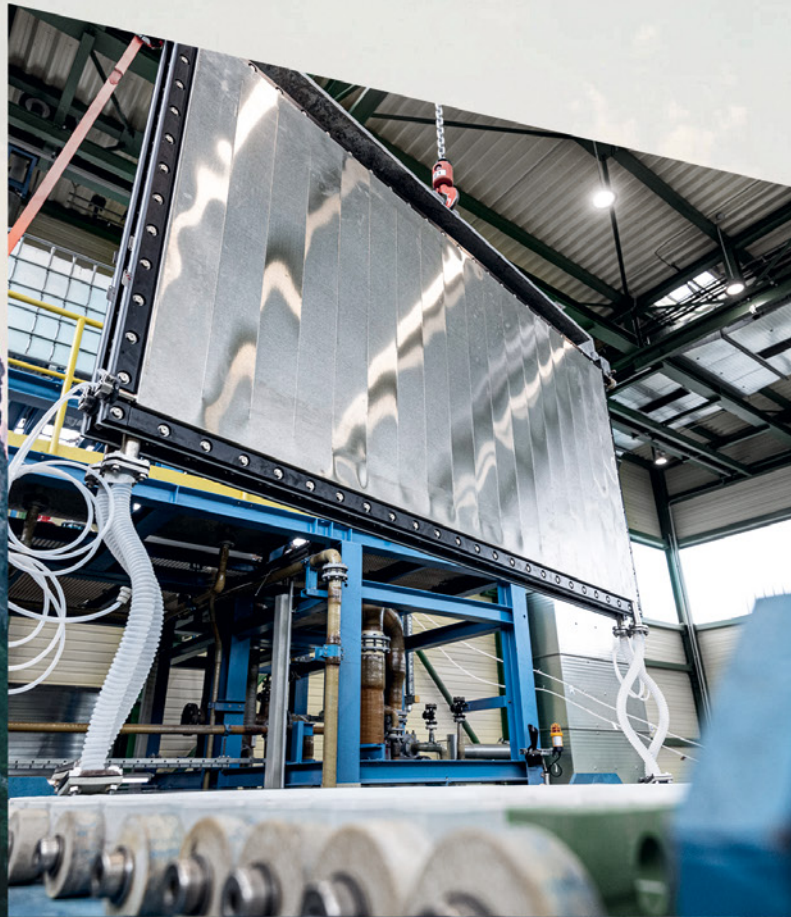




thyssenkrupp
nucera



Industrial-Scale Water Electrolysis for Green Hydrogen Production

World-leading
electrolysis technologies

> 10 GW
of capacity installed

1.5 GW/yr
supply chain established

> 3 GW
contracted capacity

*Includes green hydrogen and chlor-alkali



Who We Are

Driven by innovations in chemical engineering, thyssenkrupp nucera® leads the way in high-efficiency electrolysis technology, drawing on over 60 years of experience. Throughout our journey, we have developed two robust portfolio segments that create synergies and offer innovative solutions for industrial advancement and sustainable value chains: chlor-alkali and green hydrogen.

Our state-of-the-art electrolyzers, deployed globally, harness the power of solar, wind, and water energy to produce hydrogen without generating harmful greenhouse gas emissions. We believe that by producing green hydrogen at a commercial scale, we facilitate sustainable transformation and provide our customers with access to clean, renewable energy that can endure for generations. Safety is at the core of our pursuit of high-tech breakthroughs, as we embrace challenges with resilience.



8
regions

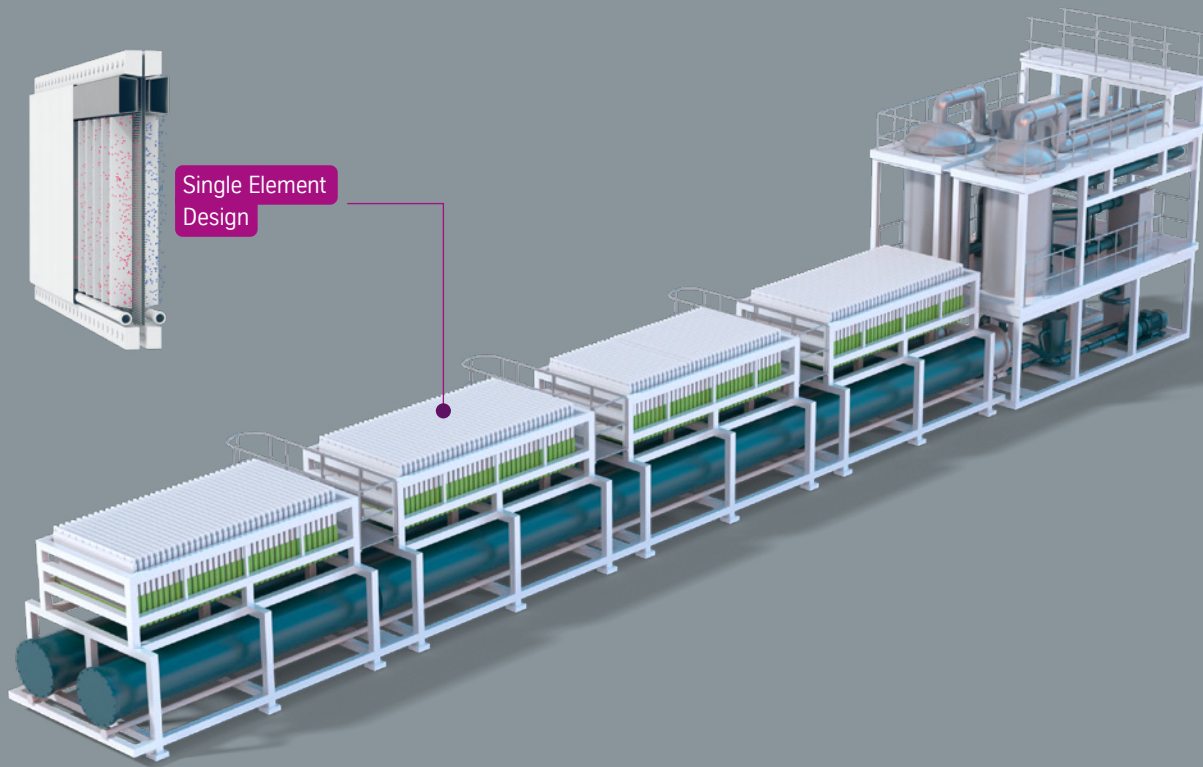


1000+
employees worldwide



600+
successful projects





scalum[®]

Key features & benefits

Performance

- **Dynamic Operations:**
Wide operating range enables handling of renewable energy fluctuations, ensuring stability and reliability
- **Quality & Longevity:**
Highly durable cell design ensures flexibility and long cell life

Reliability

- **Maintainability:**
Holistic service portfolio supported by global network and expertise to ensure best possible electrolyzer performance
- **Design certified by TÜV Rheinland** to meet requirements of chapter 4 of ISO 22734:2019

Scalability

- **Flexibility & Modularity:**
Modular design allows for scalable solutions
- **Process Optimization:**
Dedicated R&D roadmap focused on automatizing serial production to deliver high capacities at reduced costs and lead times.

Enabling green transformation

Alkaline Water Electrolysis (AWE) technology delivers the two vital components: speed and scale. Based on proven quality, safety, reliability, and the passion to innovate, we set a benchmark: scalum[®]

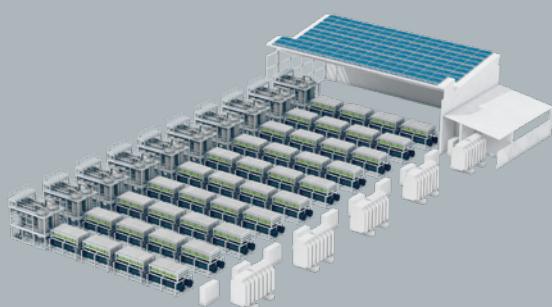
To make the construction of new hydrogen plants as simple, cost-effective and flexible as possible, we offer our electrolyzers in pre-fabricated standard modules. We combine about 300 high efficiency cells into one powerful unit with a system capacity of 20 MW. scalum[®] is designed as a standardized modular solution that can be easily interconnected and scaled up to match highest demands and obtain the desired plant capacity, up to several hundred megawatts or even gigawatts. The plants can be operated flexibly - both for the production of green hydrogen for industrial power-to-X applications and for grid stabilization.

scalum[®] 20 MW Unit

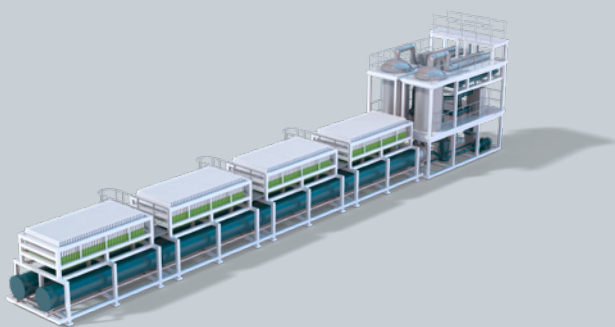
Design capacity H ₂	4000 Nm ³ /h
Standard operation window	10% - 100%
H ₂ product quality at electrolyzer outlet	> 99.9% purity (dry basis)
H ₂ product quality after treatment (optional)	as required by customer, up to 99.999%
H ₂ product pressure at electrolyzer outlet	~300 mbar

All figures above are to be understood as „expected values“ and may vary depending on operating conditions.

An Efficient and Highly Scalable Module Concept to Match Market Requirements



Highly scalable to gigawatt (GW) plant size



scalum® 20 MW electrolyzer unit

- Quality & Longevity | proven cell design with high durability
- High Performance | long-term technology experience
- Design certified | by TÜV Rheinland to meet requirements of chapter 4 of ISO 22734:2019
- Service | global service network



Single-element

- Ability to remove an individual single element from a stack of cells
- Repairable at single-cell level without having to replace entire stacks
- During cell refurbishment, plant operation can continue. Only the electrolyzer unit being refurbished is shut down.
- Single-element monitoring enhances safety



Our Commitment to Quality, Operability & Safety

Our innovative single-element design: The heart of scalum®

Building on decades of experience in chlor-alkali electrolysis, we have developed a state-of-the-art technology that integrates advanced safety features with exceptional operational flexibility. Our single-element design ensures easy maintenance and a long cell life, while our safety framework delivers reliable and secure operations in challenging conditions.

Wide operating range for flexibility

Fast dynamics ensure that our modern alkaline water electrolyzers can manage the fluctuating power input of renewable sources and be integrated into PtX applications. In fact, scalum® can be operated safely even at load profiles as low as 10% - one of the widest operating ranges in the AWE market today. This flexibility is achieved without compromising on safety.

When multiple scalum® electrolyzers are operated simultaneously, our nucera load balancer, an intelligent process control system, optimizes input load distribution across units, providing various optimization strategies for enhanced efficiency. This flexibility, combined with a strong safety foundation, ensures reliable performance even under demanding conditions.

Comprehensive safety and monitoring features

Our electrolyzers feature a comprehensive safety framework with a Distributed Control System (DCS) and a separate Safety Instrumented System (SIS) for reliable plant control. The advanced power control system and full plant automation ensure high reliability.

To mitigate risks, we use fully automated hydrogen and oxygen gas measurements, and SIL-rated single cell monitoring with shutdown functions. Continuous condition monitoring enables predictive maintenance, enhancing reliability.

scalum's® full-tight single cell technology and atmospheric pressure operation minimize leak risks, ensuring safe deployment in critical environments like refineries while maintaining operational accessibility. In line with our commitment to the highest safety standards, we have also conducted independent testing of our cell integrity with the German Federal Institute for Materials Research and Testing to ensure that our technology meets stringent requirements.

All these measures underline the high quality and reliability of thyssenkrupp nucera's® electrolyzers in a wide range of operating conditions, showing that scalum® offers both – scale and safety.

360° Service Solutions for High-Quality Maintenance

360° Service for your thyssenkrupp nucera® electrolyzers

To ensure you obtain optimized performance from your electrolyzers, we offer a holistic service portfolio supported by thyssenkrupp nucera's global network and expertise. Our skilled engineers, specialists, and trainers assist customers with innovative service solutions throughout the entire plant lifecycle – from start-up to on-site operations and maintenance support.

Cell refurbishment promotes circularity and sustainability

To maintain the planned hydrogen production over the electrolyzer's lifetime and to achieve initial start-up performance, we refurbish the cells by recycling certain components. Thanks to the nucera single-element design, each cell is isolatable and repairable at a single cell level without having to replace entire stacks. This means plant operation can be continued during the entire refurbishment campaign, with all other electrolyzers running.

First point of contact for customers worldwide

Providing fast, efficient, and high-quality support to customers across the globe is not only our aim but, most importantly, our passion. thyssenkrupp nucera's local personnel is your first point of contact for on-demand predictive, preventive, and corrective maintenance support and execution.



Key features & benefits

- Long Term Service Agreement is configured for optimizing operation, maintenance, and asset value over scalum's® entire lifetime. It includes essential services such as operations and maintenance personnel training (remote and on-site), predictive and preventive maintenance support, advisory services and more.
- Professional support enables maximized efficiency, improved reliability, high safety standard, and sustainable operations.
- As part of our innovative software solutions, thyssenkrupp nucera offers an interactive product navigator to efficiently manage spare parts supply.
- Major cell refurbishment can be executed via the lifecycle service team of thyssenkrupp nucera to achieve start-up performance levels.
- During the entire refurbishment campaign, plant operation can be continued with all other electrolyzers running.



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