

OCTOBER 26, 2023

Expanded use of AVEVA™ PI System™ for the energy transition and smart infrastructure

MISSION NET ZERO

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AVEVA



Hiroyasu Ishigaki

Digital Strategy Chief Manager

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- Keywords : Plant Digitalization, Control System



Ryota Hiura

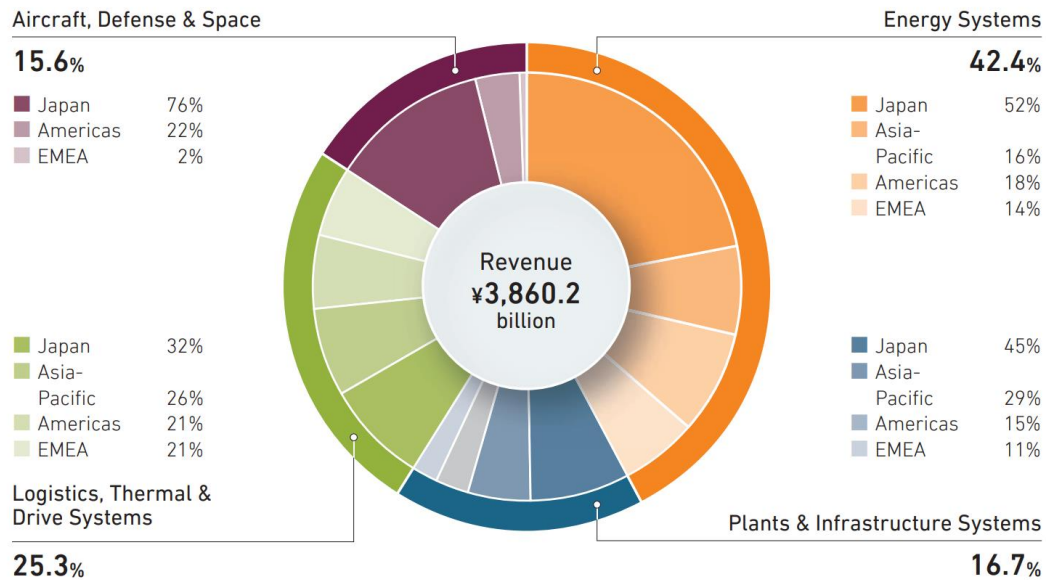
Director

- Mitsubishi Heavy Industries, LTD.
- ryota.hiura.pe@mhi.com
- Keywords : Agile development, Robotics, Computer vision



Founded year 1884
 Employees 77,991 (Consolidated)

► Composition of Revenue by Segment (FY2021)



Energy Systems



Main Businesses

- Gas & steam power systems*
- Nuclear power systems
- Compressors
- Aero engines
- Marine machinery

* Includes GTCC, steam power and air quality control system

Plants & Infrastructure Systems



Main Businesses

- Commercial ships
- Engineering
- Environmental systems
- Metals machinery
- Machinery systems

Logistics, Thermal & Drive Systems



Main Businesses

- Material handling systems
- Engines
- Turbochargers
- HVAC systems
- Automotive air conditioners

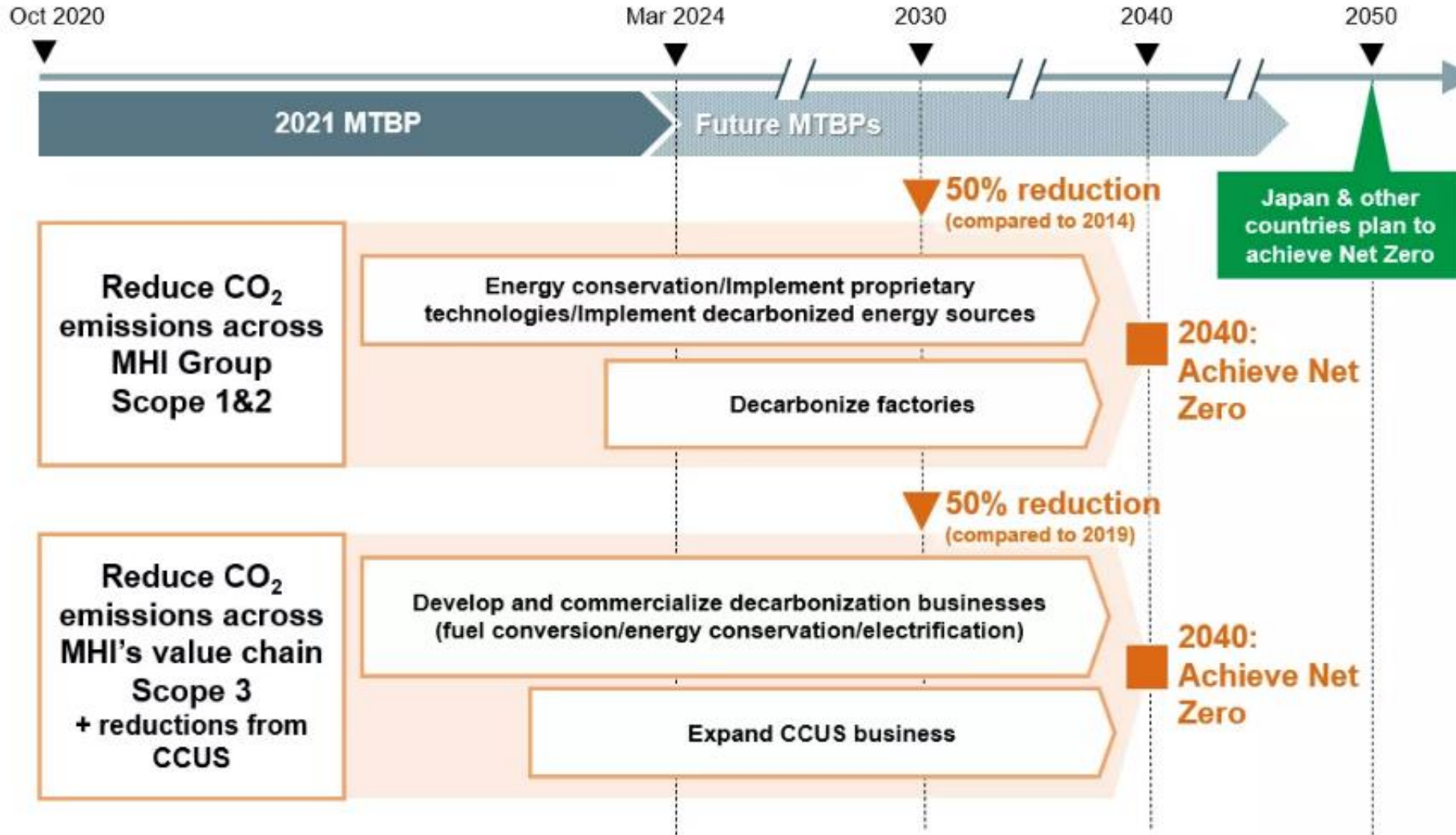
Aircraft, Defense & Space



Main Businesses

- Commercial aircraft
- Defense aircraft
- Missile systems
- Naval ships
- Special vehicles (tanks)
- Maritime systems (torpedoes)
- Space systems

Our Company Mission to 2040 Carbon Neutrality Declaration



MISSION NET ZERO

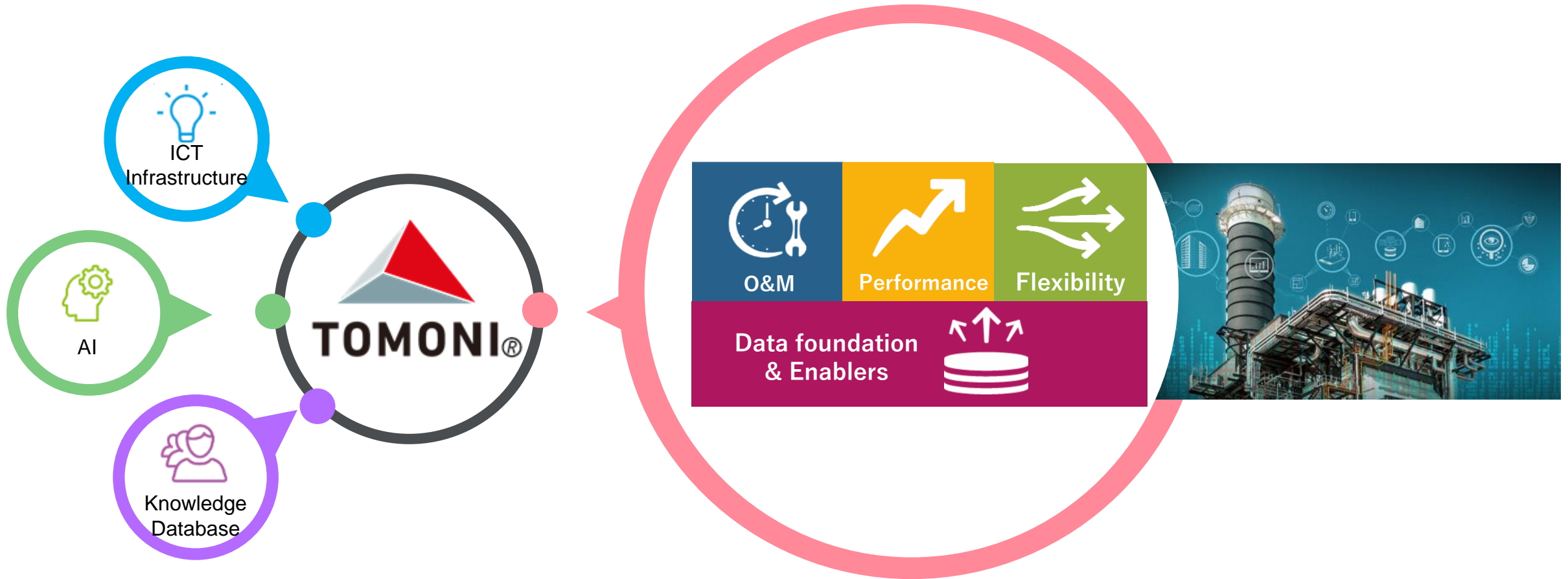
Through our group products, technologies, and services that help reduce CO₂ emissions, as well as new solutions and innovations to be developed with partners around the world, Mitsubishi Heavy Industries Group will contribute to realizing net zero emissions for the world as a whole.

To this end, each and every one of our employees is embracing and internalizing "MISSION NET ZERO" and will act to implement a net zero future.

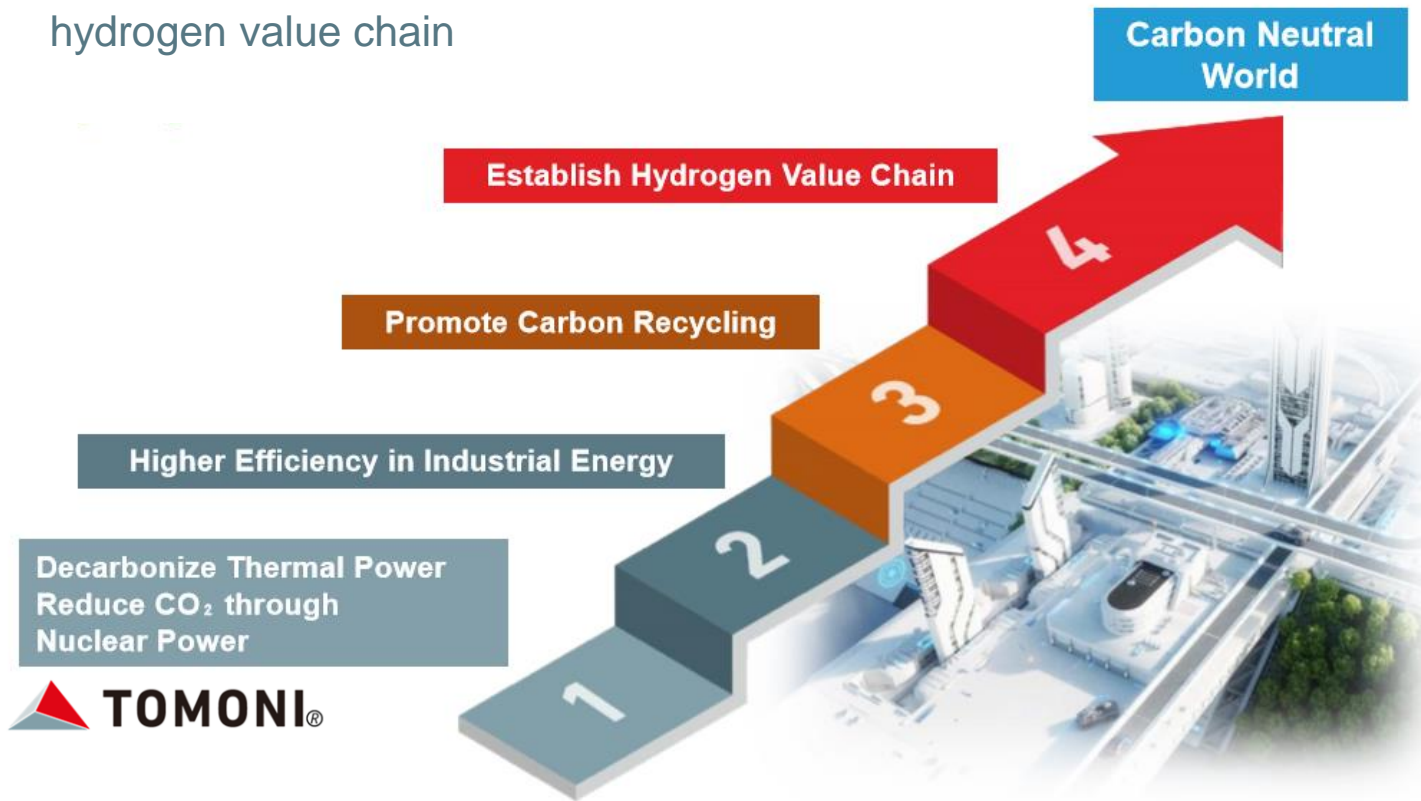


What is TOMONI®?

- Customers, our partners and MHI: Together with.
- Covering total plant lifecycle: From construction to after-sales service for a carbon neutral society
- Our suite of data-based intelligent solutions is a package of different modules that leverage remote monitoring, advanced digital control systems, predictive analytics, and AI to optimize power plants.



Contribute to achieve a carbon-neutral world by 2040 through decarbonization technologies and hydrogen value chain



TOGETHER, SMARTER,
POWERING THE ENERGY TRANSITION

Digitalization on whole plant lifecycle

Keeping customer assets in best condition from construction to after sales service

Support customer digitalization

Knowledge management, advanced O&M, expertise support and equipment upgrade

Smarter power plant

Performance and flexibility improvement with our remote support

During start-up, Load operation and shut-down, TOMONI can support and/or make decisions to maximize the profit and to realize the easy & safe operation/maintenance.

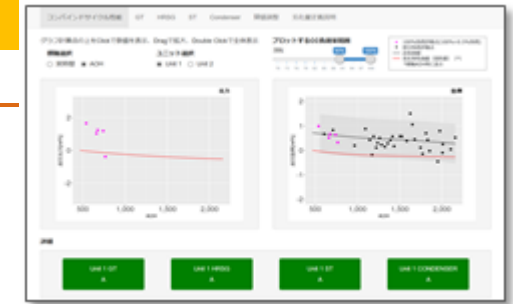
【Operation (Monitoring)】

1. Expert Support (Remote Monitoring)
2. Plant Operation Viewer
3. Post-ACT
4. Water Quality Assurance

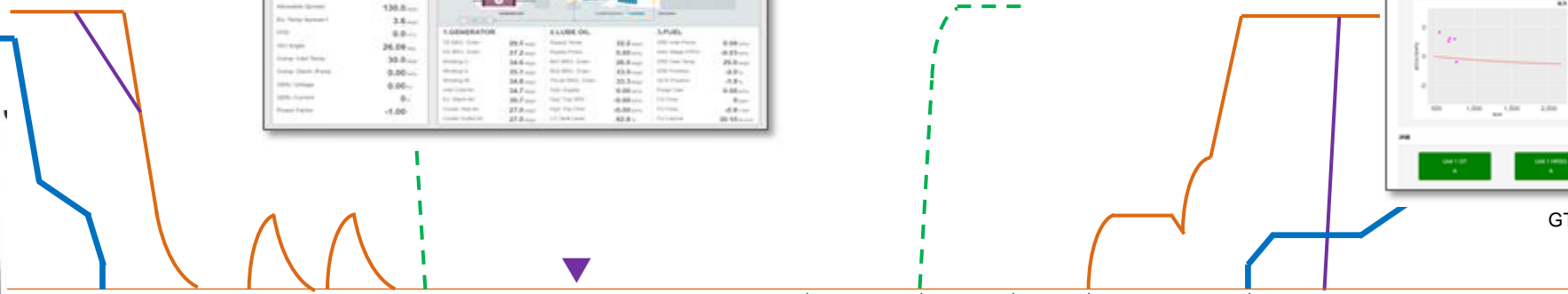
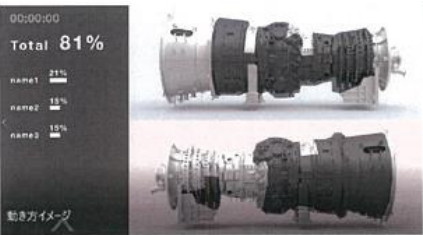


【Operation (Optimization)】 Heat Rate Improvement at Partial Load Operation

6. IGV Optimization
7. TCA Optimization



Block insulation and guide system



GT Fuel Valve Diagnosis

【Maintenance (outage)】

1. Manual Valve management system
2. Inspection guide system
3. Fuel piping installation guide system
4. Block insulation and guide system
5. Piping barycenter guide system



【Maintenance (daily)】

5. Trip prevention Application Package
 - 1) GT Fuel Valve Diagnosis
 - 2) GT Bleed Valve Diagnosis
 - 3) GT Ignitor Insertion Diagnosis



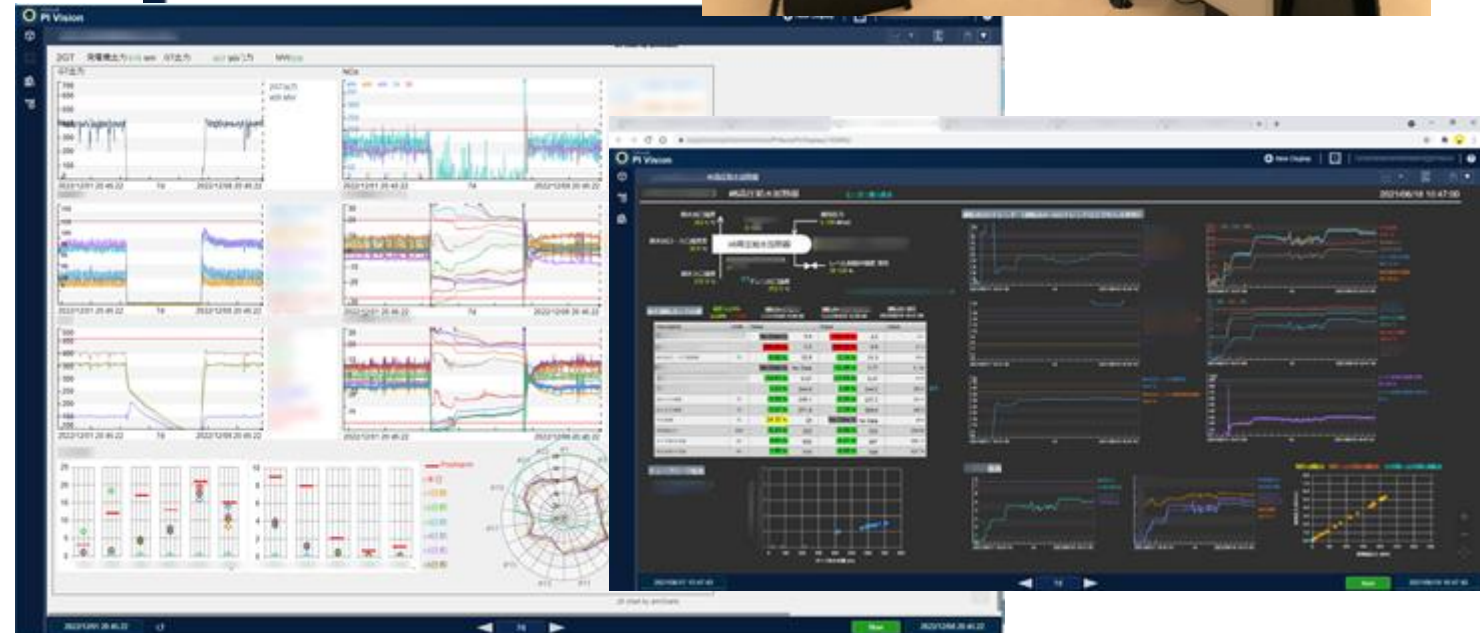
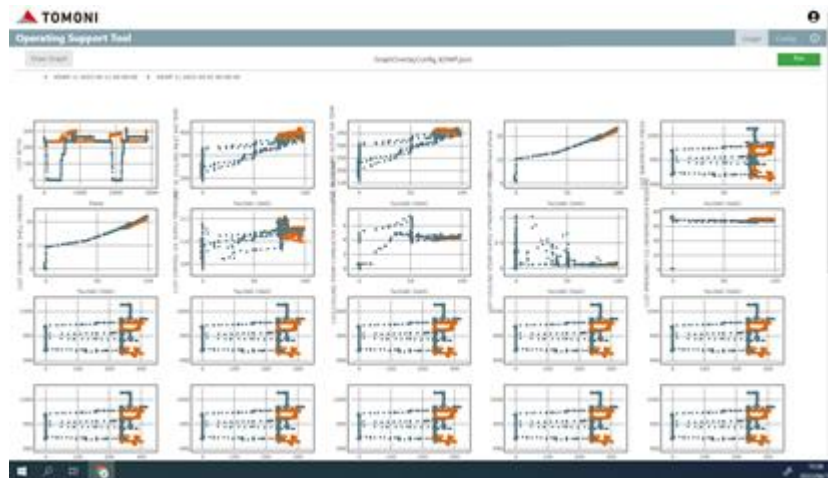
Retrieve and Analysis (JupyterLab)



“Remote” Site Commissioning



Data Segregation and Organization



- Going Beyond Monitoring with Analytics and Remote Support
- 4 Remote Monitoring Center with 24/7 Customer Support

Orlando TOMONI HUB



Orland TOMONI HUB (USA)
Since 2001



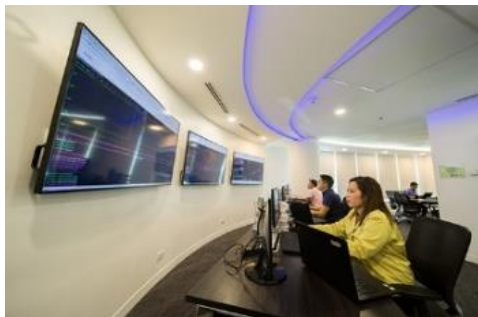
Takasago TOMONI HUB (Japan)
Since 1999



Takasago TOMONI HUB, T-Point

Nagasaki TOMONI HUB

Alabang TOMONI HUB



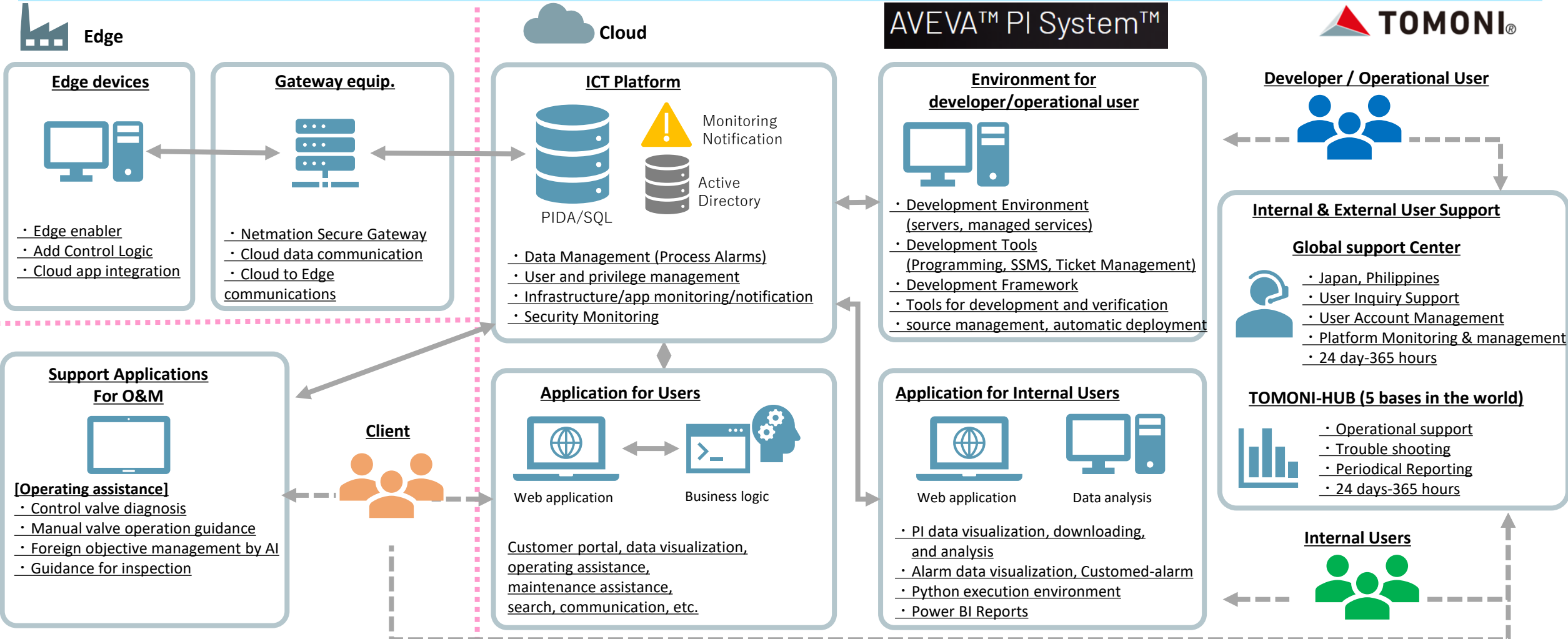
Alabang TOMONI HUB (Philippine)
Since 2016



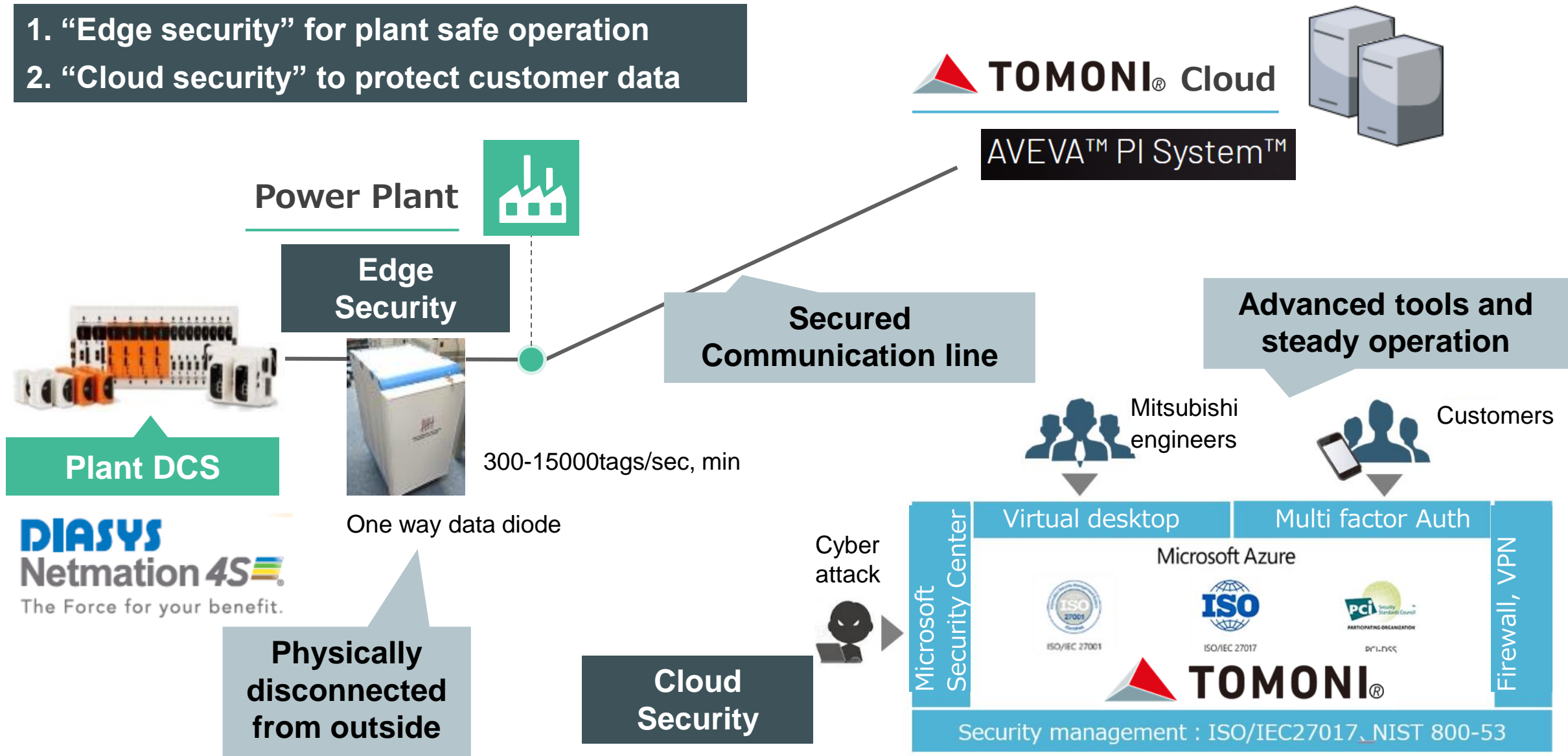
Nagasaki TOMONI HUB (Japan)
Since 2019

System Architecture Overview

- Edge devices, field applications to Cloud applications on ICT infrastructure with 24/7 operation
- Centralized cloud data (with AVEVA PI System on Microsoft Azure) and makes it available for users anytime, anywhere.
- Providing services utilizing the data with MHI's expertise as OEM








1. "Edge security" for plant safe operation
2. "Cloud security" to protect customer data

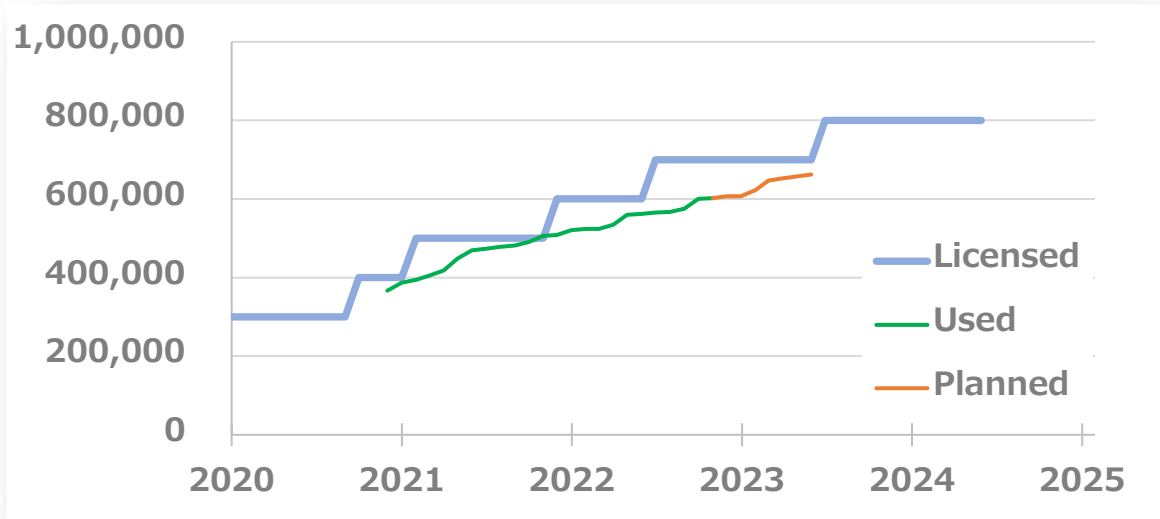


Growth of TOMONI Utilizations

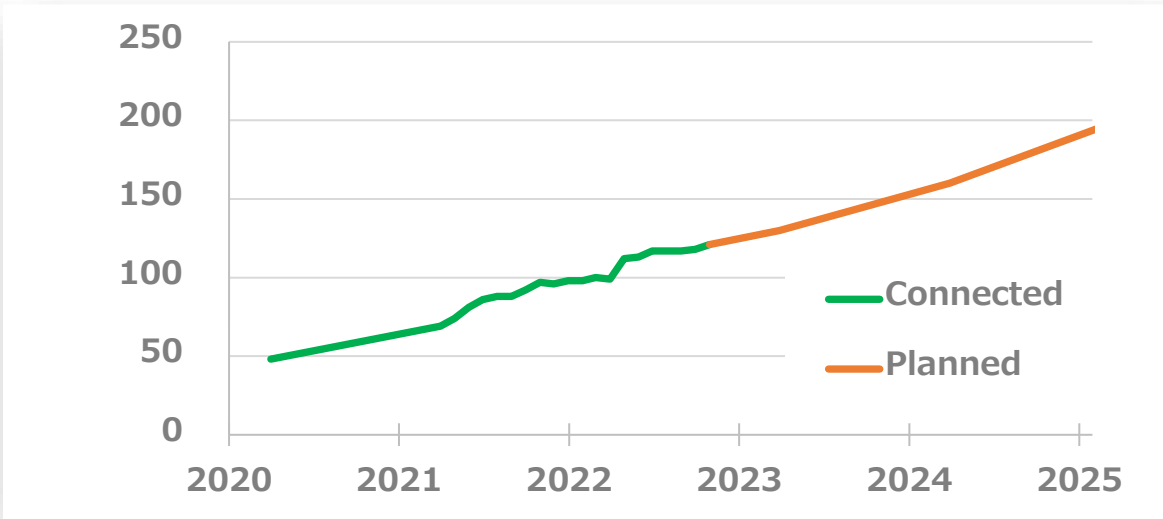
As of October 2023

	Plant Connections	146 units
	PI Data Points	680,040 tags used
	TOMONI Users	10,856 of Customers and Mitsubishi
	PI Vision	24,372 screens created
	OSIsoft Customer Portal	783 cases posted

PI Server Data Points



Plant Connections



Takasago Machinery Works – Our Gas Turbine Headquarter



【ガスタービン】 M501J形ガスタービンローター

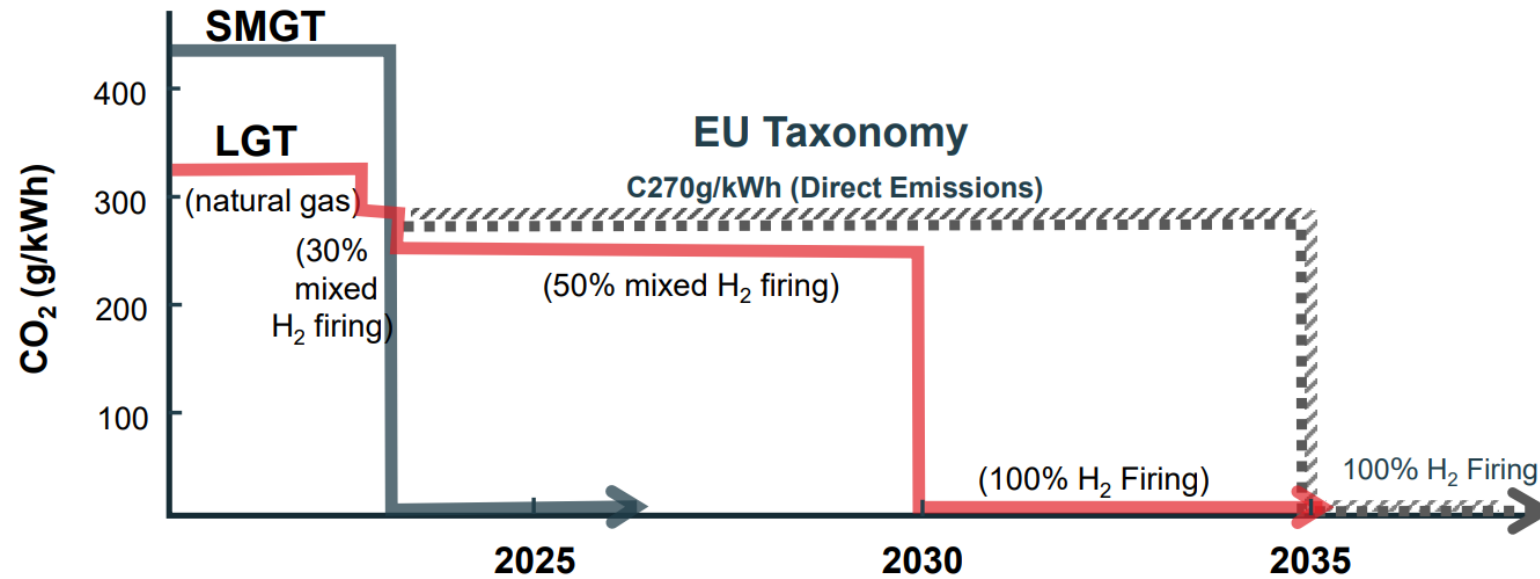


【ガスタービン】 M701J形ガスタービンローター

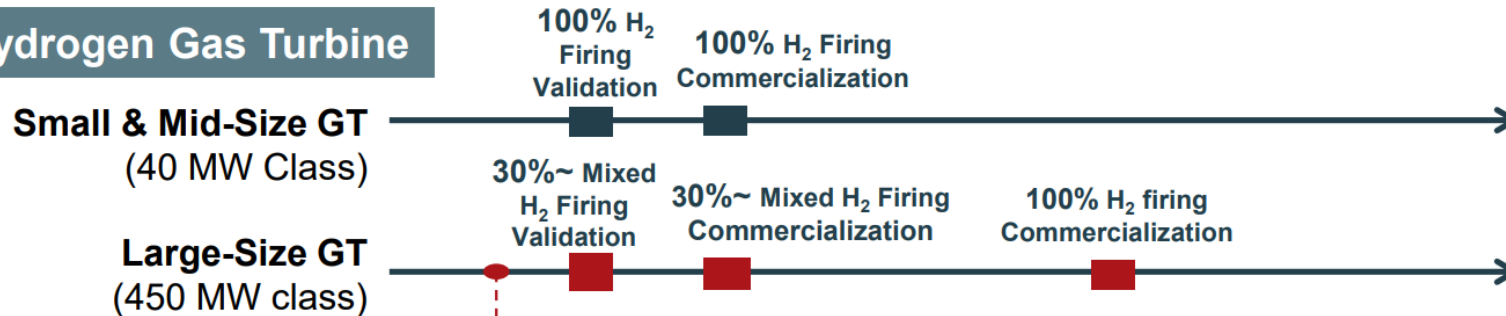


Decarbonizing Existing Infrastructure: Thermal Power

- Progressing with validation testing with the goal of commercializing carbon-free power generation using hydrogen
- Achieved 50% mixed hydrogen firing during combustor test, an important step toward achieving commercialization in 2025



Hydrogen Gas Turbine



Achieved 50% mixed hydrogen firing during combustor test, an important step toward achieving commercialization in 2025

<https://www.mhi.com/finance/library/plan/pdf/220512presentation.pdf>

Begin operation in FY2023

A one-stop-shop for validating hydrogen-related technologies from hydrogen production to power generation

■ Add hydrogen production and storage equipment to existing demonstration plant

Test and validate water electrolysis, turquoise hydrogen*¹, SOEC*² and other technologies in-house and improve product reliability

*1 Turquoise hydrogen: H₂ obtained through pyrolysis of methane into H₂ and solid carbon

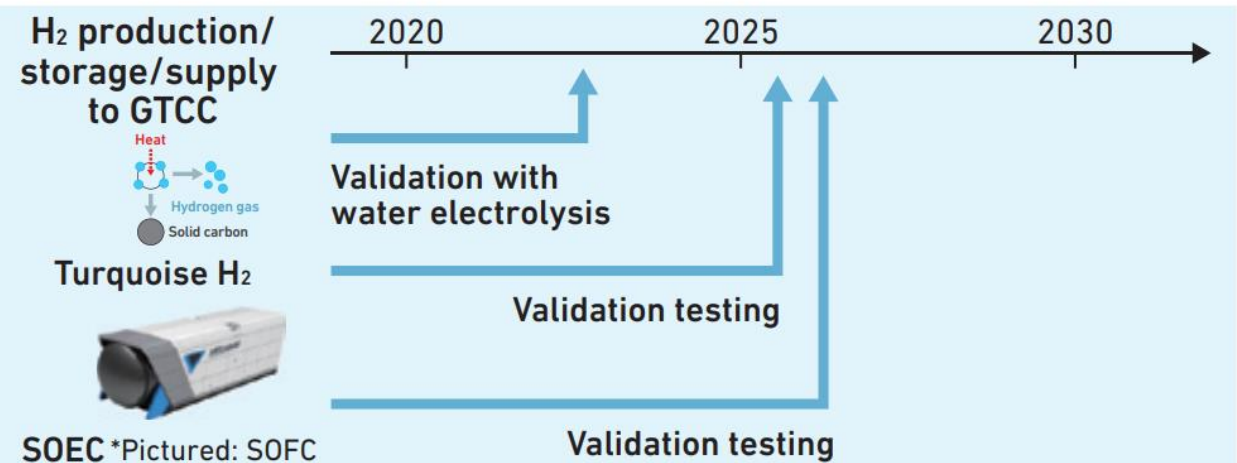
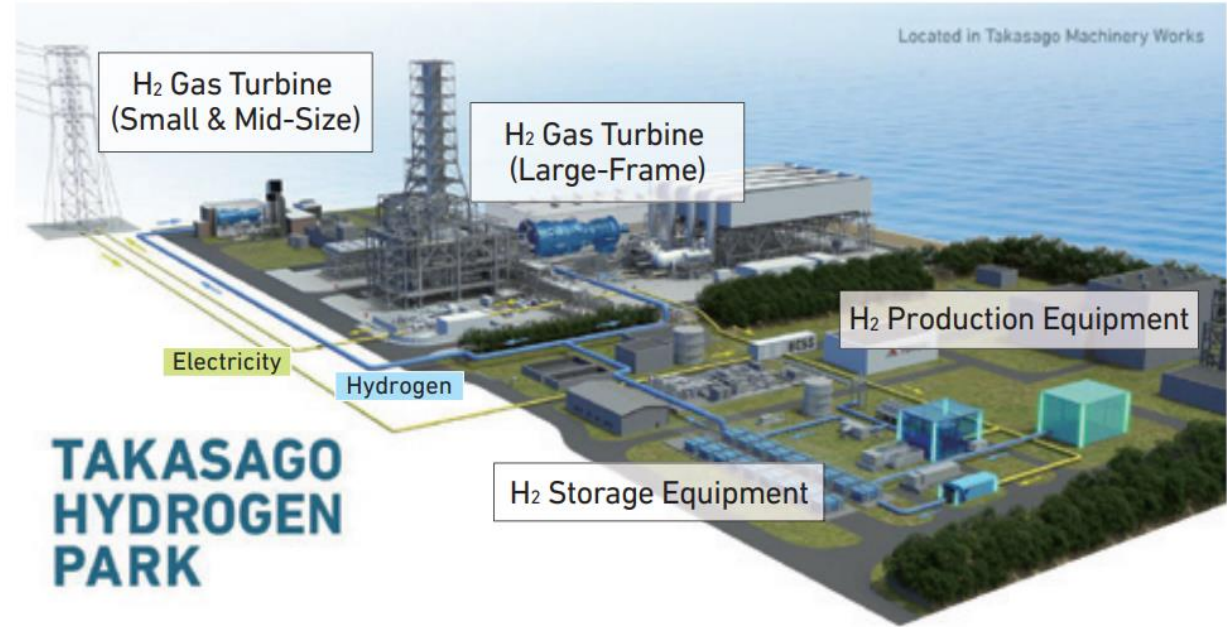
*2 SOEC (Solid Oxide Electrolyzer Cell): High temperature steam electrolysis

■ Validate hydrogen gas turbine technology

Validate technology in lead up to commercialization of 30% mixed firing in large-frame gas turbines and 100% hydrogen firing in small & mid-size gas turbines by 2025

■ Combine and evolve energy infrastructure and hydrogen technologies

Make progress toward establishing a hydrogen solutions ecosystem, which will help achieve a sustainable society by linking various industries with hydrogen technologies



https://www.mhi.com/finance/library/annual/pdf/report_2022.pdf

Level 3	Total optimization using AI
Level 2	Partial optimization using AI
Level 1	Supporting human O&M process with ICT system

EMS (Edge + Cloud)



L2 Predict (AI)

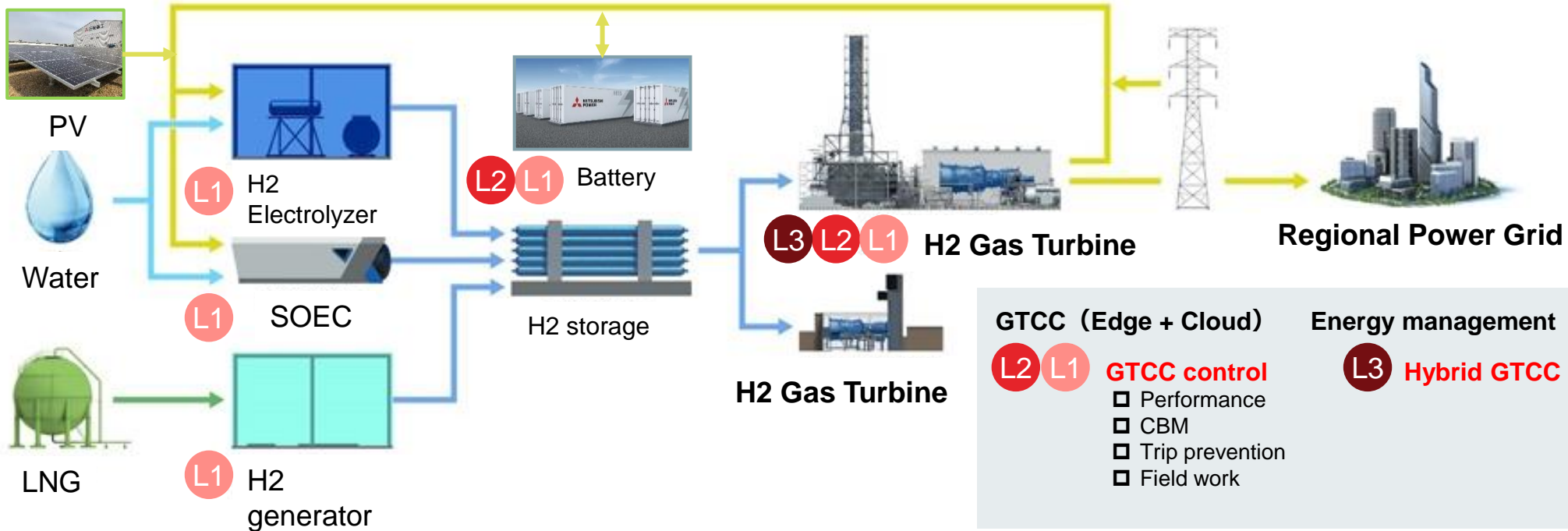
- Demand
- PV Output
- Power price
- Fuel price
- Temp
- GTCC perf.
- SOH

L2 Optimization (Plan)

- CO2 free power ratio
- CO2 output
- Power cost
- Fuel cost
- Operation planning

L3 Total optimization

- Operation/demand plan (day before)
- Start/Stop schedule
- Self consignment
- BESS charge/discharge



GTCC (Edge + Cloud)

L2 L1 GTCC control

- Performance
- CBM
- Trip prevention
- Field work

Energy management (Edge)

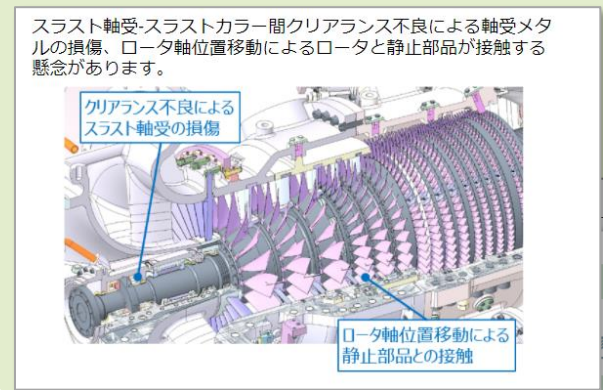
L3 Hybrid GTCC control



CO2 Capture System



Combining Maintenance data



Powered by

OpenAI

	2019/12 M	2022/1 M	2024/1 M	
ベースリング	✓	✓	✓	✓
パッド (メタル面)	✓	✓	減肉	減肉
パッド (背面)	✓	✓	✓	✓

From mobile system to huge plant
Monitored with PI System

With Generative AI in progress

Capturing CO₂: 0.3 to 5000 ton / day

Workflow Improvement at our Discrete Shop

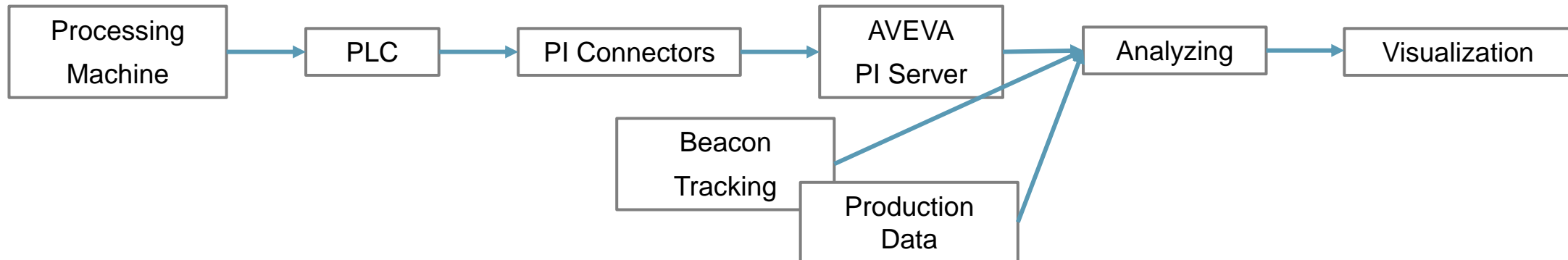
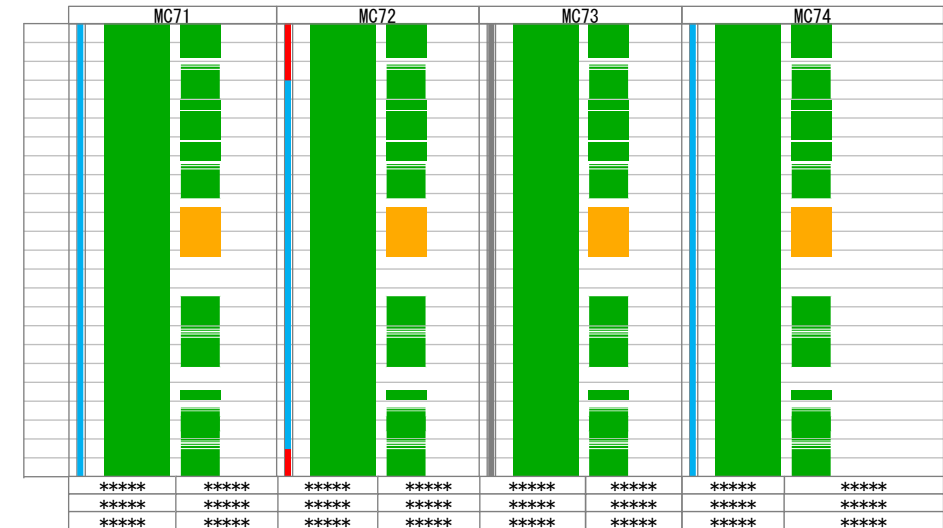
Background

- Needs to improve operation hour rate of metal processing machine
- Downtime analysis on machine issues, specific work procedures or machine tunings
- To inquire background, however, will disturb daily shift work operations
- Reliable easy to use data storage/analysis platform is required to proceed with POC and real service operation



Challenges

- Combination of Machine operation history, production record and floor staff movement by Man-Machine chart, utilizing AVEVA PI System to data collection and analytics platform
- Pilot will be deployed soon in FY2023



Accomplishments

for our power domain /customers and employees

- Data Platform accessible anytime / anywhere
- High Cyber security
- Common application development / data analysis platform

We have updated our AVEVA PI System contract to encompass all MHI activities as of April 2023.

Ongoing journey

- Expand use of our platform including PI System to all MHI domains
- Connect our various products smarter !!



Digitalization for all MHI

Σ SynX (Sigma Synchs)

Combining intelligence and technology with
"Smart Connections" to enable coordination between humans and machines.

Σ + Syn + X

"Sum Total"

Intelligence that combines and balances all elements provides optimal solutions for large sets (society).

"Synchronization and Coordination"

People and machines, and complex systems, working together in perfect harmony like smoothly flowing water, almost like a single life form.

chronization

"Future"

Suitable for all types of environments, constantly changing and evolving.

Automated Mobility

Intelligent Logistics

Safety & Security

Smart Connections



Hydrogen Ecosystem

Integrated Monitoring

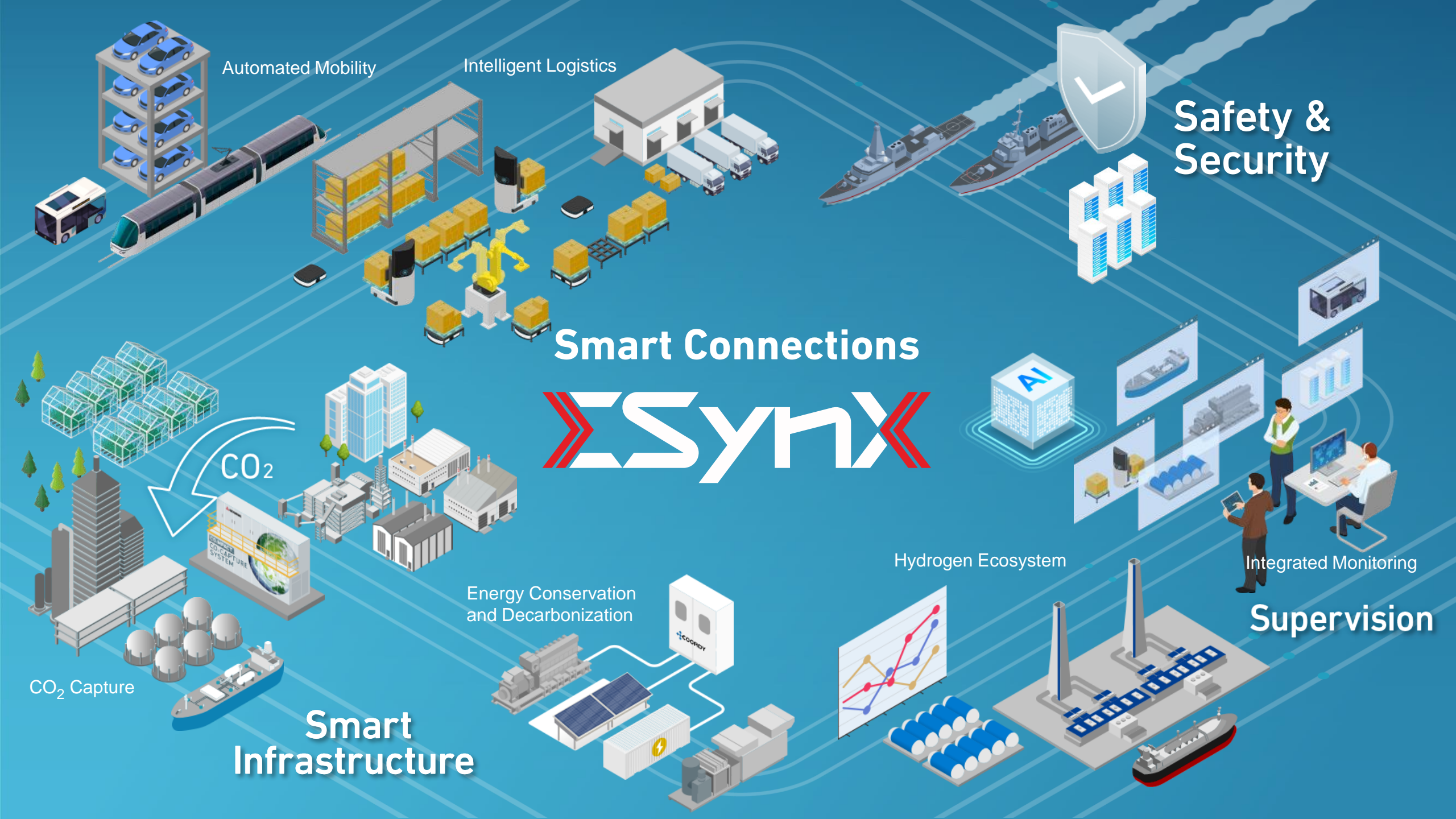
Supervision

Energy Conservation and Decarbonization

Smart Infrastructure

CO₂

CO₂ Capture



Realizing Our Customers' DX Aspirations with Σ SynX

- Proven track record of proprietary digital products accumulated in existing product lines enables us to provide agile digital solutions
- Based on this track record, deliver functionality and added value meeting customer needs in new growth areas

Proprietary Digital Products

Installations Existing Product Areas

New Growth Areas

DIASYS
Netmation 4S
 Machinery control

Control power generation equipment and marine vessels **1,000-**

TOMONI
 Supporting plant lifecycle

Monitoring power plants around the world **100-**

InteRSePT
 Cyberattack protection

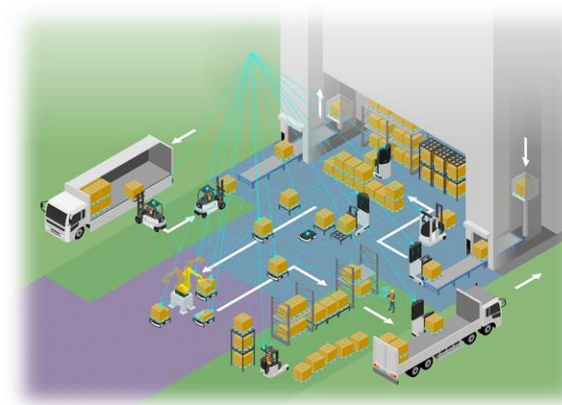
Protect important infrastructure **10-**

Σ SynX Supervision
 Intelligent video surveillance

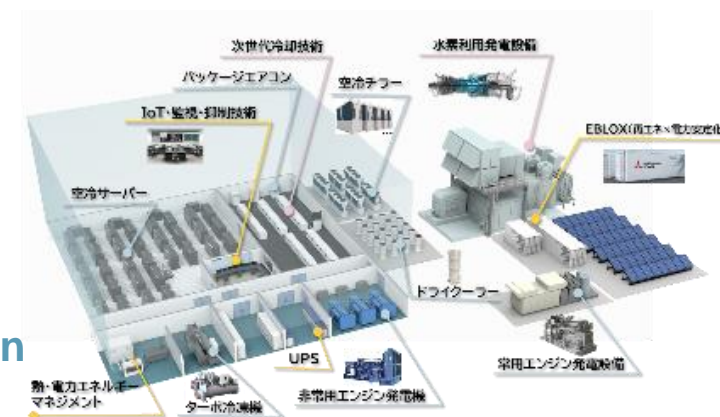
Automate steel mills **-10**

Combine & Apply

Σ SynX

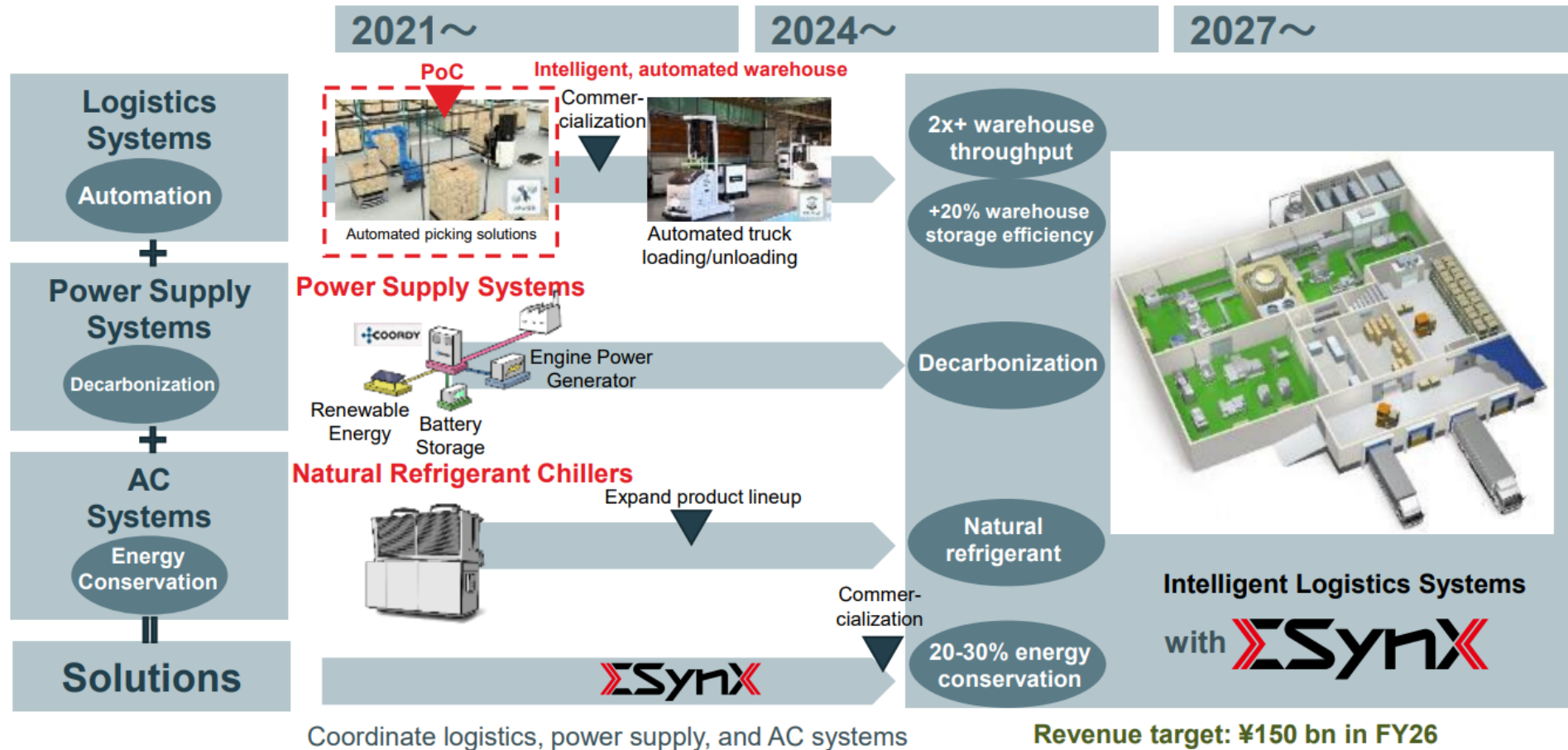


Intelligent Logistics Systems

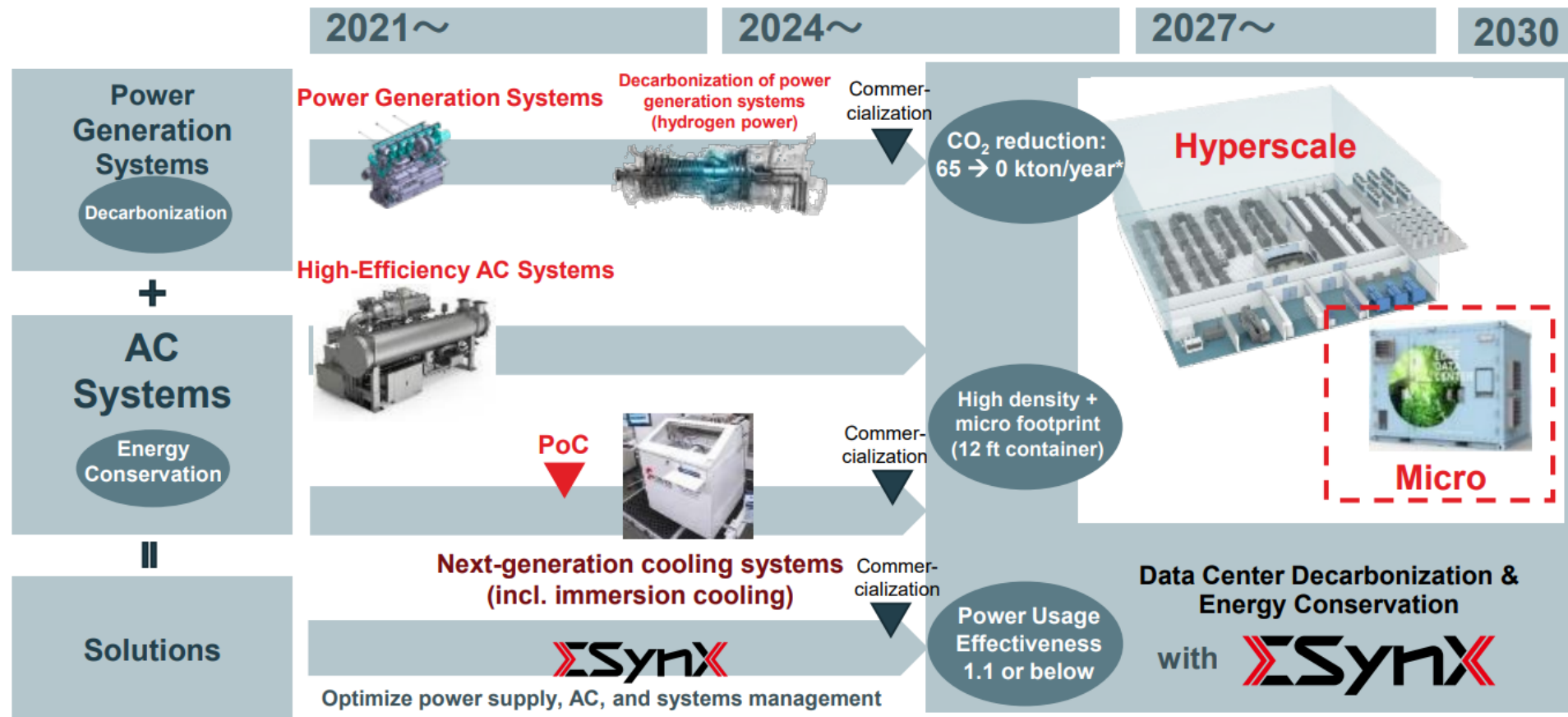


Data Centers Decarbonization

- Commercialized highly maneuverable Automated Guided Forklift (AGF) and natural refrigerant chiller to meet market needs for automation and decarbonization
- Developing intelligent logistics to achieve smooth coordination among humans and multiple logistics systems
- Achieve large-scale energy conservation and decarbonization by optimizing operation of logistics, power supply, and air-conditioning (AC) systems



- Providing high-efficiency AC and power generation systems for hyperscale data centers
- Working on proof of concept for micro data center using next-generation systems
- Will contribute to building of power supply and AC systems infrastructure for micro data centers



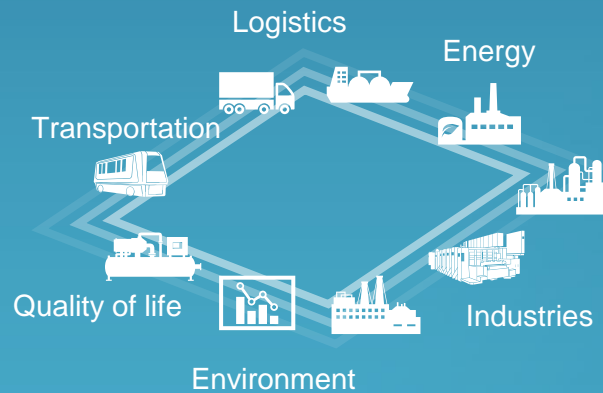
Revenue target: ¥40 bn in FY26

<https://www.mhi.com/finance/library/plan/pdf/220512presentation.pdf>



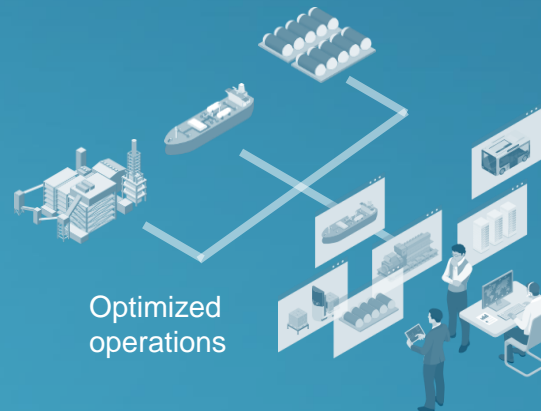
Smart Connections

Ecosystems



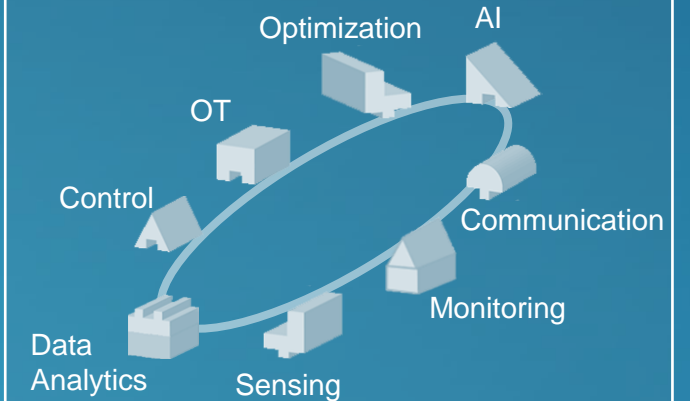
Solutions for societal challenges

Products



Enhance Customer Value

Digital Assets



Proven Technology Delivery

Security

Mitsubishi Heavy Industries on-track to meet aggressive 'Mission Net Zero' targets with AVEVA

Challenge

- Mitsubishi Heavy Industries (MHI) has committed to achieving Carbon Neutrality by 2040 by focusing on the pillars of **Energy Transition** – decarbonization of the energy supply side, and **Smart Infrastructure** – decarbonization and energy efficiency on the energy demand side. To realize these strategic goals, MHI needed to consolidate data from its entire thermal power plant lifecycle and CCUS into its proprietary TOMONI system for better visibility, analytics and optimization purposes across its scope 1, 2 and 3 emissions.

Solution

- Expanded AVEVA™ PI System™ use across the entire thermal power lifecycle. Making it a core component of data-driven work process including remote monitoring, advanced analytics, data-driven maintenance, and remote support such as AI-based combustion tuning.

Results

- Enabled monitoring and analysis of all thermal power plants with 24/7 customer support across 4 geographically dispersed Remote Monitoring Centers, even during COVID-19
- Protected mission critical data coming from customers and operating sites
- Developed various ways of reduction in carbon emissions and on-track to meet 2040 Carbon Neutrality goals and ambitious net zero commitments



MOVE THE WORLD FORWARD

**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**

Questions?

Please wait for the microphone.
State your name and company.



Please remember to...

Navigate to this session in the mobile app to complete the survey.



Thank you!