
ROLLS
ROYCE
Sustainable solutions
A HYDROGEN ECOSYSTEM
FOR A SUSTAINABLE FUTURE
mtu
A Rolls-Royce
solution

SUSTAINABLE POWER THAT MATTERS

The Power Systems business unit of Rolls-Royce is focused on creating sustainable, climate-neutral solutions for drive, propulsion and power generation. We are making a significant contribution to the energy transition with environmentally-friendly technologies from our ***mtu*** product and solution brand. As leaders in standby power for safety-critical plants and in integrated drive and propulsion systems for ships and heavy-duty land vehicles, our customers know they can depend on us, and have been doing so for over 110 years.

TRANSFORMING CORE INDUSTRIES WITH GREEN HYDROGEN

As energy demands become more decentralized and complex, there's no single solution to the climate and energy crisis.

While hydrogen alone can't solve the problem, it will be a game-changer for specific applications. Rolls-Royce Power Systems is not only providing the solutions to accelerate the energy transition with scalable hydrogen production, it is also enabling existing clients to reduce emissions with its core products to be ready for hydrogen and hydrogen-derivative fuels.

With over hundred years of experience in advancing technology through transformation we know that only a broad portfolio of renewable technologies will lead to a successful energy transition.

CREATING A HYDROGEN ECOSYSTEM FOR A CARBON-NEUTRAL SOCIETY

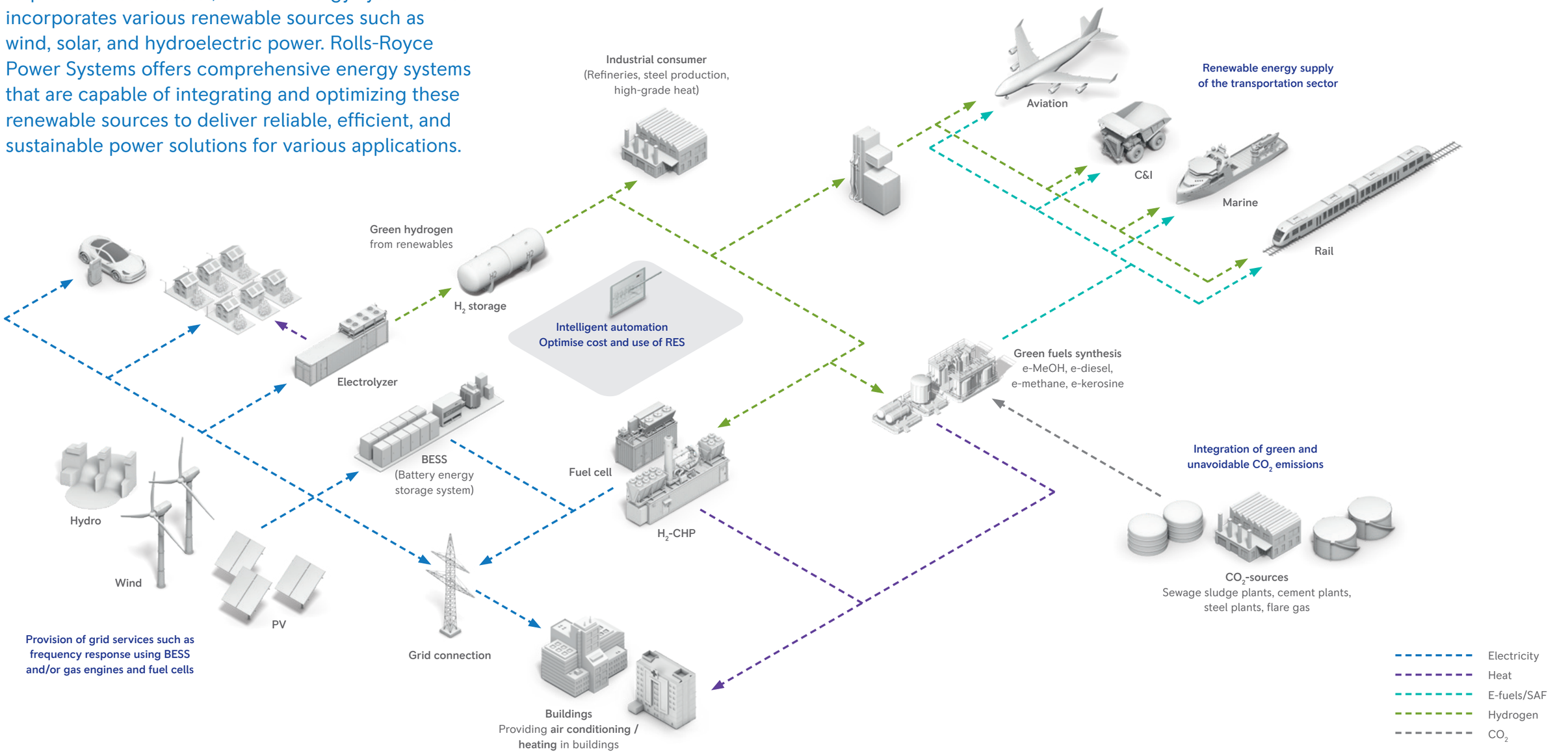
We are a solution provider: Building a diversified portfolio of sustainable technologies is the only way to effectively address the energy challenges we currently confront.

We develop cutting-edge technology: Drawing upon over a century of technical expertise, we are developing the sustainable technology of the future.

We transform core industries: Switching to green hydrogen and transforming existing engines to run on sustainable fuels is a crucial step towards making core industries greener and reducing their carbon footprint.

A RENEWABLE CROSS-SECTORAL ENERGY SYSTEM

The future of green transport and energy will require a cross-sectoral, diverse energy system that incorporates various renewable sources such as wind, solar, and hydroelectric power. Rolls-Royce Power Systems offers comprehensive energy systems that are capable of integrating and optimizing these renewable sources to deliver reliable, efficient, and sustainable power solutions for various applications.



GREEN HYDROGEN AS THE BUILDING BLOCK FOR A SUSTAINABLE FUTURE

Green hydrogen enables a sustainable transformation of hard-to-electrify sectors.

Refining: Remove impurities such as sulfur and convert heavy crude oil into lighter products like gasoline.

Sustainable fuel: Combined with carbon dioxide to produce synthetic fuels like methanol or sustainable aviation fuel (SAF), which can be used as a sustainable alternative to traditional fossil fuels.

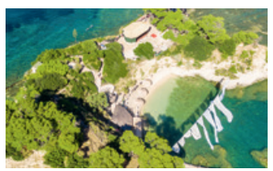
Ammonia: Key ingredient to produce ammonia, which is then used as a fertilizer and in various chemical processes.

Mobility: Used to power fuel cell vehicles, offering a zero-emission alternative to traditional gasoline or diesel engines.

Methanol: Production of methanol, used in a range of industrial applications including as a feedstock for plastics and potentially as a sustainable fuel for marine transportation.

Grid Services: Used in grid services to store excess renewable energy and provide backup power during peak demand periods.

Steel: Reducing agent in direct reduction process for iron ore.

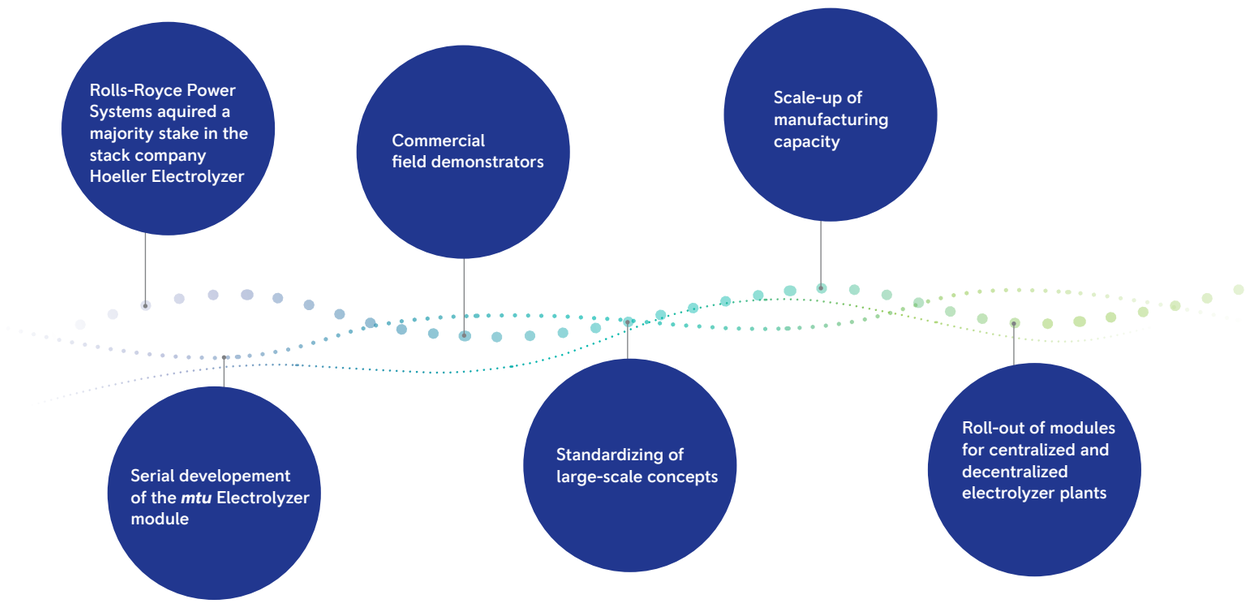


Off-Grid Power: Provide power in off-grid applications in combination with renewable energies, particularly in remote or rural areas.

Industrial high-grade heat: Used as a fuel to produce high-grade heat for industrial processes, particularly in applications where electrification is not feasible.

ROLLS-ROYCE POWER SYSTEMS IS ENTERING THE ELECTROLYZER MARKET FOR GREEN HYDROGEN

Building on years of expertise in manufacturing and servicing power generation systems, coupled with a global network of service centers, Rolls-Royce Power Systems is developing an electrolyzer with superior performance that delivers high hydrogen output pressure.



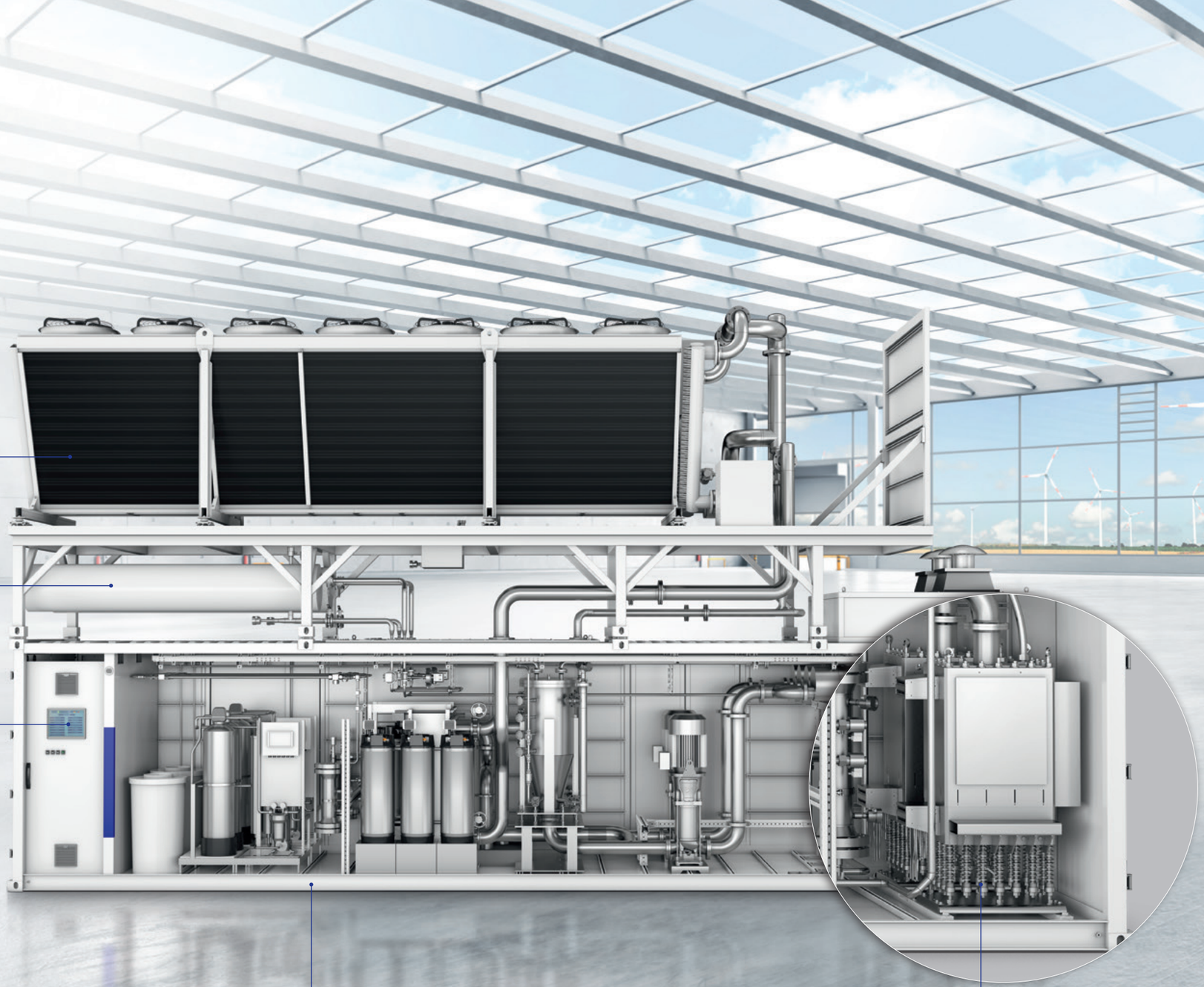
THE *mtu* ELECTROLYZER

With its modular design, our electrolyzer is particularly well suited for on-site hydrogen production for refueling stations and other small scale industrial demands or direct coupling with decentralized renewable energies.

Fully integrated system incl. waste heat rejection, water purification & on-roof cooling

Safety concept for electrical safety, explosion protection, fire detection

Automated control and digital connectivity



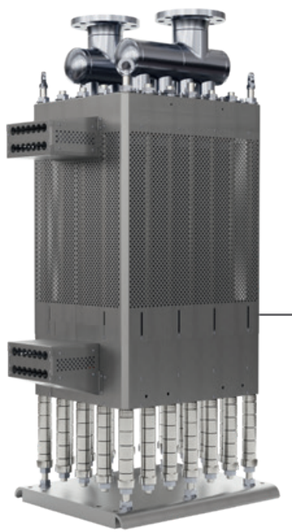
Specifications	*mtu* Electrolyzer
Input	3.6 MW el. power input
Output	68 kg/h
Installation Options	Indoor or outdoor installation
Footprint	3 x 40-ft
H_2 pressure	35-38 bar

Modular PEM system based on high-performance Hoeller stack technology

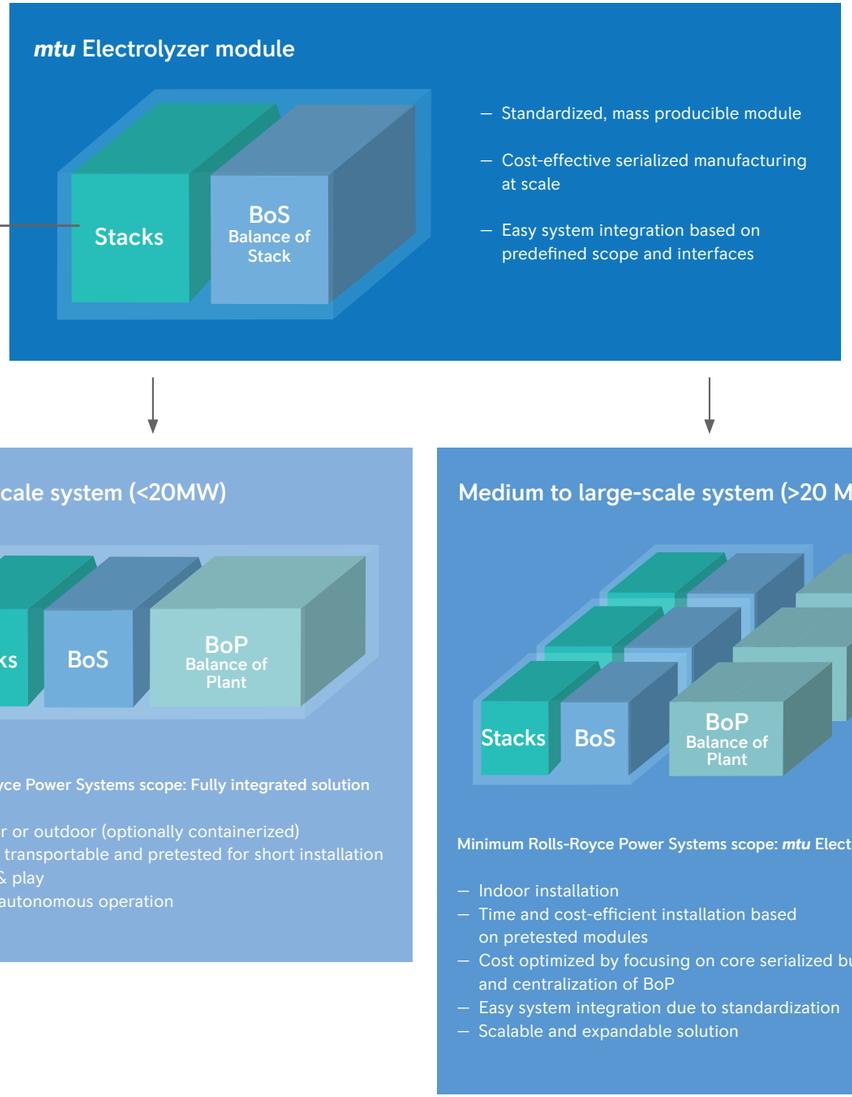
Hoeller high-performance eletrolyzer stack for hydrogen production
- Membrane electrode assembly: Better connecitivity to reduce catalyst need
- Pourous transport layer: Lower resistance to increase power and efficiency
- Bipolar plate: Opimization of the flow field to maximize power
- End plate: Advanced design to optimize installation space

mtu ELECTROLYZER MODULE FOR SCALABLE HYDROGEN SOLUTIONS

By utilizing a mass-produced module as the foundation for integrated systems and 3rd-party integration, we can address customer requests across a wide range of small to large-scale systems.

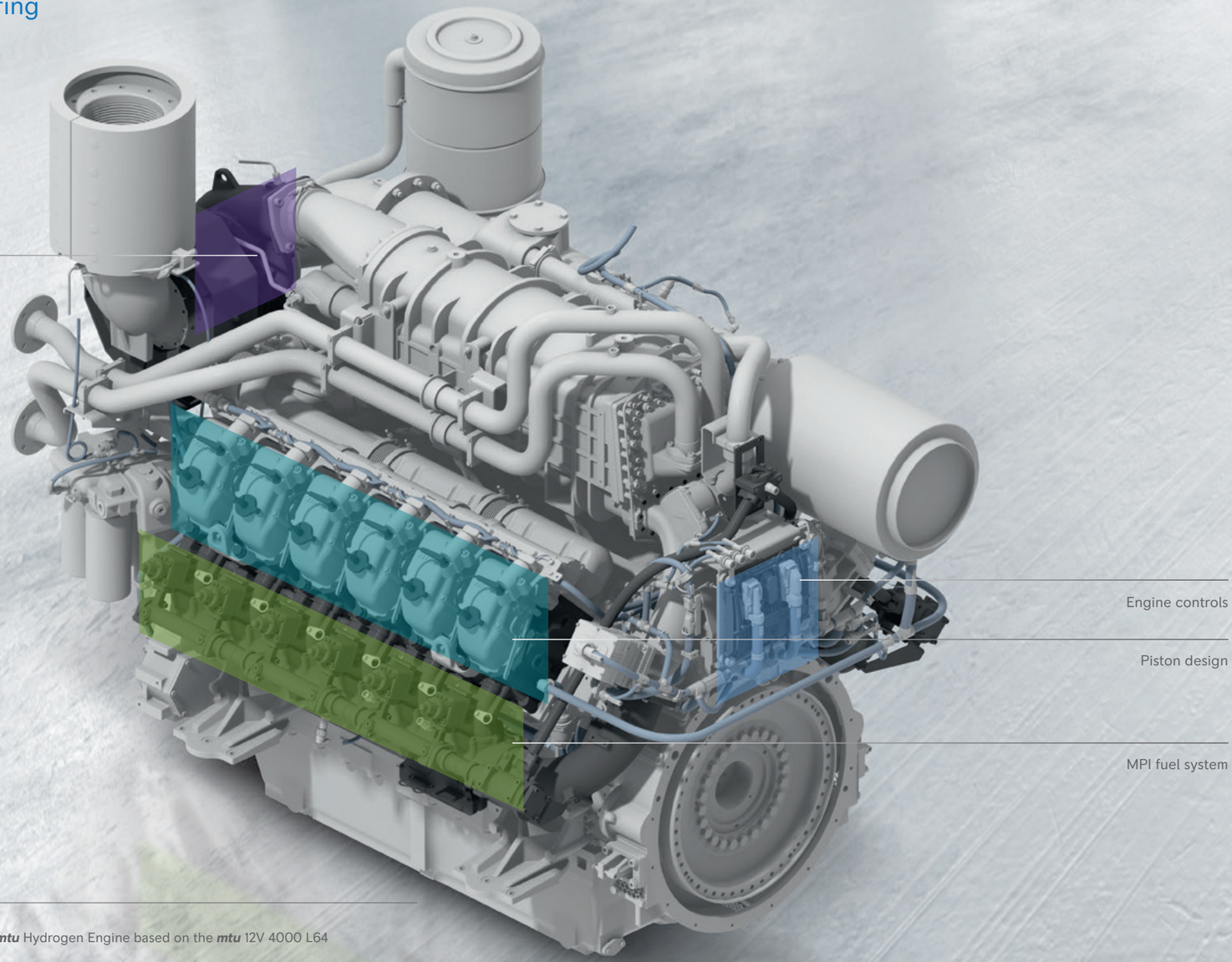


Hoeller high-performance electrolyzer stack for hydrogen production.



THE *mtu* HYDROGEN ENGINE

The hydrogen engine will be retrofitted to run solely on 100% hydrogen fuel. This conversion is based on the proven engine platform ***mtu*** Series 4000, ensuring reliable and efficient performance.



mtu Hydrogen Engine based on the ***mtu*** 12V 4000 L64

mtu Hydrogen Engine	
Electrical power	930 kW
Electrical efficiency	40%
Total efficiency	83%
Thermal power	1120 kW
H_2 consumption	74 kg/h
H_2 injection system	Port fuel injection
Fuel supply pressure	16 bar
Engine plattform	***mtu*** 12V 4000 L64
Turbocharging	Single stage
Combustion process	Ultra lean Otto

mtu FUELCELL POWERPACK

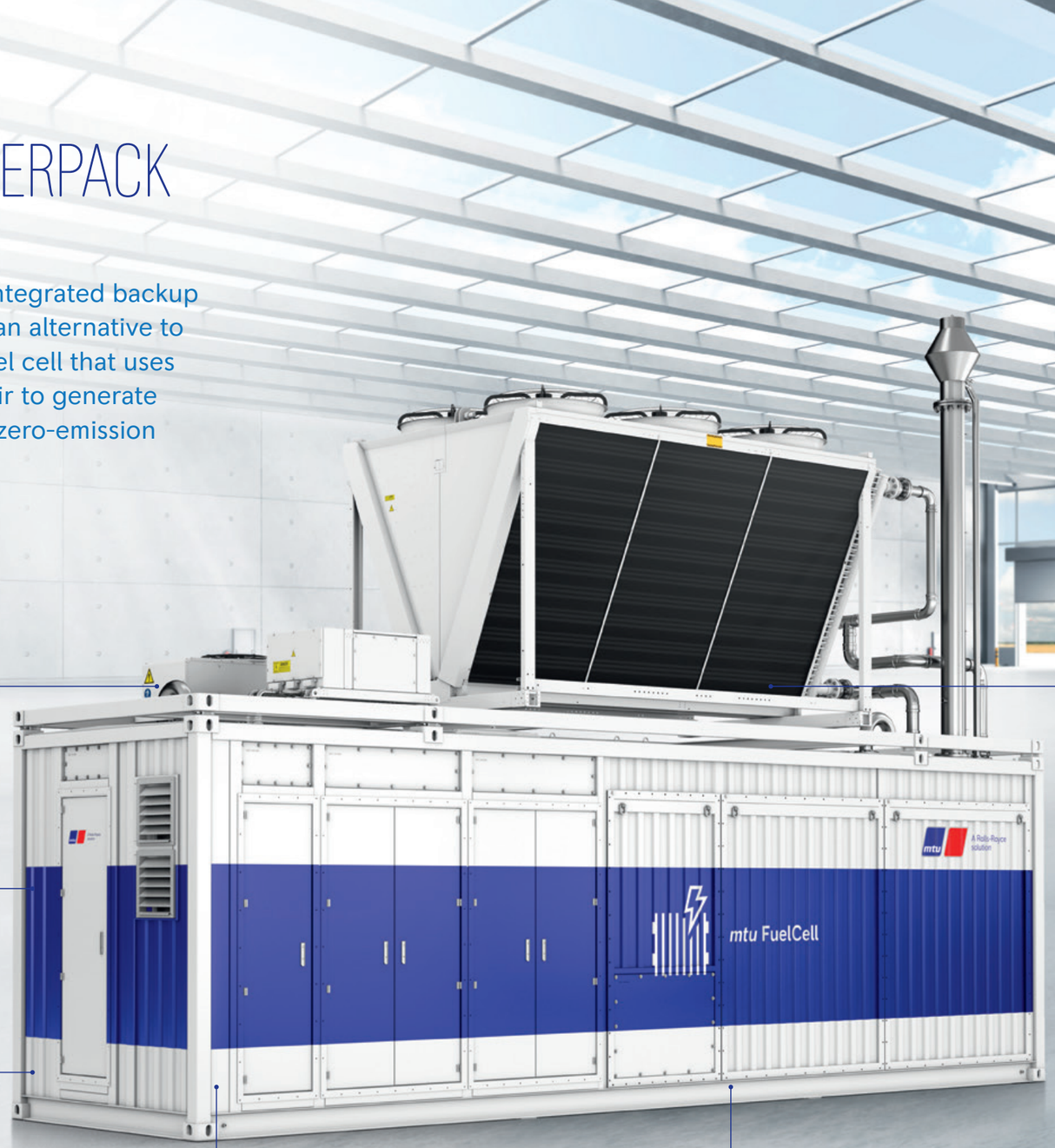
Rolls-Royce Power Systems provides an integrated backup solution based on leading technology as an alternative to conventional diesel systems, utilizing a fuel cell that uses hydrogen and oxygen from the ambient air to generate energy. This fuel cell technology offers a zero-emission alternative of power for backup systems.

The hydrogen supply can be provided either via a dedicated pipeline or a “hot-swap“ concept using established storage trailers.

Holistic safety concept for electrical safety, explosion protection, fire detection and extinguishing

Fully autonomous, blackstart capable system

Modular PEM fuel cell energy system for high reliability and availability with centralized services



Galvanic isolation included in system by transformer

Combination of fuel cell and lithium-ion battery with inverter topology ensures fast transient load response (e.g. grid services)

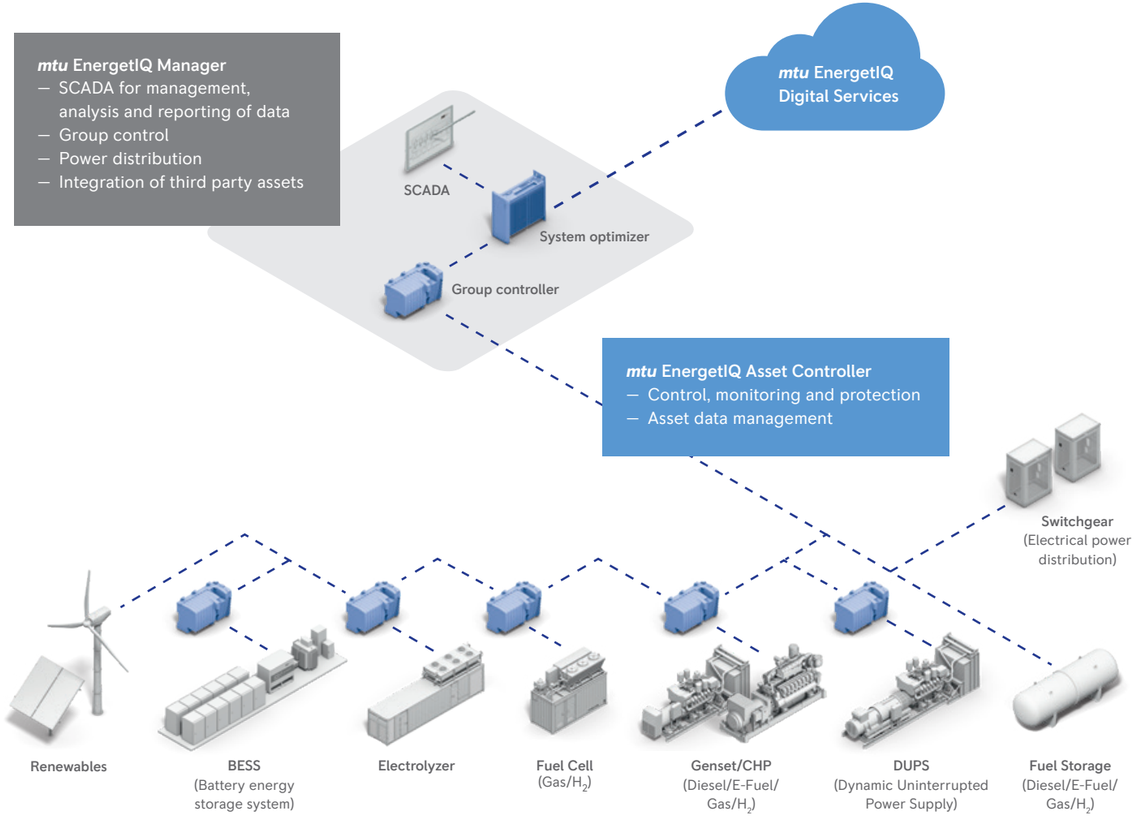
Integrated waste heat rejection from the fuel cell system and temperature conditioning of the batteries

Specifications	*mtu* FuelCell		
Voltage	AC, 3-phases		400V
Net system power output	BoL, within operational limits		600 kW
H_2 Consumption	up to 48 kg/h at 16-20 bar (inlet)		
Thermal power	BoL, at full load		840 kW
Lifetime	Min. lifetime		3,000 h
	Target lifetime	depands on load	15,000 h
Dimensions	9.13 x 2.44 x 5.63 m (30” container incl. cooler)		

mtu ENERGETIQ: THE BRAIN OF YOUR POWER PLANT

The ***mtu*** EnergetIQ Manager optimizes your power plant's performance, by seamlessly integrating its diverse assets and automating the control of power generation, storage, and demand. With the ***mtu*** EnergetIQ Asset Controller you can easily control and monitor the functional-level of your assets.

Offering	Characteristics
System-wide services	– One **common user interface** for all different assets – Easy SCADA **system integration** and customization options – **User management with audit trail** to control and record access to plant manager and assets – IT security concepts according to project specific analysis
Data management	– **Data acquisition** of connected assets, switchgear and grid – SQL database with access by web-based query technology – Modular data analysis including correlation to external data – **Data visualization and reporting** with dashboards and interactive Jasper reports
Functions	– Real-time **control, monitoring and protection** – **Asset health analytics** – Multiple BESS applications covered, such as, the reserve market, energy storage control, spinning reserve, load shedding, sector coupling etc. – Wide range of **predefined and configurable layouts** for trending and reporting



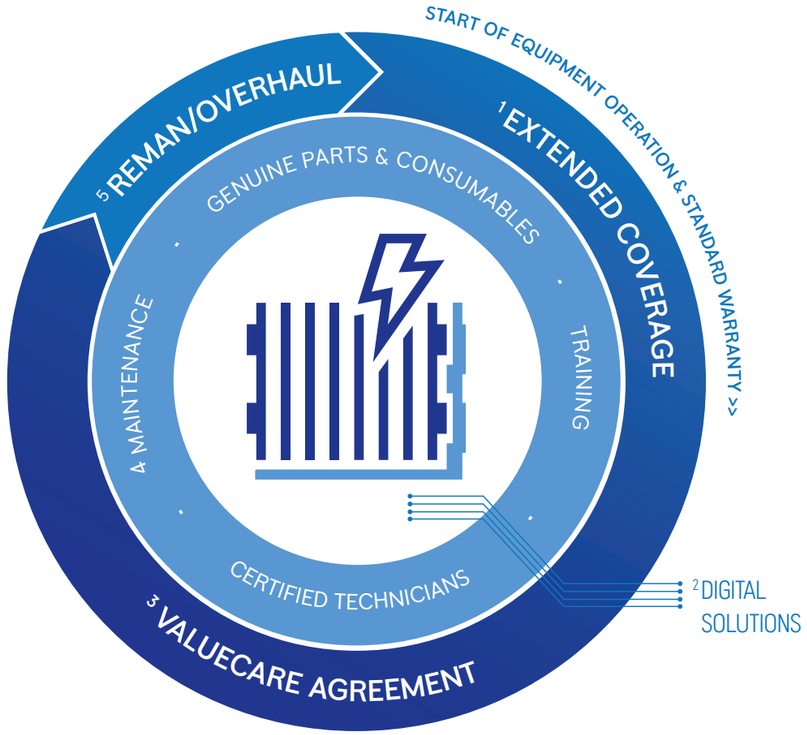
All data on one screen, including assets such as gensets, BESS, photovoltaics and more.

– Comprehensive presentation of information
– System-wide states / alarms / relevant power data
– Individual, region-specific settings are available (colors and symbols)

How complete lifecycle solutions help

ENSURE A LONG, RELIABLE LIFE

As your equipment ages, its needs – and yours – change.
Our full portfolio of service solutions wrap around your investment, providing 360 degrees of customized support, for optimal value at every stage of life.



1 Avoid the unexpected with added protection beyond the standard warranty.
2 Make better decisions faster with digitally-enhanced tools.
3 Maximize availability and optimize lifecycle costs with a ***mtu*** ValueCare Agreement.
4 Improve system performance and extend equipment life with on-demand support.
5 Keep a good thing going with factory reman/overhaul solutions.

mtu ValueCare Agreements

FOCUS ON YOUR OPERATIONS. LEAVE THE REST TO US.

You've got a tough job. With us as your partner, you'll get the power, performance and peace of mind to get it done right. Our digitally connected power systems and ***mtu*** ValueCare Agreements make it easy to keep your business running smoothly and reduce total cost of ownership by maximizing uptime, optimizing lifecycle costs and helping you avoid equipment-related business disruptions through preventive maintenance.

Service solutions designed around your priorities
With tailored solutions to meet your needs, there is a ***mtu*** ValueCare Agreement that is just right for you.

Bronze
Ensure parts availability and price stability

Silver
Eliminate unexpected maintenance costs

Gold
Maximize operational uptime

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