



TSMC 2021

TCFD Report



Contents

3 Faith and Resolution	8 Climate Change Management	23 Climate Mitigation Action
- The Importance of Climate Issues to TSMC _____ 3 - Commitment to Net Zero Emissions _____ 5 - Roadmap to Net Zero Emissions _____ 6 - Transformation to Net Zero Milestones _____ 7	- Sustainable Climate Governance _____ 8 - Total Risk Management _____ 12 - Integration of Horizon Strategies _____ 13 - Commitments and Targets _____ 18	- Climate Mitigation Management Initiatives _____ 23 - Climate Mitigation Benchmarks _____ 24
28 Resilience through Climate Adaptation	31 Climate Impact from Supply Chain	36 Climate Innovations in Products
- Climate Adaptation Management Initiatives _____ 28 - Effective Water Management _____ 30	- Carbon Reduction Management Initiatives in the Supply Chain _____ 31 - Supply Chain Risk Assessment and Management _____ 35	- Low-carbon Products and Services Management Strategies _____ 36 - Drive Global Energy Conservation with Advanced Technologies _____ 37
		39 Towards Sustainable Development
		40 Appendix
		- TCFD Comparison Table _____ 40 - Climate Change Related Reports and Policies _____ 41 - References _____ 41

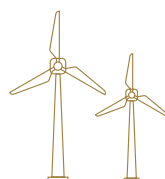


Photo Credit:
Greater Changhua 2a Offshore Wind Farm, Ørsted Taiwan

Faith and Resolution

The Importance of Climate Issues to TSMC

Climate change has been consistently listed as one of the most significant risks in the Global Risks Report published annually by the World Economic Forum. In fact, [the Global Risks Report 2022](#), for the first time, points to "Climate Action Failure" as the most severe risk the world will be facing in the next ten years. TSMC cares about the impacts of climate on company operations and the potential diseases, food, and economic problems that it may present to society. In our daily work, we use the TSMC [ESG Policy](#), [Climate Change Statement](#), and [Environmental Policy](#) to guide actions to mitigate climate change and adaptation measures as we strive towards our target of Net Zero Emissions by 2050.

In the face of the potential impact of climate change on operations and ensure the implementation and effectiveness of the action plan, TSMC has conducted an internal cross-organizational discussion and external consultant consultations to identify climate risks and opportunities in the value chain, outline response measures, and further establish metrics and targets management in compliance with the Task Force on Climate-related Financial Disclosures (TCFD) framework since 2018.

TSMC's climate change management focuses internally on strengthening its

own capabilities in both mitigation and adaptation capabilities, and externally on both supply chain carbon reduction, and providing customers with low-carbon products and services to form four major management strategies. TSMC starts from itself to drive the supply chain to follow a path of zero-carbon transformation, strengthening and demonstrating resilience to climate disasters. At the same time,

by maximizing climate-related opportunities, TSMC actively practices energy and resource conservation, expanding towards our value chain. We not only effectively reduce climate risks and save operating costs, but also provide customers with more energy-efficient low-carbon products and services to gradually achieve the long-term goal of net zero emissions across the entire value chain.



TSMC cares about the impacts of climate on company operations, and actively sets and executes plans to mitigate climate change and adaptation measures.



TSMC's climate change management focuses internally on strengthening its own capabilities in both mitigation and adaptation capabilities, and externally on both supply chain carbon reduction, and providing customers with low carbon products and services to form four major management strategies.

Value Chain Risks and Opportunities



Risks	Net Zero Emissions	In response to the zero-carbon trend, management expenses and production costs increase, thereby increasing the selling price of its products	The addition of carbon reduction equipment and the purchase of renewable energy and carbon credits lead to an increase in operating expenses	As customers commit to net zero, TSMC will be required to be more aggressive in carbon reduction
	GHG Emissions Restriction and Carbon Fee/Carbon Taxes	- Capacity is limited by carbon emissions, which in turn affects production capacity - Costs associated with compliance with regulations increase, resulting in higher product prices	- Capacity expansion is limited, affecting revenue growth - Increases expenses for code compliance - Raises product costs	Customers demand more aggressive carbon reduction from TSMC due to carbon tax levy
	Droughts/ Floods	Potentially affects shipments	Potentially affects operations	Considering the impact of drought/flood, customers ask TSMC to strengthen its investments in operation continuity in order to reduce its supply chain risks
	Reputation	Damages TSMC's image if suppliers are not actively promoting climate and carbon management	Damages the company reputation when unable to meet stakeholder expectations	Damages corporate reputation when customers are unable to meet stakeholder expectations
	Low-Carbon Products/ Services	Suppliers develop low-carbon products that help reduce carbon in TSMC's supply chain and meet the expectations of TSMC customers and other stakeholders	Meet customers' green/low carbon product requirements and generate revenue	Customer demand and trust in TSMC products increases, which in turn enhances their long-term partnership with TSMC
	Participation in Renewable Energy Plans/ Carbon Trading Market	Help TSMC achieve Scope 3 carbon reduction in net zero emissions targets and meet regulatory requirements	Help achieve net zero emissions targets and smoothly expand production capacity in compliance with regulatory requirements	Increases customers' market competitiveness, which in turn leads to growth in demand for TSMC's products
	Promotion of Water Efficiency Enhancement and Diversification	Suppliers improve water management performance and strengthen supply chain climate resilience	Strengthens climate resilience and increases competitiveness	By maintaining operation continuity, customers' trust in TSMC increases
Opportunities				

Commitment to Net Zero Emissions

In 2020, TSMC initiated the Net Zero Emission Program where the Energy Saving and Carbon Reduction Committee will spearhead a roadmap towards Net Zero Emissions in 2050. By optimizing gas usage in manufacturing processes, fully adopting exhaust gas abatement equipment and decarbonized energy, enhancing existing energy efficiency, expanding resource recycling, selecting low-carbon-footprint materials, developing energy-efficient equipment, and working with external parties

for carbon offset, TSMC is gradually progressing towards its net zero emissions target.

TSMC has established short, medium, and long-term targets as part of our roadmap to Net Zero Emissions by 2050. In the short term (2020-2025), we will see increased carbon emissions due to expansion of advanced processes. However, the Company will continue working on carbon reduction, energy conservation, and renewable energy at

TSMC and in the value chain to achieve zero growth in carbon emissions by 2025. In the midterm (2025-2030), TSMC will have increased renewable energy usage and gradually reduced overall carbon emissions. By 2030, carbon emissions by TSMC will have been reduced to 2020 emission level. In the long term (2030-2050), TSMC will introduce innovative carbon-reduction and carbon-negative technologies to fulfill our commitment to RE100 and achieve Net Zero Emissions by 2050.



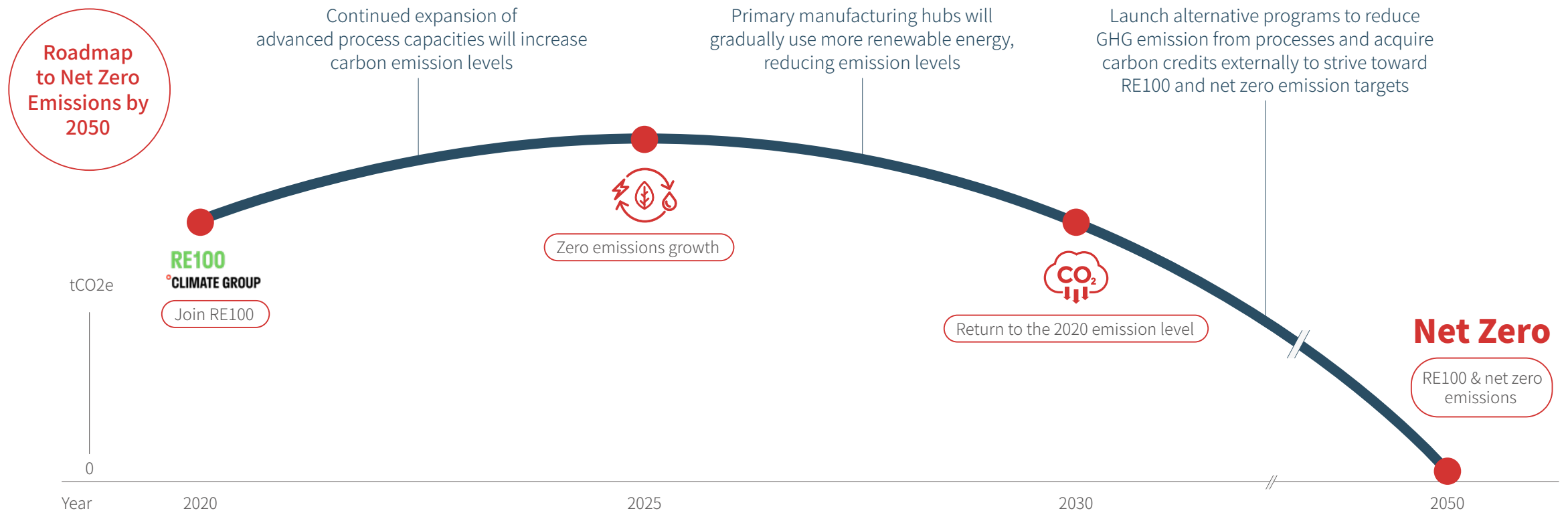
By optimizing gas usage in manufacturing processes, fully adopting exhaust gas abatement and decarbonized energy, enhancing existing energy efficiency, expanding resource recycling, selecting low-carbon-footprint materials, developing energy-efficient equipment, and working with external parties for carbon offset, TSMC is gradually progressing towards its net zero emissions target.



TSMC establishes short, medium, and long-term targets as a roadmap towards Net Zero Emissions by 2050.

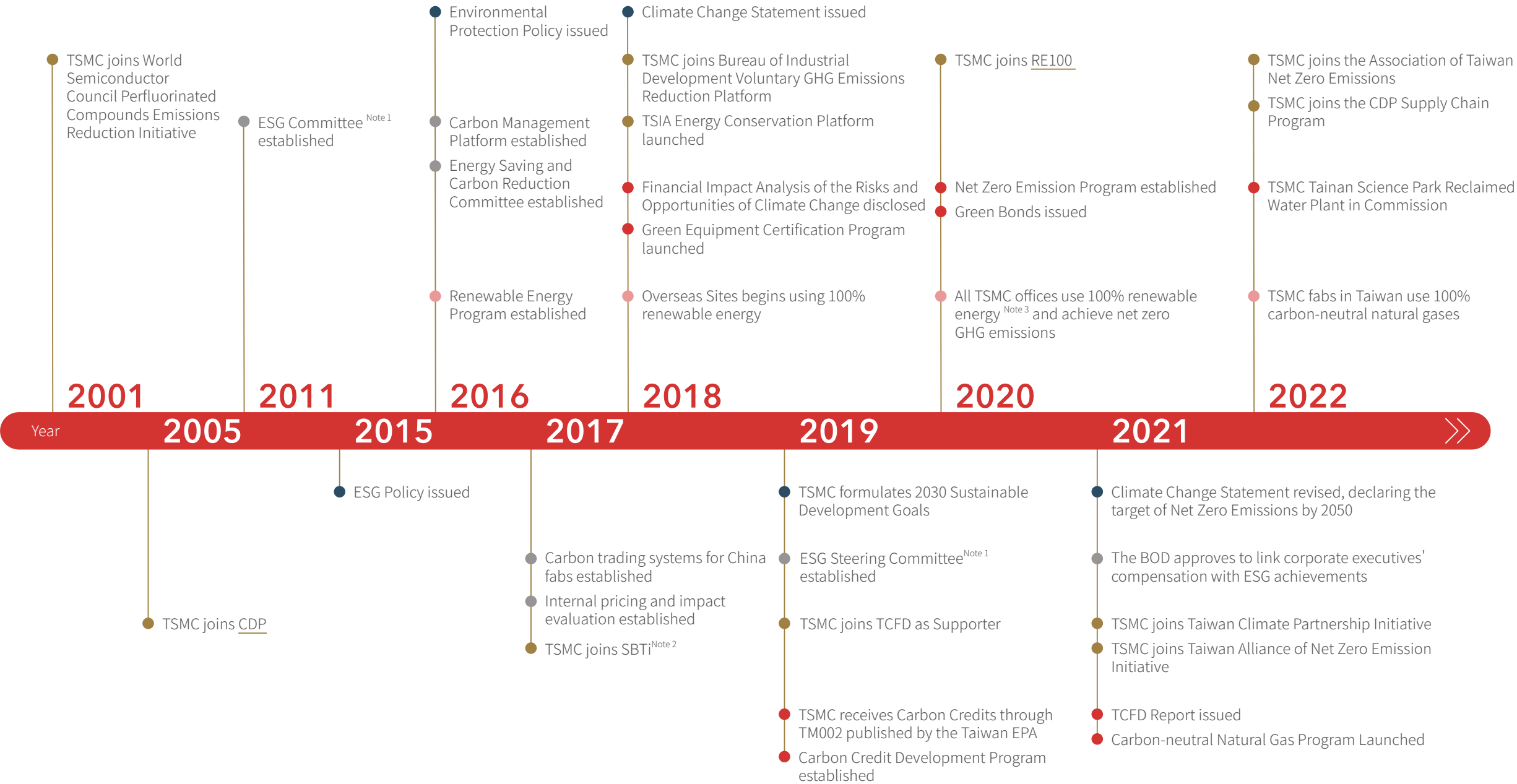
Roadmap to Net Zero Emissions

Scope1 Direct Emissions from Processes	- Install equipment with F-GHG reduction technologies - Develop nitrous oxide reduction equipment - Use carbon-neutral natural gas	- Install equipment with nitrous oxide reduction technologies - Develop alternative programs to reduce GHG emissions from processes	Launch alternative programs to reduce GHG emissions from processes
Scope2 Indirect Emissions from Energy Usage	- Use renewable energy - Increase energy efficiency of existing processes - Develop next-generation energy efficient tools - Recycle thermal energy from process tools	- Increase use of renewable energy - Introduce next-generation energy efficient process tools - Recycle H2 from EUV lithography process	- Use 100% renewable energy - Increase next-generation energy efficient process tools
Scope3 Indirect Emissions from the Value Chain	- Conduct carbon inventory and offer consultations for energy conservation and carbon reduction - Request suppliers to set targets, determine management strategies, and develop technologies - Develop a zero-waste manufacturing center and launch a recycling program for electronics-grade chemicals	- Request suppliers to use renewable energy - Introduce electronics-grade chemicals recycled from waste chemicals - Optimize delivery schedules and use low-carbon transportation vehicles	- Request suppliers to use low-carbon raw materials - Collaborate externally for carbon reduction and carbon negative programs





Transformation to Net Zero Milestones



● Policy Issuance ● Governance Organization
● Initiatives ● Climate Actions
● Renewable Energy

Note 1: The CSR Executive Committee was renamed as the ESG Executive Committee in March 2021; the CSR Committee was renamed as the ESG Committee at the same time
Note 2: The Science Based Targets Initiative (SBTi) is jointly established by the Carbon Disclosure Project, We Mean Business Coalition, UN Global Compact and World Wildlife Fund. The initiative provides companies with a clearly-defined path to reduce emissions in line with the Paris Agreement goals. TSMC pledged to set a science-based target in 2017
Note 3: Including renewable energy and Renewable Energy Certificates purchased by TSMC and its overseas subsidiaries and carbon credits generated by renewable energy

Climate Change Management

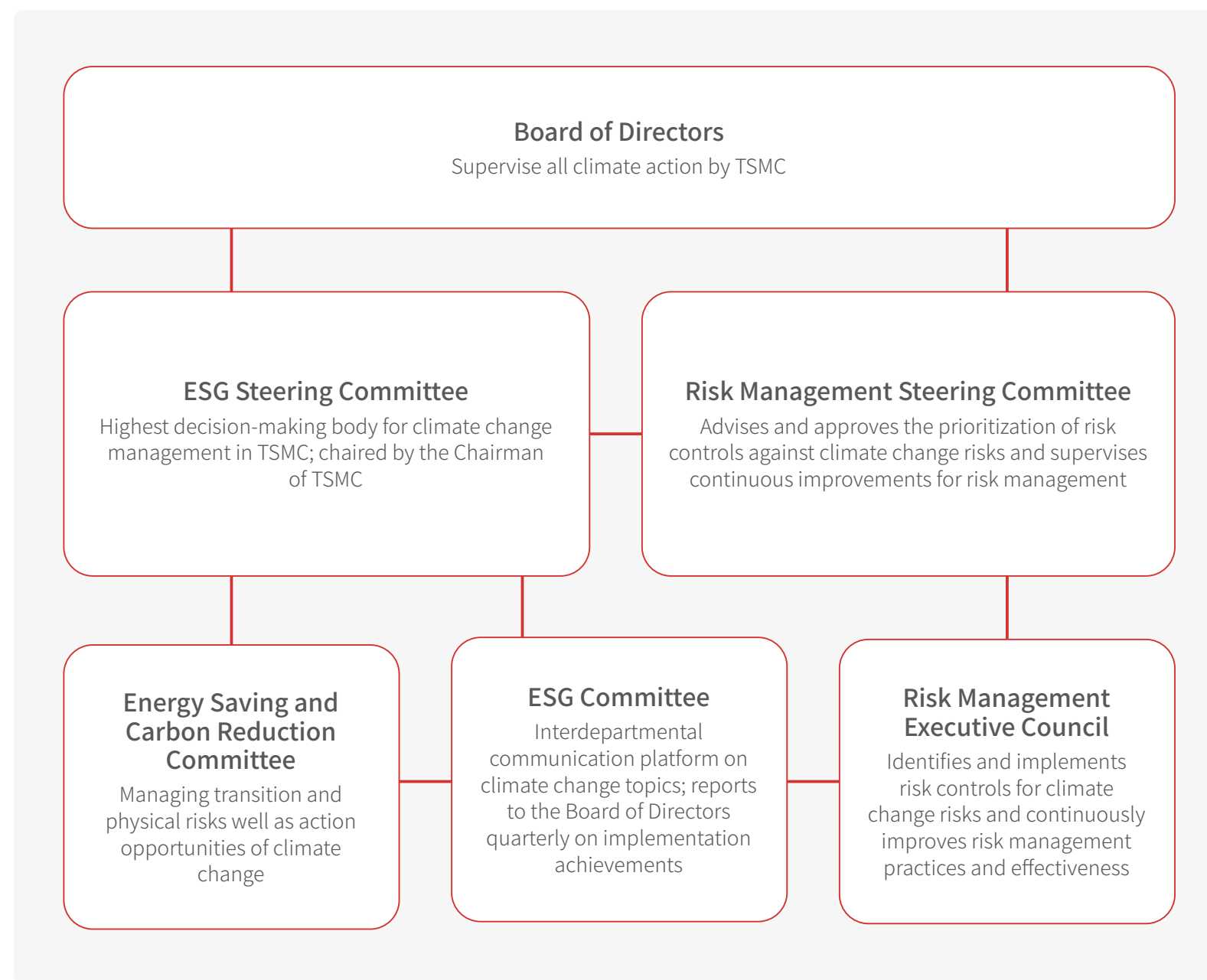
Sustainable Climate Governance

TSMC's guiding principles to address climate change are the TSMC [ESG Policy](#), [Climate Change Statement](#), and [Environmental Policy](#), all signed and released by Chairman Dr. Mark Liu as we act to fulfill our commitment to environmental sustainability. At TSMC, the Board is responsible for overseeing climate change governance and the management framework; ESG Steering Committee for formulating mid-to-long term climate change management strategies; ESG Committee for integrating interdepartmental resources for climate action; Energy Saving and Carbon Reduction Committee for formulating quarterly adaptation and mitigation plans in response to climate change, reviewing progress, discussing future plans, and reporting to the Board via the ESG Committee; RM Executive Council is responsible for identifying TSMC's climate risks, management focuses, and countermeasures, as well as executing the plan upon the approval by the RM Steering Committee, who will then report annual progress to the Board.



TSMC proactively fulfills environmental sustainability commitments with concrete action.

Climate Change Governance and Management Framework

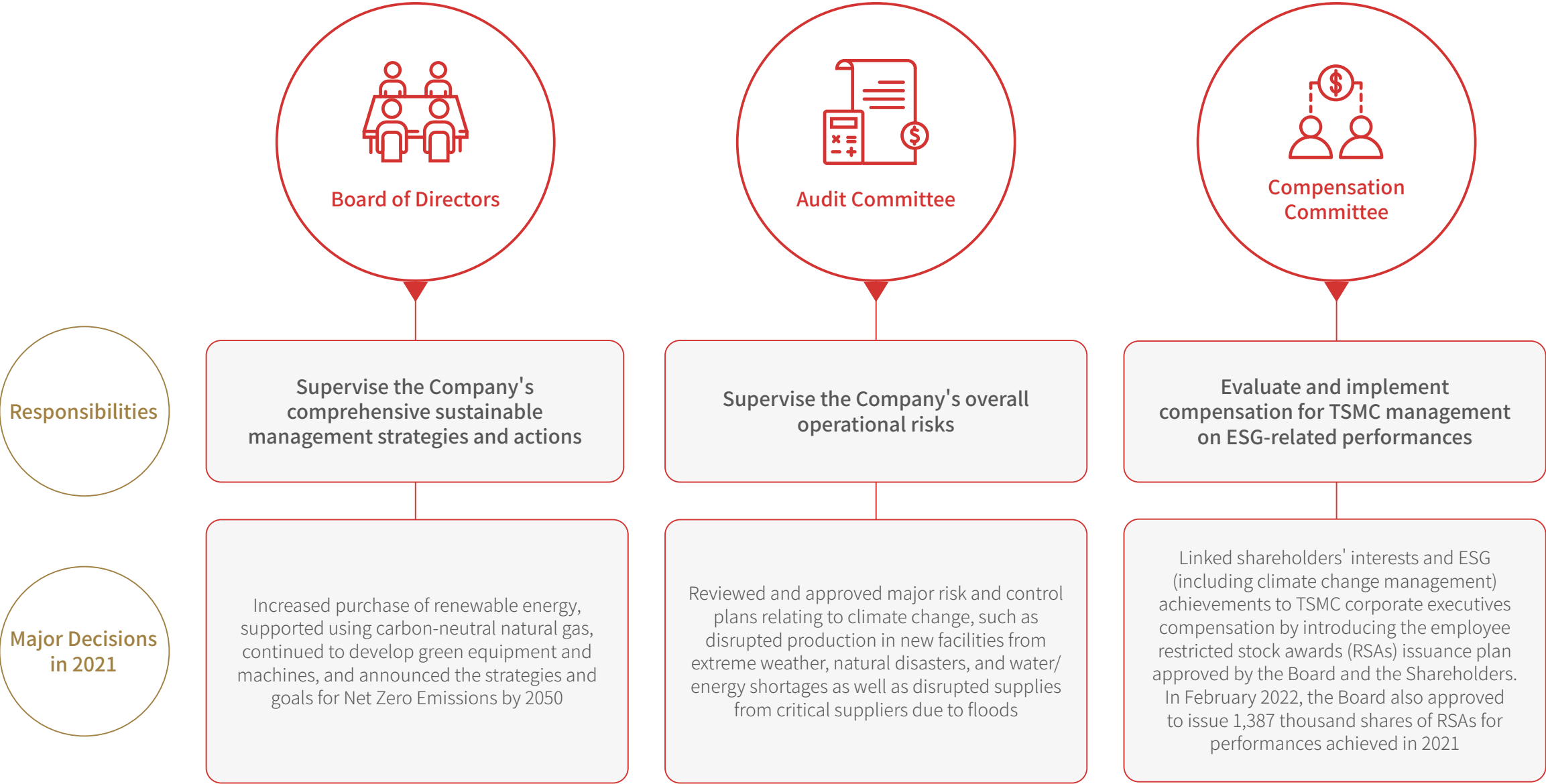


Board of Directors Oversight

TSMC advocates and acts upon the principles of operational transparency and respects shareholder rights. We believe that the basis for successful corporate governance is a sound and effective Board of Directors. The Board of Directors plays the role of overseeing and providing guidance to the Company's comprehensive climate change

and sustainable management strategies. TSMC Board delegates various responsibilities and authorities to two Board Committees: the Audit Committee and the Compensation Committee. Each Committee's chairperson regularly reports to the Board on the activities and actions of the relevant committees.

The Key Points of the Board of Directors' Climate Change Supervision



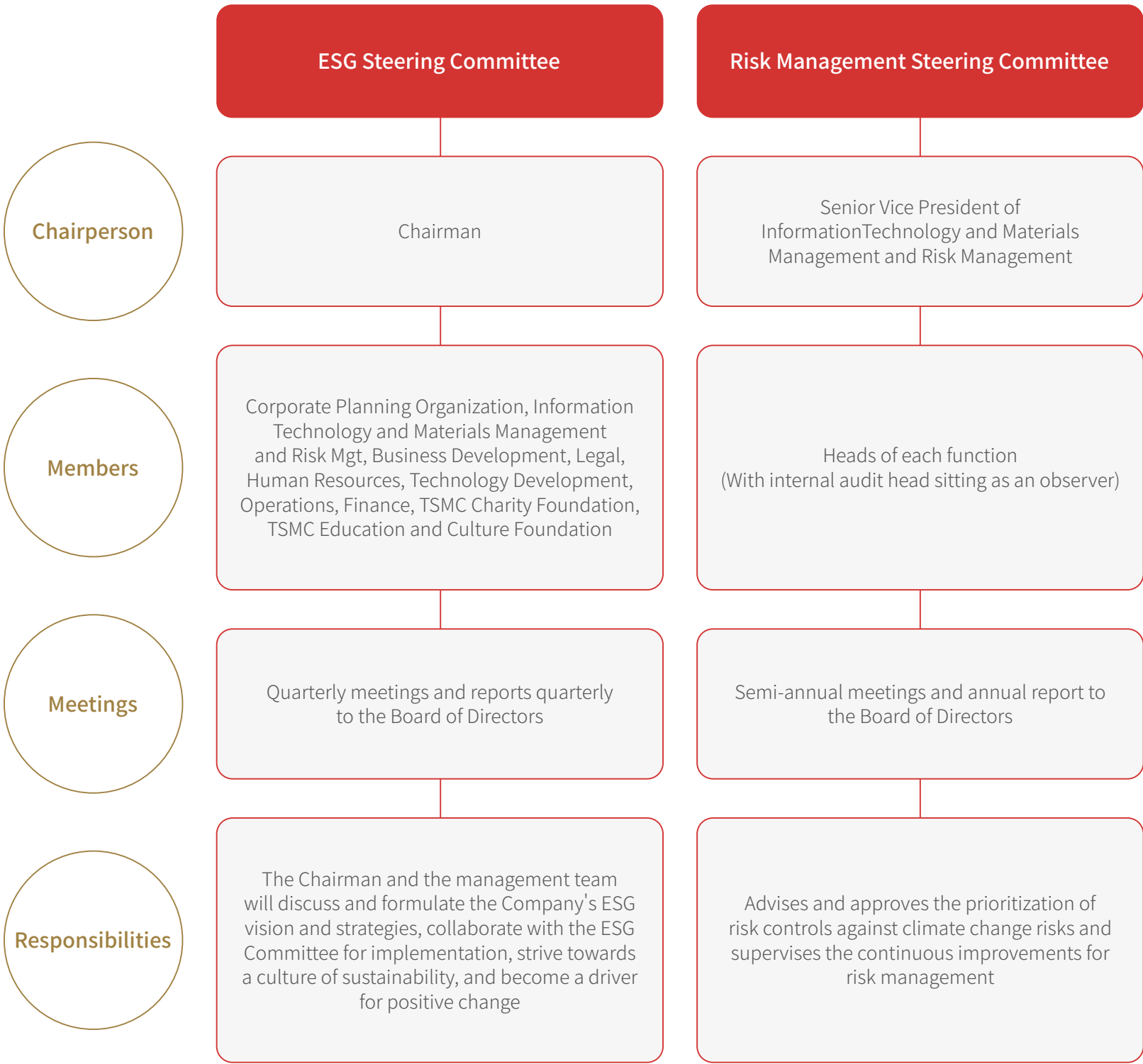
Management Responsibilities

The ESG Steering Committee is TSMC's top organization in climate change management. The ESG Steering Committee is chaired by the Chairman of TSMC, and the chair of the ESG Committee serves as the executive secretary. It reviews TSMC's climate change strategies and goals and reports quarterly to the Board of Directors. The Risk Management Steering Committee 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. The audit committee's chairperson reports on the risk environment and risk mitigation actions to Board of Directors.

Under oversight from the ESG Steering Committee and the Risk Management Steering Committee, TSMC manages action plans for climate-related issues through the ESG Committee, Risk Management Executive Council, and Energy Saving and Carbon Reduction Committee.



The ESG Steering Committee is TSMC's top organization in climate change management.



ESG Committee

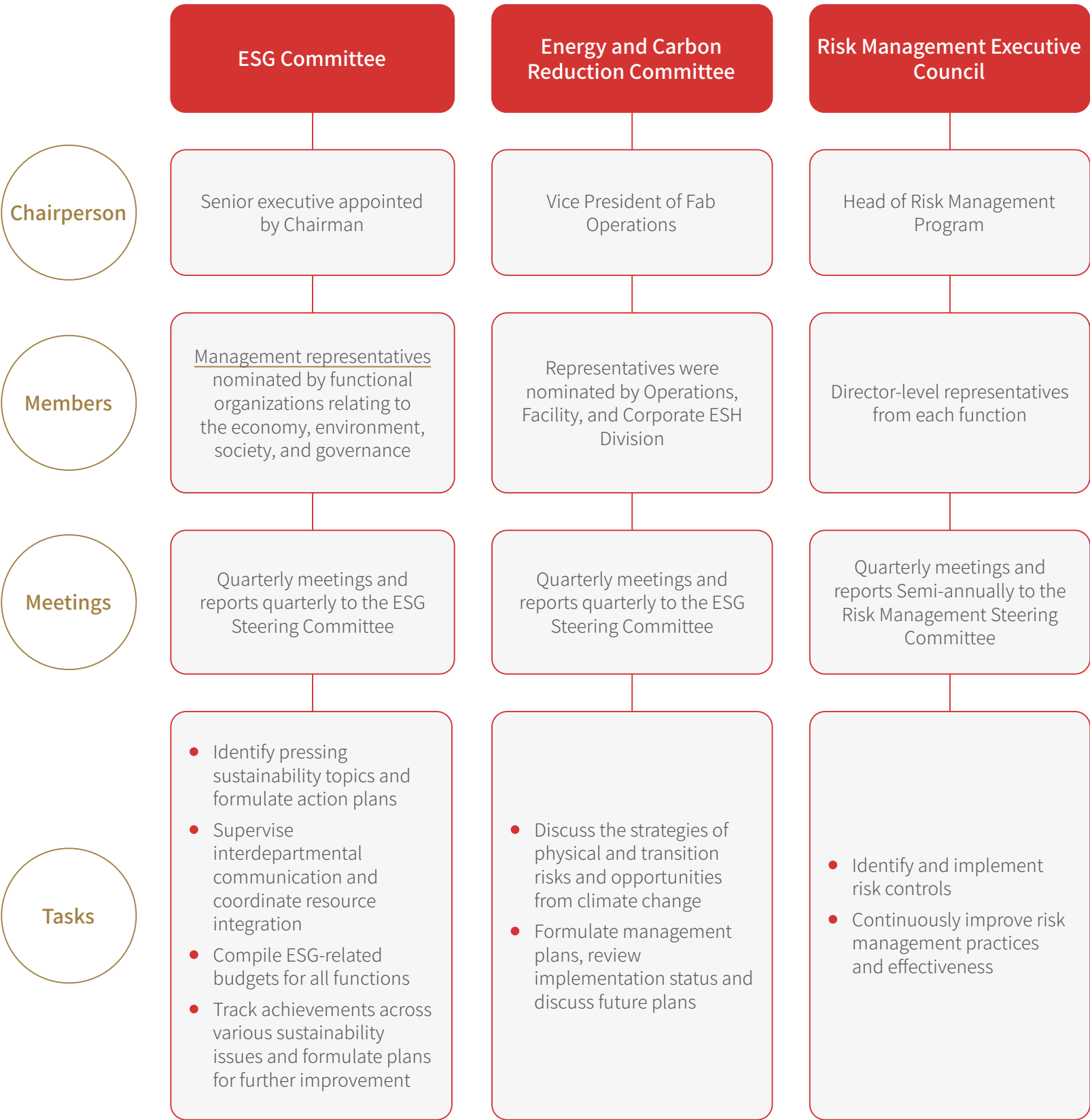
The Company's ESG Committee serves as the communication platform that integrates and brings together different departments. The Chairman appoints senior executives as chairpersons to lead committees established in response to issues identified as sustainability issues related to TSMC operations and of stakeholder interest. The committee members formulate corresponding strategies and guiding principles, compile ESG budgets for each organization, coordinate resources, plan and carry out the annual plans, and track progress to ensure that ESG strategies are fully fulfilled in daily operations.

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.

Risk Management Executive Council

The Risk Management Executive Council consists of director-level representatives from each function and uses a risk map to assess the likelihood and impact of risk events on operations, implement risk controls, and further improvements.

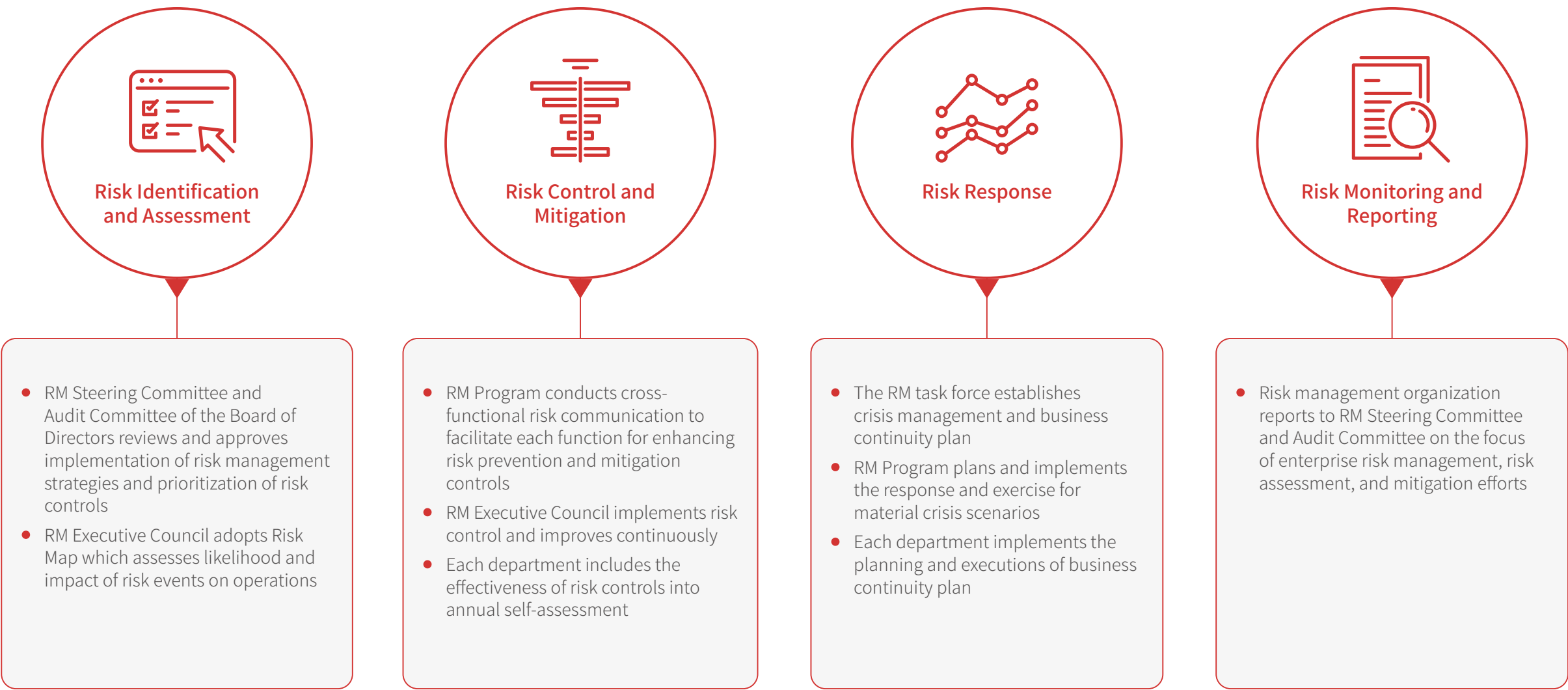


Total Risk Management

To achieve our corporate vision and fulfill long-term sustainability responsibilities, TSMC has developed an Enterprise Risk Management (ERM) Program to integrate and manage potential risks that may affect operational and profitability strategies, operations, finances, and hazards. The TSMC ESH Division reports results of the climate risk/ opportunities and financial impact assessment to the ESG Committee Chairperson annually and reviews response measures and future plans. The Risk Management Executive Council uses an enterprise risk management framework (including risk identification and assessment, risk control and mitigation, risk response, and risk

monitoring and report) and a Risk Map to establish corresponding Risk Management Task Forces to target risks from water/energy shortage or disruptions, natural disasters like floods, and climate risks in the supply chain. The Task Force will perform a quantitative risk assessment according to the possibility of climate risks and severity of impact on operations to identify risk levels and major climate risk events. This helps prioritize and adopt risk control measures, crisis management, and business continuity management to help strengthen our resilience to climate risks.

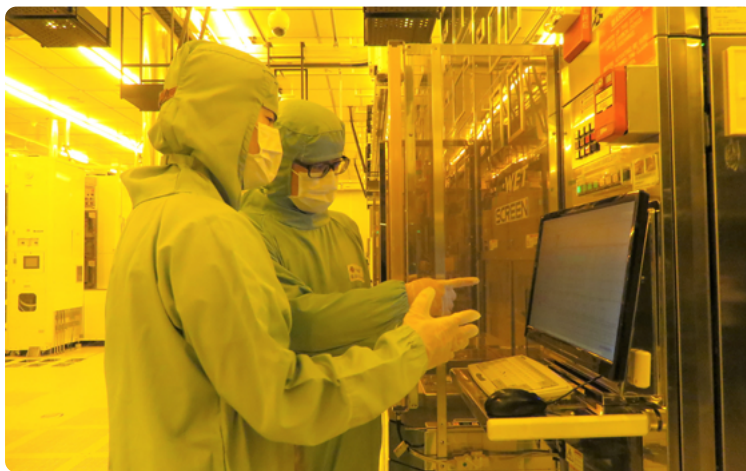
Enterprise Risk Management Framework



Integration of Horizon Strategies

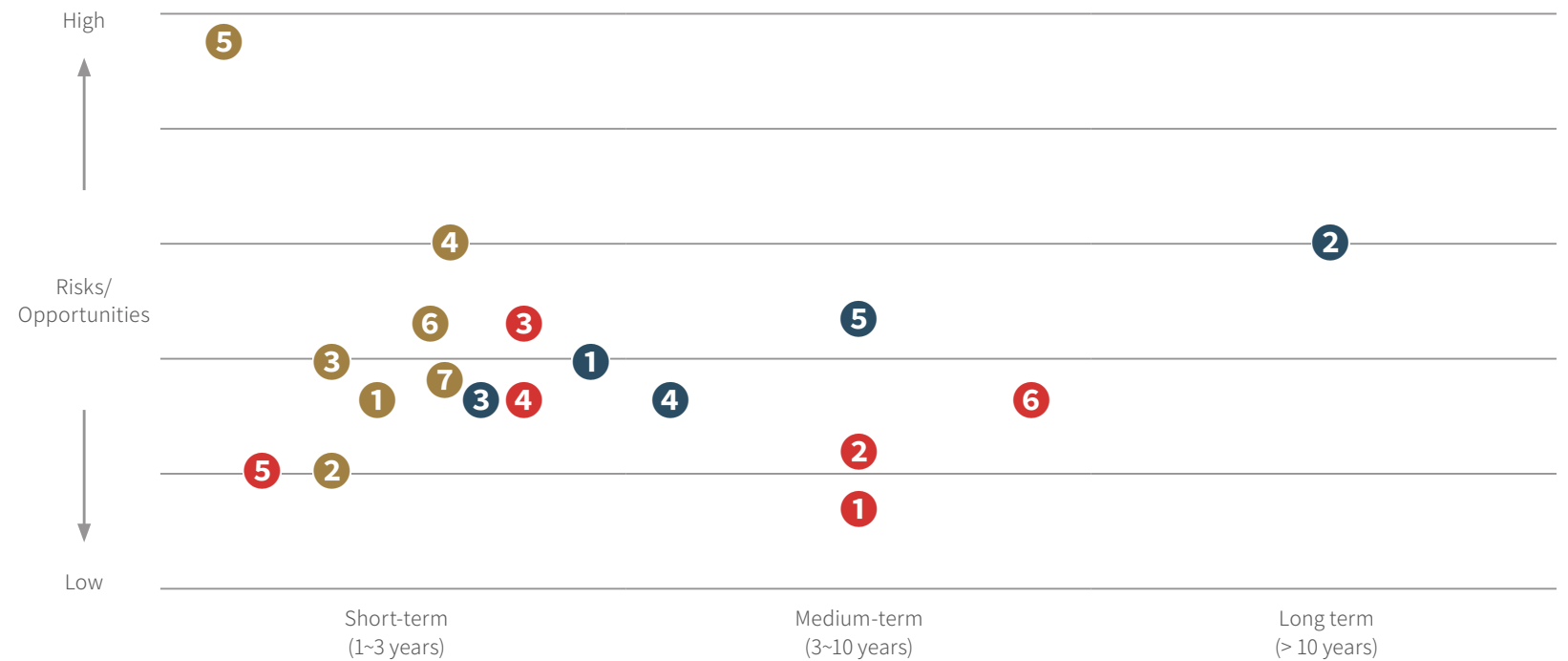
Identification and Assessment of Climate Risks and Opportunities

In compliance with the TCFD framework, TSMC has identified and assessed climate change risks and response measures across the corporation, uncovering potential risks and opportunities. TSMC also regularly hosts the Climate Change Risk and Opportunity Workshop, inviting internal organizational representatives and external experts to identify the transition risks, physical risks, and opportunities posed by climate change to TSMC's value chain regarding policies, regulations, markets, technologies, reputation, and physical risks in consideration of changes in internal and external environments and formulate response measures accordingly.



TSMC dedicates to improving facility energy efficiency.

Climate Risks and Opportunities Matrix



1. Participation in Renewable Energy Plans/ Participation in Carbon Trading Market
2. Receive rewards from the public sector for offsetting carbon reductions
3. Improve plant energy efficiency
4. Promote water efficiency and diversification
5. Develop low-carbon products and services/ Increase energy efficiency in customer products
6. Drive low carbon manufacturing
7. Increase resilience against natural disasters



1. GHG emissions control and carbon taxes/carbon fee
2. Net Zero Emission
3. EIA commitment
4. Uncertainties in the development of new energy saving/carbon reduction technologies
5. Impact on company reputation



1. Flood (TSMC)
2. Flood (Supply Chain)
3. Drought (TSMC)
4. Drought (Supply Chain)
5. Higher Natural Disaster Insurance Premium
6. Rising Temperature

Note: Short-term is 1-3 years, mid-term is 3-10 years, and long-term is >10 years

Financial Impact Analysis of Climate Change

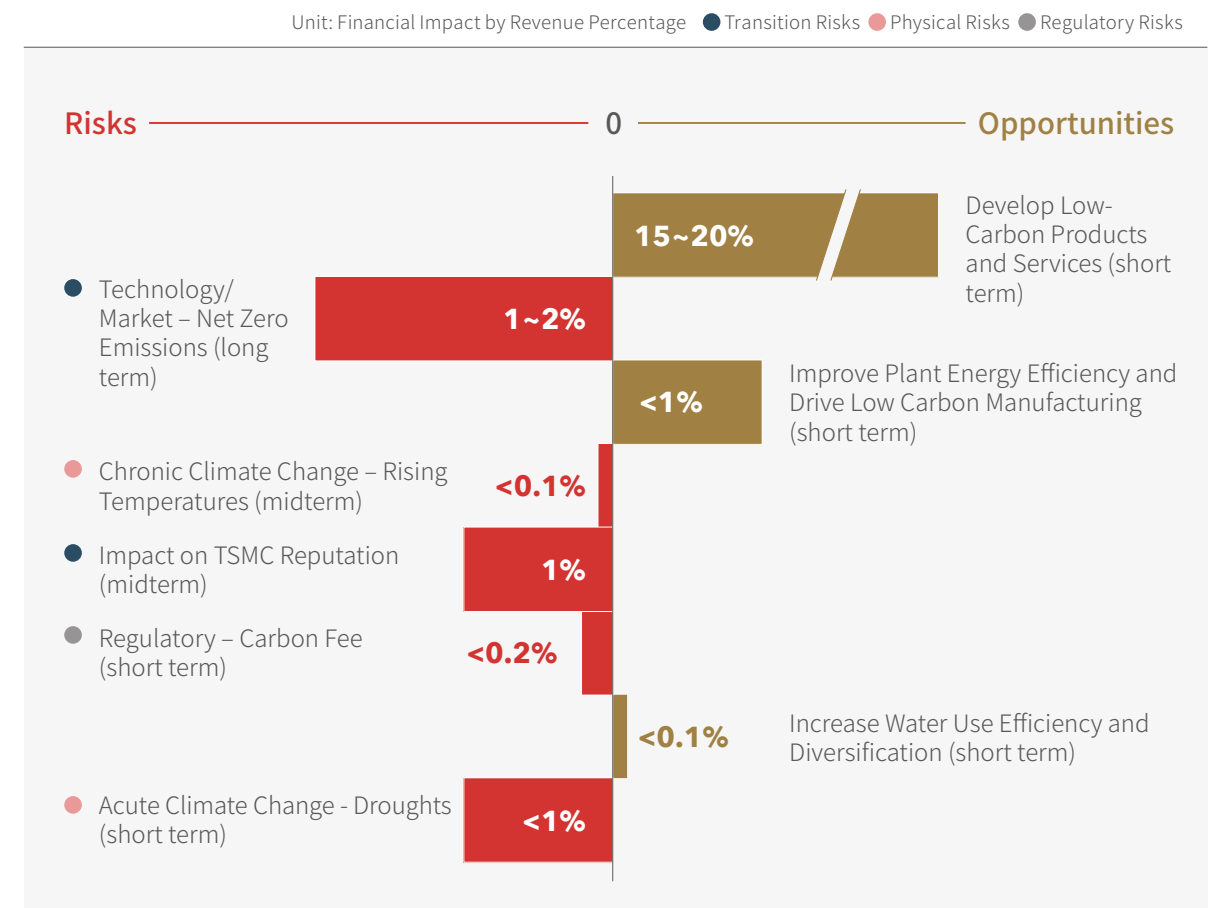
	 Climate Risks	 Potential Financial Impact	 Climate Opportunities	 Potential Financial Impact	 Actions
Transition Risks	GHG emissions restriction and carbon taxes/carbon fee	Restriction on manufacturing capacity expansion; increase in operation costs	- Participation in Renewable Energy Program - Participation in Carbon Trading Market	Early purchases of renewable energy may successfully increase manufacturing capacity	- Set ambitious carbon reduction targets: commit to zero carbon emissions from global operations by 2050 and ensure zero carbon emissions released from sites operations - 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
	Net Zero Emissions	- Increased cost of installation and operation for carbon reduction facilities - Increased renewable energy and carbon credit costs	- Receive rewards from the public sector for offsetting carbon - Develop low-carbon products and services - Increase energy efficiency in customer products	- Stock up on required carbon credits for future emissions - Satisfy customer demands for energy-efficient products and increase revenue	- Draw up a company-wide pathway to net zero emissions and plan net zero strategies for executions. - Continue carrying out GHG reduction actions and participate in government reward programs for carbon reduction to earn carbon credits - Implement long-term plans for purchasing carbon credits - Continue investing in R&D resources to develop energy-saving products
	EIA commitment	Unsuccessful attempts at obtaining renewable energy and reclaimed water become obstacles to manufacturing advanced technologies	Promote water efficiency and diversification	Successfully build advanced production line	- Continue promoting water-saving measures - Start using reclaimed water
	Uncertainties in the development of new energy saving/carbon reduction technologies	Increased energy consumption in production lines using new process technologies may result in higher operating costs	Improve plant energy efficiency	Reduce utilities costs	Build green fabs, obtain green building licenses, and share experiences with outside parties
	Impact on company reputation	Damage to company image when unable to meet stakeholder expectations			Insist on green manufacturing and green innovations and use transparent disclosure to enhance the company's green reputation
Physical Risks	- Flood - Drought - Higher Natural Disaster Insurance Premium - Rising Temperature	- Production affected, resulting in financial losses and a decrease in revenue - Increase in operating costs - Increase in energy consumption, costs, and carbon emissions	- Increase resilience against natural disasters - Drive low carbon manufacturing	- Strengthen climate resilience and lower the risk of operation interruption and potential losses - Save energy and reduce costs	- Evaluate drought/flood risks of manufacturer's region to formulate and carry out risk mitigation measures - Establish a comprehensive water monitoring system and emergency response processes and hold regular drills - Establish an Energy Saving and Carbon Reduction Committee for senior executives to lead the GHG reduction initiative

Potential Financial Impact

The potential financial impacts of climate change are categorized into transition risks, physical risks, regulatory risks, and climate opportunities. Transition risks are comprised of major carbon reduction costs from TSMC pathways to achieve Net Zero Emissions by 2050. For example, developing energy-saving and carbon reduction technologies, expenses for application projects, paying a premium for green energy or fees for renewable energy certificates, and purchasing carbon credits. Regulatory risks include risks from estimating potential future carbon fees according to the Taiwan government's existing policies. Physical risks primarily consist of growing electricity costs from air conditioner use because of slowly rising global temperatures and the cost of responding to climate changes and disasters. For example, to combat droughts, TSMC has invested in building a water reclamation system, using reclaimed water, and purchasing backup water sources. As for floods, which are also considered climate change disasters, TSMC has already designed floor prevention systems into new TSMC facilities and will therefore not be calculating its financial impact. TSMC has also estimated the cost to the company's reputation from failing to meet net zero emission targets though there is no globally recognized approach to estimate such financial impact. The financial impact of 1% revenue was a consensus reached by experts after discussions and assessments.

The estimated financial impact of climate opportunities includes reduced costs from increased energy/water use efficiency and diverse water sources as well as additional income from providing low-carbon products and services such as 7nm or more advanced processes, PMICs, and ultra-low power (ULP) ICs. Analysis results show that low-carbon products and services yield the greatest opportunities for positive financial impact.

Financial Impact Analysis of Climate Risks and Opportunities



TSMC's Ultra Low Power technology enables innovation in energy-efficient medical device.



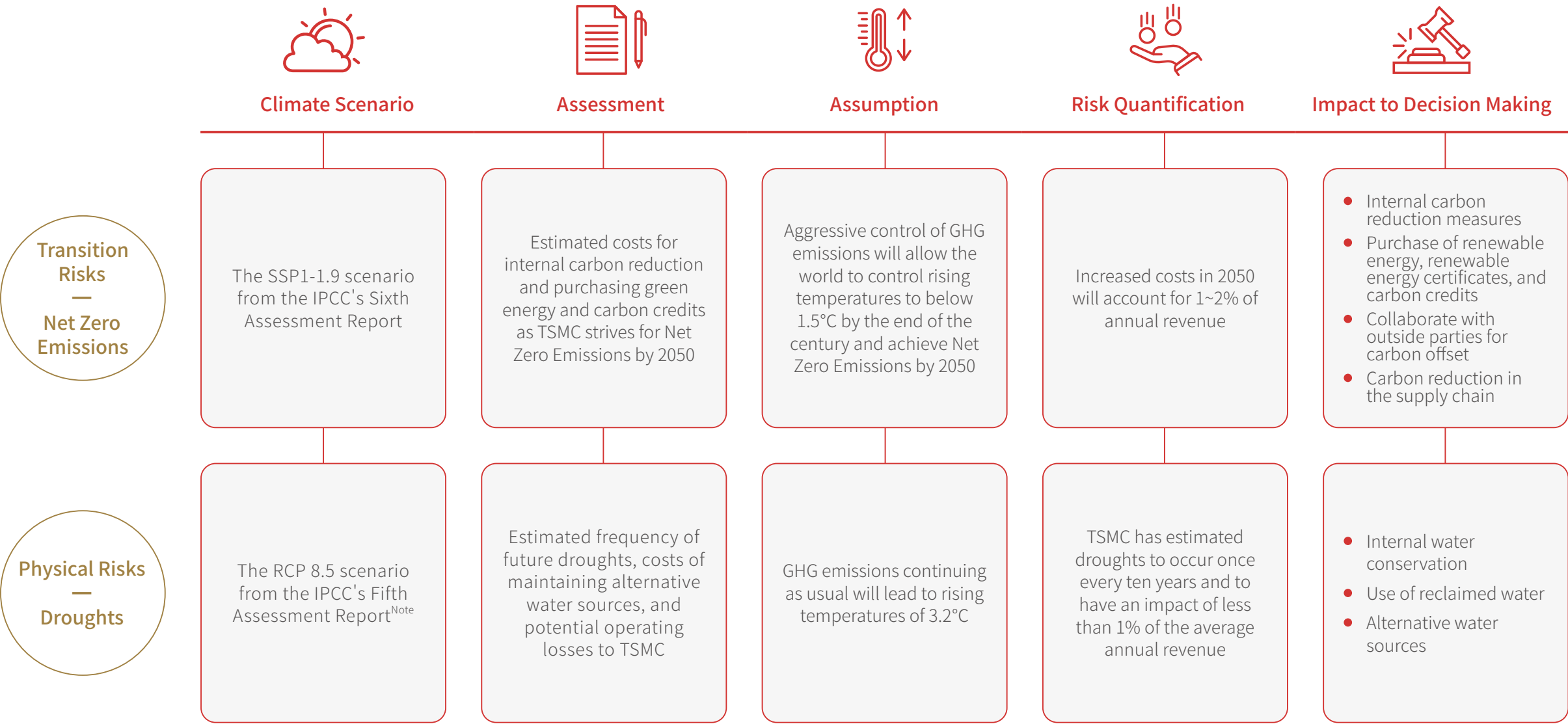
The estimated financial impact of climate opportunities include reduced costs from increased energy/water use efficiency and diverse water sources as well as additional income from providing low-carbon products and services such as 7nm or more advanced processes, PMICs, and ultra-low power (ULP) ICs.

Scenario Analysis

In compliance with TCFD recommendations, TSMC has evaluated the impact of various GHG emission controls on TSMC operations and the supply chain according to the worst-case scenario possible for transition and physical risks. TSMC has taken the outcomes into consideration when determining the resiliency of strategies and has also referred to the IPCC's report on the SSP1-1.9 and RCP 8.5

scenarios to evaluate the maximum potential impact from transition and physical risks. In addition, TSMC has also included potential growth in carbon emissions from business growth and new facilities expansion as well as existing carbon reduction actions into evaluations to analyze the potential financial impact of climate risks.

Major Transition Risks and Physical Risks under SSP1-1.9 and RCP 8.5 Scenarios

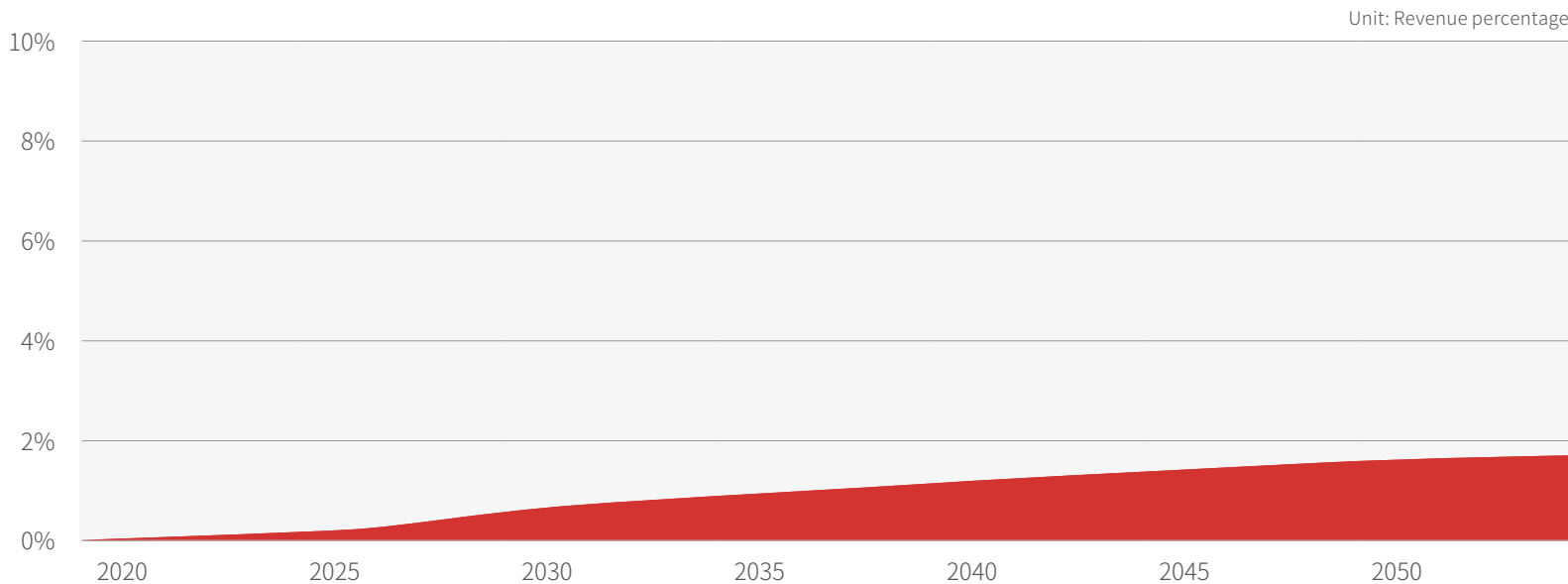


Note: The drought scenario is derived from the latest version of the Taiwan Climate Change Atlas, which gives insight into a region where the majority of TSMC facilities are located. This latest version employs the RCP8.5 scenario from the IPCC's Fifth Assessment Report and the SSP5-8.5 scenario from the IPCC's Sixth Assessment Report

In terms of transition risks, TSMC has considered the target pathways for every stage of our commitment to net zero emissions and is achieving net zero emissions through innovative green actions and carbon offsetting. TSMC has also estimated how the net zero emissions pathway will impact company finances each year in consideration of the green premium. With stricter carbon reduction demands and the potential supply shortage of renewable energy and carbon credits in market, TSMC estimates that the transition cost of our Net Zero Emissions commitment will drastically increase in 2030. In 2050, when we hit the net zero emissions target, the financial expenses will account for 1~2% of the annual revenue. The scenario also aligns with the Nationally Determined Contributions' target to achieve a 50% reduction by 2050.

In terms of physical risks, Taiwan experienced a major drought in 2021. To better understand potential drought risks in the future, TSMC employed consecutive dry days (CDD) as a critical factor and evaluated future drought frequencies according to changes in CDD between the next few years and the baseline (1986 to 2005). TSMC also referred to the Taiwan Climate Change Atlas published by the Taiwan Climate Change Projection Information and Adaptation Knowledge Platform, which included the RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5 scenarios. TSMC compared the future and baseline CDDs for Taiwan counties and cities with TSMC facilities given the RCP 8.5 scenario. Results showed that Hsinchu Science Park will experience the most drastic changes in CDD in recent years and the near future (2016 to 2035) and the end of the century (2081 to 2100), which will be an increase of 4.15% and 14.44%, respectively. In the face of rising drought risks, TSMC will strengthen water conservation efforts, increase the water recycling rate of manufacturing processes, establish a comprehensive drought monitoring mechanism, expand the use of recycled water, and prepare water trucks for water shortages to minimize the impact of droughts on operations and ensure that production is not interrupted.

Financial Impact Evaluation of Zero Emission Path



Evaluation of Future Potential Drought Increase Trend





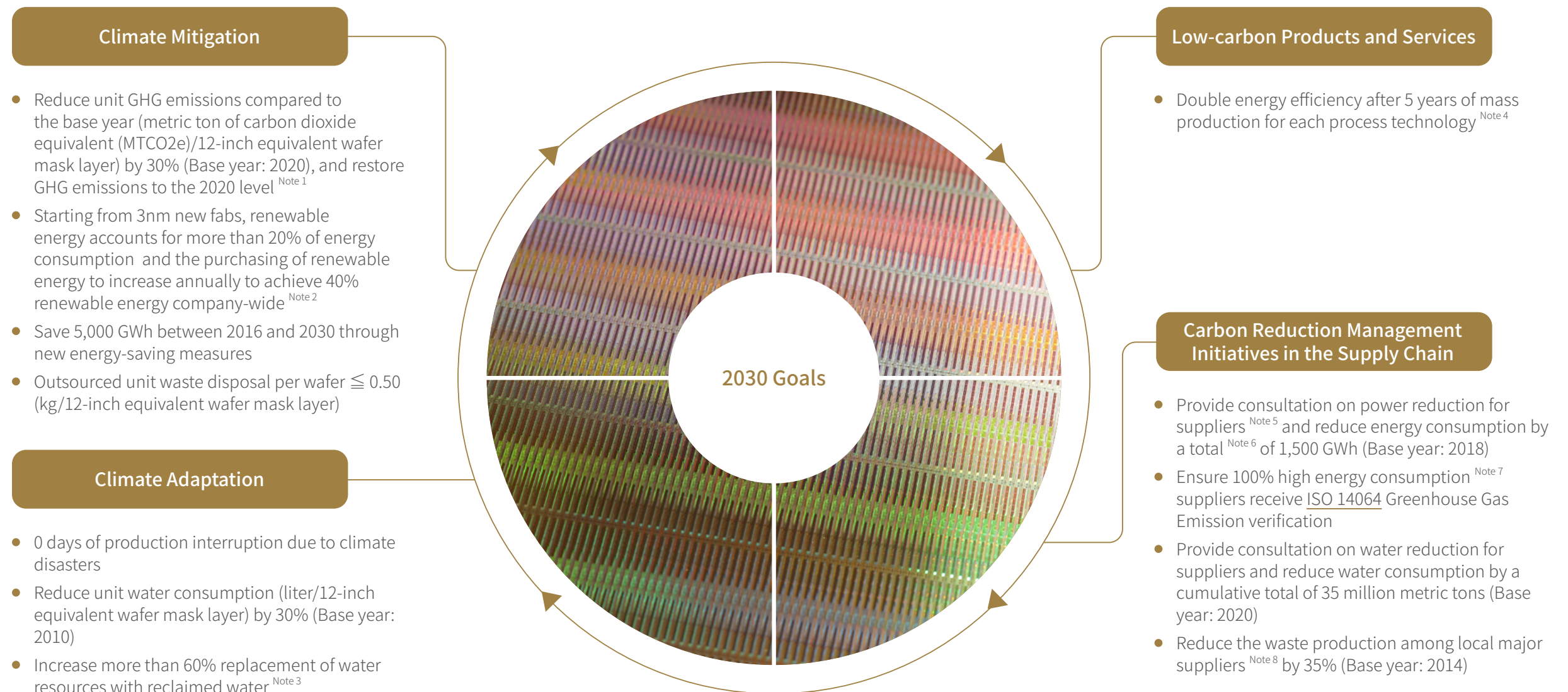

TSMC Fab Locations	City/County	Baseline Period from 1986 to 2005	Changes in Rainfall (%) / Days		
			Near Future from 2016 to 2035	Mid-21st Century from 2046 to 2065	Late 21st Century from 2081 to 2100
Hsinchu Science Park	Hsinchu County (City)	40 Days	4.15/42	6.8/43	14.44/46
Central Taiwan Science Park	Taichung City	52 Days	2.42/53	4.83/55	11.33/58
Southern Taiwan Science Park	Tainan City	62 Days	2.28/63	5.36/65	10.73/69

Commitments and Targets

TSMC has established climate indicators for GHG, energy use, and water resources to track management outcomes. As the world's largest provider of semiconductor technologies and capacity, TSMC is deeply aware of our responsibilities toward local and global environments. As such, TSMC has set mid-to-long-term goals for our four major management initiatives which are reviewed annually. In addition, TSMC will also make rolling adjustments according to trends or changes in the

external landscapes in the hopes of mitigating the impact of climate change and maintaining operations as usual through target management. In 2021, the TSMC Board of Directors decided to link senior executives' bonuses with shareholder interests and ESG progress. Senior executives will be rewarded with restricted stock awards when they contribute to climate commitments and reach certain milestones. The decision was approved at the annual shareholder's meeting.

Long-term Targets for Four Management Strategies



Achievements for Four Management Strategies

✓ Achieved ○ Missed Target

Climate Mitigation

- ✓ Reduced unit GHG emissions (metric ton of carbon dioxide equivalent (MTCO₂e)/12-inch equivalent wafer mask layer) by 27%
Target: 20% (Base year: 2010)
- ✓ Used 1,670 GWh of renewable energy and Renewable Energy Certificates (REC), and carbon credits; TSMC overseas sites used 100% renewable energy; achieving 9.2% of TSMC's power consumption
Target: 9% of TSMC power consumption and 100% of power consumption in overseas sites
- ✓ 700 GWh energy saved, and cumulatively saved 2,400 GWh
Target: 500 GWh; 2,200 GWh
- ✓ Outsourced unit waste disposal per wafer 0.99 (kg/12-inch equivalent wafer mask layer)
Target: ≤ 1.15

Climate Adaptation

- ✓ 0 days of production interruption due to climate disasters
Target: 0 days
- ✓ Reduced unit water consumption (liter/12-inch equivalent wafer mask layer) by 14.9%
Target: 9%
- TSMC Tainan Science Park Reclaimed Water Plant is under construction and will start supplying water in 2022 ^{Note 9}
Target: Complete the TSMC Tainan Science Park Reclaimed Water Plant and begin water supply

2021 Achievements

Low-carbon Products and Services

- ✓ Increase 10 and 7nm process technologies energy efficiency 1.5 times higher in the 5th year of volume production; increase 5nm process technology energy efficiency 0.2 times higher in the 2nd year of volume production
Target: Double the 10 and 7nm process technologies energy efficiency in the 5th year of volume production; increase 5nm process technology energy efficiency 0.2 times higher in the 2nd year of volume production
- ✓ Reduced unit environmental externalities ^{Note 10} by 18% (NT\$/12-inch equivalent wafer mask layer)
Target: 8% (Base year: 2010)

Carbon Reduction Management Initiatives in the Supply Chain

- ✓ Reduced supplier energy consumption by a cumulative total of 340 GWh
Target: 320 GWh
- ✓ 51% high energy consumption suppliers received ISO 14064 Greenhouse Gas Emission verification
Target: 50%
- ✓ Reduced supplier water consumption by a cumulative total of 19.71 million metric tons
Target: 4.5 million metric tons
- ✓ Reduced the waste production per unit among local major suppliers by 31%
Target: 30.4%

Note 1: In response to Net Zero Emissions by 2050 as a long-term target, TSMC sets GHG Emissions to return to the 2020 level by 2030 as a milestone, and the base year was adjusted from 2010 to 2020, and increases the percentage of renewable energy used up to 40% company-wide by 2030

Note 2: Definition of Renewable Energy Use: Purchase renewable energy, Renewable Energy Certificates, and carbon credits produced by renewable energy

Note 3: TSMC is actively working with the government to drive water reclamation projects. In 2021, the replacement rate of reclaimed water increased to 60% from 30% in 2020

Note 4: Energy efficiency is the product equivalent per kWh of power (12-inch equivalent wafer mask layer/kWh)

Note 5: Mainly focused on suppliers based in Taiwan

Note 6: The cumulative total of power reduced includes the existing achievements of past efforts and newly-achieved reduction results

Note 7: Definition for high energy consumption suppliers: Suppliers in Taiwan whose energy consumption at a single site exceeds 5 million kWh per year

Note 8: 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 the

underlying month (metric tons); B: waste produced by the factory in the underlying month (metric tons)

Note 9: Water supply works for the TSMC Tainan Science Park Reclaimed Water Plant was delayed as the government is still developing their reclaimed water supply system. The water plant is slated for operations and water supply in 2022

Note 10: GHG emissions per unit product is no longer a strategic target because 95% of environmental externalities per unit product are from GHG emissions, therefore, environmental externalities per unit product and GHG emissions per unit product are fundamentally the same

Eco-efficiency Indicators

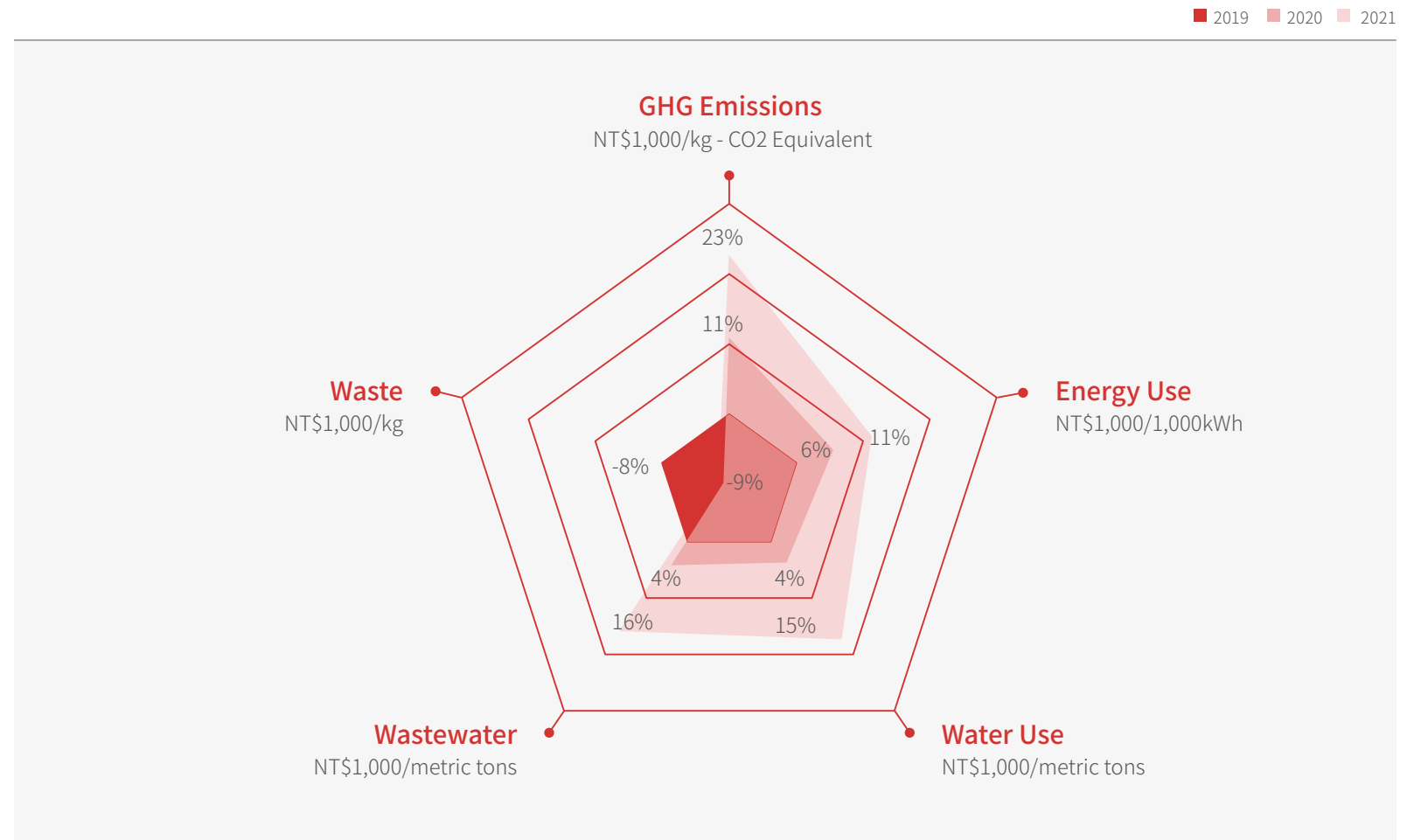
Eco-efficiency indicators are revenue created by each unit of pollutant emissions and resource consumption. TSMC is applying "create more from less" and "increase resource productivity" to promote energy/resource conservation and carbon reduction practices, striving to gradually increase eco-efficiency and create more value and revenue with minimal resources.

TSMC data from 2019 to 2021 shows the most significant increase in eco-efficiency of GHG emissions, indicating outstanding results from energy saving and carbon reduction measures and renewable energy use. On the other hand, the eco-efficiency of waste decreased by 9.4% from 2019 to 2020 due to the increasing complexity of advanced processes and higher demand for clean water. As such, TSMC promoted source reduction for chemicals at the production end, expanded recycling facilities in fabs, and built a Zero Waste Manufacturing Center, successfully reversing the trend in 2021. After the Zero Waste Manufacturing Center is commissioned in 2023, TSMC can recycle waste into electronic-grade materials for reapplication to manufacturing processes, replacing 30% of raw materials and increasing eco-efficiency.



TSMC recycles waste cupric sulfate that was originally outsourced for treatment into copper tubes.

Eco-efficiency Data

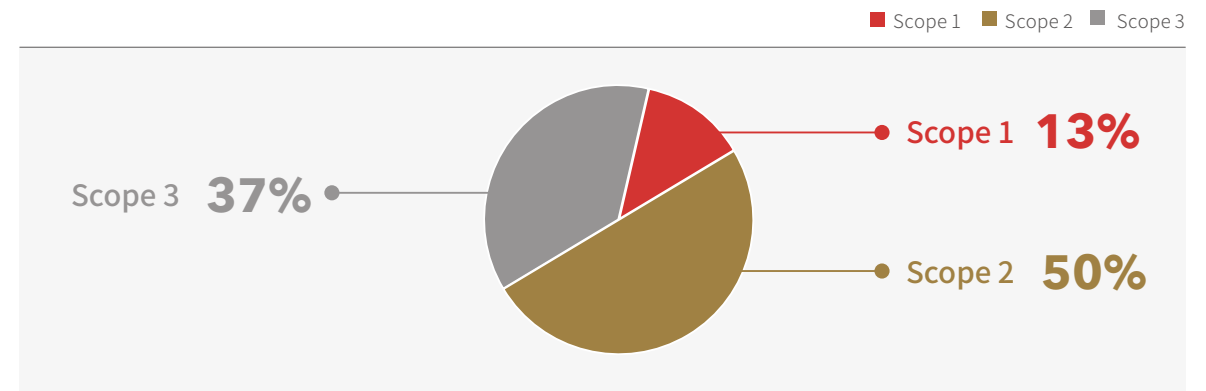


Once the Zero Waste Manufacturing Center is commissioned, TSMC can recycle waste into electronic-grade materials for reapplication to manufacturing processes, replacing 30% of raw materials and increasing eco-efficiency.

GHG Emissions

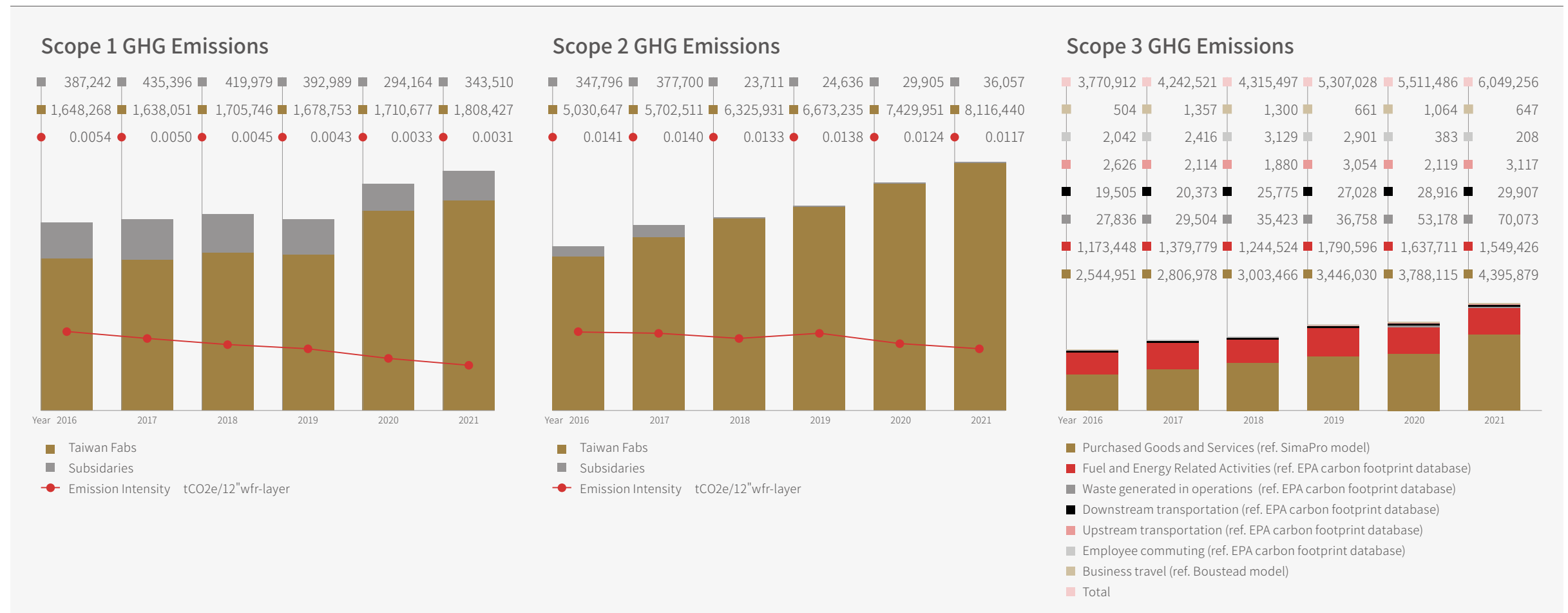
With the Net Zero Emissions commitment, TSMC will review overall carbon reduction efforts by looking at the carbon inventory results and formulating emission reduction strategies accordingly. In 2021, direct emissions from processes (scope 1) accounted for 13% and were primarily from F-GHGs and nitrous oxide in processes; indirect GHG emissions from purchased energy (scope 2) accounted for 50%; and indirect GHG emissions from the value chain (scope 3) accounted for 37%, which were primarily from producing raw materials, energy related activities in the upstream, and transportation.

Distribution of GHG Emissions



GHG Emissions

Unit: metric tons



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

Note 2: GHG emissions data for Scope 3 from TSMC facilities in Taiwan

Note 3: Emission factor based on data released in 2021 by the Bureau of Energy stating that 0.502 kg of CO2e/ kWh, where 1 kg of CO2e equals 6,805 kJ

Note 4: 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



Other Climate-related Management Indicators

Key Indicators	Year	>>	2017	2018	2019	2020	2021
Energy Consumption (GWh) (Including electricity, natural gas and diesel)			12,016	13,167	14,323	16,919	19,200
Direct Energy Consumption (GWh) (Including natural gas and diesel)			628	726	747	861	1,120
Indirect Energy Consumption (GWh) (Electricity)			11,388	12,441	13,576	16,058	18,080
Renewable Energy Use (GWh)			100	880	920	1,230	1,670
Domestic Renewable Energy Consumption			100	0	0	250	660
Overseas Renewable Energy Consumption			0	880	920	980	1,010
Unit Energy Consumption (kWh/12-inch equivalent wafer mask layer)			21.4	22.3	28.1	26.7	25.9
Water Consumption (Million Metric Tons)			48.9	56.8	64.3	77.3	82.8
Taiwan Facilities			45.2	51.0	58.0	70.6	76.1
Subsidiaries ^{Note 1}			3.8	5.7	6.3	6.7	6.7
Unit Water Consumption (liter/12-inch equivalent wafer mask layers)			106.2	105.9	133.4	128.4	119.7
Process Water Recycling Rate (%) ^{Note 2}			87.5	87.5	86.7	86.5	85.4
Total Water Saving (Million Metric Tons) ^{Note 2}			103.4	129.0	133.6	173.0	186.3

Note 1: Subsidiaries include WaferTech, TSMC (China), TSMC (Nanjing) and VisEra
Note 2: Data from TSMC facilities in Taiwan

Climate Mitigation Action

Climate Mitigation Management Initiatives

TSMC's main initiatives to mitigate the impact of climate change include promoting low-carbon manufacturing, using renewable energy, and increasing energy efficiency to reduce the GHG emissions from TSMC operations and production. In 2021, TSMC announced the Net Zero Emissions by 2050 target, and we believe that expanding our use of renewable energy will be a critical action to achieve the target. With full supports from the Board and the management team, TSMC was able to invest in purchasing renewable energy and increase the 2030 Sustainable Development Goal from "25% renewable energy for fabs and 100% renewable energy for non-fab facilities" to "40% renewable energy for all TSMC fab operation sites around the world" to expand our use of renewable energy.



Main Initiatives



2021 Investments



2021 Achievements

- **Drive Low-Carbon Manufacturing**
Continue to use best available technology to reduce emissions of greenhouse gases (GHG) and become an industry leader in low-carbon manufacturing
- **Use Renewable Energy**
Continue to purchase renewable energy and install solar-energy power systems to increase use of renewable energy
- **Increase Energy Efficiency**
Plan and implement new energy-saving measures each year to increase energy efficiency

- NT\$5.17 billion invested into reducing GHG emissions, which includes (1) Local abatement facilities for F-GHGs and nitrous oxide, (2) renewable energy premiums, (3) carbon credit expenses, and (4) other costs to reduce direct GHG emissions
- Investments into Energy-Saving Equipment: NT\$2.2 billion

- Reduced direct carbon emissions by **4.7 million** metric tons
- Used **1,670 GWh** renewable energy and reduced carbon emissions by 1.02 million metric tons
- Increased energy efficiency, saving **2,400 GWh** in electricity and reducing carbon emissions by 1.2 million metric tons

4 Years

Zero carbon emissions from energy consumption at all overseas subsidiaries for four consecutive years

499 Energy-saving Measures

In 2021, TSMC introduced 499 additional energy-saving measures across 8 major categories, effectively conserving 700 GWh in electricity



TSMC promotes low-carbon manufacturing to reduce the GHG emissions from operations and productions

Climate Mitigation Benchmarks

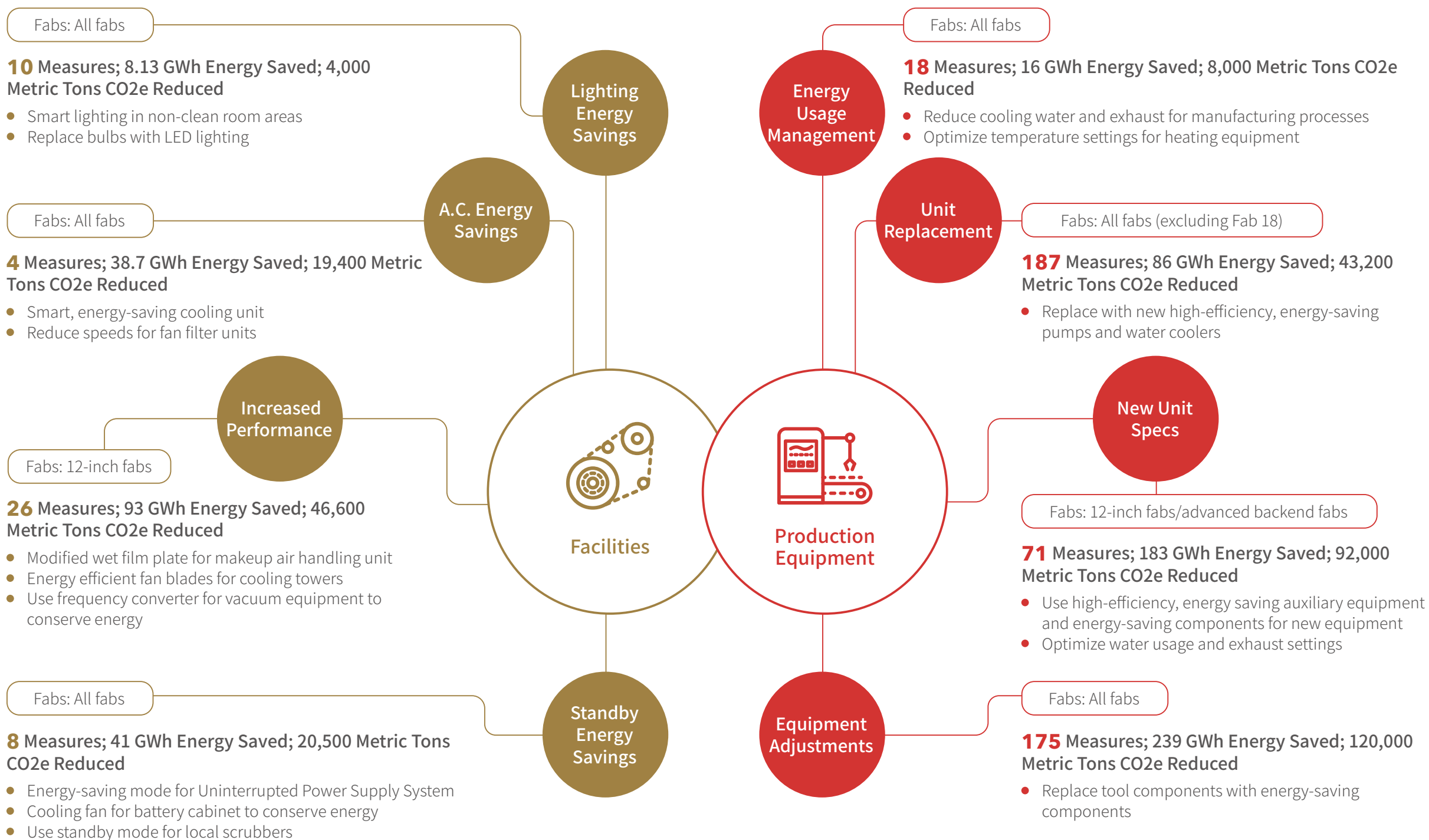
TSMC has, for many years, continued to establish industry best practices for GHG reduction by reducing Scope 1, 2, and 3 emissions. Direct Scope 1 emissions are primarily from F-GHGs and nitrous oxide followed by natural gases used in TSMC facilities. Local abatement facilities have effectively reduced F-GHG and nitrous oxide emissions. In 2021, TSMC started offsetting CO2 emissions from the carbon-neutral natural gas. Scope 2 GHG emissions are mainly indirect emissions from energy consumption. In addition to obtaining ISO 50001 energy management certificates, constructing green buildings, and spearheading five energy-saving teams to conserve energy in production equipment through the Energy Saving and Carbon Reduction Committee, TSMC is also expanding

renewable energy use by installing solar panels at TSMC facilities as well as purchasing renewable energy, renewable energy certificates, and carbon credits to achieve 100% renewable energy in overseas subsidiaries and global offices. In the long term, TSMC will strive toward the RE100 target for 2050. As of 2021, TSMC has successfully achieved zero carbon emissions from energy consumption in overseas subsidiaries for four consecutive years. Scope 3 GHG emissions are largely from raw material production from the upstream supply chain. So working with suppliers to reduce carbon emissions will be critical to reducing emissions. For more details, please refer to [Climate Impact from Supply Chain](#).



As of 2021, TSMC has successfully achieved zero carbon emissions from energy consumption in overseas subsidiaries for four consecutive years.

Energy Conservation Measures



GHG Reduction Standard Practices

Scope 1	>> Direct GHG Emissions	
TSMC Standard Practices	Performance	2021 Achievements
ISO 14064-1 emissions inventory and third-party verification	100%	All fabs and sites completed emissions inventory and third-party verification
Optimize gas quantity used in production	100%	Introduced optimized process parameters in accordance with the manufacturing specifications of the Intelligent Engineering Center
Substitute high global warming potential (GWP) process gases	100%	- All 12-inch fabs are now using optimized carbon reduction technology – remote plasma dissociation of nitrogen trifluoride (NF₃) 6-inch and 8-inch fabs are using nitrogen trifluoride (NF₃)/octafluorobutane(C₄F₈)
Local abatement facilities for F-GHGs and nitrous oxide	100%	- Developed nitrous oxide reduction technologies and made it a standard for new tools; installed 3,285 new tools with F-GHG and nitrous oxide reduction technologies - Replaced 104 machines generating F-GHGs from existing facilities and increased installment rate to 94% - Launched program to replace/install nitrous oxide abatement facilities in existing fabs
Use carbon-neutral natural gas	1	Became the first company in Taiwan to use carbon-neutral natural gas



TSMC collaborates with equipment suppliers to develop energy-saving green tools for semiconductor manufacturing.

66

As of 2021, TSMC has proposed 365 energy-saving measures and 159 measures have been verified and successfully applied to 119 different types of advanced process equipment.



Scope 2 >> Indirect GHG Emissions (From Purchased Energy)

TSMC Standard Practices	Performance	2021 Achievements
ISO 50001 Energy Management System inventory and third-part verification	100%	All the fabs are completed with ISO 50001 inventory and third-party verification; 100% have been verified.
Construct green buildings	1	The Company leads the global semiconductor industry with the largest LEED-certified building area and constructed three more fabs, which received green building certification. To date, 37 buildings have received LEED certifications and 25 buildings have received EEWB certifications
Increase energy efficiency and standardization	499 Measures	Energy efficiency of advanced technologies leads industry peers ^{Note 1}, with 499 energy-saving measures over 8 categories implemented and 700 GWh saved
Next-generation fab tools use energy-saving, carbon-reducing designs	1	First in the world to launch Energy Conservation Action Project for Next-generation Fab Tools; completed energy-saving programs on 119 models, and saved 400 GWh
Use renewable Energy	1,670 GWh	In addition to using 100% renewable energy for global offices, TSMC also use 1,670 GWh of renewable energy around the world, accounting for 9.2%

Scope 3 >> Indirect GHG Emissions (Value Chain)

TSMC Standard Practices	Performance	2021 Achievements
ISO 14064 emissions inventory and third-party audit	51%	High Energy Consumption Suppliers ^{Note 2} must pass GHG emissions inventory and third-party verification; 51% of suppliers have been verified
Reduce carbon footprint from raw materials	65,000 Metric Tons	High Energy Consumption Suppliers are asked to set annual targets and implement real energy-saving actions; in 2021, TSMC suppliers conserved 130 GWh and reduced 65,000 metric tons of carbon emissions
Logistic optimization	17,848 Metric Tons	Improved the delivery schedule for process tools and replaced air freight with ocean freight, reducing 17,848 metric tons in GHG emissions

Note 1: Figures from Joint Steering Committee (JSTC) report of the World Semiconductor Council
Note 2: High Energy Consumption Suppliers are suppliers that use >5 million kWh/year in a single facility

Resilience through Climate Adaptation

Climate Adaptation Management Initiatives

Resilience to climate disasters is an integral part of corporate operations in an environment with increasingly volatile climates. TSMC uses the latest global warming scenario issued by the UN to identify disaster factors introduced by extreme climates in existing and new facilities and established Climate Risk Adaptation Standards. In 2021, TSMC was able to successfully defend against the potential impact of disasters and potential operating losses caused by climate change to achieve the target of zero production interruption.



Main Initiatives

- **Strengthen Climate Resilience**
Establish climate change countermeasures and preemptive precautions to lower risks of climate disasters
- **Develop Diverse Water Sources**
Integrate internal and external resources to develop water reclamation technologies; continue to practice water conservation and use reclaimed water during manufacturing



2021 Investments

- Investments into Water Conservation and Reclamation Equipment: NT\$2.9 billion
- Operating, Maintaining, and Repairing Water Conservation and Reclamation Equipment: NT\$1.36 billion



2021 Achievements

- Reduced unit water consumption by **14.9%** (Base year: 2010)
- Increased quantity of conserved water by **2.48 million metric tons**
- Zero production interruption during the most severe drought of Taiwan in seventy years with the government reducing water supplies by 7~15%

A^{List}

Listed on the CDP's A List of leading businesses in Water Security for 2 consecutive years

AWS^{Platinum}

Received platinum certifications, the highest level, from Alliance for Water Stewardship (AWS) for three consecutive years



TSMC achieved the target of zero production interruption in 2021.



Climate Risk Adaptation Standards

Climate Risk		Adaptation Standards	Compliance in 2021
	Power Shortage	12-inch wafer fabs are US LEED certified	✓
		Contingency measures for power restrictions and backup emergency power generators now able to provide more than 30% of full capacity power during maximum electricity restrictions	✓
	Floods	Foundations of newly built fabs in Southern Taiwan Science Park raised by 2 meters, lowering risk of flooding	✓
		Evaluate external public facilities and major suppliers for potential flooding risks and supervise them to mitigate risks	✓
		For factories with potential flooding risk, complete contingency drills as planned	✓
		Install flood doors for existing fabs and buildings in areas with high flooding risks	✓
	Drought	Promote water conservation within the Company and increase water recycling rate from manufacturing processes	✓
		Support government policies on reclaimed water; commit to developing and using reclaimed water	✓
		Establish emergency water shortage measures: maintain water storage facilities in each fab at least 2 days water usage capacity, prepare water tankers and sources of water that can provide 20% of water supplies during maximum water restrictions	✓
	Winds	Strengthen wind resistance standards for outdoor facilities (water cooling towers, decontamination facilities, etc.)	✓
	Regulations	Participate in regulatory discussions to ensure government regulations are reasonable and viable	✓
		Strengthen mitigation measures and developed the renewable energy market to reduce impact from carbon taxes and energy taxes	✓
	Customer Demands	Conduct negotiations to ensure customer demands are reasonable and viable	✓
		Assist customers develop carbon neutral programs to reduce risks from contract violations	✓
	Expectations from Other Stakeholders	Outline and developed carbon neutral strategies with help and approval from external parties	✓

Effective Water Management

TSMC introduced AWS (Alliance for Water Stewardship) standards to ensure sustainable water management and employed the [AWS Blue Book](#) to promote a long-term strategy of Fab matching. As of 2021, major TSMC fabs in the Hsinchu Science Park, Central Taiwan Science Park, and Southern Taiwan Science Park have all received AWS certification as TSMC remains committed to achieving the five intended effects of the AWS standard: good water governance, sustainable water balance, good water quality status, healthy status of important water-related areas, and safe water, sanitation, and hygiene for all. In addition, TSMC has been on the CDP's Water Security A Lists for two consecutive years, which is recognition of TSMC's sustainable water management by the global community.

In the first half of 2021, Taiwan suffered from widespread drought. Facing the most severe drought in seven decades, TSMC actively sought diverse alternative water sources and introduced new water recycling systems to improve water usage efficiency. As such, TSMC was able to maintain facility operations and production as normal even throughout the worst stages of the drought. In 2021, TSMC continued to promote the four major water conservation measures of "Reduce Facility System Water Consumption, Increase Wastewater Recycling of Facilities, Improve Water Production Rate of the System, and Decrease Water Discharge Loss from the System" to uncover opportunities to save water and achieve maximum water conservation. As a result, in 2021 TSMC was able to successfully conserve an additional 2.48 million metric tons of water, a 28.7% increase from the previous year.

Water Conservation Measures and Achievements in 2021

Decrease Water Discharge Loss from the System

- Recycled **855,000** metric tons from MAU Drain (34.5%)

Reduce Facility System Water Consumption

- Reduced cooling tower and sand filter backwash water by **48,000** metric tons (1.9%)

Improve Water Production Rate of the System

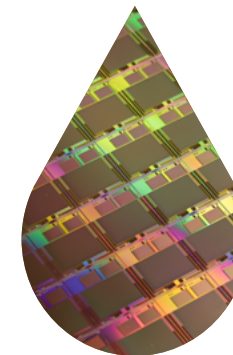
- Increased the water production rate of RO recycling systems by **86,000** metric tons (3.5%)
- Improved usage efficiency by allocating **527,000** metric tons of recycled water (21.2%)

Additional water
conservation in 2021

2.48M
metric tons

Increase Wastewater Recycling by Facilities

- Purified **183,000** metric tons reclaimed water into industrial water (7.4%)
- Recycled **94,000** metric tons of backwash wastewater(3.8%)
- Reclaimed **162,000** metric tons of acidic wastewater(6.5%)
- Reclaimed **320,000** metric tons of water from central wet scrubber(12.9%)
- Reclaimed **205,000** metric tons of organic wastewater (8.3%)



Climate Impact from Supply Chain

Carbon Reduction Management Initiatives in the Supply Chain

TSMC is committed to an environmentally and socially responsible business model. We continue to strengthen collaboration with suppliers to reduce carbon emissions and have employed core strategies such as "Develop and Purchase Energy-efficient Green Equipment" and "Low-carbon Supply Chain Management." According to our own net zero emission targets, we have also formulated a low-carbon management blueprint and action policy targeting suppliers to promote carbon reduction systematically in the supply chain and offered training resources to strengthen management capabilities as part of our efforts to build a green, low-carbon supply chain.



Main Initiatives



2021 Investments



2021 Achievements

- **Develop and Purchase Energy-efficient Green Equipment**

Collaborate with suppliers to develop energy-efficient machines, integrate energy-saving measures across fabs, and introduce procurement standards

- **Implement Low-carbon Supply Chain Management**

Establish a management mechanism and ask suppliers to set goals for energy/water conservation and carbon reduction. Check performances with data management and require third-party verification.

- Additional investments of NT\$700 million in 2021, bringing the aggregate investment up to NT\$1.5 billion (Base year: 2018)
- NT\$8 million invested annually in labor costs

- 20 new energy-saving programs were introduced by integrating cross-fab energy-saving measures and successfully applied to 51 advanced process equipment, conserving **170 GWh** in energy
- In 2021, TSMC suppliers conserved **130 GWh** in energy and **17.58 million metric tons** of water; **51%** of high-energy-consumption suppliers received ISO 14064 certification for GHG emissions verification

400 GWh

Proposed 365 Energy Conservation Action Project for Next-generation Fab Tools and conserved 400 GWh in energy

37 courses

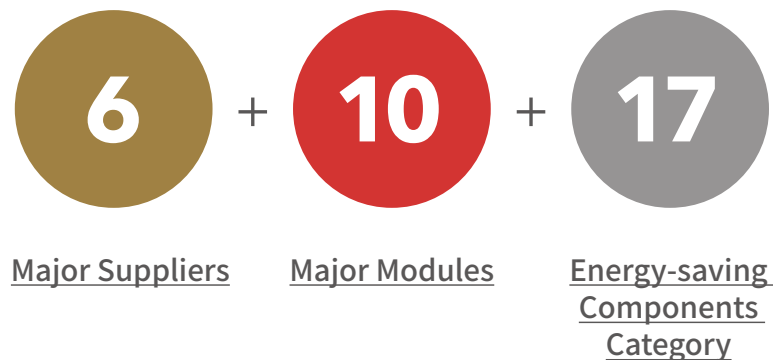
Available courses uploaded to the TSMC Supplier Sustainability Academy



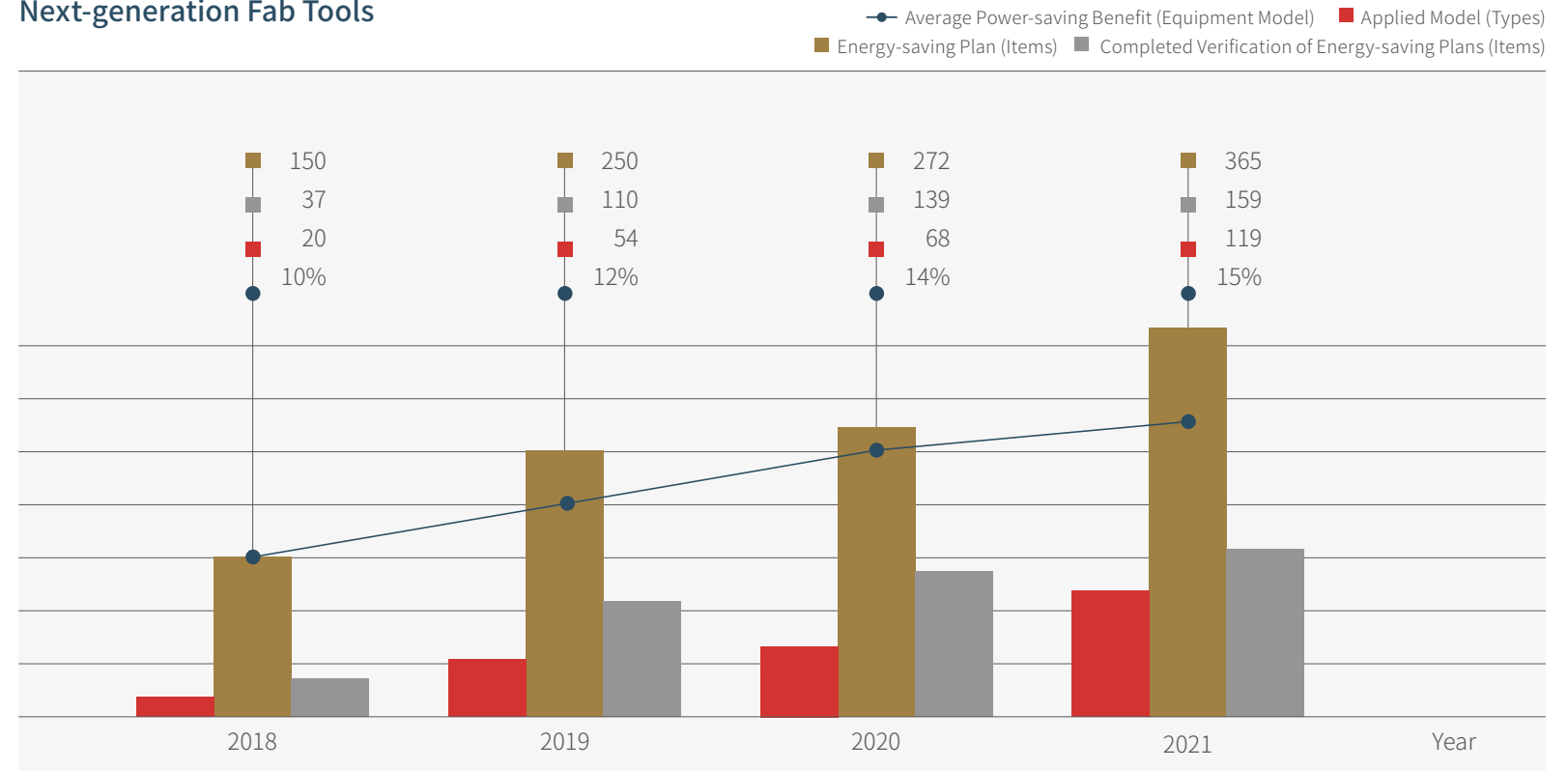
TSMC holds Supplier Environment, Safety and Health Forum to reduce energy consumption and carbon emissions with suppliers.

Develop and Purchase Energy-efficient Green Equipment

TSMC is the first semiconductor company in the world to drive equipment suppliers to introduce energy-saving measures to advanced process equipment. In addition to requiring the high-energy-consumption suppliers in the top 90% to develop more energy-efficient advanced process equipment, we have also integrated energy-efficient regulations into the procurement standards of new equipment. In 2018, TSMC launched the "Energy Conservation Action Project for Next-generation Fab Tools," which targets 10 major equipment domains. Under the Project, we continuously implemented ideation, planning, simulation test and product verification as we continue collaborating with equipment suppliers to develop energy-efficient components and designs to introduce to equipment. As of 2021, TSMC has proposed 365 energy-saving measures and 159 measures have been verified and successfully applied to 119 different types of advanced process equipment. By introducing energy-saving measures across fabs, TSMC has been able to conserve an aggregate of 400 GWh and make equipment 15% more energy efficient on average as we strive steadily towards the 20% energy conservation target of 2030.



Energy Conservation Action Project for Next-generation Fab Tools



TSMC collaborates with supplier to develop Intelligent Compressed Dry Air (CDA) Flow Control System to reduce carbon and save power.

Low-carbon Supply Chain Management

Carbon emissions from supply chain operations are of great concern to TSMC. As a leading semiconductor company, TSMC continues to advance low-carbon supply chain management through four directives: Goal Setting, Data Inventory, Carbon Reduction, and Performance Appraisal. TSMC requires all suppliers with high energy consumption or high carbon emissions to set mid-to-long-term goals and use Supply Online 360 for data tracking and real-time inventory. TSMC has also shared experiences as well as energy-saving and carbon reduction plans with suppliers to help increase their energy

efficiency. In 2021, a total of 18 suppliers participated in the Industrial Development Bureau's Energy Conservation and Carbon Reduction Support Program, uncovering 37 projects with the potential to conserve energy and contributing to an estimated annual energy conservation of 13 GWh and carbon reduction of 6,600 metric tons. In addition, to continue strengthening low-carbon supply chain development TSMC has also asked critical suppliers to join the CDP Supply Chain Disclosure Program in which suppliers are required to undergo third-party appraisal and audits.

Low-carbon Supply Chain Management



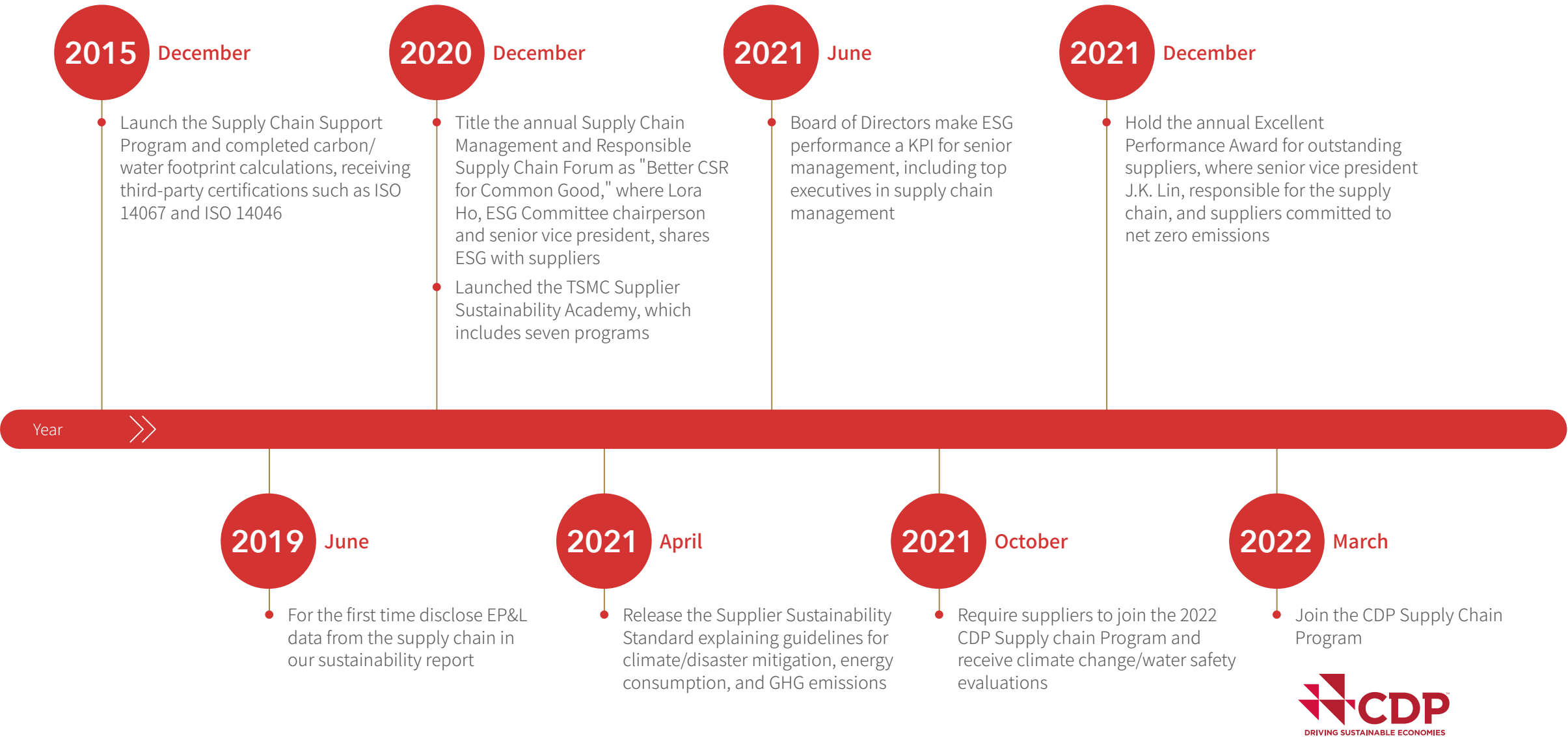


Promote the Development of a Low-carbon Supply Chain

TSMC requires that all suppliers achieve energy/water conservation and carbon reduction targets but also offers suppliers and their upstream suppliers with training resources through the TSMC Supplier Sustainability Academy. As of 2021, the TSMC Supplier Sustainability Academy has uploaded 37 courses. Courses relating to low-carbon management include "Supplier Code of Conduct"

Environmental Protection, Water and Energy Conservation, and Life Cycle Management of Waste. The courses were viewed a total of 25,525 times and 92%% of tier one suppliers completed the "Supplier Code of Conduct" Environmental Protection course, effectively advancing our suppliers' sustainability and climate resiliency.

Low-Carbon Supply Chain Milestones

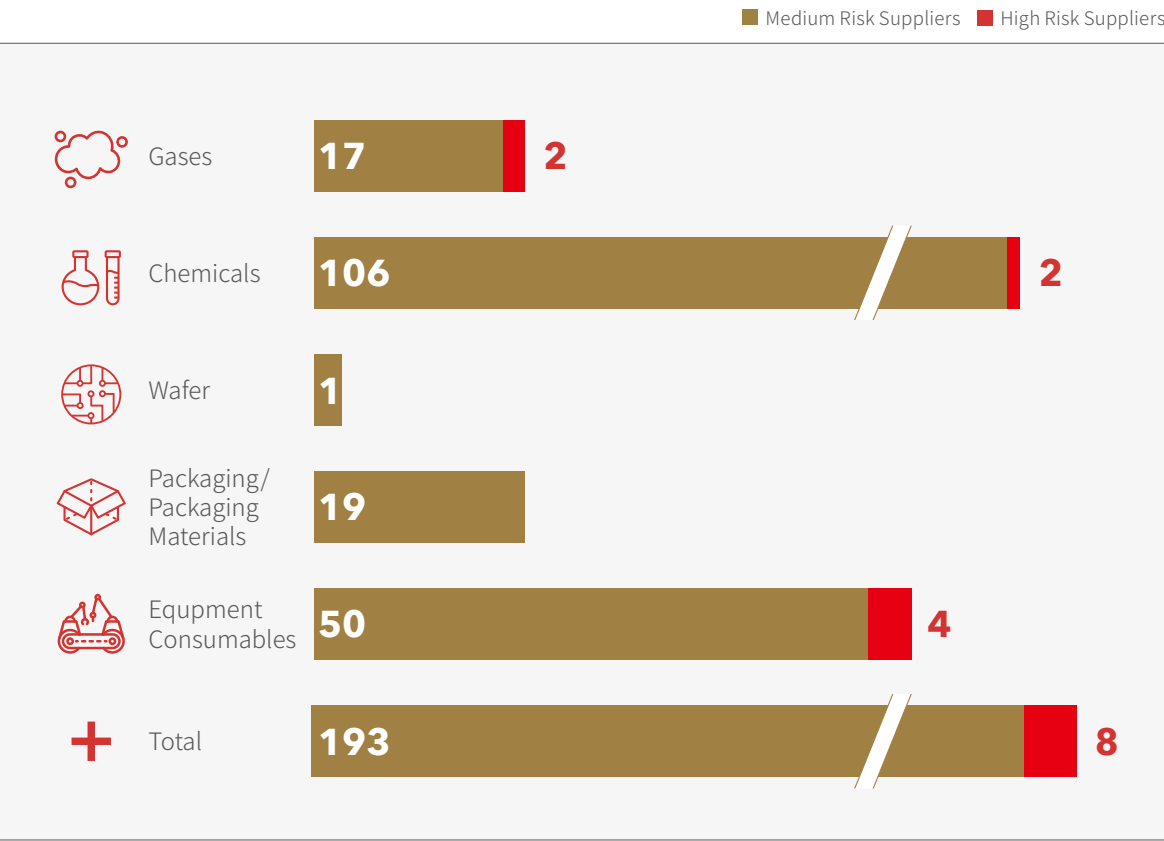


Supply Chain Risk Assessment and Management

In 2022, TSMC expanded the flood scenario to all domestic materials and equipment consumable suppliers. TSMC also strengthened data sets and analysis to obtain more accurate data and estimated the risks of mudflows and landslides from cloudbursts. Without considering basic flood preventions and emergency response capabilities in individual suppliers, TSMC identified 201 suppliers with medium and high flood risks (8 high-risk suppliers and 193 medium-risk suppliers). In the future, TSMC will first conduct on-site inspections for high-risk suppliers and send out self-assessment surveys to medium-risk suppliers to survey their flood risk readiness and supply resiliency. There were no significant risks identified from mudflow and landslide risk analyses.

TSMC will be prioritizing target areas with respect to climate change risks, existing response measures, and the criticality of suppliers. TSMC will audit critical suppliers with flood risks on site and strengthen flood prevention measures, move important equipment out of the basement or first floor, and adopt other emergency response measures to reduce the risk of flooding. In addition, TSMC has issued a comprehensive Business Continuity Management Policy for a more robust backup systems that enhances our supply chain resiliency. TSMC will continue to evaluate supplier readiness for climate disasters and help critical suppliers strengthen flood preventions to reduce the risks of interrupted operations.

Flood Potential Map for Domestic Suppliers



Note: According to the Flood Potential Map of the National Science and Technology Center for Disaster Reduction, areas with a 0.5m water depth from strong cloudbursts (500mm in 24 hours) are considered high-risk areas while areas with a 0.5 water depth from extreme cloudbursts (650mm in 24 hours) are considered medium risk



TSMC's audit team checks the supplier's chemical tanks, the properties of chemicals, spill prevention measures, and wastewater discharge management.

Climate Innovations in Products

Low-carbon Products and Services Management Initiatives

In consideration of the total product life cycle, TSMC is collaborating with upstream suppliers of raw materials and equipment, design ecosystem partners, and downstream packaging and testing suppliers to reduce the carbon footprint of TSMC products through concrete actions. TSMC is also helping customers produce more advanced, energy-efficient, and eco-friendly products with innovative and leading semiconductor technologies. Chips produced with TSMC's high-performance, energy-efficient technologies can be applied to infrastructure for sustainable cities, energy-efficient transportation, smart grids, and energy-efficient servers and data centers. Low-carbon products that TSMC is helping customers produce are now a critical part of our daily lives and have contributed to energy conservation from related products on the industry chain.

4^{kWh}

Helped the world conserve 4 kWh of energy for each 1 kWh spent in production

100%

Increased energy efficiency by 100% for all process technologies after 5 years of mass production



TSMC has raised its 2030 renewable energy target as "40% of electricity consumption by TSMC's global operation sites will come from renewable energy."


Main Initiatives

- **Develop Sustainable Products**
Research and develop low-power semiconductors and evaluate their environmental and social impacts at all stages of production in consideration of the comprehensive product life cycle to deliver customer products with low environmental footprints, low carbon footprints, and low water footprints.


2021 Investments

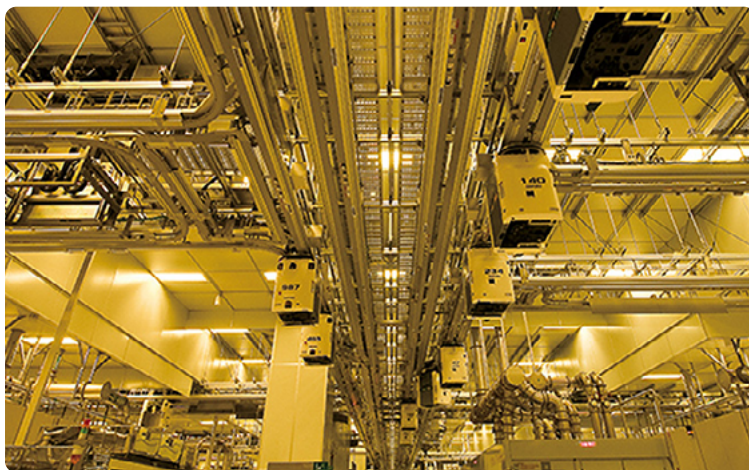
- Spent NT\$96.8 billion on research and development of advanced processes
- Spent NT\$6 billion on research and development of PMIC and ULP technology platforms


2021 Achievements

- Reached **NT\$819 billion** in revenue from sustainable products
- Products manufactured by TSMC for customers are estimated to help the world conserve **217,100 GWh** in energy in 2030
- Increased energy efficiency of 10nm and 7nm processes by **150%** in the fifth year of mass production, exceeding targets

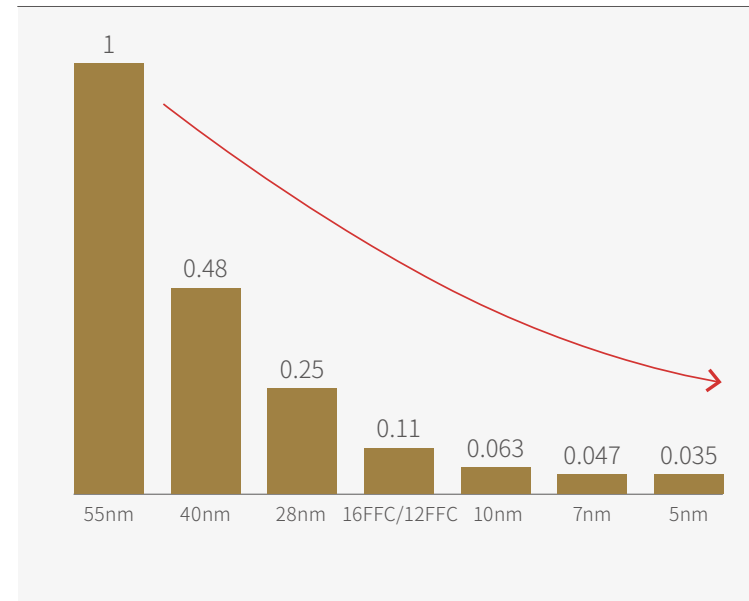
Drive Global Energy Conservation with Advanced Technologies

Semiconductors fabricated by TSMC for customers are broadly applied to computers, communications, consumer goods, industrial applications, electric cars, servers, data centers, and other end-user products. With TSMC's wafer manufacturing technology, customers are able to realize their designs and apply them to human life. We believe our chips have contributed greatly to the progress of modern society and energy conservation across the world. With new generations of semiconductor process technologies, the linewidth shrinks, allowing transistors to become smaller and electronic products to consume less energy when achieving the same tasks while operating at the same performance. TSMC continues to progress advanced semiconductor process technologies to produce more advanced and energy-efficient products for customers. In 2021, TSMC has been able to achieve the goal to increase 10nm and 7nm process technology energy efficiency by one time in the fifth year of mass production, and 20% for 5nm processes in the second year of mass production, reaching our annual targets.

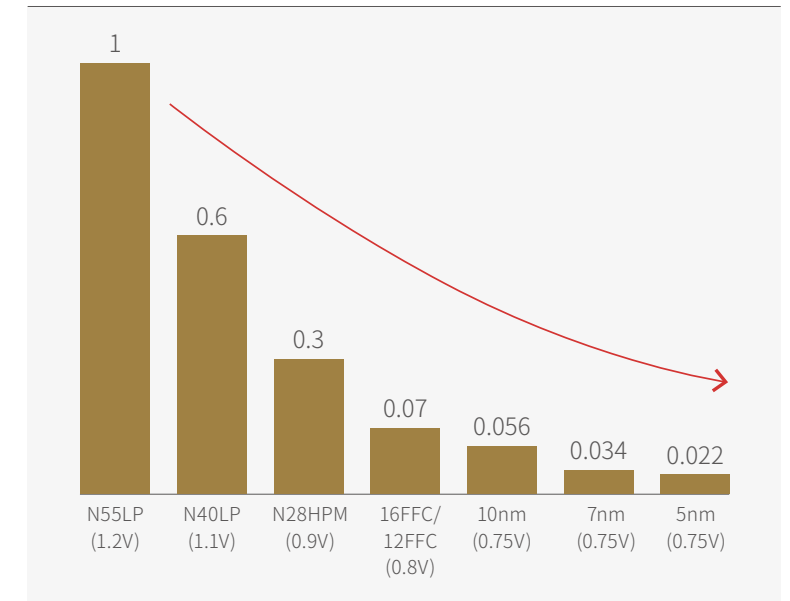


TSMC helps customers produce sustainable products that consume less energy and drive global energy savings.

Die Size Cross-Technology Comparison — Die size is shrinking as line width shrinks



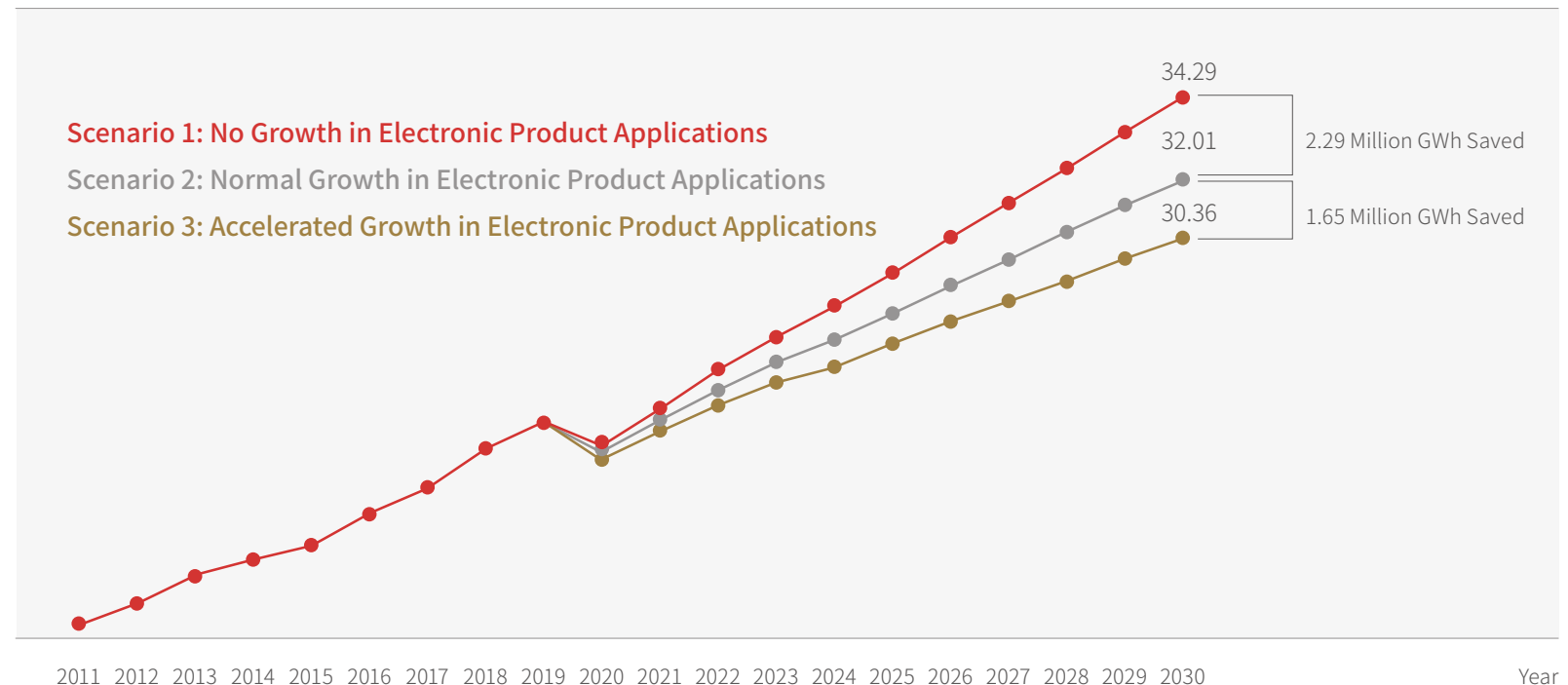
Total Power Consumption Cross-Technology Comparison — More power is saved as line width shrinks



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

Global Electricity Consumption

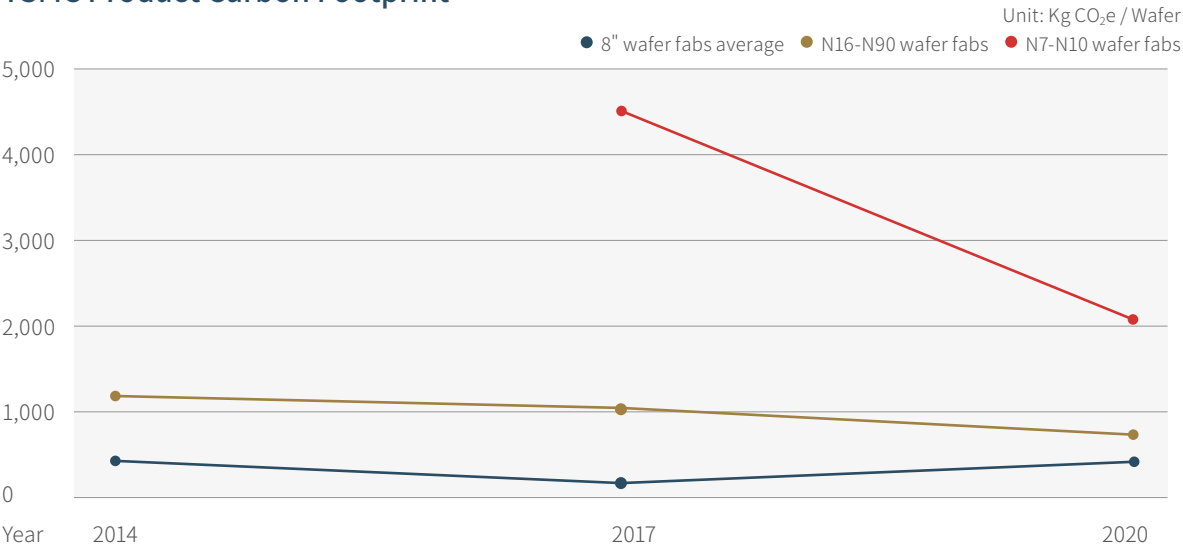
Unit: Global Electricity Consumption (Million GWh)



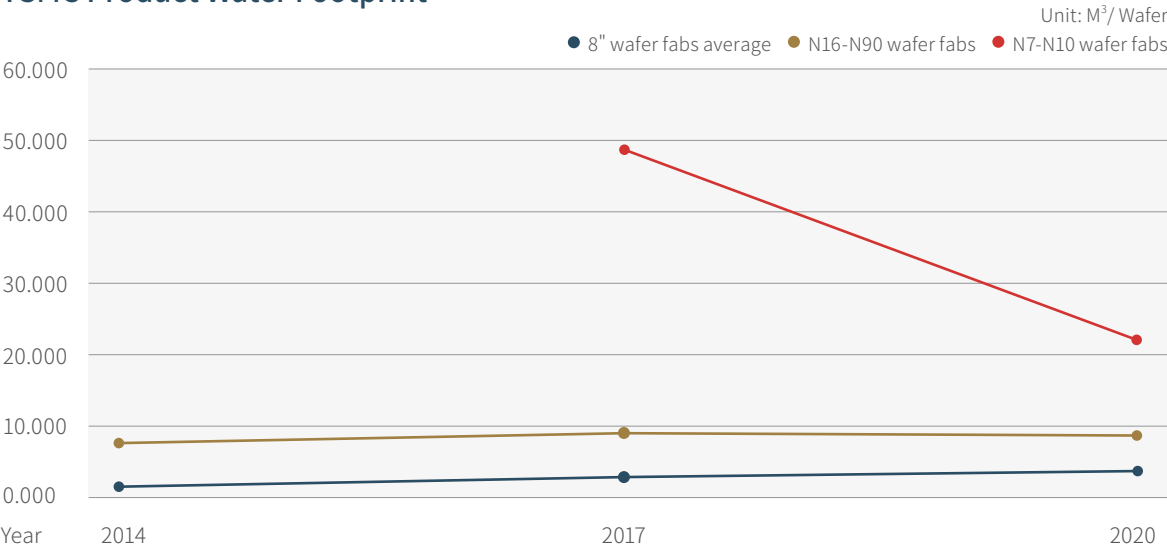
Calculations using the Industry, Science, and Technology International Strategy Center's model showed that, in 2030, electronic products with semiconductors at the core can help conserve 11.5% of the world's energy, which would be around 3.9 million GWh. Considering the semiconductor/electronic product ratio and TSMC's market share, the products TSMC produced for customers will conserve 217,100 GWh in 2030, which is four times the energy consumed during production. Every three years, TSMC conducts product life cycle assessments, water footprint assessments, and carbon footprint assessments. Results indicate that the carbon footprint and water footprint of TSMC products of different technology nodes are all trending downward. Using the advanced

process fabs (7-10nm) as an example, carbon and water footprints per wafer unit have been reduced by 54% and 53%, respectively, from 2017 to 2020. As for fabs using more mature technologies (16nm and above), TSMC has been able to reduce carbon footprint per unit wafer by 38% from 2014 to 2020. Unfortunately, due to fluctuations in production capacity and water demands to mitigate air pollution, the water footprint per wafer unit has slightly increased. TSMC will continue to promote water conservation measures in TSMC fabs and across the supply chain. In the future, TSMC will also continue to expand the use of reclaimed water, which we believe will effectively reduce the unit water footprint.

TSMC Product Carbon Footprint



TSMC Product Water Footprint



TSMC continues to drive green innovations for advanced process tools.



Considering the semiconductor/electronic product ratio and TSMC market share, the products TSMC produced for customers will conserve 217,100 GWh in 2030, which is four times the energy consumed during production.



Towards Sustainable Development

TSMC's commitment to Net Zero Emissions is our responsibility in the face of climate change. TSMC strives to maintain the carrying capacity of Earth's environment through the four management initiatives of "Mitigation, Adaptation, Carbon Reduction in the Supply Chain, and Low-Carbon Products and Services" as well as seeking climate opportunities for transition from the four dimensions of TSMC Operations, Upstream Procurement, Customer Use, and Social Impact. We strive to realize the sustainable development principle of common good for the ecosystem.

Even though there are many challenges ahead as we strive toward Net Zero Emissions, TSMC hopes to use innovative thinking and real actions to become a low-carbon semiconductor company. In TSMC operations, we will continue to promote climate mitigation and adaptation measures. In addition, we hold the [TSMC ESG AWARD](#) to encourage employees to submit innovative net zero emissions ideas and help internalize climate awareness into our employees' daily work and lives. In terms of upstream

procurement, we will share our experiences to support suppliers to meet sustainable indicators, establish the TSMC Supplier Sustainability Academy, and strengthen climate change knowledge and awareness to make our supply chain more sustainable. As for customer use, we will help customers produce high-performance and energy-efficient products that can be used in various smart applications to help the world conserve energy. In terms of social impacts, TSMC has introduced the EP&L Report to measure the positive values or negative impacts on society and the economy caused by TSMC's value chain to ensure that TSMC decisions consider both the Company and society's mutual growth.

In the face of climate emergency, as a corporate citizen of the world, TSMC will build partnerships with a broad range of stakeholders, accelerate the execution of climate risk control and mitigation measures, and expand our green influence across the semiconductor industry as we strive toward our long-term goal of Net Zero Emissions by 2050.



As a corporate citizen of the world, TSMC will accelerate the executions of climate risk control and mitigation measures, and strive to realize the sustainable development principle of common good for the ecosystem.



Appendix

TCFD Comparison Table

Core Elements	TCFD Disclosure Recommendation	Chapters in This Report	Page
Governance	How the board performs oversight of climate-related issues	Board of Directors Oversight	<u>9</u>
	How management in assesses and manages climate-related issues	Management Responsibilities	<u>10</u>
Strategies	The climate-related risks and opportunities the organization has identified over the short, medium, and long term	Identification and Assessment of Climate Risks and Opportunities	<u>13</u>
	The impact of climate-related risks and opportunities on the organization's business, strategy, and financial planning	Potential Financial Impact	<u>15</u>
	Scenario analysis (including disclosure under a 2° C or lower scenario)	Scenario Analysis	<u>16</u>
Risk Management	Processes for identifying and assessing climate-related risks	Identification and Assessment of Climate Risks and Opportunities	<u>13</u>
	Processes for managing climate-related risks	Total Risk Management	<u>12</u>
	Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process	Total Risk Management	<u>12</u>
Metrics and Targets	Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process	Commitments and Targets	<u>18</u>
	Disclose Scope 1, Scope 2, and if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks	GHG Emissions	<u>21</u>
		Identification and Assessment of Climate Risks and Opportunities	<u>13</u>
	The management targets and related performance	Commitments and Targets Climate Impact from Supply Chain Climate Innovations in Products	<u>18</u> <u>31</u> <u>36</u>



Climate Change Related Reports and Policies

[TSMC Sustainability Report](#)

[TSMC ESG Policy](#)

[TSMC ESG Procedure](#)

[TSMC Climate Change Statement](#)

[TSMC Environmental Policy](#)

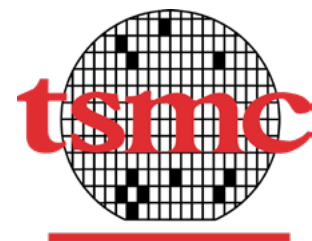
[TSMC Business Continuity Management Policy](#)

[F-GHG Reduction Declaration](#)

[Sustainable Water Management \(Alliance for Water Stewardship, AWS\) Report](#)

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3. National Science and Technology Center for Disaster Reduction (2019). Atlas of key indicators of climate change in Taiwan. Edited by Taiwan Climate Change Projection Information and Adaptation Knowledge Platform, Ministry of Science and Technology



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