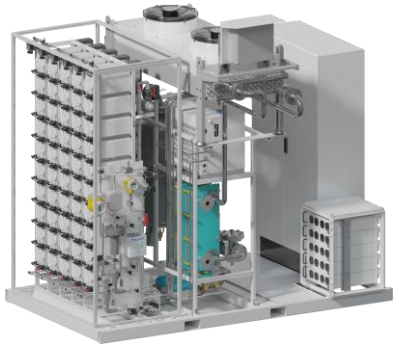
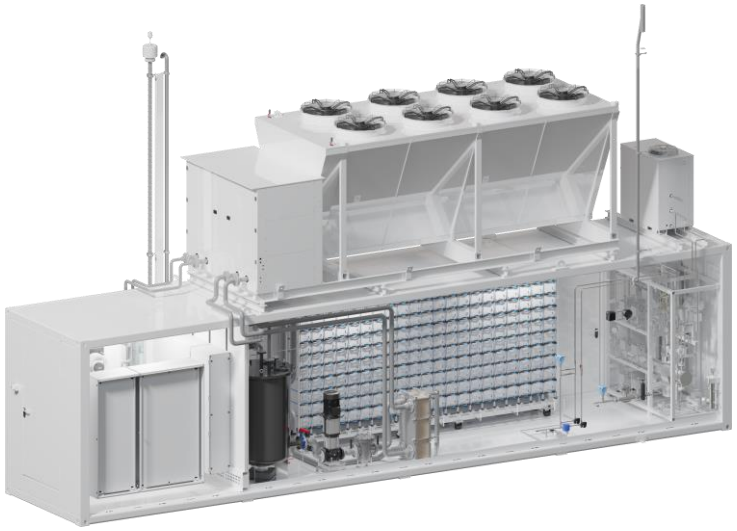
Enapter

# AEM multi-core Electrolysers

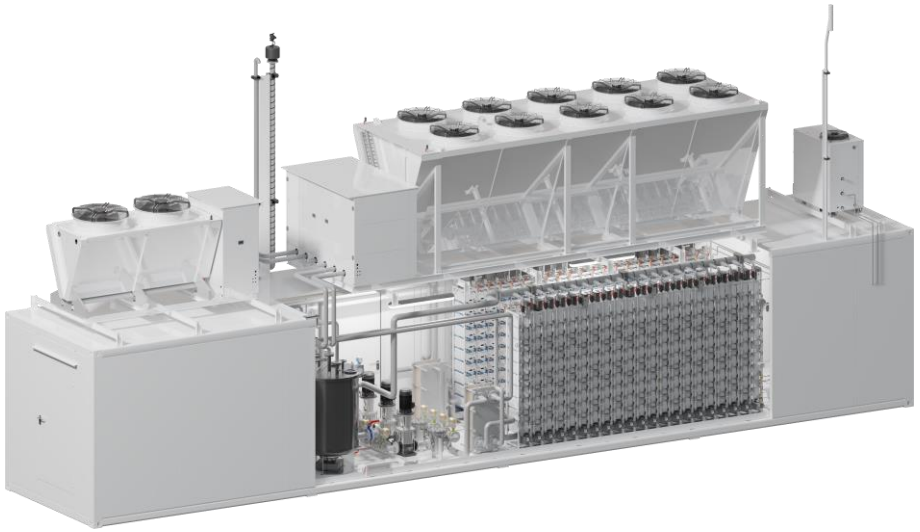
Modular. High-performance. Cost-effective.



**AEM Flex 120 kW**



**AEM Nexus 500 kW**



**AEM Nexus 1000 kW**

Our company

# Enapter at a glance

**Started in November 2017**
Builds on technology with a >10-year track record at that time

**Pioneer and commercial leader** in AEM electrolysis.
With 4.7k+ electrolysers ordered by 340+ customers across 50+ countries so far

**Changing the paradigm for electrolysers** with a high-volume focus
>150 partners integrate Enapter products into solutions of all sizes

Hardware, electronics and software in harmony for a next-generation experience.
**Smart, Connected, Adaptable**

**Scaling up** from a handful of units per month to **for mass production**.

Registered office: Heidelberg, DE
Stock exchange: Frankfurt/Hamburg Regulated Market

Customers around the world

# Thousands of units installed
# 340+ customers in 50+ countries


Many more here

Enapter Pisa, Italy

# Enapter's foundations

- **2017** – Our first building (1). Now exclusively used for R&D
- **2019** – Building (2) for serial production of electrolysers
- **2020** – Building (3) R&D extension for laboratories & testing
- **2021** – Building (4) for chemical and stack production
- **2022** – Major production capacity increase
- **2023** – Continued growth and a strong focus on R&D

Enapter Saerbeck, Germany

# Sustainable industrial production

**Life Cycle Impact Zero**

- 100% local renewable energy
- Minimal footprint throughout our products life cycles
- End-of-life electrolysers recycling process

Patented AEM technology – our secret sauce

# The strengths of AEM Electrolysers

## Alkaline

+

- Low cost
- Track record and mature technology

–

- Limited ability to operate at low loads/no intermittent usage

## AEM

+

- Low cost
- High efficiency
- Dynamic response
- Intermittent operation
- Robustness

–

- Shorter track record

## PEM

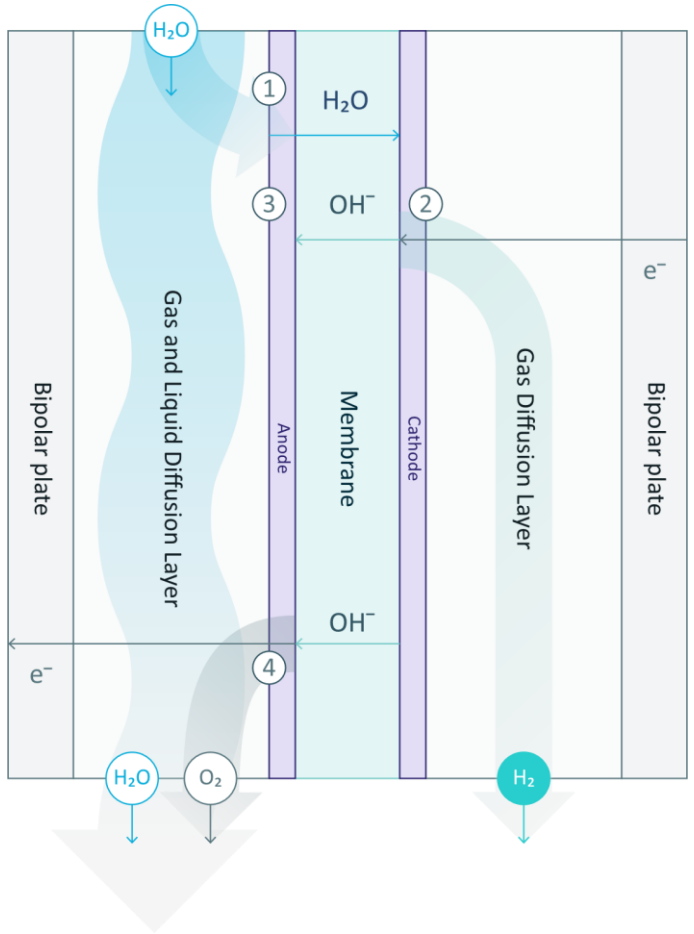
+

- Dynamic response
- Intermittent operation

–

- Comparatively low efficiency
- Higher cost due to expensive materials

patented




- $N_2$ or other gases not needed for purging
- Compressed air not needed for operation

- Titanium not needed
- Iridium not needed
- Customized power supplies not needed

- Patented “Dry Cathode” technology simplifies system design
- Combining the compactness and performance of PEM with the reliability and cost-efficiency of Alkaline

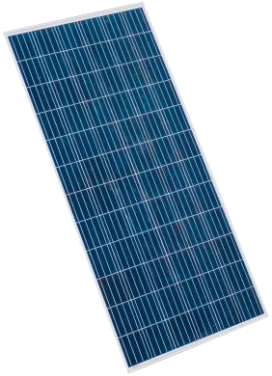
At scale, standardised modules outcompete made to order plants

# We have seen it before…

1981

today

2000



today

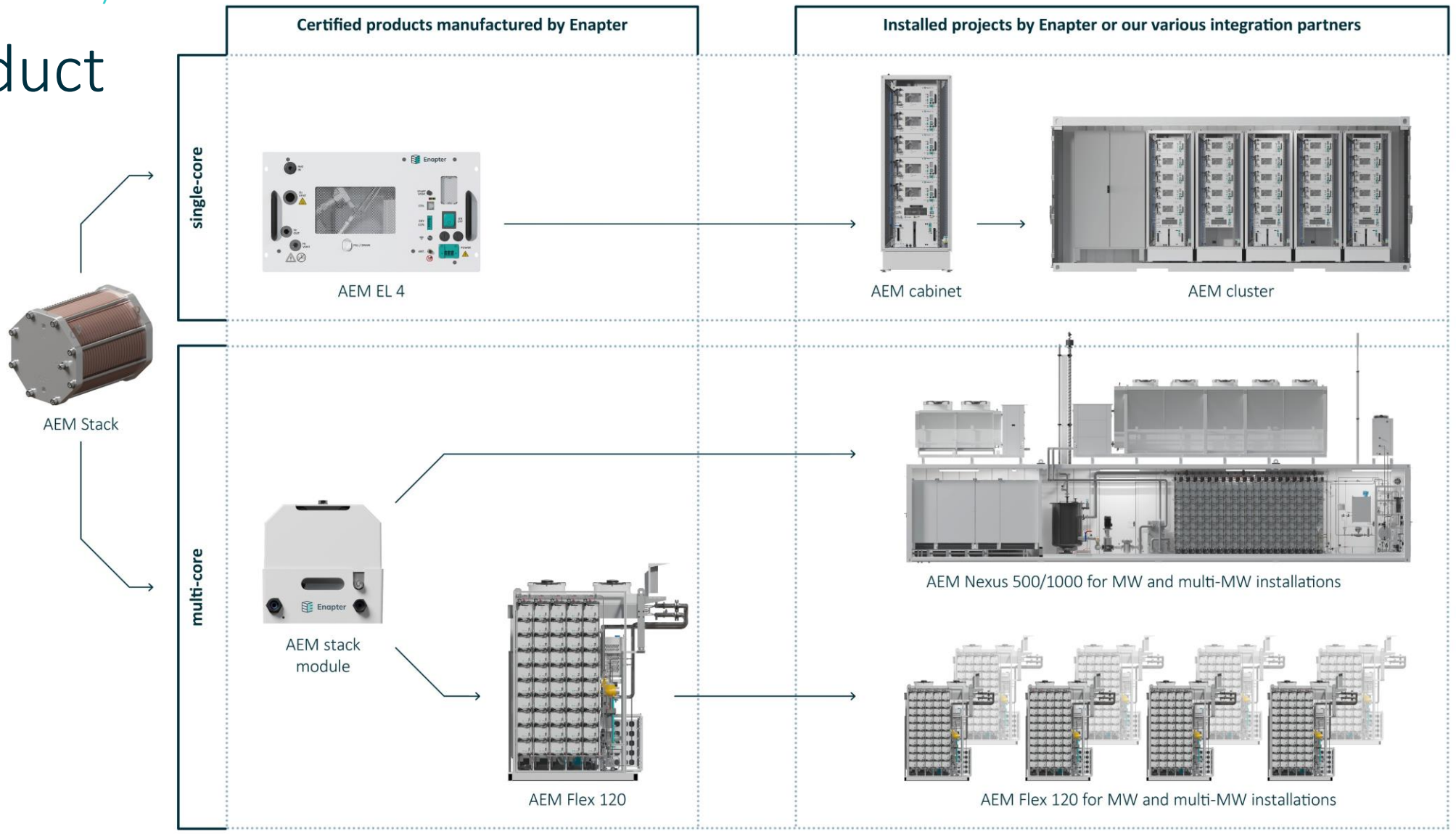
Throughout economic history, nothing has seen faster growth and cost reductions than mass-produced commodities.

PCs replaced mainframes and, in turn, stripped-down, standardized, and mass-produced blade computers now scale computing capacity to ever lower prices.

Deployment of increasingly-cheap modular solar at scale is undercutting and replacing fossil fuel energy generation. It's green hydrogen's turn.

Enapter's AEM scalability

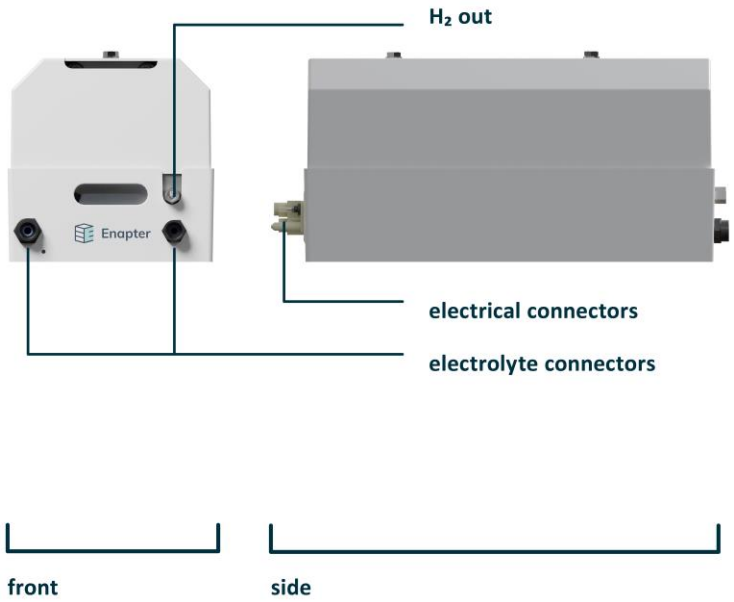
# Our product platform

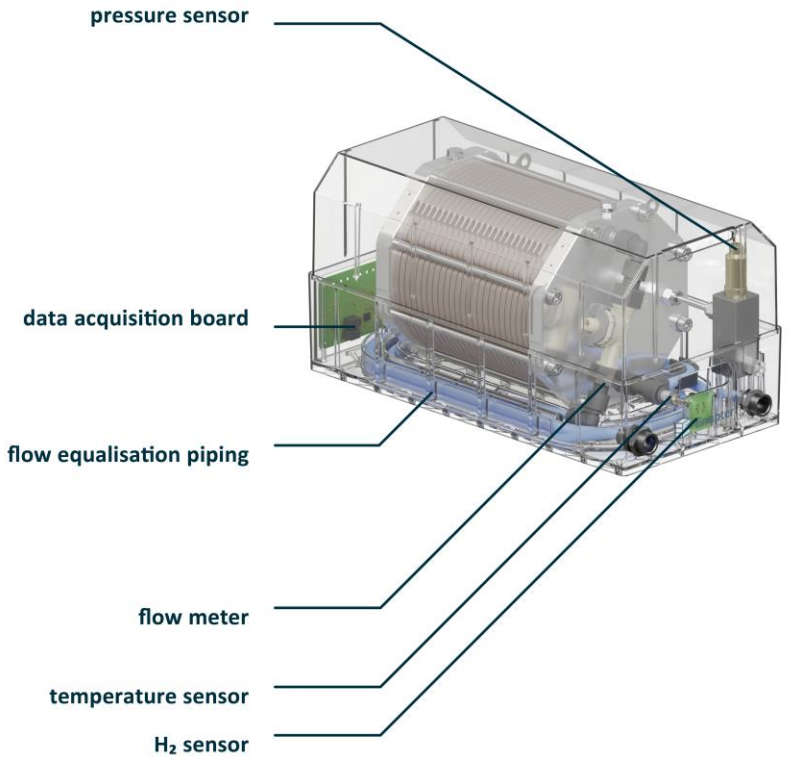


The core

# The AEM stack module

- Each stack module contains a data acquisition board and several sensors
- Each stack module can be replaced individually with ease
- Hydrogen & and water connections accessible from the front
- Electrical and data quick connectors on the back

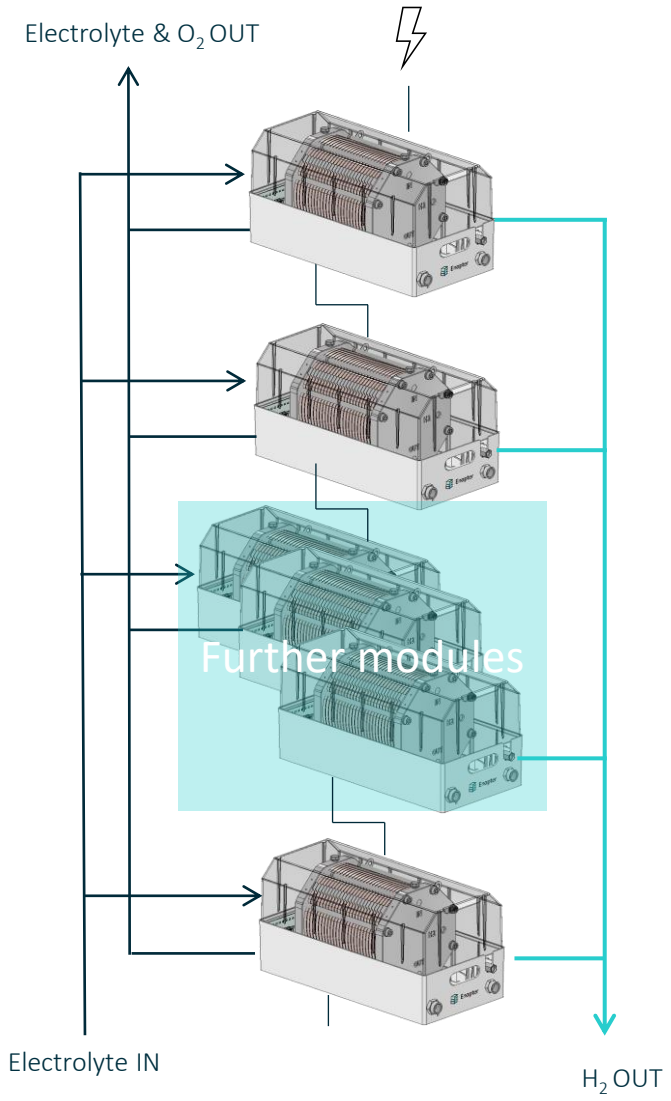


AEM multi-core systems

# The AEM String

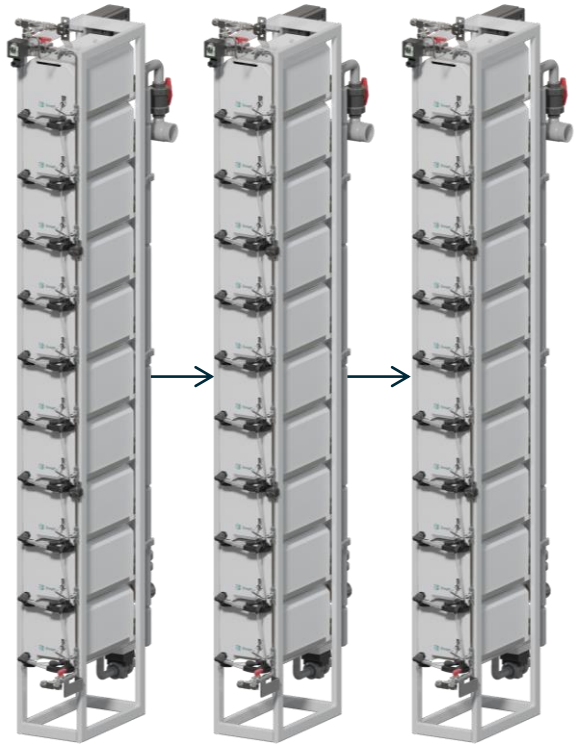
- 10 AEM stack modules connected in series
- The string is powered by a dedicated PSU
- Each String can be controlled individually
- Each string produces > 10 kg/day of H2




AEM multi-core systems

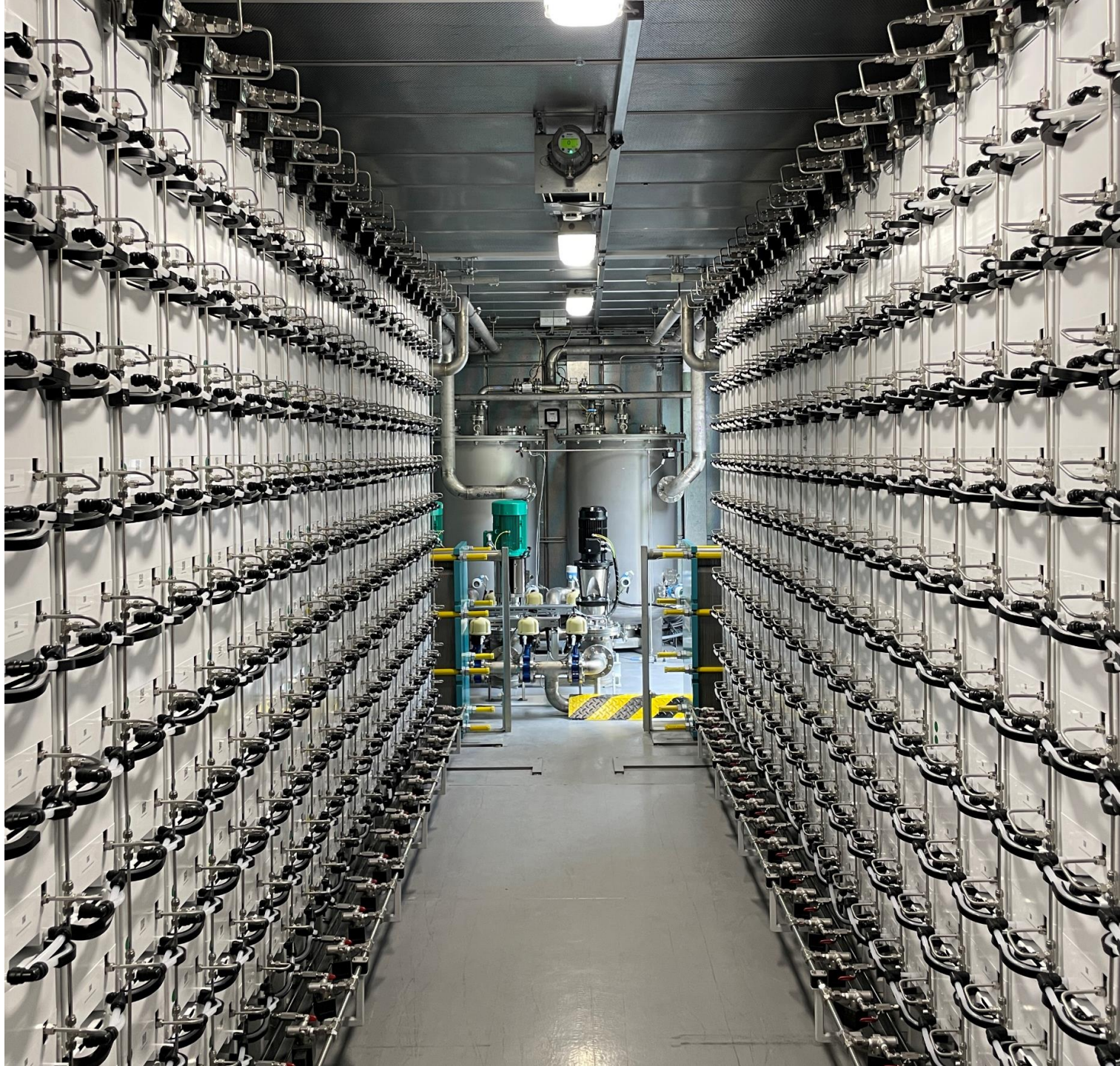
# Strings are connected in parallel

- Each string has a dedicated PSU
- Group of strings share the BoP:
  - Electrolyte tank
  - Electrolyte cooling
  - Electrolyte pumps



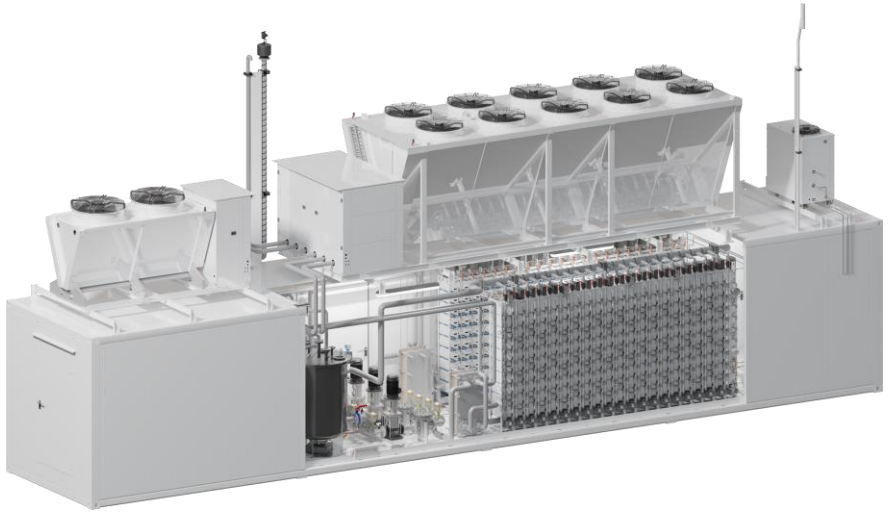
AEM Nexus in Saerbeck

# AEM inside

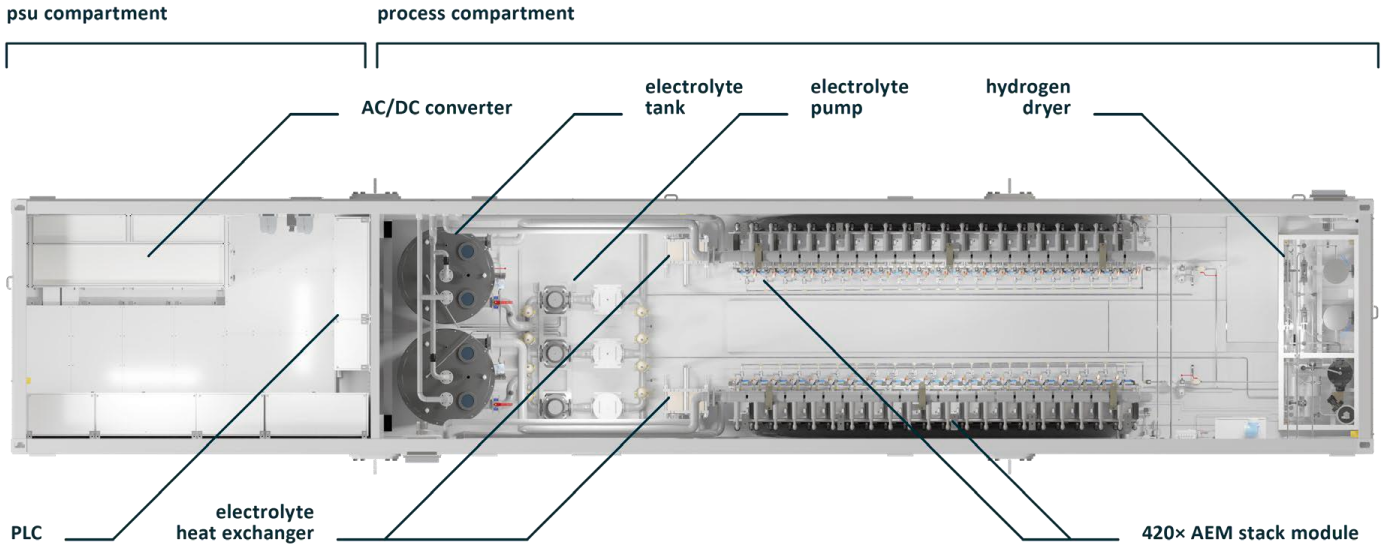



AEM Nexus 1000

# 1 MW - 453 kg/day

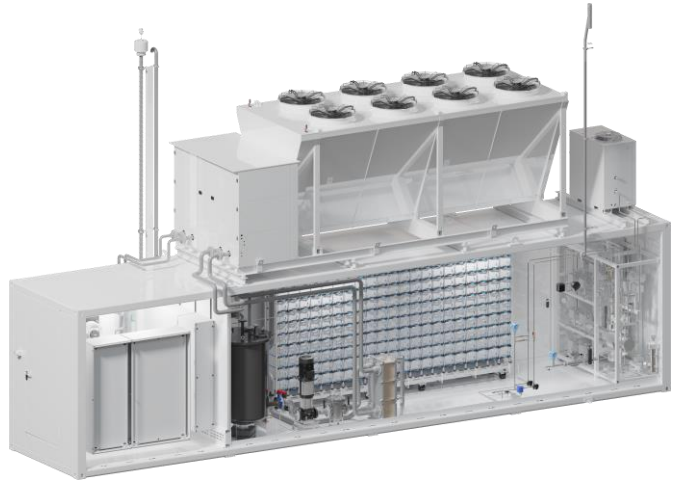


| | |
|---|---|
| **Top class efficiency** | 4.8 kWh/Nm³ |
| **Unmatched flexibility** | 3% - 100% Operating Range |
| **Extreme redundancy** | 42 independent strings |
| **Swift reaction times** | 0-100% in < 2 min |
| **High purity and pressure** | Up to 99.999% and 35 barg |
| Automatic and smart operation | |
| Attractive full-servicing option | |
| Datasheet: Enapter Handbook | |



AEM Nexus 500

# 500 kW – 226.5 kg/day

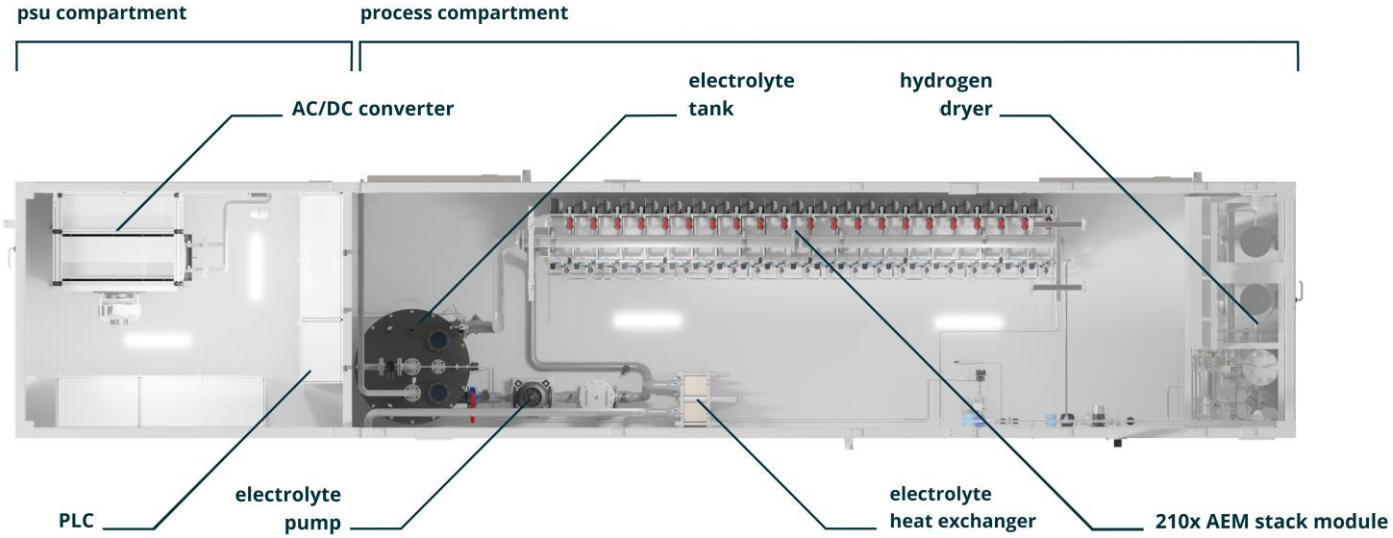


| | |
|---|---|
| **Top class efficiency** | 4.8 kWh/Nm³ |
| **Unmatched flexibility** | 3% - 100% Operating Range |
| **Extreme redundancy** | 21 independent strings |
| **Swift reaction times** | 0-100% in < 2 min |
| **High purity and pressure** | Up to 99.999% and 35 barg |

Automatic and smart operation

Attractive full-servicing option

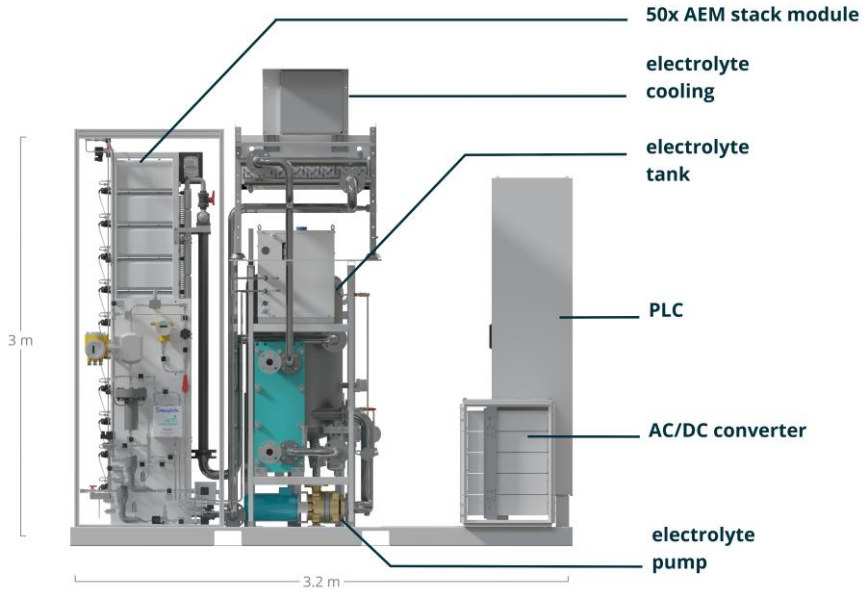
Datasheet: Enapter Handbook



AEM Flex 120

# 120 kW – 53.9 kg/day


| | |
|---|---|
| **Top class efficiency** | 4.8 kWh/Nm³ |
| **Unmatched flexibility** | 12%-100% Operating Range |
| **Extreme redundancy** | 5 independent strings |
| **Swift reaction times** | 0-100% in < 2 min |
| **High purity and pressure** | Up to 99.999% and 35 barg |
| Automatic and smart operation | |
| Attractive full-servicing option | |
| Datasheet: Enapter Handbook | |



Confirmed multi-core orders

# Strong Market Positioning

Steinbeis — 1 x MW in Germany

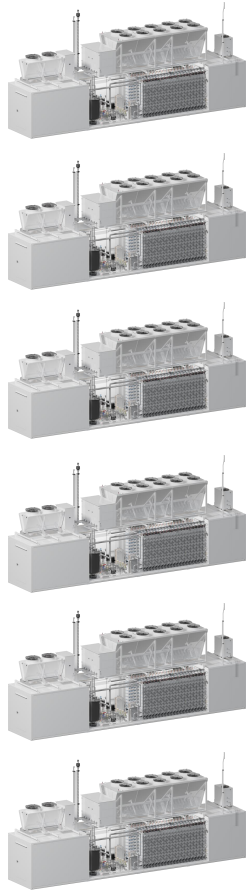
Adsensys — 1 x MW in The Netherlands

Intelligent Energy — 1 x MW in the UK

RE-FUEL H2 — 2 x MW in Canada

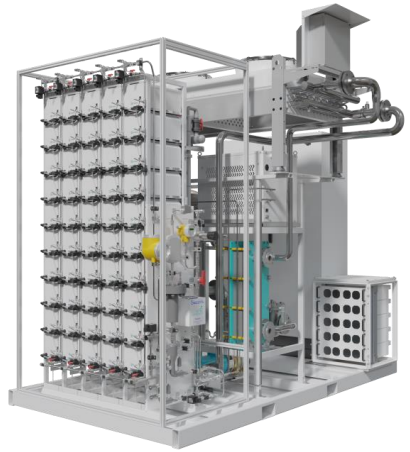
YEST — 2 x MW in South Korea

WOLONG Power your future — 5 x in China

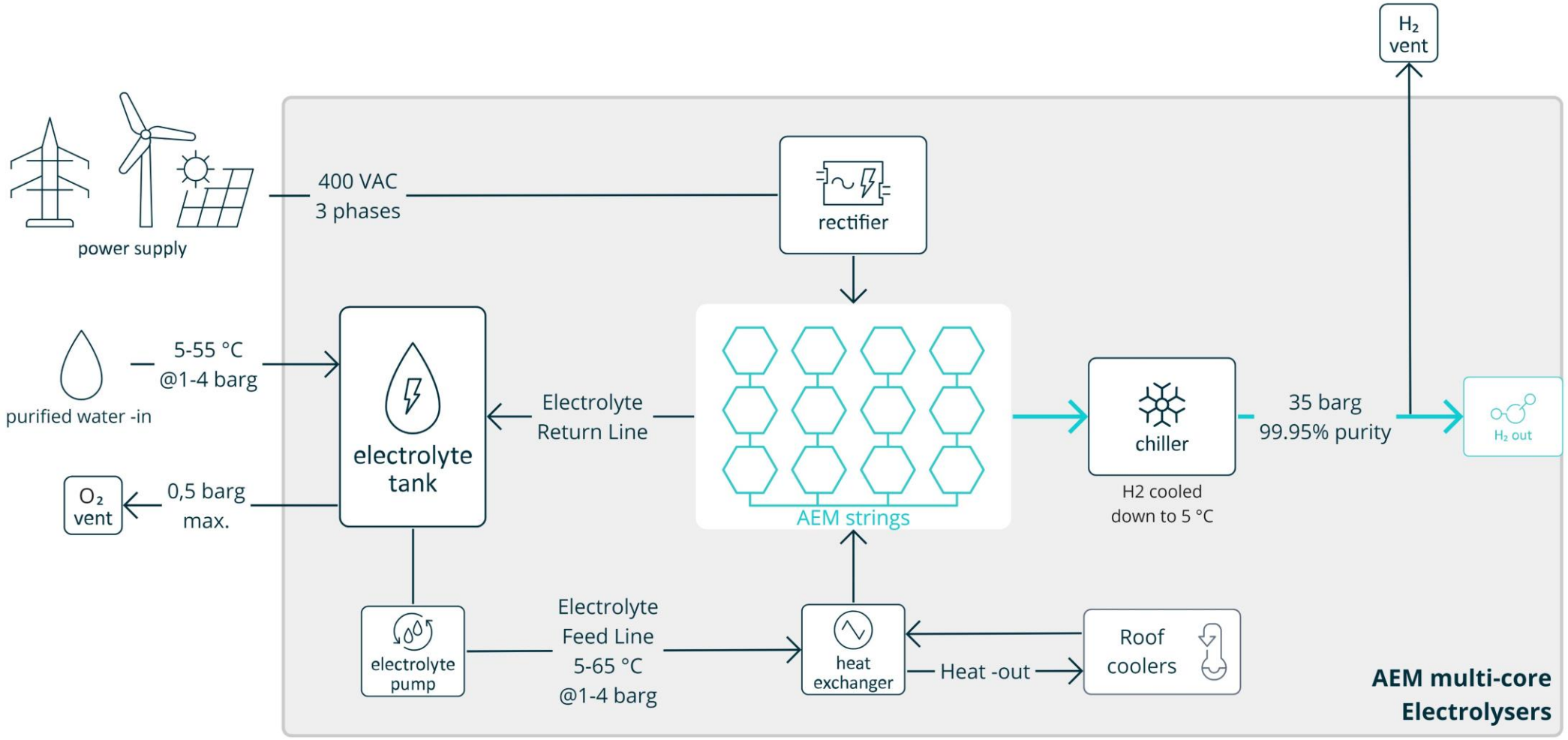


26 x Flex 120 in three continents

Only on 1st week after product launch

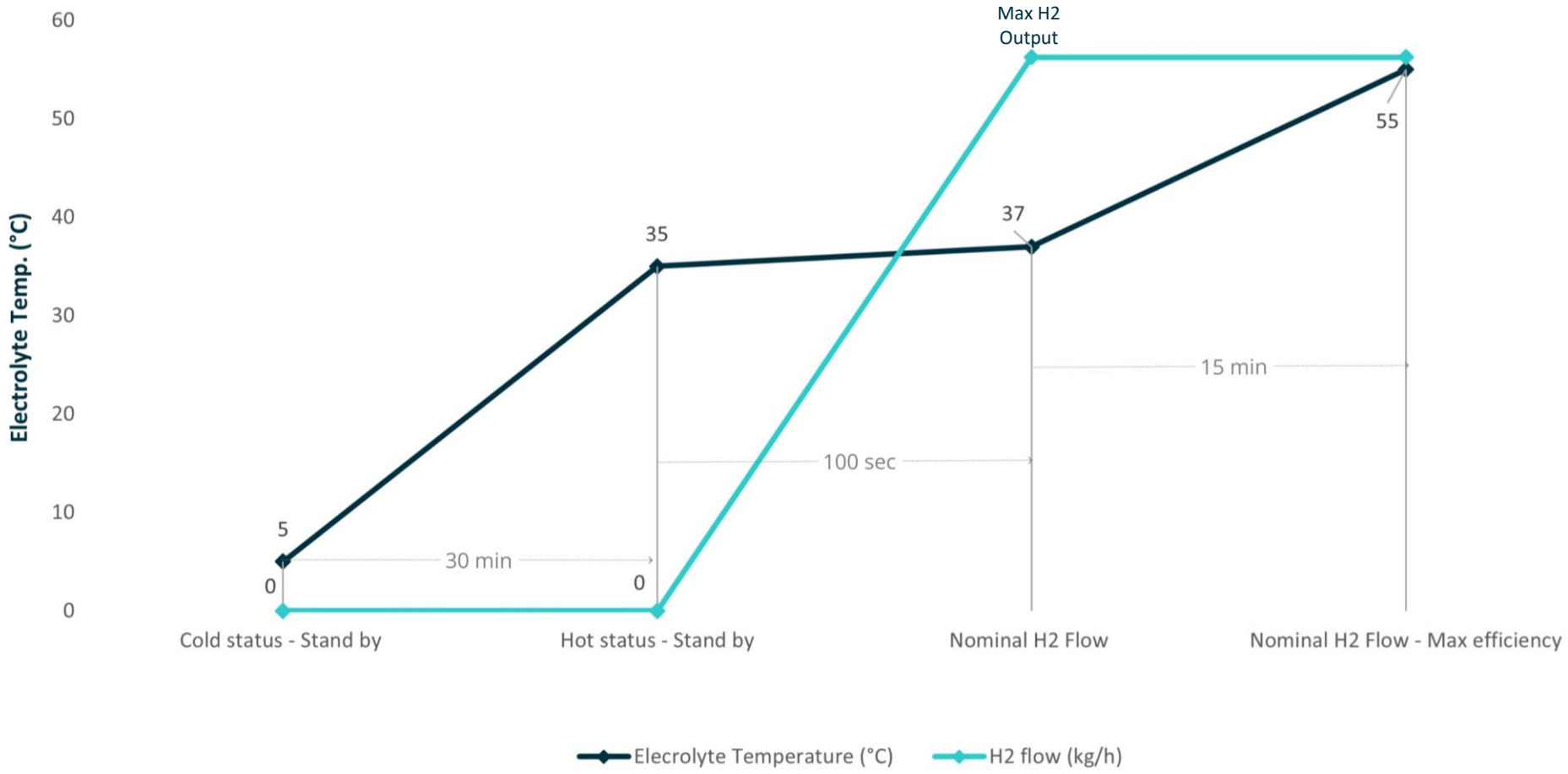


# Simplified PFD



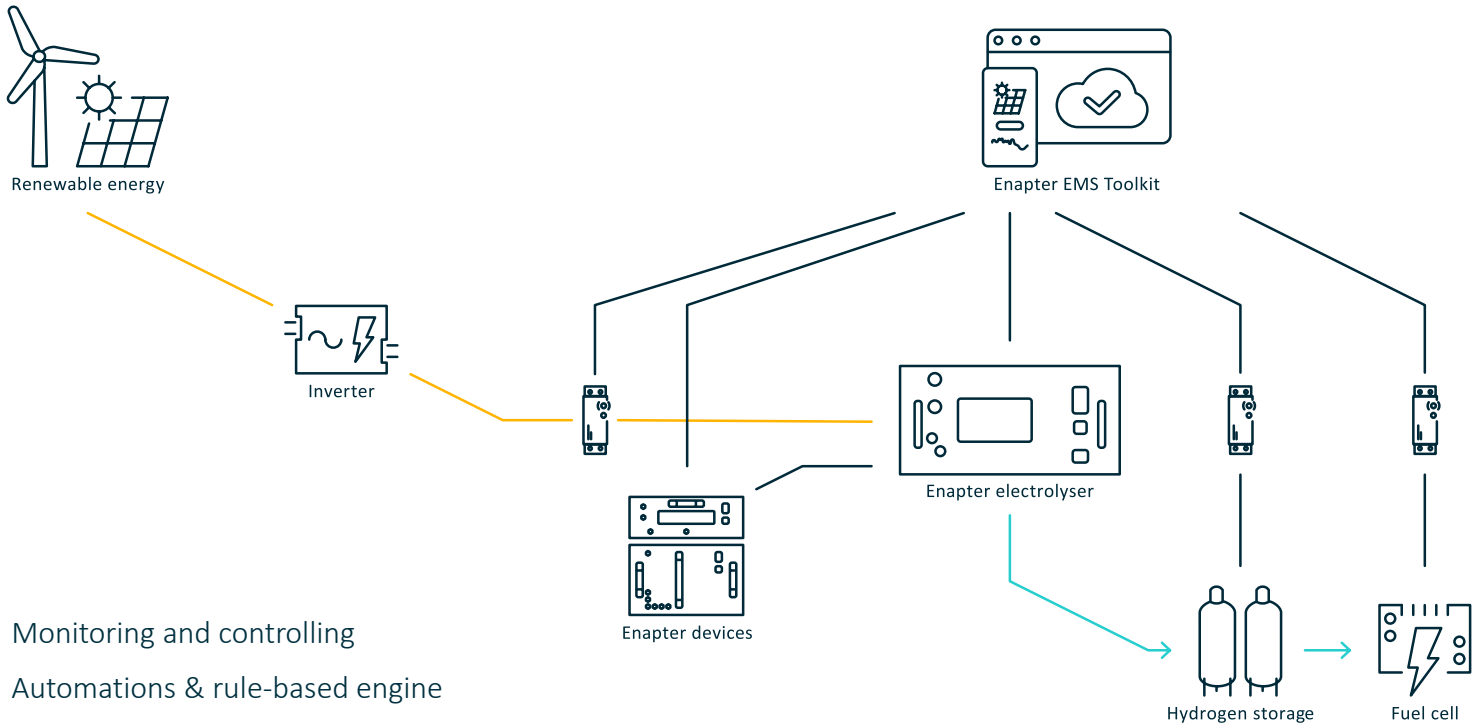
AEM multi-core Electrolysers

# Start-up Sequence



Enabling the AEM Electrolyser

# Enapter‘s Energy Management Toolkit




- Monitoring and controlling
- Automations & rule-based engine
- Machine Learning ready

AEM Nexus

# Certification & Safety

**CE Certification / EU Declaration of Conformity**

Addressing the following directives:

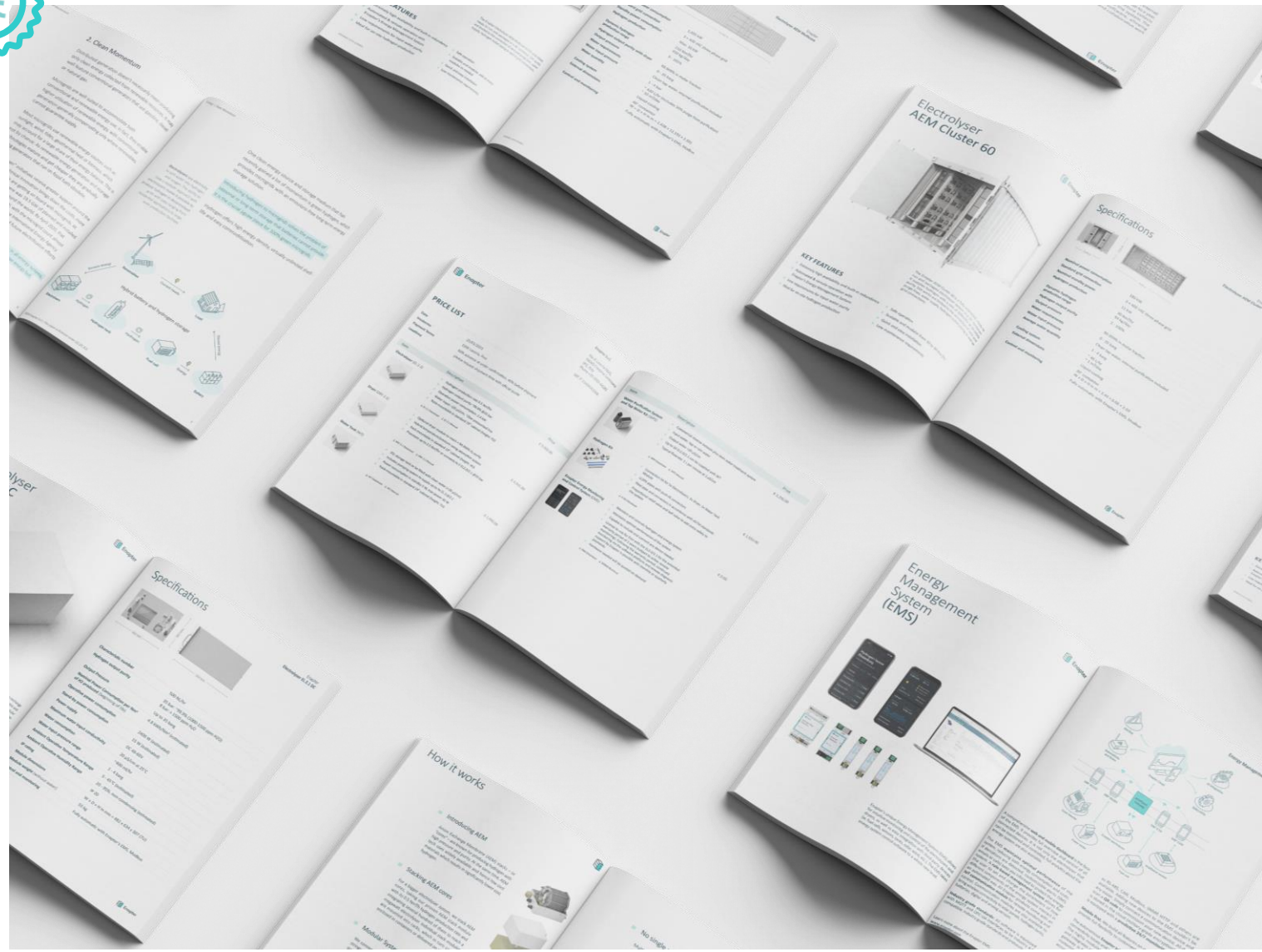
- Pressure Equipment Directive (PED)
- Machine Directive
- Electro-Magnetic Compatibility (EMC)
- ROHS Directive
- Radio Equipment Directive (RED)

**Functional Safety and HAZOP review, results**

- Pressure burst disks on H2 and O2 lines
- Flame arrestor in O2 vent
- Floor doubles as KOH Containment

**SIL Requirements according to IEC 61511-3:2016**

- Emergency stop - SIL2
- H2 gas concentration on process side - SIL2
- Temperature monitoring of the electrolyte - SIL2



AEM Nexus

# Design Reference Standards / Guidelines

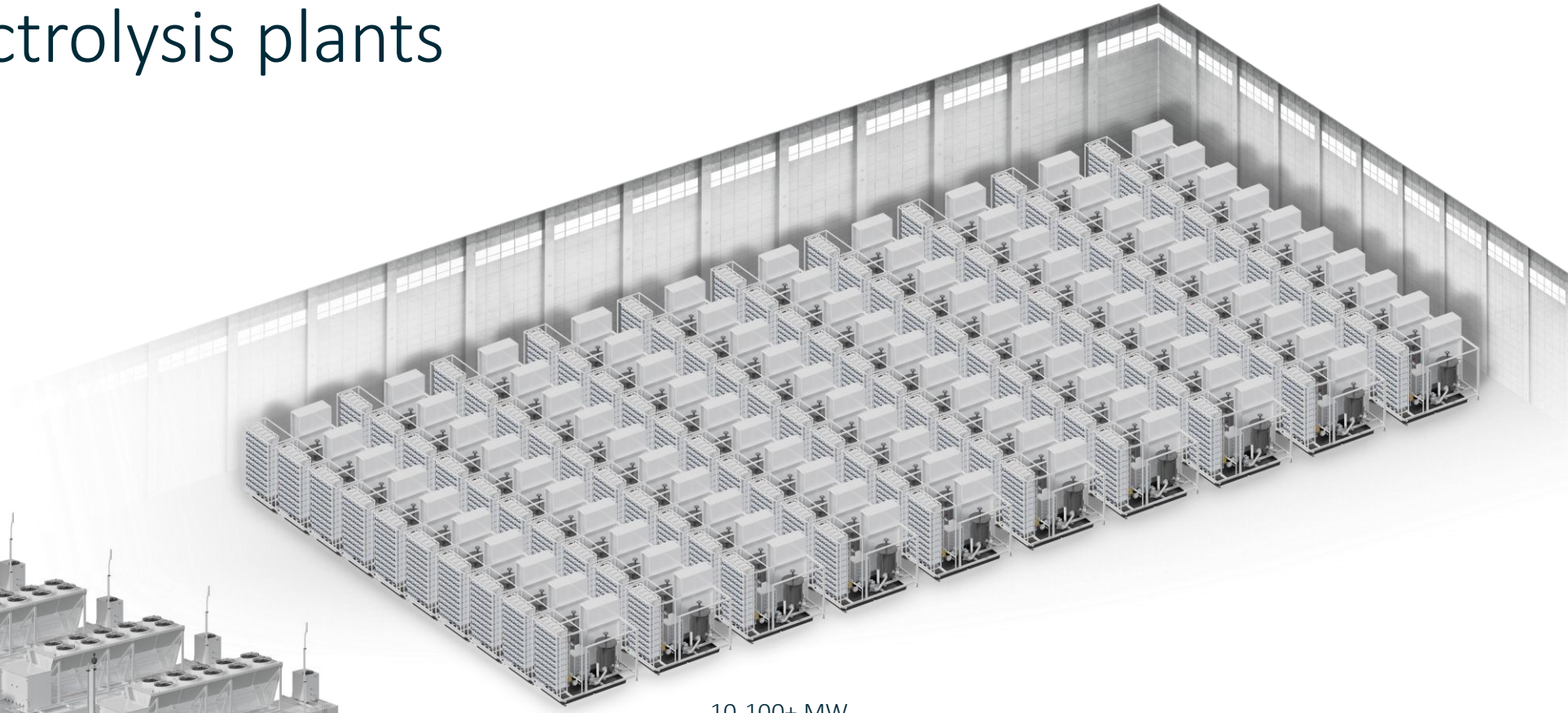
| | |
|---|---|
| **EN ISO 12100** | “Safety of machinery - General principles for design - Risk assessment and risk reduction” |
| **ISO 22734** | “Hydrogen generators using water electrolysis - Industrial, commercial, and residential applications” |
| **ISO/TR 15916** | “Basic considerations for the safety of hydrogen systems” |
| **IEC 61508-6** | “Functional Safety Of Electrical/Electronic/Programmable Electronic Safety-Related Systems” |
| **IEC 61511-1** | “Functional safety - Safety instrumented systems for the process industry sector” |
| **IEC 60079-10-1** | “'Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres'” |

Annex K, DGUV, TRGS

Multi-core approach for small to large MW scale

# Modular electrolysis plants

1-10 MW



10-100+ MW

Smart.

Simple.

Scalable.

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