

Laboratory Tour (Kurita Innovation Hub)

January 16, 2023

Kurita Water Industries Ltd.

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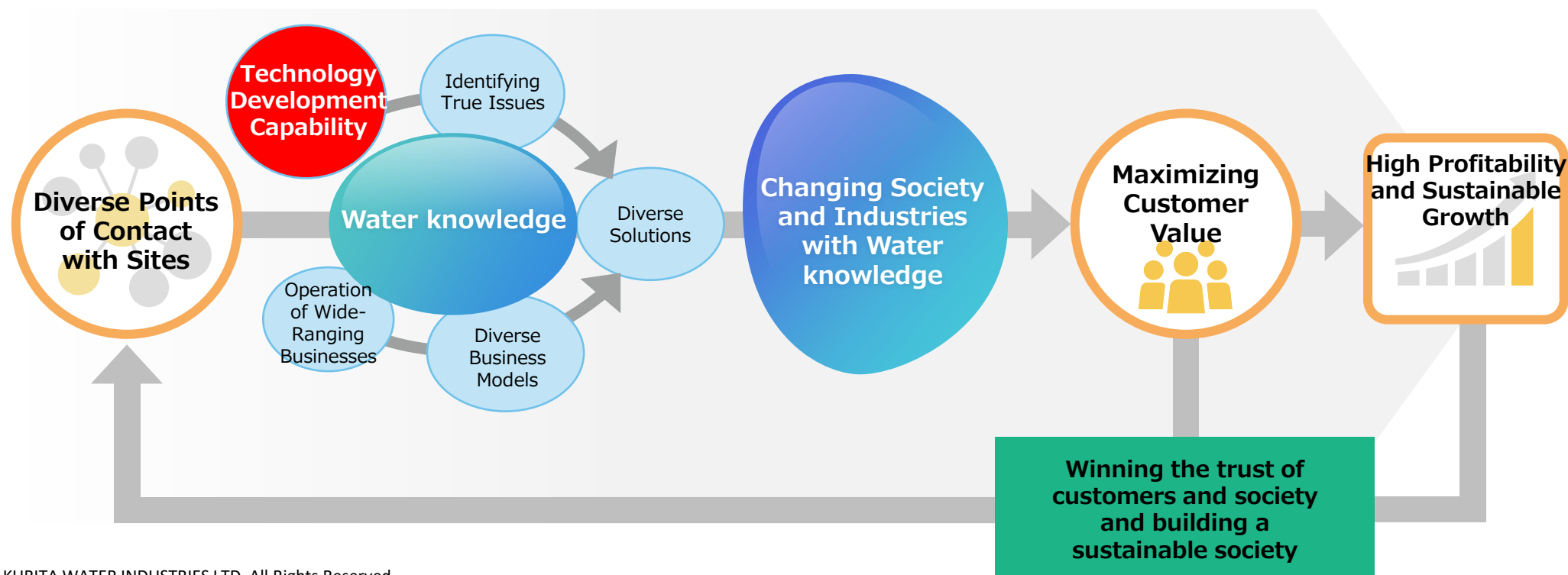
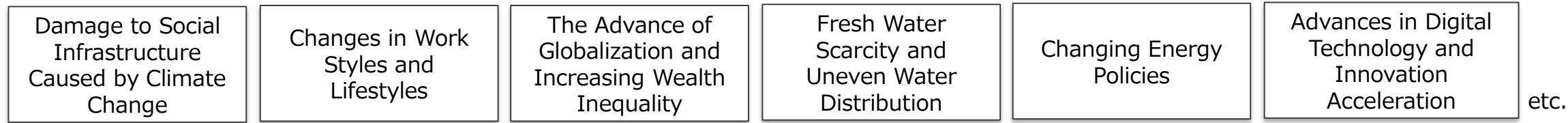
Innovation at Kurita and the Role of the Kurita Innovation Hub

Yoshio Yamada
Managing Director, Executive General Manager of Innovation Division

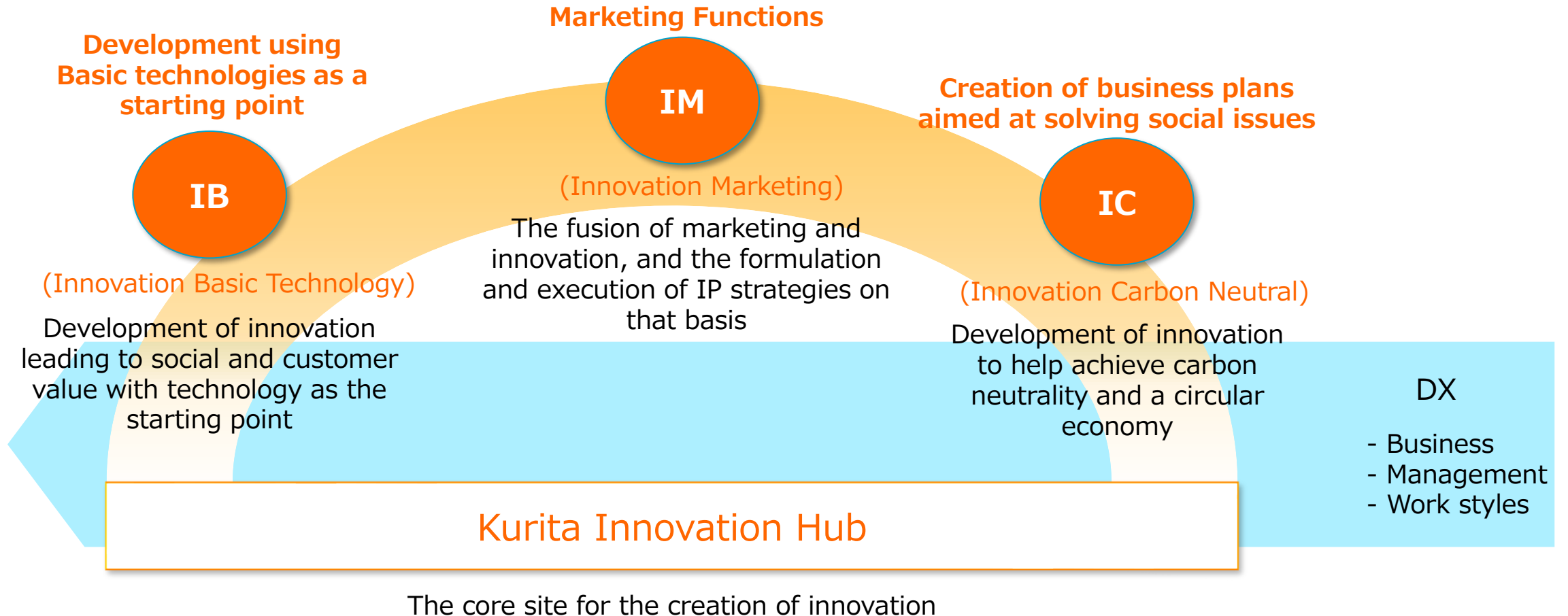
Where Innovation Fits in Kurita's Value Creation Story

Technology Development Capability serving as the starting point for diverse solutions

Major Trends Facing the Kurita Group

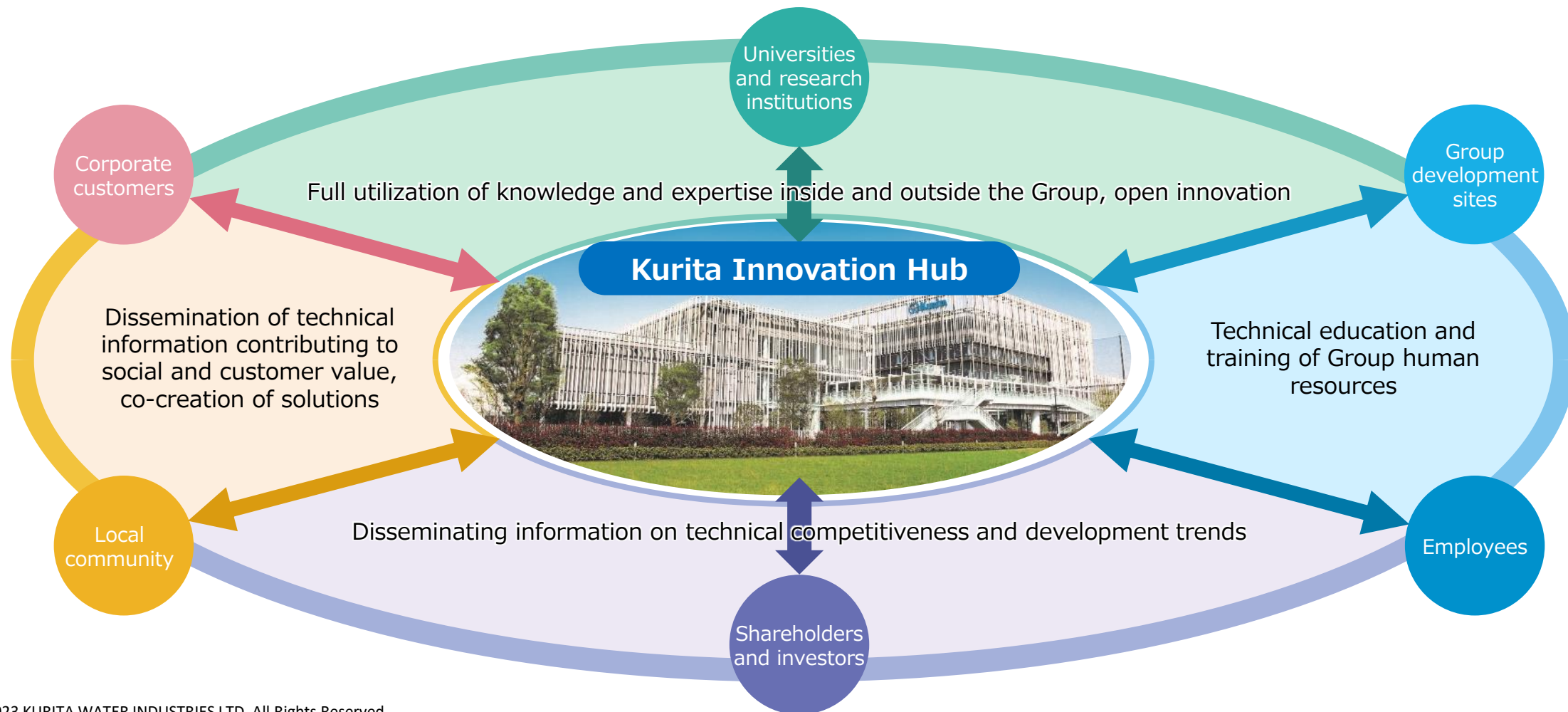


Consolidating marketing functions and development functions to produce innovation



The Role of the Kurita Innovation Hub

A hub of technological innovation and social change where a diverse range of people from inside and outside Kurita gather, learn and connect



Promoting Cooperation with Group Development Sites



Japan

Kurita Innovation Hub



United States

Avista Technologies, Inc.



Group development sites

Germany

Kurita Europe Technology Center



Singapore

Kurita R&D Asia Pte. Ltd.



Courtesy to JTC

Testing facilities also aimed at developing into open innovation



Outstanding analysis capabilities building a competitive advantage



Promotion of R&D utilizing actual facilities



Development of the Group's Human Resources



Technology transfer and the development of human resources with technical expertise

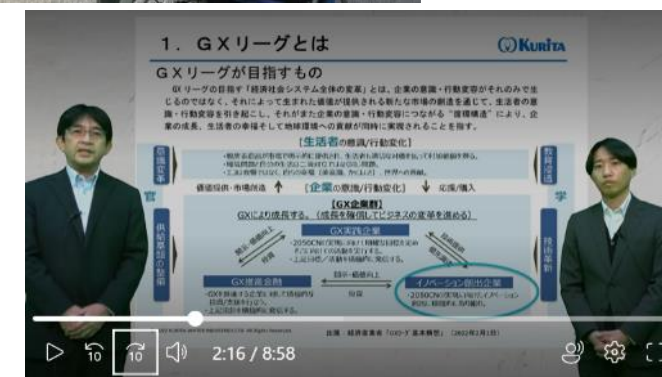


Corporate customers

Group development sites

Employees

Information delivery functions



Deepening Understanding of Kurita



Corporate displays catering to various needs



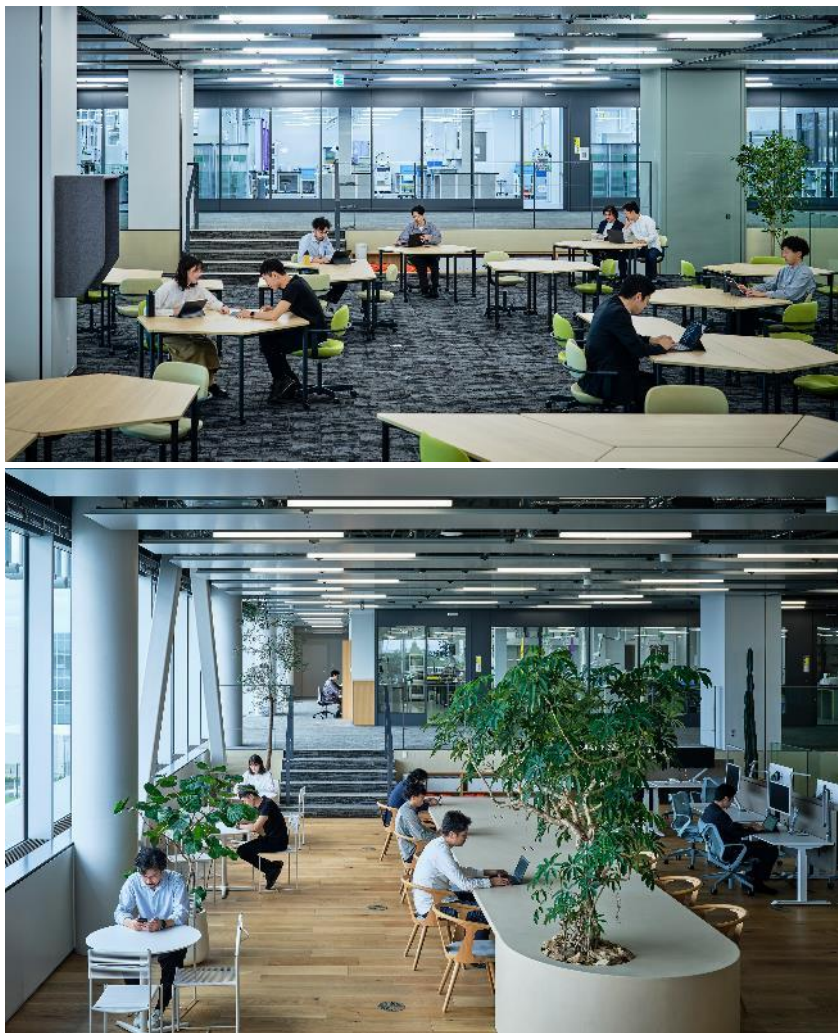
Social studies tours, workplace experiences, etc.



Mechanisms to Promote Innovation

Employees

Activity Based Working (ABW), a new work style



Contact

Engaging in tasks while in conversation with those around you
Joint work among multiple people



Discussion

Brainstorming
Information sharing, discussion and workshops



Teleconference

Web conferencing and long telephone conversations



High Focus

Intensive individual work over short periods
Data sorting and report preparation



Relax

Rest and restoring concentration
Casual conversation

The symbol representing the Kurita Group's R&D activities

From One Drop, To Earth.

The symbol incorporates our R&D aspirations, where a small drop created through our R&D activities expands into a massive solution on a global scale by connecting a diverse range of human resources and wide-ranging knowledge both internally and externally, in turn creating a brighter future for our planet.

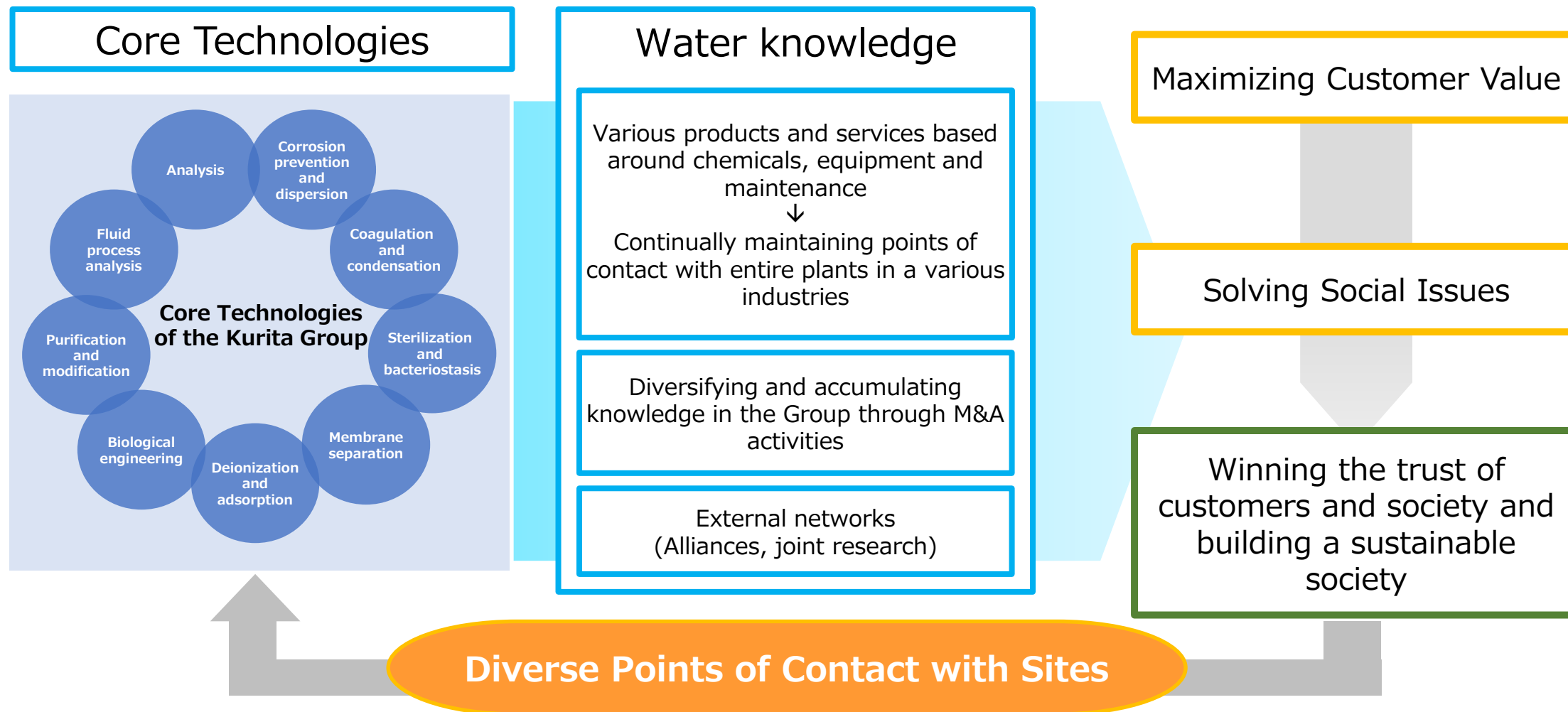


Cutting Edge Water Treatment from the In-depth Pursuit and Fusion of Technologies

Katsunobu Kitami
Senior General Manager of Basic Technology R&D Group, Innovation Division

Technology-Driven Development Approach

Development of innovation leading to social and customer value
with technology as the starting point



Kurita's Priority Research Themes



Kurita is concentrating our available resources on five themes to accelerate development

Project Acorn

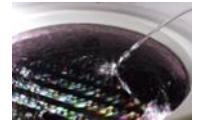
Technological development and technical support advancing the rollout of RO membrane solutions



Ultrapure water

Development of new technologies and new products for microelectronics industries

This will
be our
focus
today



Suppression and control

Development of more in-depth technologies and new products for bacteriostasis, dissolution, corrosion prevention and dispersion, etc.



Separation and decomposition

Development of more in-depth technologies and new products for bio - and physical chemistry, membranes and ion exchange, adhesion, and so on



Analysis and simulation

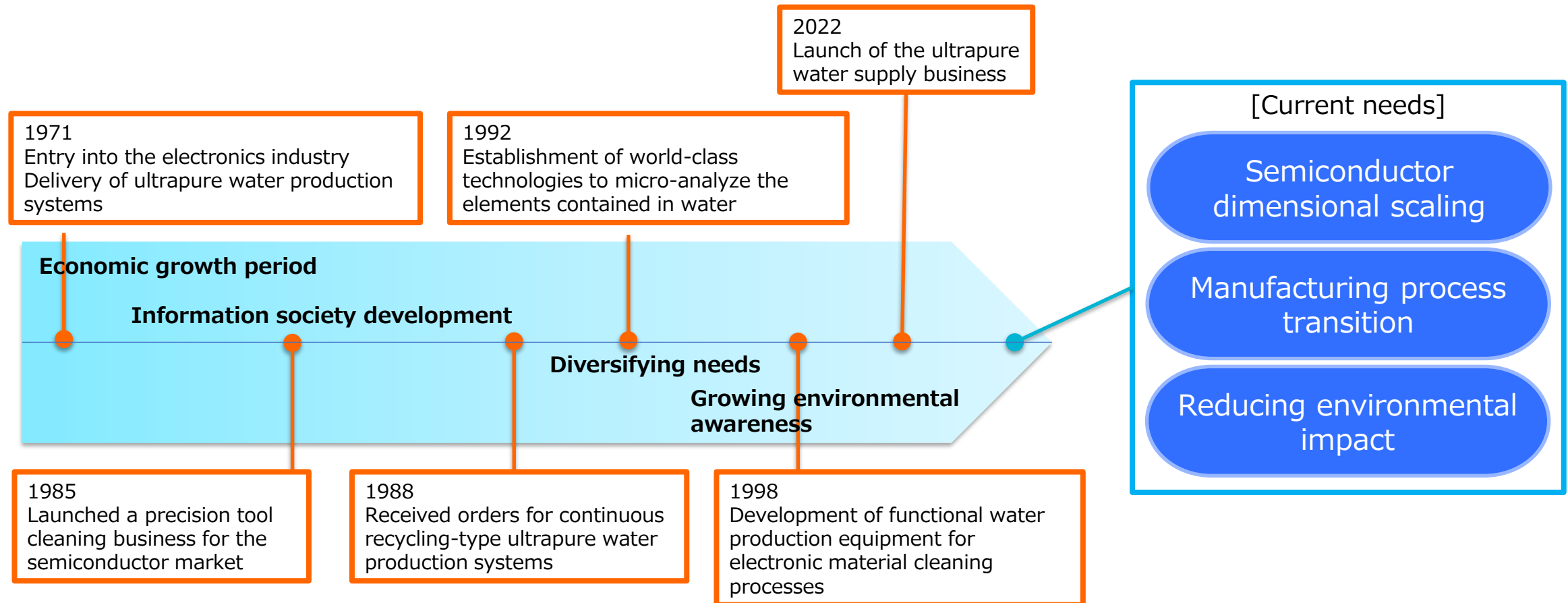
Development of more in-depth technologies and new products for analysis and measurement



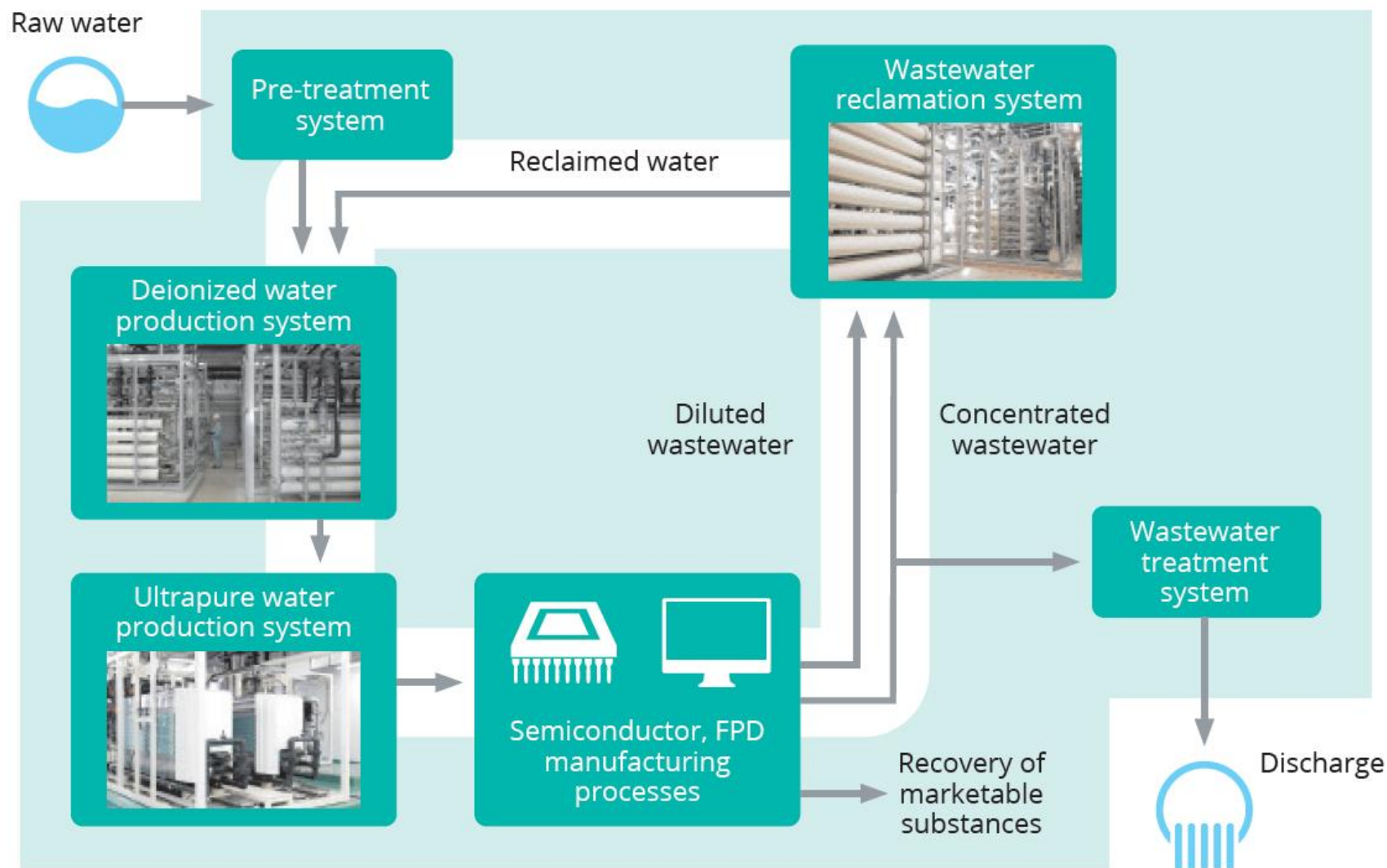
History of the Evolution of the Electronics Industry and Water Treatment



Providing high purity cleaning water, purification technologies, recovery and efficient treatment of water and valuable resources to meet the needs of semiconductor dimensional scaling, manufacturing process transition and reducing environmental impact

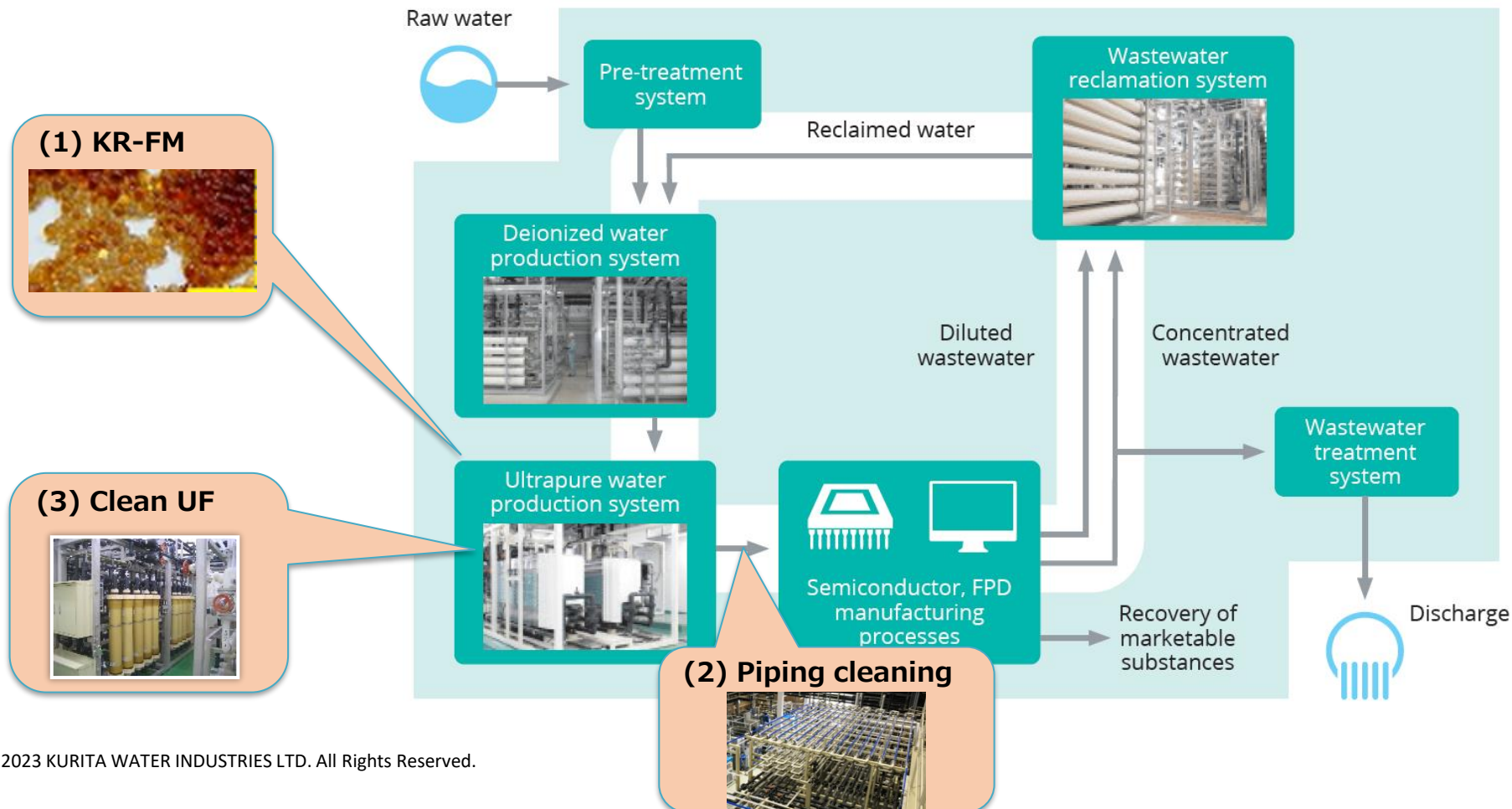


Water Treatment for the Electronics Industry



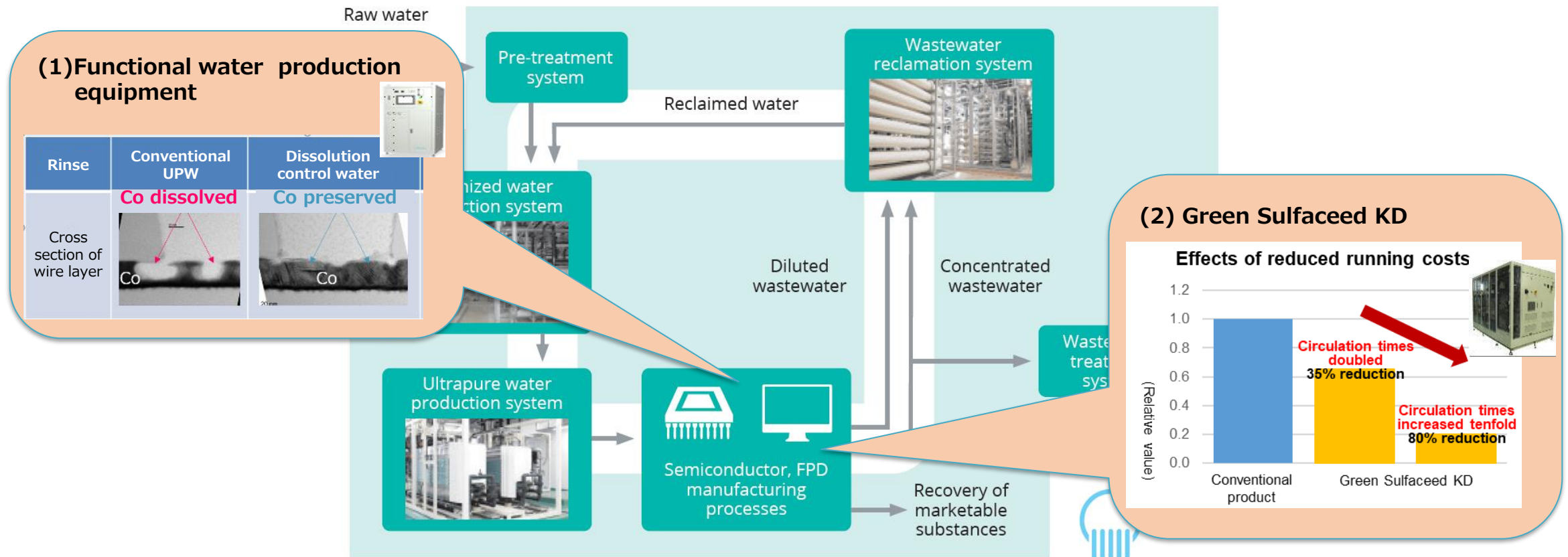
Responding to Semiconductor Dimensional Scaling

- (1) Ultrapure ion exchange resin (KR-FM) enable to treat metal and particle in water to the world top level lower concentration.
- (2) Kurita's piping cleaning method enables swift start-up of ultrapure water production system for new Fab operation.
- (3) Pre-cleaned Ultra Filter (UF) enables minimum lead time operation after UF maintenance(replacement).



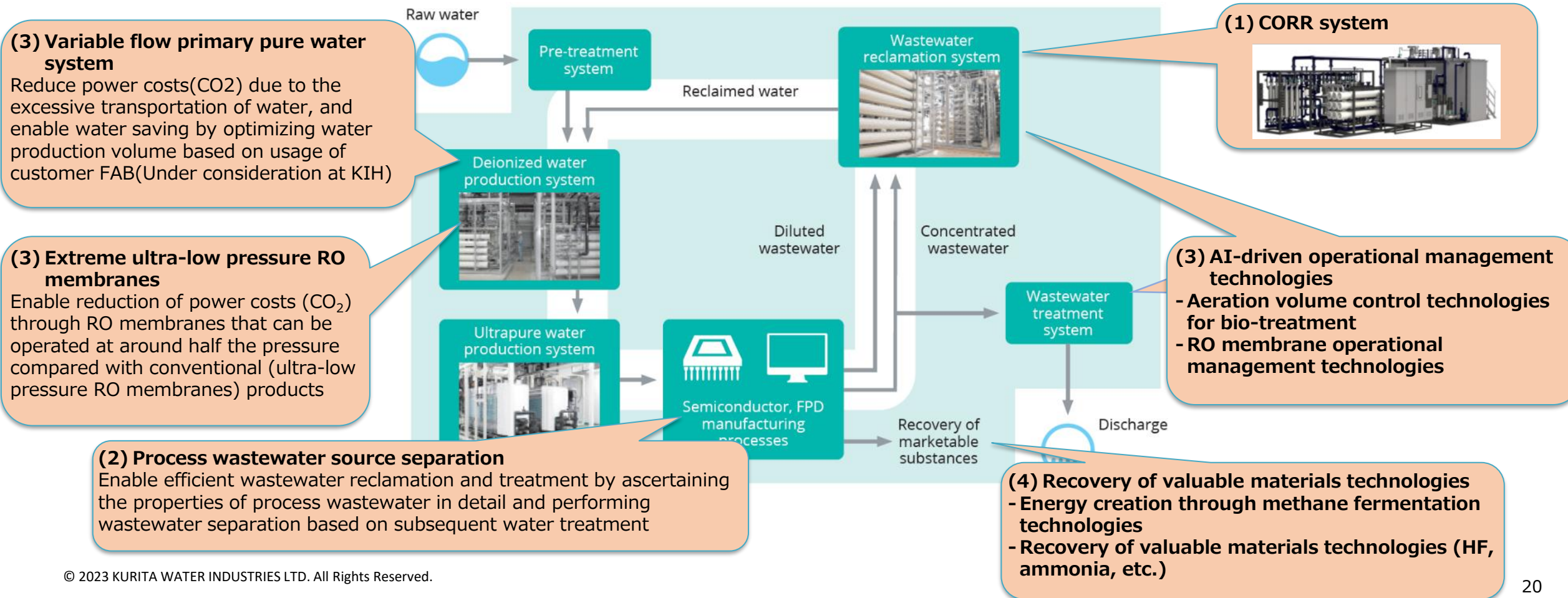
Responding to Manufacturing process transition

- (1) Functional water production equipment and its cleaning technologies (Cu/Co dissolution control technologies, etc.) for cutting-edge semiconductor manufacturing processes
- (2) Reducing of high concentrate sulfuric acid consumption and environmental loading impact by an electrolyzed sulfuric acid generator (Green Sulfaced KD)

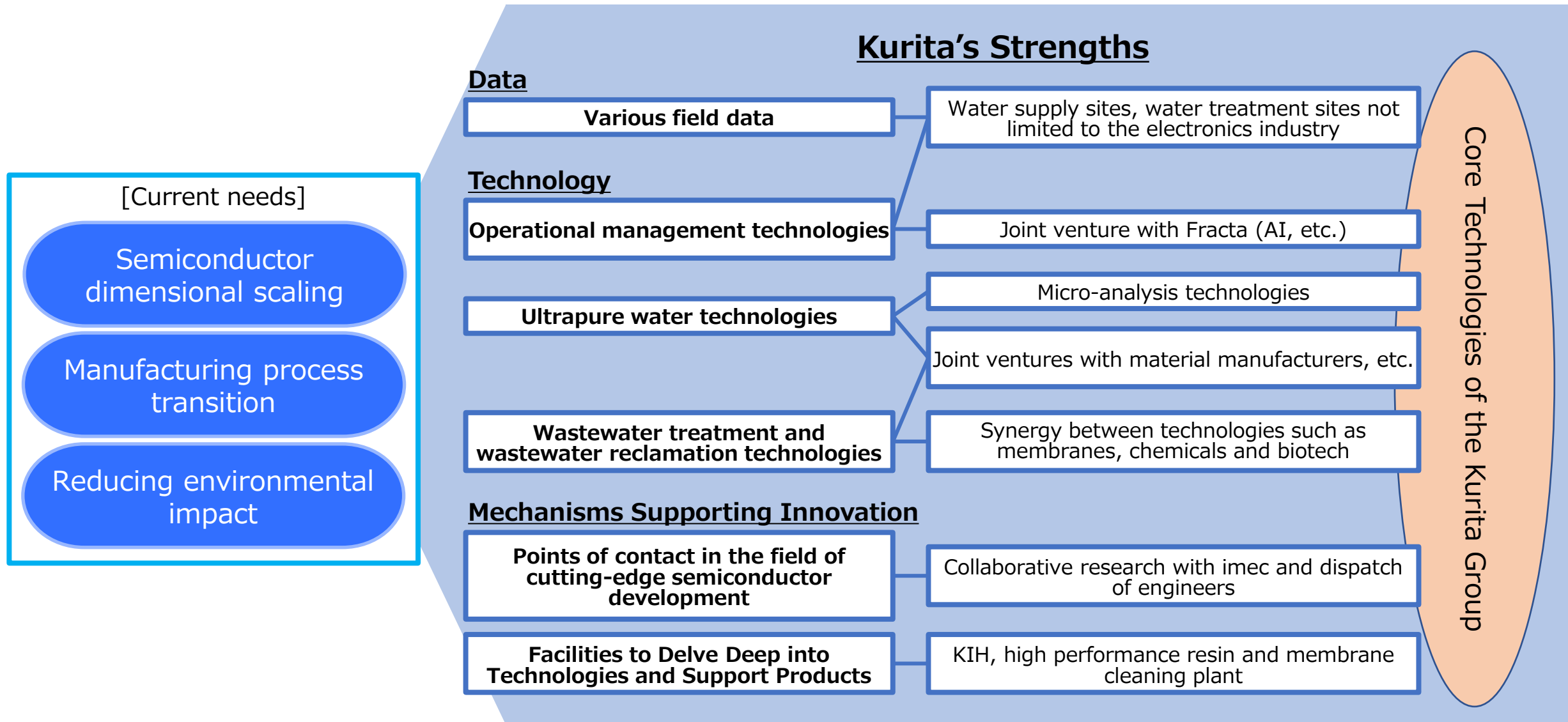


Reducing Environmental Impact

- (1) The CORR system enables stable, cost-minimum operation with a compact system for water reclaiming.
- (2) Enabled efficient wastewater reclamation through the source separation of wastewater in the customer's manufacturing process
- (3) Responded to the need to eliminate waste and reduce the environmental impact by applying highly efficient functional materials and employing operational management technologies based on AI with situational awareness
- (4) Employed technology to remove valuable resources from waste to reduce the amount of waste itself and promote reuse



Kurita's Competitiveness in the Provision of Solutions



Points of Contact in the Field of Cutting-edge Semiconductor Development

Collaborative research with imec and dispatch of engineers

- Kurita has dispatched researchers to a cutting-edge semiconductor technology research site (imec). Since 2014, we have been promoting an understanding of the next-generation semiconductor manufacturing process and conducting exchanges with the engineers of cutting-edge semiconductor manufacturers
- We are promoting the early implementation and development of solutions including cleaning technologies, improved ultrapure water production and a reduced environmental impact for next-generation semiconductor manufacturing processes



imec research site (Belgium)

Facilities to Deep into Technologies

KIH (Kurita Innovation Hub)

- Performing wafer cleaning using various types of functional water in clean rooms. Through assessment of wafer surfaces and technologies to analyze the water quality of the ultrapure water and functional water used, we ascertain effects and evaluate the impact on water quality, cleaning methods, wafer cleanliness and processes.

- We continue to develop technologies to micro-analyze the content of ultrapure water. By identifying issues for guaranteeing high-purity water quality and producing high-purity water, we are continually producing and guaranteeing ultrapure water of the highest purity.

- Data verification at actual scale utilizing KIH's water treatment facilities
- We have set up open laboratories in clean rooms and general-purpose labs to accelerate co-development with customers and collaborative manufactures



Creating Business Models to Solve Social Issues

Hiroyuki Suzuki
Senior General Manager of Carbon Neutral Group, Innovation Division

Considering draft business plans to address social issues from three starting points

Customer/market needs, technological seeds,
and cooperation between companies



Feasibility study and validation of candidate business models

Social value, competitive advantage, market feasibility, etc.



Refining proposed business models

Utilization of outside resources, internal and external
communication, verifying value with customers (PoV), etc.

Axes of Business Model Creation

Contributing to carbon neutrality and the circular economy along the dual axes of water treatment and resource recycling

This will be
our focus
today

Contributions using water treatment technologies and services as a starting point

(1) Thorough energy savings in water treatment and achievement of carbon neutrality

Contributions through resource recycling technologies

(2) Recycling of waste liquids and other waste

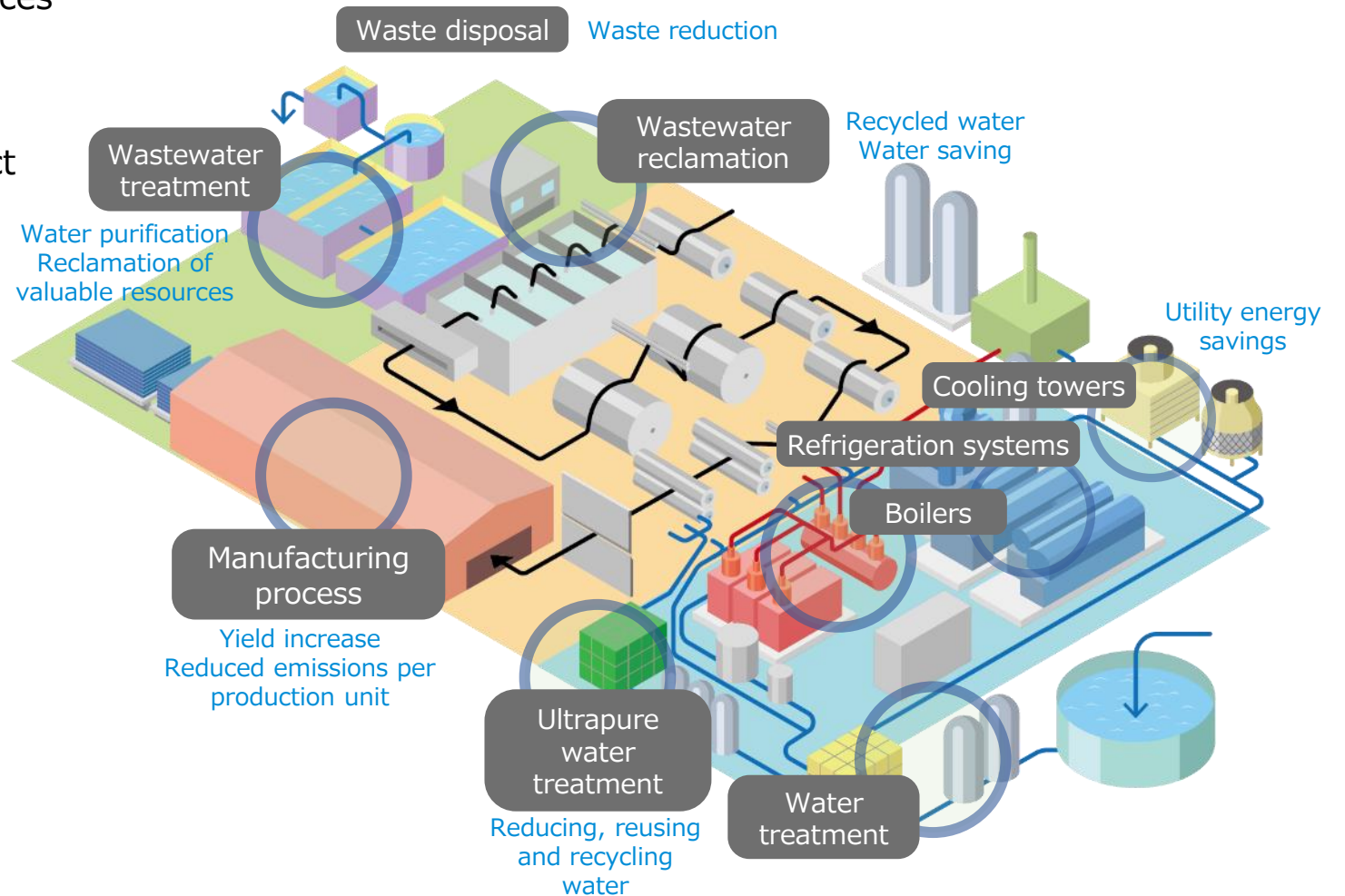
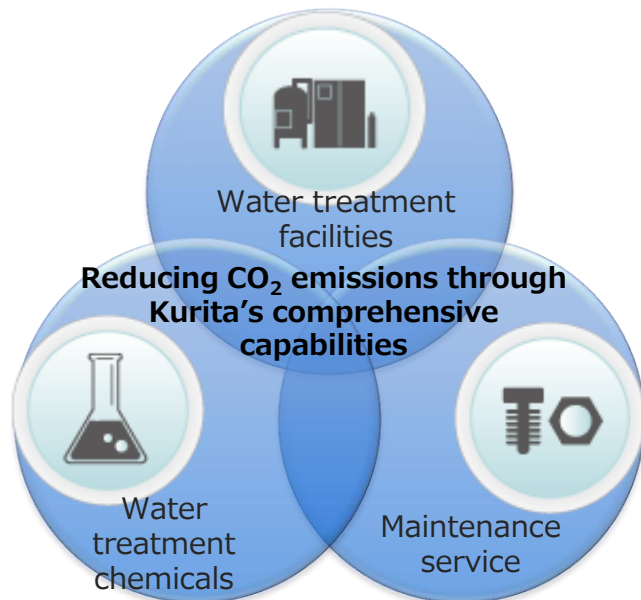
(3) Establishing energy creation processes

(4) CO₂ recycling

Contributions Using Water Treatment Technologies and Services as a Starting Point

The Kurita Group's Solutions

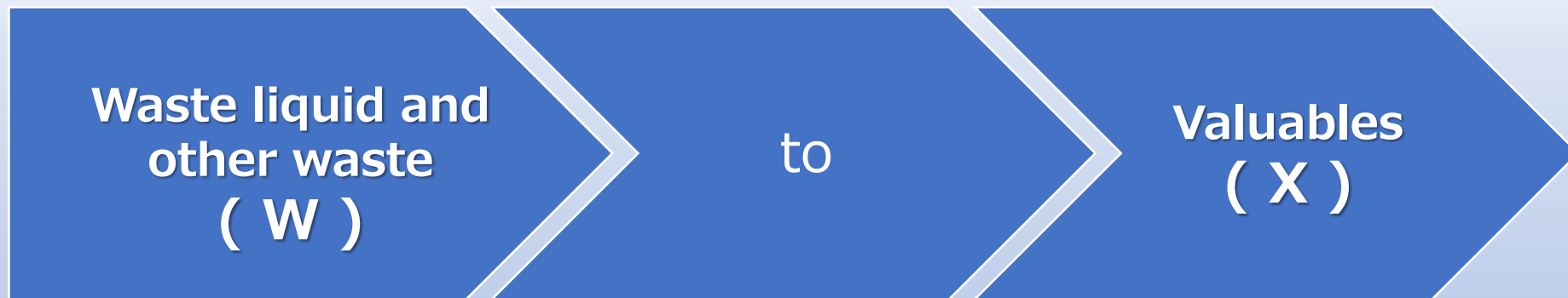
- Water saving/effective use of water resources
- Energy saving
- Waste reduction
- Improved production efficiency and product quality



Contributions Through Resource Recycling Technologies

To date, the Kurita Group has cultivated a wide range of water treatment technologies that remove solid matter or dissolved foreign materials from water to enable its reuse. If we use and further refine those technologies, we should be able to turn the foreign materials that have been removed into usable valuable resources.

Recycling Technologies



Valuable resource (x) = water, methane, electricity, fuel, NH_3 , P, rare metals, plastics, fertilizer, feed, etc.

Recycle of Used Diapers

Contribute reduction of CO₂ emission through material recycle

Issues

The amount of disposed adult diapers has increased due to population ageing

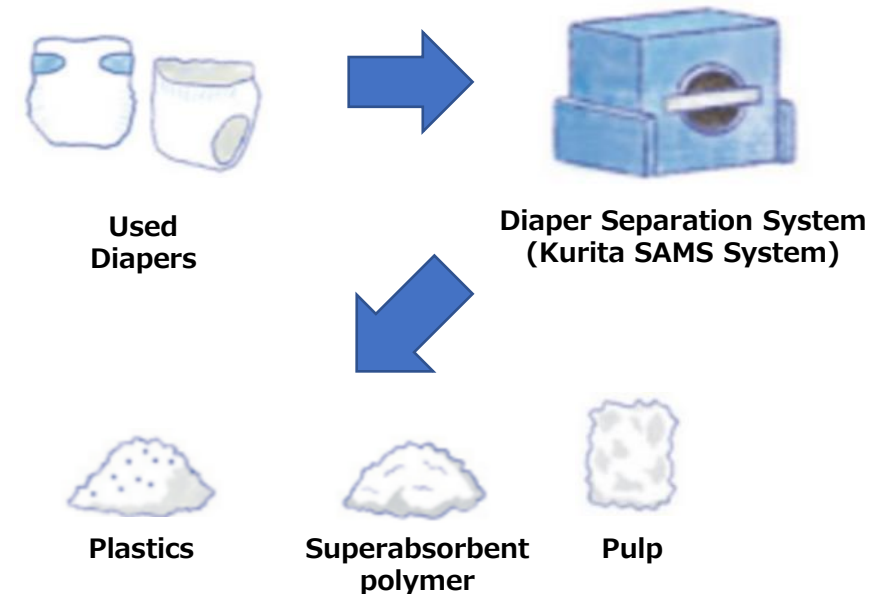
- **Incineration cost of local municipalities has increased**

Used diapers contain a lot of moisture which makes them difficult to burn. It requires higher temperature above 800 degrees, which is higher than usual. This introduces various issues: maintenance of furnaces, rising fuel costs, and concerns about an adverse impact on the environment.

- **Disposal cost at elderly care facilities has increased**

Handling of diaper waste is hard work and burdens of staff. Unpleasant odors at waste storage locations is another problem.

Kurita's Solutions



Wastewater Treatment System using Microbial Fuel Cell

Create energy and reduce CO₂ emissions from wastewater treatment

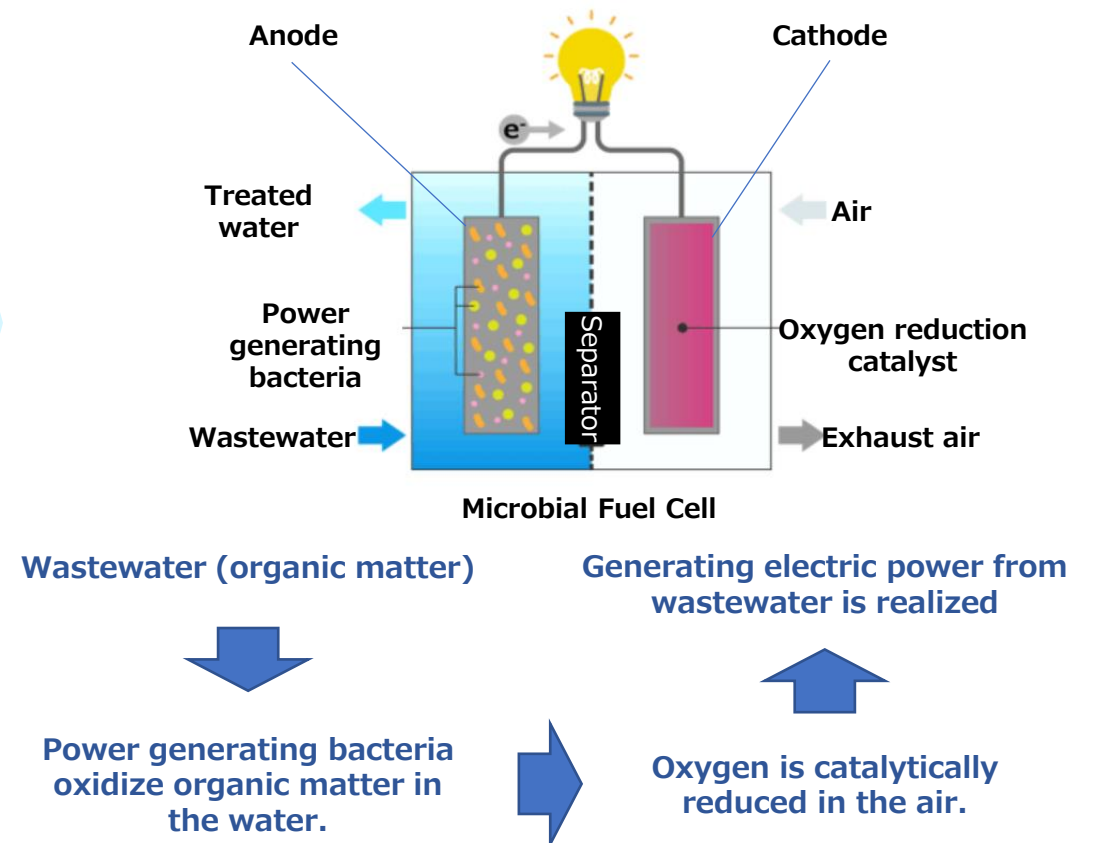
Issues

Industrial wastewaters are commonly treated by using conventional activated sludge process to obey regulations for discharge to sewer system or rivers and sea so to protect water environment.

However,

- Large amount of electricity is required for aeration
- CO₂ emissions increase due to the treatment and disposal of large amount of excess sludge.

Kurita's Solutions



Future Direction

Leveraging the various points of contact we have in the field as a strength, we will create innovations that help realize a decarbonized society.

Promoting biomass utilization

Reducing CO₂ emissions

CO₂ Negative Emission

Sustainable food production



Reducing the use of petroleum resources

Development of a hydrogen-based society

Development of an electrified society

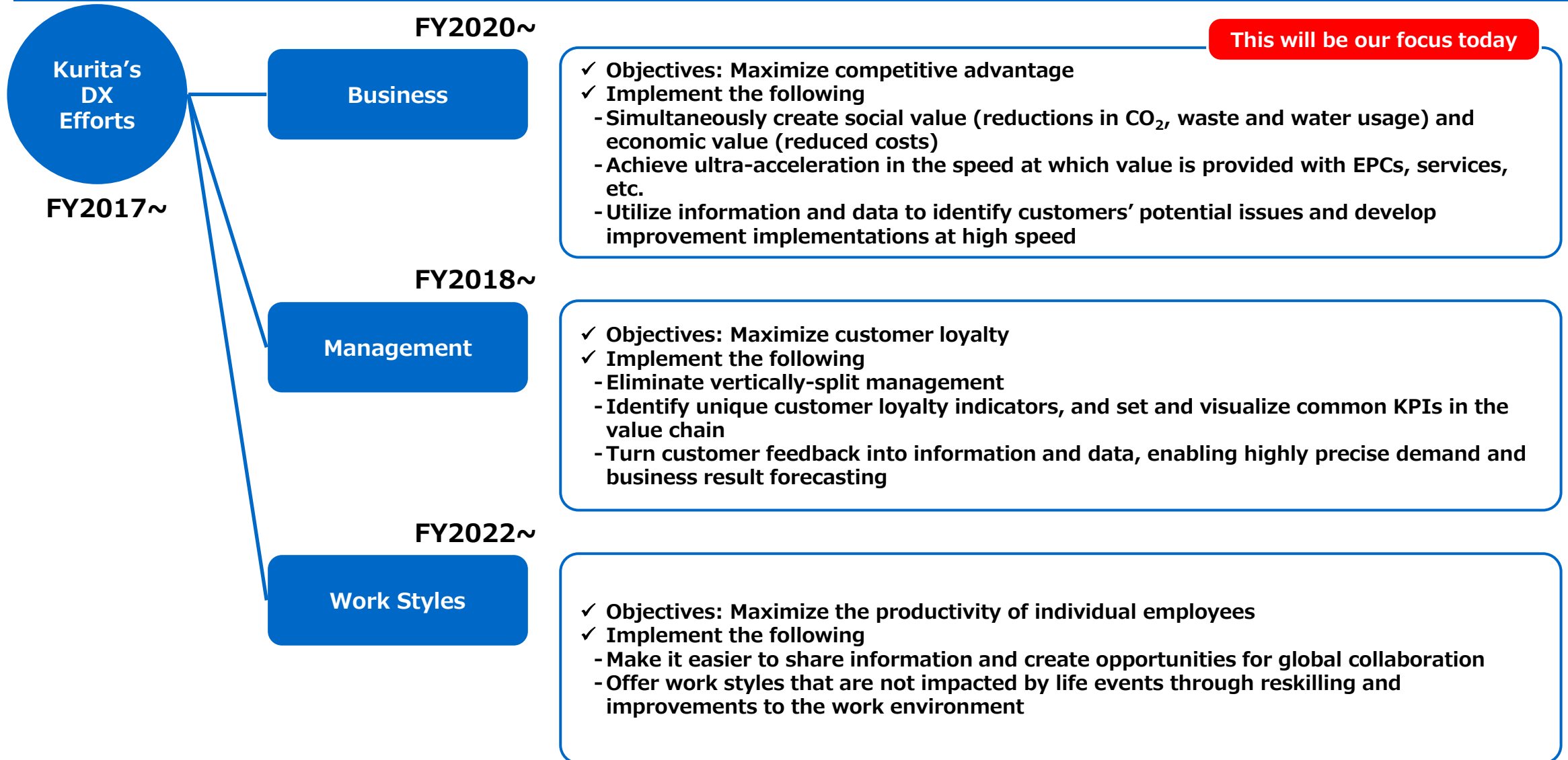
Innovative wastewater treatment

Encouraging the use of renewable energy

Kurita's DX Efforts

Makoto Mizuno
Executive Officer, Executive General Manager of Digital Strategy Division

Areas Where DX is Being Introduced



Challenges in the Business Domain



Business Process

○ Developing proposals

Determine policies on value creation methods such as the combination of solutions

○ Manufacturing

Engage in procurement, design and construction based on the terms of agreements with customers

○ Providing Services

Operational management agreements such as water supply projects, etc.

Understand customer requirements
(What kinds of functions are required?)

Formulate value creation plans
(What do we propose?)

Substantiate the creation plan
(How do we turn the proposal into reality?)

Further expand customer value
(How do we maximize value?)

[Customer testimonials]

"We want information quickly!" "we want the product ASAP!"

"We want to produce more value!"
"We want to achieve improvements!"
Secure! Stable! Safe!"

"What kind of high-added-value can we produce?"
"We want to choose from among multiple options!"
"Are there any better methods?"

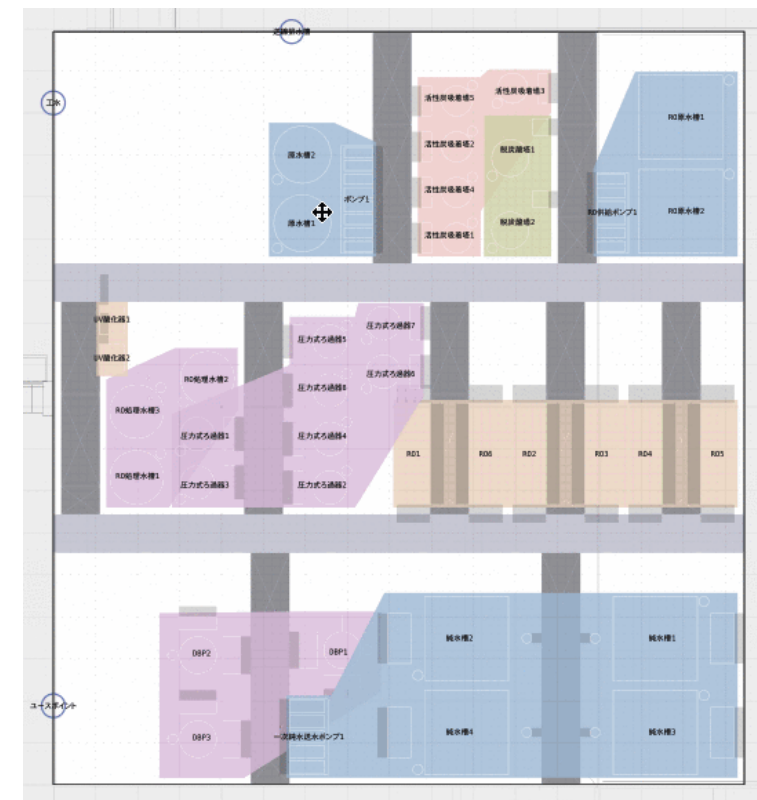
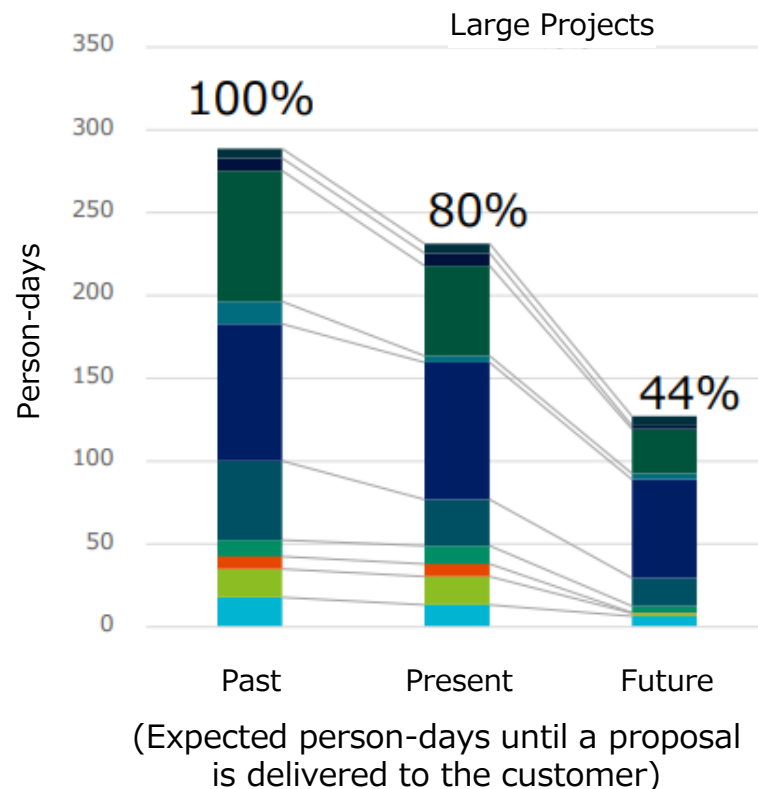
We identified and defined challenges that maximize competitive advantage

Case 1: Making the Proposal Development Super-Fast

By simply inputting the conditions, multiple proposals can be output immediately

- ❶ Equipment configuration: What functions does the equipment need to have, what size is required, and what kinds of optional configurations will be available?
- ❷ Equipment placement: How will the equipment be put in place and what is the most efficient method (minimizing the length of piping needed and land required)?
- ❸ Process development: What process should be used for the construction work to complete it the fastest?

Meta-Aqua Project



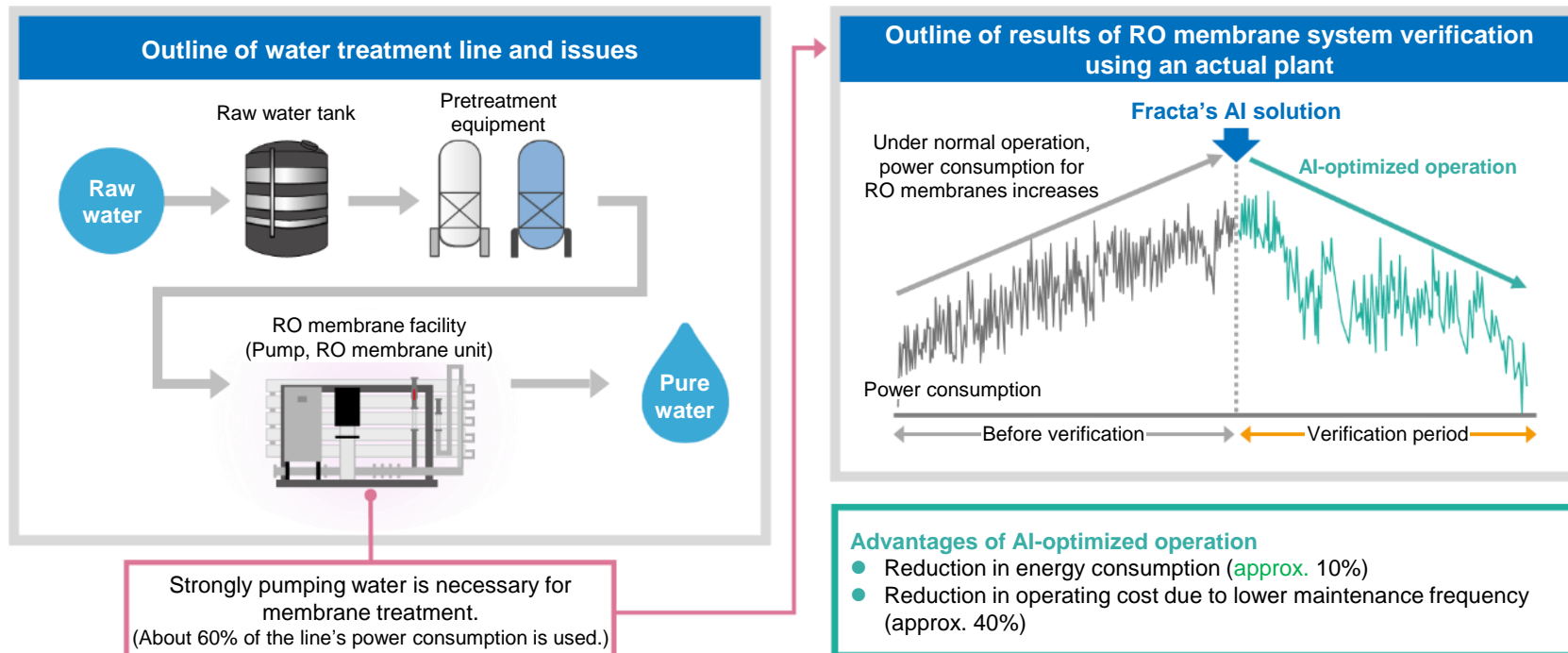
Case 2: Making Operational Management Super-Fast



Through AI-based control, CO₂ emissions from RO membrane equipment can be reduced and costs can be lowered at the same time

- ❶ Energy savings: We have demonstrated a 14% reduction over previous implementations in the amount of electricity required for RO membrane operation (*Depending on operational conditions)
- ❷ Cost savings: Cost reductions due to lower electricity costs and extended service life of RO membranes
- ❸ Improved environmental performance: Effect of reduced CO₂ emissions due to lower electricity use, effect of reduced waste from RO membranes

AI-Optimized Water Treatment Operation Initiative: Test Verification Results



Meta-Aqua Project



Received Environment Minister's Award as part of Japan Open Innovation Prize

Test verification at an actual plant was carried out from December 2020. In terms of the power consumption-reducing effects from AI-optimized operation, when considering the reduced frequency of maintenance, results showed approximately 40% decrease in operating costs compared with previous implementations, and an expected reduction in CO₂ emissions of approximately 10%.

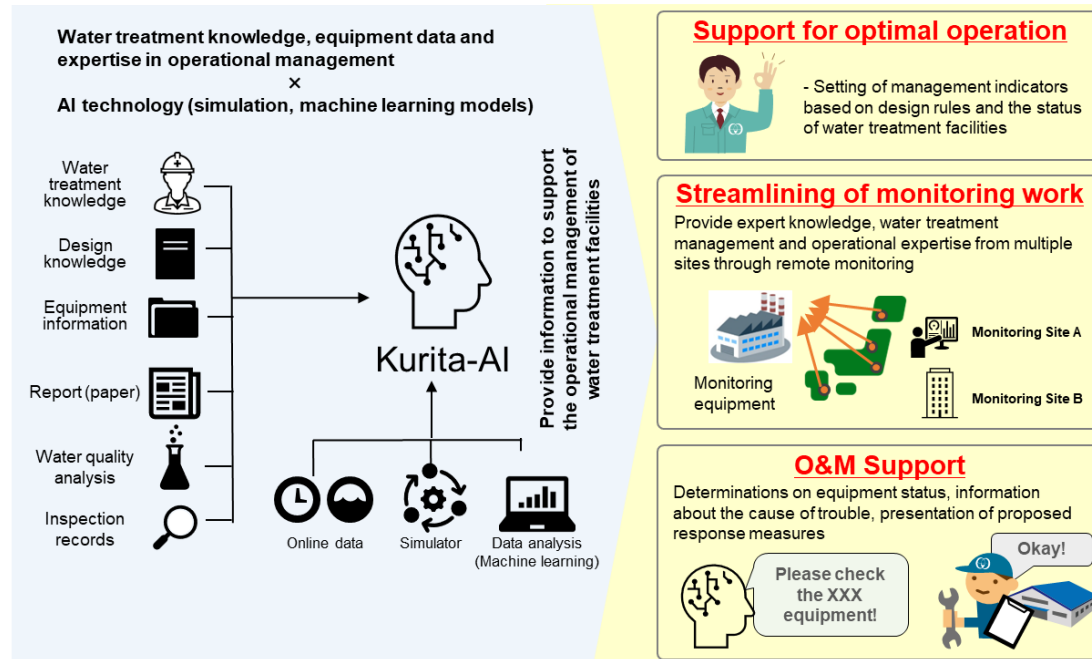
Case 3: Making Troubleshooting for Equipment Operation Super-Fast

Have the best solution at hand whenever trouble occurs

- ❶ Search for cases of similar trouble: Quickly provide information about past cases by having the user enter information about the trouble that occurred
- ❷ Provide instructions on what items need to be confirmed: Provide instructions on the numbers that need to be confirmed using plant measurement instruments, etc., to narrow down cases of similar trouble
- ❸ Provide instructions on recovery measures: Provide instructions to on-site management personnel on measures to recovery from the type of trouble that was narrowed down

Overview of Kurita-AI

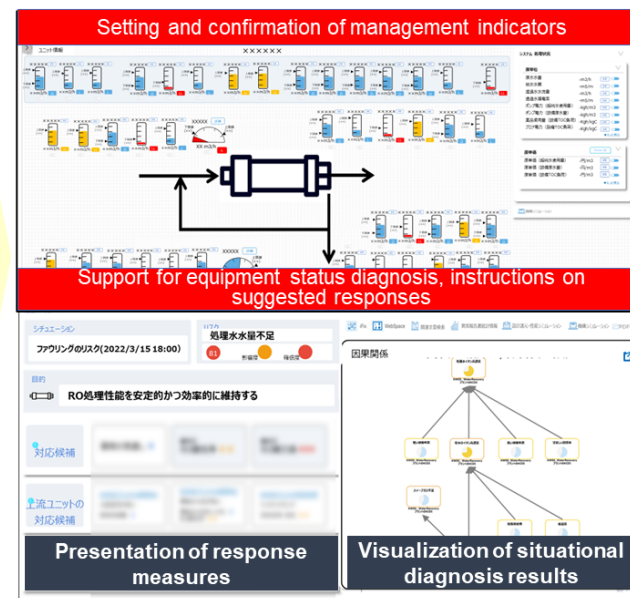
By utilizing **Kurita's technologies and expertise in water treatment and operational management** combined with **AI technology**, support is provided for the **optimum operational management of entire water treatment facilities**.



Effects

- ◆ Labor savings due to task streamlining
- ◆ Optimized operating costs
- ◆ Facility stabilization
- ◆ Improved problem solving
- ◆ Prompt response when responding to an anomaly

Web-based confirmation enabled (limited to closed networks)





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