

# Exploring Corporate Value in ESG Trends

Joseph Chou

資誠聯合會計師事務所

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The materials contained in this presentation were assembled on 2023.09.04 and were based on the law enforceable and information available at that time.



周建宏

*Joseph Chou*

**Chairman and CEO**  
**PwC Taiwan**

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## Education

- University of Missouri-Columbia, Master of Science in Accounting
- Tunghai University, Bachelor of Science in Physics

## Experience

- Chairman & CEO of PwC Taiwan since 2017

Past:

- COO of Assurance, PwC Taiwan
- CPA, Capital Markets and Accounting Advisory Services, PwC Taiwan
- CPA, Financial Services, PwC Taiwan
- Partner, Global Capital Market Group, PwC New York Office
- Assurance Manager, PwC San Jose Office
- PwC Globally Authorized Accountant for Review of Financial Statements in Accordance with GAAP
- Member of Global IFRS Group of PwC
- Speaker of GAAP & IFRS in Asia, PwC

## Specialty

- Corporate capital raising, IPO and market listing services
- Financial statement audit and certification
- Corporate M&A and spin-off consulting
- IFRS or US GAAP consulting
- Sarbanes–Oxley Act consulting

## Major Client & Industry Served

- **Semiconductor Industry :**  
TSMC (Sox 404 implementation) /  
UMC / Parade Technologies /  
Micron Technology / ChipMOS /  
Corning Incorporated / Foxconn /  
Delta Electronics / Omnivision /  
Applied Materials / SPIL /  
Unimicron Technology
- **Financial Industry :**  
HSBC / DBS /  
Taiwan Stock Exchange /  
Mega Financial Holdings /  
Yuanta Financial Holdings /  
First Financial Holdings /  
IBF Financial Holdings /  
Nan Shan Life Insurance Company

# 大綱

1

ESG發展趨勢

2

厚植企業在新式財務報告的價值管理趨勢





The background features a light gray gradient. In the top right corner, there is a 2x2 grid of squares: white, light gray, and dark gray. Below the white square is a yellow square. In the bottom left corner, there is a red square containing a white right-pointing arrow.

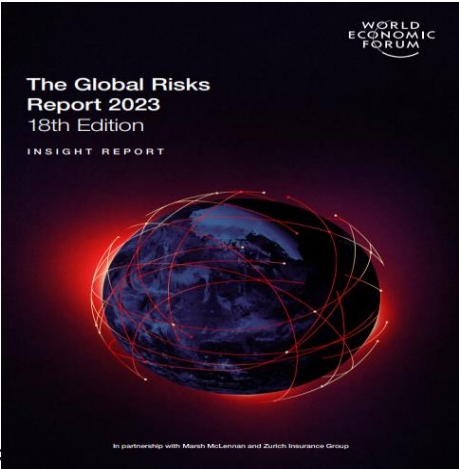
1

# ESG發展趨勢

# ESG範疇廣闊 為企業經營帶來多元發展機會點！

Environmental				Social				Governance	
Climate Change	Natural Capital	Pollution & Waste	Environmental Opportunities	Human Capital	Product Liability	Stakeholder Opposition	Social Opportunities	Corporate Governance	Corporate Behavior
Carbon Emissions	Water Stress	Toxic Emissions & Waste	Clean Tech	Labor Management	Product Safety & Quality	Controversial Sourcing	Access to Finance	Board	Business Ethics
Product Carbon Footprint	Biodiversity & Land Use	Packaging Material & Waste	Green Building	Health & Safety	Consumer Financial Protection	Community Relations	Access to Health Care	Pay	Tax Transparency
Financing Environmental Impact	Raw Material Sourcing	Electronic Waste	Renewable Energy	Human Capital Development	Privacy & Data Security		Opportunities in Nutrition & Health	Ownership	
Climate Change Vulnerability				Supply Chain Labor Standards	Responsible Investment			Accounting	
				Chemical Safety					

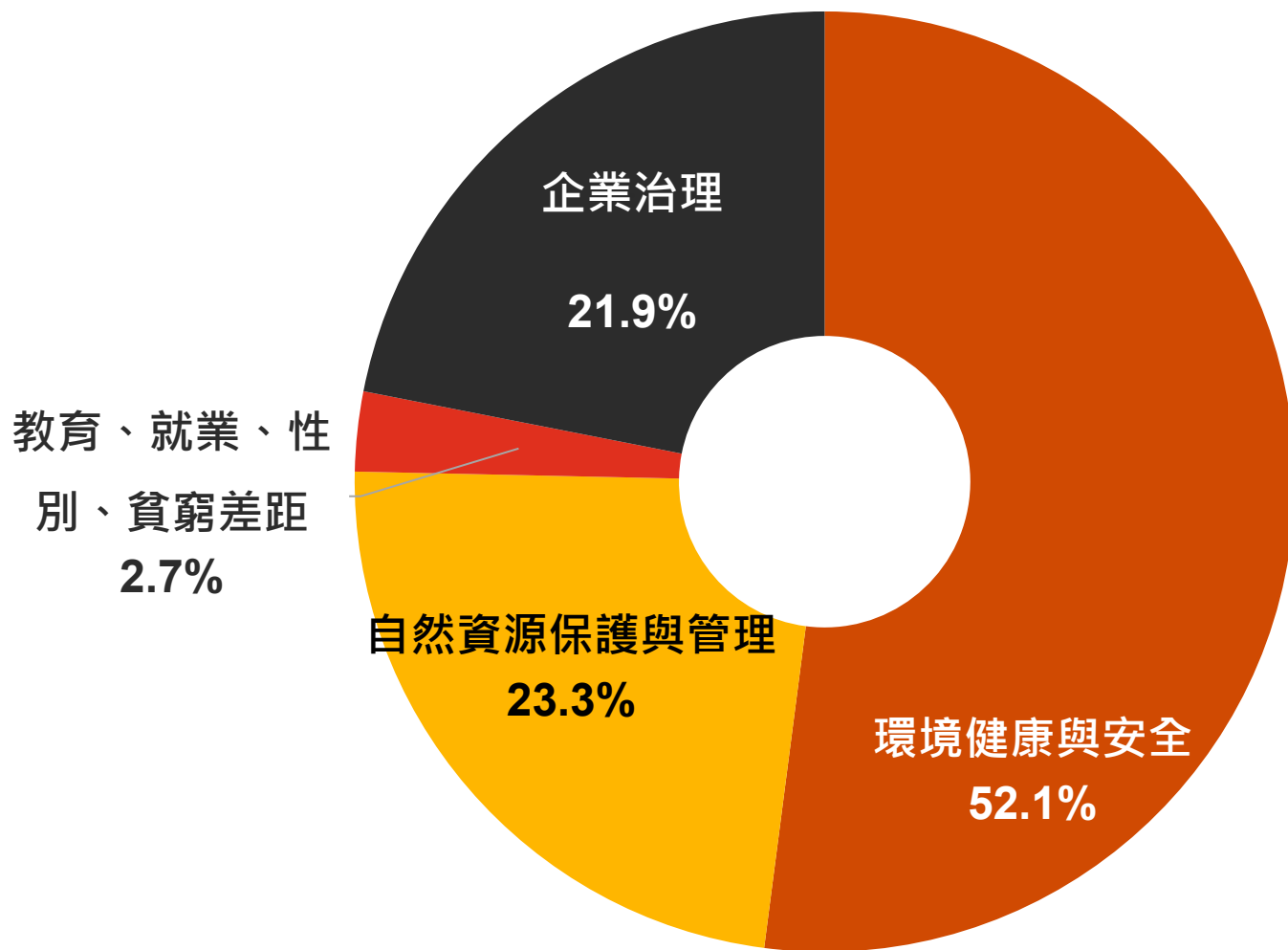
Source: [MSCI ESG Ratings Key Issue Framework](#)



## 未來10年的十大風險排名



# 投資者對ESG議題之關注現況



“

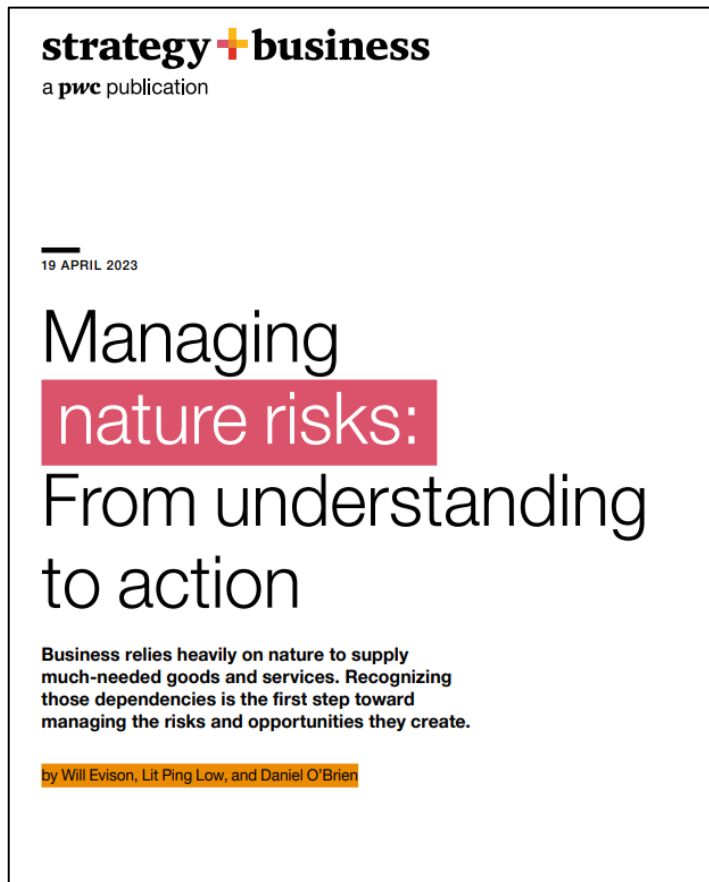
- 67.0% 投資者已經關注或投資 ESG 相關的項目。未來2-3年，73.0% 投資者會關注/投資 ESG 議題
- 另外，**ESG** 投資最關注「環境健康與安全」(52.1%)，其次是「自然資源保護與管理」(23.3%)

”

資料來源:<2022台灣新創圈大調查>, PwC、台灣經濟研究院

# PwC 《自然風險調查報告》指出 商業發展與「自然」密不可分

## 自然及水資源是所有企業必須面對的重要議題



58兆

全球一半以上的GDP、總計超過58兆美元，對自然及其服務有著中等或高度的依賴

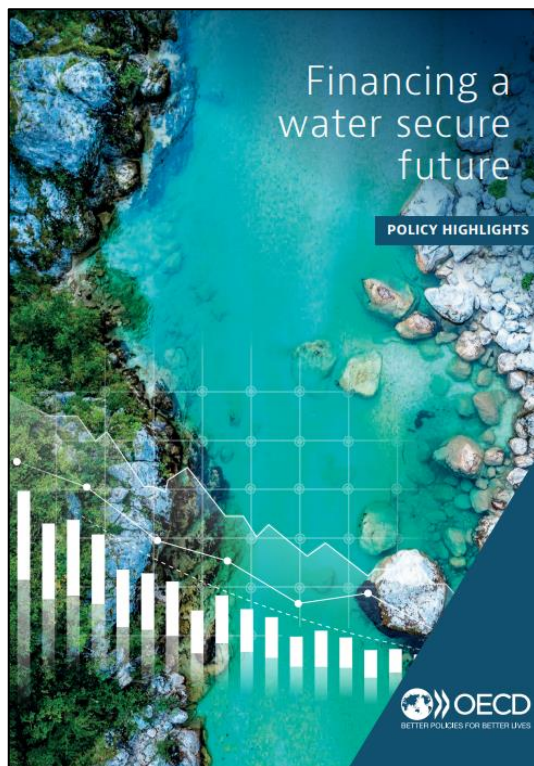
5大行業

最依賴自然資本及其服務以維持營運的5大行業，分別是農業、林業、漁業、食品飲料及菸草業、營造業；影響金額達13兆美元，佔全球GDP12%



# 水風險將為經濟與社會帶來巨大成本

**OECD 指出水相關風險將對全球企業商業價值產生重大影響**



**3,363億**

根據2020年統計資料顯示，因水風險導致現在及未來商業價值的損失達US\$3,363億

**製造業 (US\$ 2,067億)**

**發電業 (US\$ 302億)**

**材料業 (US\$ 345億)**

**其他產業 (US\$ 649億)**

資料來源:<2022 Financing a water secure future>, OECD

# 全球企業意識到水機會的價值

CDP 《2022年全球水資源報告》指出企業要抓住機會，加速水資源安全進展

**US\$4360億**

全球品牌報告顯示與水有關的機會合併財務價值US\$4360億



**4倍機會**

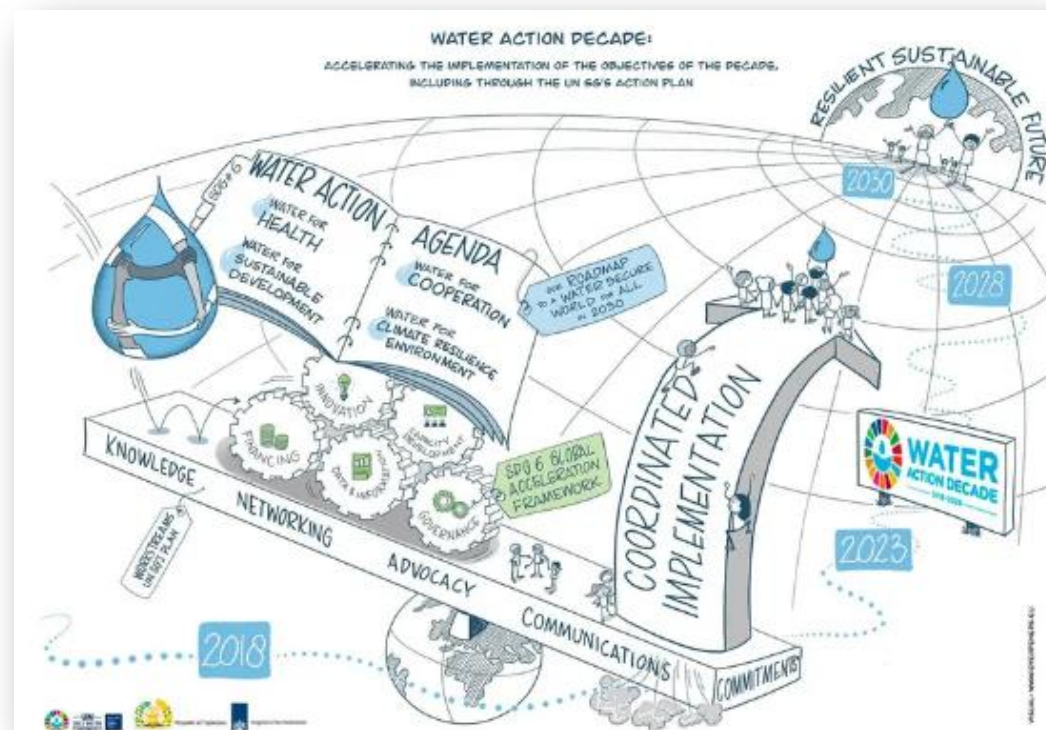
揭露資料顯示，有將水議題整合進企業長期發展目標之公司，可在財務規劃上實現4倍以上之機會

“

水相關機會行動為企業及環境帶來共好價值

”

2023年聯合國水資源大會，發佈了「水資源行動議程WAA」，集結了政府、企業和非營利組織提出近700項水資源承諾。

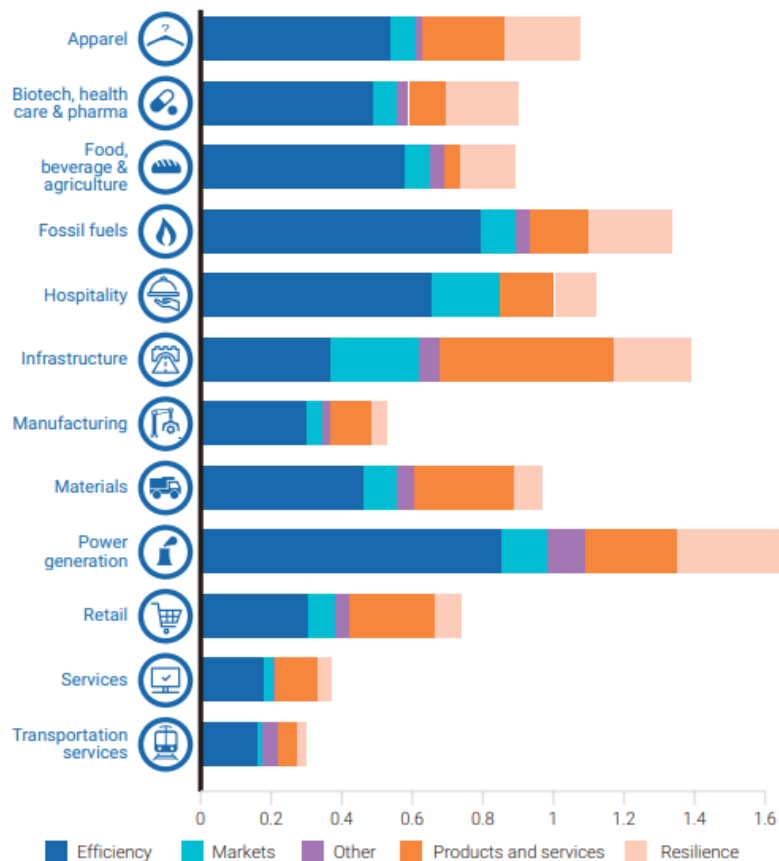


資料來源:<2022年全球水資源報告>, CDP; UN Department of Economic and Social Affairs 10

# 水機會為各行各業帶來財務收益價值

## 將全球水危機轉化為財務機會

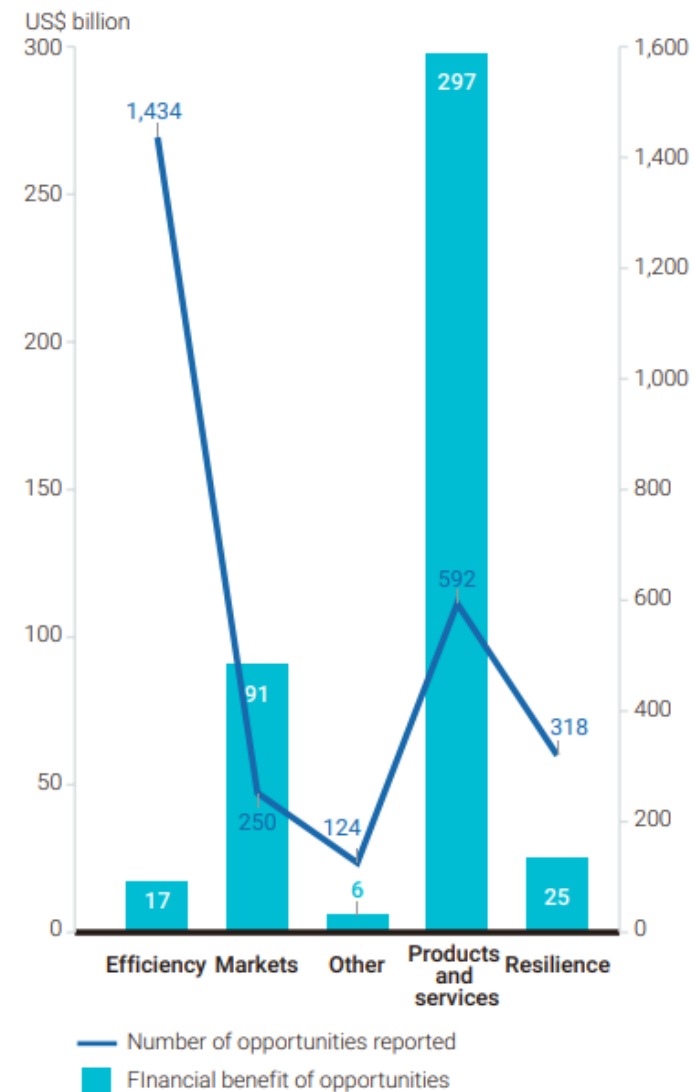
Average number of reported opportunities per organization by sector



2022年CDP調查資料顯示，以發電業、基礎建設業、化石工業提出最多水相關機會

透過進入新的市場、提升水效率、優化產品和服務、及確保供應鏈能抵禦水衝擊，將能為企業帶來財務收益及減少對水資源的影響

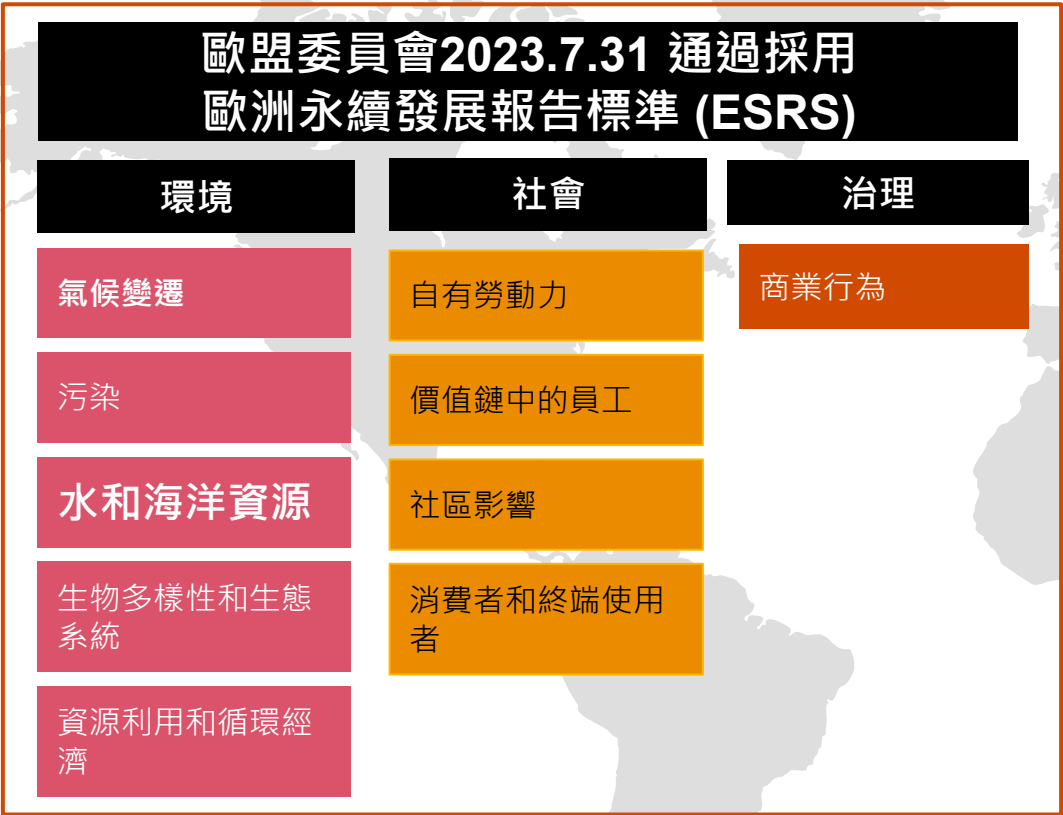
Potential financial benefit and frequency per type of opportunity



資料來源:<2022年全球水資源報告>, CDP; UN Department of Economic and Social Affairs 11

# 監管機構監管趨勢

## 歐盟企業永續發展報告指令(CSRD)

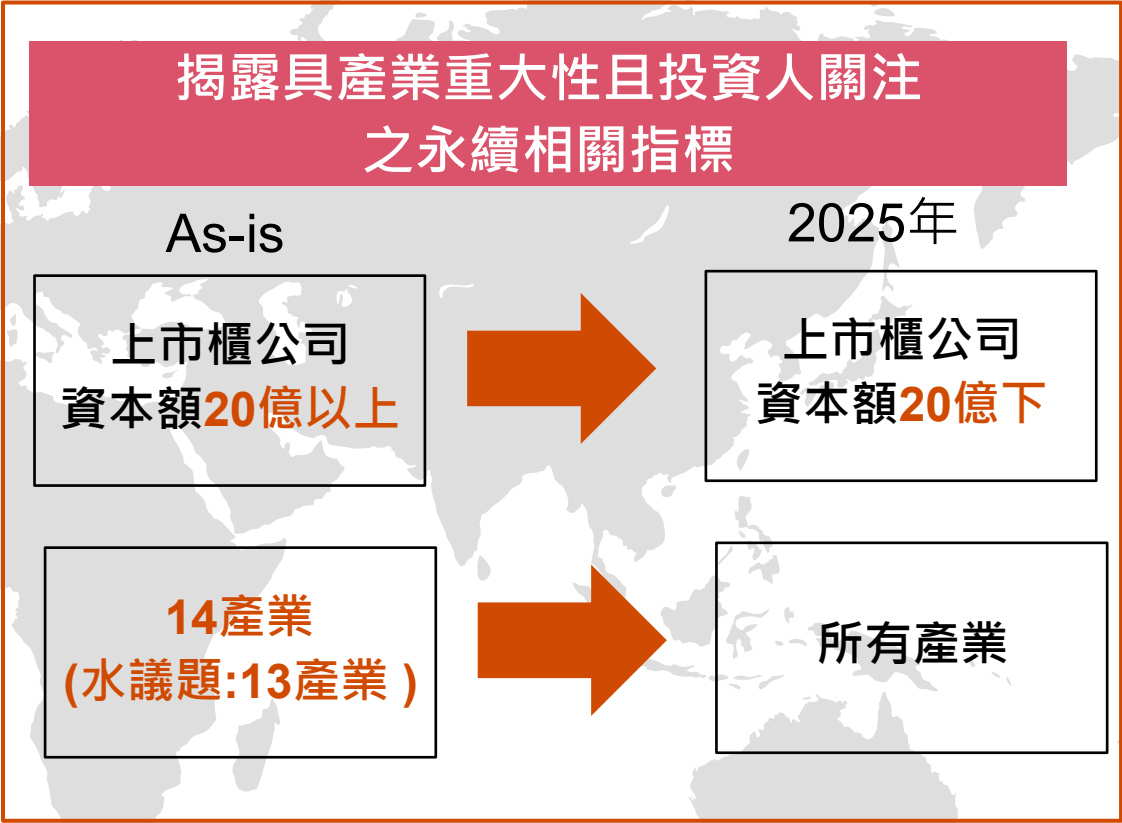


適用11,700家



適用50,000家

## 台灣永續作業辦法





# 重要國際評比納入水相關議題

水資源風險管理是國際永續評比不可或缺的一環

## S&P Global

Corporate Sustainability  
Assessment

治理與經濟

社會

環境

→ 水風險評估

Dow Jones  
Sustainability Indices

Powered by the S&P Global CSA

## CDP水安全問卷

企業水資源現況

價值鏈參與

業務衝擊

風險評估

風險機會  
管理

目標

水治理與  
商業策略

查證

塑膠



# 2

## 厚植企業在新式財務報告的價值管理趨勢



# 投資人關注水資源對產業的重要性

11個  
產業別(Sector) → 77個  
產業(Industry)



5大  
永續面向

(人力資本、社會資本、環境資本、  
領導及治理、商業模式及創新)

26個  
永續議題

參考資料：永續會計準則委員會

## 關注37 Industries

### 半導體

需要大量的「超純」水進行清潔，以避免微量分子影響產品品質



### 服裝、配件和鞋類

供應鏈在染色和鞣製過程中化學品的排放造成水污染



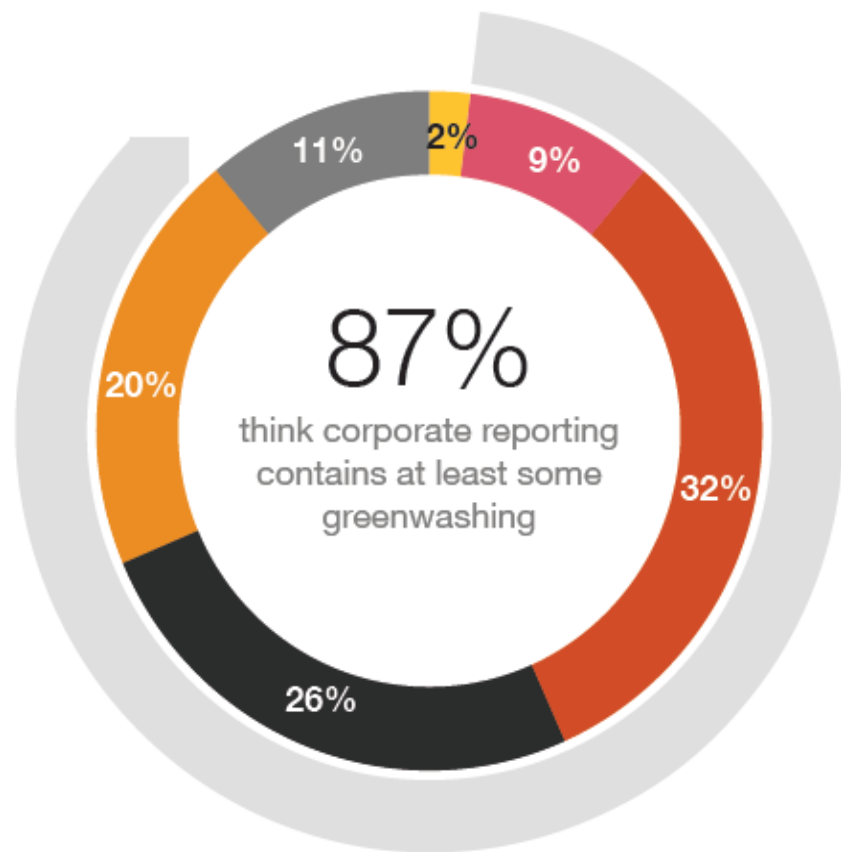
### 化學品

水主要用於冷卻、蒸氣產生和原料加工；亦是化學品生產的關鍵投入



# 降低投資人擔憂ESG投資「漂綠」，建立信任！

「漂綠行為」在企業永續報告中很普遍



Not at all To a limited extent To a moderate extent To a large extent To a very large extent Don't know



投資人取得對企業永續報導信心的來源

75%

合理確信  
( 相當於財務報表查核的程度 )

54%

有限確信  
( 低於財務報表查核的程度 )

50%

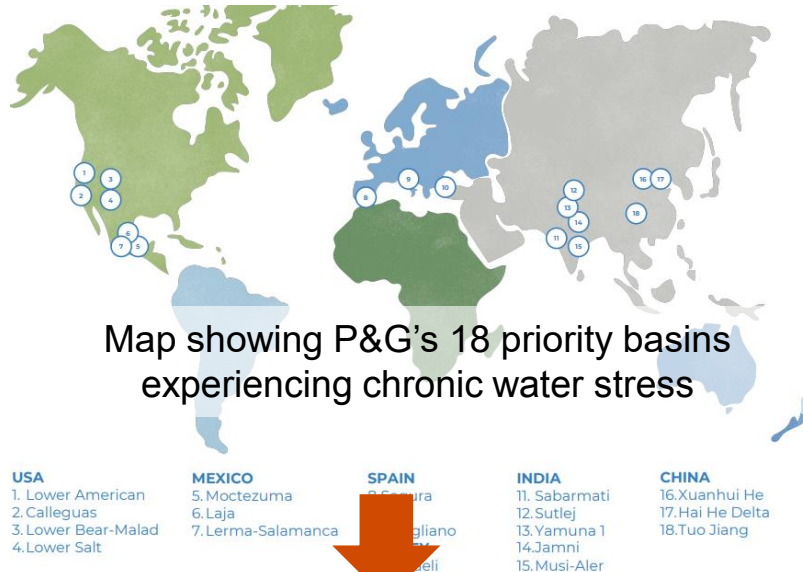
公司內部稽核



# 企業價值管理趨勢

## 價值鏈上游

### 高水風險之集水區管理

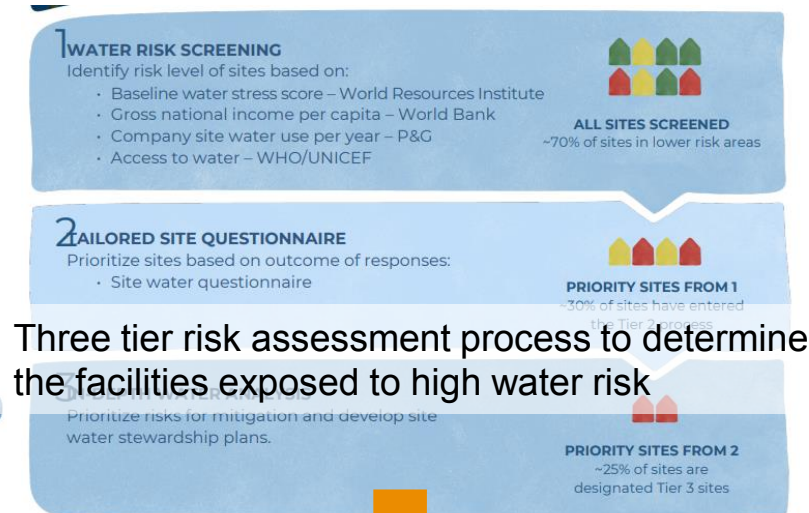


### 集水區復育



## 營運範疇

### 高水風險之廠區用水管理



### 用水目標管理

單位產品用水強度較2010年提升35%  
每年水回收及再利用50億公升

## 價值鏈下游

從產品出發降低自然依賴、影響並產生營運機會



運用新技術  
提升洗劑洗潔力

倡導消費者行為  
改變，改變洗碗  
行為模式

### 倡議推動



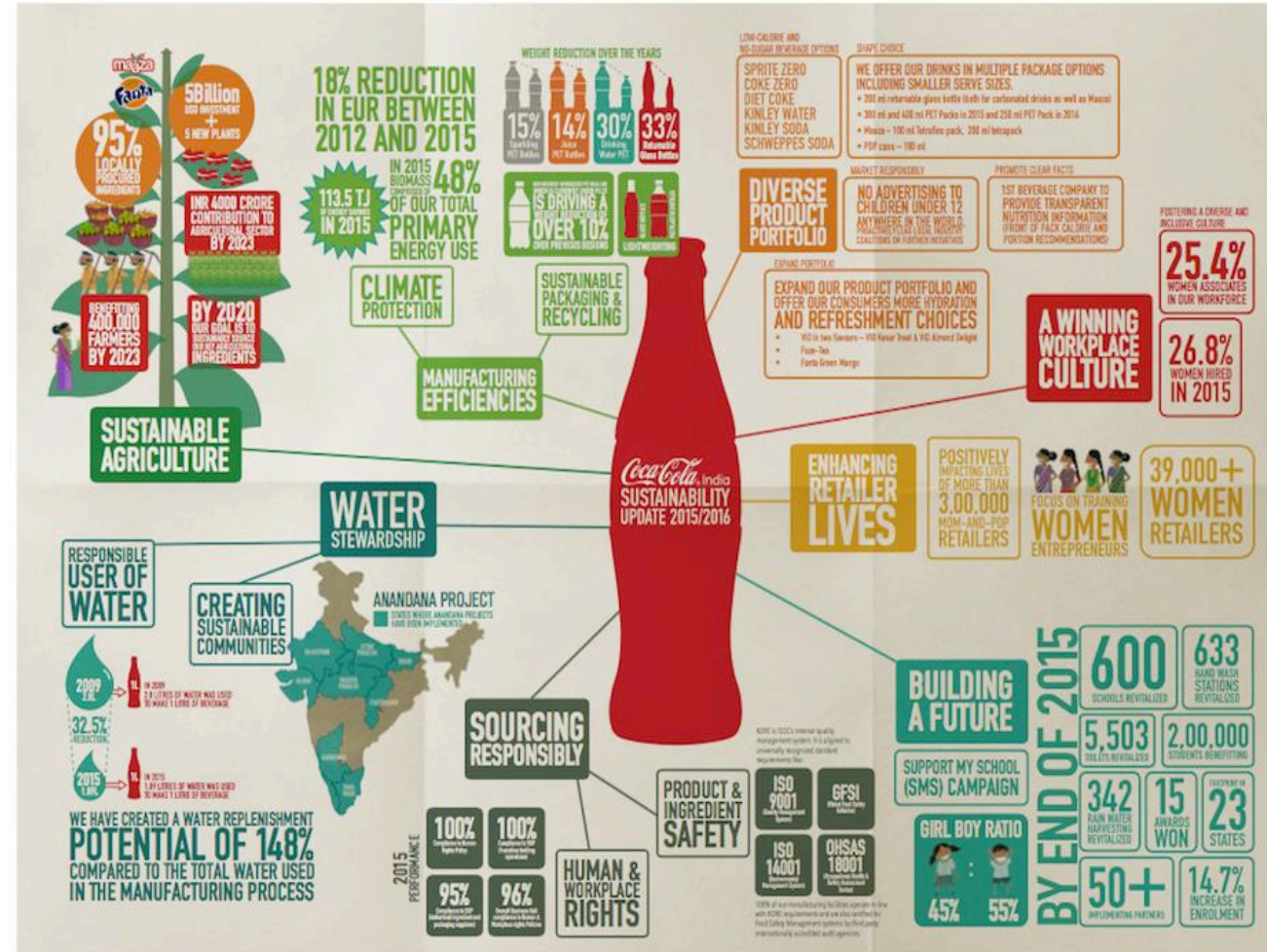
# 與時俱進、與社會環境共榮共好！

1950s

2020



## Why We Focus on Sustainability





資誠與您 攜手並進 共創價值

**Together, Stronger ! We Can Make the World Better !**

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# Micron Visions and Practices on Water Management

Bart Y.C.Chiang, Director, Taiwan Micron EHS & Sustainability  
October 2023

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# 27 years of exploring and learning in Semiconductor



**Bart Y.C. Chiang**  
Director, Taiwan Micron EHS & Sustainability

2022 –

## **Micron Taiwan**

- Director, Taiwan Micron EHS & Sustainability

2017- 2022  
2001- 2007

## **SMIC China**

- Director, Corporate ESH, Risk Management & Sustainability

2007– 2017

## **Silterra Malaysia**

- Division Head, FAC & EHS
- Senior Technical Manager, More than MOORE PM

1996 – 2001

## **TSMC**

- Senior Engineer, Diff & Wet EE; Gas & Chemical Supply
- Senior Engineer, ISEP

# Outline

- **Micron is?**
- **Micron Sustainability Visions**
- **Micron Water Management Strategies**
- **Micron Taiwan Water Management Practices and Achievements**

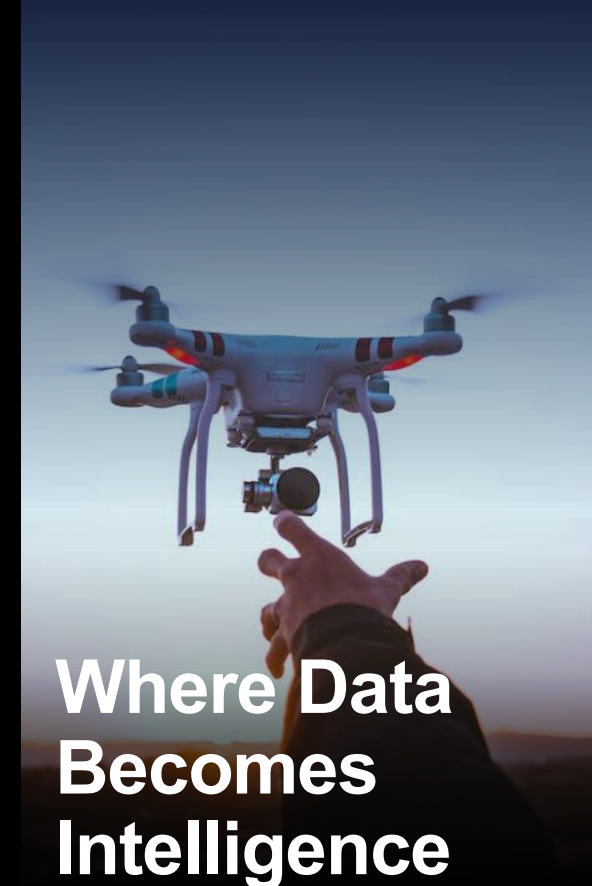
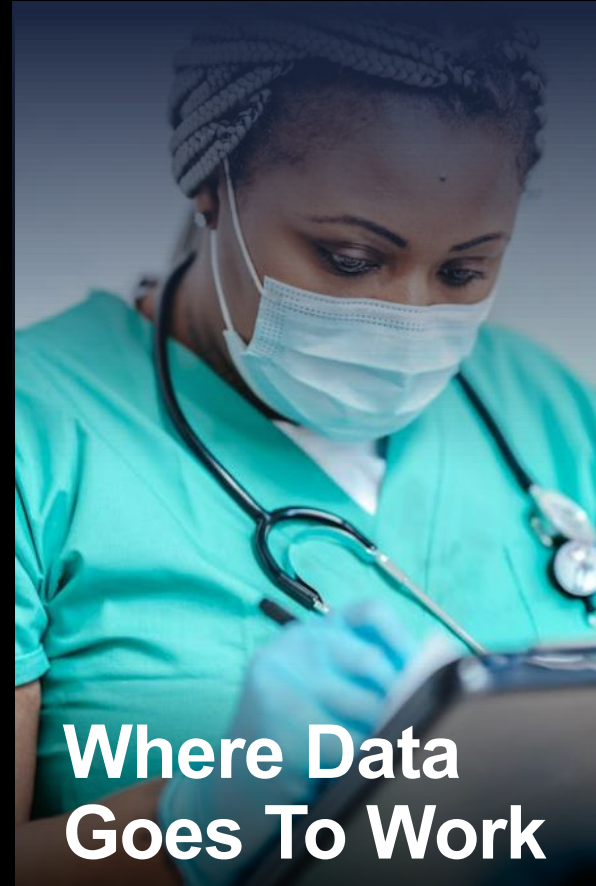
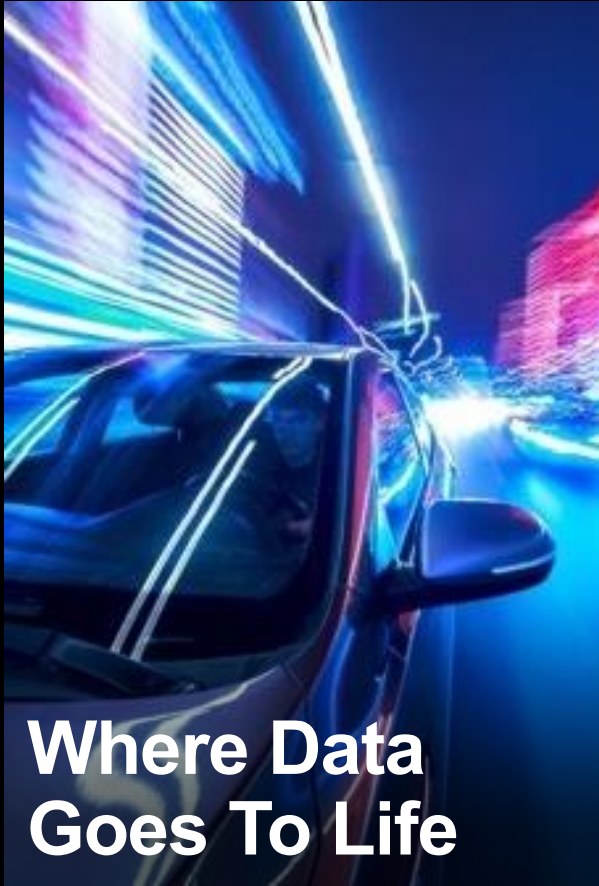




# Start Your day with Memory

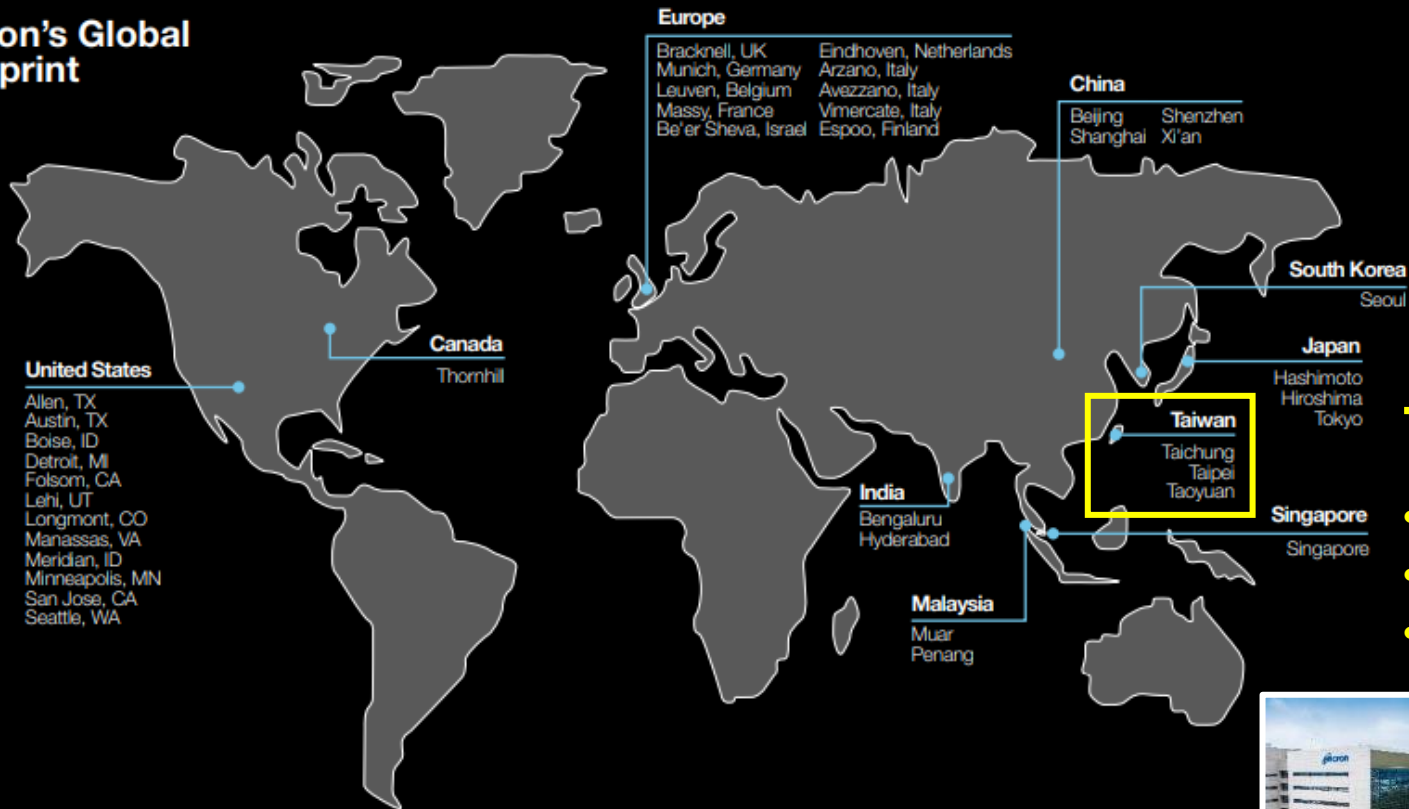


# Micron is everywhere



# Micron Global Footprint & Taiwan's Manufacturing Facilities

## Micron's Global Footprint



**Taoyuan**

- FAB11



**Taichung**

- FAB16 A1/A2
- FAB16 A3
- MTB





# Our Vision

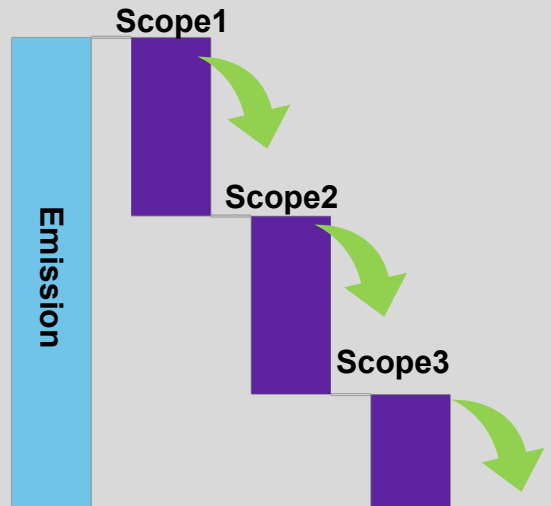
## Transforming how the world uses information to enrich life *for all*



# Net Zero Roadmap

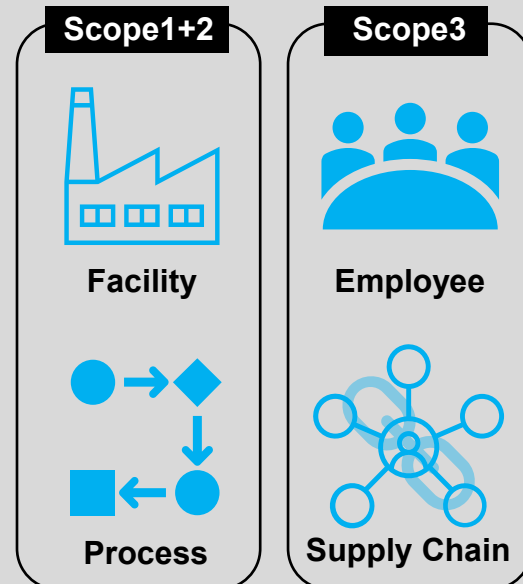
## Direct Emission

- 100% Abatement Installed
- Low GWP (Global warming Potential) Heat Transfer Fluid

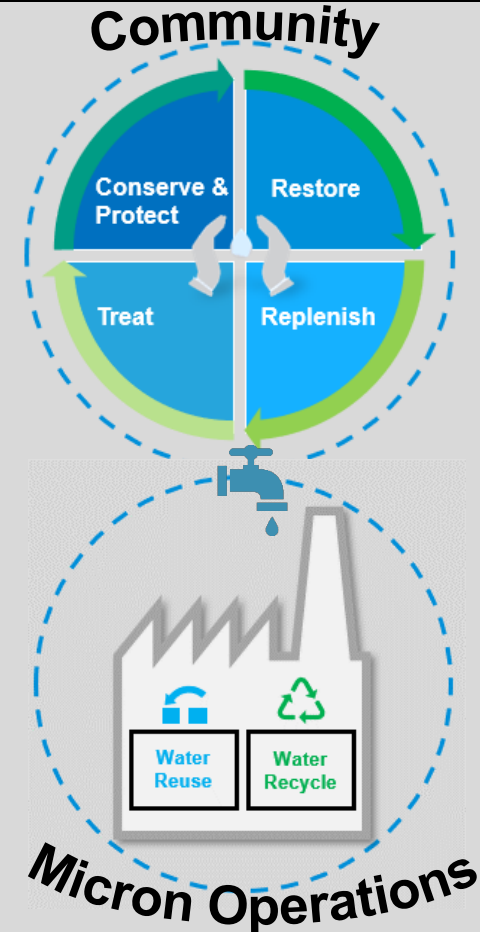


## Indirect Emission

- Process/tool Optimization
- Facilities System Enhancement
- Renewable Energy Purchase



## Water



## Waste

- Zero landfill
- Circular economy on waste chemical





# What Net Zero means for us

## Micron environmental sustainability 4 Pillars

Environmental Sustainability Goals & Aspirations	Pillars		Our Public Goals		Our Aspirations
	Climate Change Mitigation	Direct Emissions	42% absolute direct emissions reduction by CY30 (vs CY20)	75% emissions intensity reduction by CY30 (vs CY18)  Net Zero (Scope 1 +2) by CY50	Net Zero (SBTi aligned) by CY50 or earlier  <i>with 100% clean energy globally</i>
		Indirect Emissions	100% renewable electricity in U.S. by CY25		
	Water Scarcity Alleviation	Water Conservation	75% water conservation by CY30		100% water conservation
	Resource / Land Use Depletion Mitigation	Waste Management	95% waste reuse, recycle, recovery (RRR) by CY30 with zero (<1%) hazardous waste to landfill		100% waste RRR with zero (<1%) total waste to landfill

# Delivering Leading-Edge Products **Responsibly**

*Joint efforts for a sustainable future with all the stakeholders*

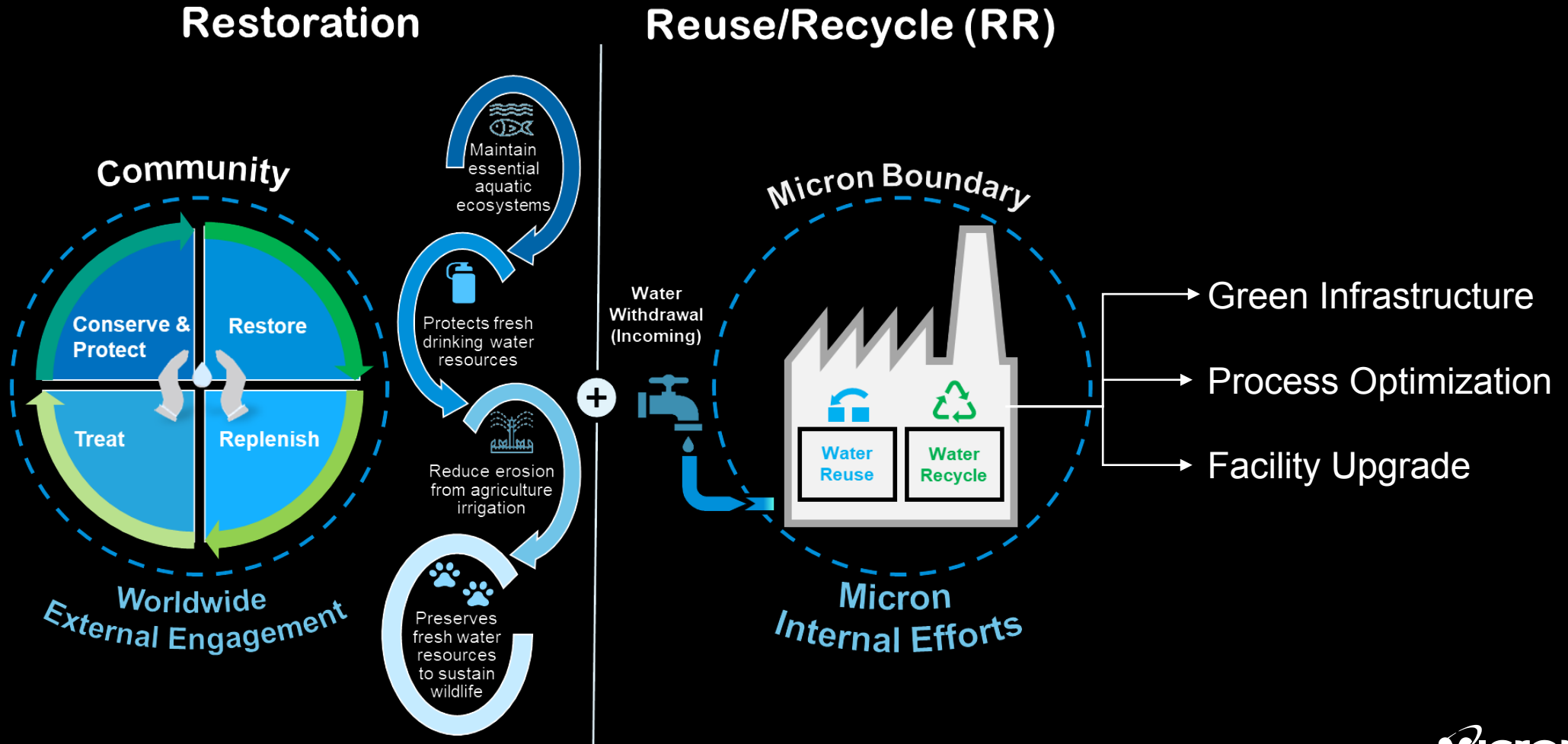
Micron takes a proactive approach to environmental stewardship, investing in technologies for our **water management**.

# Micron Water Management Strategies



Every drop of water is reused  
**3 times** in Micron Taiwan

$$\text{Water Conservation} = \frac{(\text{Community Restoration}) + (\text{Water Reuse, Recycle})}{(\text{Water Withdrawal} + \text{Water Reuse, Recycle})^*} = 75\% \text{ in CY30}$$





# Internal Water Reuse and Recycle

New Fab Green Design

- LEED. WELL. EEHW standard

**16,300,000 m<sup>3</sup>**

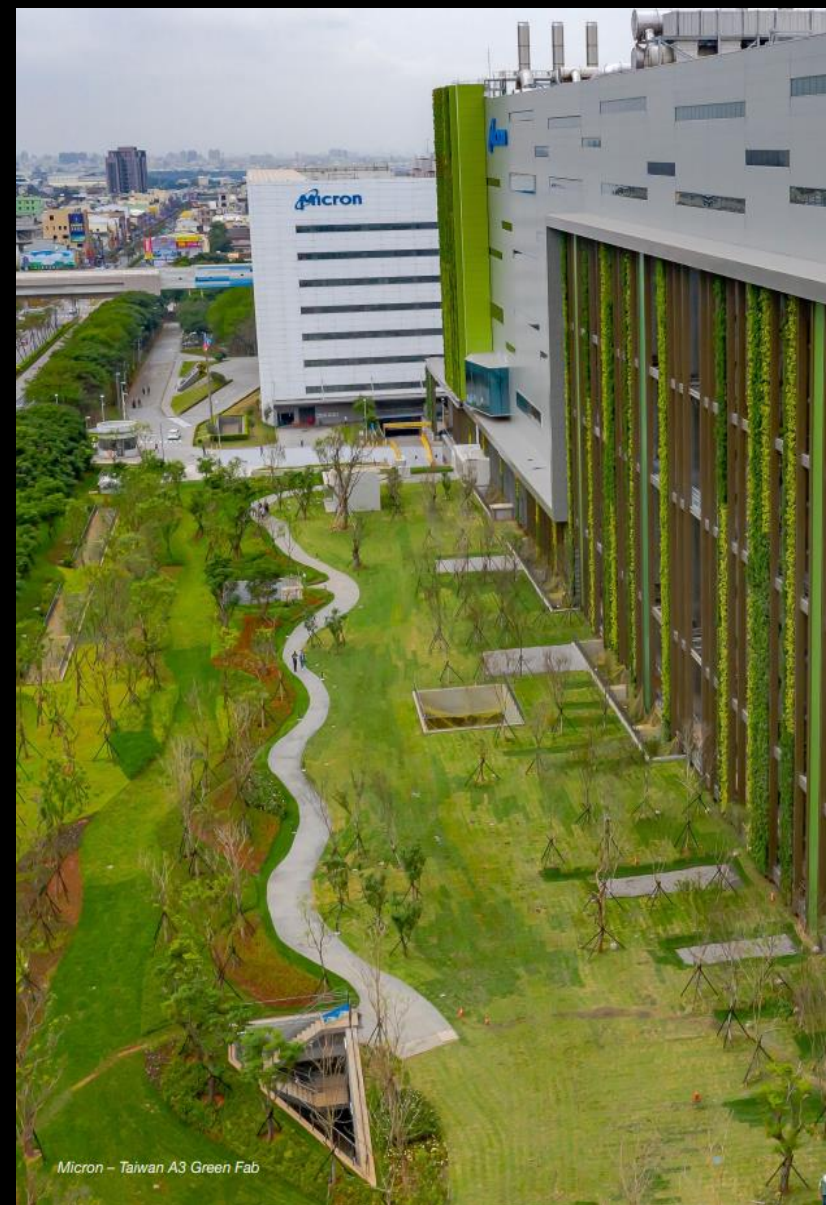
Water Saving

**6,500**

Olympic-sized  
Pools

**75%**

Water Reuse and  
Recycle



# Internal Water Reuse and Recycle

## Process Optimization-Water Rinse Optimization

> 10,000 m3/year water to be saved

**Before**

Step	Time (sec.)	DIW	Hot-DIW	QDR
Pre_1	345	30l/min	●	
PRC_1	600	30l/min	●	
PRC_2	10	30l/min	●	
Post_1	30	30l/min	●	
Post_2	60	Slow Leak		●
Post_3	60	60l/min	●	

**After**

Step	Time (sec.)	DIW	Hot-DIW	QDR
Pre_1	15	Slow Leak		●
Pre_2	60	60l/min	●	
Pre_3	10	30l/min	●	
PRC_1	290	60l/min	●	
PRC_2	10	30l/min	●	
Post_1	10	30l/min		

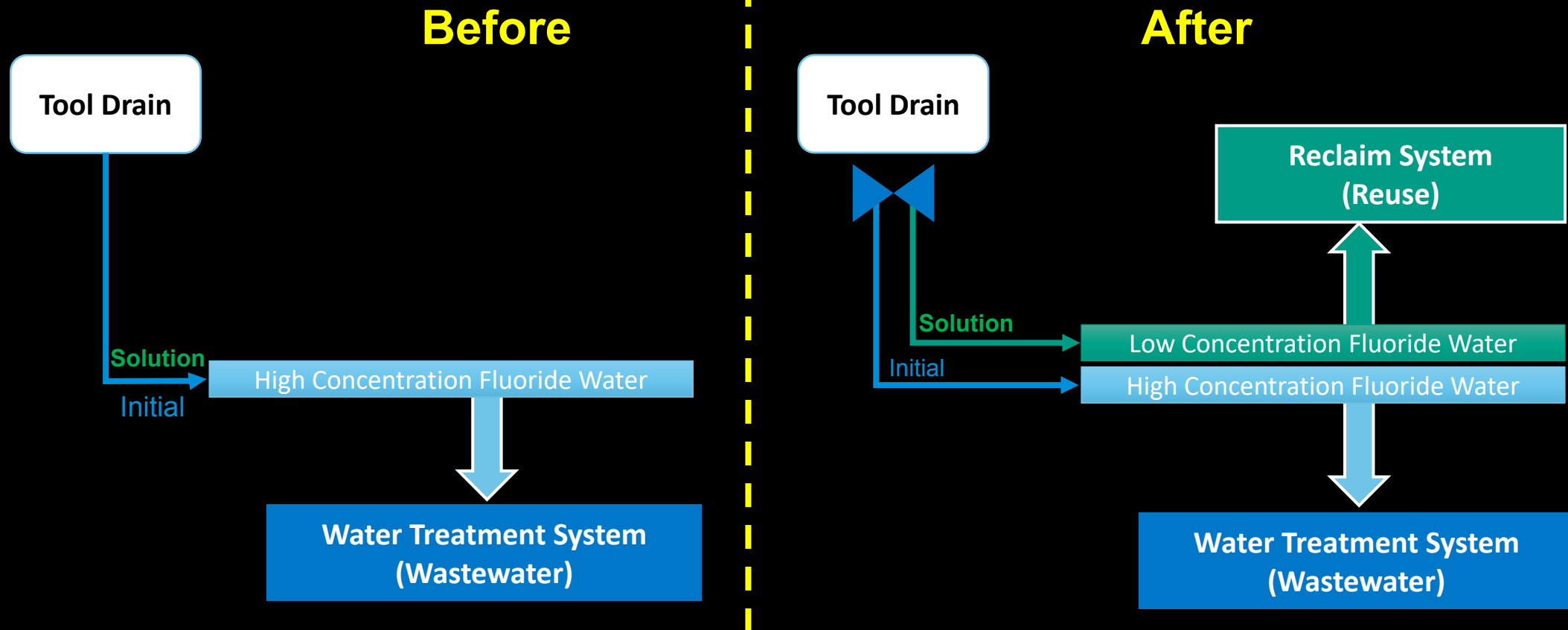
STEP	Before			After			△
	Flow (l/min)	Time (sec.)	Sub-Total (l/min)	Flow (l/min)	Time (sec.)	Sub-Total (l/min)	
Pre	30	345	172.5	60/30	65	65	-107.5
PRC	30	610	305	60/30	295	295	-10
Post	30/60	30/60	75	30	5	5	-70

**Total Water Saving: 187.5l/batch**

# Internal Water Reuse and Recycle

## Process Optimization-Fluoride Wastewater Drain switch

> 7,000 m<sup>3</sup>/year water to be reused

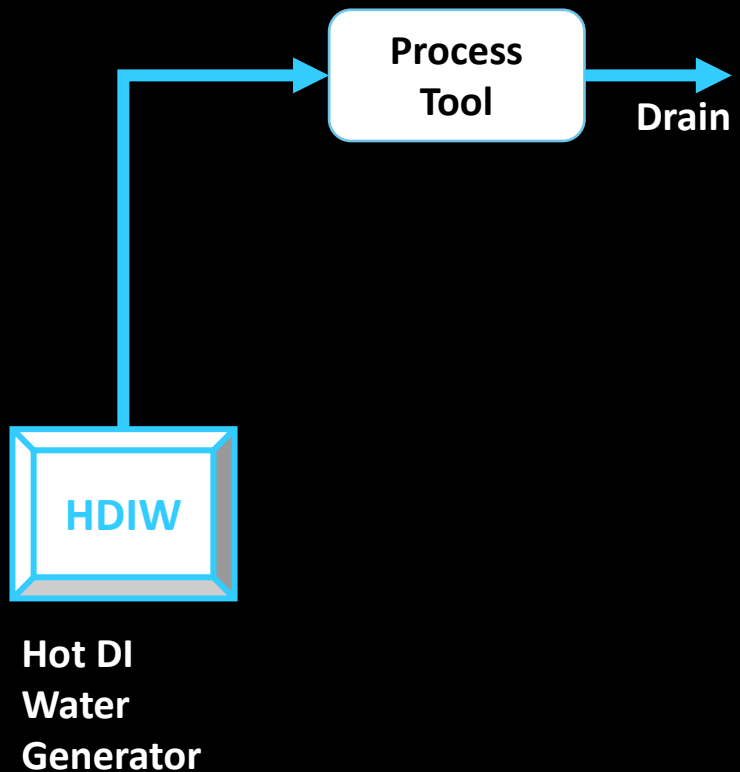


# Internal Water Reuse and Recycle

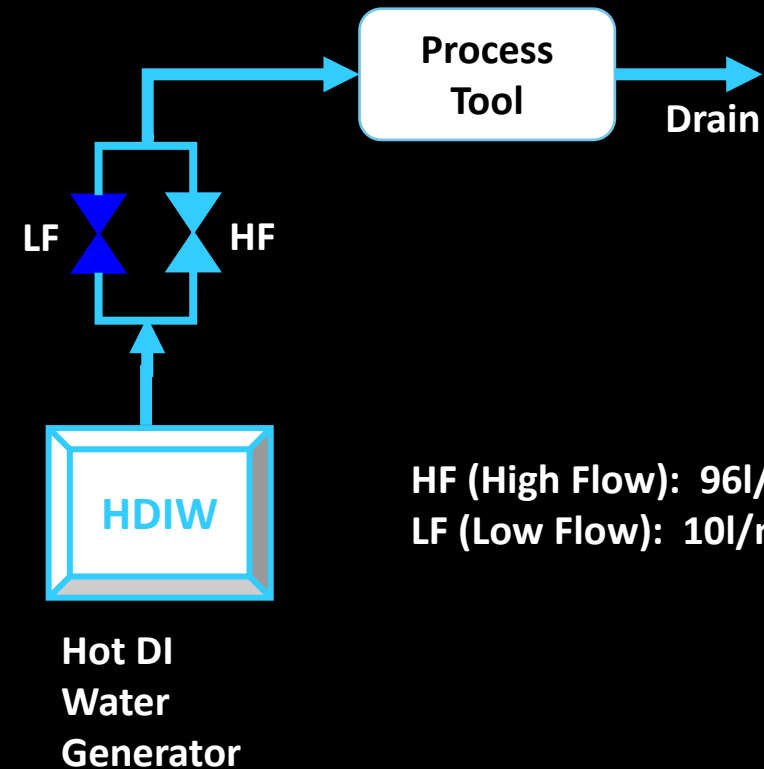
## Process Optimization-High/Low HDIW valve Switching

> 10,000 m<sup>3</sup>/year hot DI water to be saved

**Before**



**After**



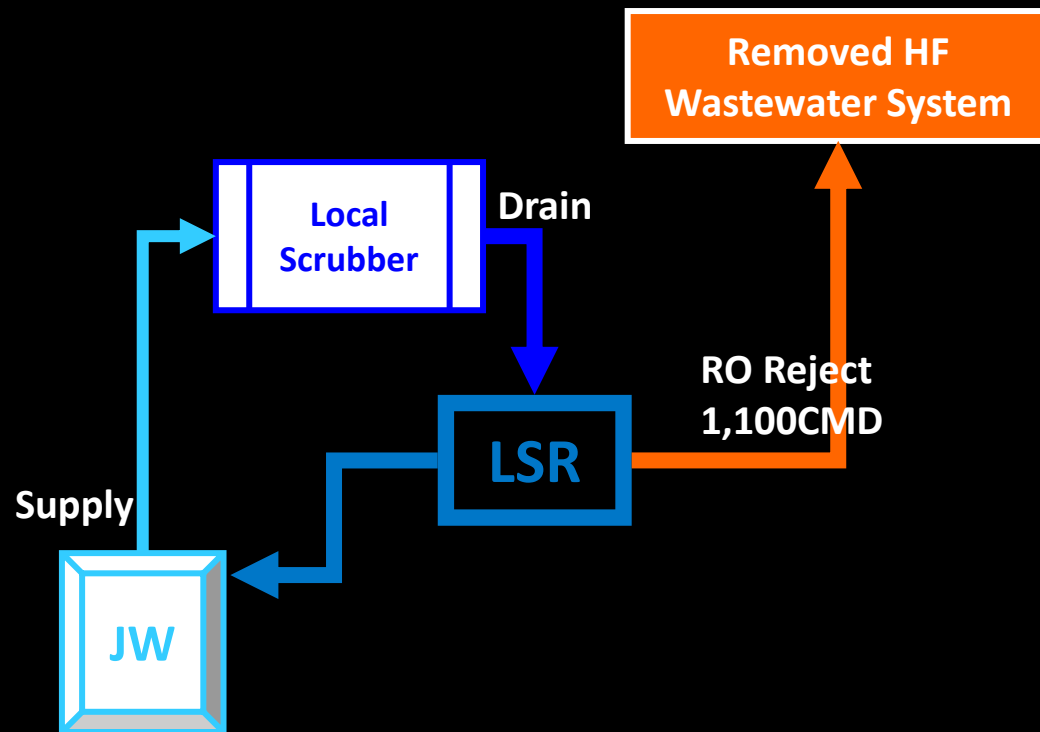


# Internal Water Reuse and Recycle

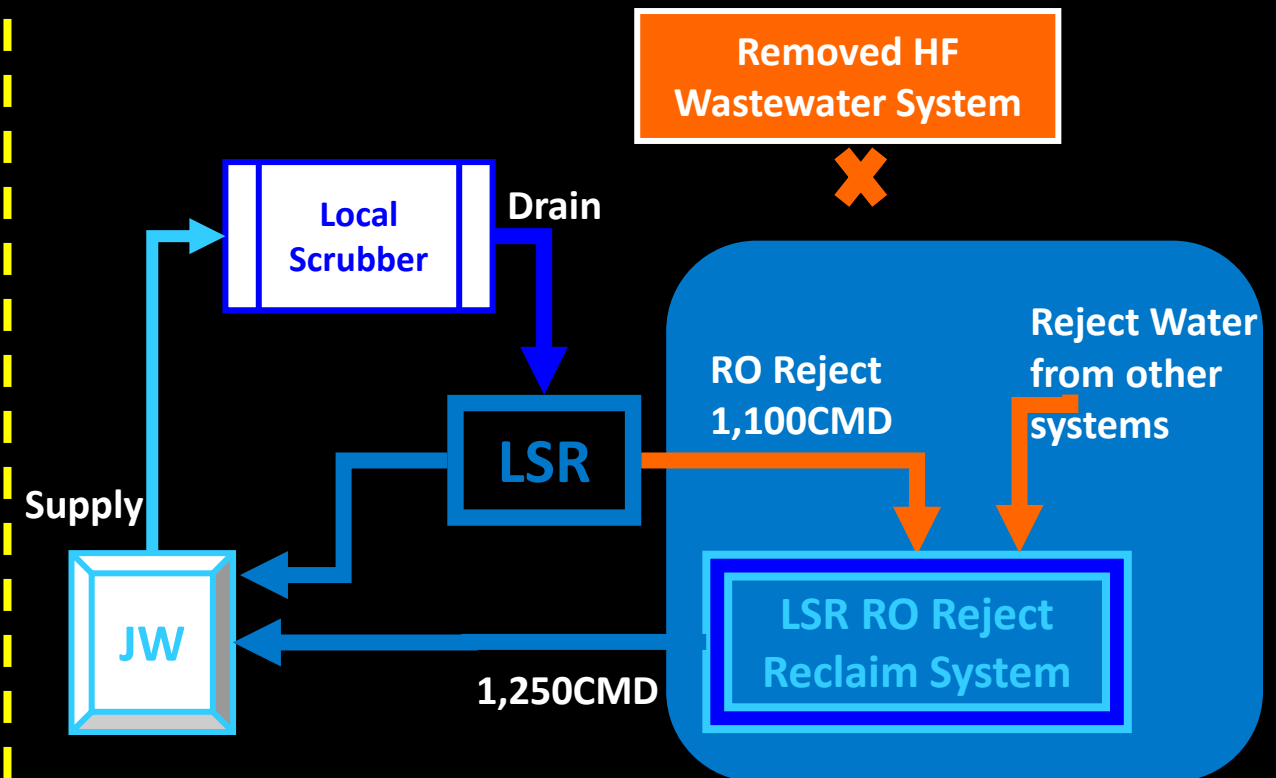
## Facility Upgrade- Local Scrubber Reclaim RO Reject Water Reclaim

> 456,000 m<sup>3</sup>/year water to be saved

### Before



### After



# External Water **R**estoration

Micron

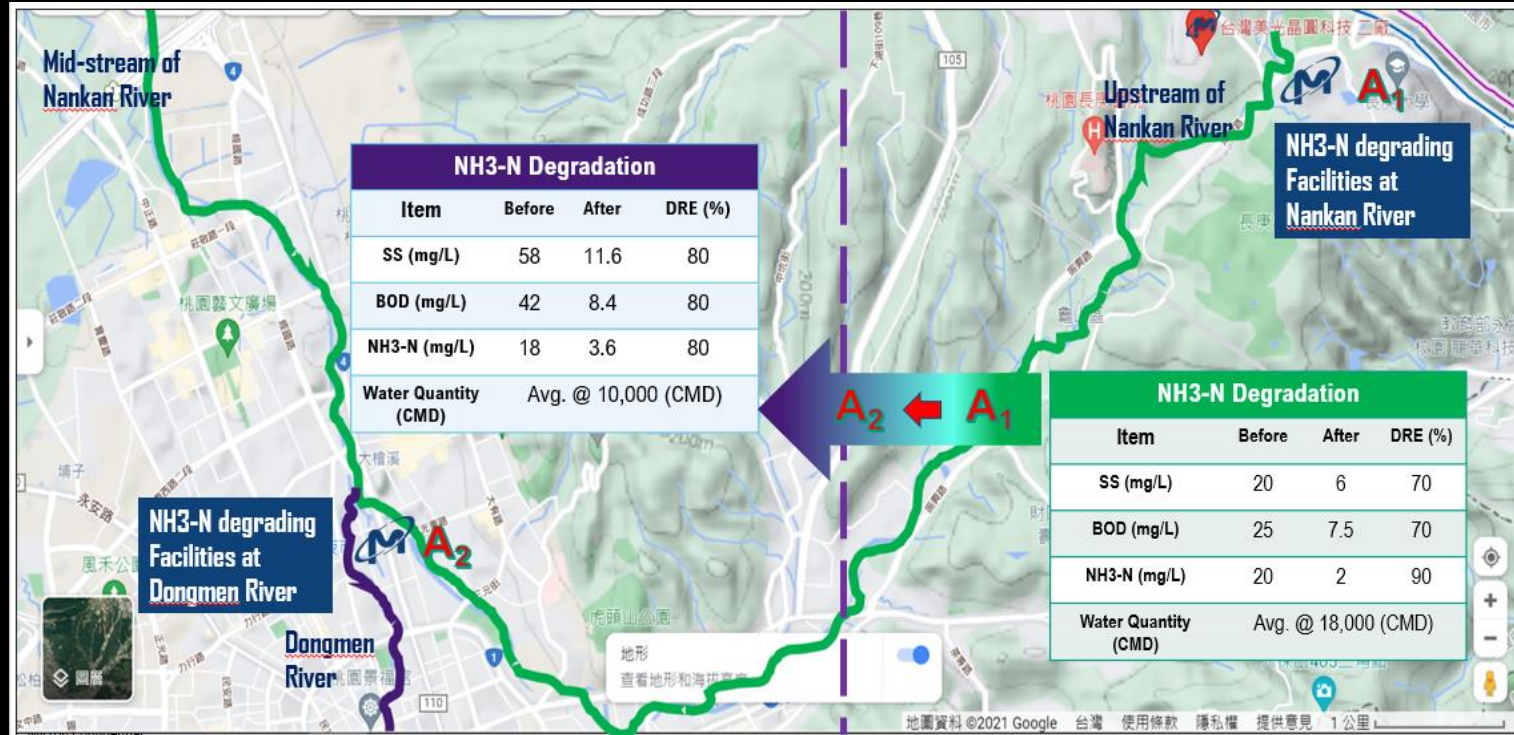


Government



# External Water Restoration

Nankan & Dongmen River (南崁溪、東門溪) water treatment



- ◆ Micron donated \$5M for setting up the NH3-N degradation systems for treating water pollutant in Nankan River and Dongmen River (南崁溪、東門溪).



# External Water Restoration

Shihmen Reservoir (石門水庫) Desluge Project



- ◆ Micron donates \$9.7M to subsidize local authority to remove the sludge to improve reservoir's lifetime and capacity.

# What's Next?

Investing in the future

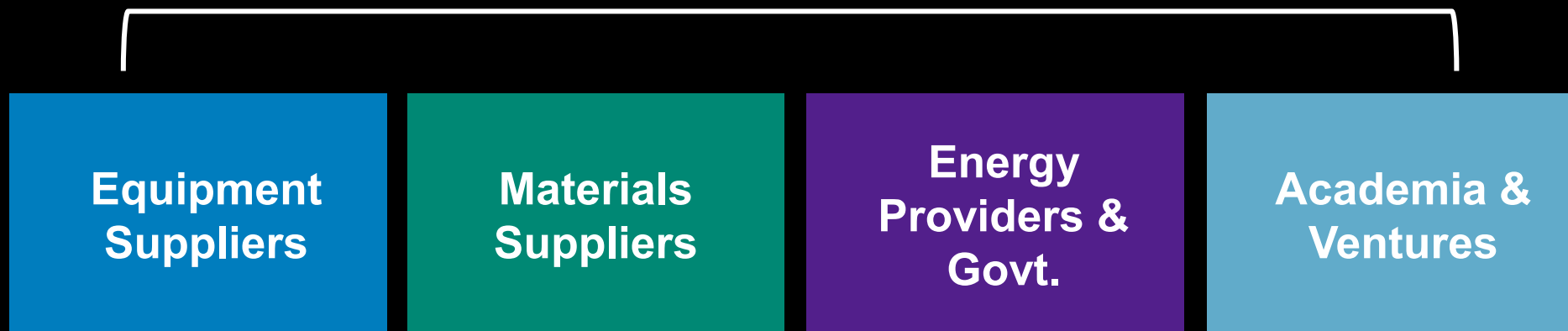
## Micron

- US\$3.7B sustainability-linked credit facilities
- US\$1B Green Bond
- Focused venture funding

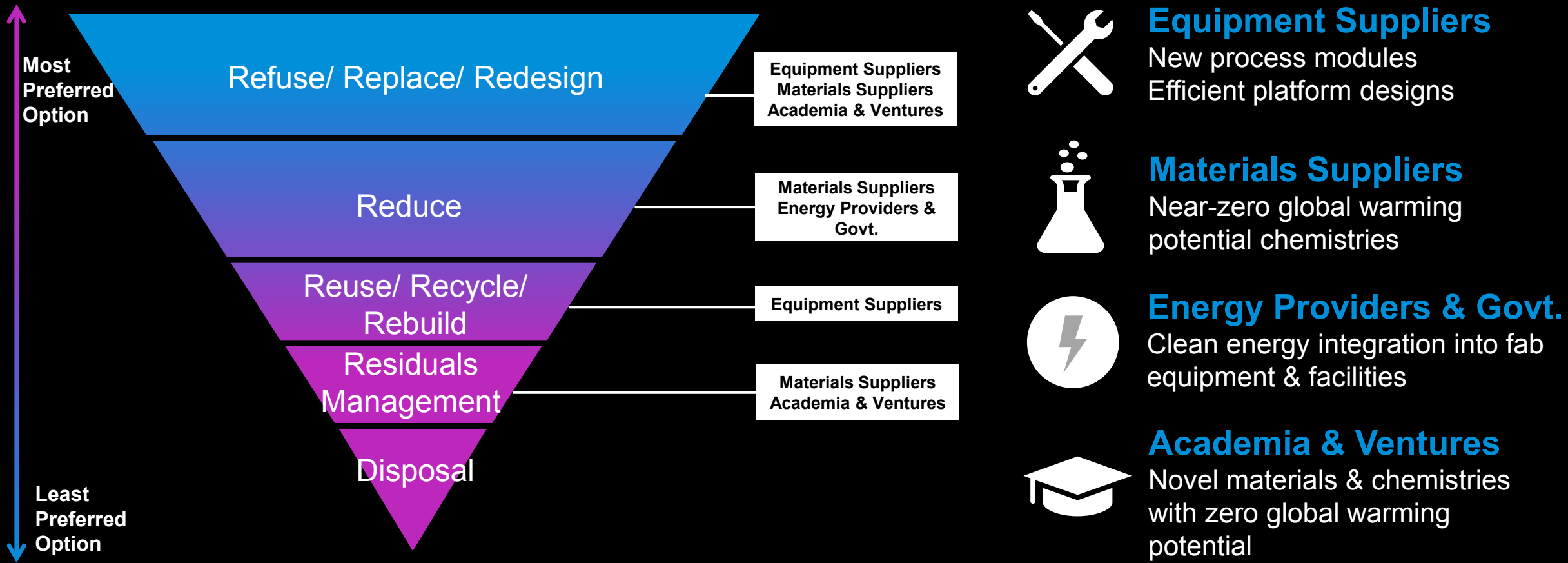
+

## Other

# IDMs



# Our Strategy







# Delivery Leading Edge Products & Responsibly

*Joint efforts for a sustainable future with all the stakeholders*





# Water and the Sustainable Development Goals

**Aleksandra (Alex) Drizo**

Professor of Sustainability Science and Management  
Tunghai University International College

# Outline

- 1 Introduction
- 2 Water Related Risks and Challenges
- 3 Drizo's contributions to solving eutrophication
- 4 Conclusions



# Introduction

- Water is in the center of all 17 SDGs
- **“Access to safe water, sanitation and hygiene is the most basic human need for health and well-being”<sup>1</sup>.**
- **“The importance of water is truly cross-cutting and is crucial to the success of not only "Planet" but also "People", "Prosperity", "Peace" and "Partnership“ Goals”<sup>2</sup>.**



Source: van Leeuwen K et al. (2019). Water. 2019; 11(6):1180. <https://doi.org/10.3390/w11061180>

<sup>1</sup>United Nations (2023). Goal 6: Ensure access to water and sanitation for all. url: <https://www.un.org/sustainabledevelopment/water-and-sanitation>; <sup>2</sup><https://documents-dds-ny.un.org/doc/UNDOC/GEN/N15/291/89/PDF/N1529189.pdf?OpenElement>

# Introduction

## PEOPLE

*"We are determined to end poverty and hunger"*



## PROSPERITY

*"We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature."*



## PLANET

*"We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations."*



## PEACE

*"We are determined to foster peaceful, just and inclusive societies which are free from fear and violence."*



## PARTNERSHIP

*"We are determined to mobilize the means required to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of strengthened global solidarity."*





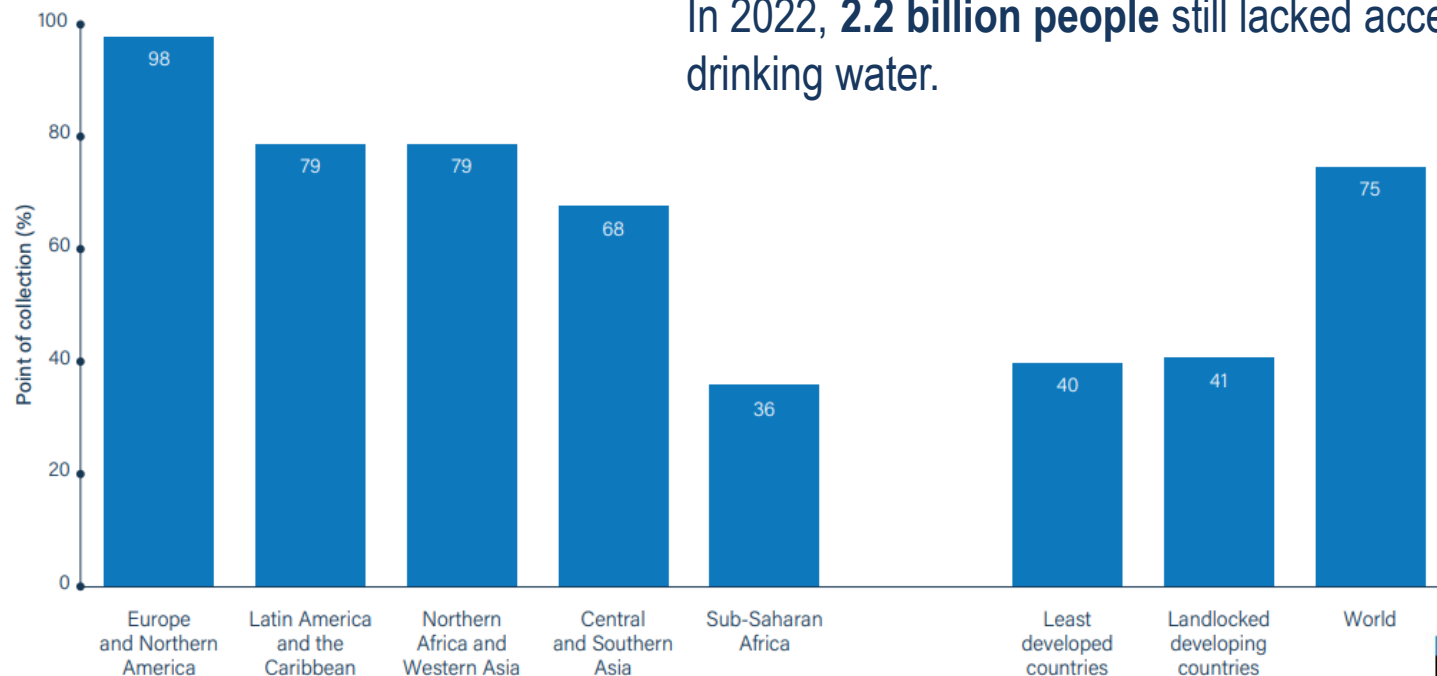
- The MDGs set out to *reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015* was achieved<sup>1</sup>.
- Access to Safe Drinking Water Increased by *2.6 Billion People Globally (1990-2015)*<sup>1</sup>.
- However, **one in three people living in least developed countries (LDCs) remained without access to clean, safe water**<sup>1</sup>.
- **Between 2015 and 2022**, the proportion of the world's population with access to safely managed drinking water increased from **69 per cent to 73 per cent**<sup>2</sup>.



<https://www.macrotrends.net/countries/WLD/world/clean-water-access-statistics>

<sup>1</sup>Development and Globalization 2016 Facts and Figures. Goal 6: Clean water and sanitation. [url:https://stats.unctad.org/Dgff2016/planet/goal6/index.html](https://stats.unctad.org/Dgff2016/planet/goal6/index.html);

<sup>2</sup><https://unstats.un.org/sdgs/report/2023/Goal-06/#:~:text=Between%202015%20and%202022%2C%20the,67%20to%2075%20per%20cent>

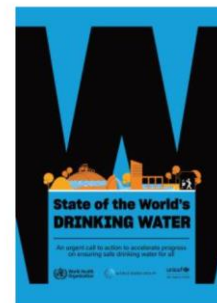


In 2022, **2.2 billion people** still lacked access to safely managed drinking water.

***“Billions of people will lack access to basic services in 2030 unless progress quadruples”<sup>2</sup>***

**Proportion of population using improved drinking water sources free from contamination by region in 2020 (%)<sup>1</sup>.**

<sup>1</sup>Source: The State of the World's Drinking Water. WHO, World Bank Group, UNICEF. url: <https://www.unicef.org/reports/state-worlds-drinking-water>; <sup>2</sup><https://www.un.org/sustainabledevelopment/water-and-sanitation>



**Author(s)**  
WHO, World Bank Group, UNICEF

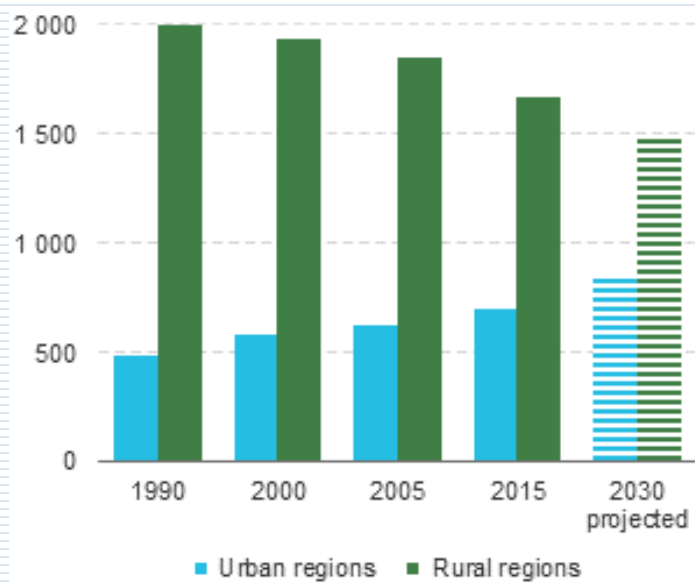
**Publication date**  
October 2022

**Languages**  
English, French





- There have been many improvements with regard to the availability of improved sanitation facilities around the world<sup>1</sup>.
- Between 1990 and 2015 about 2.1 billion people worldwide have gained access to improved sanitation<sup>1</sup>.
- **In 2022, 3.5 billion** lacked safely managed sanitation services, of which approximately 1.9 billion had basic services.<sup>2</sup>



**World urban and rural population without improved sanitation facilities for selected years** (Millions). Sources: WHO/UNICEF Joint Monitoring Programme (improved sanitation facilities) and UNCTADstat (Population)

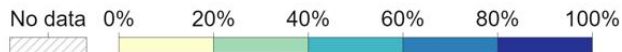
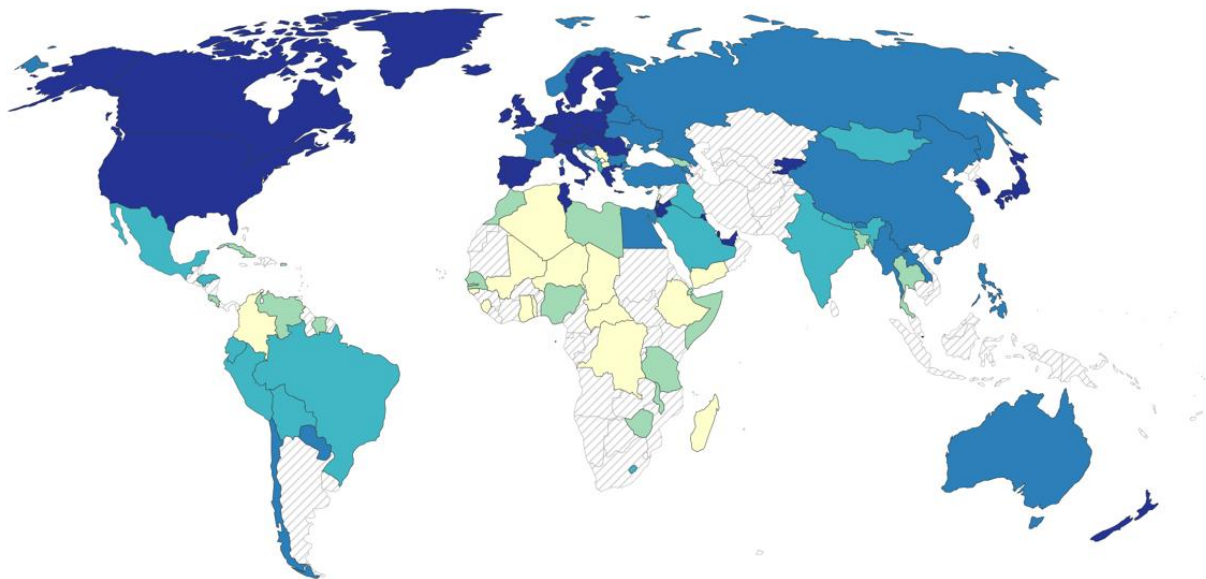
<sup>1</sup>United Nations (2023). Goal 6: Ensure access to water and sanitation for all. url: <https://www.un.org/sustainabledevelopment/water-and-sanitation>; <sup>2</sup>The Sustainable Development Goals Report 2023: Special Edition. url: <https://unstats.un.org/sdgs/report/2023>



## Share of the population with access to safely managed sanitation, 2020

Safely managed sanitation means improved facilities which are not shared with other households and where excreta are safely disposed on-site or transported and treated off-site.

Our World  
in Data



## Water Related Risks and Challenges

“Ensure access to clean water and sanitation for all”



- 26% (2.1 billion) of the world's population does not have access to safe drinking water and 46% (3.7 billion) lacks access to basic sanitation.
- The U.N. World Water Development Report 2023 highlighted the **huge gap that needs to be filled to meet UN clean water and sanitation SDG by 2030.**
- **Estimated cost is between \$600 billion and \$1 trillion a year.**



<https://www.unwater.org/publications/un-world-water-development-report-2023>

# Water Related Risks and Challenges

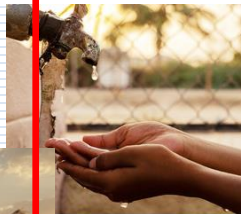
- **Physical Water Scarcity**

- **Water Pollution**

- **Water Availability**

- **Access to Clean Water**

- **Drought**



- **Water Management**



- **Water Infrastructure**



- **Climate Change**





2

# Water Related Risks and Challenges

## Why Cape Town Is Running Out of Water, and Who's Next

The South African city plans to shut off the taps to 4 million people. But it's just one of many cities around the world facing a future with too little water.



Carbon Brief

<https://www.carbonbrief.org/climate-had-no-signific...>

### Climate change had no 'significant' impact on northern ...

May 31, 2023 — Researchers focused on rainfall over the 21-day period in May 2023 in Emilia-Romagna and the maximum 21-day accumulated rainfall in April to ...

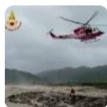


FloodList

<https://floodlist.com/europe/italy-flash-floods-cala...>

### Italy – Deadly Flash Floods in Calabria

Apr 4, 2023 — Stormy weather caused flash **floods**, landslides and wind damage in Calabria on 03 April. The worst affected areas were the provinces of Cosenza ...



Reuters

<https://www.reuters.com/world/europe/italian-farme...>

### Italian farmer battles frost, floods, heat and hail in epic year

Jul 20, 2023 — His troubles in 2023 started with a rare frost in April that halved production. The following month, rains and **floods** swept the region, killing ...



## Europe's worst ever drought summer 2022...



Switzerland



Greece



De Haan, Belgium



Portugal

<https://www.theguardian.com/environment/gallery/2022/aug/08/europes-worst-ever-drought-in-pictures?s=09>

# Water Related Risks and Challenges

## Taiwan Drought spring 2021

Google water shortage in taiwan

<https://topics.amcham.com.tw> › 2021/05 › water-shorta... ⋮

### Water Shortage Threatens Taiwan's Tech Industry Development

May 20, 2021 — After a year with no typhoons, **Taiwan** is currently experiencing its worst drought in more than half a century.

<https://focustaiwan.tw> › Society ⋮

### Water supply to be cut 2 days per week in parts of central ...

Mar 24, 2021 — In recent weeks, **Taiwan** has been dealing with a historic **water shortage**, mainly concentrated in the middle third of the country, ...

<https://www.bbc.com> › news › world-asia-56798308 ⋮

### Why the world should pay attention to Taiwan's drought - BBC

Apr 20, 2021 — That has plunged **Taiwan** into its worst drought in 56 years. Many of its reservoirs are at less than 20% capacity, with water levels at some ...

<https://web.cw.com.tw> › drought-2021-en ⋮

LIVE | Taiwan's Water Crisis 2021 | Commonwealth Magazine

COVER STORIES

## Water Shortage Threatens Taiwan's Tech Industry Development

BY ANGELICA OUNG ON 2021-05-20



Home / Taiwan News

Mon, Jul 10, 2023 page3

TAIPEI  TIMES

## Climate change affecting water quality

**EUTROPHICATION:** Climate change and development activities are helping to increase the nutrient levels present in the water reservoirs of Taiwan, the EPA said

By Chen Chia-yi / Staff reporter



The impact of climate change has deteriorated water quality at reservoirs. An Environmental Protection Agency (EPA) environmental water quality monitoring report for last year showed, 40 percent of the nation's major reservoirs are having eutrophication problems.

An academic said it is difficult to address the climate change problem quickly, but the government can improve the management of the upstream catchment areas, while an environmental protection group has urged the EPA and the Water Resources Agency (WRA) to set up management rules for catchment areas.

EPA Department of Water Quality Protection Director Yen Hsu-ming (顏旭明) yesterday said eutrophication occurs when nutrients, mainly nitrogen and phosphorus, are overabundant in a water body leading to an excessive algal growth, an exhaustion of dissolved oxygen levels, and the death of fishes and other aquatic creatures.



2

# Eutrophication

*the over enrichment of receiving waters with mineral nutrients resulting in excessive production of autotrophs, in particular algae, cyanobacteria and aquatic macrophytes...*

China



Brazil



Gulf of Mexico, USA



Canada



Baltic Sea

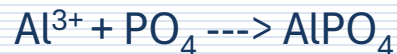
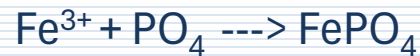
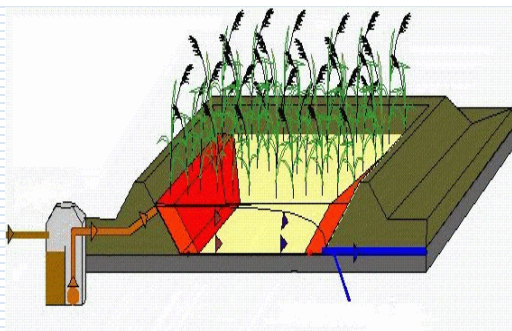


3

# Drizo's contributions to solving eutrophication

PhD studies, University of Edinburgh (1993 – 1998)

## P Removal from domestic wastewater via Constructed Wetlands Technology



## Industrial by-products and Natural Materials

- 1) Fe, Al or Ca oxides
- 2) P adsorption/retention capacity
- 3) Physical and chemical properties (specific surface area, hydraulic conductivity, particle size distribution, pH)
- 4) Cheap and locally available

*Laid down the foundation for materials selection for use in passive P filtration systems.*

Drizo et al, 1997; Drizo et al, 1999; Drizo et al, 2000.

# 3 Drizo's contributions to solving eutrophication

Ecole Polytechnique Montreal, QC, Canada  
(1999-2002)

Over 80 different Materials tested by Drizo et al (1993-to date):

Scotland, UK (1993-1998 )

6 materials

- 1) Shale
- 2) Fly ash
- 3) Zeolite
- 4) LECA
- 5) Burnt Oil Shale
- 6) Bauxite

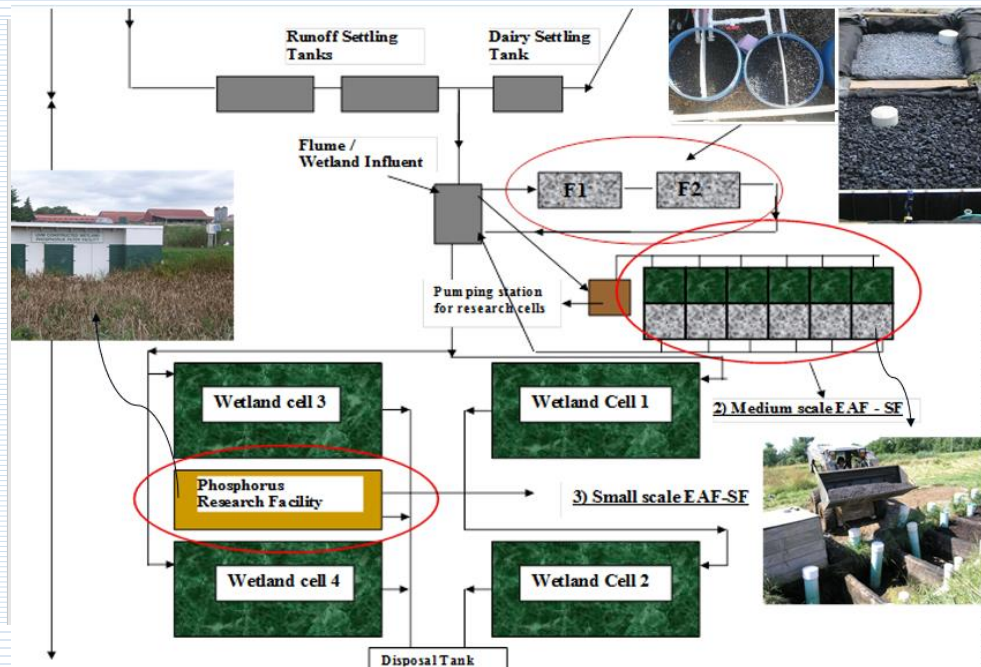
Vermont, US (2004-2012)

21 materials

- 1) Limestone products (Graymont Inc.) (7)
- 2) Various steel slag materials (14)

Canada (1999-2002)  
57 materials

- 1) Various limestone materials (31)
- 2) Sand and gravel (5)
- 3) Recyclable beton (1)
- 4) Serpentine (6)
- 5) Concrete pins (4)
- 6) Sludge from treatment plant (1)
- 7) Activated alumina (1)
- 8) Industrially modified sulphur based material (1)
- 9) Asbestos fibres (3)
- 10) Steel slag (4)



Drizo et al, 2002; Drizo et al, 2006; Weber et al., 2007; Drizo et al, 2008; Bird and Drizo, 2009; Bird and Drizo, 2009; Lee et al, 2010; Drizo, 2012

# Drizo's contributions to solving eutrophication

## Onsite Residential Systems

North Carolina, USA



Ireland



## Small Community Systems

Turkey



Brazil



## Urban Stormwater

Ohio, USA



Vermont  
USA



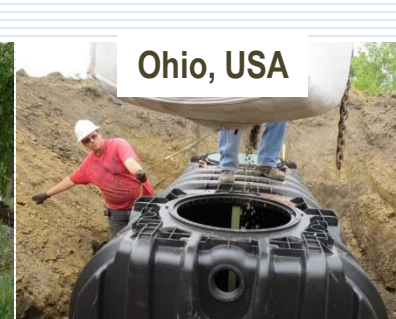
## Industrial Effluents Treatment

Virginia, USA



## Agricultural Effluents Treatment

Ohio, USA





Small Community Wastewater Treatment Systems Applications, Taiwan 2009-2011National Pingtung University of Science and Technology, NPUST

Operation Mode	Number of pore volumes	CELL 1		
		Removal Efficiency (%)		
		<sup>a</sup> PO <sub>4</sub> <sup>3-</sup>	<sup>b</sup> TP	<sup>c</sup> TSS
RUN 1: 63 d at 2 m <sup>3</sup> /d 09/08-11/10/2010	11.1	99.1	98.9	96.5
RUN 2: 69 d at 8 m <sup>3</sup> /d 12/10-19/12/2010	49.7	99.4	98.7	97.2
RUN 3: 55 d at 16 m <sup>3</sup> /d 20/12-11/03/2011	88.4	99.4	97.6	96.1
RUN 4: 36 d at 12 m <sup>3</sup> /d 12/03-22/04/2011	37.9	99.0	97.2	94.9
Total: 223 days	187.1	Average Removal Efficiency (%)		
		99.2	98.1	96.2



## Community Sewage and runoff treatment at Tubarão Lagoons, Vitoria, Brazil, 2012-2014



April 2013



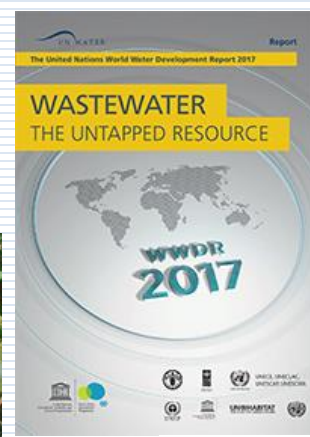
May 2014

3

# Drizo's contributions to solving eutrophication

## Add on value, in line with circular economy

Heavily polluted water resource



Sustainable  
fertilizer and  
soil  
amendment



Red Clover  
*Trifolium pratense* L.



Red fescue  
*Festuca rubra* L.



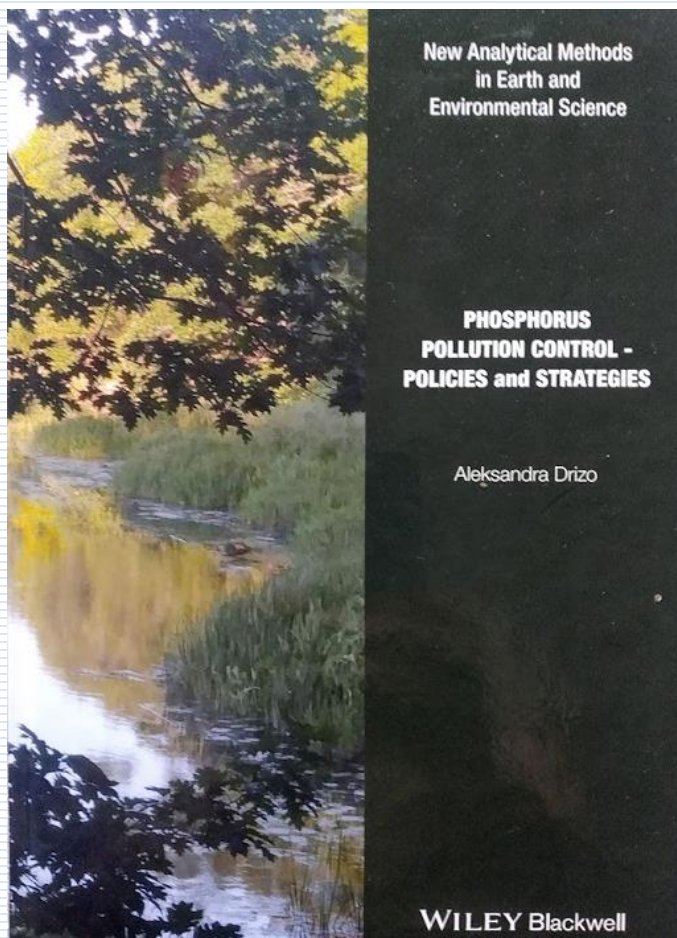
Day 10



Day 48

From waste material to beneficial water filtration media





WILEY Online Library

## Phosphorus Pollution Control - Policies and Strategies

Author(s): Aleksandra Drizo

First published: 15 October 2019

Print ISBN: 9781118825426 | Online ISBN: 9781118825518

| DOI: 10.1002/9781118825518

© 2020 John Wiley & Sons Ltd.

**Drizo, A., Johnston, C., Guðmundsson, J. (2022). An Inventory of Good Management Practices for Nutrient Reduction, Recycling and Recovery from Agricultural Runoff in Europe's Northern Periphery and Arctic Region. Water 2022, 14 (13), 2132. doi: 10.3390/w14132132.**

**Drizo, A. and Shaikh, M.O. (2023). An Assessment of Approaches and Techniques for Estimating Water Pollution Releases from Aquaculture Production Facilities. *Marine Pollution Bulletin*. In press.**

## Conclusions and Remarks

- Water plays a pivotal role in human well-being and in achieving a wider sense of security, sustainability and economic development.
- While there has been progress in achieving clean water and sanitation set out in SDG6, currently 26% of world population lacks access to clean water and 46% access to safe sanitation. Moreover, geographical distribution is uneven.
- *Estimated cost of meeting the SDG6 goals is between \$600 billion and \$1 trillion a year.*
- *Low-cost, sustainable, simple technologies and nature-based solutions for wastewater treatment and water quality protection have been developed.*
- *However, regulatory framework is fragmented and developed only for municipal wastewater treatment plants in urban areas.*
- *The cost of novel technology certification and validation is an unsurmountable obstacle for researchers and small businesses.*



# Conclusions and Remarks

- Partnerships and cooperation are the key.
- Regulatory framework ought to be revised and extended to adequately address all pollution sources and enable/promote implementation of water clean up projects.
- Better coordination and cooperation mechanisms are necessary to generate additional funding streams for water related investments into relevant projects.



**THANK YOU**

謝謝

**Questions?**

## SDG ladder for sanitation services

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or removed and treated off-site
BASIC	Use of improved facilities that are not shared with other households
LIMITED	Use of improved facilities that are shared with other households
UNIMPROVED	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
OPEN DEFECACTION	Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open places, or with solid waste

**Note:** Improved facilities include: flush/pour flush toilets connected to piped sewer systems, septic tanks or pit latrines; pit latrines with slabs (including ventilated pit latrines); and composting toilets.

<https://data.unicef.org/topic/water-and-sanitation/sanitation/#:~:text=Since%202000%2C%202.5%20billion%20people,1.9%20billion%20had%20basic%20services.>