

# Energy autonomy through rooftop solar power

The energy transition presents existing power grids with immense challenges. The increasing share of fluctuating renewable energy sources demands flexible, decentralized solutions to ensure supply security, efficiency and sustainability. Microgrids offer a promising response. They integrate renewable energy sources such as solar plants, wind power or biomass and enable intelligent control of generation, storage and consumption. Industrial rooftops, in particular, hold vast untapped potential.

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## Microgrid rationale

A microgrid is a small local power supply network that combines renewable and conventional energy sources. It can operate both grid-connected and autonomously. This flexibility makes microgrids especially attractive for industrial companies seeking to secure their energy supply while achieving sustainability goals.

Typically, they consist of several core elements. Generation plants such as photovoltaics, wind power, combined heat and power units, or fuel cells form the backbone, supplying the required energy. Energy storage systems, such as lithium-ion batteries or hydrogen storage, buffer excess energy and release it as needed to ensure grid stability.

Intelligent control systems optimize energy flow in real time, enable load management,

and ensure efficient resource use. The local distribution network directly connects producers and consumers, minimizing transmission losses and increasing system efficiency. The interface to the public grid allows for exchange with the main grid or separation for island operation.

The proximity of producers and consumers is one of the key strengths of microgrids. Local energy generation and consumption minimize transmission losses significantly. Additionally, small-scale and local energy management make it easier and safer to connect or replace energy generation units compared to large-scale systems.

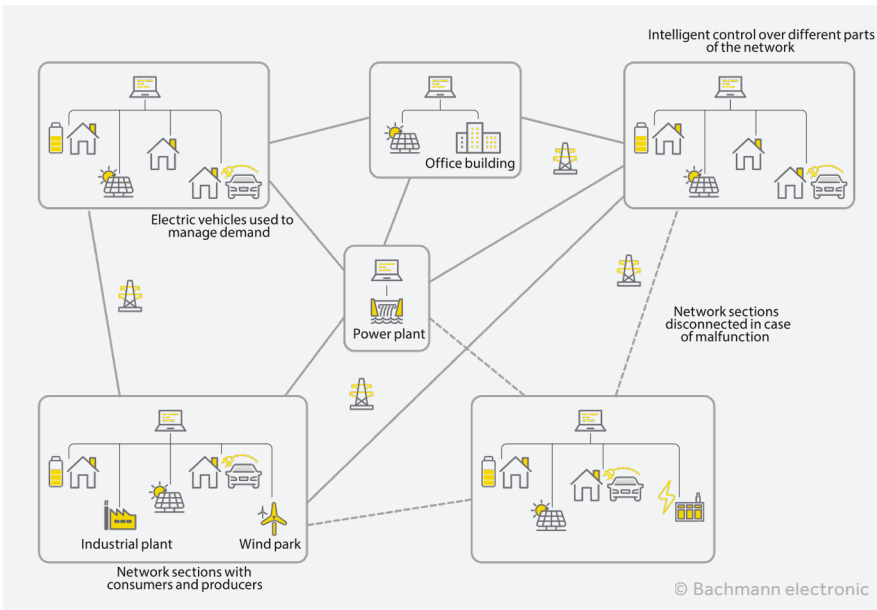
Backup systems can be more compact, and critical infrastructure is easier to protect with appropriate security concepts. Large-scale outages are unlikely due to the decoupling of small grid sectors.

These advantages translate into tangible benefits for industrial users. By optimizing self-consumption and peak shaving, companies can significantly reduce their electricity costs.





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In the event of disruption, microgrids disconnect from the public grid and use electricity from local sources such as solar systems, CHP plants, or battery storage systems. This requires intelligent control of the various grid sections



Michael Kramer

**Industry potential and market outlook**

Looking beyond individual companies, the broader market for rooftop solar and microgrids is growing rapidly. Based on estimates from SolarPower Europe and Bloomberg, the implementation of the EU Energy Performance of Buildings Directive (EPBD) in Europe could unlock an additional 150 to 200 gigawatts of solar capacity on rooftops between 2026 and 2030.

The directive mandates that all new public and commercial buildings must be equipped with solar installations. By the end of 2023, the EU had over 170 gigawatts of installed rooftop solar capacity, which could grow to 355 gigawatts by 2027.

Rooftop solar power is already cheaper than grid electricity in many regions. Fraunhofer ISE and BSW Solar analyse that companies can cover up to 80 percent of their electricity needs themselves, thereby reducing energy costs in the long term.

Each installed kilowatt-peak of solar capacity saves approximately 500 kilograms of CO<sub>2</sub> annually, a crucial contribution to decarbonization. Using industrial rooftops for solar installations also avoids sealing additional land, increasing public acceptance and preventing conflicts with other land uses.

Implementing microgrids and solar installations involves several challenges. Initial investments for generation plants, storage, and control systems pose a hurdle. However, data from Fraunhofer ISE indicates that industrial PV systems with self-consumption currently achieve returns of

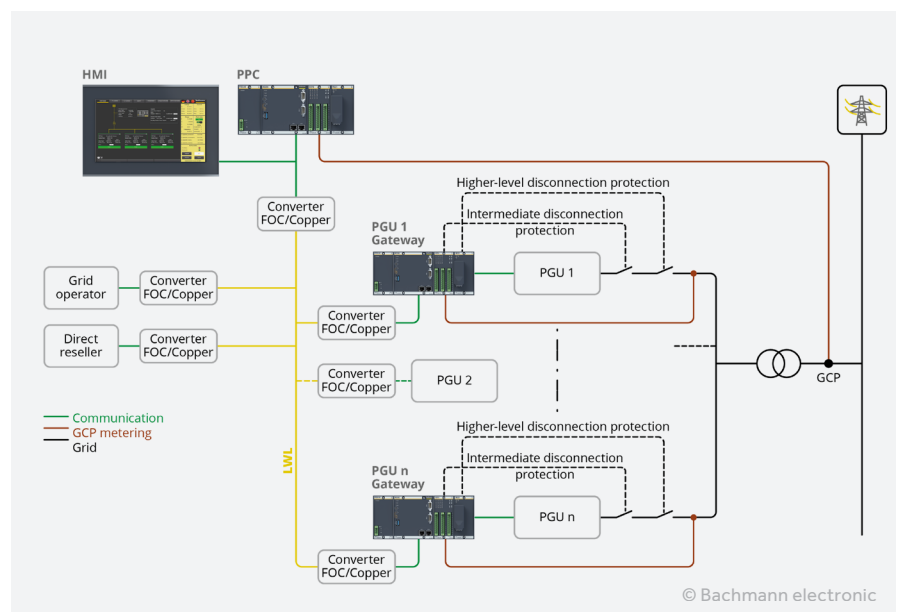
8–12% p.a., which corresponds to a payback period of five to eight years.

Subsidy programs and innovative financing models, such as Microgrid-as-a-Service, can help overcome these barriers. Power Purchase Agreements (PPAs) allow companies to source solar power without their own investments.

Modular microgrids can be expanded step-by-step to meet growing energy demands. Intelligent energy management systems provide real-time monitoring and enable optimal use of generated energy.

Multi-level security concepts, such as encrypted communication and access controls, protect against cyberattacks and ensure supply continuity.

According to a market study by Fortune Business Insights, the global photovoltaic market is expected to grow to approximately \$1.5 trillion (around €1.3 trillion) by 2034, with an annual growth rate of over 14%. Microgrids will play a central role by enabling the integration of decentralized energy generation and enhancing grid stability.



The Bachmann park controller can manage up to 100 power generation units (PGU). PGUs are connected to MAN via standardised gateways, which can be quickly parameterised for the respective PGU

Artificial intelligence will play an increasingly important role in microgrid control. More accurate load forecasting and automated control strategies enhance system efficiency and reliability. Green hydrogen can serve as a long-term storage solution, further increasing the flexibility of microgrids and improving the integration of renewable energy.

With these developments in mind, it is useful to consider how companies are already putting these concepts into practice.

**MAN Energy Solutions: A real-world example**

The MAN case illustrates the practical implementation of decentralized energy systems in an industrial setting. Further to this shift in power generation, companies such as MAN Energy Solutions are looking for ways to electrify the supply of process heat. Around 75% of industrial greenhouse gas emissions can be attributed to this area, particularly in the production of steel, metal, glass, paper, and chemicals.

Technologies that span multiple sectors, such as heating, air conditioning and ventilation (HVAC), lighting, and data centers, also offer significant load management potential.

'This is a Herculean task for a large production site and we don't know what the demands will be in the coming years,' says Michael Kramer, Head of Energy Systems, Work Services Production at MAN Energy



The connection to the public grid is established at the grid connection point. Through its regulations, the network operator ensures that a solar energy plant does not overload the energy grid downstream of this connection point

Solutions in Augsburg. 'In the past, networks were managed purely from a commercial point of view, but in the future we have to focus on energy availability. We must be able to manage the networks much more dynamically than we do today.'

A Volkswagen subsidiary, MAN Energy Solutions is aware of its role as a pioneer within the group's key industries and its

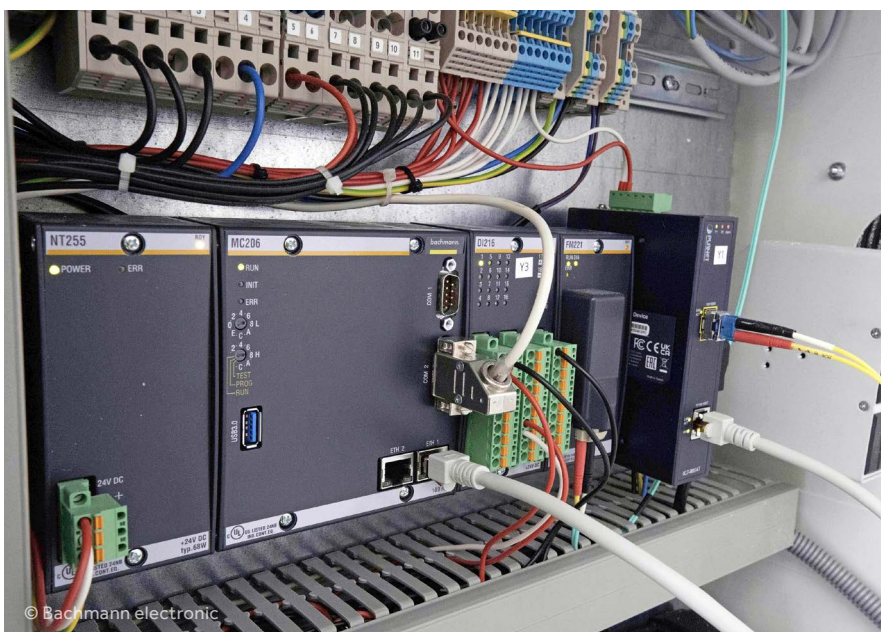
responsibility for identifying solutions that enable sustainable progress. Michael Kramer has also taken on this task for the energy management at the Augsburg site.

'Our corporate goal is to halve CO<sub>2</sub> emissions at our global production sites by 2030. But to achieve this, we have to set a course today that prepares us, as a manufacturing company, for the upcoming changes in energy supply,' he explains.

His assessment of the situation highlights the growing complexity of industrial energy systems. Kramer and his team therefore explored how such a transformation could succeed on site. The facts were clear: MAN had to meet regulatory and legal grid connection requirements at all times. At the same time, operations management had to remain efficient, sustainable, and economical.

The solution involved a close collaboration with Bachmann. Kramer has implemented a redundant park controller based on the M200 control system. The functions of the Bachmann Smart Power Plant Controller (SPPC), certified according to VDE-AR-N 4110/4120, enable MAN to certify the power generation of the entire site and connect it to the power grid.

The integration of the system was tested together with Bachmann on two large PV roof systems at the Augsburg site. The most important component is already in place: a



An MC206 processor module, a DI216 digital input module, an FM221 FASTBUS module and an NT255 power supply are accommodated in this example in the plant controller cabinet. A GMP232 grid measurement and protection module, which is also part of the controller system, is attached separately



Remote access to a visualisation allows topologies, signal flows, diagrams and set values to be displayed via an internet browser

**Recommendations for companies**

**Potential analysis:** Companies should assess the suitability of their rooftops for solar installations and evaluate integration into a microgrid.

**Utilize funding:** Current subsidy programs and tax incentives can significantly improve economic viability.

**Launch pilot projects:** Best-practice examples, such as the MAN plant in Augsburg, can serve as models for their own projects.

**Form partnerships:** Collaborating with energy experts, grid operators, and automation specialists helps overcome technical and regulatory challenges.

The future of energy supply is decentralized, intelligent and sustainable; microgrids and rooftop solar installations are key building blocks on this path.

platform that combines the different systems and requirements of network operators and the energy industry.

Kramer emphasizes that this is just the beginning: ‘We have a standard on which to build. We are continuing to add further functions to integrate generators in a system-friendly way and for the efficient control of energy consumers.’

The MAN example shows that industrial energy systems can be transformed today, not just in theory. By combining rooftop solar, intelligent microgrid control, and forward-looking planning, companies can secure energy autonomy, reduce costs, and significantly lower emissions.

As more firms follow this path, decentralized, sustainable, and flexible energy supply will become the new industrial standard, proving that the future of energy is already within reach.

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**About the author**

Frank Fladerer is a journalist with long-standing experience at daily newspapers and technical magazines. He works in corporate communications at Bachmann electronic GmbH.