



Nel Hydrogen Electrolyser


The world's
most efficient
and reliable
electrolyser

Number one by nature

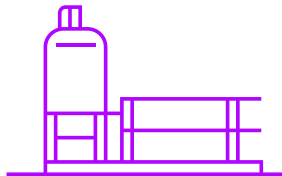
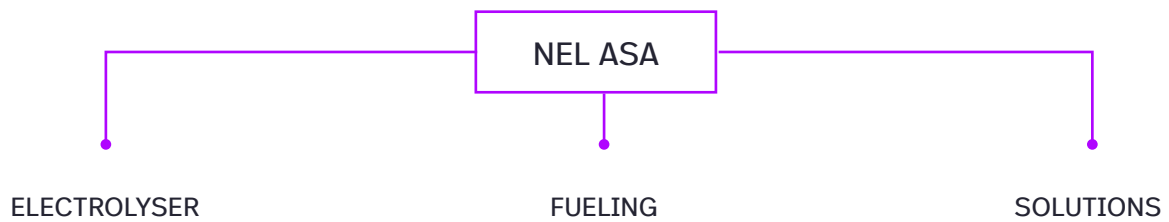
The world's hydrogen enabler

Nel is a global, dedicated hydrogen company, delivering optimal solutions to produce, store and distribute hydrogen from renewable energy. We serve multiple industries as well as energy and gas companies with leading hydrogen technology.

Pioneering renewable hydrogen for nearly a century



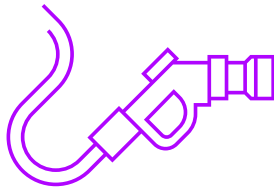
| | |
|------|---|
| 1927 | Building of the first small electrolyser installation at Norsk Hydro at Notodden, Norway. Testing for pure hydrogen for fertilizer production. |
| 1929 | World's largest installation of water electrolyzers at Rjukan, Norway. Increasing over time to 3 plants and 440 electrolyzers, exceeding 60,000 Nm ³ /hour. Sourced by hydropower. |
| 1953 | Creation of a second large-scale hydropowered electrolyser plant for supplying hydrogen for ammonia production in Glomfjord, Norway |
| 1974 | Our renowned electrolyser technology made available for other companies and other industries |
| 1988 | The world's first electrolyser supplier to provide non-asbestos alkali electrolyzers |
| 2003 | Nel opens the world's first publicly available hydrogen fueling station in Reykjavik, Iceland |
| 2004 | The world's first Power-to-Power demonstration project at the island of Utsira, Norway, enabling power to 10 households from stored hydrogen produced by excess wind power |
| 2014 | Nel becomes the first 100% dedicated hydrogen company listed on the Oslo Stock Exchange |
| 2015 | Nel acquires H2 Logic, adding world leading hydrogen fueling technology to the product portfolio |
| 2016 | Initiates construction of the world's largest manufacturing plant for hydrogen fueling stations, with a capacity of 300 units per year |



Nel Hydrogen Electrolyser

The most efficient and reliable electrolyser in the world

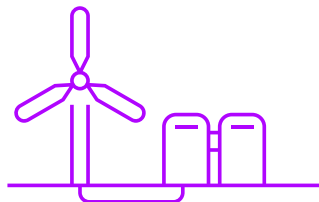
With more than 850 medium and large scale electrolysers delivered, Nel is the world leading company for alkaline water electrolysis. Since our foundation in 1927, sustained R&D efforts have contributed to continual improvement of electrolyser technology, setting the benchmark in the market. Our electrolysis technology is today widely respected for its robustness, reliability and energy efficiency.



Nel Hydrogen Fueling

The pinnacle of hydrogen fueling technology

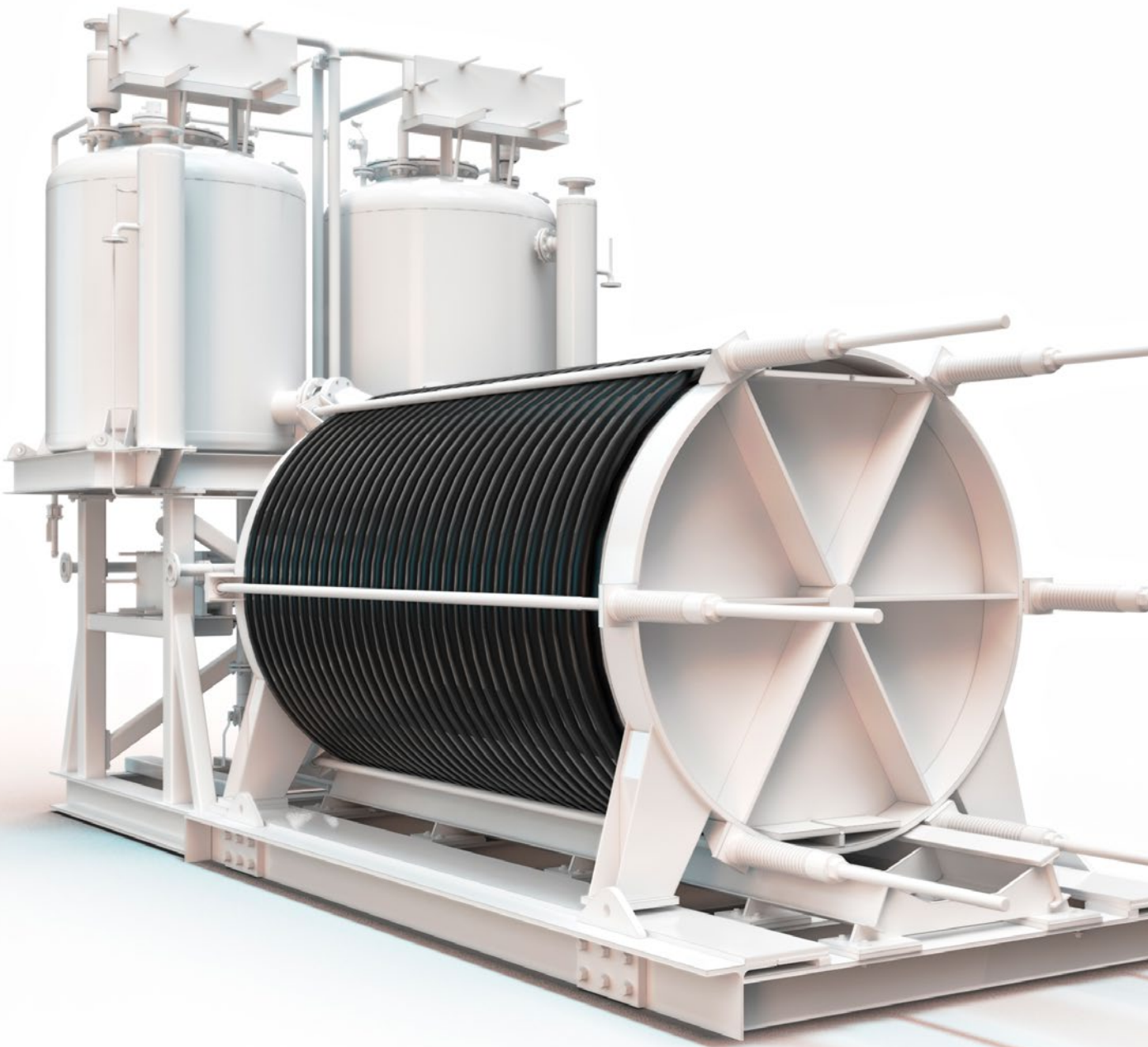
Nel Hydrogen Fueling (formerly H2 Logic) is a leading manufacturer of H2Station® hydrogen fueling stations, that provide FCEVs with the same fast fueling and long range as conventional vehicles. Since incorporating in 2003, Nel Hydrogen Fueling has invested significantly in R&D, bringing H2Station® to a level where products are offered to the early market for roll-out of larger networks of hydrogen fueling stations.



Nel Hydrogen Solutions

Unified delivery of complex renewable hydrogen solutions

As the world turns to renewables, a growing number of hydrogen-based applications are emerging. Our extensive experience with industrial electrolysis and hydrogen fueling represents new opportunities for proven Nel technology and products. Nel Hydrogen Solutions offers efficient system integration, project development and sales across segments and is the only provider of integrated solutions along the entire value chain. Nel industry experts also provide solutions for operations, maintenance, ownership and financing.



Unrivalled electrolyser performance

Nel Hydrogen is the recognised global industry leader in alkaline water electrolyzers. Our water electrolyzers offer a superior choice for industry, power-to-gas and power-to-power applications. The product ranges are sure to meet any customer requirements.



A A-RANGE

The world's most energy efficient electrolyzers, with a cell stack power consumption of down to 3.8 kWh/Nm³ H₂, up to 2.2 MW per stack / 1000 kilos per day.

KEY FEATURES

- Highest efficiency
- Minimum maintenance
- Seamless capacity scaling
- Built for future expansion
- Automatically controlled



C C-RANGE

The re-designed robust, containerised electrolyser solution. Offering the world's smallest footprint for high capacity electrolyser plants at 200 bar.

KEY FEATURES

- Turnkey solution. Easy to install and to move.
- Low-cost, minimum of site preparation
- Large capacities, small footprint
- Unattended, effortless to operate
- 200 bar output pressure, wrapped in a simple design

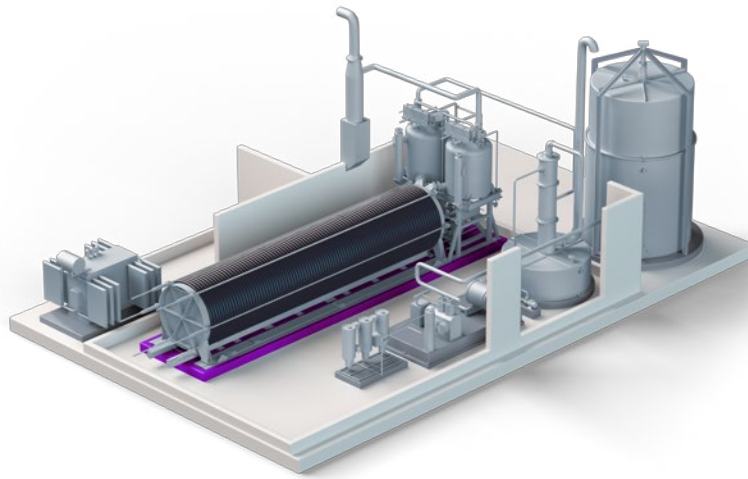
A

A-RANGE

Tailored Solutions

Atmospheric Alkaline Electrolyser

The Nel A-Range represents the most reliable and efficient electrolyzers in the world. Our modular concept enables us to deliver customised indoor hydrogen solutions for any application, configuration and size - anywhere. Nel tailors each delivery to any customer requirement, from complete installation of the entire electrolyser plant, to delivery of specific modules according to customer preferences.



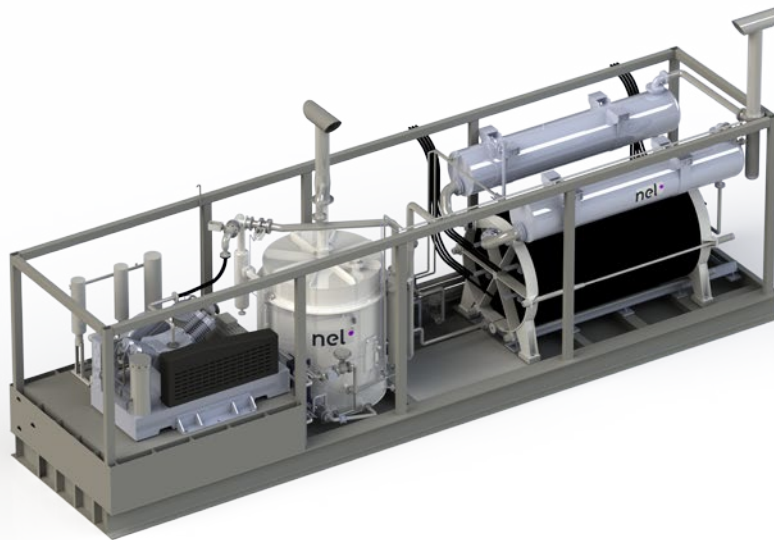
SPECIFICATIONS

| | Nel A-150 | Nel A-300 | Nel A-485 |
|--|--|---------------------------------|---------------------------------|
| Capacity range per unit (Nm ³ H ₂ /hr) | 50-150 | 150-300 | 300-485 |
| Production capacity dynamic range | 15 - 100% of flow range | | |
| DC power consumption | 3.8 - 4.4 kWh/Nm ³ | | |
| H ₂ purity (%) | 99.9 ± 0.1 | | |
| <i>After purification</i> | | | |
| O ₂ -content in H ₂ | < 2 ppm v | | |
| H ₂ O-content in H ₂ | < 2 ppm v | | |
| O ₂ purity (%) | 99.5 ± 0.2 | | |
| H ₂ outlet pressure electrolyser | 200 mm WG | | |
| H ₂ outlet pressure after compressor | Flexible range; 1 bar g - 200 bar g | | |
| Dimensions/footprint | Flexible/ ~150m ² | Flexible/ ~200m ² | Flexible/ ~225m ² |
| Operating temperature | 80°C | | |
| Electrolyte | 25% KOH aqueous solution | | |
| Feed water consumption | 0.9 litre / Nm ³ H ₂ | | |

- Tailored to any demand
- Scaled to any capacity
- Highest reliability in the world
- More efficient than any other electrolyser

Containerised Alkaline Electrolyser

The Nel C-Range wraps world-class electrolyser technology in containers, for fast and robust outdoor installations. This innovative, compact design makes a superior turnkey solution, with an output pressure of 200 bar. Typical applications include hydrogen fueling stations and redistribution of hydrogen for industrial gas companies.

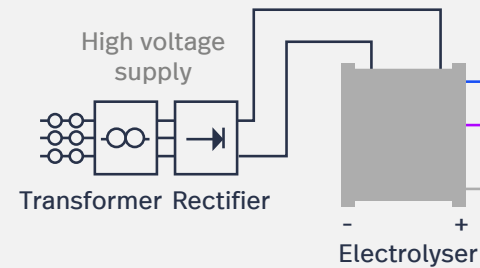


| SPECIFICATIONS | Nel C-150 | Nel C-300 |
|--|--|-------------------|
| Capacity range per unit (Nm ³ H ₂ /hr) | 150 | 300 |
| Production capacity dynamic range | 15 - 100% of flow range | |
| DC power consumption | 3.8 - 4.4 kWh/Nm ³ | |
| H ₂ purity (%) | 99.9 ± 0.1 | |
| <i>After purification</i> | | |
| O ₂ -content in H ₂ | < 2 ppm v | |
| H ₂ O-content in H ₂ | < 2 ppm v | |
| O ₂ purity (%) | 99.5 ± 0.2 | |
| H ₂ outlet pressure | 30 bar g / 200 bar g | |
| Dimensions (l x w x h) | | |
| Container 1 | 12m x 2,9m x 3,6m | 12m x 2,9m x 3,6m |
| Container 2 | 9m x 2,9m x 3,2m | 9m x 2,9m x 3,2m |
| Container 3 | | 9m x 2,9m x 3,2m |
| Operating temperature | 80°C | |
| Electrolyte | 25% KOH aqueous solution | |
| Feed water consumption | 0.9 litre / Nm ³ H ₂ | |

- Turnkey for quick and easy start-up
- Large capacity at minimum footprint
- Unattended and effortless operation
- High pressure for storage and distribution

The Process & The Hydrogen Plant

Nel electrolyser plants all consist of standard modules of proven technology, critical for a hydrogen production process that is efficient, safe and reliable:



TRANSFORMER / RECTIFIER

The transformer and rectifier convert the AC high voltage supply into DC current input.

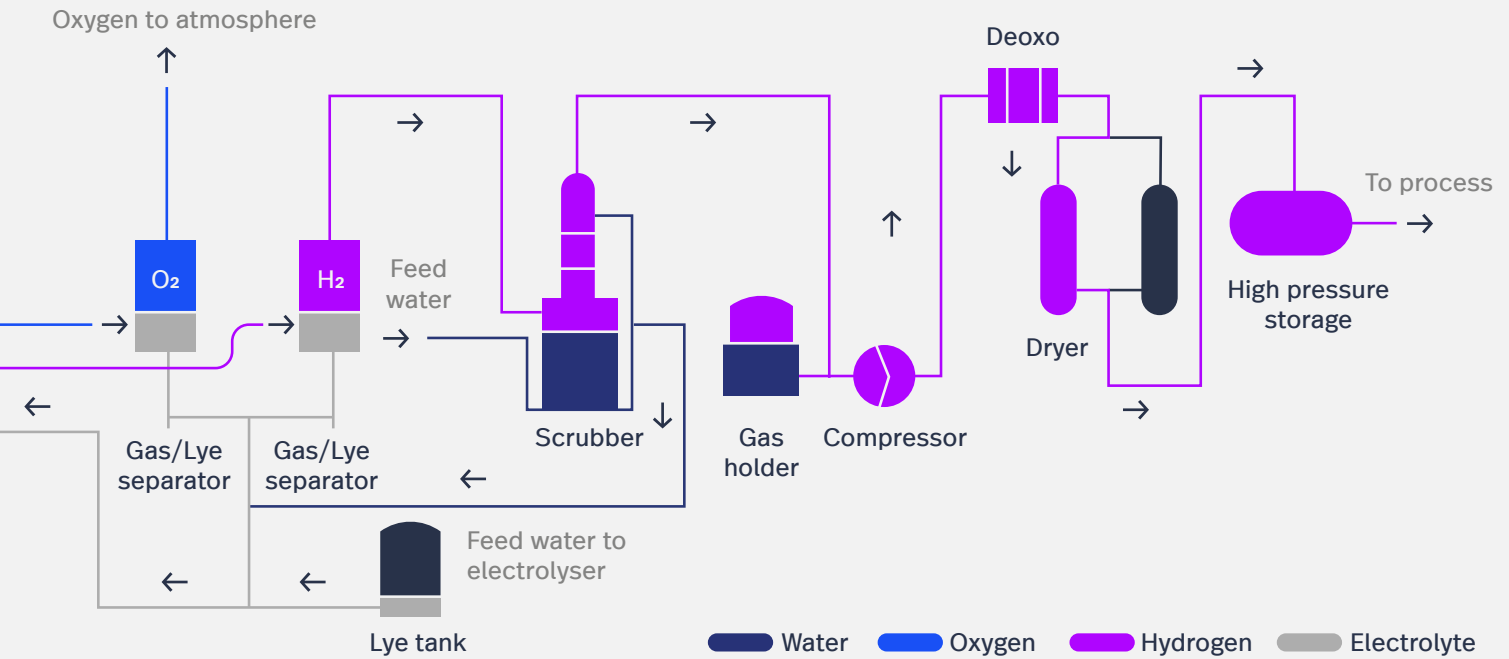
ELECTROLYSER

The electrolyser is of the filter press type with bipolar electrodes separated by non-asbestos diaphragms. Hydrogen gas is generated at the cathode and the oxygen gas at the anode.

ELECTROLYTE SYSTEM

This module consists of two gas separators and the electrolyte recirculation system. The electrolyte is recovered in the separators, then chilled and recycled into the cell block.

Electrolysis is the process of splitting the water molecule into hydrogen and oxygen using electricity. The inputs to this process are simply feed water and the current supplied to the electrolyser.



SCRUBBER

The scrubber has 3 main functions:

- Remove residual traces of electrolyte
- Cool down the hydrogen
- Feed water tank

GAS HOLDER

The gas holder is a buffer tank installed between the electrolyser and the compressor or the process at site.

COMPRESSOR

If required, a compressor is installed to compress the gas from atmospheric pressure in the gas holder to the pressure required for the process or the storage vessel.

DEOXIDISER

Hydrogen generated in the electrolyser is a very pure gas, saturated with water, and its oxygen content doesn't exceed 0.2%. If higher purity is required, the last molecules of oxygen can be removed by catalytic reaction in a deoxidiser.

DRYER

The dryer will dry the gas to reach the suitable dew point. It consists of twin towers filled with a desiccant to absorb the water.

GAS STORAGE

The gas storage provides a back-up solution or ensures the hydrogen make-up for batch applications with uneven gas consumption.

Large scale H₂ plants

Whether you need large quantities of hydrogen for industrial purposes, or utilisation of excess renewable energy for energy storage – we have experience in both fields!

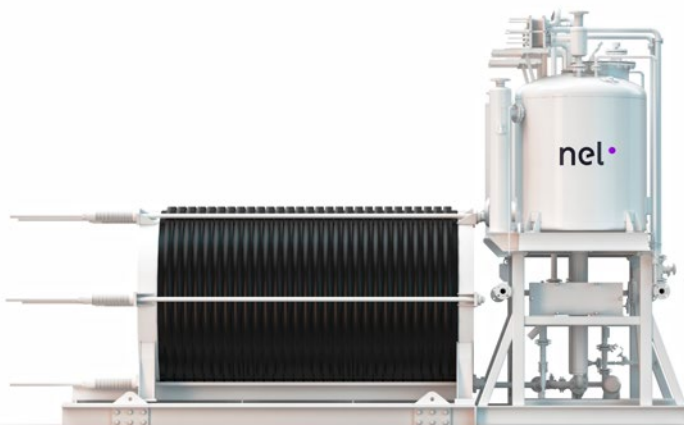
Nel is the acknowledged specialist in large scale electrolyser plants. The very nature of the Nel A-range is seamless capacity upscale from medium to large scale H₂ plants based on water electrolyser technology.

The Nel A-485, installed as parallel units, provide well-proven, highly efficient, reliable and robust technology for multiple MW hydrogen plants.

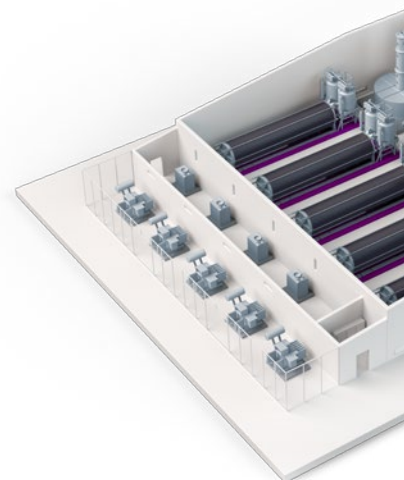
Our experience in large scale plants is exemplified through historical plants exceeding 30,000 Nm³/hr, as well as the recent installation of new plants with an energy capacity of more than 60 MW.



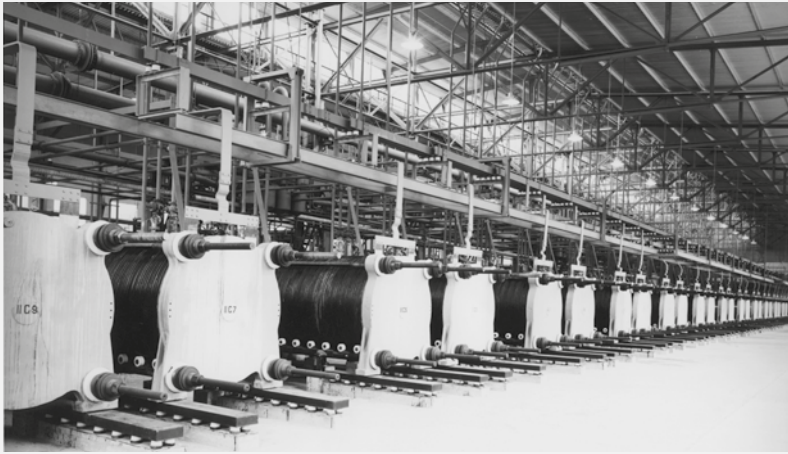
Seamless
capacity scaling



2 MW – 1 unit plant

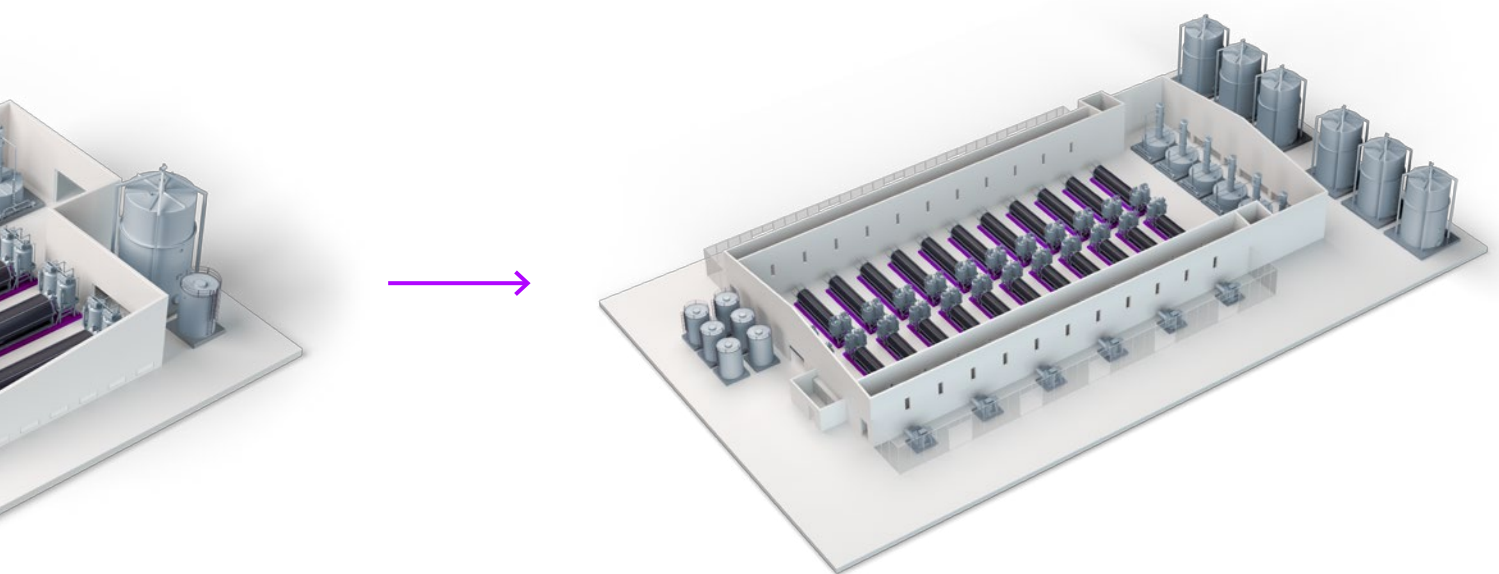
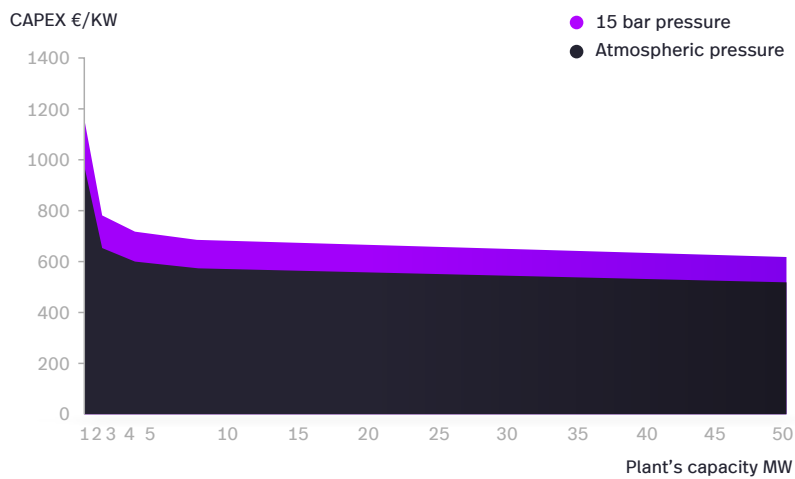


10 MW – 5 unit plant



Case World's Largest Electrolyser Plant

| | |
|--------------------------|------------------------------|
| Location: | Glomfjord, Norway |
| Application: | Ammonia/Fertilizer |
| Owner: | Norsk Hydro |
| Period: | 1953-1991 |
| Electrolysers: | 168 units |
| H ₂ Capacity: | > 30,000 Nm ³ /hr |
| Power requirement: | ~135 MW |



50 MW – 24 unit plant

Our world of electrolyzers

Case studies



Nel Hydrogen Electrolyser
NOTODDEN - NORWAY

Industria de Aceite Fino S.A.

Country: Bolivia
Product: Nel A-300
Capacity: 300 Nm³/hour
Application: Edible Oils & Fats
Installed: 2012

Industrias de Aceite Fino, part of the Peruvian Romero Group, is a manufacturer of edible oils & fats, margarine and soap. In 2012 they modernised their hydrogen-production by replacing five smaller electrolyzers from various manufacturers with a new Nel A-300.

"The refurbished electrolyser plant works perfectly for us. It is very easy and safe in operation compared to what we were used to. In addition we have made savings in our energy costs with this electrolyser."

Cesar Campoverde, Production Manager

Illovo Sugar SA (Ltd)

Country: South Africa
Product: Nel A-485
Capacity: 360 Nm³/hour
Application: Production of Furfuryl Alcohol
Installed: 1983

Illovo Sugar is Africa's largest producer of sugar and downstream products. The hydrogen is used for the production of furfuryl alcohol. During a plant expansion in 1983, a Nel A-485 with a capacity of 360 Nm³/hour hydrogen was purchased and commissioned.

"The original electrolyser is still in operation today and is extremely reliable. The electrolyser runs at full capacity 24 hours a day. No significant maintenance is required on the unit until the planned routine overhaul. Since sanctions were lifted in South Africa, Nel Hydrogen has been providing Illovo Sugar with spares and proficient professional expertise also through the company RTS that was appointed Nel Hydrogen representative in South Africa in 1996."

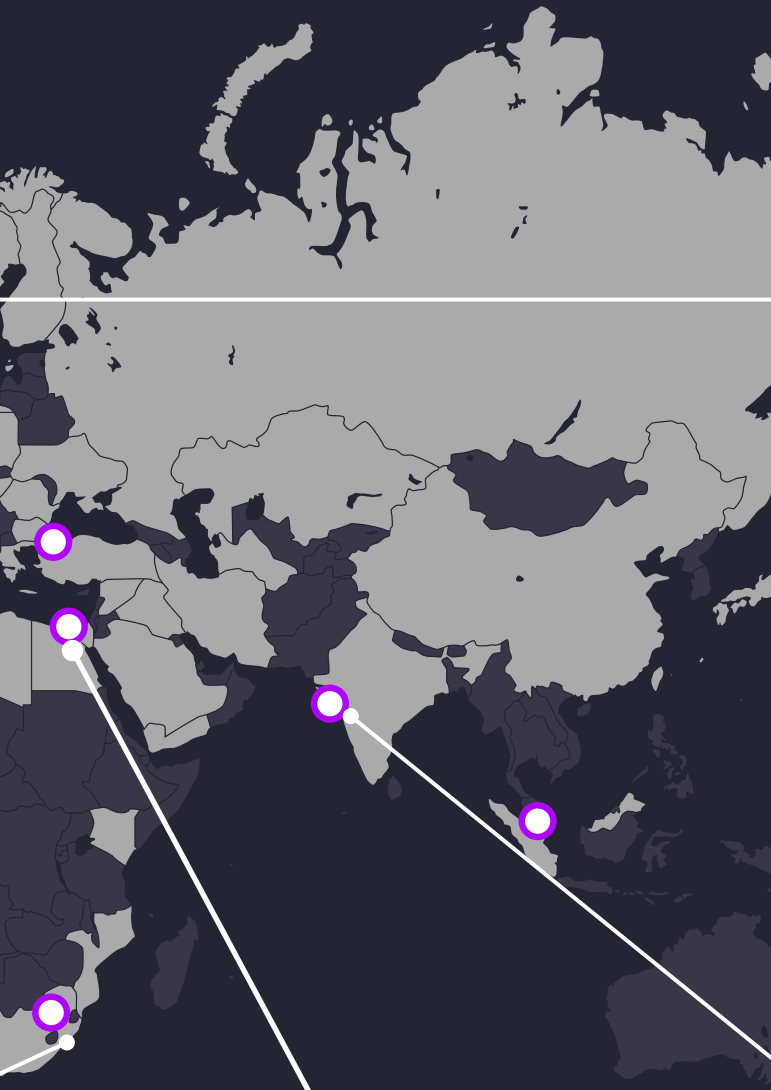
Alastair Warman, Engineering Manager, Downstream Products



Nel sales representatives



Countries with installed Nel electrolyzers



ASKO Midt-Norge AS

Country: Norway
Product: Nel C-150
Capacity: 150 Nm³/hour
Application: Transport – H₂ Mobility
Installed: 2017

Norway's largest grocery wholesaler, ASKO, is committed to becoming climate neutral through zero emission transportation. With more than 600 trucks on the road every day, ASKO is also one of the largest transport companies in the country. At their distribution hub in Trondheim, 3 Scania distribution trucks as well as 10 forklift trucks will run on hydrogen produced by Nel's new containerised unit, the Nel C-150. In addition, a Nel H2Station® with 3 separate dispensers will fuel cars, trucks and forklift trucks.

"ASKO searched the market for producers who have built and commissioned larger hydrogen production plants and fueling station solutions with strong operating results, and after an extensive tendering process the choice fell on Nel."

Jørn Arvid Endresen, CEO, ASKO Midt-Norge.

Reliance Industries Ltd.

Country: India
Product: 2 x Nel A-300, 2 x Nel A-485
Capacity: Total – 1 404 Nm³/hour
Application: Petrochemicals
Installed: 1996, 2005, 2014

Reliance Industries Ltd (RIL) is the largest private sector company in India and operates in a vast number of sectors such as oil & gas, refining, petrochemicals, textiles, retail and communication. Since 1996 RIL has purchased 4 electrolyser units from Nel. The first 3 are installed in Hazira, Gujarat State and the last unit in Dahej, Gujarat State. The electrolyzers installed at RIL's plants serve as a secure back-up and alternative hydrogen source for production of PTA (Purified Terephthalic Acid). PTA is a chemical used primarily in the manufacture of polyester, for clothing and plastic bottles.

Guardian – Egyptian Glass Company

Country: Egypt
Product: Nel A-150
Capacity: 120 Nm³/hour
Application: Float Glass
Installed: 1998

Guardian is one of the major global float glass manufacturers with numerous factories worldwide. As reliable supply of hydrogen is extremely critical for the continuous operation of these large glass factories, many companies install full redundancy on their electrolyser plant. Egyptian Glass has however been relying 100% on one electrolyser only – a Nel A-150.

"Since the start-up of the plant in May 1998, we have enjoyed a stable production with high gas purity, without any problems whatsoever."

Ihab Ishak, Utility Manager

Recognised by our customers

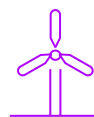
From Ecuador to Japan and from South Africa to Finland: Nel electrolyzers are used by customers in 60 countries across the globe. We are recognised for our reliability among our global, regional and national partner companies across a wide span of industries.



Are you next?

Nel builds each hydrogen plant to customer requirements, delivering complete turnkey solutions or selected modules. We can also assist with operations, maintenance, ownership and financing. Please get in touch and together we can discuss your plans and ideas.

Markets we serve



Renewable
Energy



Polysilicon
Industry



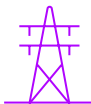
Food
Industry



Glass
Industry



Transport
Sector



Power
Industry



Chemical
Industry



Steel
Industry

The benchmark of hydrogen fueling

We offer the highest reported availability in the world, and as we were the first to comply with the latest standards for refueling, our solutions for hydrogen production and fueling set a benchmark for others to follow.

From the first dispenser to establishing complete nationwide fueling networks, Nel is ready for delivery.

The H2Station® is the latest generation hydrogen fueling station for Fuel Cell Electric Vehicles, providing fast fueling with long range according to international standards. The H2Station® offers the world's most compact footprint, and is based on years of operational experience in the field and is renowned for providing high fueling reliability.

H2Station®

CAPACITY

Daily capacity of up to 500 kg per day

- Maximum capacity: 120 kg/h @ 35MPa
35 kg/h @ 70MPa

MANUFACTURING CAPABILITY

Lean volume manufacturing capability of up to 300 stations / year.





Your hydrogen solutions development partner

Moving into hydrogen means tackling new territory and many opportunities. Investing in renewable hydrogen infrastructure requires solid solutions for operation, maintenance, ownership and financing. We know that technological advancement takes place in a wider context, and here we can give advice, facilitate and play different roles. Committed to the success of every customer, Nel has valuable experience across categories, covering most aspects of hydrogen entrepreneurship.

Solutions for

HYDROGEN FUELING NETWORKS

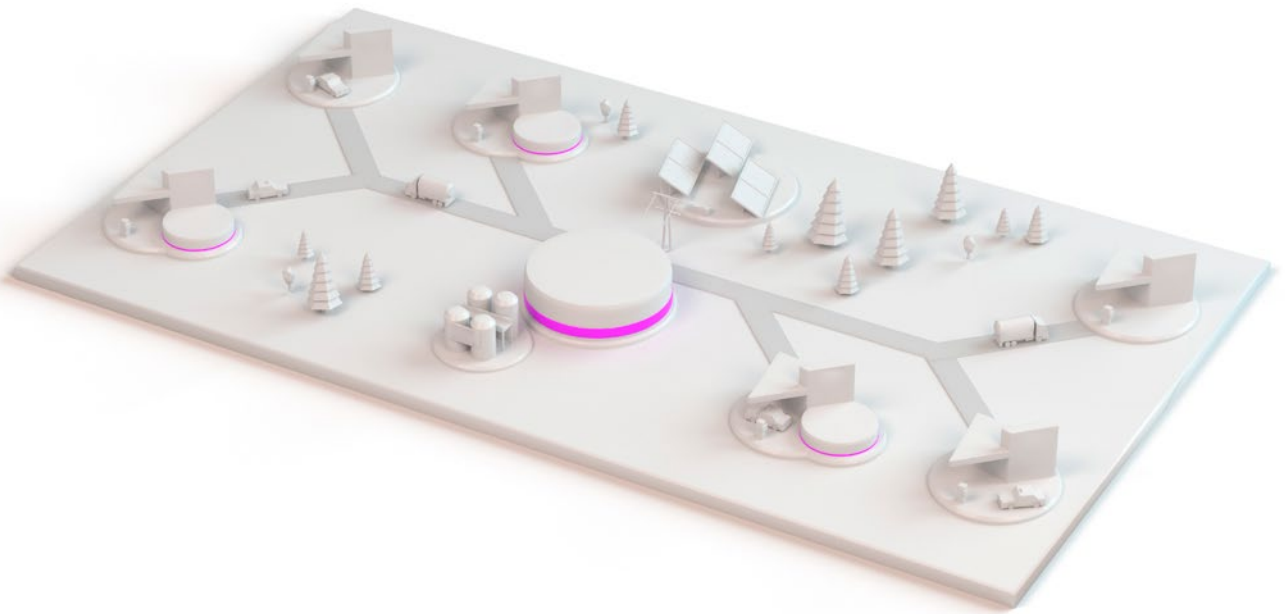
Existing oil and gas companies or new fueling companies position themselves for the coming of hydrogen powered Fuel Cell Electrical Vehicles (FCEV).

LOCAL HYDROGEN PRODUCTION AND FUELING

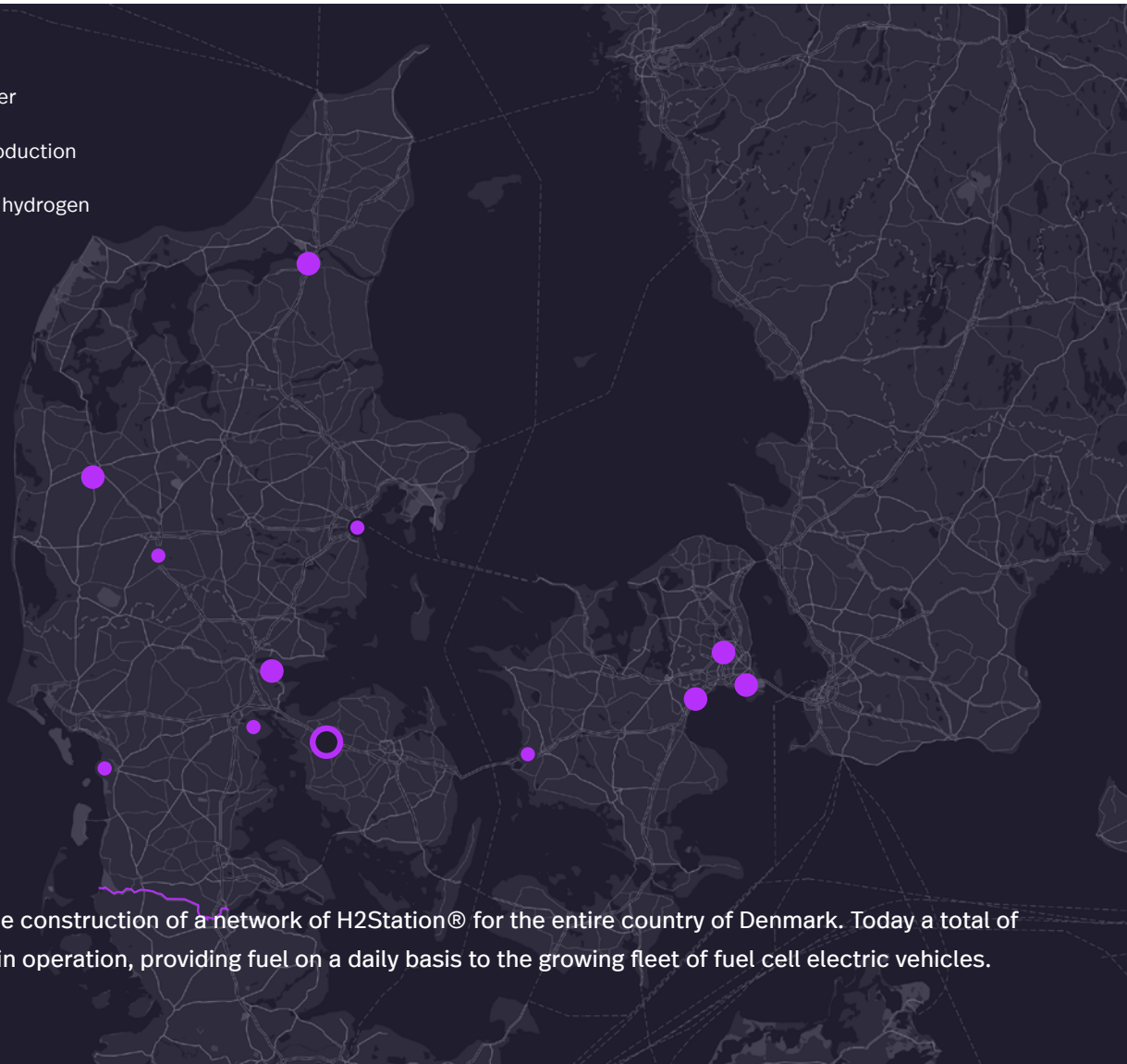
With complete turnkey hydrogen production and fueling solutions – we can provide fossil fuel cost competitive fueling of fleets of cars, busses, trucks, forklifts and trains.

RENEWABLE ENERGY STORAGE

Hydrogen will play a major part in tomorrow's society, offering intermediate energy storage in renewable energy systems.

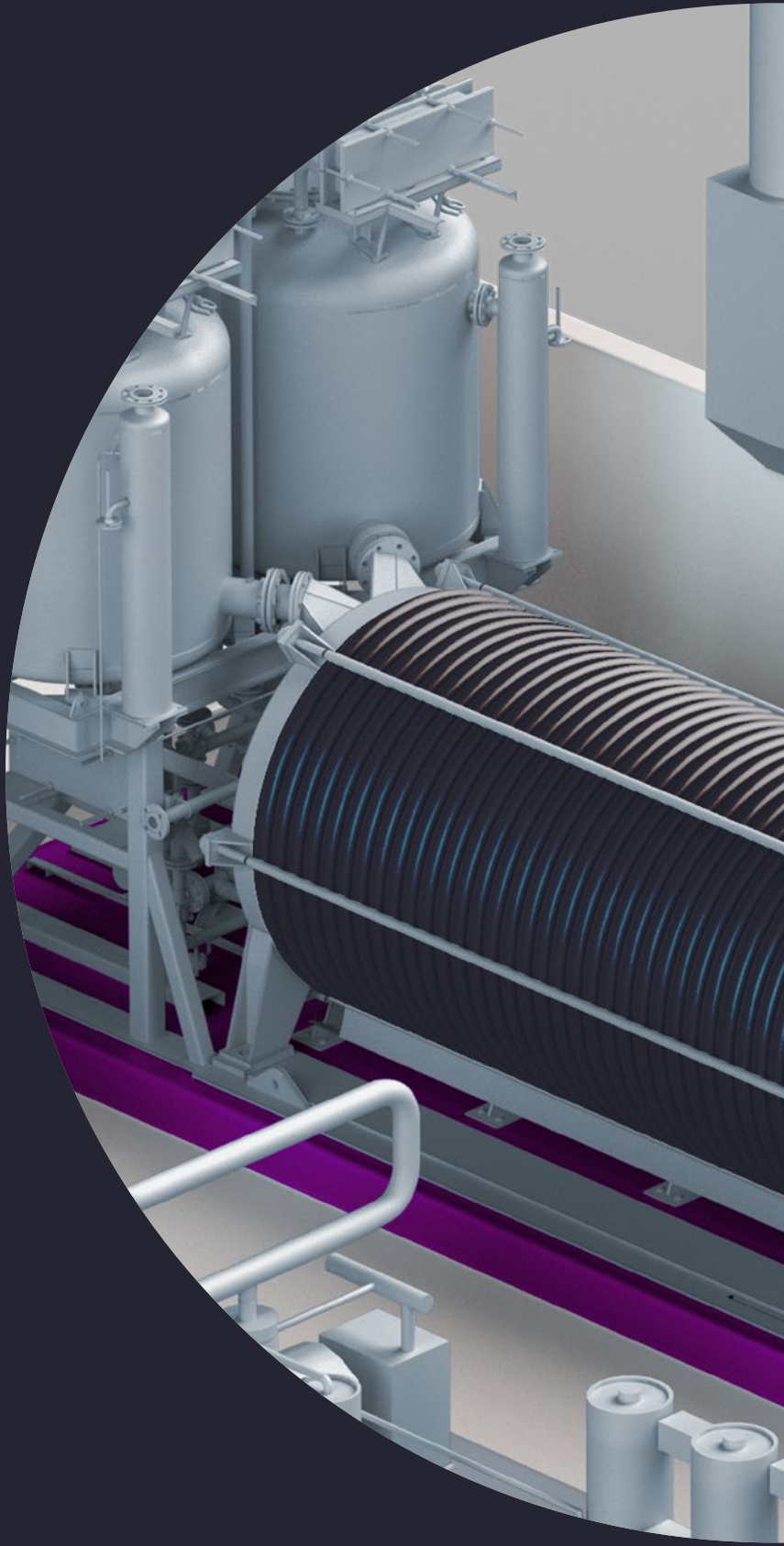


- Centralized electrolyser
- Station with onsite production
- Station with delivered hydrogen



In 2011 we began the construction of a network of H2Station® for the entire country of Denmark. Today a total of ten H2Station® are in operation, providing fuel on a daily basis to the growing fleet of fuel cell electric vehicles.

nelhydrogen.com



Nel Hydrogen Electrolyser
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