Fuel Cell and Energy

AVL Company Presentation

AVL List GmbH

AVL at a Glance

AVL China subsidiaries in Shanghai, Tianjin, Beijing, Chengdu, Wuhan, Chongqing, Jinan, and Guangzhou with **around 800 employees**

1948
Founded

29
Countries Represented

12,200
Employees Worldwide

11 %
Of Turnover Invested in Inhouse R&D

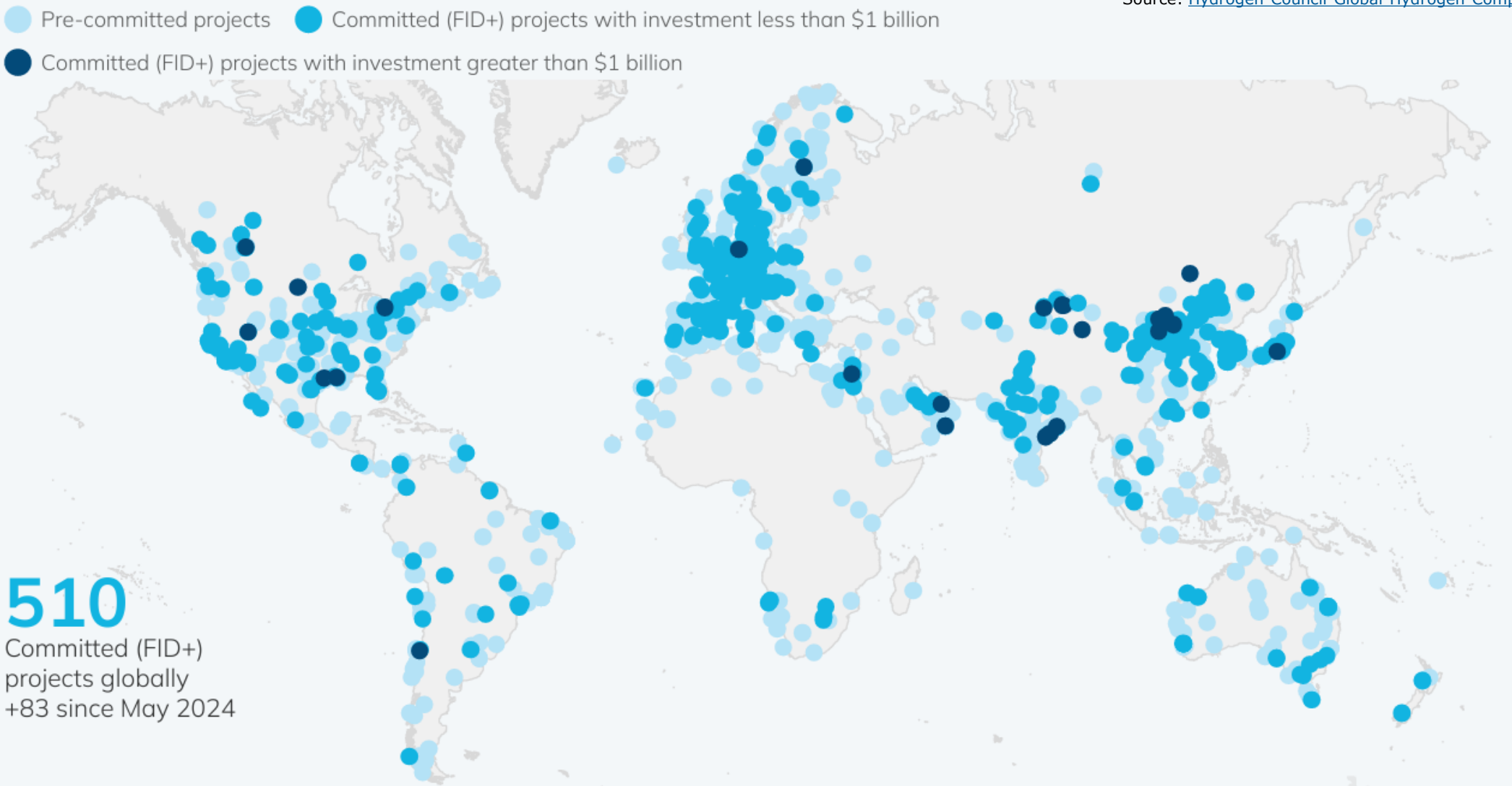
75+
Years of Experience

50+
Global Tech and Engineering Centers

67 %
Engineers and Scientists

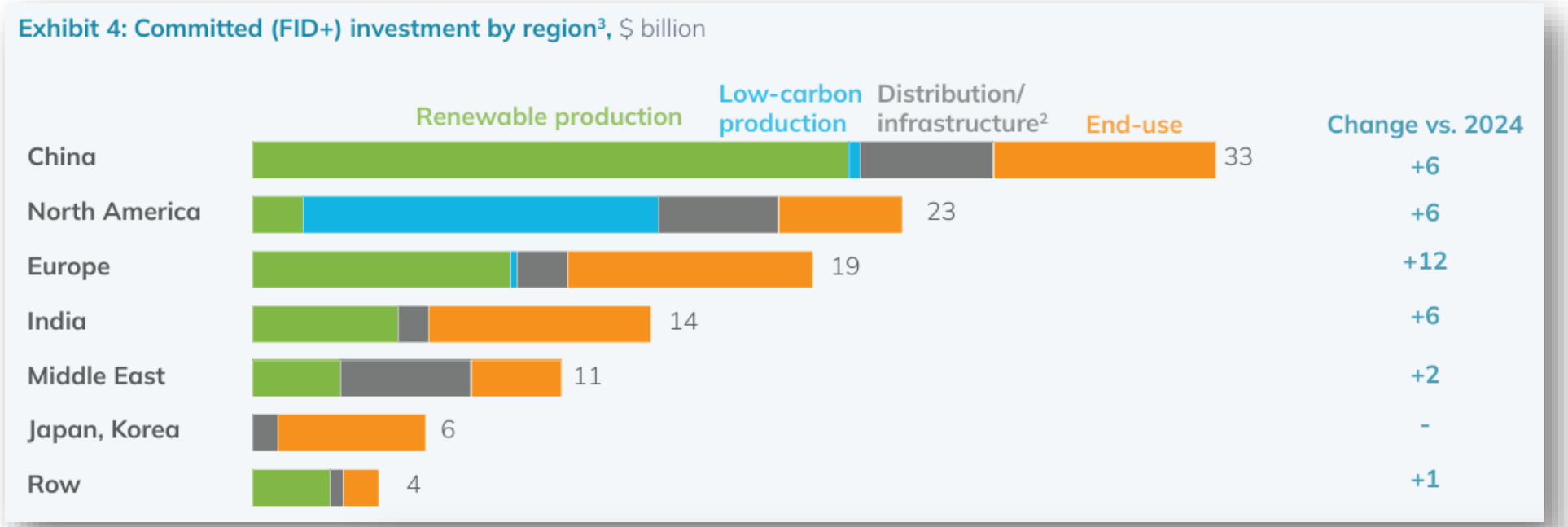
2,300
Granted Patents in Force

Source: Hydrogen-Council-Global-Hydrogen-Compass-2025.pdf



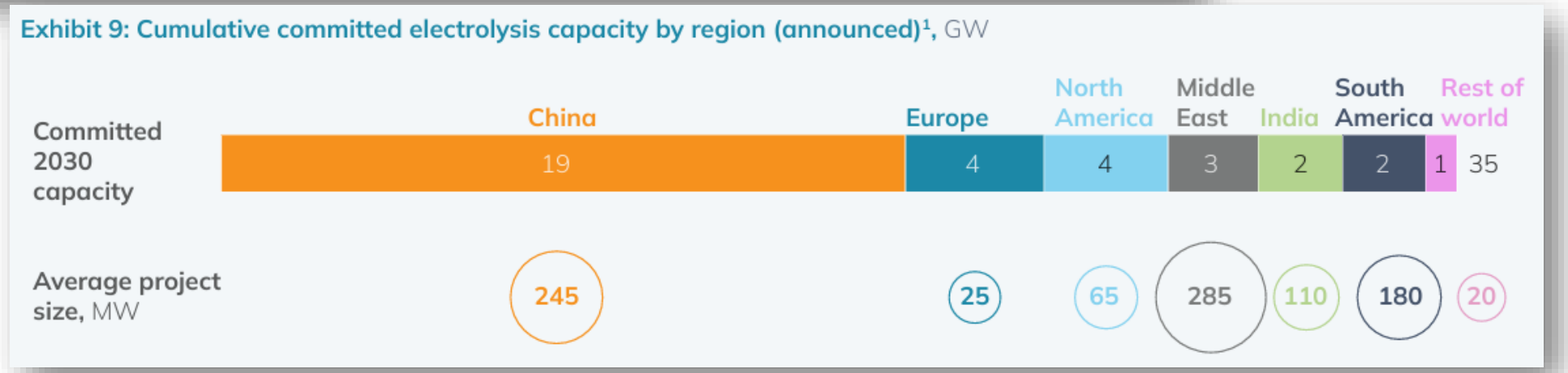
Source: Hydrogen-Council-Global-Hydrogen-Compass-2025.pdf

Hydrogen Market Update

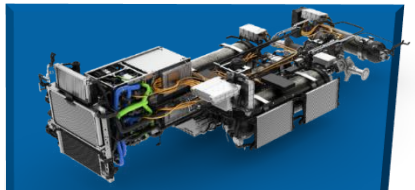


2025
H_2
Investments

2030
Electrolyzer
Capacity

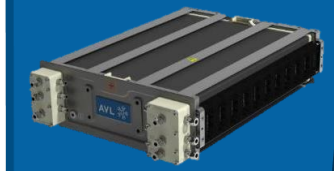


AVL Fuel Cell and Electrolysis Development Offerings

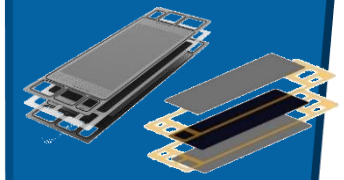


Application

System



Stack



Unit Cell and Components

Requirements Engineering

Benchmarking

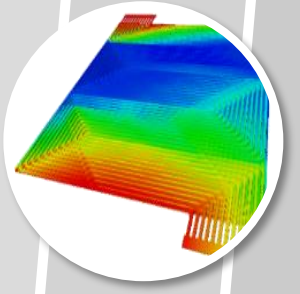
Development & Design

Validation & Testing

Production Engineering

Consulting

Component characterization



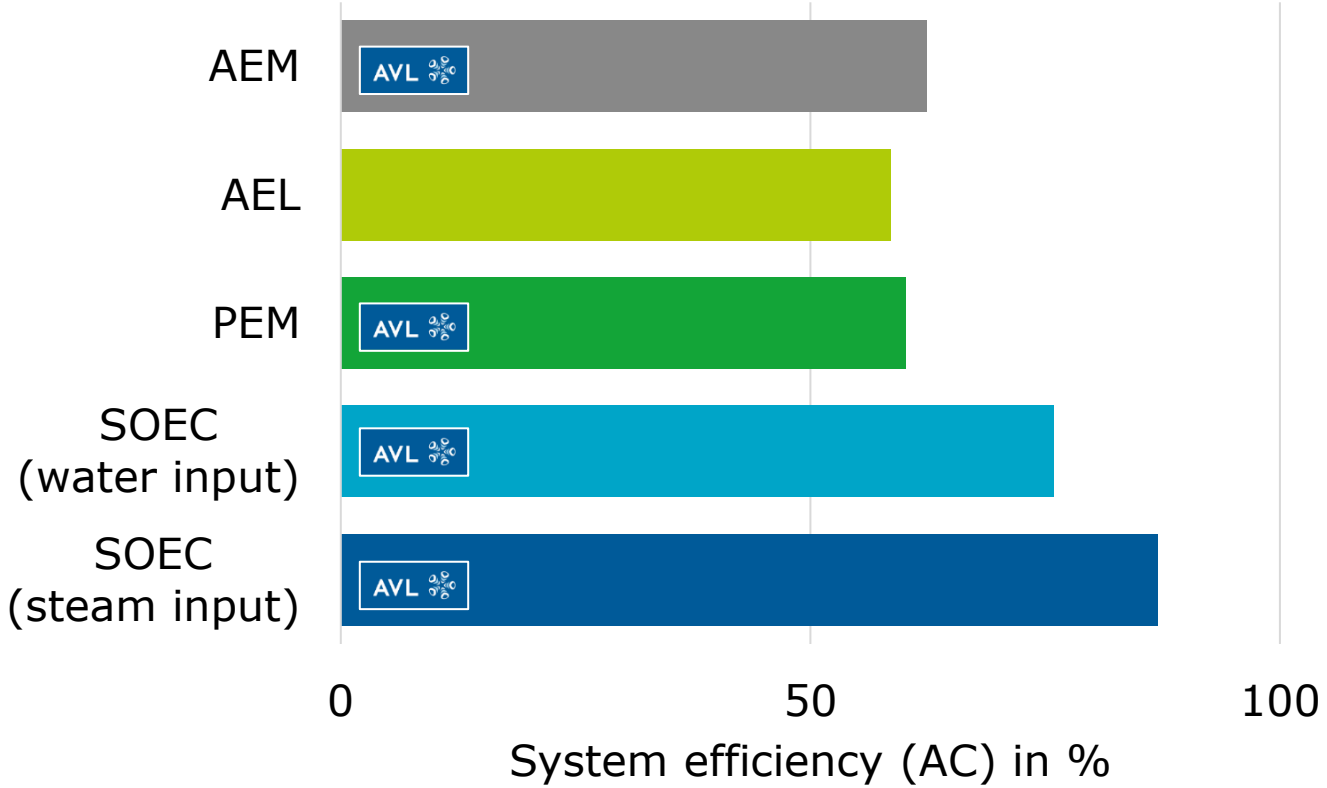
Modelling & Simulation

Prototyping

Degradation & Failure Analysis

Electrolyzer Comparison

AVL Focus Areas



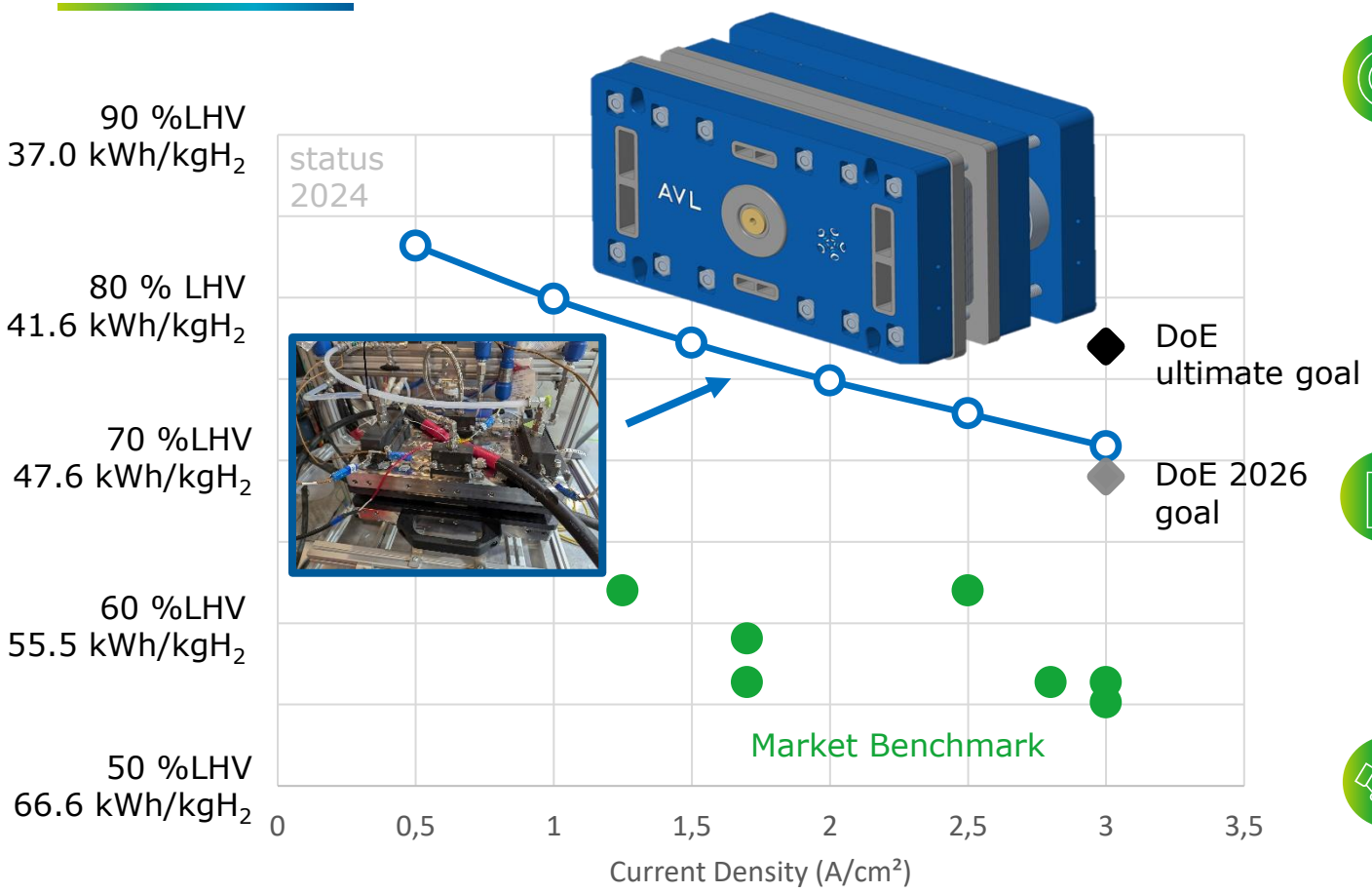
	Advantages	Disadvantages
AEM	No expensive or critical minerals	Low kW stack sizes
	Compact design and small footprint	Shorter stack lifetime than PEM and AEL due to membrane degradation
	High pressure suitable, fast start up and load changing	High ramp up time
AEL	Mature technology (GWs deployment, TRL 8-9)	High material effort (alkaline liquid as electrolyte)
	Multi MW stacks available	Low power density and large footprint
	Usage of available and inexpensive materials	High idle load, slow start up
PEM	High power density (compact design and small footprint)	Expensive materials (titanium and PGM)
	Fast start up and load changing capability	Long term stability unproven at MW scale
	Relatively mature (TRL 8-9)	Reliant on hardly degradable chemicals
SOEC	Lowest idle load	Low TRL
	High efficiency (fast kinetics and conductivity)	Highest physical footprint (3.5x PEM)
	Reversible operation	Low output pressure and long cold starts
	Co-electrolysis of water and carbon-based molecules	Poor durability - thermally accelerated aging

No single electrolyzer technology fits all applications—AVL follows a technology-open approach and supports AEM, AEL, PEM, and SOEC development, simulation and testing

PEM Electrolyzer Stack Development (AEE-1) Development, Build-Up and Testing

Video

Release by Customer



Project Scope & Key Achievements

- AVL has developed a first PEM electrolyzer stack design, AEE 1, in 2024.
- This stack was designed, built, and tested within 12 months, and combines industry-leading efficiency
- The efficiency of the stack exceeds the US Department of Energy's 2026 goal
- Four patent applications

Technical Specifications

- Technology: PEM EL
- Efficiency: 71 %LHV & 47 kWh/kgH2 @ 3 A/cm²
- Active area: 300 cm²
- Operating mode: differential pressure
- Hydrogen pressure: 30 bars

Customer Benefits

- PEM electrolyzer stack design considers high-volume automotive fuel cell stack engineering
- Stack design can be foundational large large scale Electrolyzer designs

H_2 Advanced Engineering | Industrialization | SOP | Production & Lifecycle

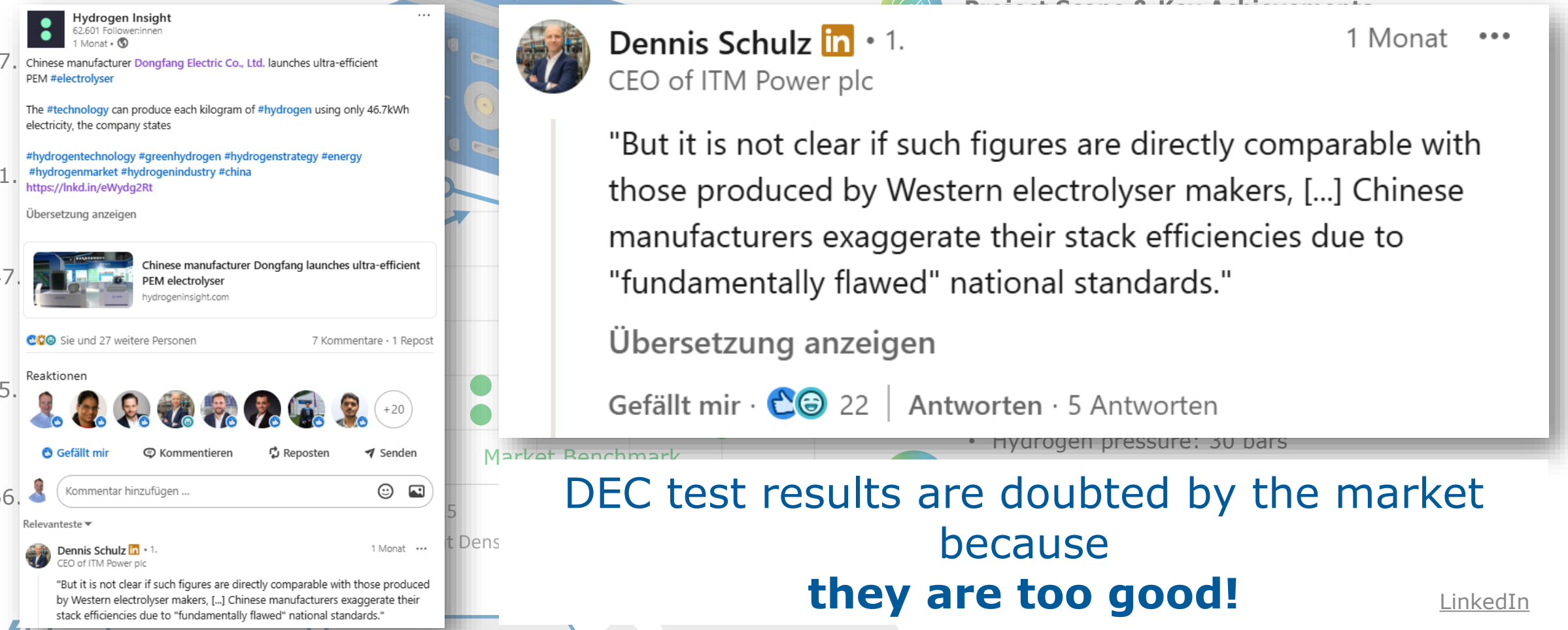
Dongfang Electric

On October 29, 2024, Dongfang Electric (Chengdu) Hydrogen Technology Co., Ltd., a subsidiary of Dongfang Electric Corporation, and AVL List GmbH signed a strategic cooperation agreement in Chengdu. Zeng Jiming, Deputy Director of the Sichuan Department of Economy and Information Technology, Lei Junshan, Consul General of the Consulate General of Austria in Chengdu, Li Jianhua, Senior Vice President of Dongfang Electric Corporation, and Prof. Helmut List, Chairman and CEO of AVL, attended the signing ceremony.

PEM Electrolyzer Stack Development (AEE-1) Development, Build-Up and Testing

Video

Release by Customer



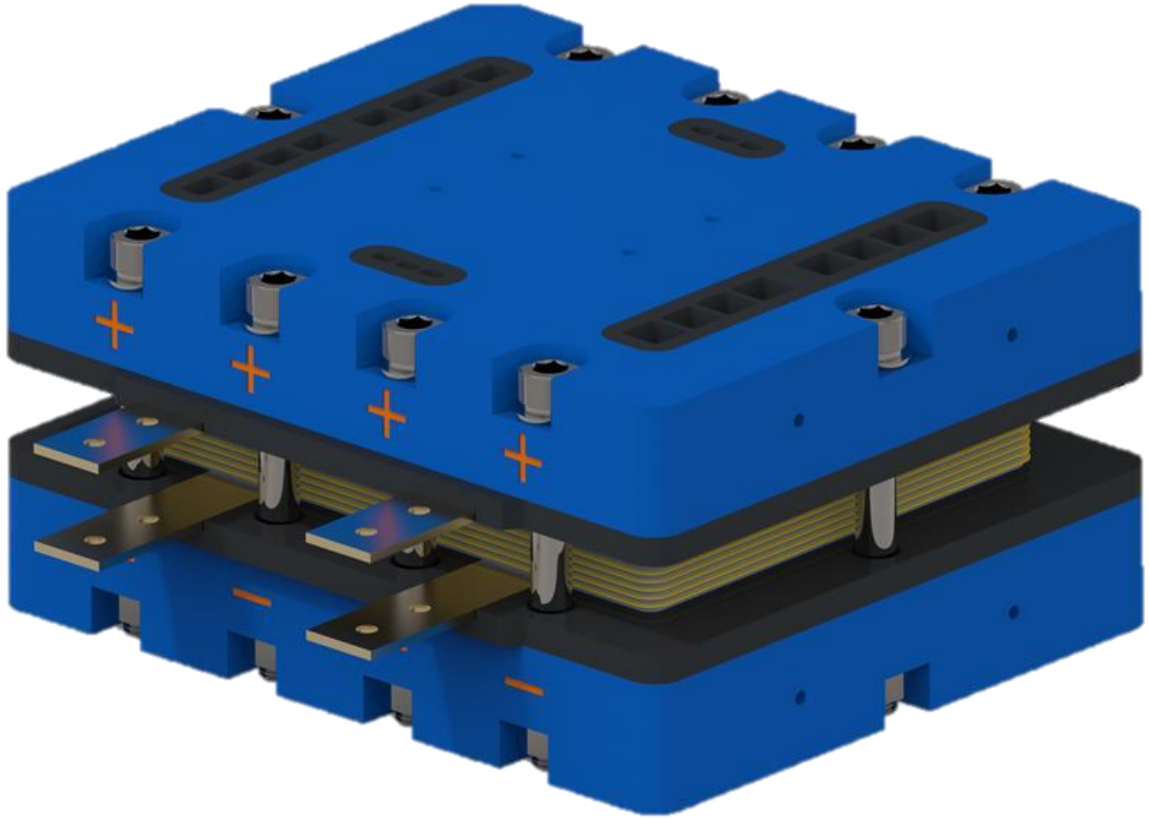
DEC test results are doubted by the market because

they are too good!

LinkedIn

H_2 Advanced Engineering | Industrialization | SOP | Production & Lifecycle

AEM electrolyzer stack development
Development, Build-Up and Testing



Project Scope & Key Achievements

- AEM stack concept definition
- Component supplier and technology market screening
- AEM specific material testing (cell frame concept testing, KOH Exposure Testing, AEM Membrane Benchmarking,…)
- What's next:
  - Unit Cell (MEA, Seal, Plate) design release → 3/26
  - Stack design release → 4/26
  - Short stack build → 6/26
  - Testing complete → 7/26

Technical Specifications (targets)

- Technology: AEM electrolyzer
- Power short stack/full stack: 15/500kW
- Active Area: 500 cm^2
- Efficiency: >69 %LHV & <48 kWh/kg @ 2 A/cm^2
- Pressure: 35bar

Customer Benefits

- AEM electrolyzer stack design considers high-volume automotive fuel cell stack engineering
- Stack design can be used foundational for large scale Electrolyzer designs

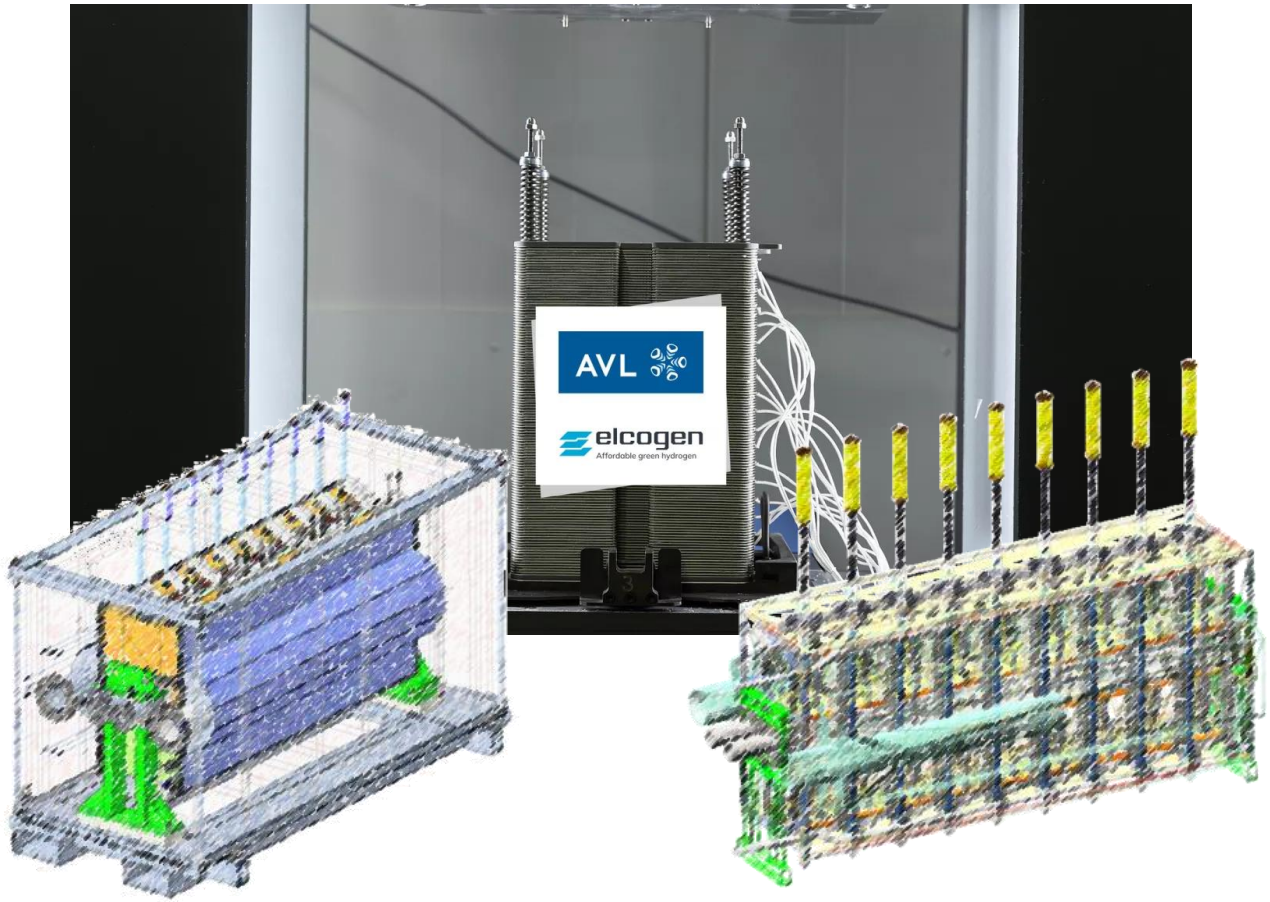
AVL is now also developing competitive AEM electrolyzer stacks. First short demonstration is plan to happen in Q3/2026.

Large Scale Stack Module Development Virtual Development

Link

Release by Customer

elcogen
Affordable green hydrogen



Project Scope & Key Achievements

- Addressing the challenge of scaling SOEC technology from small cell footprints to multi-megawatt modules.
- Developing stack modules that integrate multiple Elcogen SOEC stacks for industrial-scale hydrogen production
- The collaboration is part of the IPCEI Hy2Tech programs in Estonia/Finland and Austria, focusing on green hydrogen and emission-free electricity

Technical Specifications

- SOEC
- Water steam electrolysis
- 9x2 Boxer Arrangement of stacks
- 180 kW stack module power

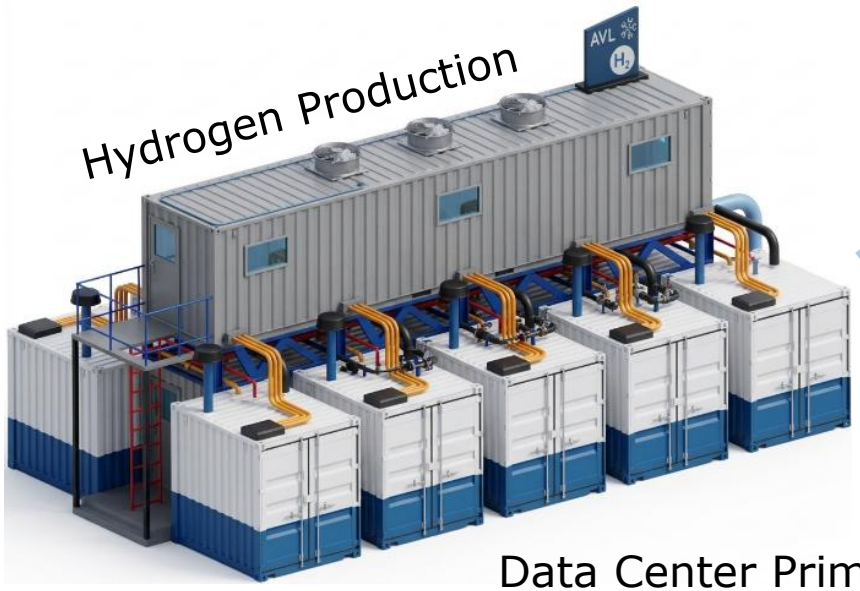
Customer Benefits

- AVL brings expertise in system and stack module development for SOFC/SOEC application

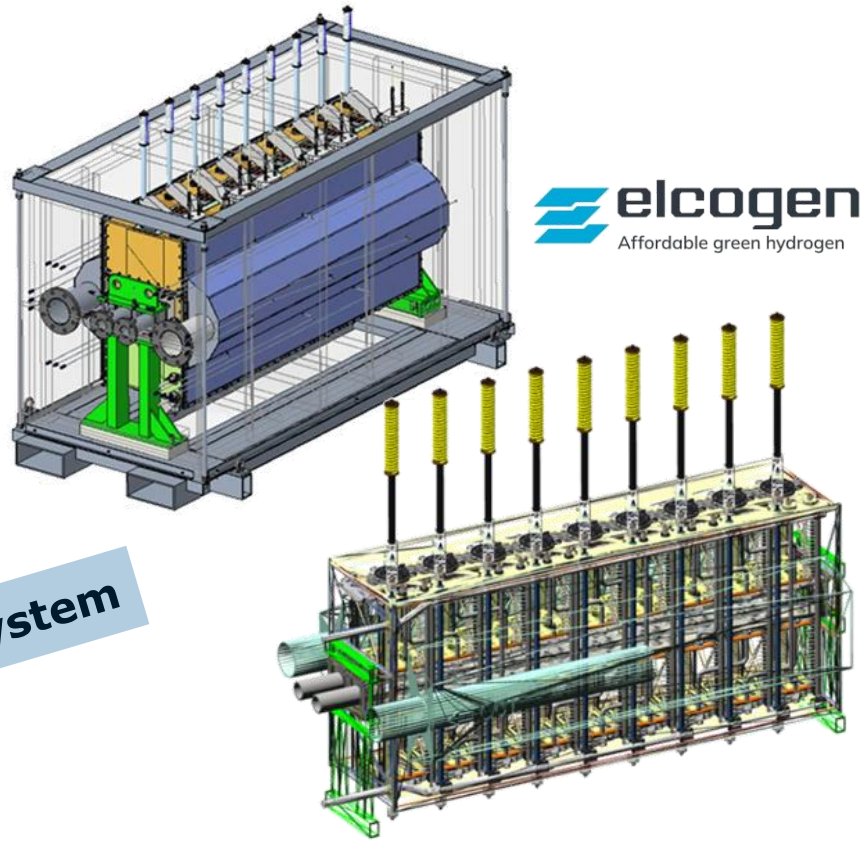
H_2 Advanced Engineering | Industrialization | SOP | Production & Lifecycle

Large Scale SOC Building blocks

Hydrogen Production

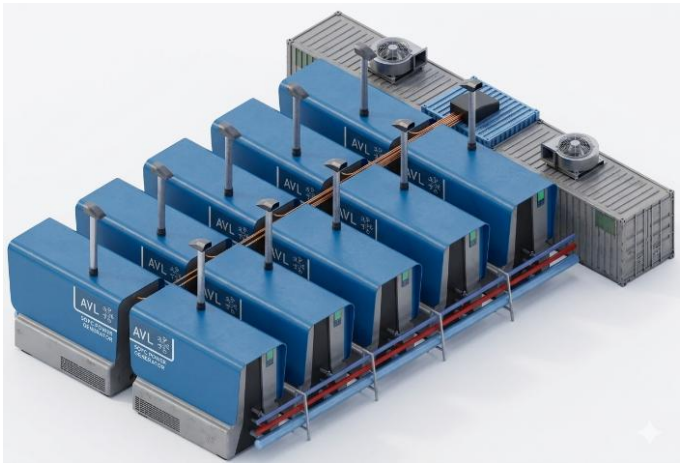


3.5 MW SOEC System



elcogen
Affordable green hydrogen

Data Center Prime Power



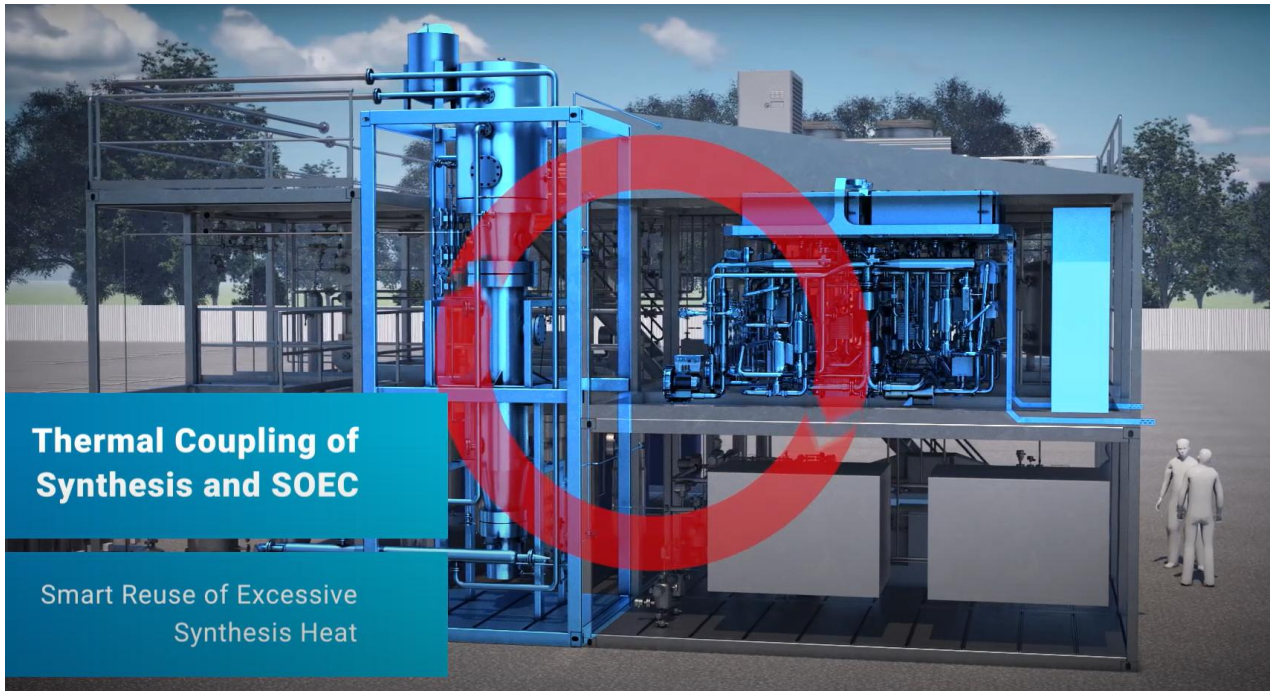
1 MW SOFC System

Power-to-Liquid Demonstration Plant Development, Build-Up and Testing

Video

Release by Customer

IFE



Project Scope & Key Achievements

- 2020 → Concept Study Finished
- 2021 - 2025 → Engineering, Simulation, Design and Component Testing of a 200 kW Power-to-Liquid Plant finished (e.g. Over 700 hours of Co-SOEC testbed operation)
- 2026 – 2028 → Build-up and operation of the coupled Co-SOEC Fischer Tropsch process to produce ~100 000l syncrude per year

Technical Specifications

- Co-SOEC (Solid Oxide Electrolysis Cell)
- 200kW Water steam and CO2 electrolysis
- >55% overall PtL efficiency (LHV)
- Fischer-Tropsch excess heat integration
- Focus: SAF production (~100 000 l/year)

Customer Benefits

- Evidence of technology competences through existing demonstrators
- Mature processes & methodologies suited for accelerated development of new technologies
- EPC services

H_2 Advanced Engineering | Industrialization | **SOP** | Production & Lifecycle

MoU with ACWA Power

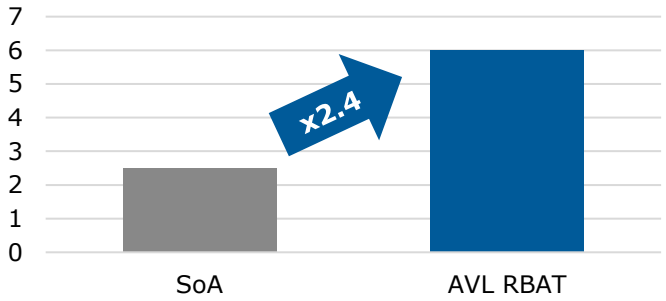
- **ACWA Power and AVL** announced a **strategic collaboration** at the ACWA Innovation Days 2026 in Riyadh.
- Focus on next-generation, **highly efficient e-Fuel production technologies**.
- Collaboration centers on **AVL's proprietary Co-SOEC technology** combined with Fischer–Tropsch synthesis for eSAF production.
- AVL investigations indicate **up to 60% production efficiency**, enabling **eSAF costs below 1.5 €/liter**.
- Partnership aims to develop and construct an **eSAF Co-SOEC R&D pilot plant in Saudi Arabia**.

High-Graphimetric-Power-Density Fuel Cell Technology Concept

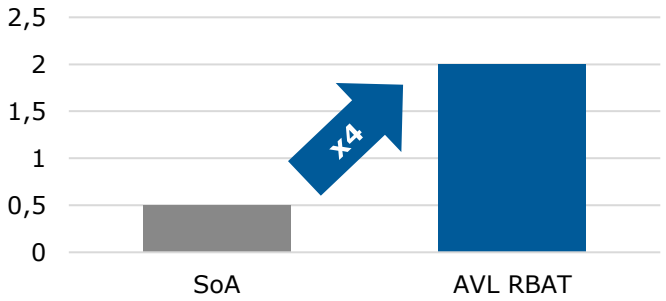
Link

Release by Customer

Stack gravimetric Power Density [kW/kg]



System gravimetric Power Density [kW/kg]



H_2 Advanced Engineering → Industrialization → SOP → Production & Lifecycle

Project Scope & Key Achievements

- Red Bull Advanced Technologies (RBAT) and AVL are collaborating to develop next-generation ultra-high-power density fuel cell technology
- Combines AVL's PEM fuel cell expertise with Red Bull's lightweight design, construction, and aerodynamics

Technical Specifications

- Power Density: 6 kW/kg at the stack level
- Power Density: 2 kW/kg at the system level
- Target application: high-performance automotive, motorsport and aviation

Customer Benefits

- Enables hydrogen mobility in sectors requiring maximum payload and high power density, such as aerospace and future motorsport series.

Thank you

www.avl.com