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# De Nora & thyssenkrupp nucera Joint Open House Event

March 21st,  
2024



# De Nora at a glance



Listed on the  
Milan Stock  
Exchange

Pioneering  
Electrochemistry  
from 1923

Electrode Technologies ⚡

Expanding  
Water Domain  
from 2015

Water Technologies 🔄

Entering Energy  
Transition  
from 2017

Energy Transition ⚙️

100  
Years of  
Innovation

2000+  
People

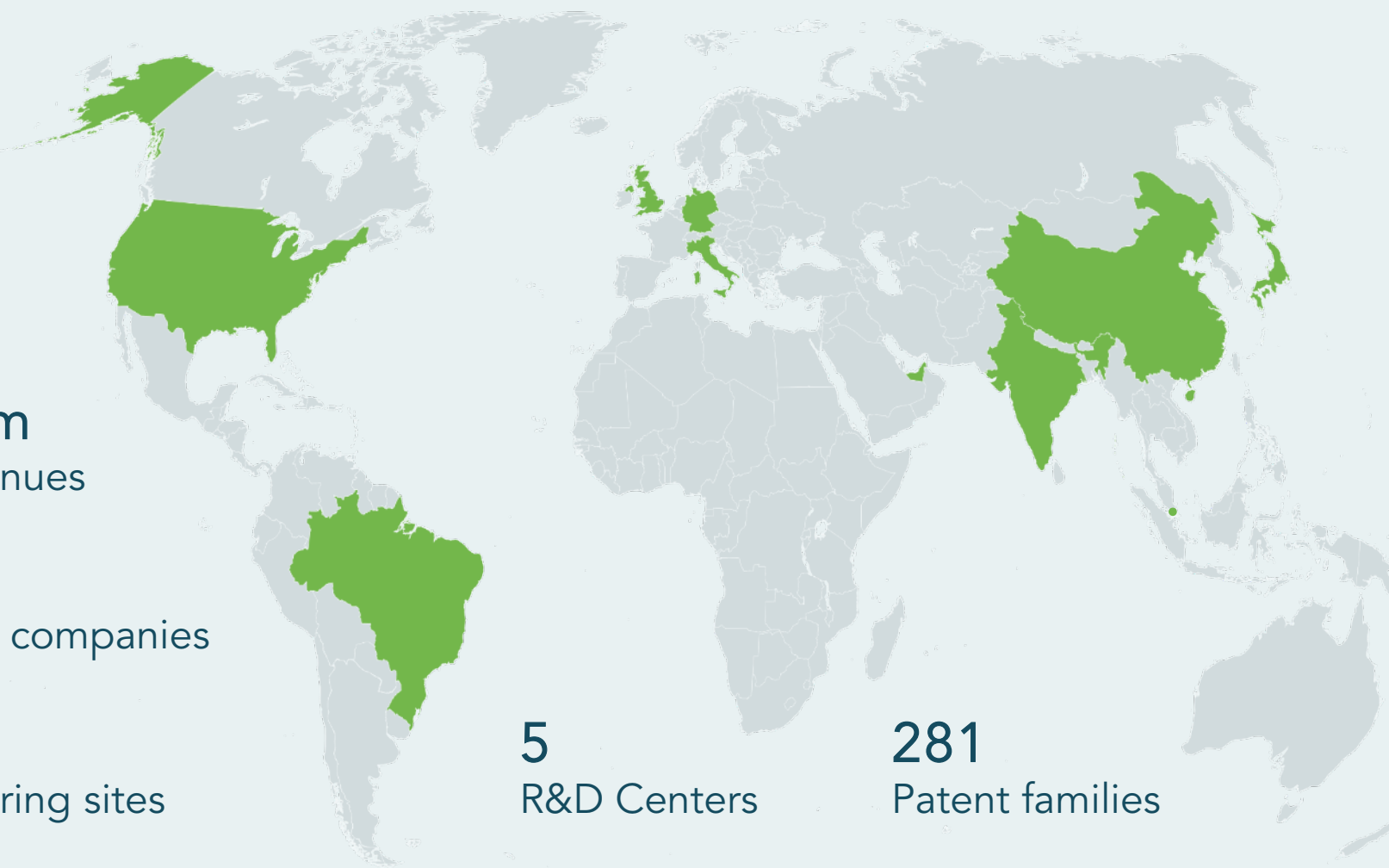
€856.4m  
2023 Revenues

24  
Operating companies

15  
Manufacturing sites

5  
R&D Centers

281  
Patent families



# Business Overview





Electrode Technologies 

## PRODUCTS

Anodes, Cathodes, Catalytic Coatings, Gas Diffusion Electrodes (GDE), Cell Manufacturing

## SERVICES

-  Electrodes recoating, repair services, and spare parts
-  Performance upgrades and retrofits





Water Technologies 

## PRODUCTS

Electrochlorination, Disinfection and Filtration Technologies, Electrodes for Pools

## SERVICES

-  Technical assistance and remote support services
-  Analytic services





Energy Transition 

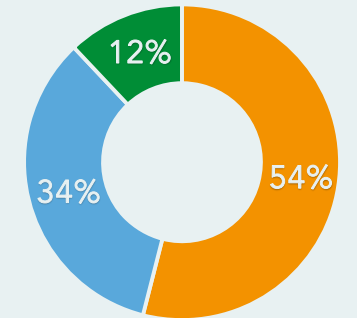
## PRODUCTS

DSA® Electrodes for Alkaline Water Electrolysis (AWE), Electrolysis Cells for tk nucera, GDE for Fuel Cells, Dragonfly® system

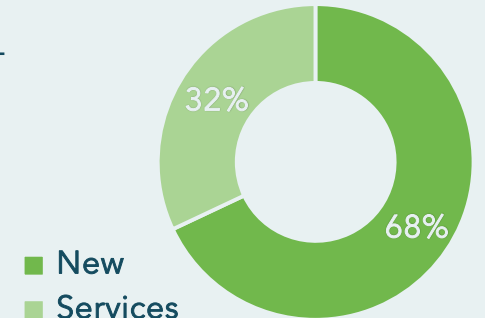
## SERVICES

-  Engineering design
-  Supply and maintenance agreements

2023 Revenues by business unit



2023 Revenues New Installations vs Services



# Strategic Goals

## Growth & market positioning

- Profitable growth in Energy Transition
- Water platform expansion

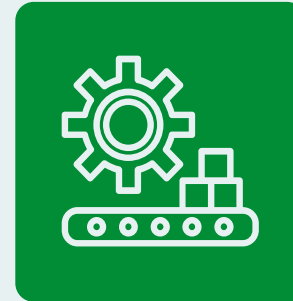


## Product Leadership

- Leadership position consolidation
- Service level enhancement

## Organization development

- Sustain Company growth
- Infrastructure improvement & ESG commitment



## Manufacturing expansion

- Strategic scalable investment
- Execution enhancement

# ESG Plan 2030

## GREEN INNOVATION

- Circular Design Guidance in the R&D process
- Product Scorecard
- Reducing Noble Metals in products

## CLIMATE ACTION & CIRCULAR ECONOMY

- Decarbonization Action Plan and renewable energy
- Improve our waste management and packaging
- Enhance recycled key raw materials



## PEOPLE: INCLUSION, WELLBEING, DEVELOPMENT

- Strengthen H&S governance and culture
- Affinity Networks and DE&I policy
- Mental health awareness project

## LOCAL COMMUNITIES, SUSTAINABLE SUPPLY CHAIN

- Supplier evaluation and engagement
- ESG in procurement processes
- Educational partnerships

# Main 2023 achievements

## Leading External Recognition



### GREEN INNOVATION

- 22% Vitaly index
- +17 New Patents
- 66% R&D costs in ETr
- -5% noble metal in products<sup>1</sup> vs '21



### CLIMATE ACTION & CIRCULAR ECONOMY

- 3.1 GWh PV plants installed production capacity
- +25% Electrodes re-used
- 12% Revenues in ETr
- 24% Revenues in WTS



### PEOPLE & LOCAL COMMUNITIES

- Great Place to Work Award in Italy
- +22% women in managerial roles
- 64% Local Spent



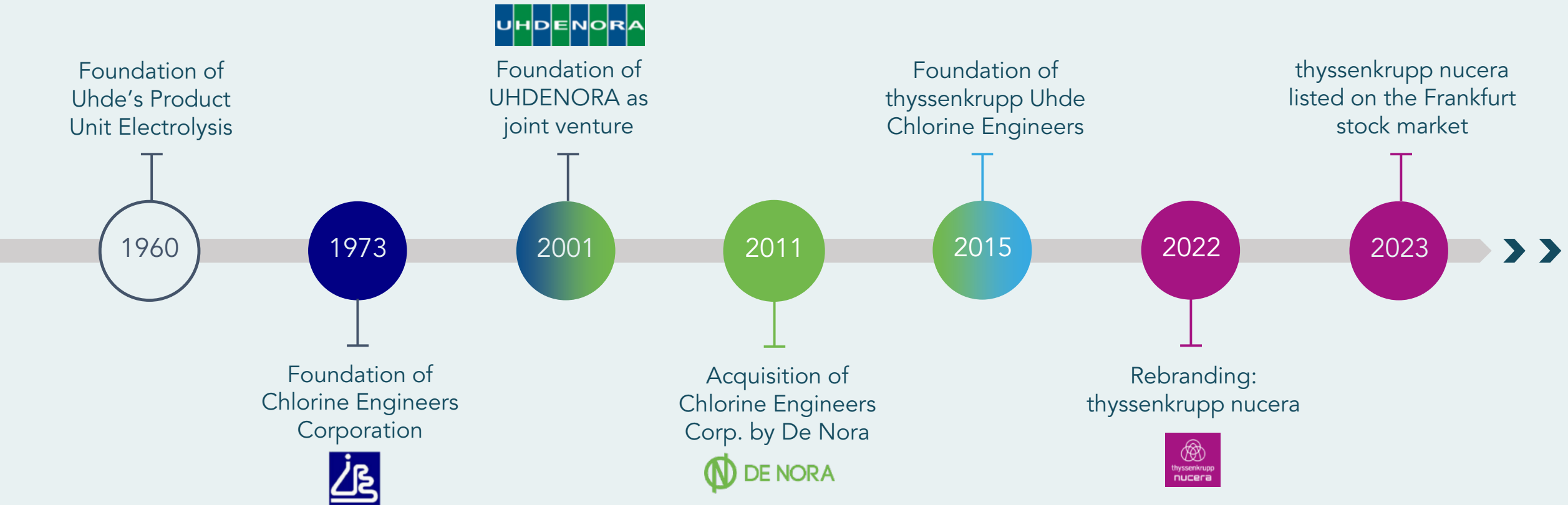
### GOVERNANCE ETHICS & COMPLIANCE

- 90% of employees trained on anti-corruption
- Human Rights Policy adopted
- 20% target ESG in CEO remuneration



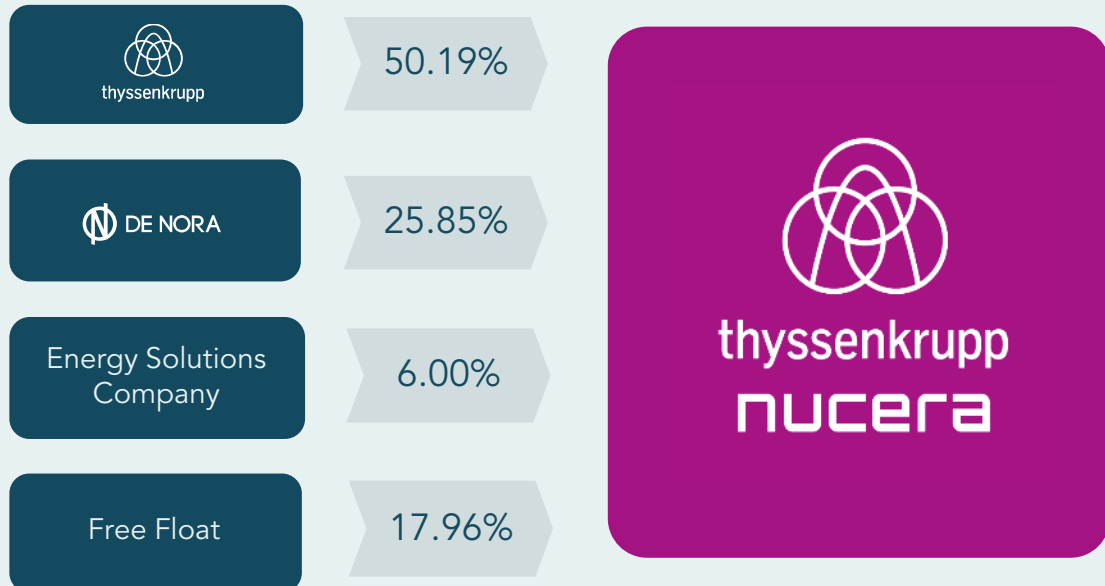
1. Membrane, Pools and Electrochlorination, Alkaline Water Electrolysis.

# Bringing together the collective expertise of renowned global electrolysis leaders



# We are the Alkaline Water Electrolysis (AWE) and Chlor-Alkali (CA) technologies provider globally


## Shareholder structure post-IPO



### CA

Order backlog Dec '23:  
~0.5bn €


Select CA Customers



### AWE

Order backlog Dec '23:  
~0.9bn €

Select AWE Customers



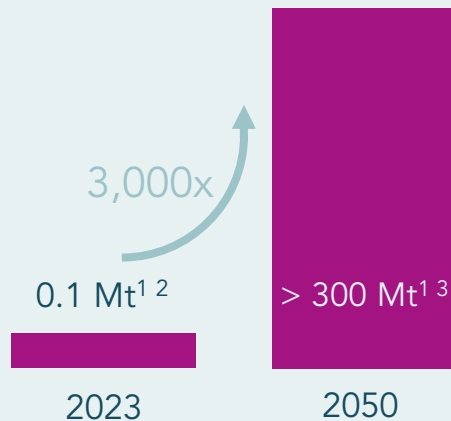


# Green hydrogen market is expected to grow 3,000-fold by 2050

Globally accelerating demand for gH2 creates significant growth opportunity for electrolyser OEMs

3 main drivers shape the global markets

Green hydrogen amount (p.a.)



Hydrogen demand



Renewable energy supply



Governmental support

Electrolyser manufacturing capacity needs to significantly increase to fulfil strong demand growth

1. Energy content of 1 kg of hydrogen is 141.9 MJ (HHV) = 39.4 kWh 2. Produced amount of green hydrogen in 2023. Source: IEA (2023), Global Hydrogen Review, Figure 3.1, <https://iea.blob.core.windows.net/assets/ecdfc3bb-d212-4a4c-9ff7-6ce5b1e19cef/GlobalHydrogenReview2023.pdf> 3. Expected annual amount of green hydrogen to achieve climate neutrality. Source: IEA (2023), Net Zero Roadmap, Figure 3.21, <https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach>



>60GW

overall project pipeline<sup>1</sup>



>19GW

actively pursued projects<sup>2</sup>



3GW+

contracted



>1.5GW

annual AWE capacity



0.9bn€

AWE order backlog



1. Includes actively pursued projects and substantial pipeline, i.e. projects which thyssenkrupp nucera had first interactions with and that are being monitored closely. 2. Projects which already passed the pursue / non-pursue gate. 3. Capacity reservations.



750+

employees  
worldwide



600+

electrochemical projects  
delivered



653mn€

Group sales in FY 22/23



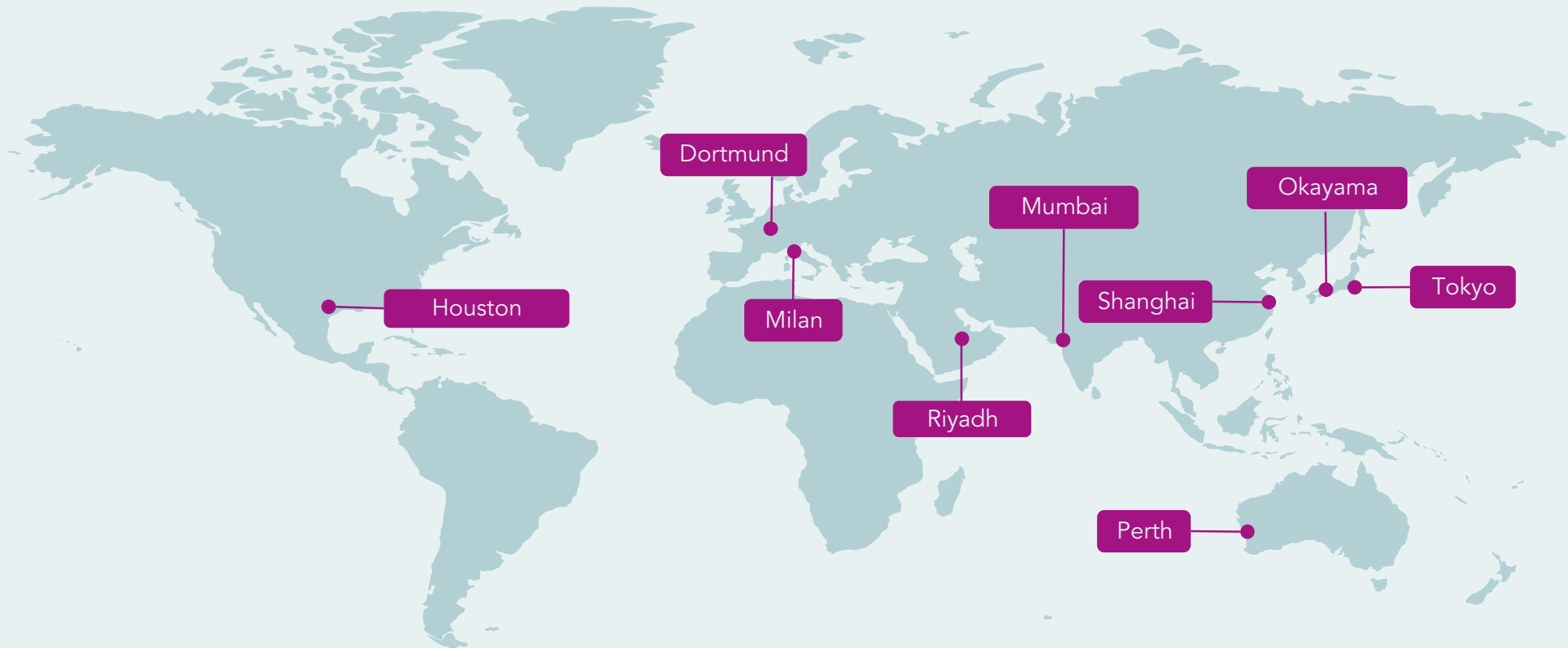
>6x

AWE sales growth in FY  
22/23



761mn€

Net financial assets  
(31 Dec '23)



# Our way forward: strategic focus areas



## Maximize growth & profitability

Capacity expansion

Process automation & serial fabrication

Strategic partnerships & diversification

Organizational ramp-up

Best in class in CA market

Preferred cost-efficient AWE technology



## Leading competitive position & resilient operations

# Full commitment to sustainability and responsible business

ESG strategy is reflected in 4 action fields

1 Sustainable value chain



2 Ethical business development



3 Sustainable product



4 Great place to work



Reporting timeline

FY 22/23

Ensure GRI<sup>1</sup>-readiness

FY 23/24

Publication of GRI report & carbon reduction goals

FY 24/25

Publication of integrated financial and ESG report according to ESRS<sup>2</sup>

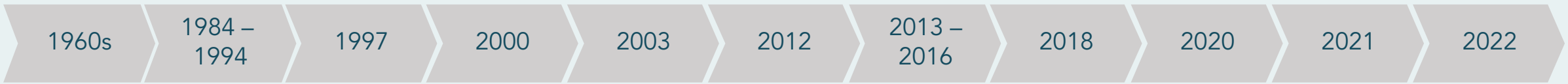
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# Let's dive into our technologies!

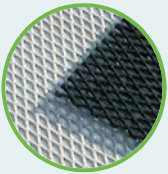



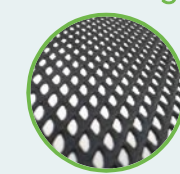
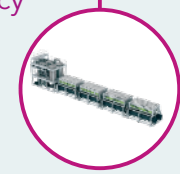


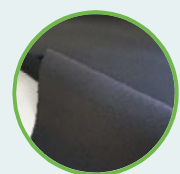


# Leading Innovation

## Power Consumption ↘



## Current Density (specific production capacity) ↗

<p><b>DSA@ anodes</b></p> 	<p><b>BiTAC</b> First zero-gap cell making 6kA/m<sup>2</sup></p>	<p><b>Advanced coating for chlor alkali (i.e., NRG® electrodes)</b></p> 	<p><b>HCl-ODC<sup>2</sup></b> First industrial reference plant energy saving hydrochloric acid recycling</p> 	<p><b>NaCl-ODC<sup>2</sup></b> Market Entry 25% energy saving CA electrolysis</p> 	<p><b>New coatings family for chlor-alkali (performance and cost improvement)</b></p> <p><b>Green Hydrogen New coatings</b></p> 	<p><b>e-BiTac v7 and BM Gen. 6plus</b> Latest high efficiency electrolyzers</p> 	<p><b>1 GW p.a. fabrication</b> De-bottlenecked production of 15,000 cells p.a.</p> <p><b>CFI</b> First project on increased capacity scalum® 20 MW module</p> <p><b>Launch of new electrodes for Energy Transition (AWE)</b></p>	<p><b>Completion of the first scalum® 20 MW module</b></p> 
<p><b>BM</b> First Single Element Bipolar Membrane electrolyzers</p> 	<p><b>BM single element Gen.3</b> First laser-welded cell, internals made possible acidified operation</p>	<p><b>GDE<sup>3</sup> for HCl-ODC electrolyzers</b></p> 	<p><b>BM single element Gen.6</b> First Full Zero-Gap cell incl. flexible elastic element and combined with independent sealing</p>	<p><b>Carbon2Chem AWE</b> (Hydrogen) Demo Plant 2 MW (stack portion of 10 MW unit)</p>				

# Strong technology basis for AWE scale-up



## Chlor Alkali

- > 600 projects
- 240,000 cell elements
  - ~1,500,000 sqm. for new building
  - ~5,000,000 sqm. for service
- >10 GW of capacity installed





# Industry-leading electrolyzer cell

## thyssenkrupp nucera

Design of cell, electrolyzer and balance of plants

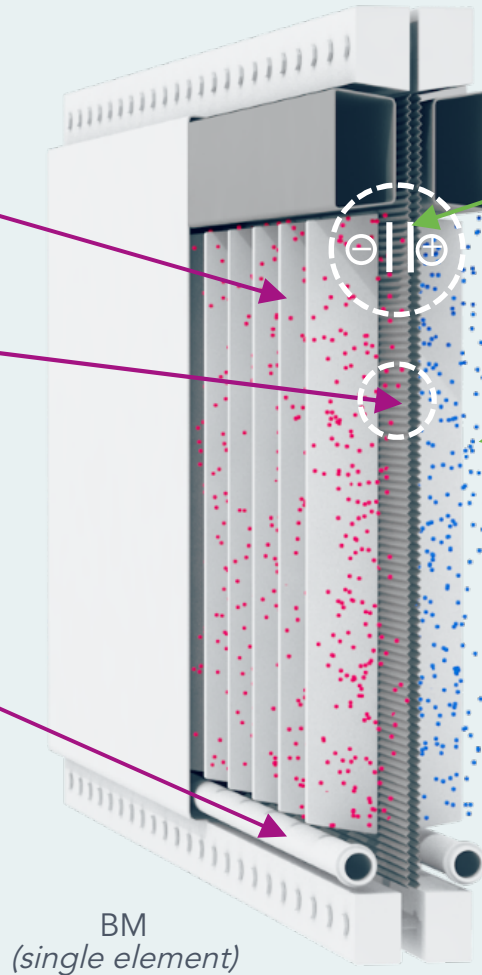


Selection of separator (membrane/diaphragm)



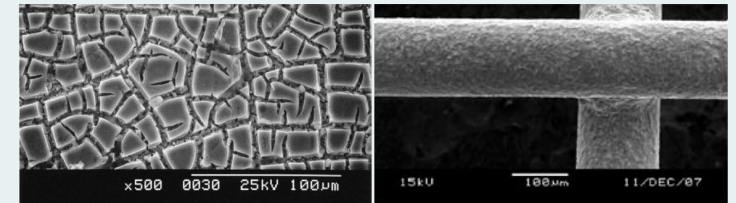
Other parts including:

- Selection of corrosion resistant materials
- Current distribution & electrical contacts
- Gas-liquid fluids handling & distribution
- Sealing
- Adaptations for different operating conditions, procedures, concepts (e.g. with or without ODC)



## De Nora

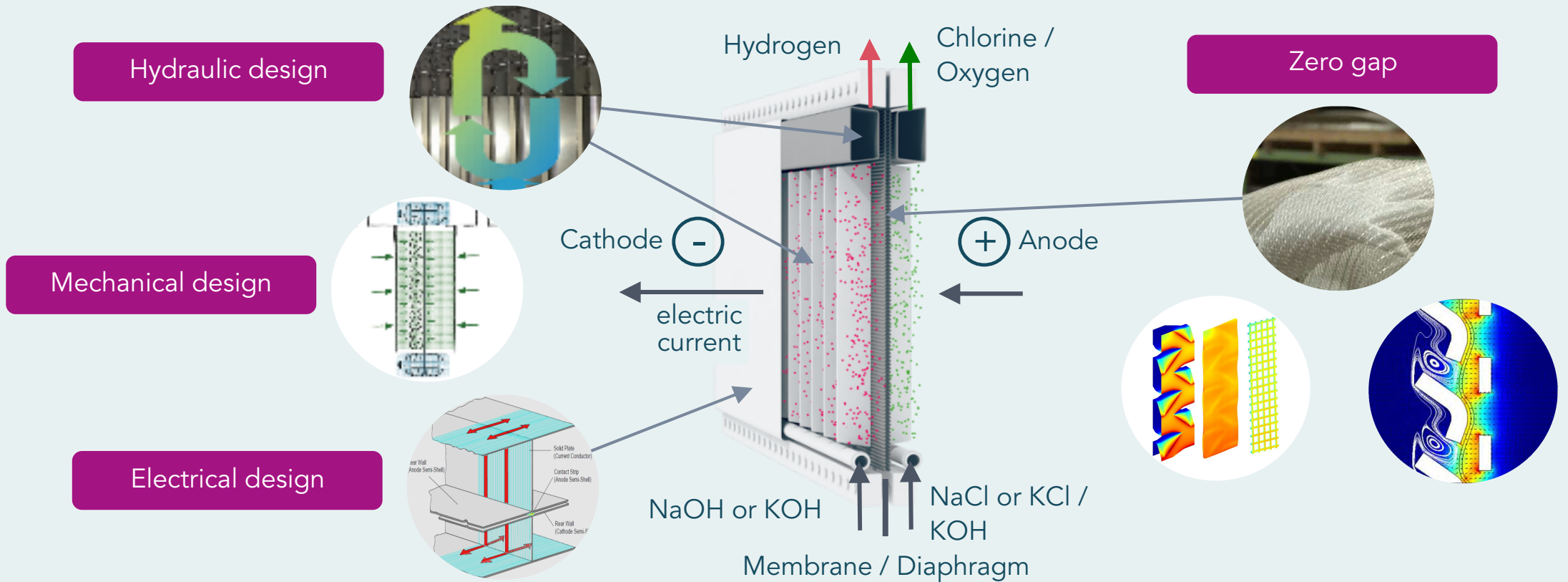
Anode and cathode catalytic coatings, and GDEs



Manufacturing of half-shells



# thyssenkrupp nucera's unique technology with leading design

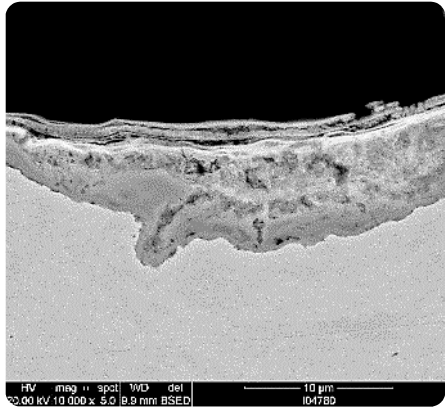


Know-how and technologies needed for implementing effectively high current density and high efficiency

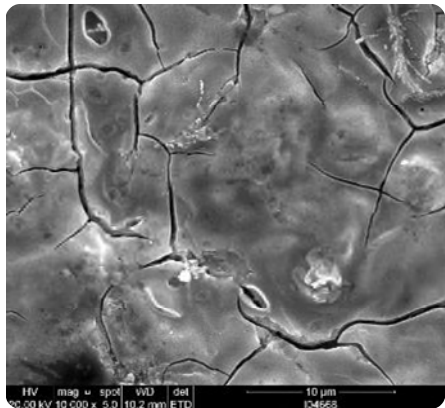
# De Nora electrocatalysts design

Chemical composition, structure definition, and manufacturing details of the coated electrodes

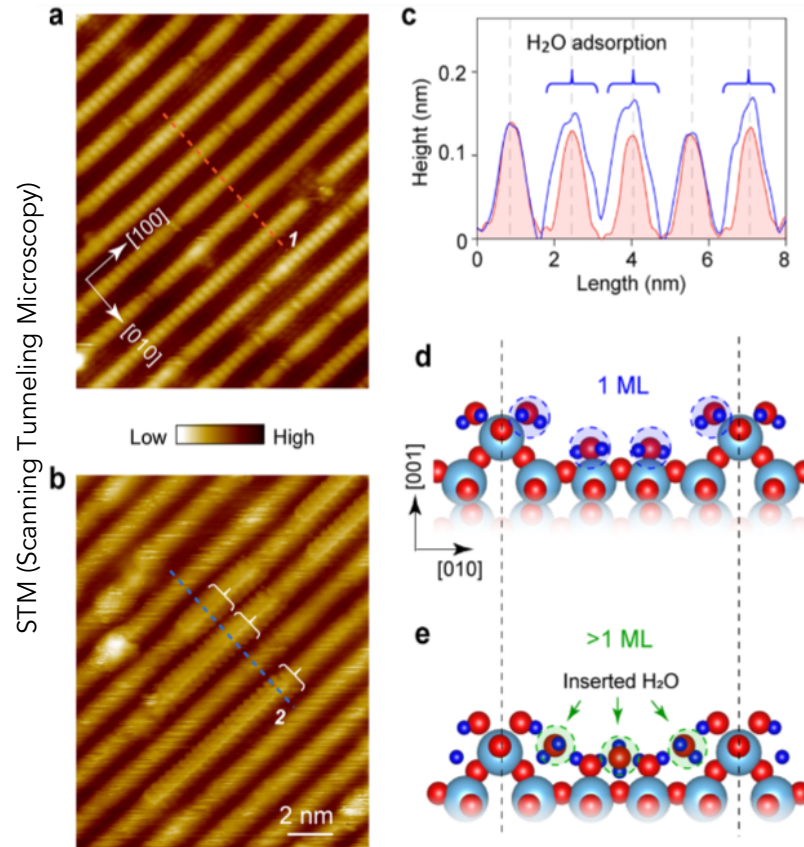
CROSS SECTION



FRONT IMAGES

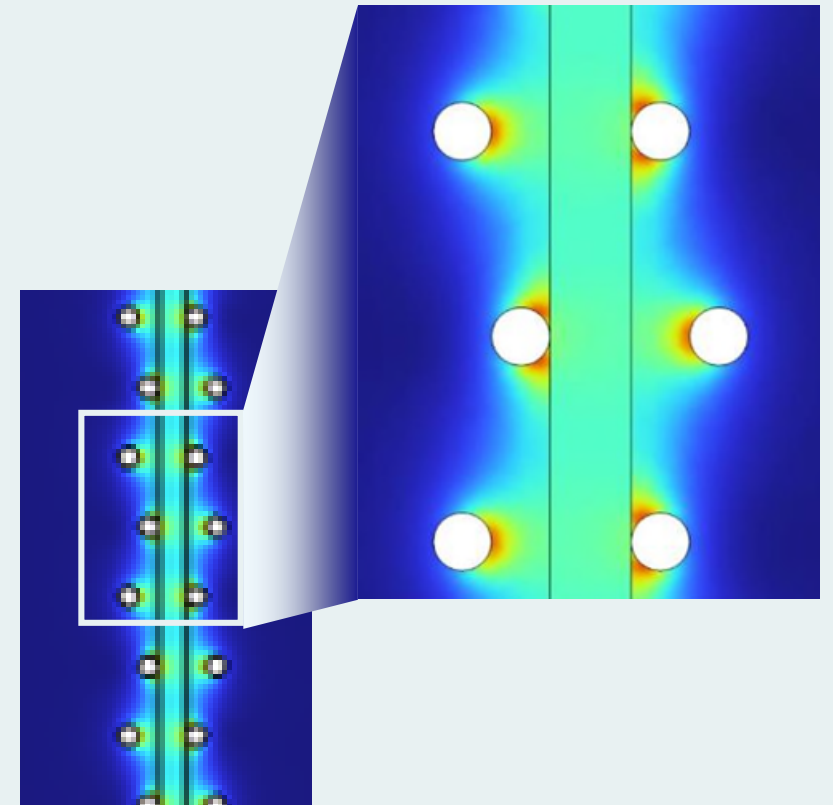


SEM analysis of a DSA® electrode  
Magnification: 10 000x



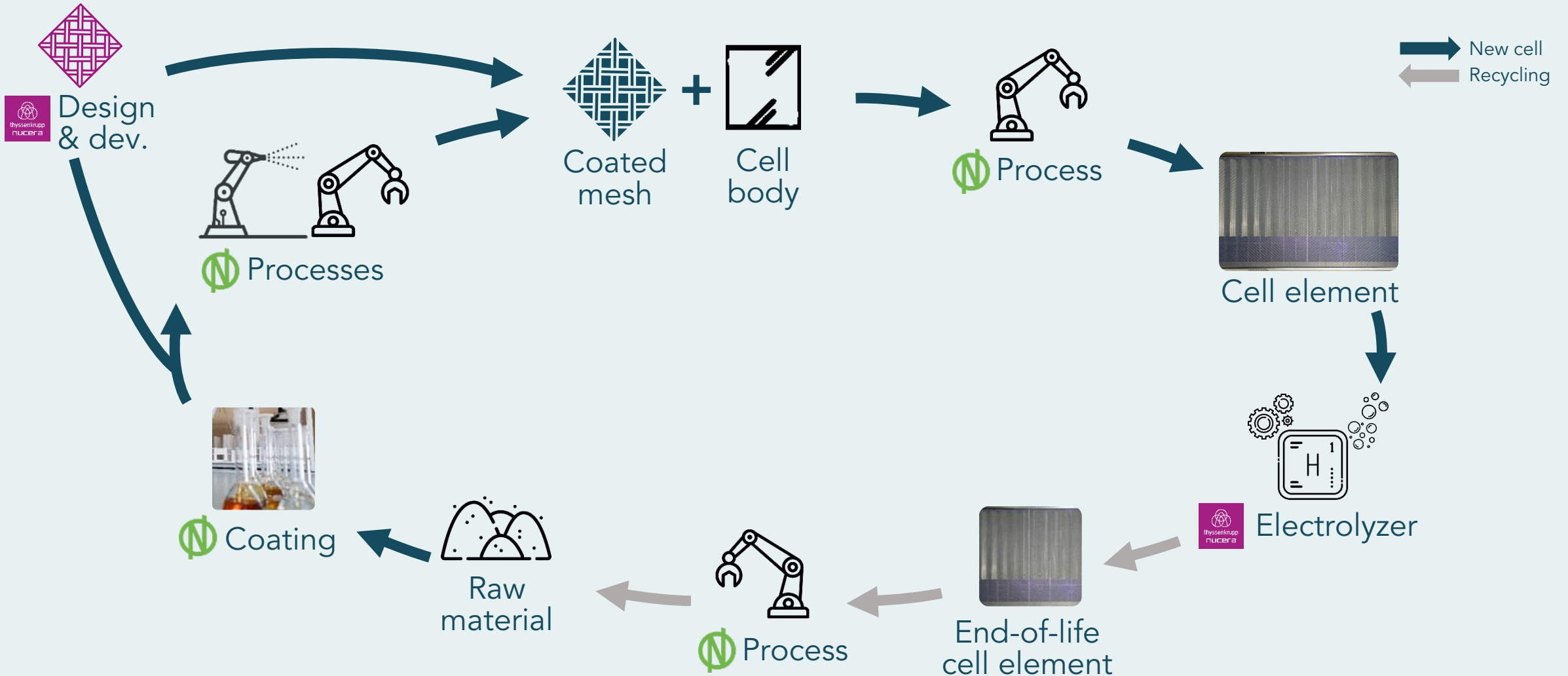
Xiaochuan et al. (2022): Hydrogen-Bond Network Promotes Water Splitting on the TiO<sub>2</sub> Surface, *JACS*

Current distribution during operation defining catalyst distribution on the final electrode

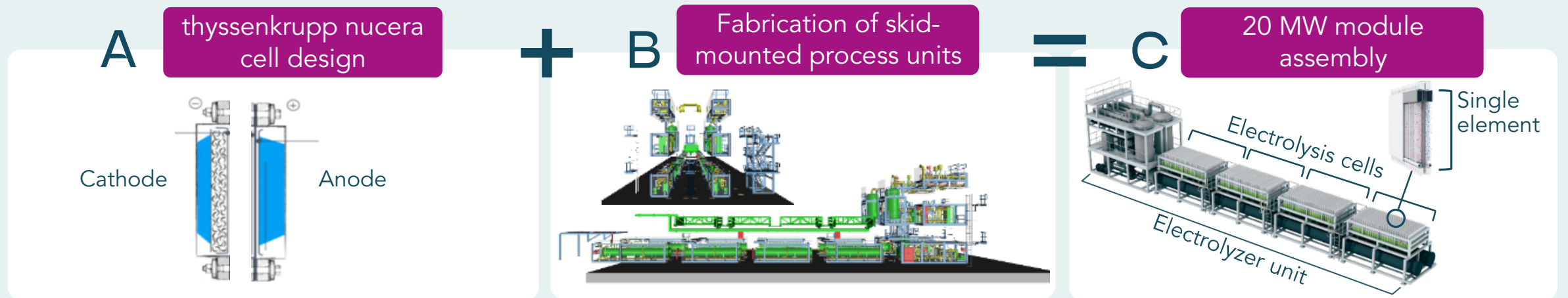


Finite Element Analysis – Model (Femlab®)

# Cell manufacturing & circular economy



# thyssenkrupp nucera provides meaningful value-add across each step of the manufacturing process



thyssenkrupp nucera supply chain of cell components:

- Half shells manufacturing according to thyssenkrupp nucera's IP design (De Nora)
- Electro-catalytic coating and production techniques (De Nora)
- Other cell components (e.g. separator / diaphragm, gasket frames and sealing, bolted flange, insert and distribution pipes, fittings and hoses for connection to the headers)

thyssenkrupp nucera supply chain of process & plant equipment:

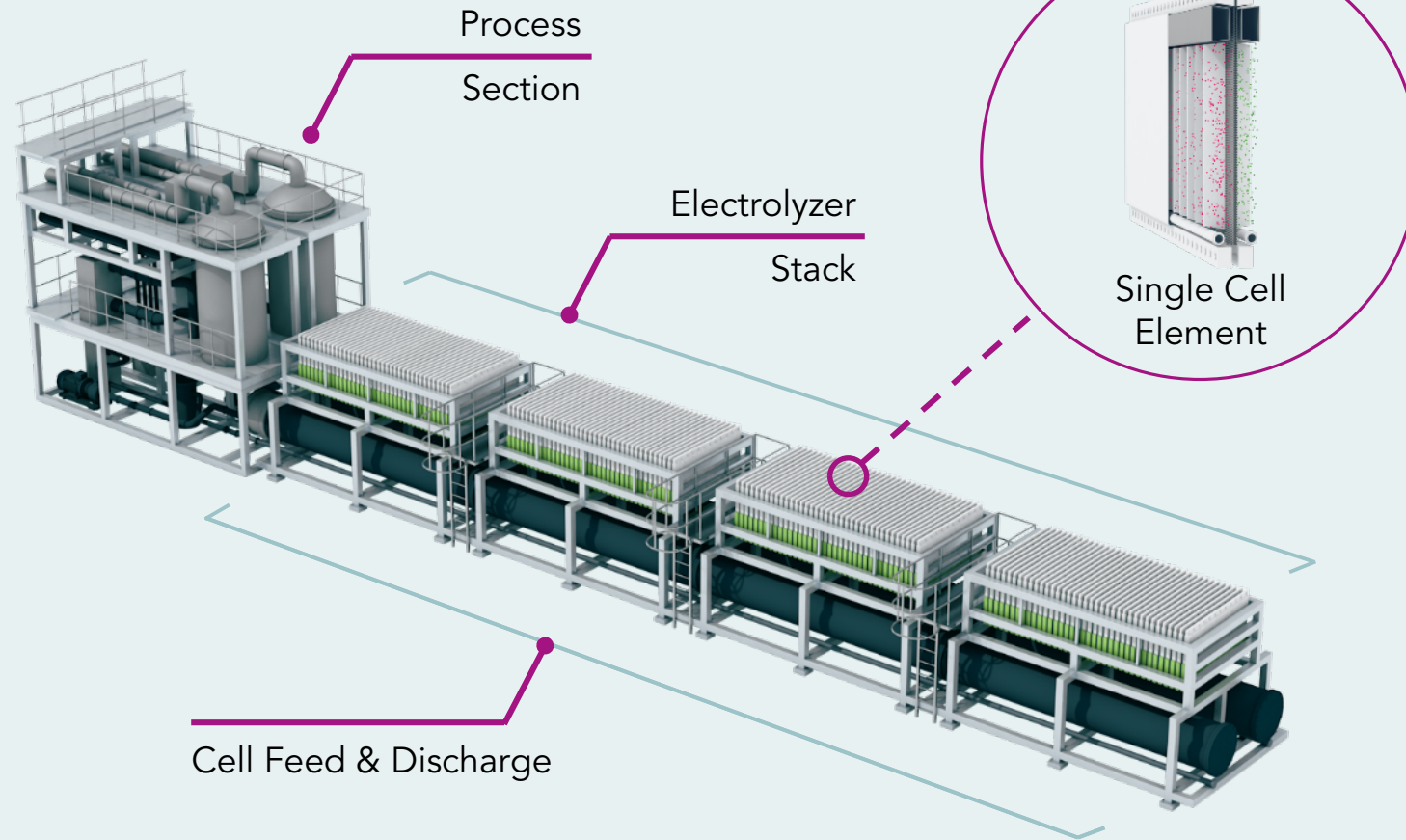
- Tanks, pumps, filters
- Piping, valves & heat exchangers
- Electrical, instrumentation and control
- Power electronics

thyssenkrupp nucera assembly:

- Assembly of cells at customers' site or at thyssenkrupp nucera workshop
- Assembly of process units at customers' site

thyssenkrupp nucera's AWE business follows a holistic serial fabrication concept to capture demand

# scalum<sup>®</sup> | Our technology for industrial-scale roll-out

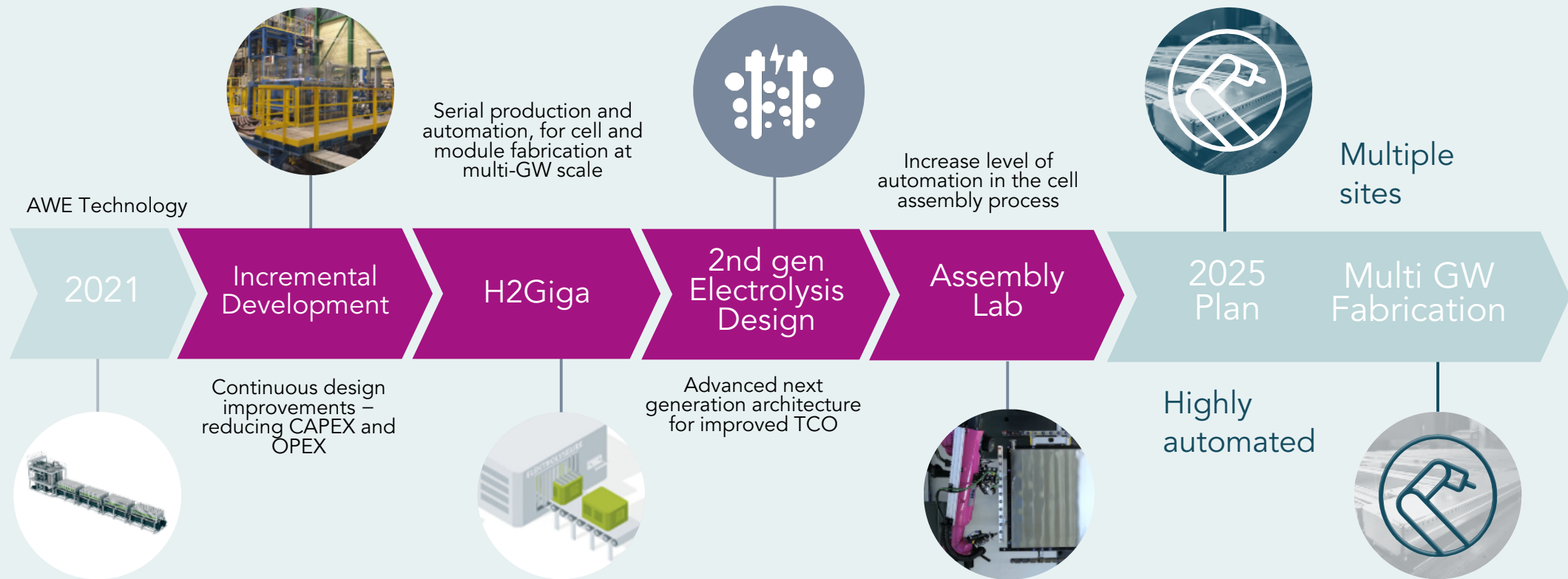


- ✓ Safety | Explosion-proof cells as confirmed by the Federal Institute of Materials Research & Testing
- ✓ Quality & Longevity | Proven cell design
- ✓ Sustainability | Low power consumption
- ✓ Fast dynamics | Suitable to renewable power sources
- ✓ Leading total cost of ownership (TCO)
- ✓ Compact footprint | High current density
- ✓ Service | Global service network with partners
- ✓ Certified design | Certified by TÜV Rheinland to meet requirements of chapter 4 of ISO 22734:2019

# Gigawatt technology for the energy transition



# thyssenkrupp nucera's dedicated product development roadmap





# De Nora development



- Sustainable coatings for chlor-alkali and other industries (low power consumption)
- Lower critical metal content for Energy Transition business
- Exploring new cutting-edge technologies sustaining decarbonization and energy storage
- New manufacturing technologies to sustain serial production on a GW scale

# Manufacturing Excellence

From *single* to *thousands* of cells,  
ensuring:



Replication



Quality



Efficiency



# Manufacturing expansion

Increase existing plants' capacity with automation and technology upgrades. Energy Innovation Center



Synergic plan of expansion for China & Japan. Multi-year scalable project



Okayama expansion ongoing



Strengthen further manufacturing set-up in Germany to enhance Energy Transition productivity

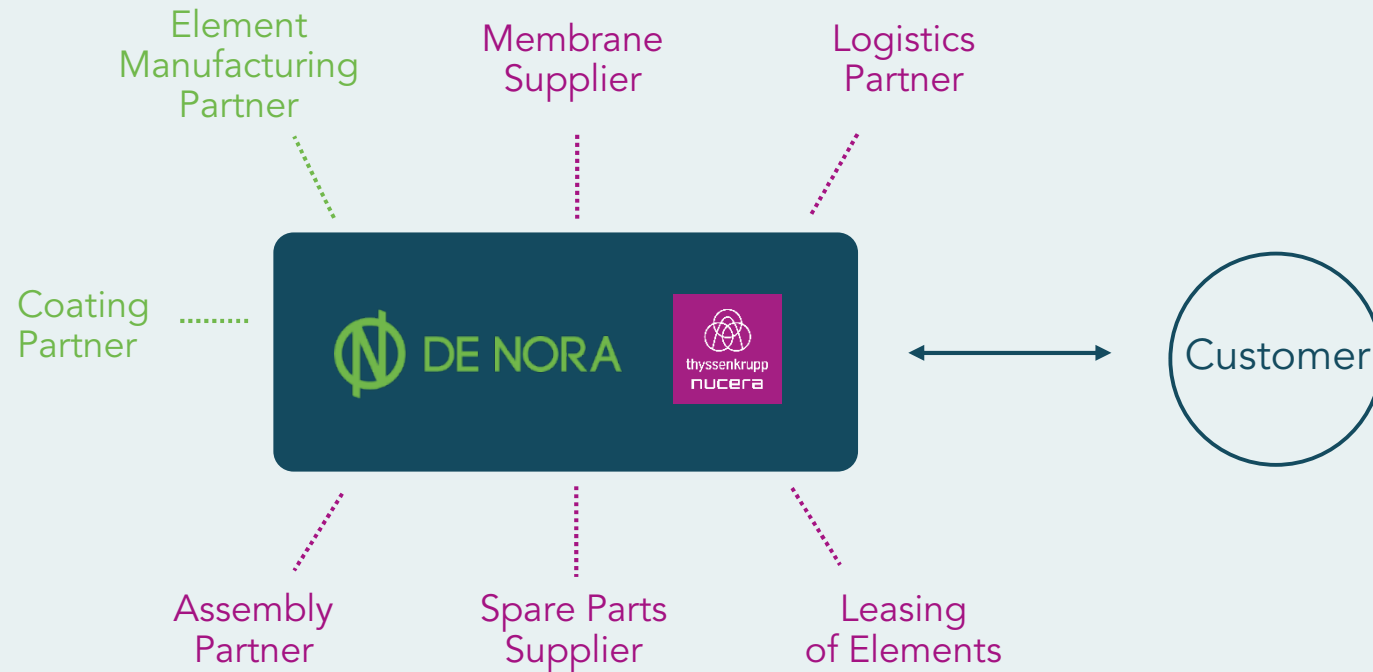


2023: 2.5 GW eq. elements

2026E: 4.5 GW eq. elements

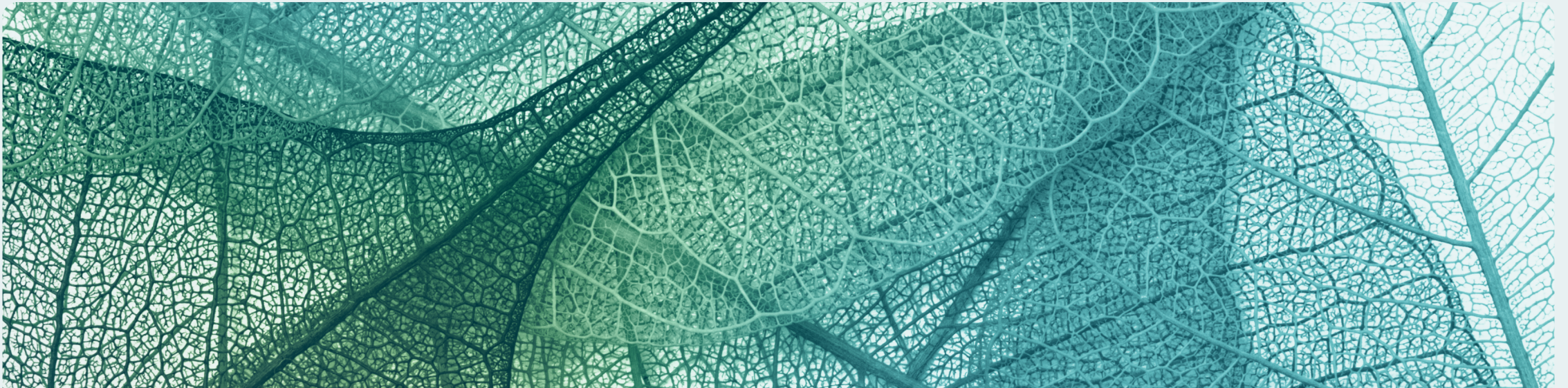
# Full-service solutions from a strong partnership

-  Element Recoating
-  Element Upgrade
-  Element Exchange
-  Various other maintenance & revamp activities



# Together we drive the green H<sub>2</sub> market

- 1 Deep knowledge, long-standing expertise, and strong strategic partnership
- 2 Global leadership in electrodes, electrolyzers technologies, and R&D
- 3 Clear commercial leadership
- 4 Manufacturing excellence and largest capacity globally
- 5 Strong balance sheet to finance future growth
- 6 Industry-leading project pipeline driven by high demand for green H<sub>2</sub>



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# Thank you

