



# TSMC 2022 Sustainability Report



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# Weaving a Sustainable Future Together

Sustainability is like weaving, pooling people's collective strengths  
and consolidating resources

Weaving a harmonious, symbiotic world by adopting a development  
model focused on the common good

Sustainability also connects people in rural and urban areas, fostering  
an exchange of mutual trust and mutual assistance

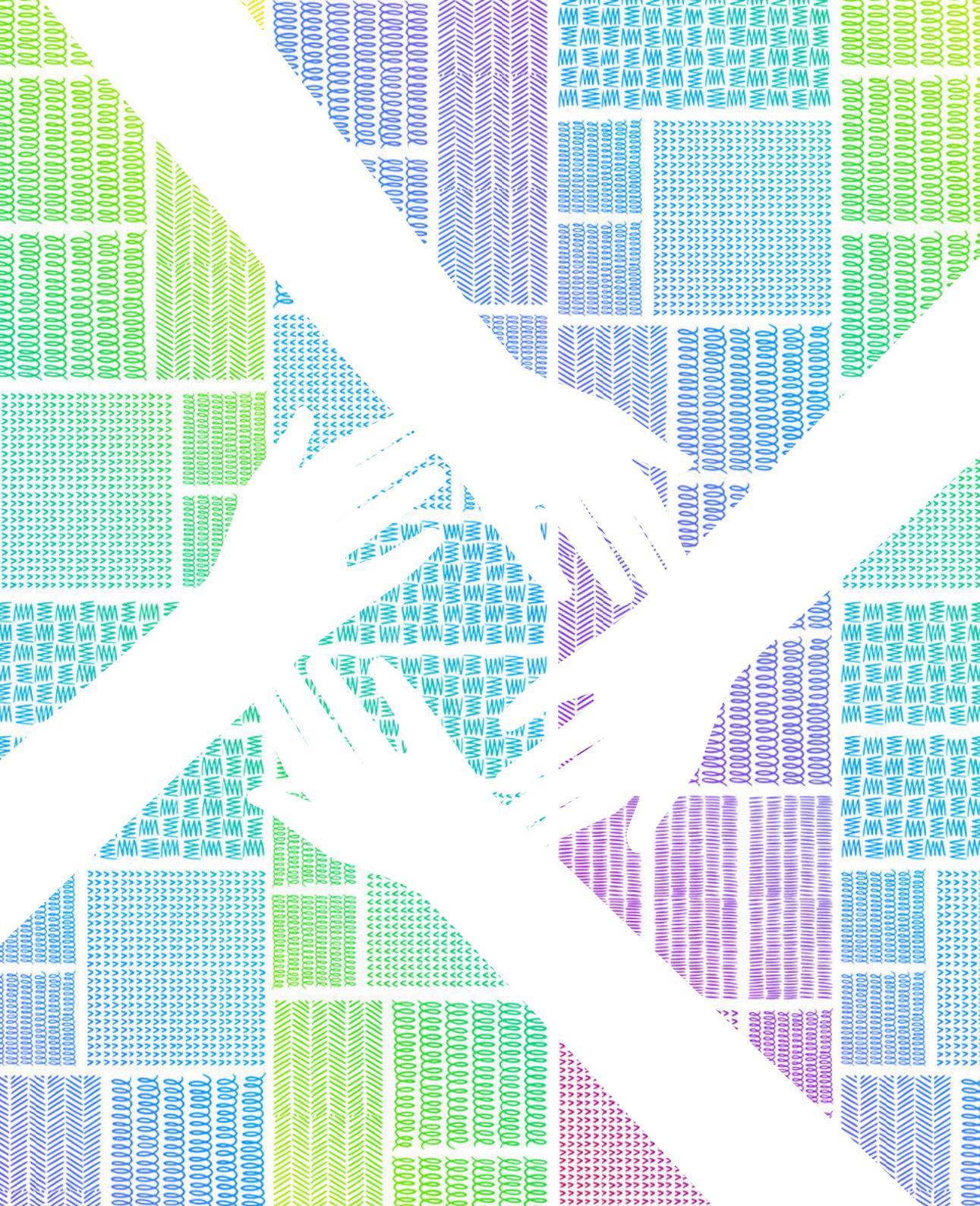
TSMC enables innovation and invites partners from all walks of life to  
weave a web of sustainability

Through technology and collaboration

Realizing co-prosperity between people and nature as well the society

Building on the foundation of innovative vertical applications, TSMC  
aspires to create a horizontal expansion of the value chain

Ensuring the resilience, breadth, and longevity of the sustainability





# Letter from the ESG Steering Committee Chairperson

Over the past year, the world has faced numerous economic, social and geopolitical changes, including uncertainties in globalization and free trade, lockdowns caused by the COVID-19 pandemic, the war in Ukraine, global transportation bottlenecks, and inflationary pressures. This has tested the resilience of the global supply chain and the adaptability of businesses. As a responsible global corporate citizen, TSMC has accelerated the adoption of ESG (Environmental, Social, and Governance) initiatives in its operations and industrial value chain, and continues to inject positive energy into society.

Prospering with the natural environment is the cornerstone of TSMC's sustainable operations, and a green and low-carbon supply chain is an important part of our 2050 net-zero emissions blueprint. As an industry leader, TSMC uses its green influence to continuously work with suppliers to deepen overall low-carbon management. By providing suppliers with guidance on carbon inventory, energy conservation, and carbon reduction, we encourage them to adopt carbon capture equipment and reduce indirect carbon emissions in the value chain. In 2022, TSMC was again selected by the Carbon Disclosure Project (CDP) as a Supplier Engagement Leader, and we continued to drive the industry towards low-carbon sustainability. In the same year, TSMC's Southern Taiwan Science Park Industrial Reclaimed Water Plant started operations, and our Zero-Waste Manufacturing Center is expected to start operation in 2023. At our Arizona fab, we also plan to build an industrial recycled water plant to gradually achieve near zero liquid discharge, advancing toward our goal of circular economy. We continue to make every effort to minimize environmental externalities through prudent decision-making and coordinated global action on four major issues: climate and energy, water stewardship, circular resources, and air pollution control.

As the leading provider of semiconductor process technology and manufacturing services, TSMC uses the power of semiconductor innovation to make products stronger, smarter, safer, more energy efficient, and more advanced to enrich people's lives and empower society for the common good. I am very proud of TSMC's employees across the company who work hard for this mission. Guided by our [Human Rights Policy](#), TSMC continues to create a working environment that respects human rights. This means we provide a dignified workplace that

is diverse, equal, and inclusive (DEI) and promotes the integration of global talents, and we require our supply chain partners to follow the same standards. At the same time, we continue to deepen our connection with the society and wholeheartedly support global STEM education. Through the [TSMC Education and Culture Foundation](#) and the [TSMC Charity Foundation](#), we deepen community relations, care for the disadvantaged, and preserve national art and culture, laying a solid foundation for social progress with common values.

In 2022, we released the [UN SDGs Action Report](#) for the first time to disclose the company's SDGs action plan and progress. We also explained the company's management policy on major issues with our [Materiality Analysis Report](#) to enhance the transparency of sustainable information disclosure. In order to make the Board of Directors more comprehensive and transparent and achieve better corporate governance, we also prepared for the establishment of the Board's Nominating, Corporate Governance and Sustainability Committee, which was approved in February 2023, strengthening the effectiveness of its sustainability governance. The Board of Directors also decided to change the Audit Committee to the Audit and Risk Committee and the Compensation Committee to the Compensation and People Development Committee to expand and deepen its supervision and review responsibilities, making the corporate governance structure more robust.

We have a deep understanding of TSMC's key position in the global semiconductor industry and its influence on many economies, and are keenly aware of our urgent responsibilities in sustainability that we shoulder as a corporate citizen. As TSMC's global business expands, we will deepen our partnership with stakeholders including employees, public associations, communities, investors and shareholders, and our supply chain and customers, listen to the voices of all parties, and open a new chapter of sustainable development together.

Mark Liu

Chairman and ESG Steering Committee Chairperson





# Letter from the ESG Committee Chairperson

Looking back on 2022, just as the COVID-19 pandemic showed signs of easing and people could see recovery on the horizon, geopolitical conflict threw the world into disarray amidst systemic risks from crises in energy, food, human rights, and environmental damage. Fortunately, substantive progress was achieved at the 27th Conference of the Parties of the UNFCCC (COP 27) and the 15th UN Biodiversity Conference (COP 15), so that we were able to continue forwards into an inclusive and sustainable future.

Facing a volatile economic environment, TSMC focused on its core competitive advantages of Technology Leadership, Manufacturing Excellence, and Customer Trust. Strong demand from 5G cellular network and high-performance computing applications enabled our total wafer shipments in 2022 to reach 15.3 million 12-inch equivalent wafers, and realize 12,698 product innovations for customers. We also delivered a 13<sup>th</sup> consecutive year of record revenue, driving sustainable development through profitable growth.

TSMC responded to the call to action at COP 27 by making carbon reduction initiatives our top priority. During the course of 2022, we successfully implemented 823 energy-efficiency, water conservation, and waste reduction innovation projects. A target of Net Zero Emissions by 2050 was also set with annual progress reviews planned to dynamically adjust and set even more ambitious carbon reduction pathways. We also drew up the [Carbon Credits Quality Standards for Voluntary Emissions Reductions](#) based on international guidelines and industry benchmarks to ensure that carbon credits are not obtained from sensitive regions. Furthermore, we leveraged our industry leadership to invite suppliers to participate in the [CDP Supply Chain Program](#). The program complements suppliers' existing carbon reduction actions to help us mitigate the global climate crisis together. In light of the close association between Climate Change and Biodiversity, we issued the [Biodiversity Statement](#) for the first time in 2022 as a climate citizen of the new era. The statement commits TSMC to achieving Zero Deforestation, No Net Loss of biodiversity, and Net Positive Impact. Achieving Water Positivity was also set as a future strategy to enhance our climate resilience as part of a multi-pronged approach.

In addition to our environmental commitments, TSMC also works tirelessly to build a diverse, equal, and inclusive working environment. The first [survey into salient](#)

[human rights issues](#) was completed in 2022, with the establishment of a trans-organizational human rights working group and due diligence scheduled for 2023. The subsequent promotion of preventive, mitigation and remedial measures as well as related education and training will ensure human rights protection from a stakeholder perspective. We also founded [Women@tsmc](#), an Employee Resource Group (ERG) primarily aimed at women, and a new dedicated ERG was set up for foreign employees to build employee cohesion and promote career development. We also completed the first [safety culture investigation](#), and introduced [free health check-ups](#) on contractor sites to build an inclusive workplace.

Upholding the spirit of Leaving No One Behind, TSMC actively works to achieve UN Sustainable Development Goals (SDGs). In addition to continuously expanding the [University Collaboration Programs](#), cultivating semiconductor talents, and helping to meet shortfalls in emergency assistance resources, we also worked to harness the power of employee volunteers for youth and rural empowerment, promotion of the arts, and assisting the disadvantaged through the [TSMC Education and Culture Foundation](#) and [TSMC Charity Foundation](#). Using the [Business for Societal Impact \(B4SI\)](#) framework as a reference, we also evaluated the overall benefits of invested resources and identified previously overlooked social needs, so that TSMC can become a force for positive change.

TSMC is the only semiconductor company in the world to be included in the Dow Jones Sustainability Indices for 22 consecutive years. Nevertheless, we don't stop there. With the publication of the annual TSMC Sustainability Report along with the [Environmental Profit and Loss \(EP&L\) Report](#), [TCFD Report](#), [UN SDGs Action Report](#), and [Materiality Analysis Report](#), we continue to adopt global trends in sustainability management, and transparently share TSMC's sustainability journey and accomplishments with stakeholders. Looking ahead, TSMC will embrace the ESG vision of "Uplift Society" to bring about positive change.

**Lora Ho**

Senior Vice President  
and ESG Committee  
Chairperson



# About TSMC

In the face of global climate change and geopolitical tensions, TSMC is committed to innovation to improve the well-being of human life. Upholding the three competitive advantages of Technology Leadership, Manufacturing Excellence, and Customer Trust, TSMC continues to fulfill its mission as a trusted technology and capacity provider to the global logic IC industry. In 2022, TSMC's consolidated income reached NT\$2,263.89 billion, achieving a record high for the 13th consecutive year. In addition to seeking the greatest achievements in its core business, TSMC adheres to its philosophy of responsible business, working together with employees, shareholders/investors, customers, suppliers/contractors, government/industry associations, and society to strive for excellence in the three dimensions of economy, environment and society. TSMC is determined to be a force that uplifts society and creates sustainable value.

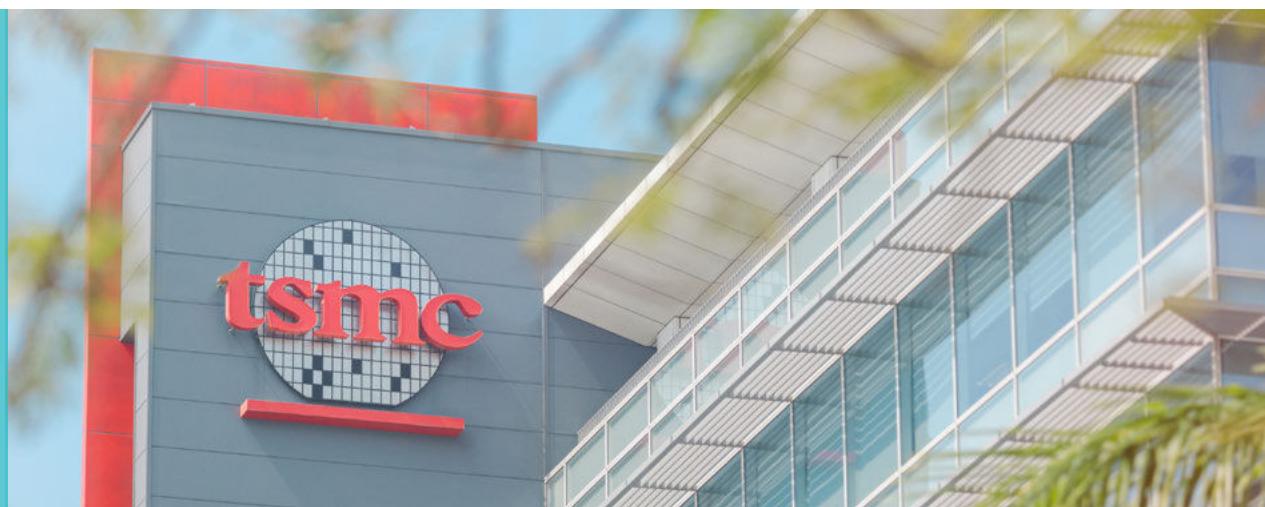
Headquarter  
**Hsinchu Science Park**

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Founded in  
**1987**

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Number of Employees  
**73,677**



**\$1,016.53 Billion**

Net income; 70.4% increase from 2021 (NT\$)

**15.3 Million**

12-inch equivalent wafers total wafer shipments reached

**532 Customers**

Needs were satisfied through 288 distinct process technologies

**13 Consecutive Years**

Record high revenue

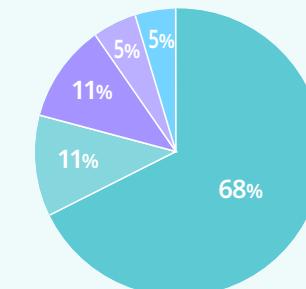
**53%**

Of TSMC's wafer revenue came from advanced manufacturing processes with geometries of 7nm and smaller, up three percentage points from 2021

**30%**

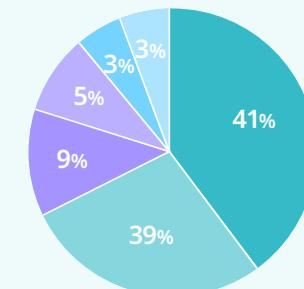
Of worldwide semiconductor output value (excluding memory) generated up four percentage points from 2021

**Revenue Percentage by Customer HQ Location**



■ North America ■ Asia Pacific excluding Japan and China  
■ China ■ Europe, Middle East, and Africa ■ Japan

**Revenue Percentage by Product Platform**



■ High-performance Computing ■ Smartphones  
■ Internet of Things ■ Automotive Electronics  
■ Consumer Electronics ■ Other Products

# Innovation Value

Semiconductors power almost everything in daily life and have significantly changed the way people live and work in areas including communications, data processing, agriculture, transportation, healthcare, education, clean energy, and more. Through its five technology platforms - High Performance Computing (HPC), Smartphone, Internet of Things (IoT), Automotive, and Digital Consumer Electronics, TSMC provides customers with comprehensive and competitive logic process technologies, specialty technologies, IPs, and packaging and testing technologies to help them accelerate their product innovation and move society forward with technology.



Supercomputers, with powerful computing capabilities, are vital to powering digital transformation and the digital economy in the era of 5G and AI. They rapidly process and analyse vast amounts of data for a wide range of applications such as accurate weather forecasts and climate predictions, which helps protect us from the impact of increasingly severe storms, floods and snow.

Photo: Courtesy of Fujitsu and RIKEN



A smartphone is now a PC in our pocket. It can overcome the limitations of time and distance to make work, communication, entertainment, and life more convenient, including video conferencing, online learning, banking, shopping, and travel booking, and telemedicine.



Continued advancement of agricultural drone technology is a key to sustainable agricultural development. GPS-fitted drones with a variety of sensors can help farmers to make timely adjustments to field management and improve farming efficiency and quality, as well as reduce waste.



The global automotive industry focuses on the four major innovation trends of connected, autonomous, shared, and electric (CASE). Electric vehicles are powered by batteries and do not emit harmful exhaust gases on the road. This, combined with continued progress in advanced driver-assistance systems (ADAS), creates a safer and more environmentally-friendly driving experience.



High-performance portable ultrasound scanners are becoming a common diagnostic tool. Unlike bulky traditional instruments, they are only the size of a mobile phone, and feature faster and sharper imaging capabilities, which can help medical professionals around the globe save time in diagnosis and treatment, and improve overall health care efficiency.

Photo: Courtesy of Butterfly Network

## Innovations for Sustainability

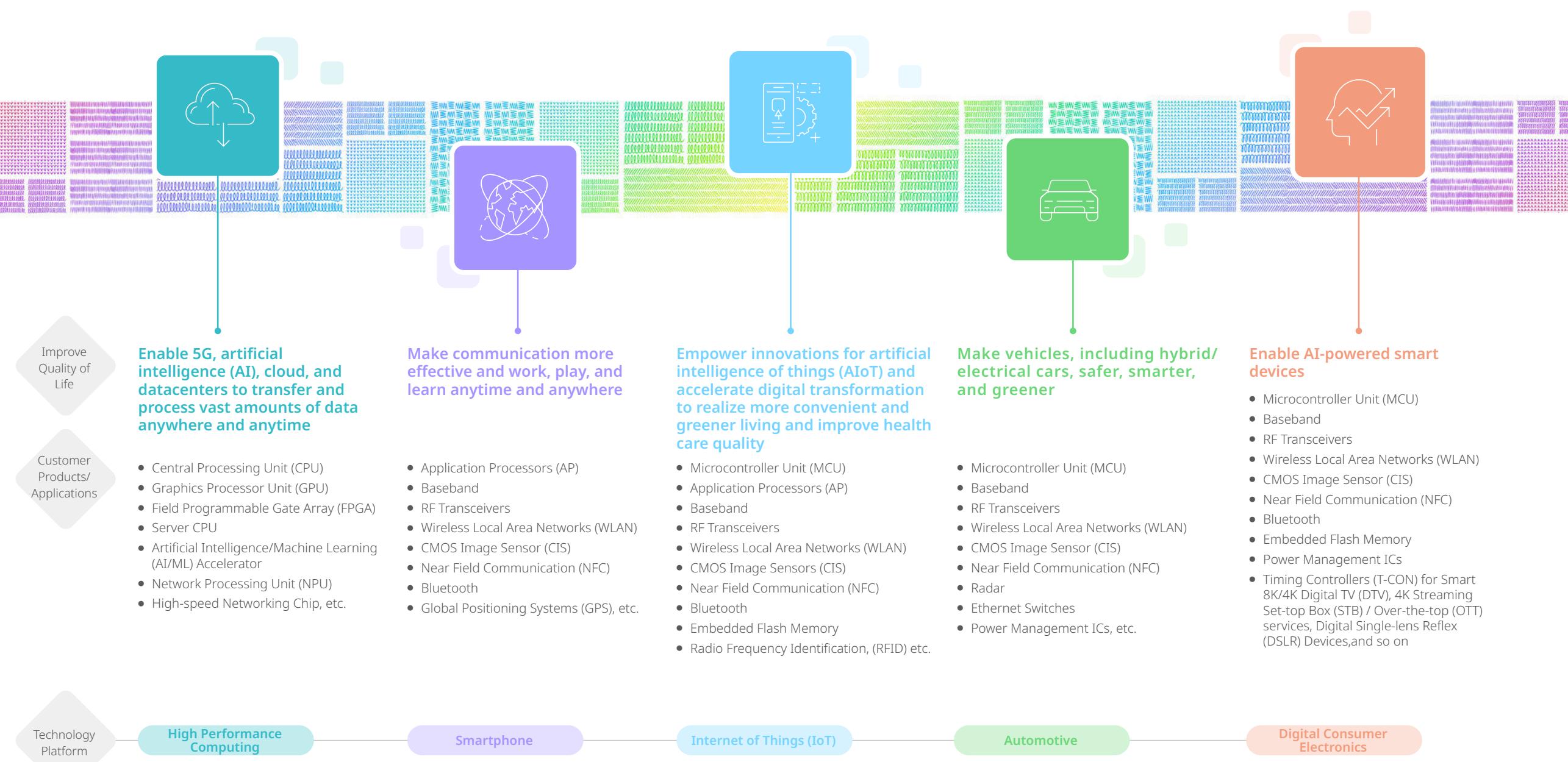
TSMC continues to advance semiconductor manufacturing technologies and services, enabling customers to unleash more than 12,600 chip innovations in 2022. These innovations make products more advanced, capable, intelligent, energy-efficient, and safer, greatly increasing the quality of life and helping to build a sustainable society based on the common good.

## Technology Development Focuses

- Continue to drive semiconductor scaling for both logic and specialty technologies
- Continue to expand specialty technology offerings
- Continue to advance and expand TSMC 3DFabric™ technology offerings

## Benefits to Customer Product Innovation

- Boost product computing power
- Increase product energy efficiency
- Enable smaller form factors
- Provide greater chip design flexibility





# Sustainability at TSMC

## Economic

5,472 Million

R&D expenditures increased 22.5% compared to 2021 (US\$)

100%

Patent approval rate in the U.S., better than any other top 10 patent holders

2.07 Trillion

Output value (NT\$) and 309,000 jobs generated in Taiwan

1

12,698 Products

Leading the world in volume production of 3nm process technology

Fabricated for customers through manufacturing excellence

## Environmental

Net Zero Emissions

1

98.9%

54.3%

96%

Overseas sites achieved net zero emissions in Scope 1 and 2

S.T.S.P. Reclaimed Water Plant commenced operation – the world's first industrial reclaimed water plant for advanced semiconductor processes

Reduction rate of volatile organic gases

The water pollution composite indicator reached the 2030 goal ahead of time

Waste recycling rate achieved and only <1% of waste has been sent to landfills for 13 consecutive years

## Social

2,518,073

People received employees' training

239.5 Billion

Total compensation and welfare for TSMC employees around the world, a 45% increase from 2021 (NT\$)

>6,800

Students around the world participated in TSMC's diverse industry-academia cooperation programs

1.779 Billion

Invested into social engagement (NT\$)

2,291,030

Beneficiaries of social engagement programs



# Awards, Recognitions, and Ratings

Member of  
**Dow Jones  
Sustainability Indices**  
Powered by the S&P Global CSA



**World Benchmarking  
Alliance**



**Dow Jones  
Sustainability Indices (DJSI)**

- Dow Jones Sustainability World Index for the 22<sup>nd</sup> consecutive year
- Dow Jones Sustainability Emerging Markets Index

**MSCI ESG Indexes**

- MSCI ACWI ESG Leaders Index component
- MSCI ESG Research – AAA Ratings
- MSCI ACWI SRI Index component
- MSCI ACWI Islamic Index component
- MSCI Emerging Markets ESG Leaders Index

**ISS ESG**

- "Prime" Rated by ISS ESG Corporate Rating

**FTSE4Good Index**

- FTSE4Good Emerging Index component
- FTSE4Good All-World Index component
- FTSE4Good TIP Taiwan ESG Index component

**World Benchmarking Alliance (WBA)**

- SDG2000 – The 2,000 Most Influential Companies

**CDP**

- 2022 CDP Supplier Engagement Leaderboard
- Water Security A Ratings
- Climate Change A- Ratings

**Alliance for Water Stewardship (AWS)**

- "Platinum" Class Certification with the Highest Score for the 3<sup>rd</sup> consecutive year

**CommonWealth Magazine**

- Excellence in Corporate Social Responsibility Award – Honorable Legion of Corporate Sustainability Top 100

**Corporate Knights**

- 2022 Global 100 Most Sustainable Corporations

**Corporate Knights & As You Sow**

- 2022 Carbon Clean 200™ List

**Forbes**

- 2022 World's Best Employers

**FORTUNE**

- 2022 World's Most Admired Companies

**Institutional Investor Magazine**

- Most Honored Company (Technology/Semiconductors) – All-Asia
- Best Overall ESG (Technology/Semiconductors) – First Place (buy-side and sell-side) – All-Asia

**Morningstar**

- The Best Sustainable Companies to Own in 2022

**Sustainalytics**

- Company ESG Risk Ratings: Low ESG Risk – Semiconductor Industry

**The Asset**

- The Asset Triple A Country Awards for Sustainable Finance 2022: Best Corporate Bond

**Taiwan Stock Exchange**

- Top 5% in Corporate Governance Evaluation of Listed Companies for eight consecutive years

**Taiwan Institute of Sustainable Energy**

- Taiwan Top 10 Sustainability Exemplary Awards for seven consecutive years
- Corporate Sustainability Report Awards
- Circular Economy Leadership Awards
- Information Security Leadership Awards
- Supply Chain Leadership Awards
- Growth Through Innovation Leadership Awards
- Sustainable Water Management Leadership Awards
- Climate Leadership Awards
- English Report – Gold Award



# Sustainable Business Practices

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# ESG Implementation Framework

With uplifting society as our vision, the [TSMC ESG Policy](#) serves as the foremost guiding principle for our sustainable development. The [ESG Matrix](#) set by TSMC's Founder, Dr. Morris Chang clearly defines TSMC's ESG scope. Through its ESG Implementation Framework, TSMC effectively carries out sustainability governance in its core business of dedicated IC foundry services. TSMC actively develops positive relationships with all stakeholders including employees, shareholders/investors, customers, suppliers/contractors, and society to create value through common good.





# ESG Management Platform

In accordance with the vision and mission of the [TSMC ESG Policy](#), TSMC's ESG Steering Committee and ESG Committee serve as management platforms to align with global trends in sustainable development and corporate growth. TSMC takes tangible actions to realize the sustainability mindset and continue to create value for stakeholders.

The board of directors supervises the overall sustainability strategy of TSMC. Chairman Mark Liu serves as the Chairperson of the ESG Steering Committee and Senior Vice President Lora Ho serves as the executive secretary of the ESG Committee. Together with senior executives from various fields, Chairman Liu and Senior Vice President Ho review ESG topics relevant to TSMC's operations, and set the mid-to-long-term development strategies and goals of the [Five TSMC ESG Directions](#), and align the Company's core competencies with the UN SDGs to develop a blueprint for ESG. The chair of the ESG Committee reports to the board of directors each quarter on ESG achievements and future plans, receiving feedback and suggestions from the board of directors.

## ESG Steering Committee

Chairperson	Executive Secretary	Members	Meetings	Tasks
Chairman	ESG Committee Chairperson	Senior Executives from organizations including Information Technology and Materials Management & Risk Management, Business Development, Legal, Human Resources, Research & Development, Operations, Finance	Quarterly	Chairman Liu and the management team discuss and formulates the Company's ESG vision and strategies, collaborates with the ESG Committee for implementation, strives towards a culture of sustainability, and becomes a driver for positive change

## ESG Committee

Chairperson	Members	Meetings	Tasks
Senior executive appointed by Chairman Liu	Management representatives nominated by functional organizations relating to the economy, environment, society and governance	Quarterly	<ul style="list-style-type: none"><li>Identify material sustainability topics and formulate action plans</li><li>Supervise interdepartmental communication and coordinate resource integration</li><li>Compile ESG-related budgets for all functions</li><li>Track achievements across various sustainability issues and formulate plans for further improvement</li><li>The Committee Chairperson reports achievements and work plans to the Board of Directors every quarter</li></ul>

Note: Listed in order of the chapters in this report that senior executives are responsible for.



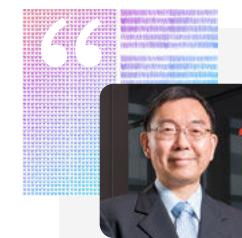
**Dr. Y.L. Wang**  
Vice President,  
Operations /  
Fab Operations I

In face of the highly complex production models of globalized manufacturing, TSMC has been able to consistently inject innovations into intelligent manufacturing, enhance operational efficiency, and provide high-quality sustainable products to achieve ecological efficiency through intelligent manufacturing.



**Dr. Kevin Zhang**  
Senior Vice  
President, Business  
Development and  
Overseas Operations Office

Semiconductors are at the core of modern technological innovation and continue to drive advancement in our lives. We are committed to building meaningful partnerships with our customers around the world and developing a sustainable technology roadmap. Together, we provide eco-friendly products that are more powerful and more energy efficient.



**Dr. L.C. Lu**  
TSMC Fellow and Vice  
President, Research &  
Development / Design &  
Technology Platform

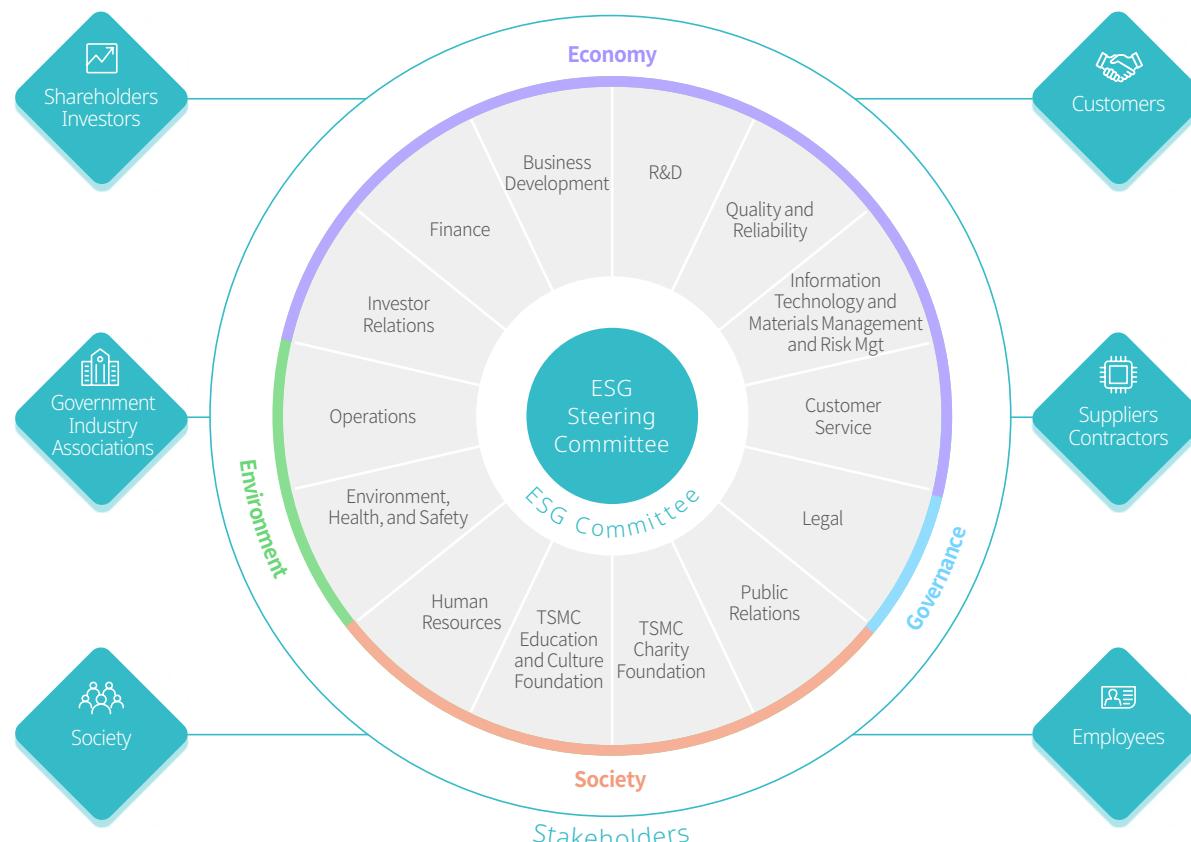
TSMC endeavors to collaborate with our ecosystem partners on the Open Innovation Platform® to deliver state-of-the-art design solutions. Furthermore, the new 3DFabric Alliance will strive to develop 3D silicon stacking and advanced packaging to facilitate the continuous innovation of global technology.



**Y.P. Chin**  
Senior Vice  
President,  
Operations and  
Overseas Operations Office

TSMC upholds commitments to environmental sustainability and continues to lead green innovation. We strive to strengthen operational efficiency through digital transformation, build green production lines, and carry out low-carbon transformation.

The ESG Committee carries out resolutions from the ESG Steering Committee, integrates and connects interdepartmental resources, and instructs the ESG Department, the responsible organization, and inter-organizational management representatives to identify sustainability topics relevant to TSMC's operations of concern to stakeholders. The ESG Committee assembles task forces to formulate strategies, targets, and action plans, and convenes quarterly meetings to track the progress and performance of sustainability topics. In 2022, the ESG Committee oversaw the development of 72 sustainability projects and continued to host the [ESG AWARD](#) to cultivate a company-wide ESG culture and ensure that ESG strategies are fully implemented into TSMC's daily operations.



**Dr. Michael Wu**  
Vice President,  
Research &  
Development /  
Platform  
Development

Technology leadership is one of the key cornerstones enabling TSMC's continuous growth. We are committed to fostering an open and innovative, as well as diverse and inclusive environment and realizing digital transformation in the R&D organization to unleash employees' full potential and achieve the goal of corporate sustainability.



**Dr. Jun He**  
Vice President,  
Quality and Reliability  
and Operations /  
Advanced Packaging  
Technology and  
Service

We uphold our vision of sustainability by joining hands with customers and suppliers for progress. TSMC works closely with customers and suppliers on quality and service to pursue perfection and pave the way for industry progress.



**Dr. Cliff Hou**  
Senior Vice  
President, Europe  
& Asia Sales  
and Research &  
Development /  
Corporate Research

In an era of rapid change, TSMC continues to innovate while upholding the core value of Customer Trust, providing advanced technologies and productivity to strengthen cooperation with customers, help customers find success, and create win-win outcomes.



**J.K. Lin**  
Senior Vice President,  
Information Technology  
and Materials Management  
& Risk Management /  
Chief Information Security  
Officer

TSMC continues to uncover ESG opportunities in our operations. We also work with suppliers, collaborating closely on company operations to exert positive influence and create a green low-carbon supply chain.



**Dr. T.S. Chang**  
TSMC Fellow and Vice President, Operations / Advanced Technology and Mask Engineering

TSMC continues to research and develop advanced processes and spotlight environmental sustainability. We introduce innovative energy-efficient components at the process R&D stage to deepen low-carbon manufacturing capabilities, enhance energy efficiency in new fabs, and work towards sustainable development.



**Y.H. Liaw**  
Vice President, Operations / Fab Operations II

TSMC believes in environmental sustainability and stays true to our commitment to society. We consistently apply innovative thinking to increase energy use efficiency and work with suppliers to promote green manufacturing, expanding the use of renewable energies to strive for net zero emissions.



**Dr. Arthur Chuang**  
Vice President, Operations / Facility

Climate adaptability is inextricably tied to global competitiveness. The Facility Organization has been dedicated to sustainable environmental development by advancing low-carbon manufacturing technologies and building critical capabilities for circular resources.



**Lora Ho**  
Senior Vice President, Human Resources

TSMC continues to build a diverse, inclusive, dynamic, and fun workplace to strengthen talent development and employee communication, fostering a humanistic management culture with the support of digital transformation to drive the globalization of the Company.



**Dr. F.C. Tseng**  
Chairman, TSMC Education and Culture Foundation

Despite the challenges of the COVID-19 epidemic in 2022, the TSMC Education and Culture Foundation relentlessly promoted various projects, continued to introduce corporate resources to the homeland, enabled education to take root, promoted arts and culture, and endeavored to build a sustainable society of goodness.



**Sophie Chang**  
Chairperson, TSMC Charity Foundation

TSMC demonstrates our commitment to ESG in many areas. The TSMC Charity Foundation is committed to identifying what society really needs by being on the frontlines. We share experiences and practices to work with more companies and increase the scope of our influence.



**Sylvia Fang**  
Vice President, Legal and General Counsel / Corporate Governance Officer

TSMC's core value is integrity, committing us to reach the highest standards of corporate governance, conduct business with accountability and transparency, and appropriately balance the interests of all our stakeholders.



**Wendell Huang**  
Vice President, Finance and Chief Financial Officer / Spokesperson

Robust corporate governance is the cornerstone that enables us to deliver outstanding financial performances, actively respond to stakeholder needs and expectations, and increase our company's investment value to generate long-term and sustainable returns for investors.

Note: Listed in order of the chapters in this report that senior executives are responsible for.



## 2022 ESG Reporting to the Board of Directors

### 2022 Achievements

- Formulated energy saving targets and actions for each stage, advanced green manufacturing performance, and increased purchasing of renewable energy in response to the strategies and targets for Net Zero Emissions by 2050
- Continued to support global sustainability trends and leveraged sustainability reports as ESG management tools to publish the [TSMC UN SDGs Action Report](#) and [TSMC Materiality Analysis Report](#) for the first time; updated the [TSMC TCFD Report](#) and [Environmental Profit & Loss Report](#) to strengthen sustainability disclosures and transparency
- Promoted low-carbon transformation across the value chain by continuing to strengthen support for suppliers on energy conservation, carbon reduction, water conservation, and waste reduction; required the supply chain to establish mid- and long-term reduction goals and propose tangible actions
- Fostered a diverse and inclusive workplace, promoted employee resource groups, strengthened the cultivation of semiconductor talents, and continued to expand [TSMC STEM for High School Girls Program](#)
- Promoted the implementation of AMAZING IDEAS awarded projects in the ESG Award and invited overseas subsidiaries to attend the 3<sup>rd</sup> [ESG AWARD](#) to involve the entire company

### 2023 Work Plans

- Continue to enhance green manufacturing performance, expand resource recycling, and develop biodiversity strategies and actions, to steadily move towards net zero emissions
- Work with the supply chain to develop green manufacturing technologies and apply TSMC's manufacturing standards to create a low-carbon value chain with suppliers
- Cultivate a diverse and inclusive culture, training programs, and related measures, expand resource groups, and empower women in tech
- Organize a cross-unit human rights task force and develop TSMC's human rights risk matrix to act as responsible stewards, promote mitigation and remedy measures, and conduct human rights training
- Expand TSMC University Collaboration Programs and science literacy programs for high school students to continue cultivating semiconductor and STEM talent

## ESG Steering Committee

### 2022 Achievements

- Continued to connect with global ESG standards and management trends and strengthened sustainability disclosure and transparency
- Reviewed the progress of action plans for net zero emissions by 2050 to ensure strategies and pathways for energy conservation and carbon reduction as well as stakeholder communication are carried out effectively
- Promoted the 3<sup>rd</sup> ESG AWARD to inject new life into the Company's innovative culture of sustainability; the ESG AWARD attracted 1,880 proposals from employees and organizations, reaching a YoY increase of 50%
- Set and oversaw sustainability-related budgets and financial controls and coordinated the demand, allocation, planning, and execution of ESG resources

## ESG Committee

### 2022 Achievements

- Strengthened green manufacturing, promoted source reduction and [hazardous substance replacement](#); launched the [world's first water reclamation plant](#) to recycle industrial wastewater; bolstered the [Environmental Lab's function](#); continued to increase the [in-house recycling rate](#)
- Mitigated climate impacts and increased the use of renewable energies; the Energy Saving and Carbon Reduction Committee proposed [684 energy-conservation programs](#) and conserved 700GWh in energy. Formulated the [Carbon Credits Quality Standards for Voluntary Emissions Reductions](#) and completed four carbon credit programs; founded the Biodiversity Task Force and launched the [Dependencies & Impacts on Nature and Biodiversity Assessment](#)
- Continued to drive the low-carbon value chain by asking raw material and equipment suppliers to join the Supplier CDP Program, promoting the [Supplier Material Packaging White Paper Regulations](#), expanding the [TSMC Supplier Sustainability Academy's scale](#), and strengthening the supply chain's sustainable development
- Gradually fostered a diverse and inclusive corporate culture through the Diversity and Inclusion Committee to unleash the potential of diverse talent; completed a [safety culture survey](#) to strive to create the healthiest workplace.
- Completed TSMC's first survey into [salient human rights issues](#), identified 11 human rights issues and formulated response measures
- The [TSMC Education and Culture Foundation](#) and [TSMC Charity Foundation](#) strove to bring positive change to society by supporting education for youth, promoting arts and culture education, empowering people from remote areas, and helping disadvantaged people

# Materiality Analysis and Stakeholder Engagement

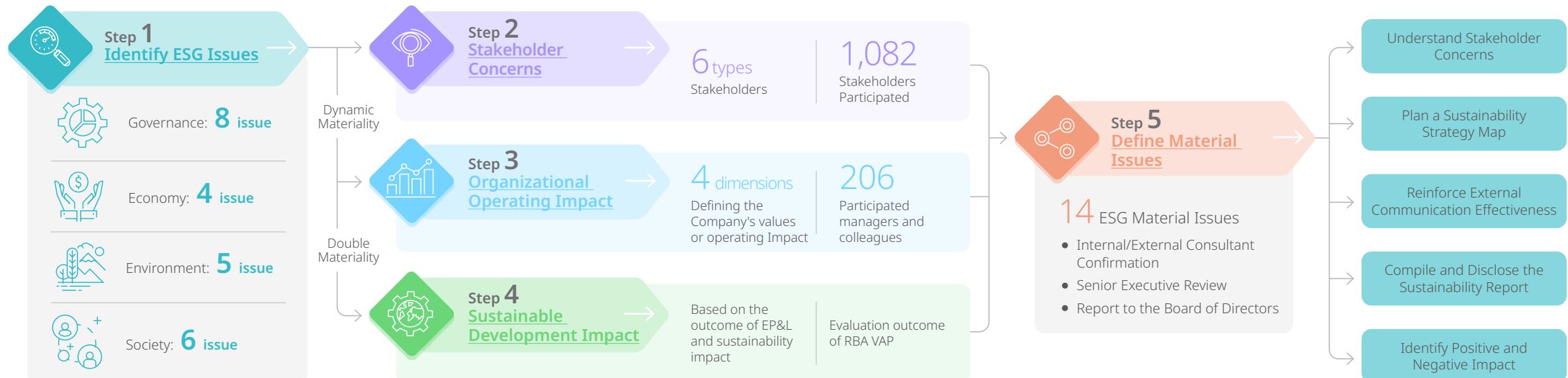
Materiality analysis is an important guideline for TSMC for formulating the Sustainability Report, long-term sustainability goals and stakeholder engagement. In 2021, TSMC published its first materiality methodology guideline to establish a knowledge base for ESG management. According to the requirements of GRI Universal Standards 2021, materiality analysis methodology incorporates sustainable development-related impact on the economy, environment, and people (human rights). Please refer to the [TSMC 2021-22 Materiality Analysis Report](#) for further details.

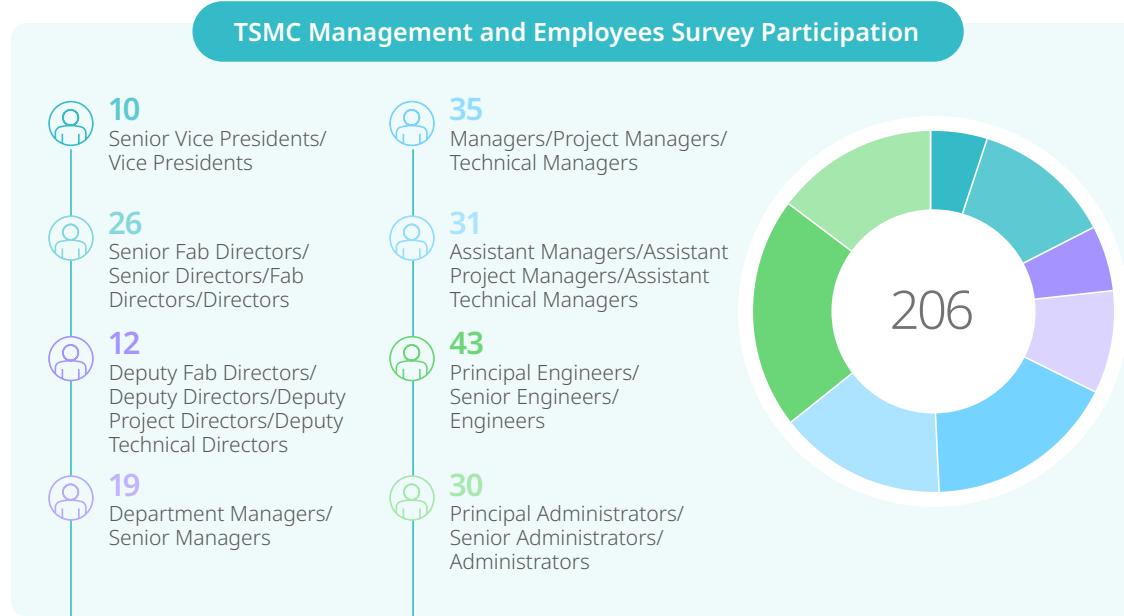
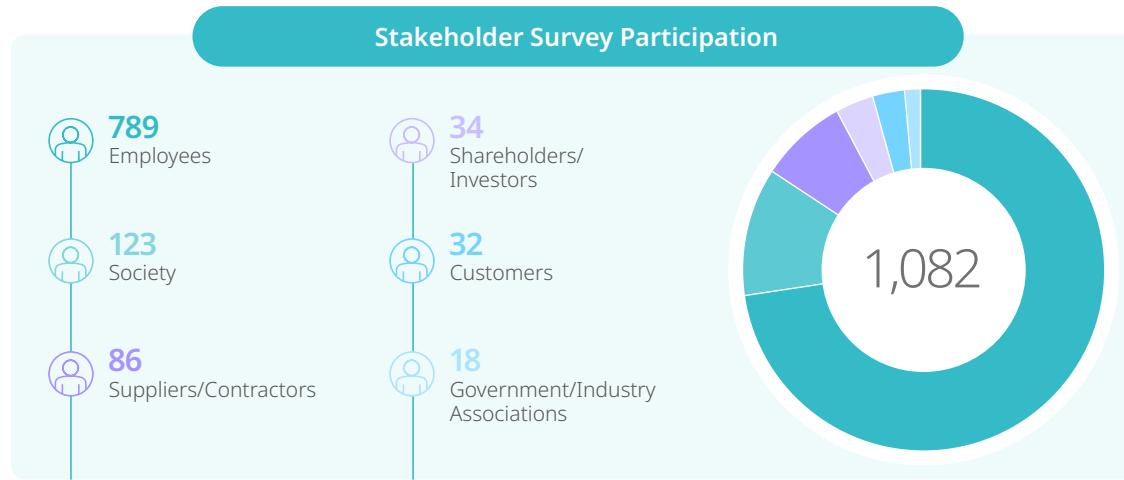
In response to the latest GRI 3: Material Topics 2021, the World Economic Forum (WEF) suggested that materiality analysis must consider the concepts of Dynamic Process and Double Materiality advocated by the European Union. TSMC has established TSMC Dynamic and Double Materiality (TDDM) as the fundamental analysis process to continuously track changes in stakeholders' level of concern regarding ESG issues. The Company also formulated a materiality analysis methodology based on dimensions such as organizational operations and sustainable development-related impact.

By consolidating the outcome of the materiality analysis in 2021 as well as the sustainability impact assessment and the results of the Validated Assessment Program (VAP) of the Responsible Business Alliance (RBA) in 2022, TSMC has re-identified impactful material issues from the three dimensions of Stakeholder Concerns, Organizational Operating Impact and Sustainable Development Impact. At the same time, the Company also adjusted the frequency of materiality analysis to

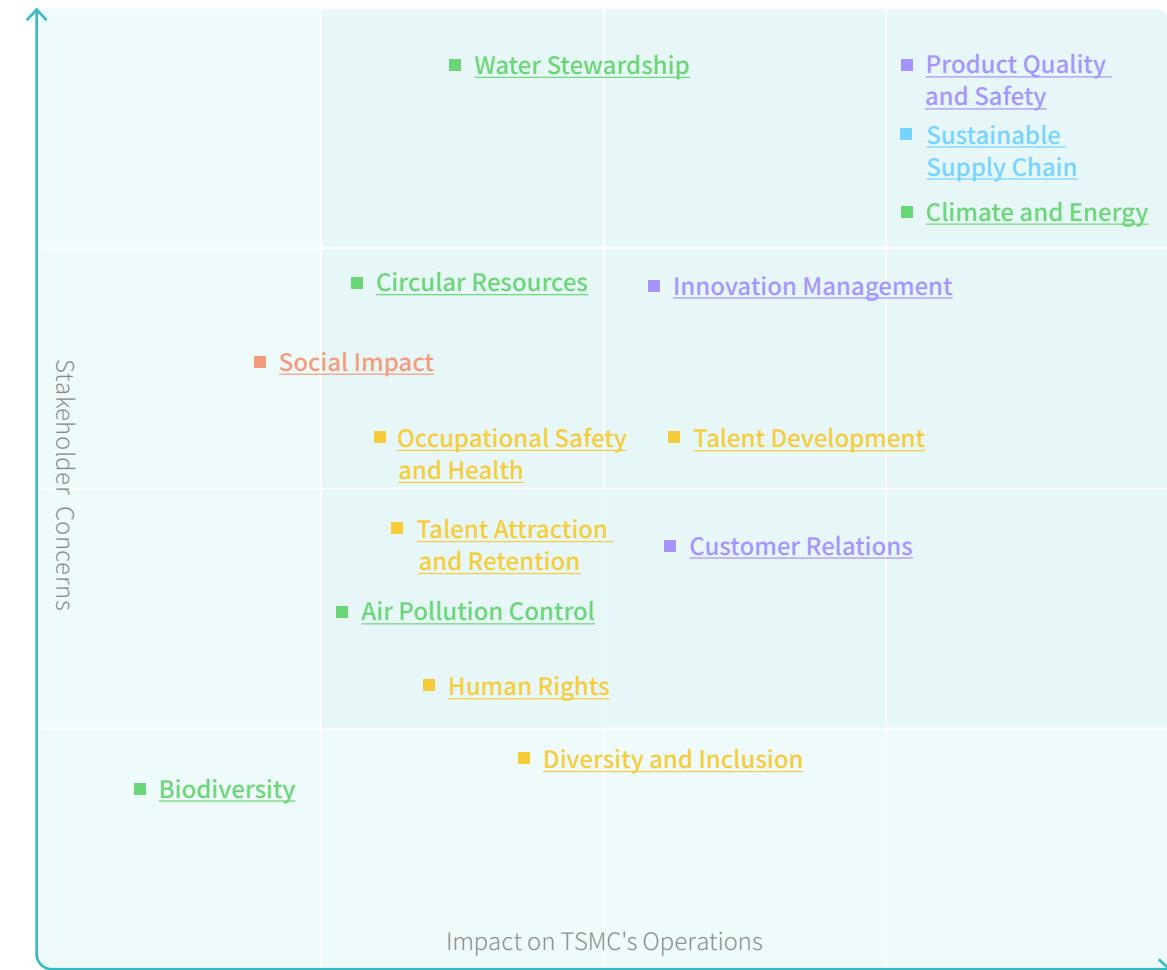
conduct comprehensive biennial surveys to observe changing trends in ESG issues and track the progress of long-term goals. The next materiality analysis is scheduled in 2023. In the meantime, TSMC will continue to collect and respond to feedback and suggestions from stakeholders via diverse communication channels and the Company's ESG Committee will continue to carry out ESG strategies and commitments.

## Process to Determine Material Issues





## TSMC Materiality Matrix



Note: Among 23 ESG issues, Corporate governance, financial performance, risk management, business continuity, ethics, information security, taxation, and regulatory compliance are classified under General Disclosures by GRI and are generally result-oriented. The above issues will, therefore, not be represented in the materiality matrix but relevant information will be regularly disclosed in the Company's annual report, company website, sustainability report, ESG website and ESG Newsletter.



## Material Issues and Value Chain

Sustainability Roles	Material Issues	GRI-specific Topics	SASB Standards	Upstream Note 1	TSMC Operation Note 2		Downstream Note 3	Operational Impact			
				Procurement Stage	Wafer Fabrication	Packaging/Testing	Customer Use	Revenue Growth	Customer Satisfaction	Employee Cohesion	Operational Risks
An Innovation Pioneer	Innovation Management	Indirect Economic Impact Energy	TC-SC-410a.2		✓	✓	✓	✓	✓	✓	
	Product Quality and Safety	Customer Health and Safety	TC-SC-410a.1	✓	✓	✓	✓	✓	✓	✓	✓
	Customer Relations	Customer Privacy			✓	✓	✓	✓	✓	✓	
A Responsible Purchaser	Sustainable Supply Chain	Procurement Practices, Supplier Environmental Assessment, Supplier Social Assessment	TC-SC-440a.1	✓				✓			✓
A Practitioner of Green Power	Climate and Energy	Energy, Emissions, Economic Performance	TC-SC-110a.1, TC-SC-110a.2, TC-SC-130a.1	✓	✓	✓	✓	✓	✓		✓
	Water Stewardship	Water and Effluents	TC-SC-140a.1	✓	✓	✓					✓
	Air Pollution Control	Emissions			✓	✓					✓
	Circular Resources	Waste	TC-SC-150a.1	✓	✓	✓					✓
An Admired Employer	Diversity and Inclusion	Diversity and Equal Opportunity			✓	✓					✓
	Talent Attraction and Retention	Economic Performance, Market Presence, Labor/Management Relations, Diversity and Equal Opportunity	TC-SC-330a.1		✓	✓		✓		✓	
	Talent Development	Training and Education			✓	✓		✓		✓	
	Human Rights	Labor/Management Relations, Nondiscrimination, Freedom of Association and Collective Bargaining, Child Labor, Forced or Compulsory Labor		✓	✓	✓				✓	
	Occupational Safety and Health	Occupational Safety and Health	TC-SC-320a.1, TC-SC-320a.2	✓	✓	✓				✓	✓
Power to Change Society	Social Impact	Economic Performance, Indirect Economic Impact, Local Communities			✓	✓				✓	

Note 1: Upstream boundaries are raw materials, equipment, and related services purchased by TSMC

Note 2: TSMC Operations boundaries are wafer fabrication and packaging/testing services offered by TSMC

Note 3: Customer Use boundaries are customer products manufactured by TSMC

Note 4: "✓" signifies the issue has real impact on this stage or that the issue is a spotlight issue

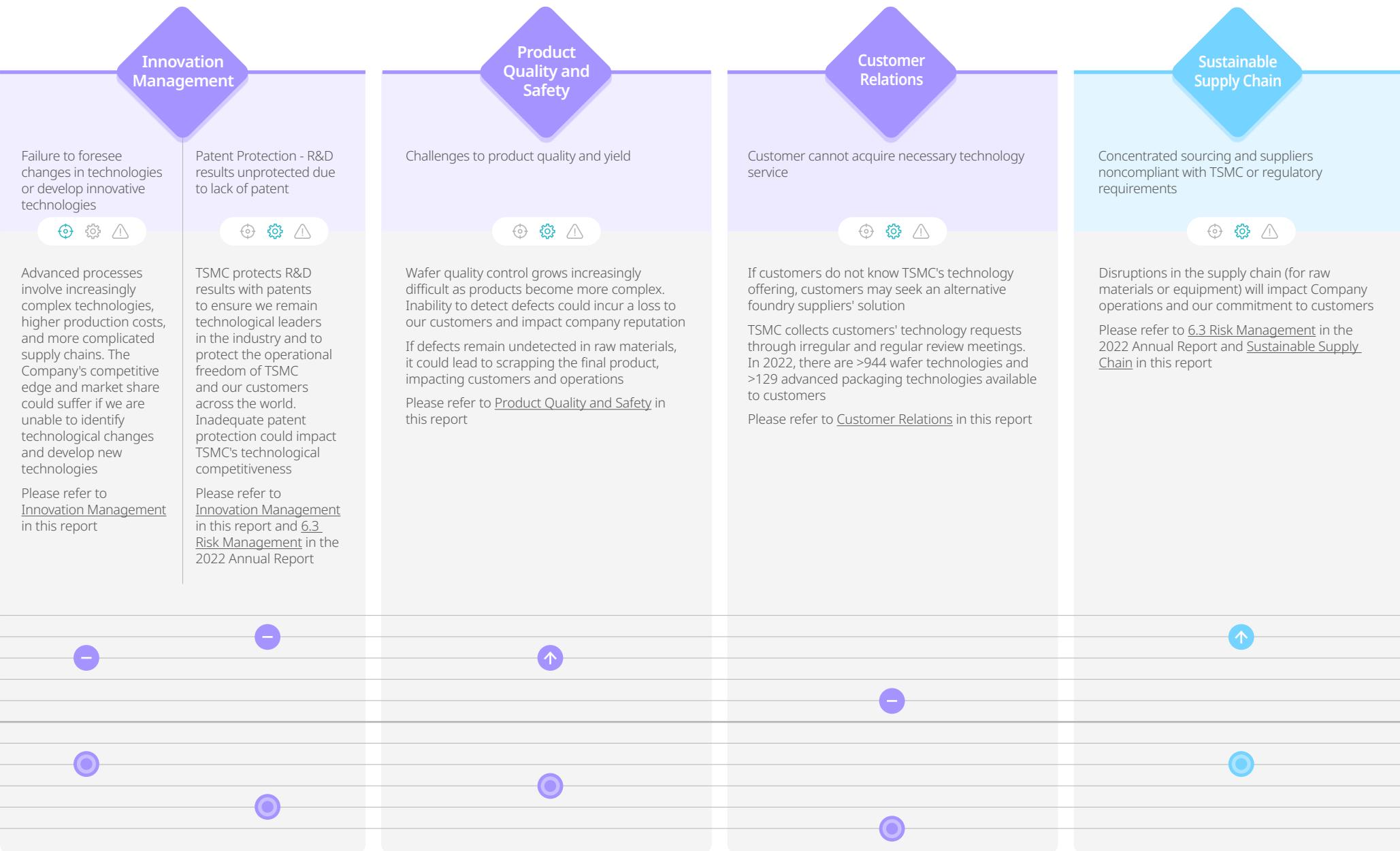


## Material Issues and Risk Management

### Risk Aspects/ Type

- Strategy
- Operation
- Hazard

### Risk Evaluation and Mitigation Measures



**Risk Aspects/ Type**

- Strategy
- Operation
- Hazard

**Risk Evaluation and Mitigation Measures**

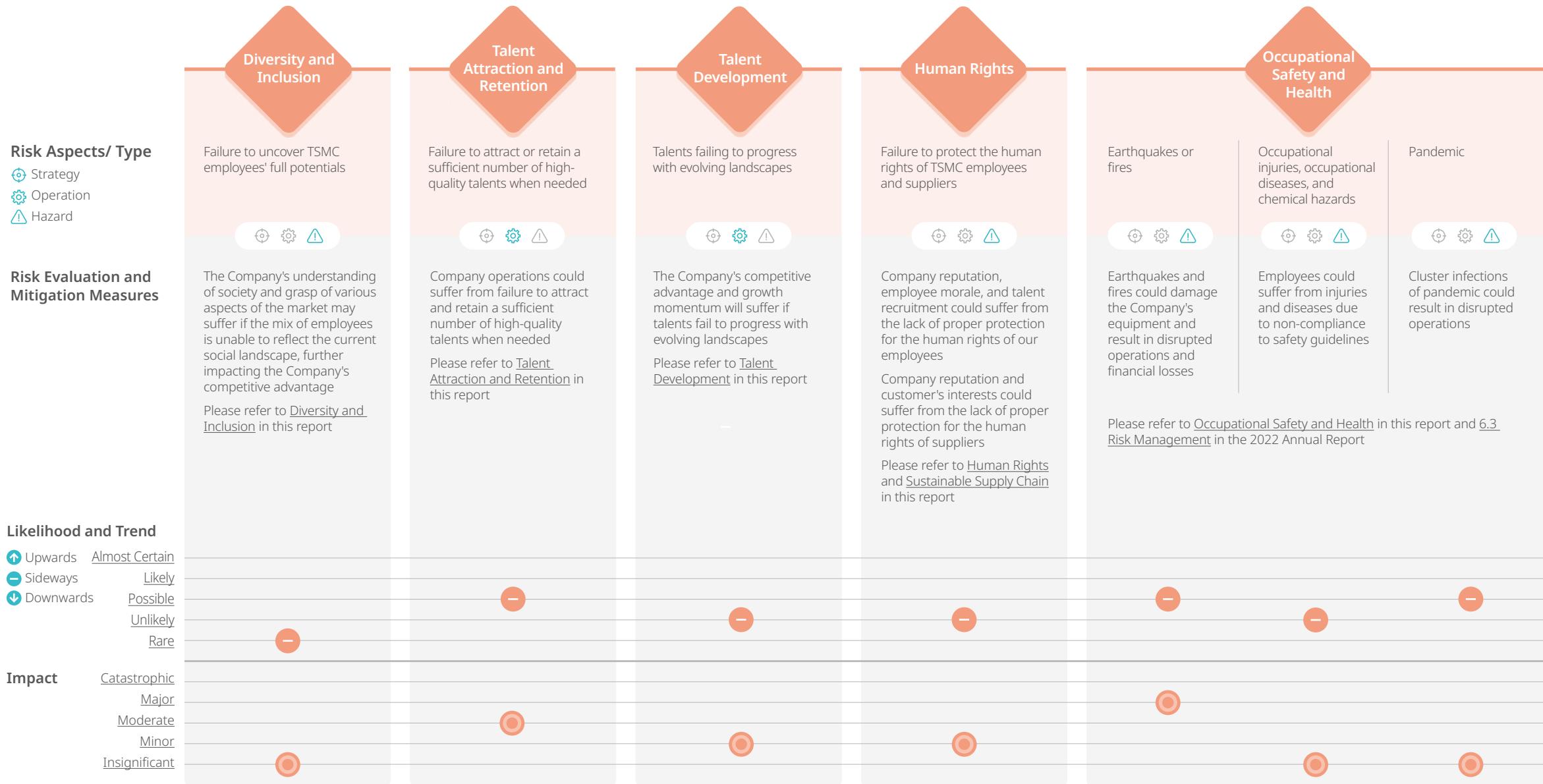
		Climate and Energy	Water Stewardship	Circular Resources	Air Pollution Control	
		Operational impact from climate disasters, increasing GHG emissions, regulations against GHG emissions, and other requirements	Water shortage or suspension, and environmental impact from wastewater	Suppliers failing to properly handle waste will pollute the environment	Environmental impact from pollutant emissions	
		<p>Increasing demands from stakeholders to increase usage of renewable energy could increase costs and, if demands are not met, fab construction progress and customer orders could be impacted</p> <p>Please refer to <a href="#">Climate and Energy</a> in this report</p>	<p>Unstable power supply will limit production capacity and impact company reputation</p> <p>Customer's trust could decline and result in fewer orders</p> <p>Please refer to <a href="#">Climate and Energy</a> in this report</p>	<p>Unstable water supplies will limit production capacity, TSMC will therefore be unable to satisfy customer demands</p> <p>Anomalies in effluents will pollute the environment and negatively impact company reputation</p> <p>Please refer to <a href="#">Water Stewardship</a> in this report</p>	<p>Waste management vendors failing to handle waste in compliance with regulations may subject TSMC to liabilities for waste cleanup and environmental recovery, impacting company reputation</p> <p>Please refer to <a href="#">Circular Resources</a> in this report</p>	<p>Improper use or failure of air pollution control equipment could result in excess emissions, penalties from the authorities, and impact on company reputation</p> <p>Please refer to <a href="#">Air Pollution Control</a> in this report</p>

**Likelihood and Trend**

- Upwards Almost Certain
- Sideways Likely
- Downwards Possible
- Unlikely Rare

**Impact**

- Catastrophic
- Major
- Moderate
- Minor
- Insignificant





## Stakeholder Communication



### Employees

Concerned with the continued growth and success of the Company as well as meaningful work, a safe and healthy workplace, competitive compensation and welfare, opportunities to grow, and work-life balance

73

Silicon Garden Meetings  
(Labor-management meetings)

4,218

Cases handled through internal communication channels



TSMC provides employees with parenting resources and holds STEAM Holiday Optoelectronics, Audio, and Science Exploration Camp

### Issues

- Talent attraction and retention
- Diversity and inclusion
- Social impact
- Talent development
- Ethics/regulatory compliance

### Engagement

- Corporate intranet (myTSMC), internal emails, and other announcement channels (such as promotion posters at facilities), TSMC Newsletter eSilicon Garden/as needed
- Human resources team/as needed
- Employee training/annually
- Communication meetings for various levels of managers and employees; e.g. the executives communication meeting, skip levels and communication meetings in individual functions or divisions/quarterly
- Employee suggestion channels, such as the Fab Caring Circle, Employee Opinion Box, Wellness Center, wellness website, employee PIP & IT Security mailbox and hot line, etc./as needed

- Ombudsman system, whistleblower reporting system, irregular business conduct reporting system, and sexual harassment investigation committee/as needed
- Employee Opinion Survey on Company Core Values, Employee Engagement Survey, employee pulse surveys and service satisfaction surveys, and employee welfare committee event questionnaire survey/as needed
- Silicon Garden Meetings (labor-management meetings)/quarterly

### Focus Areas

### Responses from TSMC

Company growth, success and contribution to the society

- Strengthen internal communication channel. Communicate with employees through 73 Silicon Garden Meetings, and 4,218 times exchange of opinions to let colleagues understand the Company's prospects

An inclusive, diversified and friendly working environment that can unleash talents' potential

- Organized a training program on TSMC's Human Rights Policy: Say No to Sexual Harassment and Build up a Friendly Workplace to enhance awareness of respect and communion with completion rate of 97%
- Held Inclusive Leadership Workshop to support senior executives in understanding the connotation of diversity and inclusion, and strengthen the awareness of unconscious bias
- The Research and Development organization established the Diversity and Inclusion Committee

More ESG activities and social participation opportunities for employees

- Leveraged TSMC ESG AWARD as a platform to promote sustainable thinking and action, and the event was expanded to overseas subsidiaries. A total of 1,880 sustainable innovation proposals were collected
- fabs organized community engagement activities such as sending warmth to the disadvantaged, elderly care, and teaching in rural areas from time to time

Work-life balance and individual growth

- TSMC Child Care Benefit Program supported employees' work-life balance. In 2022, TSMC had 2,368 newborns, accounting for 1.7% of Taiwan's total infant population
- Established employee resource group Women@tsmc to encourage female colleagues to pursue career goals and self-growth

Latest regulatory updates and compliance guideline, i.e., zero tolerance of corruptions, avoiding conflict of interest, etc.

- Provided an Annual Ethics and Compliance Training Course covering various important regulatory compliance topics and a total of 67,922 employees (including employees in subsidiaries) completed this training course, reaching 99.9% completion rate



My children learn about the profoundness of science in the Company's holiday STEAM camp, and they cherish the models made in the course. This camp has made our family's life and work more manageable during the winter and summer vacations. I am very proud of TSMC.

**Shou-Hau Tsai**  
TSMC employee



## Shareholders/Investors

Concerned with the investment value of TSMC including market prospects, growth strategy, profitability, dividend policies, shareholder returns, and sustainability performance

363

Institutional investors

281

Conferences and meetings



### Issues

- Financial performance
- Risk management
- Innovation management
- Climate and energy

### Engagement

- General shareholders' meeting/annually
- Investor conference/quarterly
- Domestic and overseas brokerage conferences/as needed
- Face-to-face meetings, video conference calls, and telephone conference calls/as needed
- Annual Report, Sustainability Report, and Form 20-F with the U.S. Securities and Exchange Commission/annually
- Major announcements on the Market Observation Post System/as needed



### Focus Areas

### Responses from TSMC

Long-term profitability

- In January 2022, TSMC raised its long-term financial targets to be gross margin of 53% and higher, and ROE of 25% and higher

Impact of the international political and economic landscape on the business environment and corresponding measures

- Communicated the impact of international political and economic situation as well as related regulations on semiconductor demand in investor conferences

Overseas investment operation risk and its impact on long-term profitability

- Communicated the overseas fab construction plan and strategy in investor conferences

Supply-demand dynamics in the industry

- Continued to communicate with investors about TSMC's technology roadmap and mass production timeline in quarterly investor conferences

Technology development and competitive advantage

- Continued to communicate with investors about recent development of technology in quarterly investor conferences

Climate change responsive measures and supplier management

- In 2022, TSMC achieved net zero emissions of Scope 1 and Scope 2 in overseas factories, and 100% use of carbon-neutral natural gas in Taiwan fabs. Also, required critical suppliers to join CDP, receive third-party audits, continuing to strengthen low-carbon supply chain development



2022 TSMC Annual General Meeting



From governance and employee engagement to climate change strategy, TSMC has always exceeded our expectations in terms of promptness, level of disclosure and receptiveness to suggestions. Overall we feel very satisfied with the discussions we have had over the years with TSMC.

**Guido Giammattei**

Portfolio Manager

RBC Global Asset Management (UK) Limited



## Customers

Concerned with TSMC's technology development and production planning, including production capacity, product quality and safety, that meets customer demands, comprehensive protection of proprietary customer information assisting customers with successful production application and gaining time-to-market advantage

100

Quarterly assessment meetings

1,200

Customer meetings



## Issues

- Innovation management
- Product quality and safety
- Customer relations

## Engagement

- Business and technology assessment/quarterly
- Customer satisfaction survey/ annually
- Customer meetings/as needed



TSMC adheres to the values of Integrity, Innovation, Commitment, and Customer Trust, focusing on improving the core capabilities



A long standing partner, trusted. They are someone we can count on to keep a commitment once the commitment is made. They are extremely professional.

NVIDIA Corporation

## Focus Areas

## Responses from TSMC

Technology development schedules and plans

- Offered 944 process technologies and 129 advanced packaging technologies in line with the technology roadmap

Product quality

- Continued perfecting production technologies and product quality. Reduced engineering deficiencies per one million 12-inch wafers to 35% of 2019

Capacity planning and production information

- In 2022, around 3,000 person-times on average made use of the upgraded TSMC-Online™ to access comprehensive technology and production information services engineering everyday

Business resilience and continuity management

- Held Crisis Management Team Staff Training to speed up decision-making and improve decision-making quality
- fabs held the tabletop emergency response drill evaluation and result sharing activities, referring to FEMA Homeland Security Exercise and Evaluation Program (HSEEP) exercise planning standards, to strengthen organizational resilience



## Suppliers/Contractors

Concerned with the development of new process technologies, improving product quality, ESH regulations, ethics and regulatory compliance, and information security; desire to strengthen and deepen partnerships for sustainable supply chain management

178

Supplier audit and communication meetings

201

Suppliers participated in the Supply Chain ESH Training Forum



TSMC issues Certificate of Appreciation for the Energy Saving and Carbon Reduction Counseling Project to suppliers

### Issues

- Sustainable supply chain
- Ethics/regulatory compliance
- Product quality and safety
- Occupational health and safety
- Information management
- Climate and energy

### Engagement

- Supply Chain ESH Training/annually
- Supply Online 360 Global Responsible Supply Chain Platform/as needed
- On-site support and audit/as needed
- Supplier meetings/as needed
- Supplier Information Security Association Meeting/monthly

### Focus Areas

### Responses from TSMC

Sustainable actions and consistent improvement

- Launched four Supplier Code of Conduct lessons on TSMC Supplier Sustainability Academy of Supply Online 360, TSMC's global supply chain management platform

TSMC regulations on ethics and the supplier code of conduct

- All tier 1 suppliers signed the Supplier Code of Conduct and complied with business ethics (completion rate 100%)

Quality of raw material

- 60 critical suppliers completed third-party supplier audits on sustainability risks by RBA-certified institutions; ten suppliers received consultation on process advancement and quality improvement

Effective ESH management mechanisms

- Continued to enhance ESH and loss prevention capabilities in the supply chain and commended outstanding suppliers. In 2022, Chang Chun Group was awarded ESH Outstanding Supplier, and Jing He Science for ESH Advancement Supplier

Information security compliance, assessment results, and experience sharing

- Published four issues of Supply Chain Security Newsletter and reached over 350,000 person-times

Management of carbon emissions

- Required 137 raw material and equipment suppliers to participate in CDP supplier carbon disclosure project

In the face of drastic changes in the global climate and limited resources, we uphold the values of "innovation, responsibility, commitment, and customer partnership" and work together with TSMC to develop green hydrofluoric acid for sustainable circular resources and sustainable development.

Jian-Wei Lin

General Manager  
SUNLIT FLUO & CHEMICAL CO., LTD

Sustainable development is the foundation of our work, the core mission of improving productivity, and the key to creating value for TSMC and society.

Jhong-Ming Bao

General Manager  
United Industrial Gases Co., Ltd.



## Government/Industry Associations

Concerned with the development of advanced process technologies, ESG actions, overseas investments, and environmental regulations revision trends; sharing of occupational safety and health management experience and discussions on regulations

39

Government Administrations

102

Associations



### Issues

- Innovation management
- Ethics/regulatory compliance
- Climate and energy
- Circular resources
- Water stewardship
- Sustainable supply chain

### Engagement

- Official correspondences and visits/as needed
- Offer industry experience and advice/as needed
- Conferences (e.g., briefings, public hearings, symposia, seminars, meetups)/as needed
- Industry association communication platforms/monthly

### Focus Areas

### Responses from TSMC

Industry specification formulation/  
Intellectual property/Trade secret protection

- Introduce the semiconductor development trend of advanced process technology and TSMC's technologies to the US Patent Office
- Participated in Taiwan Association for Trade Secret Protection, providing regulatory revision and implementation suggestions

Corporate governance, regulatory  
compliances and risk management

- Participated in explanatory meetings on the latest regulations of export control, and conduct practice exchanges
- Formulate TSMC's Risk Management Policy and corporate risk management framework with reference to relevant guidelines of risk management stipulated by the Taiwan Stock Exchange Corporation

Carbon credits transactions/Circular  
resources/Sustainable water stewardship

- Established a carbon credits working group to plan long-term purchases of carbon credits, and cooperated with industry associations to propose the establishment of carbon rights transactions to the government
- Cooperated with Environmental Protection Agency's Resource Recycling Waste Cleanup Plan Program to submit an application for circular resource demonstration cases, assisting the government to promote the program
- TSMC sites in Southern Taiwan Science Park began to use recycled water, and set a 2030 target of 60% of the Company's water resources came from recycled water

Response, suggestion and promotion  
of environmental protection related  
regulations

- Represented Taiwan Semiconductor Industry Association to communicate with Environmental Protection Agency to assist the revision a more reasonable and feasible Semiconductor Industry Air Pollutant Emission Standard and Stationary Pollution Sources that Should Be Regularly Tested and Reported in Public and Private Occasions to promote the industry's positive development

Supply chain sustainability and  
environmental safety and health  
management improvement

- In addition to Supplier Environment, Safety and Health Forum, practical operation of fire protection equipment, observation of emergency response drills, on-site diagnosis and guidance of energy saving and carbon reduction, Environmental Safety and Health, Fire Response, Fire Protection Self-training, Greenhouse Gas Inventory, Product Carbon Footprint Inventory Workshops, etc. were added in 2022

TSMC, as a member of Taiwan Carbon Capture Storage and Utilization Association (TCCSU) changes experiences with the Japanese carbon capture and reuse demonstration plant

“

In addition to actively reducing carbon emissions, TSMC also exerts its influence and drives the value chain to work hard to mitigate climate change. The Company is indeed a model.

**James C. Liao**  
President  
Academia Sinica



## Society

Concerned with the support for remote education and the disadvantaged, Network of Compassion, Public Welfare Green Energy Project, and Cherish Food Program provided by the TSMC Charity Foundation

Concerned with the resources for education and arts offered by the TSMC Education and Culture Foundation to cultivate well-rounded talents for the new era

130

Charity partners

171

Charity programs



New Generation Talent Cultivation Forum



## Issues

- Social impact

## Engagement

- Volunteer services/at least once per week
- TSMC LinkedIn/as needed
- TSMC Education and Culture Foundation and TSMC Charity Foundation websites/as needed
- Sending Love charity platform/as needed
- Project cooperation and visits/as needed
- TSMC ESG Newsletter/monthly



## Focus Areas

## Responses from TSMC

Young Generation Cultivation, Educational Collaboration, Arts and Culture Promotion

- In 2022, TSMC Education and Culture Foundation invested NT\$100.2 million to expand supports for diverse education and the promotion of art and culture with three major axes: Young Generation Cultivation, Educational Collaboration, Arts and Culture Promotion. The seventh TSMC Udreamer Project themed Young and Sustainable Island encouraged young people to care about sustainability and put it into action. A total of 161 groups of students participated with an increase of 32% compared to 2021. The Foundation also held TSMC Journeys of Female Scientists Lectures to encourage high school girls to explore STEM. As of 2022, 3,225 people have attended the event.

Local community services, the needs of the underprivileged and education

- In 2022, TSMC Charity Foundation continued to committed itself to championing social causes of Care for the Elderly, Promote Filial Piety, and Protect the Environment, and renamed the focus Care for the Disadvantaged as Empower the Rural Community to strengthen their education and employment. In addition, the Foundation linked industry, government and academia resources to provide stable life and operational support for disadvantaged groups and institutions. It repaired 285 houses for Hualien and Taitung earthquake-stricken residents, and cared for 62 vulnerable households of seniors living alone. A total of 7,607 volunteers devoted in 2022, and the service hours accumulated reached 31,760 hours, with a total investment of NT\$223.07 million

Responses to major incidents (e.g., Hualien and Taitung Earthquake), volunteer services, and dedications in environmental education

TSMC Education and Culture Foundation inspires everyone's ideals, enthusiasm and curiosity about science, so that everyone can find a stage.

**Chuan-Chin Chiao**

Director  
National Museum of Natural Science

Thanks to TSMC Charity Foundation for co-organizing Technical and Vocational Talent Development Forum, and initiate the job matching program for vocational high school students. This endeavor garnered industry resources to initiate new thinking on talent development.

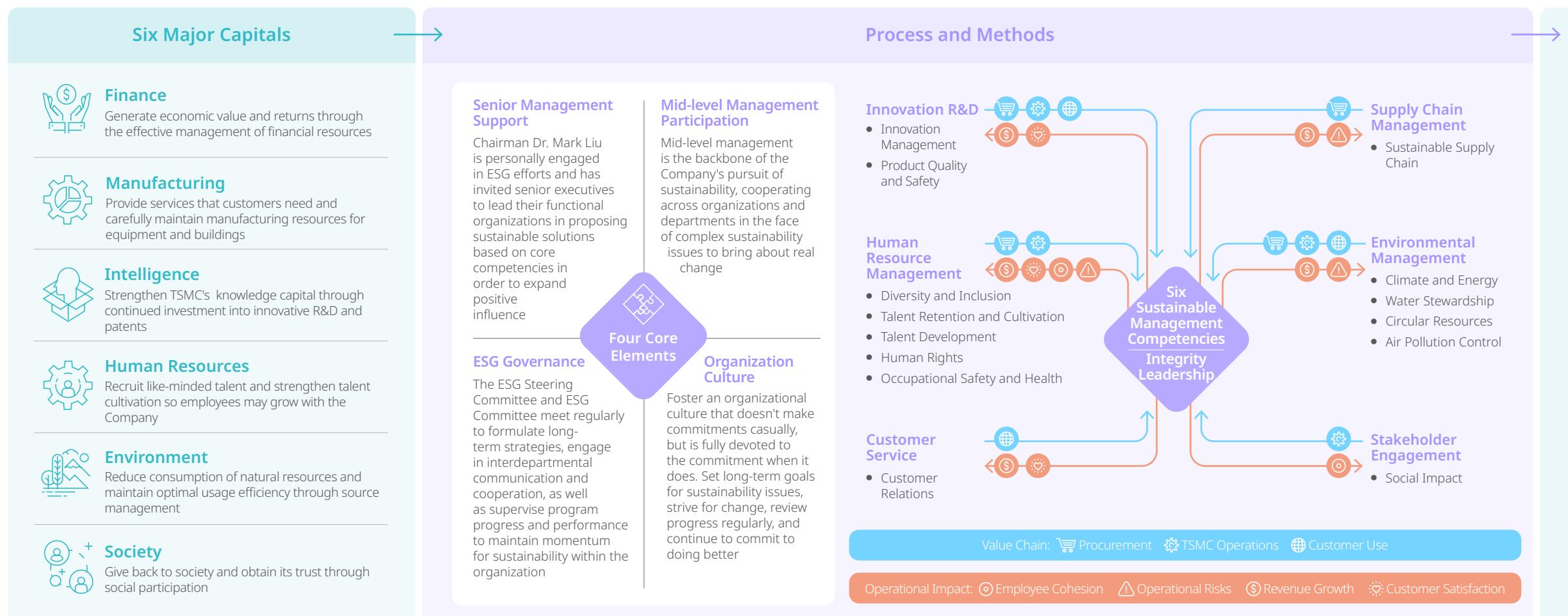
**Terry Tsao**

Global Chief Marketing Officer & President of Taiwan SEMI

# Sustainability Impact

The long-term value of a company hinges on positive impacts generated and negative impacts mitigated for stakeholders, which includes driving output value from the semiconductor industry chain, helping customers leverage the competitive edge of products, protecting natural ecosystems and biodiversity, creating direct and indirect job opportunities, and preventing health or safety hazards. The Triple Bottom Line (TBL) is a sustainable impact management framework developed by TSMC. TBL is grounded in the

Company's six major capitals, four core elements, six sustainable management competencies, and an Environmental Profit and Loss (EP&L) valuation model. It aims to, from an Outside-In perspective, measure changes and contributions to the well-being of humans from the Company's overall value chain and facilitate communication with stakeholders in the hopes of driving economic growth, reducing resource depletion, and further bettering the well-being of society as a whole.



## Sustainability Impact Strategy Map<sup>Note</sup>

TSMC has established a Sustainability Impact Strategy Map derived from causal relationships by converting all positive impacts (values) and negative impact (costs) into monetary values, beginning from the direct and indirect impacts of upstream procurement, TSMC operations, and customer use.

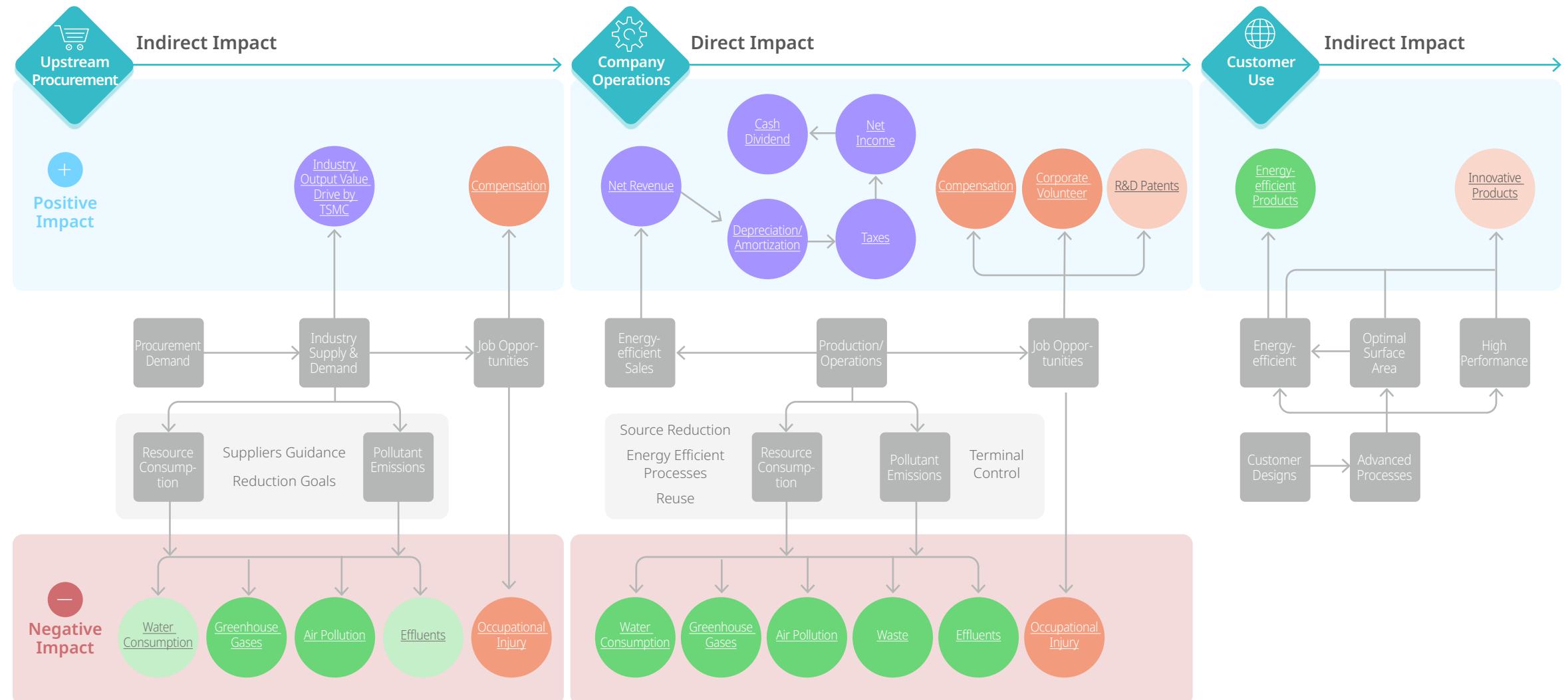
● Economic Impacts

● Environmental Impacts

● Social Impacts

● Operational Input/ Output

● Measures to mitigate negative impacts

→ Causal Relationship


Investors: Provide reliable dividends and returns to investors

Customers: Help customers realize product application and success

Suppliers/ Contractors: Drive output value and transformation in the semiconductor industry

Society: Protect natural capital through EP&L

Government/ Industry Associations: Generate tax revenue and social welfare for the government

Employees: Create job opportunities and employee benefit



## Sustainable Value

Indicators	Impact Attributions	ESG Dimensions	Impact Level	Impact Trend	Impacted Stakeholders	
Supply Chain Output Value Driven by TSMC						
Supply Chain Employee Compensation <sup>Note 4</sup>						
GHG from the Supply Chain <sup>Note 2</sup>						
Air Pollution from the Supply Chain <sup>Note 2</sup>						
Effluents from the Supply Chain			The methodology is developing			
Water Consumption from the Supply Chain			The methodology is developing			
Contractor Employee Occupational Injury <sup>Note 3</sup>						
Cash Dividend						
Net Income						
Net Revenue						
Depreciation & Amortization						
Taxes						
Employee Compensation						
Occupational Injury <sup>Note 3</sup>						
Corporate Volunteers <sup>Note 5</sup>						
GHG <sup>Note 1</sup>						
Air Pollution <sup>Note 1</sup>						
Waste <sup>Note 1</sup>						
Effluents <sup>Note 1</sup>						
Water Consumption <sup>Note 1</sup>						
R&D Patents			The methodology is developing			
Energy-efficient Products <sup>Note 6</sup>						
Innovative Products			The methodology is developing			

## Positive Impact



## Negative Impact



Note 1: Environmental Profit and Loss (EP&L) presented in this section is the monetary assessment of possible external impacts from TSMC's purchasing and production. For the costs and economic benefits arising from the implementation of environmental protection projects, please refer to Environmental Cost in TSMC's 2022 annual report. For the EP&L methodology, please refer to the [TSMC 2022 Environmental Profit and Loss \(EP&L\) Report](#).

Note 2: EP&L of the supply chain includes only Tier 1 suppliers which had more than three transactions with TSMC per year and with amounts exceeding NT\$10 million. A total of 1,050 suppliers meet the criteria. Their environmental impact is then calculated through Environmentally Extended Input Output (EExIO) analysis.

Note 3: Value of Occupational Injury = Cost of Occupational Injury + Medical Expenses + Amount TSMC is Willing to Pay to Prevent Occupational Disasters

Note 4: Supply Chain Employee Compensation = Procurement amount is input into the [EXIOBASE 2](#) database and calculated using relevant compensation coefficients based on the suppliers' industry and location

Note 5: Corporate Volunteer Value = Volunteer Service Hours \* Average TSMC Employee Hourly Income

Note 6: Product energy saving data is calculated based on the research model proposed by Industry, Science and Technology International Strategy Center, ITRI in 2020. Since the model predicts future scenarios using global power usage conditions up until 2020, the estimated calculation of product energy saving is calculated since 2020

History Data (2018~2022)



In the upstream procurement stage, TSMC leverages its leadership position in the global semiconductor industry to improve the technology and capability of local suppliers. TSMC employs an input-output model to assess output value, job opportunities, and income created from TSMC's procurement demands as well as the resulting economic growth and improvements in living conditions. To address supply chain sustainability issues, TSMC is actively promoting a responsible supply chain, using environmentally extended input-output (EEIO) analysis to identify environmental hot spots in the supply chain, and evaluating raw material suppliers with Life Cycle Assessment (LCA) to identify the environmental impact from production and service processes. TSMC aims to collaborate with suppliers to uncover opportunities for change and growth to help drive sustainable transformation. In 2022, TSMC created an output value of NT\$2,070.8 billion in the supply chain through procurement, generated 309,000 job opportunities and NT\$238.52 billion in payroll through the supply chain. Contractors' occupational injuries resulted in NT\$1.72 million in social costs. The environmental footprints and resource consumption generated from raw material supply resulted in an environmental cost of NT\$16.5 billion environmental cost. Through consultation and goal setting, TSMC will cooperate with suppliers to uncover the opportunities for process optimization and environment footprint minimization. For details, please refer to the [TSMC 2022 Environmental Profit and Loss \(EP&L\) Report](#).

In the operation stage, TSMC uses a Gross Value Added (GVA) approach to assess the positive impact generated for stakeholders by operations. Such positive impact may include equal employment opportunities, competitive compensation and benefits, cash dividends, taxes, depreciation and amortization, and others. TSMC also applies Willingness to Pay (WTP) and Value Transfer to evaluate the social cost and benefits of occupational injury and volunteer activities. Meanwhile, the Company continues to employ environmental profit and loss (EP&L) to measure the negative impacts generated from energy/resource consumption and pollution from the production process. In 2022, TSMC generated NT\$2,263.9 billion in operating revenue, booked NT\$437.3 billion in depreciation and amortization, and issued NT\$285.2 billion in cash dividends. TSMC not only helped customers succeed, but also offered good returns to its investors. In the social dimension, TSMC paid NT\$340.9 billion in taxes and payroll, supported the government in expanding infrastructure and social welfare, improved quality of life, and drove economic growth. Volunteer services from TSMC also created NT\$52.86 million in social benefits, while occupational injuries resulted in NT\$9.3 million in social costs. In the environmental dimension, environmental footprints and resource consumption generated from production process or when delivering services resulted in an environmental cost of NT\$17.89 billion. To mitigate the environmental impact,

TSMC proactively drives green manufacturing by working on creating positive impact through source reduction, energy conservation in manufacturing process, circular economy, and terminal control. For details, please refer to the [TSMC 2022 Environmental Profit and Loss \(EP&L\) Report](#).

In the customer use stage, TSMC continues to develop world-leading energy-efficient semiconductor technologies to help customers produce advanced, energy-efficient products and facilitate the evolution of energy-saving ICT technologies and product applications to fulfill the commitment to green manufacturing from the inside out. The Industry, Science and Technology International Strategy Center (ISTI) conducted a model analysis based on global energy consumption, GDP, and the number of electronic products, and found that the products TSMC produces for customers will conserve 217,100 GWh in 2030, representing four times the energy consumed during production and a positive impact of NT\$174.2 billion generated. TSMC effectively facilitates global energy conservation by continuing to innovate semiconductor technologies to realize smart applications for a wide range of electronic products. TSMC deployed 288 distinct process technologies, and manufactured 12,698 products for 532 customers in 2022 to continue to bring significant contributions to the advancement of modern society. For details, please refer to [Innovation Management](#) in this Report.



TSMC continues to innovate in green technology and strives to reduce the environmental impact from its operations

TSMC is dedicated to reducing environmental and social impacts and introduced EP&L in 2018 to evaluate environmental externalities and resulting social costs created from the production process. In 2019, TSMC further applied EP&L to the upstream supply chain, converting the environmental impact generated from product life cycles into external social costs, identifying significant environmental impact factors to formulate improvement measures and reduce the environmental externalities and social costs generated from TSMC procurement.

In terms of TSMC operations, in 2022, environmental externalities were mainly derived from GHG emissions (>96.5%), followed by air pollution (1.2%) and waste (1%). TSMC's overall and unit environmental externalities increased from 2021 by

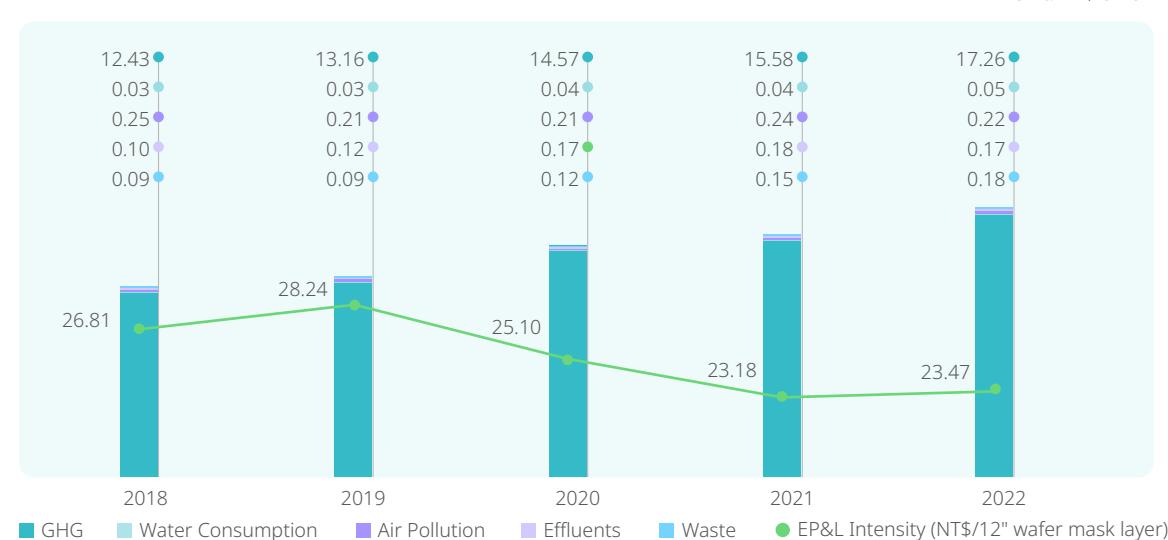
10.6% and 1.3%, respectively, but unit environmental externalities decreased by 12.5% compared with 2018. To reduce GHG emissions, TSMC continues to promote low-carbon manufacturing, increase energy efficiency, and expand use of renewable energy. In 2022, overseas production locations achieved net zero emissions in Scope 1 and Scope 2 for the first time. To mitigate air pollution, TSMC adopts Best Available Technologies (CAT) to reduce emissions of two major pollutants – acid & alkali gases and volatile organic gases – and further develops new technologies to reduce PM<sub>2.5</sub> and nitrous oxide emissions. To prevent and control water pollution, TSMC continues to focus on introducing new treatment technologies to lower chemical oxygen demand (COD) in wastewater and reduce the water pollution composite indicator.

In terms of the supply chain, environmental hot spot analysis of the supply chain reveals the most significant externalities as particle pollutants' impact on human health, followed by the social cost of carbon from GHG emissions. To reduce impacts from air pollution emitted by the supply chain, TSMC helps suppliers mitigate pollutant emissions from the source through environmental protection audit programs. For example, TSMC helps suppliers convert oil burners to natural gas burners, effectively reducing PM<sub>2.5</sub> and GHG emissions, and this successful case study was shared with other suppliers at the TSMC Supplier Sustainability Forum. In addition, TSMC found that chemical materials account for 43.2% of environmental externalities produced by the supply chain, as such, the Company conducted audits on critical raw material suppliers.

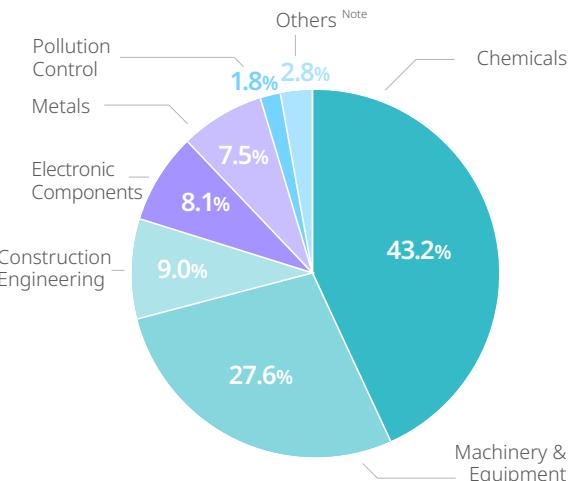
As of 2022, TSMC has audited 95 raw materials and discovered that OSAT and Substrate the largest number of environmental externalities out of all raw materials.

TSMC continues to roll out a variety of green and innovative practices to reduce environmental impacts from production processes at TSMC facilities. TSMC is also asking suppliers to establish management systems as well as energy saving, water conservation, GHG emissions, and waste reduction goals. The company hopes to work with suppliers to create a green, low-carbon supply chain, reduce environmental impacts from operating activities, and create positive influence on society together. For more details, please refer to [TSMC 2022 Environmental Profit & Loss \(EP&L\) Report](#).

## Environmental Externalities Trends



## Environmental Hotspot Analysis of the Supply Chain



Note: Others include: Textile products, paper products, printing and reproduction of recorded media, plastic products, computers, electronics, and optical products, electrical equipment, retail, land transport, transport auxiliaries & storage, food & beverage, communication services, telecommunication services, information services, professional, scientific, and technical services, rental, support services, medical care & healthcare, and other services

12.5%

Decrease in environmental externalities per unit product (compared with 2018)

1,050

Tier 1 suppliers analyzed for environment hot spot

95

Accumulated critical raw material audited (22 items increased in 2022)

 Case Study

## Supply Chain Energy Conservation and Carbon Reduction Initiatives

In 2022, TSMC leveraged EP&L analysis to compare chemical and gas suppliers against peers producing the same products and using the same raw materials to conduct variance analysis. TSMC discovered that suppliers with ISO 50001 Energy Management System certificates have significantly better energy use efficiency than those without. Given such findings, TSMC has formulated three major initiatives to help the supply chain conserve energy and reduce carbon emissions.

TSMC hopes to help suppliers evaluate environmental risks and opportunities, reducing resource consumption through a series of initiatives targeting energy conservation and carbon reduction. This can further strengthen the supply chain's green performance and resilience, striving towards a low-carbon economy.

### Three Major Initiatives to Help the Supply Chain Conserve Energy and Reduce Carbon Emissions

**1**

Require critical energy-intensive suppliers to obtain ISO 50001 Energy Management System certificates and include ISO 50001 as a requirement in TSMC Supplier Sustainability Standards

**2**

Continue to work with Industrial Development Bureau of Ministry of Economic Affairs (MOEA) to roll out energy conservation and carbon reduction support programs targeting critical suppliers and share TSMC's energy conservation experiences

**3**

Help critical suppliers introduce energy conservation and low-carbon concepts when designing new facilities. Main programs include adopting low-carbon raw materials and energy-efficient equipment, as well as complying with green building standards and ISO 50001 Energy Management System



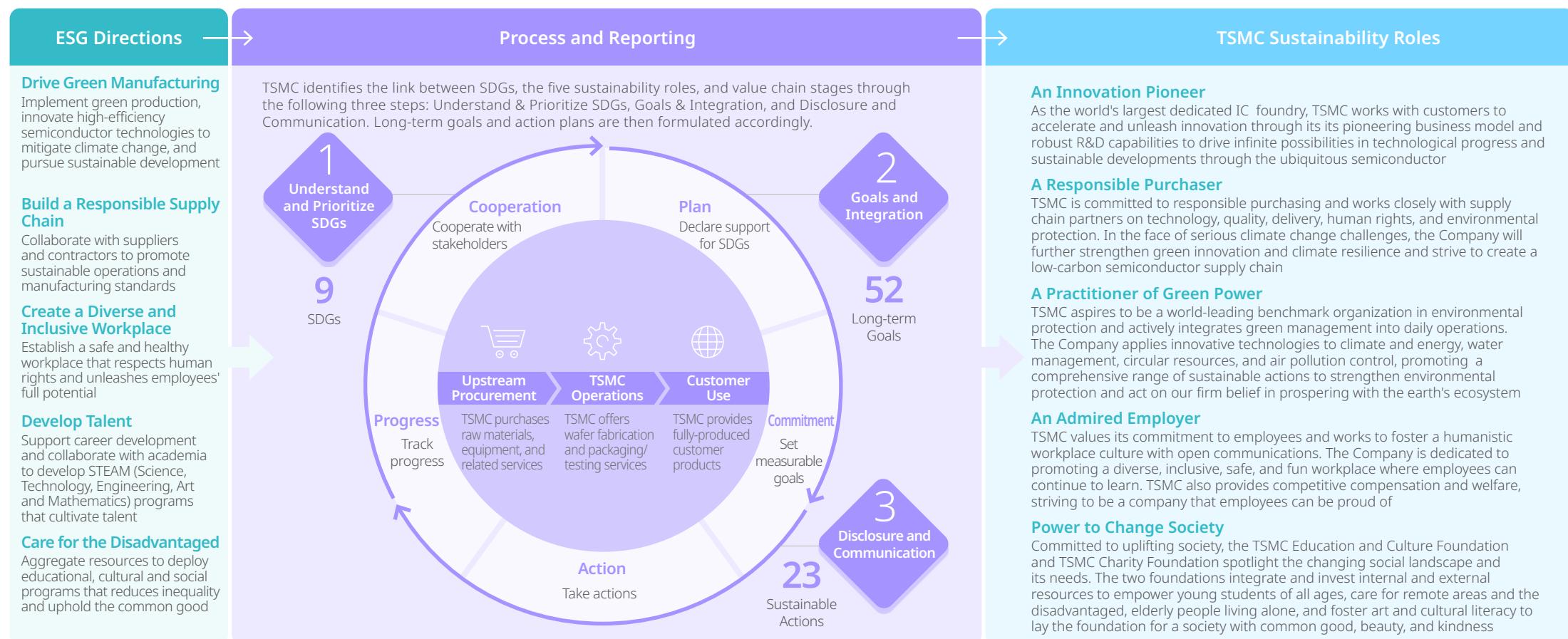
TSMC shares experiences on energy conservation with suppliers to strengthen sustainability actions

# Carry Out the UN Sustainable Development Goals

To support the United Nations' Sustainable Development Goals (UN SDGs) and trends in corporate disclosure, TSMC has complied with [Integrating the Sustainable Development Goals into Corporate Reporting: A Practical Guide](#) jointly published by the Global Reporting Initiative (GRI) and The United Nations Global Compact to identify SDGs relevant to the Company, and has published [CSR Reports since 2017](#). In 2022, TSMC further adopted five disclosure categories – Plans, Commitments, Actions, Progress, and Suppliers – defined by GRI and [Support the Goals](#) to disclose TSMC's practices and progress toward SDGs. The Company also decided to expand the single stakeholder from supplier to also cover employees, shareholders/investors, customers, contractors, governments/industry associations, and the society to connect more resources and extend the scope of influence. Achievements in related actions have been published in [TSMC's first UN SDGs Action Report](#).

In 2023, TSMC will issue the [second UN SDGs Action Report](#) to demonstrate our support for The 2030 Agenda for Sustainable Development.

Under the leadership of ESG Steering Committee Chairman Mark Liu, TSMC continued to spotlight nine SDGs: SDG 3 (Good Health and Wellbeing), SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 17 (Partnership for the Goals). TSMC has initiated 23 ESG actions and set 52 measurable long-term goals for 2030 to effect change through tangible actions.





# An Innovation Pioneer

As the world's largest dedicated IC foundry, TSMC works with customers to accelerate and unleash innovation through its pioneering business model and robust R&D capabilities to drive infinite possibilities in technological progress and sustainable developments through the ubiquitous semiconductor.

**>8,500 / >40,000**

Patent applications globally / trade secrets registered

**272**

Innovative testing methods developed for quality and reliability to enhance product, technology and quality

**944 / 129**

Provide customers process technologies / advanced packaging technologies

Innovation Management

Product Quality and Safety

Customer Relations



# Innovation Management

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Maintain Technology Leadership</b> Continuous investment in advanced technology development to maintain TSMC's technology leadership in the semiconductor industry	Maintain TSMC's technology leadership and invest 8.5% of revenue into R&D expenses annually	Maintain TSMC's technology leadership and invest 8.5% of revenue into R&D expenses annually  Begin volume production of enhanced 3nm process (N3E)	<b>Invested 7.2% of revenue into R&amp;D</b> Target: 8.5%  <b>3nm process technology in volume production</b> Target: 3nm process technology in volume production
<b>Protect Intellectual Property</b>  <b>Patent protection:</b> Strengthen quality and quantity driven patent management, apply early for patents on next-generation process technologies, and expand the patent protection network to maintain TSMC's technology leadership  <b>Trade secret protection:</b> Strengthen business operations and intellectual property innovation by recording, consolidating, and utilizing trade secrets with competitive corporate advantages through trade secret registration and management	Over 80,000 global patent applications  Over 200,000 trade secret registrations	Exceed 7,500 global patent applications  Exceed 40,000 trade secret registrations  Share TSMC's trade secret registration mechanism with eight companies  Assist six companies to successfully build a trade secret registration and management system  Exceed 500 green trade secret registrations	Submitted over 8,500 global patent applications Target: >6,600  Registered over 40,000 trade secrets Target: >25,000  Shared TSMC's trade secret registration mechanism with 17 companies Target: 6  Assisted 12 companies to successfully build a trade secret registration and management system Target: 2
<b>Enhance Industry-Academia Collaboration</b>  Link academic institutions in Taiwan and overseas by investing resources in university programs based on a long-term mechanism for interaction to cultivate the next-generation semiconductor talent	Cultivate more than 8,000 undergraduate and graduate students globally through university programs that deepen industry-academia collaboration <sup>Note 2</sup>  Cultivate more than 35,000 undergraduate and graduate students globally through university programs that deepen industry-academia collaboration between 2021 and 2030 <b>NEW</b>	Cultivate more than 8,000 undergraduate and graduate students globally through university programs to enhance industry-academia collaboration  Cultivate more than 10,000 undergraduate and graduate students globally through university programs that deepen industry-academia collaboration between 2021 and 2023 <b>NEW</b>	Launched a variety of industry-academia collaboration projects, reaching >6,800 undergraduate and graduate students globally Target: 5,500

Note 1: Since 2013, TSMC has consistently set new revenue and R&D expense records every year. The decline in R&D expenses to revenue percentage in recent years can largely be attributed to revenue growth outpacing growth in R&D expenses. In 2022, R&D expenses amounted to US\$5,472 million, 3.4 times more than ten years ago. For historical data on revenue and R&D expenses, please see [Continuous Investment in R&D](#).

Note 2: Industry-academia collaboration projects include various academic programs, internships, cooperative education programs, etc.

Exceeded Achieved Missed Target

Originating from Dr. Morris Chang's groundbreaking idea of "being everyone's foundry", TSMC became the world's first dedicated IC foundry in 1987 and has since given rise to a thriving fabless IC design industry. TSMC continues to drive innovation and improve people's lives and societies with technology. Innovation remains, to this day, a proud corporate value and integral cornerstone for technology leadership. Within the Company, TSMC encourages employees to innovate by launching innovation-sharing platforms, contests, and other incentives for different organizations. Outside of the Company, TSMC explores product innovation with customers, fosters new talent with schools and research institutes, and advocates for a green supply chain with upstream and downstream suppliers. TSMC remains consistently devoted to innovation both internally and externally.

## Innovation Management Framework





## Maintain Technology Leadership

In 2022, TSMC continued to increase R&D investments, with annual R&D expenses accounted for 7.2% of total revenue, a 22.5% growth from last year. The Company has expanded R&D organization which now has 8,558 employees, a 9.6% growth from last year. TSMC's R&D investments paralleled those of world-leading tech companies.

To address the challenge with Moore's Law, TSMC's R&D organization provides customers with advanced

technologies and design solutions to help them achieve product success. In 2022, N3E, the enhanced 3nm process technology, entered risk production. In the same year, TSMC also pioneered 2nm technology development by successfully entering the stage of baseline setup and yield learning. TSMC will continue to conduct exploratory research into technology innovation beyond 2nm.

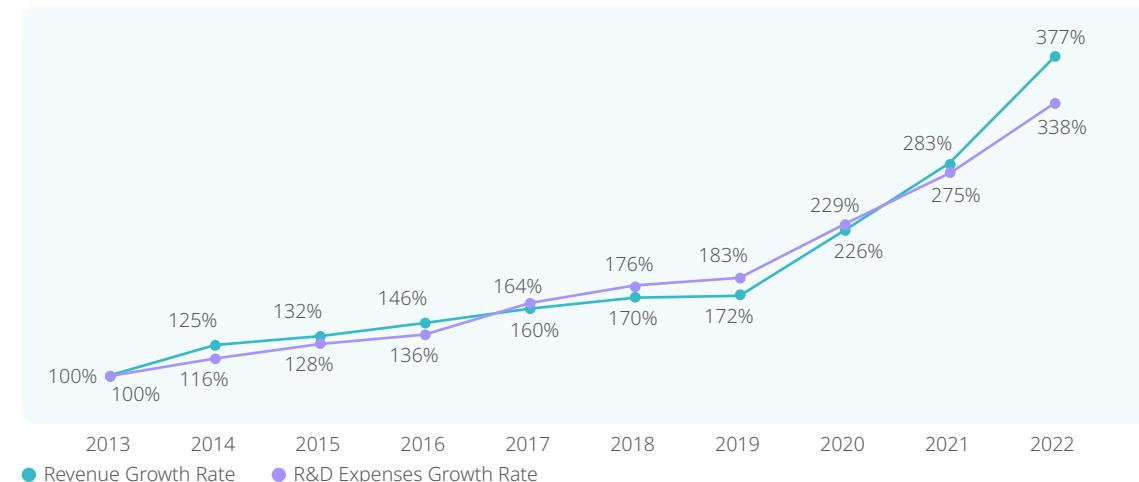
In addition to CMOS logic technology, TSMC is also developing a wide range of semiconductor technologies to meet customer demands on SoCs for mobile and other applications. The existing scope of application includes integrated interconnect and packaging solution, microcontrollers, virtual reality, edge-computing, etc.

In 2022, TSMC continued to work closely with world-class research institutes and world-leading universities such as the Semiconductor Research Corporation (U.S.), Interuniversity Microelectronics Centre (Belgium), etc., to develop semiconductor materials and design transistor structures. We aim to uphold Moore's Law and cultivate talent to usher in a new angstrom era for the semiconductor industry.

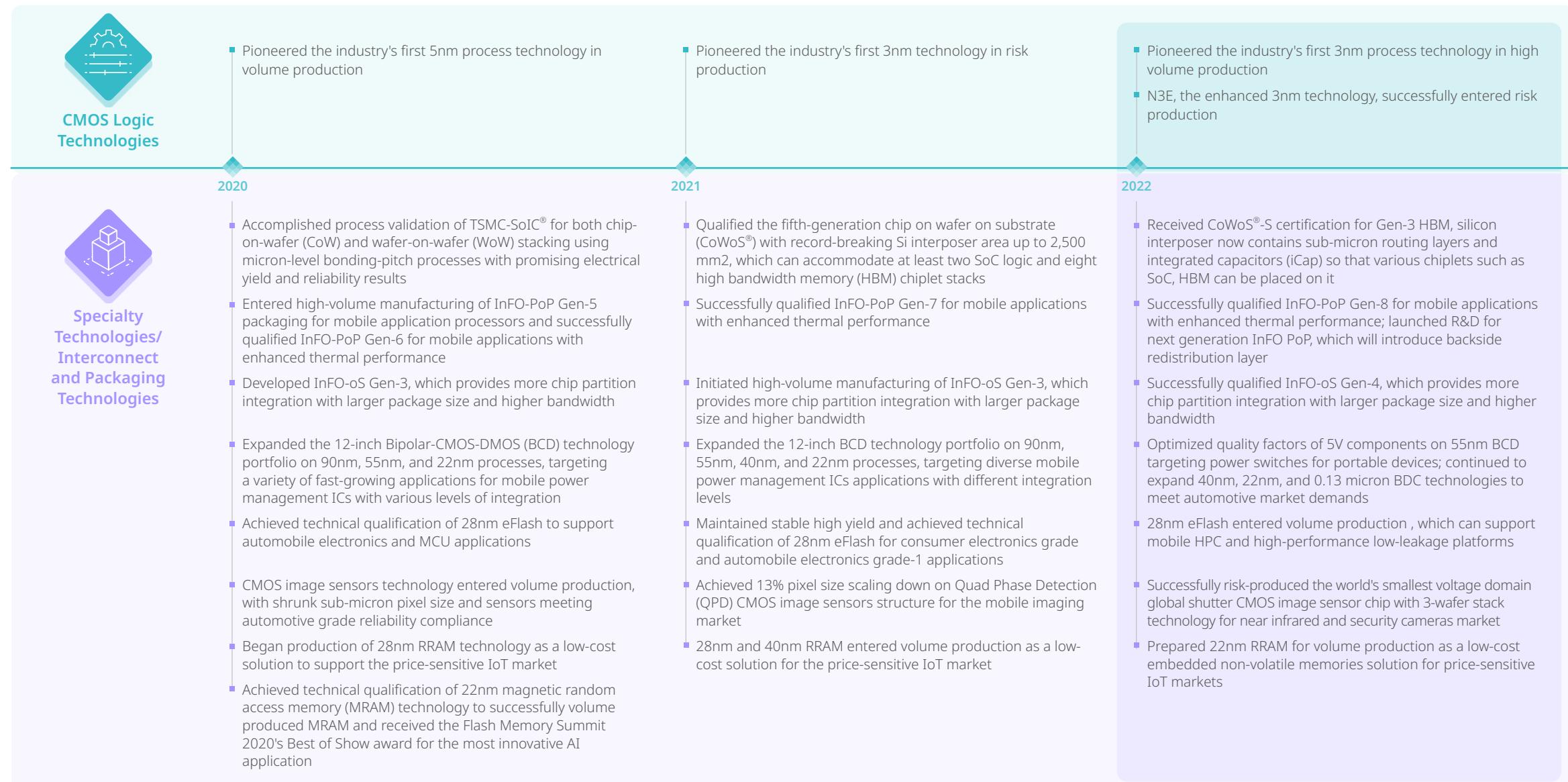
## Continuous Investment in R&D



## R&D and Revenue Growth Ratio over the Years



## Technology Leadership and Innovation



## Foundry Technology Leadership and Innovation in 2022

Process Technologies	Product Applications	Innovation / Breakthrough	Customer Success
3nm Fin Field-Effect Transistor (FinFET) (N3) technology	5G 	Customer products in high volume production with the industry-leading yield	Led the industry by introducing the most advanced products
4nm Fin Field-Effect Transistor (FinFET) (N4) technology	5G 	Led the industry to start volume production for customer products	Introduced products with the industry-leading performance and energy efficiency
The performance-enhanced 5nm FinFET technology N5P	5G 	Entered its second year of volume production for various customers' products	Introduced products with the industry-leading performance and energy efficiency
6nm FinFET (N6) technology	5G  	Widely adopted in mobile, high performance computing, and consumer electronics products	Introduced products with the industry-leading performance and energy efficiency
N6 radio frequency (N6 RF) technology	5G   	Received multiple customer product tape-outs	Introduce products with the industry-leading RF performance and cost-effectiveness
16nm FinFET Compact(N16FFC) MRAM (Magnetoresistive Random Access Memory) Technology	 	Completed reliability qualification, with one million cycles endurance and reflow capability	Introduced the industry-leading high performance microcontroller unit (MCU) for automotive and industrial applications
CMOS Image Sensor (CIS) technology		Continued to help customers gain market leadership by introducing the world's smallest pixel size products	Led the industry by introducing the most advanced products
TSMC-SoIC® (System on Integrated Chip) Chip-on-Wafer (CoW) technology		Led the industry to start volume production for customer products, with significant power and performance improvements	Introduced products with the industry-leading performance and energy efficiency
Integrated Fan-Out with local silicon interconnect (InFO_LSI) technology		Successfully integrated 5nm SoCs with ultra-high density die-to-die interconnects and entered volume production in 2022	Led the industry by introducing advanced products

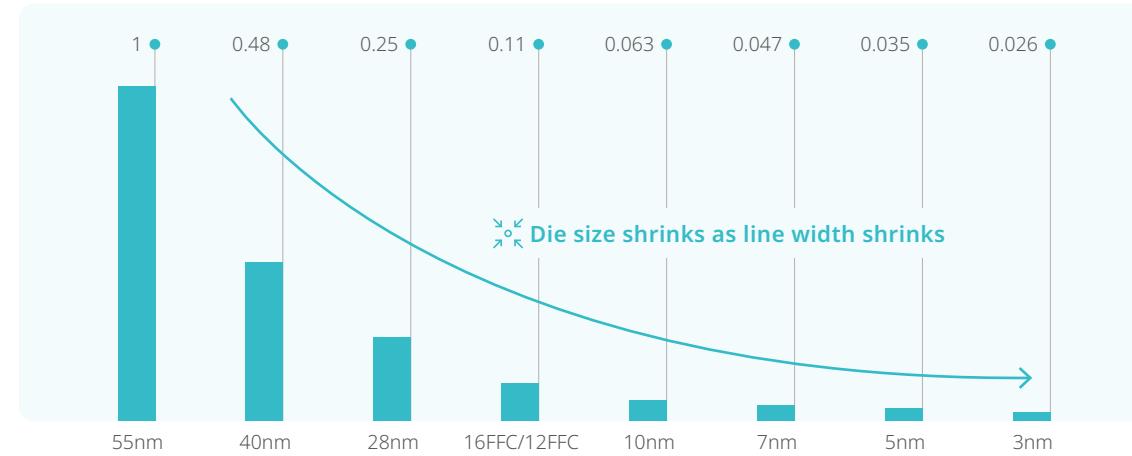
5G 5G mobile communications

 Consumer electronics WiFi High performance computing True wireless stereo (TWS) Digital TV/Set-Top Box (STB) Smartphones High performance computing applications Automotive zonal control used new electrical/electronic architecture (EEA) for software defined vehicle

## TSMC Continues to Advance Technology to Unleash Customer Innovation

Semiconductors have been playing a vital role in the development of human economic civilization, lifestyle and social evolution with greater computing power and better energy efficiency through innovations and breakthroughs. As the trusted dedicated semiconductor foundry service provider, TSMC continues to deliver the industry-leading, next-generation semiconductor technologies, with higher chip density and lower power consumption. The Company also offers comprehensive specialty technologies and leading 3D chip stacking and packaging services to help customers unleash different types of innovation and deliver more advanced, more capable, more energy-efficient, and more affordable electronic products.

## Comparison of Chip Die Size on Different Technologies



Note: The logic chip/SRAM/IO (input/output) ratio, which affects die size and power consumption, was re-aligned

## Collaborate with Customer to Push the Envelope in High-Performance Computing

One noteworthy example is our collaboration with AMD on building its leadership high-performance and adaptive computing products to help address the fast-growing compute demand from increasing adoption of cloud computing services, digital transformation, transition to exascale supercomputing, and the growing deployment of AI and high-speed 5G networks.

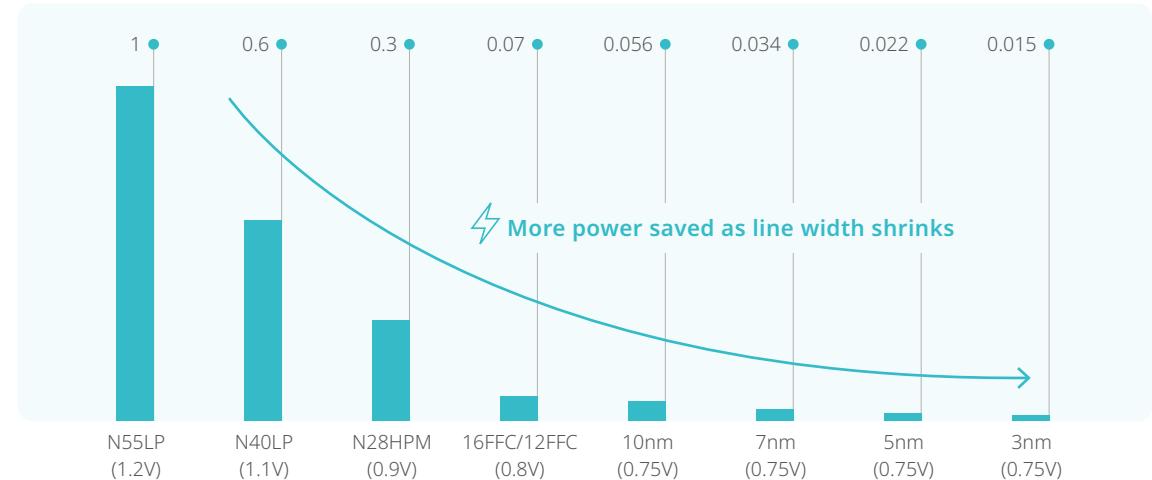
In 2022, combining AMD design innovation and TSMC's industry-leading 5nm technology process, AMD brought its 4<sup>th</sup> Gen EPYC™ processors to market. With up to 96 cores in a single processor,

the 4<sup>th</sup> Gen EPYC processors power the most energy efficient x86 servers. They offer leadership performance, energy efficiency and next-generation architecture, to accelerate data center modernization for high application throughput and more actionable insights. The 4<sup>th</sup> Gen EPYC processors can also help companies advance sustainability goals by deploying efficient, powerful servers to meet workload demands and help reduce power, energy costs, and server footprint.

In addition, in the November 2022 [Top500](#) list, Frontier supercomputer at Oak Ridge National

Laboratory (ORNL) in the US, powered by AMD optimized 3<sup>rd</sup> Gen EPYC™ processors and AMD Instinct™ MI250X accelerators using TSMC's 7nm process technology, topped the list with 1.1 exaflops for the second consecutive time. Frontier is the world's first supercomputer that breaks the exascale barrier, and it is more than twice as powerful as the next system on the list and more powerful than the next four systems combined.

## Comparison of Chip Total Power Consumption on Different Technologies



Note: The logic chip/SRAM/IO (input/output) ratio, which affects die size and power consumption, was re-aligned

On the energy efficiency front, the Frontier Test & Development System at ORNL, also powered by AMD optimized 3rd Gen EPYC™ processors and Instinct™ MI250X accelerators using TSMC's 7nm process technology, achieved an efficiency score of 62.68 GFlops/Watts, which was at the top of the June 2022 Green500 list and at the No. 2 spot of the November 2022 list. According to the Green500 November

2022 list, AMD powers 75 percent of the top 20 most energy efficient super computers.

In addition, using TSMC's process technology leadership, AMD received a 2022 SEAL Sustainable Product Award for innovative and impactful products "purpose-built" for a sustainable future in data centers and was honored in the Best Sustainability

Innovation in HPC category in the annual HPCwire Readers' and Editors' Choice Awards.

With the close collaboration with AMD, TSMC is glad to take part in contributing to the innovation and advancement in supercomputing to ensure scientists and researchers working on solving the world's toughest and most complex challenges, such

as climate change, health care, and transportation, have the most cutting-edge tools for their research.

In total, TSMC deployed 288 distinct process technologies, and manufactured 12,698 products for 532 customers in 2022, making continuous contribution to the advancement of modern society.

### Customer Product

- AMD 4<sup>th</sup> Gen EPYC™ (codename Genoa) processor



### Product Innovation and Breakthrough

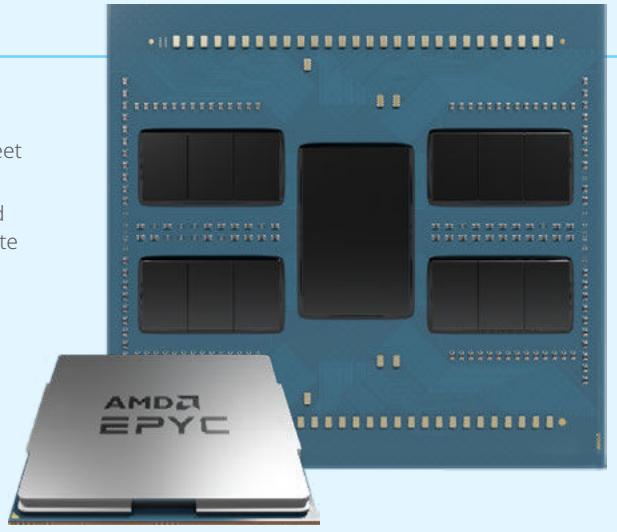
- With up to 96 cores in a single processor, the 4<sup>th</sup> Gen EPYC™ processors power the most energy efficient x86 servers



### Impact on Society

- Enable datacenters to deploy more efficient and powerful servers to meet workload demands
- Help lower power, energy costs, and server footprint to advance corporate sustainability goals

AMD collaborates with TSMC to deliver breakthrough 4<sup>th</sup> Gen EPYC™ (Genoa) 5nm processor to power the most energy efficient x86 servers  
(Photo courtesy of AMD)



### TSMC's Role

- Provide industry-leading 5nm process technology with best performance and power advantages
- Establish a dedicated team to enable deep technology and design co-optimization (DTCO) to speed up product design and volume production



## Case Study

# TSMC Enables More Than 1,500 Startup Customers Worldwide to Plant Seeds of Innovation

TSMC is the world's first dedicated semiconductor foundry, and this innovative business model has changed the landscape of the global semiconductor industry and enabled the global fabless IC companies to flourish. Today's heavyweight technology companies, including Broadcom, Marvell, and NVIDIA, have been collaborating with TSMC since their early days to continue to unleash innovation around the worldwide.

In 2000, TSMC formed a dedicated Emerging Accounts team to support startup companies to accelerate their product innovation. To date, TSMC has worked with more than 1,500 startup companies to advance applications in communication, computing, healthcare, transportation, clean energy and many other new applications. Currently, over 85% of startup companies in the semiconductor industry are engaging with TSMC to develop their prototype products.

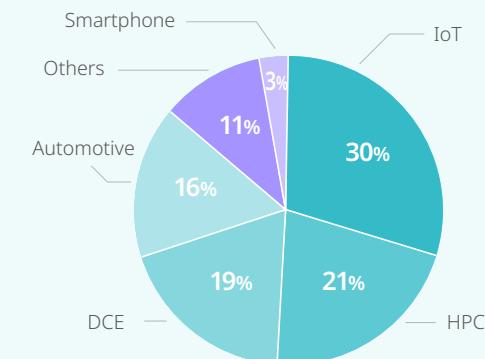
TSMC strives to be a long-term important partner that customers can trust and rely on for

their success. Driven by the passion to enable startup customers' success, TSMC hosted a dedicated Innovation Zone for the first time at the 2021 TSMC Online Technology Symposium. In the Innovation Zone of the 2022 in-person/online Technology Symposium, a total of 37 startup customers showcased a wide range of disruptive innovations that aim to make people's lives better and more sustainable, including cashier-less retail, high-performance computing interconnect, cloud and edge AI, power electronics, augmented reality, satellite-mobile communication, battery-free devices, in-vehicle networks, software-defined touch sensing, 5G private networks, and more. Through the interactive demonstration of products, startup customers vividly showcased the splendid future of next-generation semiconductor innovations.

Turning the spotlight to Kinara, which was awarded the first Innovation Zone Demo of the Year Award elected by Symposium attendees, showcased a cashier-less retail solution enabled by its edge AI platform. The platform uses a camera and AI system to identify consumers'

actions and their purchases in real-time with better energy efficiency. The cashier-less retail solution not only brings a convenient shopping experience to consumers but also creates meaningful work for retail cashiers, transforming them into sales consultants who provide value-added advice or retail system administrators. This inspiring story exemplifies how technology drives amazing changes.

## 2022 Innovation Zone Customer Demo By Application



TSMC hosted the first in-person Innovation Zone at the 2022 Technology Symposium



U.S. company Kinara received the first Innovation Zone Award for its cashier-less retail solution



## Protect Intellectual Property

IP-based development strategies are increasingly important under trends of globalized economic and trade competition. To fulfill TSMC's vision of sustainable operations, the Company seeks to strengthen its three competitive advantages—Technology Leadership, Manufacturing Excellence, and Customer Trust—by protecting technological innovations and proprietary information through two approaches: patents and trade secrets. For technology leadership, TSMC's IP and R&D teams work closely throughout each step from the beginning of technology planning to risk production and volume production. Such teamwork enables TSMC to build an IP portfolio for each generation's critical innovative technology ahead of schedule, including the latest 3nm and 2nm process technologies, to ensure the Company's technology leadership in the semiconductor industry. In manufacturing excellence, TSMC uses rigorous protection measures to secure critical information

such as capacity planning, manufacturing process management, and information related to intelligent operations in the form of trade secrets, while also actively applying for patents for manufacturing technology with strategic value to secure the Company's competitive advantage obtained through manufacturing excellence and quality assurance. In maintaining customer trust, TSMC protects confidential information concerning the Company and its customers while maintaining strategic leadership in the global patent ranking. These efforts translate into business success, ensuring the freedom of TSMC's operations around the world and strengthening partnerships with customers.

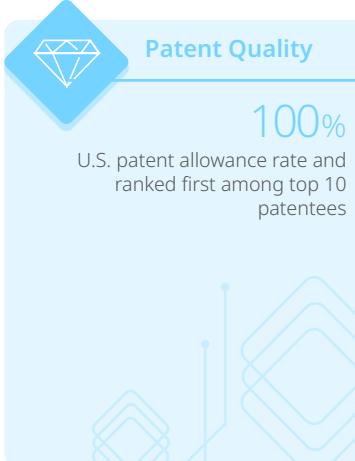
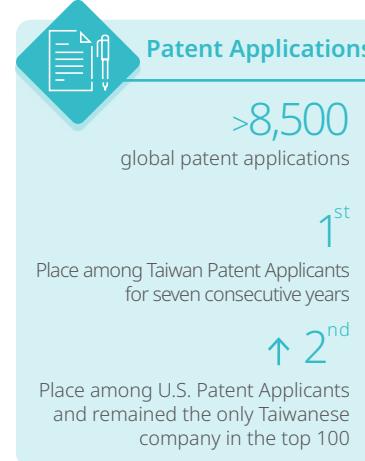
### TSMC Patent History

The history of TSMC's robust patent portfolio can be divided into three eras. In 1987, the Company applied for its first patent and has since increased patent applications every year. In 1998, TSMC filed

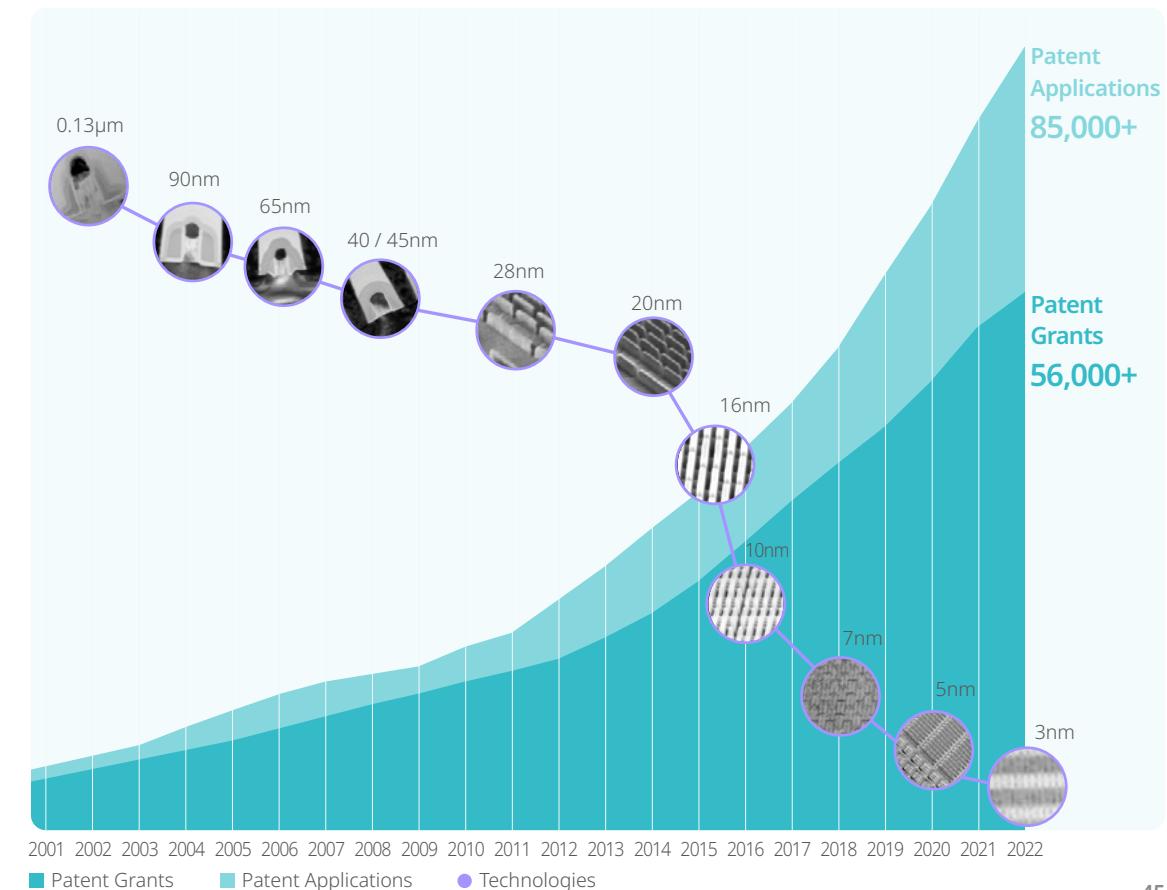
500 invention patent applications, thus concluding the Groundwork Era. In 1999, the Company entered the Growth Era and filed 1,000 patent applications in 2011. Starting in 2012, the IP team began setting patent application goals based on annual R&D investments, bringing TSMC into the Exponential Growth Era. As of 2022, TSMC has filed over 85,000 global patent applications and consistently reached record highs again and again. Using FinFET

technology as an example, TSMC introduced 16nm FinFET process technologies in 2013 and became the first to fabricate both 7nm and 5nm FinFET products. In the early stages of FinFET development, TSMC had already filed patent applications. Over the course of 20 years, TSMC has accumulated over 14,000 FinFET patents as it systematically built up patent protection coverage to ensure technology leadership.

## Patent Achievements with Quality and Quantity in 2022



## Exploratory R&D Patent Applications





## Comprehensive Patent Management Mechanism

TSMC's patent performance stems from its robust patent management institutions and patent management systems. The Company maps out short-, mid-, and long-term patent blueprints using innovative patent strategies and diverse risk control; monitors and evaluates competitive information by patent map navigation; hosts advanced invention workshops to uncover innovations in core technologies; expands the patent family by targeting key technological indicators; and manages patent prosecutions by invention tiers. Through managing the quality of patent applications and expanding patent protection coverage, TSMC has been able to consistently construct a global strategic patent portfolio with equal attention to quality and quantity. In 2022, TSMC was the only Taiwanese company ranked in the top 100 for U.S. patent applications and grants.

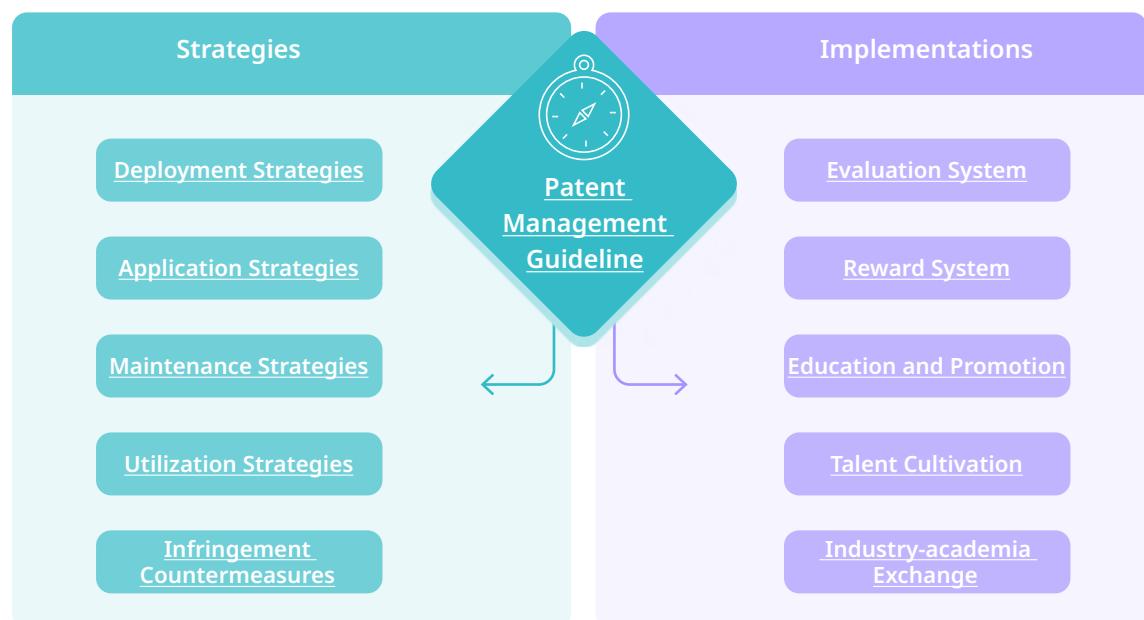
The patent team has also designed a range of incentive systems including awards for patent invention submission and a big annual IP award ceremony. The Prolific Inventor Award recognizes employees that have received over 100 U.S. patents during their employment at TSMC. As of 2022, there have been 141 Prolific Inventor Award recipients, one of whom holds over 1,000 U.S. patents. A total of 360 patents have been issued from 384 employee inventors that received the New Inventor Award in 2022. In 2022, the patent team also launched a series of patent campaigns, including the Annual Patent Competition, which

received 1,663 invention submissions; 16 on-site education and training sessions to help employees ideate valuable patents; and the Online Patent Quiz, which saw the participation of around 2,000 employees.

## Widespread Recognition of Patent Success and Industry IP Upgrades

TSMC's patent performance has been recognized by many international IP institutes. The Company ranked first in the semiconductor manufacturing category for IEEE's Patent Power Scorecard, became the first and only company to receive the highest Taiwan Intellectual Property Management

System (TIPS) certification (AAA), and ranked in the Clarivate Global Top 100 Innovators and LexisNexis Global Top 100 Innovation Momentum for two consecutive years by index of patent portfolio size and citation strength. In addition, TSMC continues promoting technology and IP upgrades in the industry by communicating with various IP authorities and legal courts, collaborating with academic institutes to develop technology and IP indicators, and spearheading IP strategy alliances for the industry's supply chain. TSMC also helps formulate and amend IP laws and provide suggestions on industry policies to help create a robust patent protection landscape.



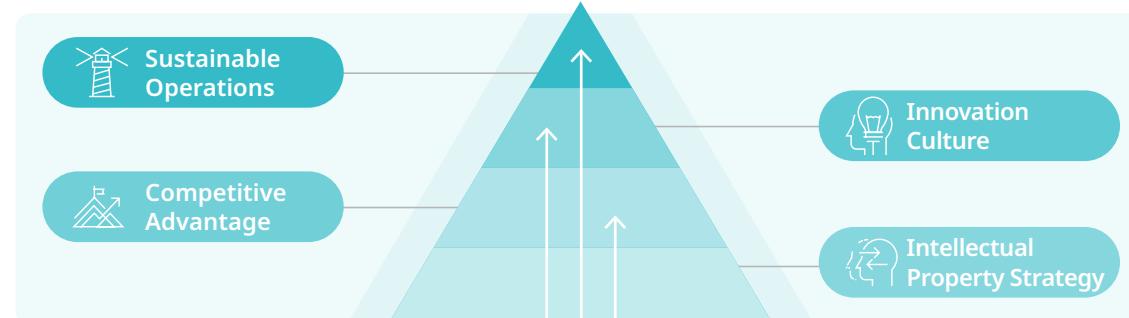
## Trade Secret Protection

Driven by its four visions—IP Strategy, Competitive Advantage, Innovative Culture, and Sustainable Operation,—TSMC has implemented three measures to drive comprehensive trade secret management: Trade Secret Registration (TSR) System, Golden Trade Secret Award, and Green Trade Secrets. With registration and incentive systems, TSMC aims to execute IP strategies and strengthen competitive advantages by instilling vigor into the Company's innovative culture and fulfill the mission of sustainable corporate governance. In pursuit of excellence, TSMC actively uses intelligent automation and AI technologies to optimize the TSR system. On top of introducing an AI chatbot to raise employee awareness of trade secret management, TSMC also developed numerous capabilities for the TSR system, such as an innovation talent pool, systematic technology clusters, and technical keyword analysis. Not only has TSMC acquired the capability to identify real-time insights into the development trends of leading technologies, the Company has also integrated the HR system and contract management system to consolidate employees' innovation prowess and contributions

to strengthen TSMC's evolving competitiveness, maximizing the impact of registered trade secret contents on sustainable technology innovation. In 2022, more than 40,000 trade secrets were registered at TSMC, far exceeding the [annual target](#), bolstering company operations and IP innovation.

In addition to improving trade secret protection and management internally, TSMC is also expanding externally to extend positive spillovers for the industry. Based on the [Supply Chain Trade Secret Management Sharing](#) public service project, TSMC established the [Trade Secret Registration System Alumni Association](#) in 2022 to share the Company's experience and help the supply chain develop robust trade secret management capabilities without disclosing any proprietary information. In 2022, TSMC successfully aided 12 companies in developing and implementing their own trade secret registration systems and shared TSMC's TSR system with 17 companies, exceeding the [annual target](#) as material contributions are continuously made to trade secret protection and management.

## TSMC's Vision of Trade Secret Management Innovation



## An Intelligent Automation (IA) and Artificial Intelligence (AI) Powered Intelligent Trade Secret Management System

### Integrated with Human Resources System

TSMC's trade secret registration system is integrated with the Company's human resources system and automatically updates employees' registration information in their personnel file. This serves to highlight employees' contributions to TSMC's technological innovations and is an important indicator for supervisors to consider for performance evaluation and promotion.

### Intelligent Reminder Function

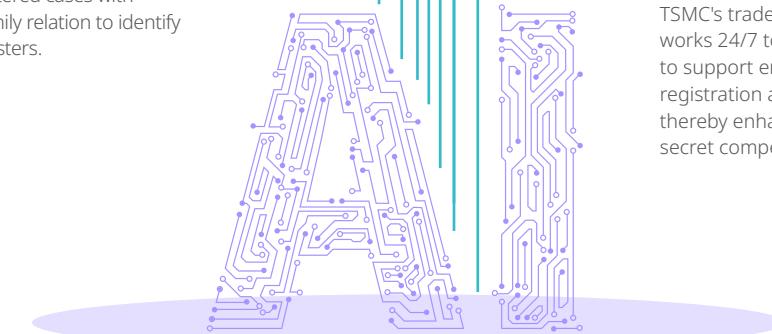
The trade secret system automatically compares employees' trade secret registration records and reminds them to complete the registration process in a timely manner.

### Keyword Analysis

Analyze technology keywords from previous trade secret registration data to compile and uncover technology development trends.

### Technology Cluster

Systematically categorize and annotate registered cases with technology family relation to identify technology clusters.



### Real Time Data Visualization Analysis

The use of advanced information analysis software in TSMC's system to visualize trade secret registration data provides employees with real-time updates and precise data on the quantity of registrations, allowing them to understand their registration status and adjust their registration strategies more efficiently and effectively.

### Innovation Talent Pool

Analyze Golden Trade Secret award winners' backgrounds to generate an "innovation talent pool" for TSMC's talent development planning and strategic management.

### Connected to Contract Management System

TSMC's trade secret registration system is connected to its contract management system, reminding employees involved in technology development and transfer to register the relevant trade secrets in a timely fashion.

### AI Chatbot Support

TSMC's trade secret AI chatbot works 24/7 to provide instant replies to support employee trade secret registration and protection queries, thereby enhancing employee trade secret competency.

## Inspire Innovation with New Projects to Reach Record-High Registrations

TSMC utilizes the TSR system to maintain comprehensive records of important inventions for its employees and targets technical innovations of interest with tailored projects. For example, TSMC launched the 100% TSR Coverage in Advance Process Volume Production Fabs Project to encourage engineers with more than one year of experience in 3nm, 5nm, and 7nm processes to come up with innovations. The project's goal of achieving a 100% registration rate was reached in 2021. In 2022, TSMC launched the Manufacturing Excellence TSR Project to focus on developing technical trade secrets for two competitive advantages: Technology Leadership and Manufacturing Excellence. As of 2022, over 31,528 employees have participated in registering a cumulative total of 241,740 technical or commercial trade secrets. In addition, Golden Trade Secret Awards are presented every year to trade secrets with strong impacts on competitive advantages to recognize employee contributions and drive innovation. As of 2022, 2,279 Golden Trade Secret Awards have been given to 5,946 recipients.



The TSR system grants exposure to and records engineers' innovative ideas while maintaining the Company's competitiveness.

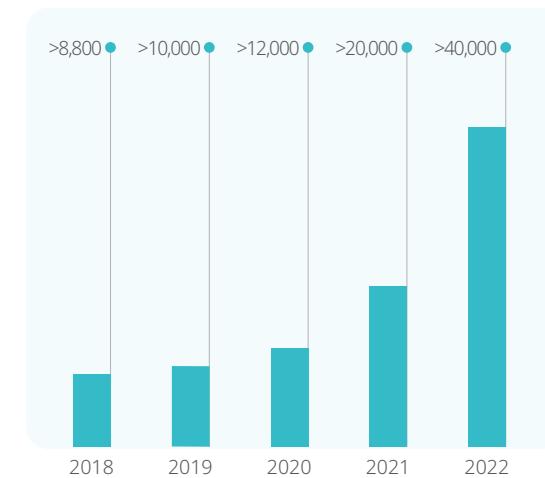
**Tsai Yu-hsuan**  
TSMC Employee

## Protect Green IPs and Deepen Co-Prosperity with the Industry and the Environment

In terms of green trade secrets, TSMC launched the Green Trade Secret Award and Green Trade Secret Registration Section to establish a robust foundation for environmental protection trade secrets and strategies and to recognize seven major contributions, encouraging employees to develop more trade secrets advancing environmental protection technologies related to Climate and Energy, Water Stewardship, Circular Resources, and Air Pollution Control. In 2022, 579 innovations were recorded, and the registrants were employees from not only facility organizations responsible for energy and water conservation, but also from R&D, manufacturing, testing, quality control, etc., indicating that a green innovative culture is now deeply rooted in TSMC's daily operations.

To extend the reach of green influence, TSMC further established the Incentive Guidelines to Encourage Green Trade Secret Registration and Sharing as a Public Service to encourage employees to publicly share their experience on energy conservation, carbon emissions reduction, energy management, environmental conservation, and more. Employees may first register undisclosed, sustainability-related innovations as green trade secrets before seeking approval from the system for public disclosure, which also qualifies the innovations to become candidates for recognition as distinguished charitable cases by the Company. Without compromising proprietary information protection policies (PIP), TSMC hopes to proliferate a green manufacturing culture and actual practices and work with the industry to promote environmental sustainability.

## Historical Trade Secret Registration



## Trade Secret Milestones





## Case Study

# Establishment of the Trade Secret Registration System Alumni Association to Extend Sustainability Influence across Industries

TSMC's Strategic Supply Chain Partners Trade Secret Management Sharing public service project strengthens trade secret management (TSM) in the supply chain and provides easy-to-understand trade secret registration (TSR) principles and practices to suppliers. In June 2022, TSMC founded the [Trade Secret Registration System Alumni Association](#) to share the Company's TSR execution experience, standard registration templates, and reference evaluation metrics to help suppliers quickly pick up TSR. Members of the association also discussed challenges in TSR execution and exchanged respective solutions, which further inspired new TSR and TSM services. In 2022, TSMC successfully assisted Solar Applied Materials Tech, eChem Solutions Corp., and [ten other companies](#) in establishing and implementing their own TSR systems. In 2023, TSMC plans to do the same for [five more companies](#). TSMC envisions itself as the advocate for TSR and intelligent management, consistently instilling the drive to innovate and elevating the industry's competitiveness.



Dr. Fortune F.Y. Shieh, Associate General Counsel of TSMC, shares his experience with the TSR system and intelligent management at the Technology Industry Integrity Governance and Trade Secret Protection Summit Forum

## Intelligent Precision Manufacturing

Volume production of advanced processes and precision manufacturing are at the core of intelligent manufacturing at TSMC and the drivers of manufacturing excellence. To keep up with the complex manufacturing model of globalized production and ensure consistent manufacturing efficiency and product quality across fabs, TSMC established and deployed the Global Manufacturing and Management Platform at all its domestic and oversea fabs. The Company also continued to promote digital transformation and digitized fabs through five major strategies: Agile Manufacturing, Precise Process Control, Maximum Tool Productivity, Optimize People Efficiency, and Consistent Management.

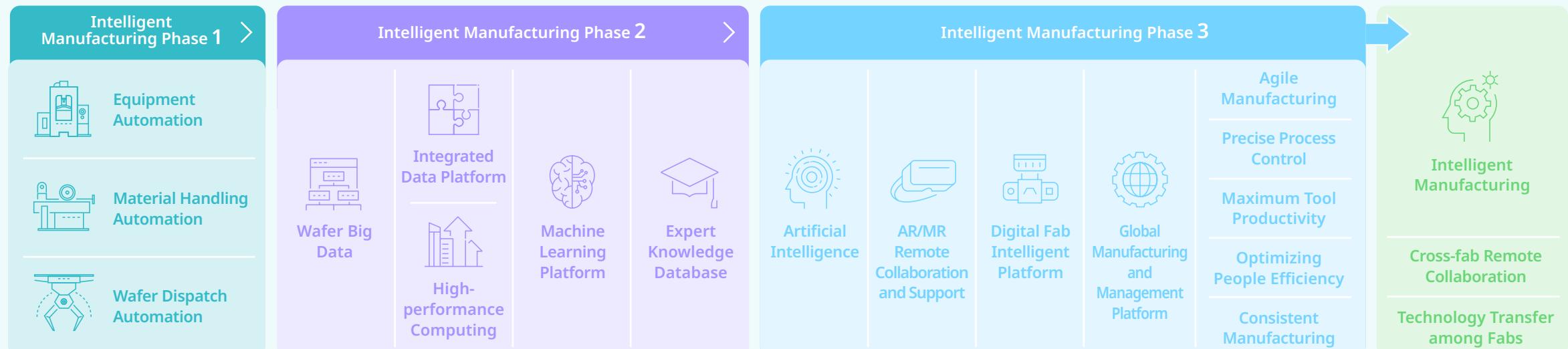
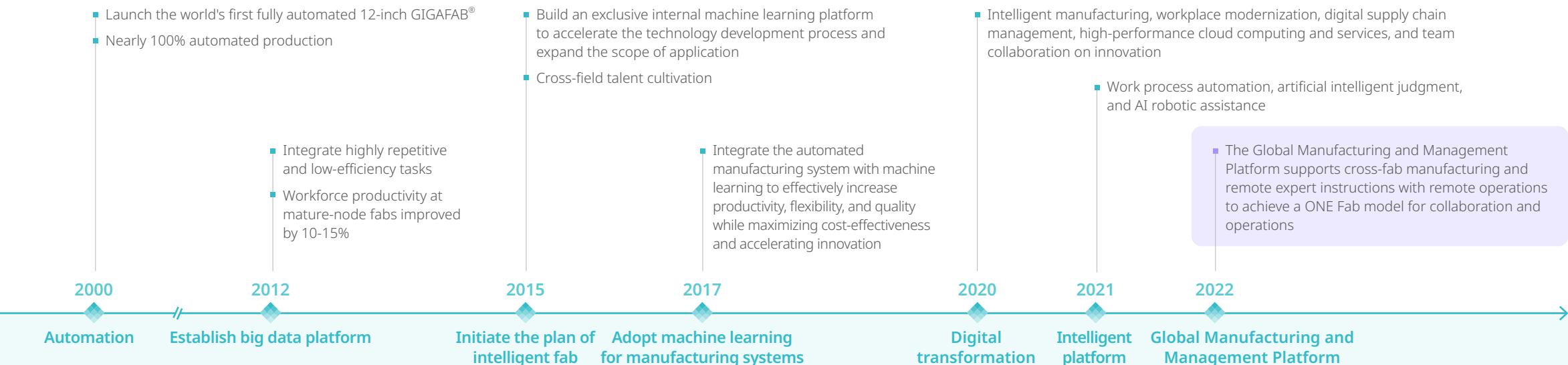
For Agile Manufacturing, TSMC utilizes a modularized Intelligent Scheduling and Dispatching system to calculate optimal dispatch orders in combination with the Intelligent Automated Material Handling System to ensure wafers are delivered to the right machine on time. Meanwhile, the Automatic and Intelligent Manufacturing System, developed in-house, supports production and ensures consistent productivity and cycle times across fabs.

For Precise Process Control, TSMC adopts its self-developed AI technologies to ensure process control consistently across fabs to reduce process variance, and also compiles big data on production from TSMC wafer fabs around the world on a universal quality control platform, using AI technology to simultaneously compare over [thirty quality defense](#)

systems, set the same specification control, and optimize global wafer production quality by benchmarking against equipment with the best wafer process performance. For Maximum Tool Productivity, TSMC utilizes an intelligent operation platform to process abnormal activities from millions of process control charts, allowing engineers to detect abnormal activities at the same time. They can then use TSMC's intelligent diagnostics platform to quickly find the root cause and promptly repair tools. For Optimizing People Efficiency, TSMC rolled out relevant measures in 2022 to all TSMC fabs around the world, continuing to digitalize knowledge from internal experts and utilizing intelligent workflows to establish 20 systems, allowing employees to focus on high-added-value tasks and effectively increasing productivity by 30 to 50%.

TSMC's goal is to enable the simultaneous deployment of manufacturing improvement activities and productivity enhancement projects to all TSMC fabs around the world with the Global Manufacturing and Management Platform and achieve consistent manufacturing practices and parameters across all fabs. This can accelerate the delivery of products with optimal yield and performance to customers. Furthermore, TSMC seeks to support cross-fab manufacturing or remote expert instructions with remote operations coupled with augmented reality and mixed reality to achieve an agile and efficient ONE Fab model for collaboration and operations. This empowers TSMC as a trusted, reliable and consistent capacity provider in the global logic IC industry for years to come.

## Development History of Intelligent Precision Manufacturing



## Open Innovation Platform®

The acceleration in digital transformation has made semiconductors more pervasive and essential in people's lives. TSMC's Open Innovation Platform® (OIP) focuses on innovation and collaboration, solidifying in Electronic Design Automation (EDA) and Intellectual Property (IP) development to achieve Design and Technology Co-Optimization (DTCO), enable IC design in the cloud, and offer design services for backend packaging and testing partners.

In addition to the existing EDA, IP, DCA and VCA, and Cloud Alliances, TSMC announced the new 3DFabric Alliance in 2022 as the sixth OIP alliance with 19 inaugural members that have 3D IC expertise covering aspects from EDA, IP, and DCA/VCA to Memory, Outsourced Semiconductor Assembly and Test (OSAT), Substrate and Testing. The new 3DFabric Alliance contains a full spectrum of best-in-class solutions and services for semiconductor design, memory modules,

substrate technology, testing, manufacturing, and packaging, aiming to help customers achieve speedy implementation of silicon and system-level innovations and enable next-generation HPC and mobile applications using TSMC's 3DFabric™ technologies, a comprehensive family of 3D silicon stacking and advanced packaging technologies.

TSMC hosted the 11<sup>th</sup> OIP Ecosystem Forum in 2022, where TSMC and its OIP partners have shared the

collaborative ecosystem solutions through DTCO to support the optimization of power, performance and area (PPA) in customer products. TSMC has worked closely with these ecosystem partners ever since the Company was established and continues to expand its libraries and silicon IP portfolio to more than 55,000 IP titles and provides more than 43,000 technology files and over 2,900 process design kits, from 0.5-micron to 3-nanometer, to customers. The latest set of comprehensive ecosystem design solutions support customer designs using TSMC's industry-leading process technology for high-performance computing, mobile, automotive, and IoT applications. These combined efforts have helped customers accelerate innovation for their differentiated products to drive continuous technology development around the world.

### Design-Technology Co-Optimization (DTCO) | Minimize Design Cycle Time | Facilitate Tape-out Success | Accelerate Time-to-market | Shorten Time-to-volume | Time-to-revenue



#### EDA Alliance

Provide the certification of Electronic Design Automation (EDA) tools that are required for IC design stages, as well as the readiness of design reference flows to timely address the latest requirements by customer designs and process technologies



#### Cloud Alliance

Deliver OIP Virtual Design Environment (VDE) and Cloud solutions required at various design stages for customer's adoption that help expedite product design cycle time by fully utilizing the high-performance computing resources available in the Cloud



#### Value Chain Alliance

Integrate design enablement building blocks and provides specific services that bring customer's innovation to IC value chain, including IP development, front-end and back-end designs, and wafer manufacturing, assembly, and testing



#### IP Alliance

Offer silicon-proven IP portfolios that fulfill TSMC's quality requirements and meet a wide variety of design needs in the semiconductor industry



#### Design Center Alliance

Offer design services ranging from system-level front-end design to back-end physical implementation/verification that assist customer's designs in TSMC technologies



#### 3DFabric Alliance

Comprise a full spectrum of 3D IC design solutions and services, memory modules, substrate technology, testing, manufacturing, and packaging, to help customers implement silicon and system-level innovations with TSMC 3DFabric stacking and advanced packaging technologies

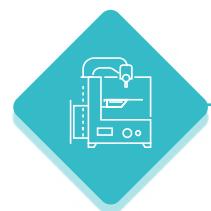


Through the collective leadership of TSMC and our ecosystem partners, our 3DFabric Alliance offers customers an easy and flexible way to unleash the power of 3D IC in their designs, and we can't wait to see the innovations they can create with our 3DFabric™ technologies.

**Dr. L.C. Lu**  
TSMC fellow and vice president of the design and technology platform

## Comprehensive Ecosystem Design Solutions

During the 2022 OIP Ecosystem Forum, a complete set of design solutions was unveiled jointly with OIP alliance partners, to address the market demands for specific platforms for mobile, high-performance computing (HPC), automotive and IoT applications.



### Advanced Technology

- TSMC FINFLEX™ innovation combines process and design co-optimization for 3nm technology
- Continues full node scaling in N3E that achieves best-in-class PPA results
- Major EDA tools have undergone optimization and certification, and relevant foundation IPs can be provided to customers to start design



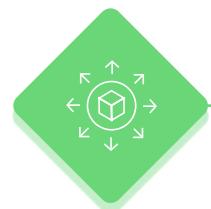
### Analog Cell

- Boosts analog IP yield
- Enables the automation of EDA tools and overall design flow
- Design solutions are ready in N5, N4 and N3, and will extend to N2 and N6; corresponding analog design migration EDA flows are also ready for customer adoption



### Automotive Technology Platform

- Automotive Service Package is available in 0.5um to 12nm
- For technologies of 16nm, 7nm and 5nm, the respective enhanced Automotive Design Enablement Platform (ADEP) is ready for customer adoption
- The platform includes aging and thermal-aware design flows, and is AEC-Q100 and IP9000A compliant



### 3Dblox™ Standard for 3DFabric™ Technologies

- The comprehensive 3DFabric™ technology offerings enable the required performance, power, form factor and flexibility for system-level designs
- TSMC 3Dblox™ standard reduces design complexity by modularizing 3DFabric™ structures and standardizing EDA tools for interoperability
- TSMC 3Dblox™ is ready for 3DFabric™ integration in CoWoS®, InFO and TSMC-SoIC® technologies with validated EDA tools

To recognize the outstanding support and collaborative achievements of TSMC's OIP ecosystem partners, the Company announced the 2022 OIP Partner of the Year awards for their excellence in accelerating semiconductor innovation.



TSMC joins hands with alliance partners to accelerate semiconductor innovation through OIP

## Enhance Industry-Academia Collaboration

TSMC maintains long-term partnerships with universities in Taiwan and abroad in three areas—Industry-Academia Collaboration, Course Collaboration, and Career Guidance—to encourage professors to conduct cutting-edge semiconductor research and develop advanced semiconductor components, process and material technologies, engineering sciences, and special process technologies relating to the electronics industry. TSMC aims to develop long-term and interactive systems for collaboration programs with universities, jointly pushing for advanced research and development and cultivating talent for the semiconductor industry.

In 2022, TSMC invested NT\$660 million in industry-academia research collaboration and worked with 26 universities in Taiwan and abroad to continue numerous research projects and industry-academia projects. With the TSMC University Shuttle Program, the Company is also helping university professors and students to validate designs, applications, and terminal performances. In 2022, TSMC took on a greater role in supporting six universities in Taiwan to establish their own National Academy for Key Fields of Research and continued to provide funding to support cutting-edge research and talent cultivation for the semiconductor industry.

TSMC also launched Semiconductor Programs at universities in Taiwan, with over 4,000 students having enrolled and learned through the programs since 2019. To close job-education discrepancy, TSMC reached out to partners in the industry, company executives, and professors to co-design and lecture programs. In 2022, TSMC launched two courses, Semiconductor Technology - Process & Equipment and Semiconductor Intelligent Manufacturing Systems, which benefitted over 810 students. In 2022, TSMC launched the Academic

Design Foster Package (ADFP) for its own 16nm FinFET technology to help universities overcome education and research bottlenecks in cutting-edge chip design, ushering in the FinFET era and strengthening R&D capabilities.

For career guidance, TSMC organized a wide range of events to give students further insight into the semiconductor industry and lay the foundations for future talent. In 2022, a total of 1,700 students attended TSMC's career guidance events. In

addition, a mini course Semiconductor Devices Physics was launched for high schools with a simplified but comprehensive course design and hands-on practice sessions to inspire passion and interest in semiconductors, thus cultivating tech talent for the future. In 2022, TSMC also continued to organize the Girls in STEM program for high schools, sharing experience of working in tech with high school girls and reaching over 2,900 students.

### TSMC University Collaboration Programs



#### Industry-Academia Collaboration

- University Research Center
- Industry-Academia Joint Development Project
- University Shuttle Program
- National Academy for Key Fields of Research



#### Course Collaboration

- Semiconductor Programs
- FinFET Academic Design Foster Package (ADFP)



#### Career Guidance

- TSMC Ph.D. Scholarship
- TSMC High School Mini Courses
- TSMC Girls in STEM Program for High Schools

660 million

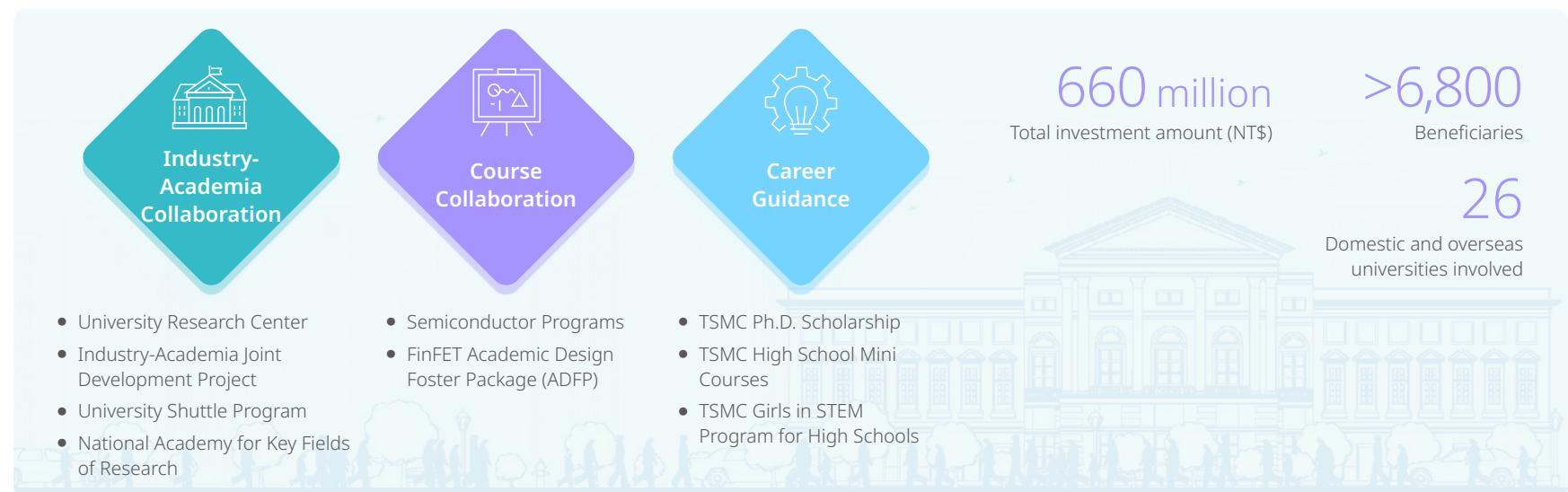
Total investment amount (NT\$)

>6,800

Beneficiaries

26

Domestic and overseas universities involved



## Industry-Academia Collaboration

### • University Research Center

TSMC worked with National Yang Ming Chiao Tung University, National Taiwan University, National Cheng Kung University, and National Tsing Hua University to establish graduate institutes and provided research funding to encourage university professors and students to come up with innovative semiconductor research projects, develop cutting-edge technologies in semiconductor components, materials, processes, and chip design, and foster semiconductor researchers. TSMC has been establishing university research centers since 2013; as of 2022, a total of 245 professors and over 3,600 top students in the fields of electronics, physics, chemistry, chemical engineering, and mechanical engineering have joined the graduate institutes in the four universities mentioned above. In addition, TSMC provided funding and collaborated with eight world-leading universities abroad, launching international research projects through graduate institutes.

### • Industry-Academia Joint Development Project

TSMC encourages university professors to explore cutting-edge semiconductor technologies through industry-academia joint development projects that allow interested students to join and learn from hands-on experience. TSMC hopes this will encourage students to consider a career in the semiconductor industry. In 2022, 147 industry-academia joint development projects were launched, with 134 professors from nine universities in Taiwan and 17 universities abroad participated. Since 2013, these industry-academia joint development projects have resulted in 228 patent applications in the U.S.

### • University Shuttle Program

Semiconductor innovations continue to drive progress in the world; it is therefore pertinent and pressing to cultivate talent for the future. In 2022, TSMC worked with professors and students from 12 world-leading universities through the University Shuttle Program to realize IC circuit designs and validate terminal performances. As a result, a total of 92 papers were published on 5G and wireless



Innovation is a never-ending journey in the field of chip designs. I'd like to thank TSMC University Shuttle Program for their support and efforts in research innovation and talent cultivation.

#### Wei-Zen Chen

Professor at the Department of Electronics and Electrical Engineering, and Institute of Electronics, National Yang-Ming Chiao Tung University

TSMC University Shuttle Program provides us stronger foundations and the opportunity to validate and realize our designs. I'd like to thank TSMC for providing such invaluable resources.

#### Yuan-Bang Huang

Student at the Institute of Electrical Engineering, National Taiwan University

communication, high-speed wireline communication, memory applications, safety, biotechnology, image sensor applications, and robotics applications. And 22 of those papers were published in esteemed journals or at renowned conferences such as the IEEE Journal of Solid-State Circuits and the International Solid-State Circuits Conference (ISSCC), often touted as the "IC Design Olympics."

### • National Academy for Key Fields of Research

To support the Ministry of Education's National Key Fields Industry-University Cooperation and Skilled

Personnel Training, TSMC is committed to helping National Yang Ming Chiao Tung University, National Taiwan University, National Cheng Kung University, and National Tsing Hua University to establish graduate institutes. In 2022, TSMC extended its collaboration with two more universities—National Sun Yat-sen University and National Chung Hsing University—to integrate TSMC's R&D resources with their R&D capabilities. In the future, TSMC will invest at least NT\$100 million in funding to support cutting-edge semiconductor research, help schools offer merit-based scholarships, and cultivate top R&D talent.

## Key Academic Collaborators and Research Topics in 2022

[National Tsing Hua University](#)

[National University of Singapore](#)

[National Yang Ming Chiao Tung University](#)

[University of California, Berkeley](#)

[University of California, Los Angeles](#)

[University College Dublin](#)

[University of Michigan](#)



Note: Universities are listed in alphabetical order



## Course Collaboration

### • Semiconductor Programs

To increase the quantity and quality of domestic semiconductor talent and attract more outstanding students to the semiconductor industry, TSMC offers Semiconductor Programs at [top universities in Taiwan](#). Six majors are offered, including components/integration, processes/modules, equipment engineering, advanced packaging, intelligent manufacturing, and advanced circuit design. In 2022, National Chung Hsing University joined the program too. In total, over 4,000 students have enrolled.

In addition to the Semiconductor Programs, TSMC invites employees to serve as industry lecturers to co-lecture two courses, Semiconductor Technology - Process and Equipment and Semiconductor Intelligent Manufacturing Systems, at [several universities](#) to give students insight into the latest knowledge and practices from the industry and mitigate any job-education discrepancy. In 2022, a total of 810 students enrolled in these courses. Since April 2022, TSMC has made internal training resources available to students enrolled at TSMC Semiconductor Programs at various universities. Students can visit the TSMC Newcomer Training Center for free courses such as Semiconductor Component Fundamentals and Semiconductor Tool Fundamentals. Professional insights from corporate trainers at the Newcomer Training Center and the opportunity for hands-on practice with real tools

enable students to integrate theory into practice and learn about the latest semiconductor processes and tools. In 2022, five sessions were offered at the Newcomer Training Center, holding 209 lectures and benefitting 271 students.

### • FinFET Academic Design Foster Package (ADFP)

To strengthen the cultivation of forward-looking design talent and reduce education-job discrepancy, TSMC launched the 16nm FinFET Academic Design Foster Package (ADFP) and leveraged government cloud platforms to help universities upgrade very-large-scale integration (VLSI) chips. In addition, TSMC organized lessons and contests related to circuit design. As of 2022, ADFP has been successfully deployed at [11 universities](#) in Taiwan for professors to use in related courses. It is estimated that over 2,000 people will benefit annually starting from 2023. ADFPs are also planned expand to universities abroad in the future to create a global FinFET design education platform and cultivate semiconductor talent for the future.

### Career Guidance

#### • TSMC Ph.D. Scholarship

Fostering Ph.D.-level scientific research talent is key to the sustained advancement of the semiconductor industry. TSMC launched a [Ph.D. Scholarship](#) in 2020

as an incentive for elite students to pursue doctoral degrees in scientific specialties related to the field of semiconductors. The program consists of three pillars: scholarship, mentorship, and internship. An annual subsidy of NT\$500,000 is issued for a maximum of five years to offer Ph.D. students financial support. After attaining the degree, the scholarship recipients can directly join the semiconductor industry or become an educator to cultivate more talent. As of 2022, a total of 74 Ph.D. students have benefited from the scholarship.

#### • TSMC High School Semiconductor Mini Courses

TSMC co-developed the mini course Physics of Semiconductor Devices and animated learning resources with college professors to introduce the fundamental principles of semiconductors to high school students, guiding high school students with simple and easy-to-understand semiconductor-related knowledge and hands-on practice. This course aims to inspire their passion for science and further drive learning motivation. In 2022, TSMC offered courses at Taipei Municipal Jianguo High School, Taipei Municipal Zhongshan Girls High School, and Taichung First Senior High School to a total of 88 students. In 2023, TSMC plans to promote courses to more schools through Train the Trainer workshops to help science education take root and invest in cultivating future tech talent.

### • TSMC Girls in STEM Program for High Schools

To encourage high school girls to pursue science, technology, engineering, and mathematics, the TSMC Education and Culture Foundation hosted the [TSMC Journeys of Female Scientist Lectures](#) for two consecutive years in 2020 and 2021. In 2021, TSMC held career lectures titled Lean in and Achieve a Better Version of Yourself aimed at inspiring students' interests in STEM as they learned about the unique strengths and capabilities of women as well as in-depth information on TSMC and the semiconductor industry. In 2022, TSMC continued to promote career lectures to 12 schools and reached out to over 2,900 students, encouraging high school girls to pursue tech careers and foster more female talent for the technology sectors.



The lecture was practical and informative, and our alumni provided us plenty of helpful advice. It was the first time that I can truly learn about TSMC and the semiconductor industry.

**Tang-Hsin Liu**  
Student at Taipei First Girls High School and Lecture Attendee



# Product Quality and Safety

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Enhance Quality Culture</b>  Promote continuous improvement programs to enhance the internal quality culture  Encourage local suppliers to participate in Taiwan Continuous Improvement Award (TCIA) to strengthen quality culture and competitiveness within local supply chain	Generate up to NT\$20 billion in value from improvement projects and involve outstanding projects in Taiwan Continuous Improvement Award (TCIA)  Encourage 100% of major local raw materials suppliers <sup>Note 1</sup> and 75% of backend packaging materials suppliers to participate in TCIA with 60% of them advancing to the finals	Generate NT\$14 billion in value from improvement projects and involve at least six outstanding projects in TCIA  Encourage 100% of major local raw materials suppliers and 60% of backend packaging materials suppliers to participate in TCIA, with 20% of them advancing to the finals	Generated more than NT\$13 billion in value from improvement projects Target: NT\$13 billion  Involved 10 outstanding projects in TCIA Target: 6 projects  74% of major local raw materials suppliers participated in TCIA Target: 100%  60% of backend packaging materials suppliers participated in TCIA Target: 60%  17% of raw materials and backend packaging material suppliers advanced to the finals of TCIA Target: 20%
<b>Improve Quality Capability</b>  Develop innovative testing methods to enhance product, technology and production quality	Develop a cumulative total of 3,000 innovative testing methods for quality and reliability <sup>Note 3</sup>	Develop 278 innovative testing methods for quality and reliability	Developed 272 innovative testing methods for quality and reliability Target: 265 projects

Note 1: Major local raw materials suppliers are those that meet at least one of the following conditions: 1. accounted for 85% of purchasing expenses; 2. single-source supplier; 3. ongoing orders in each quarter

Note 2: Due to the impact of the COVID-19 pandemic, some suppliers were unable to join the competition

Note 3: Starting from 2021

Exceeded   Achieved   Missed Target



Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Enhance Sustainable Chemicals Management</b> <sup>Note 4</sup>	<p>Develop hazardous substance analysis capabilities in chemical laboratories to ensure occupational health and safety (OHS)</p> <p>Strengthen management for hazardous substances to improve green manufacturing</p>	<p>Develop the ability to analyze 100% of carcinogenic, mutagenic, and reprotoxic (CMR) substances and help suppliers supplying materials with potential risks develop the same capabilities<sup>Note 5</sup></p> <p>Replace 100% of N-methylpyrrolidone (NMP) (Base year: 2016)</p> <p>No processes involving perfluoroalkyl substances (PFAS) that have more than four carbons</p>	<p>Developed the ability to analyze 100% of CMR substances and help 100% of suppliers supplying materials with potential risks to develop the same capabilities</p> <p>Replace 100% of NMP used for etching processes in the overseas fabs TSMC (China), TSMC (Nanjing), and WaferTech LLC</p> <p>Replace 36% of photoresists containing PFHxA related substances in VisEra<sup>Note 6</sup></p>
<b>Realize Quality Application</b>	<p>Complete quality and reliability certification for advanced process technologies, specialty process technologies, and wafer-level packaging technologies in the design and development stage based on the Company's technology roadmap</p>	<p>Complete quality and reliability certification for advanced process technologies, specialty process technologies, and wafer-level packaging technologies in the design and development stage based on the Company's technology roadmap</p>	<p>Completed quality and reliability certification for 3nm process technology, 22nm embedded RRAM IP, the first TSMC-SoIC® and Wafer-on-Wafer (WoW) technologies</p>

Note 4: To highlight the importance of product safety at TSMC, the Company will introduce a new strategy, Sustainable Chemicals Management, which will cover three existing KPIs relating to chemical management.

Note 5: In response to developments in process technologies, all materials with potential risks supplied by new suppliers must pass CMR testing.

Note 6: The target for 2023 has been changed to 36% as testing results failed to meet expectations in 2022.

Exceeded Achieved Missed Target

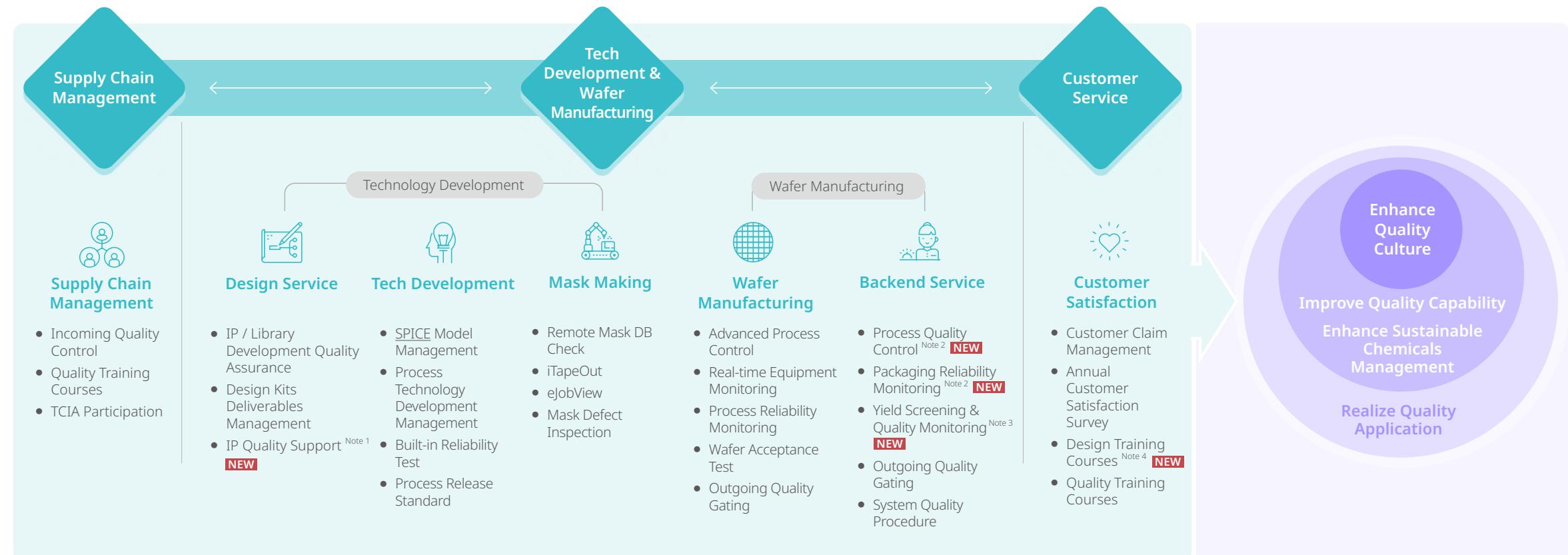
TSMC is committed to providing outstanding semiconductor foundry services. The Company spotlights the quality standards of all operational aspects and advance quality management system from supply chain management, technology

development, wafer manufacturing, and customer service. The Company also roots quality culture firmly in daily operations from six aspects: Defining, Integrating, Encouraging, Sharing, Coaching, and Driving. In 2022, TSMC organized the first Quality

Forum to encourage employees to commit to quality innovation and also added a quality culture course to the new employee orientation to strengthen quality awareness in daily operations. In 2022, TSMC's Quality and Reliability Laboratories introduced a

total of 272 innovative testing methods to facilitate technology development through an energy-saving approach and the application of AI in yield monitoring for operational efficiency and quality enhancement.

## TSMC Quality Management System



Note 1: Provided IP training courses to OIP partners to help create high-quality and certified IP solutions for customers

Note 2: Launched industry-academia cooperative research programs with Harvard University and National Cheng Kung University to exchange knowledge on mechanics and work together to overcome problems with product failure and reliability

Note 3: Developed an intelligent testing framework to drastically increase testing capacities and applied AI to yield monitoring to enhance operational quality and efficiency

Note 4: Launched standardized training courses on new processes to quickly familiarize customers with the design and process flow. The courses help reduce design cycle time and accelerate volume production of new products

## Enhance Quality Culture

Quality is the cornerstone of sustainable development at TSMC. To cultivate a quality culture that engages all employees, TSMC hosts company-wide conferences, training programs, and quality improvement projects to drive cross-organizational learning and collaboration and enhance employees' problem-solving skills. In 2022, TSMC organized two Quality Forums with executives giving keynote speeches and panel discussions to drive quality innovation, attracting nearly 6,000 attendees. Moreover, TSMC has added a quality culture course to the new employee orientation since 2022 to

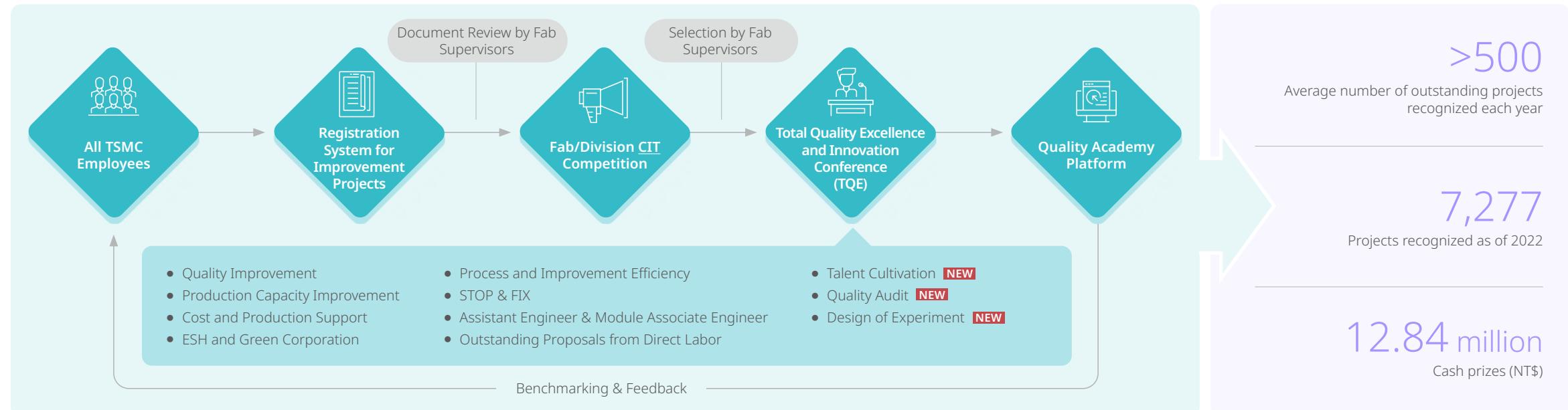
help new employees build awareness of quality and TSMC's core values, accelerating integration and adaptation to their duties. A total of 11,493 new employees have been trained to commit to the goal of quality excellence.

TSMC has been hosting the Total Quality Excellence and Innovation Conference (TQE) for 30 consecutive years to improve the quality system and methodology. In 2022, TSMC integrated existing activities related to continuous improvement into TQE, adding the Design of Experiment and

Quality Audit categories to boost quality innovation synergy and the Talent Cultivation category to motivate internal organizations to enhance talent cultivation and management for employee capability improvement. In pursuit of perfection, TSMC launched the Quality Academy platform which integrates quality cases, tools, publications and mentoring resources to facilitate employees to learn from each other and inspire more innovative ideas. In 2022, TSMC employees submitted 9,316 improvement projects and generated over NT\$13 billion in value. To encourage employees to take the

initiative in preventing abnormal quality or outdated operations, TSMC launched a new theme, STOP & FIX, in 2019 to collect and share improvement projects every year. As of 2022, the number of STOP & FIX projects has reached 9,439. Additionally, TSMC launched the CIT Outstanding Engineer program in 2000 to incentivize employees and provided training courses to build a talent pool of improvement experts. Up to now, TSMC has awarded a total of 1,394 CIT Outstanding Engineer Awards.

## Company-Wide Quality Culture



## 2022 TQE-Winning Cases



### Quality Improvement High-quality IoT chips

- Improve IC design for chips
- Optimize parameters of lithographic and etching processes
- Adjust wafer surface polarity and improve developing speed

**10.6%**

Yield loss/damage reduced

**66%**

GHG emissions reduced



### Production Capacity Improvement Improve etching processes

- Optimize etching programs and adjust photoresist thickness
- Adjust use and pairing of wet etching chemicals
- Establish oxidation layer thickness monitor procedure

**35%**

Production cycle time improved

**1%**

Total productivity increased



### Cost and Production Support Optimize statistical process control

- Develop cross-system modularized management mechanism

**90%**

Operational efficiency improved



### ESH and Green Corporation Develop carbon credit verification procedure

- Launch big data computing and AI recognition system to track carbon reduction performance



Completed carbon credit verification for TSMC



### Design of Experiment Resolve flaws in integrated voltage controller

- Collaborate across organizations to introduce thick copper and magnetic material processes

**97%**

Voltage conversion efficiency

**15.3%**

Aluminum pad defects resolved



### Process and Efficiency Improvement Develop prepayment mechanism

- Develop mechanism to reflect demand and supply changes in a timely manner
- Develop offset algorithm
- Build report platform

**32.1 million**

Estimated benefit generated (NT\$)

**66%**

Operating time reduced



### Talent Cultivation Cultivate assistant engineers

- Develop skill training and evaluation/certification system for assistant engineers

**82%**

Job satisfaction

**39%**

Manpower reduced



### STOP & FIX Protection against masks aging

- Develop automatic mask-scanning system to detect all anomalies

**92%**

Inspection time reduced

**87%**

Number of risk impacted wafers reduced



- Develop automatic system to regularly track abnormal products and equipment
- Filter non-conforming products automatically before shipping

**96%**  
Audit time reduced

**10 minutes**  
Disposal time per abnormal wafer reduced



- Develop automatic recognition equipment to replace manual operations and judgement
- Integrate software systems to increase operational accuracy and efficiency

**100%**  
Correctness of information interpretation

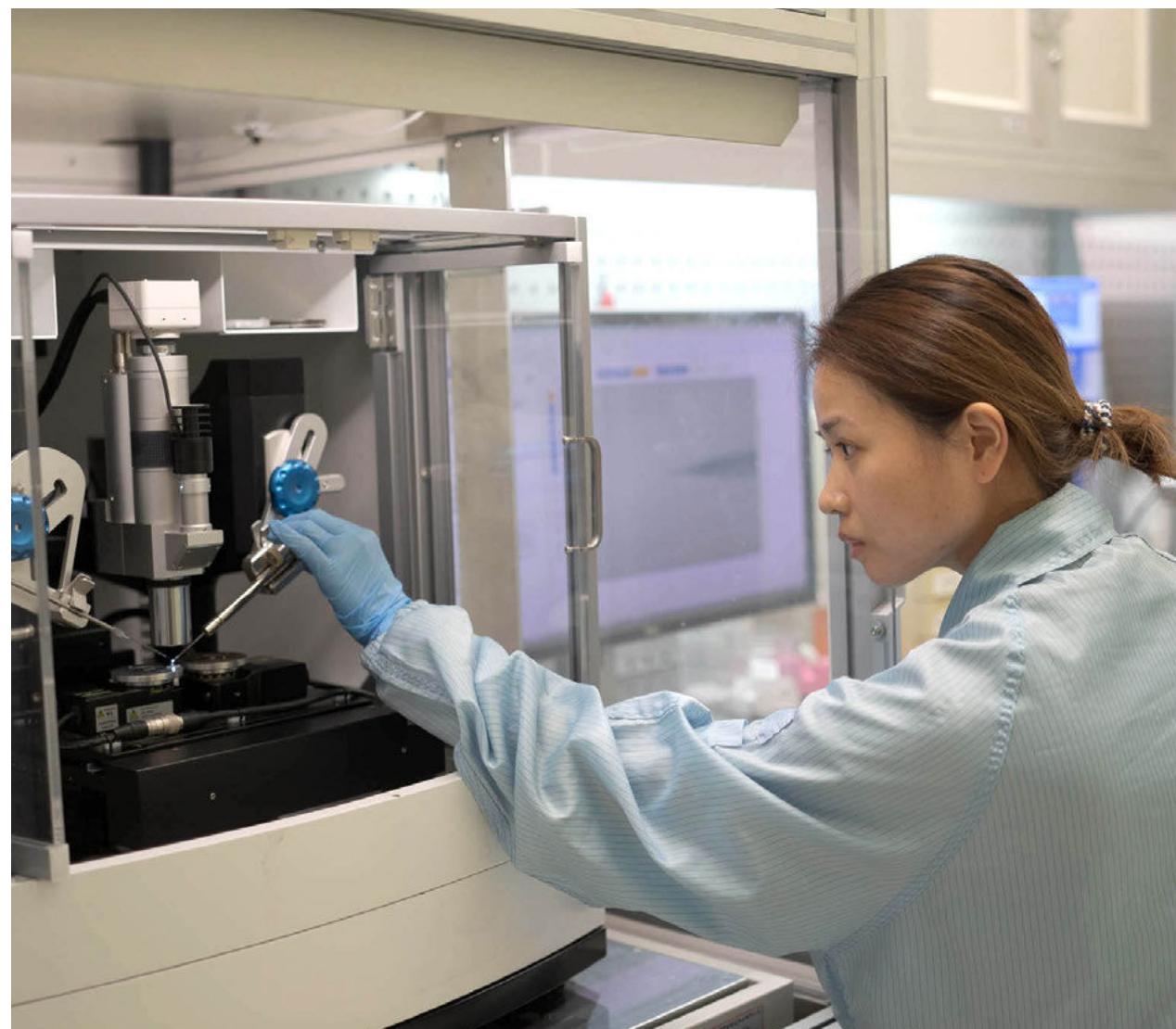
**>95%**  
Inspection rate

**88%**  
Reduced manual handling



- Standardize equipment quality control to reduce idle time and increase productivity

**20 million**  
Estimated benefit generated (NT\$)



TSMC continues to optimize methods of inspection to ensure product quality

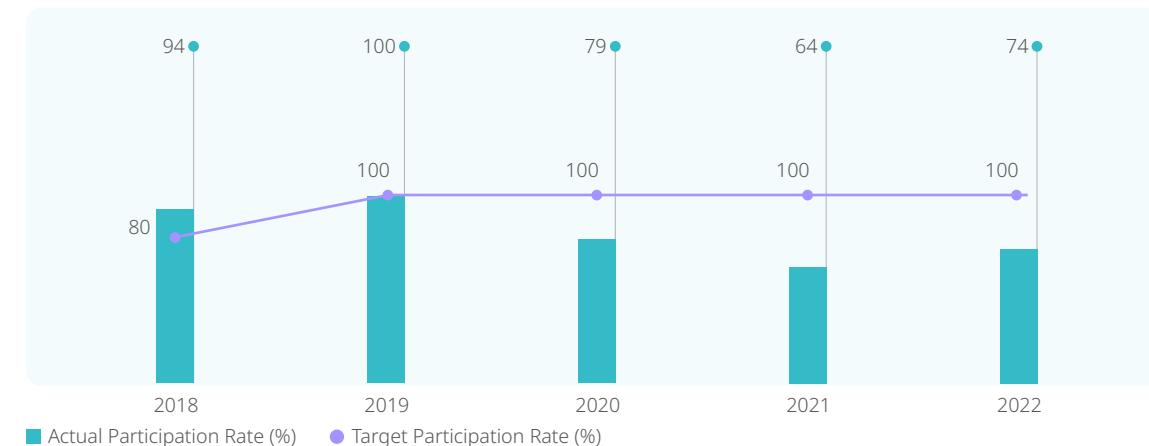


In addition to cross-functional exchanges within the Company, TSMC is also a long-term participant of TCIA. By participating in the competition, TSMC exchanges practical knowledge on quality improvement with peers from other industries and accelerates the advancement of all local industries. In 2022, TSMC received six Gold Awards, four Silver Awards, and three Best Innovation Awards at TCIA, setting a new record for TSMC.

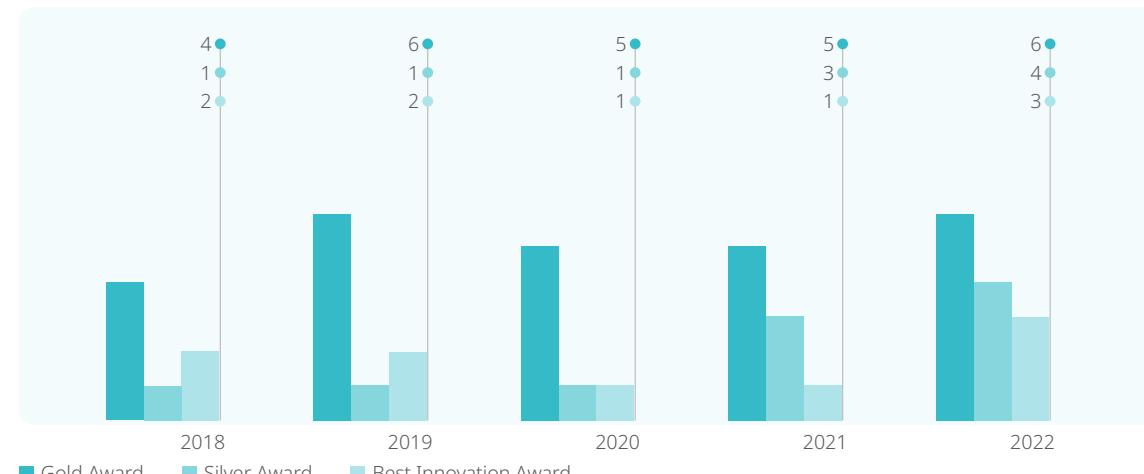
To strengthen the supply chain, TSMC also encourages suppliers to participate in TCIA. In 2022, some suppliers were restricted by the

COVID-19 prevention measures, but TSMC still ensured that 74% of major local raw materials suppliers and 60% of backend packaging materials suppliers were able to participate in the competition. A total of 17% of TSMC suppliers advanced to the finals and won four Gold Awards, three Silver Awards, four Bronze Awards, and one Best Innovation Award. TSMC announced the list of winners on its [corporate website](#) to encourage suppliers to continue to improve.

### Percentage of Major Local Raw Materials Suppliers Participating in TCIA



### TSMC Track Record of Participating in TCIA



### TSMC Supplier Track Record of Participating in TCIA



## 2022 TCIA-TSMC Winning Cases

**Gold Award**  
**Increase yield of image sensors****>70%** yield loss/damage reduced**NT\$3 billion** estimated benefit generated**Gold Award**  
**Increase productivity in the photolithography area****6%** productivity increased**85%** number of manual operations reduced**Gold Award and Best Innovation Award**  
**Develop smart testing framework****99.6%** testing efficiency increased**30%** total testing productivity increased**Gold Award and Best Innovation Award**  
**Optimize specialty chemical processes****>90%** process defects resolved**>50%** costs reduced**Gold Award**  
**Improve gas leakage in the production area**Reduced gas leakage events from an average of 3 per quarter to **0****Gold Award and Best Innovation Award**  
**Digital transformation of old equipment****15.5%** equipment productivity increased**NT\$150 million** estimated benefit generated

## Improve Quality Capability

Quality capability plays a key role in ensuring technology leadership. TSMC's Quality and Reliability Laboratories have been dedicated to perfecting, researching, and developing testing methods. In 2022, the laboratories introduced 272 innovative testing methods while ensuring that device characteristics, process yield, and product reliability all comply with customer demands and standards. From device, packaging to system level, TSMC

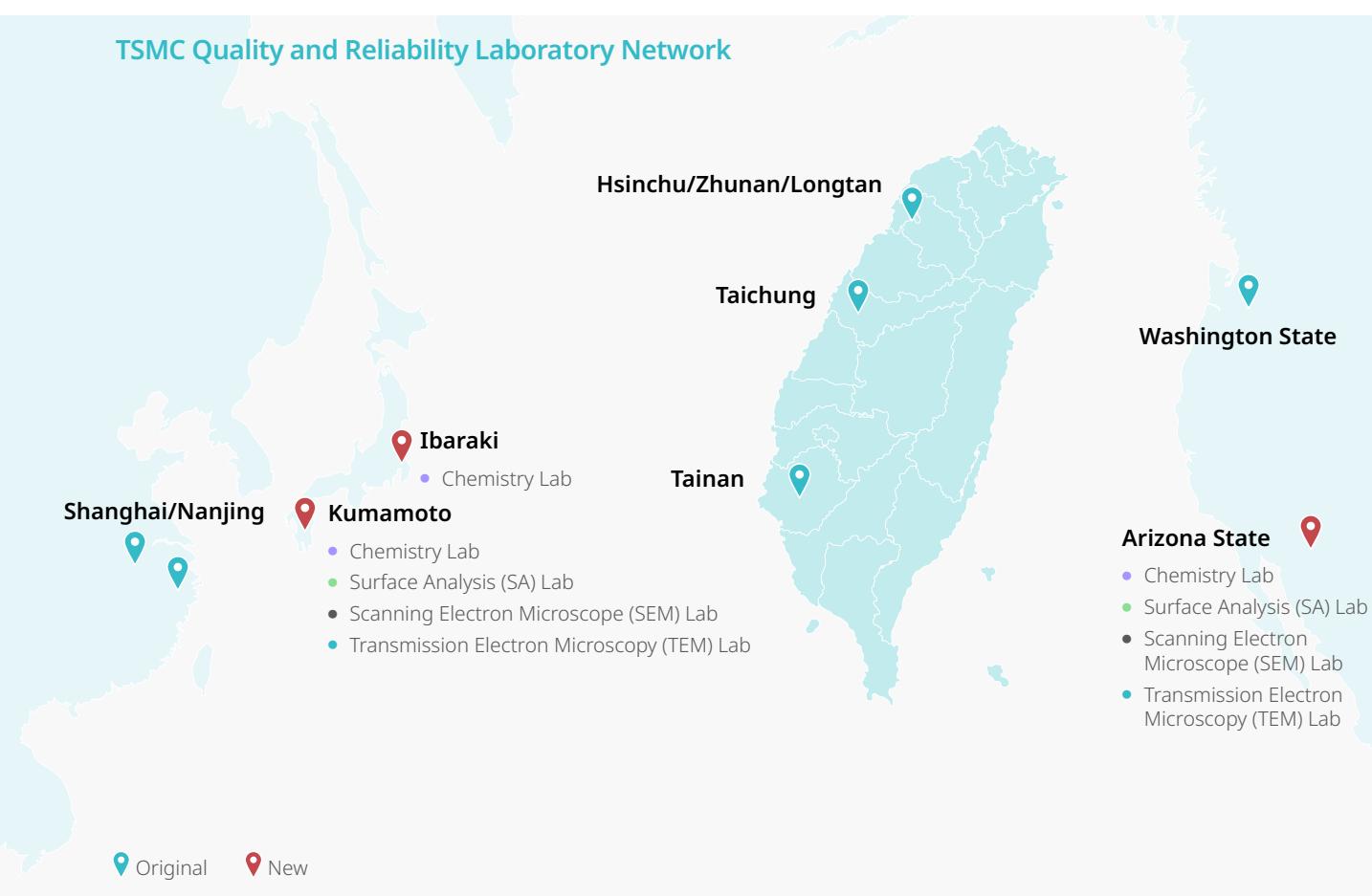
continues to minimize quality risks in customer products and maintains strict monitoring of raw material stability and safety acquired from the upstream or through recycling, aiming to realize the Company's vision of being a green, safe, and healthy workplace. As EUV is critical to advanced processes, a new aging test method for EUV mask was developed to accelerate validation and technology development with 1/5000 of the electricity consumption compared

to the original method, fulfilling the Company's commitment to sustainable operation.

In addition to strengthening quality capabilities and management throughout the supply chain, TSMC is also dedicated to talent cultivation and local industry support. In 2022, TSMC launched industry-academia cooperative research programs with Harvard University and National Cheng Kung

University to stabilize production line quality by exchanging knowledge on mechanics and working together to overcome problems with product failure and reliability. Meanwhile, TSMC collaborated with the Semiconductor Equipment and Materials International (SEMI) to organize the fourth Strategic Materials Conference in Taiwan, sharing the win-win strategy for technology and sustainable development to elevate the competitiveness of the local supply chain.

### TSMC Quality and Reliability Laboratory Network



### Sustainable Strategies from the Quality and Reliability Laboratories

- Chemistry Lab
  - Accelerate the replacement of hazardous substances and help new TSMC facilities with designs for discharging Substances of Very High Concern (SVHCs)
  - Verify the quality of materials recycled and reused at TSMC to ensure that they meet requirements for advanced processes and promote green manufacturing **NEW**
- Advanced Materials Analytic Center (AMAC)
  - Develop the ability to analyze 100% of CMR substances and facilitate source management in suppliers
  - Evaluate and select technologies and materials for advanced processes
  - Provide an analysis and technology exchange platform to strengthen suppliers' analytical capabilities **NEW**
- Surface Analysis (SA) Lab
  - Develop low-power consumption and high-capacity processes to increase the EUV energy efficiency
  - Select eco-friendly materials and replace in processes
  - Develop equipment consumables, reducing costs and extending consumable life by three times **NEW**
- Reliability Analysis (RA) Lab
  - Complete reliability certification for the latest advanced processes, special processes, and wafer-level packaging processes
- Advanced Failure Analysis (AFA) Lab
- Process Failure Analysis (PEFA) Lab
- Package & Assembly Failure Analysis (PAFA) Lab
- Product Failure Analysis (PFA) Lab
- Scanning Electron Microscope (SEM) Lab
- Transmission Electron Microscopy (TEM) Lab
  - Accelerate advanced process development, yield improvement, and product DPPM reduction learning curve (reliability point of view)
  - Apply for domestic and foreign patents through innovation and invention
  - Donate equipment to universities and elementary schools and provide training on how to operate and maintain equipment to cultivate tech talent
- Continue to promote industry-academia cooperation programs
- Apply digital transformation and automatic data processing to increase efficiency **NEW**

## Enhance Sustainable Chemicals Management

TSMC cares about the safety of its employees and supply chain. To continue tracking where materials with potential risks end up, TSMC's Advanced Materials Analytical Center (AMAC) has established mechanisms for screening CMR materials and expands its screening scope based on the Company's technology roadmap. In 2022, the AMAC completed the screening of new 16 semiconductor materials, developing the ability to analyze 100% of CMR substances. Furthermore, TSMC assisted VisEra in strengthening protection for high-risk materials by sharing measures such as substitutes for high-risk chemicals, protection gear, and regular workplace assessments. Meanwhile, TSMC incorporated hazardous substance management regulations in the [TSMC Supplier Sustainability Standards](#), and provided training, auditing, and guidance to suppliers. In 2022, TSMC continued to help all suppliers supplying materials with potential risks to develop capabilities to detect CMR substances.

In compliance with the [TSMC Environmental Policy](#) and [TSMC Safety and Health Policy](#), TSMC is committed to becoming a world-class company in environmental protection, health, and safety. Sustainable chemicals management at TSMC includes compliance with [international regulations](#) and customer requirements. In addition, the Company has always aimed to avoid or minimize the use of hazardous substances. The Corporate Environment, Safety and Health (ESH) Division and the Industrial Safety and Environmental Protection Departments of the fabs are responsible for ensuring that the storage, transport, use, and disposal of any irreplaceable hazardous materials are compliant with regulations as well as TSMC's own ESH requirements to guarantee the health and safety of all workers and prevent pollution to the environment.

Such materials can only be used with consent from VP-level executives of related divisions or departments.

NMPs are commonly used in industrial and semiconductor processes. However, due to their reproductive toxicity, TSMC launched an industry-first replacement program in 2016. In 2022, TSMC was able to achieve the goal of [reducing NMP usage at all Taiwan facilities by 95%](#). The Company expects to replace all NMP use at overseas locations by the end of 2023. NMP replacement is an innovative practice and, therefore, subject to rigorous internal review. After years of hard work across multiple facilities, TSMC is able to confirm that NMP replacement not only meets product quality demands but is also more friendly to the environment.

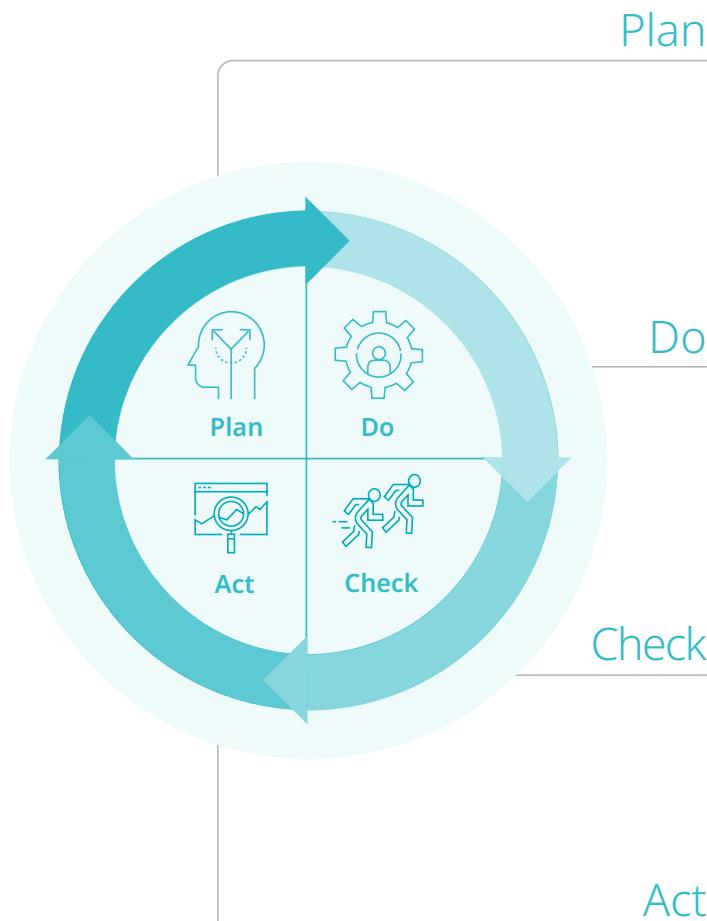
In addition, TSMC uses green procurement procedures to control chemical sources and ensure new materials are free from hazardous substances. New materials or changes to existing materials both require confirmation through the green procurement process to avoid any hazardous substances prohibited or restricted by regulations or customers. In 2022, to strengthen PFAS management, TSMC amended green procurement procedures, expanding the list of prohibited substances from PFASs with eight or more carbons to PFASs with more than four carbons, taking control from the source.

Sustainable chemicals management at TSMC is based on the QC 080000 Hazardous Substance Process Management System Requirements and strives for continuous improvements by utilizing the plan-do-check-act (PDCA) management model. All the TSMC fabs, upon official launch, acquire third-party certification.



TSMC Quality and Reliability Laboratories strive to innovate in testing methods to support technology development

## PDCA Cycle for Sustainable Chemicals Management



### Work Items

#### Identify and register in compliance with regulations and customer requirements

Each month, the Corporate ESH Division identifies regulations on hazardous substances management in Taiwan and beyond as well as customer requirements to inform related units to take the necessary measures and track progress through the internal electronic notification system

#### List of banned or restricted substances

Compile according to regulations, customer requirements, or TSMC requirements

#### Hazardous substance replacement programs

Formulate related plans in compliance with regulations, customer requirements, or TSMC requirements

### Key Tasks in 2022

- ✓ The EU added **nine** SVHCs to REACH and customers have amended management measures for hazardous substances; TSMC complied with **all** new requirements

- ✓ The Restricted Substance List now includes PFASs with more than **four** carbons

#### New material review

All new chemical materials or changes to existing materials are subject to review by the Corporate ESH Division and Industrial Safety and Environmental Protection Departments of the fabs to confirm the new chemical complies with ESH regulations before R&D evaluation

#### Carry out hazardous substance replacement programs

- ✓ Reviewed a total of **215** new chemicals, of which **127** were approved; of the **88** new chemicals that failed to pass reviews, **five** were rejected for containing substances highly hazardous to human health, **one** was rejected because TSMC was unable to treat the resulting wastewater, **one** was rejected because the proper waste handling could not be guaranteed, and **81** were rejected because suppliers were unable to provide necessary information or there were no requirements for an assessment

- ✓ TSMC continued to reduce the use of NMP in wet etching processes; in 2022, NMP usage decreased by **97.2%** from 2016

#### Raw material hazardous substance test

Suppliers are required to provide proof of compliance with hazardous substance specification test report issued by ISO 17025-certified labs. TSMC may take random samples to ensure the compliance of raw materials

In 2022, the Chemical Lab acquired an X-ray fluorescence spectrometer, brought in operators, and helped operators obtain the relevant licenses. The spectrometer is expected to be officially put into commission in 2023, which will increase hazardous substance screening speeds and safety **NEW**

#### Product hazardous substance test

Sample and send main products to external ISO 17025-certified labs for testing every year

#### Environment assessment

Developed ability to screen PFAS levels in water by referring to US EPA 537.1, enabling the regularly monitoring of effluents from various fabs **NEW**

- ✓ Completed random sampling tests for **132** raw materials; all test results were in line with TSMC specifications

- ✓ Completed hazardous substance tests for main products; results showed compliance with relevant regulations and customers' and TSMC's specifications

#### Management review

Each quarter, management from the Quality and Reliability Organization shall organize an interdepartmental meeting to review measures on hazardous substance management and progress toward annual targets

- ✓ Met the targets for NMP reduction, supplier audit and follow-up, new material reviews, and compliance with incoming material inspection



## Realize Quality Application

TSMC shows its commitment to quality in technology, manufacturing, and services. For quality in technology, TSMC helps customers design products with superior reliability. In 2022, TSMC completed quality and reliability certification for 3nm process technology, 22nm embedded RRAM IP, the first TSMC-SoIC® and Wafer-on-Wafer (WoW) technologies. For more details, please refer to [5.3.6 Quality and Reliability](#) of the TSMC 2022 Annual Report.

Demands from the automotive chip market have made automotive chips with HPC capabilities very critical in advanced processes. TSMC has cutting-edge technologies and has been able to provide design rules specific to automotive chips during the early stages of volume production using 5nm process technologies. The Company has helped customers design and plan automotive chips with HPC capabilities beforehand and will be updating design principles as more experience with the volume production of 5nm technologies is acquired. In 2022, TSMC completed verification of automotive IPs for TSMC's 5nm technology, perfectly addressing customer design requirement for auto chips.

For quality in manufacturing, TSMC has been able to strengthen the application of design principles for automotive products by timely physical failure analysis for process improvement. In 2022, TSMC completed reliability verification for 5nm automotive processes and met

customers' requirements for the defective parts per million (DPPM) of new designs. This helps improve and facilitate volume production for subsequent designs, testing, and processes. To realize intelligent precision manufacturing, TSMC leveraged machine learning to create an automatic yield monitoring system and deployed the system to all facilities in 2022. The system has been able to stabilize product yield and return problems immediately. Moreover, the Quality and Reliability Organization completed several digital transformation projects in the areas of raw materials management, statistical process control (SPC), metrology and laboratory analysis, which has enabled smart quality defense and remote management of manufacturing, making seamless quality control across all TSMC fabs around the world a reality.

For quality in services, as advanced processes become more complex, TSMC introduced innovative Design-Technology Co-Optimization (DTCO) to enhance the speed, power and density of TSMC's new process technologies. TSMC has also launched new process standardization training programs to familiarize customers with new process design processes, which can help accelerate new product design timelines and volume production. For example, the most advanced training program is currently on N3E, which was launched in November 2022. As of December 2022, a total of 10 clients with 11 training sessions and a total of 1,200 individuals have participated in the N3E course for the next generation of semiconductor innovation. In addition, to reduce product defects and risks of product returns, TSMC offers diverse courses to customers, sharing technical knowledges on high-

voltage stress, burn-in, and screening. In 2022, TSMC shared quality-related information with 29 customers and worked closely on quality and reliability testing to ensure stable production lines and strengthen partnerships.

Thanks to qualification in technology development, real-time defense systems and innovative applications in semiconductor manufacturing services, as well as its continuous quality improvement culture, TSMC had no major product recalls in 2022. Meanwhile, a third-party audit verified the effectiveness of the Company's quality management systems in compliance with IATF 16949:2016 and IECQ QC 080000:2017 requirements. In 2022, TSMC's four backend fabs also continued to pass the certification of the American National Standards Institute ANSI/ESD (Electrostatic Discharge) S20.20 standard.

## Development Focus of Quality Value Chain



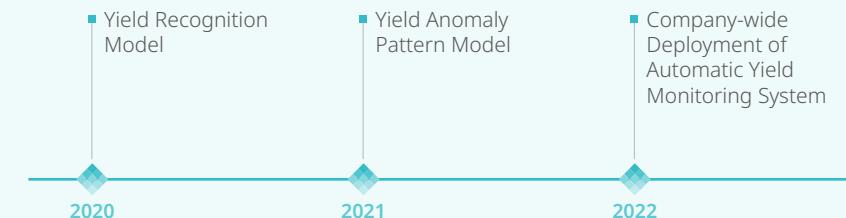


## Case Study

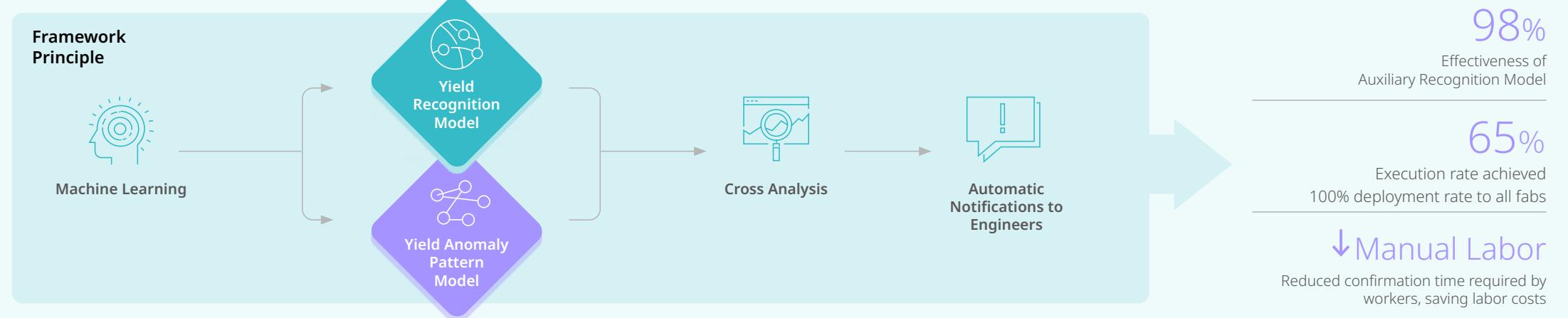
# Strengthen Yield Monitoring System with AI; Effectiveness of Auxiliary Recognition Model Reaches 98%

Stable product yield and immediate response to manufacturing challenges are critical in the volume production of semiconductor chips, where time is of the essence. In recent years, TSMC has been actively introducing digital transformation to increase the operational efficiency of yield testing and quality monitoring. In 2020, the Company developed a highly accurate yield recognition model. In 2021, a highly accurate yield anomaly pattern model was launched by introducing automatic cross-check analysis. In 2022, the

Company continued to advance the system, developing and deploying automatic yield monitoring systems at all TSMC fabs. The systems continuously improve the efficiency of yield monitoring and effectiveness of auxiliary recognition model reaches 98%. This can help reduce redundant work for engineers, enabling them to focus on real-time response and professional analysis for yield monitoring to prevent yield losses and strengthen product quality.



## Automatic Yield Monitoring System





# Customer Relations

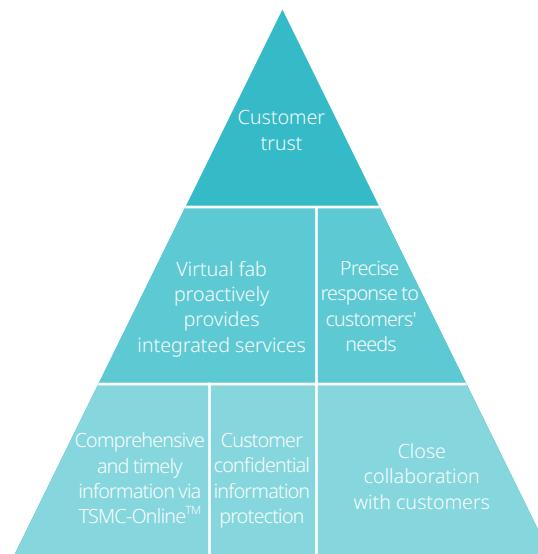
Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>React with Precise Response</b>  Provide excellent customer service through close collaboration with customers and regular customer meetings/surveys to understand their requirements and respond to their feedback	Maintain a customer satisfaction rating of over 90%  Reduce cases of problematic engineering quality to 20% of the level in 2019 for every one million 12-inch wafers shipped <sup>Note 1</sup>	Maintain a customer satisfaction rating of over 90%  Reduce cases of problematic engineering quality to 30% of the level in 2019 for every one million 12-inch wafers shipped	<p><b>Customer satisfaction rating of 88%</b><sup>Note 2</sup> Target: &gt;90%</p> <p>Reduced cases of problematic engineering quality to 36% of the level in 2019 for every one million 12-inch wafers shipped Target: 55% of the level in 2019</p>
<b>Establish Virtual Fab Service</b>  Provide comprehensive information promptly to ensure the success of customer's products; strengthen processes and systems to ensure that customer product information receives protection of the highest standard	Provide >1,200 wafer manufacturing and process technologies and >170 advanced packaging technologies in line with the TSMC technology roadmap  Pass customer product information security audits with no major flaws	Provide >994 wafer manufacturing and process technologies and >147 advanced packaging technologies in line with the TSMC technology roadmap  Pass customer product information security audits with no major flaws	<p>Provided &gt;944 wafer manufacturing and process technologies and &gt;129 advanced packaging technologies in line with the TSMC technology roadmap Target: 932 wafer manufacturing and process technologies and 107 advanced packaging technologies</p> <p><b>Passed customer product information security audits with no major flaws</b> Target: No major flaws</p>

Note 1: In 2022, cases of problematic engineering quality have been reduced to meet the 2030 Goal. As such, the 2030 Goal for reducing cases of problematic engineering quality or poor reliability has been adjusted from 50% to 20%

Note 2: Please refer to the [Precise Response](#) section for the reasons that the goal was not achieved

↑ Exceeded    ✓ Achieved    — Missed Target

Customer trust is a core value integral to TSMC. The Company believes that gaining customer's trust is critical to consistent innovation in technologies, and the Company is committed to providing products and services of the highest quality. TSMC's vision is to become "the largest and most advanced dedicated IC design and manufacturing service provider in the world." Service teams dedicated to customers have been assembled that strive to provide world-class services in areas such as product design, mask fabrication, wafer manufacturing, and backend packaging. Digital transformation is also being introduced as part of the commitment to providing excellent services to make customers more competitive, build deeper and stronger relationships with customers, and collaborate with them to get a head start in the market.



## Precise Response

Customer feedback and satisfaction ratings are opportunities for TSMC to improve. The customer service team learns and analyzes customers' commercial and technological demands through annual satisfaction surveys, quarterly evaluation meetings, and need-based meetings to provide optimal solutions to strengthen partnerships. In 2022, TSMC conducted the annual satisfaction survey with more than 200 customers and held over 100 quarterly evaluation meetings with more than 30 customers, hosting more than 1,200 online and offline meetings for the managerial level.

In 2022, the global semiconductor market experienced extreme changes: from strong demands in the first half of the year to decelerated growth in the second half. With uncertainties looming over the industry, TSMC decided to double down on collaboration and communication with customers. In 2022, customer satisfaction levels have rebounded from 84% in 2021 to 88%. In the future, TSMC will continue to work on long-term capacity planning, tech support, and other areas. The Company hopes that the newly added capacity and the distribution of existing capacity can satisfy customer demands, provide greater supply chain resilience, and ultimately, help TSMC achieve its long-term goal of 90% customer satisfaction. Meanwhile, TSMC is proud to announce that customer trust, an indicator from the annual customer satisfaction survey, has already increased to 95%. TSMC is also advancing manufacturing technologies to achieve better quality and yield. In 2022, cases of problematic engineering

An Innovation Pioneer

A Responsible Purchaser

A Practitioner of Green Power

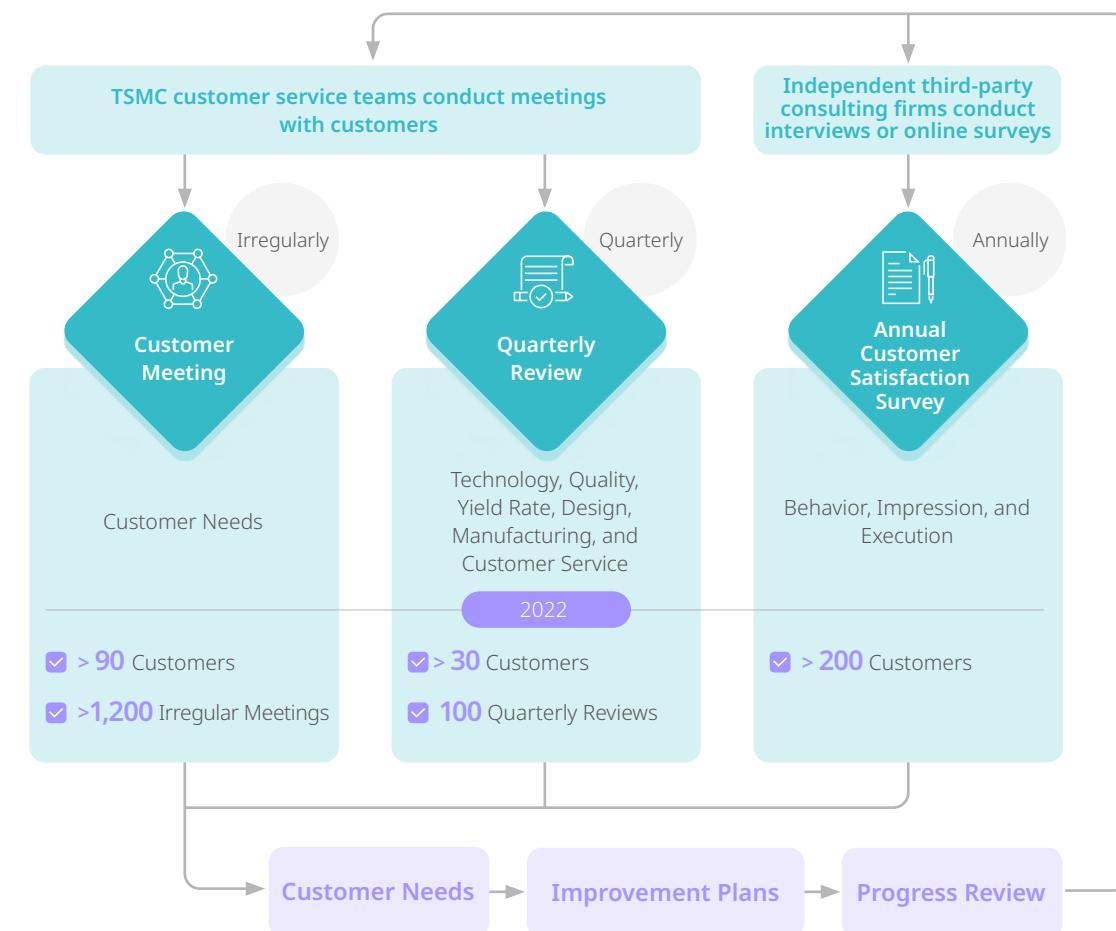
An Admired Employer

Power to Change Society

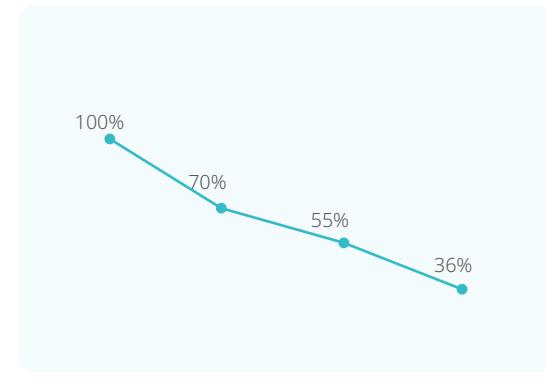
quality or poor reliability for every one million 12-inch wafers shipped were reduced to 36% of the level in

2019, exceeding the annual goal of 55%. As such, the Company decided to ramp up the 2030 Goal to 20%.

## Various Communication Channels for Customers



## Cases of Problematic Engineering Quality for Every Million Wafers Shipped



## Annual Customer Satisfaction



Note: Figures for customer satisfaction ratings include TSMC fabs in Taiwan and overseas subsidiaries

## Virtual Fab

Real-time interaction and information exchange are the main reasons customers consider TSMC as their own wafer fabs. TSMC-Online™ is a customer self-service portal that provides comprehensive information on in-house technologies and manufacturing, allowing customers to feel at home but also protected with robust proprietary information protection services. In 2022, TSMC-Online™ was upgraded by reorganizing system

functions and frameworks, importing customer workflows and personalized concepts to meet customer demands. The upgraded system allows for intuitive operation and easy self-service that can increase operational efficiency for customers. As of December 2022, TSMC-Online™ has processed an average of more than 3,000 log-ins each day.

In 2022, to accommodate the development of the

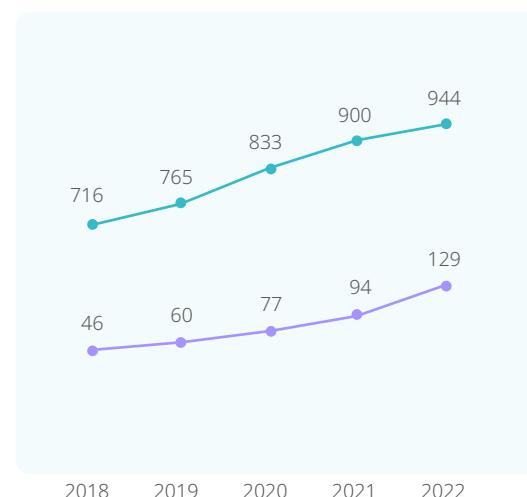
TSMC's customer service team provides world-class services in areas including wafer production, testing, etc.



established an [Information Protection Policy](#) and [SOP](#) to ensure, under the virtual fab, the highest level of security that customers enjoy with their own foundries to protect customers' interests.

TSMC is committed to delivering products of the highest quality and pursuing innovative collaborative models based on the core value of Customer Trust. As a trusted technology and capacity provider in the global logic IC industry, TSMC works with customers to support their success and sustainable operations. Customers' success is TSMC's success, and the Company will continue to work closely with customers to provide customer-oriented services.

## Types of Technology for Customers



● Types of wafer manufacturing technology

● Types of advanced packaging technology

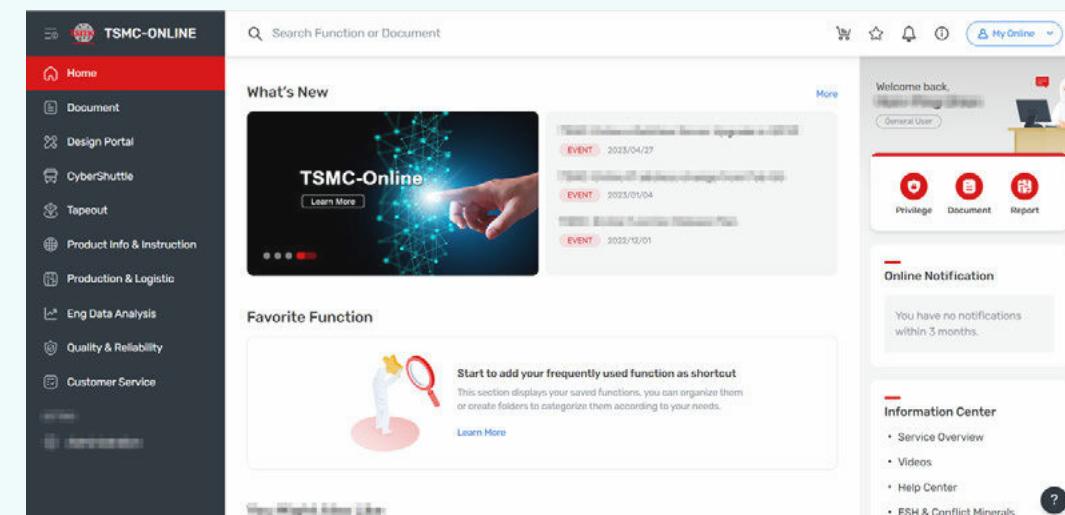
Note: Figures for types of technology are from TSMC fabs in Taiwan and overseas subsidiaries

## Case Study

# The Upgraded TSMC-Online™ Delivers a Brand-New Customer Experience

TSMC is employing innovative digital collaboration to help customers succeed. In 2022, TSMC-Online™ was upgraded not only by changing the user interface but, more importantly, by optimizing service flows. The system framework was restructured to deliver a new and improved customer experience with TSMC-Online™.

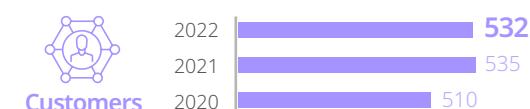
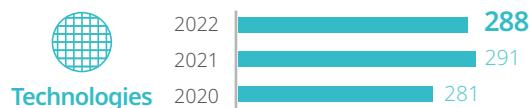
The Personalized Workspace is one of the highlights of the upgraded TSMC-Online™ system, as it makes the customer's workflow more convenient. In the Personalized Workplace, two system functions for One-Stop File Download and Subscription Management have also been added to enable customers to access and filter technical documents and download multiple files from their Carts with a single click. Customers can also schedule to send production reports at designated times and subscribe to technical documents for the latest updates to access the latest technical documents and production reports. My Favorite Functions allows customers to add frequently-used functions to their workplace to accommodate their job requirements and habits. The function makes it easy for users to manage and personalize information, which increases their operational efficiency. For more details, please refer to [TSMC Optimizes Customer Experience by Upgrading Its Online Service System](#).



## TSMC Delivers Unrivalled Manufacturing Flexibility

### >15 million

2022 total managed capacity reached over 15M 12-inch wafer equivalents



Feb 16  
Feb 10  
Feb 23

HQ and Fab 12  
Fab 2 / 3 / 5 / 8  
Fab 15  
Fab 6  
Fab 14  
Fab 18  
Feb 11  
Feb 21



Fab 2



Fab 3



Fab 5



Fab 6



Fab 8



Fab 10



Fab 11



Fab 12



Fab 14



Fab 15



Fab 16



Fab 18



25



64



1,055



68



61



306



56



158



1,194



43



155



1,953



42



167



420



22



37



1,503



68



149



2,419



79



263



1,387



28



176



86



10



30



87



# A Responsible Purchaser

TSMC is committed to responsible purchasing and works closely with supply chain partners on technology, quality, delivery, human rights, and environmental protection. In the face of serious climate change challenges, the Company will further strengthen green innovation and climate resilience and strive to create a low-carbon semiconductor supply chain.

**1.2 Million**

TSMC Supplier Sustainability Academy users

**100%**

Responsible minerals sourcing

**530 GWh**

Cumulative energy conserved by suppliers with TSMC's support

Sustainable Supply Chain





# Sustainable Supply Chain

Strategies	2030 Goals	2023 Targets	2022 Achievements	
<b>Improve Sustainability Risk Management</b>  TSMC requires all suppliers to adhere to the TSMC Supplier Code of Conduct, taking actions to improve labor rights, safety and health, environmental protection, business ethics, and the efficiency of the management system; the Company has also taken the initiative to help suppliers continue to improve their core capabilities to reduce risks of disruption to business operations	<p>Ensure 100% of Tier 1 suppliers<sup>Note1</sup> complete the Sustainability Management Self-Assessment Questionnaire</p> <p>Ensure 100% critical suppliers<sup>Note2</sup> receive Code of Conduct audits by RBA-certified agencies every three years</p> <p>Ensure 980 sessions of S.H.A.R.P. audits toward critical high-risk suppliers at a pace of 100 sessions a year</p> <p>Supplier due diligence on responsible mineral sourcing: 100% of the minerals used are sourced responsibly</p> <p>Audit a cumulative total of 30 suppliers (<math>\geq 3</math> suppliers per year) for due diligence on responsible mineral sourcing</p> <p>Continue to diversify production plant sites and assess new suppliers; develop 185 multi-source supply solutions<sup>Note3</sup> (Base year: 2018)</p> <p>Ensure a cumulative total of 145 local raw materials suppliers receive consultation on process advancement and quality improvement (Base year: 2016)</p> <p>Ensure a cumulative total of 300 raw materials suppliers<sup>Note4</sup> participate in the annual emergency response drill (Base year: 2016)</p> <p>Ensure a cumulative total of 1,500 suppliers<sup>Note4</sup> participate in the Environmental Safety and Health (ESH) training programs (Base year: 2016)</p> <p>Ensure 100% critical high-risk suppliers complete Safety and Health consultation</p>	<p>Ensure 100% of Tier 1 suppliers complete the Sustainability Management Self-Assessment Questionnaire</p> <p>Ensure 70 critical suppliers receive third-party audits</p> <p>Ensure 100 sessions of S.H.A.R.P. audits toward critical high-risk suppliers</p> <p>Supplier due diligence on responsible mineral sourcing: 100% of the minerals used are sourced responsibly</p> <p>Complete audits on <math>\geq 3</math> suppliers for due diligence on responsible mineral sourcing</p> <p>Complete the development of 145 multi-source supply programs</p> <p>Ensure a cumulative total of 75 local suppliers receive consultation on process advancement and quality improvement</p> <p>Ensure a cumulative total of 190 raw materials suppliers participate in the annual emergency response drill</p> <p>Ensure a cumulative total of 1,050 suppliers participate in the ESH training programs</p> <p>Ensure 100% critical high-risk suppliers complete Safety and Health consultation</p>	<p>Ensure 100% of Tier 1 suppliers complete the Sustainability Management Self-Assessment Questionnaire Target: 100%</p> <p>A total of 60 critical suppliers completed third-party supplier audits with an annual completion rate of 100% Target: 60 critical suppliers</p> <p>Completed 100 sessions of S.H.A.R.P. audits toward critical high-risk suppliers Target: 100 sessions</p> <p>100% responsible mineral sourcing Target: 100%</p> <p>Completed audits on 5 suppliers for due diligence on responsible mineral sourcing Target: <math>\geq 3</math> suppliers</p> <p>Completed the development of 135 multi-source supply programs Target: 130 programs</p> <p>Ten suppliers received consultation on process advancement and quality improvement, bringing the cumulative total to 65 Target: 10; cumulative total 65</p> <p>29 raw materials suppliers participated in the annual emergency response drill, bringing the cumulative total to 161 Target: Cumulative total 150</p> <p>201 suppliers participated in the ESH training programs, bringing the cumulative total to 960 Target: Cumulative total 900</p> <p>100%<sup>Note5</sup> of critical high-risk suppliers completed Safety and Health consultation Target: 100%</p>	✓ ✓ ✓ ✓ ↑ ↑ ✓ ↑ ↑ ↑ ↑ ↑ ✓ ↑ ↑ ↑ ✓

Note1: Tier 1 suppliers: Suppliers trading directly with TSMC with more than three orders per year, with order amounts exceeding NT\$5 million. In 2022, 1,230 suppliers met the criteria

Note2: Critical suppliers: Suppliers accounting for the top 85% of the purchasing expenses or of a single-source purchase, or suppliers recognized as critical by TSMC after assessing multiple risk indicators, including the suppliers' market shares, inventory levels, and other characteristics

Note3: Since risk evaluation has also been incorporated into new processes in recent years, the target was increased from 145 in 2030 to 185

Note4: Mainly involving suppliers in Taiwan

Note5: In 2021, TSMC audited 70 critical high-risk suppliers, among which five suppliers scored below 70 for Safety and Health and had received consultation; guidance has been completed (one of the shortcomings in the audit has not yet obtained ISO 14064 verification, so TSMC will continue to follow up)

↑ Exceeded    ✓ Achieved    — Missed Target



Strategies	2030 Goals	2023 Targets	2022 Achievements
<p><b>Promote Green and Low-carbon Supply Chains</b> TSMC continues to reduce environmental impact and its external cost and minimize the effects of climate change and resource depletion by leading suppliers in establishing reduction targets on power and water consumption, waste generation, and carbon emissions, propelling the sustainable development of supply chains</p>	<p><b>Increase local sourcing<sup>Note6</sup></b></p> <ul style="list-style-type: none"> <li>- 64% for indirect raw materials</li> <li>- 60% for spare parts</li> </ul> <p><b>Provide consultation on power reduction for suppliers<sup>Note4</sup> and reduce energy consumption by a total<sup>Note8</sup> of 1,500 GWh (Base year: 2018)</b></p> <p><b>Provide consultation on water reduction for suppliers<sup>Note4</sup> and reduce water consumption by a cumulative total of 35 million metric tons (Base year: 2020)</b></p> <p><b>Suppliers invited to participate in CDP in the year should achieve an average score of B and a response rate of 95% <b>NEW</b></b></p> <p><b>Ensure 100% of high energy consumption suppliers receive ISO 14064 GHG Emission verification (Base year: 2021)</b></p> <p><b>Reduce waste production among local major suppliers<sup>Note11</sup> by 42%<sup>Note12</sup> (Base year: 2014)</b></p>	<p><b>Source 62.5% of indirect raw materials locally</b></p> <p><b>Source 44.5% of spare parts locally</b></p> <p><b>Reduce supplier energy consumption by a cumulative total of 550 GWh</b></p> <p><b>Reduce supplier water consumption by a cumulative total of 30 million metric tons</b></p> <p><b>Suppliers invited to participate in CDP in the year should achieve an average score of C and a response rate of 85%</b></p> <p><b>Ensure 70% of high energy consumption suppliers receive ISO 14064 GHG Emission verification</b></p> <p><b>Reduce waste production among local major suppliers by 35%</b></p>	<p><b>Sourced 62.1% of indirect raw materials locally</b> Target: 60.5% </p> <p><b>Sourced 43% of spare parts locally</b> Target: 50% </p> <p><b>Reduced supplier energy consumption by a cumulative total of 530 GWh</b> Target: 430 GWh </p> <p><b>Reduced supplier water consumption by a cumulative total of 29.08 million metric tons</b> Target: 20 million metric tons </p> <p><b>Suppliers<sup>Note9</sup> invited to participate in CDP in the year achieved an average score of C and a response rate of 81% <b>NEW</b></b></p> <p><b>65% of high energy consumption suppliers received ISO 14064 GHG Emission verification</b> Target: 55% </p> <p><b>Reduced waste production per unit among local major suppliers by 34%</b> Target: 32% </p>

Note 6: Mainly focused on suppliers based in Taiwan, which is the main operation region of TSMC

Note 7: For spare parts, since the proportion of advanced processing increased, the quality requirements became stricter. Currently, suppliers in Taiwan have not been able to meet TSMC requirements, and since TSMC had to increase inventory levels due to the uncertainty of supply chain capacity and shipments, it missed the annual local sourcing target

Note 8: The cumulative total of power reduced included the existing achievement of past efforts and the newly achieved reduction results

Note 9: Suppliers invited to participate in CDP in 2022: A total of 137 suppliers of raw materials and equipment met the top 80% of procurement categories and expenditures

Note 10: Definition of high energy consumption suppliers: Suppliers in Taiwan whose energy consumption at a single site exceeds 5 GWh per year

Note 11: Mainly focusing on suppliers in Taiwan producing 80% of the waste in raw materials. Calculation formula: A/(A+B)(%); A: waste reduced by the factory in that month (metric tons); B: waste produced by the factory in that month (metric tons)

Note 12: In the most recent two years, the main waste-producing suppliers have vigorously promoted waste reduction and improvement plans, thus the target for 2030 has been increased from 35% to 42%. The key improvements were: (1) Recycling of heavy metal sludge, converting sludge that could only be solidified and treated into renewable raw materials; (2) Installing sludge filtration and treatment equipment to decrease sludge output

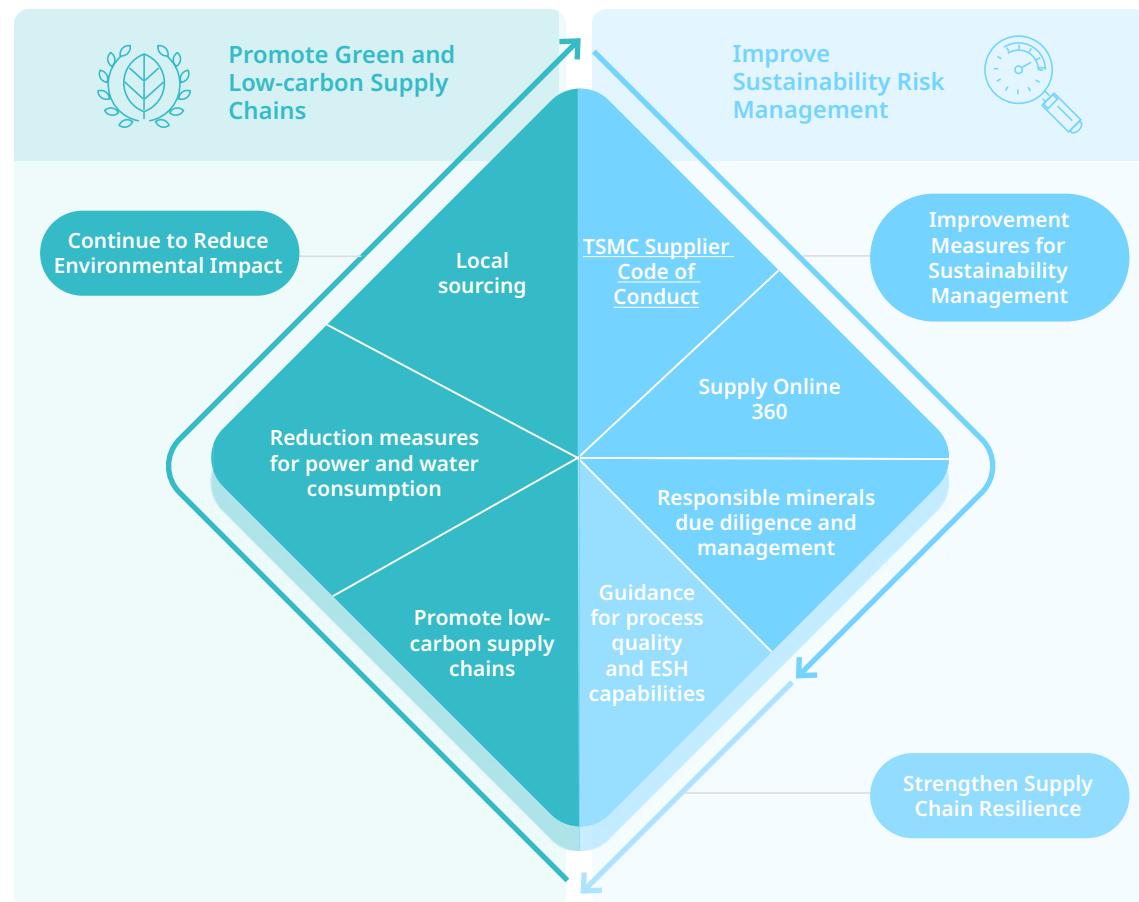
Exceeded Achieved Missed Target

TSMC is dedicated to building an environmentally and socially responsible operating model, exerting influence towards sustainability as the global leader of the semiconductor industry. In 2022, TSMC continued to uphold two main strategies as its supply chain sustainability management guideline: Improving Sustainability Risk Management and

Promoting Green and Low-carbon Supply Chains. The Company continued to require suppliers to adhere to the TSMC [Supplier Code of Conduct](#) in operations, taking actions to improve safety in the workplace, dignity for labor, ethical operations, and comprehensive protection of the environment, and continued to reduce risks of disruption to business

operations. Additionally, to answer the calls for green manufacturing, TSMC has taken the initiative to reduce the environmental impact of supply chains, prompting suppliers to set reduction targets for power and water consumption, waste generation, and carbon emissions. TSMC aims to mitigate the impact of climate change on society and lay the foundation for the sustainable development of supply chains.

## Supplier Sustainability Management Framework



## Four Guiding Principles of Sustainable Supply Chain Management

- Compliance Guidance**: Suppliers comply with the TSMC [Supplier Code of Conduct](#) and extend the scope of management to their upstream suppliers
- Risk Assessment**: Suppliers determine the level of Code compliance via the Sustainability Self-Assessment Questionnaire or Sustainability Risk Assessment by the TSMC Team
- Audit Participation**: Critical Suppliers are audited by RBA-certified third-party institutions or audited on-site by the [TSMC Supplier Healthiness Assessment Rectification Program](#) (S.H.A.R.P.) Team
- Continuous Improvement**: Suppliers implement improvement measures according to the audit results and receive relevant consultation or follow-up evaluation

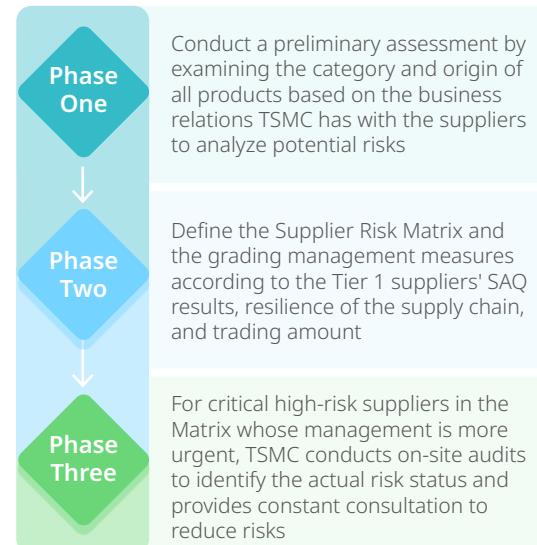


## Improve Sustainability Risk Management

### Improvement Measures for Sustainability Management

TSMC worked closely with supplier partners through the four guiding principles of Compliance Guidance, Risk Assessment, Audit Participation, and Continuous Improvement to urge suppliers to improve their sustainability performance and take the initiative to promote sustainable practices to their upstream suppliers. To prompt common growth among supplier partners worldwide, TSMC established the global responsible supply chain management platform Supply Online 360. The platform serves as an integrated communication channel with all suppliers, propelling tangible change with virtual data analysis and bringing sustainable semiconductor supply chain practices into reality.

### Supply Chain Three-phase Risk Assessment



#### • Compliance Guidance

As a member of the Responsible Business Alliance (RBA), TSMC has established its Supplier Code of Conduct according to RBA's Code of Conduct. TSMC requires Tier 1 suppliers to comply with the Code of Conduct while encouraging them to ask their upstream suppliers, contractors, and service providers to adopt the same Code in their practices and management. New suppliers must sign the TSMC Supplier Code of Conduct to be eligible for partnership.

#### • Risk Assessment

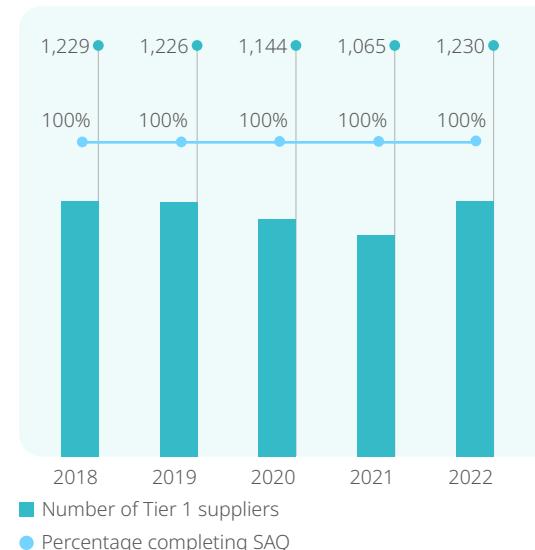
To gain an in-depth understanding of the current status of supply chain development and potential risks, TSMC conducts a three-phase risk assessment in supplier management, identifying

the improvement measures required for suppliers according to supplier classification.

First, TSMC investigates and analyzes all suppliers it conducts business with and requires Tier 1 suppliers to conduct the Self-Assessment Questionnaire (SAQ) to evaluate their performance in sustainability. In 2022, Tier 1 suppliers in Taiwan completed 1,230 SAQs. According to the survey results, for the Dangerous Workplace category, the most common problem among 4% of the suppliers was failure to stipulate operating procedures for dangerous machines; in terms of Personnel Operation Safety, 3% of suppliers did not have adequately equipped emergency response personnel, and they did not formulate effective first aid procedures; regarding Fire Protection Equipment Design and Maintenance, 16% of the suppliers had not established

a monthly fire protection equipment inspection and maintenance plan. TSMC determines the level of risk based on the SAQ results and priority accident records, and it defines supplier grades according to indicators such as procurement expenses, product criticality, and business relations with TSMC. Using the two dimensions of Risk and Criticality, TSMC establishes a Supplier Risk Matrix to define supplier grades and formulate exclusive management measures accordingly. In 2022, suppliers with physical production lines were targeted for management. Besides the existing SAQ items, two assessment items, Supply Chain Risk Management and Process Reliability, were added, while climate change response measures, fire protection system integrity, and green manufacturing were also considered. Suppliers scoring less than 70 points were included as the priority inspection targets of on-site audits.

### Self-Assessment Questionnaire Results



### Critical High-risk Supplier Assessment Process

#### Tier 1 Suppliers

Suppliers trading directly with TSMC with more than **three** orders per year, with order amounts exceeding **NT\$5 million**



#### Critical Suppliers

Suppliers accounting for the top 85% of the purchasing expenses or of a single-source purchase, or suppliers recognized as critical by TSMC after assessing multiple risk indicators, including the suppliers' market shares, inventory levels, and other characteristics



#### Critical High-risk Suppliers

Received on-site audits for continuous improvement



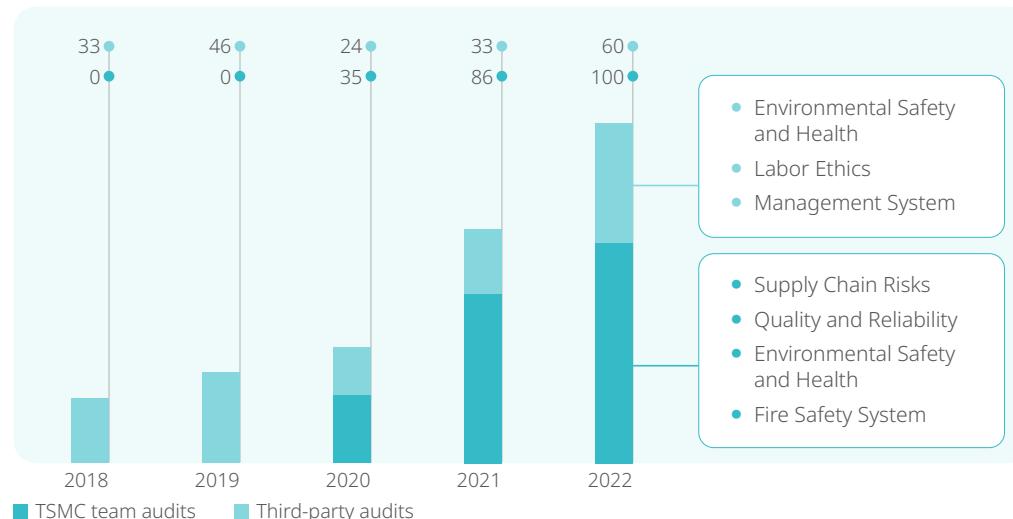
#### High-risk Suppliers

Determined according to SAQ results, priority incident records, and business items

## • Audit Implementation and Continuous Improvement

After identifying risks using the Supplier Risk Matrix, TSMC conducts on-site or remote audits focusing on the six major categories of Supply Chain Risk, Quality and Reliability, Environmental Safety and Health, Fire Protection System, Labor Ethics, and Management System to determine potential risks and opportunities. TSMC requires suppliers to propose improvement plans and schedules and assigns the TSMC S.H.A.R.P. Team to offer guidance and follow-up on improvements regularly. The Company has further extended audit projects such as key guidance and new factory design guidance, and constantly strengthens suppliers' self-management awareness and improvement ability. In 2022, TSMC conducted 160 on-site audits of critical high-risk suppliers to properly track the risk status of the suppliers and improve their operational sustainability. By doing so, TSMC can ensure stable materials supply and services, provide a safe and healthy workplace, and minimize environmental and social impact.

### S.H.A.R.P.



## Supplier Risk Matrix, Classification and Management Measures



TSMC conducts supplier audits to identify potential risks and opportunities for improvement



## 2022 Critical High-risk Suppliers Audits and Areas for Improvement

	Category/Distribution of Audit Violations	Major Audit Findings	Improvement Results of TSMC Suppliers
Auditors TSMC S.H.A.R.P. Team and RBA-certified Third-Party Institutions	Supply Chain Risks 18% Priority, 60% Major, 22% Minor	<ul style="list-style-type: none"> <li>Business continuity plan lacks contingency measures</li> <li>Some critical spare parts are below safety stock or completely out of stock</li> <li>Material and component safety stock level undefined</li> </ul>	<ul style="list-style-type: none"> <li>Formulated the business continuity plan and conducted regular drills</li> <li>Inspected the safety stock level of critical components</li> <li>Conducted another inventory of materials and established safety stock</li> </ul>
Audit Sessions	Quality and Reliability 17% Priority, 58% Major, 25% Minor	<ul style="list-style-type: none"> <li>Preventive maintenance mechanism and annual maintenance plan not clearly defined</li> <li>Engineering change management not implemented in the fabs</li> </ul>	<ul style="list-style-type: none"> <li>Established an annual Preventive maintenance mechanism and regular maintenance plan</li> <li>Use control form to record engineering changes and execution dates</li> </ul>
160 Sessions toward critical high-risk suppliers	Environmental Safety and Health 11% Priority, 48% Major, 41% Minor	<ul style="list-style-type: none"> <li>Poor contractor management, construction safety analysis not implemented</li> <li>Chemicals not stored according to regulations, anti-spill trays not installed</li> <li>Waste water system not monitored before discharge</li> </ul>	<ul style="list-style-type: none"> <li>Established a contractor management procedure, carried out a construction safety analysis and on-site construction assignments</li> <li>Formulated chemical storage regulations and purchased anti-spill trays</li> <li>Installed monitoring equipment conforming to the emission monitoring measures, implemented regular maintenance and calibration</li> </ul>
Audit Methods 147 On-site audits	Fire Protection System 6% Priority, 34% Major, 60% Minor	<ul style="list-style-type: none"> <li>Failure to establish a regular inspection mechanism for fire protection equipment</li> <li>No firestops in the destroyed area of fire zone or incorrect construction method</li> <li>Fire doors along the escape route cannot be closed completely when the alarm goes off</li> </ul>	<ul style="list-style-type: none"> <li>Created a fire protection equipment inspection table to conduct monthly and quarterly inspections</li> <li>Conducted a factory-wide inspection, and filled the openings passing through the fire zone with firestops according to the certified construction method</li> <li>Fire doors should be closed at all times, if they need to stay open at all times, magnetic door locks should be installed</li> </ul>
13 Remote audits	Labor Ethics 3% Priority, 18% Major, 79% Minor	<ul style="list-style-type: none"> <li>New employees have to pay for pre-employment physical exams, which violated the zero-cost requirement stipulated in the TSMC Supplier Code of Conduct</li> <li>Failure to devise and implement an adequate and effective policy and procedure for hiring apprentices, interns, and student workers</li> </ul>	<ul style="list-style-type: none"> <li>Expenses incurred by the employee due to employment are paid for by the employer</li> <li>Established an apprentice, intern, and student worker hiring policy and procedure</li> </ul>
	Management System 1% Priority, 99% Major, 0% Minor	<ul style="list-style-type: none"> <li>Failure to communicate the requirements of the TSMC Supplier Code of Conduct with upstream suppliers</li> <li>Lack of an adequate and effective self-audit process, failure to regularly evaluate whether they comply with the TSMC Supplier Sustainability Standard and Code of Conduct</li> </ul>	<ul style="list-style-type: none"> <li>Required and supervised upstream suppliers to adhere to the TSMC Supplier Code of Conduct</li> <li>Required suppliers to establish a self-audit process and conduct a regular evaluation to ensure compliance with TSMC's requirements</li> </ul>

■ Priority Violations <sup>Note 1</sup>

■ Major Violations <sup>Note 2</sup>

■ Minor Violations <sup>Note 3</sup>

Note 1: Priority violations may present higher risks of production halt, life, serious illegal affairs, or systematic failure. For example: lacking a response mechanism for an unexpected halt in production lines, environmental pollution, hiring child labor, or forced labor

Note 2: Major violations refer to significant differences between implementation and proper ESH procedures, such as daily operations not adhering to ESH procedures

Note 3: Minor violations refer to risks other than priority or major violations, such as incomplete training records or incomplete ESH procedures

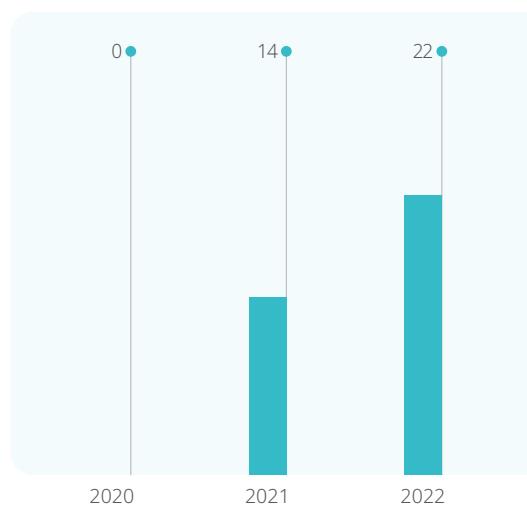
## Re-audit and Key items improved Projects

To ensure suppliers' improvement results, the TSMC S.H.A.R.P. Team focused on four major dimensions of the six major categories, Supply Chain Risks, Quality and Reliability, Environmental Safety and Health, and Fire Protection System, to launch short, medium, and long-term improvement plans to solve the problems from previous audits. Furthermore, a key items improved project was implemented and suppliers were required to formulate a business Continuity Plan (BCP) and conduct regular drills, and formulate contingency measures to minimize the potential risks of

emergencies. 22 re-audits were completed in 2022. Through multiple rectification, suppliers are able to perform self-review to effectively improve audited findings, decrease the occurrence of abnormal

events, increase process stability, operational safety, and reliability, maintain supply quality, and avoid the risk of material supply interruptions.

### Cumulative Number of Suppliers Re-audited Over the Years



### Supplier Re-audit Process and Results



#### Summarize Findings from the Previous Audit

- Evaluate suppliers' production line maintenance conditions and mechanisms, as well as the occurrence of abnormal events after the first audit



#### Arrange for Re-audit

- Improvements of the findings from the previous audit were not as expected, so an improvement consensus was reached with the suppliers and the key items direction was explained on-site to make sure all levels of suppliers understand the target in order to implement improvement measures
- Implement a regular tracking mechanism to set up and review operating procedures, provide consultation, and ensure the operational standards comply with suppliers' needs



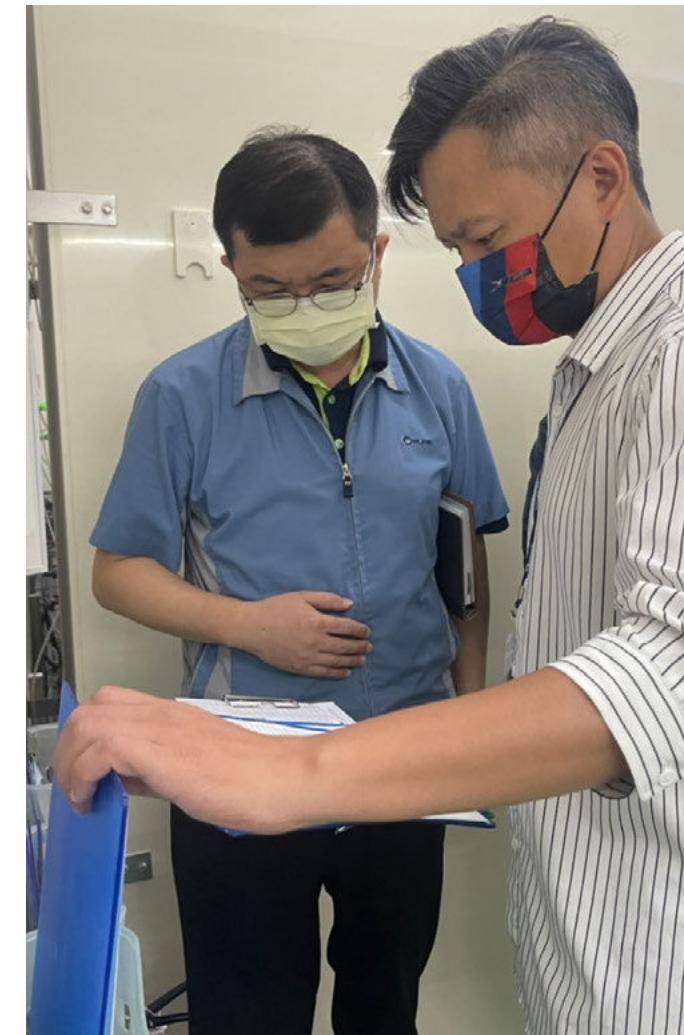
#### Design Key Items for Improvement

- Define replacement standards for obsolete equipment in the fabs
- Real-time monitoring of important processes or equipment parameters in the production lines
- Ensure regular maintenance of production line equipment
- Install relevant equipment in various areas of the fabs in accordance with environmental and fire protection regulations



#### Improvement Results of 2022

- Replaced obsolete industrial sulfuric acid production lines
- Use IE3 motors
- Created an EPA monitoring system and implemented certification
- Horizontally expanded the maintenance form to various equipment



The re-audit serves to confirm that the supplier has completed the improvement of the previous findings to design key items improvement projects

## Procurement Arrangement of Main Raw Materials

TSMC has formulated comprehensive procurement management actions for main materials, and it continues to collaborate with suppliers in five major areas: supplier distribution, diverse sources of materials, quality control, local procurement, and sustainable operations. By adjusting the global market deployment, developing diverse sources of materials, and increasing localized procurement, potential supply chain risks such as insufficient production capacity, quality defects, delivery delays, inflation, and major natural disasters can be proactively resolved. Furthermore, suppliers are required to incorporate sustainability into their operational considerations in accordance with the TSMC Supplier Sustainability Standard. At the same

time, TSMC also collaborates with suppliers to facilitate advanced material R&D, process innovation, and quality improvement, thereby continuously improving supply chain resilience and generating the values of a circular economy. For more information, please refer to [5.3.5 Raw Material and Supply Chain Management](#) in the annual report.

## Suppliers' Reporting Procedure

TSMC values people above all else and has established a Supply Chain Employee Reporting Channel on [Supply Online 360](#). This reporting channel offers protection for the employees of suppliers, extends and deepens TSMC's management practices, and builds a more inclusive workplace for the supply chain. In 2022, there were five reported cases, of which two were erroneous claims; one was a remuneration-related dispute and

one involved ambiguous overtime hours without overtime pay, for which the suppliers were immediately required to make improvements according to the TSMC Supplier Code of Conduct and compensate employees' due salaries and overtime pay; the final dispute was related to the protection of confidential information, and TSMC has reinforced information asset management.

## Reporting Procedure

### Key Management Actions for Main Raw Materials

Management Dimension	Main Raw Materials	Silicon Wafers	Process Chemicals	Photolithography Materials	Gases	Grinding Fluid, Grinding Pad, Diamond Discs
Key Suppliers	6 suppliers	12 suppliers	7 suppliers	9 suppliers	7 suppliers	
Diverse Sources of Materials	✓			✓		
Quality Control	✓	✓				
Local Procurement		✓	✓	✓		✓
Sustainable Operations	✓	✓	✓	✓	✓	



Through comprehensive management actions, TSMC requires suppliers to incorporate sustainability into their operations



## Case Study

### TSMC Supplier Sustainability Academy Reaches 1.2 Million Users—Fostering Common Good in the Industry Through Digitalization

To bolster the capabilities of suppliers, the TSMC Supplier Sustainability Academy has planned seven major programs with 44 courses, transforming TSMC's operating and manufacturing experience into online animated teaching materials and sharing them with the supply chain free of charge. As of 2022, 1.2 million people have completed training, and 284 Tier 1 suppliers have used the platform to train their suppliers and connect to the internal contractor construction management system, requiring those engaging in high-risk operations to complete the necessary courses before they can be qualified for construction to minimize potential industrial safety risks. The Enterprise GHG Inventory course is expected to be included in the compulsory courses for Tier 1 suppliers in 2023 to enhance the supply chain's green impact.

## Responsible Minerals Sourcing

TSMC ensures that human rights, health, and the environment in mineral production areas are not violated by purchasing conflict-free raw materials from dependable sources. In light of this, the Company has adopted a series of legal compliance measures including the establishment of a due diligence framework following the Model Supply Chain Policy for a Responsible Global Supply Chain of Mineral from Conflict-Affected and High-Risk Areas published by the Organization for Economic Cooperation and Development (OECD). At the same time, TSMC is one of the staunchest supporters of

the Responsible Minerals Initiative (RMI) and Global e-Sustainability Initiative (GeSI). The Company adheres to the Responsible Minerals Assurance Process (RMAP), requiring suppliers to procure conflict-free raw materials.

TSMC requires suppliers to comply with the responsible minerals sourcing policy and sign the statement of responsible minerals for products containing tantalum, tin, tungsten, and gold. Since 2017, TSMC has also disclosed the source smelters

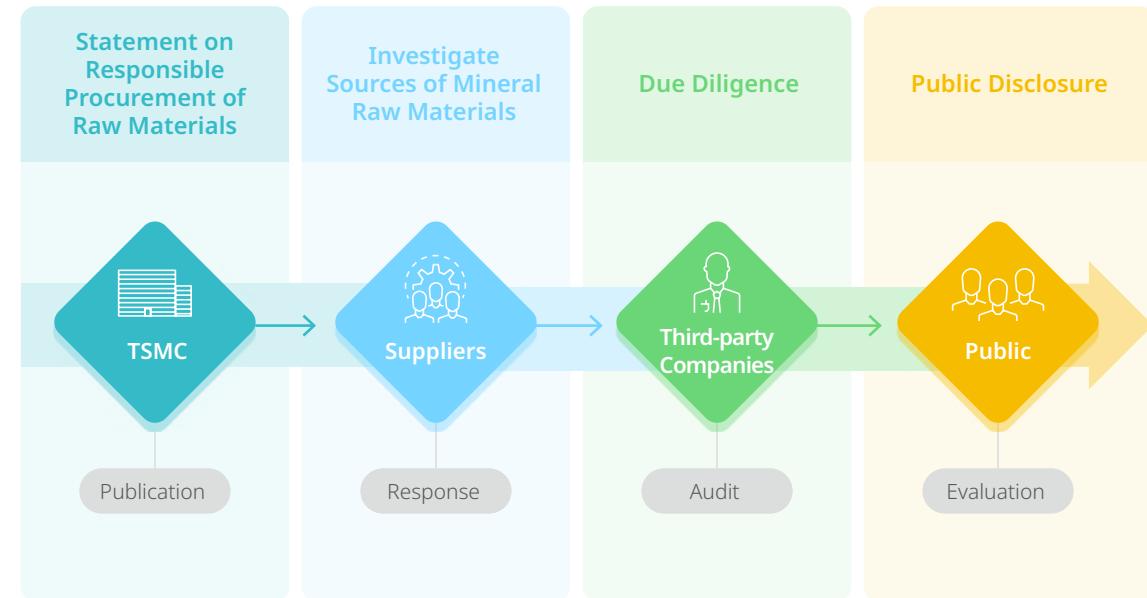
for the cobalt used in TSMC products to clients. In 2022, the Company completed the inventory of mica usage in the supply chain. Since 2021, TSMC has audited at least three suppliers of tantalum, tin, tungsten, and gold annually, ensuring that these suppliers formulate and implement conflict-free minerals management processes and conduct due diligence on upstream suppliers. For the latest TSMC disclosure documents, please visit [TSMC's official website](#) or the [US Securities and Exchange Commission website](#).

## Conflict-free Minerals Due Diligence



Note: Figures from Tier 1 Suppliers of TSMC fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra

## Responsible Minerals Management Process

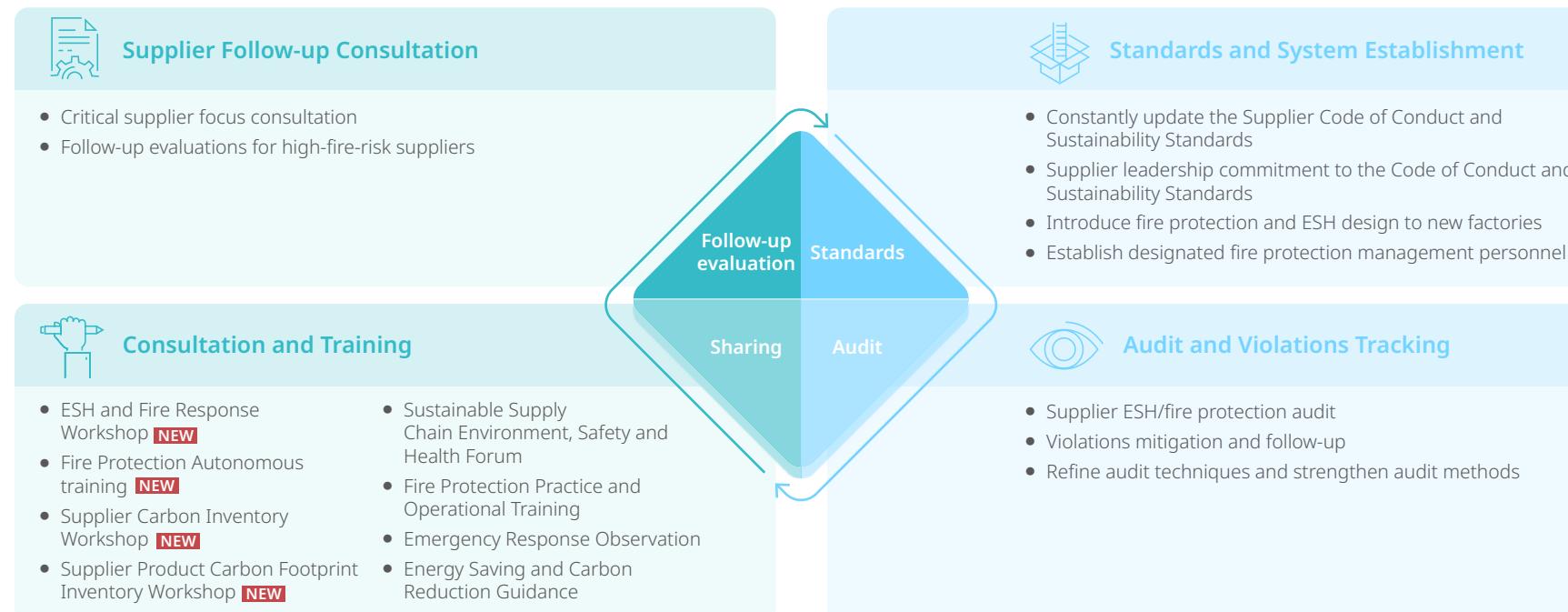


## Strengthen Supply Chain Resilience

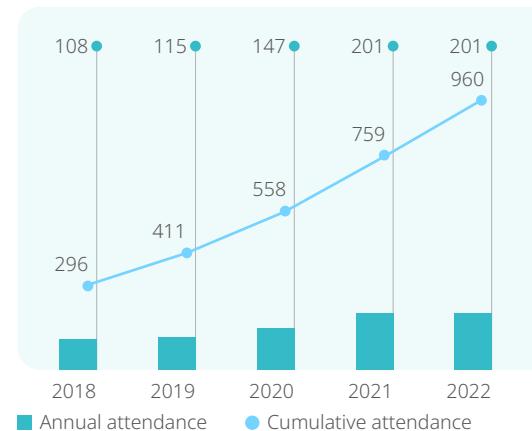
TSMC ensures ESH sustainability management in the supply chain with four separate steps: Establishing Standards and Systems, Audit and Violations Tracking, Consultation and Training, and Focus Consultation. To constantly improve the sustainability of suppliers, besides regularly organizing the Sustainable Supply Environment, Safety, and Health Forum, practical fire protection equipment training, emergency response drills and observation, and on-site energy conservation and carbon reduction diagnosis and guidance, the Company also launched a series of courses

and training including ESH and Fire Response Workshop, Supplier Fire Protection Autonomous Training, Supplier Carbon Inventory Workshop, and Supplier Product Carbon Footprint Inventory Workshop in 2022. Through hands-on teaching, group discussion, and practice by professional lecturers, the learning performance and self-management capabilities of suppliers are optimized, thereby enhancing suppliers' environmental safety, health, and loss prevention capabilities, and forming an uninterrupted supply chain.

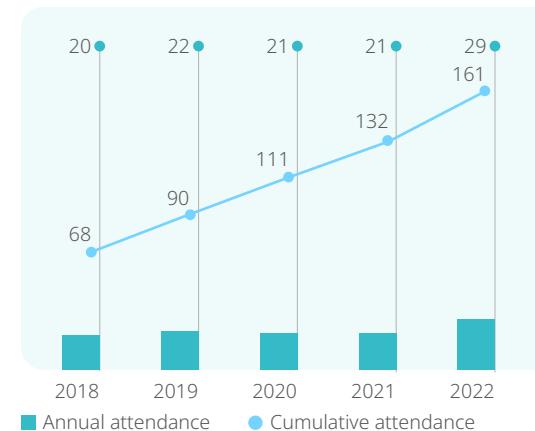
## Sustainable Management of the Supply Chain on Environmental Safety and Health



**Number of Suppliers Participating in ESH Training**



**Number of Suppliers Observing TSMC Annual Emergency Response Drills**



TSMC Sustainable Supply Chain Environment, Safety and Health Forum

## Achievement of ESH and Loss Prevention Capability Guidance in 2022

<b>Target</b>								
<b>Participants</b>								
Sustainable Supply Chain Environment, Safety and Health Forum	Supplier EHS Workshop	Supplier Fire Response Workshop	Fire Protection Practice and Operational Training	Fire Protection Autonomous training	Emergency Response Observation	Supplier Carbon Inventory Workshop	Supplier Product Carbon Footprint Inventory Workshop	Energy Conservation and Carbon Reduction Consultation
Reinforce suppliers' operational resilience and promote sustainable measures such as a supply chain net zero campaign	Help suppliers to understand the TSMC Supplier Sustainability Standard and emergency response capability through interactive discussions and practice	Elevate suppliers' capabilities in fire protection, first aid, and emergency response				Guide suppliers to accurately identify the sources and data of carbon emissions from fabs and products, and devise improvement measures to attain reduction goals		Determine energy conservation opportunities and provide them to suppliers to improve energy conservation
 116  354 Raw materials suppliers	 50  56 Suppliers requiring priority improvement due to ESH management audit shortcomings	 50  58 Bulk and specialty gas manufacturers and high-fire-risk suppliers	 40  48 Raw materials suppliers	 12  112 Raw materials suppliers	 29  34 Suppliers who have yet to obtain the ISO 14064 GHG verification certificate	 29  47 Suppliers who consume more than 5 million kWh of electricity annually	 20  24 Suppliers who consume more than 5 million kWh of electricity annually	 6 Raw materials suppliers

 Suppliers People

TSMC actively improves suppliers' fire protection, emergency response and disaster relief capabilities



## Case Study

# Supplier Fire Protection Personnel Project 2.0—Further Improvement of Self-management Capability

TSMC implemented the Supplier Sustainable Fire Protection Management Mechanism in 2020 and established a Supplier Protection Personnel System in 2021 to allocate training resources to executive personnel in order to achieve optimal training performance. In 2022, to lower the risk of material supply interruptions caused by fires, TSMC launched the Supplier Fire Protection Personnel Project 2.0 in addition to introducing fire protection requirements that are superior to RBA specifications; the Company also conducted on-site measurements and random inspections of supplier production

lines. Based on the principle of the Supplier Sustainability Standards, TSMC collaborated with external experts to open small classes for practical fire protection-related operational training and implemented the Supplier Fire Protection Autonomous Training Program. Meanwhile, online interactive courses will be planned and made available in the TSMC Supplier Sustainability Academy in 2023, so that suppliers' fire protection training will not be subject to time and venue constraints, thereby refining fire protection management and equipment reliability on an ongoing basis.



### Supplier Fire Protection Practice and Operational Training

Commissioned WuFeng University to organize the Practical Operational Training for Supplier Fire Protection Personnel, using MR equipment to conduct on-site drills in a bid to improve suppliers' professional fire protection capabilities. A total of 40 supplier representatives participated in two training sessions.



### Supplier Fire Protection Autonomous Training Program

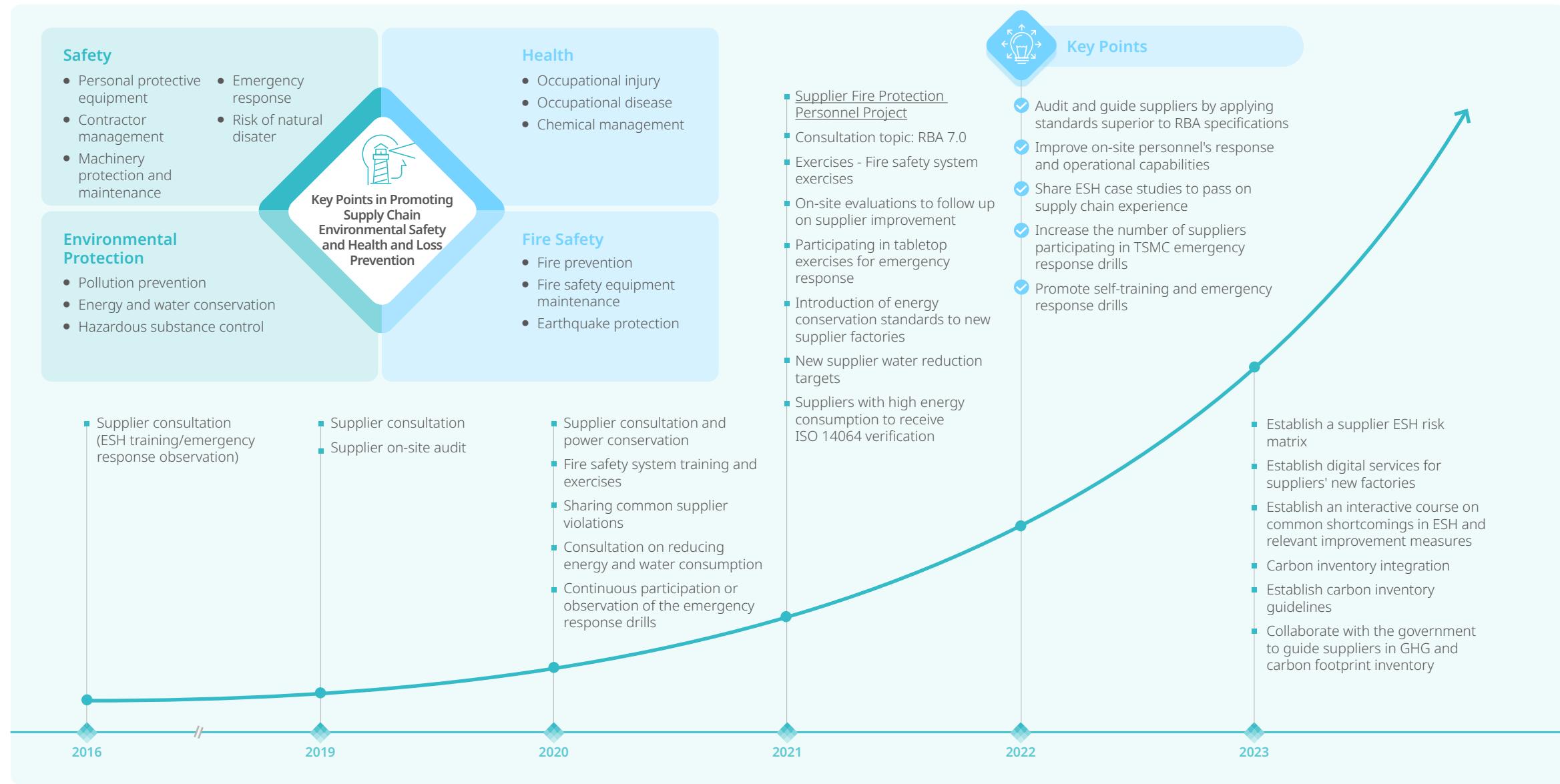
Fire protection technicians hired by suppliers were asked to conduct on-site training on employee fire protection equipment. Moreover, TSMC's fire protection experts conducted on-site guidance and observation to verify training quality. A total of 12 suppliers have completed the training.



### TSMC Supplier Sustainability Academy Interactive Fire Protection Course

Apart from physical courses, TSMC expects to launch the Deficiencies in Suppliers' Fire Protection Audits and Improvement Measures online course in Chinese and English on Supply Online 360, allowing domestic and foreign suppliers to participate in interactive fire protection training online.

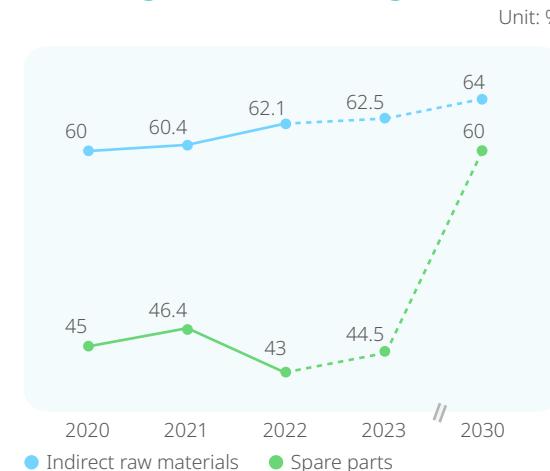
## Key Points in Promoting Supply Chain Environmental Safety and Health and Loss Prevention



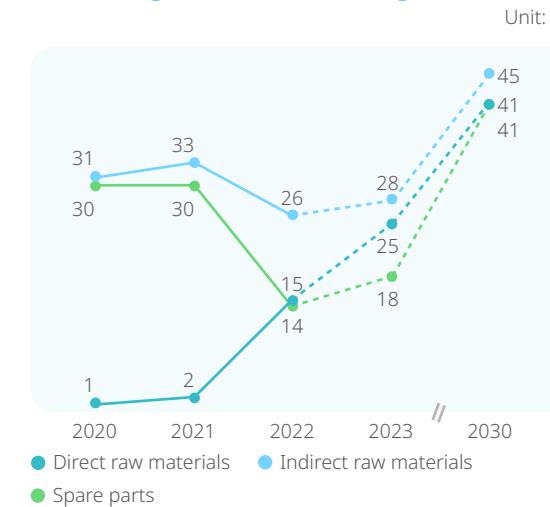
## Promote Constant Upgrade of Local Supply Chains

TSMC's main production site is located in Taiwan. Its procurement can be divided into six categories: equipment, spare parts, raw materials, facility services, IT, and goods. Besides promoting local sourcing in Taiwan, TSMC has also set up independent procurement organizations for TSMC subsidiaries, including TSMC (China), TSMC (Nanjing), and WaferTech. We also assist local suppliers to improve technology and quality and reduce costs and carbon emissions to build a highly effective and competitive semiconductor industry chain.

### Percentage of Local Sourcing in Taiwan



### Percentage of Local Sourcing in China



### Percentage of Local Sourcing in the US



## Challenges and Solutions of Supply Chain Management Activities from Taiwan Fabs in 2022

Problems/Challenges	Consultation Measures from TSMC	Number of Suppliers	2022 Performance
<b>Technology and Part</b> <ul style="list-style-type: none"> <li>Percentage of imported high-level spare parts for several advanced processes is still too high, as local suppliers lack critical technologies</li> <li>Parts of specific advanced machinery have to be sent abroad for repair and maintenance, which affects production schedules</li> </ul>	<ul style="list-style-type: none"> <li>Assemble a team of experts to provide consultation for local suppliers, offer technical support, and assist in certification, ensuring that supplier technology developments are consistent with TSMC's business needs</li> </ul>	9	<ul style="list-style-type: none"> <li>Developed parts for <b>156</b> advanced processes</li> </ul>
<b>Capacity</b> <ul style="list-style-type: none"> <li>Capacity insufficient to meet advanced process requirements</li> </ul>	<ul style="list-style-type: none"> <li>Production line expansion and process advancement</li> </ul>	10	<ul style="list-style-type: none"> <li>New factories supplied a sufficient amount of raw materials upon volume production, meeting TSMC quality requirements</li> <li>Assisted new suppliers to establish the Best Known Method (BKM) for inferior quality improvement</li> </ul>
<b>Measurement Technology</b> <ul style="list-style-type: none"> <li>Measurement technology insufficient to meet advanced process requirements</li> </ul>	<ul style="list-style-type: none"> <li>Add analytical instruments</li> <li>Introduce advanced instruments</li> </ul>	9	<ul style="list-style-type: none"> <li>Zero returns of goods</li> <li>Assisted new suppliers to increase detection thresholds</li> <li>Assisted new suppliers to acquire capabilities for IC material analysis</li> </ul>



## Promote Green and Low-carbon Supply Chains

### Continue to Reduce Environmental Impact

In response to the Net Zero by 2050 target, TSMC formed the Green Supply Chain Management Team and proposed specific action guidelines based on the five major dimensions proposed by World Economic Forum's (WEF) Net-Zero Challenge: The Supply Chain Opportunity guideline: Create Transparency, Optimize for CO<sub>2</sub>, Engage Suppliers, Push Ecosystems, and Enable Your Organization. Through this, TSMC continues to bolster the operational capability of a low-carbon supply chain.

#### • Create Transparency

In 2022, TSMC required 137 raw material and equipment suppliers to participate in the CDP Supply Chain Program and carried out an organizational GHG inventory training and CDP disclosure questionnaire briefing to improve data quality. A total of 322 people participated in the training and 111 suppliers completed the questionnaire. According to the survey results, 84% of the manufacturers have put their Board of Directors in charge of supervising climate change topics, 93% have conducted GHG inventory or estimation, 71% have set emission reduction targets, and approximately 51% of suppliers have provided Scope 3 emissions data. Also, to improve carbon emission data quality, TSMC has required suppliers with annual GHG emissions exceeding 2,500 tons to obtain third-party certification for ISO 14064 GHG inventory since 2021. The Supplier Sustainability Standard is expected to be revised in 2023, adding Scope 3 inventory request for suppliers, and requiring designated suppliers to obtain third-party ISO 14067 product carbon

footprint and ISO 50001 energy management certification.

In 2022, to manage the raw materials supply chain and identify carbon emission hotspots, a life cycle assessment of raw materials' carbon footprint was conducted. The results indicated that chemicals, bulk gases, and silicon wafers were the main emission sources. Thus, TSMC required relevant suppliers to stipulate rigorous short, medium, and long-term energy conservation, carbon reduction, and green energy consumption targets, as well as continue to track implementation performance. The Company also required suppliers to obtain the carbon footprint of their upstream materials

and communicate their carbon reduction claims. In 2023, TSMC will consolidate supplier carbon information-related inventories as the basis for subsequent Net Zero actions.

#### • Optimize for CO<sub>2</sub>

TSMC continues to bolster green manufacturing. By improving raw materials usage efficiency and decreasing the amount of raw materials required for wafer production, it is able to reduce the carbon emissions in the supply chain. In 2022, TSMC lowered the consumption of bulk chemicals with a significant proportion of carbon emissions to save roughly 178,000 tons of carbon emissions at the raw materials

manufacturing end via approaches such as reducing time span, extending use, replacing, and skipping stations. Meanwhile, the Company continues to promote the Electronic-grade Chemicals Recycling Program, indirectly decreasing carbon emissions and environmental impact during the upstream natural resource extraction process by using recycled chemicals in factories. Furthermore, the Company continues to optimize procurement strategies to minimize transport carbon emissions in the supply chain.

#### • Engage Suppliers

In 2021, TSMC stipulated the Supplier Sustainability Standard, requiring suppliers to formulate their GHG

## Five Approaches to Promote Low-carbon Supply Chains



### Create Transparency

Collaborate with suppliers to improve the quality and transparency of carbon emissions data in the supply chain

- ✓ Suppliers are required to participate in the CDP Supply Chain Program

- ✓ Review production data with suppliers to ascertain carbon emissions hotspots and carbon reduction opportunities



### Optimize for CO<sub>2</sub>

Focus on lowering carbon emissions and continue to optimize the Company's manufacturing and procurement strategies

- ✓ Improve the usage efficiency of chemicals with a significant proportion of carbon emissions to decrease consumption and facilitate the reduction of carbon emissions in the supply chain

- ✓ Promote local sourcing to lower transport emissions



### Engage Suppliers

Include carbon emissions in audits and collaborate with suppliers to minimize carbon emissions

- ✓ Demand and guide suppliers to elevate their green performance through the Supplier Sustainability Standard

- ✓ Promote green innovation projects for the supply chain



### Push Low-carbon Ecosystems

Participate in industry collaborations and initiatives on low-carbon topics

- ✓ Continue to promote the Energy Conservation Action Project for Next-generation Fab Tools

- ✓ Invite high-carbon emissions suppliers to join the Renewable Energy Joint Procurement Project



### Establish Internal Carbon Reduction Mechanisms

Establish an internal carbon reduction mechanism in the Company and increase carbon reduction incentives

- ✓ Form a green supply chain management team responsible for supply chain carbon reduction-related affairs

- ✓ Create a systematic reward mechanism



reduction targets and reduce, track, document, and disclose their Scope 1 and Scope 2 emissions. In 2022, TSMC continued to require and assist suppliers to improve their performance in making the supply chain greener. The annual total energy reduction reached 190 GWh, and the accumulative total reached 530 GWh. The annual total water reduction reached 9.37 million metric tons, and the cumulative total reached 29.08 million metric tons. Additionally, 65% of the high energy consumption suppliers received ISO 14064 verification. TSMC also required suppliers to introduce energy conservation assessments when building new factories. The waste production per unit among major waste-producing suppliers was reduced by 34%, exceeding the annual target of 32%.

Additionally, TSMC also actively promotes green innovation projects in the supply chain. In 2022, suppliers were engaged to launch the Supplier Carbon Capture Program to help them build carbon capture equipment for rectification columns, and reintroduce the residual gas from the rectification process of industrial-grade liquid CO<sub>2</sub> into the process for secondary purification. This is reproduced into electronic-grade liquid CO<sub>2</sub> that conforms to TSMC's quality standards. Up until December 2022, 800 metric tons of CO<sub>2</sub> have been captured successfully.

### • Push Low-carbon Ecosystems and Establish Internal Carbon Reduction Mechanisms

TSMC is dedicated to creating a green semiconductor supply chain. Besides working with suppliers to advance the Energy Conservation Action Project for Next-generation Fab Tools, suppliers with high carbon emissions were invited to join the renewable energy joint procurement project in 2022 to assist suppliers to expand the source of green power procurement and consolidate the upstream to form a low-carbon supply chain. In 2022, TSMC established a green supply chain management team to track and require suppliers to implement carbon reduction actions. The team is also responsible for integrating TSMC's internal and external resources to help suppliers achieve their targets. Moreover, in response to TSMC's internal application of ESG AWARD to motivate employees to constantly review carbon reduction opportunities and inspire green innovation, the Materials Management invited suppliers to submit proposals together for the first time in 2022, such as collaborating with suppliers to recycle packaging materials or recycling and transforming calcium fluoride sludge into recycled products, as well as enhancing carbon reduction awareness among TSMC personnel and the supply chain through a reward mechanism.

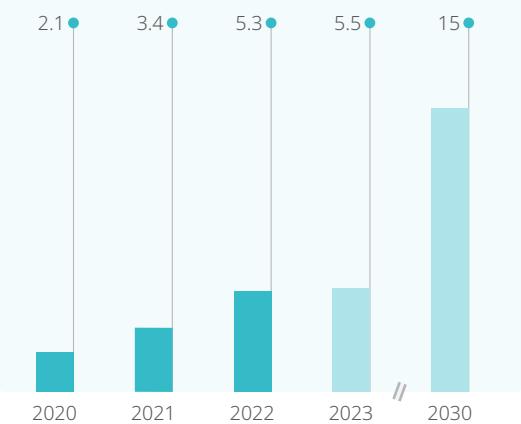
### Supply Chain Carbon Emission Management Process



### Targets and Achievements of Suppliers' Efforts to Reduce Energy and Water Consumption, Waste, and Carbon Emission

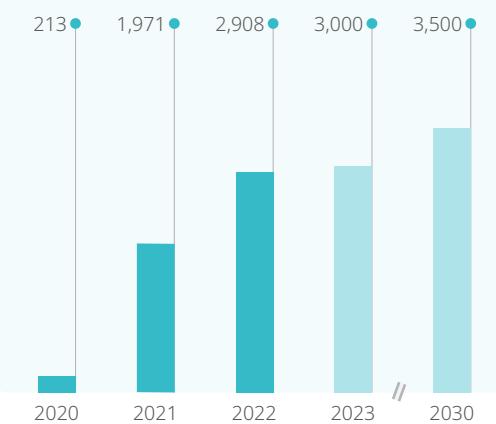
Cumulative Total of Energy Consumption Reduced

Unit: 100 GWh



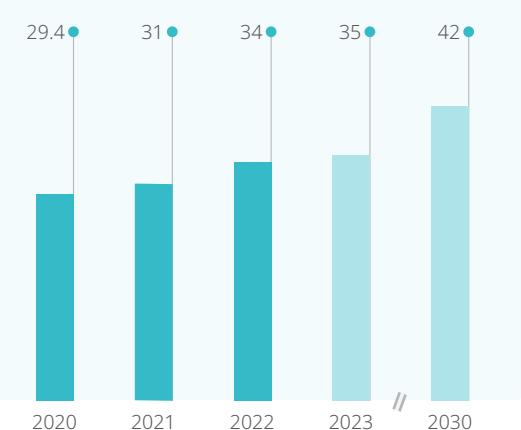
Cumulative Total of Water Consumption Reduced

Unit: 10,000 metric tons



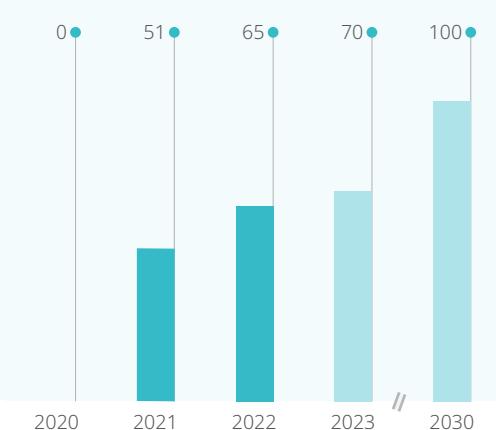
Waste Reduction Rate

Unit: %



Percentage of ISO 14064 Verification

Unit: %



## Case Study

## Supplier Material Packaging White Paper Regulations Launched to Form Optimal Packaging Supply Chain

To alleviate the environmental problems caused by excessive packaging of raw materials, TSMC and suppliers joined forces to compile the first Supplier Material Packaging White Paper Regulations to promote reduction circulation in the three major dimensions of Health and Safety, Environmental Protection, and Packaging and Labeling Standardization to establish a Handling-friendly, Environment-friendly, and Automation-friendly packaging culture. More than 1,200 domestic and foreign raw materials suppliers were encouraged to improve packaging operations, striving towards the goal of optimal packaging in the supply chain.

In 2022, TSMC took the initiative to provide packaging samples for suppliers of similar materials through inventory checks, offering improvement suggestions to elevate packaging quality. Additionally, active promotion was conducted through the Supply Online 360 platform to encourage suppliers to implement packaging optimization from the manufacturing end to the logistics process. Please refer to Supplier Material Packaging White Paper Regulations for further details.

### Implementation Results in 2022



#### Improvement

Choose an appropriate packaging method according to the total weight of raw materials and place a warning label on the box to protect box handling personnel

- ✓ Mark the weight with a warning sign on the boxes
- ✓ Provide lifting aid
- ✓ Use chemical hazard labels and signs

#### Cases

Add holes and role handles for oversized or overweight boxes to make it easy for personnel to move safely

**100,000 times**  
Improved comfort for 100,000 times handling

**4.8 metric tons**  
Reduced waste generation by 4.8 metric tons

Reduce the use of composite materials and excessive packaging with the 3R principle (reduce, reuse, and recycle)

- ✓ Volume minimization and optimization
- ✓ Reduce auxiliary materials or unnecessary labels
- ✓ Avoid packaging materials that contain heavy metals
- ✓ Provide recyclable packaging material recommendations

Minimize the excessive use of film for stacked materials without compromising the protective performance

Standardize packaging size, label, and content to improve work efficiency, reduce workload, and accelerate the development of automated packaging

- ✓ List the packaging size of various materials
- ✓ Develop radio frequency identification (RFID) systems
- ✓ Define label format and placement
- ✓ Standardize wafer packaging and packing methods

Replace disposable shipping boxes with Hybox to facilitate the transport and putting-away of silicon wafers with factory automation robots to optimize work efficiency

**13,000 times**  
Reduced manual handling  
**117 metric tons**  
Reduced weight handled



# A Practitioner of Green Power

TSMC aspires to be a world-leading benchmark organization in environmental protection and actively integrates green management into daily operations. The Company applies innovative technologies to climate and energy, water management, circular resources, and air pollution control, promoting a comprehensive range of sustainable actions to strengthen environmental protection and act on the firm belief in prospering with the earth's ecosystem.

**>10%**

Renewable energy ratio of total power consumption

**59%**

Unit air pollutant emissions reduced

**28%**

In-house resource recycling rate

Climate and Energy

Water Stewardship

Circular Resources

Air Pollution Control



# Climate and Energy

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Strengthen Climate Resilience</b> Develop climate change response and measure to reduce the impact of climate risks	0 day of production interruption due to climate disasters	0 day of production interruption due to climate disasters	0 day of production interruption due to climate disasters Target: 0 days <span style="color: green;">✓</span>
<b>Drive Low-carbon Manufacturing</b> Continue to use best available technology to reduce emissions of greenhouse gases (GHG) and become an industry leader in low-carbon manufacturing	Reduce unit GHG emissions by 30% compared to the base year (metric ton of carbon dioxide equivalent (MTCO <sub>2</sub> e)/12-inch equivalent wafer mask layer) by 30%, and restore GHG emissions to the 2020 level (Base year: 2020 )	Reduce unit GHG emissions (metric ton of carbon dioxide equivalent (MTCO <sub>2</sub> e)/12-inch equivalent wafer mask layer) by 9% (Base year: 2020)	Reduce unit GHG emissions (metric ton of carbon dioxide equivalent (MTCO <sub>2</sub> e)/12-inch equivalent wafer mask layer) by 6% Target: 6% (Base year: 2020) <span style="color: green;">✓</span>
<b>Use Renewable Energy</b> Continue to purchase renewable energy and install solar-energy power systems to achieve target of 100% renewable energy use	Starting from 3nm new fabs, renewable energy accounts for more than 20% of energy consumption and the purchasing of renewable energy increases annually to achieve 40% renewable energy company-wide	Continue to use renewable energy to achieve 12% of renewable energy in TSMC and overseas sites use 100% renewable energy	Used 2,190 GWh of renewable energy <sup>Note1</sup> and Renewable Energy Certificates (RECs); TSMC overseas sites used 100% renewable energy; accounting for 10.4% of TSMC's power consumption Target: TSMC overseas sites used 100% renewable energy; accounting for 10% of TSMC's power consumption <span style="color: green;">✓</span>
<b>Increase Energy Efficiency</b> Plan and implement new energy-saving measures each year to increase energy efficiency	Cumulative energy-saving rate reached 18% between 2016 and 2030 through new energy-saving measures <sup>Note2</sup>  Double energy efficiency after five years of volume production for each process technology <sup>Note3</sup>	14% cumulative energy-saving rate  Increase energy efficiency of 5nm process technology 0.7 times higher in the 4 <sup>th</sup> year of volume production	700 GWh energy saved, and cumulatively saved 3,100 GWh; cumulative energy-saving rate reached 13% Target: 700 GWh; 3,100 GWh <span style="color: green;">✓</span>  Increase 5nm process technology energy efficiency 0.6 times higher in the 3 <sup>rd</sup> year of volume production Target: increase 5nm process technology energy efficiency 0.4 times higher in the 3rd year of volume production <span style="color: green;">↑</span>

Note 1: Definition of renewable energy use: Purchased, self-generated renewable energy, and renewable energy certificates and carbon credits produced by renewable energy

Note 2: Absolute value of energy efficiency improvement targets are replaced with energy-saving rate to avoid value differences incurred by market fluctuation and changes in power use. The rate is the cumulative energy-saving results since the base year 2016

Note 3: Energy efficiency is the product equivalent per kWh of power (12-inch equivalent wafer mask layer/kWh)

↑ Exceeded ✓ Achieved — Missed Target



Responding to climate change is the responsibility for sustainable business operation. As the world's largest provider of semiconductor technologies and capacity, TSMC is committed to reaching Net Zero emissions by 2050 and has drawn [Roadmap to Net Zero Emissions](#), targets include zero-growth and gradual reduction in carbon emissions starting 2025, reducing 2030 carbon emission to 2010 levels, and reaching net zero emissions (with value chain included) by 2050. Among these, using 100% renewable energy is one of the key strategies in realizing net zero emissions. Other than the continuing improvements

of [various carbon reduction actions](#), TSMC is also working on expanding the use of renewable energy and establishing a diverse supply. Since the Company included a small-scale hydroelectric station as one of the sources of power supply in 2022, its yearly use of renewable energy reached 2,190 GWh, and TSMC overseas sites reached net zero emissions in Scope 1 and 2. TSMC established carbon credits quality procurement standards for the first time in 2022 and chose four carbon credits offset programs for carbon reduction, and referenced the UN's [Convention on Biological Diversity](#) and [SDGs](#) as

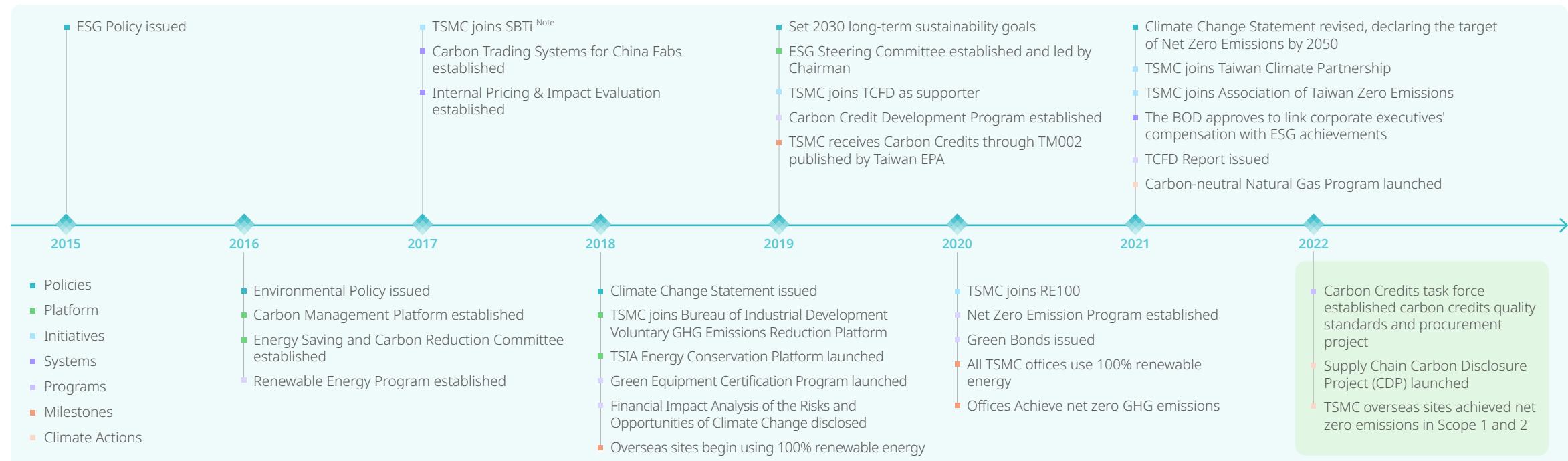
guidelines to formulate its Biodiversity Statement. Officially launched in 2023, the Statement strives to reach a balance between technology and the ecosystem to allow never-ending momentum for sustainability to realize GHG reduction targets.

### Strengthen Climate Resilience

Global Risks Report 2023 published by the World Economic Forum (WEF) pointed out that climate-related environmental issues are the most significant four risks of the [top ten global risks](#) over the next decade, including failure to mitigate climate

change, failure of climate-change adaptation, natural disasters and extreme weather events, and biodiversity loss and ecosystem collapse; it is clear that constantly improving climate risk response measures and enhancing corporate operational resilience are pressing important tasks. TSMC successfully achieved uninterrupted production target in 2022 by identifying potential risks and opportunities through regular systematic risk assessment identification and following the Company's [Climate Risk Adaptation Standards](#) to reduce potential climate disaster.

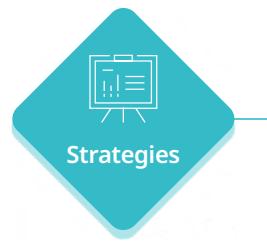
### Milestones of Responses to Climate Change



Note: Science Based Targets Initiative (SBTi) is an international initiative organization that encourages companies to set an absolute GHG emission reduction target that is in line with the Paris Agreement goals with a yearly reduction of 4.2 %. TSMC is committed to develop SBT reduction targets in 2017, and as the global demand for chips drastically increased in recent years, the CAGR of TSMC's capacity exceeds 10%. However, as the supply from the renewable energy market in the Company's main manufacturing site was insufficient, reaching SBT requirements poses as a challenge in the short term. Taking operational growth and development trends in carbon reduction into account, TSMC will put zero growth in emissions as the main target, and assess to fulfill SBT requirements in mid and long-term targets



## TSMC Climate Change Management Framework<sup>Note</sup>

Category	Corporate Management Strategies and Actions	2022 Execution Summary
 Governance	<ul style="list-style-type: none"> <li>The Board will regularly review risks and opportunities related to climate change           <ul style="list-style-type: none"> <li><a href="#">ESG Steering Committee</a>: TSMC's top organization in climate change management. Chaired by the Chairman of TSMC with the chairperson of the ESG Committee serving as executive secretary. The Committee reviews TSMC's climate change strategies and goals every quarter and reports to the Board of Directors</li> <li>Energy Saving and Carbon Reduction Committee: The Energy Saving and Carbon Reduction Committee is the Company's management organization for taking action on climate change risk and opportunity. It is chaired by the Vice President of Fab Operations. Every quarter, this Committee formulates management plans, reviews implementation status, and discusses future plans</li> <li>Risk Management Steering Council: The Risk Management Steering Council briefs the audit committee each year on the ever-changing risk environment facing TSMC, the focus of the Company's enterprise risk management, and risk assessment and mitigation efforts, including climate change issues</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>✓ The ESG Steering Committee is comprised of senior executives from various TSMC organizations and formulates long-term 2030 goals and development strategies for climate change and renewable energy. See <a href="#">ESG Management Platform</a> for more information</li> <li>✓ The executive secretary of the ESG Steering Committee delivered quarterly reports to the Board on sustainable development strategies and achievements, including green manufacturing performance, renewable energy procurement, and net zero emission targets and strategies</li> <li>✓ The Energy Saving and Carbon Reduction Committee defined five major energy conservation teams based on different process technologies to conserve more energy from production equipment and fab facilities. As an incentive for the energy conservation teams, the Committee rewards them based on the achievement on energy conservation targets and innovative ideas</li> <li>✓ The Chairperson of the RM Steering Committee gave an annual report to the <a href="#">Audit and Risk Committee</a> on water resources, energy risks, natural disasters, regulations, and other topics related to climate change; <a href="#">TSMC Risk Management Policy</a> was published in 2022 to establish and strengthen the risk management corporate culture</li> </ul>
 Strategies	<ul style="list-style-type: none"> <li>Organize interdepartmental discussions and identify short, mid, and long-term climate risks and opportunities</li> <li>Assess the potential financial and operational impact on TSMC from major climate risks and opportunities</li> <li>Conduct scenario analysis and assess SBT(Science-Based Target) and net zero emission targets and actions</li> </ul>	<ul style="list-style-type: none"> <li>✓ Planned and carried out 684 energy saving measures across eight major categories, saving an additional 700 GWh. See <a href="#">Increase Energy Efficiency</a> for more information</li> <li>✓ See <a href="#">Climate Change Risk and Opportunity Matrix</a> for more information on how response measures were formulated and enforced according to the climate risks and opportunities identified in the <a href="#">interdepartmental Climate Change Risk and Opportunity Workshop</a></li> <li>✓ See <a href="#">TSMC TCFD Report</a> for more information on how TSMC completed a qualitative assessment on the financial impact of major climate risk and opportunities and implemented quantitative assessment on the financial impact of major climate risk and opportunities</li> <li>✓ Based on the SSP1-1.9 scenario set forth by the Intergovernmental Panel on Climate Change (IPCC) AR6, TSMC analyzed climate risks in production and formulated climate change strategies and mitigation measures while also striving toward net zero emission targets</li> </ul>
 Risk Management	<ul style="list-style-type: none"> <li>Use the TCFD framework to develop a process for identifying climate risks</li> <li>Formulate response measures based on the risks/opportunities identified and prioritized</li> <li>Integrate climate risk identification and assessment in the Enterprise Risk Management (ERM) process</li> </ul>	<ul style="list-style-type: none"> <li>✓ Evaluated the qualitative and quantitative financial impact of major climate-related risks/opportunities discussed in the TCFD workshop by <a href="#">related departments</a></li> <li>✓ Reported assessment results of the climate risks/opportunities and response plans to the ESG Committee Chairperson</li> <li>✓ See <a href="#">6.3 Risk Management</a> in 2022 TSMC Annual Report for more information</li> </ul>
 Metrics and Targets	<ul style="list-style-type: none"> <li>Set management metrics related to climate change</li> <li>Through ISO 14064 annual inventory and disclosure of greenhouse gas emissions, review the impact on the company's operations, and assess the risks of Scope 1, 2 and 3 and their mitigation strategies</li> <li>Set climate change management targets and review progress and performance</li> </ul>	<ul style="list-style-type: none"> <li>✓ Established the following as climate change performance indicators: GHG emissions per unit product, amount of renewable energy purchased, total electricity saved, improved production efficiency, and days of production interruption due to climate disasters. See <a href="#">Climate and Energy Strategies, Goals, and Outcomes</a> for more information</li> <li>✓ Based on carbon inventory and evaluation results, the consistent carbon reduction actions have effectively reduced risks of Scope 1 emissions, the risks of Scope 2 indirect GHG emissions due to electricity consumption and the risks of Scope 3 due to the continual increase of supplier indirect emissions. See more on <a href="#">Drive Low-carbon Manufacturing</a></li> <li>✓ Set climate change and energy management goals for 2030 in accordance with climate change performance indicators for senior executives to regularly review implementation performance. See <a href="#">Climate and Energy Strategies, Goals, and Outcomes</a> and <a href="#">GHG Reduction Best Practices</a> for more information</li> </ul>

## Identify Climate Risks and Opportunities

TSMC holds the Climate Change Risk and Opportunity Workshop once every two years to identify and update climate risks and opportunities based on the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) framework. In 2022, the [Workshop](#) identified [11 transition and physical climate risks and eight opportunities](#). The top three climate risks were net zero emissions, impact on company reputation, and uncertainties in the development of new energy saving/carbon reduction technologies, and the top three opportunities were: develop low-carbon products and services and increase energy efficiency in customer products, drive low carbon manufacturing, and boost company reputation. Apart from continuous improvements on [carbon reduction practices](#), TSMC also set up carbon credit procurement strategies and started implementations in 2022 to further enhance corporate climate resilience. See [TSMC TCFD Report](#) for qualitative assessment methods and results on the financial impacts of each risk and opportunity.

## Climate and Energy Strategies, Goals, and Outcomes

Category	Risks / Opportunities	Key Response Measures
	<ul style="list-style-type: none"><li><span>⚠</span> GHG restrictions and carbon taxes/carbon levy</li><li><span>⊕</span> Participate in renewable energy programs</li><li><span>⊕</span> Participate in carbon trading markets</li></ul>	<ul style="list-style-type: none"><li>✓ Set ambitious carbon reduction targets: commit to zero carbon emissions from global operations by 2050</li><li>✓ Assemble a renewable energy task force to work with related associations and government agencies to accelerate the development of renewable energy and actively seek to purchase green energy</li><li>✓ Work with associations to propose suggestions to the government about building a carbon credit market</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> Net zero emission</li><li><span>⊕</span> Receive rewards from the public sector for offsetting carbon reductions</li><li><span>⊕</span> Develop low-carbon products and services; Increase energy efficiency in customer products</li></ul>	<ul style="list-style-type: none"><li>✓ Map out the company's net zero emissions roadmap, formulate net zero emission strategies, and enforce related measures</li><li>✓ Continue carrying out GHG reduction actions and participate in government carbon offset programs for carbon reduction to earn carbon credits</li><li>✓ Implement long-term plans for purchasing carbon credits</li><li>✓ Continue investing in R&amp;D resources to develop energy-saving products</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> EIA commitment</li><li><span>⊕</span> Promote water efficiency and diversification</li></ul>	<ul style="list-style-type: none"><li>✓ Diversify water sources and start using reclaimed water</li><li>✓ Strengthen water resource management and apply for AWS (Alliance for Water Stewardship) certification</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> Uncertainty in new energy saving/carbon reduction technologies</li><li><span>⊕</span> Improve plant energy efficiency</li></ul>	<ul style="list-style-type: none"><li>✓ Promote energy saving and carbon reduction actions and track facility outcomes every quarter through the Energy Saving and Carbon Emission Reduction Committee</li><li>✓ Build green factories, obtain green building licenses, and share experiences with external parties</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> Impact on Company reputation/ image</li><li><span>⊕</span> Enhance company reputation</li></ul>	<ul style="list-style-type: none"><li>✓ Stick to green manufacturing and green innovation. Enhance the company's green reputation through transparent disclosure</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> Floods (TSMC operations)</li><li><span>⚠</span> Floods (Supply chain)</li><li><span>⚠</span> Droughts (TSMC operations)</li><li><span>⚠</span> Droughts (Supply chain)</li><li><span>⊕</span> Increase resilience against natural disasters</li></ul>	<ul style="list-style-type: none"><li>✓ Assess flood and drought risks at fabs and formulate and carry out risk mitigation measures</li><li>✓ Ask suppliers to evaluate the flood and drought risks of their operational facilities and implement risk reduction actions</li><li>✓ Establish a comprehensive water monitoring system and emergency response processes and hold regular drills</li></ul>
	<ul style="list-style-type: none"><li><span>⚠</span> Rising temperature</li><li><span>⊕</span> Drive low carbon manufacturing</li></ul>	<ul style="list-style-type: none"><li>✓ Establish the Energy Conservation and Carbon Reduction Committee, led by senior executives to reduce greenhouse gas emissions</li></ul>

## Drive Low-carbon Manufacturing

The annual GHG inventory result is TSMC's first step to strengthening carbon reduction by reviewing overall carbon reduction efforts and revising the emission reduction strategies on a rolling basis. In 2022, the Company's total GHG emission was 18 million MT CO<sub>2</sub> equivalent; direct emissions from Scope 1 processes such as F-GHGs and nitrous oxide processes accounted for 11%; indirect GHG emissions in Scope 2 from electricity use, which was still the major emission source, accounted for 50%; and indirect GHG emissions from the value chain in Scope 3 accounted for 39%, which were primarily from producing raw materials, energy related activities in the upstream, and transportation. Overall GHG emissions increased

14% compared to the previous year because of the continuous expansion of advanced process capacities, however, in terms of the capacity growth ratio, per unit product emissions saw a slight decrease compared to the previous year, indicating TSMC's non-stop efforts in improving low-carbon manufacturing actions that effectively delivered GHG emissions reduction per unit product.

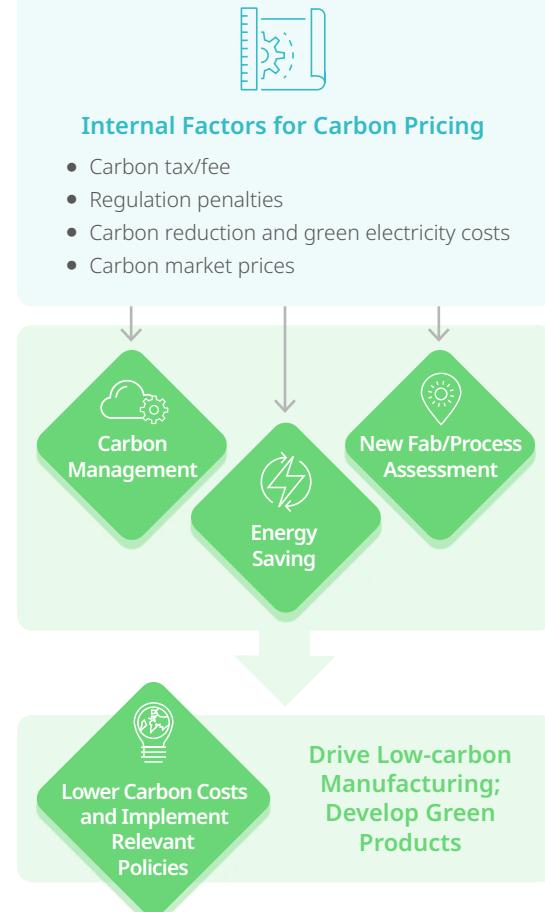
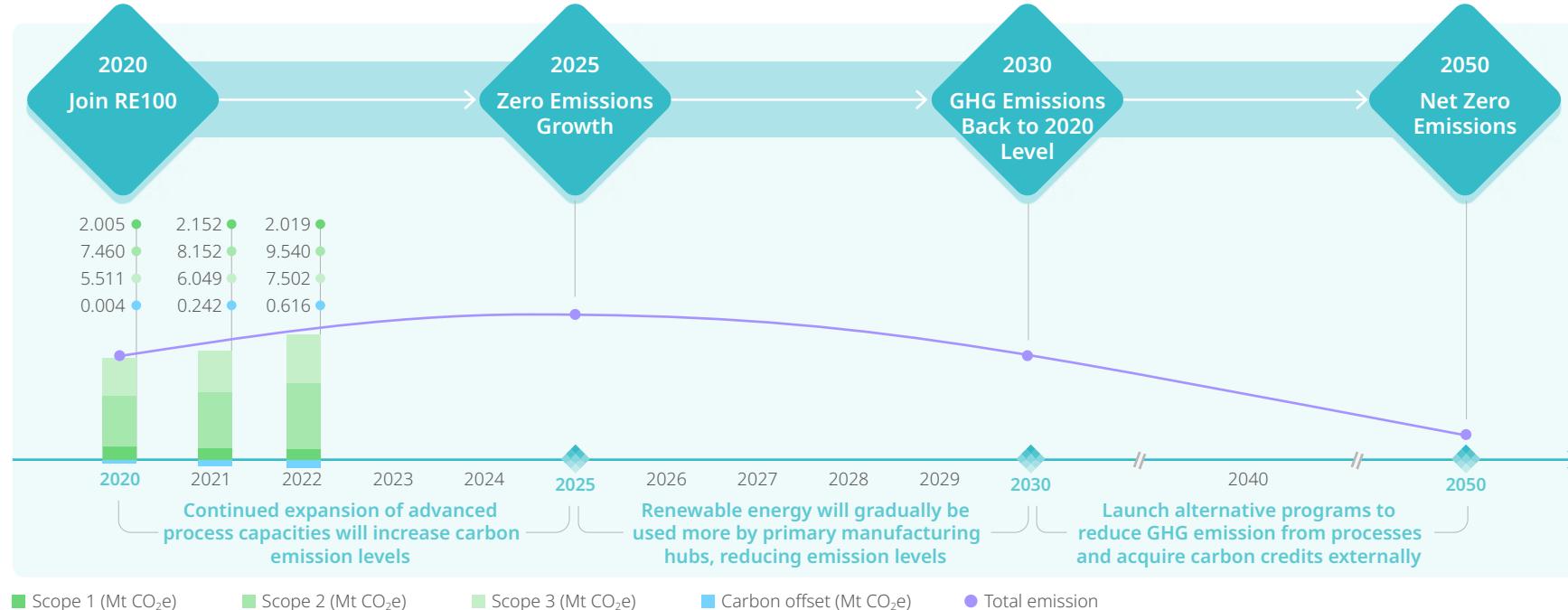
TSMC continues to enforce industry-leading best practices for GHG reduction, including ramping up replacements and installing local scrubbers on the manufacturing end, using carbon-neutral natural gases, constructing green factories with green building

certificates, implementing energy-saving projects for process tools and facility equipment, and increasing the use of renewable energy. In response to an increase in carbon cost brought about by a global trend in low-carbon transition, starting from 2022, TSMC widely uses internal carbon pricing mechanism to reflect carbon cost in efficacy estimation for daily reduction measures, and include this into decision-making evaluation for new fab investments. As for emissions reduction actions in Scope 3, TSMC continues to focus on increasing material use efficiency and implement electronic grade chemical reuse. Starting from 2022, TSMC invites suppliers to participate in the CDP Supply Chain Program to learn more about the global trend

on low-carbon transition and their own carbon hot spots, and helps them develop strategy and target on carbon reduction. TSMC also shares with suppliers its Best Known Method to support them to implement green actions together.

## TSMC Carbon Pricing Mechanism

### Roadmap to Net Zero Emissions



## GHG Reduction Standard Practices

### Scope I

#### Direct GHG Emissions



Processes that use F-GHGs and nitrous oxide

- ✓ Optimize gas quantity used in production
- ✓ Substitute high global warming potential (GWP) fabrication gases
- ✓ Install Point-of-Use abatement equipment for F-GHG and nitrous oxide
- ✓ Use carbon-neutral natural gas

100%

Introduce optimized process parameters in accordance with the manufacturing specifications by the Intelligent Engineering Center

100%

Apply optimized carbon reduction technology – remote plasma dissociation of nitrogen trifluoride (NF<sub>3</sub>) to all 12-inch fabs

100%

Apply nitrogen trifluoride (NF<sub>3</sub>)/octafluorobutane (C<sub>4</sub>F<sub>8</sub>) to 6-inch and 8-inch fabs

3,900

Install equipment with new F-GHG and nitrous oxide reduction technologies

95%

Replace 91 existing tools with fluorinated gas processes; installation rate: 95%

1

First in Taiwan to use carbon-neutral natural gas. The facilities in Taiwan have had zero carbon footprints and TSMC has been able to reduce emissions by 0.28 million metric tons CO<sub>2</sub>e

### Scope II

#### Indirect GHG Emissions (From Purchased Energy)



Energy usage

- ✓ Build green buildings
- ✓ Increase energy efficiency
- ✓ Use energy-saving & low-carbon emission designs in next-generation process tools
- ✓ Purchase renewable energy

1

TSMC led the global semiconductor industry with the largest LEED-certified building area; three buildings received green building certification in 2022, bringing TSMC's total to 40 LEED-certified buildings and 28 EEWH certified buildings

684  
measures

Energy efficiency of advanced technologies led industry peers <sup>Note 1</sup>, carried out 684 energy-saving measures over 8 major categories and saved 700 GWh, equivalent of nearly 360,000 metric tons CO<sub>2</sub>e

1

The world's only semiconductor company to launch energy-saving programs for next-generation semiconductor fab tools; completed 195 energy-saving programs with an accumulation of 500 GWh electricity saved

>10%

In addition to using 100% renewable energy for global offices, TSMC also purchased 2,190 GWh of renewable energy around the whole world, accounting for 10.4% total power consumption

### Scope III

#### Indirect GHG Emissions (Value Chain)



Raw material production, energy-related activities upstream, and transportation

- ✓ Supplier required to obtain external verification
- ✓ Reduce carbon footprint from raw materials
- ✓ Participate in CDP Supply Chain Program **NEW**
- ✓ Optimize delivery schedules

65%

High Energy Consumption Suppliers <sup>Note 2</sup> must pass GHG emissions inventory and third-party verification; 65% of suppliers have been verified.

97,000  
metric tons

High Energy Consumption Suppliers were asked to set annual targets and implement real energy-saving actions; in 2022, TSMC suppliers conserved 190 GWh and reduced 97,000 metric tons CO<sub>2</sub>e

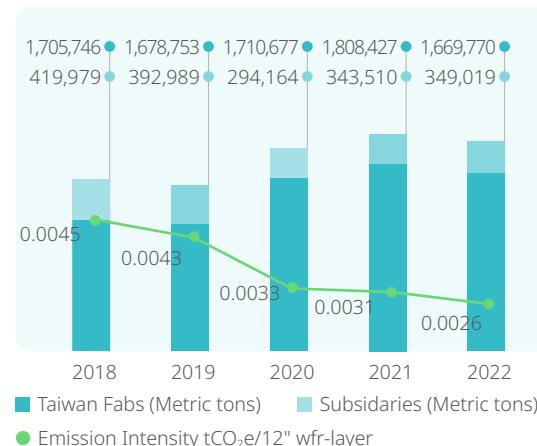
81%

Invite material and equipment critical suppliers <sup>Note 3</sup> to disclose carbon reduction targets and progress with a response rate of 81%

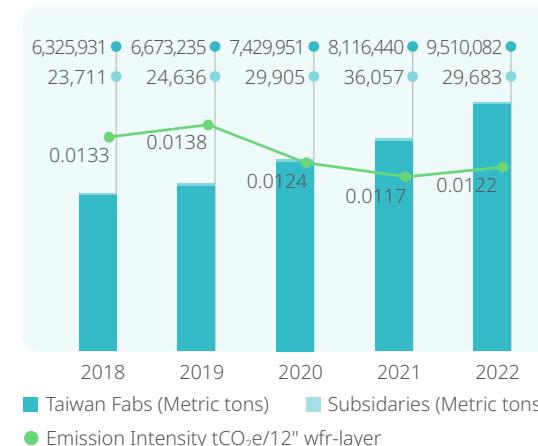
28,000  
metric tons

Improved the delivery schedule for process tools and replaced air freight with ocean freight, reducing 28,000 metric tons CO<sub>2</sub>e

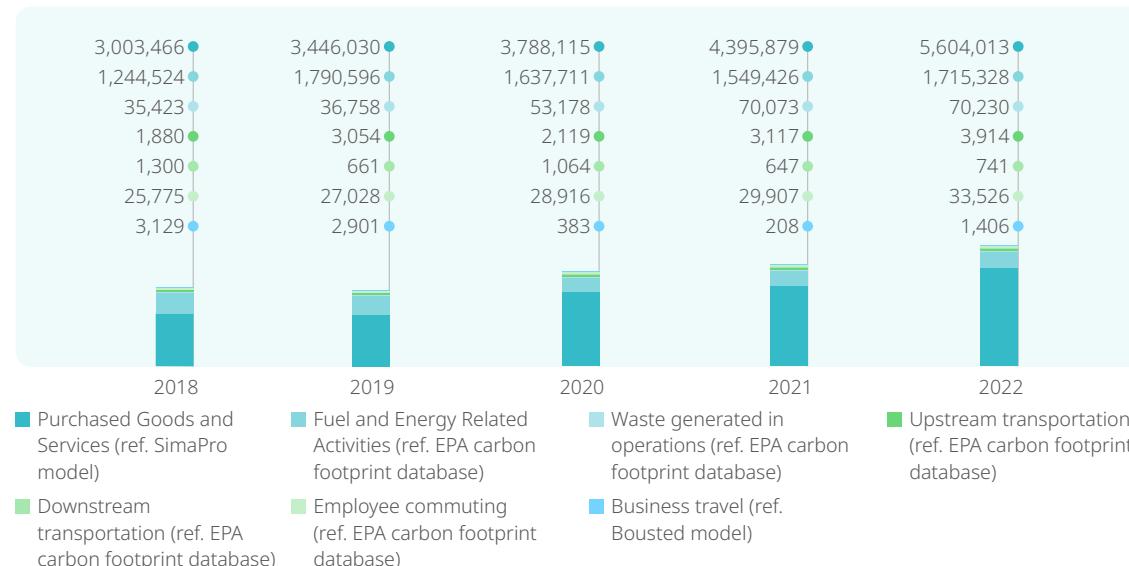
## Scope 1 GHG Emissions



## Scope 2 GHG Emissions



## Scope 3 GHG Emissions



Note 1: GHG emissions data for Scope 1 and Scope 2 include TSMC fabs in Taiwan, TSMC (China), TSMC (Nanjing), WaferTech, and VisEra

Note 2: In order to maintain the data consistency of the 2020 follow-up greenhouse gas inventory and reduction targets, the Scope 1 inventory data has been changed to 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gases Inventories since 2020

Note 3: Scope 3 GHG emissions only includes TSMC fabs in Taiwan

Note 4: Emission factor based on data released in 2022 by the Bureau of Energy stating that 0.509 kg of CO<sub>2</sub>e/ kWh, where 1 kg of CO<sub>2</sub>e equals 6,805 kJ.

## Product Carbon Footprint

TSMC is committed to reducing carbon footprints in raw material manufacturing and transportation to product manufacturing, testing, and assembling phases. In 2022, the Company obtained ISO 14067 third party certification, and conduct [Product Carbon Footprint Assessment](#) every three years. Other than actively [reducing greenhouse gas emissions](#) in manufacturing processes and [improving resource efficiency](#), the Company also [offers guidance for suppliers to join](#) its consistent endeavors in realizing environmental sustainability. In addition, although

the life cycle of TSMC's product carbon footprint covers from raw material excavation to shipment, through providing [highly energy-efficient process technology](#), TSMC supported clients in increasing the life span and function innovation of terminal smart devices applied in various fields, including developing smart home, smart city, smart health care, smart industry. This further helps save energy for the world, as [every kWh of power used in production can help save four kWh of power for other industries worldwide and households](#).



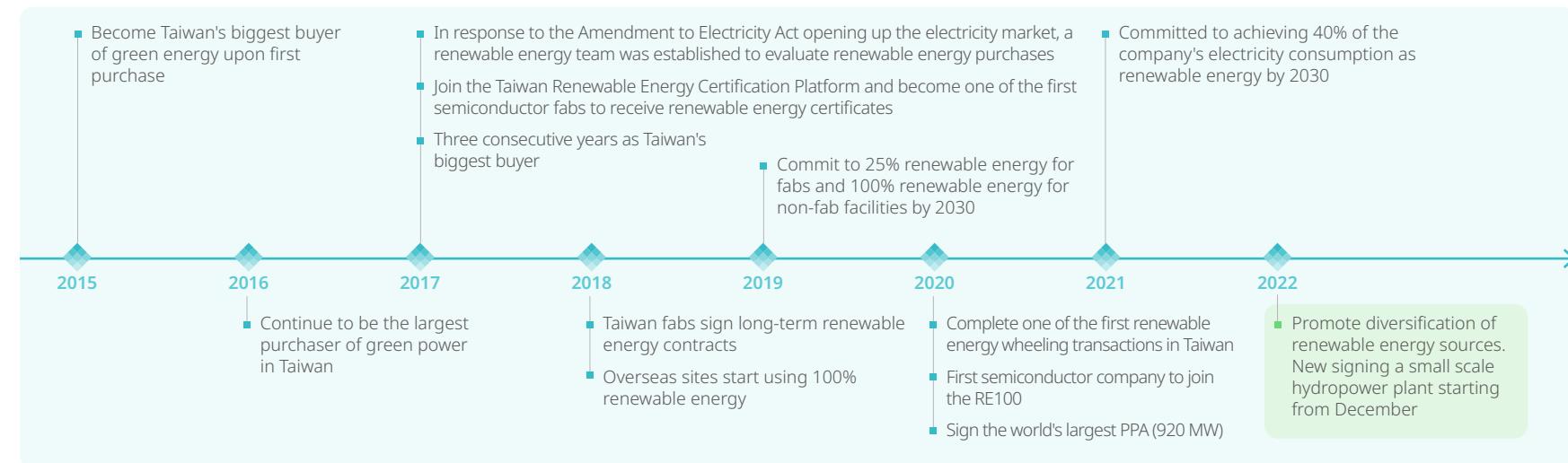
TSMC is committed to optimizing the efficiency of energy and reducing greenhouse gas emissions

## Use Renewable Energy

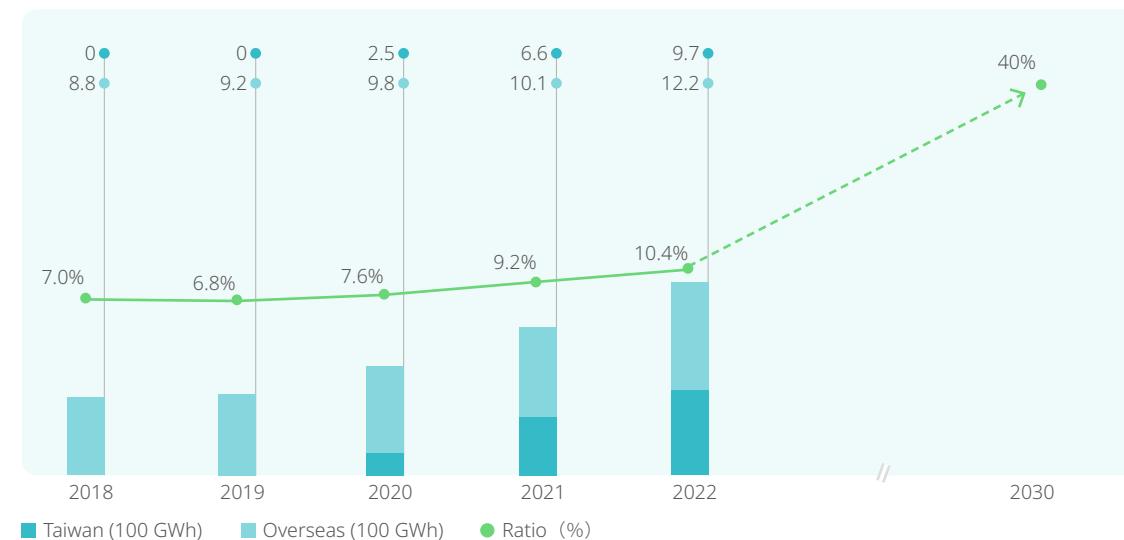
Increasing the use of renewable energy is critical to achieving the Company's goal of Net Zero Emissions by 2050. In 2022, with support from the board and management team, TSMC introduced renewable energy from small hydroelectric stations, continued to increase power supply from onshore wind farms, increased renewable energy usage by 47% to 970 GWh, and maintained 100% use of renewable energy in global offices. TSMC also signed a power purchase agreement (PPA) for 1.3 GW of renewable energy with the option to increase around 3,900 GWh of green energy each year. By the end of 2022, the Company has signed on 2.9 GW of renewable energy through PPAs, which can reduce around 4.6 million metric tons of carbon emissions each year.

In addition, TSMC has been purchasing renewable energy, Renewable Energy Certificates (RECs), and carbon credits in countries with comprehensive regulations and ample supply to offset 100% of carbon emissions from power used in overseas locations, including the United States, Canada, Europe, China, Japan, and Korea. 2022 marks the fifth consecutive year that TSMC has achieved zero carbon emissions from power consumption in overseas subsidiaries.

## TSMC Renewable Energy Development Timeline



## Renewable Energy Consumption and Ratio



40%

Renewable energy used by all TSMC operation sites by 2030

5 Consecutive Years

Zero carbon emissions from power consumption in overseas subsidiaries

100%

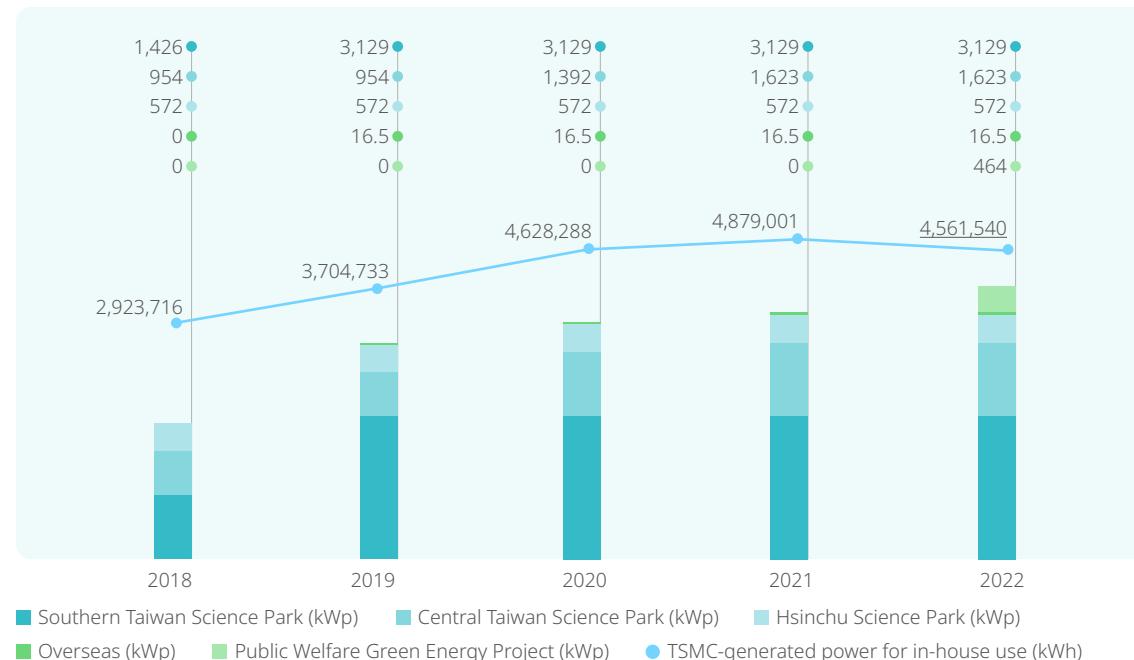
Renewable energy used in global offices

## Renewable Energy Systems

In addition to purchasing renewable energy, TSMC has also installed solar panels in TSMC facilities to produce carbon-free renewable energy for its own fabs. In 2022, TSMC had an installed capacity of 5,340 kWp in solar panels, which provided 4.56 GWh in electricity and reduced carbon emissions by 2,322 metric tons. In 2023, an additional 900 kW of solar panel capacity will be installed, which can generate up to 4.6 GWh of electricity. While strengthening its own climate resilience, the Company is also

expanding the scope of efforts toward sustainability and common good through TSMC Charity Foundation's [Public Welfare Green Energy Project](#) to install photovoltaic (PV) systems and give back all earnings from power rebates to organizations serving disadvantaged communities. As of 2022, the Company has provided an installed capacity of 464 kWp across [seven locations](#) and generated 574,000 kWh in electricity. In 2022, it also gave back NT\$2.75 million from rebates generated by the project.

### TSMC Renewable Energy Installed Capacity and Power Generation for In-house Use



TSMC introduces power supply from Tainan Xikou Hydroelectric Power Plant to diversify renewable energy

## Increase Energy Efficiency

Semiconductor technologies are evolving rapidly and increasing energy consumption. In 2022, TSMC consumed a total of 22,400 GWh in energy; with purchased electricity accounting for around 94%, natural gases for 5.8%, and diesel for 0.2%. TSMC is dedicated to optimizing energy use efficiency. The Energy Saving and Carbon Reduction Committee has defined five major energy conservation teams for different process technologies to explore opportunities to save energy and maximize energy conservation in tools. In addition to the full roll-out of various energy conservation measures

for manufacturing tools and facility equipment, TSMC also encourages employees to actively dedicate themselves to green innovation, awarding Energy Conservation Model Awards and Energy Conservation Innovation Awards to incentivize employees to come up with and realize outstanding ideas. In 2022, TSMC was able to conserve 700 GWh in electricity and successfully increase process energy efficiency for 5nm volume production to 60% in the third year, exceeding the annual target.

## Total Energy Consumption



■ Non-renewable Energy  
■ Renewable Energy  
■ Natural Gases  
■ Diesel Oil

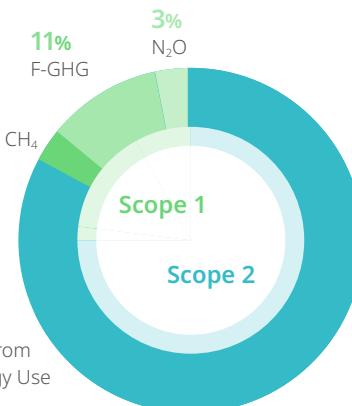
Note 1: 1 cubic meter of natural gas=10.5 kWh of electricity; 1 liter Diesel Fuel = 8,400(kcal) = 35.16(MJ); 1 kWh= 3,600 kilojoules

Note 2: Figures from TSMC fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra

Note 3: GHG emissions from fabrication processes include only direct emissions (Scope 1) and indirect emissions from using electricity (Scope 2)

Note 4: The total amount of renewable energy include solar energy, wind energy, thermal energy, and hydroelectric energy

## GHG Emissions from Manufacturing Processes



## Energy Efficiency of Process Technologies



Note 1: Standardized baseline for energy efficiency is the values taken from the first year of volume production

Note 2: Figures from TSMC fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing) and VisEra

## Unit Product Energy Consumption



● Unit Product Energy Consumption

Note1: Figures from TSMC fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing) and VisEra

Note2: Diesel and natural gas aren't used for production and excluded from calculations here



TSMC retrofits the hot DI water circulation system of wafer cleaning tools to expand energy saving benefits

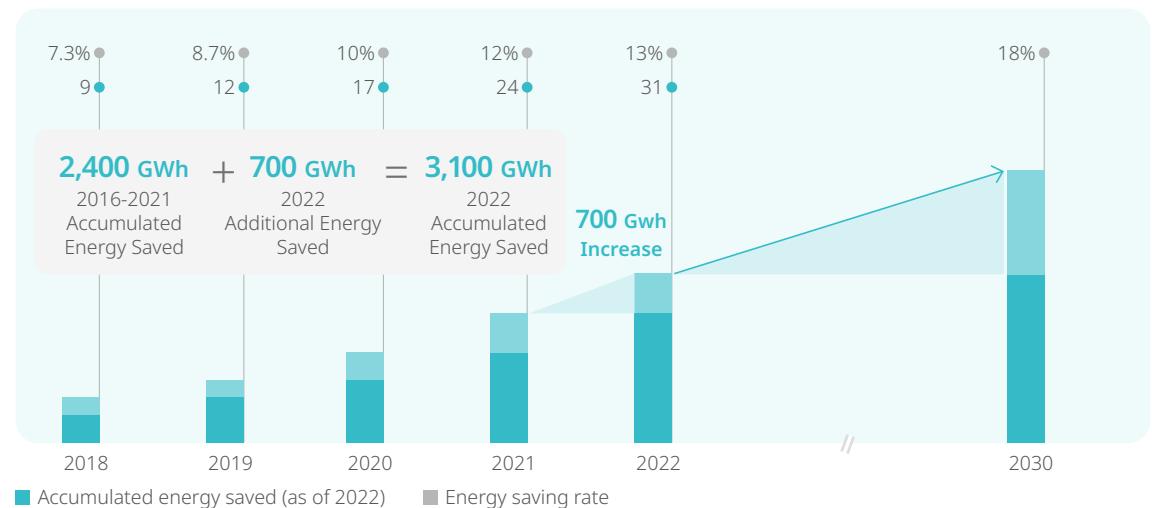
## Expand Energy-saving Measures

In 2022, the five major energy conservation teams continued to innovate various energy conservation programs, including the Hot Water Recycling System, Intelligent Compressed Dry Air (CDA) Flow Control System, and Optimized AI-powered Water Chiller System. In addition, TSMC is deploying a variety of green action plans to improve energy and resource efficiency. To strengthen energy conservation and carbon emissions, TSMC founded the Engineering Center for Green Manufacturing in 2022 to comprehensively assess, plan, and manage net zero emission strategies, energy conservation in modules and tools, energy conservation in facility equipment, and low-carbon technology R&D. Additionally, TSMC integrated energy-saving measures across facilities for horizontal roll out, which will become standard designs for new facilities. In 2022, overseas facilities - TSMC (China) and TSMC (Nanjing) - also joined

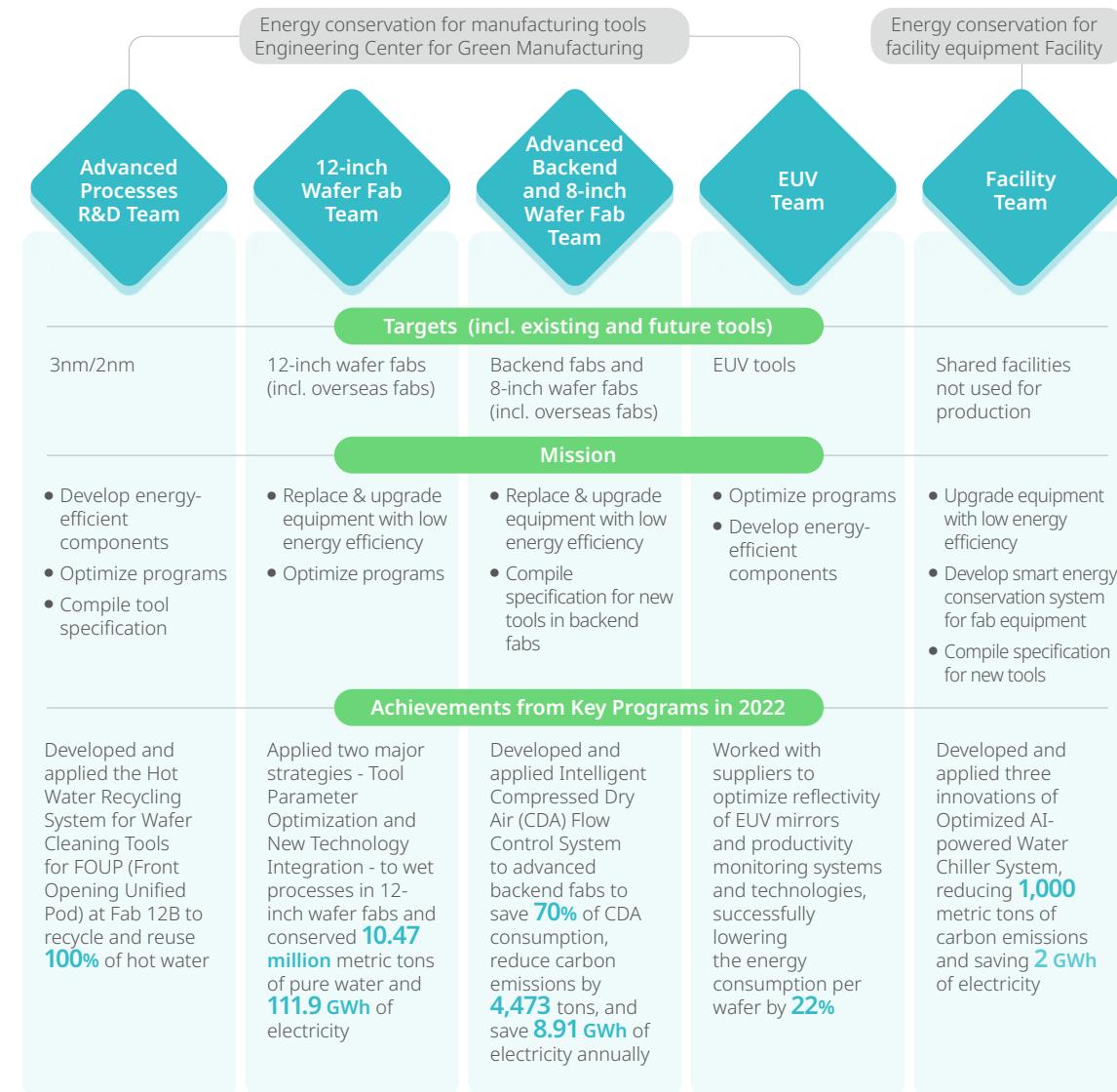
Taiwan facilities in energy conservation to generate more green benefits.

In 2022, TSMC implemented 684 energy conservation measures across eight categories, achieving a 13% energy saving rate and conserving 700 GWh in electricity. Energy conserved in 2022 is the equivalent of reducing 360,000 metric tons in carbon emissions and saving NT\$1.75 billion in energy costs. The reduced carbon emissions also decreased the potential social cost of carbon by NT\$530 million. As of 2022, the Energy Conservation Action Project for Next-generation Fab Tools launched in 2018 has validated and applied 195 energy-conservation programs to hundreds types of advanced process tools and conserved 500 GWh in energy through cross-fab roll out of energy conservation measures.

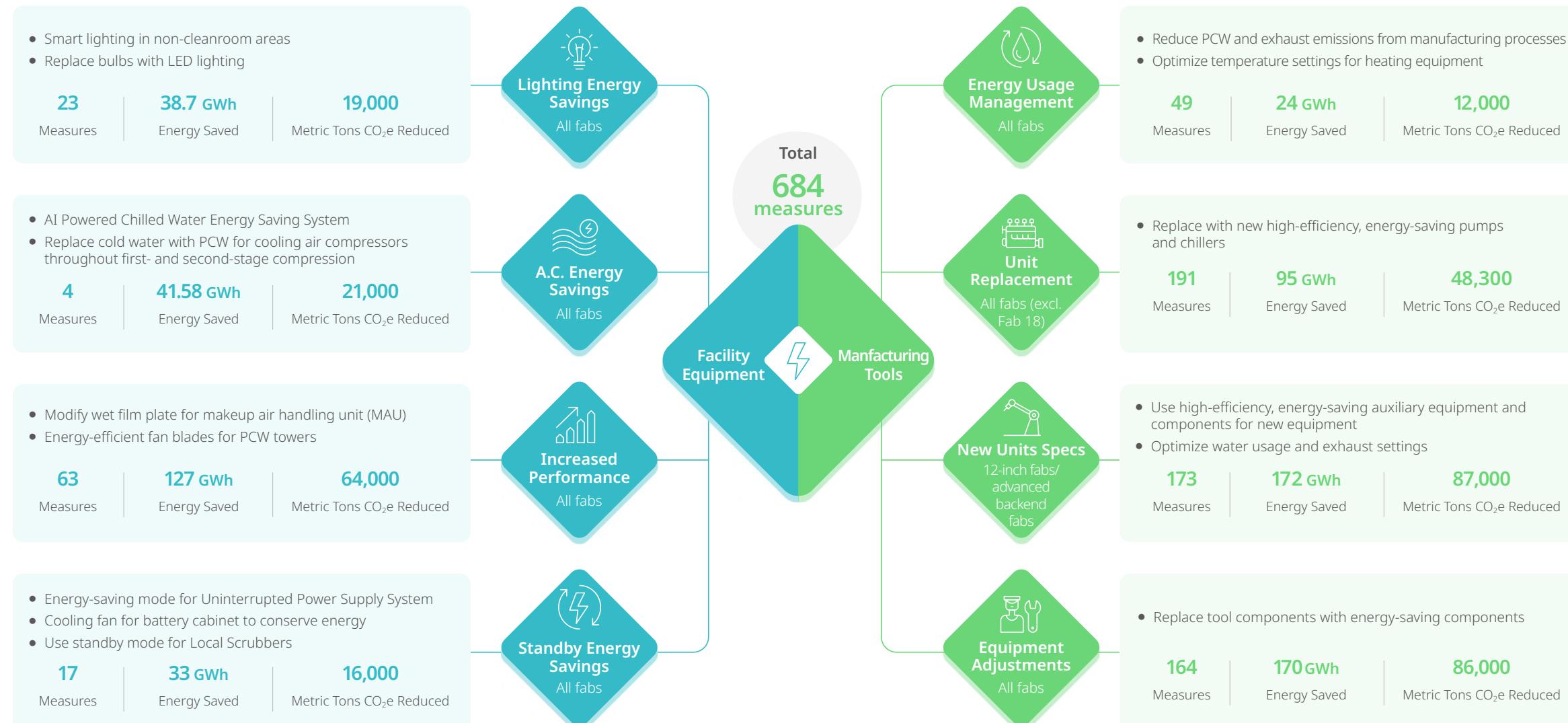
## TSMC Cumulative Energy-saving Targets



## Five Major Energy Conservation Teams Continue to Innovate



## Energy Conservation Measures



Note: CO<sub>2</sub>e factor is 0.509 kg/kWh; 1kWh= 3,600 kilojoules



## Strengthen Biodiversity Protection

TSMC cares about environmental sustainability and actively works to strike a balance between technology and ecology. To ensure sustainable ecosystems and maintain biodiversity, TSMC regularly assesses changes in ecosystems surrounding TSMC fabs, cultivates indigenous species, created firefly habitats within TSMC locations, and launched the TSMC Plant a Tree Program to facilitate stable population growth and reproduction for species. In addition to implementing eco-friendly practices, TSMC is also an avid supporter of the UN Convention on Biological Diversity and SDGs. The Company formulated its own

Biodiversity Statement in 2022, which will be formally declared in 2023. TSMC's Biodiversity Statement will commit to working with stakeholders to protect and deepen the integrity of biodiversity and working with supply chain partners to raise awareness and comply with related regulations within business locations, fulfilling its mission of strengthening environmental protection.

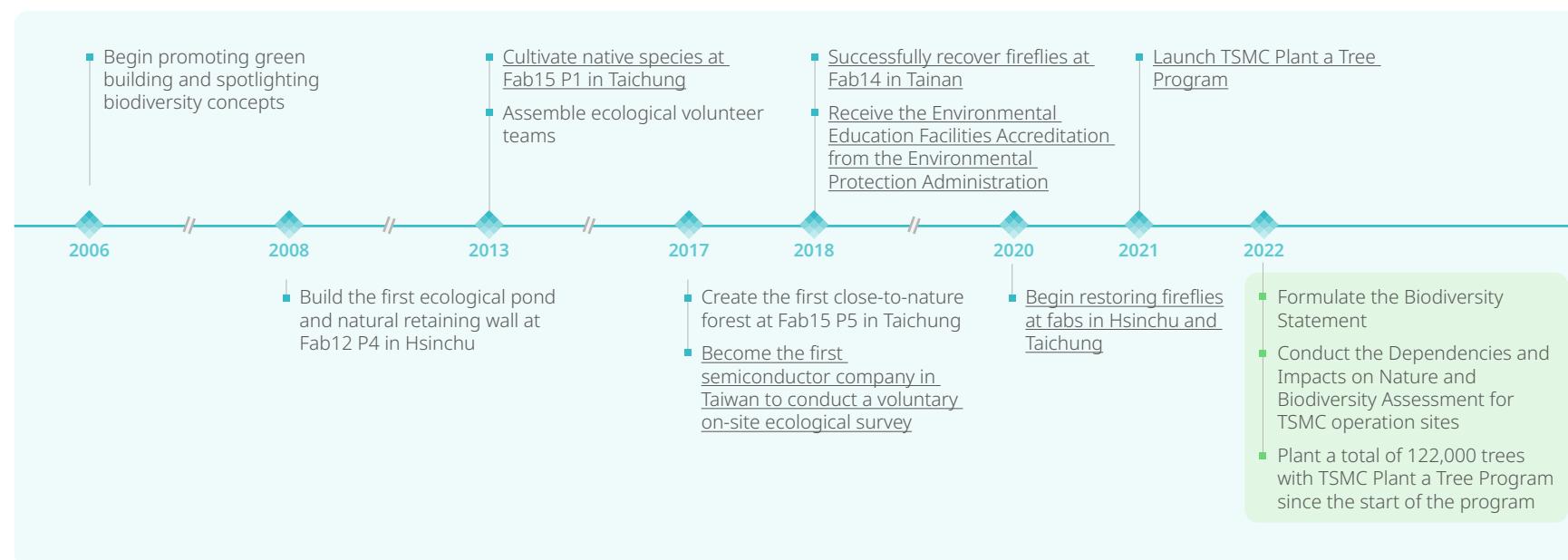
In 2022 Q4, TSMC conducted a Dependencies & Impacts on Nature and Biodiversity Assessment for deeper insights into interactions between operations

and local environments, analyzing three areas - location of facilities, emission of pollutants, and dependency on ecosystem services. For location of facilities, TSMC overlapped the Company's locations in Taiwan with the Forestry Bureau National Ecological Network GIS database and included resources consumed and emissions discharged throughout operations as assessment factors to identify mitigation and restoration. Results showed that there are no wildlife refuges or nature reserves within two kilometers of TSMC locations in Taiwan, TSMC continues to maintain green ecosystems.

around fabs and enforce environmental education. In addition, TSMC is working with stakeholders such as the Forestry Bureau, county and city governments, research and education institutes, and conservation groups to promote conservation programs based on conservation corridor assessment results and deepen the diverse values of biodiversity.

For pollutant emissions, TSMC used qualitative analysis of Life Cycle Impact and identified GHG emissions as the main cause of impact on biodiversity, followed by water consumption. TSMC is driving low-carbon manufacturing and enforcing GHG reduction standard practices to effectively reduce GHG emissions per unit of production. The Company also complies with AWS Standards to enforce sustainable water management at all TSMC fabs and improves surrounding ecosystems and soil and water conservation to foster biodiversity. For dependency on ecosystem services, which was explored for the first time in 2022, TSMC established a dedicated internal unit and invited outside experts to join in meetings and discussions and also compiled a survey on supplier enforcement. Results showed that TSMC and its supply chain are more dependent on three types of ecosystem services - water provision, climate regulation, and flood prevention. TSMC will continue to strengthen the climate resilience, promote green and low-carbon supply chains, and strengthen management in compliance with the Climate Risk Adaptation Standards to reduce dependency on ecosystem services and mitigate impact on operations from loss of ecosystem services.

## Biodiversity Milestones at TSMC



 Case Study

## Consistent Efforts to Optimize Energy Efficiency in EUV Tools Save 60 GWh Electricity per Year

TSMC has successfully applied EUV technologies for 3nm volume production, but energy consumption rises with the growing number of EUV tools. To ensure developments in process technologies do not compromise environmental sustainability, the Company continues to optimize EUV tool parameters and reduce energy consumption per unit of wafer production through big data analysis. Additionally, TSMC engages suppliers for research to dive deep and uncover opportunities to conserve more energy.

Research has shown that EUV light is transmitted with the help of unique reflective mirrors, which, after bouncing off several mirrors, result in severe energy attenuation. The multilayer mirror's flatness and smoothness determines EUV light reflectivity, so, to increase energy efficiency, TSMC has engaged suppliers to finetune mirror fabrication processes and optical structures to optimize flatness and smoothness and effectively improve reflectivity. EUV light is produced from laser pulses firing 50,000 times per second at a drop of tin. Vaporized tin often deposits on mirrors to cause fog, which impacts productivity. The Company then needs to inject hydrogen and tin to produce tin hydride before pulling the multilayer mirror out of the chamber. After repeated testing with suppliers, TSMC was able to pinpoint the optimal parameters for the number of pumps required for tin vapor removal, effectively reducing energy consumed by tin vapor pumps. In 2022, TSMC was able to successfully reduce energy consumption per wafer from EUV tools by 22%, the equivalent of 60 GWh.



TSMC works with suppliers to optimize energy efficiency in EUV tools

## Three Innovations of AI-powered Water Chiller System Improve Energy-efficiency

TSMC is committed to driving green manufacturing and actively implements energy-efficiency innovations. The Company continues to optimize the energy-saving model of water chiller systems through machine learning methods and successfully develops three functions including Single Chiller Compressor Abnormal Energy Consumption Detection, Multi-chiller Compressor Operating Load Precision Forecast, and Water Chiller System Pressure Control Optimization to strengthen operational reliability. TSMC introduced the three functions to Fab 15A in 2022, saving 2 GWh of electricity and reducing 1,000 metric tons of carbon emissions. In 2023, all TSMC 12-inch wafer fabs in Taiwan will begin to adopt the three functions, which are also listed as standard designs for new plants. Those initiatives are expected to save 100 GWh of electricity per year and reduce carbon emissions by 50,000 metric tons, bringing TSMC closer to its 2050 sustainability goal of Net Zero Emissions.



TSMC optimizes energy efficiency of water chiller systems through machine learning methods



## Case Study

## Establish Carbon Credits Quality Procurement Standards to Achieve Carbon Reduction and Sustainable Development

TSMC is committed to creating an environmentally and socially responsible business model. To fulfill the Company's commitment of Net Zero Emissions by 2050, the Corporate Environment Safety Health Division, Finance, Accounting, Legal, Information Technology and Materials Management, and Supply Chain Management Units formed the Carbon Credit Task Force and formulated the Carbon Credits Quality Standards for Voluntary Emissions Reductions in compliance with international guidelines and industry practices to serve as purchasing guidelines. TSMC assessed carbon credit verification standards, year issued, additionality, permanence, and risk management. Additionally, the Company prioritizes programs that comply with UN SDGs such as Climate, Community & Biodiversity (CCB) and the criteria that the source of carbon credits should align with emissions for rigorous quality assurance to extend the scope of TSMC's sustainability impact.

TSMC's overseas locations currently use 100% renewable

energy and exhaust gas reduction facilities to maximize emissions reduction. The remaining carbon emissions are offset, in principle, with carbon credits. In 2022, TSMC selected four carbon credit programs located in the U.S. and China that comply with the Company's Carbon Credits Quality Standards for Voluntary Emissions Reductions. The programs are mainly nature-based carbon credits from projects that establish natural forests and improve forest management. Two of the natural forest establishment programs create jobs for local residents and foster skillsets in maintaining the forest; 50% of the jobs created are offered to women to facilitate gender equality. The remaining two programs improve forest management to uphold local biodiversity and help local conservation groups and indigenous communities preserve traditional cultures and outdoor education through earnings from carbon credits. Through carbon credit trading, TSMC has been able to not only offset carbon emissions but also fulfill several SDGs to create diverse sustainability benefits.

### Four Nature-based Carbon Credit Programs

Accreditation	Project Location	Year	Sustainability Co-benefits
• VCS 2405(CCB)	Afforestation 	China	2018-2020
• VCS 1855(CCB)			<ul style="list-style-type: none"> <li>Conserve biodiversity locally (SDG 15)</li> <li>Create jobs locally (SDG 1)</li> <li>Offer &gt;50% of created jobs to women (SDG 5)</li> </ul>
• ACR 592	Improved Forest Management 	U.S.	2019-2021
• ACR 398			<ul style="list-style-type: none"> <li>Conserve biodiversity locally (SDG 15)</li> <li>Preserve traditional cultures and outdoor education (SDG 4 &amp; SDG 11)</li> </ul>

### TSMC Carbon Credits Quality Standards for Voluntary Emissions Reductions

Item	Details	Note
Verification Standards	<p>International</p> <ul style="list-style-type: none"> <li>The Verified Carbon Standard, VCS</li> <li>The Gold Standard, GS</li> <li>American Carbon Registry, ACR</li> <li>Climate Action Reserve, CAR</li> </ul> <p>Issued by any of the right-side of organizations or standards</p> <p>Regional</p> <ul style="list-style-type: none"> <li>Taiwan Offset Project, TOP</li> <li>China Certificate Emission Reduction, CCER</li> <li>J-Credits</li> </ul>	Mandatory
Year Issued	Past five years ( $\leq$ 3 years preferred), starting from date the carbon credit is issued	Mandatory
Additionality	<ul style="list-style-type: none"> <li>Program is not required by regulation</li> <li>Financial benefits are not innate, but created from carbon credit earnings</li> <li>Technological programs unrelated to common technologies or related to technologies with barriers in local areas</li> </ul>	Mandatory
Permanence	Measurable project durability	Mandatory
Risk Management	<ul style="list-style-type: none"> <li>No double issuance of credits</li> <li>Carbon leakage prevention</li> <li>Sound project management</li> <li>No negative media coverage</li> <li>Political stability of project location</li> <li>Transparent reporting of project details</li> </ul>	Mandatory
Biodiversity & Community Impact	Protect/Improve ecosystem, increase biodiversity, respect rights of locals/indigenous peoples, and create social value (e.g., increase employment & local health)	Priority
Project Location	Credits are generated from the same region where emission occurs	Priority



# Water Stewardship

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Manage Water Resource Risks</b> Enforce climate change mitigation policies; implement water conservation and water shortage adaptation measures	Reduce unit water consumption by 30% (L/12-inch equivalent wafer mask layer) (Base year: 2010)	Reduce unit water consumption by 2.7% (L/12-inch equivalent wafer mask layer) (Base year: 2010)	Reduced unit water consumption by 2.6% (Base year: 2010) Target: 16%  <small>Note 1</small>
<b>Develop Diverse Water Sources</b> Develop water reclamation technologies; continue to practice water conservation and use reclaimed water during manufacturing	>60% replacement of water resources with reclaimed water <small>Note 2</small>	5% replacement of water resources with reclaimed water  Continue to collaborate with the government to complete the second water reclamation plant located in Anping, Tainan	TSMC Tainan Science Park Reclaimed Water Plant started supplying water on September 19, 2022 Target: TSMC Tainan Science Park Reclaimed Water Plant start of operations  <small>✓</small>
<b>Develop Preventive Measures</b> Improve the efficiency of water pollution control and removal of water pollutants	Water pollution composite indicator reduction rate of >60% <small>Note 3</small>	Water pollution composite indicator reduction rate of 56%	Water pollution composite indicator reduction rate of 54.3% Target: 45%  <small>↑ Exceeded</small>

Note 1: In 2022, TSMC newly built Fab 18 Phases 6, 7 & 8. While not yet in operation (volume production level), the new facilities still consume water at a fixed rate, as such the Company failed to reach the 2022 target for unit water consumption. Excluding the new facilities, the unit water consumption was 15.6% in 2022. In the future, facilities below a certain economic scale will be excluded from the calculation of unit water consumption

Note 2: (1) The source of reclaimed water include municipal drainage and industrial discharge (2) Replacement rate of reclaimed water = consumption volume of reclaimed water/consumption volume of reclaimed water + tap water). Figures from TSMC fabs in Taiwan

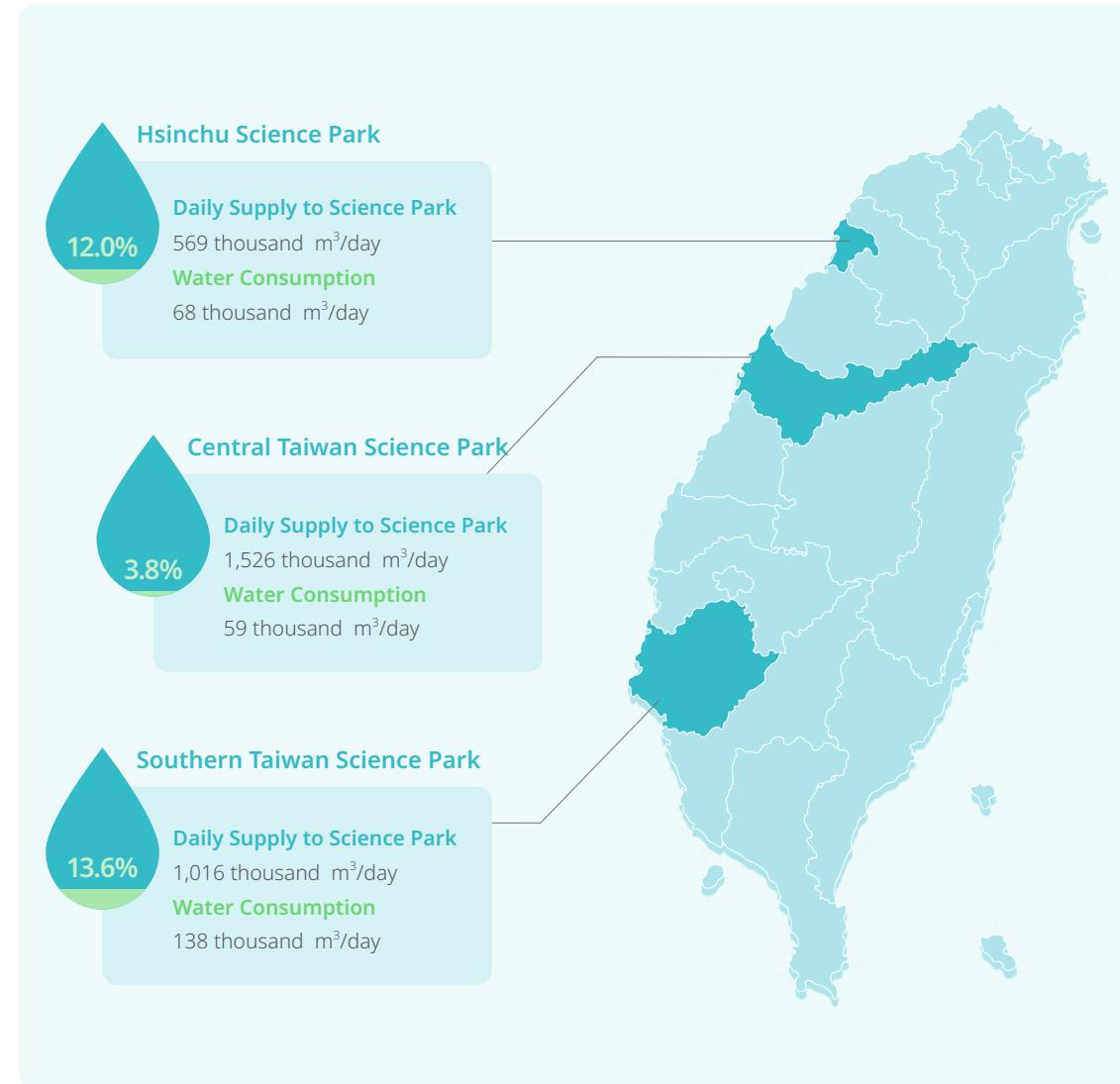
Note 3: In 2022, TSMC was able to reduce the water pollution composite indicator by 54.3%, exceeding the 2022 target of 45% and long-term 2030 goal of 50%. As such, the 2030 goal was changed from 50% to over 60%. Figures from TSMC fabs in Taiwan

↑ Exceeded    ✓ Achieved    — Missed Target

In 2022, Taiwan experienced zero typhoons while weather fronts carrying moisture failed to cover reservoirs in Taiwan, resulting in little rainfall in Southern Taiwan. Based on the drought monitoring signals issued by the Water Resources Agency, TSMC adopted response measures in compliance with the TSMC Internal Control Procedures for Low Water Supply Crisis Management to take stock of areas where more water could be conserved and to strengthen the water use efficiency of recycling systems. In 2022, the Company conserved 3.35 million m<sup>3</sup> of water and recycled a cumulative total of 215 million m<sup>3</sup> of water throughout the year.

While working to increase water reclamation efficiency, TSMC also cares about getting the most use out of every drop of water. As such, TSMC is actively developing water reclamation technologies. On September 19, 2022, the TSMC Tainan Science Park Reclaimed Water Plant—Taiwan's first privately-operated water reclamation plant—became operational and started recycling industrial wastewater produced in the Southern Taiwan Science Park into reclaimed water for advanced semiconductor processes, a first for the global semiconductor industry. TSMC also continues to work with the government and is planning to complete the Tainan Anping Reclaimed Water Plant in 2023, which is estimated to reclaim 35,000 m<sup>3</sup> of water per day for TSMC facilities in the Southern Taiwan Science Park (STSP). TSMC's goal is to increase the supply of reclaimed water to gradually reduce city water consumption each year. The Company is also exploring the concept of being water positive in the hope of restoring water resources in the future and upholding sustainable water practices.

## TSMC Water Consumption in Three Science Parks



## Drought Contingency Measures

Water Signal from the Water Resource Agency (WRA)	Government Response Measures	TSMC Response Measures
Normal water levels	Stable supply and demand	<ul style="list-style-type: none"><li>Monitor WRA reservoirs supply for TSMC fabs</li><li>Host drills regularly</li></ul>
Fairly severe	Farmers encouraged to suspend farming	<ul style="list-style-type: none"><li>Drought Emergency Response Team in operation</li><li>Check water resources and water truck capacity</li><li>Spontaneously save water by 5%</li></ul>
First stage	<ul style="list-style-type: none"><li>Reduce water pressure at specific times</li><li>Suspended irrigation water in certain areas</li></ul>	<ul style="list-style-type: none"><li>Reduce water consumption by 7%</li><li>Water truck drills</li></ul>
Second stage	<ul style="list-style-type: none"><li>Reduce water supply to industrial users by 5-20%</li></ul>	<ul style="list-style-type: none"><li>Activate water trucks</li><li>Reduce water consumption by 7-20%</li></ul>
Third stage	Water rationing by district	<ul style="list-style-type: none"><li>Activate water trucks</li><li>Reduce water consumption by 7-20%</li></ul>



## Manage Water Resource Risks

Every year, TSMC evaluates the water risk levels of all TSMC facilities using the Water Risk Atlas from the World Resources Institute (WRI). Results from 2022 were identical to those of 2021: WaferTech was rated as low risk; [TSMC facilities in Taiwan](#) and VisEra were rated as medium-to-low risk; and TSMC (China) and TSMC (Nanjing) were rated as high and medium-to-high risk, respectively, due to regional water quality differences. In 2022, TSMC added Fab 18B into the water risk evaluation.

While building Fab 18B, TSMC preemptively elevated foundations, installed floodgates, and applied existing recycling systems and wastewater treatment measures to the facility. By the time Fab 18B became operational, it already possessed outstanding flood protection and process water recycling rate, which enabled it to maximize water resources and mitigate environmental impact.

## Effective Water Management with AWS

In 2022, Fab 12A, Fab 12B, and Fab 5 at Hsinchu Science Park and Advanced Backend Fab 3 at Lungtan Science Park obtained Alliance for Water Stewardship (AWS) Platinum certification. All advanced TSMC fabs in Taiwan's three science parks have obtained [AWS Platinum certification \(the highest level available\)](#) for three consecutive years, a first for the global semiconductor industry.

Sustainable water stewardship at TSMC complies with [AWS standards](#). In 2022, the Company introduced water reclaimed from industrial wastewater to facilities at the STSP for the first

time. The reclaimed water was gradually supplied to Fab 6, Fab 14, and Fab 18 to reduce city water consumption and achieve the preliminary target toward sustainable water balance. TSMC's efforts toward good water quality include a new tetramethylammonium hydroxide (TMAH) treatment system in Fab 3 to effectively reduce effluent concentration by 90%; 70% copper concentration reduction from effluents discharged by Advanced Backend Fab 3 to improve local

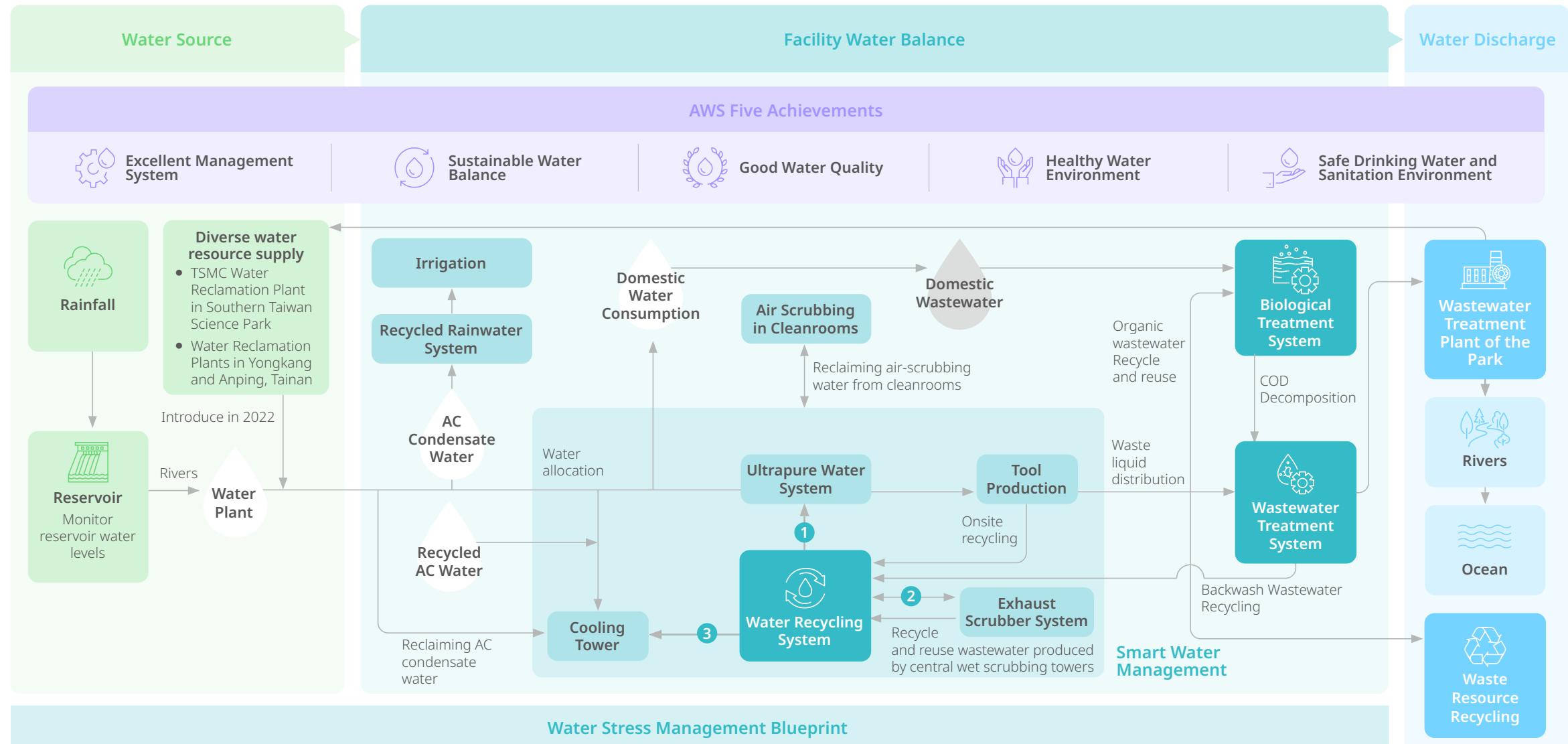
creek water quality. After improving the cooling equipment of the reaction tank and reducing the batch reaction time, in June 2022, the [hydrofluoric \(HF\) acid waste regeneration system](#) in Fab 15B achieved [zero treatment outsourcing of the HF acid waste liquid](#). The hydrofluoric acid waste regeneration system processed a cumulative total of 4,193 metric tons of HF acid waste and produced 1,025 metric tons of cryolite in 2022. In addition, ecological restoration and soil and water

conservation in areas surrounding TSMC facilities are AWS implementation priorities. TSMC compiled the [TSMC Firefly Habitat Management Process](#) to bring back fireflies and launched afforestation initiatives. In 2022, [over 1,900 adult fireflies appeared across TSMC's three major factories](#). The Company also planted 108,000 trees and 320,000 shrubs, expanding afforested areas to 10.1 hectares to create a healthier water environment.

## TSMC WRI Risk Identification



## Water Balance and Supply Chain Environmental Relationship



① Replace city water with refined recycling water

② Reclaiming exhaust scrubbing water

③ Smart water pumping model to regulate peak water consumption

## Strengthen In-house Water Reclamation and Water Use Efficiency

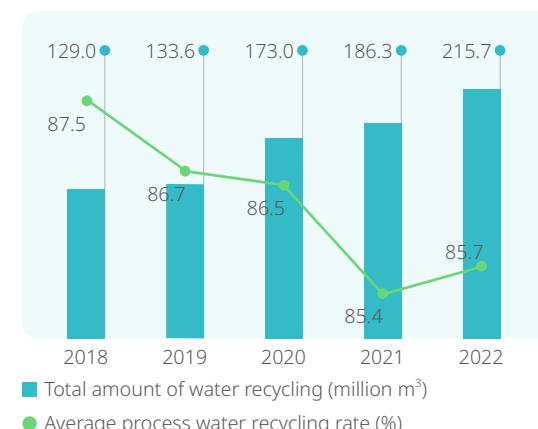
TSMC has created an internal Water Map platform to effectively manage and gain insights into water used in TSMC facilities. The Company also continues to track reservoir water levels and install in-house water quality and water level monitoring points to monitor water usage, recycled water, wastewater, and domestic water consumption in processes according to the water balance chart. This forms the basis for integrating water consumption and recycle and reuse mechanisms to calculate recycling/discharge rates and allocate water to units that use water. In 2022, TSMC continued to implement four major water saving measures: reducing facility system water consumption, increasing the wastewater recycling of facilities, improving the water production rate of the system, and decreasing water discharge loss from the system. The Company conserved 3.35 million m<sup>3</sup> of water and yielded a wafer unit water

consumption of 137.3 liter per 12-inch equivalent wafer mask layer, a 2.6% reduction from the 140.9 liter per 12-inch equivalent wafer mask layer in 2010, the base year. Nevertheless, TSMC failed to reach the 2022 target because new facilities built in 2022 were still in risk production stages. Though the new facilities have not yet reached economic scale, there was still a fixed amount of water consumption, which led to a lower water saving rate. Wastewater discharge was 93.0 liter per 12-inch equivalent wafer mask layer, an 18% increase from last year. The increase was also caused by the water consumption for risk production in new facilities. Before the new facilities reach economic scale in production, TSMC will continue to optimize operating parameters for water recycling systems, increase water use efficiency, and reduce wastewater discharge.

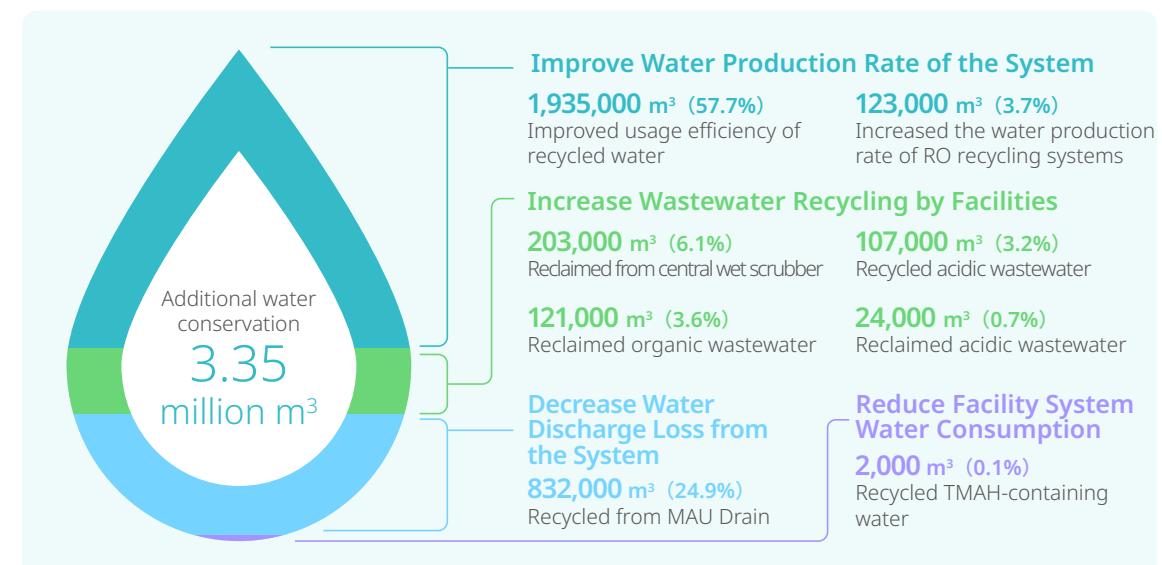
## Annual Water Conservation



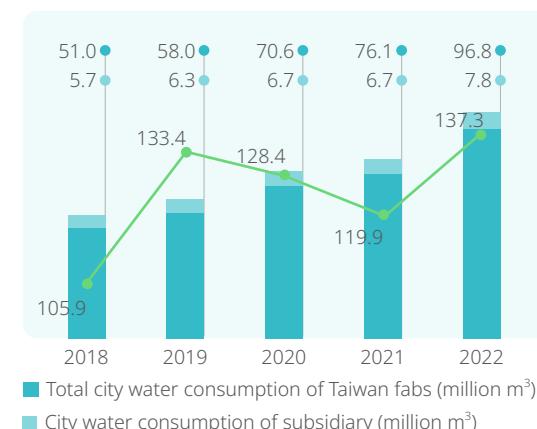
## Water Recycling and Usage Efficiency



## Water Saving Measures and Achievements in 2022

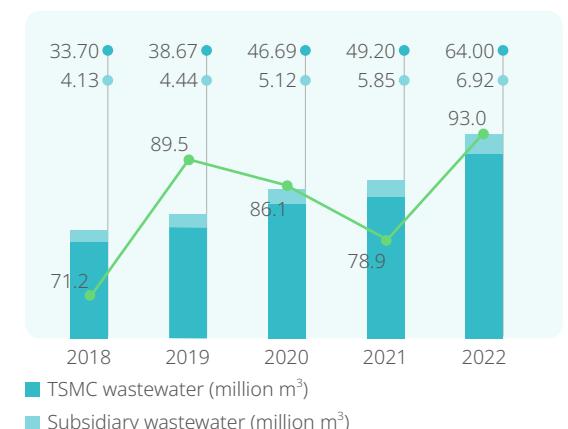


## City Water Consumption and Water Consumption per Wafer-layer



Note: Figures from TSMC fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing) and VisEra

## Wastewater Discharge per Unit

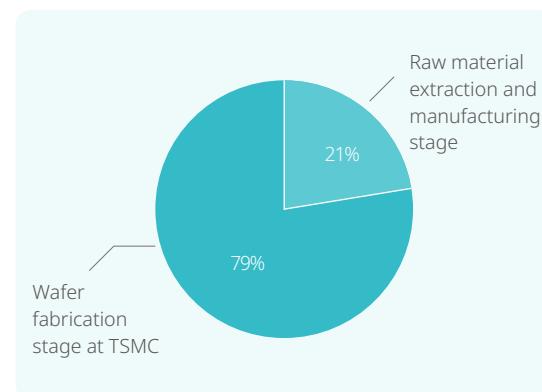


Note: Figures from TSMC facilities in Taiwan, WaferTech, TSMC(China), TSMC(Nanjing) and VisEra

## Product Water Footprint

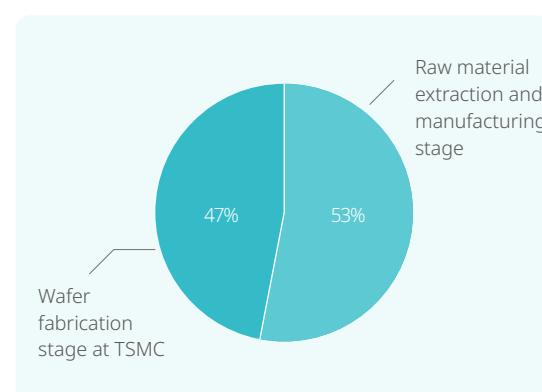
TSMC is committed to reducing product water footprint in various stages, including raw material manufacturing and transportation, product manufacturing, testing, and packaging, etc. The water footprint of products is assessed every three years. In 2022, the Company obtained third-party ISO 14046 certification. According to the Company's

### TSMC Product Water Footprint Distribution – Water Consumption Indicator

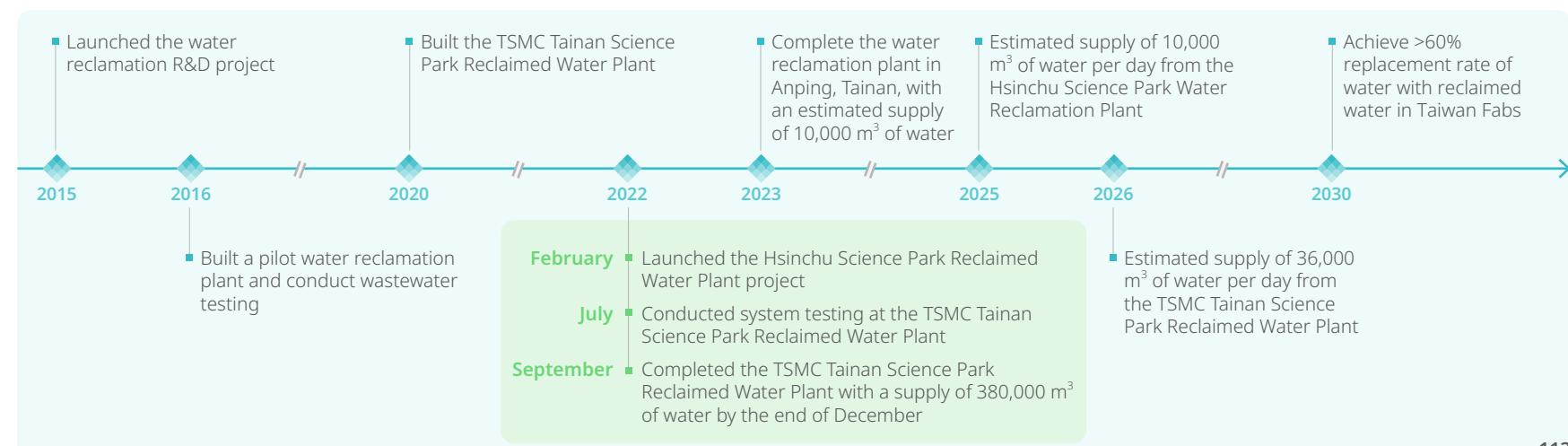


2021 [product water footprint survey](#), TSMC facilities consume 79% of water (mainly from direct water consumption by facilities) and raw material suppliers consume the remaining 21% of water (mainly chemical, silicon wafer, and bulk gas suppliers). In terms of water quality indicators, TSMC and raw material suppliers account for 47% and 53%, respectively. Water pollutants are mainly suspended solids, metals, and chemical oxygen demand (COD). In addition to actively [reducing water consumption](#) from production processes and [discharge of water pollutants](#), TSMC also helps suppliers to set water conservation targets with the Sustainability Management Self-Assessment Questionnaire. All suppliers are required to adhere to the TSMC Supplier Code of Conduct to manage water use and discharge, while identifying opportunities for water saving and implementing measures. For more details, please refer to [Sustainable Supply Chain](#) in this report.

### TSMC Product Water Footprint Distribution – Water Quality Indicator



## Reclaimed Water Supply Schedule



## Develop Diverse Water Sources

The year 2022 marked the start of water reclamation at TSMC. To get the most out of every drop of water, TSMC is actively conserving water from production processes while also developing water reclamation technologies. To ensure water quality complies with advanced process specifications and their demands for cleanliness, TSMC works with the government, industry, and academia to develop low-energy consumption biological treatment, low-energy consumption sludge treatment, high-efficiency urea removal process, and other innovative technologies. The Company also establishes multi-layered, real-time, and automatic monitoring systems to ensure the quality of reclaimed water supplies. In September 2022, the TSMC Tainan Science Park Reclaimed Water Plant entered into operation as a center for processing, monitoring, and supplying TSMC facilities in the STSP. As of December 2022, the Reclaimed Water Plant has supplied [380,000 m³ of water reclaimed from industrial wastewater](#). To develop diverse water resources, the Water Reclamation Plant in Anping, Tainan, will be

completed and enter into operation in 2023. In 2026, the water supply capacity of the Tainan Science Park Reclaimed Water Plant will reach up to 36,000 m³ per day, reducing city water consumption and contributing positively to the surrounding environment. TSMC is also designing innovative systems to reclaim concentrated wastewater and make waste sludge reusable through waste heat, thereby reducing the discharge of high-concentration wastewater.

In 2022, TSMC completed the TSMC Tainan Science Park Reclaimed Water Plant and also launched the Hsinchu Science Park Reclaimed Water Plant project to expand the use of reclaimed water. The Hsinchu Science Park Reclaimed Water Plant is expected to supply 10,000 m³ of water per day in 2025. With the Hsinchu Science Park Reclaimed Water Plant and reclaimed water provided by the city government, new fabs in the Hsinchu Science Park will use 100% reclaimed water, strengthening TSMC's operational resiliency and fulfilling the commitment to achieve sustainable water cycle management.

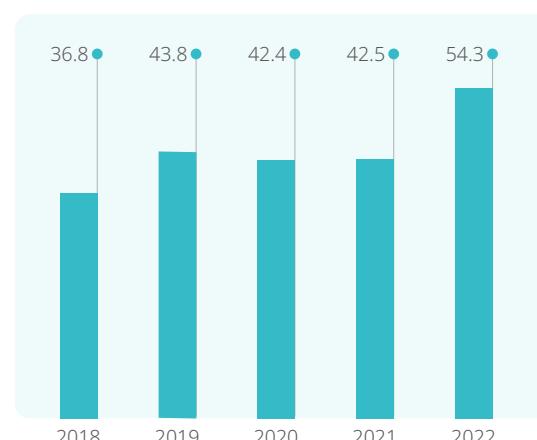
## Develop Preventive Measures

TSMC continues to advance the performance of water pollution control and treatment processes. As advanced processes have evolved and increased the use of organic chemicals, TSMC has introduced a membrane bioreactor system to strengthen water pollutant removal. In 2022, average COD and TMAH concentration levels were reduced to 151.5 ppm and 3.75 ppm, respectively. Fab 15B introduced rotating packed bed technology in 2022 to further reduce COD levels. Lab test results showed that 70% of COD levels in water can be reduced. TSMC plans to officially roll

out this technology in 2023. Due to the increased use of cobalt sulfate, cobalt sulfate treatment systems have also been expanded, which have helped to achieve a 54.3% water pollution composite indicator reduction rate, far exceeding the 2022 target of 45% and 2030 goal of 50%. As such, the reduction rate goal for 2030 has been raised to over 60% to achieve environmental sustainability.

## Water Pollution Composite Indicator Reduction Rates

Unit: %

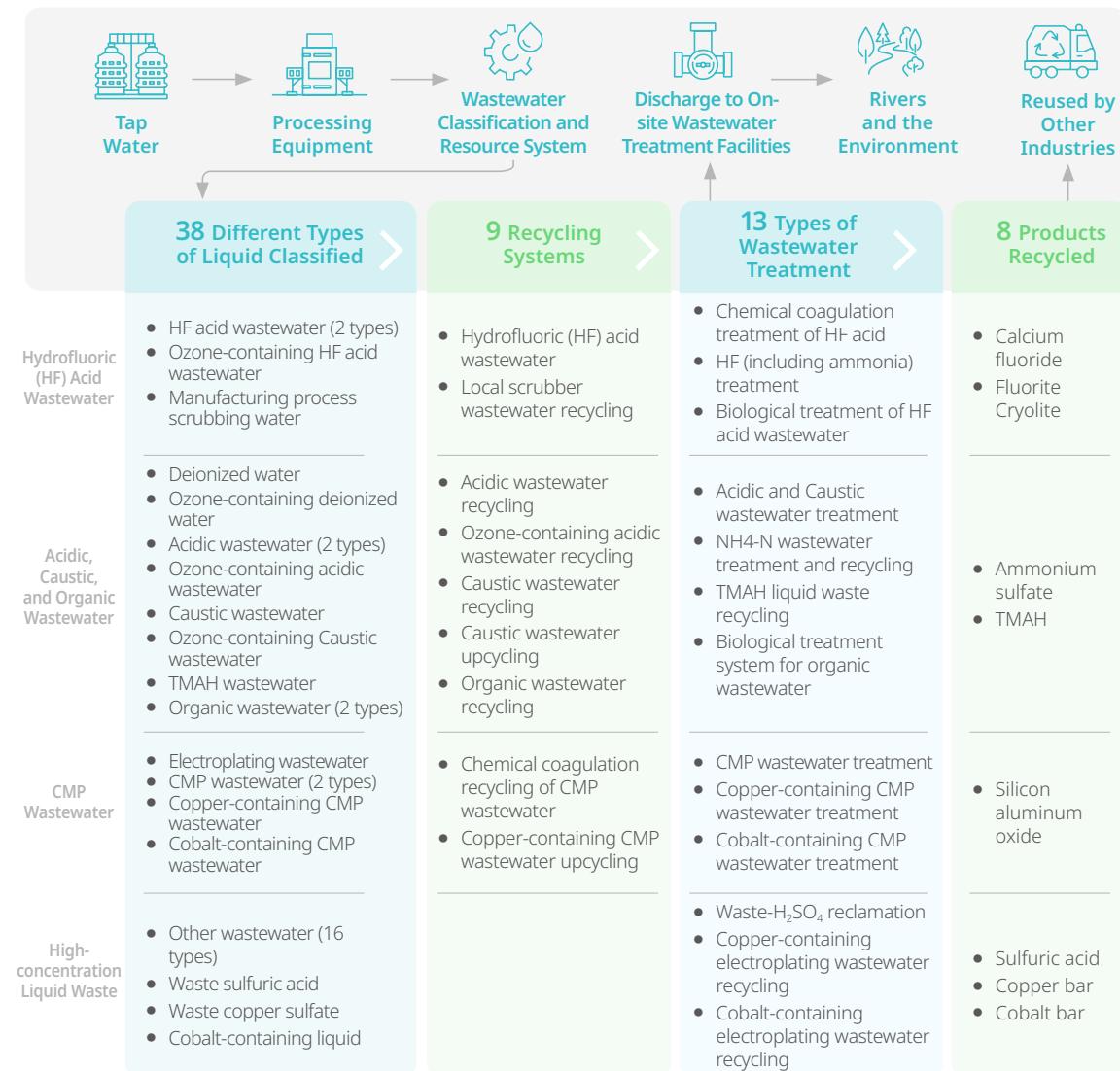


Note: Figures from TSMC fabs in Taiwan

## Wastewater Classification and Resource System

To classify and treat wastewater, TSMC has developed 38 separation systems based on the composition and concentration of wastewater for treatment, recycling, and reuse. In the third quarter of 2022, Fab 15B successfully eliminated HF acid waste outsourcing by optimizing the hydrofluoric acid waste regeneration system, further perfecting the renewable technologies of local circular economy industries. TSMC also performed sludge tests, a byproduct of the chemical mechanical polishing process, at the Zero Waste Manufacturing Center, turning sludge into aluminum silicon oxide through dehydration, grinding, and surface modification. The aluminum silicon oxide can then be used as plastic fillers for factory use.

## Wastewater Classification and Resource System



## Case Study

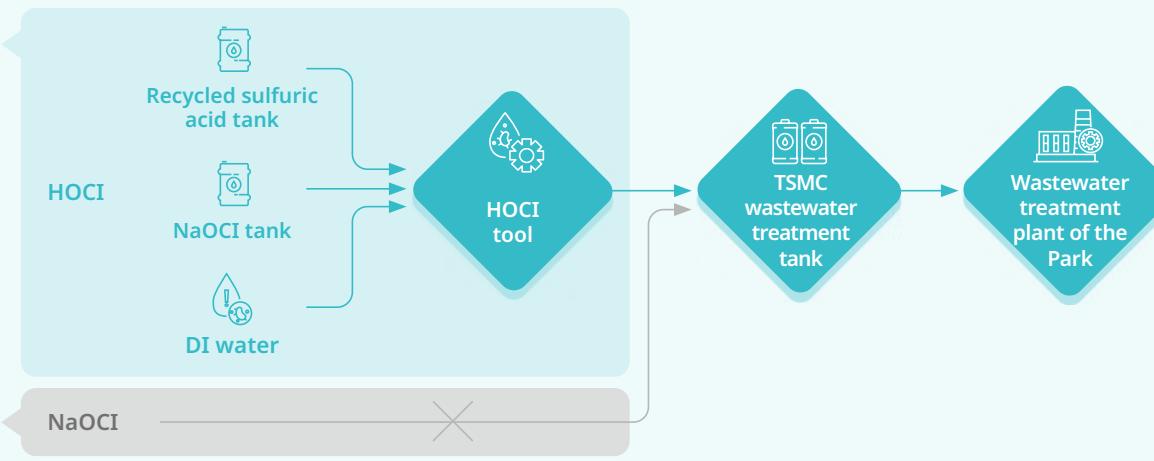
# Innovative HOCl Conversion System Reduces Chemical Consumption and Carbon Emissions

As semiconductor technologies continue to evolve, the consumption of sodium hypochlorite (NaOCl) increases to treat pollutants in wastewater. To practice green manufacturing, reduce environmental impacts, and improve the water quality of effluents, TSMC launched the NaOCl reduction project in 2022. Between pH 5.5 and 6.5, NaOCl turns into hypochlorous acid (HOCl), a strong oxidizing agent approximately 80 times stronger than NaOCl. TSMC capitalized on HOCl's strong oxidizing properties by adding recycled sulfuric acid to NaOCl with deionized water (DI water). After optimizing the mixing

ratio, it became possible to convert NaOCl to HOCl stably, reducing NaOCl consumption without compromising disinfection and ammonia nitrogen removal. In 2022, the HOCl conversion system was introduced to Fab 15B for pilot run. It is estimated that annual NaOCl consumption and carbon emissions can be reduced by 80 metric tons and 10 metric tons, respectively. The Company will continue to roll out the system in other facilities as it is friendlier for the environment and can increase the reuse value of waste liquids, promoting environmental sustainability through green innovation.

## HOCl Conversion System

New approach



TSMC innovates HOCl Conversion System to reduce chemical consumption



# Circular Resources

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Promote Source Reduction</b>  Promote waste reduction by source separation and require vendors to provide low chemical consumption equipment	Outsourced unit waste disposal per wafer $\leq 0.50$ (kg/12-inch equivalent wafer mask layer)	Outsourced unit waste disposal per wafer $\leq 0.98$ (kg/12-inch equivalent wafer mask layer)	Outsourced unit waste disposal per wafer $\leq 0.99$ (kg/12-inch equivalent wafer mask layer) Target: $\leq 0.99$ <span style="color: green;">✓</span>
<b>Enhance Circular Economy</b>  Collaborate with vendors to develop new waste recycling technology to increase the amount of waste recycled and reused	Develop multiple types of electronic-grade chemicals for resource recycling within TSMC  Reduce CO <sub>2</sub> emissions from waste treatment to <u>2020 emission levels</u> <sup>Note1</sup>	In-house resource recycling rate $\geq 28\%$  Promote 3 projects to reuse instead of incinerate	In-house resource recycling rate: 28% Target: $\geq 23\%$ <span style="color: green;">↑</span>  Reused instead of incinerating 125 metric tons of organic sludge and reduced carbon emissions by 92 metric tons <sup>Note2</sup>
<b>Strengthen Audit and Guidance</b>  Enhance vendor capabilities in self-management and implementing resource recycling through audits, guidance, and tracking with applied technologies	All waste treatment vendors shall acquire ISO 14001 or other international EHS Management certification <sup>Note3</sup>  All waste treatment vendors shall finish building the System of Waste Intelligent Fast Track (S.W.I.F.T.) <sup>Note4</sup>  Increase percentage of Excellent & Good waste treatment vendor evaluation results to 90% <span style="color: red;">NEW</span>	86% of waste treatment vendors shall acquire ISO 14001 or other international EHS Management certifications  20% of waste treatment vendors shall finish building the System of Waste Intelligent Fast Track (S.W.I.F.T.)  Increase percentage of Excellent & Good waste treatment vendor evaluation results to 82% <span style="color: red;">NEW</span>	84% of waste treatment vendors have acquired ISO 14001 or other international EHS Management certifications Target: 84% <span style="color: green;">✓</span>  9% of waste treatment vendors have finished building the System of Waste Intelligent Fast Track (S.W.I.F.T.)

Note 1: Carbon emission figures from TSMC fabs in Taiwan

Note 2: Derived from the general waste (incineration) coefficient (0.737 kg of CO<sub>2</sub>e/kg). Source: DATA.GOV.TW (STSP Recycling Center)Note 3: TSMC requires waste treatment vendors to at least acquire ISO 14001 or ISO 45001 certifications as the basis for standardized management. Waste treatment vendors include waste treatment and recycling vendors. Government-owned enterprises, public-to-private enterprises, items exempted from online reporting, and timber waste and lubricant waste vendors not included in the aforementioned vendors

Note 4: Only includes TSMC-certified waste treatment vendors that have been working with TSMC for three years

↑ Exceeded   ✓ Achieved   — Missed Target

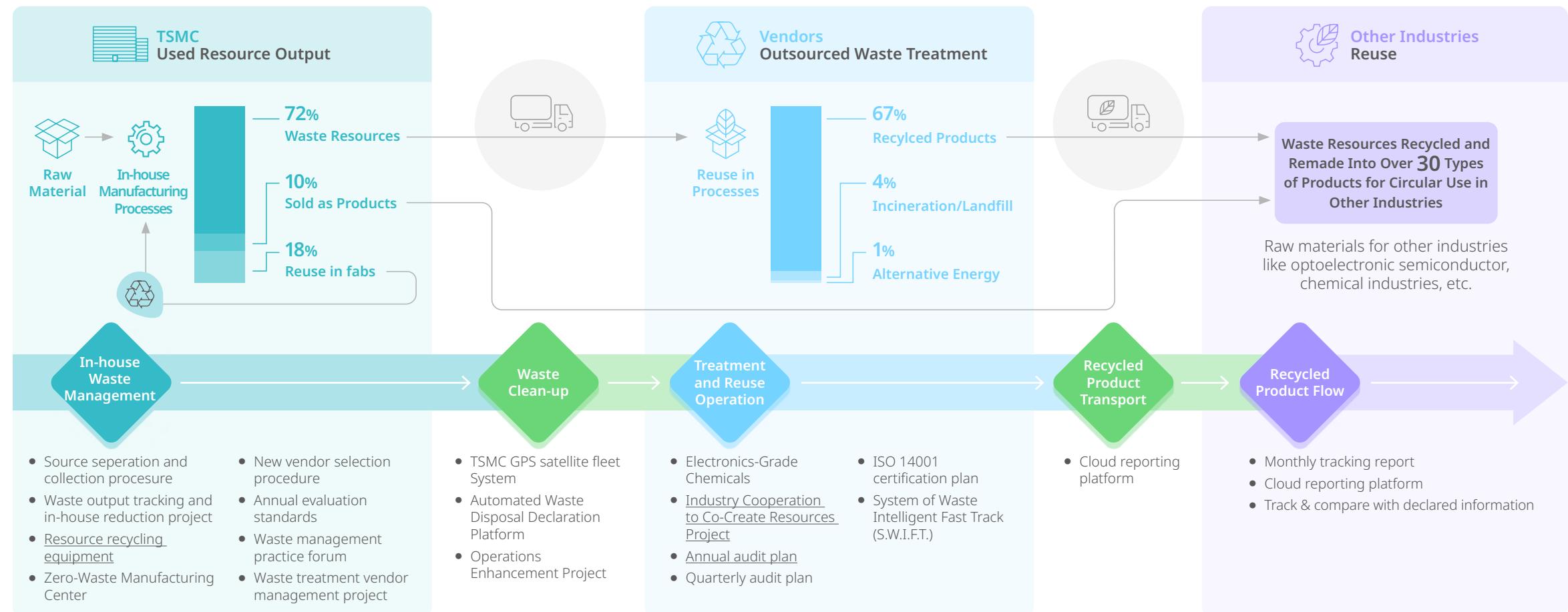
TSMC is a committed advocate of the circular economy and upholds the management principles of "minimizing waste, maximizing resource recycling, and optimizing vendor management" in its efforts to develop a comprehensive waste management system. As the Company continues to develop advanced processes, more raw materials are

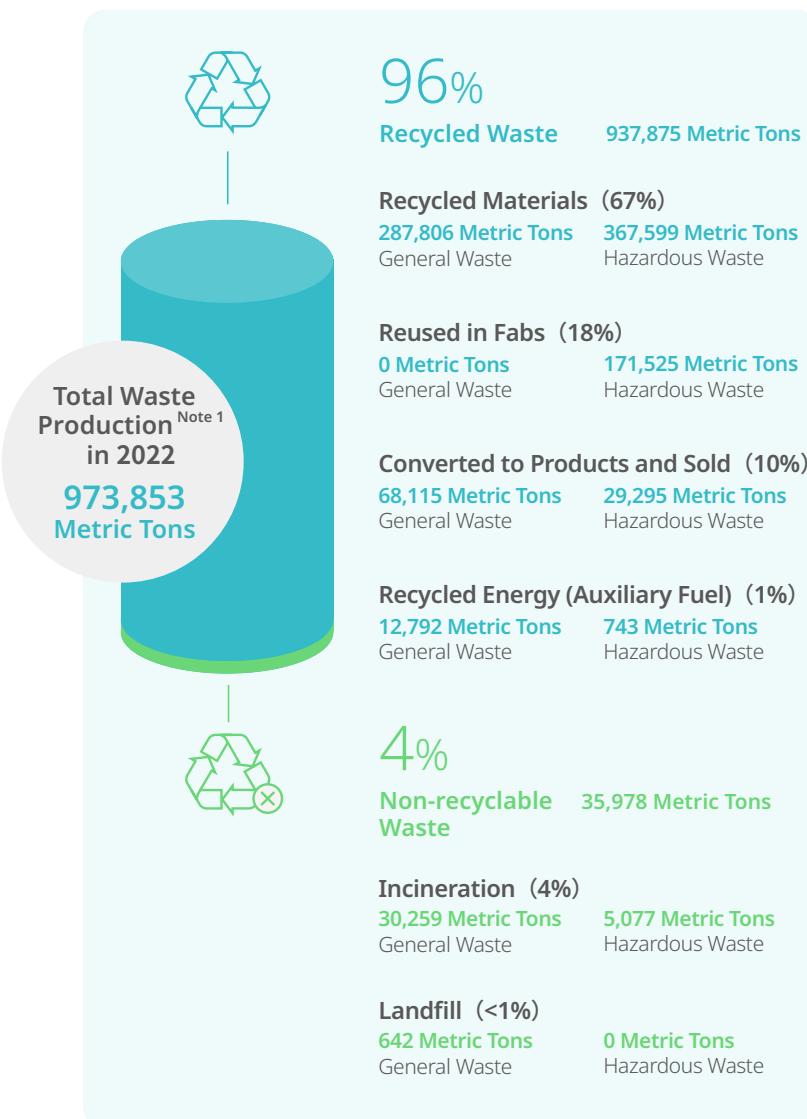
consumed and more waste is produced. As such, TSMC strives to achieve resource sustainability through three major strategies: source reduction, circular economy, and audit and guidance. In 2022, the Company's waste recycling rate reached 96%, and the landfill rate was less than 1% for 13 consecutive years. TSMC is also working with

vendors to deploy renewable technologies that can successfully produce green energy from organic sludge and reuse activated carbon waste in-house to create a circular system. In addition, to strengthen sustainable practices in our vendors, TSMC is actively promoting the [System of Waste Intelligent Fast Track](#) (S.W.I.F.T.) to help transform and upgrade vendors. In

2022, TSMC also organized communication sessions for 55 vendors and updated the Company's [five critical checkpoints](#). By 2030, S.W.I.F.T. is expected to be deployed at all waste treatment vendors as everyone joins hands to create a better environment.

## TSMC Waste Life Cycle Management Procedure 2.0



**Outsourced Waste**

Unit: Metric tons/year

**Outsourced General Waste<sup>Note 2</sup>**

Unit: Metric tons/year

**Outsourced Hazardous Waste**

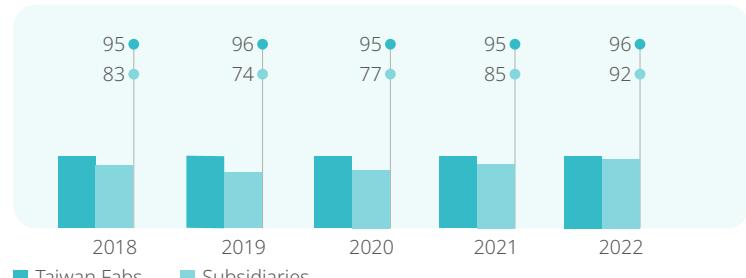
Unit: Metric tons/year

**In-house Recycled Resources**

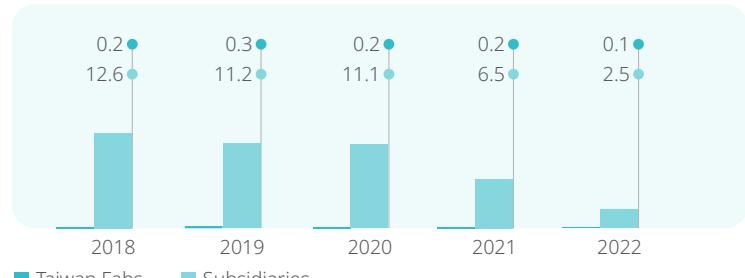
Unit: Metric tons/year

**Waste Recycling Rate**

Unit: %

**Percentage of Waste Sent to Landfills**

Unit: %



Note 1: Figures from TSMC fabs in Taiwan and the data is compiled based on waste disposal declaration data and the processing capacity of in-house resource recycling equipment

Note 2: Outsourced recycling total solid waste in Taiwan facilities are 114,492 metric tons/year, and subsidiaries are 6,195 metric tons/year. Outsourced non-recyclable total solid waste in Taiwan facilities are 14,247 metric tons/year, and subsidiaries are 2,782 metric tons/year

## Promote Source Reduction

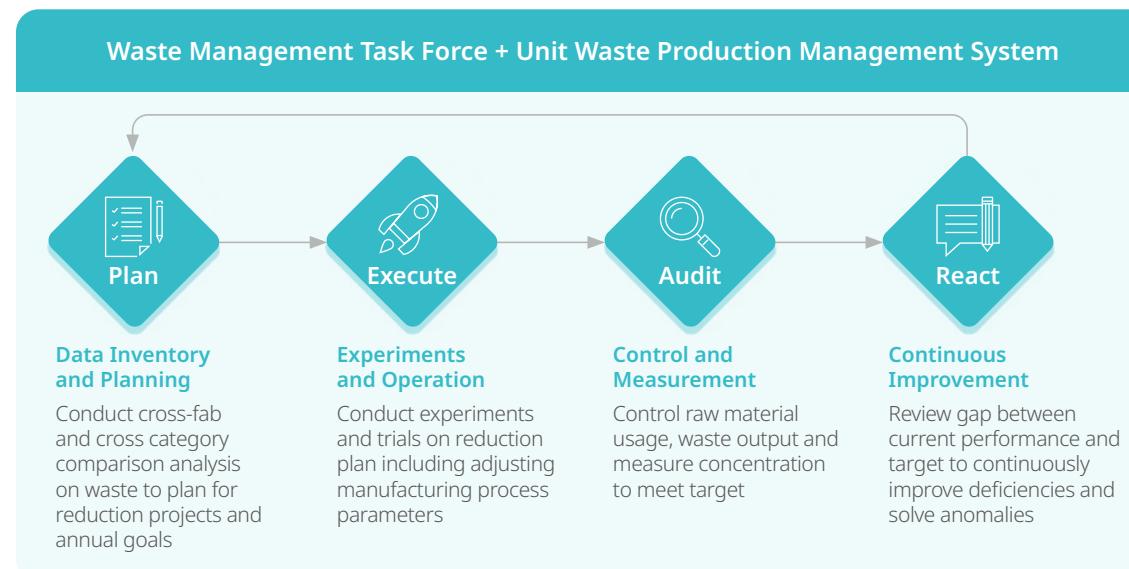
TSMC is actively practicing green manufacturing and implementing source reduction strategies to minimize waste. The interdepartmental Waste Management Task Force utilizes the Plan-Do-Check-Act (PDCA) management cycle to set waste reduction goals and improvement plans at the beginning of each year. The Task Force also leverages the Unit Waste Production Management System to directly manage and control waste production and reduction. Waste management units convene monthly to track the progress and

outcomes of waste reduction measures. In 2022, TSMC was able to reduce waste by over 20,000 metric tons through 129 projects that reduced chemical use time and quantity, adopted new chemicals, and extended use cycles.

Wafer cleaning processes and their cleanliness levels are important factors impacting yield. The higher yield demands of advanced processes have increased the use of sulfuric acids (cleaning solvent). Process, equipment, and facility

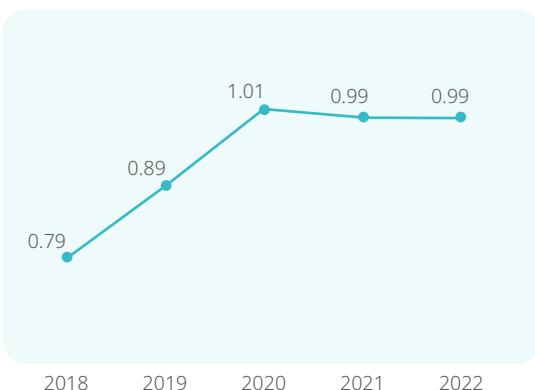
organizations worked together to improve post-wet-etching cleaning steps by increasing acid valve speeds for sulfuric peroxide mixture (SPM) cleaning processes by 54%. In 2022, sulfuric acid waste produced from cleaning each 12" wafer was successfully reduced by 20% without compromising quality. In 2023, this process will be deployed to all facilities, which is expected to help reduce sulfuric acid waste liquid by 30,000 metric tons in 2024.

## TSMC Waste Reduction Management Mechanism

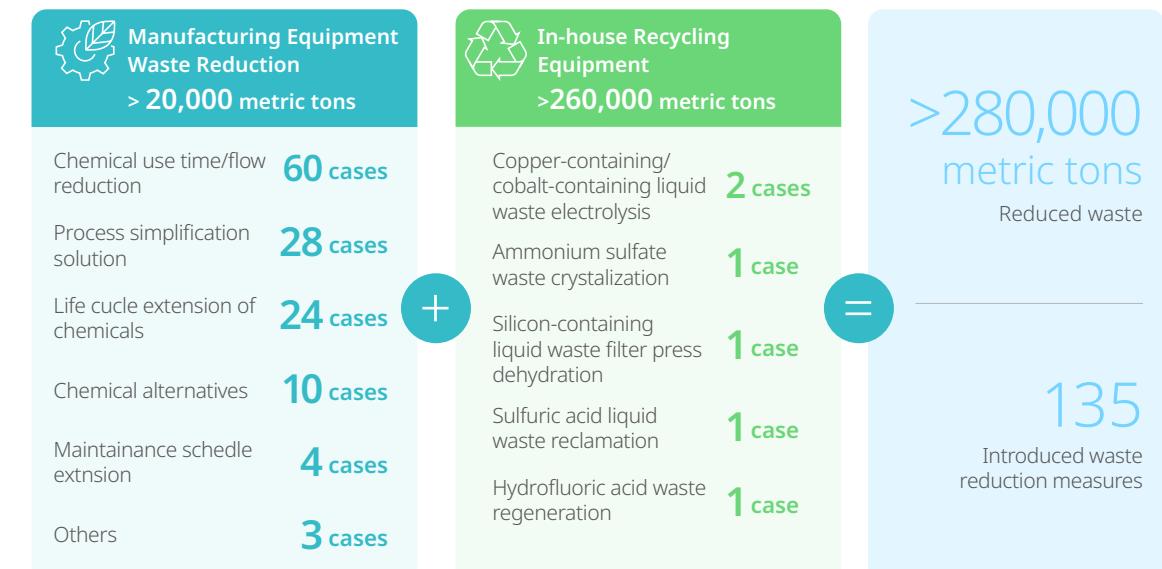


## Outsourced Unit Waste Disposal per Wafer Trend

Unit: Kg/12-inch equivalent wafer mask layer



## Waste Reduction Measures and Results in 2022





### Case Study

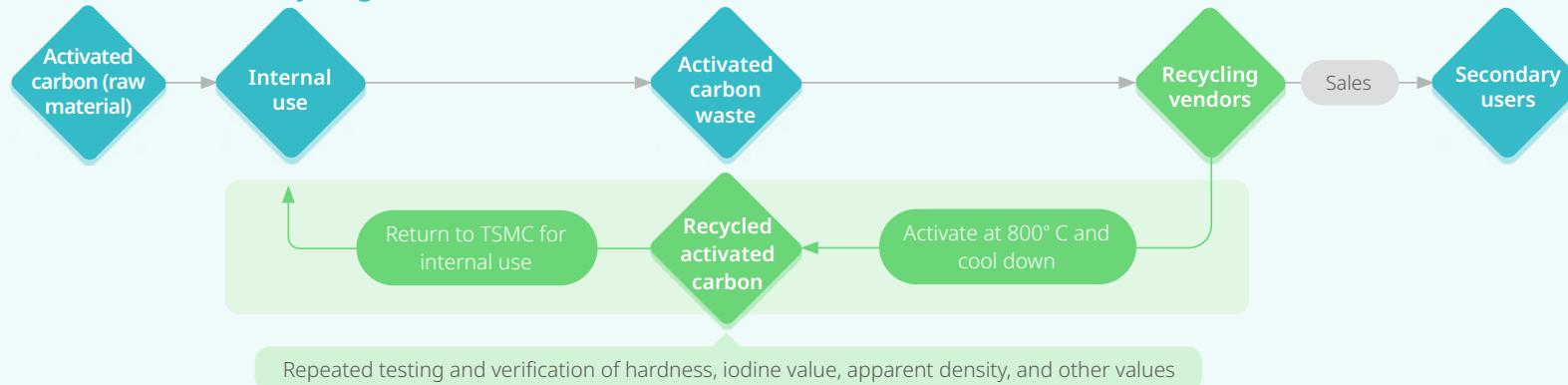
## Activated Carbon Waste Reactivation: Creating NT\$30 Million of Green Benefits

TSMC is committed to carrying out source reduction strategies. By developing a closed-loop cycle to recycle waste for in-house use, the Company has been able to reduce resource consumption and minimize environmental impacts. Activated carbon is used to recycle wastewater at TSMC. The resulting waste was previously outsourced to waste treatment vendors for treatment. To increase the waste's value, TSMC worked with vendors to research

ways to recycle activated carbon and was able to produce recycled carbon by subjected activated carbon waste to temperatures of 800°C and then cooling it. To ensure the quality of recycled carbon complies with TSMC standards, several parameters were repeatedly tested and verified: hardness (loss from abrasions), iodine value (adsorption capabilities), and apparent density (activation levels). In 2022, TSMC was able to produce recycled activated

carbon with adsorption capabilities and use cycles consistent with new activated carbon. The recycling process will be deployed to all Taiwan fabs in 2023, which will allow the reuse of activated carbon to reduce outsourcing by 6,000 metric tons and generate NT\$30 million in green benefits each year, effectively growing the Company's circular economy and supporting environmental sustainability.

### Activated Carbon Recycling Process



### Enhance Circular Economy

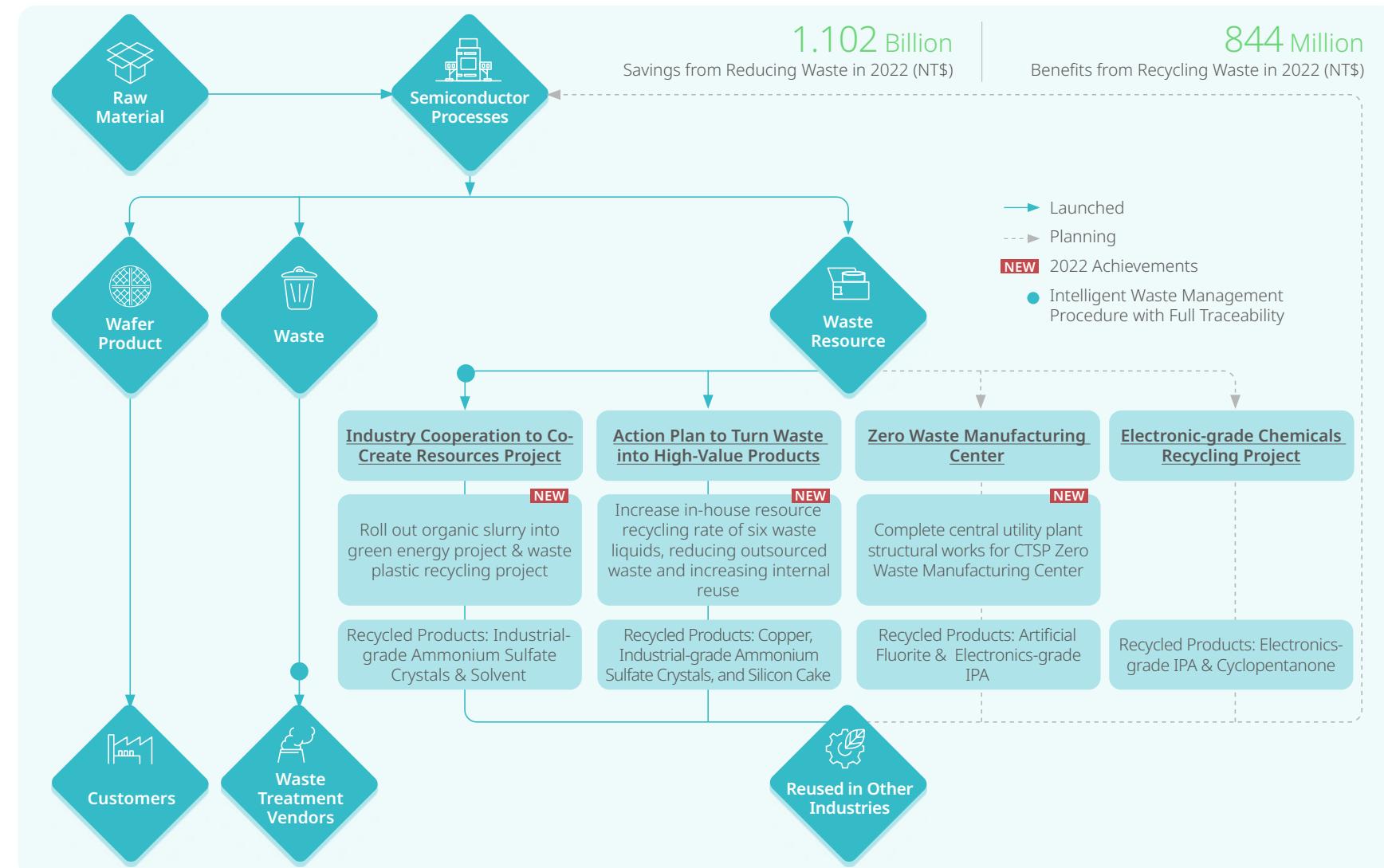
In addition to source reduction, TSMC is also carrying out circular economy practices to fulfill long-term goals for 2030 of outsourcing less than 0.5kg of waste per wafer unit. Through the Action Plan to Turn Waste into High-Value Products, resource recycling equipment were deployed in the Taiwan fabs that were able to increase the recycling of six types of waste liquids into high-value products for internal use or sale. Over 260,000 metric tons of resources were recycled with an in-house resource recycling rate of 28%, which was 6% higher than in 2021 and generated NT\$1 billion in benefits. The central utility plant structure of the Zero Waste Manufacturing Center was completed, which is slated to enter into operation in 2023. As for the Electronics-grade Chemicals Recycling Program, TSMC continues to conduct evaluations and expects to purify waste into electronic-grade chemicals for internal use. The closed-loop cycle can reduce operating risks and maximize the value of recycled products.

The Industry Cooperation to Co-create Resources Project involves working with vendors from other industries to reduce incineration and landfill rates. In 2022, TSMC increased recycling rates from 95% to 96% and reduced landfill rates from 0.2% to 0.1%. To achieve the 2050 goal of net zero emissions and zero waste, TSMC worked with vendors and introduced anaerobic digestion to treat organic sludge, which can then be used to generate green energy. The Company was also

able to reuse instead of incinerating plastic waste through four principles: source management, internal and external sorting, innovative technologies, and high-value products. In 2022, TSMC successfully developed garbage bags from 100% recycled materials for internal use. Other plastic waste was converted into solid fuel and supplied to combined heat and power (CHP) cogeneration plants to reduce coal consumption. The technology will go live in the fourth quarter of 2022 and be deployed to all facilities in 2023.

Phase 1 and 2 of Fab 12 previously obtained the highest platinum rating for zero waste to landfills (UL 2799), and all Taiwan facilities and subsidiaries will seek to obtain UL 2799 certification in 2023 and 2025, respectively, as well. In addition, as most of TSMC's waste treatment vendors use diesel trucks, TSMC launched the Electric Waste Removal Truck Program in 2022 and started conducting assessments. It was discovered that electric trucks produce 45% fewer carbon emissions per kilometer than diesel trucks. The Program is part of the Company's efforts to uphold the TSMC Environmental Policy.

## TSMC Aspires to be a Practitioner of Circular Economy



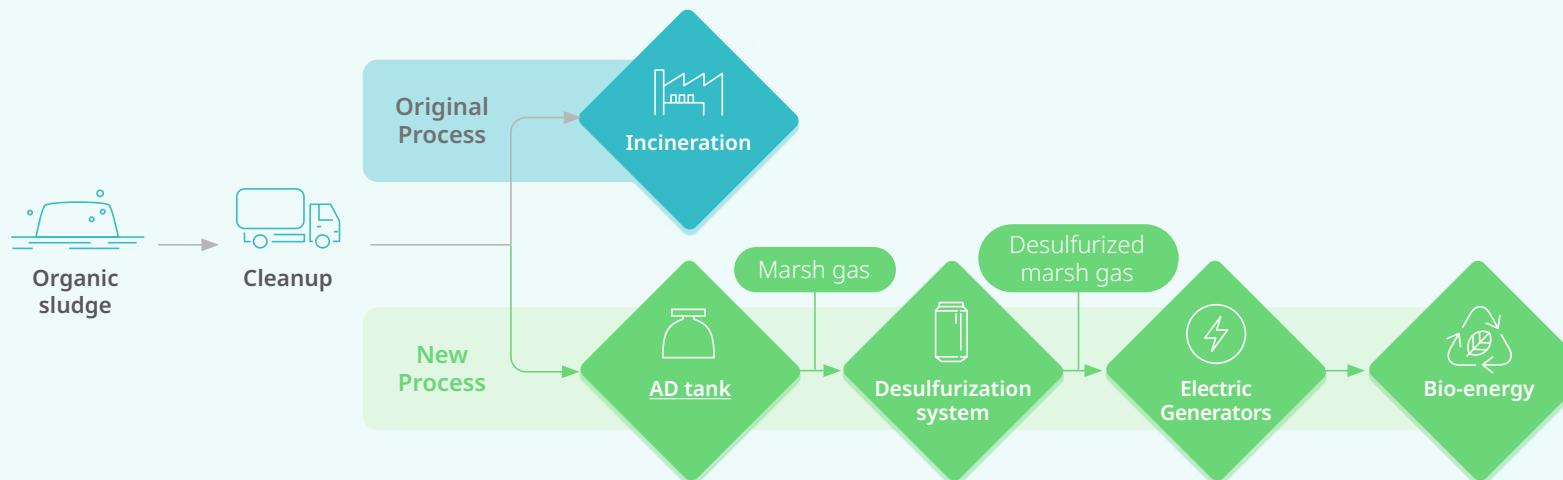


## Case Study

# Green Energy Cycle: 2.2 kWh of Green Energy from 1 Metric Ton of Organic Sludge

To promote green innovation, TSMC worked with vendors to launch the Anaerobic Digestion of Organic Sludge R&D Project, using anaerobic digestion (AD) to treat organic sludge and produce marsh gas, a form of bio-energy, for the first time. In 2022, the Company filed an [application](#) to the Hsinchu Science Park Administration and received approval in September to test out AD for organic sludge treatment at Fab 12 Phases 6 and 7. As of the end of December, the incineration of organic sludge was successfully reduced by 125 metric tons.

## Anaerobic Digestion of Organic Sludge



Using anaerobic bacteria, it is possible to break down organic sludge through four stages—hydrolysis, acidogenesis, acetogenesis, and methanogenesis—and produce marsh gas, which is primarily comprised of methane, for power generation. Each metric ton of organic sludge can generate approximately 2.2 kWh of energy through AD. The goal is to recycle instead of incinerate 100% of organic sludge in 2024, which reduces outsourced incineration by 6,500 metric tons, increases recycling rates at Taiwan facilities by 1%, and creates a circular system that can help usher in the future of green energy.



TSMC works with suppliers to convert organic sludge into green energy

## Strengthen Audit and Guidance

To ensure a safe waste clean-up system, TSMC established the Supplier Transportation Management White Paper, requiring waste clean-up vendors to strengthen systems for waste-removal trucks, drivers, processes before/during/after clean-up, and education and training and obtain ISO 45001 certification before 2023. Waste clean-up vendors are asked to protect employee health and reduce environmental risks by creating safe workplaces. As of the end of 2022, 80% of waste clean-up vendors have obtained ISO 45001

certification. In the same year, TSMC conducted on-site audits of 41 waste clean-up vendors, inspected 100% of tank trucks and sludge clean-up trucks, and mitigated ten deficiencies.

TSMC believes that corporate growth and environmental protection go hand in hand. To such end, waste treatment vendors are asked to improve environmental protection practices and prevent any possibility of illegal waste disposal through TSMC's Waste Treatment Vendor Sustainability

Enhancement Project. In the first stage, new vendor selection, an interdisciplinary team of experts conducts document reviews and on-site inspections across six dimensions to ensure compliance in waste treatment, facilities, and on-site operations. Approved vendors then enter the second stage, which includes quarterly on-site audits to confirm the flow of waste. In 2022, new assessment items were added on environmental sustainability to two of the eight dimensions evaluated during annual audits, operations management and waste

management. The items added drive vendors to work with TSMC toward a sustainable environment by obtaining ISO certifications, reducing and taking stock of GHG emissions, committing to carbon neutrality, recycling resources, and implementing smart management. Lastly, vendors that perform poorly in three dimensions assessed during annual audits are replaced to enforce green practices throughout the supply chain.

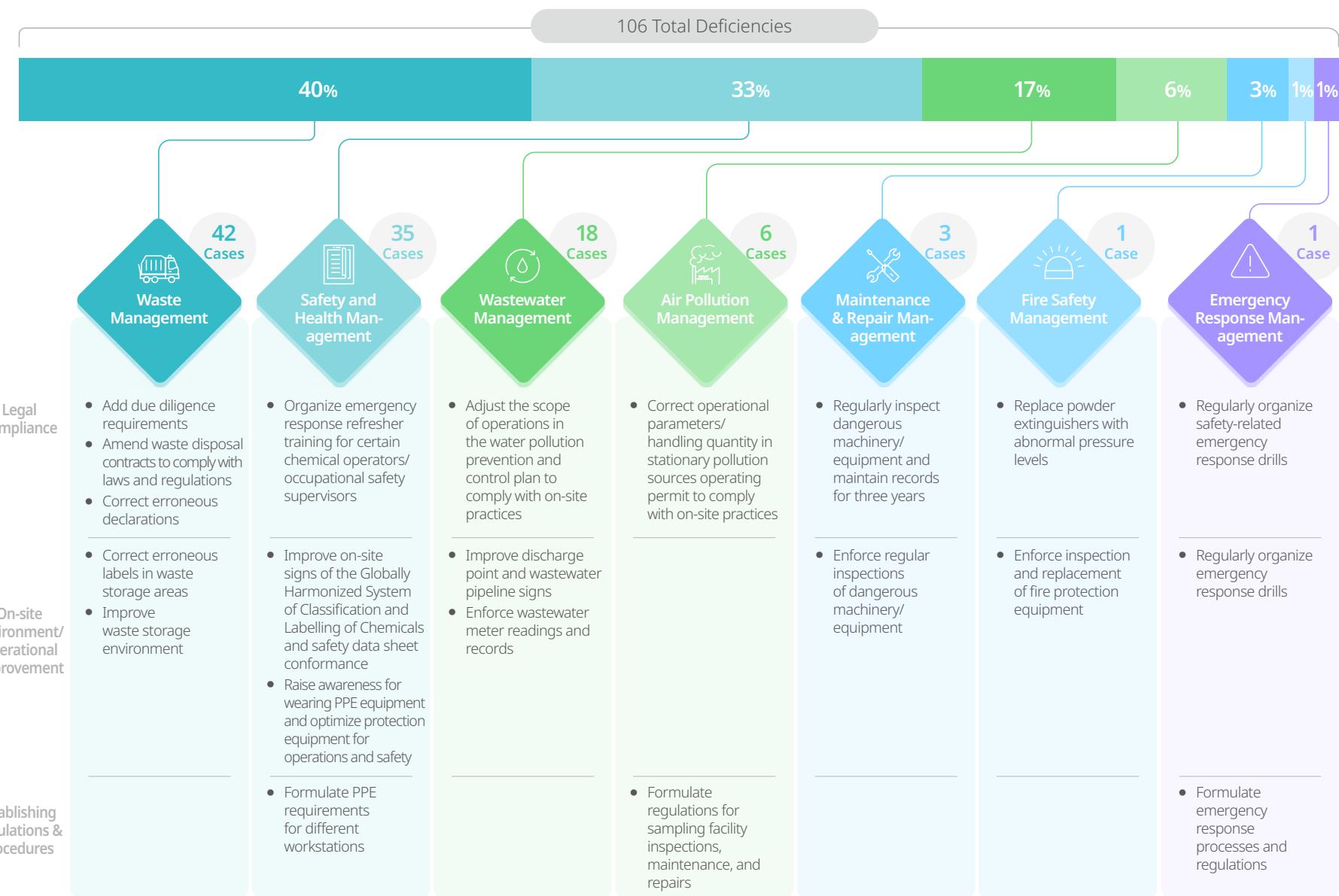
## Waste Treatment Vendor Sustainability Enhancement Project



In 2022, TSMC conducted on-site audits of 58 waste treatment vendors, reaching an audit ratio of 100% and mitigating 106 deficiencies. The number of deficiencies was reduced by 17% from 2021, and the percentage of Excellent and Good vendors has increased from 36% in 2015 to 80%. In 2022, another long-term KPI was added under the Circular Resource section—increase the percentage of Excellent & Good waste treatment vendors to 90% by 2030—to enhance vendor quality and generate greater impacts on sustainability from the supply chain. Additionally, 84% of waste treatment vendors have obtained ISO 14001 certification. All waste treatment vendors are expected to obtain the certification by the end of 2030.

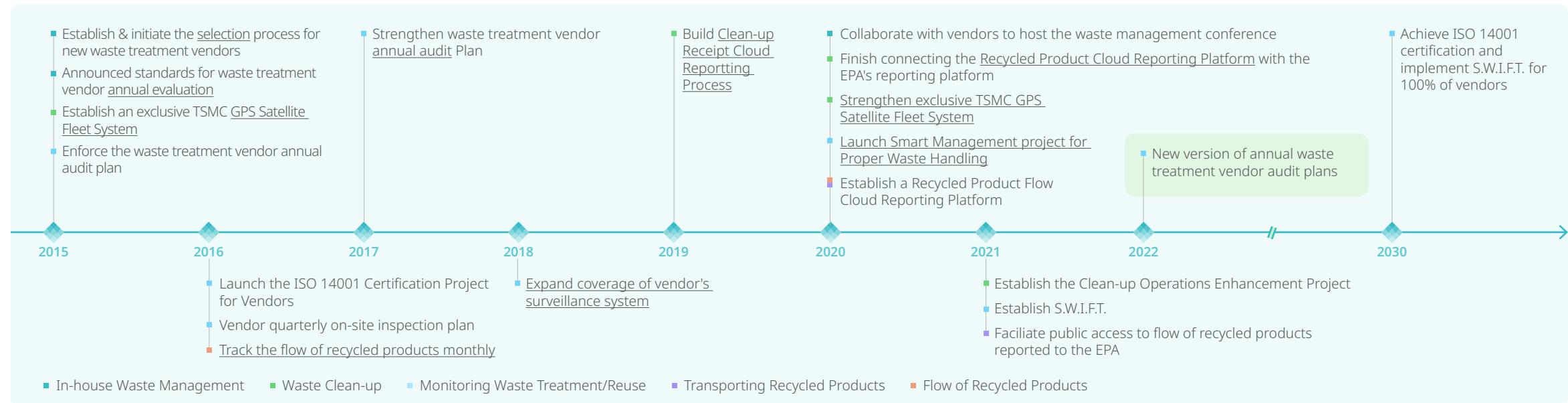
TSMC continues to leverage digital tools to improve the Intelligent Waste Management Procedure with Full Traceability. In 2022, the EPA invited the Company to the Environmental Regulation Enforcement & Corporate Integrity Forum and National Environmental Regulation Enforcement Conference to share how it was able to strengthen management, recycle resources, and reduce risks of illegal disposal by vendors. By sharing its experiences, TSMC hopes to lead the industry into a sustainable future through digital transformation.

## Waste Treatment Vendor Audit and Guidance Results in 2022





## TSMC Waste Treatment Vendor Management Milestones

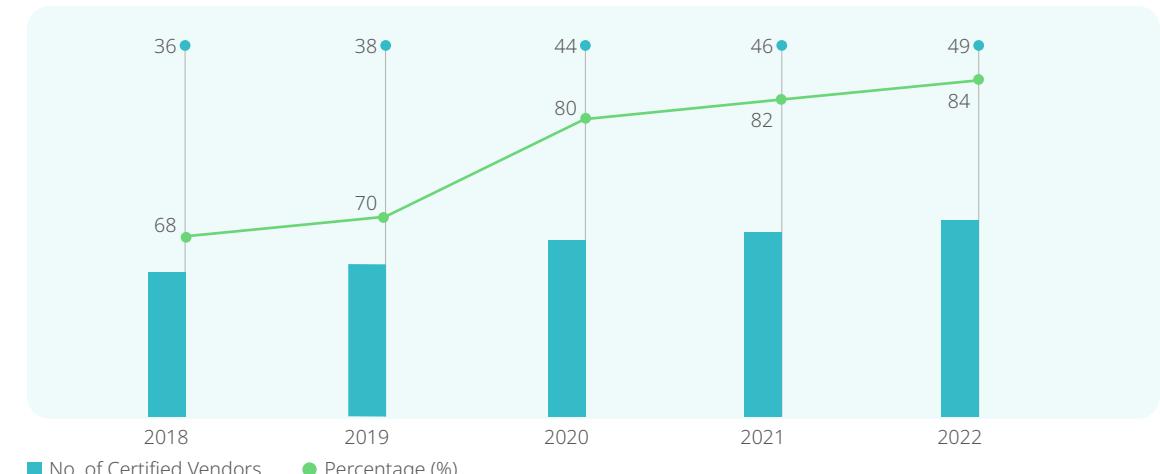


## 2022 Waste Treatment Vendor Evaluation Results



Note: The total score is 100 points: greater than 90 points are Excellent; 80-89 points are Good; 70-79 points are Average; 60-69 points are Passed; less than 60 points are Disqualified

## ISO-certified Waste Treatment Vendors





# Air Pollution Control

Strategies	2030 Goals	2023 Targets	2022 Achievements	
<b>Adopt Best Available Technology</b> Adopt the Best Available Technology to control the pollutants emitted from TSMC operations and minimize environmental impact	Reduce the unit air pollutant emissions by 65% <sup>Note</sup> (Base year: 2015)  Reduction rate of volatile organic gases: >99%	Reduce the unit air pollutant emissions by 58%  Reduction rate of volatile organic gases: >98.6%	Reduced the unit air pollutant emissions by 59% Target: 56%  Reduction rate of volatile organic gases: >98.9% Target: >98.6%	
<b>Strengthen Monitoring for Air Pollution Control Equipment</b> Leverage backup systems and dual-track management, along with pollutant monitors, to ensure that the equipment works as intended and to prevent abnormal occurrences	Report <1 abnormal occurrence in air pollution control equipment	Report <1 abnormal occurrence in air pollution control equipment	Reported 0 abnormal occurrences in air pollution control equipment Target: <1	

Note: TSMC actively invests resources to lower environmental impacts. In 2030, air pollutant emissions unit per product was adjusted from 60% to 65%

Exceeded

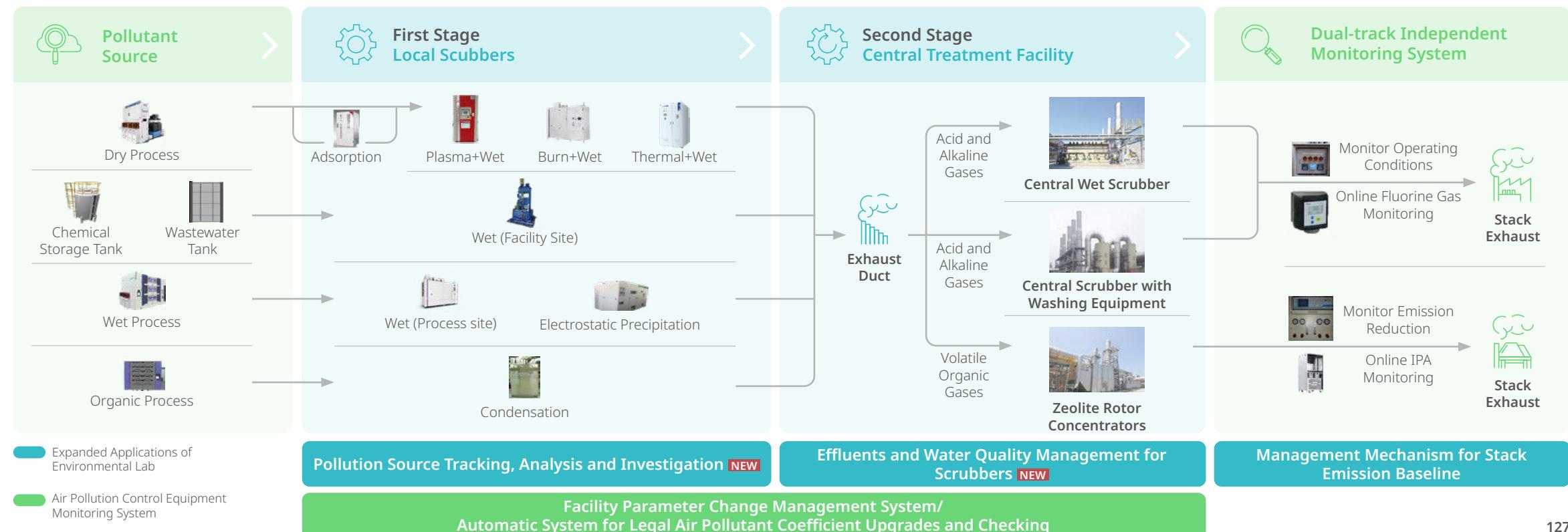
Achieved

Missed Target

TSMC is committed to air pollution control and has adopted the Emission Source Classification method and multi-phase Best Available Technology (BAT) to enhance the performance of pollution control. In 2022, Wet Electrostatic Precipitator Scrubber was applied in TSMC process for the first time, which used high-temperature sulfuric acid for cleaning, reducing alkaline gases and particulate matter (PM<sub>2.5</sub>) by 90% and 91%, respectively. The Company also actively monitoring and managing air pollution emissions from control equipment, expanding the Environmental Lab's responsibilities to include the following three

areas: air pollution monitoring, water quality analysis, and environmental protection in surrounding areas. In addition, TSMC is conducting verifications to help facilities quickly identify target pollutants, apply BAT, and introducing Effluents and Water Quality Management for Scrubbers to regularly inspect water quality to ensure air pollution control equipment is operating at optimum levels. In 2022, TSMC was able to meet the annual target for air pollutant emissions per unit of production as well as the annual target for volatile organic gases reduction, continuing to move toward sustainability goals.

## Air Pollution Control Procedures



## Adopt Best Available Technology

Acid, alkaline, and volatile organic gases comprise the majority of air pollutants produced by the semiconductor industry. TSMC employs two approaches - Classification and Reduction of Emission from Sources and Strengthened Management of Terminal Prevention Facilities to achieve BAT with this multi-phase system and effectively control air pollutant emissions. Exhaust gases are separated in the first stage based on their properties - toxic, corrosive, flammable, perfluorocarbon greenhouse gases, and acidic/alkaline. The gases are first introduced

to high-efficiency local scrubbers that will process highly concentrated pollutants. The gases with low concentrations will then be sent to central scrubbers, which are terminal prevention facilities, for the second stage of rinsing and neutralization. Depending on their boiling points, volatile organic gases may be sent to condensation type scrubbers first and then to zeolite rotor concentrators for adsorption, reducing emissions and improving decontamination results.

## Different Types of Local Scrubbers

Process	Semiconductor Fabrication	Target Pollutant	Control Technologies	Equipment	Reduction Rate	Real-time Parameter Monitoring
	Epitaxial Dry Etching	Corrosive Gases	Burn-Wet (PM <sub>2.5</sub> reduction equipment testing <b>NEW</b> )		>99%	<ul style="list-style-type: none"> <li>Natural gas flow</li> <li>Oxygen flow</li> <li>Circulating water flow</li> <li>Inlet pressure</li> </ul>
		Perfluorocarbons	Burn-Wet (Large-capacity)			
	Dry Etching	Corrosive Gases	Plasma-Wet		>95%	<ul style="list-style-type: none"> <li>Current amperage</li> <li>Circulating water flow</li> <li>Inlet pressure</li> </ul>
		Perfluorocarbons				
		Flammable Gases				
	Thin Film	Corrosive Gases	Thermal-Wet with Chemical Dosing		>95%	<ul style="list-style-type: none"> <li>Reactor temperature</li> <li>Circulating water flow</li> <li>pH value</li> <li>Inlet pressure</li> </ul>
	Diffusion	Perfluorocarbons				
		Flammable Gases				
	Sputtering	Hydrochloric Acids	Thermal-Wet with Chemical Dosing (Add High-efficiency Spray Device)		Hydrochloric Acids >87% Particulate Matters >86%	<ul style="list-style-type: none"> <li>Reactor temperature</li> <li>Circulating water flow</li> <li>pH value</li> <li>Inlet pressure</li> </ul>
		Particulate Matters				
	Ion Implantation Sputtering Epitaxy	Toxic Gases	Adsorption		>95%	<ul style="list-style-type: none"> <li>Pressure difference of local scrubber</li> <li>Inlet pressure</li> </ul>
		Nitrous Oxide (N <sub>2</sub> O)	High-Temperature Thermal+Wet (PM <sub>2.5</sub> Reduction Equipment Testing <b>NEW</b> )		>90%	<ul style="list-style-type: none"> <li>Reactor temperature</li> <li>Circulating water flow</li> <li>Inlet pressure</li> </ul>
	Wet etching	Corrosive Gases	Wet + Chemical Dosage (Process Site)		>95%	<ul style="list-style-type: none"> <li>Differential pressure of local scrubber</li> <li>Circulating water flow</li> <li>Inlet pressure</li> <li>pH value</li> </ul>
		Organic Gases	Wet Electrostatic Precipitation		>90%	<ul style="list-style-type: none"> <li>Inlet pressure</li> <li>Corona voltage</li> <li>Corona current</li> </ul>
		Alkaline Gases PM <sub>2.5</sub> <b>NEW</b>				
	PR Stripping	High Boiling Point Organics	Condensation		Specific High Boiling Point Organics >95%	<ul style="list-style-type: none"> <li>Differential pressure of local scrubber</li> <li>Condensation temperature</li> </ul>
	Chemical Storage Tank	Corrosive Gases	Wet + Chemical Dosage (Facility Site)		>95%	<ul style="list-style-type: none"> <li>Differential pressure of local scrubber</li> <li>pH value</li> <li>Circulating water flow</li> <li>Inlet pressure</li> </ul>
	Wastewater tanks	Acid and Alkaline Gases				

## Source Reduction and Management – High Efficiency Local Scrubbers

As TSMC accelerates the development of advanced process technologies, the New Tool & New Chemical Review Committee evaluates the hazard of new processes and chemicals on ESH to prevent added risks of air pollution. In 2022, the Committee conducted 430 reviews for 198 new tools and 232 new chemicals. The [two-stage review](#) enables the Committee to carefully identify optimal separation methods and local scrubbers for new tools and chemicals. Depending on exhaust gas properties, they are sent to different types of local scrubbers - thermal, burn, plasma, wet with chemical dosage, adsorption, condensation, and wet - for pre-treatment. As TSMC continues to bring in new types of high efficiency local scrubbers, the Company is also working with suppliers to optimize the performances of existing local scrubbers. In 2022, TSMC applied the wet electrostatic precipitator scrubber in the process which used high-temperature sulfuric acid for cleaning in Fab 12B, using corona technologies and wet scrubber method to remove pollutants - alkaline gases and PM<sub>2.5</sub> - at the same time.

Launched in 2021, the three-year [High-efficiency Spray Equipment Upgrade Program](#) to upgrade existing thermal-wet scrubber has upgraded 508 scrubbers, with a finish rate of 68% by the end of 2022. To further enhance PM<sub>2.5</sub> reduction rates of existing local scrubbers, TSMC expanded the PM<sub>2.5</sub> Reduction Equipment Upgrade Program to



develop devices that can improve decontamination for different types of local scrubbers, including eddy gas/water separators, centrifugal washers, or cyclone particle collectors to strengthen exhaust gas treatments.

### Strengthen Management of Terminal Prevention Facilities — Central Scrubbers

After first-stage treatment, the exhaust gases undergo second-stage treatment: acid/alkaline

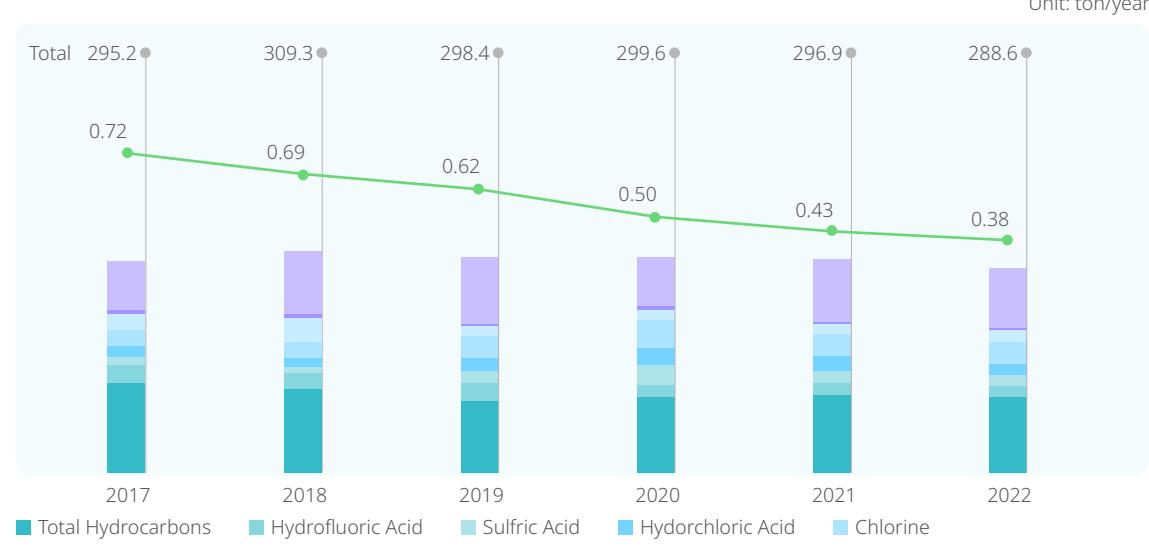
gases are channeled to central treatment facilities for scrubbing and acid/alkali neutralization to remove pollutants. Exhaust gases from certain wet processes that emit large amounts of acid/alkaline gases are sent to a two-step scrubbing – central scrubber connecting washing tower – to increase pollutant adsorption. To enhance the effectiveness of central scrubbers, existing facilities installed hydro membranes, changed filters, and added Raschig rings to optimize tower structures and decontamination. TSMC will continue to install

High-efficiency Central Scrubbers in new facilities to enhance the overall performance of terminal prevention facilities.

As for volatile organic gas treatment, TSMC continues to carry out the Low-efficiency Single Zeolite Rotor Concentrators renew Initiative in existing facilities and install Dual Zeolite Rotor Concentrators in new facilities. In 2022, all facilities reduced volatile organic gases by 98.9%. Due to enhanced prevention and control measures, total air pollutant emissions have

not increased with the addition of new facilities. When concentrated gases adsorbed by zeolite rotors enter thermal oxidizers, pyrolysis can remove volatile organic gas pollutants but may also produce the byproduct of nitrous oxide ( $\text{NO}_x$ ) pollutants. In 2022, Fab 18 Phase 7 applied low nitrous oxide burner (low- $\text{NO}_x$  burner) in the volatile organic gas treatment facilities, using Moderate or Intense Low Oxygen Dilution (MILD) thermal oxidizers and combustion flow field control technologies to reduce NOx emissions by 65% each year.

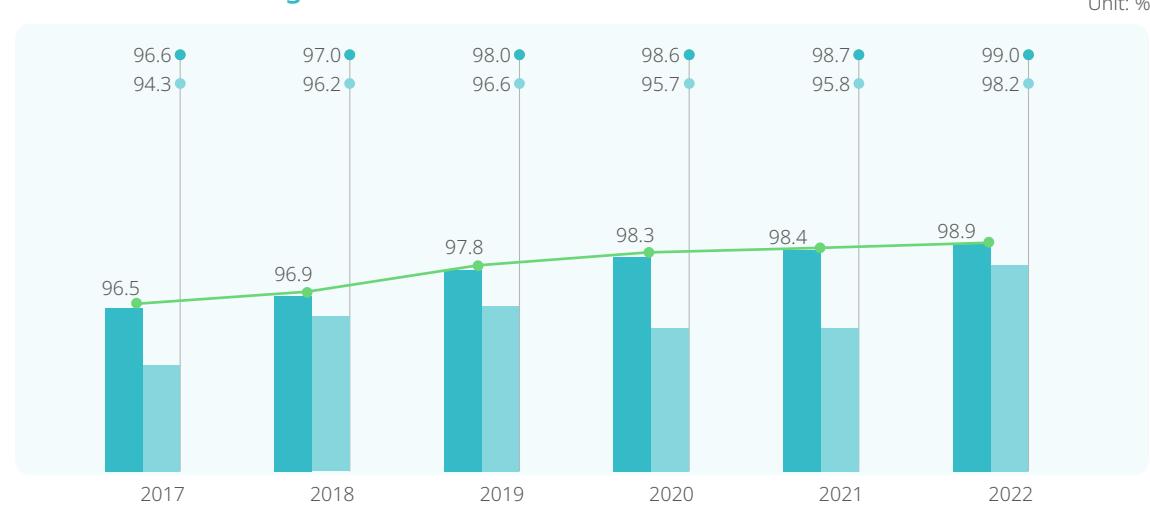
### Historical Emissions and Emissions Per Unit of Production



Note 1: TSMC air pollutant emissions are reported in accordance with local laws and regulations

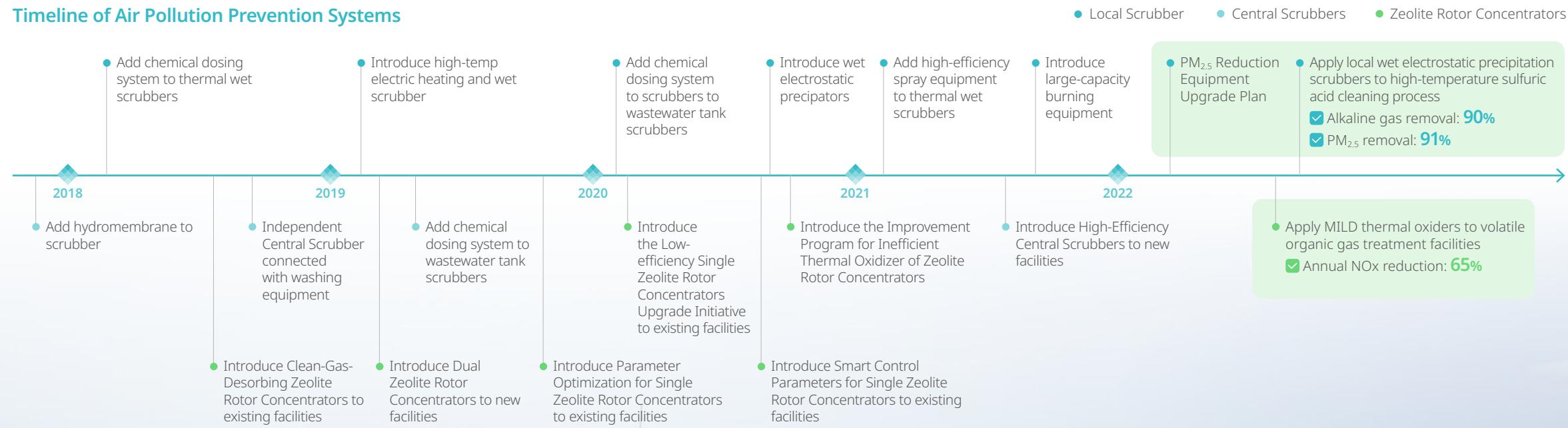
Note 2: Air pollutant emissions include the total emissions of eight gases: hydrocarbons (THC), sulfuric acid ( $\text{H}_2\text{SO}_4$ ), hydrochloric acid (HCl), nitric acid ( $\text{HNO}_3$ ), hydrofluoric acid (HF), phosphoric acid ( $\text{H}_3\text{PO}_4$ ), chlorine ( $\text{Cl}_2$ ), and ammonia ( $\text{NH}_3$ ).

### Historical Volatile Organic Gas Reduction Rates

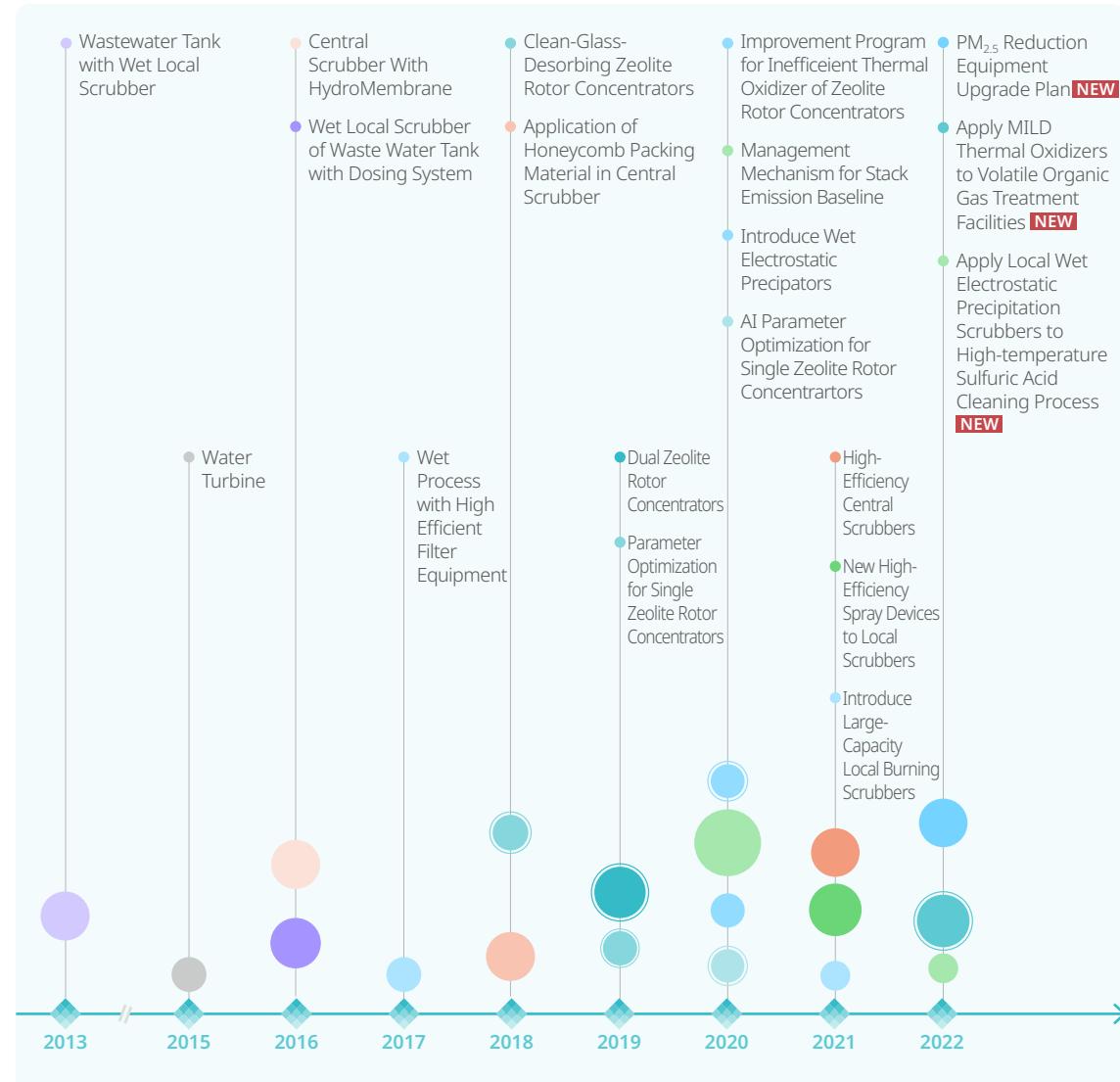


Note: Figures from TSMC fabs in Taiwan, TSMC (China), TSMC (Nanjing), and VisEra. Data excludes WaferTech as local regulations required individual hydrocarbon monitoring instead of total hydrocarbon monitoring

## Timeline of Air Pollution Prevention Systems



## Prevention Technology Feasibility and Reduction Effectiveness Evaluation



Note 1: Size of the bubble indicates the technology's reduction efficiency

Note 2: Single circle indicates local/central scrubbers; double circles indicate zeolite rotor concentrators

## Empower Environmental Lab for Comprehensive Air Pollution Control

In compliance with TSMC [Environmental Policy](#), the Company is dedicated to reducing air pollution emissions. The Environmental Lab has strengthened [pollutant monitoring and management for stacks](#), using [baseline management](#) to control the concentration of air pollutants, achieve source reduction and enhance the performance of prevention facilities. In 2022, 104 stacks exceeding baseline concentration standards have been mitigated by the decontamination method, including replacing terminal prevention facilities that have reached the end of their life cycles, upgrading existing facilities, or introducing new high-efficiency facilities. The outcome shows 88 stacks have been mitigated.

For air pollution sampling, the Environmental Lab introduced various sampling and analysis technologies according to the demands and regulatory requirements. In 2022, the Lab developed ways to analyze inorganic acids, ammonia, heavy metals, NMHCs, etc., to increase the facilities' abilities for different pollutants identification, provide sampling data more rapidly, and shorten mitigation period. The Lab further traced air pollution sources by sampling central scrubber exhaust ducts to confirm the source of abnormal exhaust gas emissions. Then, TSMC can investigate upstream process tools to clarify special gases and emission properties for ensuring the coverage rate of local scrubber installation is sufficient. The Lab also verifies the performance of upgraded local scrubber, filler variance, and optimal parameters. This allows facilities to rapidly develop optimal treatment for target pollutants. In 2022, 2,282 exhaust ducts, sub-ducts, and equipment units were sampled.

and tested; 16 cases of mixed acid and alkaline gas emissions were found and resolved, and improved performances in 15 treatment facilities were verified.

For water quality testing, the Environmental Lab provided the [analyzation for 29 items](#) of pollutants in scrubber water. The result showed that water containing acid-base ions could be turned into gaseous pollutants at [certain pH levels](#). In 2022, the Environmental Lab established Effluents and Water Quality Management for Scrubbers to regularly inspect water status to ensure air pollution control equipment operates at the optimal levels.

## Three Applications of Environmental Lab to Strive for Zero Emission

- Air Emission:** Develop comprehensive sampling and testing technologies to monitor emissions and verify upgrades of control equipment
  - Manage emission stacks
  - Increase variety of pollutants sampled **NEW**
  - Investigate emission sources **NEW**
- Effluents:**
  - Manage effluents and water quality for scrubbers **NEW**
  - 29 items for water quality test **NEW**
- Surrounding Areas:**
  - Monitor surrounding areas with air quality vehicles
  - Build stationary monitoring stations around Zhunan, Taichung and Tainan Science Parks

## Strengthen Monitoring of Air Pollution Prevention Equipment

TSMC is strengthening the reliability of air pollution control equipment operating systems and air pollution monitoring to ensure compliance with Taiwan and overseas regulations. The Company also deployed automatic monitoring systems - total hydrocarbon monitors, online IPA monitors, and online fluorine gas monitors - to rigorously control monitoring data and actual emission levels. In addition, the Facility Division, Industrial Safety and Environmental Protection Division, and Instrument Control System Division used Automatic System for Legal Air Pollutant Coefficient Upgrades and Inspection, Facility Parameter Change Management System, and Facility Monitoring and Data Collection System to monitor facility parameters. The systems automatically compare and inspect data to prevent flaws or losses from human error. This effectively increases the accuracy and reliability of TSMC reports to government agencies.

In addition, to ensure air pollution treatment facilities remain at optimal efficiency for operations all year round, all control equipment is equipped with a Dual-track Independent Monitoring System that allows the Facility Division and Industrial Safety and Environmental Protection Division to perform emergency repairs or initiate backup systems to minimize damages and losses. TSMC also adopts the N+1 rule where all equipment must have at least one backup system and uses Uninterrupted Power Supply Systems to help fulfill the management target of zero failure in control equipment. With dedicated efforts from various divisions, TSMC is proud to report zero abnormal occurrences in air pollution control equipment in 2022.

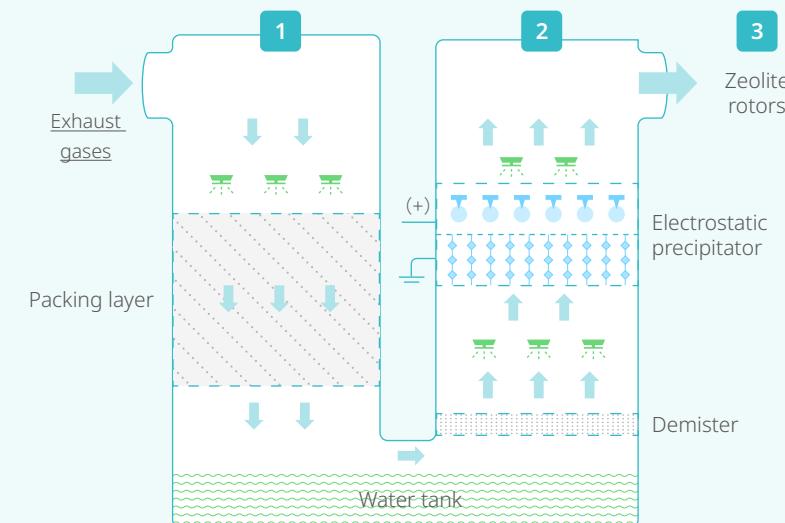
### Case Study

## Improve Corona Technologies in Air Pollution Control Equipment to Reduce Alkaline Gases and PM<sub>2.5</sub> by over 90%

With the evolution of advanced processes, TSMC continues to work with suppliers to optimize the performance of air pollution prevention equipment and has applied Wet Electrostatic Precipitator (wet-EP) Scrubbers in the process which used high-temperature sulfuric acid for cleaning. As this process simultaneously uses acids, alkaline, and organic chemicals, it produces large amounts of acid/alkaline gases and high-concentration PM<sub>2.5</sub>. TSMC improved on wet-EP corona technologies to ensure safety and enhance the effectiveness of air pollution treatment, changing electricity discharge mode and installing protective mechanisms. The improved technology has obtained SEMI S2 safety certification and, after repeated testing, can be used for three-stage pollutant treatment. The first stage is a washer that transmits gaseous acid/alkaline liquid phases for decontamination. The second stage is a particle collector that accumulates and removes particulate matter with corona discharge. Finally, the gases which have been treated by wet-EP would enter to the zeolite rotors for organic pollutant removing. The three-stage process can effectively minimize acid/alkaline gases, organic gases, and PM<sub>2.5</sub> emissions simultaneously.

In 2022, TSMC introduced wet-EP into Fab 12B. Results showed that the three stage process was able to remove 90% of alkaline gases, and 91% of PM<sub>2.5</sub> which is the form of acid gases after reaction. In the future, TSMC will continue to evaluate the feasibility and efficacy of wet-EP applications to other exhaust gases to reduce air pollution emissions and strive toward zero emissions.

### Wet-EP Scrubbers: Three Stages of Decontamination



#### Three Stages of Decontamination

- 1 Washer: Remove acid/alkaline gases
- 2 Particle Collector: Remove Particles
- 3 Zeolite Rotors: Remove VOCs



## Case Study

# Optimize Thermal Oxidizer Structures and Treatment Process to Reduce Nitrogen Oxide (NO<sub>x</sub>) Emissions by 65%

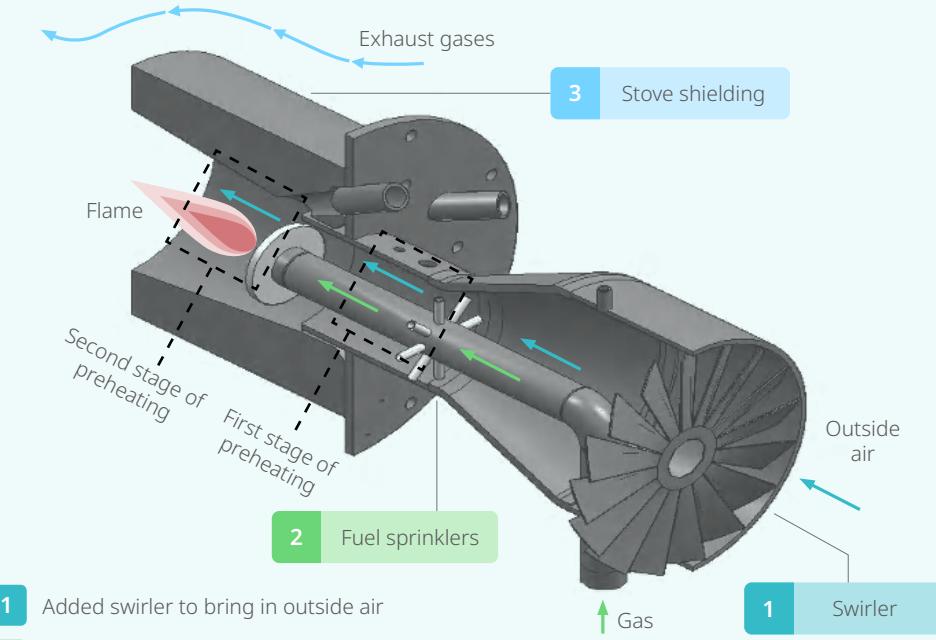
Volatile organic compounds (VOCs) and perfluorinated compounds (PFCs) are byproducts of wafer manufacturing. Air pollution control equipment mainly uses pyrolysis to remove VOCs and PFCs. However, this process also causes dinitrogen (N<sub>2</sub>) to react with oxygen (O<sub>2</sub>) in the air and produce nitrogen oxides (NO and NO<sub>2</sub>) pollutants.

### Develop Low-NO<sub>x</sub> Burner to Reduce NO<sub>x</sub> Production

TSMC has launched a NO<sub>x</sub> reduction project in all facilities around the world to comply with assessment requirements for the new U.S. facility. First, TSMC conducted survey and analysis for comprehensive stacks in the facilities. Results showed that NO<sub>x</sub> is mainly produced by pyrolysis in local scrubbers and VOC control equipment. To reduce NO<sub>x</sub> emissions, TSMC adapted the structure and treatment processes of thermal oxidizers in control equipment, adding swirlers to introduce outside air into oxidizers to facilitate combustion. Fuel sprinklers are also added for pre-heating in stages. In the first stage, the oxygen concentration is lower in the low-temperature reaction. In the second stage, the air with low oxygen concentration is introduced into the combustion. Under the low-oxygen combustion, flame temperature dip from 1,600° C to 1,300° C and result in lower NO<sub>x</sub> production. At the same time, combustion flow field technologies are used to change where exhaust gases enter into thermal oxidizers so that the gases can circumvent high-temperature zones, which reduces the production of thermal NO<sub>x</sub>.

In 2022, TSMC tested the new process on VOC control equipment in the Fab 18 Phase 7 and was able to minimize target pollutants and NO<sub>x</sub> byproducts by simply adapting thermal oxidizers and using optimal temperatures. The process does not compromise the performance of exhaust gas treatment and can reduce NO<sub>x</sub> emissions by 65% each year. TSMC will continue to evaluate ways to improve local scrubbers to further reduce NO<sub>x</sub> production and strive for environmental-friendly goals.

### Low-NO<sub>x</sub> Burner Reduces Nitrogen Oxides Emissions



1 Added swirler to bring in outside air

2 Added fuel sprinklers for pre-heating

3 Stove shielding is installed to allow exhaust gas to flow in from outside to avoid direct contact with high-temperature flame



# An Admired Employer

TSMC values its commitment to employees and works to foster a humanistic workplace culture with open communications. The Company is dedicated to promoting a diverse, inclusive, safe, and fun workplace where employees can continue to learn. TSMC also provides competitive compensation and welfare, striving to be a company that employees can be proud of.

**Top 25%**

Total compensation amongst industry peers

**7,817**

New high-quality jobs around the world

**8,836**

Beneficiaries of health-promotion programs for contractors

Diversity and Inclusion

Talent Attraction and Retention

Talent Development

Human Rights

Occupational Safety and Health



# Diversity and Inclusion

## Strategies

## 2030 Goals

## 2023 Targets

## 2022 Achievements

### Establish an Open-style Management System

Fulfill Core Values and Business Philosophy and continue to shape an inclusive culture

Rank in the 75<sup>th</sup> percentile for Diversity and Inclusion; the rank is determined by comparing results from the Engagement Survey <sup>Note 1</sup> against the WTW Global High Performance Norm

Rank in the 50<sup>th</sup> percentile for Diversity and Inclusion; the rank is determined by comparing results from the Engagement Survey against the WTW Global High Performance Norm

### Unleash the Potential of Diverse Talent <sup>Note 2</sup>

Provide resources to support diverse talent to grow and flourish

Women in management:  $\geq 20\%$

Women in management:  $\geq 14\%$

Women in management: 13.3%  
Target: 14%

Women account for 30% of all newly-hired technical professionals

Women account for 25% of all newly-hired technical professionals

Women accounted for 23.7% of all newly-hired technical professionals  
Target: 25%

Note 1: The Engagement Survey is issued once every two years and will be issued next in 2023. For the 2021 Engagement Survey, please refer to [Employee Commitment](#)

Note 2: TSMC respects difference, hence the hiring or promotion of colleagues is not affected by gender, religion, race, nationality, or political affiliation. The Company proposes that the employee mix should reflect the current social situation, thus the strategy of Unleashing the Potential of Female Employees was changed to Unleashing the Potential of Diverse Talent to build a diverse and inclusive workplace

Note 3: Although the proportion of women in managers in 2022 has not been achieved, it was still 0.3% higher than that in 2021. For details on talent retention, please refer to [Talent Attraction and Retention](#)

Note 4: Due to labor market conditions in 2022, although the proportion of women in newly-hired technical professionals has not been achieved, it was still 2.4% higher than that in 2021. For details, please refer to [Talent Attraction and Retention](#)

Exceeded Achieved Missed Target

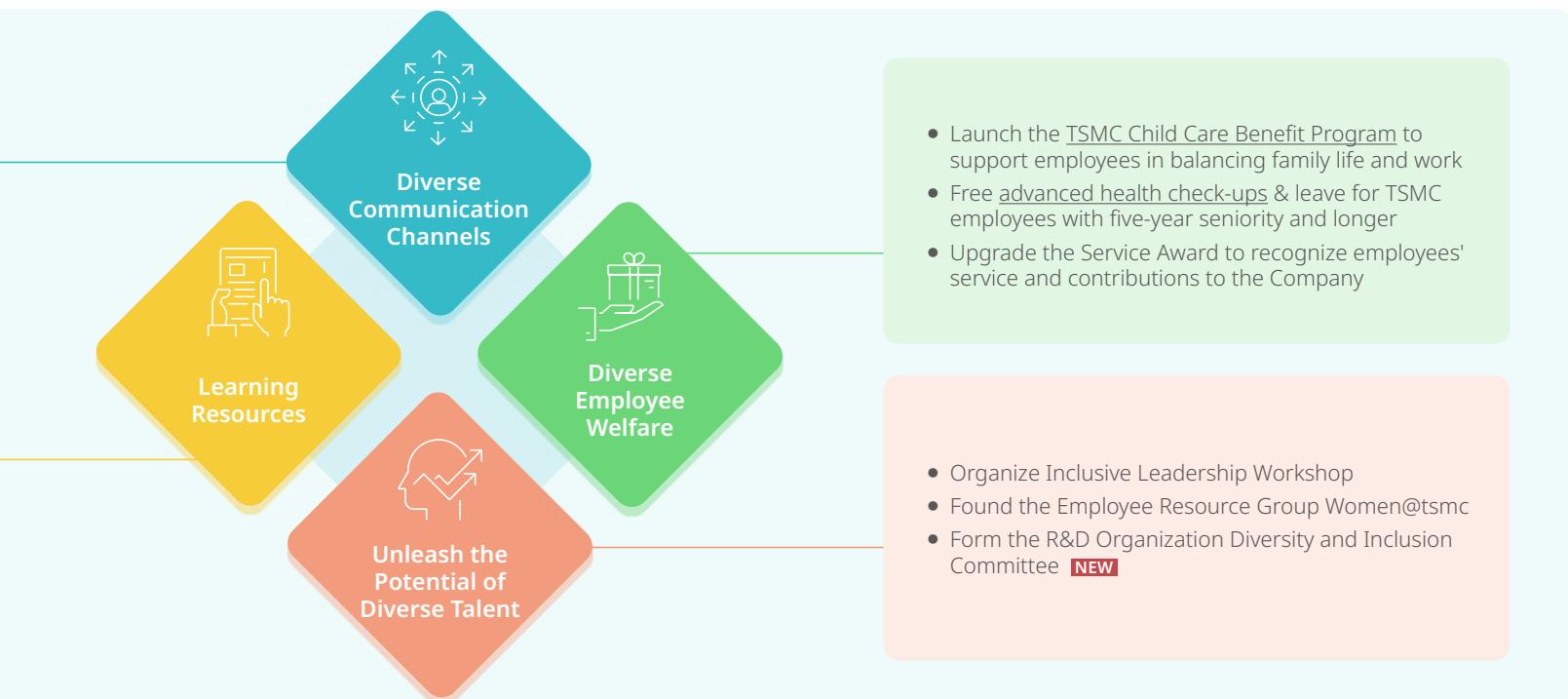
TSMC respects difference and sees talent as the most important asset for driving industry upgrades and social development, hence the hiring or promotion of colleagues is not affected by gender, religion, race, nationality, or political affiliation. Furthermore, diverse management and employee mix are applied to bolster the Company's competitive edge and sustainable

development. By implementing the Diversity and Inclusion Statement, TSMC vigorously creates an open-style management system and inclusive workplace that integrates people from different backgrounds. By strengthening collaboration through mutual understanding, acceptance, and respect, the Company will maximize the benefits of diverse talent resources.

## The Four Areas of Diversity and Inclusion

- Communication meetings at all levels / across levels
- A global Engagement Survey to regularly and systematically compile employee opinions
- Establish multiple channels for employees
- CEO on Quarterly Outlook **NEW**
- Expand Silicon Garden Meeting Feedback Channel **NEW**

- Provide diverse learning resources and tools to strengthen the professional know-how and self-efficacy of employees
- Diverse learning methods to help employees understand the significance of Diversity and Inclusion



## Establish an Open-style Management System

TSMC strives to create an open-style management system inspired by the Business Philosophy written and published by TSMC Founder Dr. Morris Chang, and continues to work on the four areas of Diverse Communication Channels, Learning Resources, Advance Employee Welfare, and Unleash the Potential of Diverse Talent. It is hoped to prove the Company's commitment and actions to fostering,

cultivating, and retaining talent, thereby realizing a diverse and inclusive workplace where everyone respects each other and is willing to communicate. TSMC aims to enable global employees to fully utilize their strengths in suitable positions, growing together with the Company and creating win-win situations.

## Unleash the Potential of Diverse Talent

In 2022, TSMC organized 15 Inclusive Leadership Workshops to support senior executives in understanding diversity and inclusion, as well as reinforce the awareness of unconscious bias, learn how it is formed, and appreciate the value of diversity and inclusion in their work through case studies. Furthermore, they also learned how to create a diverse and inclusive workplace. The training completion rate was 81%.

In the same year, the R&D Organization Diversity and Inclusion Committee was formed to focus on female employees' issues, actively recruit female interns, and hold a series of lectures. The aim was not only to promote knowledge sharing from the perspective

of career planning and building a workplace mentality, but also to facilitate exchanges among female colleagues, encourage dialogue between different generations, and provide all-round support for female employees, so as to promote innovative values of diversity and inclusion.

Additionally, TSMC officially established the employee resource group Women@tsmc in 2022 to provide female employees with a platform to support each other. Activities such as female colleagues forums and mentoring programs serve to enhance female employees' interpersonal networks within the Company and encourage them to pursue their careers and self-growth. Women@tsmc also supports

the [TSMC Journeys of Female Scientist Lectures](#) by inviting lecturers to communicate with students, helping the Company to expand talent cultivation and create a talent pool for the semiconductor industry.

In 2023, TSMC will design projects according to different stages of employees' careers. These include experience camps for people with disabilities and job

content design, forming diverse employee resource groups, hosting training courses to raise awareness of diversity and inclusion, implementing flexible work hours, as well as support programs for expatriates and their families in a bid to create a diverse and inclusive experience for employees. The purpose is also to implement a friendly workplace and unleash the potential of diverse talent.

## Diverse and Inclusive Employee Experience



The company holds a "Tech Your STEM Genes" women in science and technology symposium

## Case Study

## Unleash Employee Potential and Create a Role Model for Female Semiconductor Talent

TSMC prides itself on its people-oriented corporate culture. To support the career development of female talent in the semiconductor industry, TSMC is committed to realizing the value of diversity and inclusion and creating a challenging, fun, and sustainable learning workplace. Through teamwork, experience sharing, and guidance programs, the Company can assist female colleagues to tap into their potential and develop their strengths, as well as support colleagues in looking after their families and work development with a robust employee welfare system. Moreover,

Defending TSMC's industry leadership and operation freedom is the most honorable mission in my career. Thanks to the R&D team's innovation achievements and the legal team's joint efforts that made the new patent record.

**Billie Chen****Associate General Counsel  
National Manager Excellence Award**

Chinese Professional Management Association



Constructed strategic patent portfolio with internationally-recognized quality; led patent litigations to establish victory results for

**Accolade** TSMC's freedom of operation.

My first impression of TSMC was that it is a company with an exceptional ability to get things done and an emphasis on teamwork.

**Joy Cheng****TSMC Academician  
National Industrial Innovation Award –  
Woman Group**

Ministry of Economic Affairs



Pushed through the nm process limit, developed photoresist technology of Extreme Ultraviolet Light (EUV), and collaborated with suppliers to lower process costs and risks, as well as maintain TSMC's technological leadership.

TSMC's abundant resources and innovations enable novel ideas to be turned into actions in a short time. Thanks to the guidance of senior colleagues and mentors, I can complete tasks with minimal effort and explore the infinite possibilities of semiconductor applications.

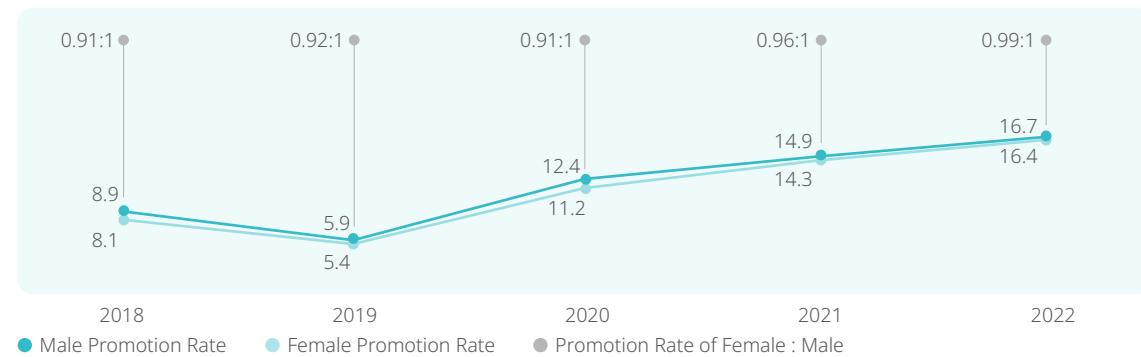
**Yi-Rou Liou****TSMC Technical Assistant Manager of the  
Product Component Engineering Department  
Female Up and Comer Award**

Global Semiconductor Alliance

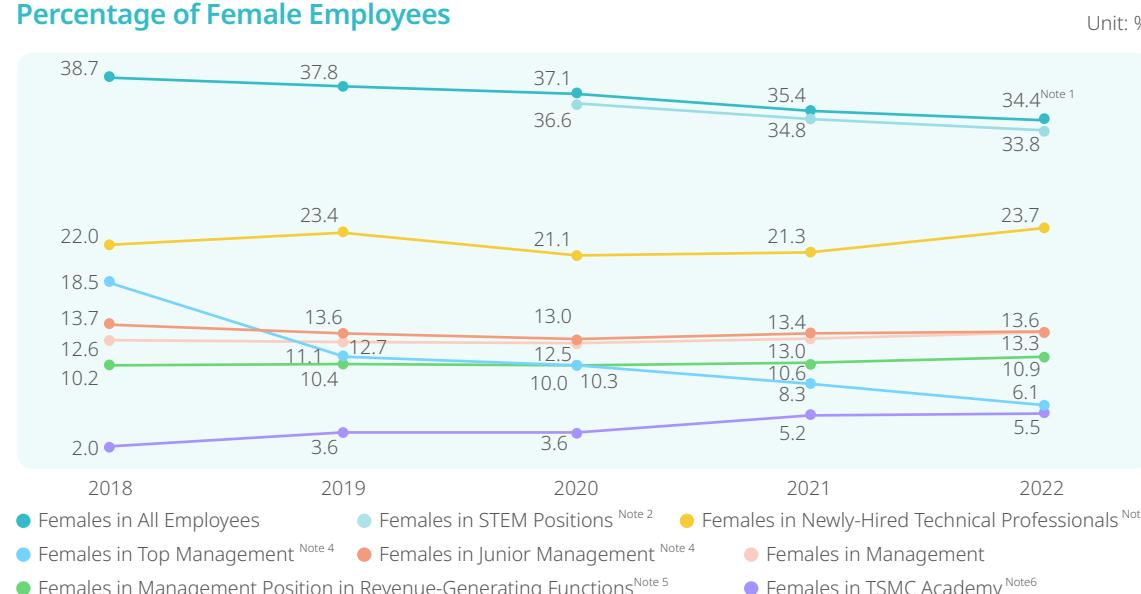


Improved chip computing speed significantly in a short time, controlled costs effectively, increased customer product performance, and fostered innovation in the semiconductor ecosystem.

### Promotion Rate by Gender



### Percentage of Female Employees



Note 1: The percentage of female employees declined in 2022 because new hires were mainly engineers and there was a significantly lower number of female engineers than male engineers in the labor market

Note 2: STEM positions include R&D, operations, Q&R, information technology, and information security employees, and other units

Note 3: Newly-hired technical professionals include all newly-hired technical professionals with less than one year of recognized experience

Note 4: Junior management positions include first-line managers while top management positions include Vice Presidents and higher.

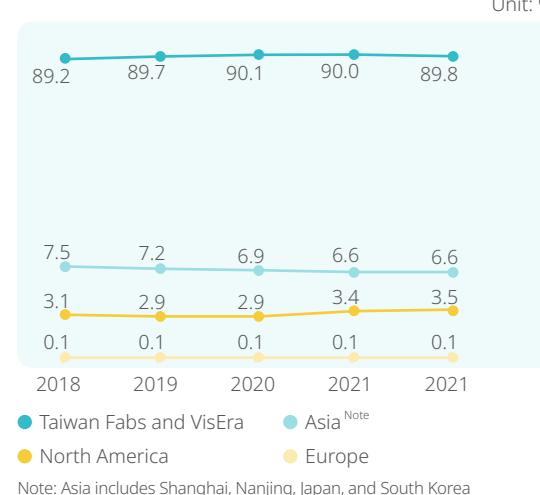
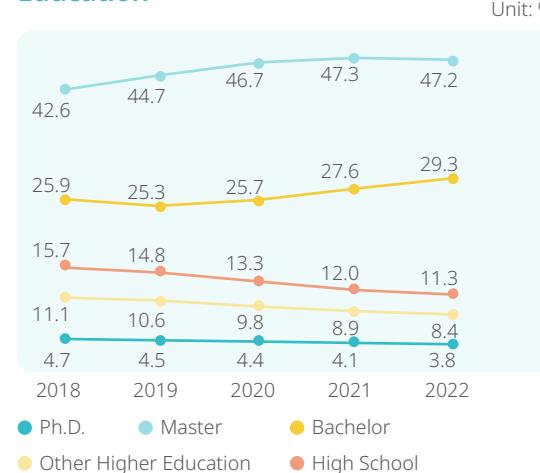
Note 5: Management positions in revenue-generating functions include managers of R&D, operations, Q&R, sales, and other units

Note 6: TSMC Academy members with outstanding achievements, insights, or breakthroughs in specific fields or experts with outstanding contributions to TSMC

### Compensation Ratio by Gender

Region/Subsidiary	Position	2018	2019	2020	2021	2022
Taiwan	Managers	0.99:1	0.95:1	0.97:1	0.97:1	0.97:1
	Professionals	0.93:1	0.93:1	0.93:1	0.93:1	0.93:1
	Assistants	0.98:1	0.97:1	0.97:1	0.93:1	0.91:1
	Technicians	1.14:1	1.13:1	1.13:1	1.14:1	1.15:1
China	Managers	0.96:1	0.94:1	0.96:1	1:1	0.96:1
	Professionals	0.89:1	0.89:1	0.88:1	1:1	0.99:1
	Assistants	0.93:1	0.88:1	0.91:1	1.14:1	1.19:1
	Technicians	1.07:1	1.05:1	1.11:1	1.16:1	1.13:1
North America, Europe, Japan, Korea Note	Managers	0.88:1	0.95:1	0.94:1	0.97:1	0.93:1
	Professionals	0.78:1	0.79:1	0.78:1	0.82:1	1.03:1
	Assistants	-	-	-	-	0.97:1
	Technicians	-	-	-	-	0.96:1
VisEra	Managers	0.79:1	0.72:1	0.71:1	0.69:1	0.69:1
	Professionals	0.87:1	0.86:1	0.86:1	0.85:1	0.91:1
	Assistants	1:1	1.03:1	1.06:1	1.18:1	1.18:1
	Technicians	1.04:1	1.13:1	1.03:1	1.04:1	1.05:1
WaferTech	Managers	0.79:1	0.84:1	0.75:1	0.79:1	0.80:1
	Professionals	0.83:1	0.91:1	0.83:1	0.87:1	0.82:1
	Assistants	0.87:1	0.91:1	0.91:1	0.93:1	0.95:1
	Technicians	1:1	0.99:1	1:1	1.02:1	1.02:1

Note: From 2018, statistics for Japan, North America, and Europe have been changed from individual statistics to consolidated statistics

**Age****Work Location****Position****Education**

TSMC implements a diverse and inclusive workplace, creating an environment of mutual respect and communication



# Talent Attraction and Retention

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Fulfill the "Commitment" Core Values</b> Offer employees quality jobs and strengthen employee commitment	Conduct an Employee Engagement Survey every two years to reinforce core values <ul style="list-style-type: none"><li>- Ensure that over 95% of employees are fully committed to their work</li><li>- Ensure that over 95% of employees are willing to continue working for TSMC in the next five years</li></ul> Conduct an Engagement Survey every two years to reinforce core values; rank in the top 25% for Sustainably Engaged; rank is determined by comparing results from the Engagement Survey against the WTW Global High-Performance Norm <sup>Note 2</sup>	Rank in the top 75% for Sustainably Engaged; rank is determined by comparing results from the Engagement Survey <sup>Note 2</sup> against the WTW Global High-Performance Norm	Over 93% of employees were fully committed to their work Target: 95%
Maintain position above 75 <sup>th</sup> percentile among industry peers in total compensation	Maintain position above 75 <sup>th</sup> percentile among industry peers in total compensation	Maintained position above 75 <sup>th</sup> percentile among industry peers in total compensation	✓ Target: 75 <sup>th</sup> percentile
Maintain total turnover rate between 5-10%	Maintain total turnover rate between 5-10%	Total turnover rate: 6.7%	✓ Target: 5-10%
Less than 10% new hire (<1 year) turnover rate	Less than 14.5% new hire (<1 year) turnover rate	New hire turnover rate (<1 year): 15%	✓ Target: ≤ 15%

Note 1: Expected to launch the TSMC Culture Refinement Plan in 2023

Note 2: The Engagement Survey is issued once every two years and will be issued next in 2023. For results from the 2021 Engagement Survey, please refer to the [Employee Commitment](#) section

↑ Exceeded    ✓ Achieved    — Missed Target



In 2022, the semiconductor industry continued to flourish. To cater to the needs of global customers, TSMC expanded investment in Taiwan, the U.S., China, Japan, etc. The Company also invested in advanced technology R&D and expanded production capacity. In addition to bolstering the recruitment and cultivation of local talent, TSMC advanced to Japan, Southeast Asia, and Europe to expand global talent recruitment. In 2022, TSMC recruited 12,442 new employees worldwide, creating 7,817 premium new job opportunities, providing employees with competitive compensation and welfare systems better than statutory requirements, as well as a safe and healthy workplace, so that colleagues are willing to devote themselves to work, learning, and

growth, in turn obtaining a sense of belonging and accomplishment. Furthermore, the Company strives to respond to their needs through new employee care measures in order to successfully lower the new employee turnover rate.

## Fulfill the "Commitment" Core Values

### Fulfill Core Values

TSMC's core values of Integrity, Commitment, Innovation, and Customer Trust were defined by TSMC Founder Dr. Morris Chang. Chairman Mark Liu and CEO Dr. C.C. Wei expect all TSMC employees to uphold these core values, reinforcing the Company's business philosophy and vision through internal websites, meetings, lectures,

publications, and various communication channels. In the fourth quarter of 2022, a core value survey was conducted to listen to employees' feedback on the implementation of the Company's core values and relevant strengthening measures that will be launched in 2023. Through seminars and case studies, the Company aims to enhance employees' understanding and experience of the core values, thereby ensuring that employees can grow together with TSMC.

When it comes to talent attraction and retention, TSMC has always believed in "putting the right people with the shared vision and values in the right positions". "Shared vision" means that all employees share the same vision and mission; "shared values"

means that all employees abide by the same core values and code of conduct; and the "right people in the right positions" means that the Company is dedicated to helping employees unleash their full potential in the right positions.

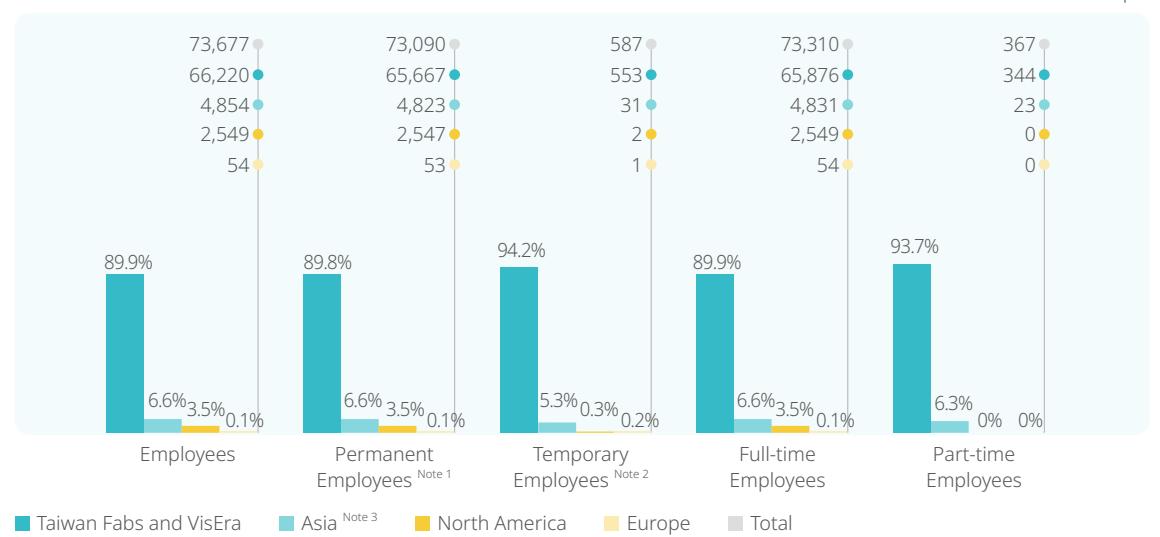
## Strong Talent Pool

TSMC has remained true to its core values and has always strived to be a company that employees can be proud of. In 2022, the total number of global employees was 73,677, consisting of 73,090 permanent and 587 temporary employees based on employment contract type. In terms of employment type, 73,310 were full-time employees and 367 part-time employees.

### Workforce Type Distribution - by Gender



### Workforce Type Distribution - by Work Location



## • Reinforce the Recruitment of Female and Foreign Science and Engineering Talent

To encourage more outstanding female science and engineering talent to join the Company, TSMC continues to provide female colleagues with a friendly and supportive workplace. In 2022, two female career-sharing and interview sessions were held, inviting female executives to share their work and workplace experience to help participants better understand the semiconductor industry and TSMC.

Additionally, TSMC continues to expand its diverse talent pool. The total number of foreign employees in 2022 was 1,147, accounting for 1.6% of global employees; 2.3% of new employees in 2022 were foreign employees, higher than the proportion of foreign employees among all employees; the

proportion of women in new managers reached 16.3%.

### • Recruitment Criteria

Abiding by the guidelines of shared vision and values, and the basis of diversity and inclusion, TSMC does not discriminate against candidates because of their gender, religion, race, nationality, or political affiliation. TSMC prioritizes character and capability over professional skills when assessing candidates. All candidates must pass rigorous selection criteria and interviews for a comprehensive evaluation before they are welcomed on board.

### • Talent Recruitment in Taiwan Fabs and VisEra

TSMC's global recruitment stresses local hiring. However, in the principal place of business, Taiwan

fabs and VisEra, the Company must consider technological development and diversity. Therefore, in addition to the recruitment of professionals and recent graduates, overseas special professionals are listed as a recruitment focus as well.

### » Strengthen Internship Program

In 2022, TSMC continued the 2021 DNA Internship Program, which revolves around the theme of Development, Navigation, and Advance Offer to provide diverse learning activities and practical project involvement such as lectures, courses, and workshops to give interns the opportunity for self-discovery and learning about the semiconductor industry and technologies. Outstanding interns were given advance offers to TSMC upon graduation, contributing to the success of both the students and the Company.

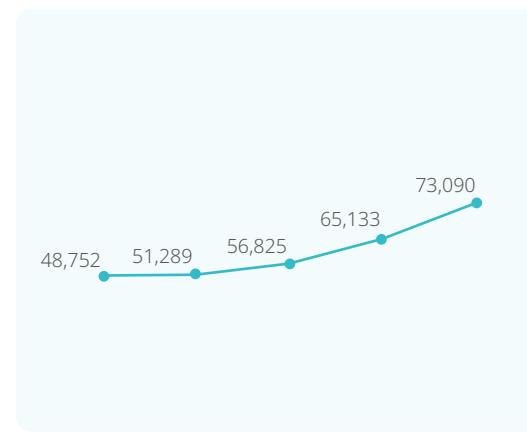
## Interns Receiving Advance Offers in Taiwan Fabs and VisEra

Unit: Number of People



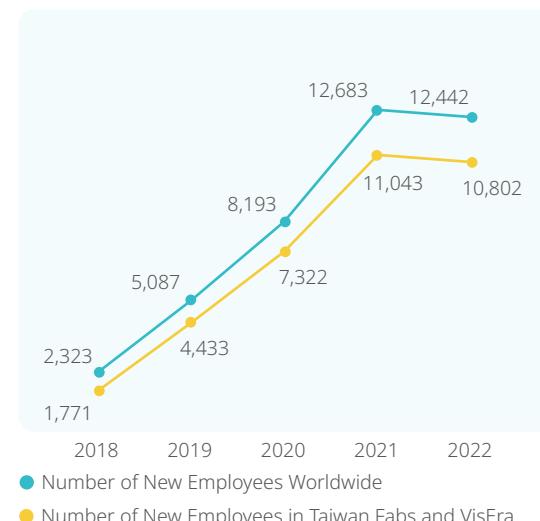
## Number of Permanent Employees Worldwide

Unit: Number of People



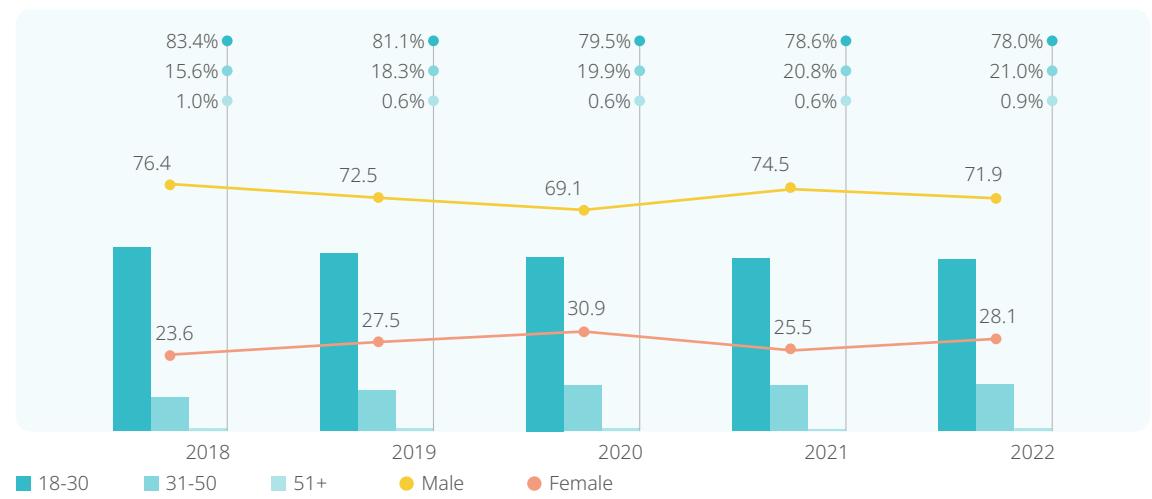
## Number of New Employees

Unit: Number of People



## Ratio of New Employees - by Gender and Age

Unit: %



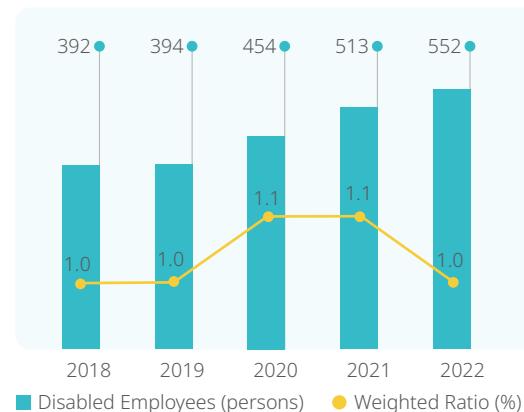
In 2022, TSMC welcomed 639 interns through the DNA Internship Program, of which 31% (195 interns) were female students. After the internship, 226 interns were evaluated as outstanding and received advance offers, accounting for 35% of total interns. Of them, 29% were female students.

## » Disabled Employees

In compliance with local regulations, TSMC hired a total of 443 employees with mild or moderate disabilities, and 109 employees with severe disabilities. In light of the rapid growth of the number of employees, TSMC has also vigorously recruited disabled personnel. In 2022, the Company organized two recruitment briefing sessions for disabled personnel and added

job vacancy announcement channels to reach more potential talents. In 2023, TSMC expects to join forces with school resource centers and government employment service centers to increase the recruitment of disabled talents. The Company also plans to launch a workplace experience camp for disabled interns, helping TSMC in restructuring specific job positions for the disabled. Furthermore, disabled interns with outstanding performances will be hired as permanent employees. VisEra also provided vacancies for disabled candidates. However, due to the nature of job vacancies, VisEra received a dearth of suitable applicants, leading to its failure to meet minimum requirement of 1% and has paid subsidies according to legal regulation.

### Disabled Employees - Taiwan



### Disabled Employees - VisEra



## Case Study

# TSMC Holds Inaugural Female Career Sharing and Interview Session

World-changing innovation relies on diverse perspectives and ideas. To foster ongoing innovations in the semiconductor industry, TSMC has invested resources to proactively attract female technological talents to join the industry. In 2022, the inaugural female career sharing and interview session was held, inviting female senior executives and engineers from fields related to technology to interact with female engineering college students and graduate students through the lecture titled Explore Your Boundless Potential in the Nanometer World. Through career experience sharing, the students could understand the work and life of female employees at TSMC, as well as gain insights into their career development paths. The lecture was combined with Q&As and one-on-one interviews to help female students explore suitable jobs, as well as increase TSMC's female employment rates.

The event saw the participation of 107 students, of which 67 received one-on-one interviews. Eventually, 32 people were hired, who will certainly demonstrate their expertise and confidence in the professional field of semiconductors in the future.



TSMC helps female students explore career development

## • Overseas Recruitment for Special Experts

To sustain the Company's diversified talent pool and recruit talent in special fields, TSMC continues to recruit overseas talent around the world. In terms of industry-academia cooperation, TSMC has closely maintained long-term connections with MIT, Stanford University, UC Berkeley, Tokyo University, and other prestigious universities around the world to incubate top research talents and ensure early engagement with global talents for future recruitment. In addition to recruiting semiconductor professionals in major cities in the U.S., Singapore, and Malaysia, TSMC has also expanded its scope to include European IT talents, attracting new talents via online briefings and physical recruitment activities.

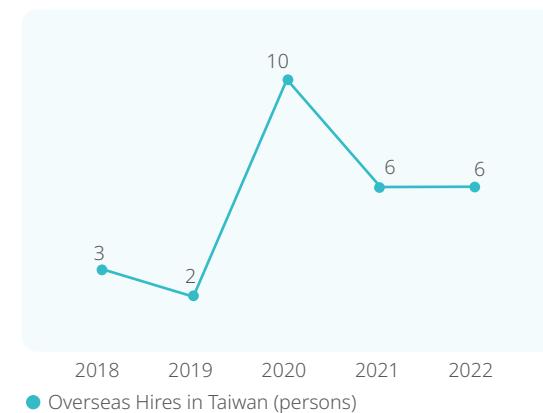
### Overseas Hires in Taiwan



## » Assimilate Foreign Employees

To help foreign employees quickly adapt to the new environment, TSMC offers assistance for relocation and settlement including exclusive newcomer orientation, subsidies for learning Chinese, and rewards for receiving Chinese certificates, so as to encourage foreign employees to assimilate into the workplace and environment of Taiwan. In addition, TSMC also invites foreign employees and their families to join exclusive groups such as the Formosa Cultural Society and Indian Culture Research Society. The Company also holds cultural festivals such as Thanksgiving and Indian Diwali etc., to increase mutual communication. In 2022, 21 people applied for a Chinese training subsidy, and the total subsidy amount was NT\$303,737.

### Overseas Hires in Taiwan - VisEra



## Case Study

### Advance to Southeast Asia - Expand Global Talent Recruitment

To expand global talent recruitment, TSMC visited Singapore and Malaysia in 2022 to communicate with diverse engineering talent in the local area. Three recruitment sessions and four face-to-face interviews were held to let local talent gain more insight into the semiconductor industry and TSMC. In total, 56 people participated in the interviews, and 12 accepted TSMC's offer for internships or permanent employment.

Besides recruitment activities, TSMC also visited the National University of Singapore, Nanyang Technological University, University of Malaya, and Universiti Tunku Abdul Rahman to meet with engineering professors, hoping to promote TSMC's internship program and industry-academia collaboration by strengthening campus relations, thereby establishing long-term partnerships, cultivating future talent, and introducing innovative energy into the semiconductor industry.



TSMC expands hiring of global talents to inject more innovation into semiconductor industry



## Employee Commitment

In 2021, TSMC introduced the [Engagement Survey](#), created using WTW's High Performing Employee Experience Model as a blueprint, to systematically learn about employees' experiences at work and analyze the Company's advantages and opportunities to formulate improvement measures. In 2022, three improvement measures were completed.

## Engagement Survey Improvement Measures

### Improvement Measures

### 2022 Improvement Measures

Establish an open-style management system and foster a workplace of mutual respect. Encourage employees to speak up and encourage management to be open to suggestions and make appropriate responses.

Unleash employees' potential, allowing them to enjoy work and learn and grow continuously to garner a tremendous sense of belonging and achievement.

In addition to cash rewards, non-monetary incentives are also used to motivate and retain talent.

Held CEO's communication meetings in Hsinchu, Taichung, and Tainan, and expanded the scope of labor-management meetings by adding Silicon Garden Meeting to each organization. Representatives were selected through peer voting, while suggestions and ideas could be submitted anonymously through representatives.

Launched physical and online courses complemented by diverse learning resources such as internal/external learning platforms to let colleagues enjoy learning at work.

Launched WeCare Survey and regular questionnaire surveys to care about new hires. Retention interviews were also carried out for groups at risk of resignation in a bid to improve problems promptly.

## Competitive Compensation Packages

TSMC provides competitive compensation packages to attract and retain the best talent, as well as reward employee performance and encourage long-term contribution. Besides referring to market information of selected benchmark companies and compensation survey reports, the Company also reviews market information on compensation data of the whole industry for competitiveness analysis to develop the most effective compensation strategies.

TSMC's compensation package includes a base salary, allowances, cash bonuses, and profit-sharing schemes. In 2022, the average annual compensation of a newly graduated TSMC engineer with a master's degree at Taiwan fabs and VisEra was higher than NT\$2 million. The average compensation of direct laborers was higher than NT\$1 million, which is four times the minimum monthly wages in Taiwan. Compared with the previous year, Taiwan fabs experienced year-on-year growth in 2022 in terms of the number of full-time employees, average salary, and median salary.

In addition to cash basis compensation, starting from 2022, regular employees of TSMC and its 100%-owned subsidiaries may participate in the Global Employee Stock Purchase Program. TSMC offers a 15% stock purchase subsidy to encourage colleagues to purchase company stocks and participate in the Company's long-term success. A total of 70% of colleagues worldwide participate in the program.

In recent years, TSMC has continued to grow in revenue and profit. The Company has increased [total compensation and benefits](#) for employees from around NT\$108.2 billion to NT\$239.5 billion between 2018 and 2022, and average compensation and benefits for every

employee from NT\$2.21 million to NT\$3.25 million during the same period. According to the Engagement Survey conducted in 2021, 81% of colleagues believe that the Company provides reasonable overall rewards and compensation. This result is better than that of global high-performance companies (67%) and high-tech companies (66%) participating in WTW Global's survey, indicating that besides offering competitive compensation in the market, TSMC's rewards are also recognized by colleagues as being reasonable.

In 2022, TSMC's revenue and profit reached a new record high yet again. The cash bonuses and profit-sharing schemes allocated for Taiwan fabs were valued at NT\$121.4 billion, and the annual salary adjustment for 2022 also took place as planned.

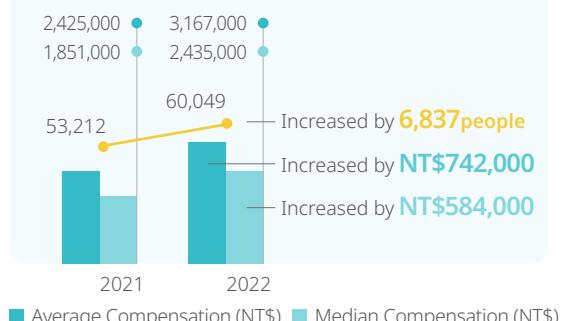
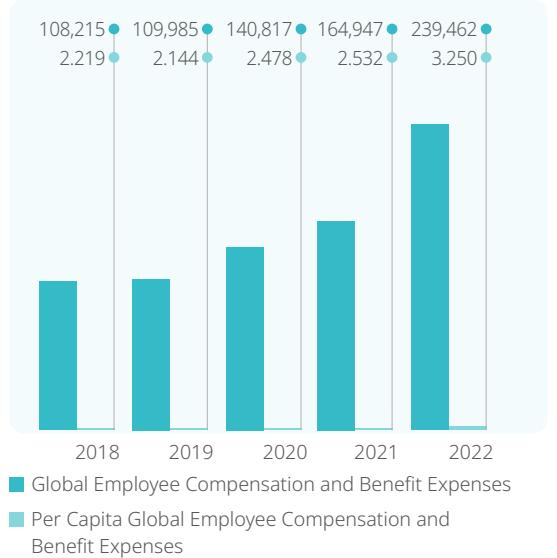
## Bonus

The incentive program of TSMC facilities in Taiwan is implemented over two years. Cash bonuses are paid quarterly to provide timely incentives and profit-sharing is paid annually in the following year to encourage long-term service and continuous contribution. The incentive programs of overseas regions are designed in consideration of local cultures and markets and are given out through annual cash bonuses or long-term one to three-year schemes. In 2022, [the median total compensation of TSMC employees globally \(excluding pension and other benefits\)](#) was approximately NT\$2.33 million, which was 1/276 of the CEO's total compensation. The median of the CEO's annual total compensation percentage increase and the annual average total compensation percentage increase was around 3.4:1.

## Average and Median Compensation

### Compensation and Benefit Expenses

Unit: NT\$ million



### Full-time Employees (persons)

Note: In compliance with the regulations set forth by the Taiwan Stock Exchange, TSMC started, in 2020, to disclose the number of full-time employees in non-executive positions, their average and median compensation, as well as respective differences in compensation from the previous year. The numbers are calculated in accordance with the regulations of the Taiwan Stock Exchange, which excludes executive officers (managers) and employees eligible for exemption. For those not employed by the Company for a full year, the data is prorated, and the profit-sharing amount is on a profit-year basis, therefore part of the compensation data is projected

## ● Corporate Officer Shareholding Guidelines

TSMC believes that the long-term ownership of company shares by corporate officers helps align their interests with those of all shareholders; therefore, the Company formulated the Corporate Officer Shareholding Guidelines in 2020. The required value for the Chairman, CEO, and other corporate officers' holding of TSMC shares is proportional to their annual base salary. Officers shall achieve the required value within three years of their appointment and maintain the required value for the entire period of their employment.

## ● Executive Officer Compensation Policy

TSMC's policies, systems, standards, and structures pertinent to the compensation of executive officers are stipulated and assessed by the independent Compensation and People Development Committee, including monthly salaries, quarterly

performance bonuses, and compensation paid based on annual profit conditions. If necessary, sign-on bonuses will be offered to attract critical talent. Since 2021, TSMC has offered Employee Restricted Stock Awards for corporate executives and critical talents to link their compensation with shareholders' interests and environmental, social, and governance (ESG) performance. In 2021 and 2022, the Employee Restricted Stock Awards Rules were stipulated; please refer to 4.6.1 Status of Employee Restricted Stock in the Company's 2022 annual report. According to laws and regulations, proposals related to the compensation of the Company and executive officers must be submitted to the Compensation and People Development Committee for deliberation and forwarded to the Board of Directors for resolution. Matters requiring the approval of the shareholders' meeting will take effect after the proposed resolutions have been presented at the shareholders' meeting and a

vote has been conducted in accordance with legal procedures. In addition to the aforementioned compensation policy, TSMC also provides a retirement policy that is better than the statutory requirements of Labor Standards Act to ensure future viability of executive officers' retirement benefits. Furthermore, in response to the regulations of the U.S. Securities and Exchange Commission, TSMC will formulate a claw-back policy for the compensation of executive officers in 2023 to enhance corporate governance and ensure the Company's financial integrity.

## ● Parental Benefits

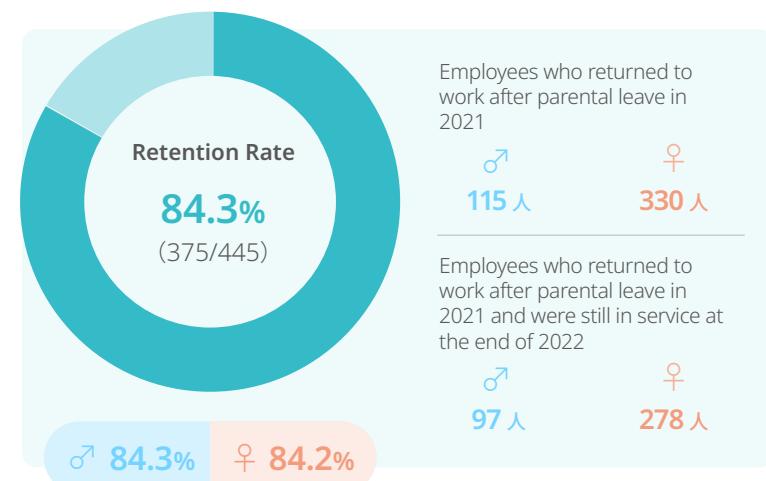
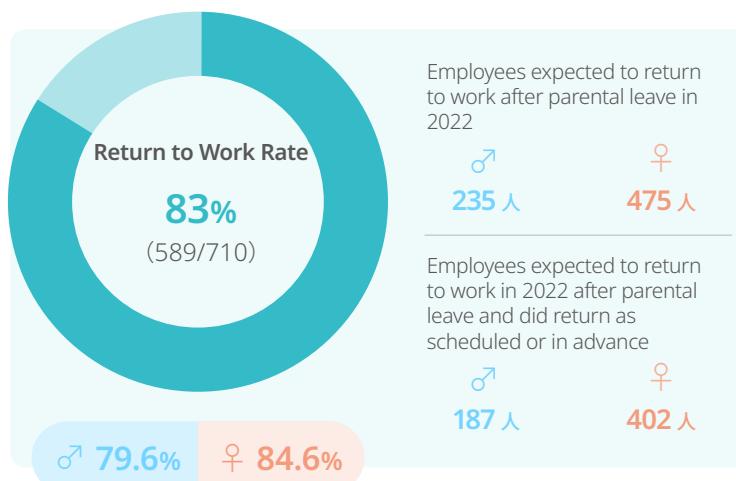
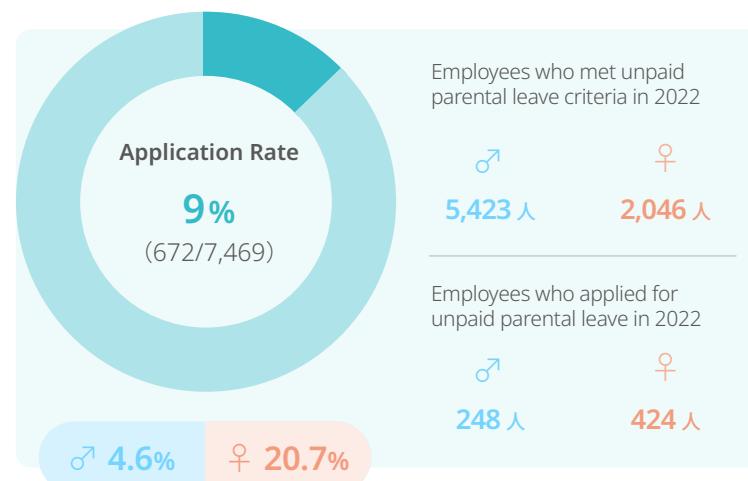
TSMC provides breastfeeding and breast milk collection rooms to support the breast milk collection needs of female employees. Besides, providing parental leave in accordance with local laws and regulations for employees after childbirth, the Company also offers a comprehensive leave

management system so that employees have flexibility in making use of their vacation days to take care of their children. In addition, TSMC launched the TSMC Child Care Benefit Program in 2022 to help employees balance their personal and work needs.

In 2022, a total of 672 employees in TSMC's Taiwan fabs and VisEra applied for unpaid parental leave. The expected number of employees to return from parental leave for the year was 710, of which 589 employees returned on time or ahead of time, achieving an 83% return to work rate. As for the retention rate after returning, of the 445 employees who returned to work in 2021, a total of 375 remained at TSMC as of the end of 2022, achieving an 84.3% retention rate.

In 2022, the number of employees in TSMC's Taiwan fabs and VisEra aged between 20 and 64 accounted for 0.43% of Taiwan's population of the same age group. During the same time, the number of

## Unpaid Parental Leave in TSMC's Taiwan Fabs and VisEra - Application, Return to Work, and Retention Rate





employees' newborns was 2,368, which was 1.7% of the total number of newborns in Taiwan, an example of the Company's outstanding benefits in mitigating the impact of sub-replacement fertility in Taiwan.

### • Solid Pension System

TSMC established its statutory defined benefit plan and supervisory committee of labor retirement reserve according to the Labor Standards Act, and also set up its statutory defined contribution plan according to the Labor Pension Act, which was effective starting July 1, 2005. For each region, TSMC also established pension plans according to local standards and regulations. The previously mentioned supervisory committee not only holds quarterly meetings but also supervises affairs in connection with labor's retirement reserve fund. To meet legal requirements for disclosure of financial reporting and ensure sufficient funding levels, TSMC makes contributions based statutory requirement and also

engages an actuarial consulting firm to assess the valuation of the defined benefit plan. Please refer to [Please refer to page 43-46 of the attached financial report in the Company's 2022 annual report](#) for details. Thanks to the Company's sound financial condition, it is able to ensure the future viability of employees' retirement benefits and solid pension contributions and payments, which encourages employees to make long-term career plans with and further deepen their commitment to TSMC.

### New Employee Orientation and Retention

To assist new employees to retain their jobs and quickly fit into the workplace, orientation training was launched in 2022 for newcomers who have worked for at least four months but less than one year. Inspired by the theme of workplace ecology, workplace communication, and stress regulation, the physical course Success for Newcomers in the

Workplace and the online broadcast Soft Power in the Workplace were launched. In total, 17 sessions of Success for Newcomers in the Workplace were conducted with 501 participants, achieving a post-class evaluation score of 97 points. For Soft Power in the Workplace, professional psychological counselors were invited to share with new employees how to regulate stress, adopt a growth mindset, as well as coping methods for challenges and setbacks based on their personal experience. Nearly 1,300 people participated in the program, achieving an average post-class evaluation score of 94 points.

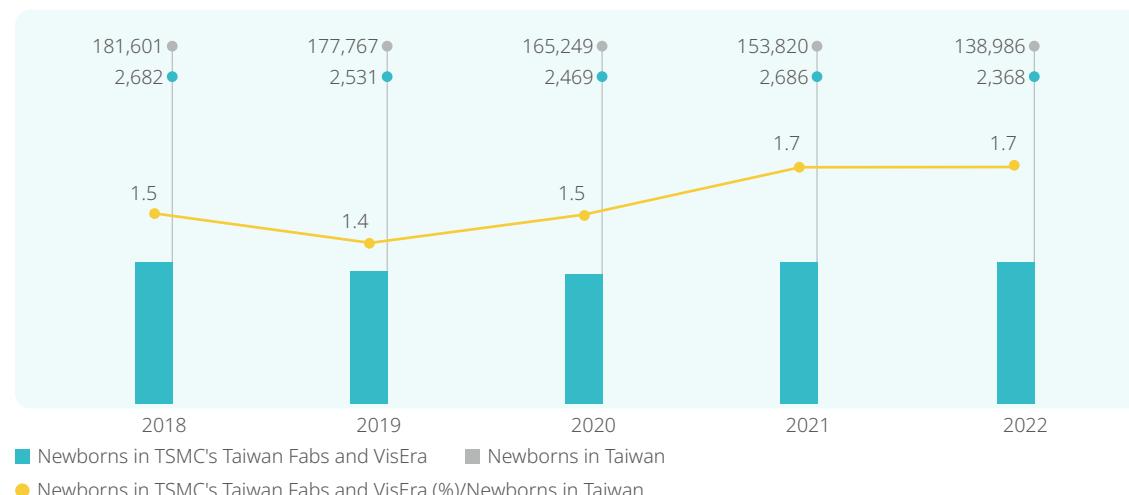
In addition to training, the WeCare Survey was launched in August 2022 to help new colleagues adapt to the workplace within one year of joining the Company. The survey includes dimensions such as self-efficacy, role clarity, social interaction, and understanding of the culture. Feedback is collected regularly every month and systematically analyzed to provide necessary assistance on time. After a pilot

run of five months, the adaptability assessment score of new employees increased from 7.4 to 7.9 points. Since October of the same year, direct supervisors can use the online dashboard to keep track of the progress of new employees. In 2023, TSMC expects to launch the online robot Bonnie, which can quickly answer new colleagues' questions and help them integrate into company life seamlessly.

### Maintain Healthy Turnover Rate

To ensure talent mobility and long-term growth, TSMC believes that a healthy employee turnover rate should be between 5 and 10%. In 2022, the total turnover rate was 6.7%, or 0.1 percentage points lower than that of 2021. The new hire turnover rate (<1 year) was 15.0%, or 2.6% lower than that of 2021, indicating that new employee care measures implemented in 2022, such as the WeCare Survey, new employee orientation training, etc., helped retain employees.

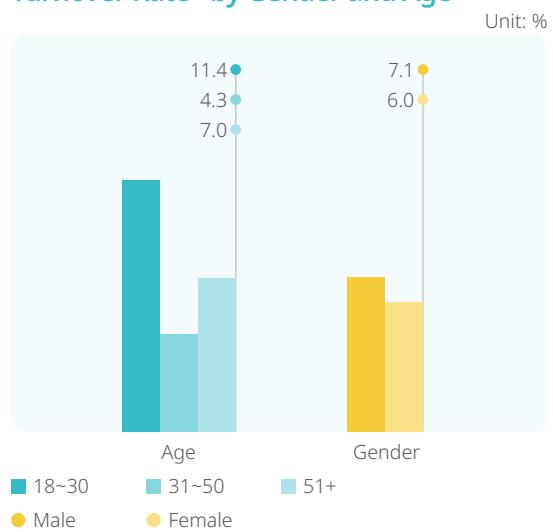
### Newborns in TSMC's Taiwan Fabs and VisEra



### Historical Turnover Rates



### Turnover Rate - by Gender and Age



Note: Starting from 2021, the new hire turnover rate (<1 year) includes data from VisEra



# Talent Development

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Equip People with Future Capabilities</b> Prepare employees with the skills for the future and build a talent pool	Fill over 80% of manager positions through internal promotions  Fill over 50% of vacancies through internal transfers  90% completion of the talent pipeline within three years for fab directors/directors	Fill over 80% of manager positions through internal promotions  Fill over 50% of vacancies through internal transfers  Review 80% of the talent pipeline for fab directors/directors	Filled 88.6% of manager positions through internal promotions Target: ≥ 80%  Filled 57.6% of vacancies through internal transfers Target: ≥ 50%  Reviewed 69% of the talent pipeline for fab directors/directors Target: 80%
<b>Unleash Employees' Potential and Innovation</b> Enable self-learning and create positive impact to the Company and the society	Achieve an annual average of 100 hours of learning in employees	Achieve an annual average of 75 hours of learning in employees	Achieved an annual average of 69.5 hours of learning in employees Target: 50 hours

Note: In 2022, the organizational structure was adjusted to meet operational needs, and 88 new organizations were established, lowering the talent pipeline's review rate

↑ Exceeded    ✓ Achieved    — Missed Target

Employees are the most important asset of TSMC. Besides encouraging colleagues to learn constantly and unleash their talents, TSMC also emphasizes the cultivation of their skills and ongoing development. Consequently, the Company integrates internal and external resources to provide employees with a world-class workplace as well as challenging, meaningful, and interesting jobs. In addition, the TSMC Employee Training and Education Procedures have been formulated. In 2022, the TSMC Talent Development Model was formulated to materialize the two major strategies of Equipping Employees

with Future Capabilities as well as Unleashing Employees' Potential and Innovation based on core attributes, in turn developing an ability-based learning program and a diverse and versatile learning approach. Complemented by various training and development programs at all levels, the Company aims to equip colleagues with capabilities that will be needed in the future in advance, actively implement comprehensive talent pipeline management, and enable employees to engage in lifelong learning with goals, plan and discipline, thereby becoming a force to uplift the society.

## TSMC Talent Development Model



## Equip People with Future Capabilities

To accommodate the needs of operational growth, TSMC values the pre-training of employee capabilities and talent pipeline management. This is to ensure that when there is a mission, positions can be filled with suitable talent immediately to support the Company's rapid development. In 2022, 88 new organizations were added and the review of talent pipeline for fab directors/directors reached 69%. Through the talent pipeline, the Company can systematically formulate a detailed talent development plan, focus on operational needs, and complete the Company's talent pool.

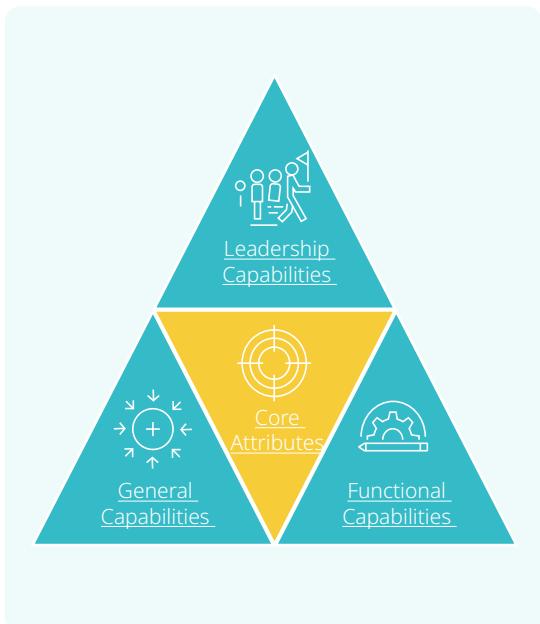
To take fab director talent as an example, the one-year Operations People Development Program (OPDP) emphasizes the four major learning themes of Problem Solving, Strategic Thinking, Systems Thinking, and Change Management. Through group learning, application case studies, experience sharing by vice presidents and senior fab directors, as well as mentoring and other plans, TSMC strives to enhance the knowledge of fab directors and train all-round talent. The participation rate was 100%.

In terms of manager talent pipeline management, the updated New Manager Program was launched in 2022. The program was attended by 1,255 persons, achieving a participation rate of 97% and a cumulative total of 7,300 person-times. The Operation Engineers Training Committee (OETC) also plans training for engineers with different jobs and levels, builds capability stages and learning roadmaps, and provides courses in regulations, technology, management, and personal effectiveness to equip employees with the necessary skills for future development. The program was attended by 48,000 persons, achieving a participation rate of 100% and a cumulative total of 380,000 attendees.

## Ability-Based Learning Program

The TSMC Capability Model centers on the Core Attributes to define Functional Capabilities according to the characteristics of each organization. General Capabilities and Leadership Capabilities necessary for employees are also developed. These are divided into two categories, Managing Work and Managing People/Organization, and they are further divided into three levels: basic, intermediate, and advanced. This is complemented by organizational development diagnosis to offer a series of learning and development plans.

## TSMC Capability Model



## Diverse and Versatile Learning Approach

By applying the 70-20-10 rule, TSMC provides employees with specific development needs in three dimensions: Experience Learning, Feedback and Guidance, and Education and Training. Also, in combination with blended learning, employees are encouraged to apply the learning results to work and life in order to improve their performance and self-efficacy.

### 70-20-10 Rule



70%

### 2022 Learning and Development Activities



20%



10%

#### Dual track development of management and professional technical competencies

- Employees continue to accrue management and professional technical experience based on organizational needs and personal expertise to learn from work tasks and enhance their competencies

#### Transfers and Rotations in 2022

	Outbound	Incoming	Taiwan Fabs and VisEra			Overseas	Total
			Hsinchu Site	Taichung Site	Tainan Site		
Taiwan Fabs and VisEra	Hsinchu Site	7,090	268	436	36	7,830	
	Taichung Site	301	1,165	439	69	1,974	
	Tainan Site	516	151	4,733	14	5,414	
Overseas		20	20	15	1,507	1,562	
Total		7,927	1,604	5,623	1,626	16,780	

#### Internal Promotions, Transfers, and Rotations

Passing on organizational knowledge through internal talent mobility

- 88.6%** manager positions filled through internal promotions
- 30.5%** and **26%** of the transfer and rotation rates for managers and professionals respectively
- 57.6%** vacancies filled through internal transfers
- 16,780** employees transferred to new positions



#### Buddy System

- 12,442** new employees expedited their understanding of the corporate culture through the buddy system and continued to offer feedback and suggestions during their employment

#### Mentor System

- Employees are encouraged to learn from outstanding senior employees, who can provide them with work or personal adaptation-related guidance

#### Feedback and Development on Performance

- Two performance management development tools are provided (Goal Management and Individual Development Plan) to encourage employees to set goals and update progress of implementation on a continuous basis; at the same time, managers can review employee progress as well as give feedback and recognition to help both parties effectively align work and development goals



#### Training Program

- Provide diverse learning resources on leadership, functional, and general capabilities in accordance with job titles and expertise
- 3,708** face-to-face trainings
- 8,509** online trainings
- 2,518,073** participants
- An average of **69.5** hours of learning per employee



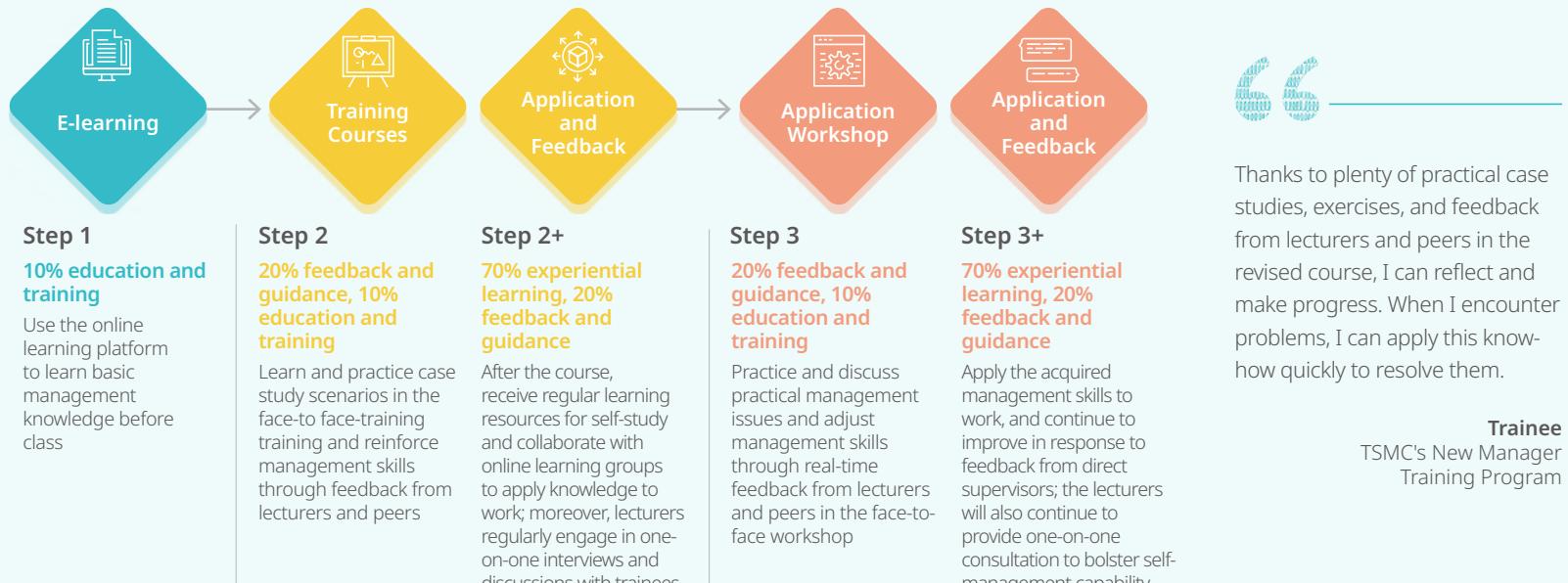
## Case Study

# 70-20-10 Rule + Blended Learning Helps New Managers Adapt to Their Jobs More Quickly

As the number of employees continues to increase along with the diversification of the workforce structure and composition, the management's responsiveness and functional development must also continue to evolve. TSMC has consolidated the 70-20-10 rule and the blended learning model to design a revised new manager

training course to guide new managers in applying it to their work via three steps. Furthermore, real-time adjustments are implemented in response to feedback to optimize management skills at work on an ongoing basis. Please refer to [TSMC's Diverse Learning Models Bolster Talent Development](#) for more details.

## Three Steps of New Supervisor Training Course



66

Thanks to plenty of practical case studies, exercises, and feedback from lecturers and peers in the revised course, I can reflect and make progress. When I encounter problems, I can apply this know-how quickly to resolve them.

**Trainee**  
TSMC's New Manager Training Program



TSMC New Manager Training Program

## Training and Development Programs at All Levels

TSMC conducts talent development based on the TSMC Capability Model and designs learning courses based on grade and expertise. In 2022, training and development plans for employees at all levels were completed and launched progressively.



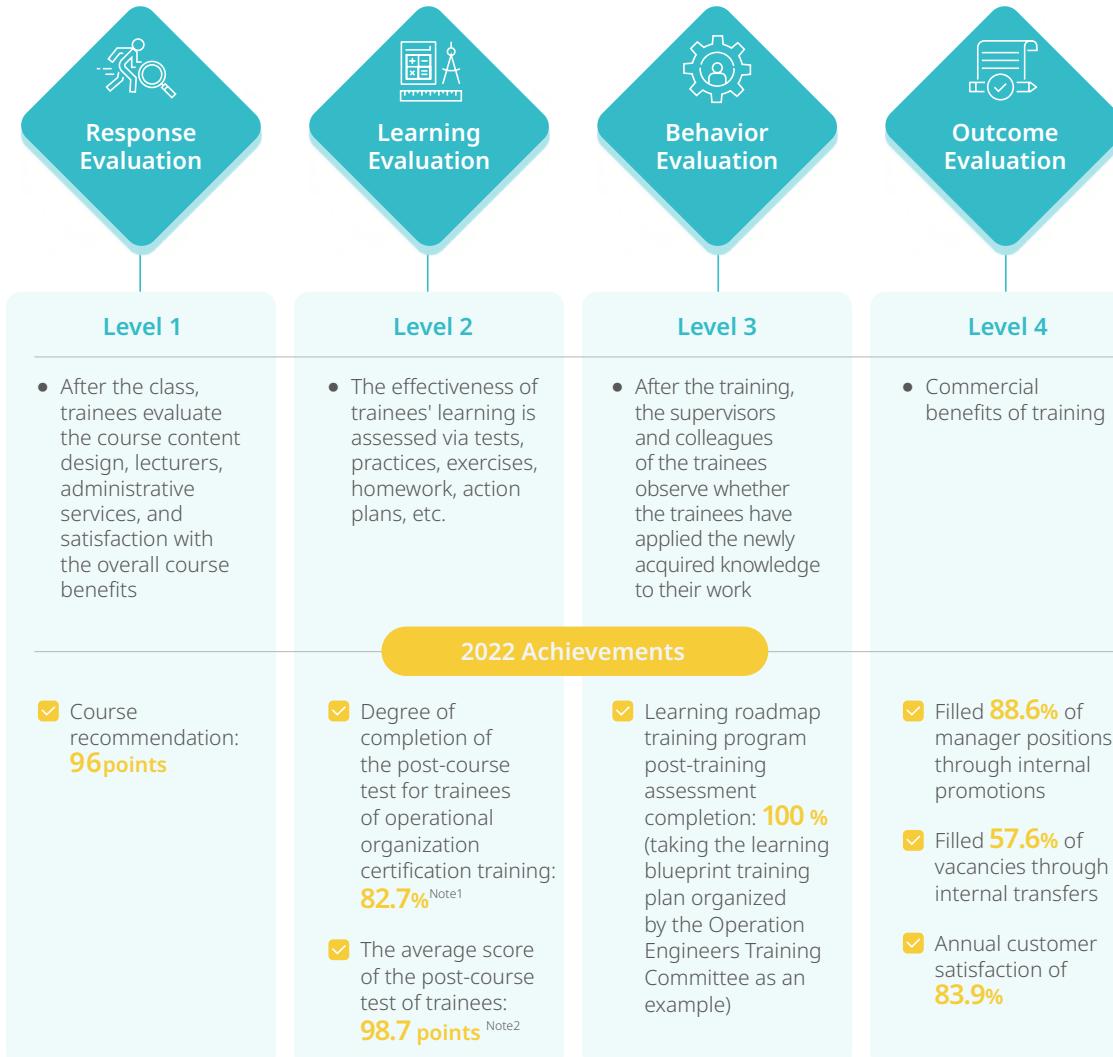
## Unleash Employees' Potential and Innovation

TSMC offers a wide range of learning resources to provide colleagues with learning content and approaches that cater to the needs of individuals and organizations, hoping to improve their work performance and self-worth and engender a positive impact on the Company and society. In 2022, face-to-face and online training were launched along with internal and external learning platforms, and employees' average annual learning hours reached 69.5 hours, an increase of 42% compared with the previous year. The total training cost was NT\$968 million, equivalent to NT\$13,000 per employee, an increase of 5.6 times relative to the year before.

TSMC measures the outcome using the four levels of evaluation of the [Kirkpatrick Model](#): reaction, learning, behavior, and results. In 2022, TSMC conducted reactive evaluations for all courses hosted by Organization Planning and Development Office. The course design, lecturers, administrative services, and overall satisfaction level were evaluated. Employees gave a score of 96 for their overall recommendations. In terms of course effectiveness, learning and behavior evaluations were completed for the majority of on-the-job training held at the organization level, allowing learners to understand and apply the training to work; the outcome evaluation was based on the staff performance management and development system, demonstrating the training benefits by achieving the performance goals.



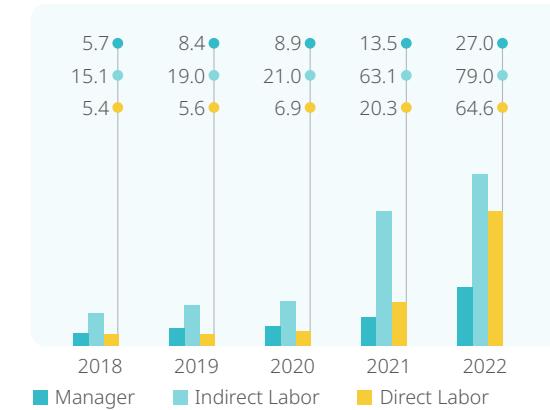
## Kirkpatrick Model



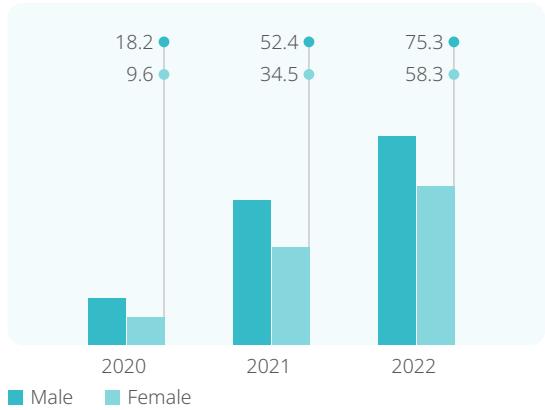
Note 1: Taking the degree of completion of advanced TSMC fabs and on-duty certification of the operational organization as an example

Note 2: Taking the course conducted by the Organizational Planning and Development Office as an example

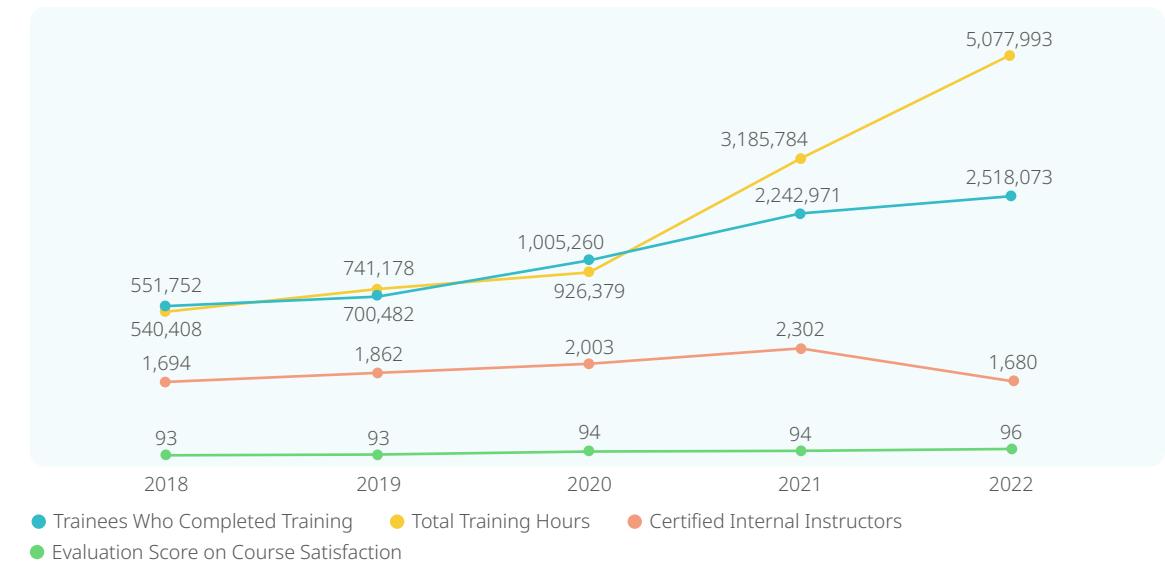
## Average Training Hours per Person - by Job Function



## Average Training Hours per Person - by Gender



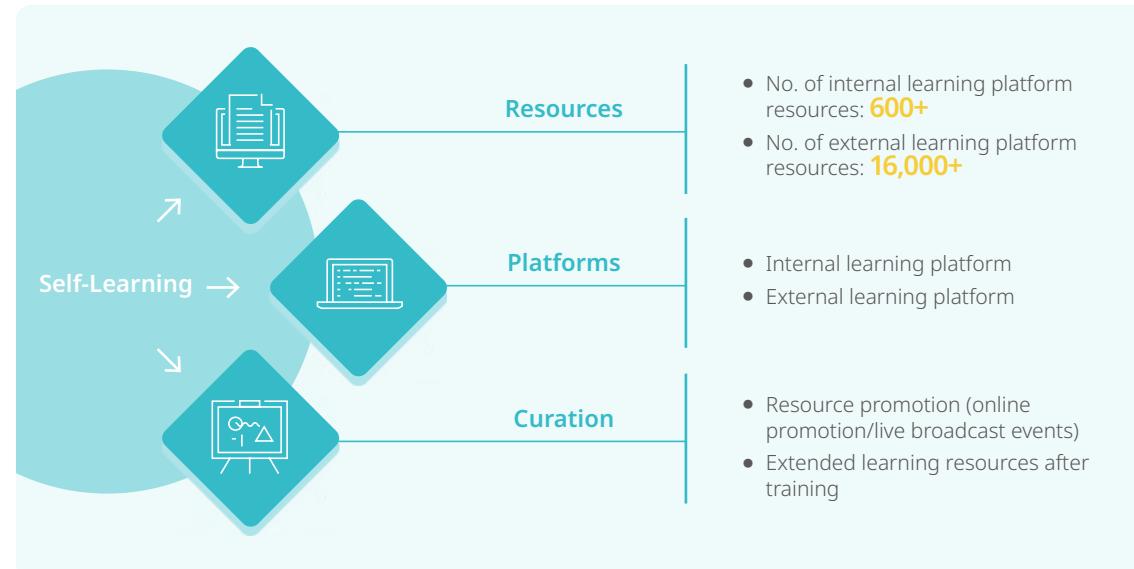
## Historical Training Index



Note: Starting in 2022, certified internal instructors who obtained repeated certifications will be counted only once

## Diverse Learning Resources and Channels

TSMC's growth is closely tied to the learning and development of employees. Besides education and training courses that have significant relevance to professional technology and functions, the Company applies skills as the foundation of development in order to cultivate employees' knowledge on an ongoing basis and strengthen the awareness of self-learning. Combined with the [internal learning manual](#) and [external learning platform](#), TSMC launched more than 16,000 diverse learning resources including online micro-classes, audio-visual storytelling, reading articles, and special broadcasts for colleagues to choose from at will. In 2022, over 152,279 colleagues partook in the program, accumulating 14,413 learning hours and achieving an overall satisfaction score of 93 points for the internal learning resources.



## Cultivate Internal Instructors & Excellent Instructor Award

Talent is one of TSMC's key strategies for bolstering its competitiveness, and internal instructors have become an important impetus for facilitating the Company's talent cultivation through the sharing of personal knowledge and experience. Established 16 years ago, the Excellent Instructor Award has recognized excellent internal instructors each year, hosting Trainer Power-Up Camp, inviting external trainers to share knowledge in the training field; at the same time, encouraging other outstanding employees to join the ranks of our instructors and share their knowledge and experience for more efficient training. In 2022, TSMC employees were trained over 300,000 times cumulatively with the help of over 1,680 internal instructors.



As senior employees of TSMC, we are obligated to pass on the experience and heritage to uphold TSMC's technological leadership.

**T.C. Luo**

Awardee of the Excellent Instructor Award



For me, being a trainer entails sharing my experience with trainees; the enthusiastic feedback of trainees enables me to examine my work and teaching from diverse angles and perspectives.

**I.W. Chen**

Awardee of the Excellent Instructor Award



2022 TSMC Excellent Instructor Award Ceremony

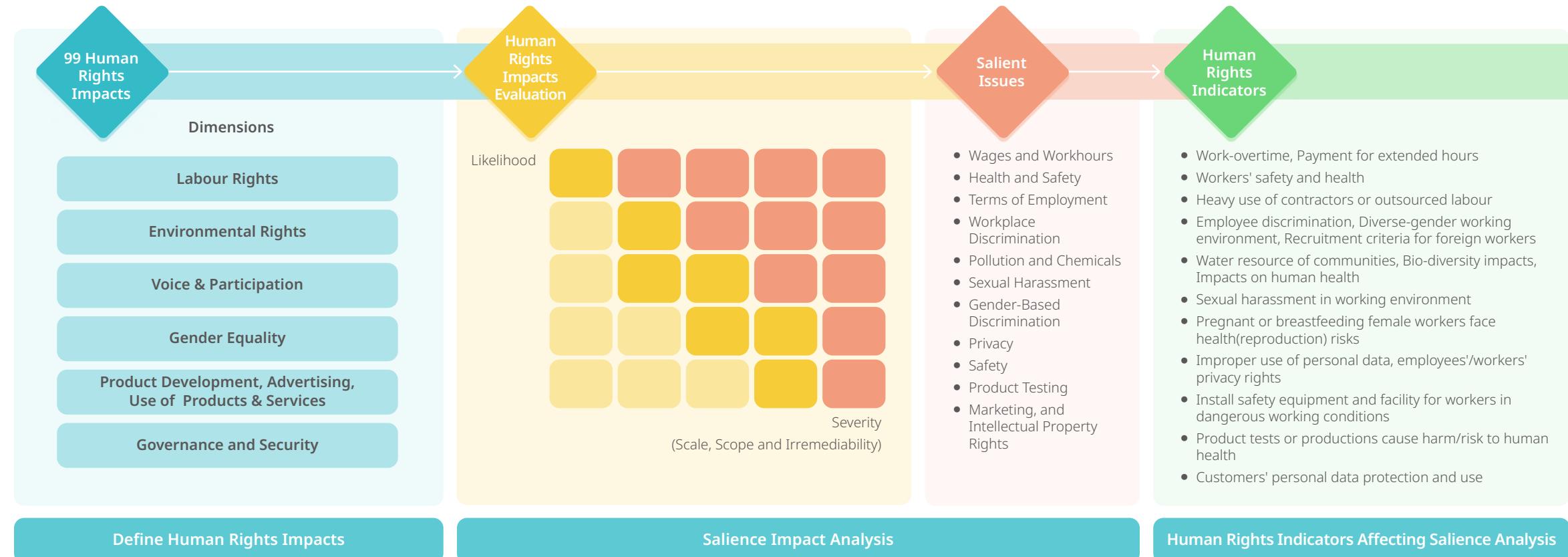


# Human Rights

Strategies	2030 Goals	2023 Targets	2022 Achievements
<p><b>Enforce the TSMC Human Rights Policy</b></p> <p>Comply with the United Nations Guiding Principles on Business and Human Rights (UNGPs) to monitor material human rights issues and minimize relevant risks</p>	<p>Maintain Human Rights Related Issues in all fabs that implement the Validated Assessment Program (VAP) of the Responsible Business Alliance (RBA) at a zero-missing level</p> <p>Optimize training and management systems to support zero sexual harassment, zero workplace bullying, work hour management, human rights of disabled employees, and proprietary information protection</p>	<p>Maintain Human Rights Related Issues in all fabs that implement the VAP of the RBA at a zero-missing level</p> <p>Organize a training program on TSMC Human Rights Policy: Say No to Sexual Harassment and Build Up a Friendly Workplace</p> <ul style="list-style-type: none"><li>- Completion rate &gt;95%</li><li>- 100% pass rate in post-class tests</li></ul>	<p>Maintained Human Rights Related Issues in all fabs that implement the VAP of the RBA at a zero-missing level Target: Zero-missing</p> <p>Organized a training program on TSMC Human Rights Policy: Say No to Sexual Harassment and Build Up a Friendly Workplace</p> <ul style="list-style-type: none"><li>- Completion rate 97% Target: 95%</li><li>- 100% pass rate in post-class tests Target: 100%</li></ul>

↑ Exceeded    ✓ Achieved    — Missed Target

TSMC adopts the RBA Code of Conduct and the UNGPs approved by the United Nations Human Rights Council to manage the human rights issues of its operations, suppliers, and business partners, as well as formulate the [Human Rights Policy](#). Furthermore, TSMC abides by the local laws and regulations of the global regions in which it operates and stipulates clear implementation guidelines for various human rights concerns in an effort to minimize human rights risks.





In 2022, TSMC launched the survey of salient human rights issues using the UNDP's human rights framework. A total of 73 managers and colleagues participated in the identification of human rights issues; the members included ESG committee members, the heads of sustainability

reports of various organizations, and ESG representatives. The importance and impact of various human rights indicators on TSMC and its value chain were measured from a cross-organizational perspective. Based on the investigation results, 11 salient human rights

issues were identified along with the targets that are impacted by the issues, including TSMC employees, employees of suppliers, employees of contractors, customers, and the community. In 2023, TSMC will use these results to build a cross-unit human rights taskforce, which will follow

the UNGPs framework to conduct due diligence, perform risk investigation and assessment, implement mitigation and remedial measures, launch human rights education and training, as well as disclose human rights management progress and goals to stakeholders.

Dimensions	Salient Issues	Indicators	Impacted Targets				
			TSMC Employees	Suppliers' Employees	Contractors' Employees	Customers	Community
Labour Rights	<ul style="list-style-type: none"> <li>• Wages and Workhours</li> <li>• Health and Safety</li> <li>• Terms of Employment</li> <li>• Workplace Discrimination</li> </ul>	<ul style="list-style-type: none"> <li>• Work-overtime, Payment for extended hours</li> <li>• Workers' safety and health</li> <li>• Heavy use of contractors or outsourced labour</li> <li>• Employee discrimination, Diverse-gender working environment, Recruitment criteria for foreign workers</li> </ul>	✓ ✓ ✓	✓ ✓ ✓ ✓	✓ ✓ ✓ ✓		
Environmental Rights	<ul style="list-style-type: none"> <li>• Pollution and Chemicals</li> </ul>	<ul style="list-style-type: none"> <li>• Water resource of communities, Bio-diversity impacts, Impacts on human health</li> </ul>				✓	
Voice & Participation	<ul style="list-style-type: none"> <li>• Privacy</li> </ul>	<ul style="list-style-type: none"> <li>• Improper use of personal data, employees'/ workers' privacy rights</li> </ul>	✓	✓	✓		
Gender Equality	<ul style="list-style-type: none"> <li>• Sexual Harassment</li> <li>• Gender-Based Discrimination</li> </ul>	<ul style="list-style-type: none"> <li>• Sexual harassment in working environment</li> <li>• Pregnant or breastfeeding female workers face health(reproduction) risks</li> </ul>	✓ ✓	✓ ✓	✓ ✓		
Product Development, Advertising, Use of Products & Services	<ul style="list-style-type: none"> <li>• Product Testing</li> <li>• Marketing, and Intellectual Property Rights</li> </ul>	<ul style="list-style-type: none"> <li>• Product tests or productions cause harm/risk to human health</li> <li>• Customers' personal data protection and use</li> </ul>	✓	✓	✓		✓
Governance and Security	<ul style="list-style-type: none"> <li>• Safety</li> </ul>	<ul style="list-style-type: none"> <li>• Install safety equipment and facility for workers in dangerous working conditions</li> </ul>	✓	✓	✓		

## TSMC Human Rights Management System

- TSMC Facilities & Subsidiaries and Human Rights**  
Operations managers on site are jointly responsible with senior executives in HR, Information Technology, Materials Management & Risk Management, and Legal. The senior executive in HR is responsible for reporting major human rights topics in TSMC to the management team.
- Employees and Human Rights**  
The HR Organization's Human Rights Operation Center is responsible for human rights topics of daily relevance to employees and ensuring the Company meets RBA or higher standards by compiling and carrying out the Measures for Human Resources Management System and the Internal Control Procedures for Human Resource Management System.
- Suppliers and Human Rights**  
The IT Supply Chain Management Section of the Information Technology and Materials Management & Risk Management organization are responsible for all human rights issues related to suppliers and for managing the issues by compiling and carrying out [TSMC Supplier Code of Conduct](#).



## 2022 Human Rights Policy Concerns and Practices

High-risk Employees

		Targets and Actions	Risk Assessment	Mitigation Measures	Remedies	Reporting Channels
Provide a Safe, Healthy, and Harassment-Free Workplace	<p>All employees  0</p> <ul style="list-style-type: none"> <li>Please refer to <a href="#">Occupational Safety and Health</a> for more information on special hazards and health management</li> <li>Top 5% of employees with the highest level of stress recorded from the employee health survey</li> <li>14 incidents verified by the Sexual Harassment Investigation Committee</li> </ul>	<ul style="list-style-type: none"> <li>Formulate OSH Management Procedures and establish the Employee Health Management Program Meeting and Occupational Disease Investigation Committee</li> <li>Formulate a Sexual Harassment Prevention Policy and establish the Sexual Harassment Investigation Committee</li> </ul>	<ul style="list-style-type: none"> <li>Investigate whether there are any occupational diseases from chemical exposure</li> <li>Increase voluntary participation rate for non-statutory employee health plans</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly meetings on occupational health management were held by senior executives to manage and control the <a href="#">five major safety hazards</a> of occupational diseases <a href="#">across departments</a></li> <li>Advanced medical imaging checks every five years for new employees and non-management employees</li> <li>Follow-up with employees with top 5% stress levels by therapists and counseling services</li> </ul>	<ul style="list-style-type: none"> <li>Immediate transfer from the original post</li> <li>Provide ample medical support</li> <li>Provide compensatory leave and subsidies according to laws and regulations</li> </ul>	Occupational Disease Investigation Committee and <a href="#">Employee Voice Channels</a>
Eliminate Discrimination and Ensure Equal Employment Opportunities	<p>New employees, indigenous peoples, women, migrant workers, contract employees, persons with disabilities, etc.  0</p>	<ul style="list-style-type: none"> <li>Declare principles of <a href="#">non-discrimination</a> in the <a href="#">TSMC Recruitment Interview Internal Control Procedures</a> and offer Recruitment &amp; Selection training courses and suggestions/reminders to hiring supervisors</li> </ul>	<ul style="list-style-type: none"> <li>Eliminate discrimination in the workplace in compliance with internal control procedures starting from recruitment</li> </ul>	<ul style="list-style-type: none"> <li>A total of 839 managers completed the Recruitment &amp; Selection training course in 2022</li> </ul>	<ul style="list-style-type: none"> <li>Violations of the non-discrimination principle by management shall be punished according to internal policies on rewards and punishment</li> <li>The Recruitment Division shall re-invite candidates into the interview process</li> </ul>	<a href="#">Irregular Business Conduct Reporting System</a>
Prohibit Forced Labor and Child Labor	<p>New employees  0</p>	<ul style="list-style-type: none"> <li>Comply with regulations on freely chosen employment in the RBA Code of Conduct</li> <li>Establish Recruitment &amp; Hiring Measures to declare that TSMC does not employ forced labor and employees under the age of 18; detail employee rights, duties, and benefits in the Offer Letter to maintain fair and transparent employee relations</li> </ul>	<ul style="list-style-type: none"> <li>Inquire about candidates' willingness to work during the interview</li> <li>Candidates must provide <a href="#">proof of identification</a> for verification</li> </ul>	<ul style="list-style-type: none"> <li>Oversaw the compliance of various procedures during employment through the prohibition of forced labor management procedures to eliminate child labor and forced labor-related problems</li> </ul>	<ul style="list-style-type: none"> <li>Risk prevention through the regular VAP and Self-assessment Questionnaire (SAQ) from the RBA Code of Conduct</li> <li>If there is any evidence of forced labor, supervisors will be required to make the necessary improvements and restore the rights to which employees are entitled</li> </ul>	<a href="#">Irregular Business Conduct Reporting System</a>
Manage Working Time	<p>All employees  Please refer to <a href="#">Occupational Safety and Health</a> for more information on the risks of overworking</p>	<ul style="list-style-type: none"> <li>Formulate Management Measures for Work Hours Procedure and build an Attendance Record System and Overtime System</li> </ul>	<ul style="list-style-type: none"> <li>Understand employee work hours through reporting channels, fab-level communication meetings, and management <a href="#">systems</a></li> <li>TSMC must first obtain employee consent for overtime requests and provide overtime pay or compensatory leave</li> </ul>	<ul style="list-style-type: none"> <li>Managed and analyzed employee timesheets and provided early warnings to fab supervisors on work hour management</li> <li>Overall employee compensation is higher than the minimum wage and industry peers</li> </ul>	<ul style="list-style-type: none"> <li>If there is any evidence of forced labor, supervisors will be required to make the necessary improvements and restore the rights to which employees are entitled</li> </ul>	<a href="#">Employee Voice Channels</a>
Encourage Work-Life Balance	<p>All employees  0</p>	<ul style="list-style-type: none"> <li>Provide a <a href="#">variety of activities</a> and clubs to enrich the concept of work-life balance</li> <li>Offer childcare services &amp; educational support/services</li> </ul>	<ul style="list-style-type: none"> <li>Examine participation rates</li> <li>Increase quota for TSMC childcare facilities</li> </ul>	<ul style="list-style-type: none"> <li>Collaborated with members of the TSMC Employee Welfare Committee and activity organizers to promote activities and encourage participation</li> <li>Optimized pay structure and offered an additional seven days of paid leave to attract and retain outstanding kindergarten teachers</li> <li><a href="#">Strengthened STEAM education at the TSMC kindergarten</a></li> </ul>	<ul style="list-style-type: none"> <li>Conduct questionnaires to make improvements in the future</li> <li>Move up the date to draw lots for the use of childcare facilities. This will allow those who did not draw a slot to have adequate time to find other childcare facilities</li> <li>Offer competitive compensation and benefits to kindergarten teachers</li> </ul>	<a href="#">Employee Voice Channels</a>
Responsible Mineral Sourcing	<p>All suppliers  0</p>	<ul style="list-style-type: none"> <li>Require suppliers to comply with and sign the <a href="#">TSMC Statement on Responsible Sourcing of Minerals</a> for products containing tantalum, tin, tungsten, and gold</li> </ul>	<ul style="list-style-type: none"> <li>Establish a due diligence framework in compliance with the Model Supply Chain Policy for a Responsible Global Supply Chain of Minerals from Conflict-Affected and High-Risk Areas by the OECD</li> </ul>	<ul style="list-style-type: none"> <li>Suppliers of products containing tantalum, tin, and tungsten, and gold were required to collaborate with more than one compliant smelter</li> </ul>	<ul style="list-style-type: none"> <li>Suppliers will be asked to terminate sourcing if there is evidence of sourcing from non-compliant mines</li> </ul>	<a href="#">Reporting Channels for Supply Chain Employees</a>



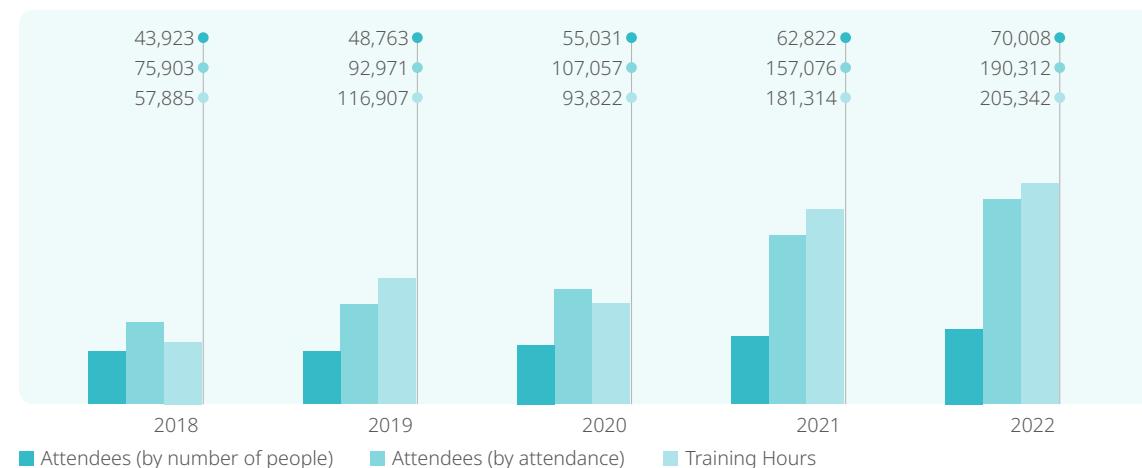
## Human Rights Protection Training Programs

In 2022, TSMC launched a wide range of human rights protection training programs on fab ESH, emergency response, first-aid training, and a friendly workplace. TSMC offered a total of 205,342.1 training hours to 70,008 employees, which was 95.7% of all TSMC employees. A total of 190,312 employees attended the human rights protection training programs. Furthermore, TSMC launched the TSMC Human Rights Policy: Say No to Sexual Harassment and Build Up a Friendly Workplace training program, which saw the participation of 63,550 employees and achieved a 100% pass rate for the post-class test.

## Risk Assessment & Management

As a full member of the RBA, TSMC conducts

## Human Rights Protection Training



due diligence in compliance with the RBA Code of Conduct to ensure that TSMC either meets or exceeds the standard.

TSMC uses the RBA SAQ as a template to identify the practices, risks, and management systems of the four major aspects of labor, health and safety, environment, and ethics in business operations. In 2022, all TSMC fabs in Taiwan scored 88 or more on the SAQ, which qualifies as Low Risk (85 or higher is considered Low Risk). To comply with customer requests, TSMC also commissioned a third-party institute to carry out the RBA VAP for seven TSMC fabs, which all received full marks on the VAP. The complete audit report will be disclosed to customers and related stakeholders on RBA-Online.

Region	Site	SAQ Assessment Scores 2022	VAP Score				
			2016-2018	2019	2020	2021	2022
Taiwan	Corporate HQ	97.3 <span style="color: #0070C0;">(●)</span>	-	-	-	-	-
Taiwan	Fab 2	92.6 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-
Taiwan	Fab 3	91.9 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-
Taiwan	Fab 5	92.1 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Fab 6	92.4 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-
Taiwan	Fab 8	92.1 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-
Taiwan	Fab 12A	92.9 <span style="color: #0070C0;">(●)</span>	193.3	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Fab 12B	92.1 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>
Taiwan	Fab 14A	92.2 <span style="color: #0070C0;">(●)</span>	182.4	-	-	-	<span style="color: #FFD700;">(✓)</span>
Taiwan	Fab 14B	92.9 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Fab 15A	92.6 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Fab 15B	93.4 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	<span style="color: #FFD700;">(✓)</span>	<span style="color: #FFD700;">(✓)</span>
Taiwan	Fab 18	92.4 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Advanced Backend Fab 1	93.5 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-
Taiwan	Advanced Backend Fab 2	93.6 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-
Taiwan	Advanced Backend Fab 3	95.5 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	<span style="color: #FFD700;">(✓)</span>	-
Taiwan	Advanced Backend Fab 5	91.6 <span style="color: #0070C0;">(●)</span>	-	-	-	-	-
Subsidiaries							
Subsidiaries	VisEra	93.6 <span style="color: #0070C0;">(●)</span>	-	-	-	-	-
Subsidiaries	TSMC (China)	93.0 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-
Subsidiaries	TSMC (Nanjing)	91.5 <span style="color: #0070C0;">(●)</span>	-	196.5	-	-	-
Subsidiaries	WaferTech	88.7 <span style="color: #0070C0;">(●)</span>	<span style="color: #FFD700;">(✓)</span>	-	-	-	-

SAQ : (●) Low Risk ( $\geq 85$ ) (○) Medium Risk ( $\geq 65 \& < 85$ ) (△) High Risk ( $< 65$ )

VAP : (✓) Full marks (200)

## Employee Voice Channels and Case Management

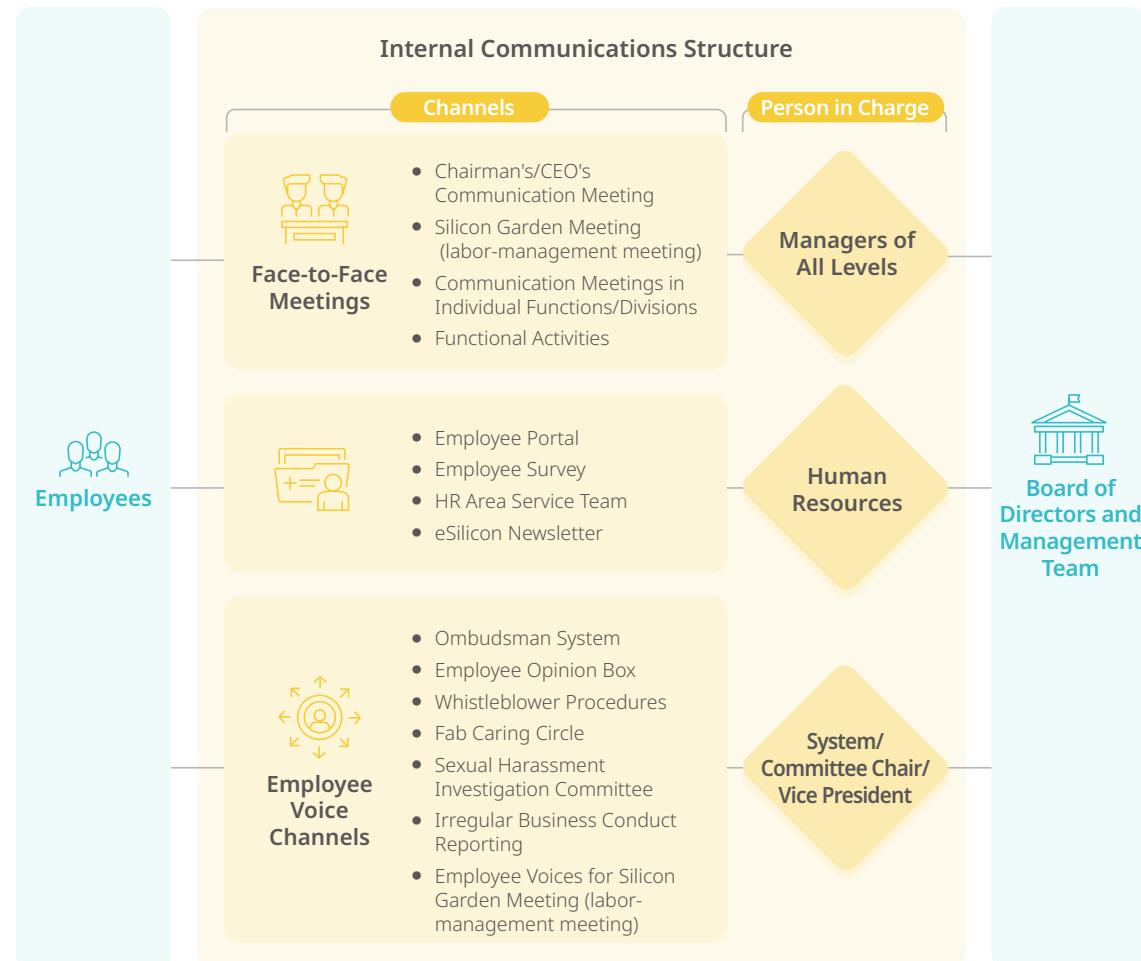
TSMC values employee opinions and interests. To protect the human rights of employees, TSMC has constructed a robust system for employee feedback that includes face-to-face communication

meetings, employee opinion surveys, Silicon Garden Meeting, and various employee feedback channels such as employee suggestion boxes, the Ombudsman System managed directly by a senior

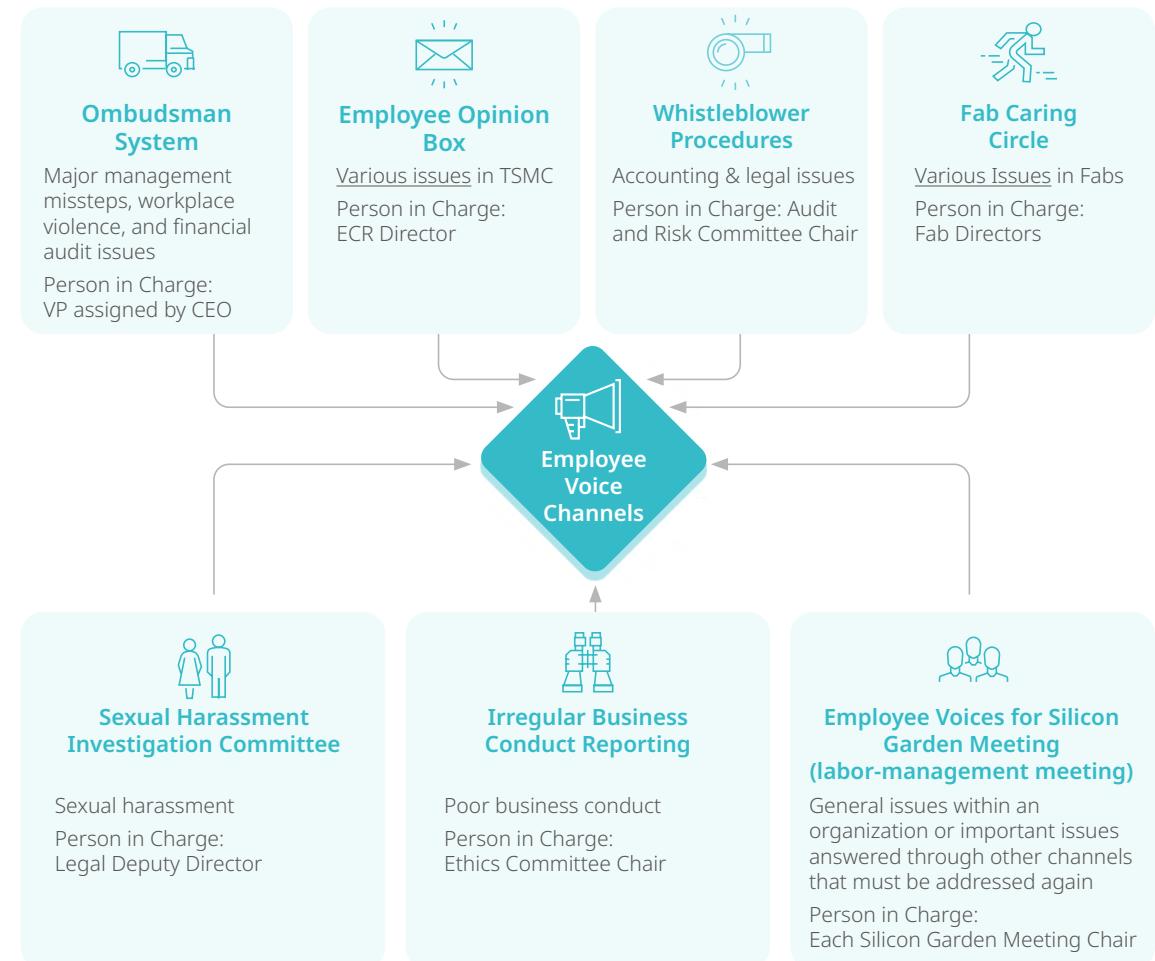
executive appointed by the CEO, the whistleblower procedures, and the Irregular Business Conduct Reporting System available to external parties on the TSMC website. Employees may express

their opinions through any of the aforementioned channels, and the Company can also respond to the opinions collected as well as conduct necessary interviews and investigations.

## Internal Communications Structure



## Employee Voice Channels



In 2022, TSMC's internal communication channels handled a total of 4,818 cases of employee opinions and complaints, including 19 through the Sexual Harassment Investigation Committee, 251 through the Ombudsman System, one through the Whistleblower Procedures, and 83 cases through the Irregular Business Conduct Reporting System. All cases reported by employees were processed and addressed immediately and confidentially.

## Cases Reported through Employee Voice Channels



Note 1: The figures for Ombudsman System, Sexual Harassment Investigation Committee, Irregular Business Conduct Reporting System, and Employee Opinion Box cover all TSMC facilities, while the figure for Fab Caring Circle covers only TSMC's Taiwan fabs

Note 2: Cases reported through the [Irregular Business Conduct Reporting System](#) are from external parties and internal employees

- The Sexual Harassment Investigation Committee verified 14 cases of sexual harassment; the perpetrating employees were punished according to the severity of the situation, and the informers were offered assistance programs including but not limited to psychological counseling. As the cases involved unwanted attention and verbal/physical harassment, TSMC has added a section on the different forms of sexual harassment and

what constitutes sexual harassment in the annual sexual harassment prevention courses. Moreover, the Company has reinforced the explanation of the new Stalking and Harassment Prevention Act in 2022, reminding employees that continuous or repeated surveillance, observation, stalking, and other behaviors constitute elements of harassment.

- There were four violations of business ethics and all employees have been punished or dismissed in compliance with the Company's regulations. TSMC continues to advocate important business ethics concepts in relevant training programs. In 2022, 67,922 employees participated in the annual business ethics and regulatory compliance training (including Personal Data Protection Act-related contents), achieving a 99.9% completion rate.

## Freedom of Association and Labor-Management Meetings

To create a communicative workplace and enforce an open-style management system, offer diverse internal communication channels, and respect employees' freedom of association, TSMC fabs in Taiwan regularly host labor-management meetings for 89.9% of the Company's global employees in compliance with local laws and regulations. TSMC management appoints a representative to explain recent developments in TSMC operations to employee representatives. At the meetings, management and employee representatives discuss topics of concern in an attempt to strengthen communication between management and employees.

In 2022, to promptly listen to the voices of employees, on top of the 13 existing fabs, TSMC went beyond legal requirements and subdivided non-fab colleagues into ten labor-management meetings with Organizations as the unit. Furthermore, the labor-management meetings were renamed Silicon Garden Meetings to bring the Company and employees closer, and electronic voting was implemented to elect representatives from various organizations. Additionally, a feedback channel for Silicon Garden Meetings has also been created, allowing employees to entrust organization representatives to voice their opinions at labor-management meetings and convey their suggestions 24 hours a day. Such information is sent to the relevant units through the system immediately for them to respond.

## Long-term Commitment

To realize the Human Rights Policy, TSMC has implemented the VAP of the RBA in all fabs. The Human Rights Related Issues have reached the faultless level as well as better governance and training on zero sexual harassment, zero workplace bullying, work hour management, human rights of disabled employees, and proprietary information protection. TSMC launched new training programs on Say No to Workplace Harassment, Workplace Bullying, and Proprietary Information Protection in 2022 to educate management and employees about human rights. TSMC will also assemble a task force of experts to inspect processes and advise better practices for a concrete work plan on annual human rights protection plans from 2023 to 2030.



# Occupational Safety and Health

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Promote Safety Culture</b> Advocate for a humanistic safety culture, manage safety risks, and establish an intrinsically safe working environment	<p>Incident Rate per 1,000 Employees: &lt;0.20</p> <p>Disabling Injury Frequency Rate (FR): &lt;0.3</p> <p>Disabling Severity Rate (SR): &lt;3</p>	<p>Incident Rate per 1,000 Employees: &lt;0.2</p> <p>Disabling Injury Frequency Rate (FR): &lt;0.4</p> <p>Disabling Severity Rate (SR): &lt;4</p>	<p>Incident Rate per 1,000 Employees: 0.145 Target: &lt;0.2</p> <p>Disabling Injury Frequency Rate (FR): 0.27 Target: &lt;0.4</p> <p>Disabling Severity Rate (SR): 3 Target: &lt;4</p>
<b>Provide Comprehensive Health Management</b> Prevent occupational diseases and promote comprehensive health management for employees	<p>0 case of occupational disorders caused by exposure to chemicals</p> <p>Employees with abnormal blood lipids, blood pressure, and blood sugar: ≤ 11%, 13.5% and 2.5%</p> <p>Employees with reported high-stress levels: &lt;9%</p>	<p>0 case of occupational disorders caused by exposure to chemicals</p> <p>Employees with abnormal blood lipids, blood pressure, and blood sugar: ≤ 11%, 13.5% and 2.5%</p> <p>Employees with reported high-stress levels: &lt;9%</p>	<p>0 case of occupational disorders caused by exposure to chemicals Target: 0</p> <p>Employees with abnormal blood lipids, blood pressure, and blood sugar: 9.2%, 10.8%, 1.8% Target: &lt;11%、13.5%、2.5%</p> <p>Employees with reported high-stress levels: 8.1% Target: &lt;9%</p>
<b>Build Internal-External Alliance</b> Collaborate with external parties to establish a safer working environment across the supply chain	<p>Assist all high-risk contractors to obtain ISO 45001 certification for occupational safety and health management system<sup>Note</sup></p>	<p>Assisted 75% of high-risk contractors to obtain ISO 45001 certification for occupational safety and health management system</p>	<p>Assist 65% of high-risk contractors to obtain ISO 45001 certification for occupational safety and health management system Target: 65%</p>

Note: The number of contractors engaged in high-risk operations increases each year, hence TSMC will continue to offer assistance.

Exceeded   Achieved   Missed Target



TSMC upholds the mission of Safety and Zero Accidents to monitor safety and health topics, develop digital disaster prevention measures, as well as control and monitor safety and health-related risks through artificial intelligence to build the best healthy workplace. Internally, the Corporate ESH Division is responsible for formulating the company-level occupational safety and health management strategies and targets. Through a clear division of labor between various organizations within the Company, the division is in charge of promoting safety and health at all levels. Furthermore, the Occupational Safety and Health Committee convenes regularly to make sure safety and health management control are implemented in different fabs in a bid to promote

the health of workers. Externally, the Company collaborates with industry, government, academia, and supplier/contractor partners to prevent and lower the impact of occupational disasters, as well as to improve the safe and healthy work environment of the industry chain.

TSMC's Fab 12B Phase 8, Fab 18B Phase 1 to 3, and Advanced Backend Fab 6, which were completed in 2021, obtained ISO 45001 certification for occupational safety and health management system and TOSHMS certification in 2022. The remaining fabs and TSMC (China), TSMC (Nanjing), WaferTech, and VisEra have all obtained ISO 45001 certification. At the same time, fabs in Taiwan will apply for

separate TOSHMS certifications, where workers are requested to observe the management regulations through the management system. In response to the continuation of the COVID-19 pandemic, pandemic prevention policies including stringent access control, reporting, and rapid case investigation mechanisms were proposed to reduce manpower and case investigation time, as well as to control group activities. Furthermore, benefits such as employee vaccination or family care leave were established, and a group operation model was adopted based on the content and needs of the work involved. During the peak period of the pandemic, the maximum single-day manpower loss was controlled below 2.9% to maintain normal operations.

In 2022, the number of contractors visiting TSMC reached a new record of 49,628 people per day. In light of the improving pandemic situation and to commend outstanding contractors, supervisors, and industrial safety personnel, TSMC hosted a [Communication Meeting for ESH Supervisors of Contractors](#). Moreover, the latest revision of the Blue Book for Contractors' Safety, Health and Environmental Protection was published to help contractors further understand safety and health codes, so as to strive towards the target of "zero incidents and zero occupational accidents."





## Safety and Health Measures

Measures	Safety and Health Efforts in 2022	SPI Indicator	Taiwan Fabs	Overseas Fabs	VisEra
				Note 1	
Regulatory Updates	<ul style="list-style-type: none"> <li>Kept up to date with the latest regulations, tracked compliance in all fabs, and issued <b>11</b> changes to safety and health regulations</li> <li>In response to demands for overseas expansion, new facilities for the U.S. and Japan are currently in the construction stage. A regulatory database of U.S. federal/state laws and Japanese laws is being compiled and overseas legal counsel is hired</li> </ul>	✓	✓		✓
Standardized Management Procedures	<ul style="list-style-type: none"> <li>Continued to gather opinions from relevant workers every year and reviewed and revised <b>56</b> management processes</li> </ul>	✓	✓	✓	✓
Safety and Health Education	<ul style="list-style-type: none"> <li>Continued to promote safety and health training to ensure <b>all</b> employees and contractors have passed related training. Training records are digitalized for record-keeping to comply with safety and health regulations and emergency response needs. Operators of hazardous operations have obtained licenses to operate in compliance with relevant laws <sup>Note 2</sup></li> <li>Digitized <b>59</b> safety and health management programs and introduced the training/teaching materials on the cloud platform for management, thereby comprehensively improving the professional skill of dedicated safety and health engineers <b>NEW</b></li> <li>Three dangerous operations including wall demolition, high-pressure waterjet, and electricity opening were added to the contractor's industrial safety certification training program <b>NEW</b></li> <li><b>All</b> of TSMC's workers have completed hazard notification/education</li> <li>Newly added hours of emergency response training and safety and health education for middle-aged and elderly workers to enhance their safety awareness. All training programs are included in the annual compulsory program, and the electronic personal learning blueprint is utilized to track their completion rate <b>NEW</b></li> </ul>	✓	✓	✓	✓
Hazard Identification and Assessment	<ul style="list-style-type: none"> <li>Conducted workplace hazard identification, safety and health management plans, workplace analysis, workplace observation and operational safety analysis, and health management analysis for employees and contractors. All identified risks were classified into different risk levels for future management, tracking, and monitoring to control, prevent, or reduce hazards and risks; <b>32,874</b> cases of hazard assessment were carried out <sup>Note 3</sup></li> </ul>	✓	✓	✓	✓
Procurement Management	<ul style="list-style-type: none"> <li>Continued to reinforce the fire protection of wet process machines. It is clearly stipulated in the machine procurement specifications that machine cavities must be made of non-flame retardant materials to minimize smoke damage caused by the burning of plastic materials and the risk of fire spreading in the event of a fire <b>NEW</b></li> <li>Formulated safety procurement regulations for auxiliary equipment such as step stools</li> </ul>	✓	✓	✓	✓
Change Management	<ul style="list-style-type: none"> <li>Completed <b>5,069</b> cases of change management with <b>zero</b> related incidents</li> </ul>	✓	✓	✓	✓
Chemical Management <sup>Note 4</sup>	<ul style="list-style-type: none"> <li>All new chemicals underwent safety review processes before entering facilities. In 2022, <b>231</b> chemicals were evaluated and introduced with <b>zero</b> related incidents and without introducing any IARC group 1 carcinogens</li> <li>Inventoried and integrated the Chemical Management System, consolidated chemical flow and personnel exposure risk tracking, and developed a chemical safety data sheet review system in Taiwan/China/U.S./Japan that allows for searching chemical labels that comply with local regulations in the electronic system <b>NEW</b></li> </ul>	✓	✓	✓	✓
Tool Management	<ul style="list-style-type: none"> <li>Evaluated and introduced <b>198</b> new tools with <b>zero</b> related incidents</li> <li>Completed the testing of all ionizing radiation-exempt control machines at TSMC, and established a control process</li> <li>Devised a safety and health management process for machine components to be cleaned, machine auxiliary equipment pipelines, and scrapped components <b>NEW</b></li> </ul>	✓	✓	✓	✓
Contractor Management	<ul style="list-style-type: none"> <li>Contractors engaged in a total of <b>638,655</b> constructions in the fabs, of which <b>62,608</b> were high-risk operations</li> </ul>	✓	✓	✓	✓
Compliance Audit	<ul style="list-style-type: none"> <li>Internal audits revealed <b>2,279</b> shortcomings, which were corrected within the specified time</li> </ul>	✓	✓	✓	✓
Emergency Response	<ul style="list-style-type: none"> <li>Created a cross-fab CCTV platform in Taiwan and a phone application that utilizes the emergency digital evacuation and roll call system. In the event of an emergency, other fabs can assist in emergency response via the monitor screen</li> <li>Due to the greater difficulty of putting out EV fires, EV parking area safety regulations were stipulated, charging piles were removed from the underground parking area, fire blankets were installed in various fabs, and emergency response procedures were created <b>NEW</b></li> </ul>	✓	✓	✓	✓
Occupational Injury Prevention	<ul style="list-style-type: none"> <li>Continued to hold investigative meetings to analyze employee occupational injuries and horizontally apply the improvement measures to all fabs in the hope of reducing accidents</li> </ul>	●	✓	✓	✓

Note 1: In response to the construction of the fabs in Arizona and JASM, it is planned for the regulatory updates platform to expand the Japanese regulations, and the plan will be extended to 2023

Note 2: 2022 Training Statistics: Trainees include both employees and contractors

Note 3: Hazard Identification and Assessment: Foster a safety culture where employees and the Company protect each other and encourage employees to speak up and offer suggestions for occupational safety. Classification management and tracking are used to control, prevent, or reduce hazards to cultivate a friendly and safe workplace

Note 4: TSMC Chemical Management Procedures

✓ Completed

● Ongoing

## Promote Safety Culture

Following the [TSMC Safety and Health Policy](#), TSMC has implemented the following health and safety measures and used the Safety Performance Index (SPI) to track performance. TSMC has strengthened

employees' safety and health awareness through training, hoping to minimize the impact of unsafe environments or conduct. An analysis of employee disabling injury statistics reveals that

most injuries are caused by insufficient safety awareness and failure to implement management regulations. To enhance safety culture, experts were commissioned to conduct a safety culture

investigation in 2022, helping to identify the direction and improvement measures.

### Case Study

## Discover Opportunities for Continuous Improvement through the Safety Culture Investigation

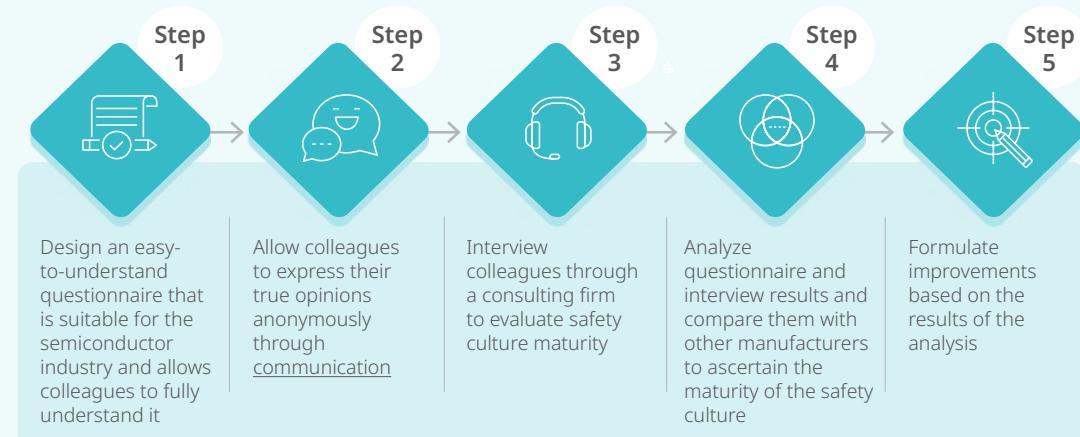
Safety culture is the consensus among workers on safety awareness, emphasis, and belief in the workplace, and it is also the foundation of a safe and healthy workplace. In 2022, TSMC commissioned a professional international safety culture consulting firm to design a questionnaire based on four aspects: teamwork, safety communication, safety values, and organizational trust. Focusing on plants with "a disabling injury frequency rate and a disabling severity rate that have fallen below the Company average" for three consecutive years, a frontend wafer processing plant and a backend chip packaging plant were chosen via sampling. The survey targets included colleagues of production and non-production units, [covering different genders, age groups, seniorities, and grades](#); a total of 2,568 questionnaires were sent out, and 1,776 valid questionnaires were retrieved, resulting in a response rate of 69.2%.

According to the analysis outcome, TSMC's safety culture was given a score of [4.8 points](#), indicating the Company is transitioning from being "compliant" to "incorporating safety awareness into our values". The top three topics of concern among the colleagues were "intrinsically safe work environment, comprehensive and transparent safety-related reporting procedures, and a team culture of looking out for each other". The most recognized measures were "feeling the management's high level of safety concern, quick adoption of improvement measures, ongoing work environment optimization, and understanding the importance of employees' physical and mental health". The least satisfied aspects were "the supervisor fails to proactively communicate safety-related topics, the employees believe that they do not have the proper ability to cope with management-related contingencies, the Company is advised to provide more safety awareness training."

To respond to the colleagues' topics of concern, the emphasis in 2023 will be placed on "reinforcing employees' day-to-day safety awareness, safety communication, and developing diverse safety awareness

training." Corporate ESH Division will identify potential risks in the workplace and design bespoke safety and health training programs; design [Safety Moment](#) programs to train seed personnel from various units; publish new safety-related knowledge every month to elevate everyone's safety awareness; demand various departments to hold monthly workplace safety and health-related problem discussions, where the seed personnel will report improvement suggestions back to the Corporate ESH Division in a bid to establish a company-wide safety culture.

### Five Steps to Launch a Safety Culture Investigation

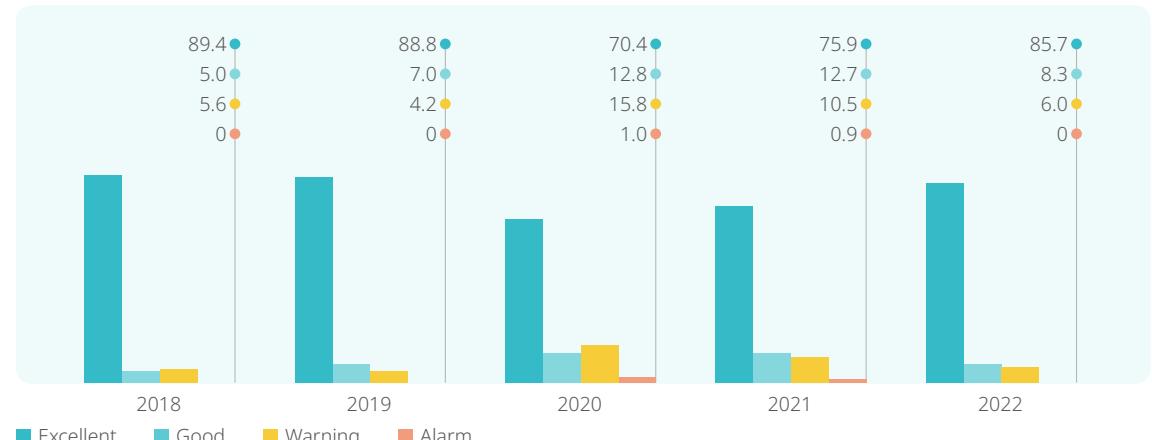


## Safety Performance Index

TSMC Safety Performance Index (SPI) is classified into four levels, including active and passive indices. The active indices encourage employees to participate in health and safety activities while the passive index shows the number of safety-related failures, false alarms, etc. To implement the improvement measures for the prevention of false alarms, if the same false alarm occurs repeatedly in the same year, additional points will be deducted from the SPI. In 2022, blue-light indices (excellent) increased by 10.1% from 2021 to 86%. The main improvement in the passive indices was reflected in the decrease in false alarms from 28 incidents in the previous

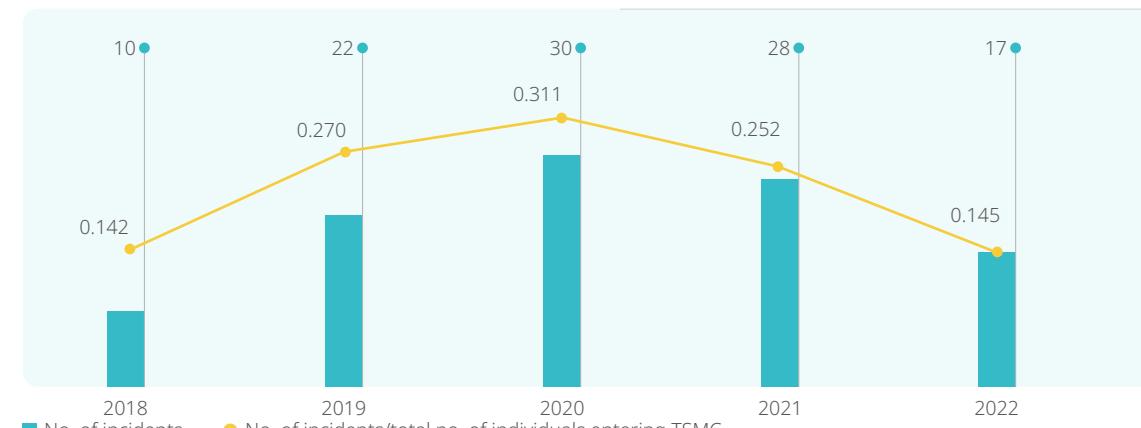
years to 17 incidents this year, and the incident rate per 1,000 employees was reduced to 0.145 from 0.252 in 2021. When a false alarm occurs, in addition to applying the 3L5W (Three-Legged Five Whys) Tool to conduct an investigation, the Company also interviews relevant personnel, analyzes and inspects the equipment, and tests the materials using the false alarm reporting and investigation procedure. Relevant documents and records are checked, or the scene is reconstructed to identify the direct, indirect, and fundamental cause of the incident to actively discover improvement opportunities and prevent similar incidents from occurring again.

## Safety Performance Index Chart



Note: Data includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), TSMC Japan 3DIC R&D Center, WaferTech, and VisEra

## Historical Incidents



Note: Starting from 2020, the incident rate per thousand individuals entering TSMC includes employees and contractors. Employee calculation includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), WaferTech, and VisEra; contractor calculation includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), and VisEra

## Historical Incidents by Type



Note: Historical incidents by type per thousand individuals entering TSMC include employees and contractors. Employee calculation includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), WaferTech, and VisEra; contractor calculation includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), and VisEra

## False Alarm Improvement Highlights in 2022



### Reduce Fire Alarms

**Two** false fire alarms were caused by the activation of a machine's CO<sub>2</sub> warning system; **one** fire alarm was caused by an aging heating element of the cleaning tank; **one** incident of a static electricity-induced fire caused by the use of flammable chemicals on the machine

#### Improvement Measures

- The safety design of the cleaning tank must include low-liquid level detectors and overheat detectors that are not controlled by the process. When the detectors are activated, they should be able to automatically turn off the heater; when the overheat detector circuit is open and faulty, it should be regarded as an alarm, and the heater is automatically turned off. This regulation has been included in the machine procurement and safety inspection standards, and new machines must pass the safety inspection before they can be used
- Static protection for valves using chemicals



### Reduce Gas Alarms

**Three** incidents were caused by damaged gas early warning alarm components, and **three** incidents were caused by workers who did not observe the gas cylinder replacement procedures. In all **six** incidents, the special gas was shut down immediately after the gas early warning alarm was triggered, hence it did not leak into the environment to cause personnel casualties or environmental pollution

#### Improvement Measures

- Record gas cylinder changes with 5G cameras, require on-site personnel to conduct steel cylinder replacement training every quarter to strengthen compliance with SOPs and operational proficiency
- To increase the safety of changing gas cylinders containing hazardous gases, in 2023 TSMC will develop VR environments or objects that are combined with visual effects and auditory information to improve the operational proficiency of on-site workers through gesture interaction and understanding intention



### Reduce Injuries

**Nine** injuries were mainly caused by contractors' unsafe conduct such as lack of safety awareness or failure to follow SOPs

#### Improvement Measures

- Construction site safety management is conducted through the three strategies of risk identification, management support, and execution review. The digital transformation of occupational safety and health training is implemented, where relevant programs are launched by the TSMC Supplier Sustainability Academy. In particular, high-risk operation contractors must complete **100%** of the training before entering the fabs to begin construction. As of December 2022, **21** occupational safety and health programs were completed by more than **200,000** people
- To bolster contractors' safety awareness, the TSMC Contractor ESH Bluebook was converted into an audio book, and the operation safety management regulations for mechanical equipment including threading machines, sheerleg cranes, and suspended cages for window cleaning were added
- Interactive promotional safety awareness animation videos were produced for the cleaning personnel, which include examples of unsafe operations and unsafe environments to improve learning results
- Unsafe environments prone to injuries and falls were improved by installing safety signs on the aisles to minimize the risk of tripping; warnings and warning lines were added on the edges of the dock area to remind people of falling risks



TSMC conducts hazardous gas leakage response drill through Virtual Reality (VR)



TSMC builds VR room for compound disaster simulation training to enhance resilience

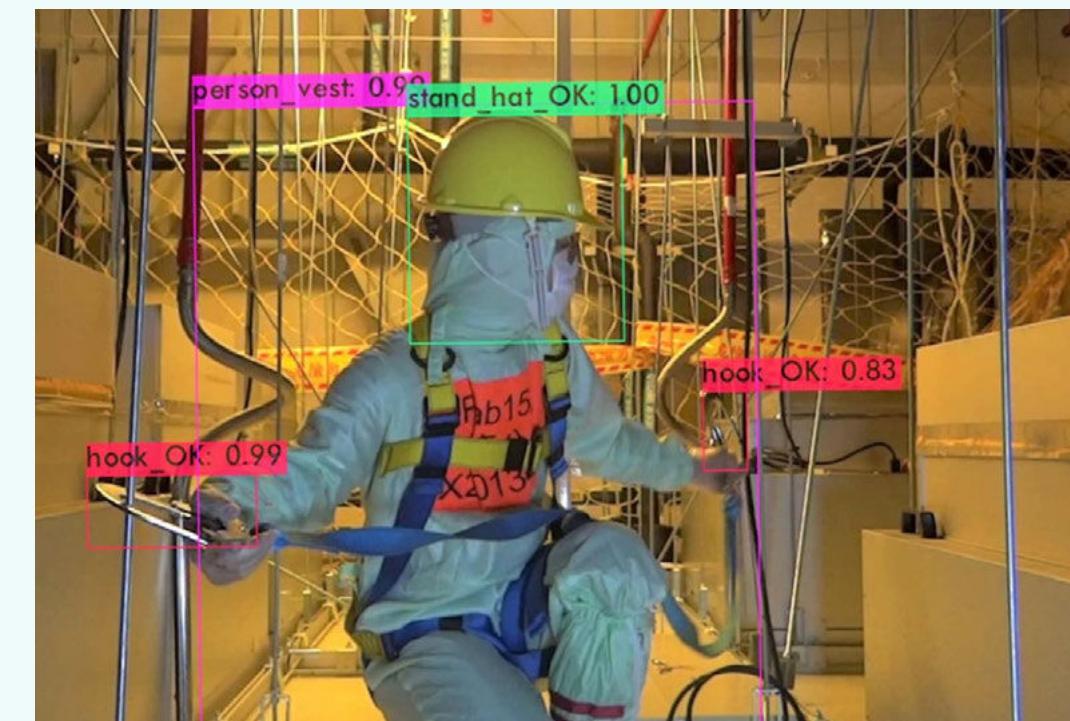


## Case Study

# Artificial Intelligence (AI) Job Hazard Analysis Technology Enhances Workplace Safety

To enhance the implementation of the construction personnel's safety regulations, minimize inattention-related occupational disasters, and improve inspection manpower allocation and time-consuming problems, TSMC has joined forces with National Chung Hsing University's Department of Management Information Systems in 2021 to develop Artificial Intelligence (AI) Job Hazard Analysis Technology, integrating existing emergency response 4G cameras in the fabs with a wired or wireless network to transmit live images, apply intelligent identification technology to identify environmental and operational risks, as well as integrate big data computing and machine learning to monitor high-risk workplaces. The Emergency Response Center personnel can monitor safety blind spots via live images around the clock. When construction workers operating in high-risk areas exhibit unsafe behaviors or find themselves in an unsafe environment, text messages or the public address system can be used to report the problem to TSMC project managers and Emergency Response Center, demanding the contractor to make immediate improvements. The contractor may only resume construction after it has passed re-inspection.

In 2022, the AI job hazard analysis technology was used in Fab 15A to monitor 1,402 ceiling operations, where three unsafe contractor behaviors were discovered in time during the test process to prevent occupational injuries. Besides the ceiling, AI job hazard analysis technologies will be developed for other high-risk workplaces. The technology will be introduced to various fabs, and it will be standard equipment for new fabs. Considering the diverse applications of AI technology, TSMC formed an internal image recognition development and review platform in 2022 to consolidate all AI image recognition system developments. Units with image recognition needs can search and utilize the application resources that have already been developed on this platform to expand the scope and depth of disaster prevention technology.



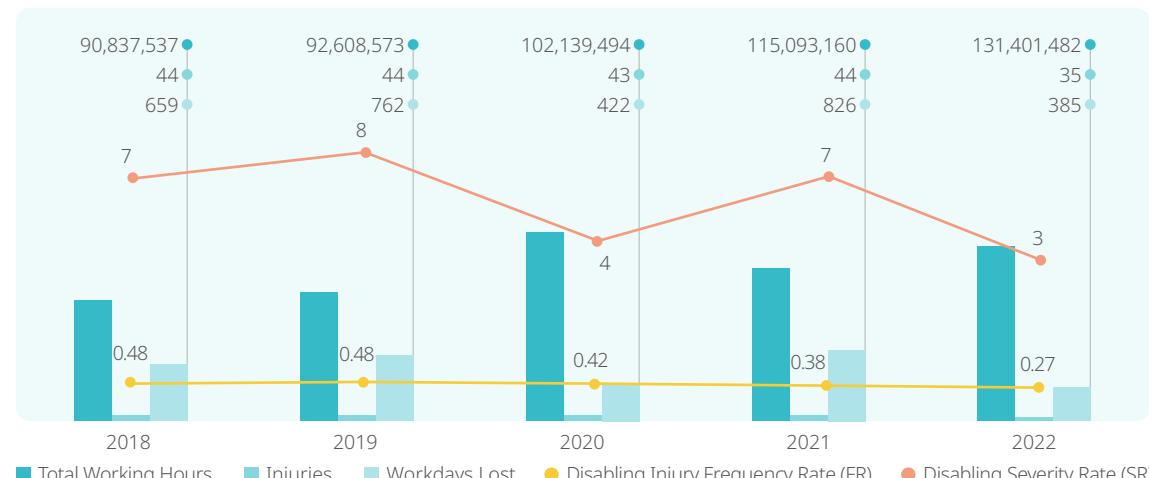
Ceiling AI Image Recognition

## Statistical Analysis of Disabling Injuries among Employees

Disclosure of occupational accidents is based on the Occupational Safety and Health Act and important disabling injury indicators issued by the Global Reporting Initiative (GRI), which uses Disabling Severity Rate (SR) and Disabling Injury Frequency Rate (FR) as primary indicators. In 2022, there were 35 disabling injuries among employees with 385 workdays lost. Of these, 21 cases of disabling injuries among men resulted in the loss of 251 workdays, and 14 cases of disabling injuries among women resulted in the

loss of 134 workdays. The employee injury rate was 0.05%. Men suffered from a higher number of work-related disabling injuries and workdays lost than women. The types of injuries were mostly falls and impact injuries, mainly caused by accidental collisions due to poor route design or failure to pay attention to people in front when using trolleys; or tripping injuries caused by the improper placement of materials when conducting machine maintenance operations.

## Total Working Hours, Injuries and Working Days Lost



Note 1: According to the Occupational Safety and Health Act, Disabling Injury Frequency Rate (FR)/Disabling Severity Rate (SR) are defined as any diseases, injuries, disabilities, or deaths of workers caused by buildings, machinery, equipment, raw materials, materials, chemicals, gases, vapors, dust, etc., at the place of duty, or as a result of work activities, or due to other occupational causes. Other unrelated injuries in the workplace such as falling in the cafeteria or parking lot due to various reasons are not considered work injuries.

Note 2: Data includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), and VisEra

## Improvement Measures



**Impact injuries**

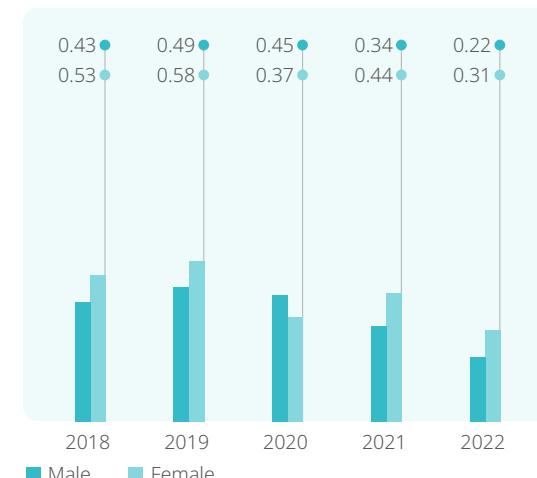
Mostly caused by colleagues using trolleys in the 6" and 8" fabs. Therefore, trolley routes and placement locations continue to be planned according to the operations involved, reflectors are installed in areas prone to collisions, and colleagues who voluntarily report incidents are rewarded. Unsafe environments were improved and quarterly communication meetings were conducted in the manufacturing department to promote preventive safety awareness using different themes. In 2023, trolley operation-related training videos will be recorded to improve learning performance



**Falls and sprains**

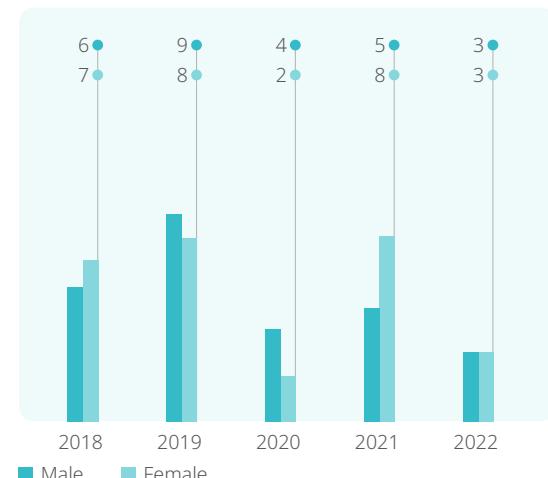
Mostly caused by missing a step in the clean room or tripping over objects during machine maintenance. Consequently, the 6S standard for maintenance processes has been formulated, including guidelines for placing relevant components, materials, and covers during machine maintenance, as well as rules for fixing extension cords and trolleys. In addition, specifications for the steps on the machines in the clean room and the regulations for using them have also been defined

## Disabling Injury Frequency Rate by Gender



Note: Data includes TSMC fabs in Taiwan, TSMC (China), TSMC (Nanjing) and VisEra

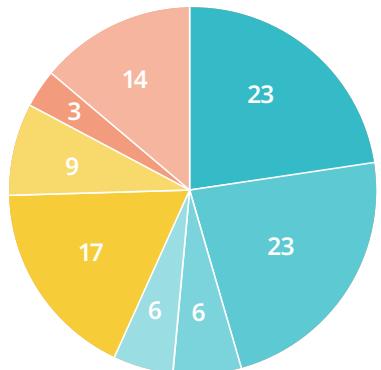
## Disabling Severity Rate by Gender



Note: Data includes TSMC fabs in Taiwan, TSMC (China), TSMC (Nanjing) and VisEra

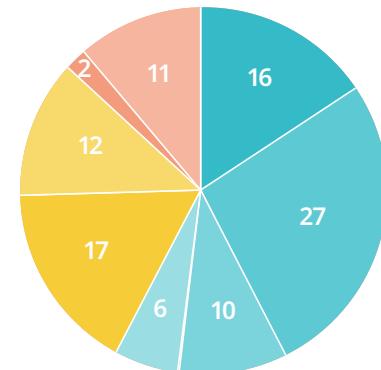
## Disabling Injury Frequency Rate by Injury

Unit: %



## Disabling Severity Rate by Injury

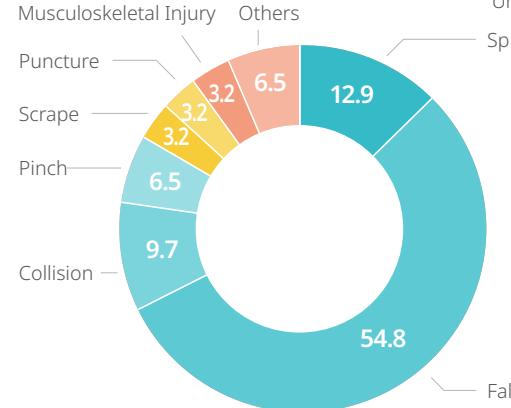
Unit: %



Male

## Non-work-related Injuries

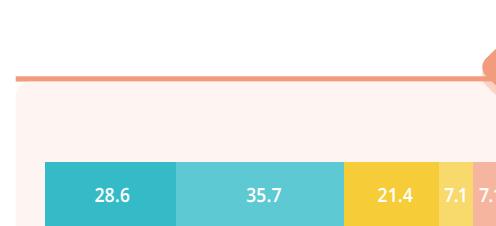
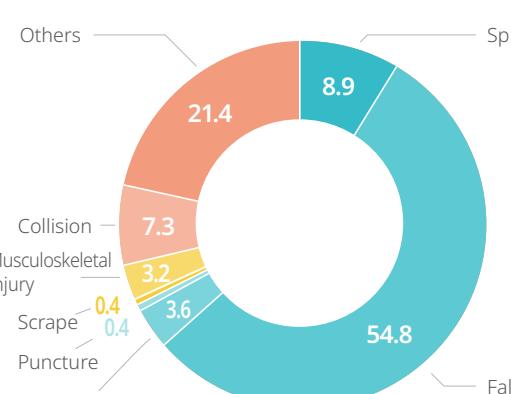
Unit: %



Female

## Non-work-related Injury Days

Unit: %

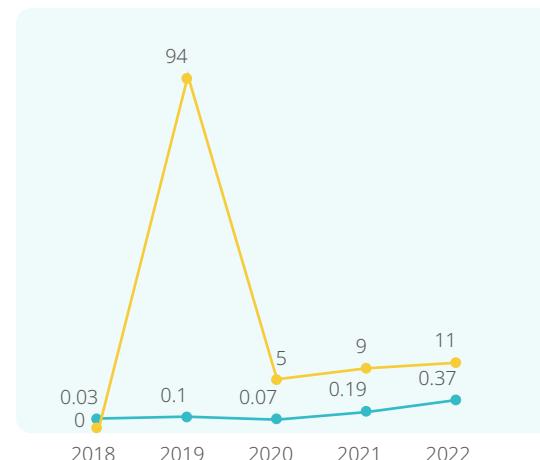


■ Collision ■ Fall ■ Burn ■ Pinch ■ Sprain ■ Musculoskeletal Injury ■ Scrape ■ Others Unit: %

## Statistical Analysis of Disabling Injuries Among Contractors

In 2022, the contractor disabling injury frequency rate (FR) and disabling severity rate (SR) were higher compared to 2021. This was mostly attributed to unsafe behaviors such as a lack of safety awareness or failure to follow SOPs. Please refer to the [Safety Performance Index](#) for relevant improvement measures.

## Disabling Injuries in Contractors



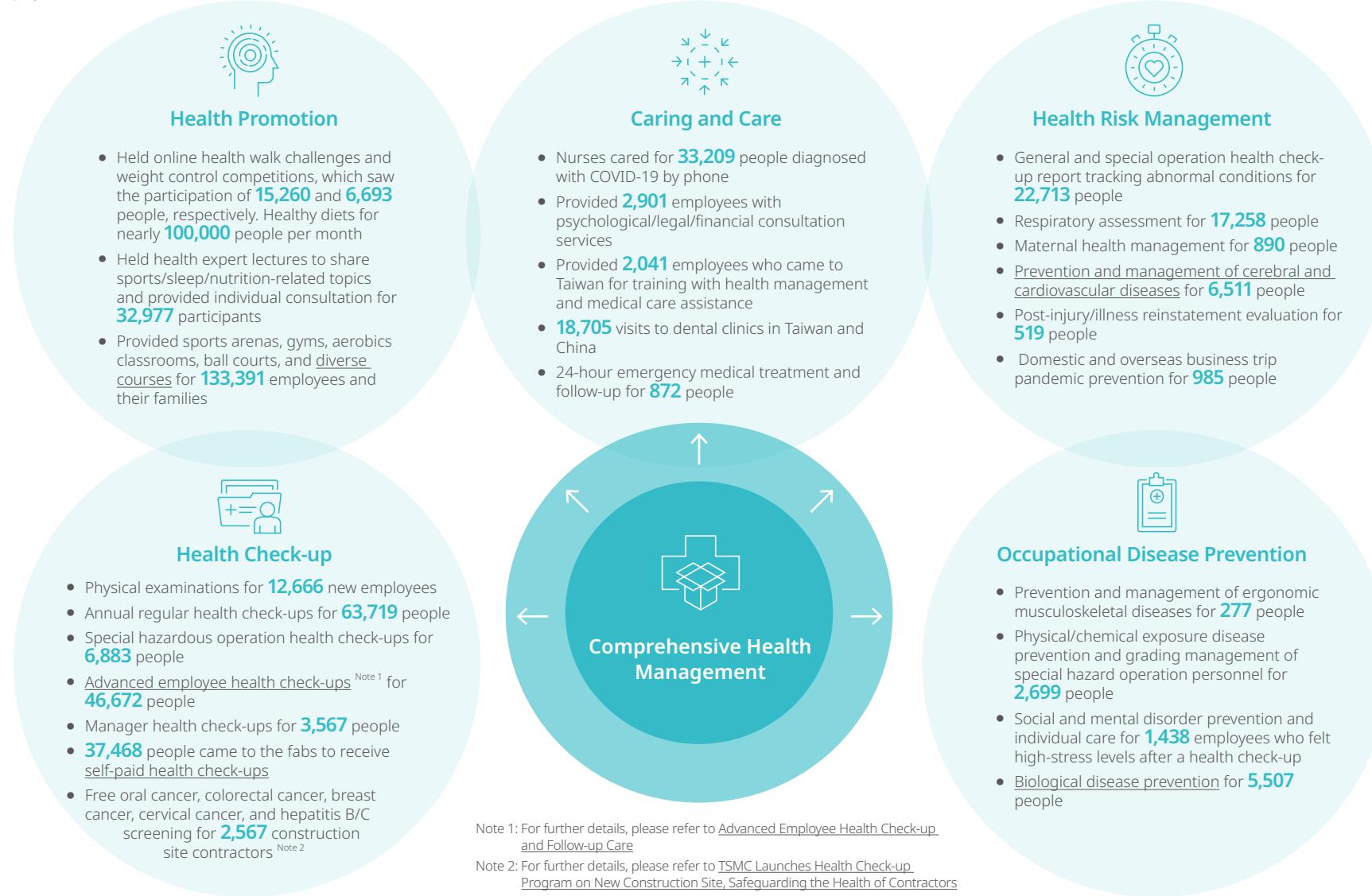
● Disabling Injury Frequency Rate (FR)

● Disabling Severity Rate (SR)

Note: Data includes fabs in Taiwan, TSMC (China), TSMC (Nanjing), and VisEra

## Provide Comprehensive Health Management

TSMC's comprehensive health management encompasses worker health promotion, health check-ups, care, and occupational disease prevention. These measures aim to control the work environment and personnel health risks to attain a work-life balance. To protect the physical and mental health of employees, TSMC has hired professional medical staff including 2 physicians, 122 nurses, and 7 psychologists in the fabs in Taiwan and China. A total of 1,743 services were provided by contracted labor health physicians.



TSMC implements occupational disease prevention and actively promotes employees' health and well-being



## Case Study

# Advanced Employee Health Check-up and Follow-up Care

According to the World Health Organization's statistics on the top ten causes of death, cerebrovascular diseases, heart diseases and cancer are the primary causes of disability and death. To enhance employees' health care, besides implementing health checks that comply with laws and regulations in TSMC fabs in Taiwan and Nanjing, the Company also collaborated with

hospitals in 2022 to provide employees with advanced imaging examinations for cerebrovascular disease, heart disease, cancer (intestine/lung/breast), and other diseases by applying a standard that is superior to regulations, hoping to adopt a more proactive approach to detect abnormalities in advance and assist employees to receive early treatment. Moreover, the

inspection results are combined with personal work hazards and applied to the physical and mental health management plan to actively mitigate employees' health risks. In 2022, 46,672 people received health check-ups, and for those who have abnormal results, all immediate assisted them back to hospitals for recheck and further treatment.

Category	Measures	Subject/Frequency	Detail information	Number of People Who Completed Inspection (Inspection Completion Rate)
Cancer screening	Colorectal cancer: stool occult blood	All employees at TSMC fabs in Taiwan and TSMC (Nanjing) / Annually	The screening service is provided regardless of age to facilitate early detection and treatment	32,184 (47%)
	Breast cancer: mammogram	Female employees over the age of 40 at TSMC fabs in Taiwan/Annually	The service is provided five years earlier than the one offered by the NHI (age 45 or above)	2,383 (28%)
	Lung cancer: chest CT scan	All employees at TSMC fabs in Taiwan	Facilitate early detection and treatment	6,102 (88%)
Cerebrovascular disease imaging examinations	ECG	1. At the time of employment 2. Every five years for existing employees	Facilitate early detection and treatment	4,777 (91%)
	Cardiac/ carotid echo			
	Cardiac CT for calcium scoring	High-risk group of cerebral and cardiovascular disease	The screening results are incorporated into the cerebral and cardiovascular disease prevention program, where a physician will conduct an overall health risk assessment and follow-up management (please refer to the <a href="#">Prevention Measures Against Occupational Diseases &amp; Achievements - Social/Mental Factors</a> )	1,060 (75%)



TSMC provides advanced imaging examinations for cerebrovascular disease, heart disease, and cancer in a manner superior to regulations

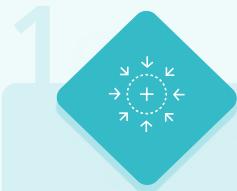
 Case Study

## Comprehensive Health Care Service to Look after the Health of Contractors and Partners

In 2022, TSMC's safety and health management measures were extended to all workers including employees, contractors, suppliers, and construction site contractors. Furthermore, two major measures Environmental Safety Protection and Labor Physical and Mental Care were implemented for work sites. First of all, technological tools were introduced to manage construction

site safety and address environmental risks, and prevent personnel from being exposed to unsafe environments. Second, the emphasis is on people, where health and screening services have been extended to construction sites, and a care group has been formed to protect the safety and health of contractors in the fab construction.

### Five Major Health Care Actions for Contractors on Construction Sites



#### Provide Vaccination Service

- Provide contractors in the construction area with influenza vaccination service



#### Health Management System

- Use the "health management system for high-risk construction groups" to identify personnel with high-health risk. Integrate access control, work order, and health database to monitor personnel work status



#### Follow-up Care

- TSMC, Safety Management Center resident nurses, and industrial safety personnel of the main contractor form a caring group to offer on-site care
- Evaluate the personnel's type of work and work environment, provide care for middle-aged and elderly workers and disadvantaged workers, measure blood pressure, and promote health education



#### On-site Physician Service

- On-site health service by "occupational medical physicians"
- Provide professional services for the four major labor health protection plans
- If precancerous lesions or cancer are discovered, the on-site medical team will assist contractors and partners to seek medical treatment



#### Free Health Check-ups in the Construction Area

- Provide oral cancer, colorectal cancer, breast cancer, cervical cancer, and hepatitis B/C screening
- If precancerous lesions or cancer are discovered, the on-site medical team will assist contractors and partners to seek medical treatment



On-site health service by occupational physicians



On-site care service by resident nurses

## Prevent Occupational Diseases

TSMC remains committed to building a safe and healthy workplace where each task is assessed repeatedly through risk identification. Furthermore, the Company collaborates with occupational disease physicians and external experts by following the risk identification method to uncover five major potential risk factors of occupational diseases (chemical, physical, ergonomic, biological, and social/mental) and design preventive measures accordingly.

### Prevention Measures Against Occupational Diseases & Achievements

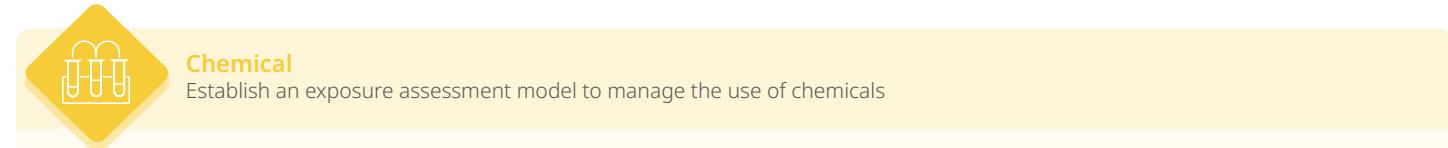


#### Existing Measures

- Arranged occupational physicians to visit loading sites at TSMC fabs in Taiwan
- Used computerized ergonomic risk assessment systems to identify operations with high ergonomics risks
- Conducted an investigation in 2021 of the departments where many people in the same unit have applied for leave due to muscle ache to determine if the operations involved ergonomic risks
- Conducted health surveys and track employees who applied for pain relief patches, and reached out to and arranged meetings with occupational physicians for employees on leave for musculoskeletal pains

#### Achievements

- Arranged **19** occupational physician on-site visits, achieving a **100%** improvement completion rate
- Employees affected by soreness were cross-checked with the computerized ergonomic risk assessment system; **none** were found to be working in areas with ergonomic or potential ergonomic risks
- A total of **eight** units had more than three people apply for leave within the same unit due to soreness in 2021; they were deemed to be at **low risk** after on-site visits and evaluations were carried out
- 198** employees were impacted by soreness and participated in the ergonomic risk exposure survey; one employee was assisted with suspected ergonomic risk factors to make work adjustments
- Three** people continued to use pain relief patches to treat body aches in the same location; an evaluation by an occupational physician determined that the illness was unlikely to be work-related, and the wellness center provided health education to help **mitigate their discomfort**



#### New Measures in 2022

- Re-evaluated the suitability of all chemical operation-related PPEs
- Evaluated PPEs that meet safety protection and comfort requirements for colleagues to choose
- Collaborated with Distinguished Professor Peng-Jy Tsai from National Cheng Kung University to confirm the justifiability of the work environment monitoring plan implemented by each fab every six months
- Implemented direct-reading instruments (TSI AM520) in conjunction with 4G cameras to monitor dust conditions in chip crushing operations

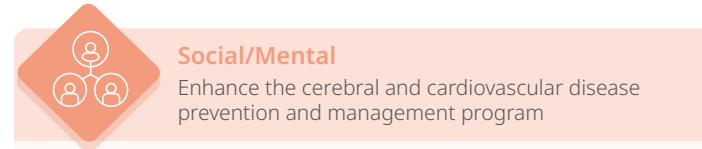
#### Existing Measures

- Chemical management: Please refer to [TSMC's chemical management procedure](#)
- Re-evaluate chemical work stations involving manual labor at **148** laboratories annually to confirm that there are zero risks of chemical exposure
- Based on the analysis of chemical exposure risk and the frequency/nature of the operation, approximately 4% of the contractors may be exposed to high health risk substances (carcinogens, mutagens, and reprotoxic substances); **10** such incidences were observed
- Continued to arrange occupational physicians to assist contractors in the fabs to conduct on-site surveys and identify chemical exposure risks in the workplace
- Requested contractors with abnormal special health check-up results to voluntarily report them to TSMC

#### Achievements

- 100%** confirmation of the suitability of PPEs for chemical operations
- Completed the assessment of **five** types of PPE, including powered air purifying respirators, eye protection safety glasses, and hearing protection earmuffs
- Established a work environment measurement plan to ensure the effective implementation of the work environment measurement
- The chip casting area was improved according to the monitoring results of chip crushing operations to reduce the risk of dust emission
- 0** case of occupational disorders caused by exposure to chemicals

- Confirmed that all chemical-related tasks in **148** laboratories are performed inside fume cupboards with zero health risks to operators
- Confirmed that **10** work sites where contractors may be exposed to high health risk substances comply with safety and health management regulations; in addition, the sites are equipped with good ventilation, and protective equipment is worn by workers, hence there are no exposure concerns
- Ensured that the personnel working inside TSMC fabs do not have any health concerns about chemical exposure
- Received **0** cases of unusual results for the special health check-up



### Social/Mental

Enhance the cerebral and cardiovascular disease prevention and management program

#### New Measures in 2022

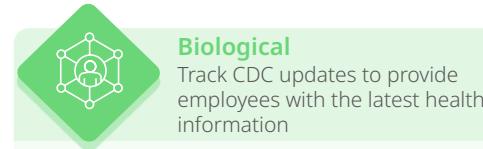
- Flagged those with abnormal advanced imaging examinations results as a high-risk group and actively managed their medical treatment and work hours

#### Existing Measures

- Offered occupational leave to employees with medium/high health risks in Taiwan and Nanjing facilities for free advanced imaging examinations, to help them prevent cerebral and cardiovascular diseases
- Used the health management system integrated with the latest employee health check-ups and work hours to evaluate health risks; in addition to informing employees, supervisors and HR were reminded to adjust workloads for said employees
- Combined with the work hour system for risk control, if the employees exhibit abnormal over time, the system will automatically remind employees, supervisors, and HR

#### Achievements

- In total, **11,939** employees in the Taiwan fabs received advanced imaging examinations, of which **1,997** were classified as moderately or highly abnormal. Employees were helped to receive re-examination and health education based on the degree of their abnormality. Of these, **508** people who refused re-examination were given health guidance via physician interviews, telephone interviews, or written reviews. Furthermore, **55** people were required to limit work hours or adjust work content according to the doctor's order, and work distribution has been facilitated. Moreover, **16** people received medical treatment.
- Work hours of employees were tracked every month to manage **6,212** people with medium/high health risks, and make sure that they comply with the doctor's orders. Health guidance was arranged for **1,757** people through approaches such as doctor's interviews, telephone interviews, or written reviews. In total, work hours or work content adjustment was implemented for **216** persons.



### Biological

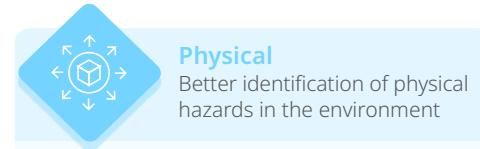
Track CDC updates to provide employees with the latest health information

#### Existing Measures

- Continued to track communicable diseases domestically and abroad and establish preventive/response measures for notifiable diseases; the Disease Prevention Committee continued to develop COVID-19 countermeasures and reporting mechanisms based on changes in the COVID-19 pandemic
- Continued to enforce reporting mechanism for non-notifiable diseases and provided up-to-date information on seasonal flu and dengue fever
- Briefed and provided disease prevention toolkits to employees on business trips to areas with disease outbreaks

#### Achievements

- Handled **5,507** high-risk cases in compliance with COVID-19 control measures
- Effectively managed a total of **33,209** instances of notifiable diseases and non-notifiable diseases to contain the spread
- Distributed **985** disease prevention toolkits to employees going on business trips



### Physical

Better identification of physical hazards in the environment

#### Existing Measures

- Developed a measurement system for ionizing radiation levels, established a full-time control mechanism for radiation sources, and banned individuals with pacemakers from operating such equipment
- Process equipment is tested for non-ionizing radiation levels every half year

#### Achievements

- There was 0 case of radiation exposure
- Completed the special eye examination of **one** precision operations machine, and the examination result was normal
- The electric field and magnetic field of the non-ionizing radiation measurement results were far below the ACGIH TLV standard, and **all** items were normal



TSMC actively establishes an intrinsically safe workplace

## Build Internal-External Alliance

As a leader in the global semiconductor industry, TSMC continues to collaborate with business partners, industry, and academia, hoping to create a sustainable, healthy workplace and minimize occupational risks.

## Work with External Parties to Optimize Work Environment

In 2022, TSMC attended the Joint Steering Committee ESH Working Group of the World Semiconductor Council on behalf of the semiconductor industry in Taiwan to exchange

information on safety and health-related risk control measures with various industry players, sharing experiences on the use of chemicals with health risks such as Per- and polyfluoroalkyl substances (PFAS) or N-methylpyrrolidone (NMP), and their substitutes.

In addition, TSMC is willing to share its experience in promoting a safe and healthy workplace. TSMC also collaborated with the Occupational Safety and Health Administration, Ministry of Labor, and the Institute of Environmental and Occupational Health Sciences, National Yang Ming Chiao Tung University, to compile materials for advanced in-service

education by combining workplace risk assessment and management theories with practices in 2021. In 2022, TSMC conducted three training and drill sessions in Northern, Central, and Southern Taiwan. The participants included 155 safety and health managers from the manufacturing industry, healthcare industry, construction engineering industry, water supply and pollution control industry, transportation and warehousing industry, and professional science and technical service industry, etc. Through the selfless sharing of knowledge and experience, the hazard identification and problem-solving abilities of occupational safety professionals

in various industries can be enhanced in a bid to create a safe and healthy working environment.

In October 2022, TSMC was awarded the National Occupational Safety and Health Award's highest honor, the Enterprise Benchmarking Award. TSMC continues to advocate a safety culture centered in human, establish an intrinsically safe workplace and promote physical and mental health of workers. By sharing its experience and collaborating with stakeholders, TSMC reduces the risks of occupational safety and health in the workplace.

TSMC receives the highest recognition of the National Occupational Safety and Health Award



TSMC proactively shares its experience in promoting a safe and healthy workplace



## Construction Site Management Process and Mechanism

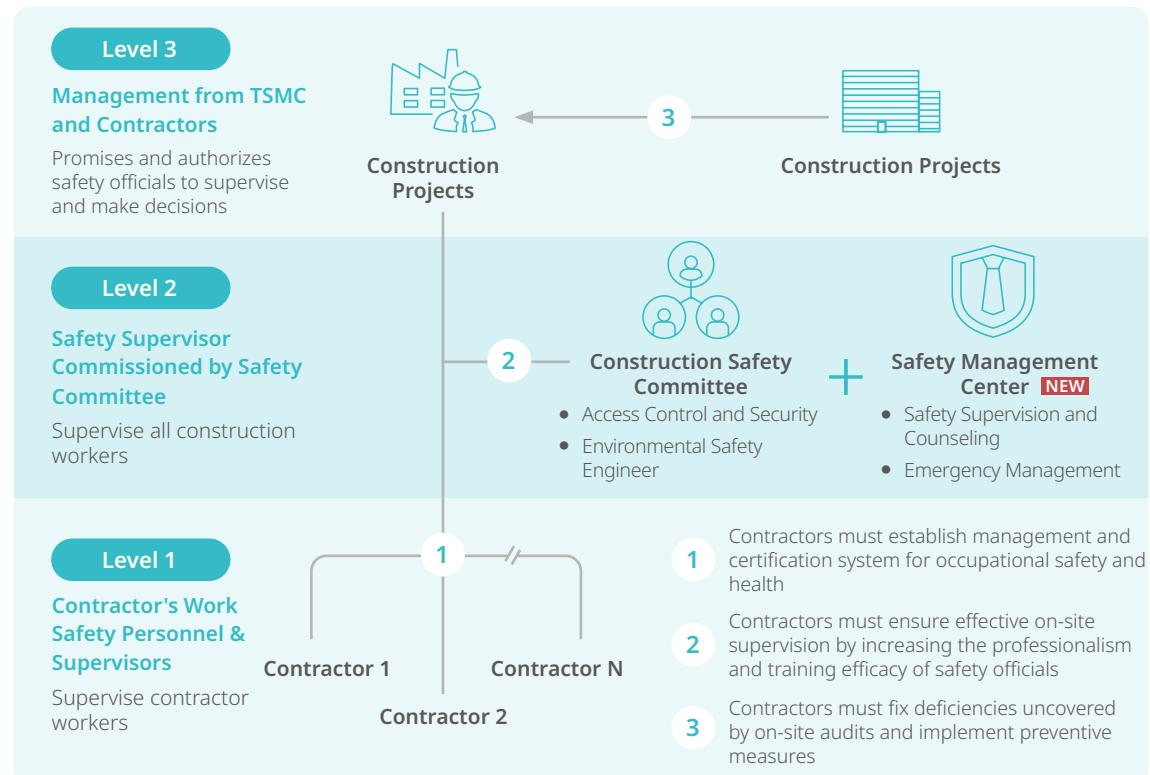
As TSMC values construction site safety, the Company vigorously aims to create a localized, people-oriented workplace, hiring only employees of local nationality. Since the start of a new construction project, a construction site safety management organization is formed with the contractors, construction site Occupational Safety and Health Committee, and Safety Management Center. TSMC rigorously monitors the construction environment using a comprehensive three-level

management system, requiring contractors to submit a Construction Safety Protection Plan before each construction project, as well as discuss and review safe construction steps through the Safety Management Center and contractor meetings. In particular, before implementing the six high-risk operations, it is necessary to assign dedicated personnel to conduct a pre-construction inspection and full-time supervision to ensure labor safety.

In 2022, TSMC collaborated with third-party safety experts to implement the Construction Safety Management Counseling Project. Besides conducting on-site safety management operation observations and interviewing contractor supervisors in the workplace, the Company also strove to enhance contractors' attitudes towards safety management. Furthermore, a new project contractor operation safety improvement meeting was held, inviting TSMC's long-term contractors to participate in the meeting. At the same time, the American

company DuPont and German company Exyte were invited to share their industry-leading safety management experience, encouraging contractors to generate the core value of "zero occupational safety accidents". The Company also required the management team to commit to creating a safety culture that involves full participation. The primary goal of the fab construction area was to reduce the risk of occupational risks. The program saw the participation of a total of 49 contractors and 140 personnel.

### The three-level management system continued at TSMC fab construction sites



TSMC holds new project contractor operation safety improvement meeting

## Three-pronged Approach to Construction Site Safety Management



### Safety Management

#### Existing Measures

- Continued to compile the ESH Bluebook on Fab Construction. The content is divided into nine major chapters, totaling 90 operational management-related items. The Bluebook is slated for publication in 2023, which will be used as an operational guideline for enhancing construction safety in Taiwan

#### New in 2022

- TSMC collaborated with third-party safety experts to implement the Construction Safety Management Counseling Project and new project contractor operation safety improvement meeting
- Established the Southern Taiwan Science Park On-duty Response Center and collaborated with the Safety Management Center to monitor abnormal situations and respond to abnormal situations and events through the safety dashboard
- Distributed zero-disaster rewards in the fab construction area to engender a sense of honor, and encourage contractors to create a zero-disaster work environment together. In 2022, a total of **1,061** rewards were distributed
- The construction management system was integrated with access control and risk matrix grading, dividing operations into three levels according to the content of the operations involved: mild/moderate/severe. Moreover, dedicated personnel was assigned to supervise operations with severe risks, achieving a severe risk supervision rate of **>85%**
- Construction units are graded according to risk. Priority is given to the identification of high-risk construction or construction workers with high violation rates. Furthermore, contractors with poor safety indicators are given guidance



### Safe Behaviors

- In continuation of the six high-risk operations, the main contractor and the Safety Management Center will dispatch personnel to oversee the entire process and mitigate risks through intensive supervision
- Established a health management system for high-risk construction groups, where blood pressure monitoring, on-site care, and health education are carried out to implement voluntary health management in conjunction with contractor counselors. A total of **8,836** persons received care through this program
- Education is the foundation of safe behavior, hence teaching materials for **16** courses were integrated with the safety topics selected by seed instructors trained by contractors to implement exhaustive inspection via the three-level audit method to discover various contractor management-related weaknesses and offer guidance



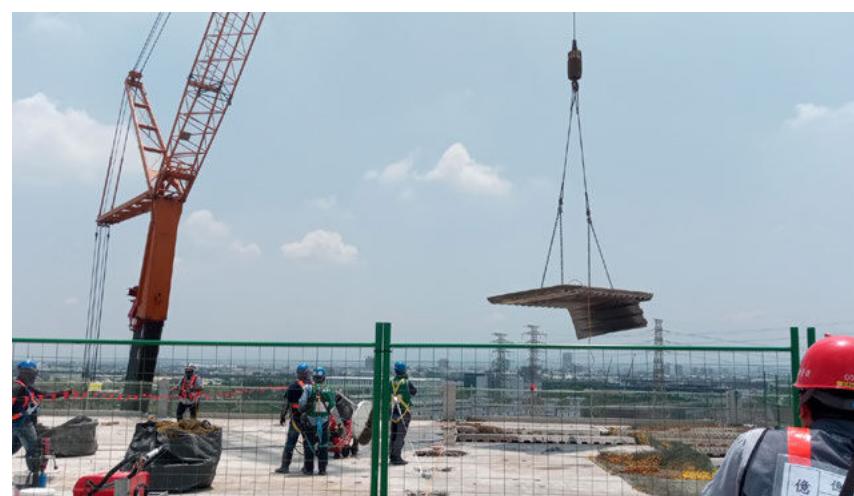
### Safe Workplace

- Implemented the construction site safety facility improvement team proxy system to eliminate risky environmental shortcomings as soon as possible
- Carried out safety inspections of high-risk tools by professional personnel to ensure they were safe before entering the fab and using the tools
- Utilized AI image recognition technology to analyze personnel behavior patterns and build an abnormal environmental image model to interpret and prevent abnormal or illegal behaviors in the work area in real time
- Created an independent QR code at every opening in the construction area for patrolling purposes. A total of **1,382** openings were listed for management, achieving **100%** protection
- Fitted construction vehicles with intrinsic safety anti-collision facilities; forklifts, skid steer loaders, and water trucks have been equipped with backup cameras and radar as standard equipment. The equipment was installed on **79** vehicles in 2022
- Monitored and audited the construction environment of underground pipelines in the construction area. In 2022, a total of **48** underground pipeline operations were monitored

TSMC collaborates with third-party safety experts to implement the Construction Safety Management Counseling Project

Full-time monitoring of high-risk operations by dedicated personnel

Specific QR codes of each entrance for inspection purposes





# Power to Change Society

Committed to uplifting society, TSMC Education and Culture Foundation and TSMC Charity Foundation spotlight the changing social landscape and its needs. The two foundations integrate and invest internal and external resources to empower young students of all ages, care for remote areas and the disadvantaged, elderly people living alone, and foster art and cultural literacy to lay the foundation for a society with common good, beauty, and kindness.

**1,907,199**

Participants in promoting arts and culture

**16,471**

Seniors benefited from care for senior living alone

**44,617**

LED project beneficiaries

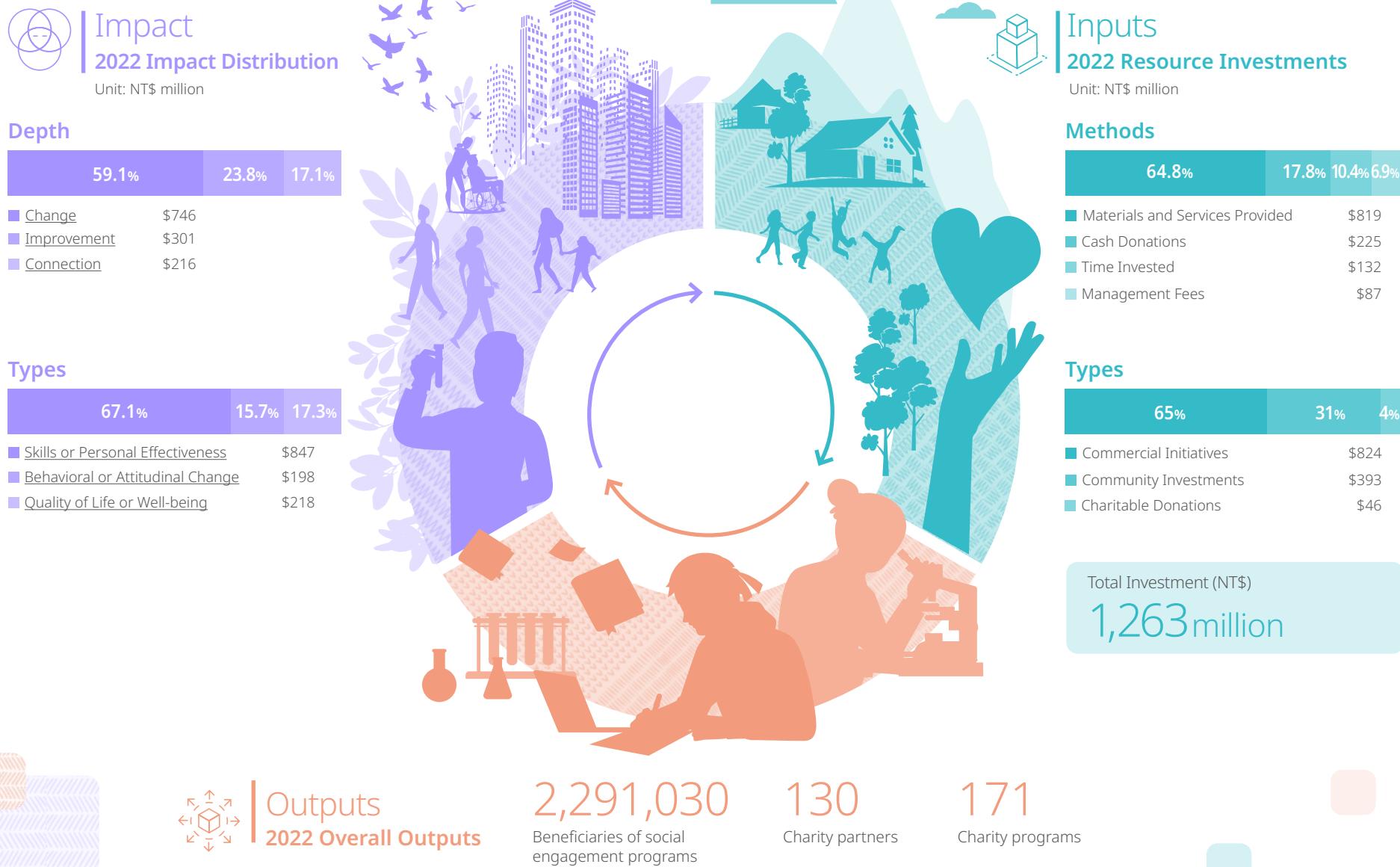
Social Impact

TSMC Education and Culture Foundation

TSMC Charity Foundation

# Social Impact

In line with the TSMC ESG Policy, TSMC actively responds to the United Nations Sustainable Development Goals (SDGs) and monitors diverse social issues, turning sustainable strategies into concrete actions; meanwhile, in reference to the Business for Societal Impact (B4SI) formerly known as London Benchmark Group's (LBG) Impact Principles, the Company analyzes the depth (connection, improvement, change) and the type (behavioral or attitudinal change, skills or personal effectiveness, quality of life or well-being) of the impact of overall resources on beneficiaries, so as to ascertain the overall benefit of resources invested, and use it as the basis for optimizing project execution and extending social impact.



In 2022, to continue driving sustainable social development and establish a reliable support network, TSMC collaborated with domestic and overseas R&D institutions to expand University Programs and provide assistance to address inadequacies in emergency relief and pandemic relief resources. Moreover, the Company teamed up with TSMC Education and Culture Foundation and TSMC Charity Foundation to form a protective shield for underprivileged groups via collaboration between industry, government, and academia. TSMC Education and Culture Foundation is dedicated

to empowering youths, guiding female students to explore the field of science, and enriching cultural heritage. By joining forces with educational institutions to empower teachers and shape the quality of students, TSMC fosters art recognition and heritage, elevating the spiritual cultivation of the Taiwanese people. TSMC Charity Foundation has connected rural education with local employment, appealing to employees and charity partners across various industries to support remote townships and seniors living alone to promote filial piety and create a society of common good, where children can grow

up, young people can apply their talents, and seniors can retire.

In 2022, TSMC and the two Foundations invested more than NT\$1.779 billion in charitable activities. NT\$516 million was used to purchase and donate vaccines to alleviate the urgent domestic demand for vaccines. TSMC also invested more than NT\$1.263 billion into seven major public welfare pillars to promote various projects, listen to, support, and empower stakeholders in the social field, mainly in the form of resources and services, which

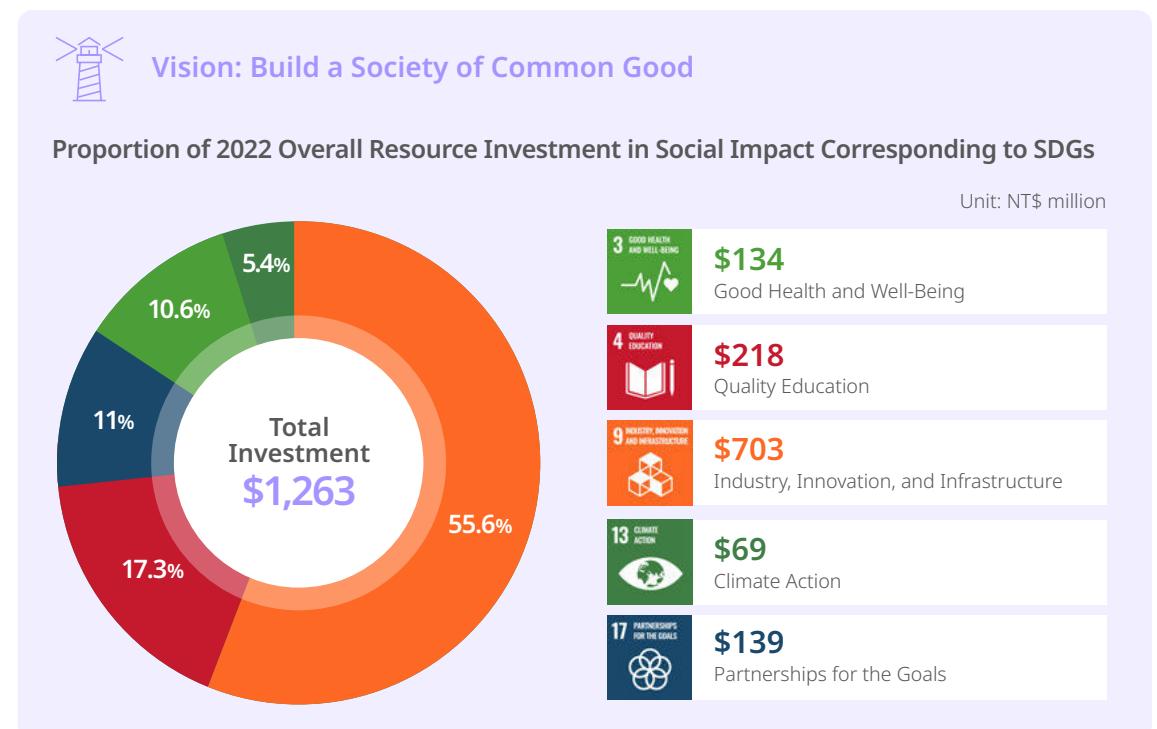
accounted for 64.8% of total donations. In terms of the type of resources invested, TSMC continues to strengthen contributions to commercial initiatives and community investments, hoping to strengthen the relationship with the community by focusing on the Company's core business. Concerning the UN SDGs, SDG 9 (Industry, Innovation, and Infrastructure) accounted for 55.6% of the resources invested during the year, followed by SDG 4 (Quality Education) at 17.3%. TSMC also paid attention to SDG 3 (Good Health and Well-Being), SDG 13 (Climate Action), and SDG 17 (Partnerships for the Goals).

### Core Services

- Cultivate Young Generation
- Promote Educational Collaboration
- Promote Arts and Culture
- Empower the Rural Community
- Care for the Elderly
- Promote Filial Piety
- Protect the Environment

### Target Groups

- High school / university students and professors
- Educationally underprivileged students
- Schools or educational institutions in rural areas
- Arts and cultural groups and local residents
- Underprivileged groups
- Seniors with low income living alone
- Care centers for seniors living alone
- NPOs / NGOs
- The public





# TSMC Education and Culture Foundation

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Cultivate Young Generation</b> Hold educational events; provide diversified educational platforms	<p>Ensure the number of overall youth competition event participants is higher than that of the previous year</p> <p>Hold <math>\geq 20</math> popular semiconductor activities with <math>\geq 1,500</math> participants<sup>Note</sup> annually</p> <p>Invest <math>\geq</math> NT\$33 million in resources annually<sup>Note</sup></p>	<p>Ensure the number of overall youth competition event participants is higher than that of the previous year</p> <p>Hold <math>\geq 20</math> popular semiconductor activities with <math>\geq 1,000</math> participants</p> <p>Invest <math>\geq</math> NT\$33 million in resources annually</p>	<p>Youth competition events attracted a total of 2,388 participants, up by 774 participants from 2021 Target: The number of youth event participants is higher than that of the previous year</p> <p>Held 18 TSMC Journeys of Female Scientists Lectures, with 1,275 participants Target: Hold <math>\geq 10</math> popular semiconductor science activities with <math>\geq 600</math> participants</p> <p>Invested NT\$34.04 million Target: Invest <math>\geq</math> NT\$30 million in resources annually</p>
<b>Promote Educational Collaboration</b> Cooperate with educational organizations to narrow the gap in educational resources	Continue to cooperate with educational organizations and invest $\geq$ NT\$20 million in resources	Invest $\geq$ NT\$15 million in resources annually	<p>Offered scholarships at five universities and benefitted 98 underprivileged students Target: Continue to offer scholarships at five universities and increase the number of underprivileged students benefited from the scholarships to 97</p> <p>Sponsored the Public and Private Experimental Emei Bilingual Junior High School NT\$1.1 million to support education, totaling NT\$3.3 million to date Target: Continue to sponsor NT\$1.1 million</p> <p>Invested a total of NT\$17.87 million Target: Invest <math>\geq</math> NT\$15 million in resources annually</p>
<b>Promote Arts and Culture</b> Hold art festivals to foster local art groups	<p>Sponsor ten local talented artists or art groups</p> <p><math>\geq 1,500</math> participants for Chinese in-person opera activities <b>NEW</b></p> <p>Ensure the annual number of beneficiaries for in-person arts and cultural events is <math>\geq 15,000</math> people</p>	<p>Sponsor ten local talented artists or art groups</p> <p><math>\geq 1,500</math> participants in Chinese in-person opera activities <b>NEW</b></p> <p>Ensure the annual number of beneficiaries for in-person arts and cultural events is <math>\geq 15,000</math> people</p>	<p>Continued to organize the TSMC Hsin-Chu Art Festival and sponsored 12 domestic art groups Target: Sponsor ten local talented artists or art groups</p> <p>Sponsored 15 Kenneth Hsien-Yung Pai Literature Lectures Target: Organize <math>\geq 15</math> humanities lectures in college</p> <p>Held four TSMC Lectures Target: Continuously organize <math>\geq</math> four TSMC Lectures</p> <p>26,821 people participated in in-person arts and cultural activities Target: Hold in-person arts and cultural activities and benefit <math>\geq 20,000</math> people</p>

With a vision of cultivating talents and fostering a benevolent society, TSMC Education and Culture Foundation strives to materialize the three themes of Cultivate Young Generation, Promote Educational Collaboration, and Promote Arts and Culture, thereby generating a positive cycle and sustainable development. In 2022, despite the COVID-19 pandemic, TSMC Education and Culture Foundation still invested copious resources to organize numerous educational activities as well as arts and cultural events. We collaborated with [educational partners](#) to empower teachers in remote townships, inviting employees to accompany young students to pursue their dreams, inspiring female senior high school students' interests in science, and establishing programs such as Chinese Opera on Campus courses and Peking opera art appreciation micro-courses, as well as organizing online arts and cultural activities by capitalizing on the power of science and technology. A total of NT\$100.2 million was invested this year. For more information on the events and the sponsorships, please refer to the official website of [TSMC Education and Culture Foundation](#).

### Donation by TSMC Education and Culture Foundation

Unit: NT\$ ten thousand



## TSMC Education and Culture Foundation Contributions

### What We Contributed



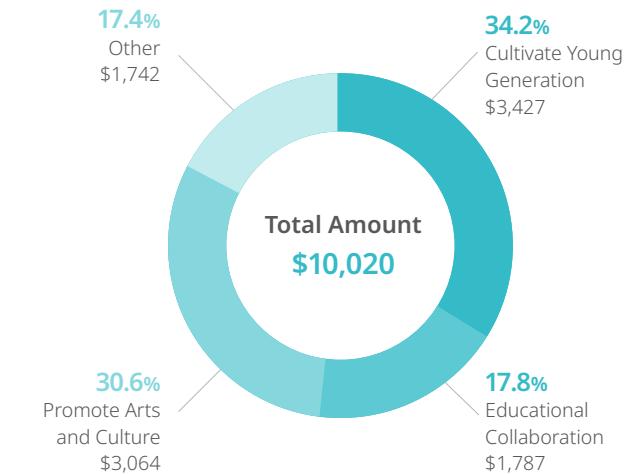
Total Amount  
\$10,020

### How We Contributed



Total Amount  
\$10,020

### Focuses of Contributions



Total Amount  
\$10,020

### Core Engagement



#### Cultivate Young Generation

- Promote popular science education and cultivate female scientist talents
- Provide diverse platforms for youths to undergo self-exploration
- Organize literature, arts, and cultural competitions to enrich cultural qualities



#### Promote Educational Collaboration

- Empower rural teachers to improve the literacy of students in remote townships
- Sponsor experimental education at junior high Schools and organize literature camps to enrich humanistic qualities
- Sponsor scholarships at universities for underprivileged students and provide digital learning equipment



#### Promote Arts and Culture

- Cultivate arts and cultural talents and promote the heritage of Chinese opera
- Promote arts and cultural events
- Sponsor cultural broadcasting programs to enhance artistic ambiance



## Cultivate Young Generation

### What We Want to Solve

Domestic education often lacks literature, art, science, and exploration courses. As a result, students do not have a holistic education that integrates technology and humanities and thus lack the comprehensive skills required for future talents.

### How We Respond

Organize competitions, science camps, lectures, and proposal competitions for senior high school and college students to inspire their interest in science and develop their cultural qualities. At the same time, the aim is to boost their self-confidence, insight, and problem-solving capabilities.

### Our Actions

- Promote Popular Science Education and Cultivate Female Scientist Talents
- Provide Diverse Platforms for Youths to Undergo Self-exploration
- Organize Literature, Arts, and Cultural Competitions to Enrich Cultural Qualities

## Promote Popular Science Education and Cultivate Female Scientist Talents

### Journeys of Female Scientists - Inspire Students' Interest in Science

To subvert the concept of "STEM is not suitable for women" and inspire senior high school girls' interest in science, TSMC Education and Culture Foundation collaborated with National Museum of Natural Science in 2022 to hold the third TSMC Journeys of Female Scientists, inviting students from 12 girls senior high schools to attend the lectures. The lectures included a guided tour of the World of Semiconductors Exhibition Hall and the TSMC Museum of Innovation. Semiconductor popular science workshops were also held in conjunction with lectures by female scientists. At the same time, outstanding female engineers from TSMC also shared their learning and career experience to encourage students to explore STEM. In 2022, TSMC Education and Culture Foundation extended the one day visit to two days and one night in-depth popular science activity, hoping to encourage more female students to join scientific research, thereby cultivating scientific talents for the country and the industry. As of 2022, 17 Journeys of Female Scientists Lectures have been held and attended by 1,925 people.

44

Technology is an integral part of people's lives, and there are semiconductors everywhere. I hope to continue to explore developments in semiconductors in my future career.

Taipei First Girls' High School Student

By having more female scientists as role models, young students can understand that the future path is not as difficult as they may think, and it also helps children to enter the technology industry with more confidence.

Mon-Shu Ho, Professor

Department of Physics, National Chung Hsing University

### Micro-course Design Helps Students Obtain New Knowledge of Semiconductors

In 2022, easy-to-understand micro-course teaching materials were used to encourage high school students to learn the field of semiconductors, TSMC Education and Culture Foundation used sponsored exhibits from the World of Semiconductors Exhibition Hall of the National Museum of Natural Science to launch the Big Brother and Sister Talk About Semiconductors course in collaboration with NYCU. The course content encompasses semiconductor introduction, manufacturing process, component digital circuit, industry overview, etc. They are combined with Artificial Intelligence of Things (AIoT) experience and a short film competition on semiconductor chip theory to inspire high school students' interest in semiconductors. The courses have been progressively launched at National Hsinchu Senior High School, National Hsinchu Girls' Senior High school, and National Experimental High School at Hsinchu Science Park with 260 participants in total.

Female students enthusiastically partake in TSMC Journeys of Female Scientists Lectures



## Sponsor Three Major Science Camps

With the mission of cultivating future scientists, TSMC Education and Culture Foundation has been a long-term sponsor of Wu Chien Shiung Science Camp, Marie Curie Science Camp, and Wu Ta-You Science Camp, thereby enriching young students' scientific knowledge and expanding their forward-looking insight. In 2022, Marie Curie Science Camp invited top scholars to present lectures with the three major themes: sustainable agriculture technology, zero waste resource recycling, and green chemistry. Camp activities included: lectures from top scientists, scientists and entrepreneurs forums, green chemistry experiments promotion and team competitions. The Foundation also invited TSMC engineers to share their educational background, work experience, and the current industry status with the camp participants. The camp attracted 96 enthusiastic participants in total.

The Foundation sponsors the Wu Chien Shiung Science Camp for 20 consecutive years. The camp activities included the Master and Student Dialogue and Creative Competition camps to broaden students'

Camp participants expand their scientific knowledge and perspectives through creative competitions



international scientific horizons, stimulate their ambition and potential to pursue extraordinary scientific achievements. Furthermore, the camp also invited high school and vocational science teachers to participate in further training activities to explore ways to cultivate outstanding scientific talents. In 2022, a total of 134 students and eight teachers signed up for the event.

### TSMC Cup - Competition of Scientific Short Talk

TSMC Education and Culture Foundation and the Center for the Advancement of Science Education have jointly hosted the TSMC Cup - Competition of Scientific Short Talk during the last ten years in the hope of elevating the scientific qualities of senior high school students as well as their oral and written skills. The competition included the Science Creative Expression Competition and Popular Science Book Guided Reading Contest. The Science Creative Expression Competition requires the contestants to view the designated reading topics and engage in scientific abstract report writing, scientific and creative

Participants enhance their competence and communication skills through science competitions



expression short film production, and interactive questioning and pop quiz based on different stages of the competition. The purpose of the competition is to cultivate young people's ability to interpret and tell stories. The Popular Science Book Guided Reading Contest requires participants to write a guide article after reading selected popular science books. Students are expected to obtain new scientific knowledge through reading to develop analytical and critical thinking skills. A total of 755 people participated in the event in 2022.

### Provide Diverse Platforms for Youths to Undergo Self-exploration

#### Guide Youths to Care About Sustainability and Build Dreams Together

TSMC Education and Culture Foundation launched the TSMC Udreamer Project since 2016. The theme for 2022 was set as "Youth for a Sustainable Island" and invited college students to care about sustainability and take action. This year's diverse proposals exemplified students' commitment to the topic of sustainability. In addition to the competition,

The final judging of the seventh TSMC Udreamer Project



## Organize Literature, Arts, and Cultural Competitions to Enrich Cultural Qualities

### Cultivate the Literary of Young People

The Foundation has organized the TSMC Literature Award for 19 consecutive years to cultivate youth literature and encourage creation. In 2022, the theme of My Youth Proposal was applied to continue providing young students with a stage for unleashing their talents for literature. A total of 668 submissions were received for the year, bringing the cumulative number of submissions over the years to 11,179, including short stories, essays, and new poems. Apart from the essay competition, other activities include lecture tours by writers, contestant-judge forums, and an online essay call for submissions on the medium blog.

### Promote Chinese Character Education and Calligraphy

The TSMC Calligraphy and Seal-carving Competition is the only annual event in Taiwan that promotes calligraphy and seal-carving education for high school students. With the theme of "Food," the 15<sup>th</sup> competition incorporates everyday life issues to bring the younger generation closer to traditional culture, inviting gourmet writers to depict classic dishes and poetic stories in the recipes of Sung Dynasty scholars. Furthermore, Kai Ping Culinary School was invited to design the Sung Flower Banquet by using seasonal ingredients. Furthermore, to encourage teachers to promote Chinese character education, the Foundation continues to hold the "creative calligraphy teaching proposal" selection, thereby fostering the development of new teaching proposals, embodying the art of calligraphy and seal carving in life, and allowing students to appreciate the artistic beauty of Chinese characters. The competition attracted a total of 449 participants this year, and 29 creative teaching proposals were received.

TSMC held the 15th Youth Calligraphy and Seal-Carving Competition



Dr. F.C. Tseng, Chairman of TSMC Education and Culture Foundation, presents the short story first prize



### Host Literature Lectures in Collaboration with Titans of Literature

The Foundation has long dedicated itself to the humanities education. In 2022, it collaborated with the Center of General Education, the Department of Chinese Literature, and the Center for Language Education at National Tsinghua University to host the Kenneth Hsien Yung Pai Literature Lectures - Classic Chinese and Western Novels, inviting Mr. HsienYung Pai, a literary giant in Chinese literature and 13 other professors in the country to give special classes and take students to explore classic Chinese / western novels, broaden the horizons of ancient and contemporary culture, and care about culture. The lecture includes 15 special classes, attracting 3,754 participants. The class was produced into a video and uploaded to the NTHU OpenCourseWare platform and the TSMC Education and Culture Foundation website for the public. As of 2022, the video has been viewed 148,216 times.



Senior high school students learn to appreciate the beauty of Chinese characters through the calligraphy competition



## Promote Educational Collaboration

### What We Want to Solve

Schools in remote townships in the country are faced with long-term shortage of teachers and educational resources, resulting in low academic achievement among students. Students from underprivileged homes are trapped by financial circumstances, hence they are unable to explore and turn their lives around.

### How We Respond

Collaborate with educational organizations from both the private and public sectors to expand curriculum development and promotion, as well as assist in the training of teachers in remote townships to improve the learning motivation and effectiveness of underprivileged students. Scholarships are also provided for disadvantaged students to reduce their financial burden.

### Our Actions

- Empower Rural Teachers to Improve the Literacy of Students in Remote Townships
- Sponsor Experimental Education at Junior High Schools and Organize Literature Camps to Enrich Humanistic Qualities
- Sponsor Scholarships at Universities for Underprivileged Students and Provide Digital Learning Equipment

## Empower Rural Teachers to Improve the Literacy of Students in Remote Townships

### Teach and Learn Program

TSMC Education and Culture Foundation collaborated with the Common Wealth Education Foundation and the Hwawei Ko Professor Reading Research Center at NTHU to launch a five-year Teach and Learn Program in 2021. The program provides rural teachers with teaching proposal assistance, forms a joint course-preparation group, as well as organizes teacher empowerment workshops, and provides on-site teaching observation and online teaching seminars. In 2022, the program attracted the participation of 94 teachers and 984 new students from 48 elementary schools in rural areas. To understand the program's achievements, teachers who participated in the program were invited to conduct a questionnaire survey in 2022. The results indicate 54% of the respondents believed that the Teach and Learn Program helped to significantly elevate the teaching quality. Moreover, a Chinese character recognition test was conducted on 1,232 students who participated in the program in 2021, and the results showed that 86% of the students possess above-average literacy skills, and the ratio of the Level C students (Improvement required) greatly improved from 80% to 14% comparing to last year.

66

I was rather confused in the early stage of teaching. Fortunately, the Teach and Learn Program inspired my teaching process.

**Chih-Hsuan Chang**

Substitute Teacher, Hsia-Yun Primary School

Through the Teach and Learn Program, I can see the curiosity of seven-year-old children and their desire for knowledge!

**En-Ju Lin**

Keelung FuShing Public School

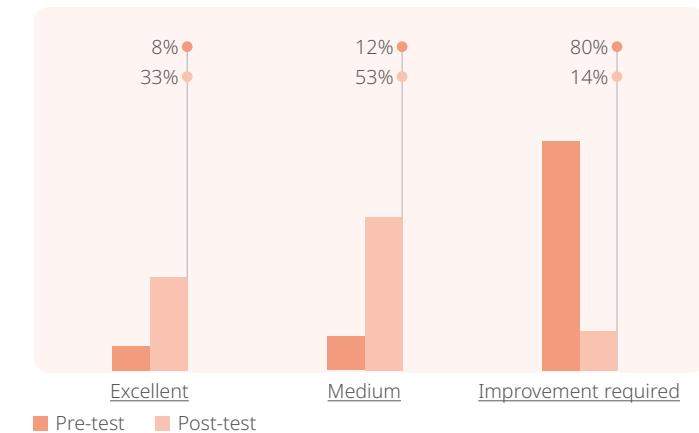
3.3 million

Invested in Emei Bilingual Junior High School to turn it into an experimental junior high school; since the plan's implementation, the number of students in the school has increased from 39 to 54

984

Students benefited from the Teach and Learn Program

## Impact on Students' Literacy from Teach and Learn Program



Teach and Learn Program at Keelung Elementary School



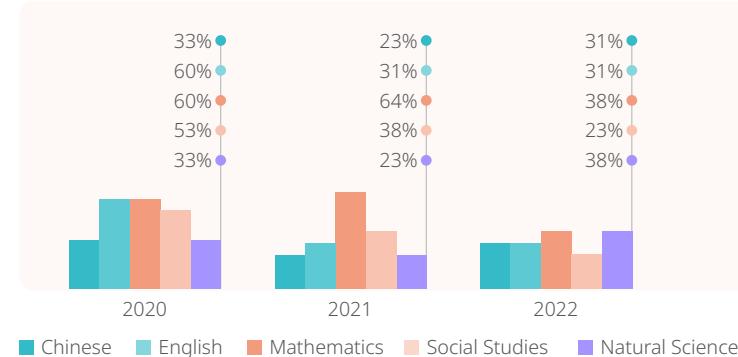
## Sponsor Experimental Education at Junior High Schools and Organize Literature Camps to Enrich Humanistic Qualities

### Cultural Nourishment through Literature Camp

Caring about remote education in Taiwan as its long-term goal, TSMC Education and Culture Foundation collaborated with Cheng Zhi Foundation to transform rural education in Taiwan. In 2022, the Foundation continued to provide funding to Emei Bilingual Junior High School and help to transform it into an experimental junior high school for the third straight year, introducing changes to the teaching quality and learning performance through abundant teacher training and the implementation of professional course preparation resources. With the long-term

resources contribution, the results of the Comprehensive Assessment Program for Junior High School Students show the ratios of English, mathematics, and social subjects that need to be improved are all lower than the previous year. Additionally, the number of students in the school has also increased steadily, from 39 in 2020 to 54 students. In the same year, the Foundation collaborated with UNITAS Magazine to organize the second TSMC Youth Student Literature Camp at Emei Bilingual Junior High School. Through the exciting sharing of writers, 62 young literature enthusiasts from Taoyuan, Hsinchu, and Miaoli were allowed to get close to literature and cultivate their word perception and writing skills.

### Emei Bilingual Junior High School Comprehensive Assessment Program for Junior High School Students - Ratio of Grade C Students



Dynamic challenges introduced students to the world of literature



Tea tasting course of the second TSMC Youth Student Literature Camp



## Sponsor Scholarships at Universities for Underprivileged Students and Provide Digital Learning Equipment

### Provide Scholarship and Digital Learning equipment to Underprivileged Students

Dedicated to assisting outstanding yet economically underprivileged students, TSMC Education and Culture Foundation continued to contribute NT\$9.8 million of scholarships to 98 underprivileged students in 2022. In addition to scholarships, the Foundation also provided summer internship opportunities at TSMC for scholarship recipients to learn about industry trends and bridge the gap between learning and practice; the program also sponsors 25 award-winning freshmen with laptop computers to eliminate their digital learning barriers.



Thanks to the scholarship, I was able to go to Kenya to become an international volunteer without financial worry, and gradually find my calling. On the shoulders of a titan such as TSMC, I could see the light of my own future.

**Recipient of Sunrise Program Scholarship**  
National Tsing Hua University

TSMC Youth Student Literature Camp attracts the participation of young literature enthusiasts





## Promote Arts and Culture

### What We Want to Solve

Improve predicaments faced by domestic art groups such as inadequate resources, loss of audience and heritage, and foster the public's interest in traditional arts and cultural activities to popularize the art and make it an integral part of life.

### How We Respond

Apply digital technology to organize high-quality offline and online arts and cultural activities, sponsor exceptional domestic art groups, provide a performance stage, as well as organize rich, diverse programs and activities to raise the public's interest in art appreciation and Chinese opera.

### Our Actions

- Cultivate Arts and Cultural Talents and Promote the Heritage of Chinese Opera
- Promote Arts and Cultural Events
- Sponsor Cultural Broadcasting Programs to Enhance Artistic Ambiance

## Cultivate Arts and Cultural Talents and Promote the Heritage of Chinese Opera

### Promote Music without Borders Educational Program

In 2022, TSMC Education and Culture Foundation joined forces with National Symphony Orchestra and Taipei National University of the Arts to sponsor the Music without Borders Educational Program, to connect Taiwan's music scene to the international stage and vigorously cultivate world-class music talents. The One-Minute Symphony Composition Project recruited young composers to engage in quick creation. German conductor Jun Märkl was invited to mentor the young composers and their composing works were then performed by the NSO orchestra. The performance was appreciated by an audience of 5,973 people; For the Conducting and Composing Advancement Project, Lu Shao-Chia, a well-known Taiwanese conductor residing in Europe, helped aspiring students to refine their conducting skills. The TNUA Orchestra Fall-Winter Concert 2022, was held and attracted an audience of 410 people.



TNUA is extremely fortunate to receive resources from the Foundation to carry on the heritage of the art education program.

Shien-Ta Su

Dean of TNUA School of Music

158,145

People participated in Hsin-Chu Art Festival's off-line and on-line activities

95

Students registered in the Chinese Opera on Campus Program

26,821

People participated in the Foundation's off-line arts and cultural activities

### Practical Chinese Opera Learning - Shattering Traditional Frameworks

To promote the heritage of Chinese opera, the Education and Culture Foundation teamed up with Guoguang Opera Company in 2021 to launch the Chinese Opera on Campus Program, opening Chinese opera elective courses at National Tsing Hua University and National Tunghai University. The courses consisted of Chinese opera-related knowledge, opera script appreciation and analysis, Peking opera performance demonstration and teaching; the class attracted 35 students to sign up since the beginning of the first semester in 2021, and the number increased to 95 in 2022. To deepen collaboration and facilitate the appreciation of Peking opera, the Foundation also launched TSMC Theatre at National Yang Ming Chiao Tung University to perform classic opera repertoires. Furthermore, campus micro-courses were also held at three senior high schools in Hsinchu area, where wonderful, guided introductions were arranged in conjunction with live demonstrations by professional actors, taking students to transcend time and space. The performances attracted 644 participants in 2022.

National Tsing Hua University students take Peking opera as their elective and participate in opera performance



Music without Borders Educational Program cultivates potential conductors



Guoguang Opera Company actors demonstrate how to perform on stage and train potential talent

## Combine Etiquette and Customs - Edutainment

The Foundation has sponsored the Tainan City Cultural Affairs Bureau to hold the TSMC Youth Theater Project - 16 Year Old Festival since 2015. The program theme is inspired by the 16 Years Old Coming of Age Ceremony, a traditional custom in Tainan, which combines three major strategies of "viewing theater, making theater, and performing theater" to bring youths closer to traditional customs and enrich their artistic cultivation. In 2022, youths are encouraged to portray the life of the younger generation through narrative history theater and montage-style directing. The program attracted 54 students from 25 high schools in Taiwan to attend in 60 performances, and a total of 39,512 people participated in the promotional activities. The 16 Year Old Festival has demonstrated tremendous success and became the cradle of Taiwan's artistic talents. Over the eight years, a total of 399 youths have participated in the festival with 97 students studying at art-related departments in Taiwan or abroad.



Young people are invited to perform at the 16 Years Old Festival to showcase their passion and vigor

## Promote Arts and Cultural Events

### Promote Public Appreciation of Artistic Performances

Since 2003, TSMC Education and Culture Foundation has continued to hold the TSMC Hsin-Chu Art Festival, a large-scale art and cultural event in Hsinchu, Taichung, and Tainan. In 2022, the theme was A Feast of the Gods. A series of activities including drama, music, literature, history lectures, and online film exhibition were held around the theme. The Foundation invited Peking opera masters to integrate technology with traditional art, collaborating with the National Symphony Orchestra, Taiwan Film & Culture Association, Guoguang Opera Company, and other art and cultural groups to take the audience to appreciate the cultural connotation of Chinese and western myths through exquisite art performances. 158,145 participants joined 15 offline and 27 online events in total.

### Enhance the Appreciation of Classical Music

To enhance the public's appreciation of classical music, TSMC Education and Culture Foundation sponsored National Taichung Theater and New National Theatre, Tokyo to launch Mozart's opera The Magic Flute. Darrel Ang, the artistic director of Sichuan Symphony Orchestra and a renowned Singaporean conductor, was invited to collaborate with the National Symphony Orchestra and numerous top international vocalists for four performances at the National Taichung Theater. Activities such as performances, lectures, workshops, and stage tours enable the audience to gain insight into the details of opera creation. A total of 7,825 people participated in the event.

Tales from Chinese Opera program interview



## Sponsor Cultural Broadcasting Programs to Enhance Artistic Ambiance

### Produce the Radio Program Tales from Chinese Opera

To deepen the younger generation's knowledge in Chinese opera, convey Chinese opera knowledge and classical Chinese literature through auditory sense the Education and Culture Foundation continued to collaborate with IC Broadcasting Company in 2022 to launch the opera broadcasting program Tales from Chinese Opera. Every week, the program introduces the provenance of classic operas and their performance styles. The program also interviews famous Peking opera actors and introduces the exciting on-stage and behind the scenes stories of Peking opera in a humorous manner, as well as offers diverse channels for listeners. As of 2022, more than 863,533 people have listened to the online program.

### Produce the Radio Program I-Yun Hsin Talks About the Classic of Poetry

TSMC Education and Culture Foundation invited Professor I-Yun Hsin, a master of Chinese studies, to produce a Chinese classic lecture radio program I-Yun Hsin Talks About the Classic of Poetry. Since 2018, he has taught classics such as the Analects, Zhuangzi, Mozi, and Laozi; in 2022, he selected contents from the Classic of Poetry to produce 43 episodes, using simple but vivid explanations to share emotional descriptions and social outlook in the Classic of Poetry. The program attracted a total of 692,075 listeners.



Tales from Chinese Opera opened my eyes to Peking opera, allowing me to gain a deeper understanding of traditional culture.

Jo-Ching Lin  
National Hsinchu Girls' Senior High school



# TSMC Charity Foundation

Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Empower the Rural Community</b> <small>Note 1</small>	<p>10,000+ hours of volunteer reading every year</p> <p>At least NT\$18 million in annual donations to disadvantaged people</p> <p>Benefit 10,000+ children in rural areas</p>	<p>9,000+ hours of volunteer reading</p> <p>At least NT\$15 million in annual donations to disadvantaged people</p> <p>Benefit 5,000+ children in rural areas</p>	<p>1,175 hours<sup>Note 2</sup> of volunteer reading Target: 9,000+ hours</p> <p>NT\$15.29 million<sup>Note 3</sup> in donations Target: at least NT\$15 million</p> <p>6,358 children in rural areas benefited Target: 5,000+ children</p>
<b>Care for the Elderly</b>	<p>Serve seniors living alone 16,000 times every year via the Network of Compassion</p> <p>400,000 meal deliveries via the Network of Compassion</p>	<p>Serve seniors living alone 12,000 times via the Network of Compassion</p> <p>330,000 meal deliveries via the Network of Compassion</p>	<p>Services offered 16,471 times Target: 11,000 times</p> <p>Meals delivered 355,692 times Target: 310,000 times</p>

Note 1: TSMC Charity Foundation combined rural education and local employment, and renamed the key focus Care for the Disadvantaged to "Rural Empowerment" in 2022.

Note 2: In compliance with the epidemic prevention measures stipulated by the Central Epidemic Command Center and service institutions, the Foundation suspended volunteer services requiring physical proximity for ten months in 2022.

Note 3: The donations were contributed by TSMC volunteers as well as internal and external donors supporting the Sending Love initiative in cash, excluding repairs and other supplies.

↑ Exceeded

✓ Achieved

— Missed Target



Strategies	2030 Goals	2023 Targets	2022 Achievements
<b>Promote Filial Piety</b>  Work with the Ministry of Education and schools at different levels to produce teaching materials and organize workshops, encouraging cross-generational conversation and parent-child communication for mutual understanding	Promote filial piety education in 120 educational institutions	Promote filial piety education in 70 educational institutions	Promoted filial piety education in 68 educational institutions Target: 60 educational institutions <span style="color: red;">↑</span>
<b>Protect the Environment</b>  Implement green energy initiatives advantageous to the underprivileged and the Cherish Food Project to conserve and generate energy and reduce resource waste; promote energy conservation and environmental education in schools through volunteers	Benefit individuals 50,000+ times every year via the Cherish Food Project  Offer environmental protection-related volunteer services at least 1,200 times every year  Install solar panels for six social welfare institutions every year <span style="color: red;">NEW</span>  Replace LED light tubes for 240 elementary schools every year <span style="color: red;">NEW</span>	Benefit individuals at least 42,000 times via the Cherish Food Project  Offer environmental protection-related volunteer services at least 1,000 times  Install solar panels for six social welfare institutions  Replace LED light tubes for 240 elementary schools	Benefited individuals 48,143 times Target: 42,000+ times <span style="color: red;">↑</span>  Volunteer services offered 182 times <sup>Note 4</sup> Target: 1,000+ times <span style="color: red;">-</span>  Solar panels installed for seven institutions <sup>Note 5</sup> Target: six institutions <span style="color: red;">↑</span>  LED light tubes Replaced for 246 elementary schools Target: 240 elementary schools <span style="color: red;">↑</span>

Note 4: In compliance with the epidemic prevention measures stipulated by the Central Epidemic Command Center and service institutions, the Foundation suspended volunteer services requiring physical proximity for ten months in 2022.

Note 5: Resources had already been allotted to one social welfare institution and six elementary schools by the end of 2021; they are included in the statistics as the installation work in these institutions was completed in 2022.

↑ Exceeded   ✓ Achieved   - Missed Target

Dedicated to becoming a force for positive change in the society, TSMC Charity Foundation has long committed itself to championing four social causes: Empower the Rural Community, Care for the Elderly, Promote Filial Piety, and Protect the Environment. Adopting a hands-on approach to serving those in need, the Foundation leads TSMC employees in efforts to care for members of society and engage with the government, industry and academia to jointly close the urban-rural gap in learning resources and support economically underprivileged groups.

In 2022, the Foundation primarily focused on Empower the Rural Community, matching rural education goals to students' employability skills. Partnering with enterprises with the same vision, the

Foundation designed and offered career exploration activities, technical and vocational training, and job matching services to fill vacancies in industry and academia.

To play a part in Protect the Environment, the Foundation invested in initiatives that generate green energy for the good of the underprivileged. The Foundation installed solar power generators and replaced existing lights with energy-saving LED light tubes, saving and generating electricity at the same time. These measures have provided underprivileged groups with regular funding from generating green power and built classrooms with better lighting in schools in remote areas, while at the same time saving money on electricity bills.



31,760

Service Hours



62,684

Donations



372,690

Beneficiaries



&gt;\$223.07 million

Social Investments (NT\$)



11,378

Volunteers



7,607

Volunteer Service Times

## Core Engagement

### Empower the Rural Community

- Close the urban-rural gap in educational resources by injecting resources into rural areas
- Partner with organizations to empower vocational high school students in remote townships and assist them with employment
- Provide underprivileged people with financial support to improve their living conditions and remove barriers to education



### Care for the Elderly

- Strengthen the care for seniors living alone by providing much-needed resources and companionship



### Promote Filial Piety

- Diversify creative efforts to instill the virtue of filial piety



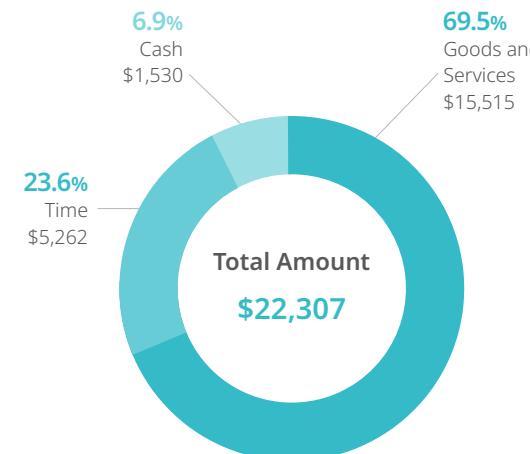
### Protect the Environment

- Conserve and generate electricity for social welfare institutions through implementing green energy initiatives advantageous to the underprivileged and the Cherish Food Project
- Provide environmental and energy conservation education to cultivate sustainable practices

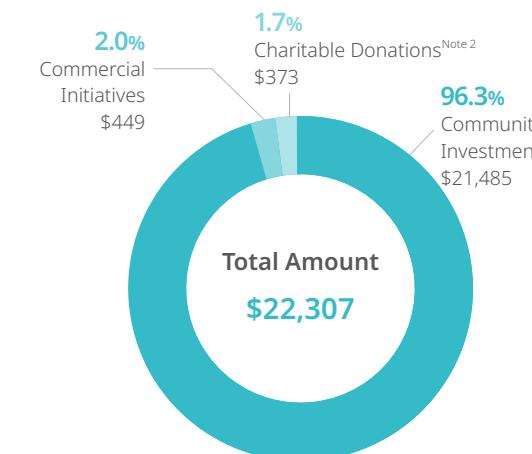


## TSMC Charity Foundation Contributions

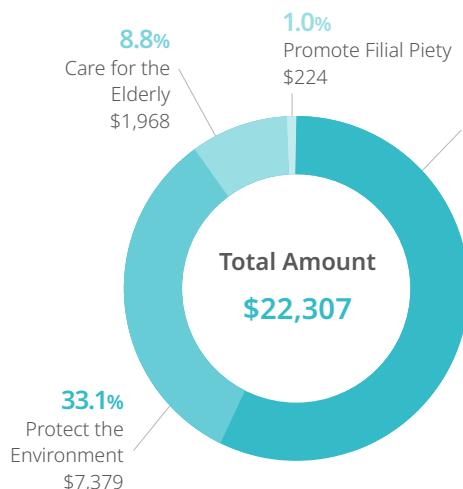
### What We Contributed<sup>Note 1</sup>



### How We Contributed<sup>Note 2</sup>



### Focuses of Contributions Unit: NT\$ ten thousand



TSMC volunteers lead rural children to tell stories with videos

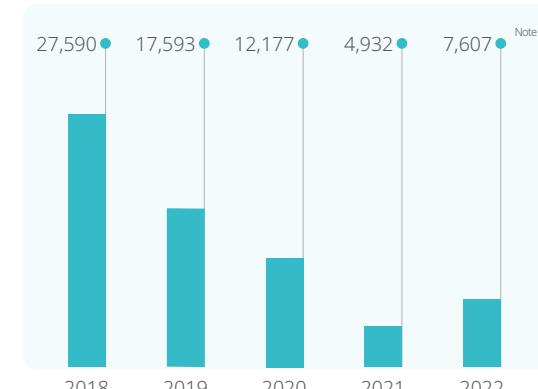
### Total Number of Volunteers<sup>Note 3</sup>

Unit: Number of Volunteers



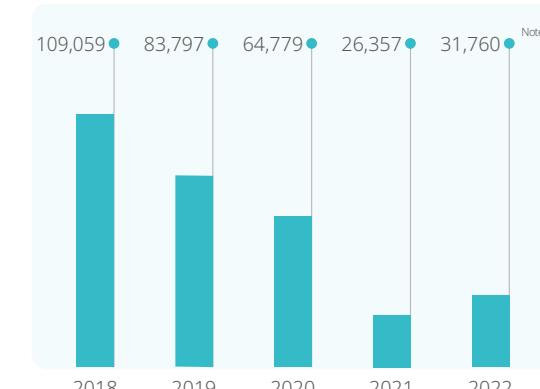
### Number of Volunteered Sessions

Unit: Person-time



### Volunteered Hours

Unit: Hours



In the information age, TSMC volunteers help rural schools improve digital capabilities

Note 1: Types of contributions are sorted using the definitions of the Dow Jones Sustainability Index (DJSI) into the categories of cash, time, goods and services, and all forms of donations are converted to be shown in New Taiwan dollar (NT\$) for percentage calculation. Time equals volunteered hours multiplied by hourly pay, whereas goods and services equal the amount of money invested by TSMC to provide such goods or services and the management thereof.

Note 2: Types of projects supported are sorted using the definitions of the Dow Jones Sustainability Index (DJSI) into the categories of commercial activities, charitable donations and community investments, and all forms of donations are converted to be shown in New Taiwan dollar (NT\$) for percentage calculation.

Note 3: The numerous volunteers participating in the Foundation's charity events include TSMC employees, former employees, retired employees, families of employees, employees of partner corporations, and students under University Social Responsibility (USR) programs.

Note 4: In response to the prevention and control of COVID-19, volunteer activities requiring physical proximity were suspended from the second half of 2021 to the second half of 2022, in compliance with the Ministry of Health and Welfare's pandemic policies and the rules put in place by TSMC's pandemic prevention committee.



## Empower the Rural Community

### What We Want to Solve

Schools in remote areas and schools neither in mountains nor cities are plagued by the inadequate distribution of educational resources and the unsatisfactory support systems hindering students' pursuit of higher education and employment.

### How We Respond

Integrate resources from industry, government and academia to help students in elementary schools and junior highs in rural areas improve their subject-oriented studies and cultivate the employability skills of vocational high school students through career exploration activities.

### Our Actions

- [Close the Urban-rural Gap in Educational Resources by Injecting Resources into Rural Areas](#)
- [Partner with Organizations to Empower Vocational High School Students in Remote Townships and Assist Them with Employment](#)
- [Provide Underprivileged People with Financial Support to Improve Their Living Conditions and Remove Barriers to Education](#)

## Strategies to Empower the Rural Community



## Close the Urban-rural Gap in Educational Resources by Injecting Resources into Rural Areas

### A Variety of Education to Close the Resource Gap

In 2022, volunteers led by TSMC Charity Foundation continued visiting elementary schools in remote townships and NGOs providing after-school care to offer students a variety of enjoyable and instructive activities and lessons, including picture book reading, post-processing in photography, and media literacy. Courses on enhancing the pedagogical skills of teachers in rural schools were also organized. In response to the Ministry of Education's focus on science education and hands-on inquiry in the 2019 Curriculum, the science games designed by the Foundation were combined with AI programming courses to cultivate students' scientific thinking skills. Working with National Yang Ming Chiao Tung University on the Programming Education Plan for Hsinchu County project, teachers and students residing in rural areas were taught how to utilize programs to solve life problems. During the pandemic, the Foundation distributed science learning materials and conducted science experiments online so students could learn remotely.

### Encourage Career Exploration and Focus on Adaptive Development

To expand educational resources in rural townships and provide rural students with information about career choices, the Foundation has partnered with 104 Job Bank since 2021 to launch the World of Jobs, Road to Employment website, on which interest quizzes based on the Holland Codes were introduced to help students learn about their personality traits. A total of 104 vlogs featuring professionals from all walks of life were produced and featured on the website as valuable reference for students exploring career paths.



#### TSMC Participating Units

TSMC Charity Foundation, TSMC Storytelling Volunteers, Legal, Quality & Reliability, Fab 2 & Fab 5, Fab 18B, Fab 15B, Intelligent Manufacturing Center, Production Control Integration Department, Intelligent Engineering Center



#### Cooperating Units

104 Job Bank, China Medical University Hospital, education bureaus of local governments, Ming Chi University of Technology, National Yang Ming Chiao Tung University, National University of Tainan, BoniO Inc.



#### Institutional Beneficiaries

10 after school programs, 124 elementary schools (1 in Yilan County, 1 in Kinmen County, 5 in Nantou County, 3 in Pingtung County, 1 in Miaoli County, 2 in Taoyuan City, 14 in Kaohsiung City, 41 in Yunlin County, 3 in New Taipei City, 2 in Hsinchu City, 27 in Hsinchu County, 1 in Chiayi County, 2 in Changhua County, 1 in Taichung City, 1 in Taitung County, 19 in Tainan City)

“

TSMC's program for enhancing teachers' pedagogical skills covers a variety of subjects and is very informative. A number of tools were introduced to help more disadvantaged families.

Lan-Hsiang Liang

Director of Heart's Ease Care Association

TSMC volunteers led students to conduct enjoyable experiments relevant to our everyday life. Students were inspired to learn actively, expand their horizons, and be passionate about science!

Ching-Fang Yang

Principal of Tainan Municipal Zuojhen Elementary School

134 schools

Served schools and after-school programs

6,358 students

Students benefited

44,254 users

World of Jobs, Road to Employment website accessed users

412 times

Volunteer reading services

2,060 hours

Volunteer reading

A Fab 12A volunteer builds a gingerbread house with member of an underprivileged community during Christmas season



IMC volunteers guides pupils in after-school programs to instill the idea of sustainability



IEC volunteer lead pupils of Meihua Elementary School to conduct enjoyable science experiments as part of a long-term undertaking



## Partner with Organizations to Empower Vocational High School Students in Remote Townships and Assist Them with Employment

### Technical and Vocational Training and Empowerment to Boost Employment

To encourage students to start their careers in their hometowns and find a solution to workforce shortage, the Foundation in 2021 began to partner up with corporations to organize technical and vocational training events in rural areas. Through 30 hours of dynamic vocational training, some students were able to acquire specialized skills that landed them jobs straightaway. The Foundation also arranged for trained vocational high students in rural areas to bring after-school study services to local elementary schools and social welfare institutions, thereby building a successful mode of public welfare beneficial to all parties. Collaborating with Microsoft Taiwan and several labor affairs bureaus on Microsoft Office 365 skill enhancement program, the Foundation honed the Microsoft Office competency skills of disadvantaged youths and augmented the information education of rural teachers.

### Call on Fellow Enterprises to Offer Job Opportunities

Partnering with Semiconductor Equipment and Materials International Organization (SEMI), the Foundation held a lecture titled Technical and Vocational Talent Development in the Field of Semiconductors during SEMICON Taiwan 2022, inviting members of industry, government and academia to share their perspectives on the advantages of pursuing higher education and employment. Appeals were made to the industry to analyze the structure of workforce costs, restructure internal positions, hire vocational high school students, and look for solutions to workforce shortage. The Foundation simultaneously worked on building a job matching platform on its World of Jobs, Road to Employment website, increasing employment opportunities and the range of job selections for technical and vocational high school talent.



#### TSMC Participating Units

TSMC Charity Foundation, Human Resources, Material Supply Chain Management Division



#### Cooperating Units

104 Job Bank, 15 TSMC suppliers, Microsoft Taiwan, Chi Mei Food Co., Ltd., Semiconductor Equipment and Materials International Organization, Lohas Biotech Development Corp.



#### Institutional Beneficiaries

National Pei-Kang Agricultural & Industrial Vocational High School, Tu Te Industrial and Home Economics Vocational High School, National Nei-Pu Senior Agricultural-Industrial Vocational High School, National ChiaTung Agricultural Vocational Senior High School, National Tung Kang Maritime and Fishery Vocational High School, National Heng-Chun Industrial & Commercial Vocational High School



The dynamic technical and vocational training session tested our ability to respond appropriately in a given situation. Upon completion of the training, there's a chance you could be hired by Chi Mei Food. The training boosted my confidence and expanded my knowledge.

Yi-Chen Lin

student from Yu Te Industrial and Home Economics Vocational High School



#### Dynamic technical and vocational training sessions

2

Rural vocational high schools

78

Students participated

14

Letters of appointment issued



#### Job matching program

30

Enterprises participated

600

Job opportunities offered

#### Microsoft job enhancement courses

3

City / county government participated

451times

Rural teachers and underprivileged students benefited

Students from National Nei-Pu Senior Agricultural and Industrial Vocational High School visit corporate booths for information on employment

Students from the Department of Culinary Arts of Yu Te Industrial and Home Economics Vocational High School are led by instructors from Chi Mei Food in breadmaking

## Provide Underprivileged People with Financial Support to Improve Their Living Conditions and Remove Barriers to Education

### Support the Lives of Underprivileged People

In collaboration with the departments of social affairs of local governments, the Foundation launched the NT\$10,000 Per Household and emergency aid programs to financially support underprivileged families and families tackling emergencies. For rural and underprivileged farmers ending up with surplus produce due to lack of market information, TSMC volunteers help them out by way of harvesting, bulk order or sale, giving the earnings back to farmers or donating such surplus produce to social welfare institutions.

### Support the Pursuit of Education and Operation of Institutions

To support hardworking students who can not afford to go to school due to their families' financial conditions, the Foundation offered scholarships for underprivileged students on the recommendations of local departments of education and schools. With the help of the Sending Love platform, appeals were made to the public and corporations to make donations. In 2022, the Foundation funded six rural schools to participate in the School of Future Competencies: Initiative to Support Model Schools in Rural Areas Cultivating Reading Competencies project and installed distance learning equipment. In addition to purchasing items for learning purposes for rural students, the Foundation utilized the TSMC i-Charity platform to secure monthly donations of fixed amounts and organize charity concerts for fundraising. All of these donations went to NGOs committed to long-term rural educational efforts.



#### TSMC Participating Units

Human Resources, TSMC Community Volunteers, TSMC Charity Foundation, System Package Integration Program, Quality & Reliability, More-than-Moore Technologies, Product Derivative Technology Development Division, Product Engineering, E-Beam Operation Division, Fab 8, Fab 12A, Fab 12B, Fab 18A, Fab 15B, Fab 14A, Fab 14B, Fab 6, Intelligent Manufacturing Center, Production Control Integration Department



#### Cooperating Units

Association of Literacy Education, Taiwan, social/education bureaus of local governments



#### Institutional Beneficiaries

7 social welfare institutions, 7 after-schools, 23 schools / educational institutions



Thanks to TSMC bringing resources to underprivileged families, a lot of stress from day-to-day living was taken off their shoulders. They felt society was there to help and that they weren't alone.

**Hsiang-Mei Huang**

Social worker of the private long-term home care institution under Stella Matutina Social Welfare Foundation

When I saw the living environments of seniors living alone, I could feel their loneliness and difficulties. I was glad to be able to help, and I would like to have more opportunities to help them in the future.

**Hsiao-Ping Tou**  
Fab 10 volunteer

Volunteers from Fab 14A and Fab 14B help senior pomelo farmer out by harvesting and buying surplus pomelos



**30.09 million**

Voluntary fundraising by TSMC employees via TSMC i-Charity platform



Accompanied by the TSMC Production Planning Integration department volunteers, pupils from after-school programs attend a charity concert



## What We Want to Solve

As Taiwan will soon become a super-aged society, the need for long-term care services and facilities increases every year. Insufficient resources pose a particular challenge to the health and well-being of senior citizens living in rural areas and seniors living alone.

## How We Respond

Strengthen the Network of Compassion system to bring together medical and social welfare institutions and integrate and distribute long-term care resources from the government and social welfare institutions to offer comprehensive and quality care to the seniors living in rural areas and seniors living alone.

## Our Actions

Strengthen the Care for Seniors Living Alone By Providing Much-needed Resources and Companionship

### Strengthen the Care for Seniors Living Alone By Providing Much-needed Resources and Companionship

Through the Network of Compassion, the Foundation combines resources from medical and social welfare institutions to meet the needs of seniors living alone in rural areas, including offering medical services, meal deliveries, and transportation vehicles, thereby reinforcing the quality and mobility of resources dedicated to caregiving in rural areas. Due to the rising need for providing long-term care in local communities, the Foundation in 2022 collaborated with Taipei Municipal Gan-Dau Hospital and National Yang Ming Chiao Tung University to build a new smart fitness club for seniors. Smart workout devices adapted to train aging muscles were introduced to help prevent disability and delay aging.

During the COVID-19 pandemic, seniors aged 65 years and older were at high risk of severe illness. The Foundation provided long-term care institutions with pandemic prevention and control supplies and nutritional supplements to safeguard the health of seniors and caregivers. Although services requiring physical proximity were suspended, TSMC volunteers led handicraft activities through video conferencing, participated in empowering seniors through storytelling initiatives, and handed out heartwarming presents during holidays and festivals, enriching the lives of seniors residing in caregiving institutions. When the September 2022 Taitung earthquakes damaged many homes of seniors living alone and disadvantaged families, TSMC volunteers joined forces with providers and local governments to repair the damaged houses, employing their facility expertise and efficient division of labor. Throughout the repair process, sufficient care was given to the everyday living spaces and environments of disadvantaged seniors and their supply of goods.



TSMC helping set up a smart fitness club for seniors in the community can utilize the technology researched and developed by the university to measure precise health stats that will help seniors get the most out of their workouts.

Chi-Hung Lin  
President of National Yang Ming Chiao Tung University

With the long-term commitment of TSMC volunteers, we have been able to locate resources and enhance the overall quality of our services. Despite all the difficulties we've had, they've supported us all the way, enabling us to establish a sheltered workshop.

Yu-Wen Huang  
Director of St. Camillus Center for Intellectual Disability

#### TSMC Participating Units

TSMC Community Volunteers,  
TSMC Charity Foundation,  
Quality & Reliability, Product  
Derivative Technology  
Development Division, Product  
Engineering/E-Beam Operation  
Division, Fab 2 & Fab 5, Fab 3,  
Fab 8, Fab 12A, Fab 12B, Fab  
18A, Fab 15B, Fab 14A, Fab 14B

#### Cooperating Units

15 medical and social  
welfare institutions  
under the Network of  
Compassion, Taipei  
Municipal Gan-Dau  
Hospital, National  
Yang Ming Chiao Tung  
University

#### Institutional Beneficiaries

10 eldercare  
institutions and  
2 medical service  
institutions

The volunteers dedicated to repair and energy conservation from the Division of Facility visited earthquake-hit homes to assess the extent of the damage



355,692 times  
Meals delivered

3  
Helped caregiving  
institutions buy  
transportation vehicles



285 homes

Repaired homes  
damaged in the  
September 2022 Taitung  
earthquakes

62

Offered care to  
households of  
underprivileged seniors  
or seniors living alone



Volunteers from the Quality & Reliability department helped seniors living alone with year-end-cleaning of their living environment



## What We Want to Solve

The rapid advance of the digital era has caused generational estrangement and put the family support system at risk of becoming vulnerable. The traditional culture of filial piety has seen a gradual decline, with ever fewer people espousing and practicing the virtue.

## How We Respond

Combining resources from industry, government and academia, and by way of educational materials, interactive activities and contests calling for entries, parent-child conversation is guided to achieve better understanding and to develop cohesion in families and harmony in society.

## Our Actions

Diversify Creative Efforts to Instill the Virtue of Filial Piety

## Diversify Creative Efforts to Instill the Virtue of Filial Piety

The Foundation continued working with the K-12 Education Administration under the Ministry of Education to organize parent-child workshops on filial piety, drawing activities, and contests receiving entries on the subject of filial piety. The teaching plans and demonstration videos of the parent-child workshops on filial piety developed by the Foundation were made available for educational agencies to download free of charge. Though storytelling activities by volunteers were suspended during the pandemic, the TSMC i-Charity platform was used to raise funds for pupils and their families in rural areas to watch family-themed movies on Mother's Day, in a bid to let children understand and appreciate the hard work of family caregivers, and to remind the latter to pay attention to their own health and well-being.

“

A family's warmth is an important stabilizing power for middle-aged parents and children. These activities for promoting filial piety helped children to have a conversation with their parents and grandparents, allowing them to learn more about each other. It was heartwarming and moving.

Yen-Kuang Pu

Director of the General Education Center, Ming Chi University of Technology



TSMC volunteers accompanying children crafting cards for Mother's Day to show gratitude



### TSMC Participating Units

TSMC Charity Foundation, Product Derivative Technology Development Division, Product Engineering, E-Beam Operation Division



### Cooperating Units

Chung Yuan Christian University, Ming Chi University of Technology, K-12 Education Administration



### Institutional Beneficiaries

Si Wei Elementary School, TEAMTC Community Services Association, Guang Rong Elementary School, ShuangLong Elementary School, Heshing Elementary School, Beyond the Hill Bookstore

Filial piety parent-child workshop guides parents and children to get to know each other better through painting

1,272 pieces

Excellent drawings, comics, stories and mini-films on the subject of filial piety received

68 institutions

Promoted filial piety education in 2022



10 workshops

Organized parent-child workshops promoting filial piety

>150 families

Led 150 families to have intimate conversations





## Protect the Environment

### What We Want to Solve

Climate change impacts the natural environment and threatens certain species. It particularly strains the support systems vital to underprivileged groups, calling into question the stability of such systems in the face of environmental disasters, inequalities in energy distribution, and malnutrition.

### How We Respond

With a comprehensive focus on the environment, ecology and society, the Foundation works with industry, government and academia to devise plans that help underprivileged groups reduce resource waste and energy consumption and develop renewable energy sources. TSMC volunteers work on promoting environmental and energy conservation education.

### Our Actions

- Conserve and Generate Electricity for Social Welfare Institutions Through Implementing Green Energy Initiatives Advantageous to the Underprivileged and the Cherish Food Project
- Provide Environmental and Energy Conservation Education to Cultivate Sustainable Practices

## Conserve and Generate Electricity for Social Welfare Institutions Through Implementing Green Energy Initiatives Advantageous to the Underprivileged and the Cherish Food Project

In the Foundation's efforts to promote green energy, partnerships have been with local governments and social welfare institutions to sponsor the installation of solar panels on the rooftops of institutions. In 2022, the Foundation built seven solar power plants, reducing the monthly electricity bills of social welfare institutions. Through electricity wholesale based on feed-in-tariff contracts, these institutions receive NT\$2.76 million every year to fund their operations. To improve school lighting for elementary school students, the Foundation funded underprivileged students enrolled in vocational colleges to install LED energy-saving light tubes in 246 schools across Taiwan, saving as much as NT\$9.61 million in electricity fees every year—enough to pay for 320,000 more school lunches. To help solve the problem of hunger and reduce food waste, the Cherish Food Project was launched, working with seven food businesses to distribute goodwill foods to 130 underprivileged groups in 16 cities and counties, benefiting individuals 48,143 times.



Student volunteers helping to replace lights in schools not only warmed the hearts of pupils and faculty members but saved 30% on the electricity bill.

**Te-Wen Hsu**  
Principal of Tainan Municipal Yanshuei District Annei Elementary School

When we improved the school's overall lighting, the children were very happy about it. That made us happy, too.

**Chun-Yu Lin**  
Volunteer from Kun Shan University under the University Social Responsibility (USR) program



### TSMC Participating Units

TSMC Charity Foundation,  
Fab 15A



### Cooperating Units

7 food companies  
and 4 vocational universities



### Institutional Beneficiaries

Tainan City's Ren-Ai Home, Presbyterian Church in Taiwan Zhutian Church, Pingtung Christian Bethany Home, 2 elementary schools in Yunlin County, Madou Resthome, Shun-Yuan Eldercare Center

Solar panels installed on the idle rooftop of Tainan City's Ren-Ai Home for Senior Citizens



Before installation of solar panels



After installation of solar panels

### Achievements of the Cherish Food Project

48,143

2022	58,862	Note
2021	58,862	
2020	37,071	

Volunteers from Kun Shan University visiting a rural school to replace existing lights with energy-efficient lights



7

Solar power plants built

9.61 million

2.76 million

Electricity fees saved per year (NT\$)

Electricity wholesale earned per year (NT\$)

246 schools

School installed energy-saving LED light tubes

130

Underprivileged groups benefited regularly from the Cherish Food Project

## Provide Environmental and Energy Conservation Education to Cultivate Sustainable Practices

The Foundation continued to lead TSMC volunteers to give diverse tours and offer courses on environmental and energy conservation to raise awareness of environmental protection and sustainability among rural students and the general public. TSMC Ecology Volunteers, dedicated to the work of ecological preservation, invited and funded rural students to travel to TSMC's premises, where they were given an informative ecological tour. As part of the focus on environmental education, the students learned about biodiversity as well as water and energy conservation. Ecology Volunteers gave tours in Jacana Ecological Education Park to talk about conservation systems and introduced the public in the National Museum of Nature Science to semiconductor science and technology. In 2022, the Foundation co-published the picture book Fen-Fen's Promise with Old Tree Yard Environment Protection Foundation, whose mission is to promote old trees, protect forests, and advocate for an eco-friendly education that views old trees as our friends.



Many thanks to TSMC for introducing students to how an effective water recycling system works. It inspired them to care more about environmental protection issues and take action.

Ssu-Hsian Li  
Head of Sanitation Division, Guo-An Elementary School

I hope the concept of ecological sustainability will bring about incremental yet profound changes to the public.

Pei-Chun Tu  
TSMC volunteer



### TSMC Participating Units

TSMC Charity Foundation, Production Control Integration Department, Fab 6, Intelligent Manufacturing Center, TSMC Ecology Volunteers, TSMC Energy-Saving Volunteers, TSMC Museum Tour-Guiding Volunteers



### Cooperating Units

Industrial Technology Research Institute, Jacana Ecological Education Park, Old Tree Yard Environment Protection Foundation, National Museum of Natural Science

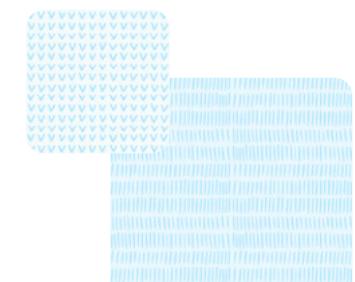


### Institutional Beneficiaries

After School Association of Taiwan, Love Infinite Association of Taiwan, Hsinchu I-Link Association, Shinmei Elementary School



FAB 6 volunteers visit rural schools to teach pupils about concepts of energy conservation



182 times

Ecology Volunteer services offered

>728 hours

Ecological tours

Ecology Volunteers lead children to learn about the features of different plants and their roles in the ecosystem





# Operations and Governance

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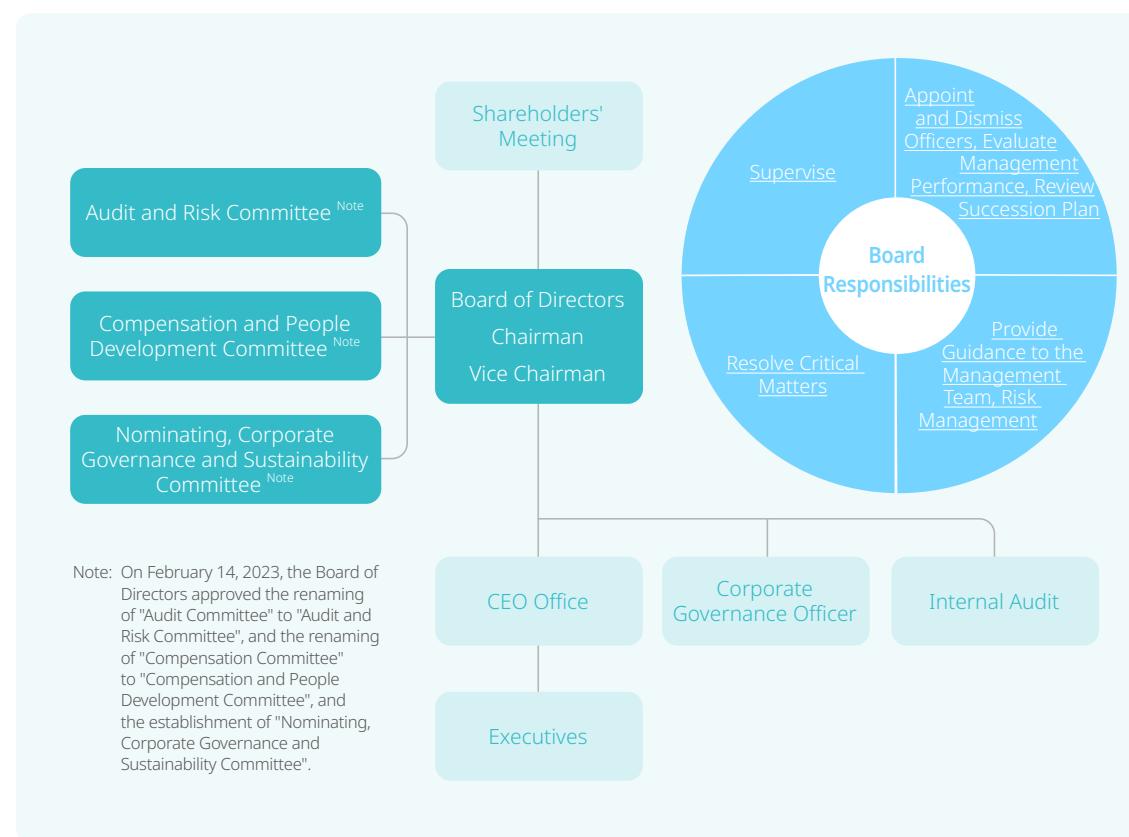
# Corporate Governance

TSMC advocates and acts upon the principles of operational transparency and respect for shareholder rights. We believe that the basis for successful corporate governance is a sound and effective Board of Directors. In line with this principle, TSMC Board of Directors set up the "Audit Committee" and the "Compensation Committee" in 2002 and 2003 respectively. To continue to make our corporate

governance more comprehensive, the TSMC Board took a step further in February 2023 to expand and strengthen the functions and responsibilities of its committees, including renaming the "Audit Committee" to the "Audit and Risk Committee", and the renaming the "Compensation Committee" to the "Compensation and People Development Committee". In addition, in order to strengthen the

selection mechanism for directors, build diversified and professional board, TSMC's Board of Directors approved the establishment of the "Nominating, Corporate Governance and Sustainability Committee" referencing international practices. Each Committee supports the Board to fulfill its responsibilities and each Committee's chairperson regularly reports to the Board on its activities and recommendations.

## Governance Structure



## Board of Directors and Committees

Inheriting the spirit of TSMC's Founder, Dr. Morris Chang's philosophy on corporate governance, under the leadership of Chairman Dr. Mark Liu and CEO & Vice Chairman Dr. C.C. Wei, TSMC's Board of Directors takes a serious and forthright approach to its duties and is a dedicated, competent and independent Board.

Title/Name	Board of Directors	Audit and Risk Committee	Compensation and People Development Committee	Nominating, Corporate Governance and Sustainability Committee
Chairman Mark Liu	✓			✓
Vice Chairman C.C. Wei	✓			
Director F.C. Tseng	✓			
Director Ming-Hsin Kung (Representative of National Development Fund, Executive Yuan)	✓			
Independent Director Sir Peter L. Bonfield	✓	✓ Chair	✓	✓
Independent Director Kok-Choo Chen	✓	✓	✓	✓
Independent Director Michael R. Splinter	✓	✓	✓ Chair	✓
Independent Director Moshe N. Gavrielov	✓	✓	✓	✓ Chair
Independent Director Yancey Hui	✓	✓	✓	✓
Independent Director L. Rafael Reif	✓	✓	✓	✓
Jan C. Lobbezoo		Financial Expert Consultant		

## Nomination and Election Directors

TSMC has established the "[Guidelines for Nomination of Directors](#)" that set out the procedures and criteria for the nomination, qualification and evaluation of Director candidates to be nominated by the Board of Directors, and provide that "Nominating, Corporate Governance and Sustainability Committee" will propose independent director candidates to the Board of Directors. The independence of each independent director candidate is also considered and assessed under relevant laws. The members of TSMC Board of Directors are nominated via rigorous selection processes. It not only considers background diversity, professional competence and experience, but also attaches great importance to his/her personal reputation on ethics and leadership. Directors shall be elected pursuant to the candidate nomination system specified in Article 192-1 of the R.O.C. Company Law. The tenure of office for Directors shall be three years. The Company aims to have at least of 50% independent directors and as least one female director to serve on the Board.

## Board Diversity and Independence

The ten members of the Board of Directors represent diversified perspectives, including a complementary mix of skills, experiences, and backgrounds such as that from the industry, academia, and in law. etc. These professionals include citizens from Taiwan, Europe and the U.S. with world-class business operating experience, one of whom is female. The six Independent Directors constitute 60% of the Board, and there is no marital or is within the second degree of kinship relationship between or among

the Directors. As such, the Board of Directors carries independence.

For more details of "Corporate Governance", please refer to [TSMC's Annual Report](#) and [www.tsmc.com](http://www.tsmc.com).

## Risk Management

TSMC adopts a balanced risk-reward approach to risk management to optimize business returns while considering the overall impact on corporate sustainability. In 2022, the [Risk Management Policy](#) was established, approved by the Board of Directors and signed off by the Chairman, affirming the Company's commitment to a proactive and robust risk management system that assist TSMC in making well-considered and risk-based decisions, thereby fulfilling

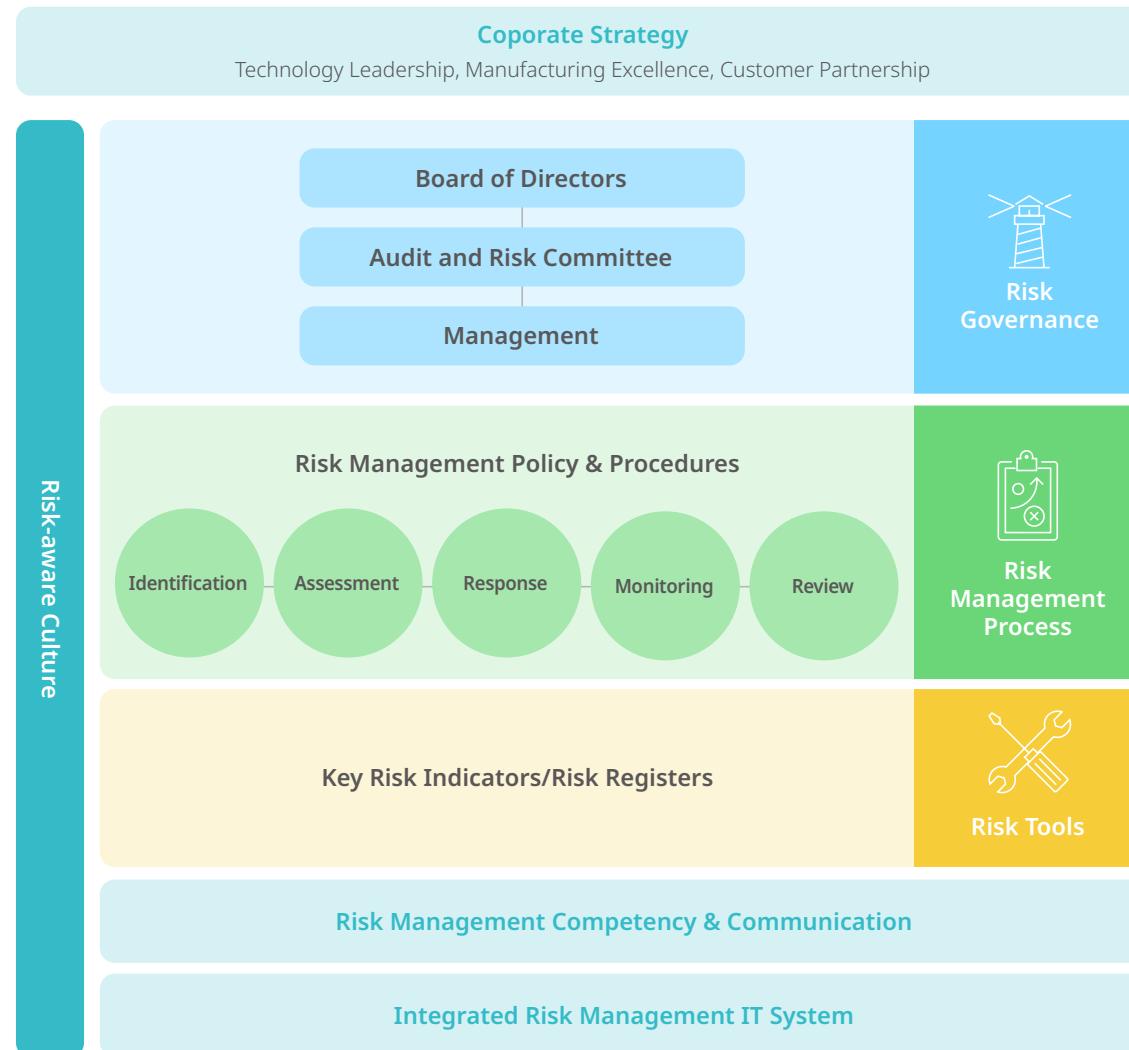
the Company's ESG vision and actions and delivering sustainable value for TSMC and its stakeholders. To support the implementation of the Risk Management Policy, the Enterprise Risk Management (ERM) framework was enhanced in 2022 to outline the risk management mechanisms, processes, systems and tools. Through a 5-step process of identification, assessment, response, monitoring, and review, potential sustainability risks such as climate change, utility supply, earthquakes, fires, and chemical spillage as well as emerging risks are managed. A series of training courses are provided to foster a risk-aware mindset and culture.

TSMC further renamed the Audit Committee to Audit and Risk Committee in February 2023 to enhance

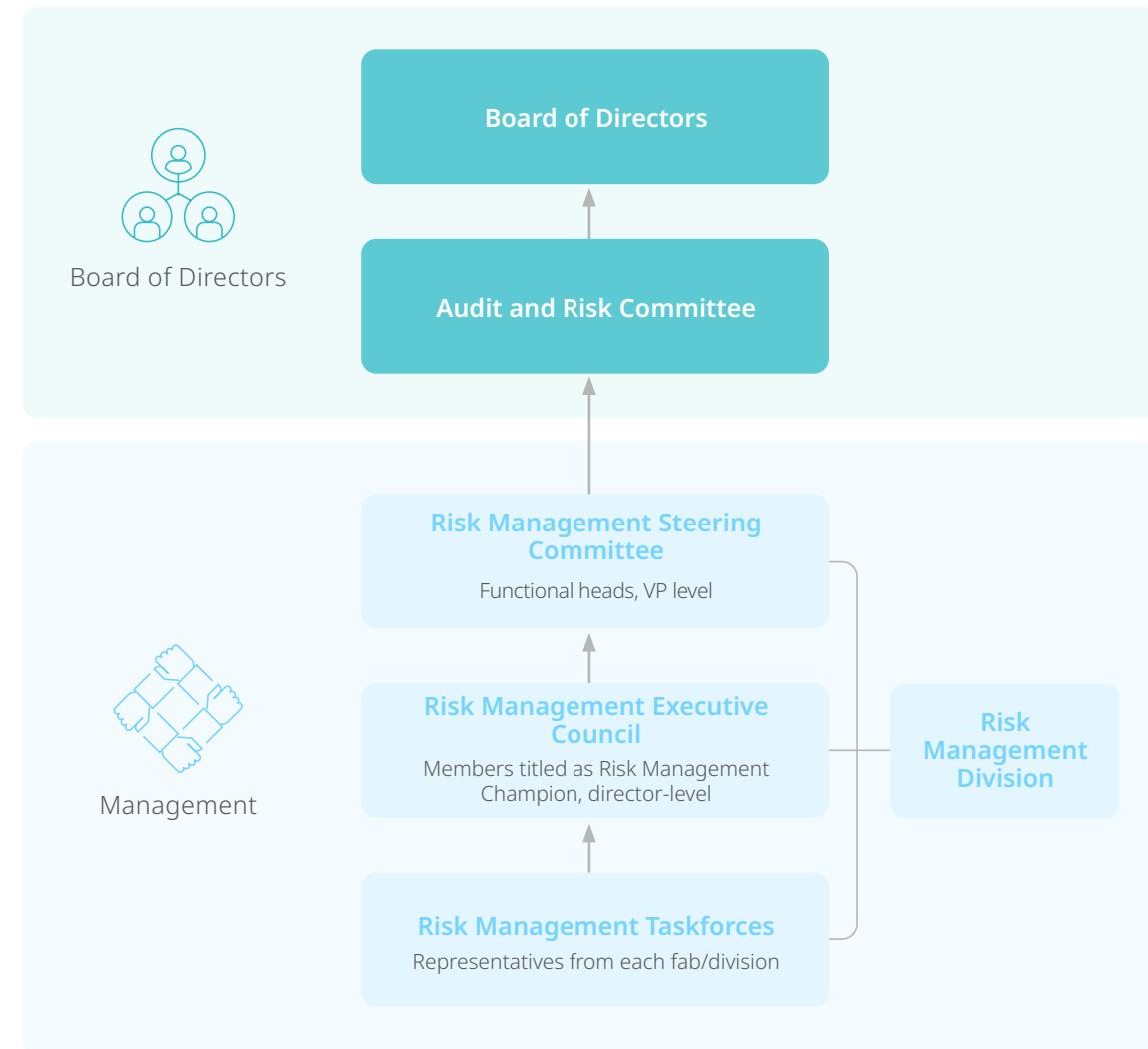
the Board of Directors' risk oversight of TSMC's ERM framework. At the management level, the risk governance structure comprises the Risk Management Steering Committee, Risk Management Executive Council, Risk Management Taskforces, Central Crisis Command Center, and Crisis Management Team. Risk Management Division works with each function in applying the ERM framework to ensure that significant risks and crises across TSMC are assessed and adequately mitigated. This is performed through risk monitoring, conducting workshops, visiting sites, participating in key meetings, and implementing risk related policies and guidelines. For more details on Risk Management, please refer to [6.3 Risk Management](#) in TSMC's 2022 Annual Report.



## Enterprise Risk Management Framework



## Risk Management Governance Structure





## Ethics and Regulatory Compliance

### Ethics

"Integrity" is the cornerstone of TSMC's business philosophy. TSMC established its [TSMC Ethics and Business Conduct Policy](#) (Ethics Code) to be the guide for operating TSMC's business and to form a robust culture of integrity within TSMC, with "integrity, commitment, innovation and customer trust" as our core values. At the same time, by establishing the [Supplier Code of Conduct and Supplier Sustainability Standards](#), TSMC extends its core value of integrity into its supply chains and to enable suppliers to demonstrate business with integrity behavior. In addition, TSMC publishes its [TSMC Anti-Corruption Commitment](#) on the TSMC website to emphasize TSMC's commitment to its core value of integrity.

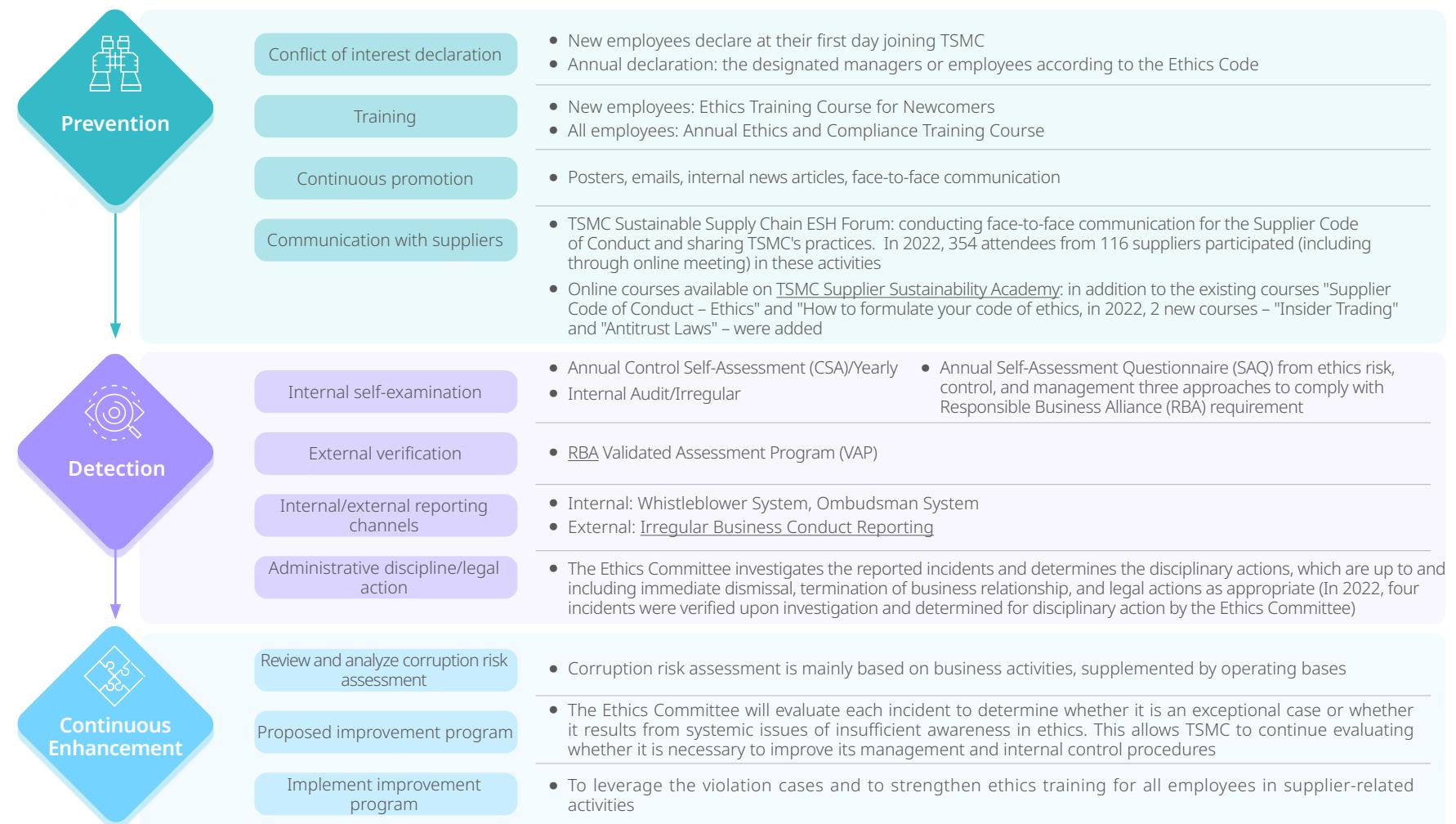
TSMC established and published the [Complaint Policy and Procedure for Certain Accounting & Legal Matters](#), making multiple reporting channels available for internal and external voices, and accepting anonymous reports to protect the rights and interests of the Company and its constituencies. All reported incidents collected from these reporting channels are properly recorded, confidentially investigated, well traced, and enhancements to TSMC practices are made where applicable. TSMC keeps individual identities confidential and prohibits any retaliation on any individual who in good faith reports a suspected violation or participates in an investigation. Furthermore, TSMC has an Ethics Committee that oversees the implementation of the Ethics Code and investigations and disciplinary actions for

reported incidents. The Ethics Committee meets quarterly or whenever necessary. In 2022, the Ethics Committee met six times to examine major

reported incidents under investigation. Four incidents were verified upon investigation and determined for disciplinary action by the Ethics

Committee. The Company will take progressive disciplinary actions according to the nature and severity of each misconduct.

### Ethics Compliance Activities



## Regulatory Compliance

TSMC operates in many countries. To ensure that every business activity in compliance with applicable governing legislation, laws, regulations and regulatory expectations, TSMC has established a complete regulatory compliance system, including a sequence of regulatory identification, compliance policy and procedure formulation, implementation and execution, compliance training program, to closely monitor domestic and foreign government policies and regulatory developments that could materially impact TSMC's business and financial operations.

## Regulatory Compliance and policy and procedure formulation

### Regulatory inventory check



### Regulatory monitor and update



### Regulatory identification



### Regulatory compliance review



### Policy and procedure formulation or update



### Training and promotion

## 2022 Achievements



### Regulatory Compliance

- In 2022, TSMC did not receive any reports related to finance, accounting or antitrust matters, nor did we receive any complaints concerning breach of customer privacy and loss of customer data, or any material regulatory violations (where a fine exceeds NT\$1 million), including non-monetary sanctions.
- More information related to TSMC ethics and regulatory compliance, please refer to the [3.5 Ethics](#) section and [3.6 Regulatory Compliance](#) section of TSMC 2022 Annual Report.



### Training

#### Ethics Training Course for Newcomers

New employees in Taiwan sites (including contractors)



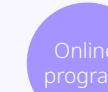
Online program

#### Performance by person Unit: Person



#### Annual Ethics and Compliance Training Course

All employees



Online program

#### Performance by person and ratio



#### Conflict of interest declaration / Declaration of Compliance with the Ethics Code

New employees, the designated managers or employees according to the Ethics Code

#### Declaration by person-time





# Financial Performance

TSMC believes a strong financial foundation is the key to corporate sustainability. Since the founding of the Company, TSMC has developed prudent business plans, adhered to disciplined capital management, and delivered solid financial performance to help create long-term economic value, which allows the Company to give back to all its stakeholders, including shareholders, investors, employees, customers, suppliers/contractors, government/industry associations, society, and others, and to drive positive changes in society.

In an effort to better communicate with investors, TSMC strives to ensure the transparency and timeliness of its financial information. In addition to the regular disclosure of its latest financial results, the Company also sets clear and measurable strategic financial objectives and continues to deliver results that are aligned with its long-term financial targets. In doing so, TSMC is able to strengthen investors' confidence in the Company's long-term investment

value. As the insatiable demand for computation will propel the continued drive for chip performance and a greater need for energy-efficient computing, TSMC expects strong growth potential in its advanced and specialty technologies in the next several years. Thus, from 2021 to 2026, the Company expects its long-term revenue growth, in US dollar terms, to have a compound annual growth rate (CAGR) of 15 to 20%, with a long-term gross margin to be 53% and higher, and a return on equity (ROE) to be 25% and higher across the cycle.

Given the funding requirements to address the business growth opportunities and the need to maintain a solid financial foundation, since 2020, TSMC has issued a total of NT\$311.5 billion in NT dollar denominated corporate bonds and US\$17.5 billion in US dollar denominated corporate bonds with favorable pricing terms. Since the bond issuances, TSMC has continued to maintain the semiconductor industry's highest credit ratings.

AA-

Standard & Poor's (S&P)  
Ratings

Aa3

Moody's Ratings

twAAA

Taiwan Ratings

## Four Strategies to Increase Long-term Investment Value



Continue to invest in technology leadership

14.9%

CAGR in R&D investment<sup>Note</sup>



Provide excellent manufacturing services and capacity support

15 million

Total capacity exceeded 15 million 12"-equivalent wafers in 2022



Pursue revenue and market share growth

16.2%

CAGR in net revenue<sup>Note</sup>



Maintain or improve profitability and investment returns

19.9%

CAGR in net income<sup>Note</sup>

8.2%

CAGR in R&D headcounts<sup>Note</sup>

15.9%

CAGR in capital expenditures<sup>Note</sup>

30%

Of the world's semiconductor excluding memory output value produced in 2022

2.5 trillion

Cumulative cash dividends from 2004 to 2022 (NT\$)

Note: From 2013 to 2022



Since TSMC went public in 1994, the Company has been profitable every year and its market capitalization has been growing steadily. As of December 31, 2022, TSMC's market capitalization reached NT\$11.7 trillion, or US\$379.7 billion.

TSMC's solid financial performance enables the Company to distribute profits to shareholders in the form of cash dividends. In June 2021, TSMC's Board of Directors approved the increase in quarterly cash dividend from NT\$2.5 to NT\$2.75 per share. Therefore, TSMC's shareholders

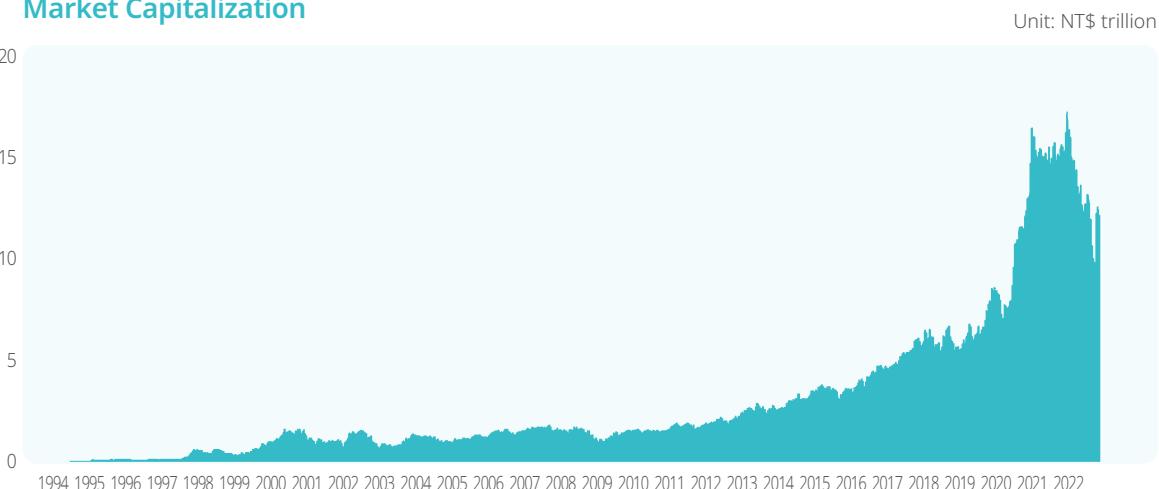
received a total of NT\$11 per share in cash dividends in 2022. From 2004 to 2022, TSMC has paid out a total of NT\$2.5 trillion, or US\$81.5 billion, in cash dividends.

In the future, TSMC intends to maintain a sustainable and steadily increasing cash dividend, and to distribute the cash dividend each year/quarter at a level not lower than the year/quarter before.

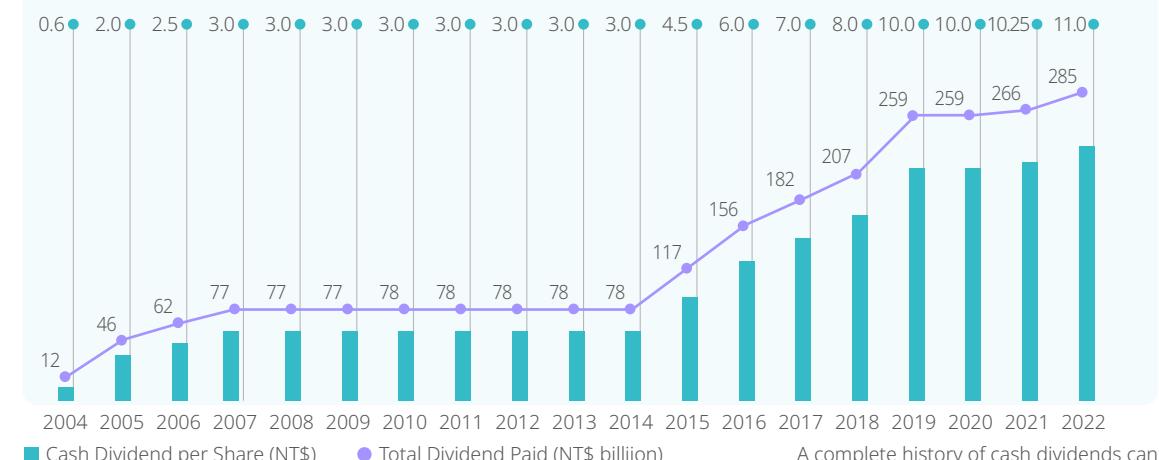
## Financial Performance



## Market Capitalization



## Cash Dividends



# Tax

TSMC supports the government in formulating regulations that encourage enterprise innovation and foster economic growth. The Company's tax policy is reviewed and approved annually by the Chief Financial Officer, which aims to ensure transparency and sustainability in the long term.

## Tax Policy

- ✓ Act at all times in compliance with the spirit and the letter of all applicable tax laws and regulations in the jurisdictions in which we operate.
- ✓ Conduct inter-company transactions on an arm's length basis and in accordance with the internationally accepted transfer pricing guidance published by the OECD.
- ✓ Be transparent in financial reporting, make disclosures in accordance with applicable regulations and reporting requirements.
- ✓ Do not use tax havens or tax structures whose sole purpose is tax avoidance.
- ✓ Do not transfer value created to low-tax jurisdictions.
- ✓ Develop strong, mutually respectful relationships with tax authorities based on transparency and trust.
- ✓ Always consider tax as a part of major business decisions.
- ✓ Analyze the operating environment and assess tax risk through a corporate management mechanism.

## Tax Risk Management

TSMC is subject to tax laws and regulations in the various jurisdictions in which it operates or conducts business. Any unfavorable changes in tax laws and regulations in these jurisdictions could increase the Company's effective tax rate and have an adverse effect on its operating results. In order to effectively manage tax risks, TSMC follows internal control processes, identifies, assesses, and manages tax risks from regulatory changes and its business transactions, accounts for them appropriately, and implements and monitors controls over them.

Tax risk management is incorporated in TSMC's enterprise risk management (ERM) system. The risk management organization annually reports to the Audit and Risk Committee on TSMC's key risks and mitigation efforts. For more details on risk management, please refer to the [6.3 Risk Management](#) section in TSMC's 2022 Annual Report.

## Tax Governance

The ultimate responsibility for the taxation management of TSMC and its subsidiaries rests with the Chief Financial Officer, who delegates day-to-day responsibility to the Controller. A team of qualified and experienced tax professionals supports

the Controller to meet TSMC's tax obligations. In addition, TSMC also leverages external tax service providers for complementary expertise.

TSMC's Audit and Risk Committee is delegated by the Board to oversee the quality and integrity of the accounting, auditing, reporting, and financial control practices of the Company through periodic review of certain major matters, including accounting policies and procedures, internal control systems, legal compliance, and corporate risk management, etc. Among these, tax compliance is included as part of the Company's legal compliance.

## Effective Tax Rate

TSMC's effective tax rate and cash tax rate in 2022 were 11.1% and 7.6%, respectively, both of which were lower than the industry average effective tax rate of 15.9% and the industry average cash tax rate of 14.12% based on S&P Global CSA Handbook in the Semiconductors and Semiconductor Equipment industry group, and also lower than Taiwan R.O.C. statutory tax rate of 20%. This was primarily due to a five-year tax exemption for capital investments made in previous years, and tax credit for research and development expenditures according to regulations under the R.O.C. Statute for Upgrading Industries and Statute for Industrial Innovation.

**101.5 billion**

In 2022, TSMC's total tax payments on a cash basis worldwide

**>90%**

In 2022, over 90% of TSMC's revenue and profit before tax were generated from its business operations in Taiwan. Meanwhile, over 90% of its tax payments were also made to the Taiwan R.O.C. government

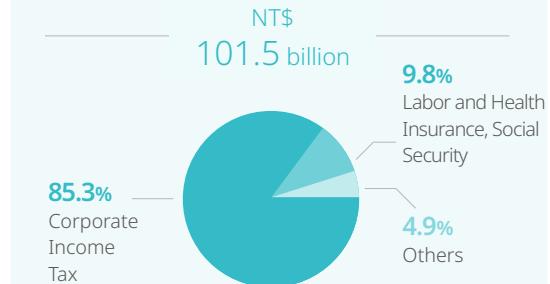
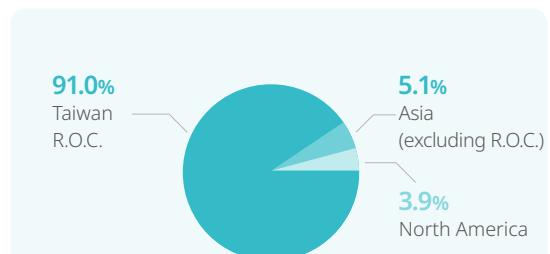
**1**

Based on data provided by Taiwan Economic Journal (TEJ) database, TSMC was the largest corporate income tax payer among all public listed companies in Taiwan in 2022

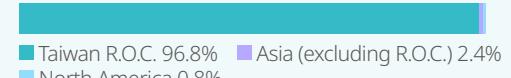
**8.1%**

TSMC's 2022 income tax payment in Taiwan represented 8.1% of total corporate income taxes collected by the R.O.C. government <sup>Note 2</sup>

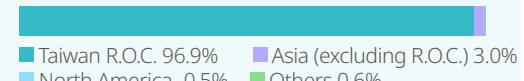
## 2022 Tax Breakdown<sup>Note 1</sup>



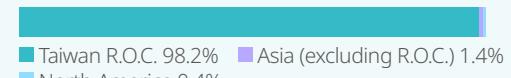
### Income Tax Paid — 86.6 Billion (NT\$)



### Profit Before Tax — 1,144.2 Billion (NT\$)



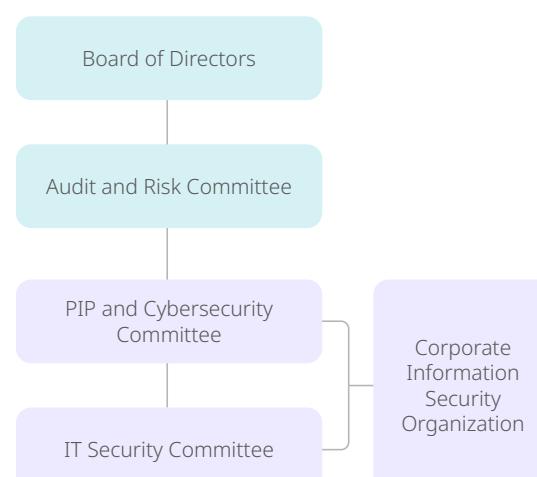
### Income Tax Accrued — 147.7 Billion (NT\$)



# Information Security

Information security and proprietary information protection (PIP) are TSMC's commitments to customers, suppliers, and employees. To strengthen corporate information security protection and management mechanisms, TSMC created the new role of Chief Information Security Officer in 2022 to take charge of information security policy and procedure planning, monitoring, and management. The Company also continues to perform information security risk analysis and develop smart information security technologies and measures, including cloud information security analysis, alarm summaries, the SOAR (Security Orchestration, Automation, and Response) system, etc., to improve protection and monitoring performance. TSMC is also influencing the supply chain by working with SEMI to overcome information security challenges in the semiconductor industry. Through four major directions, information security awareness and protection standards in the industry are raised to achieve the goal of sustainable operations.

## TSMC Corporate Information Safety Organization



## Robust Information Security Governance

The Board of Directors has authorized the Audit Committee to manage and oversee corporate information security. The Audit Committee is chaired by Sir Peter L. Bonfield, an independent director with a background in information security. In 2022, following the regulations of the Financial Supervisory Commission of Taiwan, TSMC appointed J.K Lin, Senior Vice President of Information Technology, Material and Risk Management, to take on the addition role of Chief Information Security Officer (CISO). Lin is responsible for the overall planning and coordination of company resources, communicating on information security policies and directions. TSMC has established a dedicated information security organization (Corporate Information Security, CIS), led by Director James Tu, is responsible for the implementation,

planning, monitoring, and management of information security operations. TSMC has also established the PIP and Cybersecurity Committee and the IT Security Committee to cooperate with the Company's information technology and related organizations to strengthen corporate information security protection and management mechanisms. Both committees are chaired by the CISO and comprise VP-level executives who meet regularly to review and deliberate on important information security and protection policies as well as project implementation. Every six months, the CIS executives report risk management measures to the Audit Committee, including global information security trends, corporate information security policies, plans, and implementation results. The chair of the Audit Committee also reports on the effectiveness of information security supervision and risk control measures to the Board of Directors.

## Implement Information Security Culture and Build Management Mechanisms

TSMC is fully committed to the TSMC Information Security Declaration and continues to work on the five major areas of information security management. Over the years, TSMC has consistently met the information security requirements of customers and third-party agencies. In 2022, TSMC's external audits concluded that no major information security flaws, major violations, incidents of customer data breach and regulatory fines occurred. Moreover, there have been zero complaints concerning breach of customer privacy and loss of customer data from either third parties or regulatory bodies resulting in judicial action. By actively strengthening information security and PIP, TSMC hopes to safeguard market competitiveness and customers and partners' interests.

## Five Major Areas of Information Security Management

Adopt International Information Security Standards	Professional Talent Cultivation and Certification	Strengthen Employee Management	Information Security Training and Social Engineering Drills	Diverse Communication Channels
<ul style="list-style-type: none"> <li>Establish automated information security management system, obtain ISO/IEC 27001 information security certification, and pass two external Continual Assessment Visit (CAV) evaluations</li> <li>Continuously pass ISO/IEC 15408 facility security certification to create an optimal and safe wafer manufacturing environment</li> <li>Comply with <u>international standards</u> to manage and control workplace environments, information security, system operations, and product safety</li> </ul>	<ul style="list-style-type: none"> <li>Encourage information security personnel to obtain top <u>international information security certification</u>; in 2022, TSMC employees acquired 47 Cyber Security Management Act licenses, bringing the total to over 140 licenses</li> <li>Organize <u>training courses</u> on different topics based on the natures of the organizations and develop best practices for information security operations, management, and control</li> </ul>	<ul style="list-style-type: none"> <li>The PIP Working Committee, comprised of representatives from each organization, meets regularly to address employee <u>feedback</u> by proposing <u>management practices and suggestions</u> in compliance with organizational demands</li> <li>Provide comprehensive information security reporting channels and protection; collect employee feedback to assess outcomes, propose improvement plans to strengthen mechanisms for information security operations</li> </ul>	<ul style="list-style-type: none"> <li>Require all employees and suppliers to complete information security training programs each year</li> <li>Utilize benchmark phishing <u>email testing tools</u> and <u>question databases</u>; regularly detect phishing emails and drill and test employees on common mistakes</li> </ul>	<ul style="list-style-type: none"> <li>Continue to produce awareness posters, lectures, and communication meetings to promote the importance of information security through diverse means</li> <li>Collect employees' opinions through information security suggestion boxes and regular questionnaires to craft and roll out improvement plans</li> <li>Take punitive action against employees for information security noncompliance based on the impact level</li> <li>Hold annual internal review meetings to assess policy outcomes for the year and draft goals for the coming year</li> </ul>



## Perform Risk Assessment and Strengthen Information Security Measures

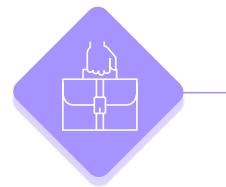
TSMC regularly performs information security risk assessments and adopts a comprehensive layered cybersecurity defense. In 2022, information security measures focused on cybersecurity control, information asset management, access control and safety, and workplace security items to strengthen information security defense.

### Major Information Security Items and Measures



#### Cybersecurity Control

- Enhance the security and convenience of web browsing, strength email security and protecting against phishing emails and malware
- Strengthen KPI management for cloud security posture management



#### Information Asset Management

- Introduce endpoint smart terminal protection to detect, analyze, and automatically respond to malware attacks
- Introduce zero downtime patching solutions to strengthen the protection of important servers
- Integrate automatic information security evaluation into the development process platform to improve application security
- Build information security designs into applications to strengthen security and repair weaknesses



#### Access Control and Safety

- Manage information by defining different levels and categories to bolster protection and access control



#### Workplace Security

- Install multi-layered workplace monitoring and detection equipment to ensure security control

## Strengthen Information Security Operations and Management

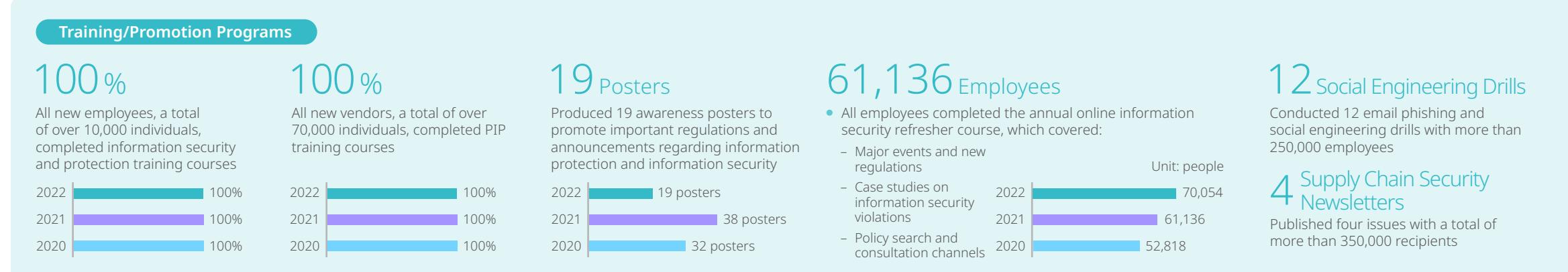
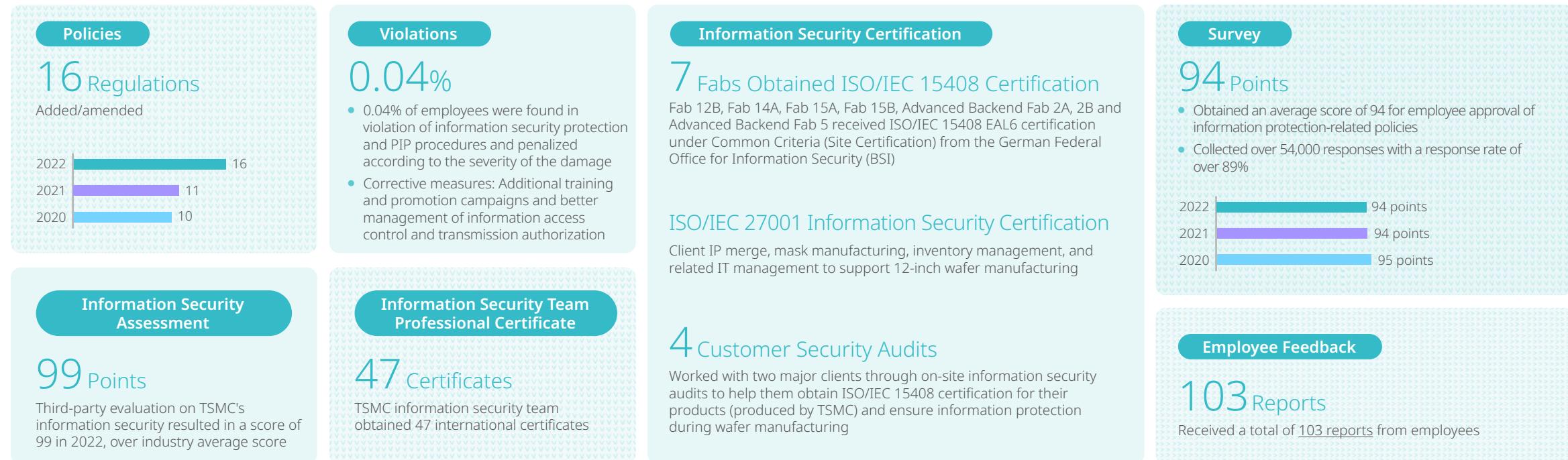
TSMC has implemented the Business Continuity Management Policy to ensure business continuity. The 24-hour Cybersecurity Incident Response Center (CIRC) is responsible for coordinating related efforts and ensuring the effectiveness of control measures in compliance with the information security incident notification procedures. In 2022, new measures were added, including strengthening cloud information security analysis and alarm summaries for overseas facilities, introducing automatic response systems with preset responses that are automatically executed, etc. In addition, TSMC continues to organize cybersecurity drills, focusing in 2022 on ransomware, remote access, and weaknesses in overseas facilities. The Company also worked with third-party experts to conduct penetration testing and red team vs. blue team drills to enhance information protection and monitoring. In addition to internal measures to strengthen information security at TSMC, the Company recognizes that companies are currently facing dangerous landscapes and have, therefore, invested in information security insurance as the last line of defense to reduce risks of information security incidents.

## Strengthen Supplier Information Security

TSMC seeks to strengthen information security across the supply chain in four areas: first, establishing standards; second, assessment & collaboration; third, advocacy; and fourth, risk management. In 2022, the information security practices of 659 suppliers were evaluated, of which 481 received a grade of A and 326 suppliers were able to bring up their grades by one or more levels within six months. The reach of TSMC's Supply Chain Security Newsletter was also expanded. In 2022, four issues were published with a readership of 350,000. TSMC also assisted SEMI in establishing the SEMI Cybersecurity Committee. Chaired by Dr. James Tu, Head of Corporate Information Security at TSMC, the SEMI Cybersecurity Committee advocates information security solutions based on the zero trust model to strengthen supply chain resilience. In 2022, the Committee rolled out four major directions to strengthen information security in the industry, using third-party risk assessment tools to create the SEMI Semiconductor Cyber Security Risk Rating Service dedicated to semiconductor suppliers. The rating service can help suppliers compare baselines, monitor postures, and drive the industry toward a better future.



## 2022 Information Security Measure Enforcement Results



Note: 2022 indicators cover TSMC's Taiwan fabs and overseas subsidiaries



# Appendix

## About this Report

### Sustainability Information Disclosure Framework

- Global Reporting Initiative Index 217
- United Nations Global Compact Index 221
- Task Force on Climate-related Financial Disclosures Index
- Sustainability Accounting Standards Board Index
- WEF IBC Stakeholder Capitalism Metrics Index

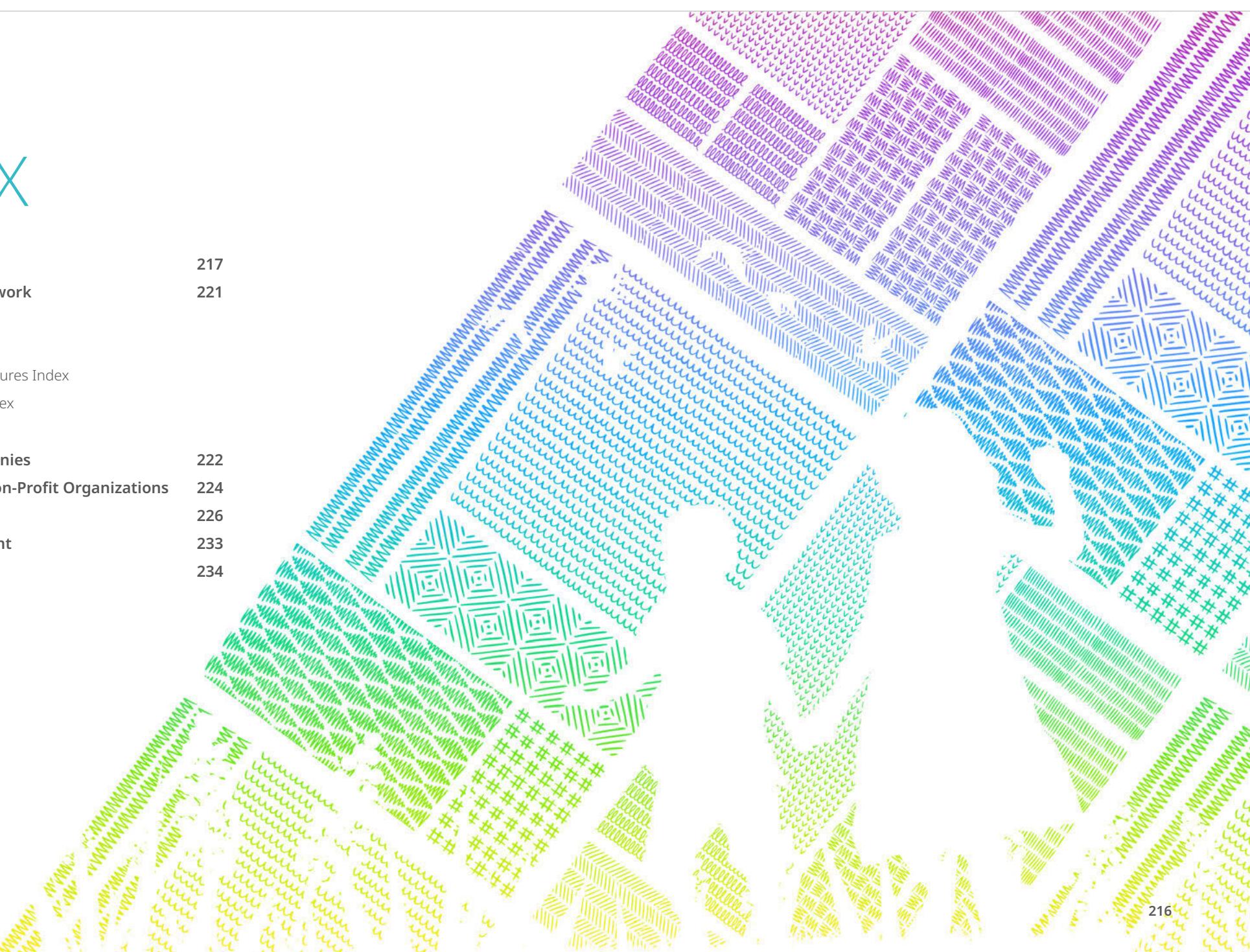
### Climate-related Information of Listed Companies

### Participation in Industry Associations and Non-Profit Organizations

### ESG Performance Summary

### Independent Third Party Assurance Statement

### Contact Information





# About this Report

Adhering to the vision of Uplift Society, TSMC has been issuing non-financial reports for 24 consecutive years. In addition to complying with Global Reporting Initiative (GRI), TCFD Recommendations, Sustainability Accounting Standards Board (SASB), the report also heeds expectations and suggestions from various stakeholders with systematic communication channels in the Company's daily operations and uses materiality analysis to adjust sustainable management practices and align with international sustainability standards. The annual Sustainability Report has become an important tool for managing ESG practices internally and a way to disclose mid- and long-term strategies, practices, and progress. TSMC collaborates with employees, shareholders/investors, customers, vendors/contractors, the government/associations, and society to strive for a sustainable future.

## Reporting Period

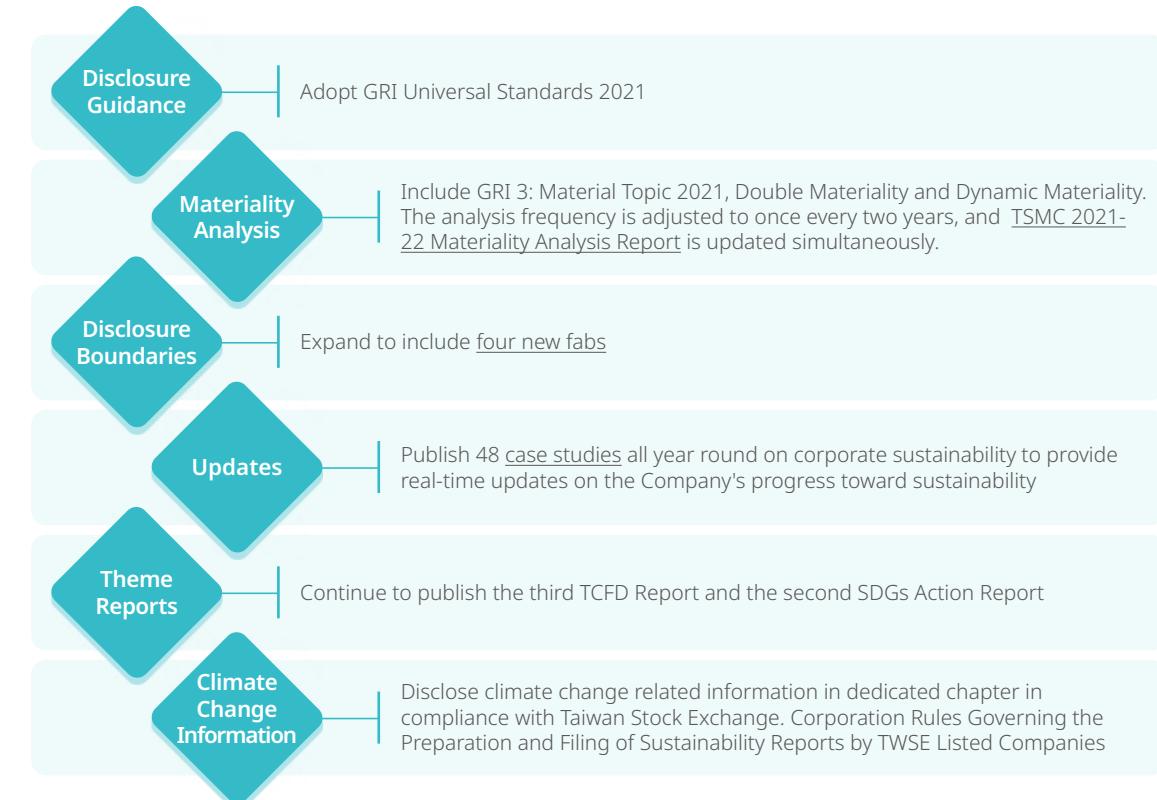
The reporting period is between January 1, 2022 and December 31, 2022. The report is published in June 2023 in both English and Chinese and is available on [TSMC ESG website](#). The report covers major topics of stakeholders concerns as well as TSMC practices in the economic, environmental, social, and governance dimensions. Visit the following links for more historical data and information:

	<b>ESG Performance Summary/Video</b>		<b>ESG Website</b>		<b>ESG Newsletter</b>
	<a href="#">TSMC LinkedIn</a>		<a href="#">TSMC TCFD Report</a>		<a href="#">TSMC UN SDGs Action Report</a>

## Reporting Scope

The reporting scope includes all TSMC fabs in Taiwan (the corporate headquarters and all wafer fabs and backend fabs in Taiwan), TSMC (China), TSMC (Nanjing), WaferTech, VisEra, and other subsidiaries. Changes from last year include an expansion to Fab 12 Phase 8, Fab 18 Phase 6, 7, and 8 in Taiwan. If the scope of reporting is different from the above statement, a note will be added to explain any differences in this paragraph.

## Primary Changes in the 2022 ESG Disclosures





## Data Collection Boundaries for Sustainable Development Issues

Complete data collected

Partial data collected

— The issue lacks materiality to the institution and is not included in the boundary of data collection

Issues	Boundaries	Taiwan Facilities <sup>Note1</sup>	WaferTech	TSMC (China)	TSMC (Nanjing)	VisEra	Other Subsidiaries <sup>Note2</sup>
Innovation Management		—				—	
Product Quality and Safety							
Customer Relations							
Sustainable Supply Chain							—
Climate and Energy							
Water Stewardship							—
Circular Resources							—
Air Pollution Control							—
Diversity and Inclusion							
Talent Attraction and Retention							
Talent Development							
Human Rights							
Occupational Safety and Health							—
Social Impact		—				—	—

Note 1: TSMC's fabs in Taiwan include corporate headquarters, wafer fabs, testing and assembly facilities

Note 2: TSMC subsidiaries or offices in North America, Europe, Japan, South Korea, and other countries

## Report Writing and Quality Management Process





## Report Writing Guidelines and Principles

 ESG	Standards	Certification Organization
	<ul style="list-style-type: none"><li>✓ GRI Standards</li><li>✓ TCFD Framework</li><li>✓ SASB Index for the Semiconductor Industry</li><li>✓ AA1000 AccountAbility Principles</li><li>✓ The International Integrated Reporting Framework</li><li>✓ CDP Climate Change/ Water Security</li><li>✓ The United Nations Global Compact (UNGC)</li><li>✓ The United Nations Sustainable Development Goals (UN SDGs)</li><li>✓ WEF IBC Stakeholder Capitalism Metrics</li></ul>	<ul style="list-style-type: none"><li>✓ DNV GL Business Assurance Co. Ltd. certified this Report</li><li>✓ In compliance with the <a href="#">DNV VeriSustain™ Protocol</a>, GRI Standards, SASB Index, and the TCFD Framework</li></ul>

 Financial Information	Standards	Certification Organization
	<ul style="list-style-type: none"><li>✓ IFRSs endorsed by the Financial Supervisory Commission (FSC) with the effective dates</li><li>✓ Regulations Governing the Preparation of Financial Reports by Securities Issuers</li></ul>	<ul style="list-style-type: none"><li>✓ Deloitte &amp; Touche</li></ul>



## Feedback

If you have any feedback, advice, or suggestion on this report or TSMC's sustainable development, please feel free to contact us. For more information about TSMC's latest sustainability practices, please [subscribe](#) to the TSMC ESG Newsletter.

Responsible Unit: ESG Committee

ESG Website: <https://esg.tsmc.com/en/>

Email: [ESG@tsmc.com](mailto:ESG@tsmc.com)

Phone: +886-3-5636688

Address: 8, Li-Hsin Rd. 6, Hsinchu Science Park, Hsinchu 300-78, Taiwan, R.O.C



# Sustainability Information Disclosure Framework

Dedicated to driving more positive changes, the TSMC Sustainability Report follows the editorial standards of the [Global Reporting Initiative \(GRI\)](#), [AccountAbility \(AA\)](#), [United Nations \(UN\)](#), [Carbon Disclosure Project \(CDP\)](#), [International Integrated Reporting Council \(IIRC\)](#), [Sustainability Accounting Standards Board \(SASB\)](#), [Financial Stability Board \(FSB\)](#), [World Economic Forum International Business Council \(WEF IBC\)](#) and refers

to their principles of reporting disclosure (to establish a systematic management process for reports) and indicators (environmental, social and governance indicators) to report TSMC's sustainability information and data. TSMC utilizes sustainability information disclosure as a proactive management tool to serve as a guide for organizations to stay in alignment with international sustainability management trends.





# Climate-related Information of Listed Companies

Items	Execution Status
1 Description on the Board and Management's oversight and governance on climate-related risks and opportunities	See <a href="#">TCFD—Governance</a>
2 Description on how the identified climate risks and opportunities impact the company's business, strategies, and finance (short, mid, long-term)	See <a href="#">TCFD—Strategies &amp; Climate, Change Risks/Opportunities and Response Measures</a>
3 Description on the impact extreme climate events and transitional actions have on finance	See <a href="#">TCFD—Strategies</a>
4 Description on how the climate risk identification, assessment, and management process is integrated in the overall risk management system	See <a href="#">TCFD—Risk Management</a>
5 Should scenario analysis is used to assess the Company's resilience in face of climate change risks, explanations on the scenario, parameters, hypothesis, analysis factors and major financial impacts should be provided	See <a href="#">TCFD—Strategies</a>
6 Should there be transitional programs in response to managing climate-related risks, please explain the program's content and metrics and targets used to identify and manage physical and transitional risks	See <a href="#">TCFD—Metrics and Targets</a>
7 Should the internal carbon pricing is used as the planning tool, the pricing mechanism should be explained	See <a href="#">TSMC Carbon Pricing Mechanism</a>
8 Should climate-related targets are in place, information such as their scope of action, GHG emissions, planned timeline, and yearly achieved progress should be stated; for targets achieved through carbon offset and RECs, the source of offset amount and number of RECs should be stated	See <a href="#">TCFD—Metrics and Targets</a>
9 Carbon inventory and assurance efforts	See chart on the next page



Year	Area	Scope 1		Scope 2		Assurance Institutes	Assurance Efforts
		Total Emissions (metric tons CO <sub>2</sub> e)	Emission Intensity (metric tons CO <sub>2</sub> e/NT\$ thousand)	Total Emissions (metric tons CO <sub>2</sub> e)	Emission Intensity (metric tons CO <sub>2</sub> e/NT\$ thousand)		
2022	the Parent Company	1,669,770	0.0007	9,510,082	0.0042	DNV	Reasonable level
	Visera	5,845	0.0006	29,683	0.0033	DNV	Reasonable level
	TSMC (China)	187,181	0.0066	0	0	DNV	Reasonable level
	TSMC (Nangning)	46,209	0.0011	0	0	DNV	Reasonable level
	WaferTech, LLC	109,784	0.0107	0	0	AWN	Limited level
2021	the Parent Company	1,808,427	0.0011	8,116,439	0.0052	DNV	Reasonable level
	Visera	7,282	0.0008	39,057	0.0043	DNV	Reasonable level
	TSMC (China)	196,834	0.0093	0	0	DNV	Reasonable level
	TSMC (Nangning)	29,778	0.0011	0	0	DNV	Reasonable level
	WaferTech, LLC	105,346	0.0136	0	0	AWN	Limited level

Note 1: Greenhouse Gases include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>)

Note 2: Scope 1 (direct emissions) are emissions based on the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gases Inventories directly owned or controlled by the Company, and the calculation uses the Global Warming Potential (GWP) from IPCC's Fifth Assessment Report; Scope 2 (indirect emissions) are indirect GHG emissions from purchased electricity, heat, and steam

Note 3: New additions to the 2022 emissions boundary include Fab 12 Phase 8, Fab 18 Phase 5, Fab 18 Phase 6, Advanced Backend Fab 2C, and Advanced Backend Fab 6

# Participation in Industry Associations and Non-Profit Organizations

<sup>Note 1</sup>

As a key player in the global semiconductor supply chain, TSMC works diligently to integrate the ESG ethos into our daily operations with the aim of sustainable development, setting systematic management strategies, taking tangible action and reviewing results. TSMC works with partners and stakeholders from all walks of life to carry out our environmental and social commitments and continue bringing positive change to the world. TSMC participates in a variety of industry associations and public policy related nonprofit organizations to promote industry dialogue and development, as well as track key issues such as technology innovation, corporate governance, environmental sustainability, human rights, and supply chain management<sup>Note 2</sup>. In 2022, TSMC participated in 72 industry associations and non-profit organizations at home and abroad, with expenditures of over NT\$70.94 million<sup>Note 3</sup>. Total expenditures in the past five years (2018~2022) were about NT\$197.58 million<sup>Note 4, 5</sup>.



## Industry Dialogue and Development

TSMC strives for the development of the semiconductor industry. Through participating in industry associations, the Company forges consensus, facilitates collaboration, defines standards, develops talents, and makes policy suggestions to the government in areas including land, water, electricity, talent, intellectual property protection and other areas related to the competitiveness of the industry. Industry associations that TSMC participates in to steer industry development include:

- Taiwan Semiconductor Industry Association (TSIA)
- Semiconductor Industry Association (SIA)
- Semiconductor Equipment and Materials International (SEMI)
- Global Semiconductor Alliance (GSA)
- The Allied Association for Science Park Industries
- Chinese National Association of Industry and Commerce, Taiwan (CNAIC)
- Monte Jade Science & Technology Association of Taiwan
- Taiwan Electrical and Electronics Manufacturers' Association (TEEMA)
- Center for Asia-Pacific Resilience and Innovation (CAPRI)
- Information Technology Industry Council (ITI)
- National Committee on United States-China Relations
- Greater Phoenix Chamber of Commerce

TSMC Chairman Dr. Mark Liu served as Chairman of TSIA for 4 consecutive years since 2019, chaired the World Semiconductor Council for 2 consecutive years since 2021, and currently serves as director of CNAIC. Senior Vice President Y.P. Chin currently serves as chairperson of TSIA's Energy Committee, Vice President Dr. Y.L. Wang currently serves as chairperson of TSIA's Industry and University Committee, Director Han-Wen Fung currently serves as chairperson of TSIA's Environment, Safety and Health Committee, and Director Dr. Cheng-Ming Lin currently serves as chairperson of TSIA's JSTC Committee. Vice President Dr. Douglas Yu currently serves as co-chair of SEMI Taiwan's Packaging & Testing Committee, Senior Director Hsiao-Chin Tuan served as chairperson of SEMI Taiwan's MEMS & Sensors Committee, Director Dr. John Lin currently serves as chairperson of SEMI Taiwan's IC Committee, Director M.D. Chen currently serves as chairperson of SEMI Taiwan's Materials Committee, and Director Dr. James Tu currently serves as chairperson of SEMI Taiwan's Cyber Security Committee. Senior Vice President Rick Cassidy currently serves on the board of GSA. Senior Vice President Y.P. Chin currently serves as executive director of The Allied Association for Science Park Industries, and Vice President Connie Ma served as executive controller of The Allied Association for Science Park Industries.<sup>Note 6</sup> Senior Vice President J.K. Lin currently serves as director of TEEMA. Vice President and General Counsel Sylvia Fang currently serves as director of CAPRI. Vice President Peter Cleveland currently serves as director of ITI.

Note 1: Non-profit organizations in the areas of charity and education are not included here. For details of TSMC's participation in the TSMC Charity Foundation and TSMC Education and Culture Foundation, please see pages 181 to 203 of this report

Note 2: By law, TSMC is not permitted to make political donations as the Company is majority owned by foreign shareholders. TSMC has always followed this legal requirement and maintained political neutrality but encourages employees to fulfill their civic duty

Note 3: The five largest membership fees paid or donations made by TSMC in 2022, in descending order, are:

1) Center for Asia-Pacific Resilience and Innovation (CAPRI)/ NT\$ 12,000,000  
TSMC participates in CAPRI to explore global policy and promote innovative governance by drawing on the experience of the Asia-Pacific region through comparative research on health, innovation, sustainability, and the economy

2) Information Technology Industry Council (ITIC)/NT\$11,934,000  
The United States is one of TSMC's primary markets. TSMC participates in the ITIC in the U.S. to join other global technology companies to discuss policy trends and industry standards related to technology industry development, and to communicate with the U.S. and global governments on the importance of technology to the global economy

3) Taiwan Semiconductor Industry Association (TSIA)/NT\$5,679,000  
TSMC participates in the TSIA to support Taiwan's semiconductor industry, develop consensus on the development of the industry through the association's activities and promote healthy growth for the sector through cooperation amid competition

4) Semiconductor Industry Association (SIA)/NT\$4,420,960  
TSMC participates in the SIA to join other industry members to collectively communicate with the U.S. government and highlight the importance of the semiconductor industry to U.S. economic development, national security, and global competitiveness

5) Allied Association for Science Park Industries/NT\$1,980,000  
TSMC participates in the Allied Association for Science Park Industries, which serves as a conduit between government and business for promulgation of policies and communication of views. It serves the common interests of companies in Taiwan's science parks and facilitates cooperation for the stable development of science park businesses

Note 4: TSMC's expenditures of membership and donation for industry associations and nonprofit organizations between 2018 and 2022 were NT\$21,735,668, NT\$20,338,992, NT\$40,197,059, NT\$44,367,769, and NT\$70,943,042, respectively

Note 5: In addition to the expenditures disclosed in Note 4, TSMC's government relations expenses in 2022 amounted to NT\$83,836,350, with the primary expense being employee payroll. TSMC did not make any political donations in the reporting period. In the past five years (from 2018 to 2022), TSMC did not make any political donations or other spendings related to ballot measures or referendums

Note 6: Since November 2022, Vice President Connie Ma retired from TSMC



## Technology Innovation

Technology innovation is the key driving force moving the industry and economy forward. TSMC not only cares for and invests in technology innovation and participates in the definition of technical standards, the Company also calls on the government and private sector to protect the results of innovation together so that it can gain appropriate economic value and encourage further innovation, creating a fair competitive environment. TSMC participates in industry associations in the area of technology innovation including:

- Epoch Foundation
- K.T. Li Foundation for Development of Science and Technology
- Taiwan Association for Trade Secrets Protection (TTSP)
- Information Technology and Innovation Foundation (ITIF)
- Global Women's Innovation Network
- JEDEC

TSMC Chairman Dr. Mark Liu currently serves as director of both Epoch Foundation and K.T. Li Foundation for Development of Science and Technology. TSMC Vice President and General Counsel Sylvia Fang jointly founded the Taiwan Association for Trade Secrets Protection (TTSP) in 2015 and served as its chairperson for the first two terms to help promote legal reform of Taiwan's trade secret laws and regulations. Currently she is an executive director of the TTSP. Associate General Counsel Dr. F.Y. Shieh currently serves as vice chairman of TTSP.



## Corporate Governance

TSMC advocates and acts upon the principles of operational transparency and respects shareholder rights. Based on strong governance foundation, TSMC believes in leadership integrity and adopts ethics, regulatory compliance, and risk management mechanisms into daily business operations. TSMC participates in industry associations in the area of corporate governance including:

- Asia Business Council
- Asian Corporate Governance Association (ACGA)
- Chinese Professional Management Association
- Association of Certified Fraud Examiners, Taiwan Chapter



## Environmental Sustainability

Responding to climate change and mitigating climate impact to protect our shared global environment, TSMC integrates green management into daily operations and continues to enhance climate and energy, water stewardship, circular resources, and air pollution control through introducing innovative green technologies. The Company's goal is to become the global standard of eco-friendly corporations. To achieve the commitment of Net Zero Emissions by 2050, TSMC mobilizes supply chain partners to reduce carbon footprint, creating a green supply chain for the semiconductor industry. TSMC participates in industry associations and non-profit organizations in the area of environmental sustainability including:

- Taiwan Association for Net Zero Emissions
- Taiwan Climate Partnership
- Taiwan Institute for Sustainable Energy/Taiwan Center for Corporate Sustainability
- Science and Technology in Society Forum
- RE100
- Business Council for Sustainable Development of Taiwan
- Common Wealth Sustainability Council

TSMC is among the first members of Taiwan Association for Net Zero Emissions, Taiwan Climate Partnership, and Common Wealth Sustainability Council. Senior Vice President J.K. Lin currently serves as vice chairman of Taiwan Association for Net Zero Emissions. Senior Vice President Lora Ho currently serves as director at the Taiwan Center for Corporate Sustainability.



## Human Rights and Supply Chain Management

Respecting human rights and creating a respectful workplace are critical to TSMC and our suppliers. TSMC is a full member of the Responsible Business Alliance, and in addition to meeting the alliance's requirements in auditing suppliers, we have also asked our suppliers to strictly comply with local regulations to safeguard human rights. TSMC requires all suppliers to commit to the Assurance to Comply with TSMC's Code of Ethics and Business Conduct and in July 2021, TSMC issued a statement titled Supply Chain Partners Should Ensure Protection of Human Rights During the COVID-19 Pandemic to ensure a dignified work environment. TSMC participates in industry associations in the area of human rights and supply chain management including:

- Responsible Business Alliance (RBA)
- Responsible Minerals Initiative



# ESG Performance Summary

	Key Indicators	2020	2021	2022
Operational and Economics	Revenue (NT\$ billion)	1,339	1,587	2,264
	Net income (NT\$ billion)	518	597	1,017
	Income tax expense (NT\$ billion)	67	66	127
	Cash dividend (NT\$ billion)	259	266	285
	R&D expenditures (NT\$ billion)	109	125	163
	Capital expenditures (NT\$ billion)	507	839	1,083
An Innovation Pioneer	R&D expenses to revenue (%)	8.2	7.9	7.2
	Global patents granted	45,162	50,506	56,693
	Registered trade secrets	100,000	160,000	240,000
	Value generated from improvement projects (NT\$ billion)	15	12	13
	Encourage all major local raw materials suppliers to participate in the Taiwan Continuous Improvement Competition (%)	79	64	74
	Encourage back-end packaging materials suppliers to participate in the Taiwan Continuous Improvement Competition (%)	46	67	60
	Local and back-end packaging materials suppliers that advanced to the finals of the Taiwan Continuous Improvement Award (%)	-	16	17
	New innovative testing methods for product quality and reliability	-	254	272
	Complete quality and reliability certification during the design stage for advanced processes, specialty processes, and wafer-level packaging processes in compliance with the TSMC technological roadmap	Completed	Completed	Completed
	Develop analytical abilities for carcinogenic, mutagenic, and reprotoxic substances and assist the suppliers that supply materials with potential risks in developing such abilities (%)	100	100	100
A Responsible Purchaser	NMP replacement rate (%) (Base year: 2016)	59	75	97.2
	Ensure that manufacturing processes are free from PFASs with more than 4 carbon atoms	Ensured that all 3nm process and beyond are free from PFASs with more than 4 carbon atoms	Selected PFHxA substitutes and launched production line testing	Photoresist substitutes that do not contain PFHxA-related substances failed to pass production line testing; to select new substitute materials

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	Key Indicators	2020	2021	2022
A Responsible Purchaser	Tier 1 suppliers' completion rate of the Sustainability Management Self-Assessment Questionnaire (%)	100	100	100
	Critical suppliers' completion rate for receiving third-party audits (by RBA-certified auditing institutions) every three years (%)	40	60	100
	Total number of critical high-risk suppliers that have received audits for the S.H.A.R.P. Program	-	86	100
	Requires suppliers to conduct due diligence for responsible mining; % of legally compliant mines	100	100	100
	Audit at least three suppliers for due diligence in responsible mining each year	-	3	5
	Total number of suppliers audited for due diligence in responsible mining	-	3	8
	Diversify facilities and assess new suppliers in compliance with the multi-source program (Base year: 2018)	70	109	135
	Cumulative total of local raw materials suppliers receiving consultation on process advancement and quality improvement (Base year: 2016)	45	55	65
	Raw materials suppliers invited to observe the annual emergency response drill (Base year: 2016)	111	132	161
	Total number of suppliers that participated in the ESH training program (Base year: 2016)	558	759	960
	Critical high-risk suppliers that received safety and health support (%)	100	100	100
	Increase local sourcing of indirect raw materials (%)	60	60.4	62.1
	Increase local sourcing of parts and components (%)	45	46.6	43.0
	Total energy conserved by helping suppliers (GWh) (Base year: 2018)	2.1	3.4	5.3
	Total water conserved by helping suppliers (metric tons) (Base year: 2020)	2,130,000	19,710,000	29,080,000
	Score and response rate of suppliers invited to participate in the CDP (Carbon Disclosure Project) in the year	-	-	C/81%
	High-energy-consumption suppliers that have received ISO 14064 certification for GHG emissions (%)	-	51	65
	Waste reduction in major waste-generating suppliers (%) (Base year: 2014)	29.4	31	34

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	Key Indicators	2020	2021	2022
<b>A Practitioner of Green Power</b>	Greenhouse gas emission (metric ton-CO <sub>2</sub> equivalent) (Scope 1 and Scope 2 market-based)	9,464,696	10,304,344	11,599,089
	Scope 1 (metric ton-CO <sub>2</sub> equivalent) <sup>Note1</sup>	2,004,841	2,151,937	2,018,789
	Taiwan sites	1,710,677	1,808,427	1,669,770
	Subsidiaries <sup>Note2</sup>	294,164	343,510	349,019
	Scope 2 (metric ton-CO <sub>2</sub> equivalent) (market-based)	7,459,856	8,152,497	9,539,765
	Taiwan sites	7,429,951	8,116,440	9,510,082
	Subsidiaries <sup>Note2</sup>	29,905	36,057	29,683
	Scope 2 (metric ton-CO <sub>2</sub> equivalent) (location-based)	8,282,509	9,196,964	10,887,145
	Scope 3 (metric ton - CO <sub>2</sub> equivalent) <sup>Note3</sup>	5,511,486	6,049,256	7,502,136
	Carbon offset (metric ton - CO <sub>2</sub> equivalent)	4,125	241,577	616,271
	Fluorinated greenhouse gas emission (metric ton - CO <sub>2</sub> equivalent)	1,311,530	1,369,478	1,102,353
	Reduction rate of GHG emissions per unit product compared to the base year (metric ton - CO <sub>2</sub> equivalent - 12-inch equivalent wafer mask layer) (%)	23	5	6
	Energy consumption (GWh) (including electricity, natural gas and diesel)	16,919	19,192	22,423
	Direct energy consumption (GWh) (including natural gas and diesel)	861	1,112	1,336
	Indirect energy consumption (GWh) (non-renewable energy)	14,828	16,409	18,895
	Indirect energy consumption (GWh) (renewable energy)	1,230	1,671	2,191
	Renewable energy used at all TSMC fab operation sites (%)	7.6	9.2	10.4
	Renewable energy used at overseas subsidiaries (%)	100	100	100
	Total energy conserved from new energy saving measures since 2016 (GWh/y)	17	24	31

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Key Indicators	2020	2021	2022
Energy efficiency after volume production - 10nm & 7nm technology	1.4 (4 <sup>th</sup> year)	1.5 (5 <sup>th</sup> year)	-
Energy efficiency after volume production - 5nm technology	-	0.2 (2 <sup>nd</sup> year)	0.6 (3 <sup>rd</sup> year)
Days of production interrupted due to climate disasters	0	0	0
NOx emissions (metric tons)	170.36	205.57	159.87
SOx emissions (metric tons)	38.13	39.48	37.78
VOC emissions (metric tons)	106.8	107.7	112.9
Reduction in air pollutant emissions per unit of production (%)	45	54	59
Reduction rate of volatile organic gases (%)	98.3	98.4	98.9
Number of unusual events reported in air pollution prevention equipment	0	0	0
ISO 14001 certified sites number	23	24	27
ISO 14001 certified sites percentage (%)	100	100	100
Water consumption (million metric tons)	77.3	82.8	104.6
Taiwan sites	70.6	76.1	96.8
Subsidiaries <sup>Note 2</sup>	6.7	6.7	7.8
Process water recycling rate (%)	86.4	85.4	85.7
Total water saving (million metric tons)	173	186.3	215.7
Ultra-pure water usage (million metric tons)	102.4	109.5	132.1
Tetramethylammonium hydroxide (TMAH) <sup>Note 3</sup>	6.3	5.5	3.8
Copper ion (Cu <sub>2+</sub> ) <sup>Note 3</sup>	0.07	0.07	0.06

**A Practitioner of Green Power**

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	Key Indicators	2020	2021	2022
A Practitioner of Green Power	Reduction % in unit water consumption (liter/12-inch equivalent wafer mask layer) (Base year: 2010)	8.9	14.9	2.6
	% of water pollution composite indicator above effluent standards <sup>Note 3</sup>	42.4	42.5	54.3
	Outsourced unit waste disposal per wafer (kg/12-inch equivalent wafer mask layer)	1.01	0.99	0.99
	Waste recycling rate (%)	95	95	96
	Taiwan sites	95	95	96
	Subsidiaries <sup>Note2</sup>	77	85	92
	Waste generated (metric tons)	575,740	674,703	744,019
	Outsourced General waste generated	277,340	335,080	342,804
	Taiwan sites	269,640	326,069	331,499
	Subsidiaries <sup>Note2</sup>	7,700	9,011	11,305
	Outsourced Hazardous Waste generated	298,400	339,623	401,215
	Taiwan sites	280,635	319,763	373,419
	Subsidiaries <sup>Note2</sup>	17,765	19,860	27,796
	Develop multiple types of electronic-grade chemicals for resource recycling within TSMC - % of resource recycling within facilities	22	22	28
	Waste treatment vendors that have obtained ISO 14001 or other international EHS Management certifications (%)	80	82	84
	Waste treatment vendors establishing a smart system for tracking waste (%)	-	-	9
	Waste treatment vendors graded as Excellent and Good (%)	75	77	80

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	Key Indicators	2020	2021	2022
<b>An Admired Employer</b>	Global Full-time Employees (people)	56,825	65,133	73,090
	Employee training hours	926,379	3,185,784	5,077,993
	Females in all employees (%)	37.1	35.4	34.4
	Females in management (%)	12.5	13	13.3
	Females in junior management (%)	13	13.4	13.6
	Females in top management (%)	10	8.3	6.1
	Females in newly hired technical professionals (%)	-	21.3	23.7
	Turnover rate (%)	5.3	6.8	6.7
	New hire (< 1 year) turnover rate (%) <sup>Note 4</sup>	15.7	17.6	15
	Voluntary turnover rate (%)	5.1	6.7	6.5
	Total compensation amongst industry peers	Top 25%	Top 25%	Top 25%
	Management positions filled through internal promotions (%)	79.3	82.5	88.6
	Management positions filled through internal promotions (%)	45.2	57.6	57.6
	Employees fully committed to their work (%)	96	-	93
	Employees willing to continue working for TSMC in the next five years (%)	95	-	90
	Goals for the issue of sustainably engaged from the Engagement Survey in comparison to the WTW Global High Performance Norm	-	Missed top 50%	-
	Injury frequency rate <sup>Note 5</sup>	0.42	0.38	0.27
	Injury severity rate <sup>Note 6</sup>	4	7	3
	Occupational fatalities - employees	0	0	0

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	Key Indicators	2020	2021	2022
An Admired Employer	Occupational fatalities - contractors	0	0	0
	RBA Self-Assessment Questionnaire (SAQ) scores in all facilities		100	100
	Incident rate per 1,000 employees	0.311	0.252	0.145
	Cases of occupational disorders caused by exposure to chemicals	0	0	0
	Contractors that have obtained ISO 45001 certification for occupational safety and health management system with help from TSMC (%)	60	65	65
Power to Change Society	Total participants in youth competitions	1,551	1,614	2,388
	Promotional events on semiconductor sciences	5	6	13
	Sponsor outstanding local artists or groups	Suspended due to COVID-19	12	12
	Hours of reading services	5,060	4,910	2,060
	Annual cash donations to the disadvantaged (NT\$ million)	1,210	2,263	1,529
	Children in remote areas that have benefited from TSMC programs	3,279	5,287	6,358
	Service visits to seniors living alone by Network of Compassion	10,855	15,719	16,471
	Meals delivered by Network of Compassion	-	304,477	355,692
	Promote filial piety education	57	64	68
	Annual beneficiaries of the Cherish Food Program	37,071	58,862	48,143
	Volunteer service from environmental protection volunteers	1,044	794	499

Note: Figures from all Taiwan fabs and subsidiaries of TSMC

Note 1: To ensure consistent data in GHG inventory and reduction goals after 2020, inventory data for Scope 1 will comply with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gases Inventories starting from 2020 and the base year also change from 2010 to 2020

Note 2: The scope of subsidiaries in Environmental parts includes WaferTech, TSMC China Company Limited, TSMC Nanjing Company Limited and VisEra

Note 3: Figures from all Taiwan Fabs of TSMC

Note 4: Since 2021, the statistic of new hire (&lt; 1 year) turnover rate included VisEra

Note 5: Safety -Injury Frequency Rate=Injury Number x 1,000,000/Total hours worked

According to the Occupational Safety and Health Act, Disabling Injury Frequency Rate are defined as any diseases, injuries, disabilities, or deaths of workers caused by buildings, machinery, equipment, raw materials, materials, chemicals, gases, vapors, dusts, etc., at the place of duty, or as a result of work activities, or due to other occupational causes. Other unrelated injuries in the workplace such as falling in the cafeteria or parking lot due to various reasons are not considered as work injuries. Target has been amended according to new definition. See Statistical Analysis of Disabling Injuries for detailed information

Note 6: Safety -Injury Severity Rate=Lost Work Days x 1,000,000/Total hours worked

According to the Occupational Safety and Health Act, Disabling Injury Frequency Rate (FR)/Disabling Severity Rate (SR) are defined as any diseases, injuries, disabilities, or deaths of workers caused by buildings, machinery, equipment, raw materials, materials, chemicals, gases, vapors, dusts, etc., at the place of duty, or as a result of work activities, or due to other occupational causes. Other unrelated injuries in the workplace such as falling in the cafeteria or parking lot due to various reasons are not considered as work injuries. Target has been amended according to new definition. See Statistical Analysis of Disabling Injuries for detailed information



# Independent Third Party Assurance Statement



## Independent assurance statement

### Scope and approach

Taiwan Semiconductor Manufacturing Company Ltd. ('TSMC' or 'the Company') commissioned DNV Business Assurance Co. Ltd. ('DNV') to undertake independent assurance of the 2022 Sustainability Report (the 'Report') for the year ended 31 December 2022.

We performed our work using DNV's assurance methodology VeriSustain™<sup>1</sup>, which is based on our professional experience, international assurance best practice including International Standard on Assurance Engagements 3000 (ISAE 3000) and the Global Reporting Initiative (GRI) Sustainability Reporting Standards.

The Report also incorporated the relative sustainability reporting guidelines, such as Sustainability Accounting Standards Board (SASB) Semiconductors Sustainability Accounting Standard and Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

We evaluated the performance data using the reliability principle together with TSMC data protocols for how data are measured, recorded and reported. The performance data in scope was against TSMC's significant Environmental, Social and Governance (ESG) issues and the 2030 sustainability commitment and the topics set forth in the GRI standards 2021.

We understand that the reported financial data and information are based on data from TSMC's Annual Report and Accounts, which are subject to a separate independent audit process. The review of financial data taken from the Annual Report and Accounts is not within the scope of our work.

We planned and performed our work to obtain the evidence we considered necessary to provide a basis for our assurance opinion. We are providing a 'moderate / limited level' of assurance.

### Responsibilities of the Directors of TSMC and of the assurance providers

The Directors of TSMC have sole responsibility for the preparation of the Report. In performing our assurance work, our responsibility is to the management of TSMC; however, our statement represents our independent opinion and is intended to inform all of TSMC stakeholders. DNV was not involved in the preparation of any statements or data included in the Report except for this Assurance Statement.

DNV provides a range of other services to TSMC, none of which constitute a conflict of interest with this assurance work.

DNV's assurance engagements are based on the assumption that the data and information provided by the client to us as part of our review have been provided in good faith. DNV expressly disclaims any liability or co-responsibility for any decision a person or an entity may make based on this Assurance Statement.

### Basis of our opinion

A multi-disciplinary team of sustainability and assurance specialists performed work at headquarters and site level. We undertook the following activities:

- Review of the current sustainability issues that could affect TSMC and are of interest to stakeholders;
- Review of TSMC approach to stakeholder engagement and recent outputs;

<sup>1</sup> The VeriSustain protocol is available on [dnv.com](http://dnv.com)



- Review of information provided to us by TSMC on its reporting and management processes relating to the Principles;
- Interview with selected Directors and senior managers responsible for management of sustainability issues and review of selected evidence to support issues discussed. People who worked in functions for financial, legal, environment (including climate change & energy, air emission, water resource, chemical and waste management), human resource, safety, procurement, wellness, product development, information security, intellectual property, trade secret and TSMC cultural and educational foundation were chosen to interview;
- Site visits to HQ in Taiwan, remote meeting with other production sites to review process and systems for preparing site level sustainability data and implementation of sustainability strategy. Sites chosen were based on materiality issues;
- Review of supporting evidence for key claims and data in the report. Our checking processes were prioritised according to materiality, and we based our prioritisation on the materiality of issues at a consolidated corporate level;
- Review of the processes for gathering and consolidating the specified performance data and, for a sample, checking the data consolidation. Where financial data had been checked by another third party, and, where data of scope 1, 2 and 3 of Green House Gases Emission has been verified by DNV, we tested transposition from these sources to the report; Where relevant data and information has been generated from a certified management system note which data and management system certification and that this was considered;
- An independent assessment of TSMC's reporting against the Global Reporting Initiative (GRI) Standards 2021.
- There was a confidential issue that we cannot assess the salary data. The verification was conducted based only on the Chinese version Report.

### Opinion

On the basis of the work undertaken, nothing came to our attention to suggest that the Report does not properly describe TSMC's adherence to the Principles.

TSMC has developed its own data management system for capturing and reporting its ESG performances. In accordance with DNV VeriSustain Protocol requirements for a moderate / limited level assurance engagement, we conclude that no systematic errors were detected which causes us to believe that the specified sustainability data and information presented in the Report is not reliable.

### Observations

Without affecting our assurance opinion, we also provide the following observations.

The following is an excerpt from the observations and opportunities reported back to the management of TSMC:

- Considering the completeness, balance and transparency of data disclosure, it would be advisable to disclose the environment information and establish targets (i.e. reducing discharge or emission) of domestic and overseas facilities with same scope and depth.
- To effectively achieve resource cycling goals and performance, it would be beneficial to include overseas facilities in this effort. Currently, only TSMC's Taiwan factory appears to be prioritizing this aspect.

### Sustainability Context

Sustainability Report provides an accurate and fair representation of the level of implementation of related ESG policies and meets the content requirements of the GRI Standards 2021.



### Materiality

The materiality determination process was revaluated based on survey from key stakeholders including employees, customers, suppliers / contractors, NGOs, governments, shareholders, investors, regulatory bodies, local communities and senior management of TSMC and has not missed out any significant and known material issues about the Semiconductor Sector. A methodology has been developed to evaluate the priority of these issues and identified priority issues are fairly covered in the Report. An internal assessment process for monitoring and management on a continual basis for their long-term organisational sustainability has been established.

### Completeness

The Report has fairly attempted to disclose the generic disclosures and management approaches and performances of identified material topics for GRI Standards 2021. The reporting of performance and data are within the Company's reporting boundary and reporting period except for certain material topics. A system to report the performances of material topics are being established and set the internal timelines for disclosure.

### Accuracy and Reliability

The majority of data and information verified at the Corporate Office and sampling operational sites were found to be accurate and nothing came to our attention to suggest that reported data have not been properly collated from information reported at operational level, nor that the assumptions used were inappropriate. Some of the data inaccuracies identified during the verification process were found to be attributable to transcription, interpretation and aggregation errors and the errors have been communicated for correction.

### Inclusivity

The Company has identified the expectations of stakeholders through internal mechanisms in dialogue with different groups of stakeholders. The stakeholder concerns are well identified and documented. The significant ESG issues identified through this process are reflected in the Report.

### Responsiveness:

TSMC 2022 Sustainability Report meets the content requirements of the GRI Standards 2021. The report provides an accurate and fair representation of the level of implementation of related ESG policies.

The Company has adequately responded to stakeholder concerns through its policies, ESG Committee, and quarterly / annual financial report, and this is reflected in the Report.

### Impact

The Company presents the impacts related to its identified material topics by measuring and monitoring impacts through appropriate performance metrics demonstrating outcomes and outputs of its value creation processes. Nothing has come to our attention to suggest that the Report does not meet the requirements related to the Principle of Impact.

For and on behalf of DNV Taiwan  
18 May, 2023

Wu, Johnny  
Lead Verifier  
Business Assurance  
DNV Taiwan

Statement Number: C594569-2022-TWN-AG-DNV

David Hsieh  
District Manager,  
Business Assurance  
DNV Taiwan



# Contact Information

## Taiwan Facilities

### Wafer fabs

#### Corporate Headquarters & Fab 12A

8, Li-Hsin Rd. 6, Hsinchu Science Park,  
Hsinchu 300-096, Taiwan, R.O.C.  
Tel: +886-3-5636688 Fax: +886-3-5637000

#### R&D Center & Fab 12B

168, Park Ave. 2, Hsinchu Science Park,  
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Tel: +886-3-5636688 Fax: +886-3-6687827

#### Fab 2, Fab 5

121, Park Ave. 3, Hsinchu Science Park,  
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Tel: +886-3-5636688 Fax: +886-3-5781546

#### Fab 3

9, Creation Rd. 1, Hsinchu Science Park,  
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Tel: +886-3-5636688 Fax: +886-3-5781548

#### Fab 6

1, Nan-Ke North Rd., Southern Taiwan Science Park,  
Tainan 741-014, Taiwan, R.O.C.  
Tel: +886-6-5056688 Fax: +886-6-5052057

#### Fab 8

25, Li-Hsin Rd., Hsinchu Science Park,  
Hsinchu 300-094, Taiwan, R.O.C.  
Tel: +886-3-5636688 Fax: +886-3-5662051

### Backend fabs

#### Advanced Backend Fab 1

6, Creation Rd. 2, Hsinchu Science Park,  
Hsinchu 300-077, Taiwan, R.O.C.  
Tel: +886-3-5636688 Fax: +886-3-5773628

#### Advanced Backend Fab 2

1, Sanbaozhu Rd., Southern Taiwan Science Park,  
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Tel: +886-6-5056688 Fax: +886-6-5057223

#### Advanced Backend Fab 3

101, Longyuan 6th Rd., Longtan Dist.,  
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Tel: +886-3-5636688 Fax: +886-3-4804250

#### Fab 14A

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Tainan 741-014, Taiwan, R.O.C.  
Tel: +886-6-5056688 Fax: +886-6-5051262

#### Fab 14B

17, Nan-Ke 9th Rd., Southern Taiwan Science Park,  
Tainan 741-014, Taiwan, R.O.C.  
Tel: +886-6-5056688 Fax: +886-6-5055217

#### Fab 15A

1, Keya Rd. 6, Central Taiwan Science Park,  
Taichung 428-303, Taiwan, R.O.C.  
Tel: +886-4-27026688 Fax: +886-4-25607548

#### Fab 15B

1, Xinkue Rd., Central Taiwan Science Park,  
Taichung 428-015, Taiwan, R.O.C.  
Tel: +886-4-27026688 Fax: +886-4-24630372

#### Fab 18A

8, Beiyuan Rd. 2, Southern Taiwan Science Park,  
Tainan 745-093, Taiwan, R.O.C.  
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#### Fab 18B

8, Beiyuan Rd. 2, Southern Taiwan Science Park,  
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Tel: +886-6-5056688

#### Advanced Backend Fab 5

5, Keya W. Rd., Central Taiwan Science Park,  
Taichung 428-303, Taiwan, R.O.C.  
Tel: +886-4-27026688 Fax: +886-4-25609631

#### Advanced Backend Fab 6

No.1, Kezhuan 1st Rd., Zhunan Township,  
Miaoli County 350-012 Taiwan, R.O.C.  
Tel: +886-3-5636688

## Subsidiaries

### TSMC North America

2851 Junction Avenue, San Jose, CA 95134, U.S.A.  
Tel: +1-408-3828000 Fax: +1-408-3828008

### TSMC Europe B.V.

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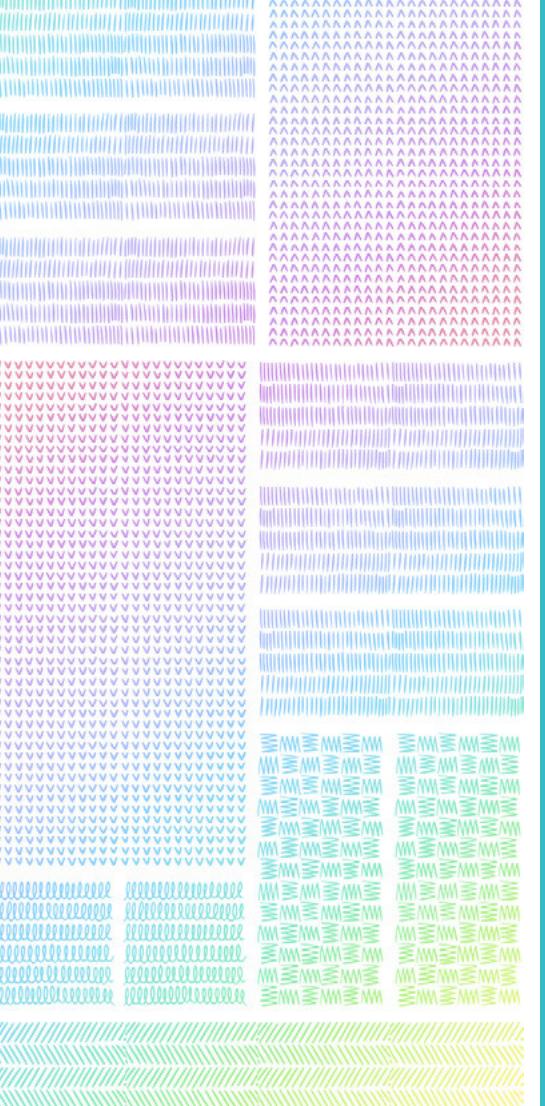
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