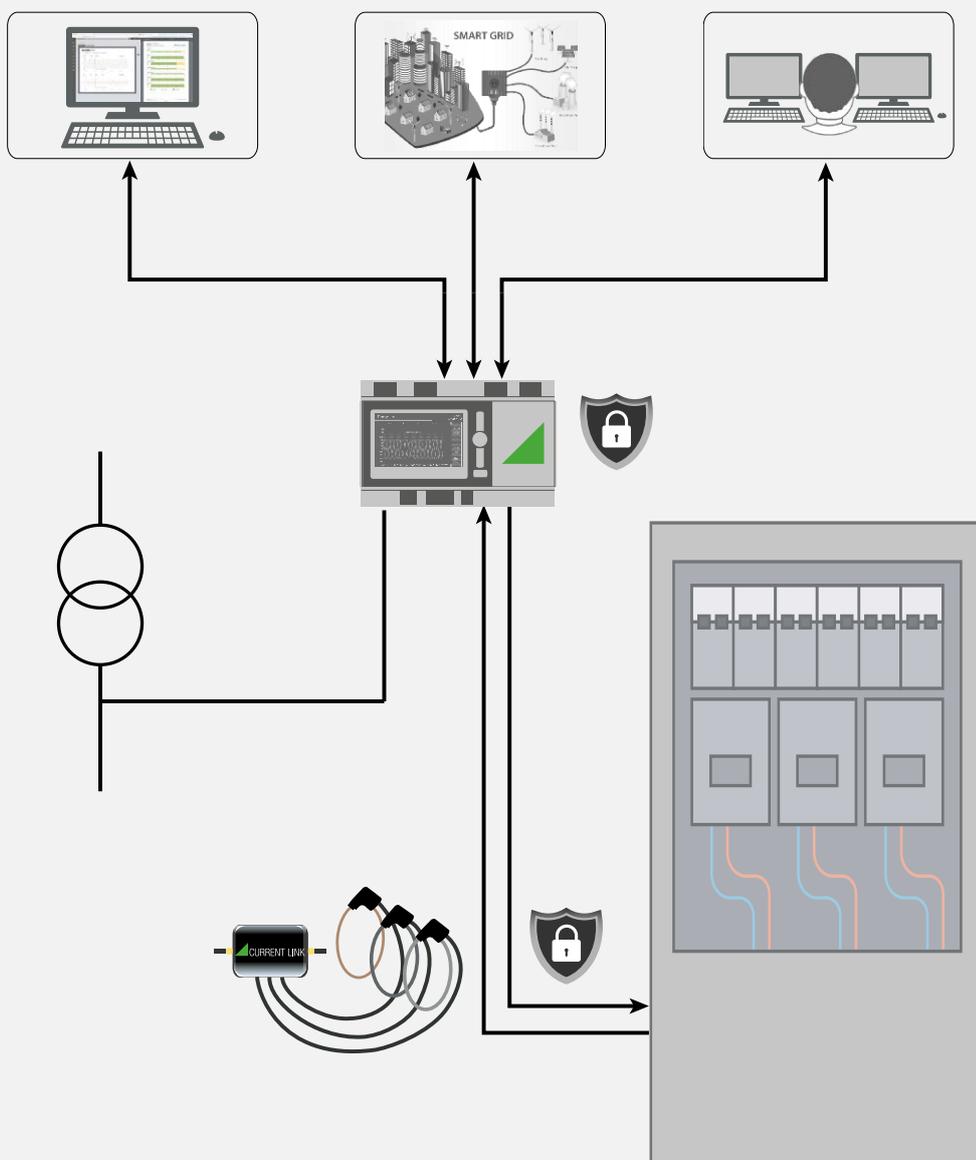


ON THE WAY TO A SMART GRID

HOLISTIC APPROACH USING THE EXAMPLE OF ELECTRICITY WORKS OF THE CITY OF ZURICH (EWZ)



MEASURE ■ ANALYZE ■ DECIDE ■ ACT



THE CONSORTIUM



High-quality and basic measurement data with maximum flexible connectivity

Camille Bauer Metrawatt AG is a Swiss medium-sized company for the development, production and marketing of industrial measurement technology. Camille Bauer offers customer and application-oriented solutions in the field of electrical monitoring and position sensors. This includes a high understanding of the needs for electrical power generation, energy distribution as well as industrial consumers. With its Swiss claim to the highest quality and its high innovative strength, Camille Bauer Metrawatt AG provides its customers with measurable benefits.



Electricity company of the city of Zurich

The key to a sustainable energy future lies in the ability to innovate. That's why we invest in renewable energies, in intelligent energy solutions and promote targeted innovations. By using our natural resources sustainably, we work with our partners and customers to ensure that future generations will also be able to use our energy resources and benefit from the rich diversity of life.



Generic measurement, control and regulation system for the power grid of tomorrow

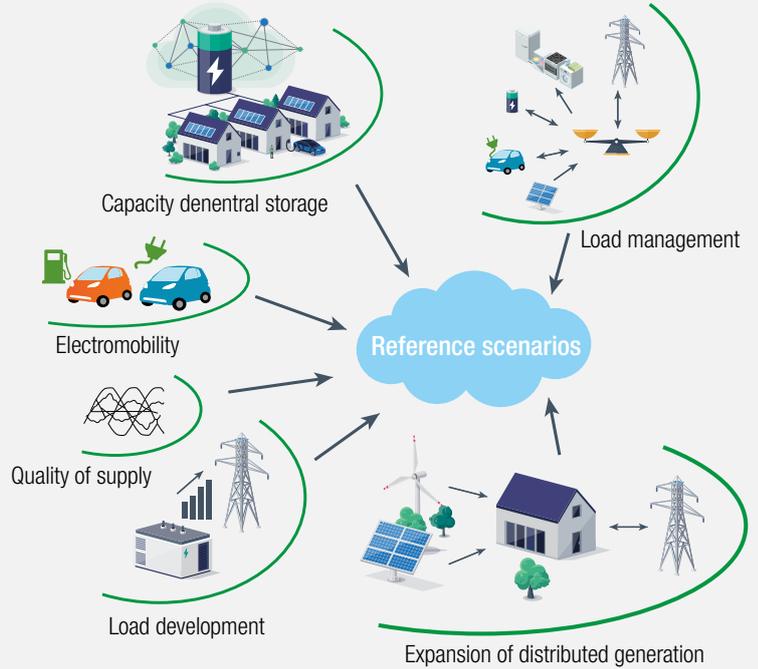
Our energy world is increasingly changing into a highly dynamic decentralized system, which poses new challenges for local power grids in particular. In addition, the merging of consumer and producer requires new business models. Both challenges require new information and targeted data handling.

We have set ourselves the goal of accompanying grid operators on their way to the decentralized energy future with the help of our technology, so that I can also guarantee reliable and economical operation of the power grids tomorrow.

THE MOTIVATION FOR A SMART GRID

The new challenges

- The distribution network operators are directly affected by the changes in the energy world (politically, technically, monetarily)
- Rapid development from a formerly centralized to a highly dynamic decentralized energy system
- Quasi blind flight“ prevails at grid level 7 (low voltage)
- Load flow in connection with power quality receives only limited attention
- The impact on our infrastructures is massive
- Establishment of a reference scenario to represent and deal with uncertainties
- Shortage of energy due to new and extremely high demands
- Decision for a correct investment
- Use of data (e.g. smart meters) in consideration of data protection guidelines

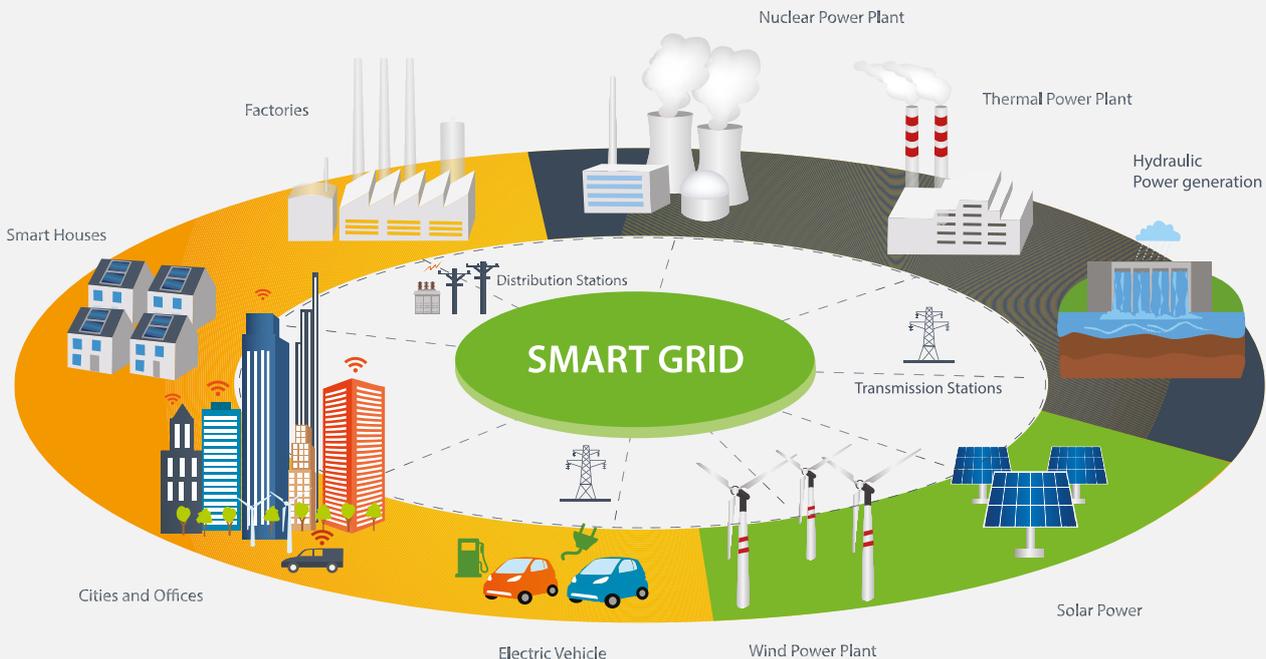


Reference scenarios

ewz on the way to the smart grid

Local energy suppliers are the key to a successful energy transition in Switzerland. And a smart grid ensures grid stability in the process. Because smart grid is a system that intelligently coordinates the feed-in and consumption of electricity by incorporating metering technologies and modern information and communication technologies. The aim is to ensure more efficient, safer and more powerful operation of the ewz distribution grid. Starting in 2021, it is planned to successively connect

more of the nearly 900 transformer stations in the neighborhoods to the ewz fiber optic network, install measuring devices and integrate them into a monitoring and control platform in order to build up an intelligent and future-oriented ewz power grid. The complete system of smart grid solutions AG will be used, which is built with Camille Bauer Portfolio and the Venios platform.





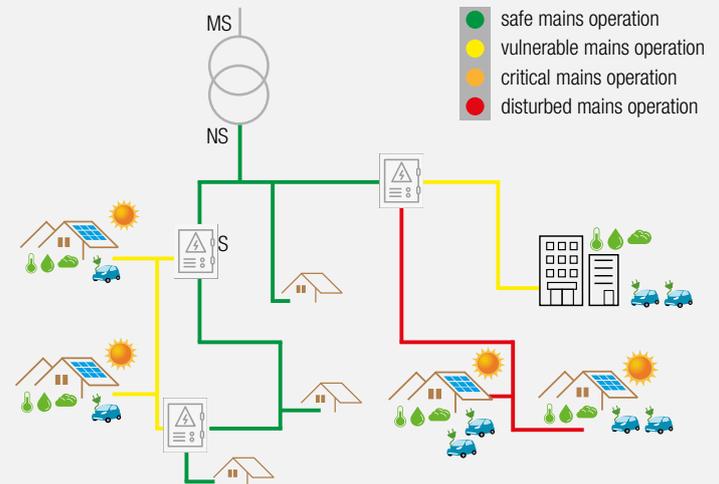
REAL OPERATION OF THE ELECTRICITY COMPANY OF THE CITY OF ZURICH (EWZ)

On the road to the network future



Combination of grid expansion and intelligence

- Use of modern monitoring systems in conjunction with intelligent control systems
- We use monitoring systems and intelligent control to provide our customers with an efficient, intelligent network - a smart grid
- Measurements and data analysis help monitor local loads and avoid bottlenecks in the future
- Asymmetrical phase occupancy is increasing and will be actively eliminated in the future



Traffic light system for safe network management

Towards a smart grid system



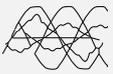
From sensitization to active control



Benefits for ewz and its customers

- Transparency in grid level 7 through the combination of hardware and software
- Determination and display of network conditions in the low-voltage network
- Combination of grid expansion and intelligence, since a pure expansion of the conventional grid in an urban environment is very expensive and hardly realizable in terms of time
- The use of intelligent solutions will enable both current and future challenges to be mastered, so that ewz can continue to ensure a reliable and cost-efficient supply of electricity for customers in the future
- ewz will provide customers with an efficient and intelligent network - a smart grid.

The foundation is the network monitoring of network level 7



1. Measurement data from

- Buildings (smart meters)
- Transformer stations (load flow and power quality in real time)



2. Communication

- City-wide fiber optic network, all buildings and all transformer stations connected
- Building Gateway, interface fiber optic network <--> smart meter (ewz in-house development)



3. Computable network model

- Linking GIS and SAP information
- Daily and automated update of the digital twin from the power grid

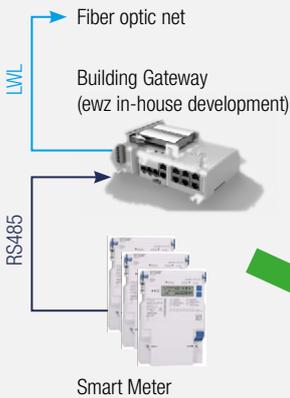


4. NE7 monitoring and control platform

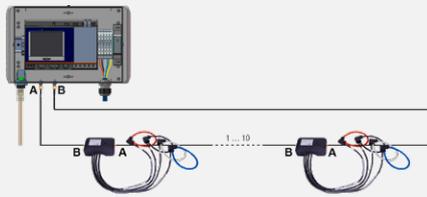
- Use of the Venios Energy platform to link the measurement and master data
- Load flow calculation for the simulation and representation of network conditions in the low-voltage network

The realization of mains monitoring on the network level 7

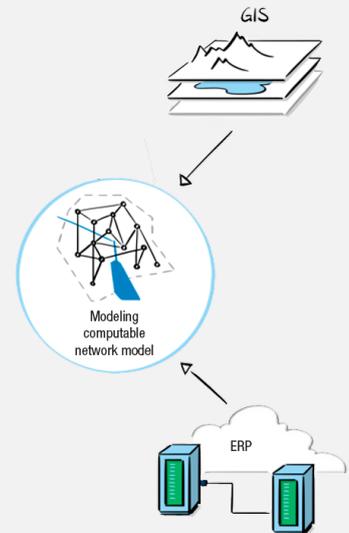
1. Smart Meter Rollout



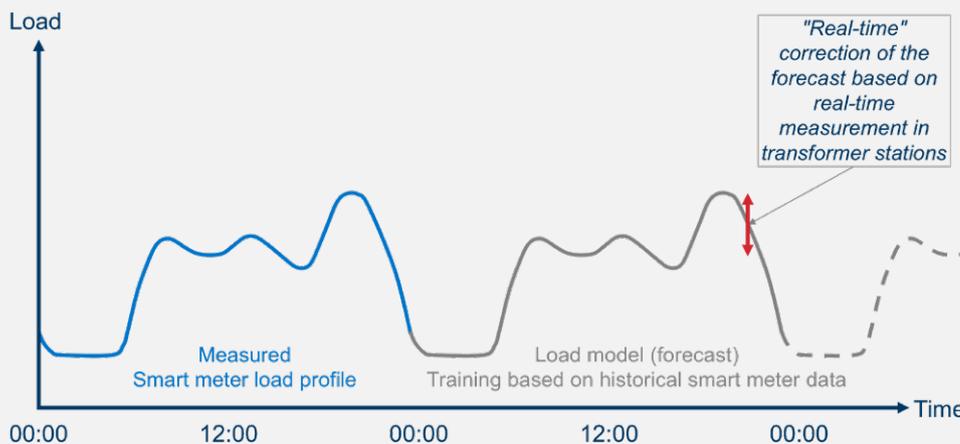
2. Rollout transformer station signalization



3. Computable network model

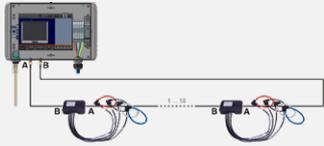


Use of smart meter data and real-time data from transformer stations in the Venios Energy platform by linking it to the computable network model





HOLISTIC APPROACH OF SMART GRID SOLUTIONS AG



1. Real-time measurement with LINAX® PQ5000CL

- Load flow
- Power reserves
- PQ Reserves (U/I)

2. Analyze / Decide

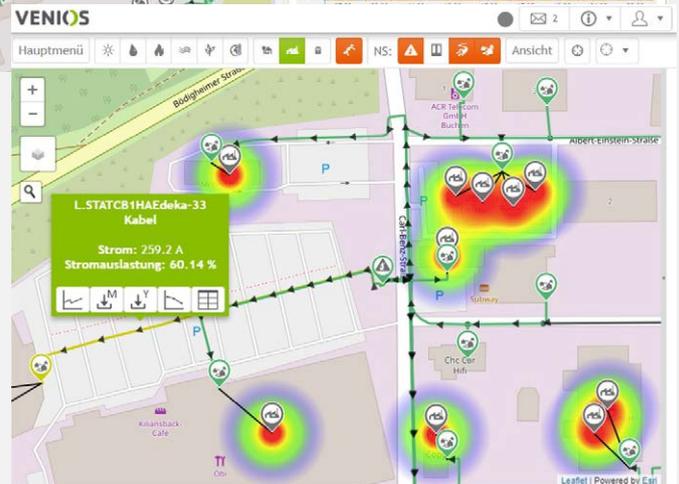
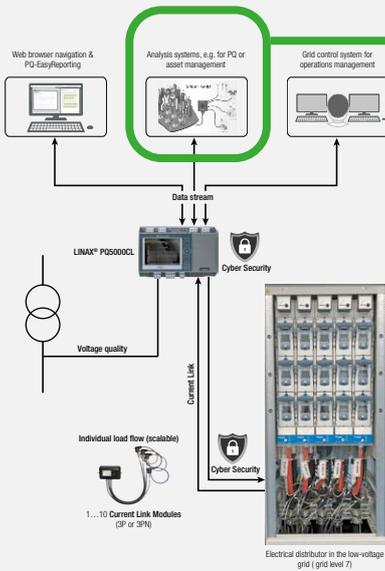
- Reduce power peaks
- Optimize ripple control
- Ensure voltage/current quality

3. Act

- Load management (heat pumps, batteries, e-mobility, etc.)
- Production management / Redispatch (PV, batteries, CHP, etc.)
- Grid expansion - only according to necessity

Implementation by means of IT high-performance platform

The Venios Energy Platform (VEP) relies on the customer's existing systems and offers a variety of solutions from a single source.



A secure solution for the transformation to the smart grid. Intelligent grid usage through transparency and versatile applications based on it.



THE BASIS: A METROLOGICAL COMPASS

Fundamental measurement technology from the «bottom up» forms the basis for cellular energy systems and thus also smart grids in order to be able to stabilize grids (e.g. due to prosumer behavior, switching off grid mass, etc.). Here, not only scalability is important, but also absolute future viability, e.g., through flexible connectivity, function adaptations, etc.

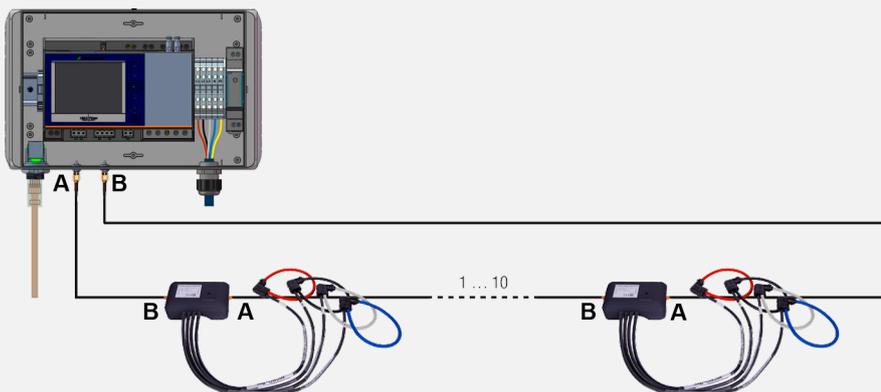
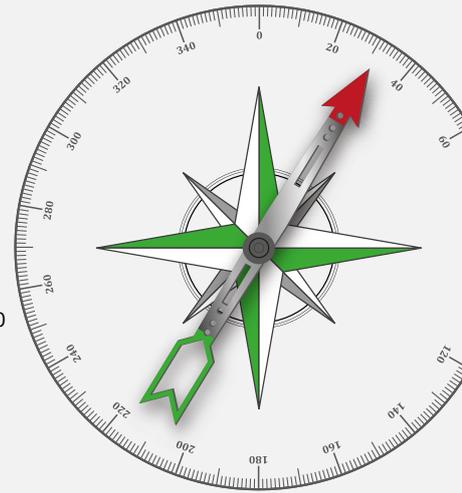
ewz proposes certified power quality detection and power analysis up to 32 channels in the sub-distribution. The signal processing is implemented on the measuring device of the

LINAX® PQ5000CL series. There, the respective current measured values of the so-called Current Link modules are processed. Thanks to the Current Link technology, the individual Current Link modules and their sensors (Rogowski) are networked in a scalable manner by means of a signal loop via coaxial cables. This reduces the installation effort to an absolute minimum and ensures proper cable routing. In addition, this measuring system for determining power quality and load flows is extremely cost-efficient and metrologically certified on top. Thus, the scalable

measuring instrument virtually combines the areas of transducers according to IEC 60688, power metering and monitoring according to IEC 61557-12 as well as power quality instruments according to IEC 62586-1.

LINAX® PQ5000CL

- Metrologically certified PQI according to IEC61000-4-30 Ed. 3 class A as basic device
- A scalable system for the areas of certified power quality as well as for load and efficiency management for up to 10 feeders
- An optional basic current measurement (e.g. directly after the transformer) with a high accuracy due to current transformer sensors
- 3 or 4 channels via Current Link per feeder (max. 32 currents)
- Simultaneous measurement of multiple feeders instead of traditional per feeder measurement
- Direct compliance reporting and event display by PQEasy reporting via web browser (e.g. according to EN50160)
- Time-synchronous fault recording of voltage events with currents of the individual channels (IEC61000-4-30 Ed. 3)
- Time synchronous load management for U/I/P/Q/cosφ
- Current measurement per Current Link channel up to 1'000A and overcurrents up to 20'000A
- Grid tariff meter P & Q (purchase & delivery)
- Upgrade to control task in smart grid (e.g. PQ grid utilization)
- System management by means of a user-friendly multi-device tool for easy commissioning and efficient maintenance
- Large distribution systems (feeders) are continuously monitored with only one metrologically certified measurement system
- Low space requirement due to single voltage measurement
- No need to shut down the plant for installation of the measuring system due to the non-invasive Rogowski measuring technique (Attention: observe occupational health & safety)
- Very high robustness due to proven coaxial principle
- Current values are time synchronous to voltage (IEC61000-4-30)
- Various communication interfaces (Modbus TCP/IP, Modbus RTU, REST API, IEC61850, Cloud with MQTT, Webbrowser) allow high connectivity flexibility to parallel as well as higher-level systems
- Fast roll-out with robust measurement technology
- Measuring interval 100/s at 50 Hz (zero blind technology)

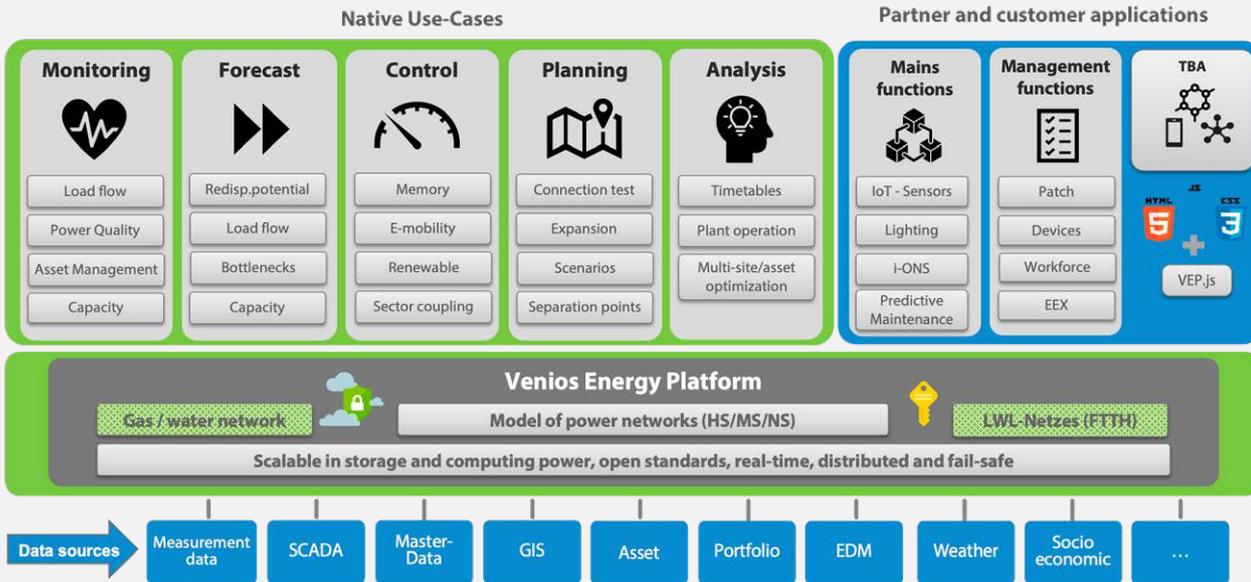


LINAX® PQ5000CL-3 in field housing with connected Current Modules 3PN



ASPECTS OF THE VENIOS ENERGY PLATFORM

The Venios Energy Platform (VEP) combines the grid-related data available today and enables data-driven grid management on a flexible platform.



Venios Energy Plattform (VES)

1. Transparency

Link data from individual applications. Create computable networks and recognize sources of error in the upstream systems. Combine model data and measured values as desired. Visualize network structure and network state in real time.

2. Taxes

Optimized control of flexibilities. Controllable local network transformers for voltage adjustment. Control of charging stations via load forecasts. Counteracting grid bottlenecks by calling up flexibilities.

3. Forecast

Load forecasts for the next day. Network condition forecasts to detect bottlenecks at an early stage. Create scenarios for future network situations incl. simulation of switching operations. Precise forecasts based on measurement data and algorithms. Basis for planning.

4. Planning

Automate processes. Plant connection: simple handling, precise output. Detect network bottlenecks early and act intelligently. Asset manager: derive actions from current conditions.

5. Partner applications

The Venios ecosystem offers a multitude of use cases, whose enormous added value only arises from the intelligent networking of partner and customer applications with different functions.



Already successfully in use today

- Over 90 implementations with various distribution system operators
- Deployed in four European countries



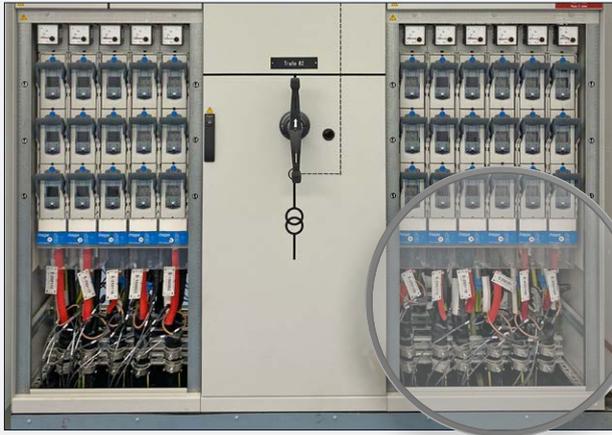
A solution in the enterprise cloud

- High availability and data security
- VEP obtained classically as a cloud platform
- VEP hosted locally as a private cloud solution

Further details on the system approach of smart grid solutions AG can be found at: <https://smartgridsolutions.ch>

IMAGE GALLERY OF THE HARDWARE REAL OPERATION

Greencity is an urban district in Switzerland that meets the conditions of the 2000-watt society and is a largely off-grid area equipped with digital measurement and control systems.



Structure of a switchgear in the front view



Representation of the Current Link modules for individual power curve measurement/channel



Representation of the switchgear and the decentrally mounted LINAX® PQ5000CL base stations



Detailed view of the decentralized mounted base stations LINAX® PQ5000CL





OUR PORTFOLIO

Measuring and Displaying



Grid management and equipment monitoring require precise and reliable information of different grid variables. For this purpose, we offer a wide range of high-quality instruments to acquire all variables of the electrical grid.



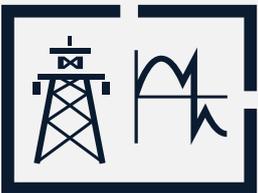
Position sensors



With our portfolio of POSITION SENSORICS we offer solutions for angle, position and inclination measurement. Here, the offer ranges from simple built-in devices to the robust devices for applications in harsh environments. The angle and inclination measuring systems serve as an important link between mechanics and control.



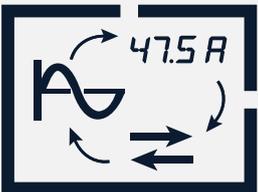
Power Quality



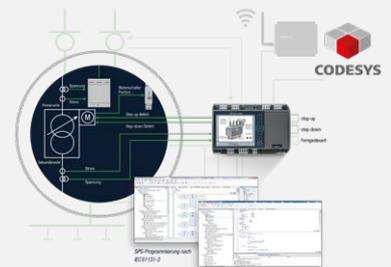
Modern power electronics and non-linear consumers increasingly impair the electrical grid which is the reason why alternating current has not shown the original sinusoidal characteristic already for a long time. This bears heavily on electrical devices and machines and extends to higher thermal losses, increased energy consumption through to the disturbance and downtime of plants. Our solutions ensure that problems are early recognised, even before they occur.



Monitoring and controlling



We offer the unique possibility of not only acquiring all variables of the electrical grid precisely and reliably, but also processing them directly via a PLC integrated into the device and controlling processes. This enables us to realise process controls directly at the measuring point. You thus save a separate PLC or you realise an autarkically working redundant solution.



Software and Systems



We design modular customer-specific solutions and systems which can be extended at any time regardless of manufacturer. Through our non-proprietary interfaces is also an integration in already existing applications and systems with components from different manufacturers no problem.





 CAMILLE BAUER

| smart grid solutions |



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