台灣國際水週
Taiwan International Water Week

Cross-departamental Collaboration in Water Supply Policies and Strategic Planning in Response to High-Tech Development

Water Supply Strategies and Water Treatment Technologies for High-Tech Industry
Taipei, 2024, September, 11

Mara Ramos, SABESP

Objectives

- Why **water cooperation** is relevant?
- What are the **key success factors for Collaboration** in Water Supply Policies?
- What is the **role of regulation** for Water Supply Sector?
- How **an integrated planning process** can support a **resilient water and sanitation systems in climate change scenarios?**
- How do regulators and utilities respond to the changing environment to sustain **progress towards SDG targets**?

VULNERABLE COUNTRIES
REGISTER
US$ 500 BILHÕES IN LOSSES PER YEAR

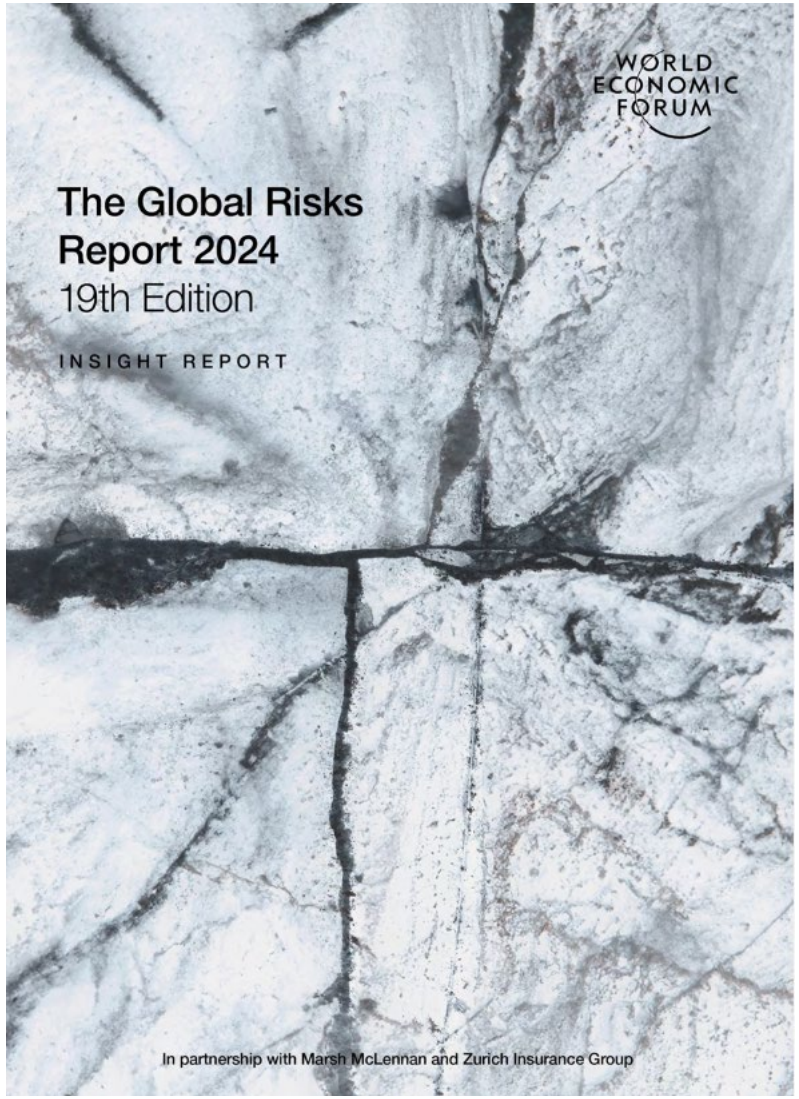


FIGURE C **Global risks ranked by severity over the short and long term**

"Please estimate the likely impact (severity) of the following risks over a 2-year and 10-year period."

Risk categories
- Economic
- Environmental
- Geopolitical
- Societal
- Technological

	2 years	10 years
1st	Misinformation and disinformation	Extreme weather events
2nd	Extreme weather events	Critical change to Earth systems
3rd	Societal polarization	Biodiversity loss and ecosystem collapse
4th	Cyber insecurity	Natural resource shortages
5th	Interstate armed conflict	Misinformation and disinformation
6th	Lack of economic opportunity	Adverse outcomes of AI technologies
7th	Inflation	Involuntary migration
8th	Involuntary migration	Cyber insecurity
9th	Economic downturn	Societal polarization
10th	Pollution	Pollution

Source
World Economic Forum Global Risks Perception Survey 2023-2024.

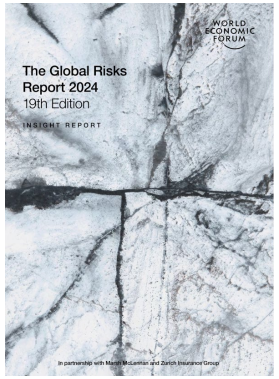
- **Extreme weather events**
- **Critical change to Earth systems**
- **Biodiversity loss and ecosystem colapse**
- **Natural resouce shortages**
- **Pollution**

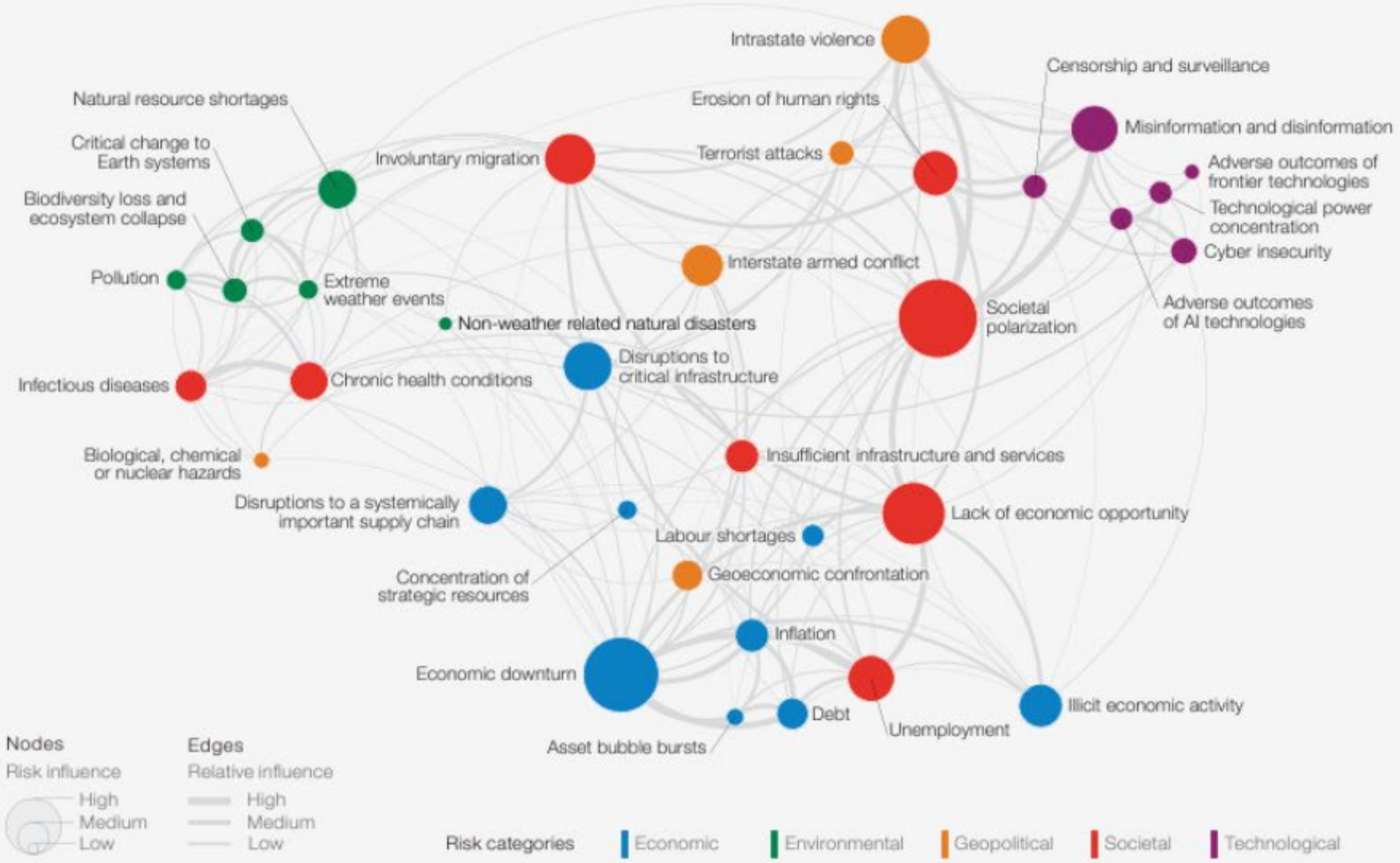
Water-Related Risks:

- Water Scarcity
- Water Pollution
- Extreme Weather Events
- Rising Demand for Wate
- Inequality in Water Acces
- Climate Change Impacts

Strategies for Mitigation:

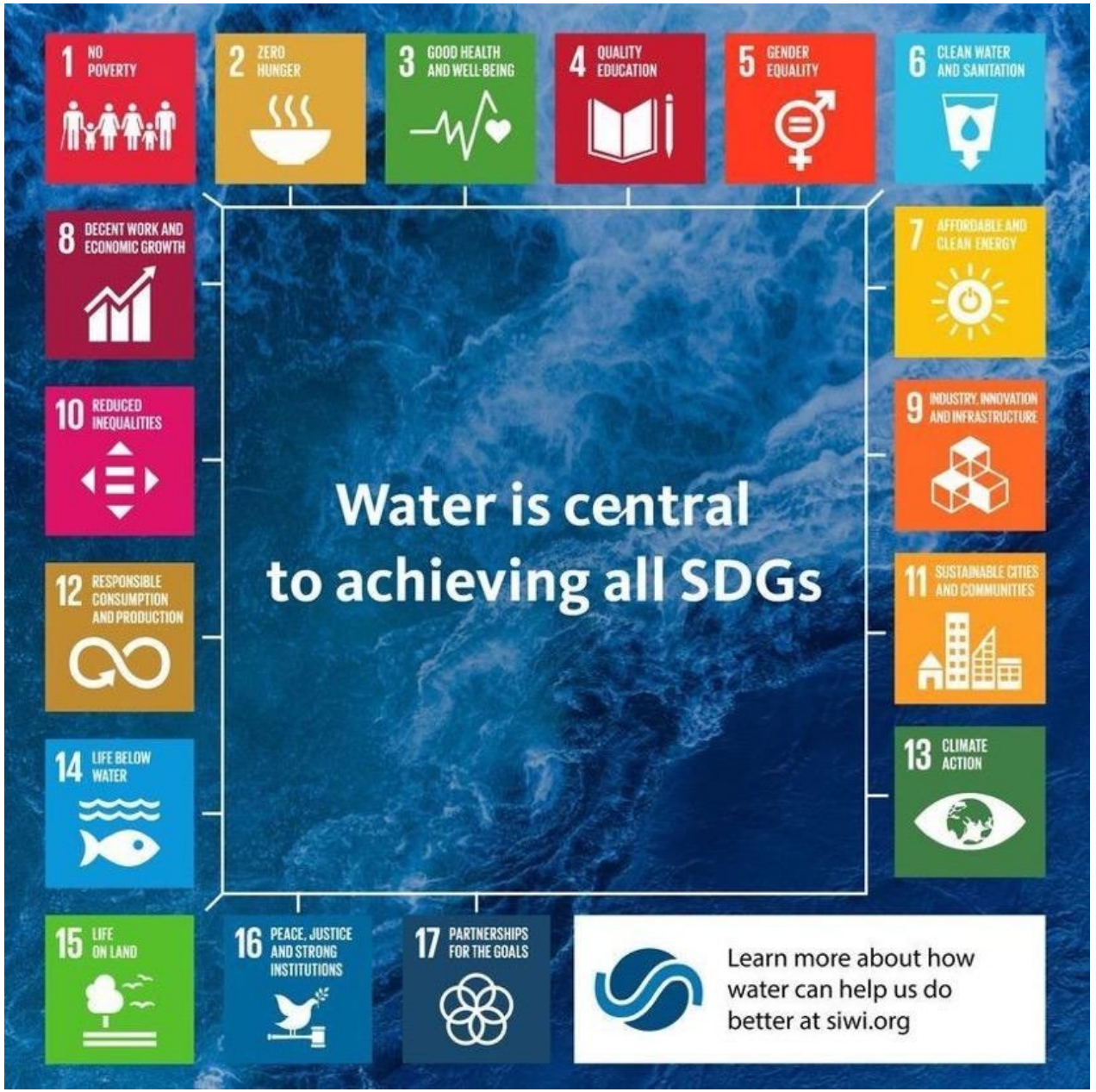
- **Investment in Water Infrastructure**
- **Sustainable Water Management**
- **Innovation and Technology**
- **Global Cooperation**





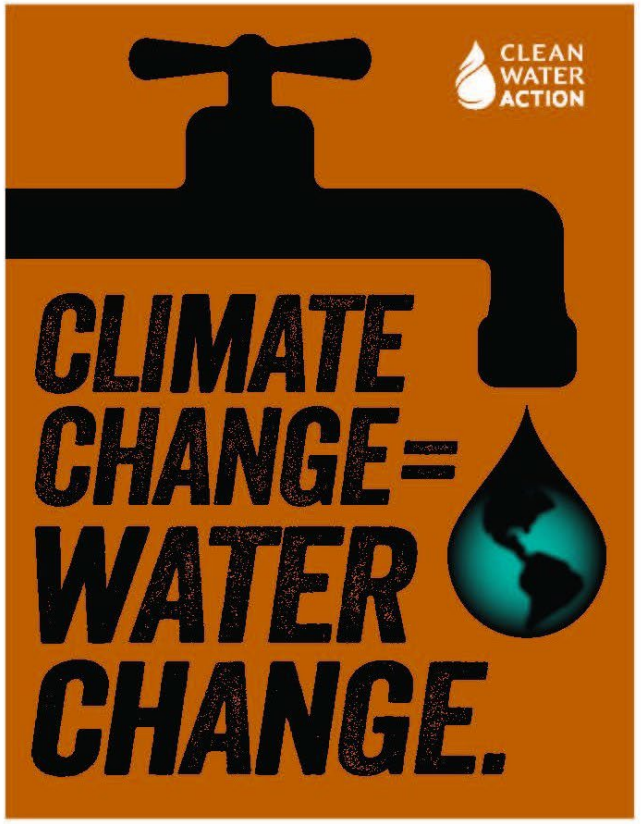
Source

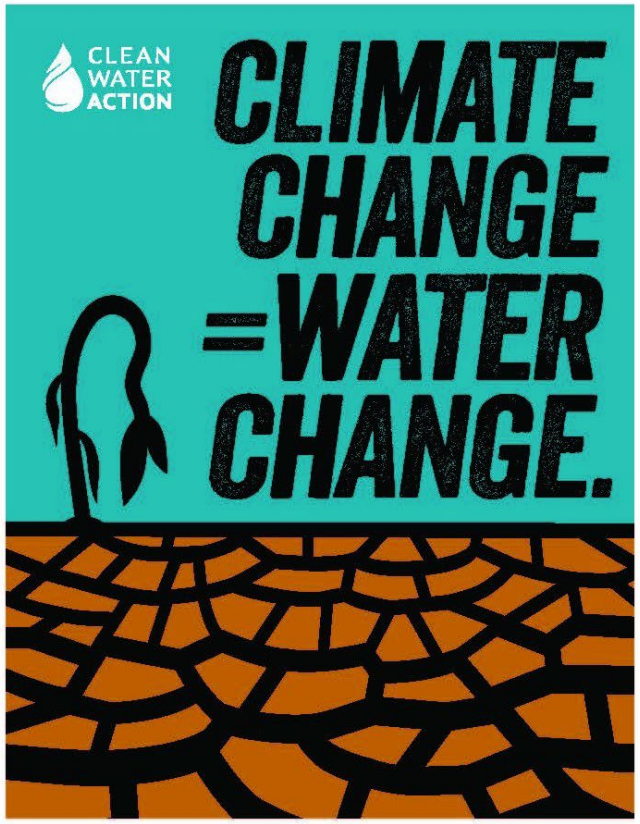
World Economic Forum Global Risks Perception Survey 2023-2024.


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS
Water is central to achieving all SDGs
Learn more about how water can help us do better at siwi.org

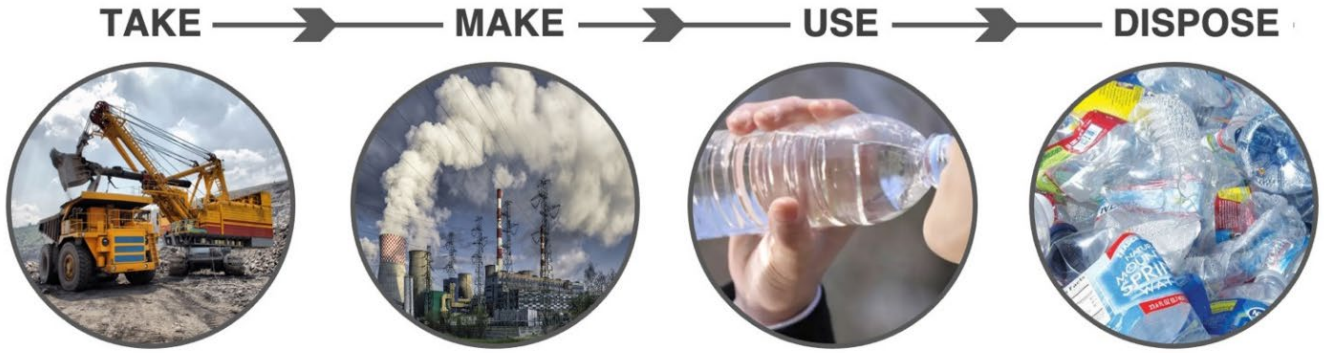
Concepts:

- **Water Security**
- **Service Level**
- **Resilience**
- **Adaptation**

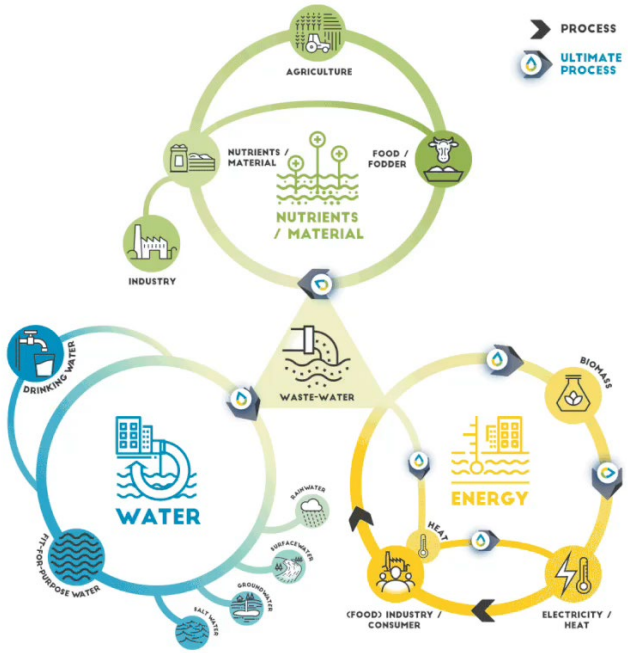




Linear



Circular Econo



Levels of governance and stakeholders:

- Government and Agencies: Public Policy
- Regulators
- Operators (Utilities)
- Users (comittes, population, industry, irrigation and other users)

key strategies for cross-departmental cooperation:

- Integrated Water Resources Management (IWRM)
- Data Sharing
- Collaborative Planning and Policy Development
- Conflict Resolution Mechanisms
- Policy Alignment and Collaborative Governance
- Innovation and Technology Sharing
- Capacity Building and Training
- Public-Private Partnerships (PPPs)
- Stakeholder Engagement and Public Awareness
- Joint Working Groups and Committees
- Transparent Communication Channels
- Regular Audits and Feedback Mechanisms

Areas of Cooperation: Users and Regulators

- Regulatory Compliance and Monitoring
- Tariff Setting and Financial Planning
- Performance Benchmarks and Accountability
- Infrastructure Investment and Approval Processes
- Crisis Management and Emergency Response
- Data Sharing and Transparency
- Customer Protection and Communication

Benefits of Cooperation

- Improved Service Delivery
- Improved Water Quality
- Increased Efficiency and Resource Optimization
- Enhanced Consumer Trust
- Risk Mitigation
- Resilience to Climate Change

Success factors for Positive Collaboration:

- Knowledge of the sector: risks and opportunities
- Planning in different scenarios
- Clear definition of roles and responsibilities
- Safe and proper environment for Cross-Sectoral Collaboration
- Mature and efficient regulatory environment
- Technology Integration
- Transparency in the relationship – accountability
- Communication among stakeholders: policy makers, regulators, utilities, users and communities

ABES PNQS
Prêmio Nacional da Qualidade em Saneamento

https://pnqs.com.br/presentation-in-english/

https://iwa-network.org/learn/wash_regulation/

SUMMARY PROGRESS 2024: SDG 6 INDICATORS

United Nations | UN WATER

6.1.1 DRINKING WATER

2.2 **billion people** (nearly 1 in 4 people around the world) lacked safely managed drinking water in 2022.

6.2.1a SANITATION

3.5 **billion people** lacked safely managed sanitation services, and **419 million people** practised open defecation, in 2022.

of the world's population.

6.2.1b HYGIENE

2 **billion people** lacked a basic handwashing facility with soap and water at home in 2022.

of the world's population.

6.3.1 WASTEWATER

Only **27%** **of industrial wastewater is safely treated** (based on limited data from 22 countries).

42% **of household wastewater is not safely treated.**

6.3.2 WATER QUALITY

56% of monitored water bodies in **120 countries** were classified as having **'good ambient water quality.'**

By 2030, **the health and livelihoods of 4.8 billion people could be at risk** if current water quality monitoring is not improved.

6.4.1 WATER-USE EFFICIENCY

From 2015 to 2021 **water-use efficiency has increased by 19.3%** globally.

Approximately **58%** **of the countries still exhibit low water-use efficiency,** with less than 20 USD added value for each m3 of water used from all economic activities over time.

6.4.2 WATER STRESS

Approximately **10%** **of the global population** lived in countries with high and **critical water stress levels** in 2021.

6.5.1 INTEGRATED WATER RESOURCES MANAGEMENT

The world will not achieve sustainable water management until 2049.

40% of countries are being left behind, having limited capacity to balance competing demands across sectors and cope with increasing pressures.

6.5.2 TRANSBOUNDARY COOPERATION

Only **43** **out of 153 UN Member States** sharing transboundary waters have **operational arrangements** covering **90% or more** of their shared rivers, lakes and aquifers.

At least 20 countries **lack any arrangements** for sharing transboundary waters.

6.6.1 ECOSYSTEMS

More than **90** **out of 185 countries** have one or more water-related ecosystem types in a state of degradation.

River flow has significantly decreased in **402** **river basins worldwide,** where approximately **107.5 million people** live

6.a.1 INTERNATIONAL COOPERATION

Aid disbursements to the water sector **decreased by 5%** between 2015 and 2022.

1/3 **of countries reported that donor funds are poorly aligned with national water sector plans,** overwhelmingly in low-income countries.

6.b.1 PARTICIPATION

Less than **1/3** **of 106 responding countries** indicated having high levels of participation by local communities in water and sanitation decision-making.

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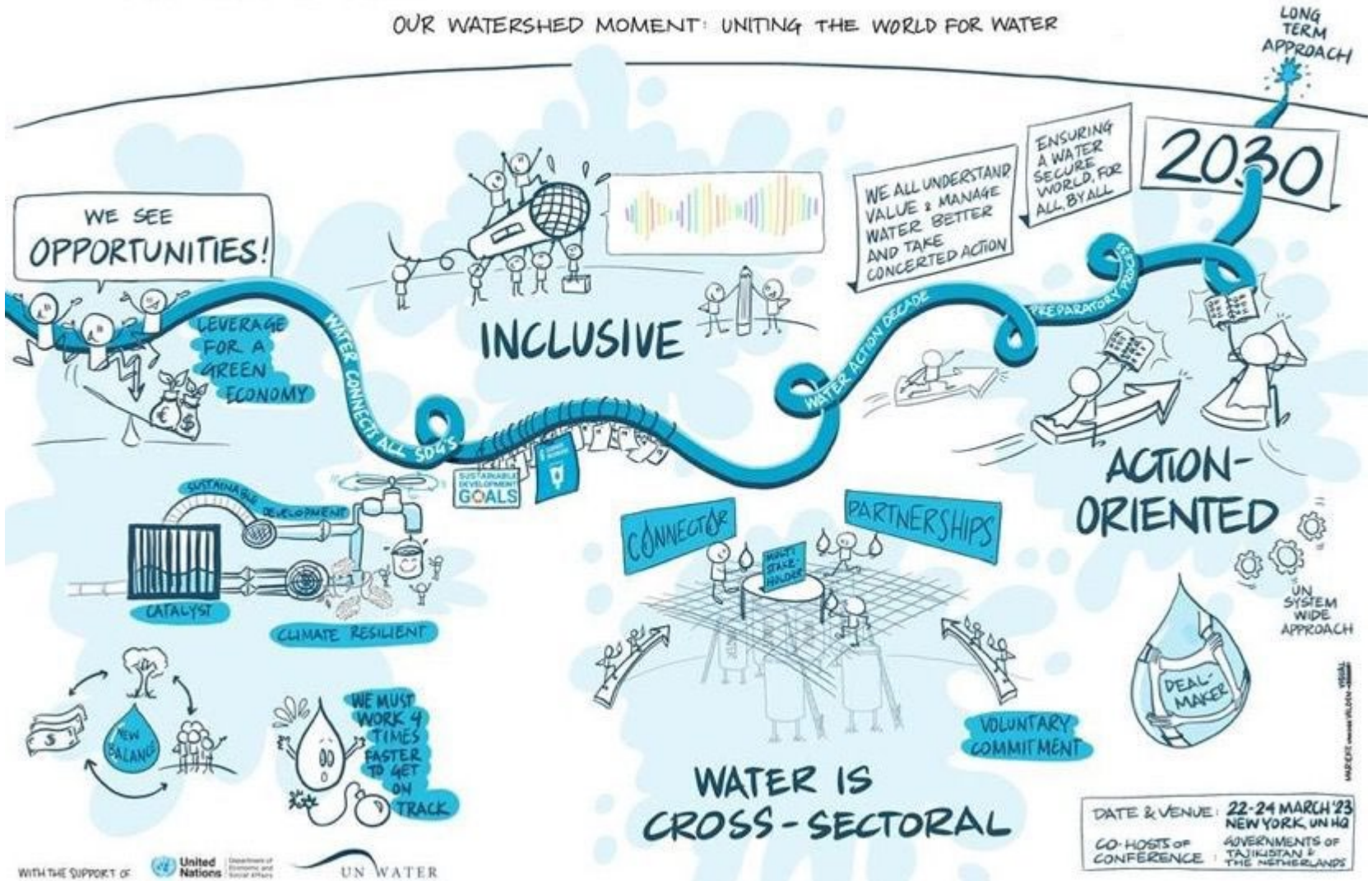
VISION STATEMENT UN 2023 WATER CONFERENCE

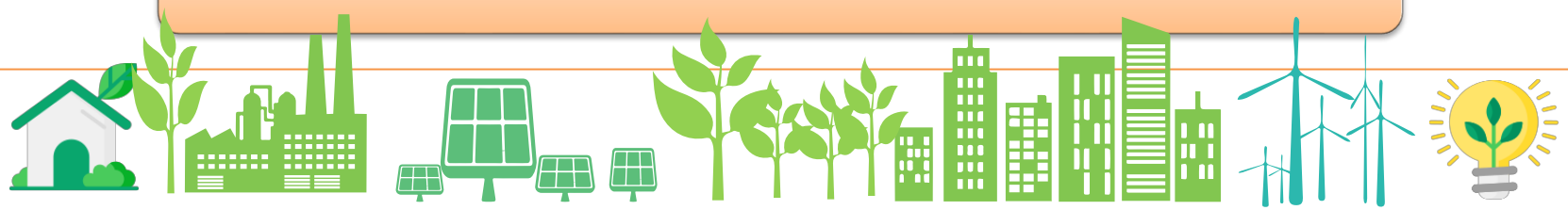


Patent Trend Research on Wastewater Treatment and Recycling Technology in Semiconductor Industry

Intellectual Property Office
Ministry of Economic Affairs, R. O. C.

Outline:

- Introduction
- Research Methodology
- Patent Analysis
- Selected Case Studies
- Conclusion



Environmental, Social, and Governance (ESG)

Environmental

- Energy management
- Waste management
- Wastewater treatment and reclamation
- Air pollution control
- Greenhouse gas emission

Social

- Labor rights and interests
- Privacy data protection
- Supplier management
- Occupational safety risk

Governance

- Shareholder rights
- Business ethics
- Supply chain management
- Transparency of business conduct

Research Methodology

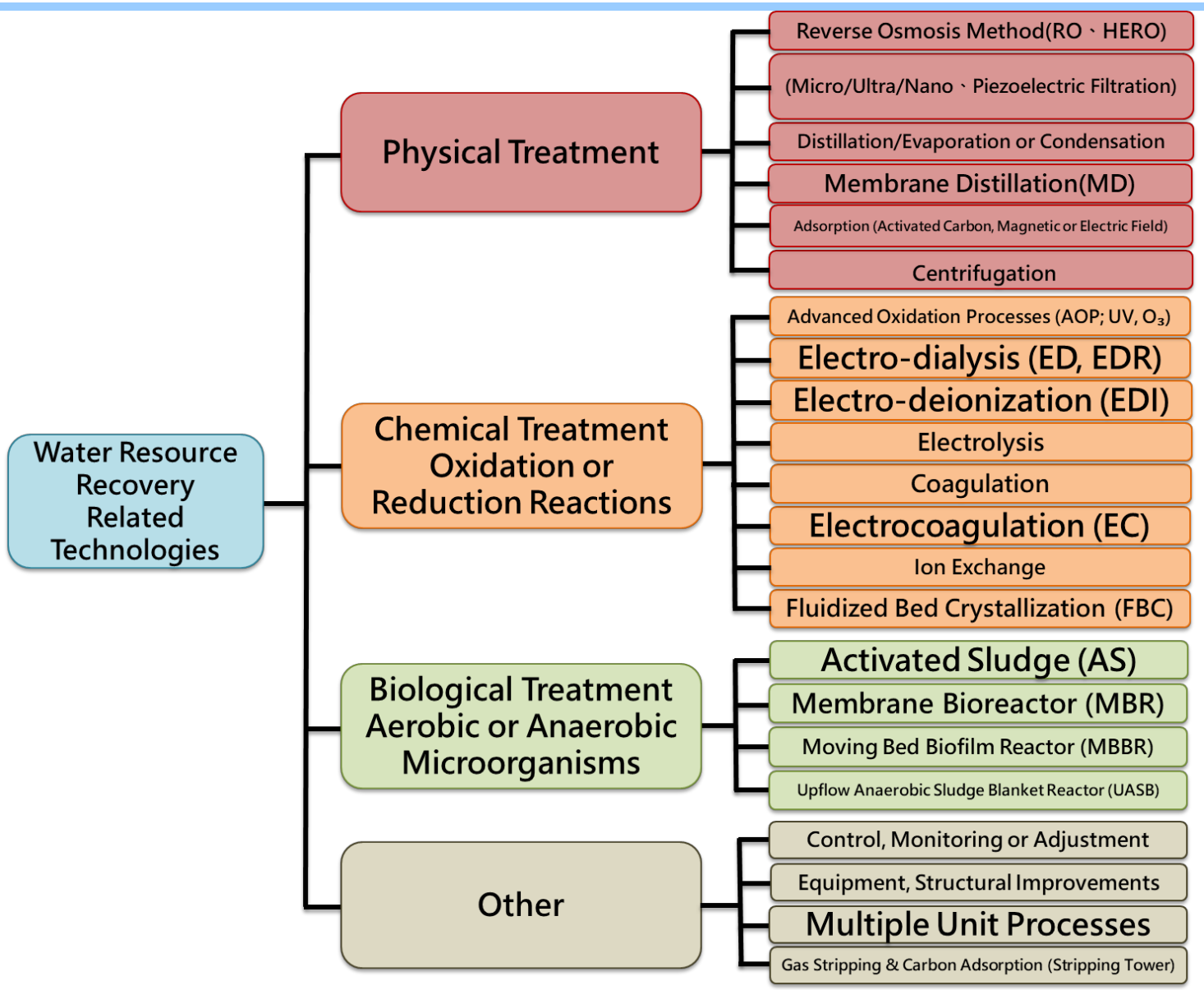
- **Databases:**
  - Global Patent Search System (GPSS), Derwent Innovation (DI) etc.
- **Research Topic:**
  - **Water resource recovery, recycling**
- **Search Interval**：Up to December 2023 (published/applications)
- **Search Strategy**：
  - Referencing WIPO Green Inventory
  - Japan Green Transformation Technology Inventory (GXTI)
  - **[IPC classification numbers] and/or[keywords]**

Research Methodology
-[IPC Classification Numbers]

- More comprehensive classification numbers (related to water resource recovery and regeneration)

IPC(3rd Order)	Screening	Statistics by GPSS	WIPO (IPC Green Inventory)	GXTI	ChatGPT	Derwent AI	Instructions
C02F	V	V	V	V	V	V	Treatment of water, waste water, sewage, or sludge
H01L	V	V			V		Semiconductor devices; electric solid-state devices not included in other categories
B01D	V	V			V	V	SEPARATION
G03F		V					PHOTOMECHANICAL PRODUCTION OF TEXTURED OR PATTERNED SURFACES, e.g. FOR PRINTING, FOR PROCESSING OF SEMICONDUCTOR DEVICES; MATERIALS THEREFOR; ORIGINALS THEREFOR; APPARATUS SPECIALLY ADAPTED THEREFOR
B01J	V	V			V		CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS OR COLLOID CHEMISTRY; THEIR RELEVANT APPARATUS
B08B	V	V			V	V	CHEMICAL OR PHYSICAL PROCESSES, e.g. CATALYSIS OR COLLOID CHEMISTRY; THEIR RELEVANT APPARATUS
B24B	V	V					MACHINES, DEVICES, OR PROCESSES FOR GRINDING OR POLISHING; DRESSING OR CONDITIONING OF ABRADING SURFACES; FEEDING OF GRINDING, POLISHING, OR LAPPING AGENTS
C01B		V					NON-METALLIC ELEMENTS; COMPOUNDS THEREOF
B05C		V					APPARATUS FOR APPLYING FLUENT MATERIALS TO SURFACES, IN GENERAL
B04B	V						CENTRIFUGES
C25D	V	V					PROCESSES FOR THE ELECTROLYTIC OR ELECTROPHORETIC PRODUCTION OF COATINGS; ELECTROFORMING; JOINING WORKPIECES BY ELECTROLYSIS; APPARATUS THEREFOR
B63J	V		V				AUXILIARIES ON VESSELS
C25B	V				V		ELECTROLYTIC OR ELECTROPHORETIC PROCESSES FOR THE PRODUCTION OF COMPOUNDS OR NONMETALS; APPARATUS THEREFOR
E03B						V	INSTALLATIONS OR METHODS FOR OBTAINING, COLLECTING, OR DISTRIBUTING WATER
E03C	V		V			V	DOMESTIC PLUMBING INSTALLATIONS FOR FRESH WATER OR WASTE WATER; SINKS
E03F	V		V			V	SEWERS; CESSPOOLS
G01N					V		INVESTIGATING OR ANALYSING MATERIALS BY DETERMINING THEIR CHEMICAL OR PHYSICAL PROPERTIES

Research Methodology
-[Keywords (Technologies)]



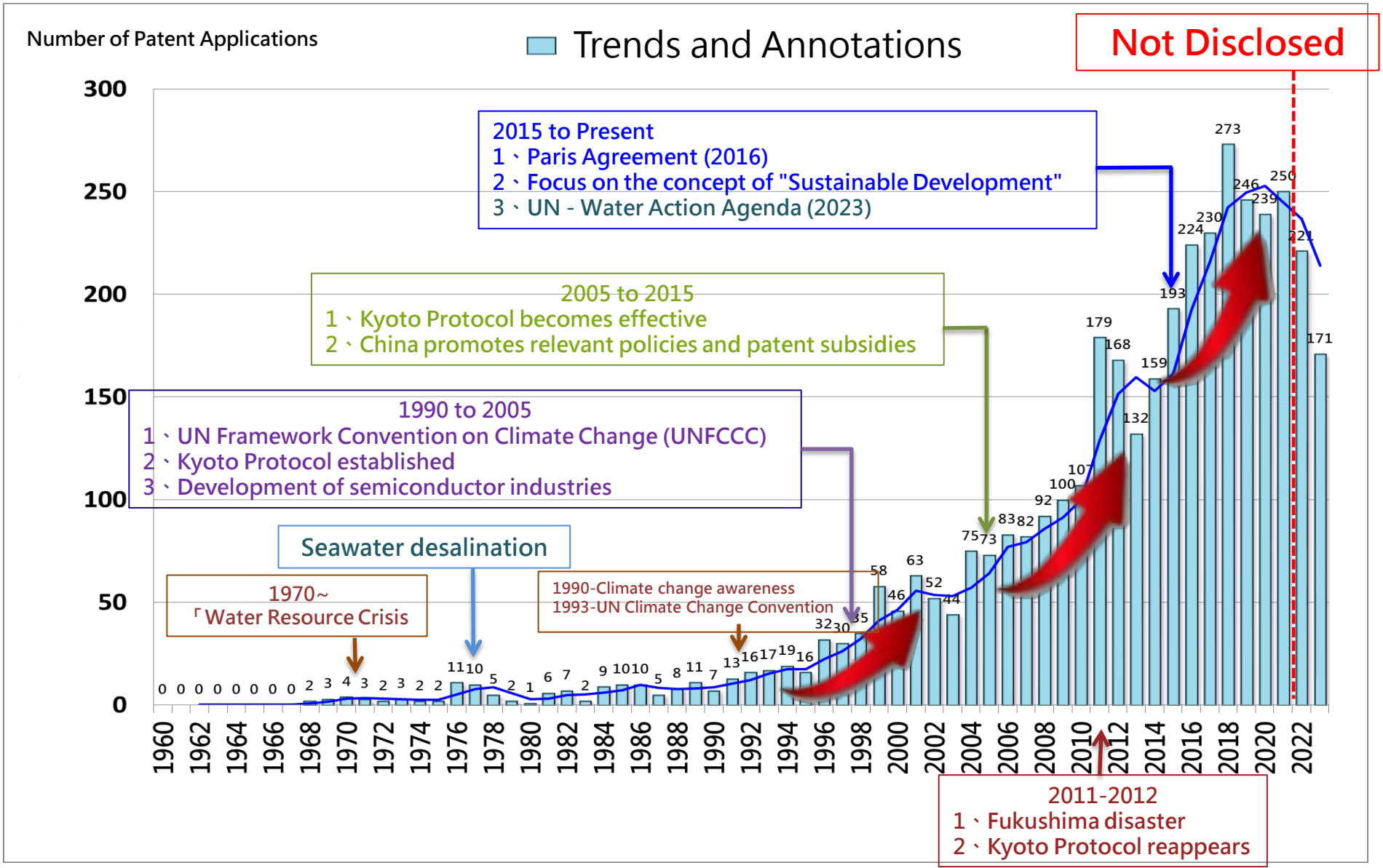
Research Methodology
-[Search Results]

Topic: Water Recycling Technology in the Semiconductor Industry	
Database	Derwent Innovation(DI)、GPSS
Search Area	GPSS
Search Period	1900~2023/12 published/applications
Search Results	17,592
Screening	17,592 →3,860
Note: 1 Case belonging to the same patent family are counted	

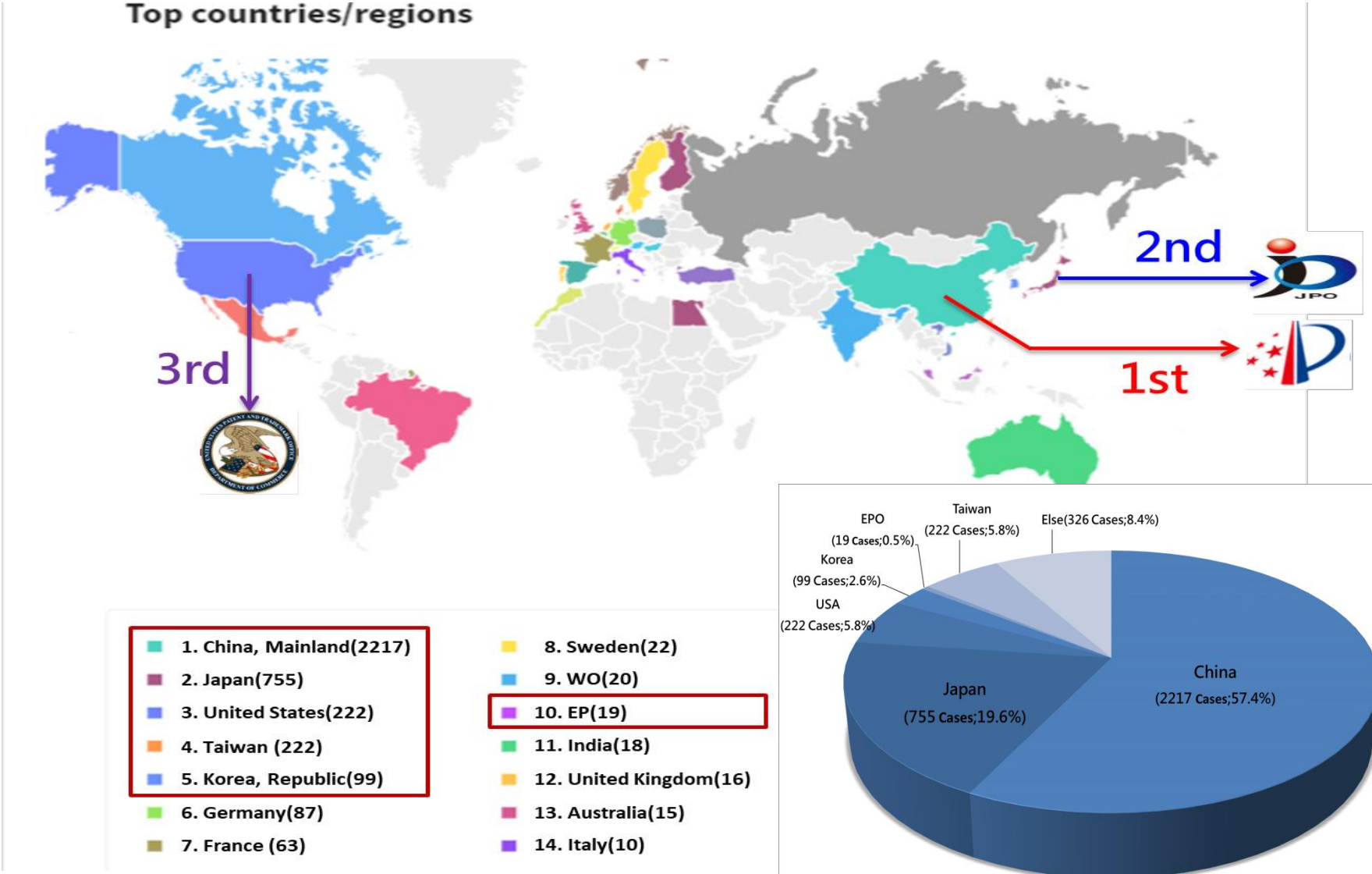
Patent Analysis

- Global Patent Application Trends
- Proportion of Applications by Major Countries Globally
- Application Trends of the Top 10 Countries Globally
- Patent Map (3,860 cases; By Technical Perspective)
- Top 20 Applicants
- Application Trends of the Top 20 Applicants
- Technical Classification of Applications by the Top 20 Applicants
- Modes of Patent Applications by Top 20 Applicants
- Overview of Applications by Applicants in Taiwan

Patent Analysis
-Global Patent Application Trends

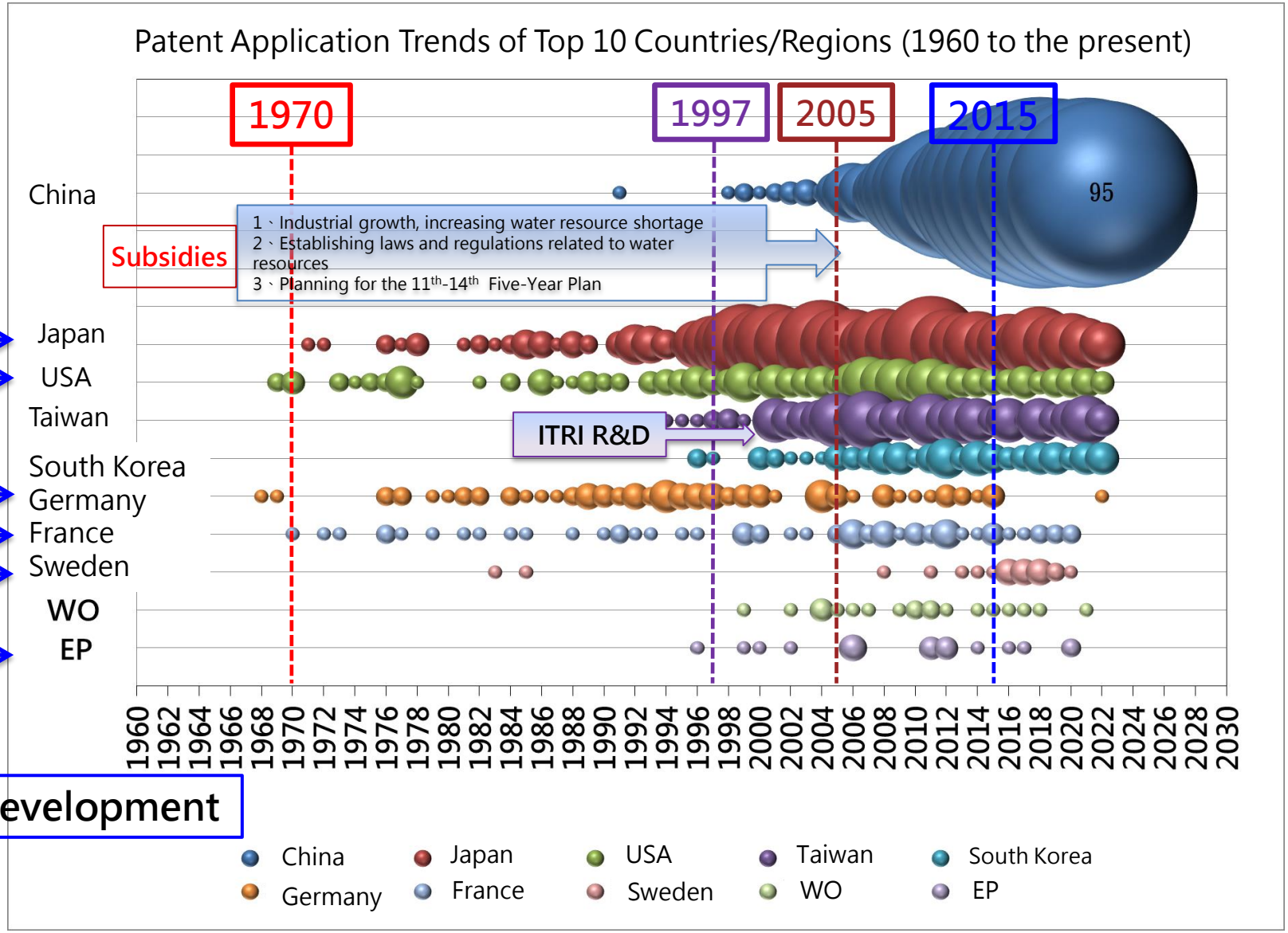


Patent Analysis
-Major Application Countries/Regions



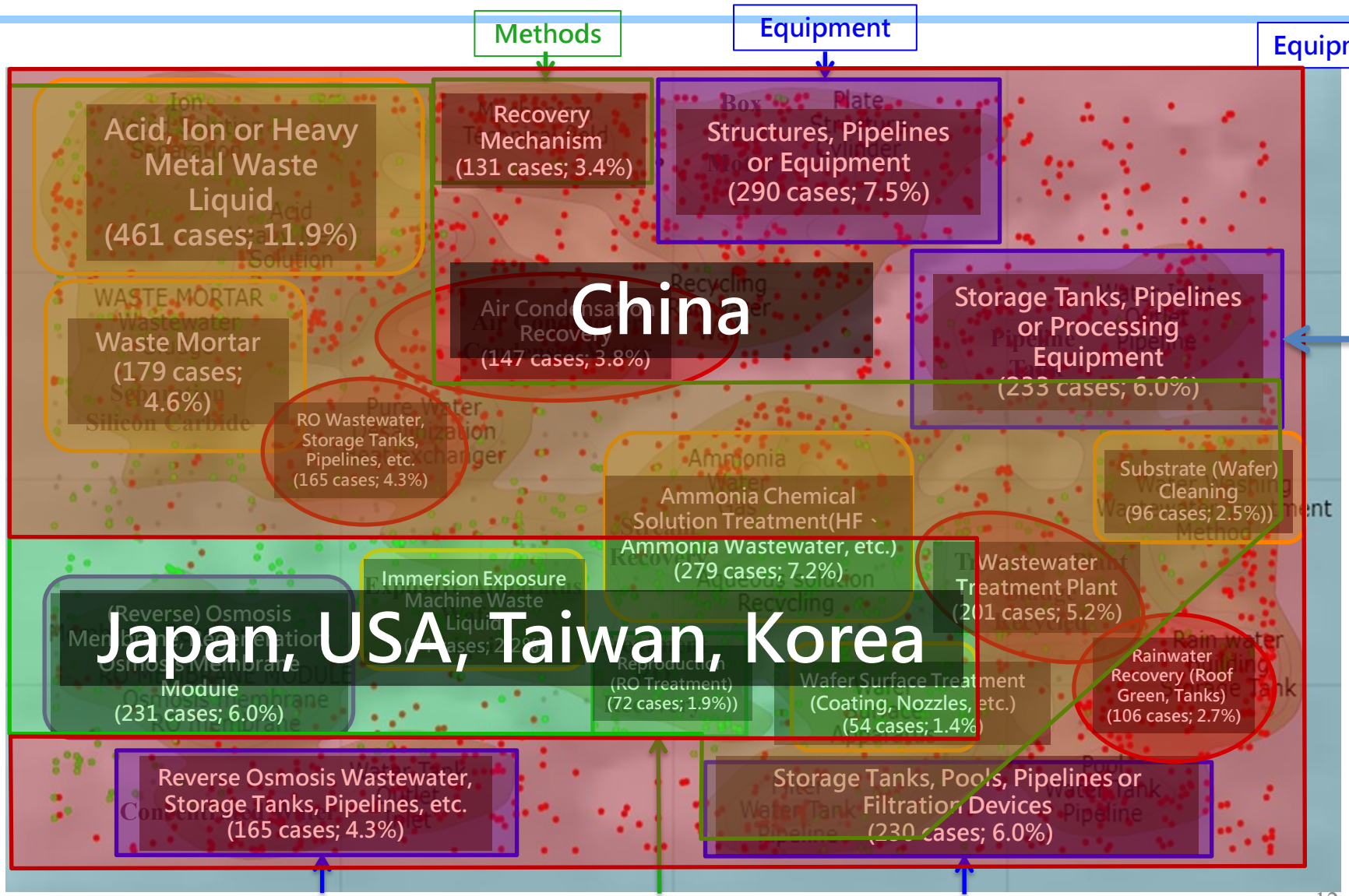
Patent Analysis

-Patent Application Trends of Top 10 Countries/Regions

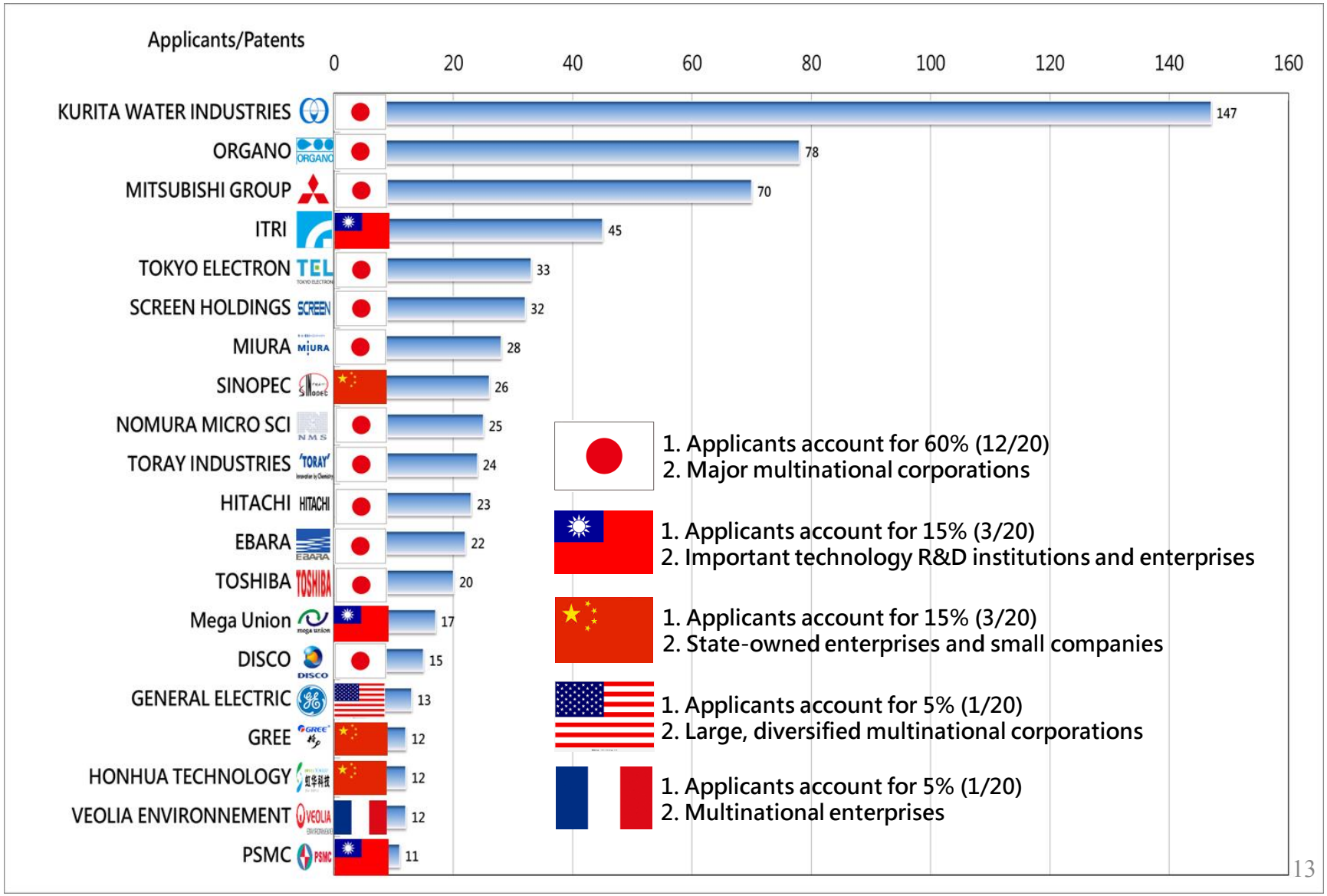


Patent Analysis

-Patent Map (3860 Cases; Technical Perspectives)

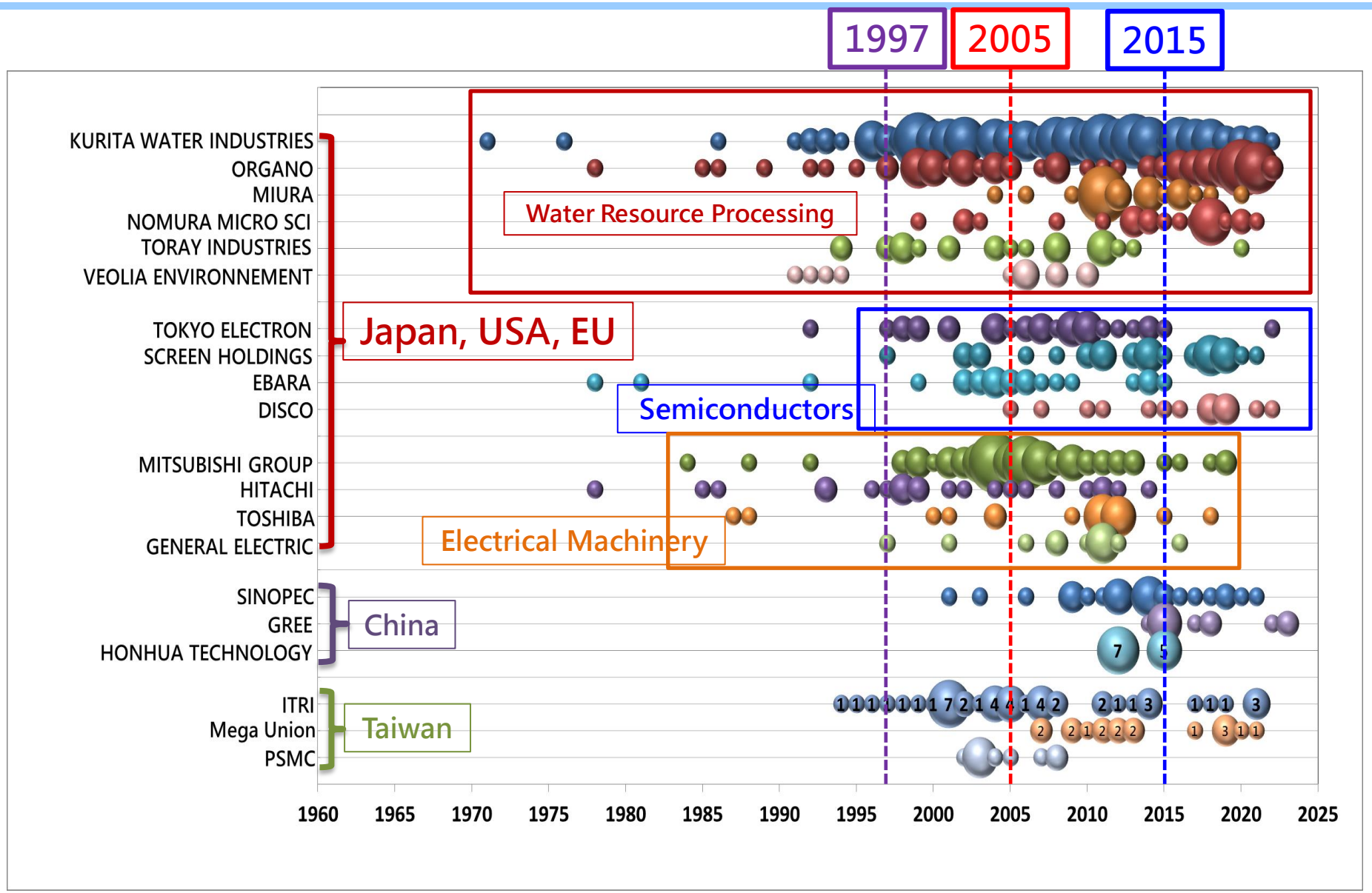


Patent Analysis
-Top 20 Global Applicants



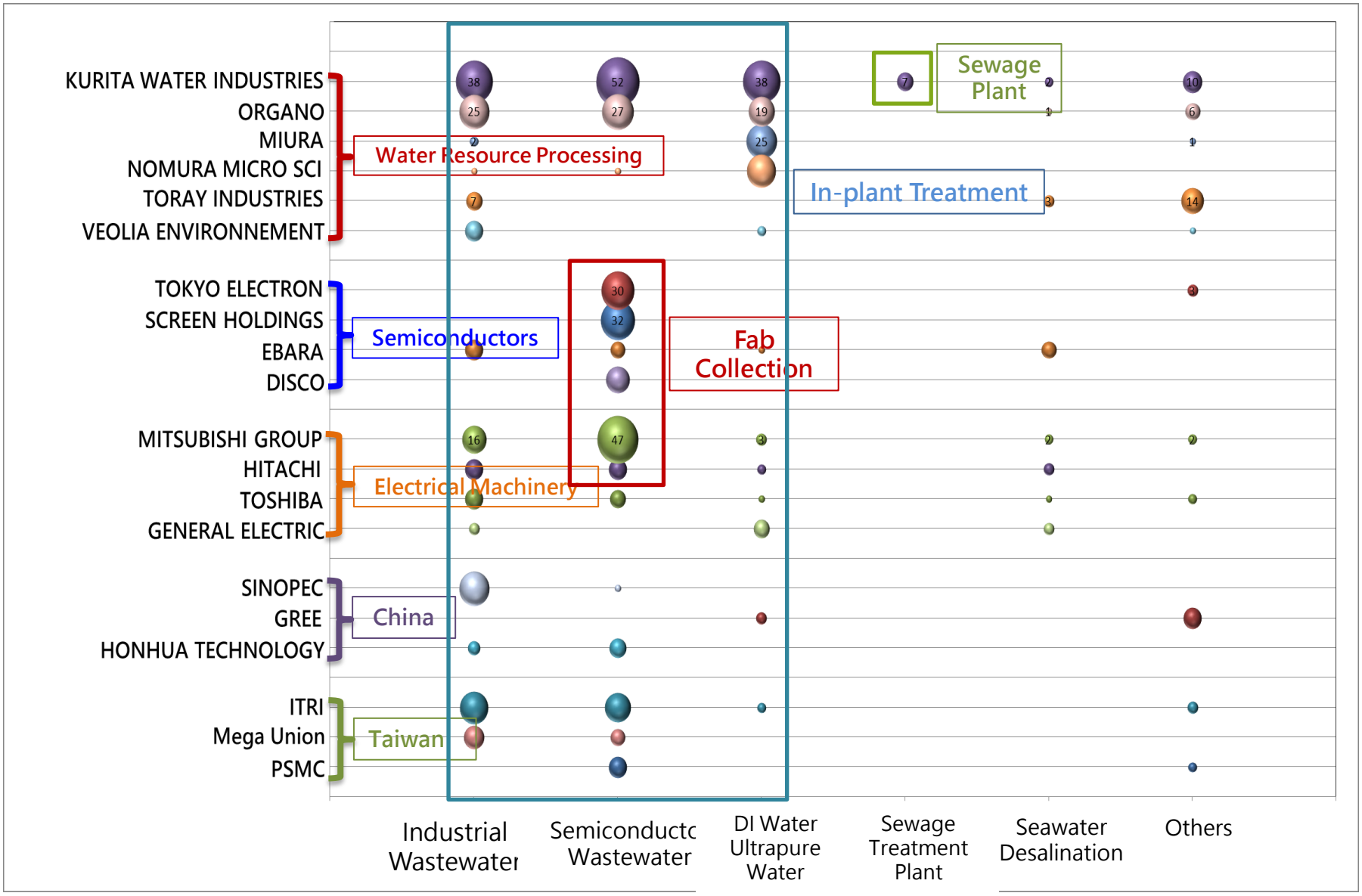
Patent Analysis

-Patent Application Trends of Top 20 Global Applicants



Patent Analysis

Modes of Patent Applications by Top 20 Global Applicants



Patent Analysis

-Overview of Patent in Taiwan’s Applicants

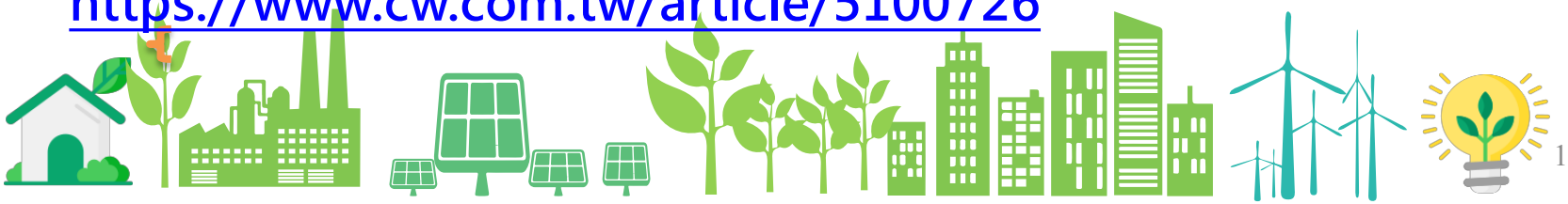
Name	Company/Institute	Patents	About
Industrial Technology Research Institute	ITRI	45	ITRI is a world-leading applied technology research institute with more than 6,000 outstanding employees. Its mission is to drive industrial development, create economic value, and enhance social well-being through technology R&D. Founded in 1973, it pioneered in IC development and started to nurture new tech ventures and deliver its R&D results to industries. ITRI has set up and incubated companies such as TSMC, UMC, Taiwan Mask Corp., Epistar Corp., Mirle Automation Corp., and Taiwan Biomaterial Co.
Mega Union Technology Inc.	Mega Union	17	Mega Union was founded in 2004. It is a high-tech factory water system engineering service provider as well as an engineering firm that plans and designs pure water and wastewater recycling systems.
Powerchip Semiconductor Manufacturing Co.	PSMC	11	PSMC provides foundry services in advanced memories, customized logic integrated circuits and discrete components with the Open Foundry operation model. From chip design and manufacturing service to equipment and production capacity sharing, PSMC establishes a close and flexible cooperation with customers according to their attributes and demands.
Taiwan Semiconductor Manufacturing Co.	TSMC	7	TSMC created the semiconductor Dedicated IC Foundry business model when it was founded in 1987. In 2023, TSMC served 528 customers and manufactured 11,895 products for various applications covering a variety of end markets including high performance computing, smartphones, the Internet of Things (IoT), automotive, and digital consumer electronics. Annual capacity of the manufacturing facilities managed by TSMC and its subsidiaries exceeded 16 million 12-inch equivalent wafers in 2023.
China Steel Corp.	CSC	4	CSC is the largest steel company in Taiwan with market share of more than 50% and export products mainly to Southeast Asia, Europe and Japan.
Changhua Water Refiner Co.	CHW	3	CHW has specialized in pure water, ultra-pure water, The design, production, construction, and maintenance of waste water and waste water recovery systems provide the best services for the public and industry with one-stop technology.
CHYI DING TECHNOLOGIES Co.	CHD TECH	3	CHD TECH excels in mini-environment control: detection, removing airborne molecular contamination (AMC) and accurate control of temperature and humidity.
Grand Process Technology Co.	GPTC	3	Grand Process Technology is the nation's leading brand in the semiconductor wet processing equipment industry, founded in 1993.
TOPCO SCIENTIFIC Co.	TSC	2	Topco built a complete supply chain and service network by providing integrated services from design, construction, operation, and maintenance.
United Microelectronics Co.	UMC	2	UMC is a leading global semiconductor foundry company. The company provides high quality IC fabrication services, focusing on logic and various specialty technologies to serve all major sectors of the electronics industry.

Selected Case Studies
-Industry-Related Practical Achievements

- Fluidized Bed Crystallization Technology
  (TW 310313；Patent and Technology Transfer)
  https://www.itriwater.org.tw/technology/More?id=59

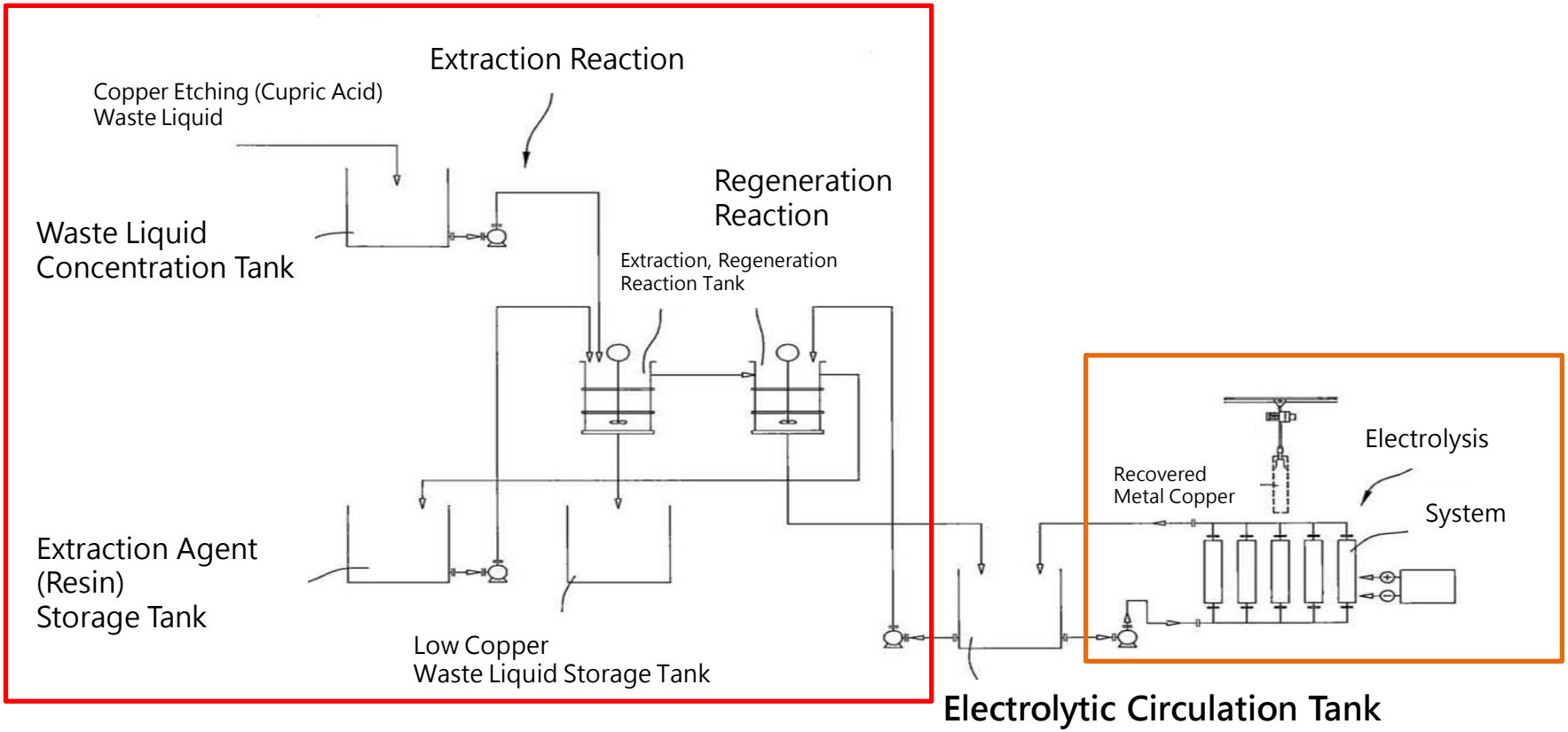
- Porous Biological Carrier and Anaerobic Biological Fluidized Bed
  (TW I261575、TW 363945 ；Related cases of ITRI and TSMC)
  https://www.cw.com.tw/article/5123167?template=transformers

- Extraction, Regeneration, and Electrolytic Technology
  (TW I658994；Industry collaboration)
  https://www.cw.com.tw/article/5100726



Selected Case Studies
-TW I658994；Waste Recovery Technology

Extraction, Regeneration, and Electrolytic Technology

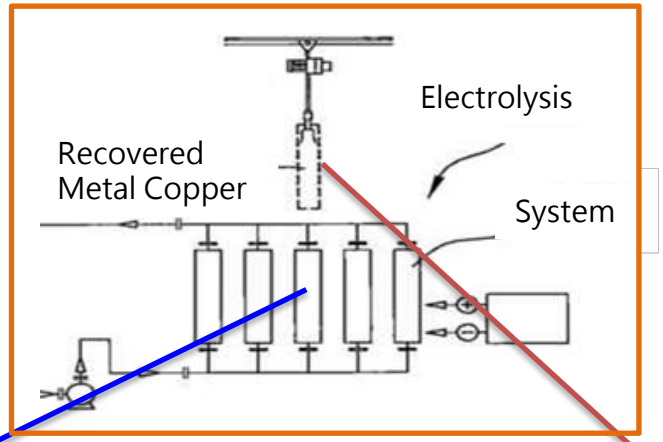


- Technology: Extraction, regeneration, and closed-loop electrolytic reduction
- Efficacy: High current density, reduction of electrode area, and improvement of electrolytic efficiency

https://www.cw.com.tw/article/5100726

Selected Case Studies
-TW I658994；Waste Recovery Technology

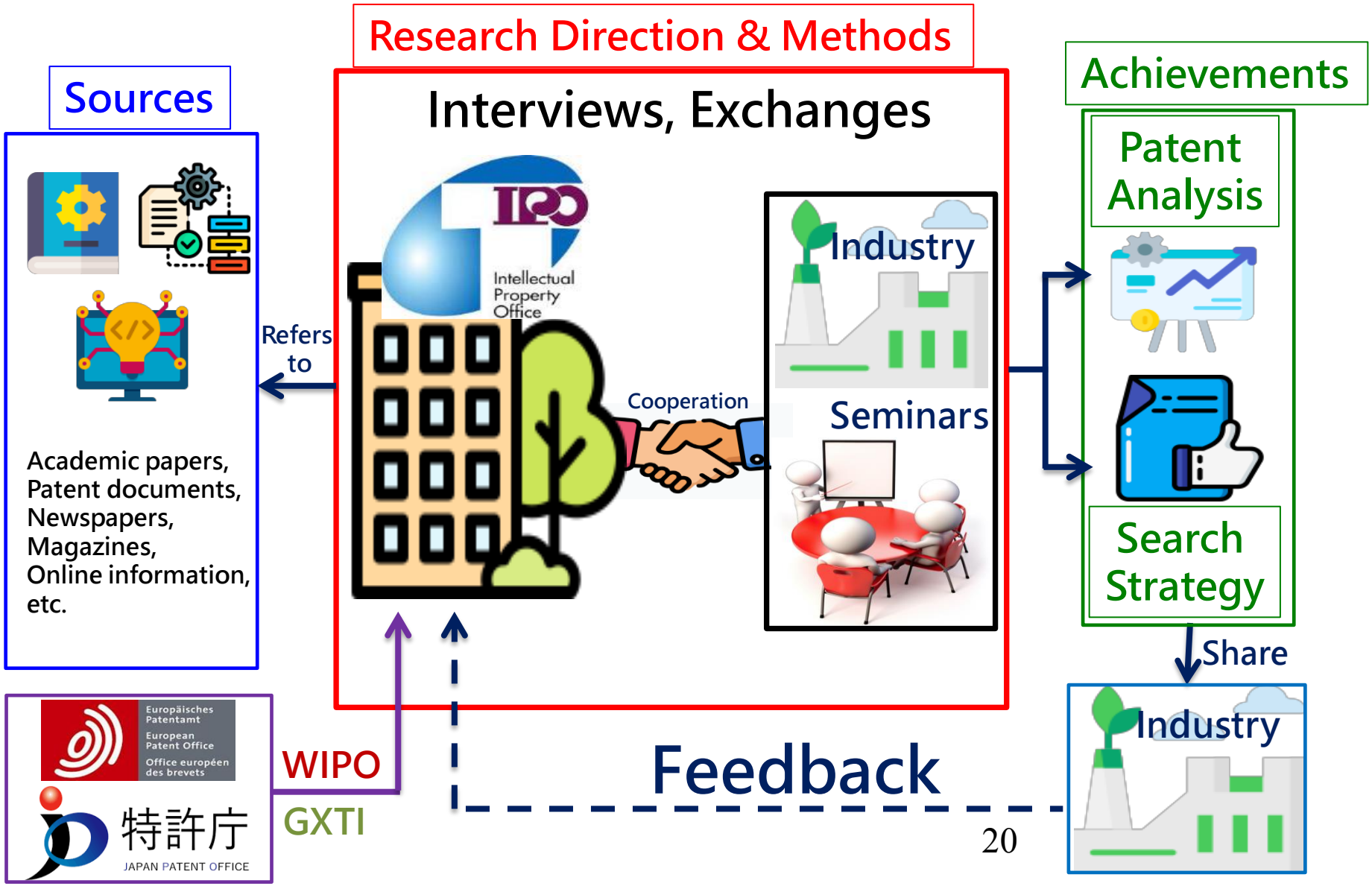
Closed-Loop Electrolytic Reduction



- TSMC CASE STUDY:

Photos from：**TSMC Leads the Industry in Recycling Electronic-Grade Copper Materials**
https://esg.tsmc.com/ch/update/greenManufacturing/caseStudy/13/index.html

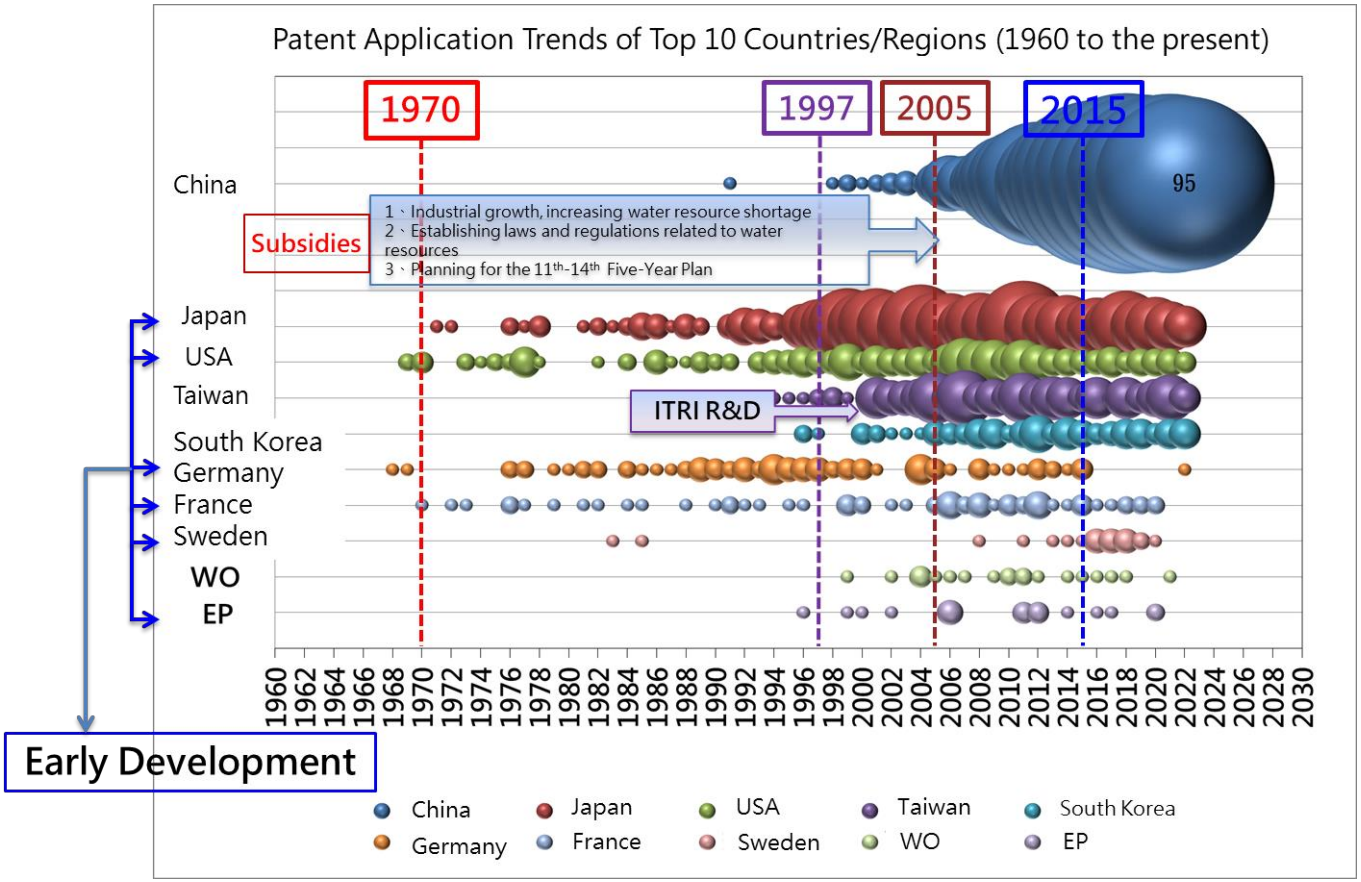
Conclusions



Conclusions

Policy Aspect:

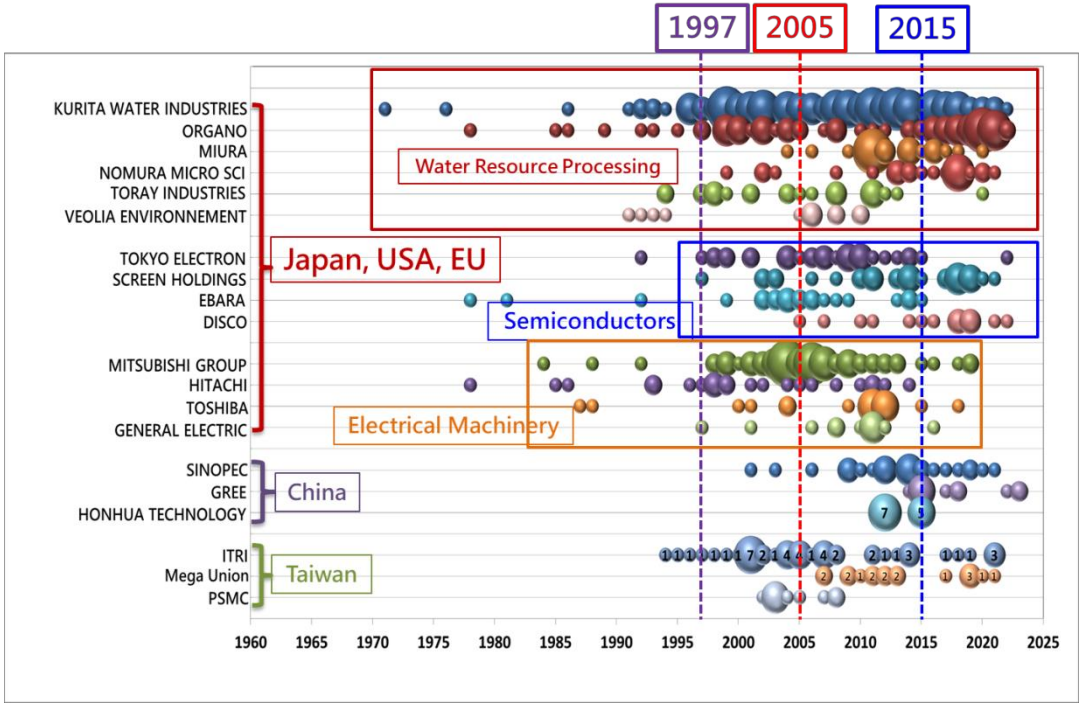
- Kyoto Protocol (1997), Paris Agreement (2015), periodic UN conferences
- China invested in the development of related technologies by its policies.



Conclusions

Industry Aspect:

- Europe, USA, and Japan: Multinational companies in electrical appliances and reclaimed water equipment, with early investments in research and development capacity. (around the 1970s)
- China: There are many small-scale environmental engineering companies and new startups, but their development are relatively slow.
- Taiwan: Emphasize "corporate mutual cooperation" or "academic institutions and enterprise mutual cooperation" to develop related technologies.



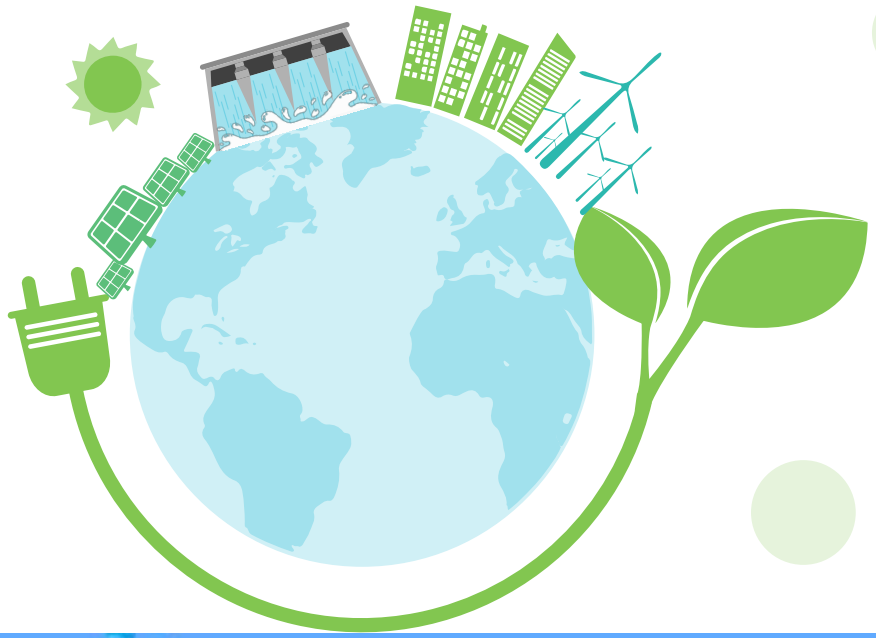
Conclusions

Technical Aspect:

- Membrane Filtration and Related Pretreatments: UF, NF, RO, Advanced Oxidation Processes, Mixed Coagulation and Sedimentation Processes or Ion Exchange Processes, etc. are common technologies.
- Activated Sludge Process or Membrane Bioreactor, etc., which have the characteristics of large scale and low cost in wastewater treatment, should have promising future development.

Photo: https://www.cw.com.tw/article/5123167?template=transformers

Thank you for your attention!



Some of the Image Sources for This Presentation :
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Revolutionizing Water Management in Semiconductors with AI

Sep 10, 2024

Lian Bin Zhong
VP, Taiwan Frontend MFG Operations


Transforming how the world uses information to enrich life for all

Founded nearly 46 years ago on October 5, 1978

Headquartered in **Boise, Idaho, USA**

264
on the 2024 Fortune 500

56,000+
patents granted and growing

17
countries

11
manufacturing sites and
12 customer labs

~45,000
team members

30 Years of Micron in Taiwan

Micron in Taiwan

TAIPEI, office

TAOYUAN, FE Fabs

TAICHUNG, FE Fabs, BE A/T, HBM

HSINCHU, office

10,500+
Team members (33%+ female; 95%+ volunteered in 2023)

60%+
Micron's total DRAM output from TW Fabs – Largest Micron site

EUV
In Taichung fab

HBM
Advanced Packaging R&D and HVM

Largest foreign investor in Taiwan

DRAM Center of Excellence

DRAM Mega Fabs

1γ Advanced Pilot Line Corridor

Product Engineering

Advanced Packaging / High Bandwidth Memory

Assembly & Test Factory

Customer Labs

Leading node deployment

1α	Taiwan
1β	Taiwan & Japan
1γ	2025 with EUV Taiwan, Japan, US

Micron's largest cleaning room cluster

*EUV: Extreme Ultraviolet Lithography, HBM: High Bandwidth Memory

Industry growth engine: AI


Micron

When we talk about AI

AI is everywhere

Autonomous vehicles

Healthcare

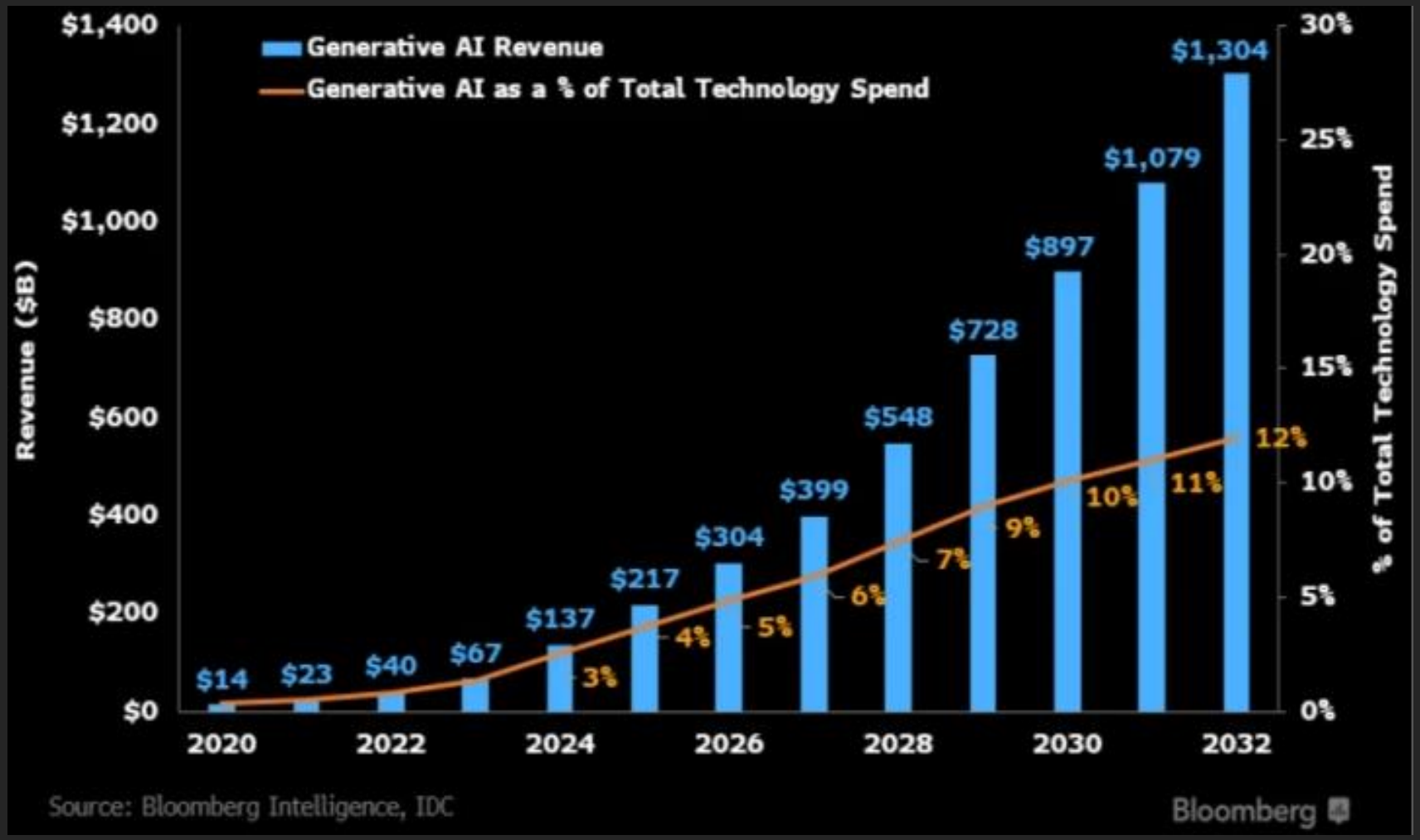
Climate and natural disaster prediction

Personal and workplace productivity

Learning

Smart manufacturing

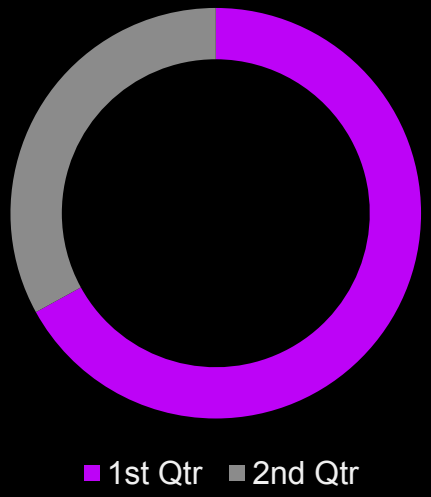
AI: New Engine of Semi Industry Growth



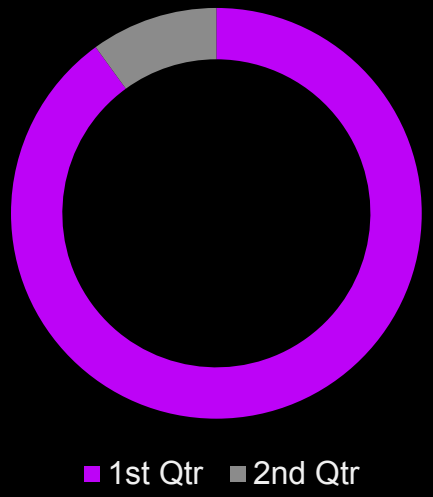
Generative AI market: $1.3T by 2032 with 42% CAGR

tAIwan - Critical Enabler of AI Revolution

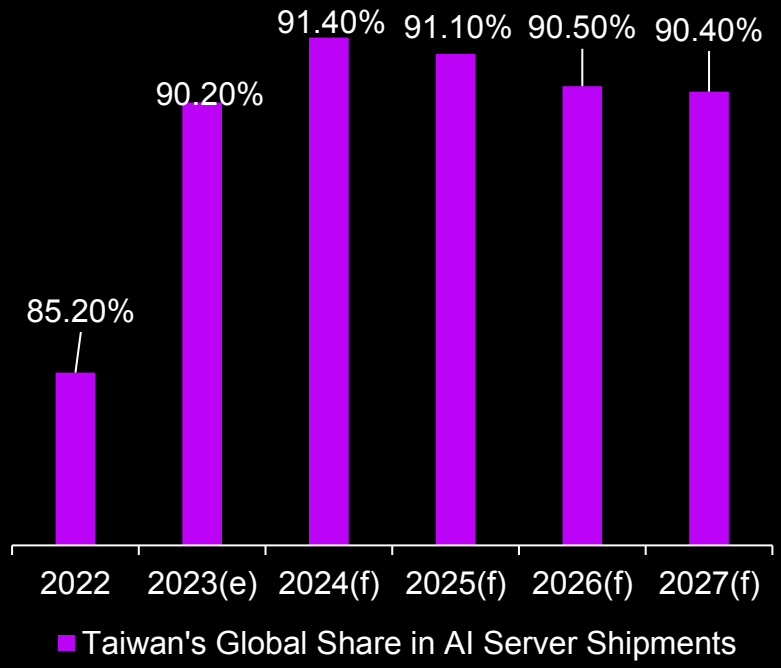
two-thirds of AI server production worldwide



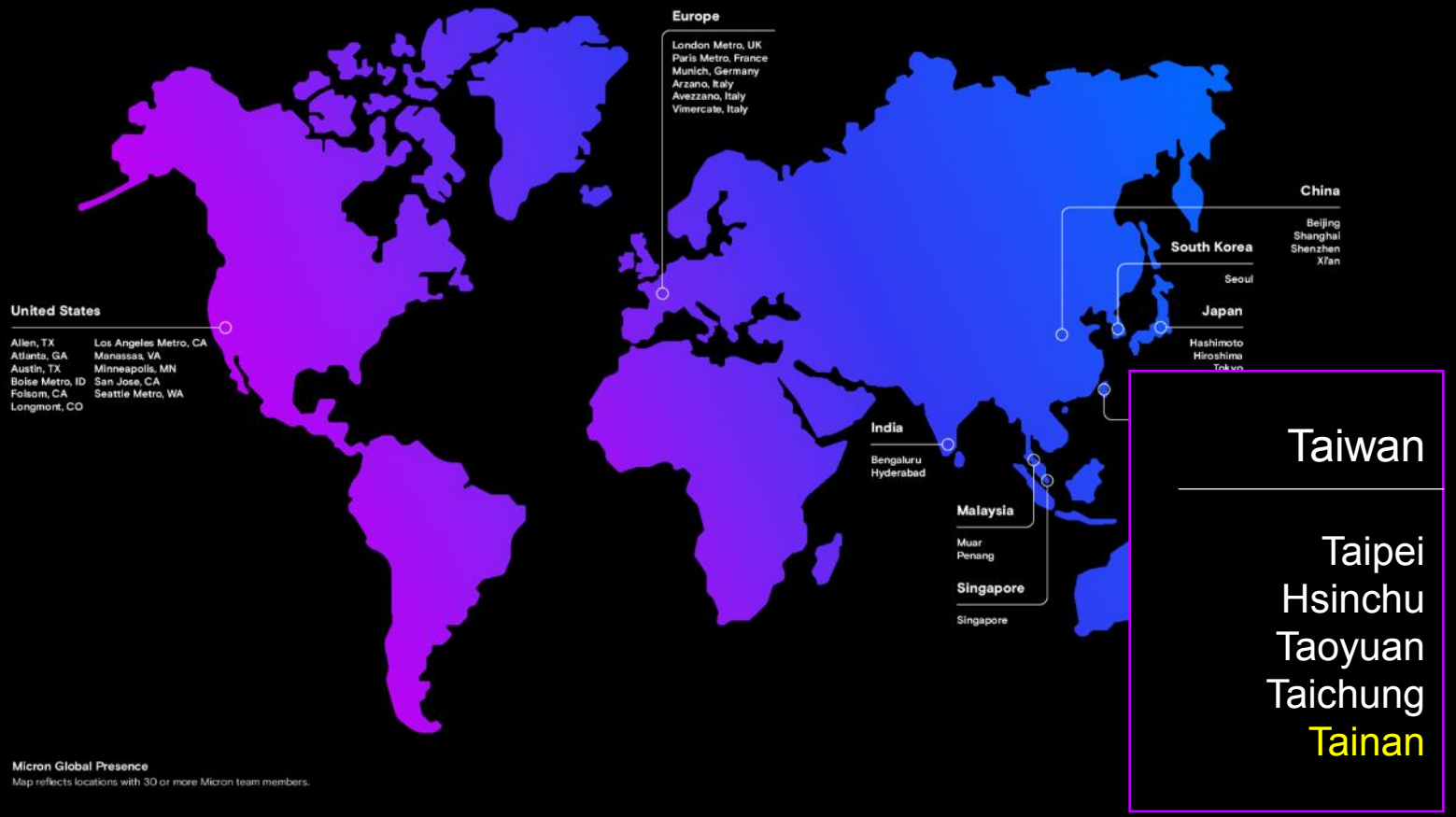
Producing 90%+ of the most advanced chips



90%+ of Global AI Server Shipments



Micron’s ongoing investment in Taiwan to fuel AI

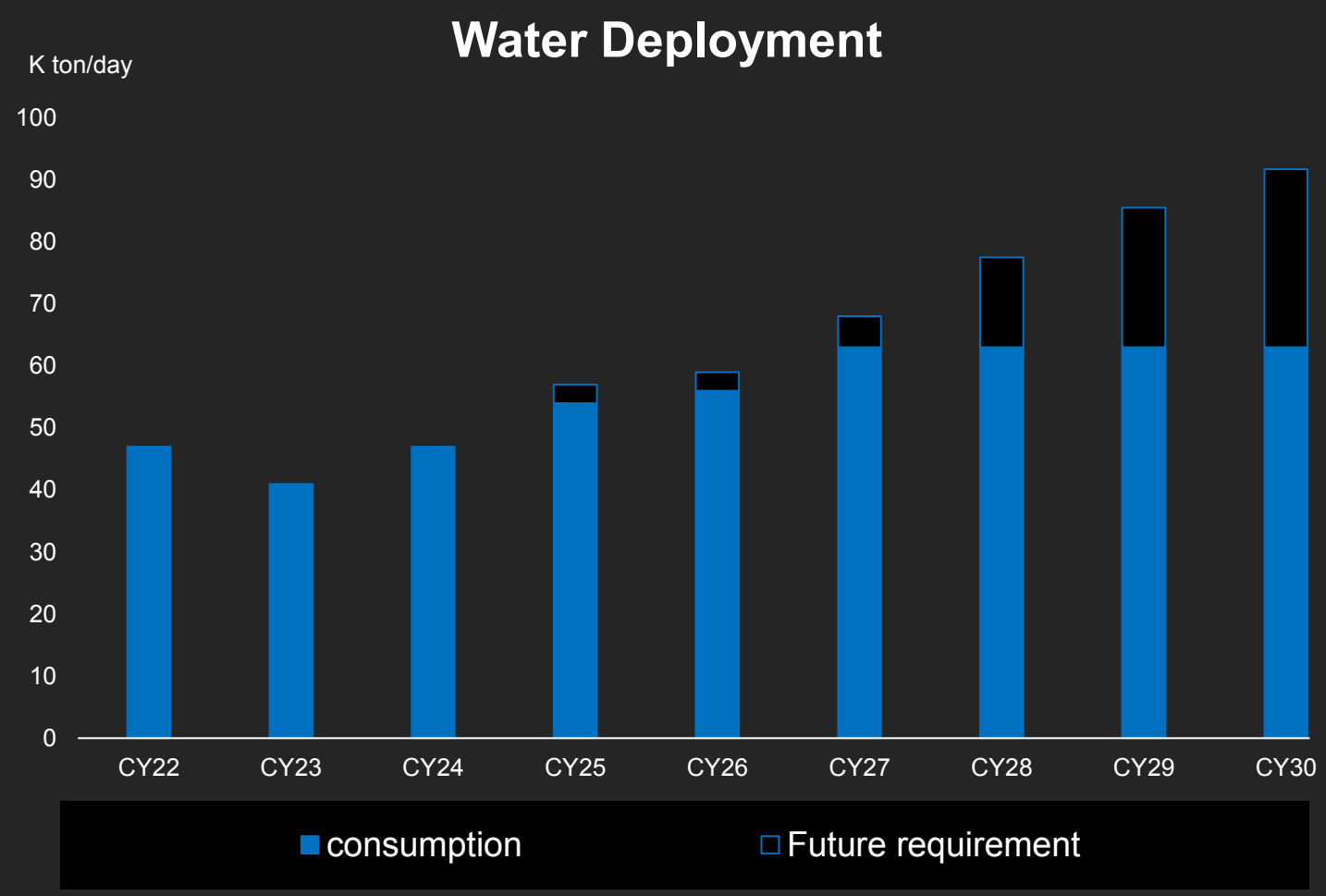


Leading investment location as DRAM Center of Excellence

Deploying leading edge technologies to fuel AI revolution

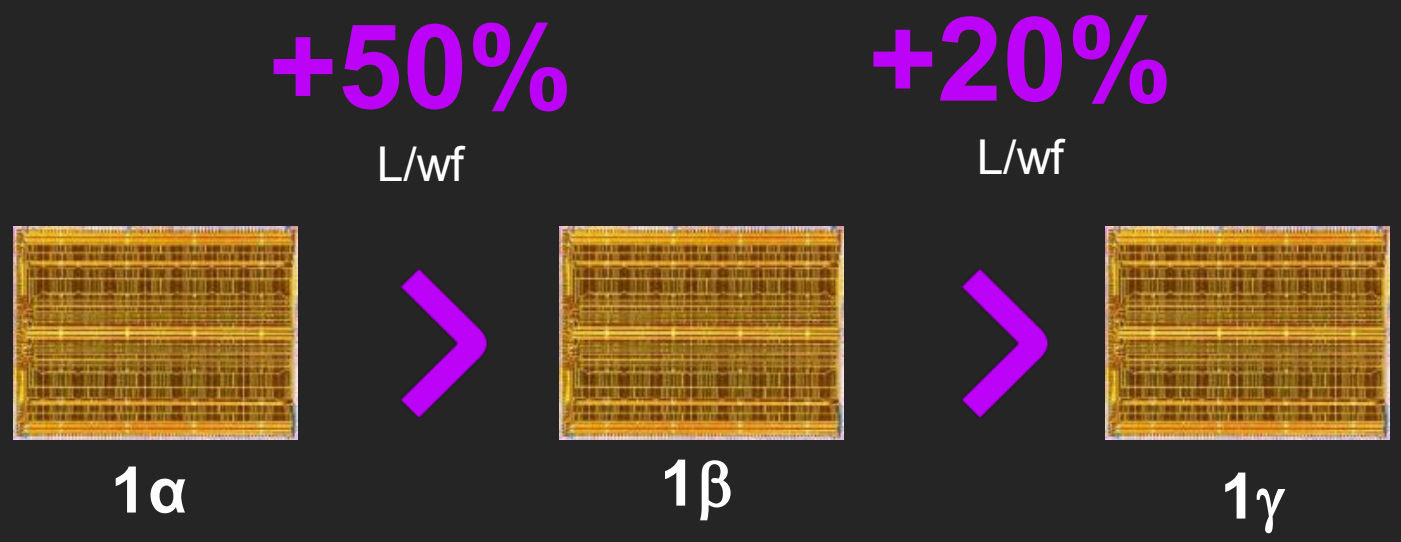
Rising AI Demand Drives Rapid Increase in Water Usage

In Micron Taiwan, water demand is estimated to grow by more than 200% by 2030 as capacity rises and with potential customer demand.



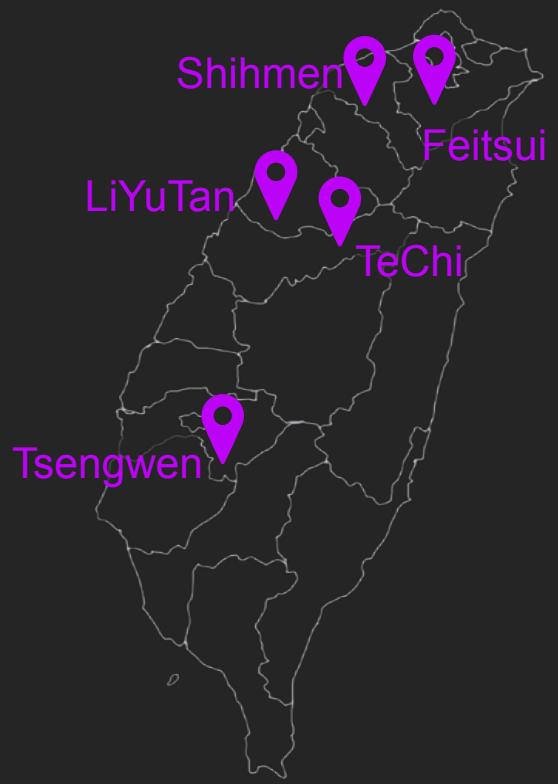
Water is more and more essential for semiconductor industry

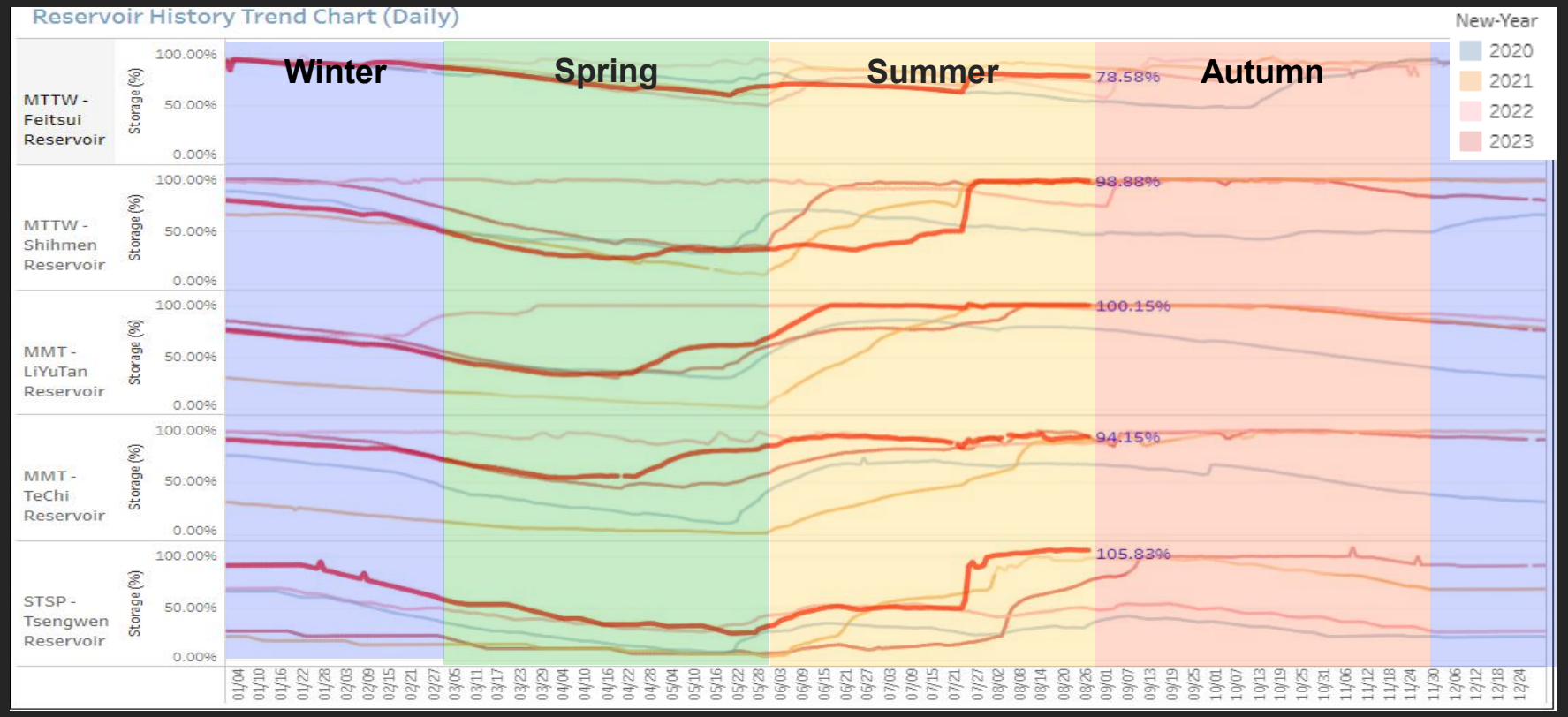
As the manufacturing technology has become more complex, the demand for water has grown significantly.



Water management challenge in Taiwan

- **Climate Change**
  - Short precipitation duration with high intensity in limited region
- **Coexisting with Agriculture**
  - Rapidly declining reservoir levels during agricultural irrigation
  - Preventive Water Adjustment





Unique and complex water requirements: massive usage and multi-step purification

- Up to **60%** of the steps require the use of ultrapure water
- The ultrapure water is **1000** times cleaner than tap water

RAW Water → **22** Steps → Ultrapure Water

~1600 gallons

~1000 gallons

Deepening our environmental ambitions

Ambitious time-bound targets demonstrate our commitment to improving water recycling infrastructure at our global and local facilities.

Our environment targets

Emissions

42%
Absolute reduction in scope 1 emissions by CY30 from CY20 baselines

Net Zero
scope 1 and 2 emissions by CY50

Energy

100%
Renewable energy in the United States in CY25

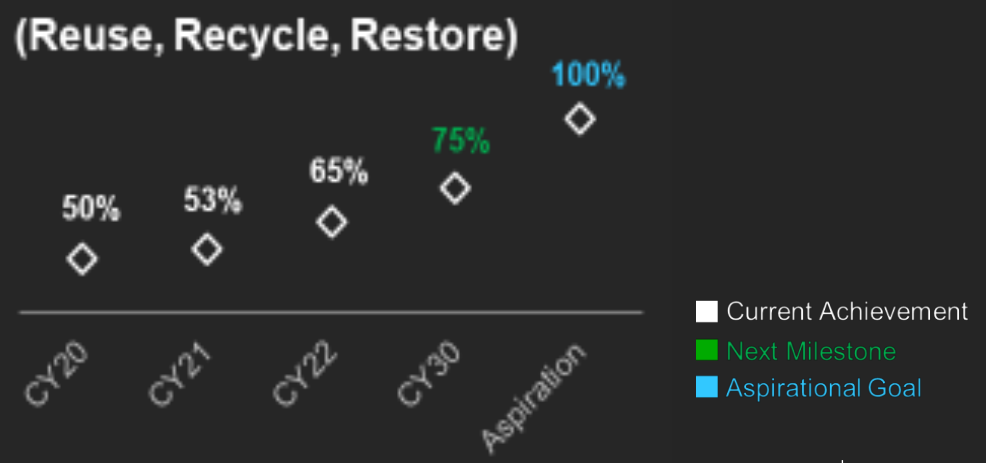
100%
Renewable energy in Malysia in CY22

Waste

95%
reuse, recycling and recovery, and zero hazardous waste to landfill in CY30

Water

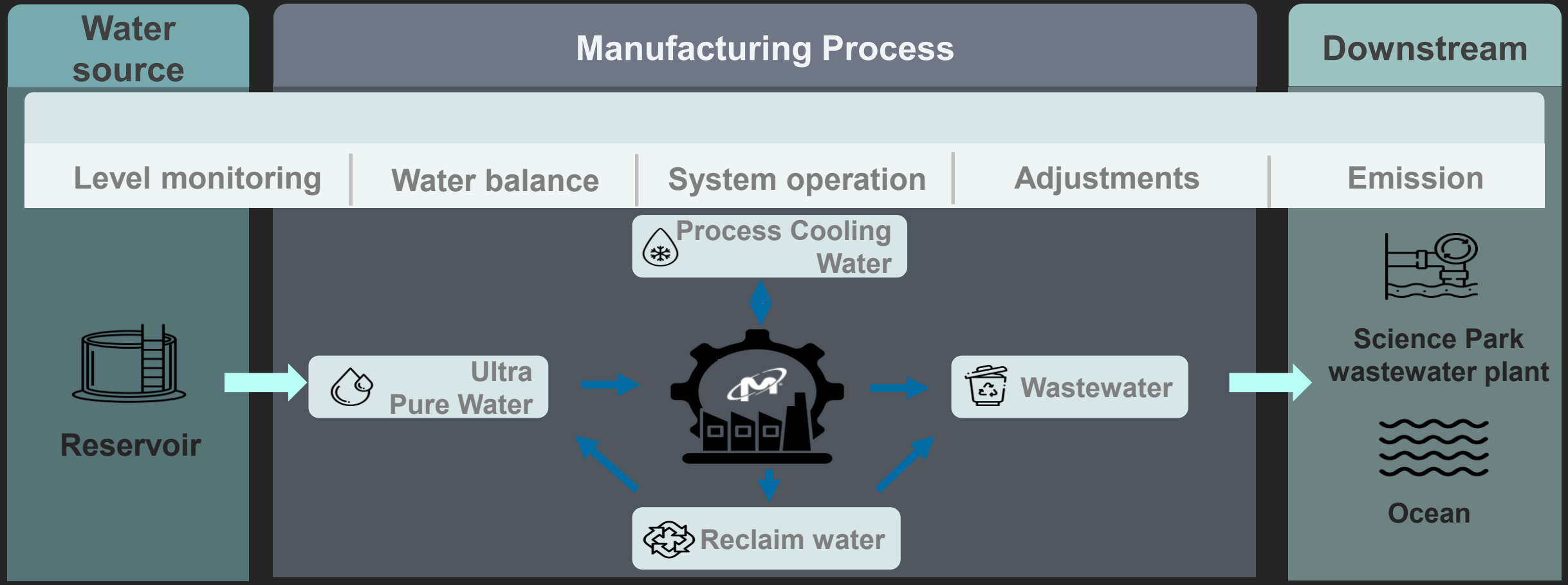
75%
Water conservation in CY30



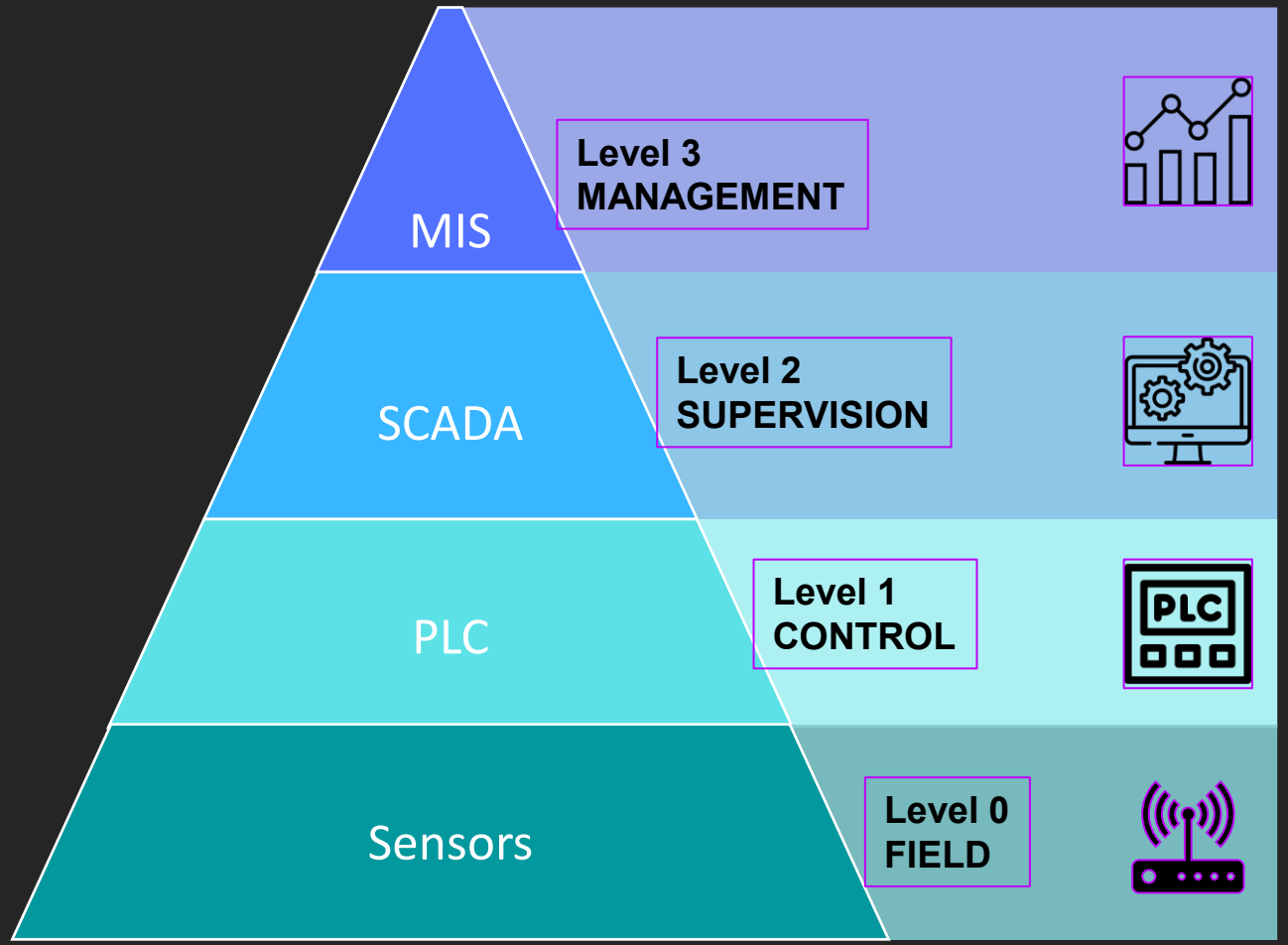
Revolutionizing Water Management

Micron Water Management Journey

Intelligent Management brings more forward-thinking, stable and efficient



Intelligent Management Technology Structure



Automatically collect, integrate and analyze data with web-based and visualized way to support decision making and improve efficiency

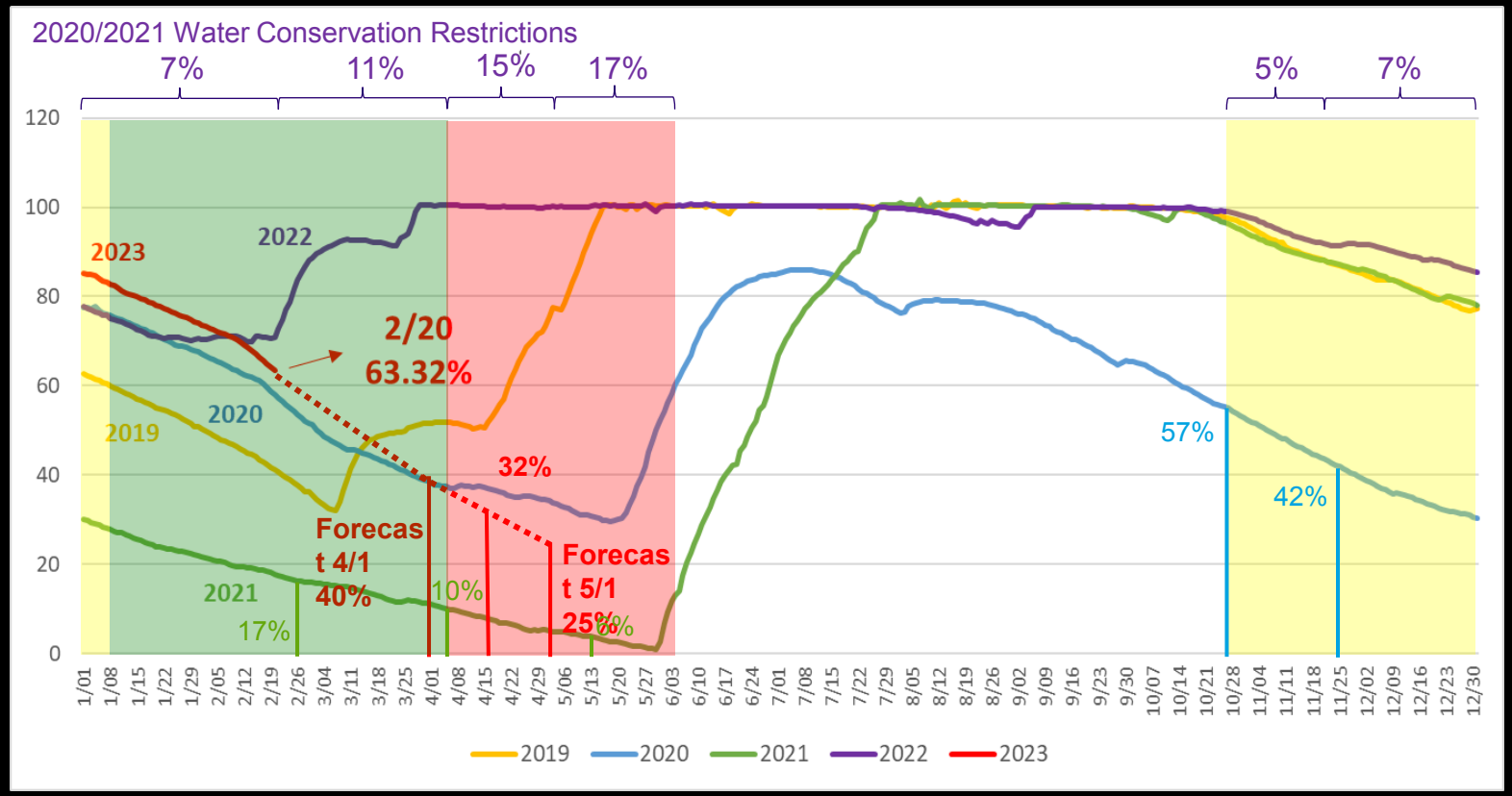
Real-time sensor data and alarms

Programmable Logic Controller (PLC) for relatively simple and repetitive tasks.

Installation of sensors (flow meters, thermometers, etc.)

MIS: Management Information System
SCADA: Supervisory control and data acquisition

Ensuring sustainable operations through predictive monitoring and adaptive supply



2019~2023 LiYuTan Reservoir Level

Data Collection

- Historical Trajectory
- Restricted period

Forecast

- Supply condition including rainfall and limit scenarios

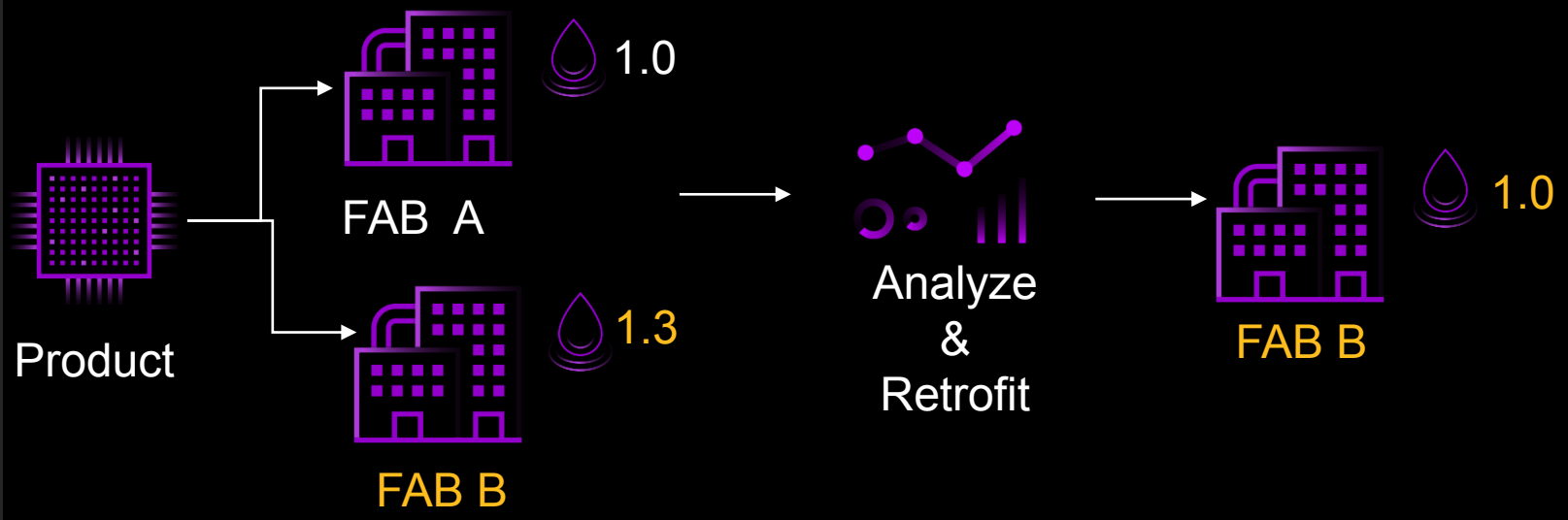
Adjustment

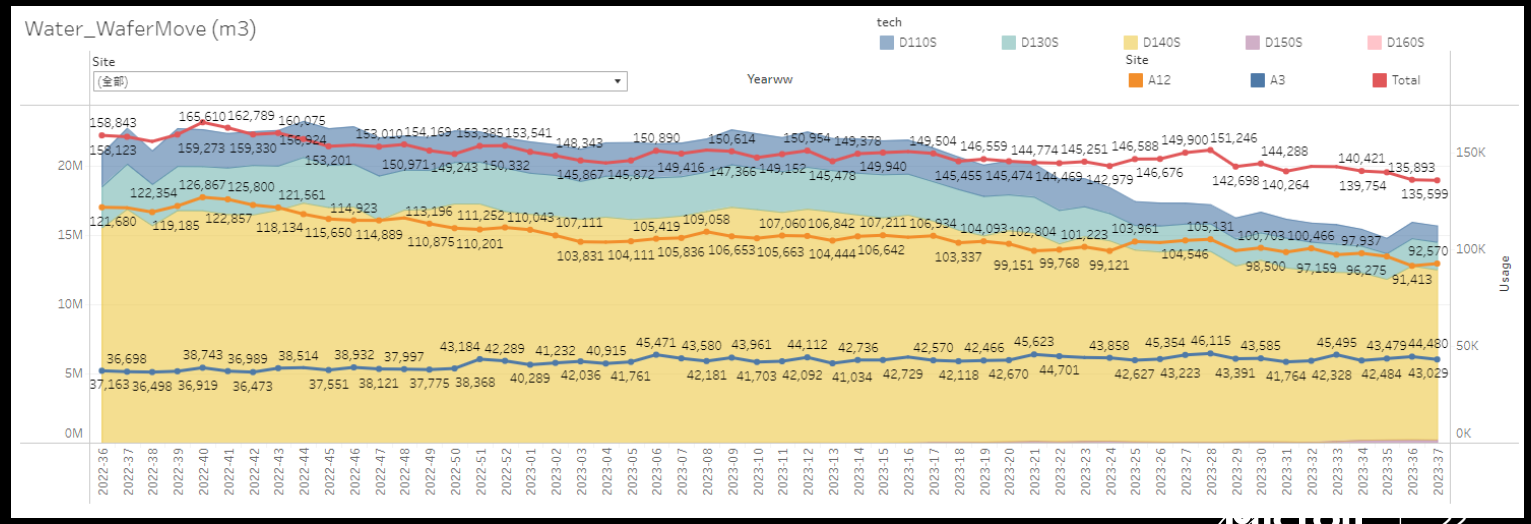
- Equipment Operation/Production
- Second source of water activation

Water use efficiency analysis and adjustment

Analyzing generational changes in products to monitor tap water consumption and wastewater discharge to identify opportunities.

Set up more than 1,000 flowmeters → Generating data from different fabs/nodes → Analysis data to find opportunity → Adjust water usage strategy

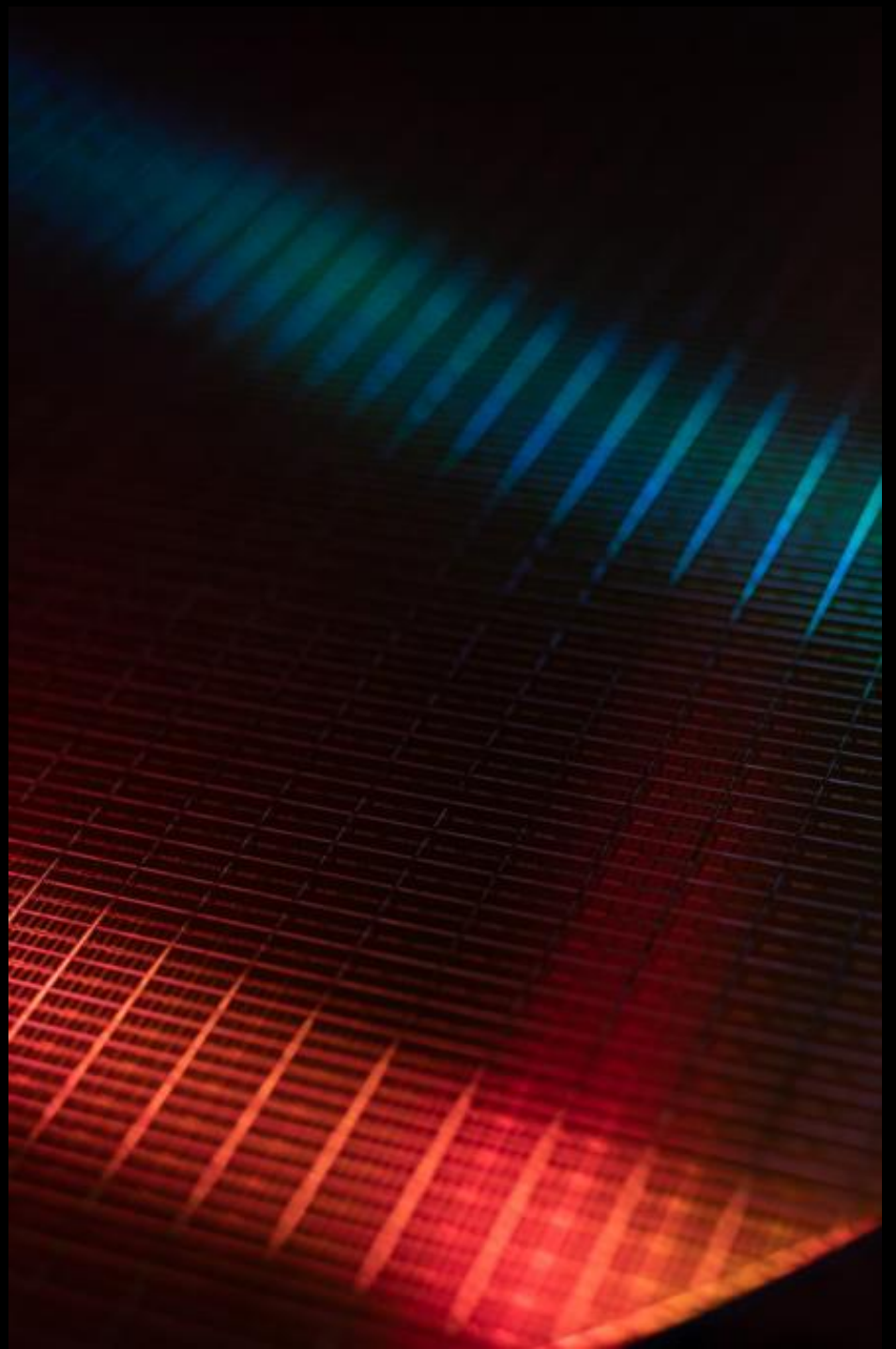




Cooling Water Management

Cooling water accounts for **20%** of the total water usage in site, making it the largest water-consuming facility aside from machine production.

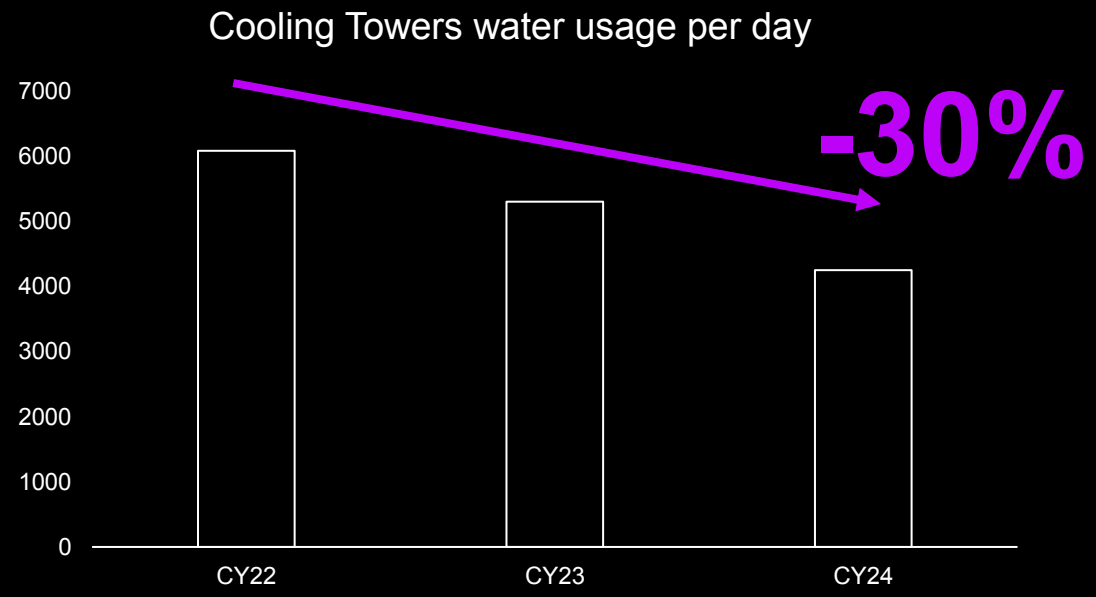
Strategically adjust the management of cooling water further evident significant impact on Micron’s aspirational goal in sustainability.



Cooling Water Management – reducing the frequency of water change

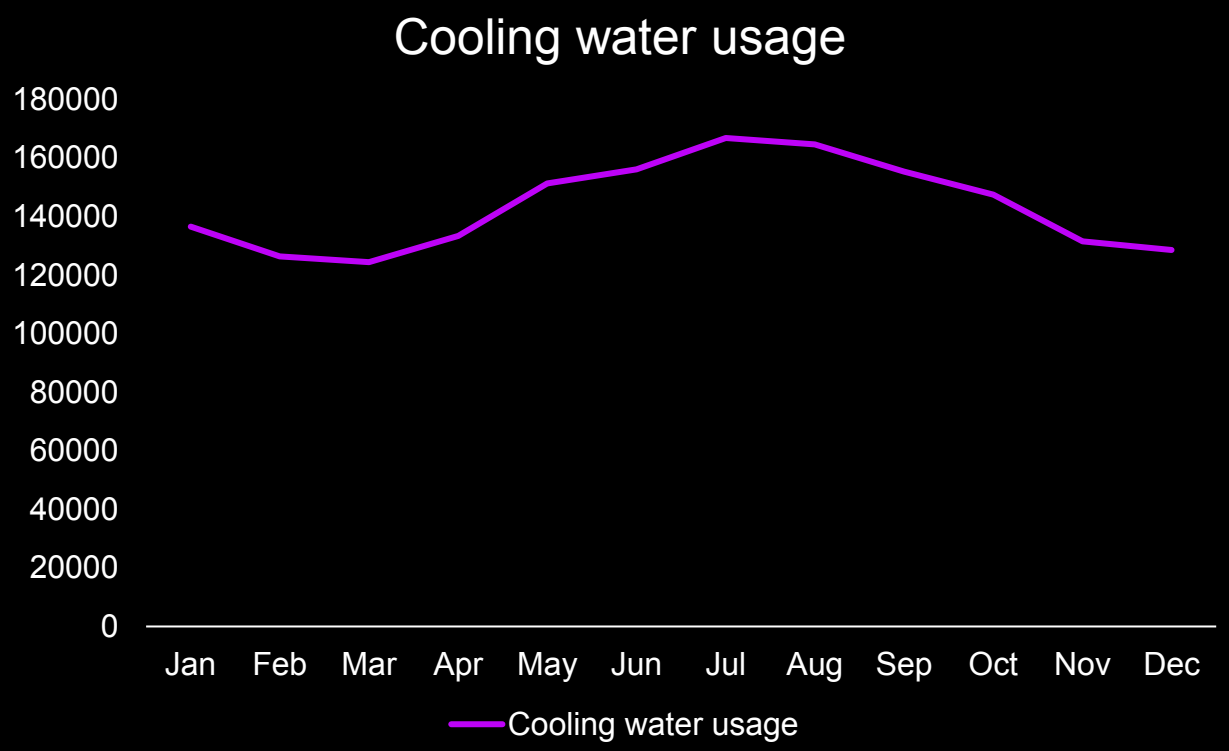
- Set sensors in cooling tower to monitor the quality of water and generate the real-time data
- By analyzing the data to set an efficient criteria for water change to significantly reduce the frequency of water change and reduce consumption

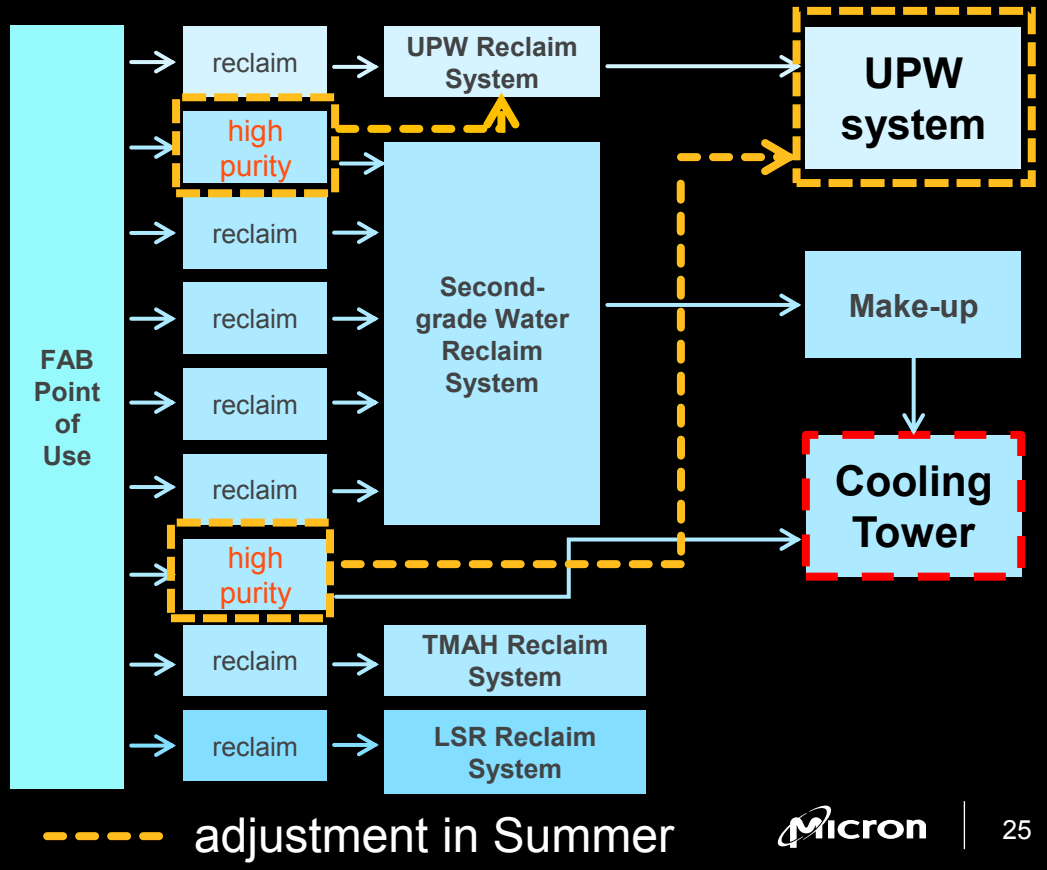
water change point



Cooling Water Management – seasonal water supply adjustment

- The daily usage of cooling water in summer is nearly 1000 cubic meters (metric tons) more than in winter.
- Strategically adjust the water supply to ensure water usage efficiency and reduce consumption





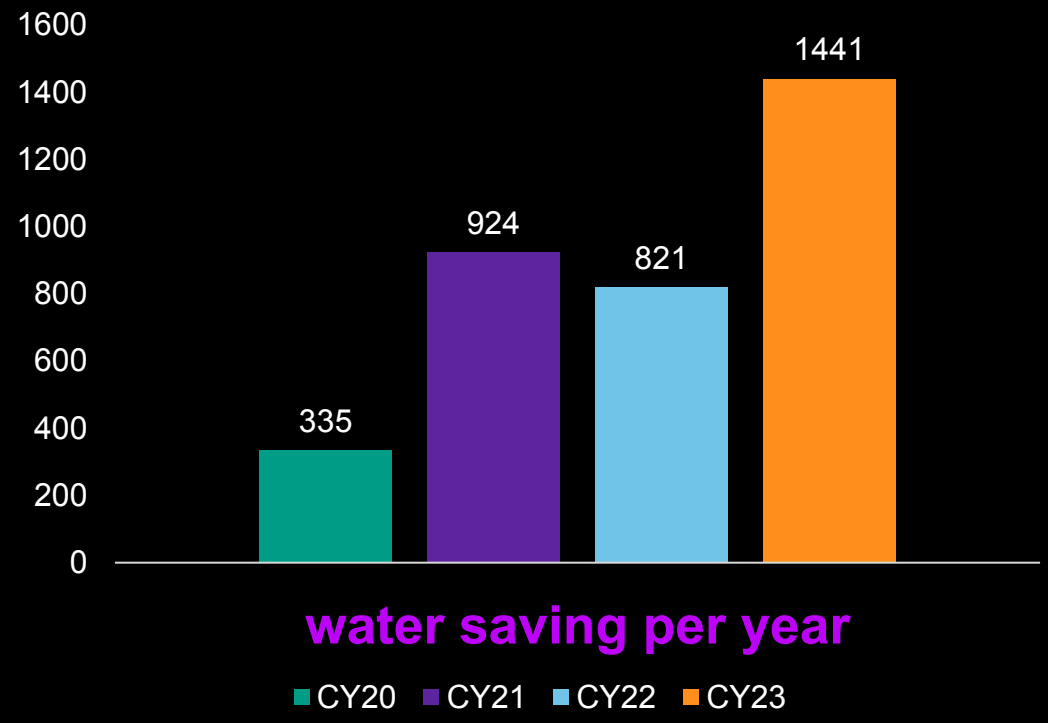
Significant milestones we achieved

over 1.4 million ton water saving in CY23

Equivalent to 473 Olympic swimming pools

External recognitions

- First place of Water Saving Excellence from Ministry of Economic Affairs
- Water Purification Sustainability Award from Ministry of Environment)



Deepen our commitment in water restoration with strong partnership - NEWater

15,000 tons per day

Recycled water will be use in Taoyuan and Taichung from 2028

Micron achieved 100% NEWater usage rate in Singapore site

Artificial Intelligence

is reshaping the world and the very fabric of our daily lives.

Micron will continuously invest in Taiwan to deliver the most groundbreaking products to fuel AI and employ advanced water management strategies for a sustainable future.