5

Green Manufacturing and Operation

Suggested priority for referring to the stakeholders in this chapter:
■ Supplier ■ Customer □ Employee ■ Investor □ Government ■ Media
□ Others (such as the general public, academic institutions, etc.)

The climate change issue should brook no delay. In order to mitigate the impact on the natural environment, and achieve energy and carbon reduction, TSC is committed to maintaining the spirit of sustainable development and minimizing the environmental impact of our operating activities. In an effort to assess risks and opportunities arising from climate change and propose strategies to cope with them, TSC has been promoting the Task Force on Climate-related Financial Disclosures (TCFD)-based impact assessment since 2022, where the assessment results will be disclosed annually on our official website and in our sustainability reports. At the same time, TSC not only carries out carbon emissions management based on the results of our greenhouse gas inventory, but has also introduce the ISO 14001 Environmental Management System and the ISO 50001 Energy Management System with respect o various areas, including energy sources, water resources, waste, wastewater, and air pollution prevention and control, with a view to implementing various environmental management actions on an ongoing basis.

5.1 Climate Governance and Strategies GRI 3-3 GRI 201-2

Material Topics -
Climate Strategy and Energy Management - Climate Governance and Strategy

Policy and Commitments

Actively promote energy conservation programs to enhance energy efficiency, study and develop energy alternatives, and reduce the impact of greenhouse gas emissions on the environment through various climate actions to bolster climate resilience.

Management Policy and Evaluation Mechanism

- Conduct regular assessments on the financial impact of climate change based on the TCFD framework.
- Continue to roll out and conduct greenhouse gas emission inventories, as well as expand the scope and items of these inventories.
- Pass the ISO 14064 standards certification process.
- Roll out and implement various energy resource reduction programs and track the progress of these programs on a regular basis.
- Draw up a CDP rating plan.

Action Plan and Performance

- A quantitative assessment of climate-related risks and opportunities was completed based on the TCFD framework.
- The coverage rate of greenhouse gas inventory at each operating site reached 50%.
- In 2023, our Li-Je and Shandong sites have been awarded the ISO 14064 certification, with the scope of inventory expanded to include Categories 3 to 6 emissions at the same time.
- TSC saved 2,567 GJ of energy in 2023.
- Our operating sites in Taiwan have completed on-site survey and assessment for the construction of solar energy facilities in 2023.

5.1.1 Climate Governance and Strategies

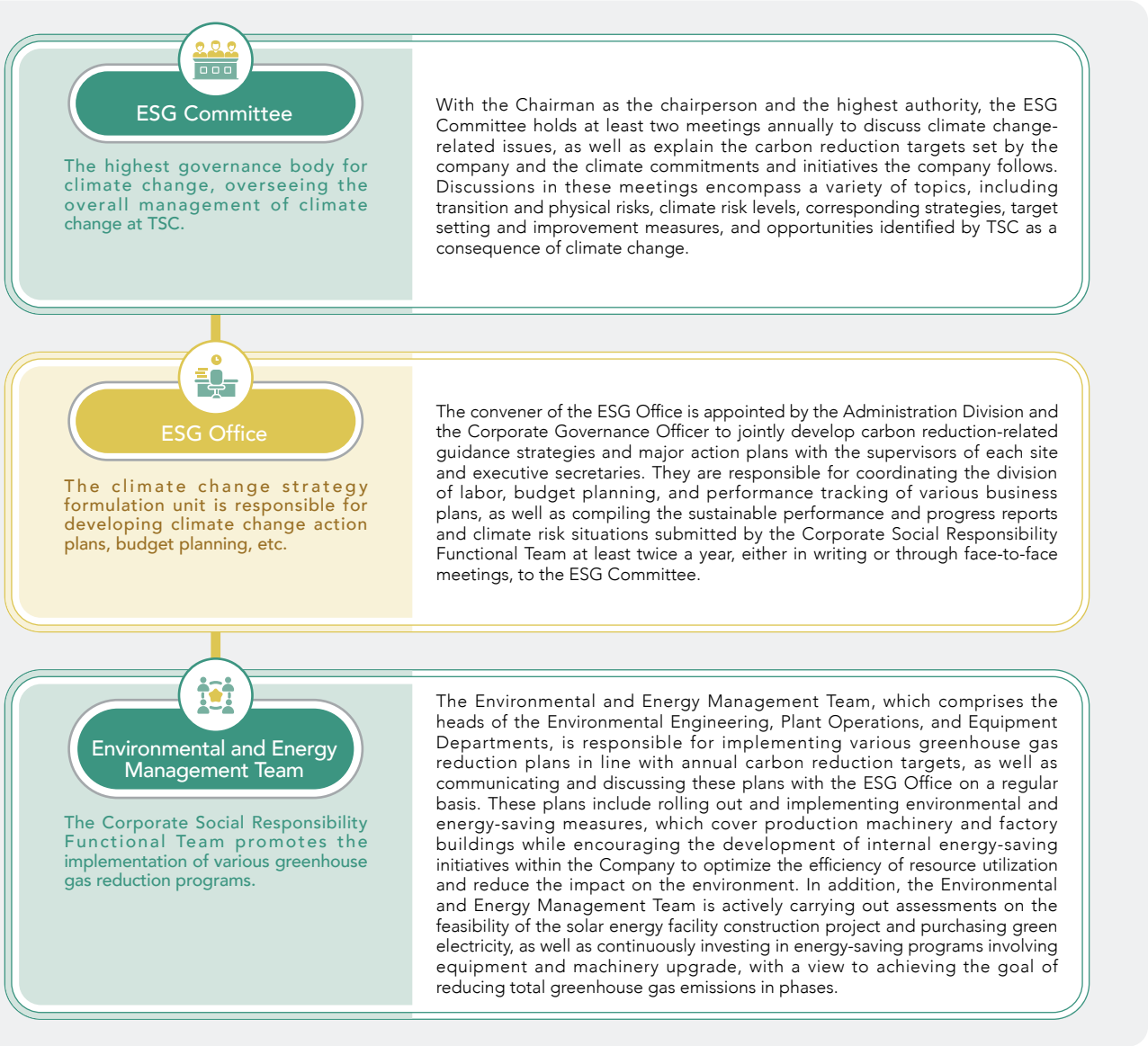
TSC pays close attention to risks and business opportunities that may arise from climate change. Hence, TSC discloses our management approaches and response measures in response to climate-related risks and opportunities in a transparent manner in compliance with the Rules Governing the Preparation and Filing of Sustainability Reports by TWSE-listed Companies promulgated by the Taiwan Stock Exchange Corporation while referencing the TCFD recommendations on climate-related financial disclosures. With the mutual integration of our climate risk and opportunity management mechanism and corporate risk management process, we continue to engage in low-carbon transition and bolster the company's resilience to climate change in four directions: governance, strategy, risk management, as well as metrics and targets.

Management approach based on the TCFD recommendations		Implementation status in 2023
Governance	TSC's ESG Committee is a functional committee at board level, chaired by the chairman and the highest-ranking executive. The committee is responsible for overseeing climate-related risks, opportunities, response strategies, goals, preventive measures, and concrete outcomes.	In 2023, the ESG Office reported the to the ESG Committee on the management mechanism concerning climate change issues and climate-related risks and its actual implementation to the ESG Committee. A total of three meetings were convened in 2023.
	The ESG Office annually reviews and assesses climate change issues, planning response plans, promoting risk protection, reviewing performance execution, and regularly reporting to the ESG Committee.	The ESG Office is responsible for formulating climate change-related guidance strategies. After formulating the main action plans, the Environmental and Energy Management Team of the Corporate Social Responsibility Functional Team is tasked with implementing climate-related actions.
Strategy	TSC has developed a methodology for assessing climate change risks and opportunities in accordance with the TCFD framework, with a view to identifying short-, medium-, and long-term climate risks and opportunities.	• TSC evaluates the climate risks we and our upstream and downstream value chains face in terms of potential impact, possibility of occurrence, and potential vulnerability to develop and implement response measures. For more information, please refer to the tables below, Climate-related Risks and Impacts on TSC Value Chain and Climate-Related Risks and Response Measures for TSC. • TSC identifies climate-related opportunities according to the characteristics of the business and TSC's low-carbon strategy planning. Please refer to the table below titled "Climate-related Opportunities" for more details.
	TSC has developed a methodology for assessing climate change risks and opportunities in accordance with the TCFD framework, with a view to identifying short-, medium-, and long-term climate risks and opportunities. TSC analyzes the potential operational and financial impacts of significant climate risks and opportunities on our company based on the TCFD framework.	**TSC completed the assessment on the impact of increased greenhouse gas** emissions costs under different scenarios of major climate risks. Please refer to the "Climate Risk Impact Assessment and Scenario Analysis" section for more details.
	TSC analyzes climate risks in different scenarios, as well as assesses short-, medium-, and long-term carbon reduction strategies.	In 2023, TSC analyzed the impact of increased cost of greenhouse gas emissions based on the International Energy Agency's (IEA) Announced Pledges Scenario (APS) and Net Zero Emissions by 2050 Scenario (NZE), and developed climate change strategies and relevant mitigation measures.
Risk management	TSC has established a climate change risk identification procedure based on the TCFD framework.	TSC identifies climate change risks with reference to climate change laws and regulations. Please refer to the Climate Risks and Opportunities section for more details on climate change risk identification procedure.
	• TSC develops corresponding adaptation and mitigation strategies based on the results of climate risk identification and ranking. • TSC integrates the climate risk identification procedure into our existing risk management procedure.	The materiality of office risk identification is driven by the ESG Office. Based on the materiality of climate risk, strategies and measures are formulated by the ESG Office. After confirmation by ESG Committee, these measures are implemented in daily operations and integrated into the risk management process.
Metrics and targets	TSC has set climate change-related management indicators to facilitate annual performance tracking.	TSC set "reducing total greenhouse gas emissions," "using renewable energy," and "enhancing energy efficiency" as our climate change performance metrics.
	TSC conducts inspections and discloses Scope 1 and 2 greenhouse gas emissions annually to examine the impacts caused by our company's operations.	TSC continues to implement carbon reduction measures based on the results of various inventories and assessments, with a view to reducing greenhouse gas emissions from the organization. Please refer to 5.2.1 Carbon Emissions Management for more details.
	TSC reviews climate management goals achievement annually.	The ESG Office regularly reviews the project performance of the Environmental and Energy Management Team of the Corporate Social Responsibility Function Group on climate change mitigation to confirm the progress of indicators and goals, compiles and reports to ESG Committee, and regularly monitors the implementation results.

Climate Governance

In 2022, TSC established the ESG Committee, a functional committee at the Board level, to oversee climate-related risks, opportunities, response strategies, goals, preventive measures, and specific outcomes. The ESG Office will hold at least two meetings each year to report on and discuss the implementation performance of climate change-related issues, risk response strategies, greenhouse gas reduction, renewable energy layout, water resource utilization with the ESG Committee.

The ESG Committee has established the ESG Office. After formulating relevant sustainability policies and guidelines by ESG Office, the Corporate Social Responsibility Functional Team is responsible for executing these policies. The Environment and Energy Management Team is specifically in charge of climate change-related issues, including achieving annual carbon reduction targets, implementing greenhouse gas reduction plans, and promoting renewable energy development. The organizational structure and division of responsibilities for climate risk management at TSC are detailed as follows.



Climate Risks and Opportunities

To improve the climate-related risks and opportunities management mechanism, TSC has established the climate-related risk management procedure in compliance with the TCFD guidelines. The procedure consists of the five steps:

STEP 01

Compile a list of climate risks and opportunities
The ESG Office convened a discussion to establish a list of TSC climate risks and opportunities by referencing the TCFD recommendations, including risk and opportunity types, international sustainability indicator evaluation, and climate risks of concern to benchmark companies.

STEP 02

Analyze the scope of risk impacts
The ESG Office examines the extent and scope of various risks to TSC's operations by distributing questionnaires to each site and its supervisors. After that, the supervisors of departments evaluate the risks based on three aspects: potential impact level, potential vulnerability, and possibility of occurrence. The impact level of each risk is then ranked in percentile order.

STEP 03

Rank risk by materiality
The analysis results are cross referenced with the position of each risk on the matrix chart. If the risk satisfies both conditions - (1) it fell within the top 20% of risk values and (2) it landed in the high vulnerability and high impact region of the matrix (yellow area) - the risk is categorized as high risk; otherwise, it is low risk; if only one condition is met, it is classified as the next level of risk.

STEP 04

Confirm and report
The ESG Officereports climate risks, corresponding opportunities, response strategies, and the risk matrix to the ESG Committee Member. This process should be confirmed with the ESG Committee.

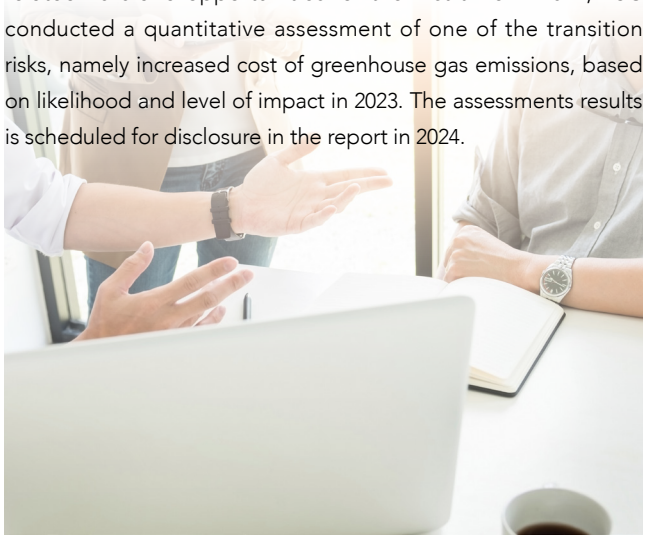
Condition 1: Risk Value

- Ranking is done by multiplying the scores of all risk vulnerabilities, impact levels, and possibility of occurrence. The top 20 to 30% is considered high risk, while the bottom 20 to 30% is considered low risk.
- This logic is a comprehensive consideration of vulnerability, impact, and possibility of occurrence.

Condition 2: Matrix Position

- The yellow area in the matrix is designated as high risk, in need of risk mitigation due to its relatively high fragility and impact level.
- The gray area in the matrix is designated as low risk, in need of resource reallocation due to its relatively low fragility and impact level.

TSC compiled 10 climate-related risks and three climate-related opportunities by taking into consideration the characteristics of operations and evaluating climate risks and opportunities based on potential impact, possibility of occurrence, and potential vulnerability while referencing the TCFD recommendations, including risk and opportunity types, evaluation of international sustainability indicators, and climate risks that benchmark companies are concerned about. The transition risks identified by TSC include increased cost of greenhouse gas emissions, increased sustainability-related demands and regulations, and changing customer behavior; while the physical risks identified by TSC include acute risks such as increased severity of extreme weather events such as typhoons and heavy rain over the short term, and chronic risks such as rising mean temperatures over the long term. We plan to identify and assess climate-related risks and opportunities every three years, while taking into consideration the frequency, characteristics, and timing of these risks. In the remaining years, we will review and confirm the current risks and ensure the adequacy of response measures. After analyzing related risks and opportunities for the first time in 2022, TSC conducted a quantitative assessment of one of the transition risks, namely increased cost of greenhouse gas emissions, based on likelihood and level of impact in 2023. The assessments results is scheduled for disclosure in the report in 2024.



Identifying the Impact of Climate-related Risks on the Value Chain

In order to understand the impact of climate risks on TSC's value chain, we reviewed the impact and scope of various risks on upstream suppliers (wafer materials and diffusion materials), TSC's own operations, and downstream customers (information products, communication products, digital appliances, automotive electronics, etc.). Department heads at TSC ranked the impact of each risk within the three groups, namely upstream suppliers, TSC's own operations, and downstream customers, using the three-level scoring method. The scores were arranged in percentile order, with the top 33.4% considered to have a high impact, 33.4% to 66.7% considered to have a moderate impact, and the remaining 33.3% considered to have a low impact. This process identified the level of impact of climate risks on TSC' s value chain, which then serves as a reference for operational strategies.

Climate-related risks and their impact on TSC's value chain

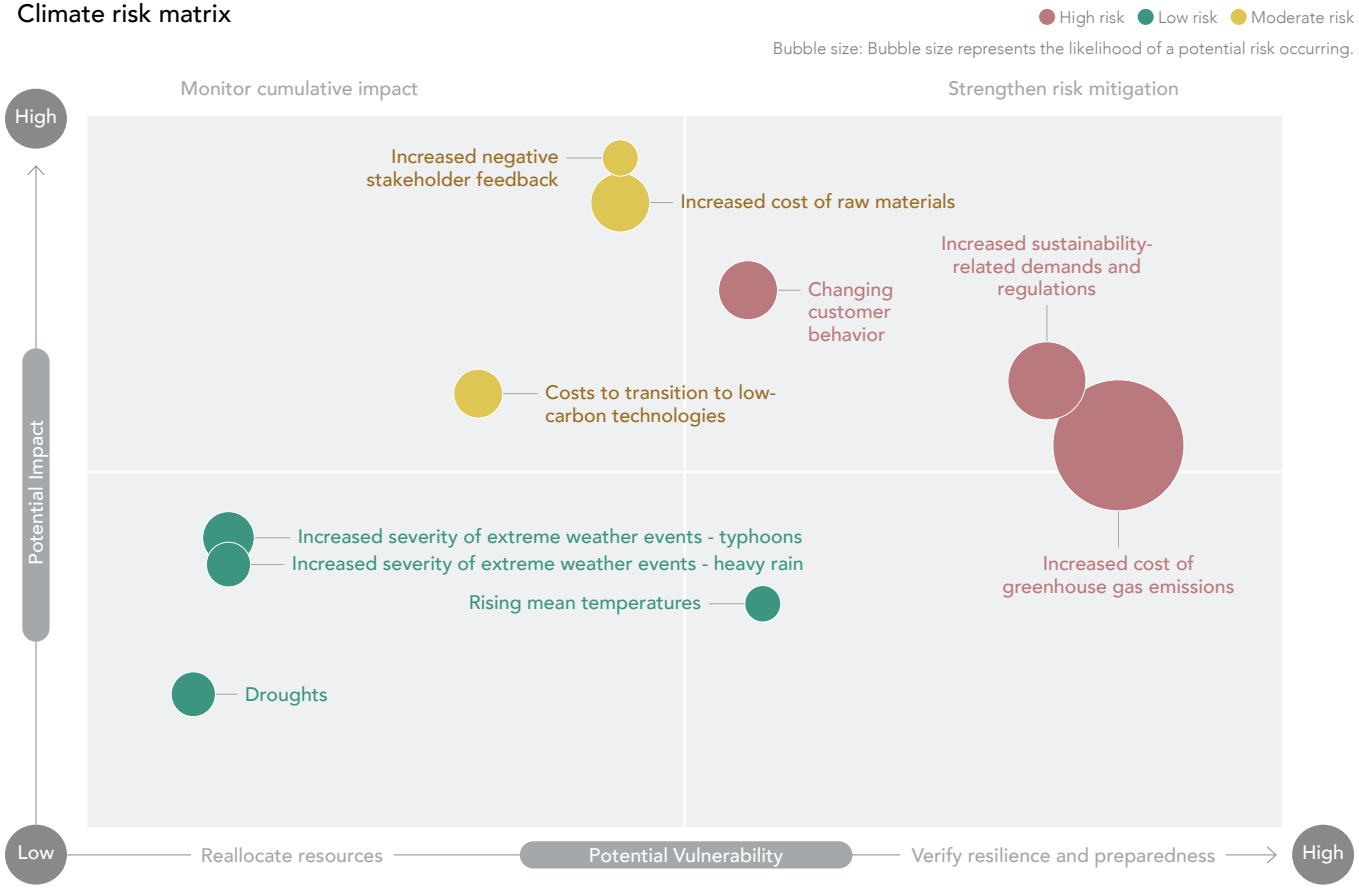
● Low ● Moderate ● High

Type	Dimension	Risk	Impact on value chain		
			Upstream	TSC	Downstream
Transition risk	Policy and legal	Increased cost of greenhouse gas emissions	●	●	●
		Increased sustainability-related demands and regulations	●	●	●
	Market	Changing customer behavior	●	●	●
		Increased cost of raw materials	●	●	●
	Technology	Costs to transition to low-carbon technologies	●	●	●
	Reputation	Increased negative stakeholder feedback	●	●	●
Physical risk	Acute	Increased severity of extreme weather events - typhoons	●	●	●
		Increased severity of extreme weather events - heavy rain	●	●	●
		Droughts	●	●	●
	Chronic	Rising mean temperatures	●	●	●

Identifying the Materiality of Climate Risks

In an effort to understand the impact of climate risks on TSC, department heads at TSC (including those at our I-lan, Li-Je, Shandong, and Tianjin sites) reviewed the impact of various risks on TSC by giving scores to climate-related risks from three aspects: potential impact, potential vulnerability, and likelihood of occurrence. The materiality of climate risks to our operations was comprehensively assessed from these three aspects, while the impact levels of each risk were ranked in percentile order. The top 20% were considered high-risk, while the next 20 to 30% were considered low-risk. According to these results, the risks were examined and placed within a matrix. If a risk met both of the following conditions - (1) the risk fell within the top 20% of risk values and (2) the risk landed in the high vulnerability and high impact region of the matrix (yellow area) - then it was classified as high-risk; otherwise, it was classified as low-risk. If only one condition was met, the risk was classified as a risk at the next level. Using the above methodology, a climate-related risk matrix for TSC was completed, and the results were used as a reference for developing risk response and mitigation plans for TSC, as well as crisis management mechanisms.

Climate risk matrix



TSC assessed the potential impact of the identified 10 risks on TSC's operations and financial planning based on the analysis of the materiality of climate risks, and then formulated the corresponding risk response measures, which are detailed in the following table. In consideration of the possible impact of climate-related risks and opportunities on various aspects of our operations, TSC actively rolls out and implements energy-saving programs, studies and draws up our renewable energy plan, and continues to keep a close eye on climate-related policies. These measures will be incorporated into our daily operations management and risk management procedures on a ongoing basis upon confirmation by the ESG Committee.

Climate-related risks and response measures

Low Moderate High

No.	Dimension	Risk	Impact on TSC	Potential financial impact	Period of impact on TSC	Risk level	Response measures and strategies
Transition risk							
1	Policy and legal	Increased cost of greenhouse gas emissions	Following the implementation of the Climate Change Response Act in Taiwan and climate-related policies and regulations in various countries (such as carbon taxes or tariffs, carbon trading systems, carbon price or fees, etc.), TSC may need to pay carbon fees, carbon taxes, and carbon tariffs on products in the future. Also, the related regulations may become stricter year by year, and the costs and carbon taxes will thus also increase year by year.	Increased costs	Short term	High	• Adopt energy-saving equipment • Develop innovative products • Adopt low-carbon or renewable energy. For instance, renewable energy accounted for 50% of energy consumption at our Tianjin site in 2023. • Raise carbon reduction awareness among employees
2	Policy and legal	Increased sustainability-related demands and regulations	According to Taiwan's Pathway to Net-Zero Emissions by 2050, energy transition is listed as one of the main strategies, actively promoting the maximization of renewable energy. In addition, the Renewable Energy Development Act in Taiwan stipulates that users with an electricity contract capacity of 5000 watts or more must have a 10% renewable energy obligation by 2025, all of which promote TSC's accelerated climate action, such as increasing the proportion of renewable energy, reducing product carbon footprints, and enhancing climate-related management.	Increased costs	Short term	High	• Improve product performance • Adopt low-carbon or renewable energy sources • Optimize energy management on an ongoing basis • Improve employees' knowledge and skills in carbon management
3	Market	Changing customer behavior	Customers choose to use lower carbon and lower environmental impact products or request the company to provide more transparent environmental information products/services to meet the trend of global net zero emissions and reducing environmental impact. If TSC cannot meet these requirements, there may be a potential risk of losing customers.	Reduced revenue	Medium term	High	• Develop products or services that minimize environmental impact. • Improve product performance • Use eco-friendly packaging materials.
4	Market	Increased cost of raw materials	In recent years, extreme climate changes have occurred frequently, causing instability in raw materials supply and increasing the difficulty of mining and transportation of raw materials. Factors such as natural disasters may block mining roads and high temperatures may reduce productivity, making it difficult to control the supply of raw materials and causing a shortage of raw material supply, increasing transportation and scheduling costs, and increasing operating costs.	Increased costs	Medium term	Moderate	• Keep a close eye on suppliers' level of focus on climate issues • Conduct supplier risk assessment to avoid or reduce purchases from high-risk production areas
5	Technology	Costs to transition to low-carbon technologies	Due to the growing international trend towards carbon reduction, many companies have begun requiring their supply chains to adopt sustainable and low-carbon actions. TSC is gradually planning its transition and promoting carbon reduction technologies and equipment, which will have an impact on TSC's operating costs.	Increased costs	Medium term	Moderate	• Invest in R&D initiatives on high-performance equipment and low-carbon technologies • Actively develop talents in low-carbon transition • Assess investment in low-carbon technologies and equipment
6	Reputation	Increased negative stakeholder feedback	Owing to the growing importance of climate change issues, stakeholders prefer low-carbon or environmentally friendly companies that contribute positively to humans and the environment. If TSC does not take proactive measures, we will not be able to meet stakeholder expectations and may damage the Company's reputation.	Reduced capital	Long term	Moderate	• Strengthen climate change response and prevention • Enhance appropriate disclosure of our company's climate action information • Strengthen communication with stakeholders

Low Moderate High

No.	Dimension	Risk	Impact on TSC	Potential financial impact	Period of impact on TSC	Risk level	Response measures and strategies
Physical risk							
7	Acute	Increased severity of extreme weather events - typhoons	Increasing frequency and severity of typhoons will lead to the following impacts: • Typhoons may destroy the power system, causing partial regional power outages, leading to operational or service interruptions. • Typhoons may cause supply chain disruption. • Asset insurance premiums in high-risk areas have increased, increasing operating costs.	Increased costs	Medium term	●	• Strengthen flood control, drainage facilities, and contingency measures at our production sites • Roll out and implement a business continuity plan (BCP) • Strengthen the emergency supply mechanism
8	Acute	Increased severity of extreme weather events - heavy rain	Increasing frequency and amount of heavy rain may cause damage to production sites, production interruptions, and transportation disruptions that prevent employees going to work.	Reduced revenue	Medium term	●	• Strengthen flood control, drainage facilities, and contingency measures at our production sites • Roll out and implement a business continuity plan (BCP) • Strengthen the emergency supply mechanism
9	Acute	Droughts	Water shortages caused by droughts lead to water supply interruptions, increased water fees, and disruptions in the purchase of external water sources, affecting the water usage in factories. This may also cause interruptions in operating activities.	Increased costs	Medium term	●	• Implement water-saving measures • Study and draw up a water reclamation program to increase consumption of reclaimed water
10	Chronic	Rising mean temperatures	Climate change has led to an increase in the duration of high temperatures, electricity demand, and rising energy costs globally. Moreover, droughts caused by high temperatures pose a risk of operational disruptions.	Increased costs	Long term	●	• Implement water-saving measures • Roll out and implement a business continuity plan (BCP) • Closely monitor electricity consumption and adjust it as needed in a timely manner

Note: Short term represents a period of up to three years; medium term represents a period from three to five years; and long term represents a period of five years and above.

Climate-related Opportunities

According to the identification results, the top three opportunities were "improved product efficiency," "use of more efficient production and distribution processes," and "participation in renewable energy programs."

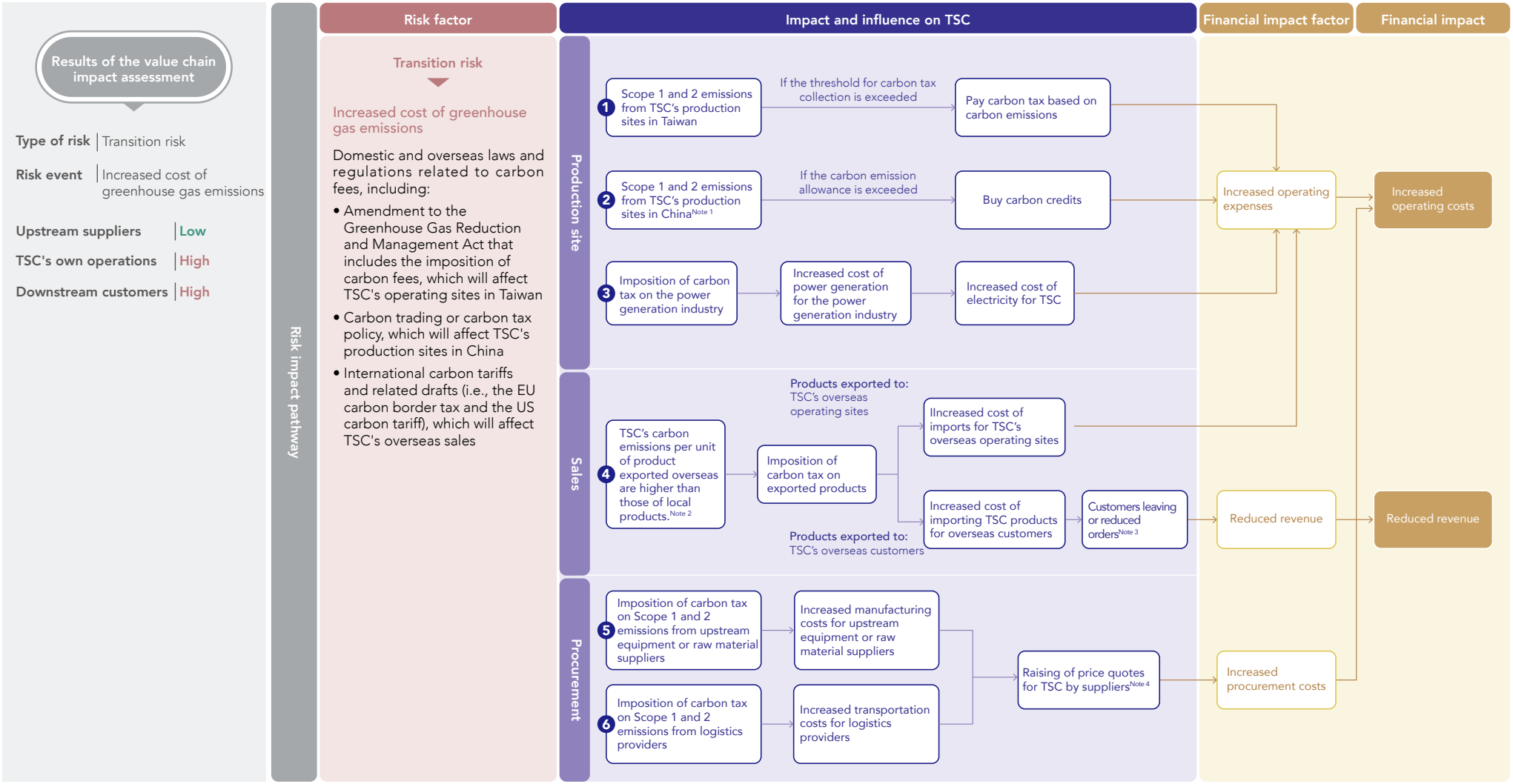
No.	Dimension	Opportunity	Significance to TSC	Potential financial impact	Period of impact on TSC
1	Products and services	Enhanced product performance	We are actively working to improve the energy efficiency of our products, aiming to assist customers and users in reducing energy consumption and greenhouse gas emissions during product use. In light of the rapid growth of the new energy vehicle chip market and the 5G industry, TSC will persist in optimizing product performance, expanding our market presence, and increasing profitability.	Increased revenue	Short term
2	Resource efficiency	Use of more efficient production and distribution processes	By enhancing the energy efficiency of production processes and transportation logistics, as well as bolstering material, energy resource, and waste management, it is feasible for TSC to decrease energy resource consumption and carbon emissions, thereby reducing operating costs.	Reduced costs	Medium term
3	Resilience	Participation in renewable energy programs	To promote the adoption of low-carbon energy and establish a diversified power supply to enhance climate resilience, it will be feasible for TSC to sustain our transition towards low-carbon energy by constructing and procuring renewable energy sources.	Changing costs	Medium term

Note: Short term represents a period of up to three years; medium term represents a period from three to five years; and long term represents a period of five years and above.

Climate Risk Impact Assessment and Scenario Analysis

Following the rollout of climate risk and opportunity assessment analysis in 2022, TSC prioritized the quantitative assessment of the transition risk, namely **"increased cost of greenhouse gas emissions,"** according to risk level, probability of occurrence, and level of impact in 2023. Aside from the path of impact of "increased cost of greenhouse gas emissions" on TSC, the impacts of carbon fees and tariffs on TSC's value chain and own operations under different scenarios were also taken into consideration, while the assessment results were employed in the adjustment of TSC's operating strategies and the review of TSC's risk tolerance while revising the relevant response measures on a rolling basis.

Climate risk impact pathway - Increased cost of greenhouse gas emissions



Note：
1. In the current carbon market in China, the semiconductor industry is not included in the scope of carbon trading control. Therefore, this project will be assessed under the hypothetical scenario, where "the semiconductor industry is included in the carbon emissions trading mechanism in China."
2. As there is no announcement under the current carbon tax system stipulating that semiconductors or electronic products are placed under carbon tax control, this project will be assessed under the hypothetical scenario, where "the semiconductor industry is included the scope of carbon tax control under the EU carbon border adjustment mechanism (CBAM) and the US border carbon adjustment system."
3. The actual extent of shift in sales orders is affected by various factors such as product irreplaceability and price advantage.
4. Raising of price quotes is affected by suppliers' cost-shifting ability.

In order to analyze the future impact of climate change on TSC, we initiated the analysis process based on the Net Zero Emission by 2050 (NZE) scenario and the Announced Pledges Scenario (APS) proposed by the International Energy Agency (IEA), with the intention of understanding the impact of different scenarios on TSC.

As climate change continues to escalate, the rollout of laws and regulations related to carbon fees both at home and abroad, including the EU CBAM, Taiwan's carbon pricing policy, and China's carbon trading and tax policy, may lead to increased production costs for TSC. Furthermore, these policies and regulations not only impact TSC directly, but also have repercussions throughout the value chain. If suppliers become subject to these fees, the costs of relevant raw materials and equipment investments may rise gradually.

At the present stage, TSC has assessed the three impacts under two carbon fee scenarios, namely NZE and APS: increased operating expenses, reduced revenue, and increased procurement costs.

1. Increased operating expenses

Following the rollout of carbon tax across various countries, including the carbon trading mechanism in China, carbon fees imposed by the Ministry of Environment in Taiwan, and the EU CBAM, TSC may face the risk of having to pay carbon taxes or purchase carbon credits according to our carbon emissions if the threshold for carbon tax collection or carbon emission allowance is exceeded. In view of the fact that electricity suppliers may raise electricity prices to shift the cost of greenhouse gas emissions, there could be a certain percentage of increase in electricity prices by 2030, which will lead to increased operating expenses and costs on TSC's part. According to estimates, TSC's Shandong Site may be subject to carbon taxes if the Chinese carbon trading market includes the semiconductor industry in the country's carbon emissions trading mechanism, which could result in potential financial impacts on TSC.

In an effort to cope with increased operating costs, TSC will actively engage in energy transition through various initiatives, including studying and drawing up renewable energy development plans, as well as rolling out and implementing energy conservation and carbon reduction programs at all our production sites, with the intention of minimizing the financial impacts of this risk.

2. Reduced revenue

As TSC's products are primarily exported overseas, these exported products may be subject to carbon tax or carbon fee if semiconductors or electronic products are included in the scope of international carbon tax-related policies. This may indirectly affect overseas customers' intention to purchase products from TSC and cause them to switch their focus on purchasing products with lower carbon content from other competitors, which in turn poses great challenges to TSC in the sales market and thus lead to reduced revenue for TSC.

TSC will focus on low-carbon operations and improving product performance as the primary strategy. This will involve offering customers more competitive low-carbon products and services, while also consistently reducing the risk of customer order shifting due to increased cost of greenhouse gas emissions.

3. Increased procurement costs

Climate-related laws and regulations may have an impact on not only TSC, but also our suppliers and logistics providers, which in turn lead to increased production and transportation costs, thereby putting TSC at risk of cost shifting by suppliers and thus resulting in increased procurement costs for TSC.

Aside from keeping a close eye on developments related to international climate-related laws and regulations on an ongoing basis, we also maintain active communication with our suppliers to learn about the impact of carbon tax and fee-related policies on our suppliers, in hopes of minimizing the financial impacts of tax shifting on material procurement and logistics services to the best of our ability.

Risk factor	Climate scenario	Scenario assumptions	Carbon fee in 2024 (Unit: monetary amount per ton of CO_2e)	Scenario analysis factor	Possible financial impact
Transition risk- Increased cost of greenhouse gas emissions	Scenario 1 NZE	Under the NZE scenario, the global energy sector is expected to achieve net-zero carbon emission in 2050, where greenhouse gas emissions will decrease year by year, whereas global average temperature rise will be less than 1.5°C by 2100.	• Asia- Taiwan: NT$300 Tianjin, China: RMB34.30 Shandong, China: RMB45.61 US$90 by 2030 • Europe- USD 80.82 元 • US- US: US$55 US$140 by 2030	• Cost of carbon tax • Electricity charges for production sites • Carbon tariffs on exported products • Procurement costs	**The financial impact of increased cost of greenhouse gas emissions accounts for approximately 0% to 5% of total revenue,** which primarily emanates from the following: 1. Production sites are subject to carbon fees if the statutory requirements for Scope 1 and 2 emissions are exceeded: According to estimates concerning to production capacity and electricity consumption at TSC's four production sites across Taiwan and China before 2030, it is likely that TSC could cross the carbon fee threshold if the statutory limits for Scope 1 and 2 emissions are exceeded in the future, which in turn leads to increased cost of emissions. 2. Impact of carbon tax or fee shifting from purchased electricity: As the power generation industry in the region where our production sites are located is also subject to carbon fee, there could be a shift in the cost of power generation to electricity tariffs, which in turn leads to increased cost of purchased electricity for TSC. 3. Impact of carbon tariffs on exported products: Exporting TSC's products to countries that implement carbon tax may lead to increased costs for TSC as a result of carbon tariffs. 4. Impact of tax or fee shifting on material procurement: Owing to rising carbon prices, upstream equipment or raw material suppliers are facing increased production costs, which may be passed on to TSC, thus resulting in increased procurement costs for TSC.
	Scenario 2 APS	Under the APS scenario, all the greenhouse gas reduction and net-zero targets declared by governments around the world will be achieved on time and in full. Greenhouse gas emissions are projected to reach a peak in mid-2020s, while global average temperature will increase by 1.7°C in 2100.	• Asia- Taiwan: NT$300 Tianjin, China: RMB34.30 Shandong, China: RMB45.61 US$40 by 2030 • Europe- USD 80.82 元 • US- US: US$55 US$135 by 2030		

Climate Change Risk Metrics and Targets

In an effort to cope with the impact and challenges of climate change, TSC endeavors to meet the Taiwan government's net-zero target by 2050. Echoing the Taiwan government's policy on climate change, not only do TSC's operating sites in Taiwan achieve a minimum 1% reduction in electricity consumption each year, which is better than that required by law, but TSC has also developed ISO-related management systems through the rollout of numerous energy conservation and carbon reduction programs. In 2023, TSC has initiated the Renewable Energy Research and Development Project, with the related work plan to be carried out gradually in due course.

Carbon reduction strategy	Content	Current implementation status
Rolling out and implementing energy conservation programs	Continue to carry out equipment upgrade and energy management through regular equipment inspections, as well as replace old energy-consuming equipment with new energy-saving ones, in order to enhance the effectiveness of our carbon reduction efforts. Please refer to 5.2.2 Energy Management for more details.	Our operating sites have completed many energy conservation programs each year while reducing carbon emissions from energy-consuming equipment. TSC saved up to 2,567 GJ of energy in 2023.
Developing renewable energy	Draw up renewable energy utilization program based on an energy conservation, energy creation, and energy storage mindset, which prioritizes the installation of solar panels on the rooftop of our operating sites, supplemented by the purchase of green electricity.	Our operating sites in Taiwan have completed on-site surveys and assessments for the construction of solar energy facilities in 2023. Related construction works will gradually commence upon completion of detailed study.
Stepping up the establishment of management systems	Continue to update our ISO management systems and pass third-party verification on a regular basis. Please refer to 5.2.1 Carbon Emissions Management for more details.	In 2023, our Li-Je and Shandong sites have been awarded the ISO 14064 certification, with the scope of inventory expanded to include Categories 3 to 6 emissions at the same time, whereas our Li-Je site has been awarded the ISO 50001 Energy Management Systems certification.
Introducing digital management systems	Assess smart carbon management solutions and replace manual input with digital technology to improve data quality. Endeavor to carry out intelligent monitoring and collect data in real time to facilitate analysis and forecasting.	TSC is expected to carry out the supplier selection process in 2024, and establish a carbon management platform while each operating site conducts their own inventories.

5.2 Energy Resource Management

GRI 305-1 GRI 305-2 GRI 305-3 GRI 305-4 TC-SC-110a.1 TC-SC-110a.2

Natural resources are shared by the whole world. As TSC recognizes the critical role we play in the semiconductor production chain, TSC is committed to enhancing our energy efficiency, with a view to preventing the depletion of natural resources due to overuse, and thus protecting the living environment for future generations. In 2023, TSC not only expanded the scope of greenhouse gas inventory and developed alternative energy solutions, but also replaced old equipment with new ones through various energy conservation programs to enhance energy efficiency, in hopes of minimizing the impact of our operations on the environment through various actions.

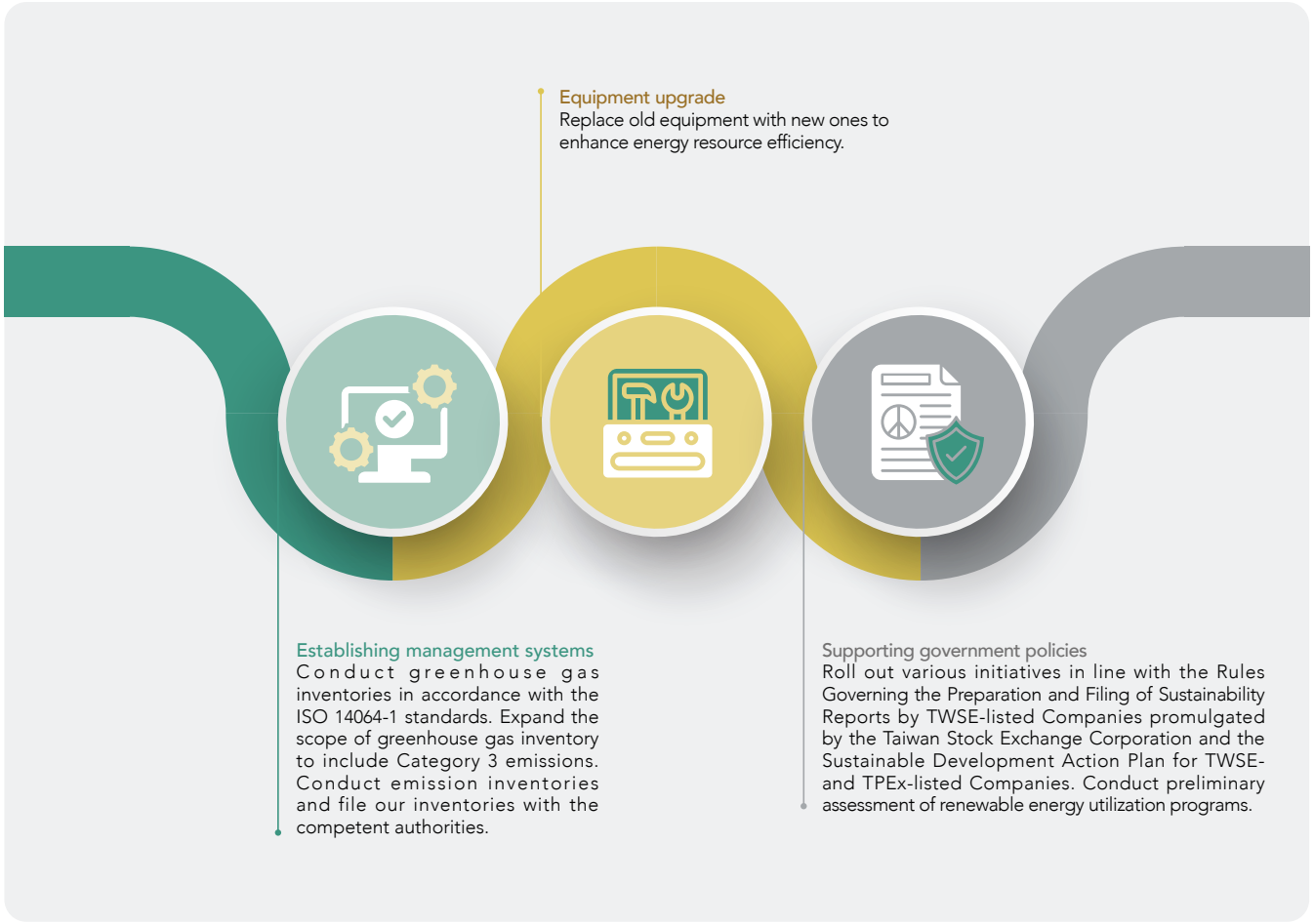
Coverage of environmental sustainability-related ISO management systems standards at TSC's production sites

Standards	Coverage	Verification body
ISO 14001 Environmental Management Systems Standards	100%[註1]	TUV
ISO 50001 Energy Management Systems Standards	25%[註2]	TUV
ISO 14064-1:2018 - Greenhouse Gas Inventory Standards	50%[註3]	TUV

註：
1. 台半全數生產據點皆通過 ISO 14001 環境管理系統
2. 利澤廠於 2023 年通過 ISO 50001 能源管理系統
3. 利澤廠、山東廠通過 ISO 14064-1:2018 溫室氣體盤查

5.2.1 Carbon Emissions Management

We conduct direct and indirect greenhouse gas inventories in compliance with the ISO 14064-1 standards, and file our inventories with the competent authorities in accordance with regulatory requirements. In addition, we gradually set renewable energy targets in line with government policies while reducing greenhouse gas emissions through various greenhouse gas reduction programs and the deployment of renewable energy.

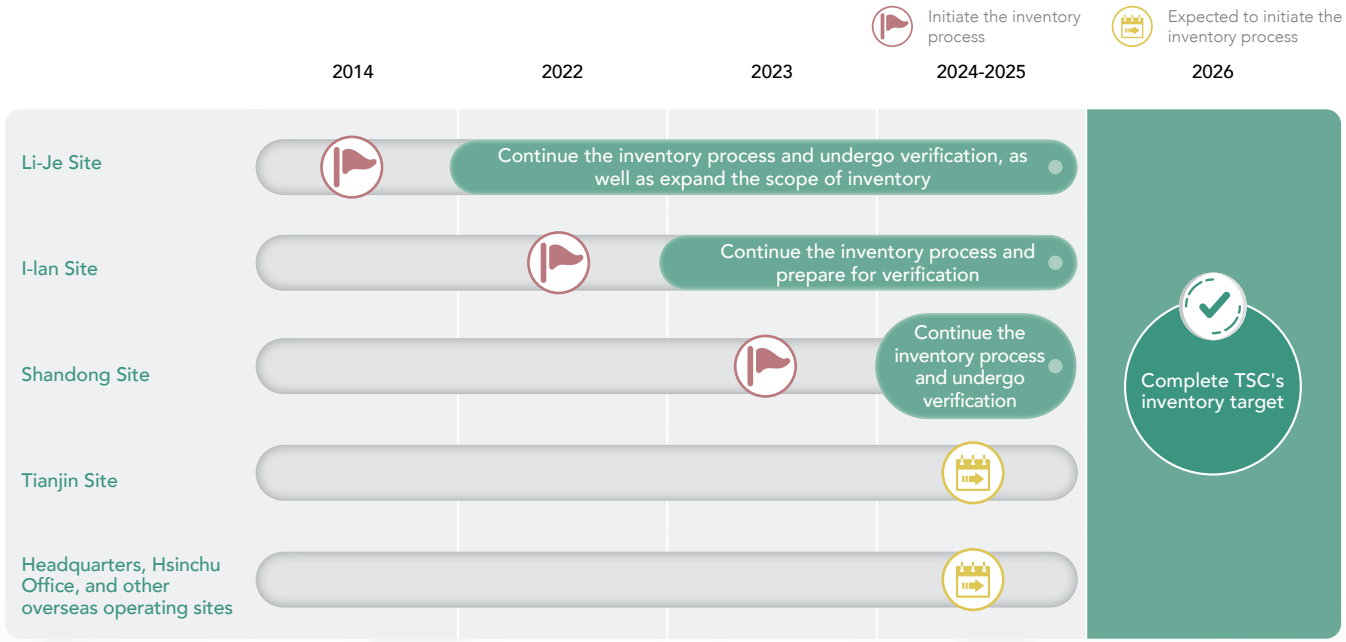


Greenhouse Gas Inventory

All TSC production sites have put in place a greenhouse gas inventory mechanism in accordance with the ISO 14064-1 standards. TSC also includes the progress of these inventories in the matters to be regularly reported to the Boar of Directors in line with the Sustainable Development Action Plan for TWSE- and TPEx-listed Companies. We are expected to complete our overall greenhouse gas inventory, which will cover our production sites across Taiwan and China, as well asother overseas operating sites, by 2026. In addition, we continue to expand emissions categories in accordance with the latest ISO 14064-1:2018 standards, in hopes of understanding the emissions hotspots of the organization through our inventory and setting more accurate greenhouse gas reduction targets. In 2023, there was a slight increase in TSC's overall greenhouse gas emissions due chiefly to the expanded scope of inventory at our Li-Je and Shandong sites, as well as emissions of perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3) as a consequence of the newly developed manufacturing processes at our Li-Je site.

Carbon emissions at TSC are dominated by Category 2 emissions from purchased electricity. Since carbon emissions primarily emanate from all our production sites, greenhouse gas emission inventory was first rolled out at each production site, while our overall greenhouse gas inventory is scheduled for completion by 2026.

Progress of greenhouse gas inventory at TSC's operating sites



Greenhouse gas emissions at TSC's operating sites in 2023

Unit: tCO_2e

Category	Source of emission	Type of greenhouse gas	Emissions	Total
I-lan Site				
Category 1	Stationary combustion	CO_2、CH_4 and N_2O	0	0.8534
	Mobile combustion	CO_2、CH_4 and N_2O	0.2479	
	Process emission	VOCs	0	
	Fugitive emission	CH_4	0.6055	
Category 2	Purchased electricity	CO_2	4,003.7533	4,003.7533
Li-Je Site				
Category 1	Stationary combustion	CO_2、CH_4 and N_2O	1.3322	4,699.6808
	Mobile combustion	CO_2、CH_4 and N_2O	5.9009	
	Process emission	PFCs、HFCs、N_2O、SF_6 and NF_3	4,676.5465	
	Fugitive emission	HFCs、CO_2 and CH_4	15.9012	
Category 2	Purchased electricity	CO_2	10,103.8808	10,103.8808
Categories 3 to 6	Transportation emissions (Category 3) and emissions from products used by the organization (Category 4)	CO_2	5,123.5114	5,123.5114
Shandong Site				
Category 1	Stationary combustion	CO_2、CH_4 and N_2O	39.51	39.51
	Mobile combustion	CO_2、CH_4 and N_2O		
	Process emission	VOCs		
	Fugitive emission	CH_4		
Category 2	Purchased electricity	CO_2	23,261.74	23,261.74
Categories 3 to 6	Transportation emissions (Category 3) and emissions from products used by the organization (Category 4)	CO_2	10,641.92	10,641.92

Note:
1. Greenhouse gas inventory data was compiled using the operational control approach.
2. Our production sites in Taiwan made the relevant calculations using the electricity carbon emission factor in 2022, while the GWP values for our Li-Je and I-lan sites were adopted from the IPCC AR5 and AR4 emission factors. On the other hand, our production sites in China made the relevant calculations using the 2012 North China Regional Grid emission factors, while the GWP values for these operating sites were adopted from the IPCC AR6 emission factors.
3. The Li-je site calculated process emission based on the "Greenhouse Gas Emission Factor" announced by the Ministry of Environment on February 5, 2024. The emission sources include PFCs, HFCs, N2O, SF6, and NF3, resulting in an increase in direct emissions for 2023 compared to previous years.
4. The Tianjin site and our other operating sites are scheduled to initiate the inventory process before 2025.
5. The Shandong site initiated the inventory process in 2022.

Direct and indirect greenhouse gas emissions at TSC's production sites over the past few years

單位：tCO_2e

		Li-Je Site			I-lan Site			Shandong Site			Total		
		2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Direct emissions	Category 1	27.8049	34.247	4,699.6808	0.8214	0.9059	0.8524	N/A	101.6407	39.5100	28.6263	136.7940	4,740.0432
Indirect emissions from energy	Category 2	9,604.0632	10,341.862	10,103.8808	3,883.6527	3,997.2177	4,003.7533	N/A	27,005.9631	23,261.7431	13,487.7159	41,345.0428	37,369.3772
Total Category 1 and 2 emissions		9,631.5678	10,376.109	14,803.5620	3,884.4741	3,998.1236	4,004.6057	N/A	27,107.6038	23,301.2500	13,516.3422	41,481.8368	42,109.4204

Note:
1. Greenhouse gas inventory data was compiled using the operational control approach.
2. Our production sites in Taiwan made the relevant calculations using the electricity carbon emission factor in 2022, while the GWP values for our Li-Je and I-lan sites were adopted from the IPCC AR5 and AR4 emission factors. On the other hand, our production sites in China made the relevant calculations using the 2012 North China Regional Grid emission factors, while the GWP values for these operating sites were adopted from the IPCC AR6 emission factors.
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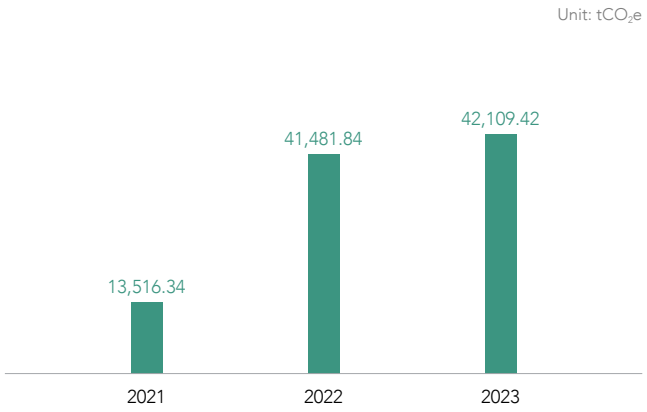
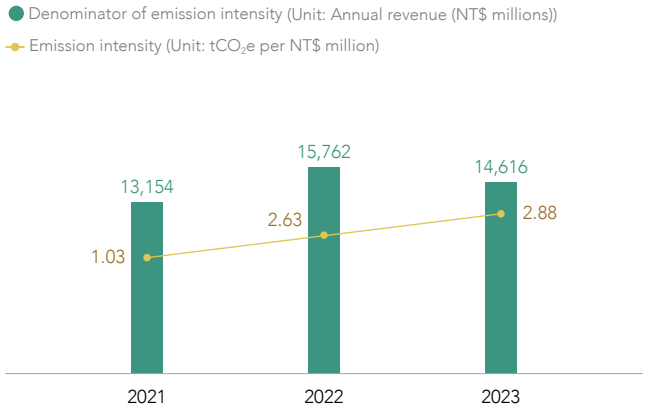
4. The Tianjin site and our other operating sites are scheduled to initiate the inventory process before 2025.
5. The Shandong site initiated the inventory process in 2022.

Direct and indirect greenhouse gas emission intensity per unit of revenue

• Total greenhouse gas emissions



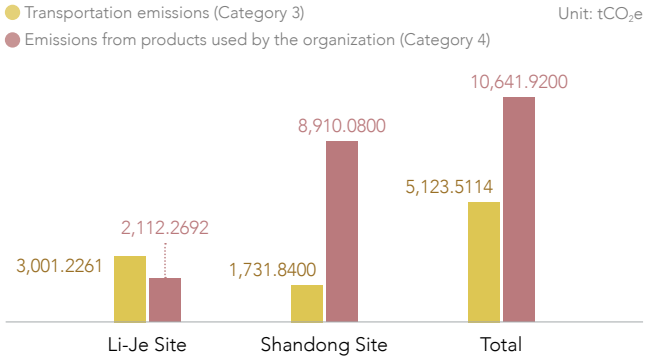
• Emission intensity



Note:
1. The diagram above does not include our Tianjin site, headquarters, Hsinchu Office, and other overseas operating sites as they are yet to conduct greenhouse gas inventories.
2. Total greenhouse gas emissions represents the sum of Category 1 and 2 emissions at our Li-Je, I-lan, and Shandong sites. Specifically, emissions at our Li-Je and I-lan sites were included in the calculation of total greenhouse gas emissions for 2021, while emissions at the Shandong site was added from 2022 onwards.
3. The denominator of emission intensity is annual consolidated revenue in NT$ millions.
4. There has been an upward trend in overall emissions due to the expanded scope of inventory; however, consolidated revenue remained group-wide.

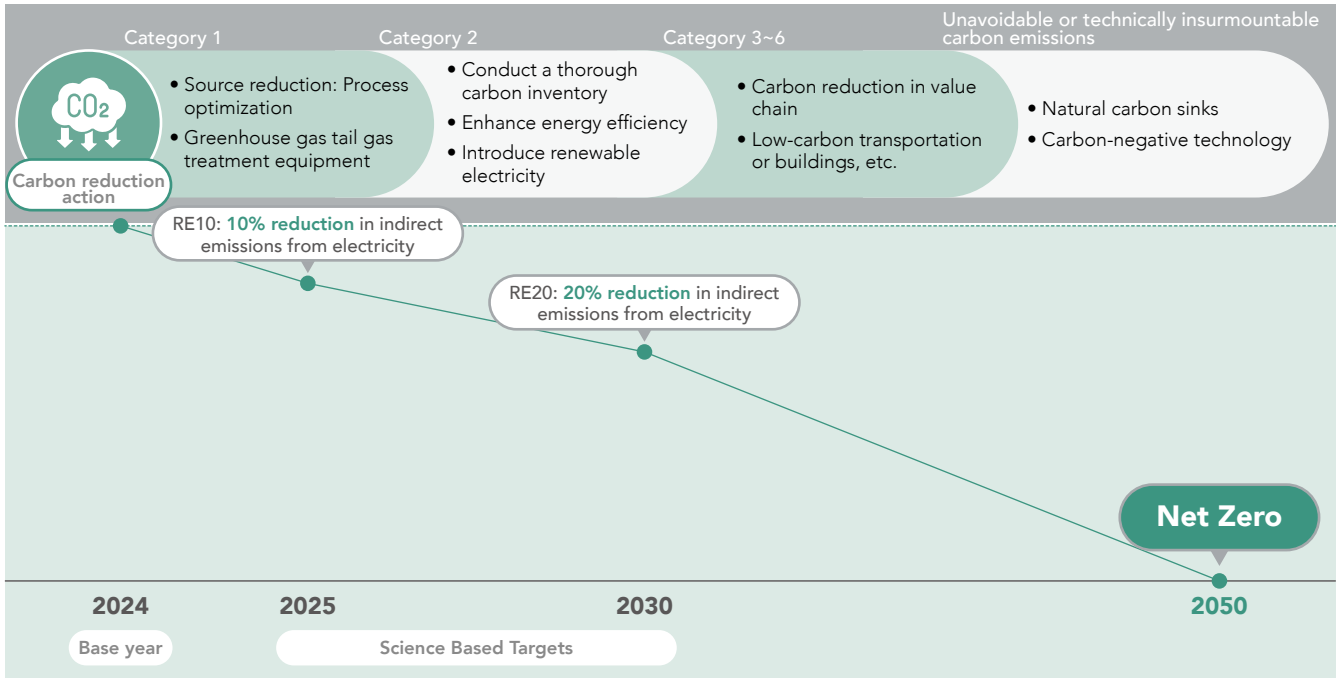
Other indirect greenhouse gas emissions (Categories 3 to 6) in 2023

Our Li-Je and Shandong sites began to expand the scope of inventory, which initially covers Category 1 and 2 emissions only, and conduct inventories of other indirect greenhouse gas emissions in 2022. TSC will continue to improve the scope of inventory and roll out the inventory process at other production sites. TSC's other indirect greenhouse gas emissions for 2023 was 15,765,4314 tCO_2e.



Note:
1. The Li-Je Site made the relevant calculations based on the electricity carbon emission factors for 2022, while the GWP values for the Li-Je Site was adopted from the IPCC AR5 emission factors.
2. The Shandong Site made the relevant calculations using the 2012 North China Regional Grid emission factors, while the GWP values for the Shandong Site were adopted from the IPCC AR6 emission factors.

Carbon Reduction Strategies



TSC drafted a carbon reduction roadmap in 2024. In view of the fact that all major production sites are expected to gradually complete their greenhouse gas inventories from 2024 onwards, we propose to roll out and implement carbon reduction through short-, medium-, and long-term strategies, with 2024 as the base year. Our targets include a 10% reduction in total Category 1 and 2 emissions by 2025, followed by a 20% reduction by 2030, and eventually achieving the net-zero target by 2050. Specifically, we primarily focus on reducing Category 1 emissions by optimizing the use of process gases and installing additional relevant gas treatment equipment, as well as reducing Category 2 emissions by conducting greenhouse gas inventories, enhancing energy efficiency, and developing renewable energy.

TSC's short-, medium-, and long-term carbon reduction strategies revolve around four approaches: rolling out and implementing energy conservation programs, developing renewable energy, stepping up the establishment of management systems, and introducing digital management systems. With a number of energy conservation and carbon reduction measures in place, we endeavor to not only gradually replace old equipment at our production sites with high-efficiency treatment equipment and optimize energy efficiency on an ongoing basis, but also roll out and engage in energy transition by installing renewable energy equipment such as solar power generation facilities across all operating sites, thereby gradually moving towards energy transition.

Rolling out and implementing energy conservation programs

- Carry out carbon reduction with energy-consuming equipment and energy conservation with water chillers at all our production sites.
- Replace old equipment with new ones in order to enhance energy efficiency
- TSC completed a number of energy conservation programs in 2023, saving 2,567 GJ of energy in the process.
- Continue to enhance the effectiveness of our carbon reduction efforts through regular equipment inspections.

Developing renewable energy

- Draw up a solar panel assessment plan with the aim of generating electricity for our own use.
- Assess the option of purchasing green electricity.
- Our I-lan and Li-Je sites have completed on-site surveys and assessments for the construction of solar energy facilities at the end of 2023. Related construction works will gradually commence thereafter.
- Draw up renewable energy utilization program based on an energy conservation, energy creation, and energy storage mindset, which prioritizes the installation of solar panels on the rooftop of our operating sites, supplemented by the purchase of green electricity.

Stepping up the establishment of management systems

- ISO 50001 Energy Management System
- ISO 14064-1:2018 Greenhouse Gas Inventory (Categories 1 and 2, along with selected components under Categories 3 to 6).
- In 2023, our Li-Je and Shandong sites have been awarded the ISO 14064 certification, with the scope of inventory expanded to include Categories 3 to 6 emissions at the same time.
- In 2023, the Li-Je site was awarded the ISO 50001 Energy Management Systems certification.
- Continuously update the ISO management systems and pass third-party verification on a regular basis.

Introducing digital management systems

- Assess smart carbon management solutions, have the headquarters compile carbon emissions data at all production sites, replace manual input with digital technology to improve data quality.
- Expected to conduct supplier selection in 2024, and gradually set up a carbon management platform as each production site conducts its own inventory.
- Implement smart monitoring and management of energy resources and collect data in real time to facilitate analysis and forecasting.

5.2.2 Energy Management

GRI 302-1 GRI 302-3 GRI 302-4 TC-SC-130a.1

TSC is committed to improving energy efficiency and ensuring that electricity consumption and other energy consumption are reduced by at least 1% annually. At present, all our production sites have implemented environmental protection plans that are based on their energy consumption. They conduct inspections on equipment that consumes a significant amount of energy and continuously upgrade to new energy-saving equipment as replacements. In 2023, our Li-Je and Shandong sites gradually incorporated the ISO 50001 Energy Management Systems standards in hopes of identifying energy-consuming hotspots based on data analysis upon monitoring and measurement of energy consumption to prevent waste of resources.

Establishing management systems
Introduce the ISO 50001 Energy Management System.

Equipment upgrade
Roll out and implement energy conservation and carbon reduction programs while replacing old equipment with new ones.

Supporting government policies
Our production sites in Taiwan achieve a 1% reduction in electricity consumption each year, which is better than that required by law.

Energy Structure

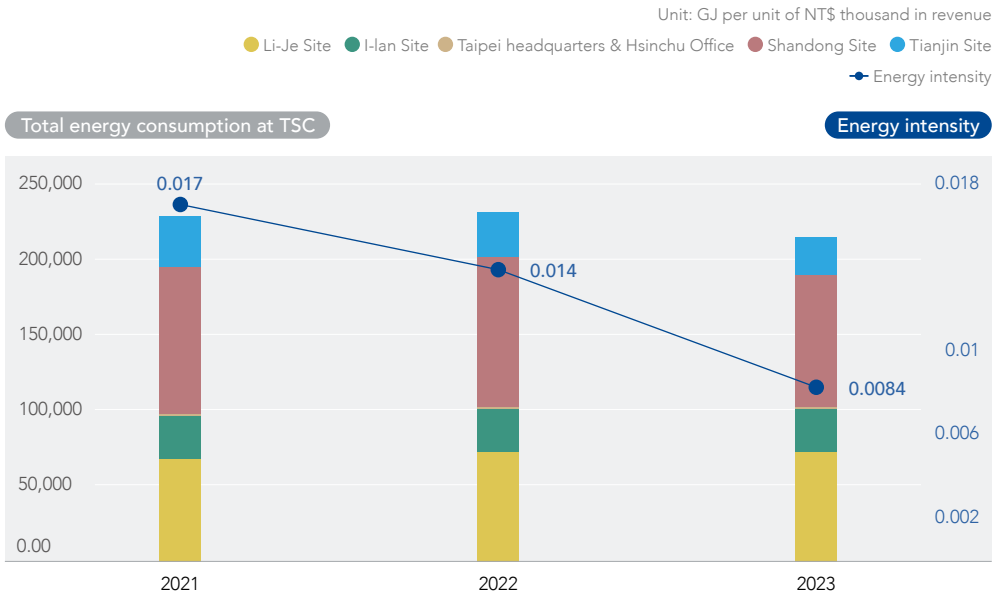
TSC's production sites use electricity, diesel, and gasoline as their energy sources. In 2023, the primary source of energy consumed by TSC was purchased electricity, which accounted for 99.8% of TSC's total energy consumption. The remaining energy sources, i.e., fuels, were primarily used in emergency generators, stackers, forklifts, and other equipment at the site. On the other hand, the Shandong Site has invested up to NT$640,000 to replace all diesel forklifts with electric forklifts, which is projected to reduce 1.5 tons in diesel consumption each year. As far as energy intensity is concerned, there has been a downward trend over the past three years, which suggests a significant increase in energy efficiency at our production sites.

Energy consumption at TSC's operating sites over the past few years

Energy source	Site	2021					2022					2023				
		Li-Je Site	I-lan Site	Shandong Site	Tianjin Site	Taipei head-quarters	Li-Je Site	I-lan Site	Shandong Site	Tianjin Site	Taipei head-quarters	Li-Je Site	I-lan Site	Shandong Site	Tianjin Site	Taipei head-quarters & Hsinchu Office
Non-renewable fuels	Gasoline	7.72	1.31	108.42	0	Note 5	6.39	1.31	85.57	0	44.45	10.20	1.31	173.48	0	51.05
	Diesel	65.34	2.81	119.82	0	0	108.89	2.46	101.86	0	0	86.96	2.81	53.98	0	0
	Liquefied Petroleum Gas	0	0	0.51	0	0	0	0	1.01	0	0	0	0	1.52	0	0
	Purchased electricity	68,873.76	27,850.90	97,652.13	33,521.76	1,353.12	73,144.80	28,160.78	99,912.81	29,738.23	1,114.84	73,631.52	28,317.31	87,627.76	19,002.10	1,180.72
Renewable fuels	Purchased electricity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total energy consumption		68,946.82	27,855.02	97,880.88	33,521.76	1,353.12	73,260.08	28,164.55	100,101.25	29,738.23	1,159.29	73,728.68	28,321.43	87,856.74	19,002.10	1,231.77
Total		229,557.60					232,423.40					210,140.72				

Note:
1. Gasoline is not distinguished by octane number.
2. Conversion coefficients were taken from published by the Heat Content of Energy Products published by the Bureau of Energy, Ministry of Economic Affairs, where Gasoline: 7,800 kcal per liter (1 liter of gasoline = 0.0327 GJ); Diesel: 8,400 kcal per liter (1 liter of diesel = 0.0352 GJ); Liquefied Petroleum Gas: 6,635kcal per liter (1liter of liquefied petroleum gas = 0.0505GJ);Electricity: 860 kcal per kWh (1 kWh of electricity = 0.0036 GJ).
3. The figures above are rounded to two decimal places.
4. The Hsinchu Office was officially opened in 2023, and its data was combined with that of the Taipei headquarters starting in 2023.
5. Only data for the Taipei headquarters between 2022 and 2023 was disclosed as the relevant source documents in 2021 were incomplete.
6. TSC did not sell any electricity, heating, cooling, or steam in 2023.
7. The total non-renewable energy consumption in 2023 was 210,140.72 GJ, and the total renewable energy consumption was 0 GJ.

Energy intensity



Continuous Improvement on Energy Conservation

Since electricity is the main source of energy consumed at TSC, the energy conservation programsrolled out at TSC are aimed at saving electricity. These programsinclude improving heat dissipation at cooling towers and optimizing the power rating of water chillers, upgrading lighting equipment, and replacing old air-conditioning equipment with new ones,with a view to achieving the goal of energy conservation and carbon reduction. In 2023, TSC successfully reduced 9,299.15 GJ in energy consumption.

In 2023, the Li-Je Site introduced the ISO 50001 Energy Management System, in hopes of enhancing energy efficiency to an optimal level by establishing a PDCA (Plan-Do-Check-Action) mechanism and formulating relevant management methods, so that TSC can attain our goals of sustainable operation and environmental friendliness through greenhouse gas reduction.

Considering that there is a risk of wasting energy resources during non-summer seasons when the air-conditioning system at the I-lan Site operates at full capacity regardless of the season, the I-lan Site implemented an improvement program for chilled water pumps and cooling water pumps in 2023, where three cooling water pumps (25HP) and three chilled water pumps (15HP) were retrofitted with frequency inverters. It was initially estimated that the program can lead to a 4% reduction in electricity consumption across the site, which is estimated to save 350,000 kWh of electricity each year. The program yielded greater results than expected after it was carried out, as evidenced by a 6% reduction in electricity consumption, which is estimated to save 480,000 kWh of electricity each year. Please refer to "Featured Story: The Energy Conservation Program for 2023 at the I-lan Site" for more details on the implementation of this program. As the aforesaid pumps have reached their replacement age after being put to use for over 20 years since 2001, the I-lan Site will upgrade the pipelines for chilled water pumps and cooling water pumps, replace these pumps with high-efficiency pumps, and also change some of the valves that are already old or faulty.

Energy conservation and carbon reduction programs and their results over the past few years

Li-Je Site Energy conservation item

- 2021
  - Boost the power of water chillers
  - Reduce equipment ventilation
  - Improve lighting in the repair area
- 2022
  - Implement power saving with air-conditioning systems
- 2023
  - Reduce the frequency of MAU fans.
  - Reduce the frequency of air-conditioning water supply pump to save electricity.
  - Improve power saving with lighting equipment at the site.

I-lan Site Energy conservation item

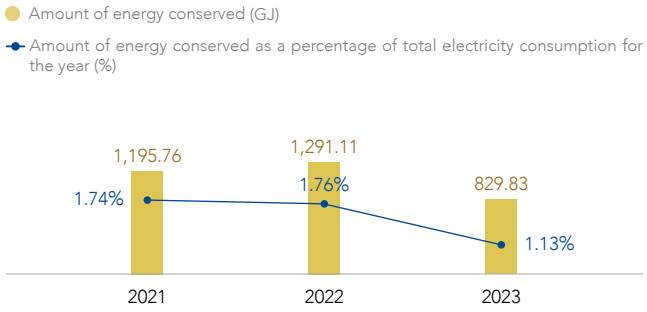
- 2021
  - Implement improvement measures for outside air handling unit and chiller
- 2022
  - Implement the light source replacement program for the TMTT station and molding press station on the front end
  - Replace mercury lamps in the utility apparatus room with LED lamps
  - Implement the on-site exhaust pipeline merger project
- 2023
  - Equip chilled water pumps or cooling water pumps with inverters for flow control

Shandong Site Energy conservation item

- 2023
  - Replace the old water-cooled air conditioners with inverter air conditioners with fluorine pumps at Production Workshop 1.
  - Replace old light fixtures with energy-saving LED ones.
  - Change all air conditioners at its dormitory to full DC invert air conditioners.
  - Install insulated industrial doors in the material turnover area at the site.

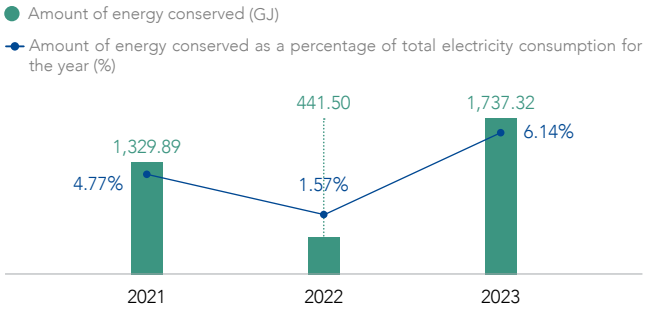
Li-Je Site

Amount of energy conserved as a percentage of total electricity consumption for the year



I-lan Site

Amount of energy conserved as a percentage of total electricity consumption for the year



Shandong Site

Amount of energy conserved as a percentage of total electricity consumption for the year

Amount of energy conserved	6,732 GJ
Amount of energy conserved as a percentage of total electricity consumption for the year	6.8%

Use of Renewable Energy

Following our effort to gradually seek alternative energy sources in line with international trends, TSC, despite not currently being named a large electricity consumer under the Renewable Energy Development Act, continues to keep a close eye on international regulations and policies, prices and costs, as well as market trends related to renewable electricity while gradually studying and drawing up long-term renewable energy development strategies. Aside from assessing the option of constructing solar energy facilities at our production site to generate electricity for our own use, we also assess the option of purchasing renewable energy.

Since 2021, the Tianjin Site has been working with external suppliers to explore the procurement of renewable energy. Our other operating sites will conduct ongoing assessments on renewable energy utilization programs, aimed at reducing greenhouse gas emissions with concrete actions, thereby minimizing the impact of our production activities on the environment.

Introducing the ISO 50001 Energy Management System at the Li-Je Site

Proactively echoing efforts to save energy and reduce carbon emissions, the Li-Je Site began introducing the ISO 50001 Energy Management System in 2023, in hopes of gradually enhancing energy efficiency by establishing a PDCA (Plan-Do-Check-Action) mechanism and formulating related management methods, along with systematic energy inventories, energy consumption analysis, as well as periodic inspections and continuous improvements, while achieving our goals of sustainable operation and environmental friendliness through greenhouse gas reduction.

Upon analysis and comparison, the Li-Je Site proposed a number of improvement plans for the first year of implementing the system, including reducing the frequency of MAU fans, improving the performance of the water chiller system, and improving power saving with lighting equipment at the site, which can save 230,508 kWh of electricity in total and reduce approximately 114,101 kg of CO_2e each year.

	Before improvement	Process	After improvement
Reducing the frequency of air-conditioning water supply pump to save electricity	The water supply pump uses 16.9 kW of electric power when its frequency is 49.3 Hz.	The water supply pump uses 31.02 kW of electric power when its frequency is 60 Hz.	After improvement: The water supply pump uses 12.6 kW of electric power when its frequency falls to 44.4 Hz.
Reducing the frequency of MAU fans	51（MZ）	-	3（MZ）
Improving power saving with lighting equipment at the site	Amount of electricity consumed by 22 mercury lamps: 11,880 kWh	-	8,316（kWh）

登 錄 證 書

此證書頒予

台灣半導體股份有限公司 (利澤廠)

宜蘭縣五結鄉利工一路二段31號

其領域如下

晶圓設計與製造之相關活動

之能源管理系統符合以下標準

ISO 50001:2018

驗證稽核已通過並予以登錄

登錄號碼： 23ENA13921
發證日期： 2023 年 12 月 21 日
發證日期： 2023 年 12 月 21 日
有效日期： 2026 年 12 月 20 日
驗證通過認定日： 2023 年 12 月 21 日
核 准：

環球國際驗證股份有限公司
UNIVERSAL CERTIFICATION SERVICE CO., LTD.

Certificate of Registration

This is to certify that the
ENERGY MANAGEMENT SYSTEM
of
Taiwan Semiconductor Company Limited (LiJe Factory)
No. 31, Sec. 2, Lixing 1st Rd., Wujie Township, Yilan County, TAIWAN, R.O.C.
for
Activities Related to Design and Manufacture of Wafers
has been assessed and registered against the provisions of
ISO 50001:2018
International Standard with

Registration Number: 23ENA13921
Registration Date: 21 Dec., 2023
Issue Date: 21 Dec., 2023
Expiration Date: 20 Dec., 2026
Cycle Start Date: 21 Dec., 2023
Certification Approved:

UNIVERSAL CERTIFICATION SERVICE CO., LTD.

The Li-Je Site was awarded the ISO 50001:2018 Energy Management Systems certification in December 2023.

Improvement Plan for Chilled Water Pumps and Cooling Water Pumps at the I-lan Site

In an effort to realize energy conservation and carbon reduction, TSC not only enhances energy efficiency, but also reduces electricity load while increasing production capacity. In recent years, the I-lan Site has been actively rolling out and implementing initiatives to replace old equipment with new ones, including installing temperate difference monitoring systems on the main chilled water and cooling water pipelines, retrofitting chilled water pumps or cooling water pumps with inverters, adding an inverter control panel and related power distribution wiring, and adding an air-conditioning automation control system, aimed at enhancing the overall chilled water or cooling water efficiency. After implementing the improvement plan for chilled water pumps and cooling water pumps in 2023, the percentage of electricity saved, which was initially estimated to be 4.9%, rose to 6.6% as shown in the actual measurement results, suggesting that this plan has yielded relatively good energy conservation results as it can not only save at least 350,000 kWh of electricity and reduce 173,250 kg of carbon emissions each year.

	Before improvement	After improvement
Lowering the average operating frequency of motor	-	Fall to 50 Hz or below
Temperature difference of evaporator	1.5° C on average	Rise to 3° C or above
Temperature difference of condenser	2° C on average	Rise to 3° C or above

Looking ahead to 2024, the I-lan Site is expected to roll out plans to upgrade the pipelines for chilled water pumps and cooling water pumps, as well as replace these pumps with high-efficiency ones. As the site's assessments show that these pumps have already reached their replacement age and the conversion efficiency of existing pumps has dropped to a range between 55% to 60%, while some valves are already old, the I-lan Site is expected to upgrade the motors for the purpose of extending the service life of the system, and replace the old valves with high-efficiency pump heads. At the same time, the I-lan Site will also install cooling water circulation pumps to improve usage efficiency and reduce motor power, thus reducing energy consumption. This initiative is estimated to save 130,000 kWh of electricity each year, which equivalent of 1.8% of the total amount of electricity used at the site.

5.2.3 Water Resource Management

GRI 303-1 GRI 303-2 GRI 303-3 GRI 303-5 TC-SC-140a.1

Approaches and Targets

Following the significantly increased attention to water resource management at the international level, TSC, as a member of the semiconductor industry, recognizes the significant impact of climate change and water resources on operations. To ensure environmental sustainability and economic efficiency, TSC carries out proper management of water resources, which includes monitoring and recording water withdrawal and discharge, as well as implementing a grinder and cooling cycle water recycling mechanism to efficiently recycle water.

Both our I-lan and Li-Je sites are located in Yilan County. Despite not having any reservoirs, Yilan County benefits from abundant rainfall throughout the year and natural groundwater areas in the Lanyang Plain, which is why water shortages rarely occurs in Yilan County. Meanwhile, the Tianjin Site has not experienced water restrictions or outages as it does not use groundwater. On the other hand, the Shandong Site, despite being a water stress area based on evaluation conducted using the WRI Aqueduct Tool, has begun stepping up water conservation efforts since 2016 while adjusting its planning of water resources to reduce the amount of groundwater it uses. TSC has put in place a complete wastewater management process in order to minimize the impact of wastewater on the environment. Each production site runs its wastewater facilities based on the discharge permit, which is in compliance with the Effluent Standards and the Integrated Wastewater Discharge Standards, which includes conducting daily water quality analysis and engaging third-party verification units to test the quality of effluents on a regular basis, with the intention of stabilizing wastewater discharge while complying with regulatory standards.

Water Resource Structure

Our I-lan and Li-Je sites are situated in Yilan County, which is located in the northeastern part of Taiwan. According to the Central Weather Administration, Yilan County experiences a monsoon climate, with an average annual precipitation of over 2,700 mm. Hence, water shortages rarely occur in Yilan County. In 2023, groundwater constituted approximately 92.3% of the process water used at the I-lan Site, while tap water accounted for 7.7%. Due to the extended rainy seasons in Yilan County and the site's proximity to the mountainside, coupled with a daily withdrawal of less than 100 tons of groundwater, there has been no depletion of groundwater, and no water rationing measures have been necessary . On the other hand, the Li-Je Site relies on surface water as its water source. It utilizes Wulangkeng River as its primary source of pure water, accounting for approximately 90.7%, with tap water making up the remaining 9.3%. As the Wulangkeng River has consistently maintained its water flow over the years, the Li-Je Site currently does not require any water rationing measures.

The Shandong Site is situated in the North Shandong Plain, where it is located on the shore of the Yellow River, i.e., 130 km from the mouth of the Yellow River, and faces the Bohai Sea to the north as it is located 75 km from the Bohai Sea, with an annual rainfall of about 930 mm. Over the years, the Shandong Site has adopted groundwater as its primary source of water, which makes up 96% of its water consumption, with tap water accounting for the remaining 4%. Following the local government's proactive efforts to introduce and implement groundwater mining restrictions and management, implement control of total water volume in the Yellow River, and carry out strict monitoring of the use of water resources in recent years, the Shandong Site has rolled out various water resource management measures for many years, resulting in its unit water consumption to be far lower than the industry average and the water consumption quota. Furthermore, water withdrawal and consumption at the Shandong Site have not been affected by regulatory policies as the site is a key enterprise in the local area. Meanwhile, the Tianjin Site, which is located in the Binhai New District in the eastern suburbs of Tianjin and faces the Bohai Sea to the east, draws water from sources of surface water.

TSC's Taipei headquarters and Hsinchu Office adopt tap water as their primary source of water, which is used purely for domestic purposes.

Amount of water withdrawn and discharged at TSC's operating sites over the past few years

Unit: megaliters

	Li-Je Site			I-lan Site			Shandong Site			Tianjin Site			Taipei headquarters and Hsinchu Office			Total		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
Surface water	227.97	249.29	223.91	0	0	0	0	0	0	0.00	0.00	0.00	註 3	0.00	0.00	227.97	249.29	223.91
Groundwater	0	0	0	49.80	34.82	30.15	356.97	339.48	211.14	0.00	0.00	0.00	註 3	0.00	0.00	406.77	374.30	241.29
Third-party water	37.94	35.22	22.85	2.50	2.80	2.62	11.12	16.93	7.03	295.80	268.31	237.11	註 3	2.11	1.92	347.36	325.37	271.53
Total water withdrawal	265.91	284.51	246.76	52.30	37.62	32.77	368.09	356.41	218.17	295.80	268.31	237.11	註 3	2.11	1.92	982.10	948.96	736.73
Total water discharge	270.71	297.99	260.21	12.32	10.84	12.86	257.60	249.50	161.26	236.64	214.65	189.69	註 3	2.11	1.92	777.27	775.09	625.94
Total water consumption	-4.8	-13.48	-13.45	39.98	26.78	19.91	110.49	106.91	56.91	59.16	53.66	47.42	註 3	0	0	204.83	173.87	110.79

Note:
1. Third-party water refers to tap water. In 2023, TSC did not withdraw water from seawater or produced water sources.
2. Third party water and surface water withdrawal data is obtained from the water bill, whereas groundwater withdrawal data is collected from the water meter reading records of the operating sites.
3. Disclosure of related data for the Taipei headquarters began in 2022, which was calculated based on the proportion of water used on each floor indicated on the water bill of the office building. There were no separate water meters to measure water discharge at the Taipei headquarters and the Hsinchu Office. The Hsinchu office was officially opened in 2023, and its data has been consolidated with the Taipei headquarters for disclosure.
4. According to the WRI Aqueduct Tool, the formula for calculating water stress is as follows: Total annual water withdrawals divided by total available annual renewable supply. Areas with a water stress index ranging from 40% to 80% are classified as high water stress areas, while those exceeding 80% are categorized as extremely high water stress areas. TSC exclusively relies on freshwater sources with a total dissolved solid content of≤ 1,000 mg/L. The water stress index for Taiwan region and Tianjin Site is below 40%; only the Shandong Site is located in an area with extremely high water stress risk, accounting for about 30% and 51% of TSC's overall water withdrawal and water consumption, respectively.

Water Risk Management

The semiconductor industry is a significant consumer of water during wafer production, and any water shortage could have an immediate impact. Furthermore, the more advanced the process, the greater the water consumption. TSC inventoried our production sites in water stress zones using the WRI Aqueduct Tool developed by the World Resources Institute (WRI), and identified the Shandong Site to be in the water stress zone. In an effort to cope with water risks at the Shandong Site, TSC has begun rolling out and implementing the rainwater harvesting pond pump system in recent years in line with the government's water resource policy. Please refer to "Featured Story: Establishing the rainwater harvesting pond pump system at the Shandong Site and using recycled rainwater for greening and irrigation" for more details.

TSC will continue to keep a close eye on local governments' water-related laws and regulations and rollout of related policies while promoting water conservation measures on an ongoing basis.

Water Risk Identification Results

Production site	Water risk assessment	Explanation and management mechanism
Li-Je Site I-lan Site	Areas facing low water stress	TSC's two production sites are located in Yilan County, which is a high water stress area. However, water shortages are not likely to occur in this region over the short term, thanks to the abundance of water resources in the Lanyang River Basin.
Shandong Site	Area facing extremely high water stress	Despite the fact that the Yellow River crosses the border of Binzhou City, where the Shandong plant is located, the Chinese government has imposed controls on water withdrawal indicators that prohibit unlimited withdrawal of water from the Yellow River. At the same time, the Chinese government has also implemented stringent control over groundwater resources and imposed restrictions on groundwater mining. We do not rule out the possibility of the Chinese government raising related restrictions in the future. With environmentally friendly and long-term considerations in mind, the Shandong Site has been stepping up its water conservation efforts since 2016, including shutting down the "pickling station," which is the largest water user, as well as upgrading equipment and improving water recirculation in the electroplating process, which has successfully reduced water consumption in the production process to an industry-leading level, well below the industry's water consumption quota. In the future, the Shandong Site will adjust its plans concerning water resources while reducing its water consumption as it looks to increase tap water consumption and lowers groundwater consumption.
Tianjin Site	Area facing low-medium water stress	The Tianjin Site does not face water rationing or water outage as it sources water from the Tianjin Development Zone Tap Water Company and does not use groundwater.

Wastewater Monitoring Mechanism

TSC's production sites have implemented the Wastewater Management Operating Procedure to effectively control and process wastewater discharged during the production process. This procedure clearly regulates wastewater collection, monitoring, recording, testing, and reporting. By strengthening wastewater quality control, we can prevent abnormal effluent quality that negatively impacts the environment. Each production site diligently documents the discharge and dosage on a daily basis, ensuring compliance with the effluent quality standards promulgated by the local government. Additionally, they conduct 24-hour monitoring of the wastewater treatment system. The duty staff records the daily wastewater system operation data and water quality analysis values, which are then approved by the system engineer. The unit supervisor reviews these records, and the monthly reports are compiled into charts and submitted to the top supervisor of the site for review.

Part of TSC's production process results in wastewater discharge that contains small amounts of heavy metal nickel and fluorine ion pollutants. Our production sites in Taiwan discharge wastewater in compliance with the Effluent Standards established for the semiconductor manufacturing industry, whereas our production sites in China discharge wastewater in accordance with the Integrated Wastewater Discharge Standards promulgated by local governments across the country.

Historical Trend of Wastewater Discharge at TSC's Production Sites

The amount of wastewater discharged at each production site varies due to the slight differences in production activities and scale of production across all production sites. To address the specific needs and circumstances of each site, TSC has put in place appropriate project management methods and a water quality monitoring mechanism. In 2023, TSC discharged 625,94 megaliters of wastewater in total, exhibiting a downward trend over the past three years.

Water Quality Control Mechanism

I-lan Site

Wastewater from the I-lan Site is discharged into the I-lan River under the supervision of the Site Affairs Department. The department conducts daily pH value examinations, weekly observations of suspended solids, and prepares semi-annual water quality reports. Additionally, the department undergoes annual ISO 14001 inspections conducted by external third-party certification units. As wastewater at the I-lan Site primarily comes from the cutting process, an inspection conducted on wastewater discharge from the site revealed that the discharge contained only a small amount of suspended solids (<5mg / L) and the pH level was determined to be neutral without requiring any adjustments (pH 7 ± 1). Based on these findings, TSC concluded that all wastewater discharged from the I-lan Site in 2023 met the Effluent Standards and did not cause any water pollution.

Due to the high purity and low pollution levels of the wastewater at the I-lan Site, as well as its low volume, the environmental impact is minimal. In 2022, TSC applied for change to the wastewater simple discharge permit in accordance with legal requirements upon receiving the advise of the Environmental Protection Bureau under the Yilan County Government, and thus formulated the Wastewater Site Simplification Project. Review of the relevant documents has been completed in 2023, with the simplification project scheduled for completion by the end of 2024. The project includes relocating the groundwater treatment unit tanks to the ground floor, so that unprocessed wastewater does not spill and contaminate the soil.

Li-Je Site

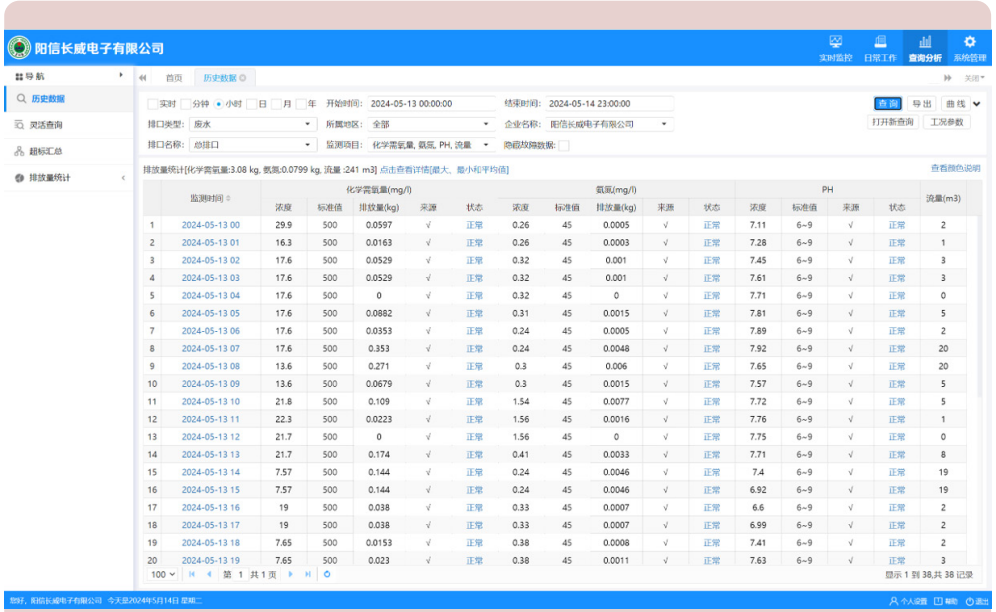
The Li-Je Site discharges wastewater into Xincheng River. The wastewater treatment system is continuously monitored 24 hours a day, and water quality is analyzed twice daily. Environmental safety and site affairs personnel collect the data, which is then submitted to the system engineer for approval. The unit supervisor verifies and analyzes the data, which is then compiled into monthly charts and reports for review by the highest-level supervisor at the site. The Li-Je Site closely monitors any changes in water quality and promptly initiates an analysis and improvement process if the plant's limits are exceeded. Any violations are documented, and improvement plans are proposed. In terms of external audits, the site's management performance is evaluated and certified by a third-party organization annually. This organization examines the operations and records of ISO 14001. Additionally, the quality of effluents at the Li-Je SIte is tested quarterly by a third-party inspection units, which reports the results to the Ministry of Environment using production data.

Shandong Site

The Shandong Site, which possesses a discharge permit issued by the Bureau of Ecology and Environment, has not only instituted a set of comprehensive wastewater management procedures, is also equipped with a wastewater treatment station to treat wastewater from the site. Industrial wastewater treated at the site is able to meet the standards and can be discharged steadily from the site as it meets the requirements of the four major indicators for discharge water quality detected through the online monitoring system, namely pH, ammonia nitrogen, chemical oxygen demand (COD), and flow rate. A third-party organization is also engaged to collect at least four water samples from the site each month to carry out testing on a total of 16 discharge indicators.

The results of online monitoring and periodic third-party testing at the site revealed that discharge water from the Shandong Site has been stable and complies the requirements of the GB 39731 2020 Discharge Standards of Water Pollutants for the Electronic Industry and other environmental protection-related laws and regulations. The primary indicators under regulation, such as the actual COD and ammonia nitrogen emissions, were significantly lower than the emission limits (e.g., the average COD emission limit was 500 mg/L, while the actual emissions at the Shandong Site was about 30 mg/L; on the other hand the actual ammonia nitrogen emission limit was 45mg/L, while the actual emissions at the Shandong Site is 0.2mg/L), so as to minimize the impacts on the environment with concrete actions, thereby fulfilling the environmental protection responsibilities.

The Shandong Site has established the Regulations on Industrial Wastewater Treatment and the Regulations on Operation, Maintenance and Repair of Wastewater Treatment Systems, which clearly set out the procedures for wastewater collection, monitoring, recording, testing, and reporting for the purpose of bolstering wastewater quality control to prevent negative impacts on the environment due to abnormal effluent quality. The Shandong Site conducts 24-hour monitoring of the quantity and quality of discharge water through the online water quality monitoring system, while the Management Department at the site sends dedicated personnel to inspect and supervise the operation of the system, with one round of inspection to be carried out every two hours, so as to ensure that the setting of each parameter is reasonable and the system is in good condition. At the same time, the Shandong Site is also equipped with an emergency accident pool to ensure that proper emergency response is in place should any water quality anomaly arise, and prevent discharge exceedances. No incident related to wastewater discharge was reported in 2023. On the other hand, the Shandong Site obtained a total of 11,000 water quality test results from the online water discharge test system, as well as 12 water quality test reports consisting of 576 items from third-party organizations, all of which were in compliance with the discharge standards.



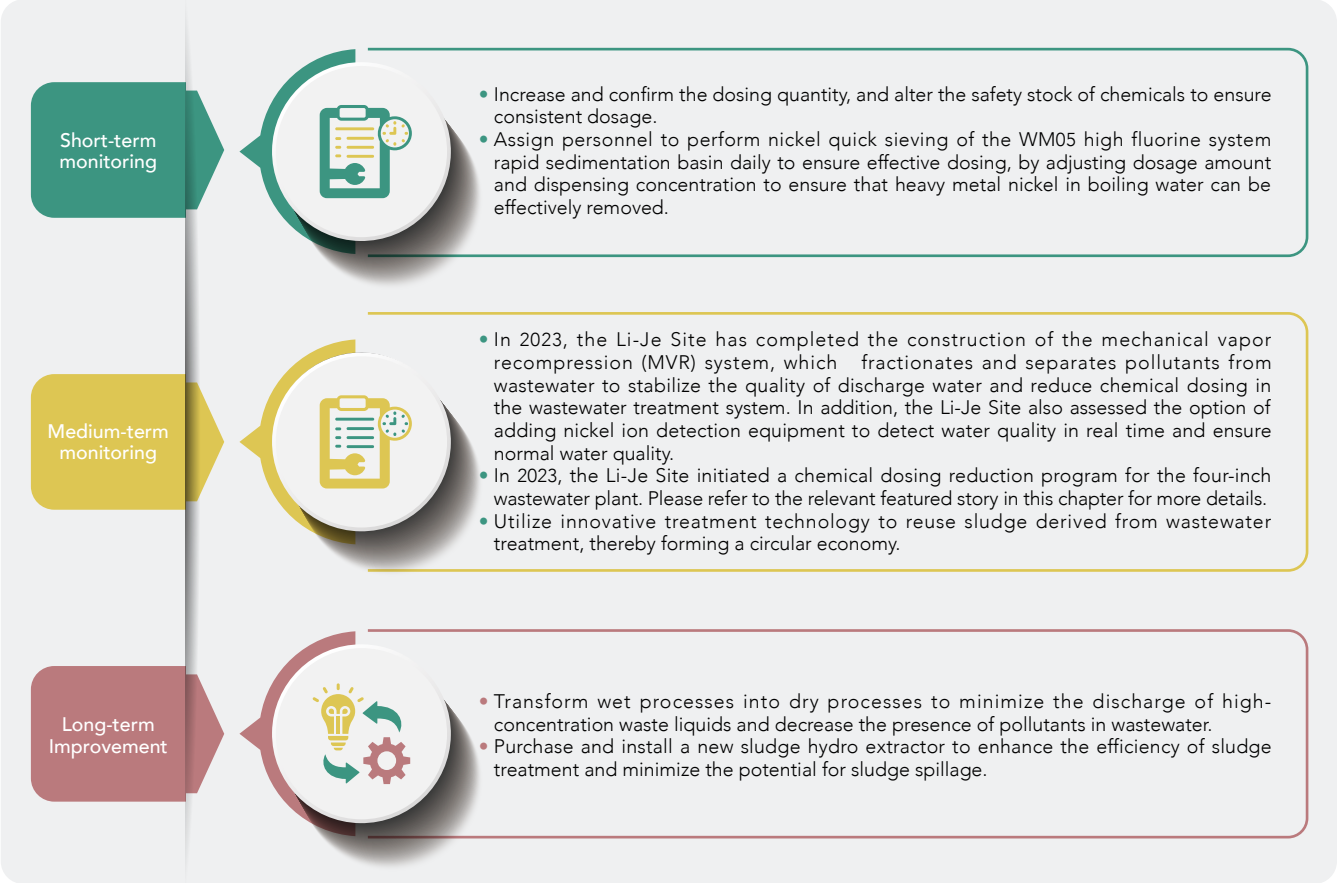
The online water discharge testing system at the Shandong Site

Tianjin Site

Wastewater discharged from the Tianjin Site is channeled to a municipal wastewater treatment plant. The site is equipped with an online wastewater monitoring system, which monitors the value of pollutants in wastewater on a daily basis and sends the data to the Environmental Protection Bureau . Each year, the testing unit of the site's vendors collects water from the site to test the quality of discharge water, and files reports based on production data with the Environmental Protection Bureau. In addition, the Shandong Site engages external vendors to validate the content of its ISO 14001-related operations and records, carry out performance evaluation in the area of management, and issue the relevant certificates on an annual basis

Water Quality Improvement Program at the Li-Je Site

Owing to two violations of the Water Pollution Control Act committed in 2023, the Li-Je Site, aiming to improve water quality management, conducted an in-depth investigation into the case and drew up a water quality improvement program based on the problems involved to understand the reasons why the water quality samples failed to meet the standards. Thereafter, the site formulated improvement measures, which includes short-term monitoring and long-term improvement. Please refer to 1.3.2 Regulatory Compliance for more details on the relevant penalty cases.



Note:
The Li-Je Site utilizes heavy metal collecting reagents to conduct a rapid screening test for nickel. This test is performed on heavy metal wastewater in a quick sedimentation basin. The purpose of this test is to confirm the dosing status and ensure that the concentration of heavy metals in the water meets emission standards.

The Mechanical Vapor Recompression System

The Li-Je Site is situated in Yilan County. In order to address the expensive outsourcing costs associated with removing highly concentrated waste liquid produced at the site, it was decided to process it through the site's wastewater system. In light of the "Effluent Standards" regulation implemented in 2021, which imposes stricter controls on ammonia nitrogen and nitrate nitrogen management, the Company conducted an assessment of the potential risks to the effluent water quality at the site. In 2022, the Li-Je Site carried out water sample testing and developed plans to incorporate it into the wastewater treatment facilities. TSC has completed the construction of the mechanical vapor recompression (MVR) system in 2023, which is expected to result in a significant reduction in various chemical substances in wastewater and effectively minimize the production of sludge used in the wastewater systems.

1 | Discharge high-concentration waste liquids to the low-fluorine wastewater treatment system through the MVR system

2 | Implement wastewater management, with the wastewater plant at the Li-Je Site in charge of wastewater treatment

3 | Recycle and reuse wastewater Reduce water consumption

Highlight Story 03

Following the impact of climate change across the globe, efficient utilization and recycling of water resources has become an important topic. In an effort to effective recycle and reuse water resources, the Li-Je Site proposed a grinding machine cooling water recycling program in 2022. The program was officially launched in 2023, with the aim of reducing the amount of water treated, which was initially estimated to generate a recycling benefit of NT$540,000, but, in fact, generated a recycling benefit of NT$588,162.

As there are different types of wastewater from semiconductor manufacturing processes, the Li-Je Site recycles cooling water, collects it through piping to the reservoir, and then transfers it to the raw water tank using a power pump as a source of pure water. At present, the Li-Je Site drains the recycled water into the raw water tank for use in the plant. Upon implementation, the site managed to save 13.2 metric tons of water per day in 2023. Moving forward, TSC aims to continue maximizing the use of water resources. The Li-Je Site is expected to incorporate a cooling water recycling system in 2024 to recycle uncontaminated and low-pollution water resources, thereby achieving the goal of saving water.

Highlight Story 04

In an effort to refine wastewater management on an ongoing basis, the Environmental Engineering Department at the Li-Je Site inspected the existing wastewater treatment process and rolled out the chemical dosing reduction program for the four-inch wastewater treatment plant in 2023, in hopes of gradually reducing the amount of chemicals used in the wastewater treatment process, thereby realizing the benefit of reducing the amount of raw materials consumed. The site tests the concentration of water pollutants through daily water quality sampling and analyzes the dosage and hydraulic retention time at each treatment unit while comparing the operating parameters for wastewater at other production sites before conducting jar test simulations to confirm the optimal dosage and test whether the water quality meets the Effluents Standards at the final stage.

▶ Implementation results based on a benefit analysis of 500 CMD in treated water:

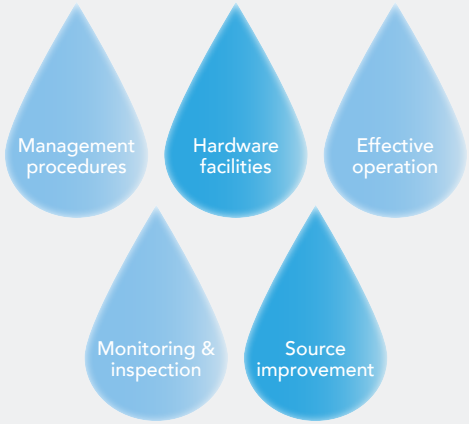
- 26% reduction in CaCl2 dosage
- 20% reduction in PAC dosage
- Adjustment of polymer foam concentration from 0.1%wt to 0.06%wt, and 47% reduction in polymer dosage

In the future, the Environmental Engineering Department at the Li-Je Site will continue to refine management processes, aimed at re-diverting process wastewater, including fluorine-containing QDR, non-fluorine-containing QDR, high-concentration acidic wastewater, ammonia-containing wastewater, and organic wastewater; re-testing the concentration of hydrofluoric acid in wastewater through clearer source treatment; and eventually studying and planning for treatment and recycling based on classification.

Highlight Story 05

Industrial wastewater at the Shandong Site primarily emanates from the metal surface treatment process, where the wastewater is acidic before treatment, and the main pollutants are copper ions and COD. The Shandong Site has been operating steadily for more than 10 years in five areas, namely management procedures, hardware facilities, effective operation, supervision and testing, and source improvement to ensure that its discharge water meets the standards while making continuous improvements at the same time. At present, the site has moved from the "wastewater management" stage to the "source treatment" stage, which has yielded remarkable results. For instance, the shutdown of the pickling station at the site in December 2016 has led to a reduction of 60,000 tons in industrial wastewater discharge per year. Following efforts to improve molds from 2022 to 2023, the site has removed the small holes in the shell of ITO series products, so that there is no need to clean residues in the small holes using isopropyl alcohol (IPA) during the metal surface treatment process. This completely removes IPA from the metal surface treatment process, which in turn prevents residual IPA liquid from being discharged into the water to produce COD, and eventually leads to a reduction of approximately 15 tons in IPA discharge per year. At the same time, a front-end sludge sedimentation tank was officially put to use in 2023, where sludge sediments are stripped off and removed from the water body before the wastewater enters the wastewater treatment system, thereby preventing the impact of these sediments on the flocculation and sedimentation process in wastewater treatment, and eventually stabilizing discharge water indicators.

Five areas in wastewater management at the Shandong Site



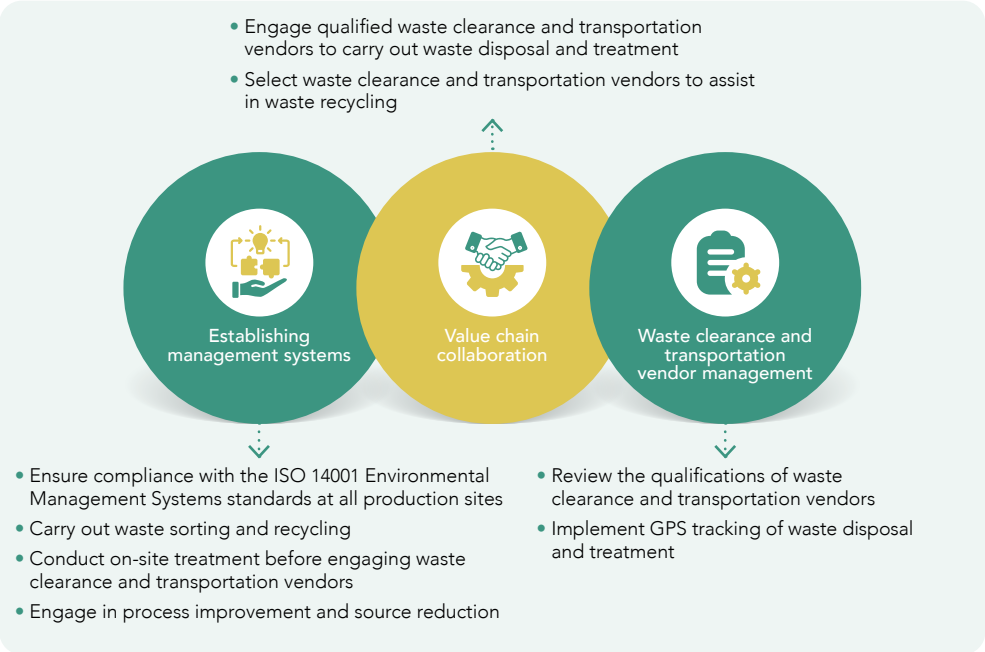
Highlight Story 06

With the intention of effectively recycling water resources to realize energy conservation, the Shandong Site has constructed a rainwater harvesting pond pump system in recent years, aimed at storing rainwater and reusing it for watering purposes in the greening process, thereby saving tap water. This system, which is already in operation, is expected to enable the actual quantification of recycled water utilization performance in the future after it is equipped with metering.

5.3 Waste Management GRI 306-1 GRI 306-2 GRI 306-3 GRI 306-4 GRI 306-5 TC-SC-150a.1

5.3.1 Waste Management

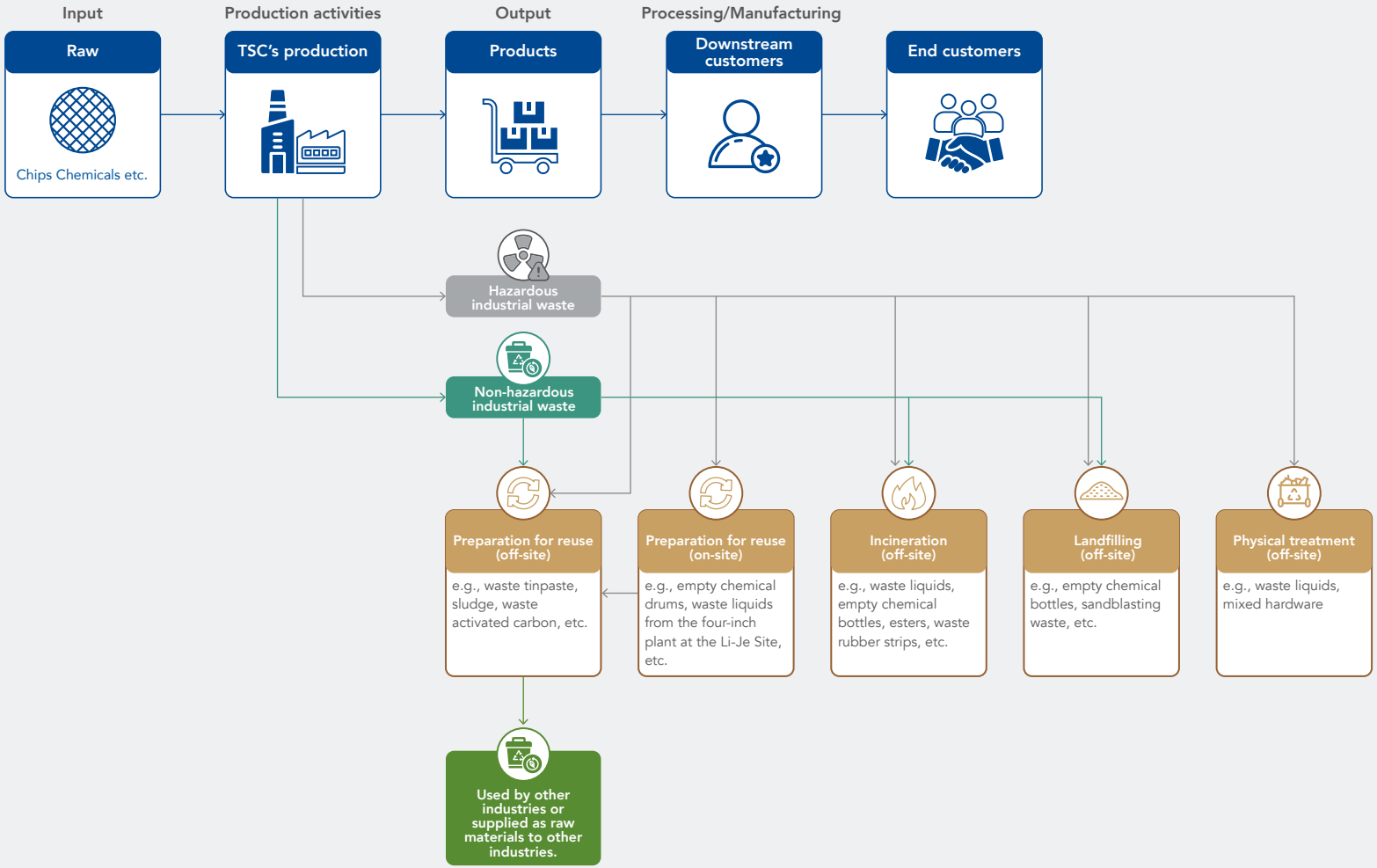
TSC is dedicated to reducing environmental impacts, specifically waste pollution, while cutting operating costs by refining waste management and improving resource utilization efficiency. Consequently, each production site has been awarded the ISO 14001 Environmental Management Systems certification and conducts regular internal audits based on the system. In an effort to implement waste reduction, declaration, and cleaning (removal, treatment and reuse), each production site collects the resource-type waste generated from the site and classifies it based on its nature, and entrusts it to the external clearance. Moreover, for special waste generated during the process, such as chemical solvents, are temporarily stored in specific areas after classification, and are handled by qualified waste clearance and transportation vendors approved by the government authorities. On the part of grasping the final flow of waste, we also formulated an audit plan for waste clearance and transportation vendors, including tracers, GPS tracking, etc., and established a complete contractor management mechanism to actively implement waste management.



TSC's Commitment to Waste Management

Waste Disposal Process

Hazardous waste and general industrial waste from TSC's production sites are primarily outsourced for off-site treatment by means of physical treatment, landfilling, incineration, and recycling. Empty chemical drums and waste liquids from some production sites first undergo simple treatment before being transported by waste clearance and transportation vendors to be used in other industries or supplied to other industries as raw materials. On the other hand, general industrial waste are mainly treated off-site by means of landfilling, incineration and recycling.



Waste Statistics

In 2023, TSC produced 4,831.10 metric tons of waste in total, including 3,550.28metric tons of hazardous industrial waste (73%) and 1,280.81 metric tons of non-hazardous industrial waste (27%). Each production site engages qualified waste clearance and transportation vendors to assist in waste disposal and treatment, whereas waste produced by the Tianjin Site is primarily disposed of and recycled collectively by the public sector. Waste statistics for each production site are compiled internally by the site affairs unit and reported on a regular basis, with supporting documents such as the waste weighing triplicate form to be retained for future reference, in accordance with the rules and regulations promulgated by local governments.

In an effort to bolster waste management, the Li-Je Site has not only formulated a calcium fluoride sludge reduction program, but also worked with specific vendors to recycle waste liquids from the four-inch plant, with 100% of these waste liquids to be recycled and reused as cement raw materials. Please refer to "Featured Story: Circular economy - Recycling of sludge at the Li-Je Site" for more details. On the other hand, our production sites in China has rolled out a number of source reduction programs, including the plastic mold optimization program and the digital manufacturing execution system (MES) program in 2023, aimed at reducing the use of raw materials at source, and eventually triggering a decline in the amount of waste produced.

Total waste in 2023

Unit: metric tons

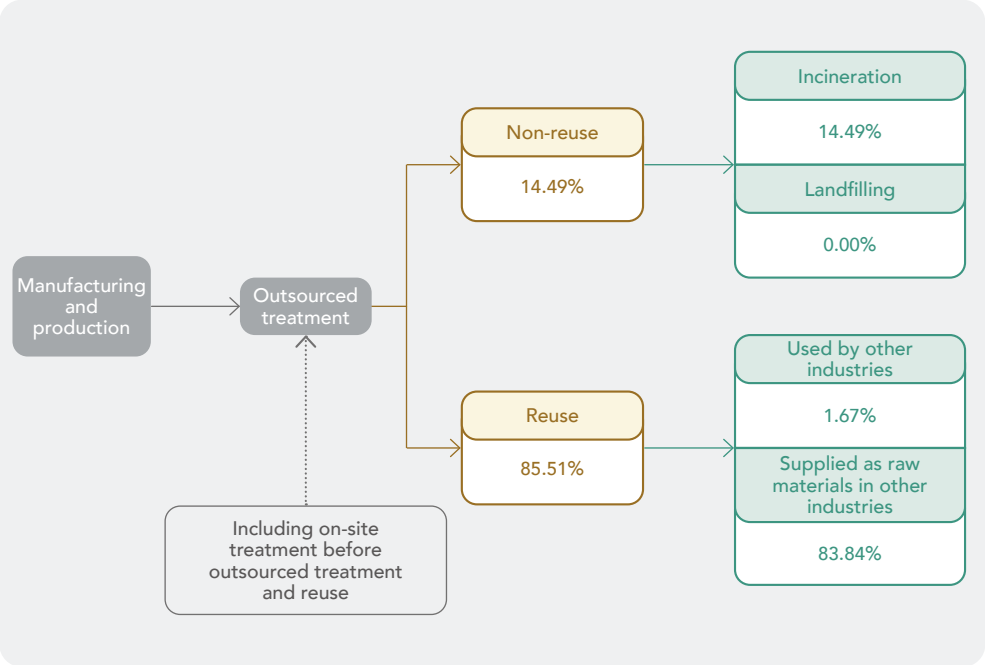
Category		Item	Off-site	On-site
Hazardous waste	Direct disposal	Incineration (including energy recycling)	0	0
		Incineration (excluding energy recycling)	194.17	0
		Landfilling	1.29	0
		Other disposal methods	1,822.66	1,336.00
	Reuse	Preparation for reuse	196.17	0
		Recycling and reuse	0	0
		Other recycling operations	0	0
Total amount of hazardous waste			2,214.29	1,336.00
Non-hazardous waste	Direct disposal	Incineration (including energy recycling)	0	0
		Incineration (excluding energy recycling)	7.61	0
		Landfilling	450.32	0
		Other disposal methods	0	0
	Reuse	Preparation for reuse	822.89	0
		Recycling and reuse	0	0
			0	0
Total amount of non-hazardous waste			1,280.82	0
Total amount of hazardous and non-hazardous waste			4,831.10	

Note:
1. Other disposal methods include physical treatment and on-site treatment.
2. The hazardous industrial waste reuse rate was 5.5% (including preparation for reuse, recycling and reuse, and other recycling operations). where the relevant data was calculated based on the amount of hazardous industrial waste reused as a percentage of the total amount of hazardous waste.
3. The non-hazardous industrial waste reuse rate is 64.2% (including preparation for reuse, recycling and reuse, and other recycling operations), where the relevant data is calculated based on the amount of non-hazardous industrial waste reused as a percentage of the total amount of non-hazardous waste.
4. The terms "hazardous" and "non-hazardous" are defined in accordance with the Methods and Facilities Standards for the Storage, Clearance and Disposal of Industrial Waste in Taiwan.

Waste Reduction Actions

Li-Je Site

The Li-Je Site primarily outsources waste disposal to external vendors. However, the site actively promotes the utilization of off-site resources, effectively transforming waste from production processes into valuable resources. In 2023, the waste reuse rate at the Li-Je Site was 85.51%. The site has reaped the benefits of waste reduction, reduced energy consumption and waste treatment costs, and enhanced efficiency in resource recycling through value chain collaboration. For instance, the Li-Je Site collaborated with cement manufacturers to recycle calcium fluoride sludge as a raw material in cement production. In addition, the Li-Je Site implements physical treatment methods to crush and reuse waste glass, and conducts noble metal separation of waste electronic components. At the same time, we partner with recycling vendors to recycle waste liquids and convert them using physical treatment methods such as distillation into raw materials such as banana oil, which can be further utilized in various industries, including paint production.



I-lan Site

In the past, when our production site purchased new equipment and materials, we would often end up with a significant amount of waste packaging materials, such as wooden pallets and crates, which were typically incinerated. Following our proactive effort to promote waste reduction, the I-lan Site is actively selecting external waste clearance and transportation vendor partners in hopes of promoting resource recycling in collaboration with partners in other industries, thereby achieving the goal of waste reduction. In 2023, the site has selected partners to recycle waste plastics and wood, with the relevant recycling program scheduled to commence in 2024.

Waste plastics	Waste clearance and transportation vendors are engaged to collect, break down and reprocess waste plastics, which is expected to lower incineration cost by 75% while reducing 10 to 20 tons of waste plastics each year.
Waste wood	Waste clearance and transportation vendor partners are engaged to collect, break down, reuse, and reprocess waste wood into a new energy source, which is expected to lower incineration cost by 30%. This new energy source, which is an economical source of renewable energy, is regarded as one of the alternative energy sources in the future.

In the future, the I-lan Site will continue to select vendor partners to engage in various programs, including reprocessing waste plastic strips into eco-friendly bricks, with a view to exploring the possibility of reusing more waste materials.

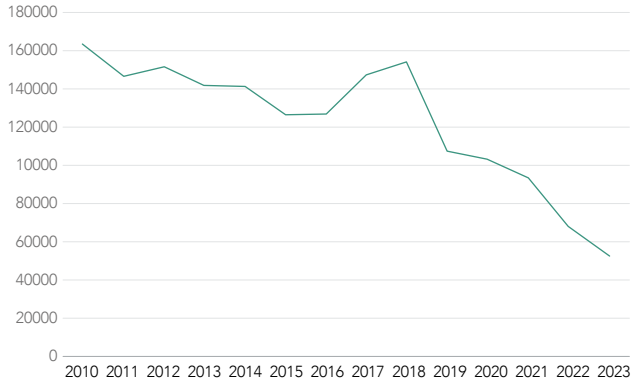
Shandong Site

In 2023, the Shandong Site invested over RMB2.48 million (equivalent to over NT$10 million) in a source reduction program, which includes improving mold rubber runner design, replacing disposal paper packaging materials, digitalizing the manufacturing execution system (MES), and implementing the chemical substances alternatives program, with a view to reducing overall waste output.

Waste reduction program in 2023	Description	Reduction benefits in 2023
Improving mold rubber runner design	Due to problems such as mold rubber runner design, waste rate was higher before the rubber seal mold was optimized since a large quantity of rubber seal material was not converted into the product shell, but rather became rubber runner and rubber rod waste, which were eventually disposed of as solid waste. Following the optimization of rubber seal mold design using various methods such as digital and stress analogies, four sets of mold systems were upgraded, which improved the shape and size of the rubber runner. Furthermore, small particles of rubber seal materials were selected and used for precise control to reduce rubber rod waste rate.	Reduced waste (waste rubber rod) generation rate from 44% to 36%.
Replacing disposal paper packaging with reusable rolls and other packaging materials	In the past, the majority of packaging materials for raw materials at the Shandong Site were disposable paper packaging materials, which turned into waste cartons after one use. In recent years, the Shandong Site has been continuously promoting the replacement of disposable packaging materials with reusable plastic packaging materials, which has successfully led to a replacement rate of over 50% and a reduction in waste paper box output to 33% of peak output in previous years.	Reduced 100 tons of waste cartons per year.
Introducing the manufacturing execution system (MES)	In the past, production data was recorded using paper forms. In 2023, paper forms were replaced with electronic forms following the introduction of the manufacturing execution system (MES) to minimize paper consumption.	Expected to reduce 500,000 pieces of waste paper forms per year upon completion.
Refining industrial process to reduce the use of chemical products	In March 2023, the site has completely stopped the use of acetone through efforts to improve industrial processes, while all methylene chloride was replaced with n-bromopropane.	Reduced the use of chemicals such as acetone each year to lower waste output at source.

Historical trend of paper packaging material reduction at the Shandong Site

Unit: Kg



Waste Clearance and Transportation Management

Due to the different nature of manufacturing processes, the types of waste generated at each production site vary to some extent. Consequently, TSC's production sites in Taiwan have developed their own waste clearance and transportation process to enhance waste management. This includes staying updated on Taiwan's laws and regulations, periodically assessing the implementation status, organizing meetings, and conducting regular reviews and corrections to ensure effective waste management. On the other hand, the Tianjin Site has signed a waste clearance and transportation contract with the public sector to centralize waste clearance and transportation in line with local government policies.

Waste Clearance and Transportation Methods

Waste generated from production activities at TSC is categorized into non-hazardous industrial waste and hazardous industrial waste. TSC's production sites in Taiwan outsource the clearance and transportation of all waste to external vendors. The outsourced process is carried out in accordance with the procedure of the external waste clearance and transportation vendor and is meticulously documented as follows.

General industrial waste

- On-site: Contact vendor for quotation ▶ Contact waste clearance and transportation vendor to arrange waste clearance and transportation ▶ Issue waste clearance and transportation document ▶ Proceed with waste clearance and transportation
- Off-site: Track vendor's vehicle until the vendor undergoes the weighing and photo-taking processes

Hazardous industrial waste

- On-site: Contact waste clearance and transportation vendor to arrange waste clearance and transportation ▶ Issue waste clearance and transportation document ▶ Proceed with waste clearance and transportation ▶ Issue waste clearance and transportation triplicate document
- Off-site: Modify the actual weight and verify the document ▶ Download and archive waste clearance and transportation vehicle's GPS track map ▶ Archive the triplicate form and other processed documents

Highlight Story 07

Circular economy - Recycling of sludge at the Li-Je Site

Sludge production at the Li-Je Site accounted for 69.27% of the total waste. As outsourcing the removal of high-concentration waste liquid incurred high costs, in the past, the sludge was processed through the site's own wastewater system. We have further reduced sludge output by minimizing the use of chemicals in the wastewater system. Following the rollout of the sludge reduction program, the amount of sludge produced in the chip production process has been reduced from 1.06 kg per piece to 0.66 kg per piece, resulting in a sludge reduction of over 60%.

The Li-Je Site collaborated with the cement factory to recycle 100% of the sludge produced by the site to form a circular economy. During wafer manufacturing process, TSC uses hydrofluoric acid for wafer cleaning and etching. After chemical condensation and precipitation, the resulting hydrofluoric acid waste can be converted into calcium fluoride sludge. This sludge is then ground, stirred, and high-temperature fired in a rotary kiln reaching about 1,450℃ . Afterwards, gypsum is added and ground to form cement. TSC then provides the recycled cement to the cement factory as raw material to fully enhance the reuse value of waste liquid.

The amount of sludge generated during chip production was reduced from 1.06 kg per piece to 0.66 kg per piece, resulting in a sludge reduction of more than 60%.

Waste Clearance and Transportation Vendor Management

For contractors' waste treatment, TSC strictly requires manufacturers to regularly update their license. This includes conducting an annual audit of waste clearance and waste handling business activities, as well as noting it in the contract terms and regularly updating the contract. Failure to comply with waste management laws and regulations may result in contract termination. To effectively monitor industrial waste clearance, We utilize the "Global Positioning System (GPS) Real-Time Tracking System" website. This allows us to track the driving routes of the waste clearance and transportation vendor's vehicles and promptly confirm their movements. We also check and save the GPS track map of the vehicles, and occasionally conduct inspections to strictly monitor the flow direction of the clearance.

TSC ensures proper handling of proof documents and produces scrap equipment treatment reports. The Li-Je Site conducts an annual audit of waste removal vendors, while the I-lan Site conducts audits on average once every two months. Vendors are scored based on the details provided in the table, with scores ranging from 0 to 5. A final score of 90 points is considered qualified according to the TSC waste clearance and transportation vendor standards. There have been no substandard contractor assessments for each site in 2023.

Contractor Waste Assessment Items

Waste clearance and transportation	Regular maintenance on clearance machines
	Pollution prevention and safety equipment for clearance machines
	Assessment on the fit of waste clearance and transportation equipment and their waste clearance and transportation capabilities
	Personnel driver's license management, and dangerous goods delivery personnel certificate
	Emergency response equipment, methods, and manuals
Storage	Whether storage capacity in the clearance site meets processing capacity
	Chemical compatibility/regional classification
	Groundwater/rainwater infiltration prevention facility
	Abnormal spills in storage area
	Preservation of hazardous and non-hazardous clearance documents
Industrial safety and fire protection	Safe protection apparatus documents
	Feasibility of wearing and operation of protective equipment
	Inspection of fire safety facilities, audit records
	Establish security measures and fire protection equipment
	Other industrial safety management systems
Others	Organizational structure/Professional competence
	Online reporting and proper handling of documents' accuracy and completeness
	Relevant performance and experience
	Accuracy of written information
	Establish the ISO 14001 system or operating standards

5.3.2 Air Pollution Prevention and Control GRI 305-6 GRI 305-7

TSC is committed to air pollution prevention and environmental protection. All of our production site comply with local environmental laws and regulations and undergo regular gas testing. The primary types of gases generated in the production process at our production sites include acid waste gas and volatile organic compounds (VOCs). In addition, a small amount of flue gas is emitted from the solid crystal welding process, which is treated by the acid-alkali scrubber, ionization decomposition, fume filtration, and VOCs adsorption treatment system, while a third-party inspection organization is commissioned to conduct regular inspections to ensure that the emission standards are met.

The air pollutants generated by each production site vary slightly due to the different nature of chip manufacturing and packaging testing. There are no emissions of sulfur oxides (SOx), ozone layer depleting substances, persistent organic pollutants (POPs), suspended particulates (PM), and other gases. In 2023, the average VOC emissions at TSC's production sites in Taiwan were better than the emission standards set by the Ministry of Environment, whereas our Shandong and Tianjin sites recorded a VOC emission rate of 0.206 kg per hour and 0.039 kg per hour, respectively, which were better than the emission standards set by the local environmental protection agencies.

Air pollutant emissions at TSC's production sites over the past few years

Unit: metric tons

	Li-Je Site			I-lan Site			Shandong Site			Tianjin Site			Total		
	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023	2021	2022	2023
NOx	1.398	2.596	1.307	N.D	N.D	N.D	N.D	N.D	N.D	0.705	N.D	5.075	2.103	2.596	6.382
SOx	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
VOCs	3.523	3.865	0.692	0.811	1.773	0.605	3	3.53	1.63	1.881	0.496	0.276	9.215	9.664	3.203
Particulate pollutants	0.117	0.217	0.109	N.D	N.D	N.D	1.21	1.79	1.96	N.D	N.D	N.D	1.327	2.007	2.069
Others	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	2.754	1.651	0.556	2.754	1.651	0.556
Total hazardous gas emissions	5.038	6.678	2.108	0.811	1.773	0.605	4.210	5.320	3.590	5.34	2.147	5.907	15.399	15.918	12.21

Note:
1. The data above are measured using the average of monitoring data from the Site Affairs Department and three sets of inspection data from external inspection units. The real-time monitoring data is primarily sourced from our Li-Je and I-lan sites. On the other hand, the Shandong Site engages external inspection units to conduct regular inspections, while the Tianjin Site engages third-party inspection units to conduct three inspections, whose data was averaged.
2. Only the types of gases emitted were listed in the table above. There were no emissions of sulfur oxides (SOx), ozone-depleting substances, persistent organic pollutants (POPs), particulate matter (PM), or hazardous air pollutants (HAPs). N.D. represents not detected.
3. In conjunction with amendments to the Air Pollution Control and Emissions Standards for the Semiconductor Industry promulgated by the Ministry of Environment in 2023, the source of statistics on VOCs at TSC's production sites in Taiwan was revised to the Report on Volatile Organic Substance and Inorganic Acids Pollution Control in the Semiconductor Manufacturing Industry.
4. "Others" in the table above refer to three types of gases, namely xylene, ethylbenzene and non-methane hydrocarbons, at the Tianjin Site, which require mandatory testing in accordance with the Atmospheric Pollutant Discharge Standards, where the emissions of these three types of gases meet the requirements of the local government.

Monitoring of Air Pollution Prevention and Control

Regular monitoring is carried out through air pollution prevention equipment in parallel with both internal and external audits at TSC's production sites in Taiwan according to the Air Pollution Control and Emissions Standards for the Semiconductor Industry, as well as TSC's production sites in China, namely the Shandong and Tianjin sites, according to the Regulation on the Administration of Permitting of Pollutant Discharges, the Atmospheric Pollutant Emission Standards, the Shandong Province Regional Atmospheric Pollutant Discharge Standards, and the Volatile Organic Compounds Emission Standards Part 7: Other Industries. The average values and emissions rates are calculated based on the results of inspections conducted three times by a qualified third-party organization engaged by the Tianjin Site.

Waste Gas Treatment

The main types of air pollutants at TSC are acidic and alkali waste gases and VOCs. TSC prevents pollution using treatment equipment and processes corresponding to the type and properties of waste gases. Acidic and alkaline waste gas, as well as VOCs, are effectively managed through various control equipment, including acid and alkaline scrubbing towers, and zeolite rotor incineration systems, while continuous monitoring is conducted using the gas chromatography flame ionization detector (GC-FID) system to ensure that the control equipment operates efficiently and meets regulatory standards.

Treatment Methods for Different Types of Air Pollutants

Type of air pollutant	Treatment Method
Acidic or alkaline waste gas	Acidic and alkaline waste gases are collected in an acidic or alkaline waste scrubbing tower for appropriate treatment, ensuring that the resulting wastes comply with emission standards.
VOCs	**Li-Je Site** Volatile organic compounds (VOCs) are adsorbed and concentrated using a zeolite rotor. This is followed by a continuous high-temperature desorption process and catalytic incineration. As a result, the treated waste gas meets emission standards. The reduction of VOC control equipment (RCO) in 2023 was 94.67%. **I-lan Site** VOCs are treated using scrubbing towers to remove VOCs from the waste gas. The resulting waste liquid is then discharged into the wastewater system. Since the concentration of VOCs is lower at the I-lan Site compared to the Li-Je Site, scrubbing is the preferred treatment method. This eliminates the need for concentrated purification using zeolite rotor adsorption.

The scrubber tower at the Li-Je Site utilizes a parallel method to process both acidic and alkaline waste gases. In the event of an emergency, the remaining equipment can be adjusted to handle the target exhaust treatment, while also coordinating with the production line to prevent air pollution. Furthermore, the zeolite rotor continuous incineration (RCO) system, which is employed to treat volatile organic exhaust gases, can be switched to the activated carbon tower in parallel during emergencies. This allows for simultaneous coordination with the production line to minimize environmental impact.

In 2020, the Shandong Site invested over NT$4 million to complete the upgrading of its exhaust gas treatment facilities, which enable the purification and treatment of acidic gases, flue gas particulate matters, and VOCs using acid and alkali scrubbers, a filtration system, ionization decomposition, and an activated carbon adsorption system according to the properties of exhaust gas from different manufacturing processes. Specifically, the filtration system, which uses filter cotton for primary filtration and filter bags for secondary filtration, demonstrates a 93% dust particle treatment rate, whereas the activated carbon adsorption system, which adopts molecular sieve technology, effectively adsorb and purify VOCs through 18m³ of activated carbon in the adsorption box to realize waste gas emissions that steadily meet the standards.

Waste Gas Treatment Flow Chart