrolyzer: Depending on price forecasts and the current utilization of the gas and electricity network, the VPP remotely starts and stops the electrolyzer from Cologne while at the same time being on stand-by to deliver control reserve to the national grid at any given second.

Norbert Zösch especially appreciates Next Kraftwerke’s professionalism and willingness to engage in dialogue: “Cooperation with Next Kraftwerke has developed positively over the operating period. Of course, we had some differences at the beginning: Next wants to optimize the sale of control reserve, we want to generate gas as cheaply as possible from renewables - that does not always work together. In the meantime, however, we have achieved good compromises in the control of our plant that are viable for both sides,” says the Stadtwerk’s manager with a conciliatory smile. Following this statement, Norbert Zösch takes a last look at the electrolyzer for today before his colleague closes the roller shutter. The plant continues to run with a now muted hum.
For this, it simply has to be checked out via an online form in the Next Kraftwerke customer portal. This way, the control center of the Virtual Power Plant is informed that the plant is not available for ancillary services. “Checking out one of the plants is done quickly and conveniently. It is also practical in this context to be informed by a mobile message when a control reserve activation is taking place - just maybe not at three o’clock in the night, if it were up to me” says Georg Schelp, the responsible technician at OBO Bettermann, cheerfully. The start of providing balancing energy to the grid via Next Kraftwerke was uncomplicated. “The connection of the two backup generators to the Virtual Power Plant went smoothly. Our service provider for electrical engineering took care of this. So this task was completed quickly. Also the coordination with the technical department of Next Kraftwerke to prequalify the aggregates for the control reserve markets was a piece of cake.”

On top of the additional revenue that OBO Bettermann receives for the capacity and activation of control reserve, the activations of balancing energy provide another service. Schelp explains: “In addition to the balancing energy revenues, the individual activations can also be used without any problems as test runs for our emergency power generators. In doing so, we win twice by integrating our generators into the Virtual Power Plant. On the one hand financially through the revenues we gain, and on the other hand because we save ourselves additional work for test runs - that’s quite practical.”

OBO Bettermann’s head office is located on the southern edge of the Ruhr area, the symbol of an age characterized by coal and steel. The company has been based in the city of Menden for more than 100 years and is what is commonly known as a hidden champion. OBO is now represented at more than 60 locations worldwide and produces cable trays and ducts for a wide range of applications in commercial and industrial installations.

Behind the main building is one of the two emergency backup generators utilized by Next Kraftwerke to provide secondary reserve capacity for the power grid. If the frequency of the power grid deviates too much from 50 Hertz, Next Kraftwerke activates decentralized power generators such as OBO’s via the control center of the Virtual Power Plant in order to compensate for the fluctuations. These occur, among other things, when sun and wind do not feed in to the extent predicted. Up to 500 kW of the Menden facility are on standby in the control system of Next Kraftwerke’s Virtual Power Plant as power that can be activated if necessary. With a total output of 600 kW, the container aggregate - manufactured by Polyma - has slightly more power than is reserved for the Virtual Power Plant in order to supply power for the adjacent buildings if necessary. In addition to the permanently installed genset, OBO Bettermann also runs a second emergency power generator. This mobile unit, which looks like a mixture of a camper van and a market stall, stands behind one of the large production halls. As a rule, the unit is permanently wired to the Next Box. If necessary, the emergency power generator can also be used at another location on the site.
Georg Schelp, Responsible Technician at OBO Bettermann

Applied products
- Balancing energy

Facts & figures
- Capacity of the fixed emergency generator: 600 kW
- Capacity of the mobile emergency generator: 250 kW
Paul Weber, Managing Director of Stadtwerke Groß-Gerau Versorgungs GmbH

Applied products
› Power trading / Balancing energy
› Balancing group management
› Portfolio management

Facts & figures
› Transported electricity on mid- and low-voltage grid: 150 GWh p.a.
› Power production from renewable sources: 12 GWh p.a.
Public utilities as participants in Virtual Power Plants? What sounds unusual is by now common practice. After all, municipal utilities also have a great deal of flexibility that can be put to good use by means of digital networking and short-term electricity trading through Virtual Power Plants. In January 2012, Stadtwerke Groß-Gerau Versorgungs GmbH (GGV), a local utility in the West of Germany close to Frankfurt, was the first municipal utility to join the Next Pool of Next Kraftwerke.

The cooperation began with the integration of GGV’s biogas plants into the Virtual Power Plant. However, the cooperation soon expanded to other areas. “Due to limited internal personnel resources, we were looking for a market partner with whom we could optimise our electricity procurement costs. Based on our previous cooperation, the choice of Next Kraftwerke was obvious,” explains Paul Weber, Managing Director of GGV. Today, in addition to the integration of all of GGV’s renewable energy plants, the joint project includes balancing group management and portfolio management for the utility’s day-to-day operations.

In portfolio management, Next Kraftwerke is responsible for forecasting generation and load (household as well as C&I consumers) for GGV’s balancing group in close cooperation with GGV. Next Kraftwerke then transmits the forecast schedules to the transmission system operator daily in schedule management and trades the reported quantities in day-ahead trading on the EPEX spot exchange. The balancing group of GGV is then smoothed in the event of forecast adjustments through intraday trading on EPEX in order to reduce balancing costs and to comply with the obligation of quarter-hourly balancing group management. What are the results of the cooperation? Paul Weber takes stock, “Thanks to the good and trusting cooperation at eye level, we reduce our electricity procurement costs without having to invest in our own trading department. On top of this, of course, there are the smooth renewables trading and the participation in the balancing energy market with our dispatchable renewable electricity generation plants. The decision for this type of cooperation was easy, as Next Kraftwerke also assumed balancing risks associated with portfolio management and feed-in forecasts. In the medium term, we would like to expand the cooperation, especially with regard to the flexibilization of our bioenergy plants and the procurement of electricity via short and long-term electricity markets.”
Next Kraftwerke is a company founded by two former students who first met while researching at the University of Cologne in Germany. The academic spirit of the first years is visible still today in the numerous research projects and pioneering corporate projects. The following list of projects and initiatives in which Next Kraftwerke was or is involved provides an overview of our research work for the energy transition.

**RESEARCH PROJECTS**

**Current research projects**

**DA/RE**
The "Grid Security Initiative for Baden-Württemberg" is a pilot project for the provision of redispatch capacities from decentralized, renewable power generation plants and electricity storage facilities. Next Kraftwerke is implementing the project together with MVV Trading, sonnen, Entelios, the three distribution grid operators Netze BW, MVV Netze, Stadtwerke Schwäbisch Hall and the transmission grid operator TransnetBW.

**FRESH**
Together with HHLA (logistics company in the port of Hamburg), the Institute for Information Technology of OFFIS e. V. and Georg-August-University Göttingen (Chair of Information Management), Next Kraftwerke is running a hitherto unique project: Under the name “FRESH”, short for “Flexibility Management and Control Energy Provision of Heavy Duty Port Vehicles”, participants are testing new ideas in the supply of control reserve from batteries of automatically controlled electric vehicles (Automated Guided Vehicles, AGV).

**BE20plus**
With the BE20plus research project, the German Biomass Research Centre gGmbH, the IZES GmbH, the University of Stuttgart, the University of Hohenheim, the Helmholtz Centre for Environmental Research GmbH and Next Kraftwerke research the economic perspectives of biogas plants after the end of the twenty-year support scheme. The project partners want to identify and evaluate new business models and reference scenarios for the use of bioenergy in the context of the energy transition. The project is funded by the Federal Ministry for Food and Agriculture (BMEL).

**C/sells**
Project C/sells, which is funded by the SINTEG (Showcase Intelligent Energy) funding program of the German Ministry of Economics and Energy, investigates new energy supply concepts using a cellular, highly networked approach. Next Kraftwerke is involved in five C/sells subprojects: Regulatory Requirements, Infrastructure Information System (IIS), Organisation of Smart Grids, Methods for Smart Properties and Markets as well as Demonstration of Intelligent Network Cells.

**BestRes**
BestRes is an EU-funded program within the “Horizon 2020 Research and Innovation Programme” to promote the integration of fluctuating renewable energies by aggregating decentralized plants such as wind, photovoltaic, biogas, hydropower and CHP as well as storage technologies and electricity consumers. The project, which was launched in March 2016, will run for three years. Next Kraftwerke in Cologne is participating in the project for Germany, Italy, and France; Next Kraftwerke Belgium is responsible for the Belgian part.

**NEDO**
The international demonstration project Automated Demand Response for Air Conditioners of the Japanese New Energy and Industrial Technology Development Organization (NEDO) with the participation of Next Kraftwerke is investigating how air conditioning systems can be networked, made more flexible and operated in an optimized manner. The project investigates the influence of various parameters such as user restrictions (temperature level) and technical restrictions of air conditioning systems, and looks at various applications such as electricity price optimization or grid-supporting measures.

More information: www.next-kraftwerke.com/company/research-projects
Non publicly funded projects

Frequency Control Reserves from EVs
In cooperation with Jedlix, a Dutch aggregator of electric vehicles and operator of a platform for intelligent charging concepts, Next Kraftwerke is conducting an international pilot project to stabilize the Dutch electricity grid. The participants are providing balancing power in the form of secondary reserve (aFRR) from electric vehicles. The project is carried out in cooperation with the Dutch transmission system operator TenneT, which wants to test the technical feasibility of secondary reserve from new technologies.

Integration of a 2 MW battery into the VPP
In cooperation with Eneco Belgium and the battery supplier Alfen, Next Kraftwerke has launched a pilot project to include a 2-megawatt battery in its Virtual Power Plant. The battery will provide primary control reserve (FCR) for the Belgian power grid. By permanently monitoring the grid frequency, the fast power storage unit can fully exploit its qualities thanks to the real-time connection to the Virtual Power Plant.

Completed research projects

OptFlex Biogas
In the completed project OptFlex Biogas, the German Biomass Research Center GmbH (DBFZ) together with Next Kraftwerke came to the conclusion that the subsequent optimization of a flexibly operating biogas plant significantly improves the overall efficiency and helps reducing greenhouse gas emissions.

FlexHKW
The FlexHKW project investigated the potential of biomass cogeneration plants for flexible power generation from 2013 to 2015 with the participation of Next Kraftwerke. The aim was to optimize the operation of the plants in order to adapt their power generation to current electricity demand and to the intermittent power generation from wind and solar energy. That way, the share of renewable energies can be increased and CO2 emissions reduced.

DSM Bavaria/Baden-Württemberg
The aim of the projects Demand Side Management DSM Bavaria and DSM Baden-Württemberg was to support regional companies in identifying and economically marketing existing load shifting potentials and to promote the development of a market for Demand Side Management in Germany. For this purpose, practical potentials for flexibility were identified and conclusions for an improved market development were derived.
The transition to renewable sources of energy is an enormous challenge for our energy system. Since 2009, we’ve risen to this challenge and have developed solutions for the energy market of the future. Today, we operate one of the world’s biggest Virtual Power Plants – with a capacity of more than 7,500 MW, and subsidiaries in a large number of European countries.

Become a part of our Virtual Power Plant and enjoy all the advantages of this strong network.
In-house expertise
The Next Kraftwerke headquarters houses all departments necessary for a smart dispatch of networked assets: IT, control and communication systems, the power trading floor, customer relations, and sales. These processes are essential for seamlessly running a Virtual Power Plant, but this full-service approach is also one of the reasons many power producers, consumers, and utility companies have been working with Next Kraftwerke for years.

Trading services
With our in-house trading floor, we provide a wide array of services to our clients: we offer direct access to the day-ahead and intraday markets on the EPEX Spot and the control reserve market as well as other European power markets. Every day, our highly-qualified power traders aim for the best possible results for our customers.

Sustainable concepts
The future power supply will mainly consist of wind and solar power. Other power producers and consumers will need to compensate for the fluctuating feed-in. This is already happening in our Next Pool, helping us leave behind fossil and nuclear-based power production.

Customer portal
With our customer portal we are offering a precious tool to our customers: Here you can view and manage the status of your assets, organize schedules for flexible assets, access data and invoices, and download important documents at any time. “My Power Plant” can be used by all standard operating systems and browsers. In addition, “My Power Plant” is available as an app on Apple or Android mobile devices, allowing you to stay up to date even on the go.

Facts & figures
› Aggregated units: > 8,500
› Total capacity of the Virtual Power Plant: > 7,450 MW
› Traded energy quantities (2019): 15.1 TWh
› Control areas: Active in 7 European TSO areas
› Founded: 2009
› Locations: 7
› Employees: 159
› Sales (2018): 627.7 million Euro

Awarded
We have received a number of awards for our innovative concepts and products:
› Global Cleantech 100, 2020
› Digital Champions Award, 2019
› Financial Times 1000, 2017
› Intersolar Award, 2017
› National Energy Globe Award Germany, 2017
› RGI Good Practice of the Year Award, 2016
› eco Internet Award, 2016
› Global Cleantech 100, 2015
› Eurelectric Award, 2015
› Nominated for the Hermes Award, 2015
› German Energy Award, 2014
future-oriented
As part of the digital energy transition, we are shaping the future of the energy industry.

balanced
With the aggregated capacity in our VPP, we balance fluctuations in the electricity grid.

networked
Networking thousands of units allows us to control them like one single power plant.

cooperative
Together with the participants in the Next Pool, we create a new energy world.