REvision 2020

Session 2: Green Hydrogen and 2050 Futures

4th of March 2020, Tokyo

On-site green hydrogen production with modular, scalable and standardized AEM electrolysers

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Enapter

Important steps have been taken to decarbonise electricity; molecules remain stubbornly dependent on fossil fuels.

Why Green Hydrogen?

- **Sector coupling**: the energy carrier hydrogen allows for the energy transition to reach all sectors
- “Hydrogen could provide almost **1/5 of total energy** consumed by 2050, and cut carbon emissions by about six billion tons compared to today” (Hydrogen Council)
- Green energy can help to increase independence and security

Hydrogen momentum is picking up…

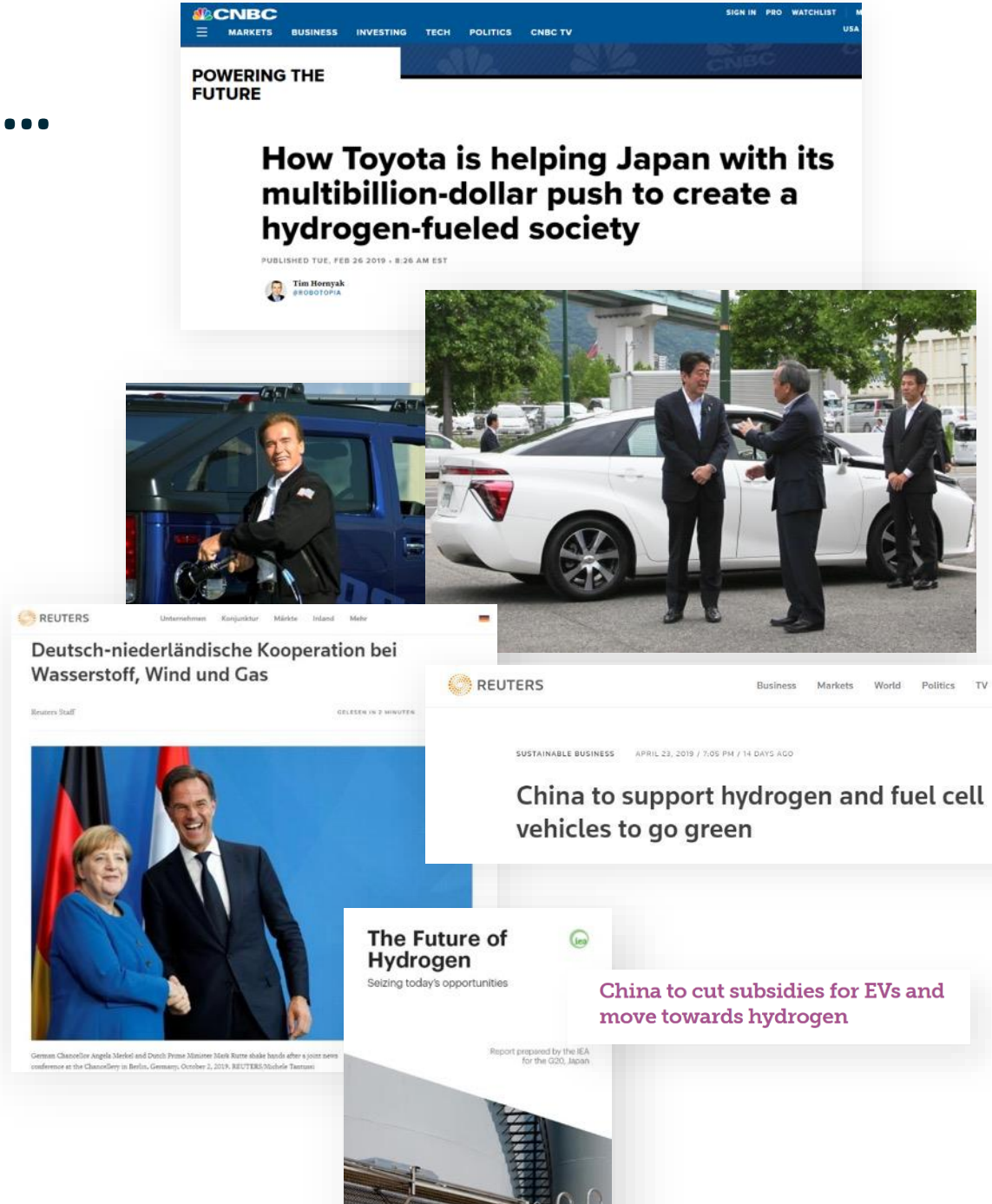
Support for hydrogen is growing around the globe. Think tanks, governments, industry and investors are realizing the potential of green hydrogen. The market will grow very fast.

In 2016

the global electrolyser market was small with industry turnovers at about **EUR 100-150m** per annum

In 2025

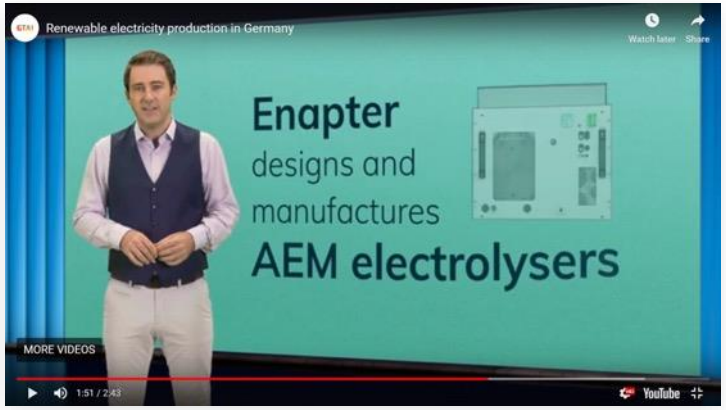
the global electrolyser market could reach **EUR 75-120bn**. While this looks massive, growth is mirroring the market developments in the solar industry.



… so is Enapter’s momentum

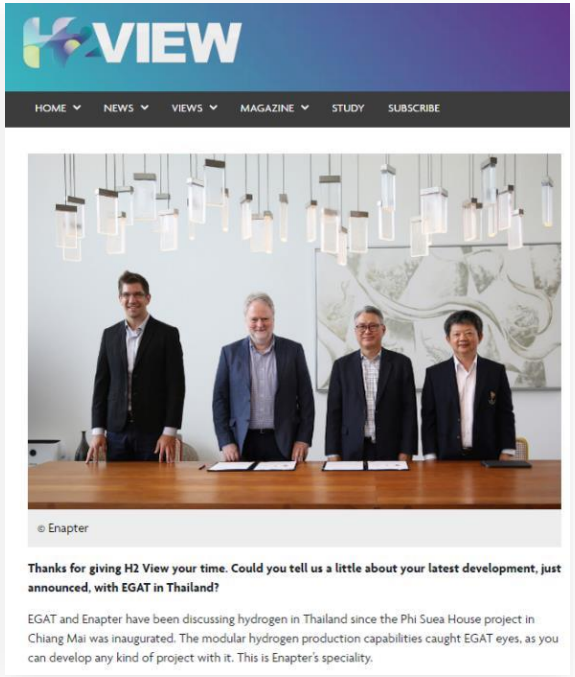
Forbes: Dedicated articles about Enapter as well as prominent mentions

Forbes 30 Under 30 2020: Energy



Germany Trade and Invest about Enapter

Enapter Interview in Handelsblatt Online and Print



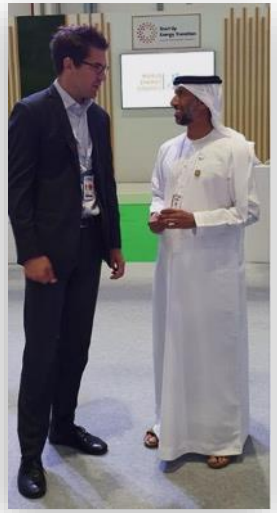
H2VIEW: Prominent coverage in industry news

Winning major Awards

Shell NEW ENERGY CHALLENGE
Amsterdam — 14.10.2018

Winner Start Up Award German Energy Agency (dena)
Berlin — 08.04.2019

Enapter about
hydrogen at the IAA



Enapter at the World Energy Congress 2019. Meeting several high-level contacts such as the Energy Minister of UAE

Forbes 30 UNDER 30

Start Up Energy Transition

NEW ENERGY CHALLENGE

Handelsblatt ENERGY AWARDS

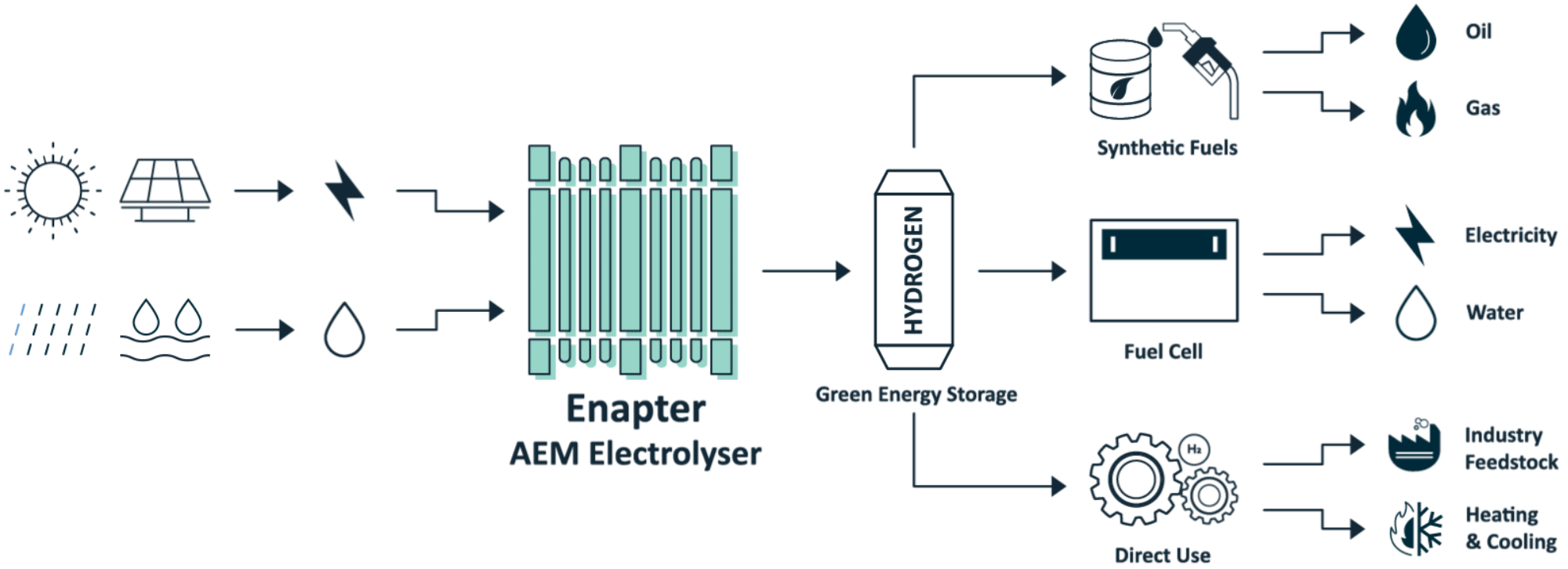
pv magazine

pv magazine HIGHLIGHT 2020 STORAGE GIGAWATT WINNER

European Commission SEAL OF EXCELLENCE

Enapter AEM Electrolyser

Enapter develops and manufactures the patented AEM (anion exchange membrane) electrolyser



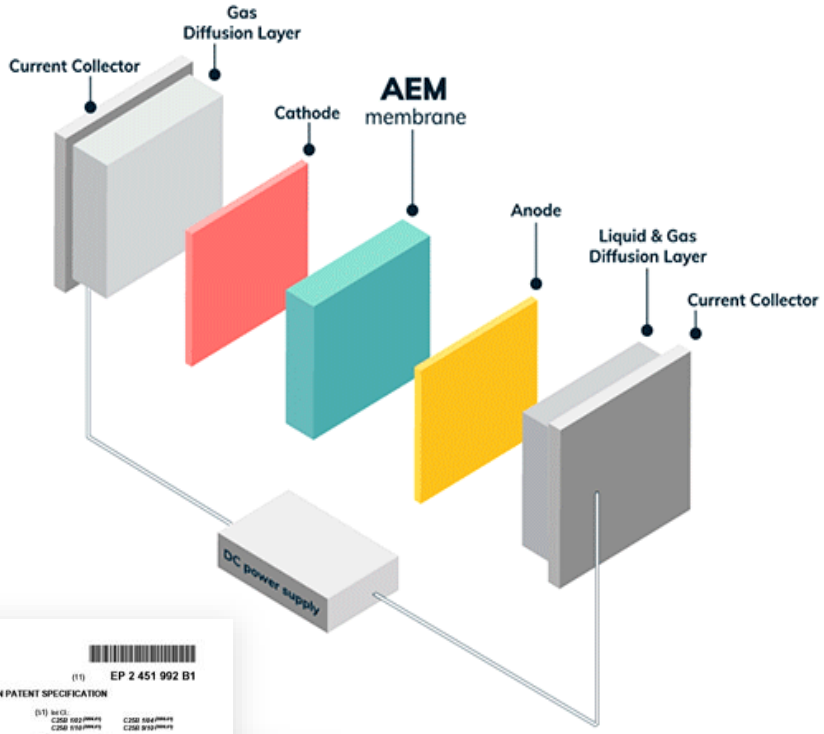
How is Enapter different?
Technology: AEM electrolyser
Strong Technology and R&D

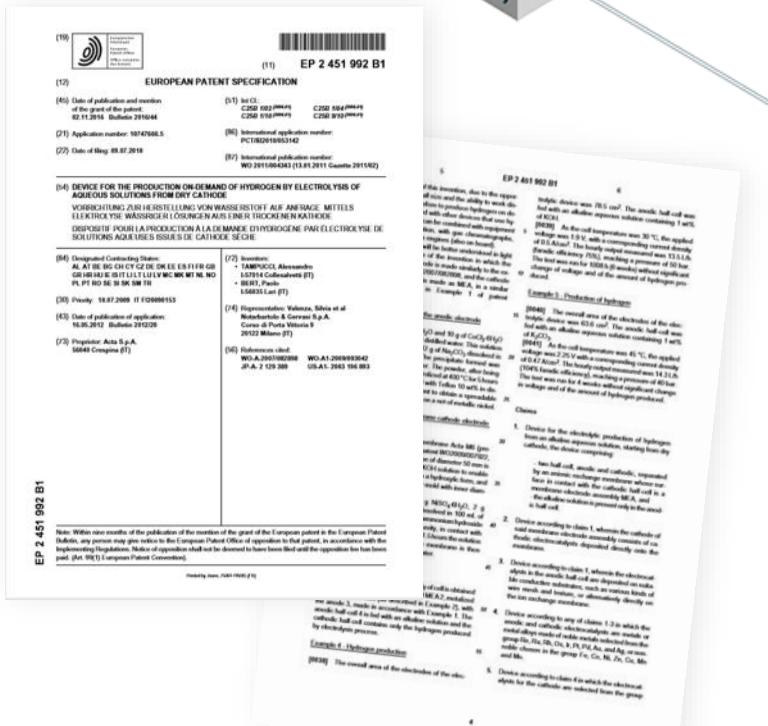
Unique Technology for Electrolysis, proven and patented.

- Noble metals not required.
- Low cost.
- Great Performance.
- Simple Balance of Plant.
- Easy to handle.
- Low water input quality requirement.

Durable

> 30.000 hours




EP 2 451 992 B1

EUROPEAN PATENT SPECIFICATION

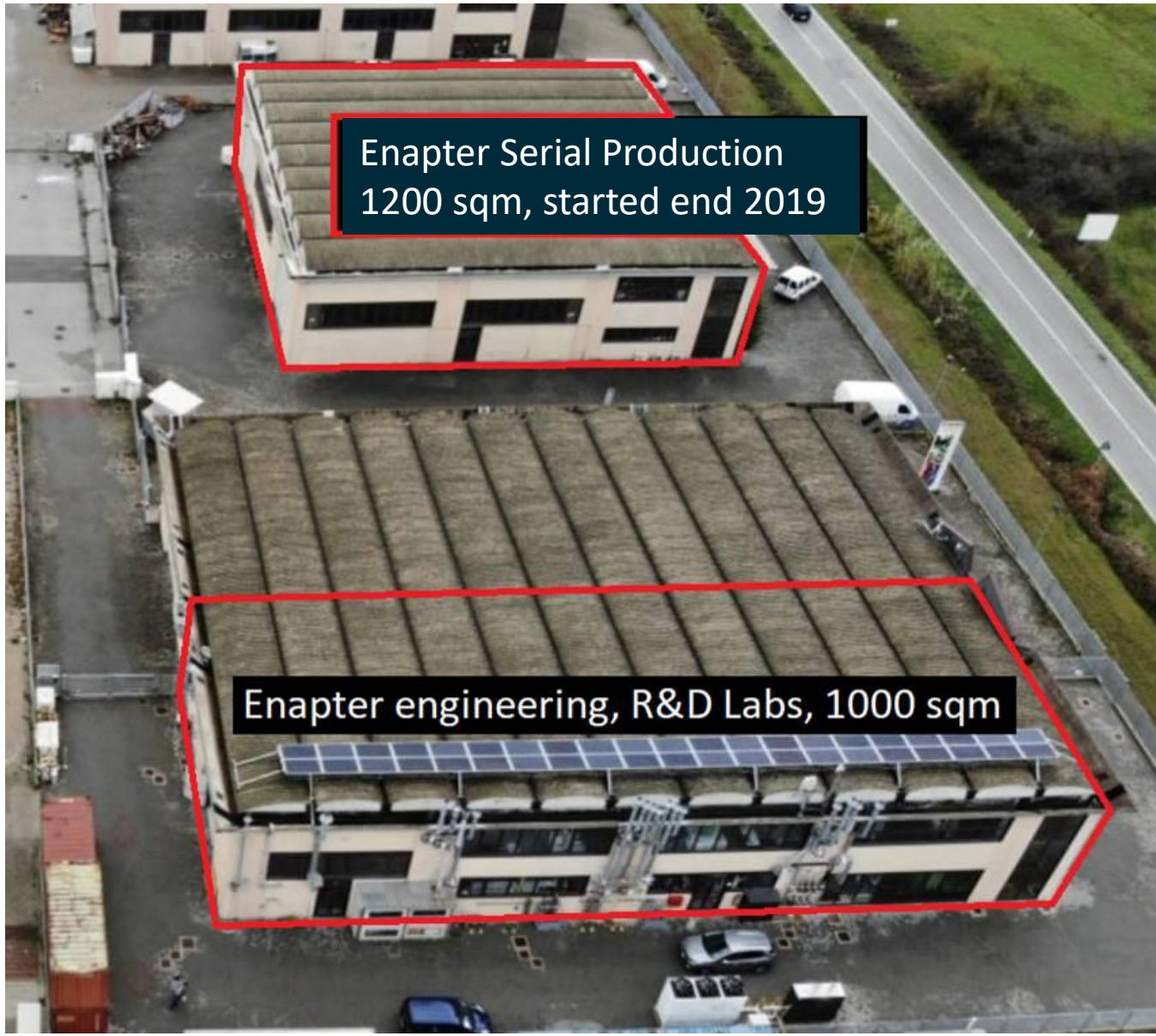
DEVICE FOR THE PRODUCTION ON-DEMAND OF HYDROGEN BY ELECTROLYSIS OF AQUEOUS SOLUTIONS FROM DRY CATHODE

Facts about Enapter

Enapter acquired proven core technology, patents and key employees from ACTA S.p.A. ACTA had 10+ year track record of AEM electrolyser R&D and technology development and global installations.

Employee numbers are fast growing
01.11.2017: 11 employees
01.05.2019: 59 employees
01.01.2020: 83 employees
(16 chemists, 30 engineers, 11 mechanics, 26 others: HR, IP, Certifications, Technical Documentation, Administration, Business Development) (all full-time, 18% PhD, 55% Master, MBA etc.).

Locations
Italy: R&D centre and production (see picture).
Offices in Germany, Russia and Thailand.
Japan office will start in Q2/2020.



Enapter

Main R&D Facility in Pisa, Italy

Enapter Serial Production went live with a “soft starting” in July 2019 after 6 months of planning in record time.

Production capacity increased 8-fold.
New testing areas were built.

What makes Enapter special?

Scalability
Standardised
Software Approach

How is Enapter different?

Think of Electrolyser as a commodity.

Nothing has seen more rapid cost reduction in economic history than mass produced commodities. We will mass produce our electrolyser.

Enapter’s approach is different from most other electrolyser manufacturers and can be well understood by drawing an analogy between the electrolyser industry today and the IT industry in 1980. Today’s manufacturers of large-scale electrolysers are developing systems comparable to the IT industry’s early "Mainframes". Each system is designed as an individual project, demanding highly sophisticated engineers and planning.

Enapter is mimicking the introduction of the PC: a product that is small, modular and scalable. The Enapter Electrolyser vision has unique characteristics and capabilities poised to disrupt the storage and fuel markets.

1981

2019

The Product Electrolyser EL 2.1

Production start today - EL 2.1 in February 2020

High Efficiency
4.4 kWh for 1 Nm^3 of H_2

Hydrogen Production
500 NL/hr or 0.5 Nm^3/hr

Hydrogen Purity
99.9%
99.999% with optional dyer

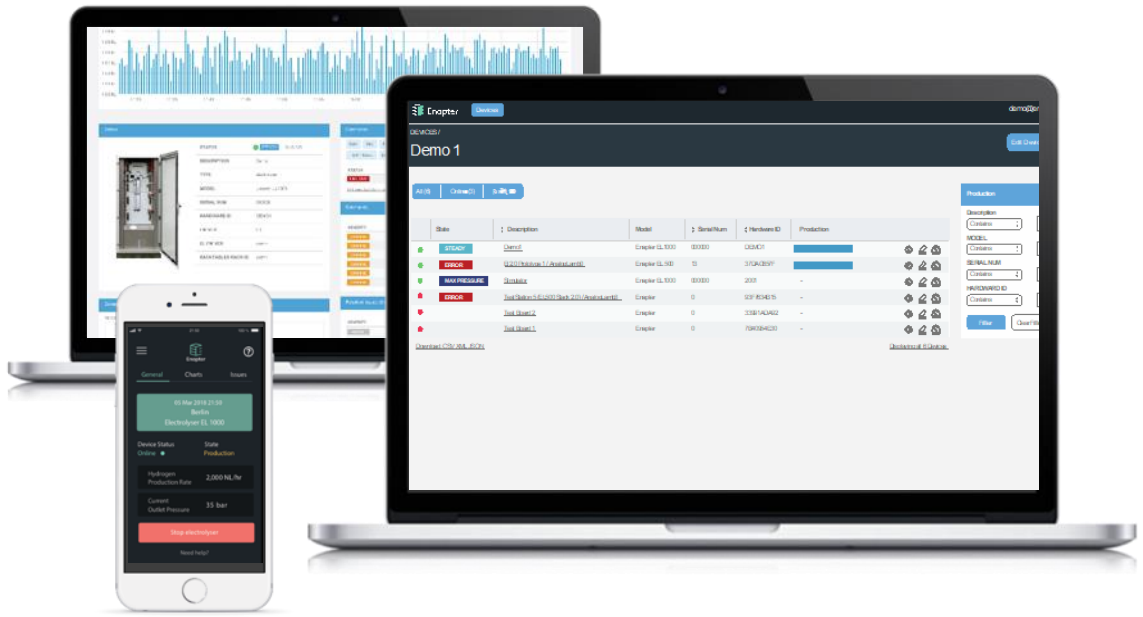
Input Water Purity
<20 µS/cm

Output Pressure
35 bar

EL 2.1
Brochure
available

How is Enapter different?

- Full energy monitoring system.
- Setup time in minutes with full remote monitoring and control.
- Any energy device can be integrated.
- Industry-grade security standards.
- All protocols are supported.



Use Cases

30
countries

90
customers

Electricity Storage (Seasonal) — French Alps

H2 as feedstock in Industry

Nitrogen purification, glass cutting, …

Enapter

Enapter Use Case

Refueling

One area of application for green hydrogen is the refueling. We are supplying drone, car, aviation and other vehicle manufacturers with our electrolysers.

DRONES

BShark's hydrogen-powered Narwhal 2 flies for 2 hours, and transmits nearly 20 miles

By Loz Blain
September 17, 2018

VIEW 3 IMAGES

BShark's Narwhal 2 offers two hours endurance and 30 km range for both control and video transmission BShark

BShark has moved mountains to bring down the price of its long-range Narwhal 2 drone. Powered by a hydrogen fuel cell, this 6.6-kg (14.5-lb) monster flies for up to two hours, transmits up to 30 km (18.6 mi) away and costs just US$6,800, making it an attractive option for industrial inspection and surveillance applications.

Enapter Use Case

Power-to-Heat

In Rozenburg, the Netherlands, 8x EL 2.0 are producing green hydrogen that is used to heat a building complex.

FuelCellsWorks

News

Select Language

Google Translate

Netherlands: Apartment Complex in Rotterdam Municipality Rozenburg Heated with Hydrogen

By FuelCellsWorks | June 6, 2019

0 6 No Comments

In the Rozenburg district of Rotterdam, a trial is starting to heat homes with 100% hydrogen. The companies Bekaert Heating, Remeha, DNV GL, the municipality of Rotterdam, housing association Ressort Wonen and network manager Stedin are all involved in this project.

The test is a first, because never before have houses been heated in the Netherlands with HR boilers using pure hydrogen.

When burning hydrogen gas, unlike natural gas, no CO2 is released.

Hydrogen will be produced locally with green electricity and transported via a separate gas network from Stedin to the boiler house of the apartment complex. Both a Bekaert Heating and Remeha boilers will subsequently heat part of the units.

Microgrid and Emergency / Back-up power

Rural microgrid in Africa

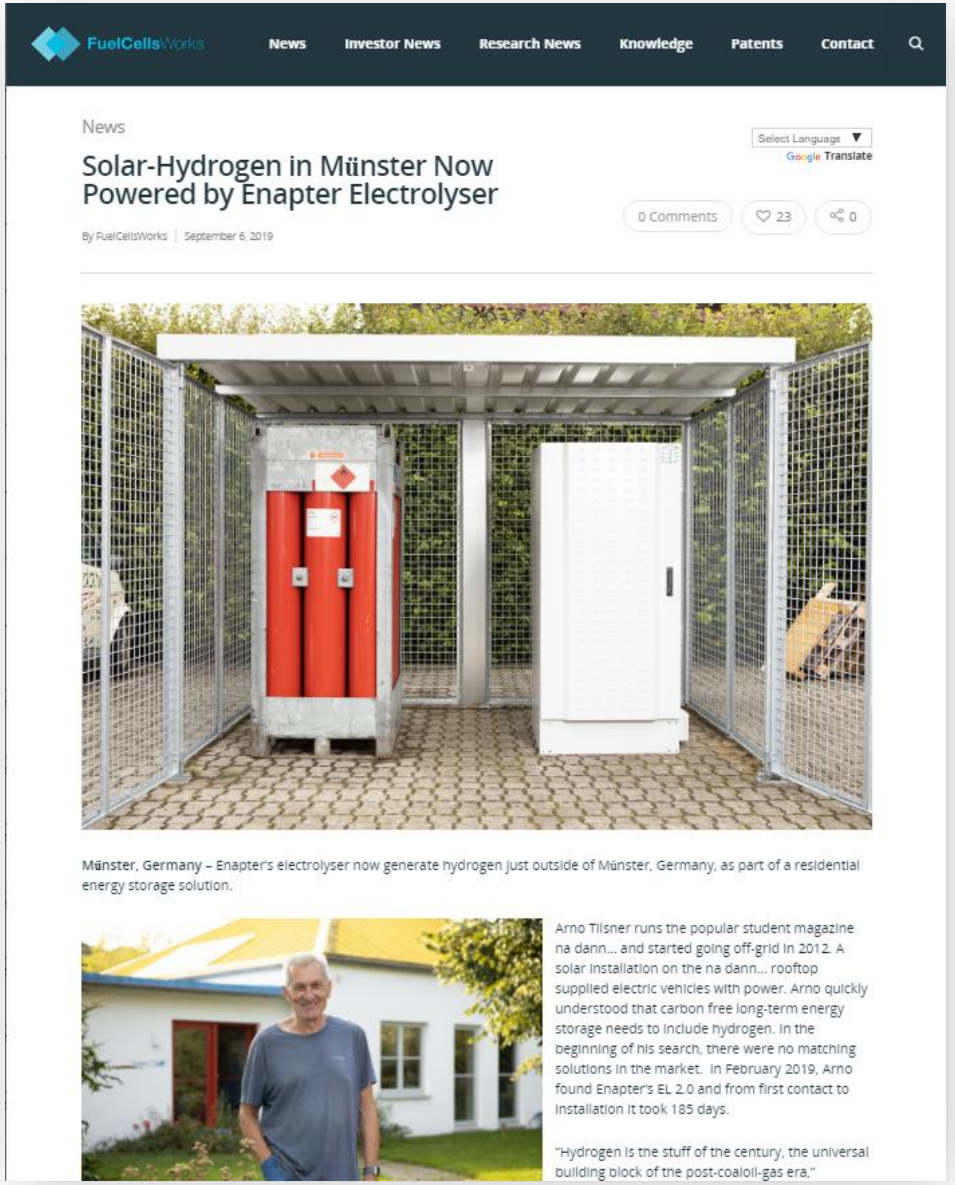
Energy storage for telecommunication tower in Malaysia

Our Electrolysers are used in Microgrid application (e.g. to bring electricity and storage to remote areas) as well as in back-up power for telco installation and in containerized emergency back-up power system.

Enapter Use Case

Residential Storage

In Münster, Germany, we commissioned 1x EL 2.0 in combination with a fuel cell to provide seasonal storage capabilities. Hydrogen could be use for much more than just power in the future.



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News

Solar-Hydrogen in Münster Now Powered by Enapter Electrolyser

By FuelCellsWorks | September 6, 2019

Münster, Germany – Enapter's electrolyser now generate hydrogen just outside of Münster, Germany, as part of a residential energy storage solution.

Arno Tilsner runs the popular student magazine na dann... and started going off-grid in 2012. A solar installation on the na dann... rooftop supplied electric vehicles with power. Arno quickly understood that carbon free long-term energy storage needs to include hydrogen. In the beginning of his search, there were no matching solutions in the market. In February 2019, Arno found Enapter's EL 2.0 and from first contact to installation it took 185 days.

"Hydrogen is the stuff of the century, the universal building block of the post-coal/oil-gas era,"

Australia's first hydrogen test station opens in Canberra

ACT gas network operator Evoenergy and the Canberra Institute of Technology have partnered to build a first of its kind hydrogen test facility at CIT Fyshwick. The station will test up to 100% hydrogen in deployments in which natural gas is currently used.

DECEMBER 5, 2018 MARIJA MAISCH

TECHNOLOGY AND R&D | UTILITY SCALE STORAGE | AUSTRALIA

Hydrogen is often described as the missing link in the energy transition.

Enapter Use Case

Power-to-Gas

In Australia evo energy is using our AEM electrolyser in test facility for feeding hydrogen into gas grids

Target Price

1.50 €/kg or less

Enapter aims to drive the cost for green hydrogen
to a level where it is competitive with fossil fuels.
This requires massive scaling efforts.

EL 500

Available 11/2017

10 Units

- Separate stack and control modules
- Significant onsite installation tasks
- All 4 sides of the module need to be accessible for air flow, electrical, gas connections

EL 2.0

Introduced 01/2019

8 Units

- **Single module** simplifies onsite installation
- **Front-to-back airflow** allows space saving and stackable systems
- Integration into **Enapter EMS** allows mobile setup and remote monitoring
- New **stack 40% smaller**

EL 2.1

Unveiled at FC EXPO,
Tokyo, 26.02.2020,
Production start today.

7 Units

- **Increased efficiency! 8%** less energy needed and low standby power
- Revised interface design allows easier installation and **hot-swapping**
- Completely new FW improves reliability and introduces **OTA capability** for new features

Project: Enapter Campus

The Enapter Campus will become Enapter’s HQ, R&D and main production site to reach the needed cost reductions. It will be the first automated electrolyser mass-production facility in the world.

300+

employees can be hosted on the Enapter Campus

2021

will see soft launch of production at the campus

Sustainable

The campus will be fully energy independent, powered by solar.

Location

We are still scouting for the best possible location

Overall Roadmap

Thanks for your attention!

Enapter

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Join the hydrogeneration