HORIBA

Energy Innovation with HORIBA

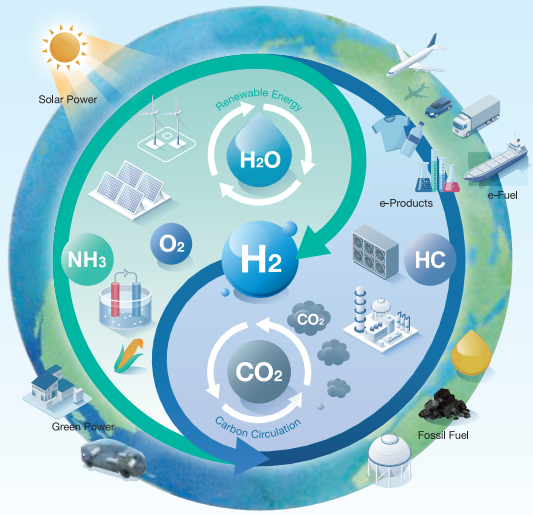
Introduction of HORIBA's Initiatives towards
a Hydrogen Society and Carbon Neutrality
2023 - 2024

Energy Innovation with HORIBA

HORIBA is committed to the realization of a carbon-neutral society and the adoption of new energies, such as hydrogen, to enhance energy efficiency worldwide. However, the practical implementation faces challenges, including reducing manufacturing costs. While technology development for CO_2 capture and reuse progresses, there are still hurdles to overcome.

Since our founding, we have been dedicated to developing and implementing advanced analytical and measurement technologies to protect the Earth and human health. In the field of hydrogen and energy, we offer flexible solutions ranging from gas measurement for hydrogen and CO_2, material analysis, plant monitoring, to the evaluation of secondary batteries, fuel cells, and electrolysis. Additionally, we provide comprehensive services, including engineering, consulting, contract analysis, and testing and evaluation expertise to meet your diverse needs.

With our global products and solutions, we contribute to achieving a carbon-neutral society and accelerating the scale-up of the hydrogen and energy industry. As your true partner, we address the evolving measurement needs of the new era by harnessing our knowledge and technology.



HORIBA WILL CONTRIBUTE TO REALIZE THE CARBON NEUTRALITY THROUGH OUR MEASUREMENT TECHNOLOGIES TOWARD 2050.

Maximize Total Energy Efficiency

To realize the optimization of energy society as a whole by improving energy efficiency, implementing energy-saving measures, and leveraging digital and IT technologies.

Utilize Sustainable Green Energy

By generating electricity and heat energy from renewable energy sources and using that energy to convert water into hydrogen, it can be efficiently utilized as an energy source for daily life, transportation, and industry.

Realize Carbon Capture & Circulation

To effectively capture and recycle carbon dioxide (CO_2) to use it as a valuable resource for chemicals and synthetic fuels. Hydrogen also plays a key role in this process.

HORIBA is the World's Partner in Sustainable Society

HORIBA, chosen by the world for the implementation of hydrogen society.

USA

HIMaC²

(HORIBA Institute for Mobility and Connectivity²)

- A Joint Initiative with University California Irvine (UCI)

Official Website | Facility Tour Video

Projects with World's Leading European Companies

U.K.
- Ceres (Fuel Cell)
- OCTOPUS (H_2 On-site Production & Distribution)

France
- Genvia (Electrolysis)
- CRMT (H_2 Engine/FCV)
- SYMBIO (Fuel Cell)
- HORIBA France H_2 Laboratory Venissieux

Netherlands

Partnering with **European Space Agency (ESA)**

- PEM Fuel Cell Evaluation

Germany

Our Global Center of Excellence for Fuel Cells, Batteries and Electrolyzers

HORIBA eHUB

Projects with Fraunhofer Institutes

- IKTS (SO Electrolysis)
- ISE (PEM Fuel Cell & Battery)
- IWES (Electrolysis)
- and others

R&D Project for Mass Produce Electrolysis

H2Giga

- In Cooperation with Sunfire for HTEL-Stacks Project

Japan

Our Flagship Factory with Complete Test Cell for xEV

HORIBA BIWAKO E-HARBOR

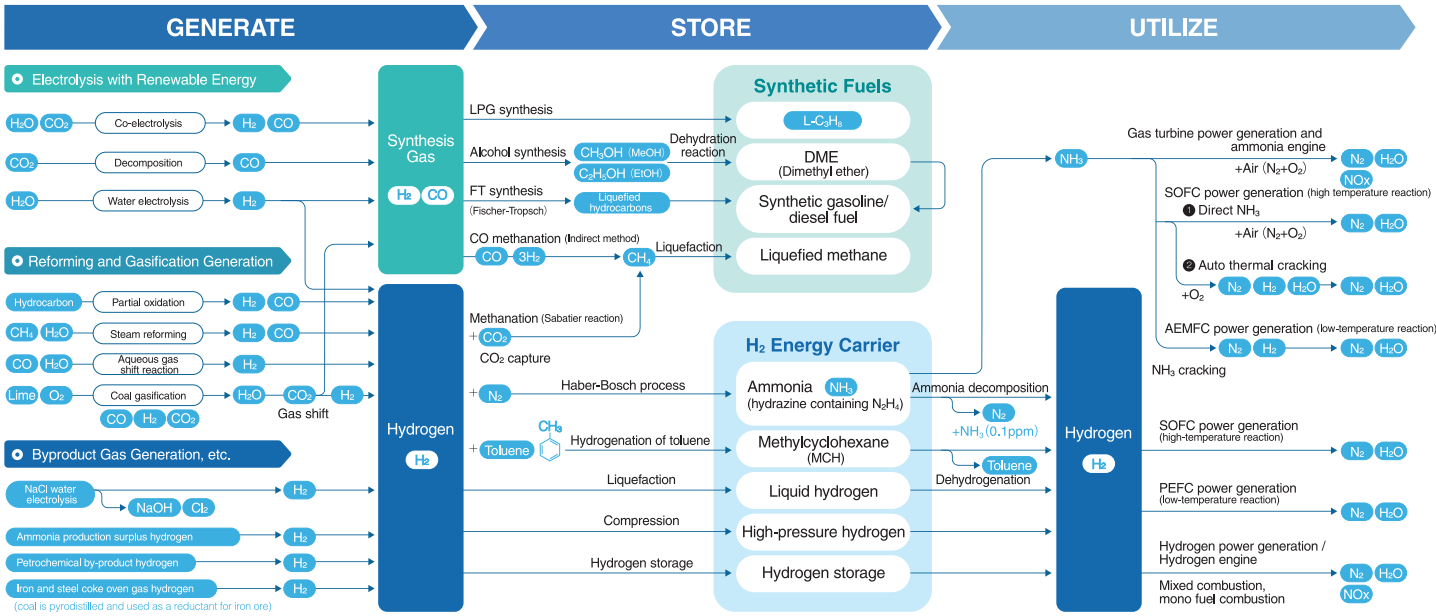
China

Our Largest Base for R&D, Engineering and Mass-production

HORIBA C-CUBE

Why Hydrogen?

Hydrogen is a common medium for generating, storing and utilizing energy, and can be converted into the wide variety of hydrocarbon fuels and bulk materials.



Our Measurement and Testing Solutions for Decarbonation Technologies

Fuel Cell

Fuel Cell Vehicle

Stationary Fuel Cell

Engine & Combustion

Hydrogen Station

Water Electrolysis

Hydrogen Production

Battery and Its Recycling

Reduction of CO_2 Emission

Direct Carbon Capture

Carbon Recycling

Life Cycle Assessment (GHG protocol)

Materials and Physical Properties

- Structural analysis
- Elemental analysis / quantitative elemental analysis
- Particle characterization and particle size analysis
- Thin film characterization
- Optical property characterization
- Hydrogen embrittlement evaluation
- In-line and on-line analysis

Monitoring of Industrial Process

- Real-time gas monitoring
- Air quality (CO_2) monitoring
- Process monitoring for thermal power generation
- Synthesis process monitoring
- Temperature monitoring
- Semiconductor manufacturing process monitoring
- Water quality analysis
- Water, sewage and wastewater monitoring

Evaluation of Performance

- Fuel cell and water electrolysis performance evaluation
- Hydrogen and ammonia combustion evaluation
- Battery charge/discharge characteristics evaluation
- Initial shipping performance inspection (Fuel cells, water electrolysis, batteries)
- Catalyst performance evaluation
- Battery material degradation analysis

Evaluation of System

- Powertrain evaluation
- Conformity and certification testing
- Vehicle evaluation and testing
- On-road real driving evaluation
- Factory energy management system
- Thermal management
- Safe operation of labs

01 Hydrogen Energy - from Research, Development to Social Implementation

Analysis of FC / EC Materials

Platinum distribution and Quencher mapping over electrolyte membrane

Evaluation of crystallinity of DLC membrane separators, crystallinity of carbon coating on Bipolar Plate and also Pt/C catalyst carbon analysis

Film quality evaluation of DLC membrane separators

Depth profiling of DLC membrane separators

Performance Evaluation of FC / EC

CELL 0

Impedance evaluation (EIS/CV)

Measurement of unreacted hydrogen evaluation

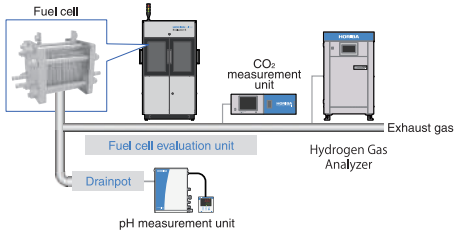
H_2 measurement at explosion-proof area

Efficiency evaluation of hydrogen generation (H_2 measurement)

Membrane degradation evaluation (pH measurement)

Catalyst degradation evaluation (CO_2 measurement)

EIS: Electrochemical Impedance Spectroscopy
CV: Cyclic Voltammetry



Example of fuel cell evaluation system configuration

Evaluation of FC System

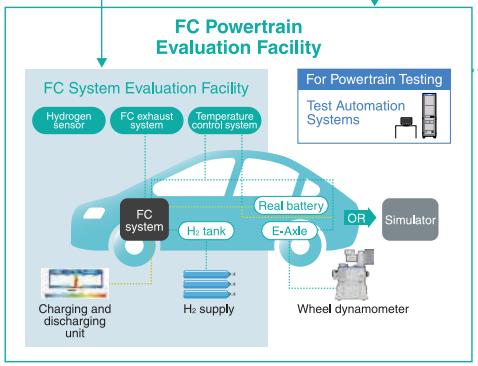
CELL 1

❶ FC system

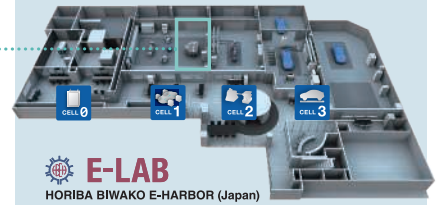
Development and adaptation of systems combining FC with auxiliary equipment such as air compressors, converters, and pumps.

❷ FC powertrain

Development and adaptaion of powertrains combining FC systems and E-Axle batteries.



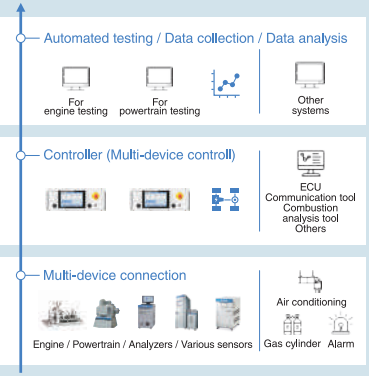
HORIBA proposes an upgrade to the FC system leveraging existing test bench assets. Furthermore, HORIBA will enable real-time connectivity with the powertrain bench in the future.

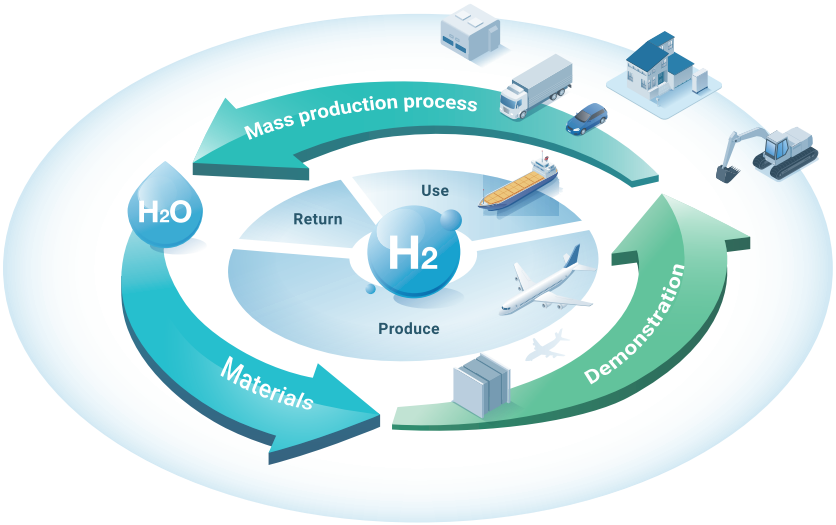


Test Automation System

Improved development efficiency by integrating and automating the measurement and control required for testing

STARS

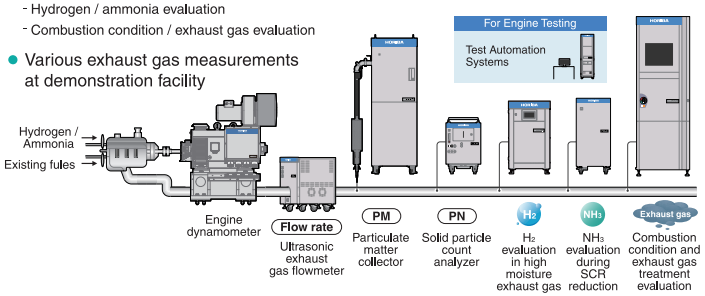




Hydrogen and Ammonia Combustion

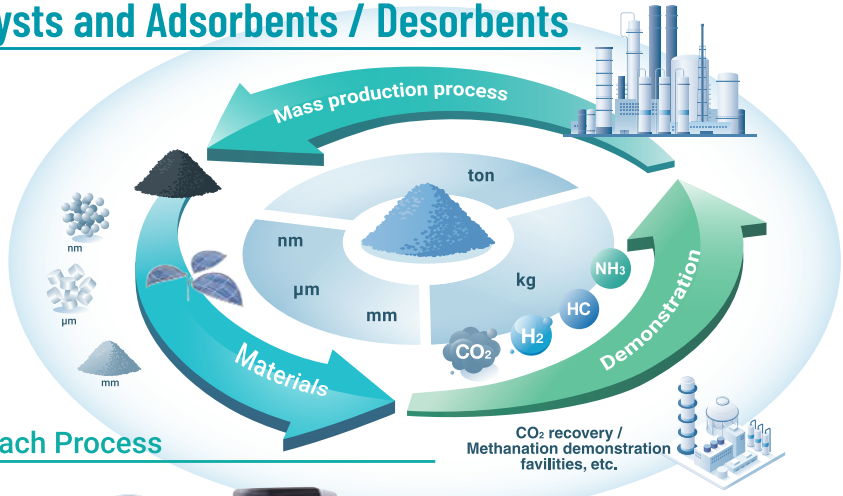
CELL 2

- Combustion evaluation at engine test lab
  - Hydrogen / ammonia evaluation
  - Combustion condition / exhaust gas evaluation
- Various exhaust gas measurements at demonstration facility

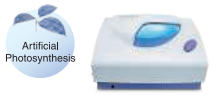


Example of hydrogen / ammonia evaluation system configuration

02 Research, Development and Production of Carbon-Neutral Catalysts and Adsorbents / Desorbents

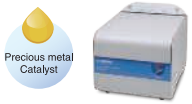


Characterization of Catalyst Materials



Evaluation of nanoparticle size of metal complexes for artificial photosynthesis

Particle size evaluation in catalyst ink



Adhesion evaluation of precious metal catalyst

Characterization of Surface Reaction

Evaluation of crystallinity of catalyst and adsorption / desorption materials

Evaluation of photocatalyst luminescence characteristics

Operation of Each Process

Desulfurization, denitrification, exhaust gas monitoring

Solution and drainage monitoring

Measurement of Performance and Generation

Evaluation of photocatalytic conversion efficiency

Performance evaluation of ammonia synthesis catalyst (NH_3 measurement)

Efficiency evaluation of hydrogen generation (H_2 measurement)

Capacity Assessment of the Entire Facility

Desulfurization and denitrification (SO_2, NH_3, NOx measurement)

Hydrogen generation and purification (H_2 and impurity gas measurement)

CO_2 capture (CO_2 and impurity gas measurement)

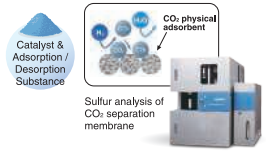
Evaluation of CO_2 Adsorbent / Desorbent

- Evaluation of CO_2 adsorption activity point of zeolite and amine
- Evaluation of CO_2 adsorption of concrete
- Generates the real gas for simulation and supplies as test gas
- Evaluates under different test conditions (humidity, temperature, etc.)
- Continuously measures various gases

Evaluation of Catalysts and Adsorbent / Desorbent

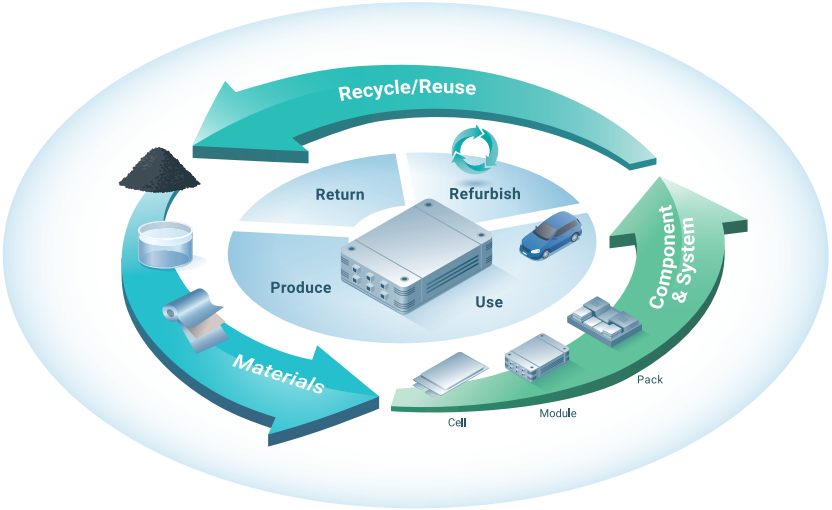
Measurement of gases generated in each raction process

Structural analysis of material solutions



Material analysis (sampling)

03 The Circular Economy of Batteries



Material Analysis of All-Solid State Battery

Crystal structure evaluation of solid electrolytes

Measurement of oxygen concentration in solid electrolytes

Depth profiling of solid electrolytes

Material Analysis of Lithium-ion Battery

Particle dispersion evaluation of electrode material

Evaluation of crystallinity of carbon for anode and cathode material, and dispersion state of electrode material

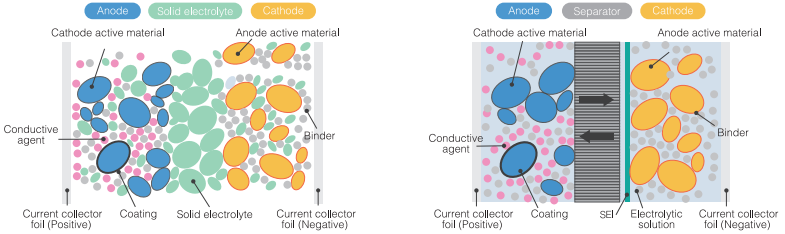
Analysis of mixing condition of electrode slurry

Quality Assuarance of Batteries

Gas concentration measurement during material production (H_2S measurement)

Evaluation of anode degradation due to cathode leaching (Depth profiling / surface analysis)

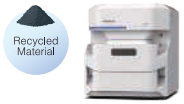
In-line foreign material analysis in electrodes



Recycle and Reuse of Batteries

Contract analysis, subscription and remote support for analysis

Diagnosis of deterioration (SoH: State of Health) of used batteries



Quantitative analysis of impurity elements in recycled materials

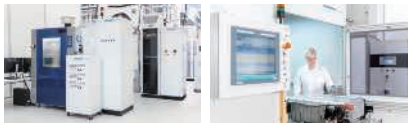
GHG (Green House Gas) and emission gas measurement of recycling furnaces

Component & System Testing Solutions

Battery performance evaluator

Thermostatic chamber with shaker

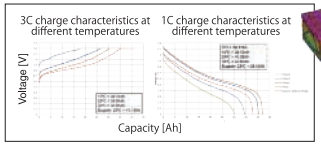
Evaluation of vibration or temparature effects on all-solid-state batteries

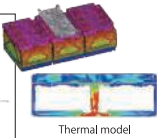


Charge / discharge characteristic evaluation of batteries

Safety evaluation in nail penetration tests of battery pack

BMS development according to application



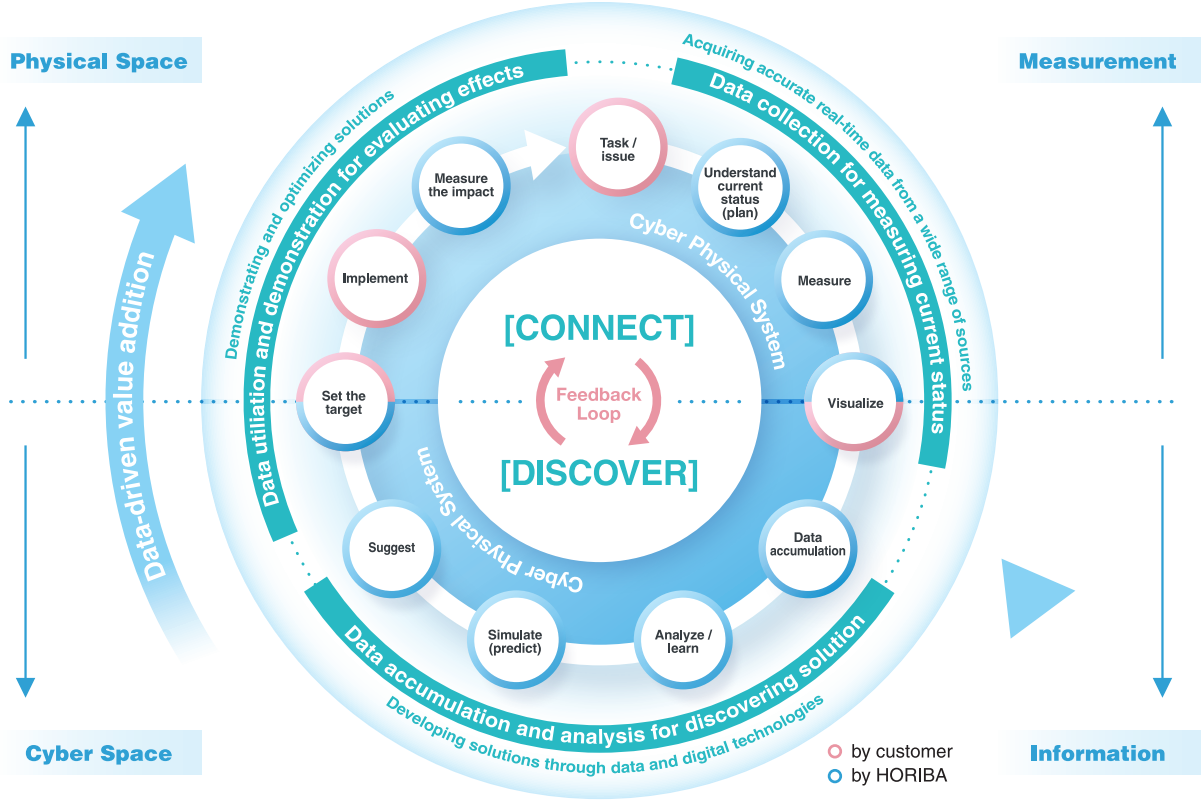


Thermal model

Consulting - development, design, and prototyping of BMS (Battery Management System) and thermal management

HORIBA's Contribution to the Future of Measurement Technology

We will advance the evolution of our measuring, connecting and discovering technologies and build a Cyber-Physical System (CPS).

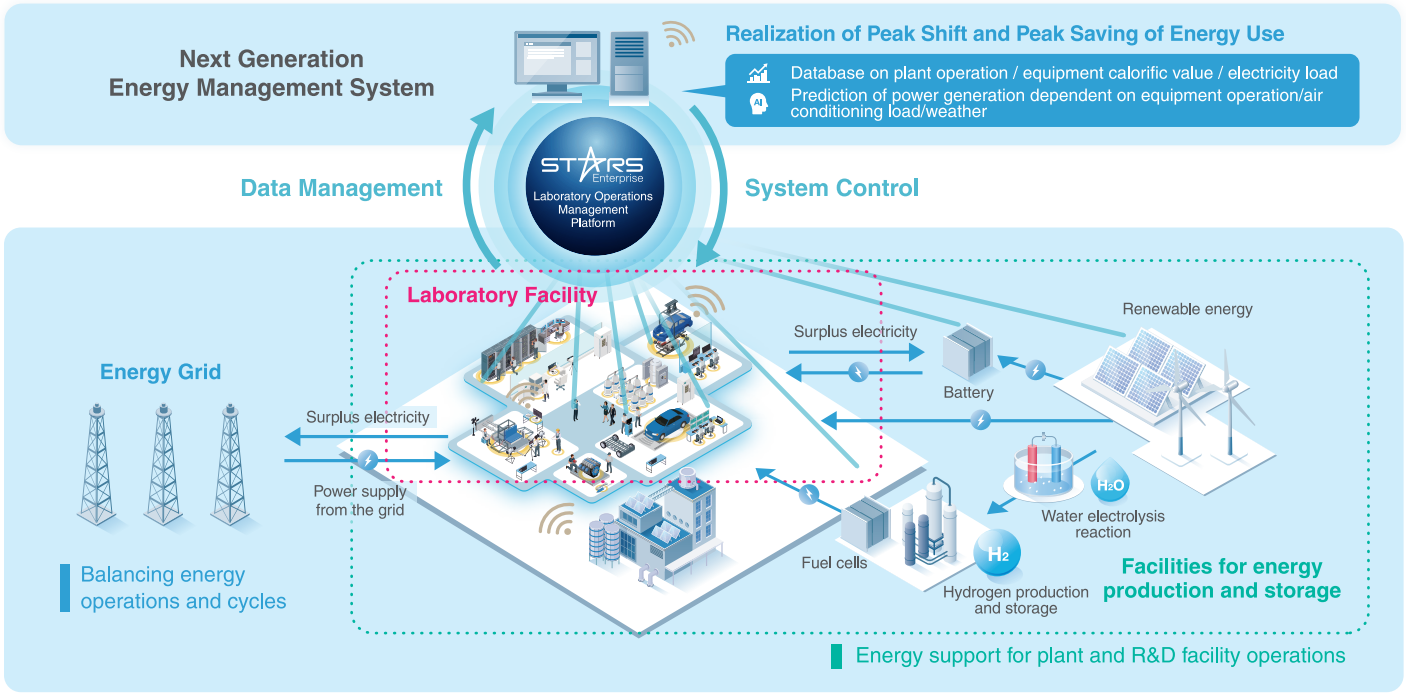


HORIBA's Vision for CPS Implementation

HORIBA Energy Management System Concept for Lab

HORIBA is addressing the challenges of fluctuating energy demand and the promotion of energy efficiency and renewable energy utilization in research and development facilities, where it is difficult to standardize the business processes for a wide range of experimentation and evaluation tasks.

We are working on establishing an "Energy Management System" that visualizes energy consumption in research and development sites and connects it to optimal utilization. Furthermore, we aim to develop a system that conducts software-based energy utilization simulations in virtual spaces, enabling us to propose optimal facility designs from the early stages of construction in research and development facilities.



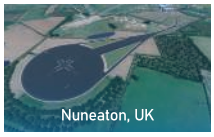
HORIBA Global Initiatives for Carbon Neutrality & Hydrogen Society

As a global company, HORIBA has 50 offices and centers of activity around the world, as well as technology development and business centers in key business areas, which can be regarded as the "headquarters" of HORIBA's business operations.
In the field of energy, we have development and production sites in main areas such as Japan, Europe, the U.S., and China, where we can find clues to global trends, and our excellent engineers continue to work on new technological development rooted in the needs of each region.


Magdeburg, Germany


Oberursel, Darmstadt, Leichlingen, Germany


Paris Saclay, France

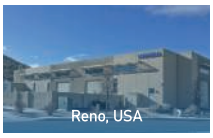

Nuneaton, UK


Northampton, UK


Kyoto, Japan


Irvine CA, USA


Houston, USA


Reno, USA

Companies by Region

Americas: 5 Europe: 25 Japan: 4 Asia: 15

49 Group Companies

Ratio of Overseas Sales 73%

Ratio of Overseas Employees 64%


Analytical Solution Plaza Kyoto


Otsu, Japan


BIWAKO E-HARBOR/ E-LAB in Otsu


Ann Arbor, USA


Piscataway, USA


Sao Paulo, Brazil


Pune, India


Shanghai, China


Aso, Japan

As of December, 2022

Special Website for the Energy Field

Please visit our website for the latest energy trends and a wide range of analysis and measurement solutions related to hydrogen energy, CO_2 circulation, and energy management systems.
HORIBA contributes to the new era of smart energy production, storage and utilization.

Please access from the link:
https://horiba.link/energy

HORIBA Energy-related industry associations membership (as of 2023)

Japan
- FC-Cubic Technology Research Association
- Hydrogen Value Chain Promotion Council
- Technical Research Association Lithium Ion Battery Materials Evaluation Research Center

Germany
- Hydrogen Europe

HORIBA, Ltd.

Bulletin: HRE-0078B