

SUN IN THE TANK



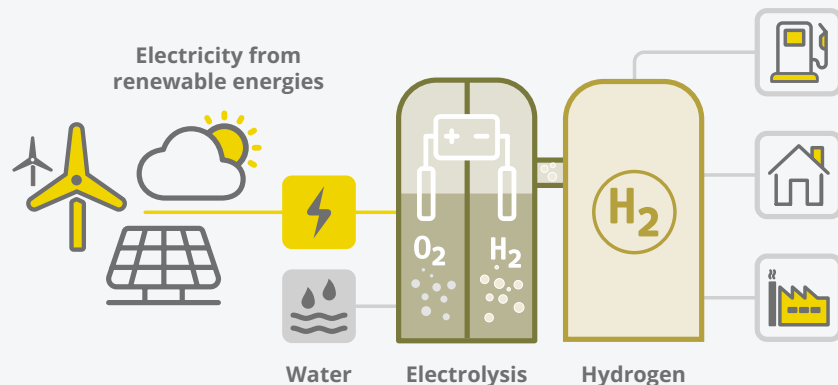
Model-based Development for an Electrolyzer

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Green hydrogen is a solution for the temporary storage of sustainably generated electrical energy; one that also makes it mobile. The efficient operation of electrolyzers requires intelligent converter systems. For best-possible control, SMA Solar Technology relies on model-based development with Bachmann's M-Target for Simulink®.



GREEN HYDROGEN – A KEY ELEMENT OF THE ENERGY TRANSITION



In an energy supply system that increasingly relies on fluctuating renewable sources, such as solar and wind power, green hydrogen is becoming indispensable. It serves as a flexible energy storage medium, a clean fuel, and the basis for a CO₂-free industry.

However, efficient and economical green hydrogen production requires more than just electrolyzers – it requires intelligent systems that dynamically provide energy according to current supply and demand for electrolysis.

For over four decades, SMA, headquartered in Niestetal, Germany, has been a leading innovator in the field of renewable energy technology. The company's advanced inverter technologies and system solutions have shaped the evolution of the industry. That's why SMA is also developing solutions to ensure the sustainability and reliability of future hydrogen production. Hydrogen produced by electrolysis from renewable energies is entirely free of carbon dioxide emissions. Its storage options give it a central role in the decarbonization of the energy supply.

Inverters are a key component for grid-friendly and efficient energy conversion in hydrogen applications – and a core competence for SMA. The company was in search of a new solution for a green hydrogen production pilot plant. Bachmann's M200 controller took on the coordinated control and monitoring of the convert-

ers, which are required for three electrolyzers with a total output of 8 MW.

New approaches

SMA needed an innovative approach for the development of the control and regulation program. Their control and regulation engineering teams closely collaborated to reduce application development time. Notably, all developers worked with a uniform engineering tool for the first time. Previously, regulation engineers developed necessary current controllers using a model-based approach with MATLAB®/Simulink®. Generated libraries were then integrated into the plant automation system by the control engineering team, in accordance with IEC61131-3.

The pilot project saw the first time that Simulink® was used by all developers as a common development and simulation environment. Regulation

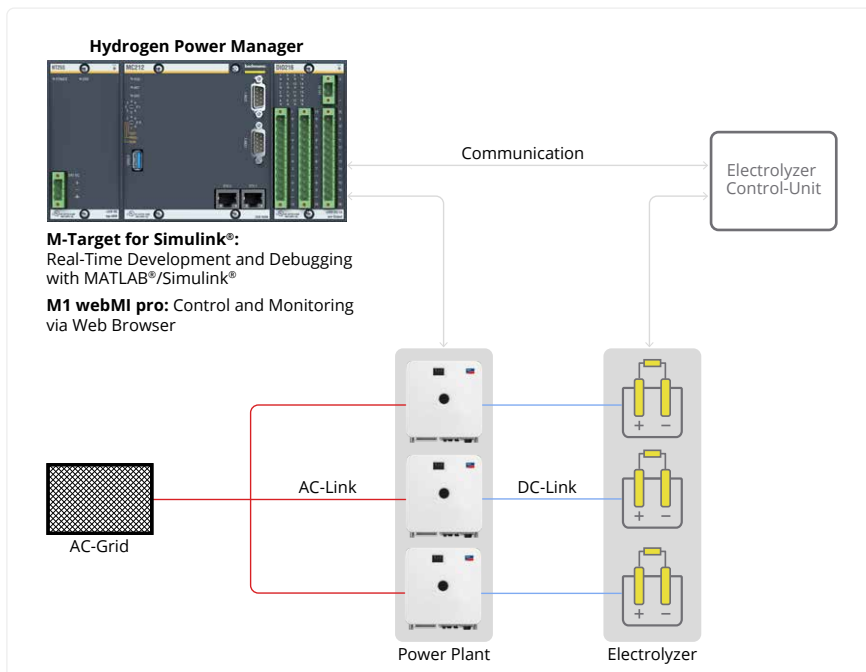
and control engineers programmed graphically, using the toolboxes that best suited their needs. "This enabled us to develop a shared perspective on the overall application. In addition, the code is more transparent and less prone to errors," explains Chokri Khalfet, System Development Engineer at SMA's Innovation Center.

Bachmann's M-Target for Simulink® solution will enable SMA to send code straight from Simulink® to the controller. This is a major advance in the connection of model-based development and programming. According to Khalfet, this will also improve time to market.

Seamless integration testing

The new control code is processed on a Bachmann MC212 CPU and will be known at SMA as the "Hydrogen Power Manager". The entire application software can be simulated in two ways: at the developer's workstation and in dedicated software test systems in MATLAB®/Simulink®, which allow it to be tested against a wide variety of scenarios without any risk.

It was put through its paces in a hardware-in-the-loop (HIL) test setup, together with real SMA inverters. To confirm the functionality of the initial automation, SMA checked that the inverter was operational and communicating with the electrolyzer control system. Then, current regulators were put into operation, and their parameters optimized. Consequently, each rectifier supplies the exact current value required by its respective electrolyzer.



The Hydrogen Power Manager was developed using a model-based approach with M-Target for Simulink®. SMA relies on M1 webMI pro for operation and monitoring.

»M-Target for Simulink® streamlines the creation of functions by reducing the need for extensive PLC coding experience amongst developers.«

Chokri Khalfet

System Development Engineer
SMA Solar Technology AG

Here, too, the development pathway demonstrates its strengths. Both the basic control of the rectifiers, as well as the current control, are integrated in a common application program. This not only reduces code complexity, but also saves developers a lot of integration time and minimizes the search for errors.

Relaxed commissioning and reliable operation

The construction of large electrolyzers is complex. Complete functional testing is usually only possible at the installation site during commissioning. The addition of external components, such as the Hydrogen Power Manager, increases uncertainty. However, SMA reassured us that the necessary functionality for controlling the inverters and communicating with the electrolyzers had been verified in advance through simulation on the test setup.

SMA relies on M1 webMI pro for the operation and diagnosis of the Hydrogen Power Manager. M1 webMI pro is a web HMI based on native web technology and implemented directly on the M200 controller. This solution's high performance ensures that the current system status can be monitored during continuous operation and interventions made as required.

Goal achieved

By using model-based development across development teams for the first time, SMA was able to rapidly implement the optimal solution. Due to the nature of the system, some questions arose during the revision of the original cyclic PLC program and porting to the Simulink® function block language, but SMA quickly resolved them - with Bachmann's support. "The collaboration ran very smoothly and was very helpful," says Chokri Khalfet. The next projects

are already in the pipeline. And another step has been taken toward a successful energy transition.

SMA SOLAR TECHNOLOGY AG

- Established in 1981
- Headquarters in Niestetal (Germany)
- More than 4,000 employees worldwide
- Sales and service companies in 19 countries
- Revenue: €1.53 million (2024)

www.sma.de



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