



thyssenkrupp
NUCERA

Large-scale water electrolysis for green hydrogen production

**A leading
supplier**

for electrolysis
plants & equipment

600

electrochemical
projects worldwide

> 10 GW

of power installed

1 GW/year

supply chain
established

Our business case: Climate neutral with green hydrogen. Industrial scale.

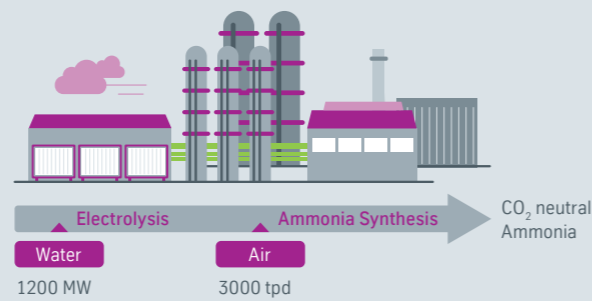
Scale up technology for efficient operations

1 Substitution of gray hydrogen in existing value chains already requires **gigawatt scale**



* Direct reduction of iron ore.

2 Power-to-X applications require scale to compete against gray commodity prices



3 Scaling up electrolysis plants shows **significant cost reduction**



4 Only at gigawatt scale **global transport chains** operate efficiently



Our 20 MW electrolyzer unit



20 MW module

Design capacity H ₂	4000 Nm ³ /h
Power consumption (DC) at start up	4.5 kWh/Nm ³
Water (demineralized) consumption	<1l/Nm ³ H ₂
Standard operation window	10% - 100%
H ₂ product quality at electrolyzer outlet	> 99.9% purity (dry basis)
H ₂ product quality after treatment (optional)	as required by customer, up to 99.999%
H ₂ product pressure at electrolyzer outlet	~300 mbar
Operating temperature	up to 90 °C

All figures above are to be understood as "expected values" and may vary depending operating conditions

Key benefits

- Modular, skid mounted design
- Low power consumption
- Fully automated operation possible
- Fast dynamics suitable to renewable power sources
- Mass production & supply chain at scale
- Current 1 GW electrolysis capacity p.a. under ramp-up to 5 GW p.a.
- Non-pressurized safety design avoids requirement of classified area
- Global service
- Design certified by TÜV Rheinland to meet requirements of chapter 4 of ISO 22734:2019

360 degree solutions for green hydrogen applications

1

Building your business case with concept modeling & optimization

The key question in any project development process is the economic viability of the project. Especially at the early stages, many decisions have to be taken which later have a huge impact on CAPEX, OPEX and project execution. The aim is to identify the best opportunity for the lowest cost and to avoid late concept changes which incur costly rework as well as schedule delays. With our techno-economic studies, we investigate green hydrogen value chains and select the most appropriate concept for our clients based on our proprietary know-how.

2

Global footprint

We have planned, built and commissioned over 600 electrolysis plants and installations with a total capacity of 10 GW all over the world – experience you can rely on. As a globally renowned EPC specialist for electrochemical plants, we are a leading supplier of electrolysis equipment, solutions and services. You benefit from our proven competence in realizing complete plants which operate smoothly and safely over decades.

3

360° Service throughout the entire plant life-cycle

With our know-how we assist you throughout the plant's life cycle – from start-up to on-site support by thyssenkrupp nucera engineers, specialists and trainers for your personnel. We are your single point of responsibility for all maintenance inspections, spare parts or capacity increases.



Reliability, availability, maintainability analyses
Operation & maintenance strategy & execution, personnel training



Predictive, preventive & corrective maintenance support & execution



Support for operation & optimization – digitally & on site



Electrolyzer stack refurbishment

360° service

Key features

- Identify the most attractive hydrogen value chain concept flowsheets
- Identify material and energy sector coupling opportunities
- Develop strategies for energy monetization
- Estimate carbon emission intensity for the PtX concepts
- Identify risks and opportunities
- Assist in engagement with potential partners and financiers
- Develop ideas sufficiently to estimate capital cost and quantify preliminary economics
- Develop the selected concepts in sufficient detail to obtain funding
- Develop a project road map

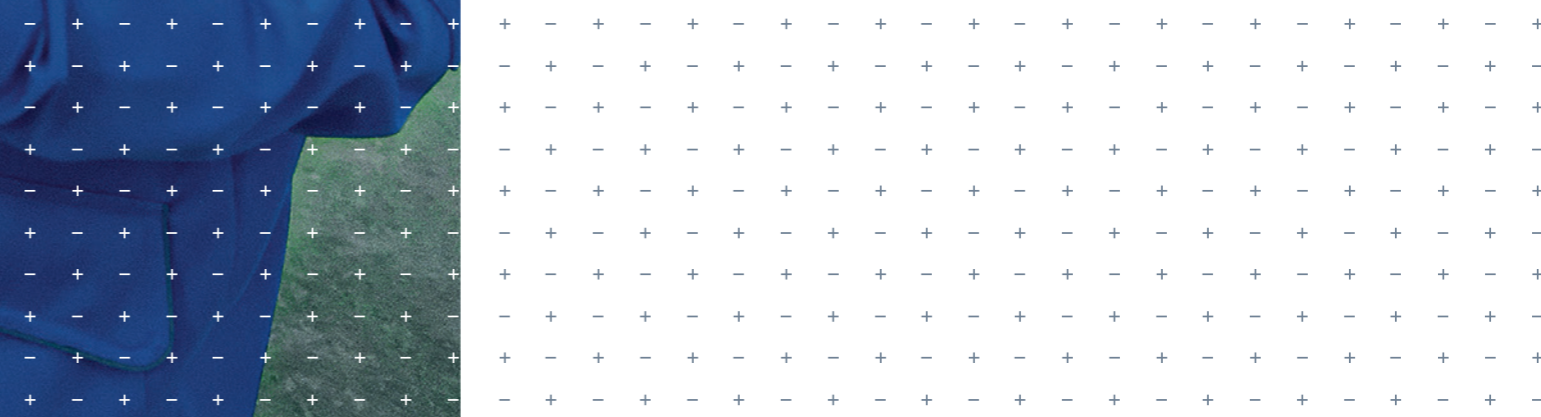
1 GW supply chain >>>>>
On the road to 5 GW



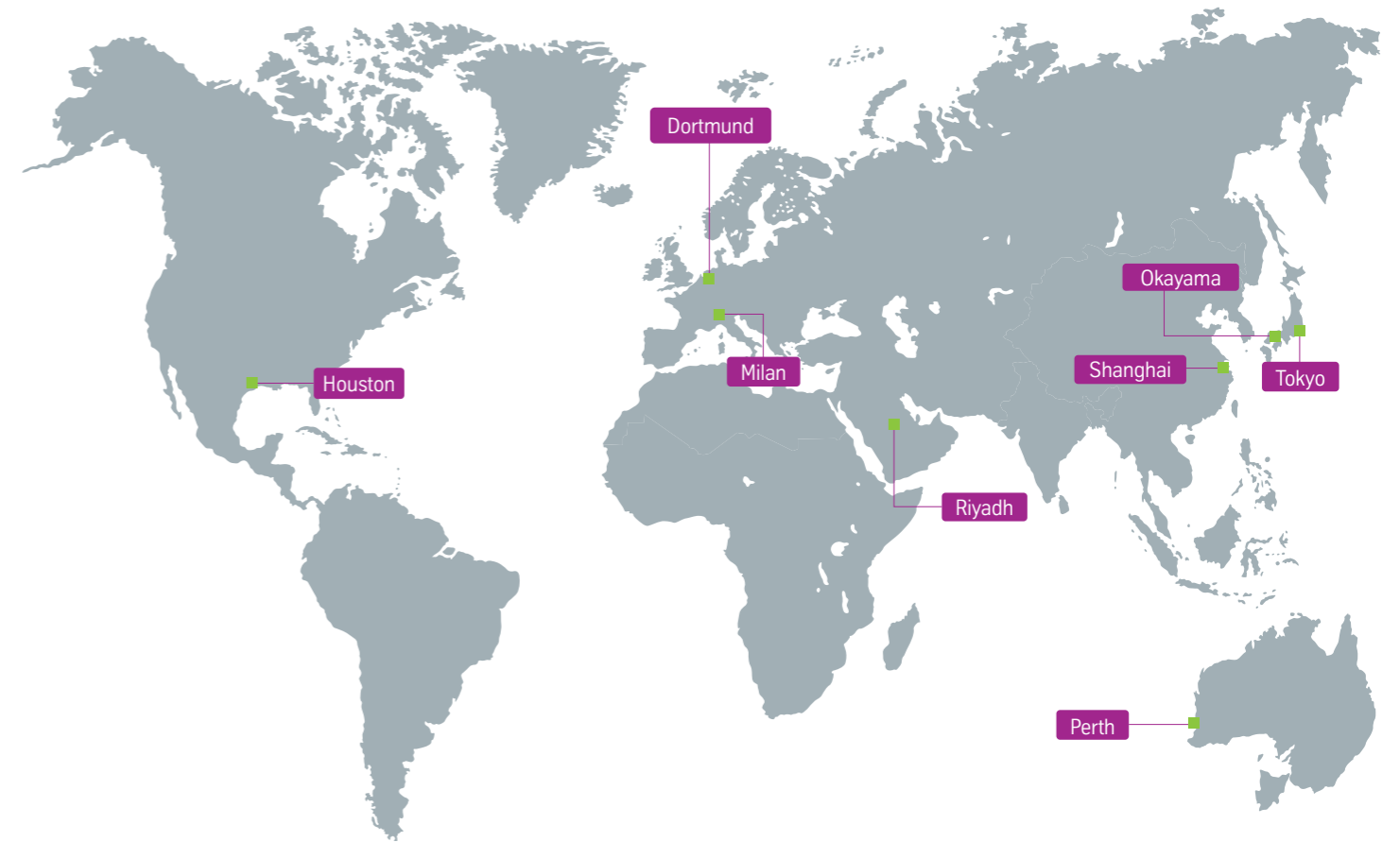
Through continuous improvements and dedicated research and development, we deliver cutting-edge technologies for high-efficiency and maximum revenue.

With our strategic and long-term partner De Nora, we have a globally renowned specialist in electrochemistry for cell manufacturing, coatings and repairs at our side. Together with De Nora, we deliver fast and efficient value to our clients all over the world. Thanks to our long cooperation for our chlor-alkali electrolyzers, we can rely on a fully set-up supply chain for our water electrolysis cells. Today, we can deliver a total of 1 GW electrolysis cells per year and have already set the course for expanding to a 5 GW supply chain.

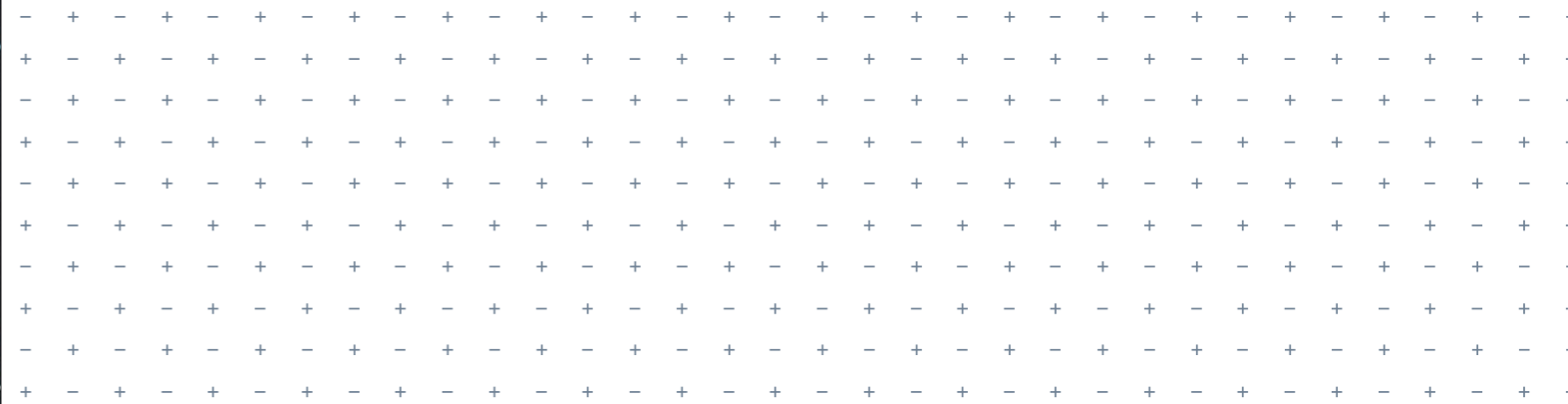
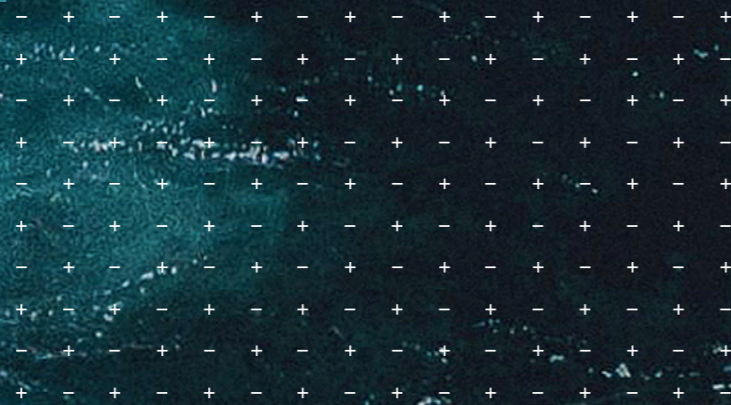
In the upcoming years we will research to optimize the cell and stack design even further, in order to enable fully automated series production on the one hand and thus reduce the overall target costs of alkaline water electrolysis on the other. Also the full automation of manufacturing and assembly processes is at the center of our considerations in order to realize efficient supply chains in the gigawatt range in the long term. We are convinced that we can also significantly strengthen the competitiveness of hydrogen technology as a whole. We increase the availability of hydrogen, reduce costs – and establish a new market standard as well as a valuable contribution to a fully automated and integrated gigawatt supply chain.



We shape
the new era.

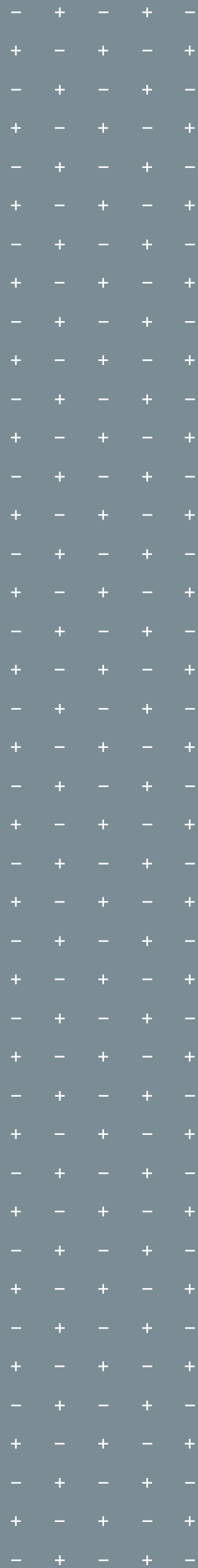


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