

# NEMOCS

Our platform for your  
Virtual Power Plant

THE POWER OF MANY



# A POWERFUL PLATFORM

## Use the infrastructure we trust

Managing the shift towards a more distributed energy system based on renewables is an enormous challenge for the energy sector. Numerous distributed energy resources (DERs) need to be perfectly coordinated to provide a reliable supply of energy. Consumption processes should also be intelligently scheduled to ensure that energy supply at any moment meets the energy demand. The Virtual Power Plant (VPP) is a key technology for solving the tasks of this distributed energy world. The VPP not only allows to aggregate thousands of electricity producers, consumers, and storage units. It also allows to bid their power and flexibility into different markets by intelligently controlling their feed-in and consumption.

As the operator of one of the world's largest VPPs and an experienced energy trader, we can offer you a customizable IT solution for building your own VPP. You'll gain access to the

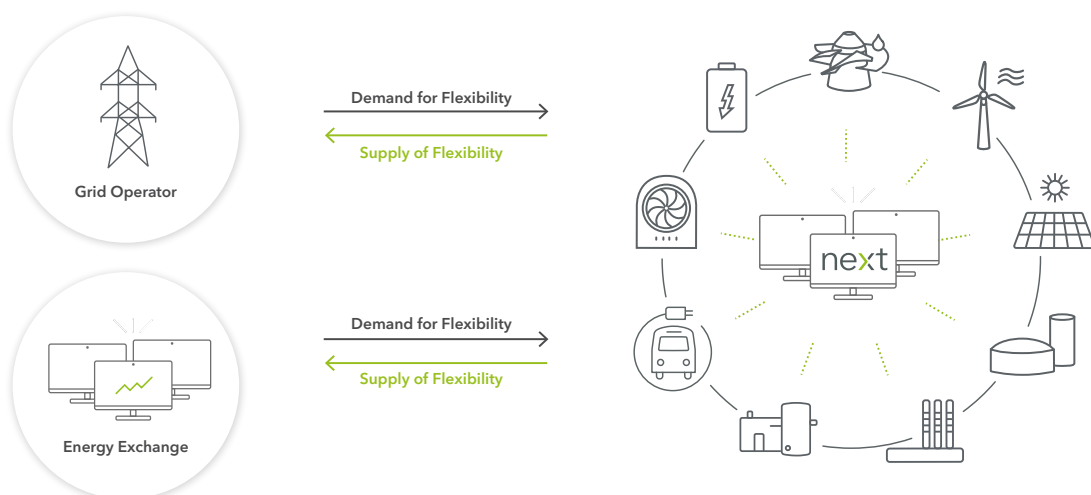


powerful infrastructure, which has proven its value time and again in our daily business. Our platform NEMOCS incorporates the ideas and features developed by our IT experts and energy traders. This guarantees that your VPP is based on a successful model that incorporates our full expertise.

## NEMOCS is the result of our expertise

For several years, we've operated a Virtual Power Plant that now includes more than 8,500 networked energy producers using diverse sources of energy as well as industrial energy

consumers. With an installed capacity of more than 7,400 MW, we are an established player on the energy market and active on all the relevant power exchanges in Europe.

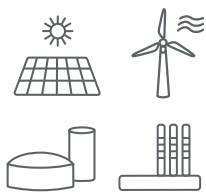


- › **Tried and tested on all markets:** Price based dispatch for wholesale markets as well as balancing markets
- › **Suitable for flexible loads and various energy sources:** Ranging from renewables like solar, wind, hydro, and biogas to emergency power generators and CHPs
- › **Continued optimization:** Steady improvement of automation, scalability, and performance

## Features of our VPP solution

NEMOCS is a modularly designed software-as-a-service solution that enables you to connect, monitor, and control distributed power producers, consumers, and storage systems. Thereby, it offers a wide range of business fields

to plant operators, electricity suppliers, grid operators and power traders. NEMOCS provides everything you need for the successful operation of your VPP.



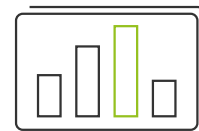
### Aggregation

Using a standard interface, you can connect different assets such as wind, solar, or biomass and controllable loads into the VPP and steer them remotely. We can network the assets via our Next Box if desired.



### Monitoring

The control system displays and records real-time information on current capacity, storage levels, and standby status of your assets. You can see the exact amount of available capacity in your VPP.



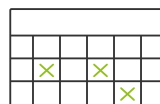
### Data visualization

The control system of NEMOCS provides several visual interfaces. For example, you can filter by technology type, customer groups, or location.



### High-performance data processing

Price signals from the energy markets and control signals from the system operator are processed in seconds and converted to operational commands for the assets. Using API or file exports, the data can later be transferred to your master data, trading, or accounting systems.



### Optimized asset operation

Based on input and output data of the networked assets in addition to market and weather data, you can execute schedules for peak-load operation, optimize flexible assets and implement demand response solutions.



### Individual control

The central control system remotely manages each asset and ensures the predetermined schedule is executed respecting the individual restrictions of the assets. Schedule changes are possible on short notice.

# NEMOCS USE CASES

## Live Monitoring: Accurate live data for better forecasts

The higher the share of renewable energies in the electricity mix, the more important it is to reliably forecast their production: Parties with grid responsibility such as DSOs and TSOs require precise information on expected feed-in electricity volumes to maintain stable operation of the

infrastructure transporting volatile and fluctuating volumes of electricity. Any deviations from the predicted volumes must be compensated for in the short term, thus resulting in high system costs. NEMOCS is the perfect tool for monitoring the feed-in of renewable energy sources.



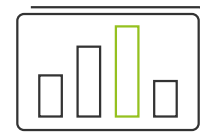
### Monitoring assets & pools

From a central control system, you can monitor multiple DER assets such as PV and wind.



### Gaining live data

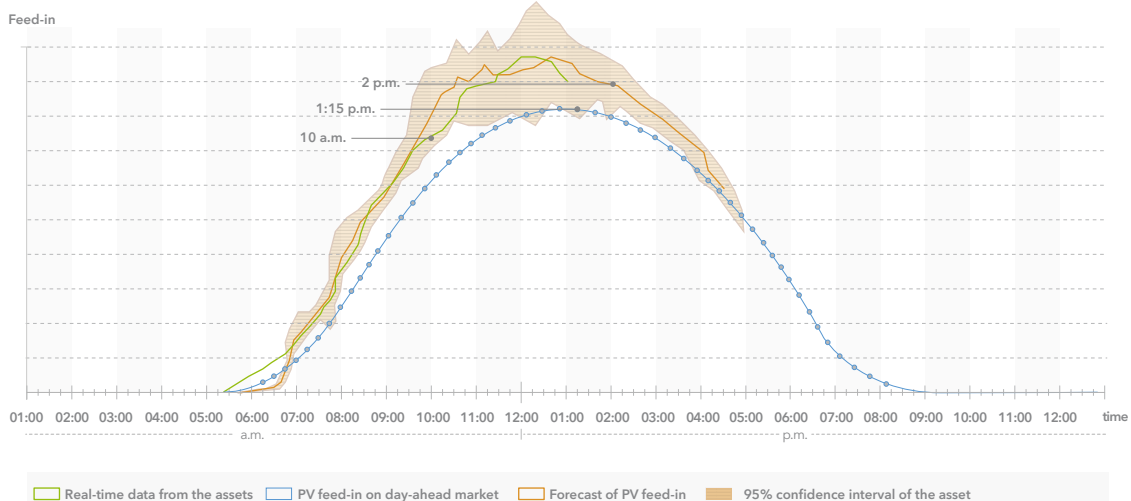
The control system displays and records real-time information on current feed-in and status of your assets in a high-frequent and maximum accurate way.



### Refining data

Tools for substitute value creation and data cleansing make it possible to significantly increase data quality. The data can be further processed in associated systems like billing or trading systems.

## Case Study: Trading on short-term markets



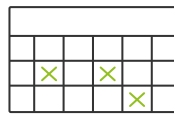
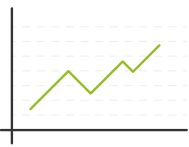
In many countries, deviations between forecasted and actual feed-in can be compensated by trading on short-term energy markets. This is exactly what we do as a certified power trader with our 2,000 MW portfolio of PV in Germany. First, we trade the assets on the day-ahead market based on forecasts. On the day of the actual feed-in, deviations from the day-ahead

forecast occur. If this deviation persisted, it would have to be eliminated by balancing energy. In order to minimize the need for costly balancing energy, our traders continuously try to close the gap between day-ahead forecasts and actual feed-in. Live data from our assets is essential for this, as it brings the forecast closer to real generation.

## Asset dispatch & control: Increased revenues through schedule operation

The volatile feed-in of wind and solar energy strongly affects power exchanges. As a consequence of rapidly changing electricity supply, the market prices fluctuate significantly. As an operator of steerable assets, you can take advantage of changing energy prices. By producing energy when prices are

high and letting your systems rest when prices are low, you can boost the revenues of your plants and support a sustainable utilization of the grid. In case you are operating flexible consumption assets, the process goes vice versa: The VPP software can dispatch consumption during low price hours.



### Gaining live data

NEMOCS processes real-time data of a large number of assets in addition to market and weather data.

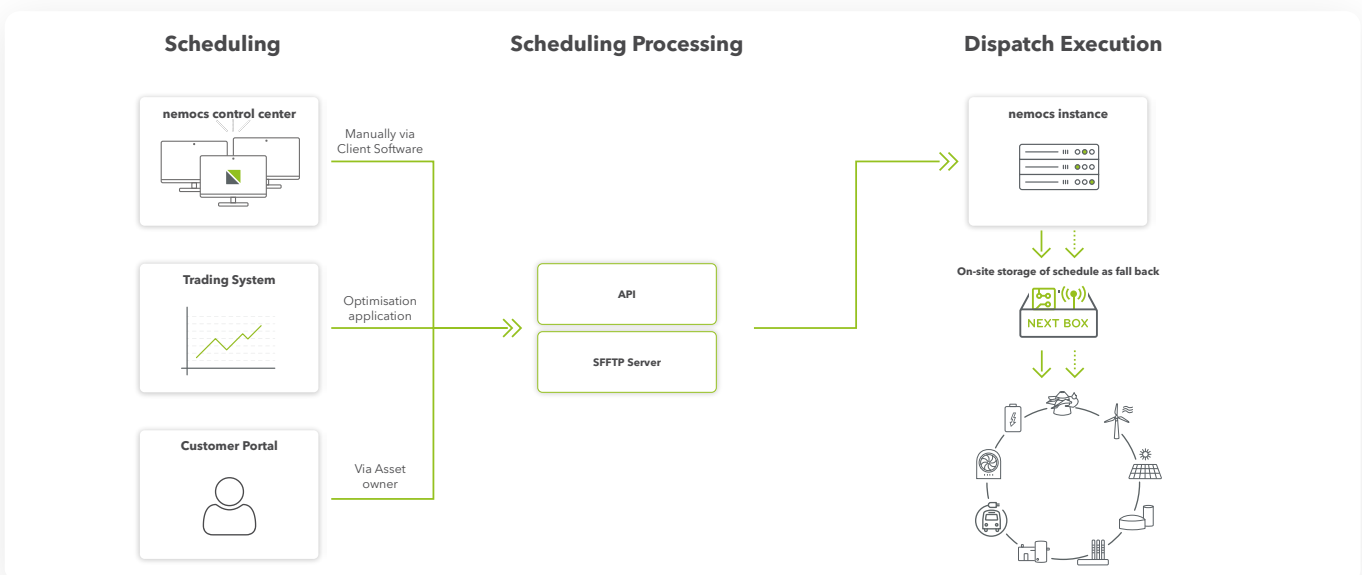
### Dispatching schedules

Based on this, NEMOCS schedules peak-load operation, optimizing flexible assets and their respective market value.

### Controlling assets & pools

The central control system can dispatch operation of individual assets or pools and ensures the predetermined schedule is executed. Restrictions on individual assets are, of course, taken into account.

## Case Study: Price-based control of networked assets



EPEX Spot in Paris is the most important European market for short-term power trading and thus also a central trading place for our VPP. In the course of one day, the electricity price changes 24 times on the day-ahead market and even 96 times in intraday trading. The difference between quarter-hours can be more than 50 euros per megawatt hour. To

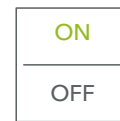
benefit from these price differences, flexible members of our pool produce or consume electricity when it is most economically viable. For this purpose, we continuously optimize the schedules and feed them into the control system. The execution runs fully automatically.

# NEMOCS USE CASES

## Balancing services: Keeping the grid in perfect balance

With the rise of weather-dependent energy sources, fluctuations in the power grid are increasing. A central task in the modern energy industry is therefore to guarantee grid stability at all times through controlling the power infeed of distributed energy

resources and offtake of controllable loads. Today, not only large power plants can provide balancing services. Aggregated in a Virtual Power Plant, smaller units with a shorter reaction time can play a vital role in levelling out these fluctuations.



### Gaining live data

In addition to all the live data of the networked assets, the control system displays external data like grid frequency or market prices and their respective market value.

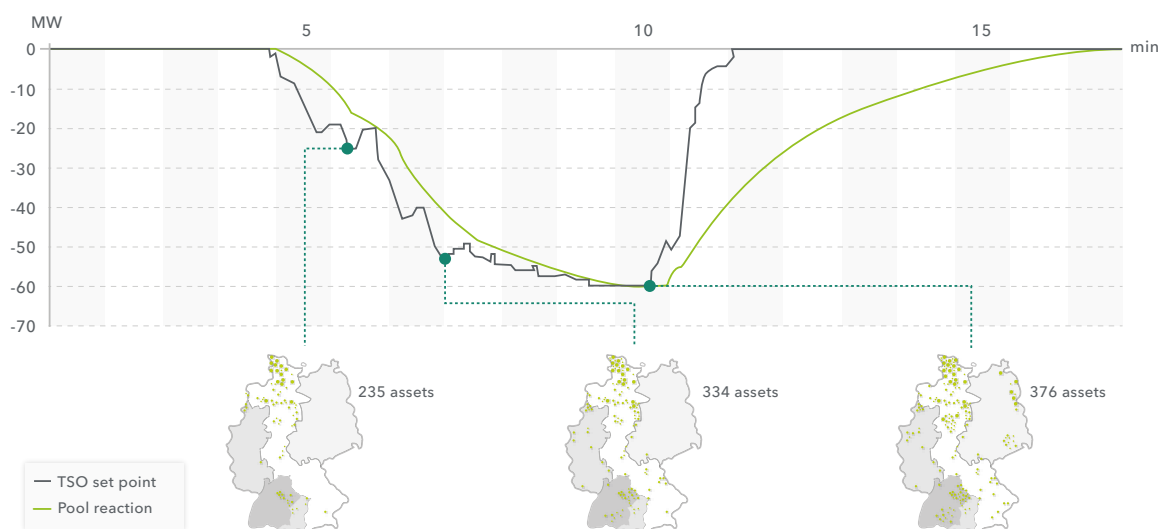
### Adjusting consumption/production

You can adjust power production, consumption and storage systems depending on grid requirements and thereby achieve a stable power supply. The dispatch signal which is distributed by NEMCOS can be instructed by you, the VPP operator, or the system operator.

### Curtailement of assets

In case of critical grid situations, negative prices, or imbalances of your portfolio, you can also ramp down your renewable electricity production.

## Case Study: Balancing services for the European grid



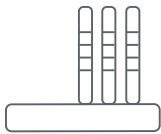
As the operator of our own VPP, we provide balancing services in seven European TSO areas. With our pool of prequalified assets, we participate in the auctions of the TSOs. In case of frequency imbalance, we'll receive an order from the system operator requesting a certain amount of control reserve. The algorithm of the VPP decides which asset provides how much

control reserve, based on individual restrictions of the assets. The respective units then are ramped up or down at short notice. The providers receive additional revenue for this service. In addition, they effectively support the energy transition by protecting the grid against the fluctuations associated with volatile energy sources.

## Demand Response: Utilizing the flexibility of C&I consumers

The volatile feed-in of wind and solar energy strongly affects power exchanges. As a consequence of rapidly changing electricity supply, the market prices fluctuate significantly. As an operator of steerable assets, you can take advantage of changing energy prices. By producing energy when prices are high and

letting your systems rest when prices are low, you can boost the revenues of your plants and support a sustainable utilization of the grid. In case you are operating flexible consumption assets, the process goes vice versa: The VPP software can dispatch consumption during low price hours.



### Connection of C&I consumers

In addition to power producers, C&I consumers can also be easily networked in your VPP.



### Processing price signals

Price signals from the power exchanges and control signals from the system operator are processed as a central parameter for controlling industrial processes and assets.



### Adjusting consumption/production

Power consumption and production are adjusted based on the current data. For example, by consumers reducing their consumption when prices are high and increasing it when prices are low.

## Case Study: Optimizing energy costs - active dispatch of consumers



The water company Bodensee-Wasserversorgung is responsible for the water supply of Stuttgart and the whole area of Baden-Wuerttemberg. Therefore, 356,000 cubic metres of water are pumped from lake Constance every day. With an annual consumption of 150 gigawatt hours of electricity, mainly for pumping, the water company was looking for ways to improve energy and cost efficiency and has found these in the flexible electricity tariffs at Next Kraftwerke. A variable electricity supply contract with the

product "Best of 96" makes the price fluctuations on the electricity exchange directly usable. To adjust consumption, the four 8 MW pumps and the two 11 MW pumps can be switched on or off. Next Kraftwerke transmits the electricity prices to the waterworks via the REST-API, while the waterworks sends its timetable back to the VPP via the same route. Through these optimizations in electricity procurement, the water company can save a six-digit amount of electricity costs annually.

# COMMUNICATION & DATA FLOW

**Interfaces:**  
OPCDA  
Modbus  
Profibus  
IEC 104  
and others

Operational commands

Live data

**NEM  
Control**



**API**

- Data import/export
- › Master data management
  - › Trading systems
  - › Accounting system

**Your Co**

## Producers & Consumers



Solar



Wind



Bioenergy



Hydro



CHP



Emergency  
gen-set



Energy  
storage



Consumers

**Use**



Asset monitoring  
and dispatch



Curtailment



Forecasting



## The structure of NEMOCS

The control system is the technological core of the Virtual Power Plant. Here, all information from each asset comes together in real time using M2M communication. This provides a precise snapshot of your Virtual Power Plant's available capacity at all times. Market and network data is also processed in the control system and converted to individual operational commands. This allows flexible assets to be, for example, powered up or down as needed. NEMOCS is based on standard interfaces and is therefore scalable and open to all types of technologies. Importing and exporting data to and from other systems is easy with the API.

## OCS System



### Control Center

#### Client access

- › Visualization
- › Asset dispatch
- › Reports

## Company

## Cases



### Ancillary Services



### Power Trading



### Demand Response

## External data



### Market data



### Price data



### TSO signals



### Weather forecast



### Grid frequency



### Consumption forecast

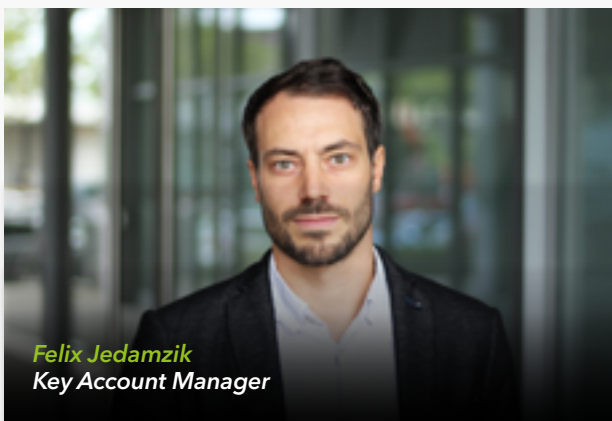
# A CUSTOM-MADE VPP SOLUTION

## 5 steps to run your own VPP with NEMOCS

- | 1 Use case definition  | 2 Kick-off  | 3 Technology set-up   | 4 Pilot phase  | 5 Full service  |
|--|---|---|--|---|
| <ul style="list-style-type: none"><li>› Use case evaluation</li><li>› Software demo</li><li>› Consultation</li></ul> | <ul style="list-style-type: none"><li>› Agreement tailored to your needs</li><li>› Two day kick-off workshop</li><li>› Support market development</li></ul> | <ul style="list-style-type: none"><li>› Set-up NEMOCS software instance</li><li>› Roll-out control center</li><li>› Asset connection via "Next Box"</li></ul> | <ul style="list-style-type: none"><li>› VPP software access for monitoring &amp; dispatch</li><li>› Limited asset number at reduced service fee</li><li>› Continuous evaluation for future use cases</li></ul> | <ul style="list-style-type: none"><li>› Optional start of NEMOCS full service</li><li>› Software updates &amp; maintenance included</li><li>› System adaptations &amp; APIs on demand</li></ul> |

## Advantages of our software-as-a-service solution

- › **Cost-effective:** You take advantage of a high-performance VPP solution without investing in your own costly IT infrastructure and IT development.
- › **Modular and scalable:** NEMOCS is tailored to your individual needs. The system adapts to a growing number of participants and use cases and can be set up for as many users as needed.
- › **Flexible:** You can integrate diverse products and technologies and react to changing market conditions.
- › **User-friendly:** All data and information are depicted in a way easily understandable for all users. Protocols and analyses allow for simple documentation and evaluation of processes.
- › **Fully-developed:** NEMOCS has proven itself in day-to-day operation by our IT specialists and traders. Your Virtual Power Plant is built on a platform that has been tried and tested for years. You'll also be a part of future developments to the system.
- › **Secure:** Our platform meets the strict criteria of German IT security laws and is ISO certified (ISO/IEC 27001 and ISO/IEC TR 27019).



**Felix Jedamzik**  
Key Account Manager

## Tailored to your needs

*"Every customer has different needs and use cases. That's why our platform has been constructed modularly and can be individually configured. I am happy to support you in planning and implementing your custom-made software solution."*

# ABOUT NEXT KRAFTWERKE

## A reliable partner for the energy supply of the future

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 capacity equivalent

to four nuclear power plants, and subsidiaries in a large number of European countries. NEMOCS incorporates the entire spectrum of our expertise. We are happy to share this knowledge and to support you in creating your own Virtual Power Plant.

### Reliable

As a VPP operator and energy trader, we've got plenty of practical experience with the challenges that come with operating a Virtual Power Plant - and the market opportunities it provides. After incorporating your specific goals and market circumstances, we are uniquely positioned to help and advise as you plan and implement your VPP.

### Specialized

By supplying control reserve, we're helping to stabilize the grid and are currently operating in seven European control reserve zones. Our software solution is perfectly suited for providing balancing services and trading energy flexibility.

### Comprehensive

As a full service provider, the complete infrastructure is available to you for operating your Virtual Power Plant. At the same time, you can always rely on our full support: If needed, we provide 24/7 operation service of your Virtual Power Plant. Just get in touch.

### Elaborated

The development of NEMOCS is based on all the experience we have in our company. You benefit from the know-how of our developers, traders, meteorologists, automation engineers, and usability experts.

### Awarded

We have received a number of awards for our innovative concepts and products:

- > 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



## Facts and figures

- › Aggregated units: > 8,500
- › Total capacity of the Virtual Power Plant: > 7,450 MW
- › Traded energy quantities (2017): 12.1 TWh
- › Control areas: Active in 7 European TSO areas
- › Founded: 2009
- › Locations: 7
- › Employees: 155
- › Sales (2018): 627.7 million Euro



## Cologne Headquarters

Lichtstraße 43 g • 50825 Cologne  
Germany  
T: +49 (0)221 82 00 85 70

[info@next-kraftwerke.com](mailto:info@next-kraftwerke.com)

[next-kraftwerke.com](http://next-kraftwerke.com)

## International Offices

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