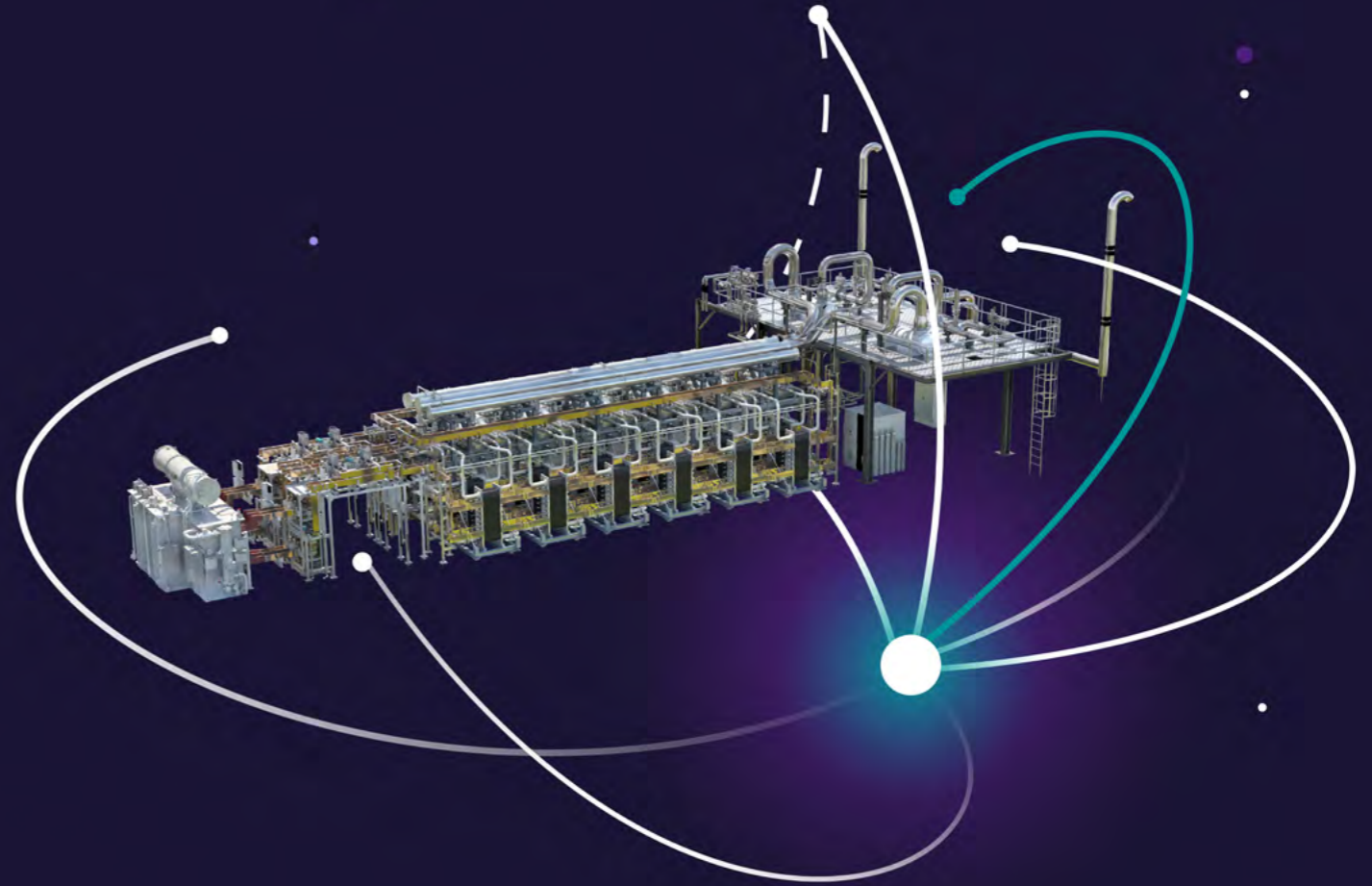


Hydrogen and Power-to-X solutions

Versatile and scalable technology to
make a difference in the energy transition



Challenges

- How to decarbonize industry, mobility, buildings, and other sectors, which cannot easily be electrified?
- How to harness sector coupling to use renewable hydrogen and its derivatives – including e-Methanol, e-Ammonia, and e-Fuels – to make green energy available to these hard-to-abate sectors?
- How to bring renewable energy from energy-rich regions like South America, North Africa, and Australia to energy-hungry industrial centers like North America, Europe, and Japan?

Other challenges:



Cost-efficient green hydrogen from renewable energy



How to ensure the availability and reliability of this young technology



Up-scaling of the existing technology and manufacturing



Offtake

Solutions

- We offer products, engineering and strong solution capabilities and a strong partner ecosystem across the whole hydrogen and Power-to-X value chain for the industry, mobility, and energy sectors.
- Gigawatt-scale production: We are prepared for delivery at Gigawatt scale through automation and digitalization of manufacturing.
- Scale-up is becoming a reality with projects in implementation based on our modular Elyzer P-300 platform from 6 MW in H2Future to 280 MW in Green Hydrogen Coastline and more to come in all sectors.
- CertaLink Energy Certificate provides tamper-proof documentation that a product has a renewably generated origin.
- Services delivered from Siemens Energy's global service network. We offer our customers services that extend from installation to maintenance of the electrolyzer system throughout its entire lifecycle, including recycling and refurbishment.

Electrolyzer references





Trailblazer Project – Green Hydrogen for Air Liquide pipeline infrastructure

Power dimension: up to 20 MW based on Elyzer P-300

Installation: 2024

Location: Oberhausen, Germany

Customer: Air Liquide

Use cases:

- Hydrogen for industry and mobility

Potential:

- Connect hydrogen production to both existing hydrogen and oxygen pipelines

Solution:

- Operation of a 24-module array Elyzer P-300
- One of the largest renewable hydrogen and oxygen production plants of Germany



Kassø PtX Project – First large-scale e-Methanol project for marine use in Europe

Power dimension: 50 MW based on Elyzer P-300

Installation: 2025

Location: Kassø, Denmark

Customer: European Energy

Use cases:

- Hydrogen for e-Methanol for shipping (e.g. MAERSK) and for plastics production (e.g. Lego) – 1000 kg/h
- Decarbonize the world's shipping industry

Potential:

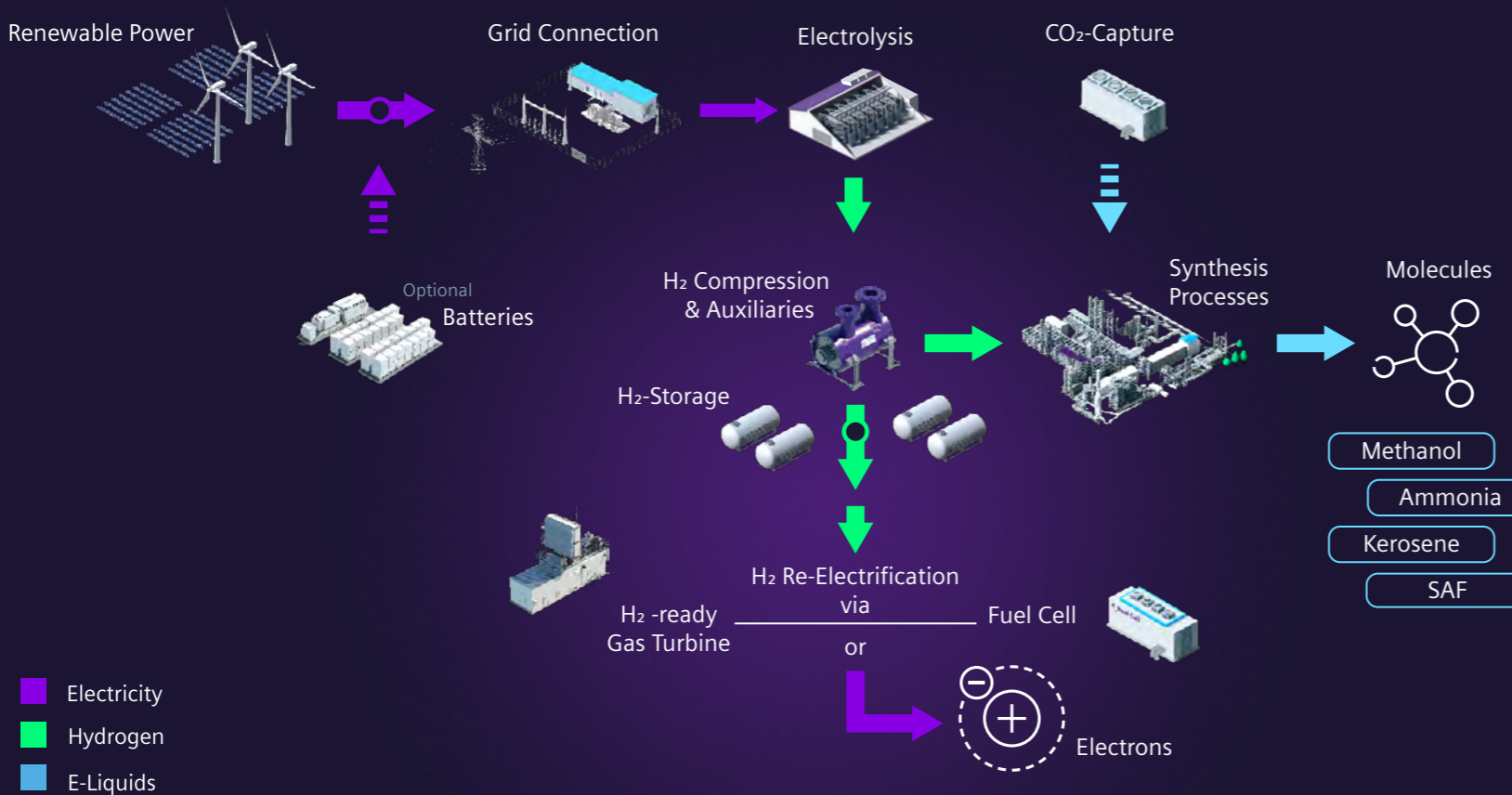
- Fast track project (bid and execution)
- First large-scale e-Methanol plant build by customer

Solution:

- 3 full Arrays Elyzer P-300, transformers, rectifiers, and demin water plant, commissioning by SE Denmark
- Powered by largest solar park in Scandinavia

Energy Landscape: Power-to-X and Hybrid Power Solutions

Decarbonization and cost optimization through integrated, customized technology.



Power-to-X (PtX) and Hybrid Power Solutions are always a subset of the depicted energy landscape. In PtX applications, hydrogen is converted into molecules along the energy landscape via a synthesis process, but there is no re-electrification.

By integrating different technologies, our customized solutions are tailored to your local challenges and needs, regardless of remote locations, grid access, existing network or decarbonization requirements.

The challenges are many – but the solution is simple with a Power-to-X or Hybrid Power Solutions from Siemens Energy.

- **Powerful and intelligent**
Integrating multiple technologies through advanced control capabilities for simplified, improved and efficient operation of complex energy systems
- **Powerfully sustainable**
through an increased share of renewable energies in power generation
- **Powerful and reliable**
through the integration of storage solutions

Elyzer P-300 – Technical Data

Benefits of PEM Electrolysis

- High power density
- Safety-oriented PEM design
- High dynamic operation range; direct coupling to renewables
- High efficiency and low module internal losses
- High gas purities
- Extreme low standby consumption
- Low maintenance needs
- Consumes only water and power, no hazardous chemicals

Electrolysis type:	Proton Exchange Membrane
Output Pressure (array):	100 mbar
Plant efficiency:	>75.5%
Minimum load:	down to 40%
DeminerIALIZED water consumption:	<10 l per kg hydrogen
Hydrogen quality:	up to 99.999% with de-oxo dryer
Startup time:	<1 minute
Dynamics:	up to 10 %
Stack design:	Optimized for 80k EOH*. Operation beyond 80k EOH possible.

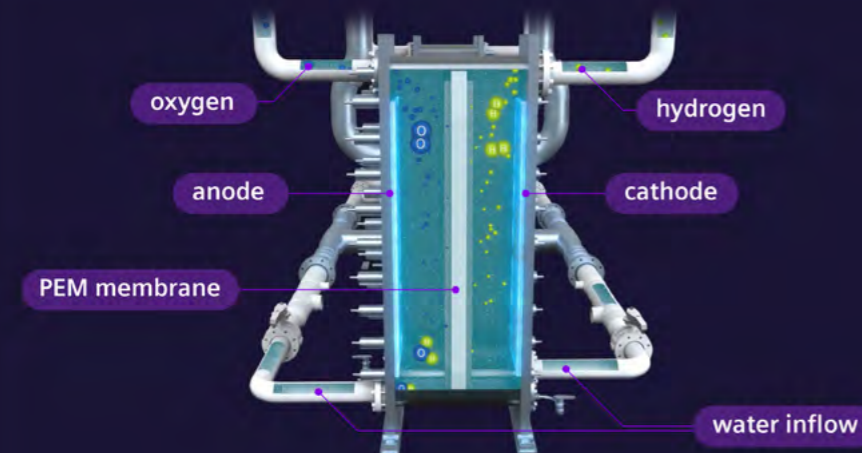
24 stacks
to build a full stack array

17.5 MW
plant power demand

>75.5 %
plant efficiency

335 kg
hydrogen per hour

PEM Electrolysis – how does it work?



For our hydrogen electrolyzer system, we focus on PEM technology taking its name from the proton exchange membrane. The membrane's special property is that it is permeable to protons but not to gases such as hydrogen or oxygen. As a result, in an electrolytic process the membrane takes on, among other things, the function of a separator that prevents the product gases from mixing.

*Equivalent Operating Hours

Service

Together we outperform: Custom-tailored service contracts



Service packages

Basic: Get the foundation for a smooth, economical and safe operation of your electrolysis system with a package of maintenance, spare parts, hotline support & digital services.

Advance: Best insurance against unforeseen downtime. Expanded the basic package to further reduce risks and to safeguard your business case for your electrolysis plant.

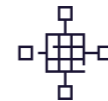
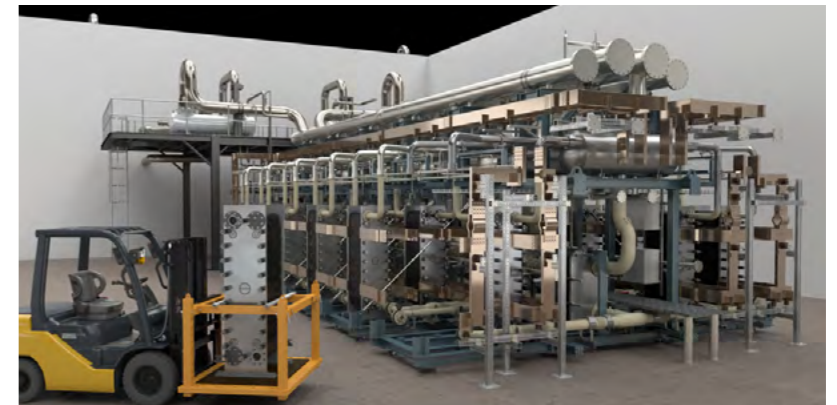
Integrated: Total peace of mind – since operating efficiency and value creation are your priorities, let us take care of your electrolysis plant. We strive to enhance the value of your plant operations.



Digital services

We offer innovation by utilizing state-of-the-art digital service to drive operational excellence of your plant.

We are prepared for the future of scheduled maintenance, asset management or digital twin studies to maximize your plant availability and operating efficiency.



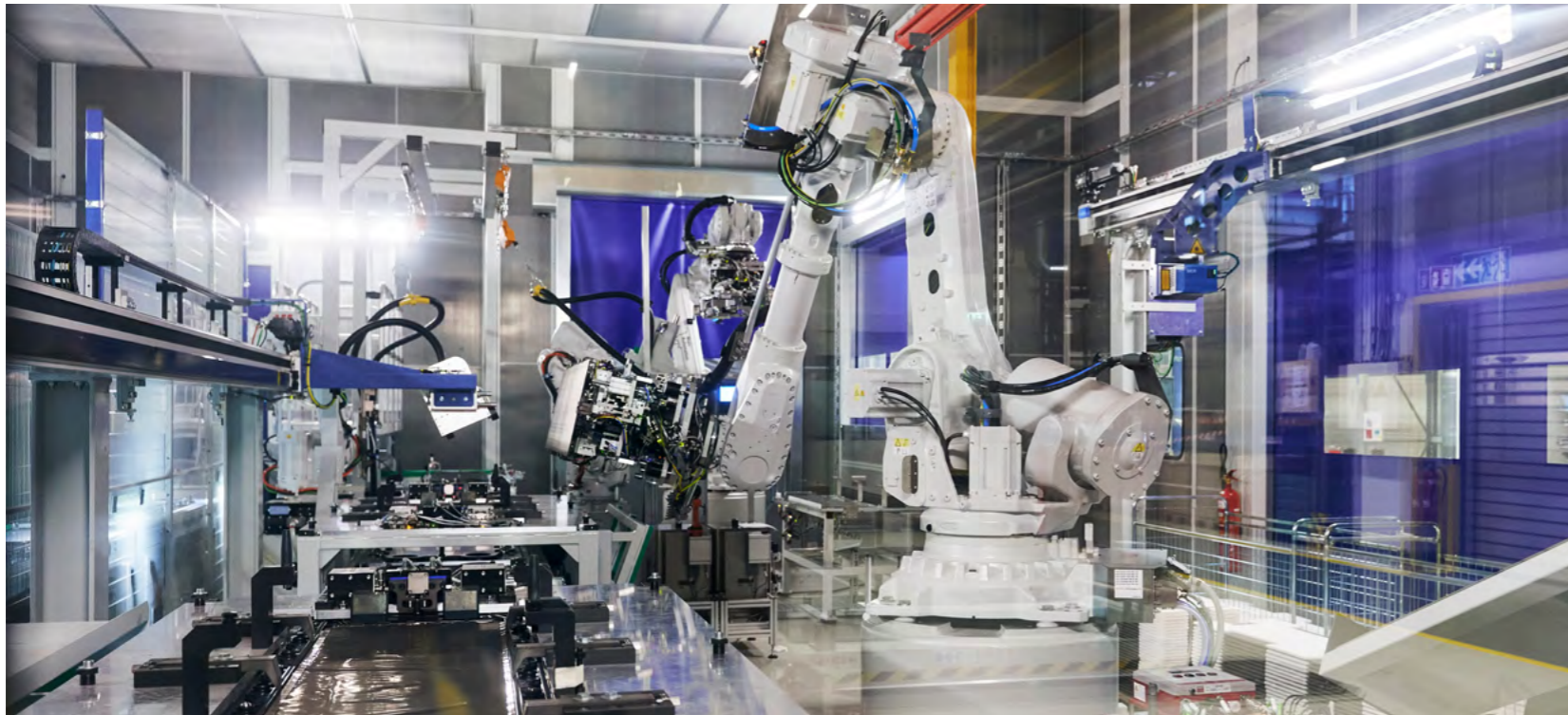
Performance enhancement services

Your path to maximum performance assuring operational reliability and efficient performance of your electrolysis plant.

Discover our stack exchange offerings of

- recycled and refurbished stack components. Ensuring quality without compromising your budget and sustainability goals
- stack upgrades based on our continuous research and development for the latest technical enhancement.

Industrial scale production of electrolyzer in Berlin



The European Union is aiming for many Gigawatts of electrolyzer manufacturing capacity to drive the energy transition. We are starting the required massive scaling-up and acceleration of manufacturing: In 2023, industrial production of PEM electrolysis stacks began

at our multi-Gigawatt electrolyzer facility in Berlin – highly automated according to latest production standards – and can be ramped up any time depending on market demand.



Cost efficient multi-Gigawatt stack factory

- Highly automated central PEM manufacturing according to latest production standards
- Large quantities and strong supply chain management
- Strong partner relationships for supply of key components



Localized decentralized packaging

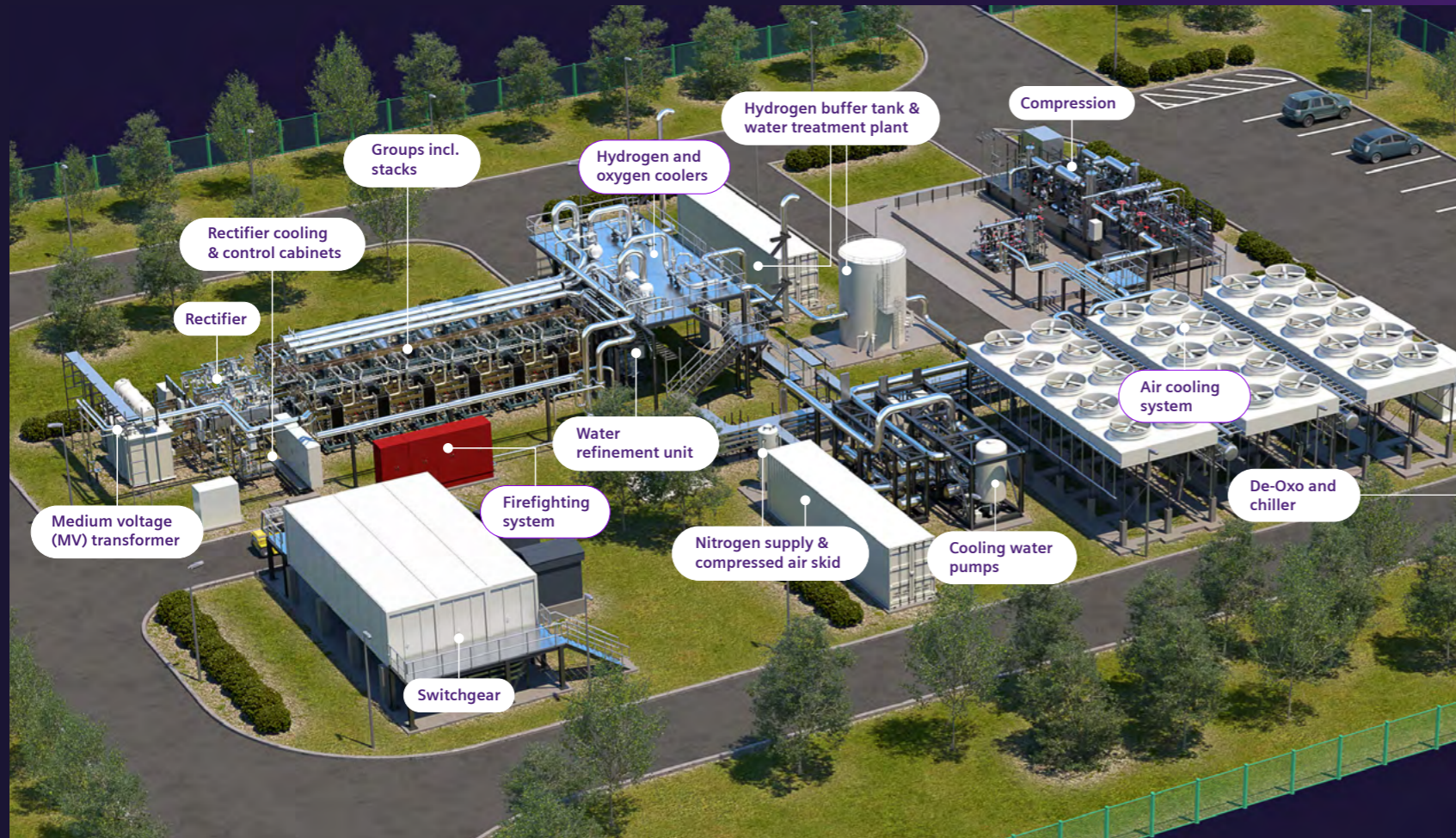
- High quality by pre-assembly
- Transportable units
- Local packagers in key regions facilitate local value chain



Scalable electrolysis system

- Minimize on-site installation
- Clearly defined interfaces maximize standardization
- Pre-engineered for contract manufacturing

Elyzer P-300-based hydrogen plant



The electrolysis system and compressor are indoor equipment. The halls have been removed to explain the components

We deliver what we promise



Highest standards in safety and project excellence

- Certified project managers
- ISO9001 Quality Management System
- Safety is in our DNA



Cost efficiency and operational performance

- Fast start-up and shut-down
- Highest operational flexibility
- Cold start capability
- Reduction of OPEX due to maintenance-free stack and available recycling concept
- Competitive hydrogen price per kg at green electricity prices below 3 ct/kWh



Green Hydrogen Solutions

- Proven industrial-grade large-scale electrolyzer systems >300,000 operating hours in MW range

Optimized plant design



50 MW reference plant

Rated plant power: 50 MW

Total electrolysis plant space (L×W): 55 m×71 m

Dimensions electrolysis system hall (L×W×H): 35.5 m×15.5 m×9 m

Hydrogen production kg / h) approx. 1,000

Oxygen production (kg / h) approx. 8,000



100 MW reference plant

Rated plant power: 100 MW

Total electrolysis plant space (L×W): 186 m×90 m

Dimensions electrolysis system hall (L×W×H): 77 m×18 m×10,5 m

Hydrogen production (kg / h) approx. 2,000

Oxygen production (kg / h) approx. 16,000



Industrial scale

- Double-digit Megawatt PEM electrolysis system
- Modular design scales up to Gigawatt plants
- High volume production: Automated production for a flexible ramp up of the Gigawatt factory



Cost efficient solution

- Modular design / scaling effects minimize investment costs for large-scale industrial electrolysis plants
- Simple design for economic system and reliable operation with natural water circulation within the array
- Pre-engineered, standardized and pre-packaged arrays reduce project risks and accelerate execution
- Recycling concept enables cost reduction for modernizations and upgrades



Future proof

- High dynamics meet the challenge of integrating fluctuating renewable energy sources
- Plant design flexibility
- Tailored service concepts
- Different packages for different project needs: from basic maintenance activities to comprehensive all-round service using state-of-the-art data analysis

Prove your product is green with CertaLink Energy Certificate

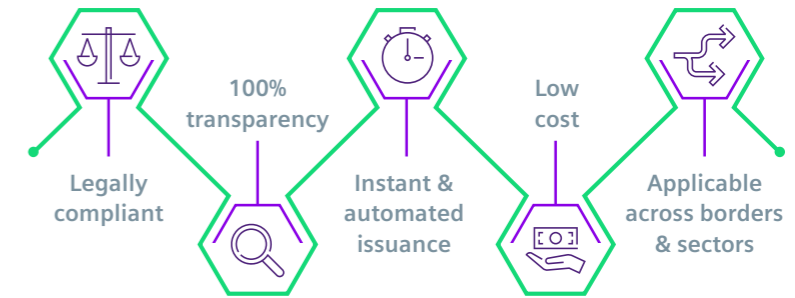


Siemens Energy offers the Clean Energy Certification digital service to track the environmental impact of energy production by issuing automated, timely, and government-approved certificates across sectors and across borders through partnerships with independent, accredited bodies and other companies in the energy sector.

CertaLink Energy Certificate ensure traceability of the carbon-neutral origin of energy production, energy imports, and energy consumption. Getting green versions of products and fuels will be a significant part of the transition to a carbon-neutral economy.

Our CertaLink Energy Certificate will establish the proof of origin of energy and will satisfy the market needs of the whole range of Power-to-X customers, allowing them to:

- Gain customs and tax reductions,
- Achieve higher market prices for products produced by clean energy,
- Meet future governmental requirements (e.g. EU program "Fit for 55"), and
- Enable the trading of clean energy on stock exchanges and in other marketplaces.



CertaLink Energy Certificate ensure traceability of the carbon-neutral origin of energy production, energy imports, and energy consumption. Getting green versions of products and fuels will be a significant part of the transition to a carbon-neutral economy.

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