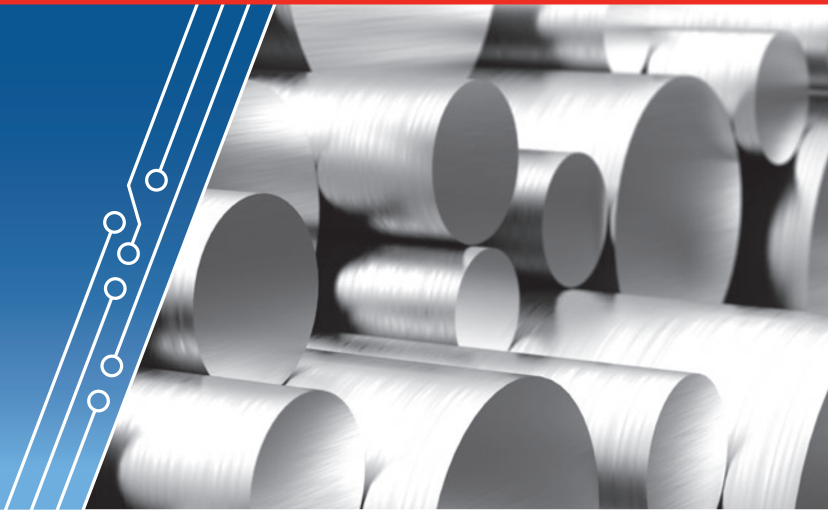
Elektro-Automatik

OVERCOME CHALLENGES TO SPEED UP YOUR ELECTROLYSER BUSINESS

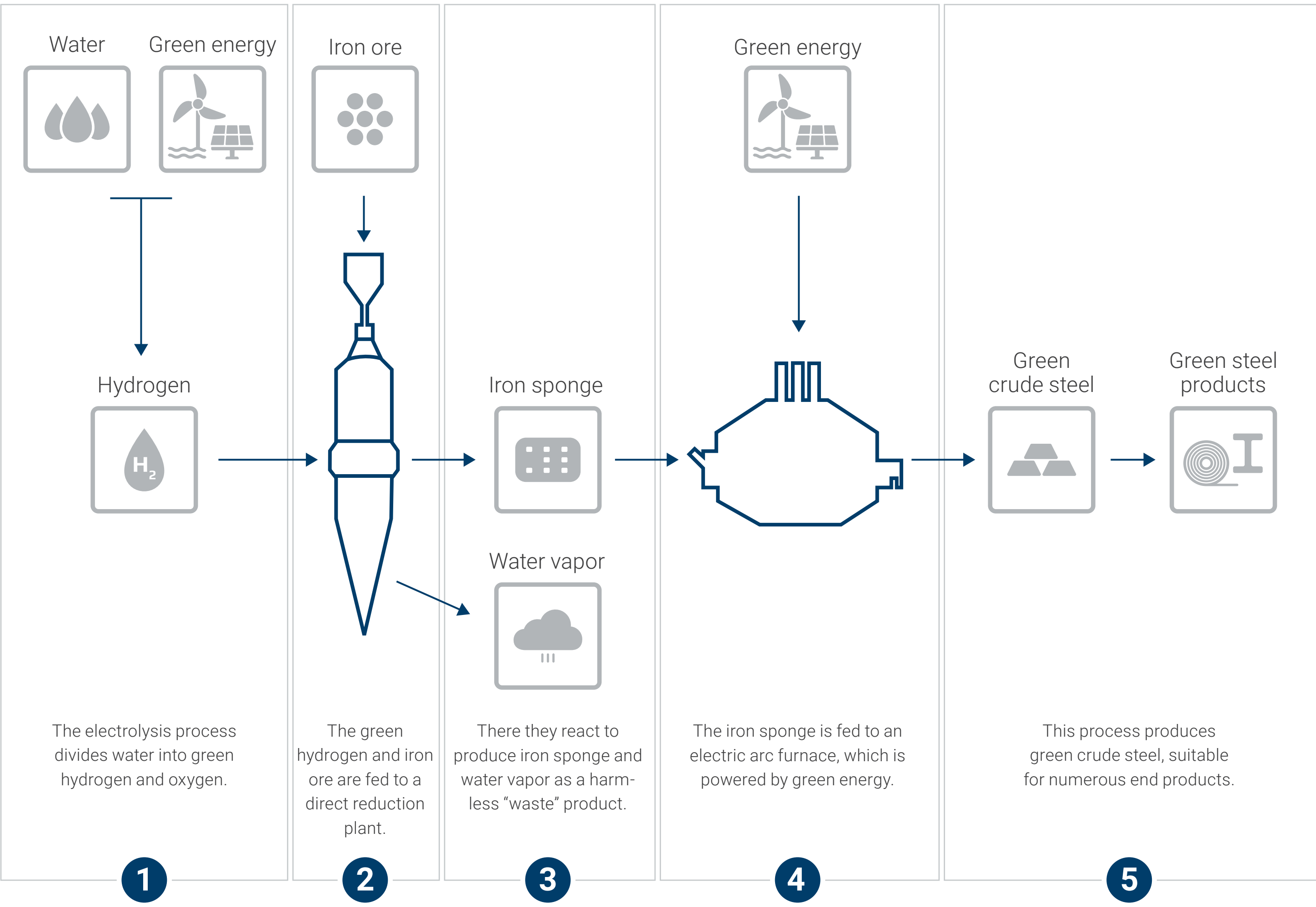
MARKET OVERVIEW



The world and the global industry are undergoing a transformational process toward a zero-emission future. To achieve this, various areas are being electrified, for example, in the field of electromobility. But it is not possible to electrify all industries. Therefore, other solutions need to be used. Hydrogen is a key element in achieving the Paris climate agreement goals. It can be used for the hard-to-decarbonate industries, such as steel, glass, or cement production industries.

For example, many steel producers are investing to produce "green steel" by using hydrogen in a direct reduction plant. In this plant, hydrogen reacts with iron ore and removes oxygen from it. In an electric arc furnace, the remaining sponge iron is melted and processed into raw steel. If the needed hydrogen is produced emission-free and the needed electrical energy is provided by renewable energies, the steel produced is free of CO_2 pollution.

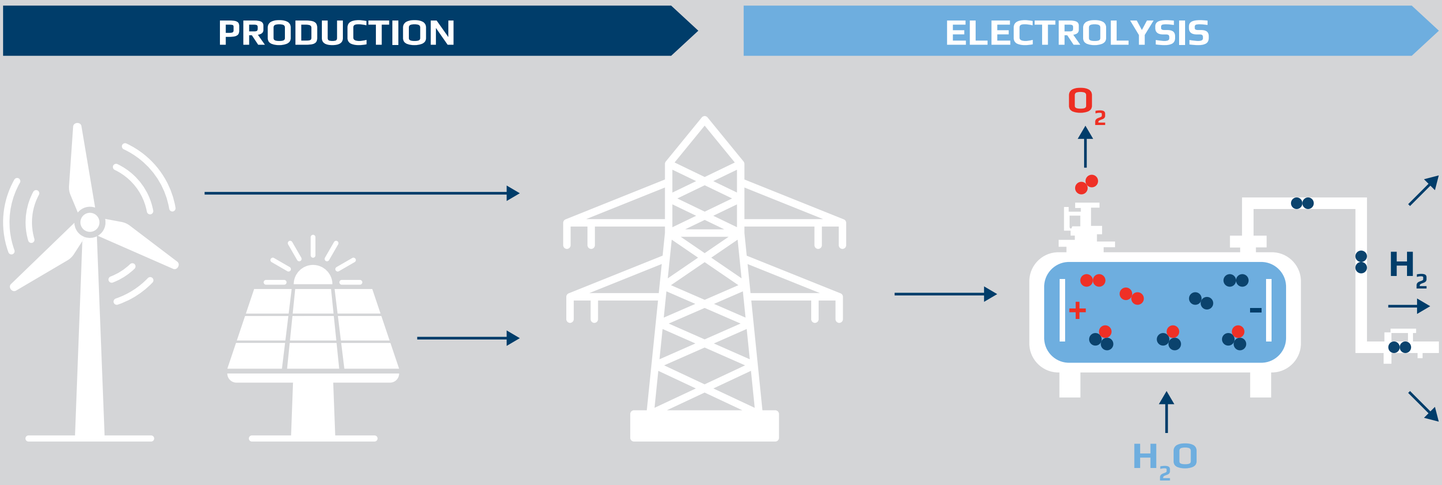
THE FIVE STEPS TO GREEN STEEL



Also within the mobility sector a direct electrification is not always possible. This applies to the heavy transport sectors like aviation, the shipping and the train industries and also for trucks. Higher energy densities are required here in order to provide sufficient energy and to achieve the required ranges. The hydrogen is used either directly by the use of fuel cells or the hydrogen is used to produce hydrogen derivatives like eFuels as a climate neutral propulsion.

HYDROGEN PRODUCTION AND TECHNOLOGIES

Hydrogen can be produced by various processes, but most are not climate-neutral because CO_2 will be emitted. A process to produce hydrogen without CO_2 emissions is called green hydrogen. Here water is split within an electrolyser into its components, hydrogen and oxygen, by the use of direct current. If the needed electrical energy is provided by renewable energies like wind or solar, the produced hydrogen is created carbon neutral.

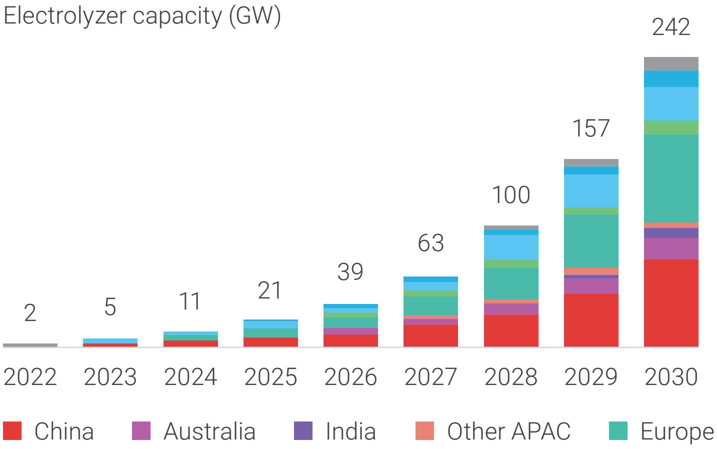


Jules Verne prophesied already in 1875:

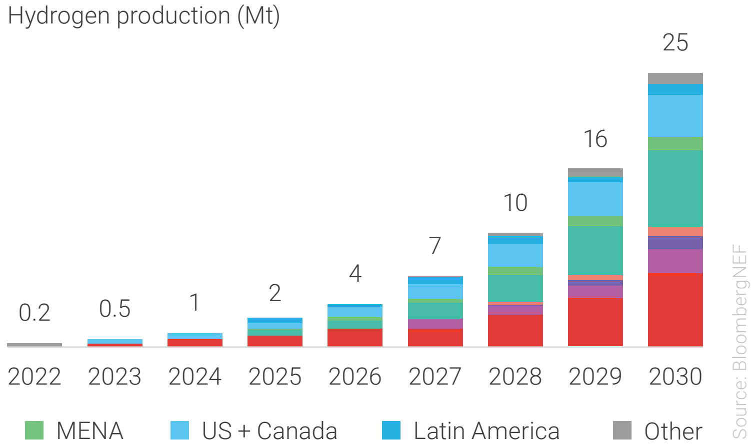
"Water is the coal of the future. Tomorrow's energy is water that has been decomposed by electric current. The elements of water thus decomposed, hydrogen and oxygen, will secure the earth's energy supply for the unforeseeable future."

Market studies forecast enormous growth in the demand for hydrogen produced by electrolysis. This can be attributed to the previously mentioned applications.

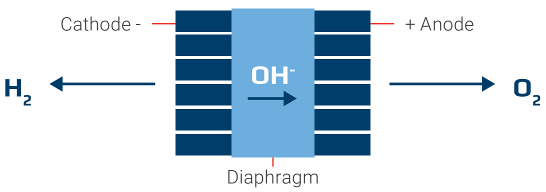
CUMULATOVE ELECTROLYZER CAPACITY



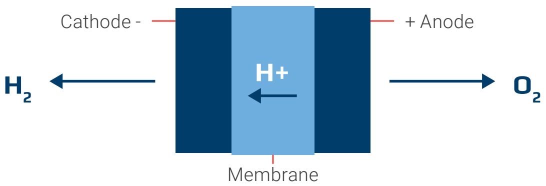
GREEN HYDROGEN PRODUCTION



Currently, four electrolyser technologies exist, the alkaline electrolysis (AEL), the Proton-Exchange Membrane (PEM) electrolysis, the Solid-Oxide-Electrolysis (SOE) and the Anion-Exchange-Membrane (AEM) electrolysis. The AEL, PEM and AEM are low-temperature systems where water (H_2O) is separated into hydrogen (H_2) and oxygen (O_2). In contrast, the SOE is a high-temperature system in which water vapor is used as the input medium for the process.

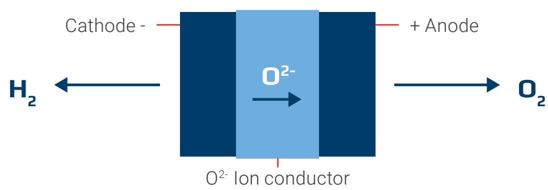


The AEL technology is the most mature one of the above mentioned because it has been used for a long time in the chemical industry, so long-term experiences are available here. Another advantage is that the investment costs are low because less rare or expensive materials are needed. Additionally, the system efficiency is good.

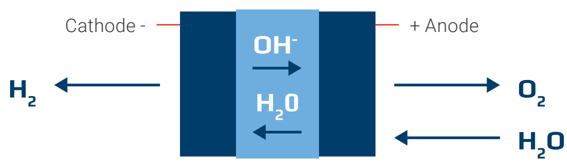


The PEM technology has the advantage that the current density per area in the cells is high, so it is possible to reduce the construction space and the weight of the stacks significantly.

Furthermore, the hydrogen produced by PEM electrolysis is of good quality. The disadvantage is that the PEM technology currently needs rare materials like Iridium and materials that are hard to process, like platinum. Therefore, the PEM technology is expensive in terms of capital costs.



The SOEC Technology is highly efficient if the desired energy for the required high temperatures is taken over from the waste heat of adjacent systems. The disadvantages are that the current stack sizes are smaller, and the stack lifetime is shorter in comparison to the other mentioned technologies.



The AEM is the youngest technology but also the most promising one because it combines the advantages of the AEL and the PEM technology, and no rare or expensive materials are necessary.

The processes and technologies mentioned are already an integral part of the market. However, there is still a substantial need for research and development of these technologies.

KEY CHALLENGES

The main challenge today in the electrolyser business is to reduce the Levelized Cost of Hydrogen (LCOH). This is what is needed to make the production of green hydrogen profitable and to make a success story out of it. The LCOH are the costs to produce 1 kg of hydrogen, and here the investment cost (CAPEX) and the operating cost (OPEX) are taken into account. Currently, the LCOH produced with electrolysers is higher compared to other processes to produce hydrogen.

To reduce the LCOH produced with electrolysers it is necessary to further develop the electrolyser technologies. The electrolyser cells and stacks need to become more efficient and reliable to reduce the OPEX, which is the most significant part of the cost. Much research is being done in the field of materials to develop cells that can be produced with inexpensive and non rare materials and improve sustainability. That will reduce the CAPEX and, thereby the LCOH.

Another key challenge is to cope with the needed market ramp-up. The stacks are currently produced in a semi-automated way, which leads to high production costs. In this way, it is impossible to make the globally announced projects a reality. The high production costs, in turn have a negative impact on the CAPEX and, therefore on the LCOH. In order to achieve the climate protection goals, it is necessary to drastically increase production capacities.

By developing the technologies further and by setting up automated manufacturing systems and production capacities for the stacks, it is expected that the LCOH produced with electrolysers will decrease in the future below the LCOH of other processes to produce hydrogen.

OVERCOME CHALLENGES

To test and qualify electrolyser stacks, a programmable DC power supply is needed, which can provide the required voltage, current and power for the extensive tests. These test range generic functional tests to stress tests of new developments to determine the degradation behaviour of your stack.

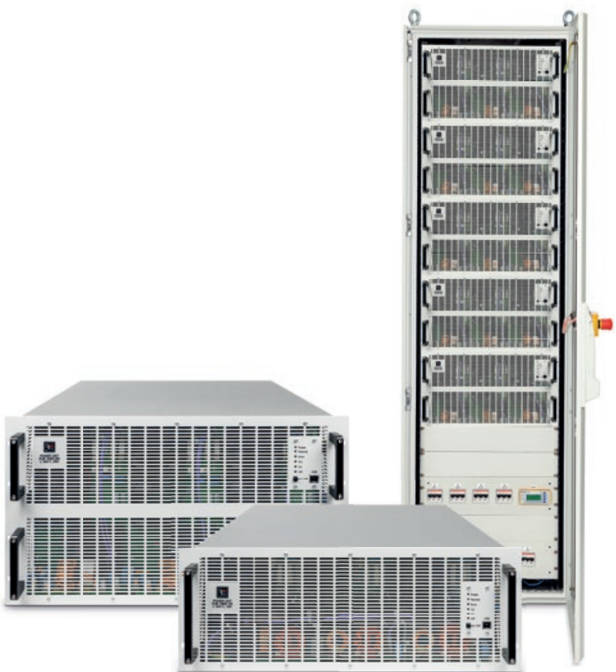
Power supply systems from EA are the perfect choice to further develop, test, and qualify your electrolyser stacks. Systems from EA differentiate themselves with amazing accuracy and the highest flexibility. With the integrated autoranging functionality, it is possible to deliver full power with different settings of voltage and current to test different stack sizes with the same test set-up.

We support the electrolyser industry in the further development of technology to reduce the LCOH. Customers can benefit from our experience in similar areas of green technologies, such as the fuel cell business or the tremendous battery market. EA makes vital contributions to the development of green technologies so that innovations can be tested and brought to market in record time.

At the end of each automated production line, an end-of-line test is necessary to ensure good quality and durability of the produced stack. Choose EA as a partner for the end-of-line testing of your stacks to scale up production capacities. Qualifying stacks with EA's fully programmable and highly dynamic equipment result in time-saving processes and a higher output rate in production. The very high power density of EA's systems, with 300 kW in a single 19" rack, saves important space in your production facility. Due to its modular design, the system can be expanded at a later stage and grows with your future requirements.

As one of the leading manufacturers of power electronics, we take power literally: We offer a wide range of innovative and high-quality solutions from electronic loads to programmable power supplies and bidirectional power supplies. Solutions that offer power up to 60 kW in a 6U housing. In parallel operation, systems with up to 3.84 MW power can be created when using the new Industrial Series. These great capabilities are rounded off with smart features such as the integrated function generator and 96% efficient mains feedback.

EA supports you to overcome the challenges to speed up your electrolyser business. Work with us, and we will take care of your individual needs and challenges.



3 QUESTIONS TO: MARTIN WILLEMS, PRODUCT MANAGER

1

Why does green hydrogen play a key role in a climate-neutral future? In your view, what are the biggest advantages over batteries?

Wherever direct electrification is possible, batteries will most likely prevail. In areas where this is not possible, alternative paths must be created for a climate-neutral future. This applies to many chemical processes and plants, as well as heavy-duty transport. To decarbonize these sectors, green hydrogen is currently seen as the only alternative. Hydrogen has the advantage that it can be used universally in various applications. As a direct energy carrier in process engineering, as a fuel for fuel cells or as a storage medium or buffer storage for excess energy from renewable energy sources. In addition, many hydrogen derivatives can be produced from the green hydrogen, such as green ammonia, e-fuels or green methanol, which can be used as a fuel for the shipping industry, for example.

2

What are the advantages for users when employing EA Elektro-Automatik solutions for testing electrolysis stacks?

EA Elektro-Automatik is a leading manufacturer of high-quality power supply units for the further development of green technologies. EA's systems are freely programmable, flexible in use and subsequently expandable due to their modular design. High-quality and precise tests can be carried out, which shortens development times and increases product quality. Due to the wide range of products and the high power density, there is a suitable solution for every stack size. In addition, the customer is our top priority. We support you in finding the optimal setup for your test bench and also provide support after delivery of the systems to help you with your challenges.

3

How do you think the market for green hydrogen will develop in the coming years?

The market for green hydrogen will grow enormously in the coming years. According to current forecasts, the demand for green hydrogen will multiply every year. The energy transition can only succeed if all CO_2-emitting processes are converted to climate-neutral solutions. Since more or less all processes use hydrogen as an input medium or energy carrier, the future demand for green hydrogen will be enormous. The global energy industry is undergoing a transformation away from coal and natural gas towards hydrogen as the energy carrier of the future.

SERVICE FOR YOU WORLDWIDE.

At the headquarters in Germany in the industrial centre of North Rhine Westphalia more than 350 qualified associates, in a facility of 19000 m², research, develop and manufacture high-tech equipment for laboratory power supplies, high power mains adaptors and electronic loads with or without power feedback. The sales network includes branches in China and USA, sales office in Spain and an extensive partner network.

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