

The background of the slide features a light blue gradient with numerous water molecules and bubbles. The water molecules are depicted as two small spheres (one white, one black) connected by a thin line. The bubbles are of various sizes, some appearing as simple spheres and others as more complex, multi-lobed structures. The overall effect is a sense of fluid motion and scientific precision.

**SCHAEFFLER**

**Strategic Business Field  
Hydrogen Industrial  
Electrolysis Technology**

Dr. ir. Peter Bouwman

As a technology partner, we're constantly challenging ourselves – especially when it comes to green hydrogen.  
We pioneer motion

We pioneer motion


## We are Schaeffler – A world-leading technology business

A photograph of a modern, multi-story office building with a glass facade. The word "SCHAEFFLER" is mounted on the roof in large, green, three-dimensional letters. The building is surrounded by lush green trees, and the sky is a clear, bright blue with a few wispy clouds. The overall scene is bright and professional.

SCHAEFFLER

As a **leading global supplier to the automotive and industrial sectors**, the Schaeffler Group has been driving forward groundbreaking inventions and developments in the fields of motion and mobility for over 75 years. With **innovative technologies, products, and services** for electric mobility, CO<sub>2</sub>-efficient drives, chassis solutions, Industry 4.0, digitalization, and renewable energies, the company is a reliable partner for **making motion and mobility more efficient, intelligent, and sustainable** – over the entire life cycle.

## Schaeffler facts and figures – One of the world's largest family-owned companies



**~84.000**  
employees  
worldwide

**~200**  
locations in  
**~50**  
countries

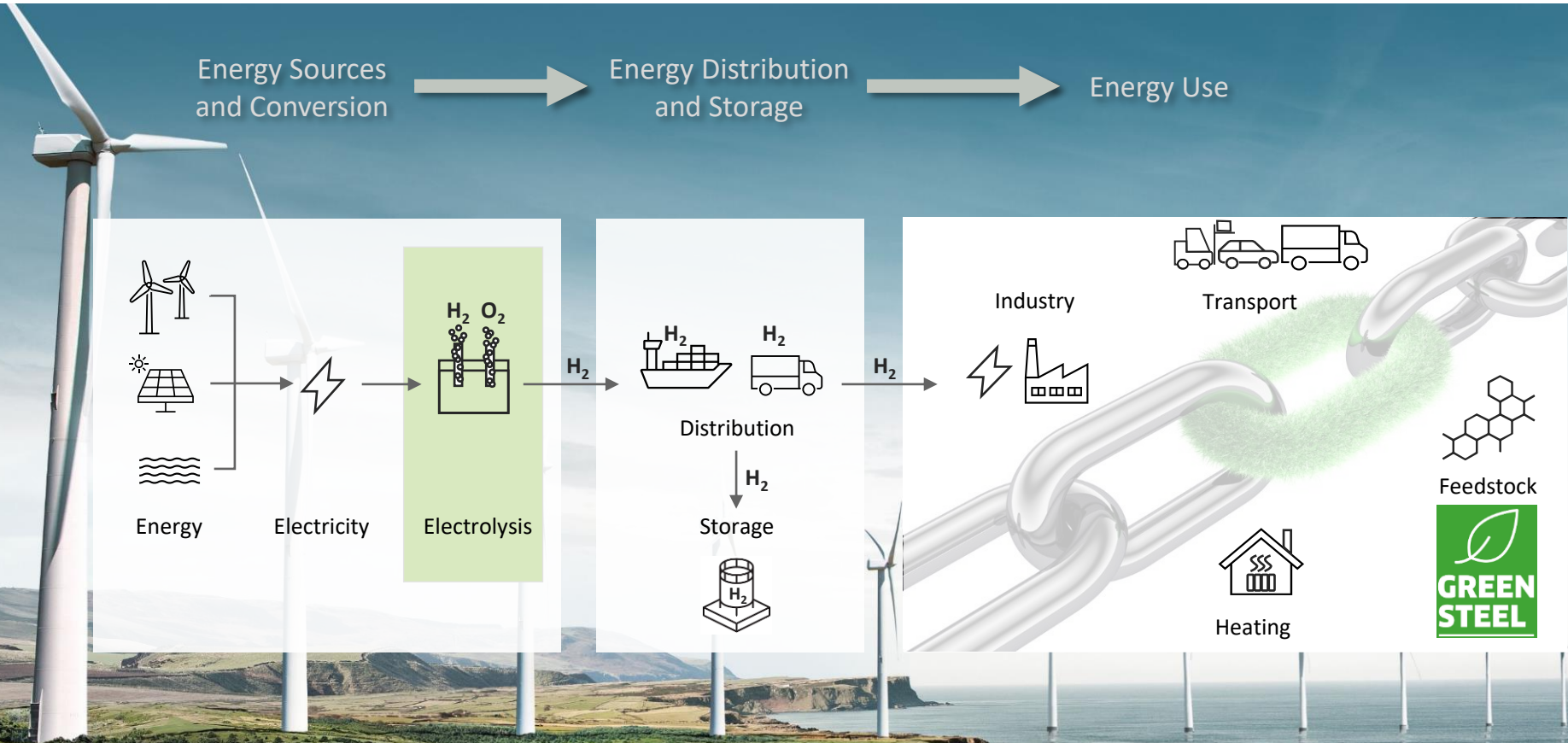
**83** plants  
and **20**  
R&D centers

Sales of  
**~€15.8**  
**billion**  
in 2022

**6.6%**  
EBIT Marge  
in 2022<sup>1</sup>

**>1.250**  
patents  
registered  
in 2022

# The Green Hydrogen Chain: Integrating Electrolysis to capture intermittent renewable energy



## Global Hydrogen market uptake is the key game changer to achieve climate neutrality

**1.1 mln tonnes**  
of processed steel p.a.

**90 mn t**

Global hydrogen consumption 2020

**660 mn t**

Global hydrogen demand 2050



**22%**

of global final energy demand 2050

Source: Hydrogen Council



Enable large-scale renewable integration



Decarbonize end uses through sector-coupling



Carrier for energy transport



Energy system resilience by seasonal storage

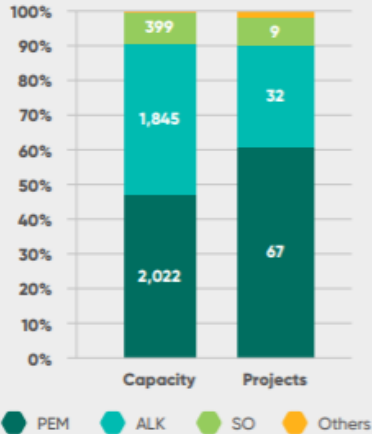


Seizing economic chances need support for industrial value chain and broad international application

**Considered hydrogen market is served through different technological concepts**

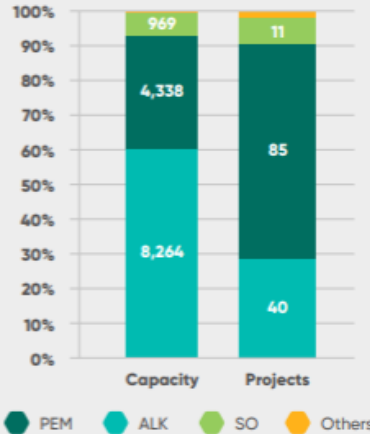
**Relevant PEM market is expected around ~30% share**

**Available electrolyser composition of planned projects in MW and # of projects by 2025<sup>4</sup>**



Source: Hydrogen Europe.

**Available electrolyser composition of planned projects in MW and # of projects by 2030**



Source: Hydrogen Europe.

**Remarks on expected technological breakdown of assumed market size**

General: breakdown on technology out of Hydrogen Europe “Clean Hydrogen Monitor 2022” \*

<b>PEM:</b>	2025: 45%	2030: 31%
<b>AEL:</b>	2025: 45%	2030: 60%
<b>SOEC:</b>	2025: 10%	2030: 8%
<b>unknown:</b>	2025: 0%	2030: 1%

**Assumed market size PEM:** 2030: 55 GW

\* no sufficient data for AEM could be collected by authors – updated in next version

**Schaeffler is strongly convinced about the future role of hydrogen and is committed to contribute with its core competences on the pathway to a sustainable energy ecosystem**



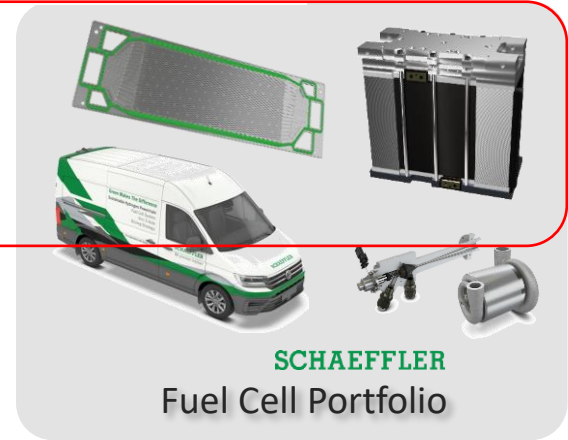
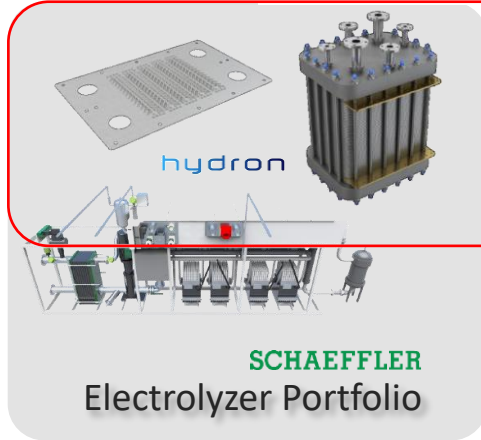
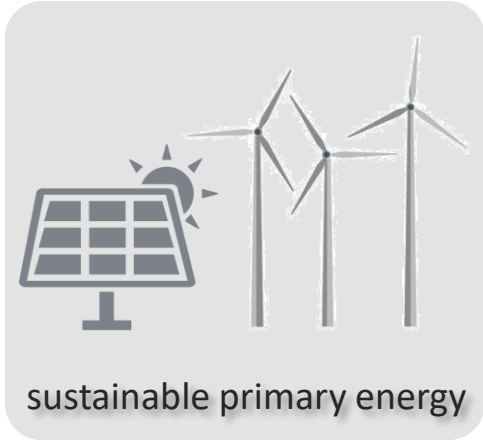
### Key aspects

- H2 will play a decisive role in future ecosystem of regenerative energy in industrial & automotive sectors
- Today ~60 Mtons Hydrogen as Industrial feedstock
- Green hydrogen for additional demand and substitution of grey H2
- Cost competitiveness of green hydrogen as prerequisite for market ramp-up

## A Holistic View on the Hydrogen Chain

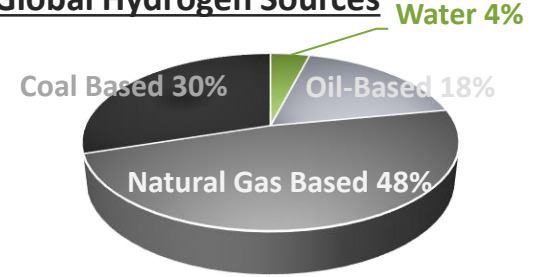
Only Green Hydrogen offers sustainable energy chain

↳ water electrolysis with renewable electricity



*Synergies & Existing Core Competencies*

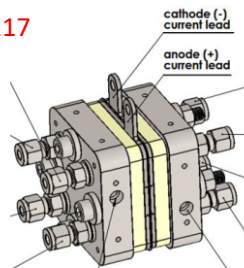
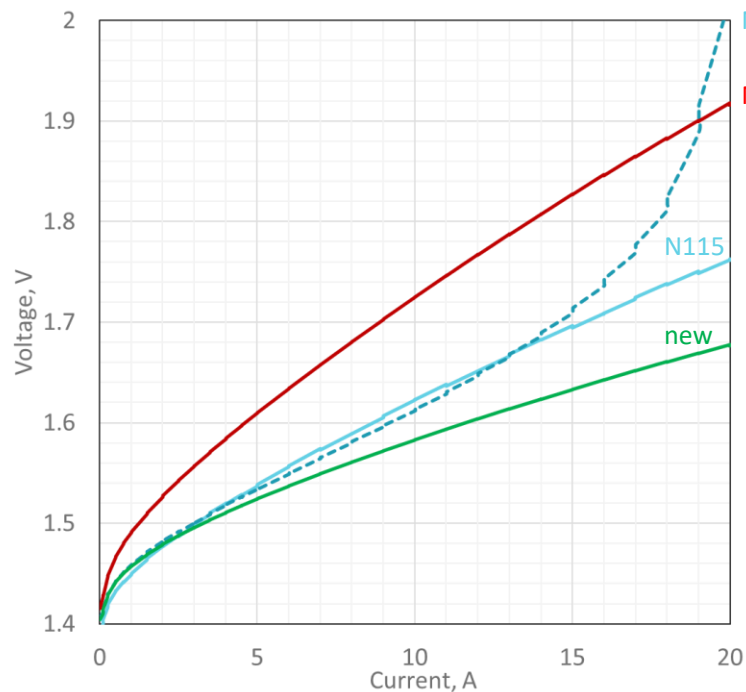
## Global Hydrogen Sources



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## Performance improvements measured on small screener cells – example IV curves



Parameter	Value	Unit
# cells	1	-
Active area	10	cm <sup>2</sup>
Max current	50	Ampere
Max cell voltage	2.5	Voltage
Max cell temperature	95	°C



## trends:

- Increasing current density
- Improving performance / efficiency
- Decreasing of catalyst loading (PGM)
- Focus on stability / degradation testing

# Scaling up production – making stacks that actually solve customer issues

## COMPONENTS: DESIGN FOR MANUFACTURING

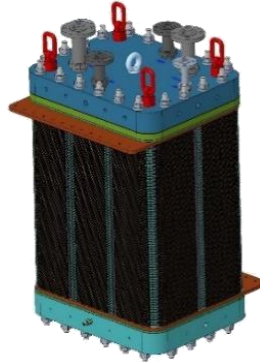
### 2/3D-Modeling:

- Multiphysics 
- Mechanical deformations 

### Results:

- **53%** total cell pressure difference improved
- **40%** stack mass flow deviations to be improved
- Hot spots in cell defined

### Stack Optimizations



## APPLICATION ENGINEERING USING FIELD DATA

### 0/1D-Modeling:

- Operating Cell and Stack Models
  - Integrated Stack in PEM System Model
- Results: **0-1D Cell Models**
- Heat generation and thermal management proposal provided



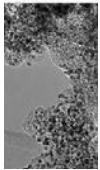
System Operation Efficiency



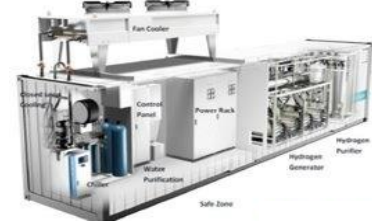
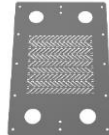
Material Design Solutions

Geometric scale:

20 nm



catalyst



2-3D CFD

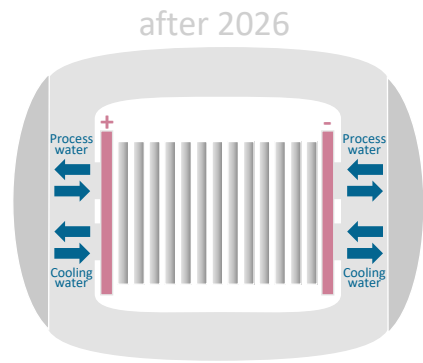
PUBLIC

0-1D Model

# Schaeffler`s current PEM electrolyzer stack portfolio at a glance



Available Electrolyzer Stack Product Portfolio



after 2026





## “SCHAEFFLER” Stack

- > 50 kg H<sub>2</sub>/hr
- Power rating: multi-MWe

### Key points

- EL10... EL100 available
- EL500 launched in 2022
- EL2200 prototype
- Schaeffler Stack for multi-stack systems (available after 2026)
- Sales already visible in Schaeffler Medias

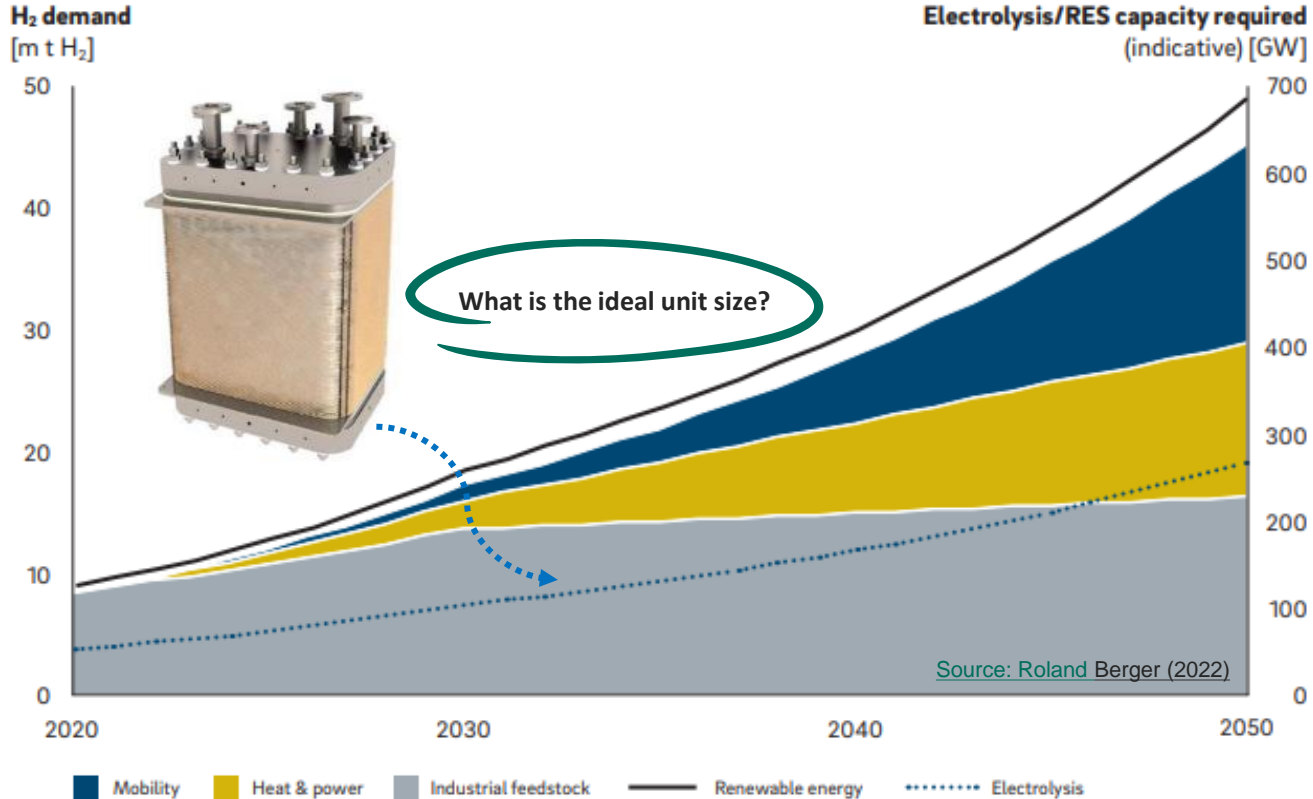
### Excerpt from Schaeffler Medias

 <p><b>HYDRON PowerStack K0 electrolyzer</b> Perfect for research purposes. Appropriate materials can be investigated using the HYDRON PowerStack K0 electrolyzer stack.</p> <p><a href="#">Data Sheet</a></p>	 <p><b>HYDRON PowerStack K1 electrolyzer</b> Extremely sensitive and efficient. Some material research for electrolysis forward with the HYDRON PowerStack K1.</p> <p><a href="#">Data Sheet</a></p>	 <p><b>HYDRON PowerStack K10 electrolyzer</b> Facilitates your R&amp;D activities on stack materials and electrochemical processes with the HYDRON PowerStack K10.</p> <p><a href="#">Data Sheet</a></p>	 <p><b>Electrolyzer HYDRON Power Stack K100</b> For use in industrial applications, the HYDRON Power Stack K100 is available in a 50kW and a 100kW configuration.</p> <p><a href="#">Data Sheet</a></p>
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cell active area

## Hydrogen demand in Europe by Sector and required ELECTROLYZER and RES Capacity



### TRENDS

- H<sub>2</sub> is already a sizeable market as industrial commodity
- Today's H<sub>2</sub> supply predominantly consists of **GREY H<sub>2</sub>** produced from fossil sources
- Gray H<sub>2</sub> is expected to be replaced by **GREEN H<sub>2</sub>**
- Growth of H<sub>2</sub> demand is mainly driven by new application and the use of decarbonised H<sub>2</sub> in the industry, heat and power and mobility sectors
- Significant ramp-up of electrolysis and renewable energy

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**Thank you for your  
attention!**

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