

Water Alkaline Electrolysis Solutions

Electrodes and Electrode Package



DE NORA
Dare. Develop. Deliver.

We pioneer clean solutions in water, circularity, hydrogen and electrochemical processes, driven by one ambition: enabling you to transition to sustainable operations with real impact.

With over a **century of electrochemical expertise**, De Nora is a global leader recognized for its forward-looking mindset and its ability to drive innovation where it matters most.

De Nora was founded in **1923** by **Oronzio De Nora**, we are driven by a **pioneering spirit** grounded in **consistency** and **reliability**. Today, as then, our spirit remains unchanged.

We have the courage to rethink what is possible, **challenging conventions** and exploring **new frontiers** to unlock **groundbreaking innovations**.

We develop with determination, designing solutions **based on our customers' needs** to drive growth across all industrial sectors.

We deliver without compromise, leveraging predictive insights and proven performance to ensure **consistent and reliable results**.

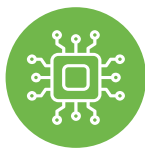
We have invested in research and innovative technologies, and to date, the company has developed and qualified a portfolio of electrodes and components for hydrogen production through water electrolysis, which is fundamental to the **energy transition**. Applications for the energy transition are a natural extension of the electrode technology business.

De Nora's solutions are used to generate green hydrogen through water splitting and convert hydrogen into electricity. Hydrogen is critical to the decarbonization of many industrial processes; green hydrogen is the key to achieving "carbon neutrality" and "net zero emissions." **However, our gaze continues to look beyond.**



Chlor-Alkali

High performance cathodes and anodes for chlor-alkali industry.



Electronics

Experienced team can design the right systems for your needs.



Mining & metals recovery

Cut operating costs with our electrodes designed to enhance efficiency and consistency of deposition, in addition to water treatment applications.



Municipal water treatment

Meeting regulatory requirements for traditional and emerging contaminants, reliably and cost effectively.



Industrial water treatment

Solutions and technologies for process water, industrial wastewater and cooling water treatment.



Green Hydrogen

Look to the future with solutions that guarantee energy security and reduced environmental impact.

De Nora high performance electrode coatings

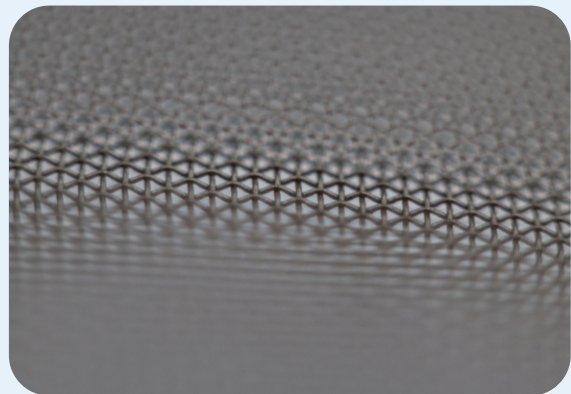
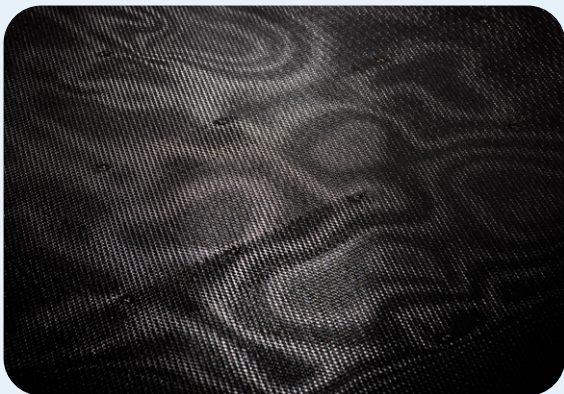
Advanced Alkaline Water Electrolysis

A high-performance, reliable technology for sustainable **green hydrogen production**. Designed for fast dynamic response to renewable energy inputs, it supports a wide operating range, from low to high plant flexibility and load utilization. De Nora innovation sets the benchmark for **Advanced Alkaline Water Electrolysis (AWE)**. With more than a decade pioneering in energy transition technologies, De Nora continues to lead the development of sustainable solutions, playing a key role in the evolving green hydrogen market.

Our core technology

Our mixed-metal oxide electrodes feature proprietary formulations of platinum-group and rare-earth metals that efficiently catalyze water-splitting reactions. De Nora explores **new concepts** in Advanced Alkaline Water Electrolysis technology, expanding its product portfolio, including non-noble metal solutions. By leveraging cutting-edge catalytic materials, De Nora electrodes reduce the overpotential required beyond thermodynamic limits to initiate electrolysis. **Decades of proven expertise** in chlor-alkali coatings and commercialization support plant **evolution** from low current density designs to highly efficient, high-productivity stack technologies.

De Nora is a reliable, credible and trusted technology partner, providing high-performance electrodes, customized solutions, and robust product warranties that enhance project bankability and turn concepts into operational reality. **Backed by a global industrial footprint and a resilient supply chain scaled to gigawatt - level production, De Nora delivers with confidence - today and for the future.**



Electrodes for alkaline water electrolysis

De Nora electrodes boost the performance of Alkaline Water Electrolysis systems and reduce the Levelized Cost of Hydrogen (LCOH). De Nora is the reliable solutions to:



Increase efficiency by lowering specific energy consumption (kWh/kg H₂), reducing overall plant OPEX.



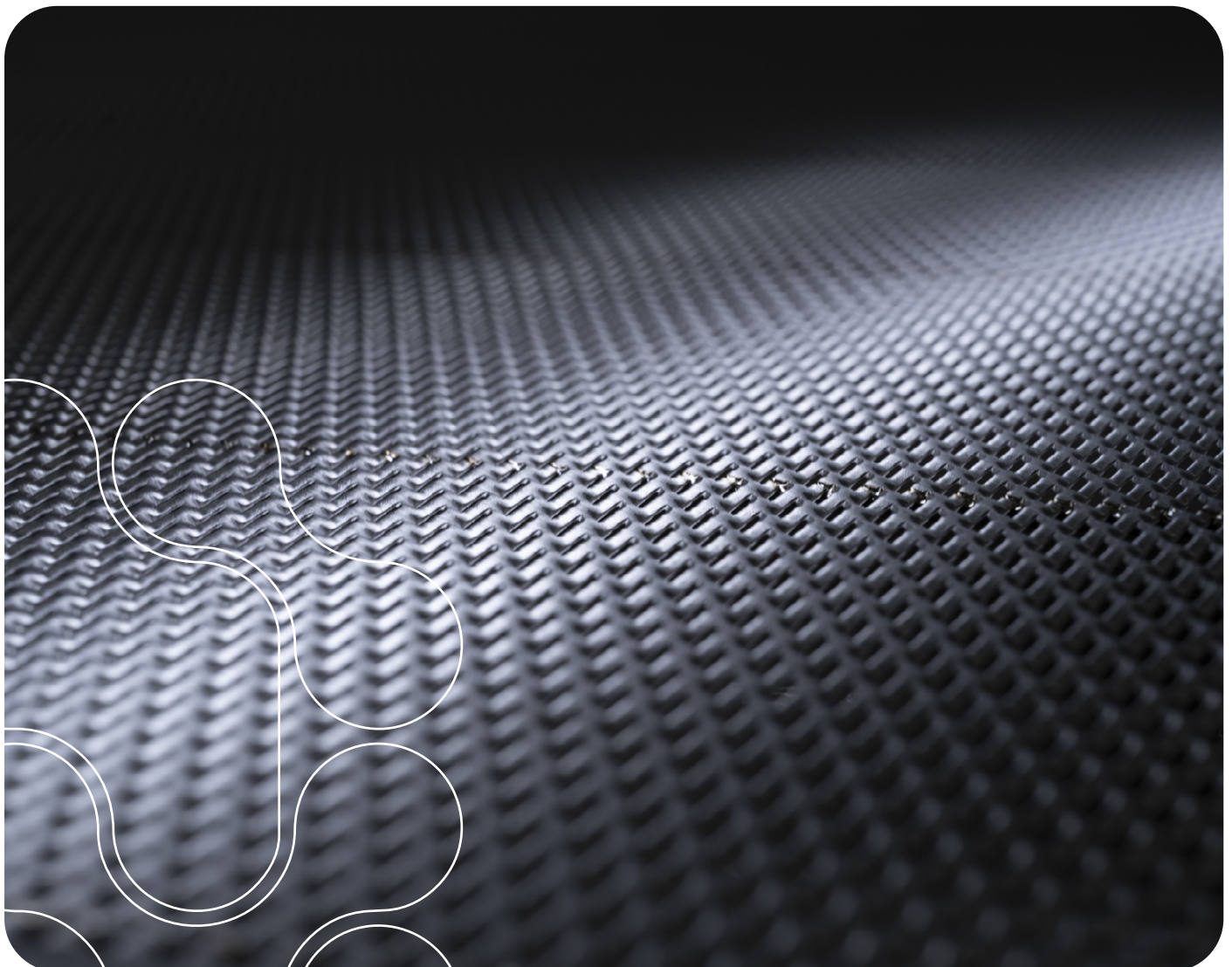
Reduce maintenance costs through extended electrode lifetime.



Cut CAPEX and minimize plant footprint through reliable operation at higher current densities.



Enable direct coupling with renewable energy sources, supported by a robust design engineered to withstand intermittent operations.



Unmatched testing capabilities

Leveraging our unique expertise and proprietary testing protocols, we develop and validate long-lasting, high-performance electrodes tailored for different operating conditions and applications.



+2 millions testing hours every year

R&D activities enable predicting electrode performance and lifetime in real industrial operations



24/7 continuous testing

Real-time monitoring to ensure safety and reliability



+300 testing stations

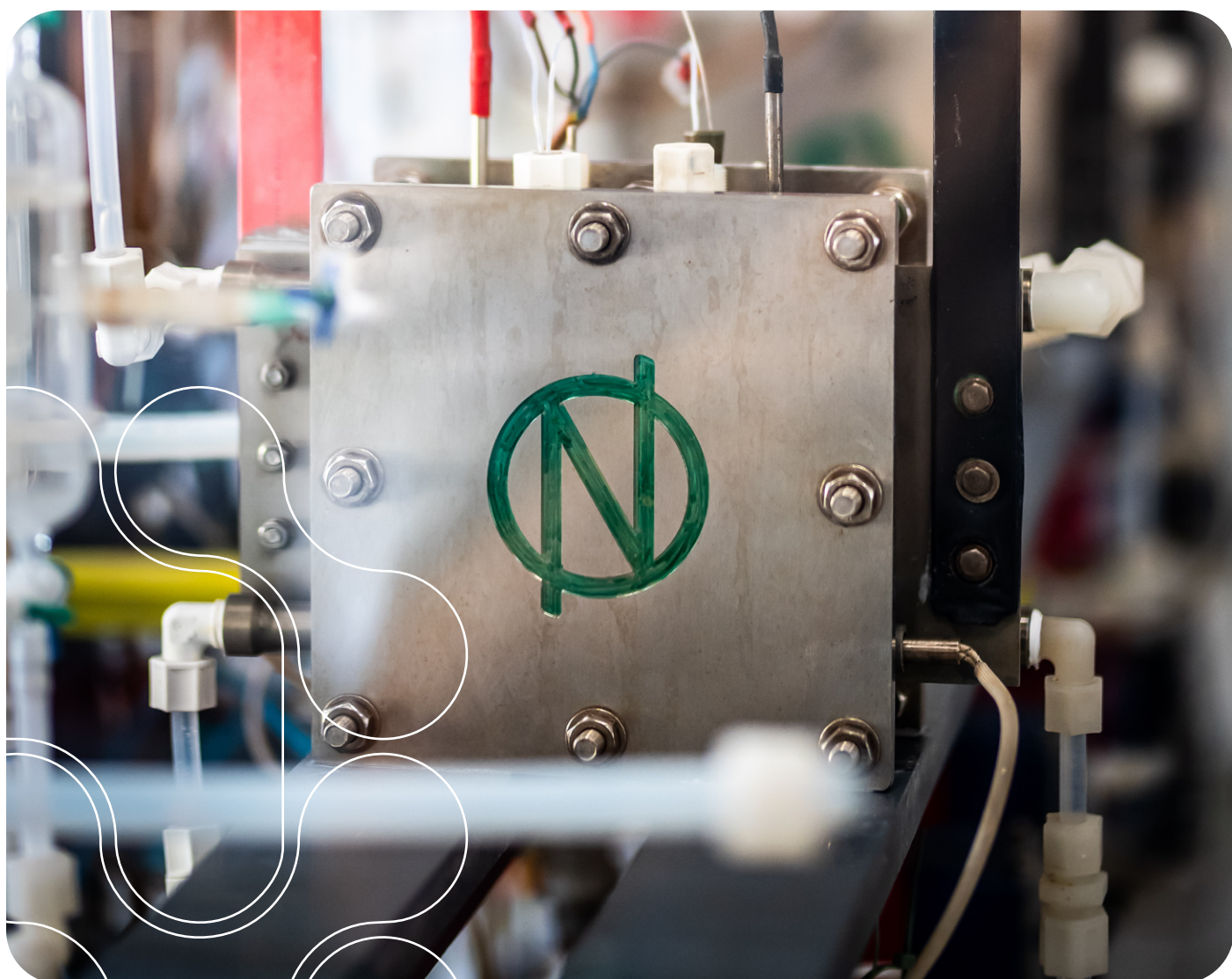
To replicate electrochemical processes at scale



From 1 to 9 TRL¹

Unmatched product development roadmap capabilities

¹Technology readiness level



Leveraging our in-house knowledge and expertise, De Nora developed cathodes for AWE to meet different operating conditions and market requirements.

The **NRG® coating family for Hydrogen Evolution Reaction (HER) is recognized as best-in-class for proven performance and stability** including operation under renewable sources.



The image is for illustrative purposes only

NRG®-A

Best-in-class coating delivering significant voltage savings, suitable for high current densities and high-performance pressurized AWE electrolyzers. Engineered to withstand reversal currents generated when operating the electrolyzer in combination with intermittent renewable energy sources.

NRG®-R

High-performance coating primarily designed for atmospheric AWE systems operating at elevated current densities. Application of polarization current during shutdown periods is required.

NRG®-L

Coating developed for lower current densities in pressurized AWE systems, enabling reduced hydrogen overvoltage and consequently ensuring consistent cell-voltage savings, lower power consumption, and a clear advantage compared to conventional "Raney Nickel" cathodes commonly used for HER in traditional pressurized alkaline technologies.



Different anodes coating families for **oxygen evolution reaction (OER)** have been developed to match different alkaline water electrolysis operating conditions and market requests.



The image is for illustrative purposes only

AENRG™-A

Noble-metal-free coating offering solid voltage savings combined with resistance to reversal currents and shutdown events. Designed for pressurized AWE electrolyzers operating in conjunction with renewable energy sources.

AENRG™-B

High-performance, best-in-class noble-metal-based electrode. AENRG-B provides significant voltage savings and is suitable for high-current-density operation. Developed for high-efficiency atmospheric AWE electrolyzers.

AENRG™-C

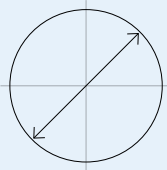
Noble-metal-free coating delivering reliable voltage savings at elevated current densities. Designed for atmospheric AWE systems. Application of polarization current during shutdowns is required to ensure proper electrode protection.



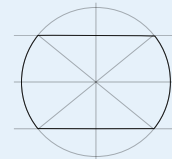
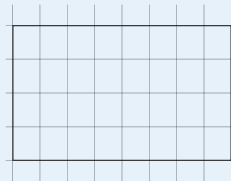
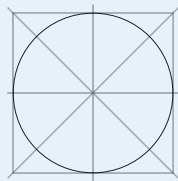
Customization: the solution to your needs

Case by case De Nora could assist customers in finding the **electrode combination** capable of providing, given the specific boundary conditions, the lowest TCO
To meet **specific client requests**, De Nora offers customized solutions – a range of custom sizes, including complex geometries and different substrates.

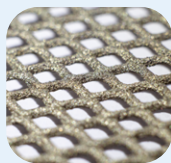
Custom Size



Custom Geometries



Custom Substrates



Designed to last

Our electrodes deliver long-term reliability and come with lifetime guarantees



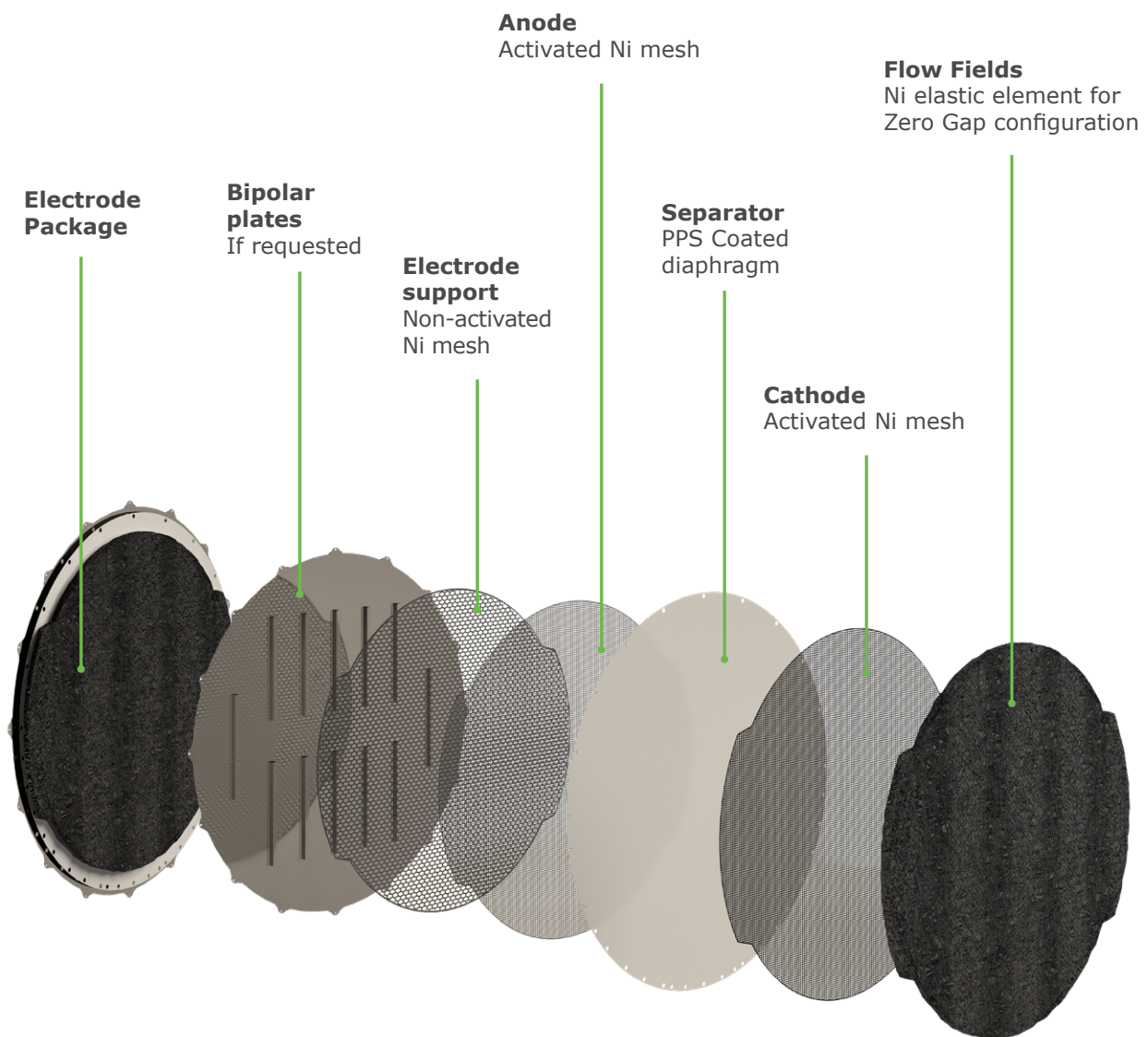
Total adaptability

This product can be adapted to multiple configurations based on the specifications of the customer

Electrode Package

De Nora can offer, in addition to electrodes, other cell components such as bipolar plate and flow fields. This «**electrode package**» is designed to ensure a precise, dynamic **zero-gap configuration**, maintaining consistent anode and cathode contact with the diaphragm under all operating conditions throughout the package's lifetime.

The Heart of the Electrolyzer



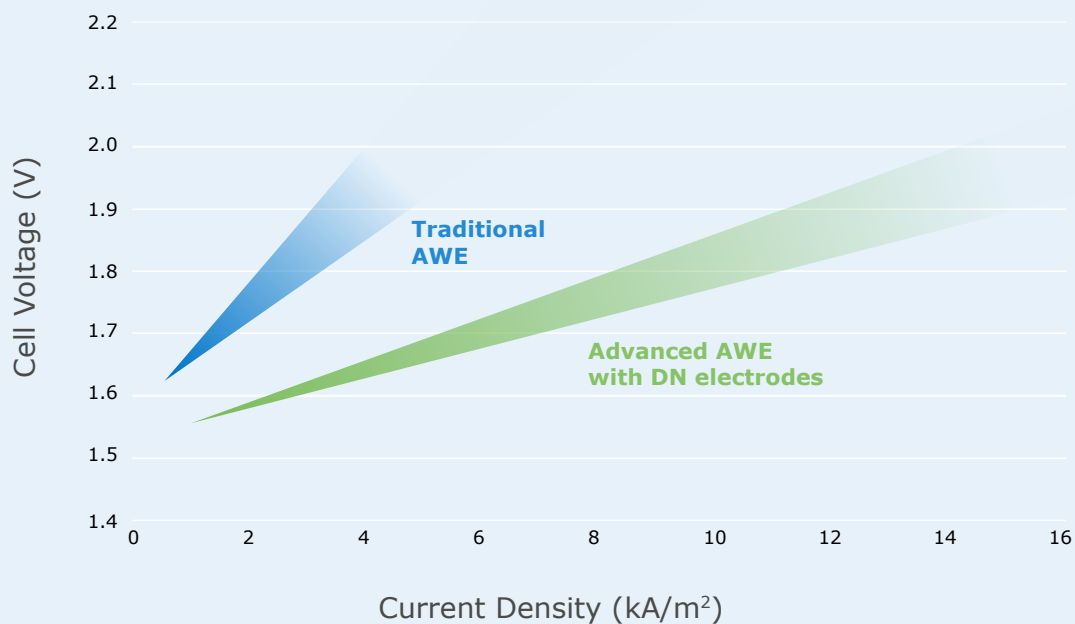
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Superior versatility and performance

De Nora electrodes and electrode packages deliver superior performance in both pressurized and atmospheric stack technologies, leveraging on decades of technological excellence:

- Up to 15% efficiency improvement at given Current Density (3-4 kA/m²)
- Unlock up to 3,5x current density increase at target Cell Voltage

All together, these parameters significantly improve and lower the Total Cost of Ownership (TCO), making De Nora solutions the **trusted choice** for high-performing and high-efficiency hydrogen production electrolysis technology.



The values shown are derived from real-world data obtained by retrofitting various technologies with DN electrodes.

Service – aftermarket

Electrode repair & recoating services

Reliable repair and recoating to restore electrodes to optimal performance.

Service & maintenance agreements

Customized maintenance and priority support for reliable operations.

Upgrade and refurbishment services of existing installations

Tailored upgrades to boost productivity.

We are wherever you need us



Contact us

service.etr@denora.com

Get in touch



www.denora.com

Discover more



Alkaline Water Electrolysis Solution Brochure ETR-AWE2604001

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