



## A Producer of Green Technology

With the green concept that we have only one earth, Nanya insists on leaving the best environment to every future generation. We actively manage all impacts on the environment incurred during operational processes. On the aspects of energy, resources, emissions, and waste, we adopt higher standards than regulations to avoid or reduce risks of the impacts, setting goals to review execution results of sustainability performance in order to fulfill our responsibilities for cleaner production and safeguard the natural environment. As climate change has become one of the most significant global risks, we implemented risk identification, assessment and management in accordance with the framework of the TCFD Recommendations to enhance our operational resilience under the risk of climate change.

**100 %**

Greenhouse gas verification in the factory area and coverage rate of climate change risk identification

**90.8 %**

Annual average process waste water recovery rate

**46.3 %**

Reduced VOCs emissions per unit production capacity by 46.3% compared with 2017



## Green

P88. Climate Change Management

P92. Energy and Resource Management

P103. Environmental Pollution Prevention

Note: The scope of environmental-related data in this chapter is mainly based on Nanya Technology Corporation, which does not include subsidiaries.

## Strategy and Performance of Material Topics



### Greenhouse Gas Management

**Energy conservation and carbon emissions reduction:** Set short, medium, and long-term goals and actively implement related management measures.

**Low-carbon manufacturing:** Commit to improvement in production technologies and reduce greenhouse gas emissions in the production process.

2022 Goals	2021 Goals	2021 Performance
Reduce unit greenhouse gas emissions by 38% from 2017	Reduce greenhouse gas emissions per die by 25% from 2017	● Reduced by 37%
Reduction rate of Fluorinated Greenhouse Gases (F-gases) emissions from processes reaches a minimum of 93%	Reduction rate of F-gases emissions during processes reaches 90 %	● Reduction rate reached 93%
Reduce F-gases emissions per die by 38% from 2015	Reduce F-gases emissions per die by 25% from 2015	● Reduced by 36.6%



### Energy Management

**Implementation of energy conservation measures:** Implement ISO 50001 Energy Management System for systematic management and improve the efficiency of energy usage.

**Innovative applications:** Use external exchanges or training to obtain the latest energy conservation technology or energy-saving methodology.

2022 Goals	2021 Goals	2021 Performance
Cumulative energy saved with energy conservation measures from 2017 to 2022 reaches 64,000 MWh (230.4 Terrajoule) and above.	Cumulative energy saved with energy conservation measures from 2017 to 2021 reaches 58,300 MWh (210 Terrajoule) and above.	● Cumulative energy saved from 2017 to 2021 totaled 58,850 MWh (212 Terrajoule).
Annual renewable energy use reached 7,880 MWh (28.4 Terrajoule)	Annual renewable energy use reached 1,260 MWh (4.54 Terrajoule)	● Actual use was 2,600 MWh (9.36 Terrajoule).



### Waste and recycling

**Circular economy:** Increase waste recycling and reuse rate to use resources effectively.

**Source reduction:** Continue to promote waste reduction and increase waste recycling rate.

2022 Goals	2021 Goals	2021 Performance
0 cases in violation of environmental laws and regulations	0 cases in violation of environmental laws and regulations	● 0 cases
Rate of auditing and coaching waste disposal contractors on-site > 90%	Rate of auditing and coaching waste disposal contractors on-site > 80%	● Auditing and counseling rate of 92%
Reduce VOC emissions per die by 46% from the base year of 2017	Reduce VOC emissions per die by 40% from the base year of 2017	● Reduced by 46.3%



### Water Management

**Response to risks:** Establish backup water sources and water storage tanks and use emergency response organization between company plants to coordinate water usage.

**Wastewater recycling and reuse:** Establish wastewater collection processing and adopt different multiple recovery and reuse to improve the water recovery rate.

**Water usage reduction:** Conserve water through daily management.

2022 Goals	2021 Goals	2021 Performance
Annual average process wastewater recovery rate: 90% and above (according to the formula set by Hsinchu Science Park Bureau)	Annual average process wastewater recovery rate: 87% and above	● Annual average process wastewater recovery rate: 90.8%
Other losses in production caused by restricted water supply: 0 wafer	Other losses in production caused by restricted water supply: 0 wafer	● Other losses in production caused by restricted water supply: 0 wafer



## Climate Change Management

### Climate Change Adaptation

Nanya responded to the international trend of carbon reduction by implementing the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), which was provided the international Financial Stability Board (FSB), in 2018 and publicly supported the TCFD in 2021, actively establishing mechanisms and strengthening operations. We developed strategies and actions in response to climate change on aspects of governance, strategy, risk management, and metrics and targets, in hopes of reducing the impact of climate risks.



Nanya TCFD Report



#### Governance

##### Management strategies and actions

- Establishing the Risk Management Committee under the board.
- Climate change strategy are established by Sustainability Committee, which is chaired by the President.
- Sustainability Committee, Risk Management Promotion Center, and Project Improvement Organization (energy-saving, waste-reduction, and carbon-reduction) are responsible to implement climate change management.

##### 2021 Operation status

- Risk Management Committee had held 6 meeting to supervise operation risks which include emerging risks (carbon fee or renewable energy).
- Energy conservation management plans are formulated each quarter, and implementation is reviewed. Of the 35 plans in total, 33 were energy conservation plans and an estimated 7,585 MWh was saved.
- The Corporate Sustainability Committee convened quarterly, discussing corporate sustainability topics such as corporate governance, society, environmental protection, and energy conservation. Responses to climate change was also one of the discussion topics. The discussion topics were listed as resolutions or action items that required follow-ups and improvements. For example, formulating a renewable energy plan and discussing the SBT.



#### Strategy

##### Management strategies and actions

- Based on the TCFD framework, short, medium, and long-term climate-related risks and opportunities are periodically identified, and so are impacts of climate-related risks and opportunities on organizational operation, strategy, and financial plans.
- The resilience of organizational strategy is considered under different climate scenarios.
- Establishing 5 strategies which are "Low Carbon Product R/D", "Green Technology Production", "Adapting to Climate Risks", "Join Hands with Sustainable Partners", and "Cultivate Climate Awareness"

##### 2021 Operation status

- In accordance with the TCFD methods, short, medium, and long-term climate-related risks and opportunities were discussed and identified cross-departmentally. A total of 23 risks and 11 opportunities were identified.
- We have submitted an application to achieve the SBT certification by 2030, and completed the schedule for purchasing renewable energy and planning of financial expenses
- We used the 2°C global warming scenario of the UN Intergovernmental Panel on Climate Change (IPCC) and International Energy Agency (IEA) to analyze climate risks during operational processes and up/down stream, and developed relevant mitigation measures that complied with the Adaptation Policy Framework for Climate Change. In addition, we formulated a long-term mitigation and adaptation strategies and goals.



### Strategy and Performance of Material Topics

##### Management strategies and actions

- Impact levels and occurrence probability are used to assess the significance of related risks and opportunities brought by the climate change, and relevant response measures are set.
- Climate risk identification and assessment results are incorporated into the Enterprise Risk Management (ERM), and are periodically verified by senior management.

##### 2021 Operation status

- Material risks that were identified include carbon fee, renewable energy requirements from regulations and customers. The financial impacts were estimated and reported to senior management for review in the annual meeting of the Finance Risk Management Committee.
- Identified a total of 9 material risks and 11 material opportunities, such as carbon fee and low carbon production R/D.

##### Management strategies and actions

- Greenhouse gas management and goals of resource recycling and reuse are stipulated.
- Compiled an inventory of the carbon footprint of all products and implemented management plans to improve hot spots of carbon footprint.
- Compliance with renewable energy regulations on major electricity users, and set the mid and long-term renewable energy targets.
- The scopes 1/2/3 of greenhouse gas inventory and verification are conducted annually to confirm sources of greenhouse gases for key project management.
- Implementing supplier chain improvement projects.
- We aim to participate in the international Carbon Disclosure Project (CDP), disclosing information on carbon emissions and communicating with stakeholders.

##### 2021 Operation status

- We set the goal to reduce GHG emissions per die by 25% from 2017, and the goal was achieved.
- Completed the inventory of the carbon footprint of all products and implemented management plans to improve the three hot spots of carbon footprint in the 2020 Inventory
- We Used 2.6 million kWh of electricity from onshore wind farms, signed a 10-year contract with a solar power plant in 2022 to purchase and use 25 million kWh of renewable energy by 2023. We set a target of renewable energy to reach at least 25~30% of electricity use in 2030
- A total of 33 energy conservation plans were completed in 2021, and saved an estimated 7,585 MWh
- Setting Science based target, we will reduce 25% carbon emissions by 2030 compare to 2020
- Implementing supplier chain improvement projects, which save 3,315 MWh in 2021.
- We received the ratings of A— in the CDP in 2018 and 2019, and acquired excellent result by receiving the rating of A List leadership level in 2020 and 2021.

## Climate Change Mitigation

The main sources of greenhouse gas emissions from semiconductor fabrication plants are electricity and perfluorocarbons (PFCs). Among them, electricity is essential for operation and production, enabling all machinery and equipment at plants to normally operate. PFCs are perfluorocarbons and other compounds of the same kind used in production process, categorized into the greenhouse gases with high global warming potential.

### Greenhouse Gas Inventory

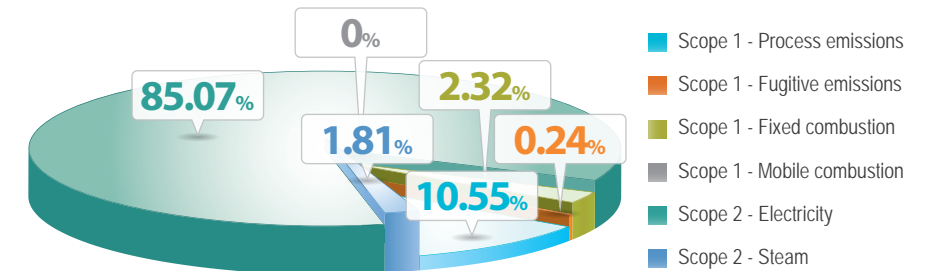
We refer to the ISO 14064-1, four regulations formulated by the Environmental Protection Administration under Taiwan's Executive Yuan, i.e., the Greenhouse Gas Reduction and Management Act, the Regulations Governing Greenhouse Gas Emissions Inventory and Registration, the Greenhouse Gas Verification Guidelines, and the Greenhouse Gas Registration Guidelines, and the requirements of the WBCSD/WRI Greenhouse Gas Protocol, using the method of 100 percent operational control to set organizational boundaries. At present, Nanya commissioned SGS to complete verification of ISO 14064-1 GHG emissions, including Scope 1, Scope 2, and Scope 3.

The inventory scopes of Nanya were all operating locations in Taiwan. The main sources of GHG emissions were purchased electricity and steam (accounting for about 86.88%) and process emissions (accounting for about 13.12%). GHG emissions in 2021 totaled 430,048 metric tons CO<sub>2</sub>e. Scope 1 emissions totaled 56,409 metric tons CO<sub>2</sub>e, and there was no CO<sub>2</sub> emissions from biomass fuel; Scope 2 emissions totaled 373,639 metric tons CO<sub>2</sub>e.

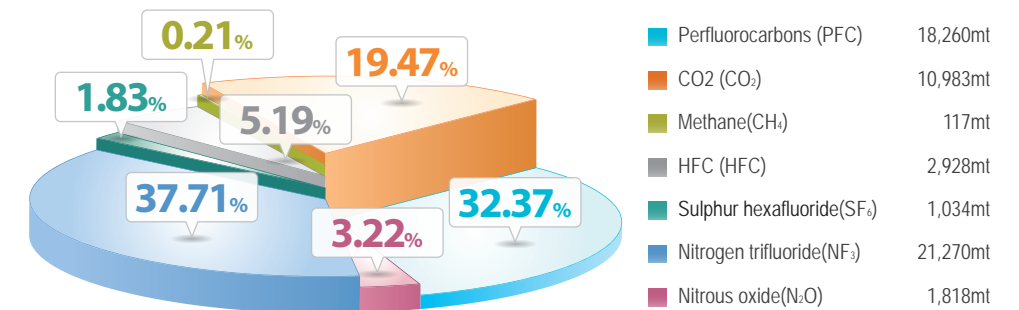
GHG emission factors were based on the GHG emission factory management table declared on the national registration platform of Taiwan's Environmental Protection Administration, the IPCC 2006, emission factors released by Taiwan's Bureau of Energy, Ministry of Economic Affairs, and emission factors made public by the company-owned steam plant of Nan Ya Plastics Corporation's utility plant. The GWP value is cited from the IPCC AR4. Compared with the base year of 2017, the greenhouse gas emissions in 2021 increased by approximately 14.2%, and the number of chips produced increased by approximately 17.2%. In terms of emissions per unit wafer area, the emission intensity in 2021 was 0.73 kg-CO<sub>2</sub>e/wafer area cm<sup>2</sup>, down 6.4% compared with 2020.

However, if viewing from the emission intensity of per unit chip output, the total GHG emissions per unit capacity in 2021 decreased 37% compared with the year of 2017.

### Percentage accounted for by Scope 1 and Scope 2 emissions in 2021

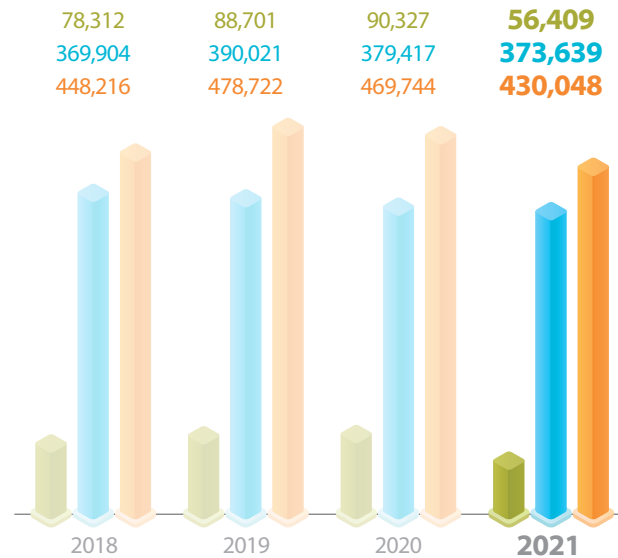


### Scope 1 GHG emission percentage





## 2018 to 2021 Scope 1 and Scope 2 emissions



- Scope 1 (Metric tons CO<sub>2</sub>e)
- Scope 2 (Metric tons CO<sub>2</sub>e)
- Gross emissions (Metric tons CO<sub>2</sub>e)

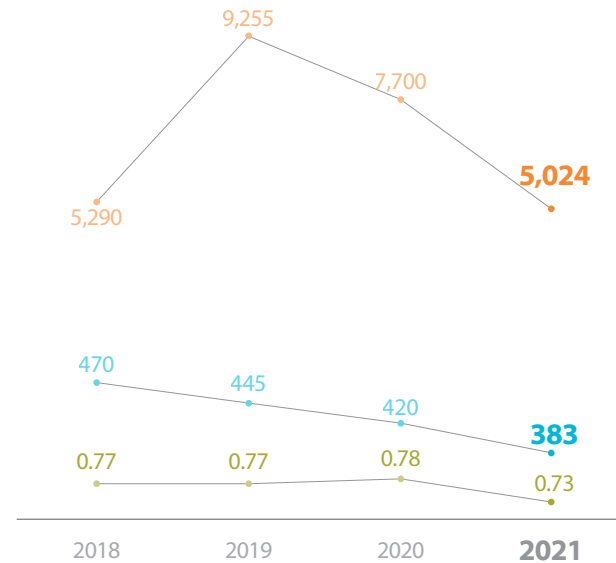
Note 1: PFCs emissions totaled 9 types of process gases, including carbon tetrafluoride (CF<sub>4</sub>), perfluoropropane (C<sub>3</sub>F<sub>8</sub>), hexafluorobutadiene (C<sub>4</sub>F<sub>6</sub>), tetrafluorocyclobutane (C<sub>4</sub>F<sub>8</sub>), trifluoromethane (CHF<sub>3</sub>), difluoromethane (CH<sub>2</sub>F<sub>2</sub>), monofluoromethane (CH<sub>3</sub>F), sulfur hexafluoride (SF<sub>6</sub>), and nitrogen trifluoride (NF<sub>3</sub>).

Note 2: Other direct emissions included CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O of process gas, HFCs, and SF<sub>6</sub> of non-process gas, such as fire extinguishing equipment, refrigerators, freezers and high-voltage power panels.

Note 3: Indirect energy emissions included the use of electricity and steam.

Note 4: Reduction equipment was installed in film process machinery to reduce N<sub>2</sub>O emissions.

## GHG<sup>Note 1</sup> emission trends in 2018-2021



- GHG emissions per unit of product area (kg- CO<sub>2</sub>e/wafer area (cm<sup>2</sup>))
- GHG emissions per unit capacity<sup>Note 2</sup> (Kg- CO<sub>2</sub>e/thousand die)
- GHG emissions per unit of revenue (kg- CO<sub>2</sub>e / NT\$1 million)

Note 1: GHG emissions in this table includes Scope 1 and Scope 2

Note 2: The calculation of production capacity was the output of Good Electronic Chip (GEC), and the output of various products was converted into around 4Gb product particle numbers, using per thousand die (k-pcs) as the calculation unit.

To improve the integrity of greenhouse gas (GHG) inventory in our value chain, we have conducted scope 3 inventory in accordance with the Greenhouse Gas Protocol, and have passed external verification of the ISO 14064-1 standards. The emissions of 7 items in Scope 3 GHG emissions passed verification in 2021. The highest GHG emissions came from the use of sold products, followed by the purchased goods and services in the upstream. The fuel-and energy-related activities not included in scope 1 or scope 2 stood at the third place.

Scope 3 Category/Year	Source of calculation	Scope 3 Emissions (ton-CO <sub>2</sub> e)
Purchased goods and services	Carbon emissions from the main material purchased and auxiliary materials in the process	124,440
Fuel- and energy-related activities	Carbon emissions from indirect upstream emissions related to the production of fuels and energy purchased and consumed	73,452
Upstream transportation and distribution	Carbon emissions from transportation and distribution of products purchased between the Company's tier 1 suppliers	3,182
Employee commuting	Carbon emissions from company cars	165
Business travel	Carbon emissions from employees traveling overseas on business trips	6
Waste generated by operations	Carbon emissions from waste generated in the production process, including waste transport and disposal.	670
Use of sold products	Carbon emissions from electricity consumption of products used by customers	771,058
Total		972,973

## Subsidizing electric scooters for employees in response to the goal for net zero emissions by 2050

In the path for Taiwan to achieve net zero emissions by 2050 announced by the National Development Council at the end of March 2022, the government plans for electric scooters to account for 100% of sales by 2040. This shows that the promotion of electric scooters is an important strategy. Nanya supports the promotion of electric transportation tools and the government policy of net zero emissions, and announced that it will subsidize the purchase (trade-in) of electric scooters by employees in 2022. Employees will not only be able to apply for government subsidies when purchasing electric scooters, but also an additional subsidy of NT\$10,000 for new purchases or NT\$16,000 for trade-in from the Company. Employees can trade their scooter in for an electric scooter at 45% of the original price, or enjoy a 35% discount for new purchases. To further encourage employees to purchase electric scooters, we are negotiating with electric scooter manufacturers to provide a discount or convenience store gift certificates when employees present their employee ID. Nanya hopes to increase the willingness of employees to switch to electric scooters through subsidies, in order to lower Scope 3 carbon emissions from employees commuting to work, and contribute to net zero emissions by companies and the government.

Electric scooters Price- (Government subsidy+Dealer discount+Company subsidy) = Employee discount

Trade in for NT\$31,200/scooter ↓ 55%

Purchase for NT\$45,500/scooter ↓ 35%



Note: Electric scooters price NT\$70,000/scooter



A Happy Enterprise that  
Jointly Reduces Carbon  
Emissions

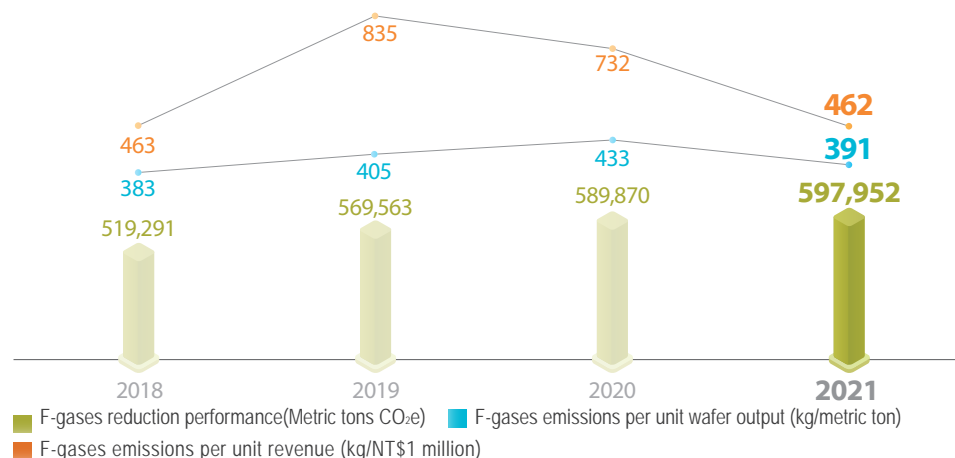
## ► Greenhouse Gas Reduction

We have actively promoted voluntary reductions and participated in the annual voluntary reduction promotion plan of industrial greenhouse gases implemented by the Industrial Development Bureau under the Ministry of Economic Affairs. As Fluorinated Greenhouse Gases (F-gases) have the properties of high global warming potential and N<sub>2</sub>O being one of the Company's main Scope 1 emissions, Nanya has actively planned and implemented GHG reduction plans for F-gases and N<sub>2</sub>O starting in 2006.

### Fluorinated Greenhouse Gases Reduction

Nanya planned to purchase a high reduction rate local scrubber when planning the plant. Currently, the PFC Local Scrubber used in the thin film and etching processes is Burn Type, destroying F-gases through the high temperature generated by combustion. In order to reduce the emissions of F-gases into the air, we formulated the acceptance criteria of F-gases reduction rate processed by Local Scrubber. The gas treatment efficiency of CF<sub>4</sub> should reach above 90%, and the reduction rate of processing C<sub>3</sub>F<sub>8</sub>, C<sub>4</sub>F<sub>6</sub>, C<sub>4</sub>F<sub>8</sub>, CHF<sub>3</sub>, CH<sub>2</sub>F<sub>2</sub>, and SF<sub>6</sub> should reach more than 95% while the reduction rate of NF<sub>3</sub> should be over 99%. After the installation of Local Scrubber is completed, the FTIR will be used to detect the reduction rates of various F-gases to meet the reduction trend in the future.

### Fluorinated Greenhouse Gases emission trends in 2018-2021



Through purchasing Local Scrubber with high F-gases reduction rate when planning to build fabrication plants, and promoting programs on reducing the use of F-gases in process, we aimed to reach a reduction rate of at least 90%. From 2018 to 2021, the reduction rates of F-gases gases used in process all reached a minimum of 93%, reducing a total of 2,276,676 metric ton-CO<sub>2</sub>e emissions over four years, which is equal to 5,853 times the carbon absorption of Daan Forest Park in one year.

Note 1: Global Warming Potential (GWP) is the warming intensity of the gases relative to carbon dioxide (set the CO<sub>2</sub>'s GWP = 1). The high global warming potential referred in this article are the gases with a GWP value higher than 675. (Based on the GWP values of the IPCC Fourth Assessment Report (FAR))

Note 2: Local Scrubber

Note 3: FTIR : Fourier-Transform Infrared Spectrometer

## N<sub>2</sub>O Reduction

Nanya was successfully implemented N<sub>2</sub>O emission destruction in thin film process by the burned-type local scrubber, reducing 90% emission and above and effectively lowers N<sub>2</sub>O emission. In 2021, N<sub>2</sub>O emissions decreased by 91% compared to 2020, and N<sub>2</sub>O emission per unit production capacity was 0.002 metric tons CO<sub>2</sub>e/thousand die; N<sub>2</sub>O emission per unit revenue was 0.02 metric tons CO<sub>2</sub>e/NT\$1 million, down more than 95% compared to 2020.



## Carbon Disclosure Project

Upholding the principle of transparent disclosure, we have participated in the evaluation of the Carbon Disclosure Project (CDP), a non-profit organization, since 2009, disclosing related information regarding greenhouse gas emissions and reductions every year. We received the ratings of leadership level (A-) in the Climate Project in 2018 and 2019, and acquired the rating of A-List leadership level (A) in 2020 and 2021. In addition to the CDP and public disclosure of related information regarding carbon emissions in this report, Nanya also actively discloses its greenhouse gas emissions and reductions in the greenhouse gas report system of the Responsible Business Alliance (RBA), or provides related information with regard to carbon emissions so as to help clients form bases for calculating footprints of their products.



## Energy and Resource Management

### Energy Management

#### ► Energy Structure

Nanya mainly used purchased electricity (accounted for 93.4% of the Company's energy consumption) and natural gas (accounted for 6.3% of the Company's energy consumption) in 2021. Purchased renewable energy (electricity), accounted for 0.3%, while the consumption of diesel accounted for less than 0.05%. Our production capacity in 2021 increased 0.3% compared to 2020, and the continued installation of advanced processes led to an increase in energy consumption. Hence, Nanya's total energy consumption reached 780,089 MWh in 2021 and increased 2.69% compared to 2020, in which electricity consumption (including renewable and non-renewable) was 731,387 MWh, and natural gas consumption was 48,702MWh (4,682,857 m<sup>3</sup>). In terms of emission intensity, electricity consumption per unit revenue was 8.5 MWh/NT\$1 million in 2021 (26.9% lower compared to 2020), and natural gas consumption per unit revenue 54.7 m<sup>3</sup>/NT\$1 million (25.7% lower compared to 2020). The downward trend in the past three years shows that Nanya continues to improve its energy management.

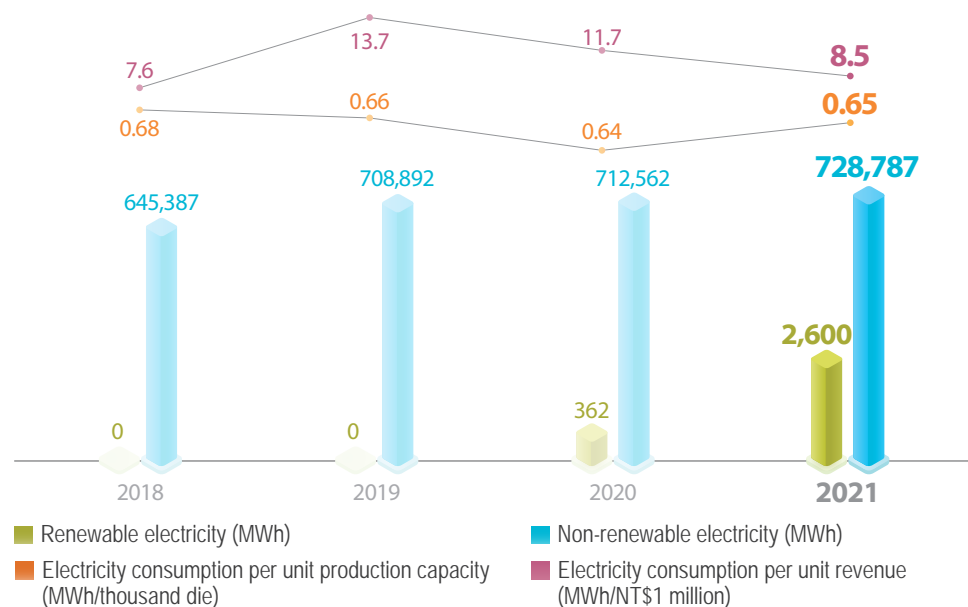
Service life and environmental impacts of fossil energy have been the most important issues so efficient management is urgent. Purchased electricity and natural gas are main energy sources that Nanya uses. Externally, other indirect energy consumption that generates greenhouse gas emissions includes raw materials transportation, production of raw materials suppliers, waste transportation/disposal, employee travel, and employee commuting. In order to mitigate the environmental impacts of greenhouse effect, when building fabrication plants, energy conservation is the base for the plans, such as adopting a dual-temperature chilled water system and waste heat recovery and utilization in freezers. Over the past years, we have constantly implemented various energy-saving technologies, using diverse thinking methods, such as automating equipment control, improving equipment efficiency, reclaiming energy for reuse, and improving production management, to reduce energy consumption. Meanwhile, we prioritize energy conservation equipment during the design of equipment installation and procurement. Moreover, the company promotes energy management programs in offices and public areas to reinforce the concepts of our employees in energy conservation. The company also continues to reduce the consumption of raw materials and increases the recycling amount of waste to mitigate the global impacts of greenhouse gases. Energy sources that Nanya mainly consumes are purchased electricity, natural gas, and a small amount of diesel. The company does not use internal energy.

#### Total energy consumption

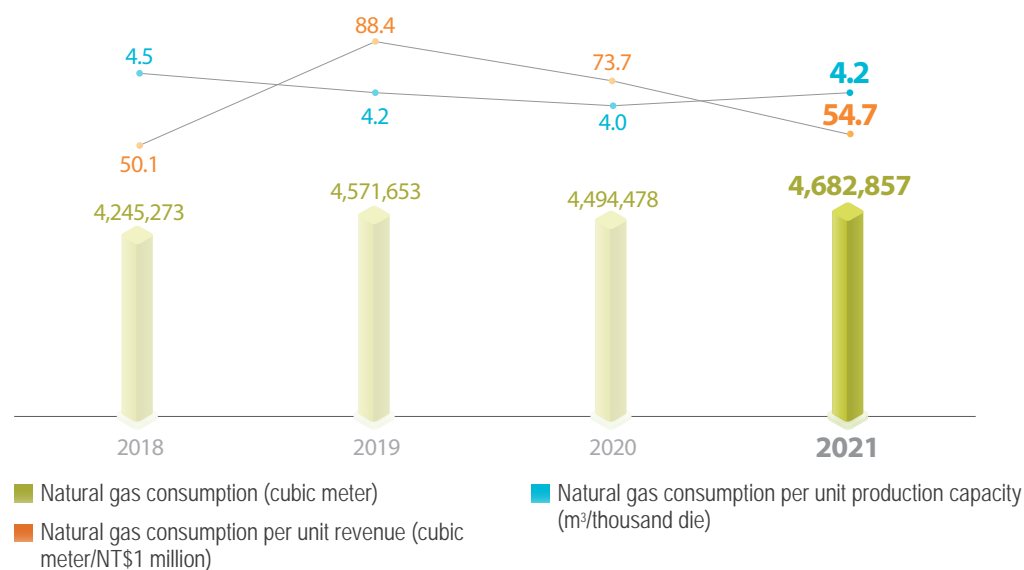
Unit: MWh

	2018	2019	2020	2021
Total renewable energy consumption	0	0	362	2,600
Total non-renewable energy consumption	689,538	756,437	759,305	777,489
Total energy consumption	689,538	756,437	759,667	780,089

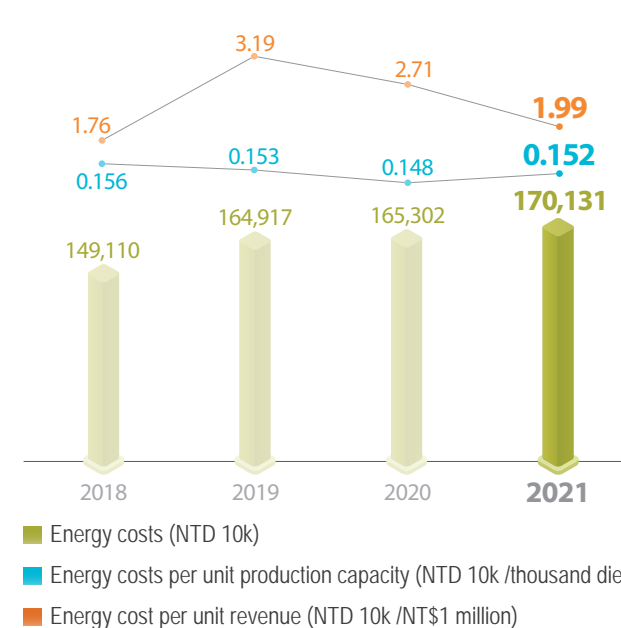
## Electricity consumption from 2018 to 2021



## 2018 to 2021 natural gas consumed



## Energy costs from 2018 to 2021



Note 1: Electricity CO<sub>2</sub>e emission is based on the electricity carbon emission factor = 0.502 kgCO<sub>2</sub>e/kWh, published in 2020 by the Bureau of Energy, Ministry of Economic Affairs

Note 2: Natural gas CO<sub>2</sub>e emission is based on the GHG Emission Factor Management Table Version 6.0.4 announced by the Environmental Protection Administration.

Note 3: Based on the Energy Product Unit Heating Value Table updated in 2020 by the Bureau of Energy for unit conversion, 1 kWh = 860 kcal = 3.6 megajoules.

Note 4: 1 cubic meter of natural gas = 10.4 kWh (Based on the Energy Product Unit Heating Value Table updated in 2020 by the Bureau of Energy for unit conversion, 1 kWh of electricity = 860 kcal; 1 cubic meter of natural gas = 9,000 kcal)

## ► Renewable Energy Use and Planning

Nanya carries out planning and implementation of renewable energy use in the following three phases.

**1 Self-development evaluation and trial implementation.**

Nanya purchased 362 T-RECs through the renewable energy trading platform in 2020, and also began evaluating available spaces in existing factories, planning the establishment of a solar power plant with installed capacity of 456.28 kW (completed in coordination with the expansion of the new factory). We are also installing 27.36 kW of solar panels on the rooftop of our new building, and expect to complete construction in 2022. New factories in the future will also fully utilize land resources to install green energy facilities.

**2 External cooperation**

Nanya is working with renewable energy selling enterprises to obtain more electricity, and is gradually expanding consumption based on regulatory requirements. In 2021, we used a total of 2,600 MWh (9.36 Terrajoule) in renewable energy, and expect to use 7,880 MWh (28.4 Terrajoule) or more of renewable energy in 2022. Starting in 2023, we will gradually increase renewable energy use until we reach 25,000 MWh (90 Terrajoule) or more.

**3 Becoming aligned with international standards by achieving net zero emissions**

In order for the percentage of renewable energy to reach 25-30% by 2030 to achieve the SBT or RE100, Nanya will target the supply contracts of large renewable energy plants to further increase its renewable energy consumption.



## ► Enhancing Energy Usage Efficiency

In order to mitigate the environmental impacts of greenhouse effect when building fabrication plants, energy conservation is the base for the plans, such as adopting a dual-temperature chilled water system and waste heat recovery and utilization in freezers. Over the past years, we have constantly implemented various energy-saving technologies, using diverse thinking methods, such as automating equipment control, improving equipment efficiency, reclaiming energy for reuse, and improving production management, to reduce energy consumption. Meanwhile, we prioritize energy conservation equipment during the design of equipment installation and procurement. Moreover, the company promotes energy management programs in offices and public areas to reinforce the concepts of our employees in energy conservation. The company also continues to reduce the consumption of raw materials and increases the recycling amount of waste to mitigate the global impacts of greenhouse gases.

Nanya implemented ISO 50001 Energy Management Systems and completed certification in 2018. We invested NT\$21.8 million in 2019 to establish the energy management system platform, and utilized the energy consumption real-time monitoring platform for statistical analysis of system equipment and smart energy conservation management. The platform helps manage and improve energy consumption of organizations and machinery groups, and promotes best practices of energy management and reinforces good management behavior.

Nanya completed a total of 33 energy conservation management projects in 2021, and total energy conservation benefits reached 7,585 MWh/year (27.3 Terrajoule /year); 25 energy conservation management projects (21 new projects and 4 ongoing projects) will be implemented in 2022 and are expected to provide energy conservation benefits reaching 5,993 MWh/year (21.6 Terrajoule /year), all from reducing electricity consumption. We have constantly paid attention to issues on energy conservation and carbon reduction, and made an effort to implement related measures. At the High-Tech Energy Conservation and Carbon Reduction Forum held by the Taiwan Semiconductor Industry Association (TSIA), we joined in the declaration of voluntary energy conservation and carbon reduction. We also received the Excellence Award in the Smart Energy Savings Competition of New Taipei City in 2019. At the 2021 Taiwan Corporate Sustainability Awards, we received the Climate Leadership Award for our energy conservation and carbon reduction project for the second consecutive year. Furthermore, we separated ourselves from other companies with excellent environmental protection performance in 2021 under the themes "energy-efficient memory" and "green manufacturing", and led Taiwan's DRAM industry in winning the Silver Award in the 3rd National Enterprise Environmental Protection Award from the Environmental Protection Administration, Executive Yuan.



Won the National Enterprise Environmental Protection Award

## Action Plans

### 2021

#### Description

- 8 projects to improve equipment efficiency, 3 projects to save electricity consumed by lighting, 18 projects for equipment energy conservation management, and 4 other projects
- Total energy conservation: 7,585 MWh/year.

Number of  
projects

**33**

Carbon reduction volume  
(Metric tons CO<sub>2</sub>e)

**3,808**

### 2022-2023 Planning and implementation

#### Description

- 10 projects to improve equipment efficiency, 1 heat recovery project, 7 projects to save electricity consumed by lighting, 6 projects for equipment energy conservation management, and 1 other project
- Total energy conservation: 5,993 MWh/year.

Number of  
projects

**25**

Carbon reduction volume  
(Metric tons CO<sub>2</sub>e)

**3,009** (Estimate)

## Energy consumption real-time monitoring platform



## Water Resource Management

Due to the effect of global climate change, rainfall has become polarized in Taiwan, resulting in floods and water shortages occurring at the same time. As an important member of the semiconductor industry, Nanya has monitored the risk of water shortage caused by global climate change, and understands the effect of climate change and water resources on operations. Nanya continues to implement water conservation measures and strives to recycle and reuse water to reduce its impact on the environment and the risk of water shortage. Our efforts in water resource management has gained the recognition of the CDP, an international environmental evaluation indicator. Nanya was ranked at the leadership level "A-" in Water Security for two consecutive years, recognizing our efforts in climate change and water resource management for global sustainability.

Nanya's main strategies for water resource management are as follows:

Actively manage indicators, conserve water in operations, and fully utilize water resources.

Assess the risks and opportunities under climate change, and mitigate the impact of water shortage.

Communicate with stakeholders so that they will take water resources seriously and implement water conservation.

Implement wastewater classification treatment and multiple recycling measures to maximize the efficiency water resources.

Comply with laws and regulations, continue to strengthen water treatment facilities, and reduce the risk of environmental pollution.

### Water Resources Structure

Nanya's total water withdrawal was 3,456.524 million liters in 2021, in which Taoyuan Canal is the main source of water, accounting for approximately 98.8% (3,416.848 million liters), followed by tap water at approximately 0.8% (27.318 million liters), and rainwater at approximately 0.4% (12.358 million liters). Our production capacity in 2021 increased 0.3% compared to 2020, and the continued installation of advanced processes led to an increase in total water withdrawal of 2.3% compared to 2020. In terms of water use intensity, water consumption per unit production capacity was 3.08 metric tons/thousand die in 2021 (increase 2.3% compared to 2020), and water consumption per unit revenue was 4.04 metric tons/NT\$1 million (decrease 26.9% compared to 2020). Ultra-pure water consumption for the year was 3,517.009 million liters in 2021 (increase 2.96% compared to 2020), ultra-pure water consumption per unit production capacity was 3.13 metric tons/thousand die (increase 2.6% compared to 2020), and ultra-pure water consumption per unit revenue was 41.1 metric tons/NT\$1 million (decrease 26.6% compared to 2020).

### Types of water sources and volume of water withdrawn by Nanya

Unit (million liters)<sup>Note 1</sup>

	2018	2019	2020	2021
Water withdrawal by source <sup>Note 2</sup>				
Fresh surface water	2,968.646	3,203.539	3,321.583	3,416.848
Fresh ground water, seawater, output water	0	0	0	0
Rainwater	30.287	31.072	19.413	12.358
Third party water <sup>Note 3</sup> (Total municipal Water supplies)	23.429	23.775	27.958	27.318
Total water withdrawal	3,022.362	3,258.386	3,368.954	3,456.524

### Nanya water consumption

Unit (million liters)

	2018	2019	2020	2021
Water withdrawal (A)				
	3,022.362	3,258.386	3,368.954	3,456.524
Water discharge (B)				
	2,495.9	2,633.701	2,705.126	2,718.373
Total net fresh water consumption (A-B)				
	526.462	624.685	663.828	738.151
Changes in water storage <sup>Note 1</sup>				
	0	0	0	0

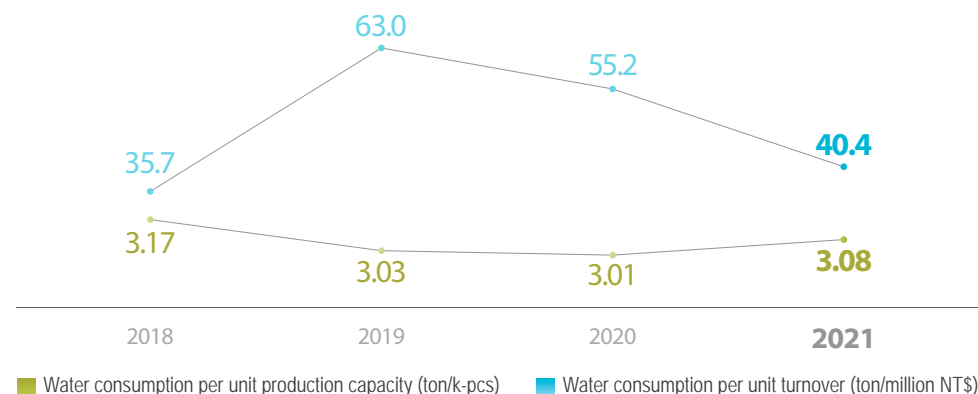
Note 1: Changes water storage = Water storage on 2021/12/31 – Water storage on 2021/1/1

Note 1: 1 million liters = 1,000 tons

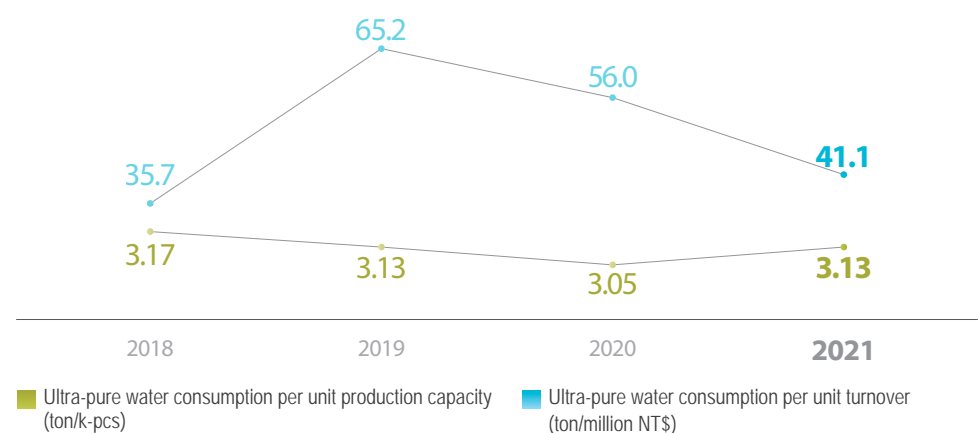
Note 2: Nanya's water sources are all freshwater ( $\leq 1,000$  mg/L total dissolved solids) and none are from areas with water stress.

Note 3: City government water supplier and sewage treatment plant, public and private utilities companies, and other organizations that participate in the provision, transportation, treatment, disposal, or use of water and sewage

## Run chart of 2018-2021 water consumption



## Run chart of 2018-2021 ultra-pure water consumption

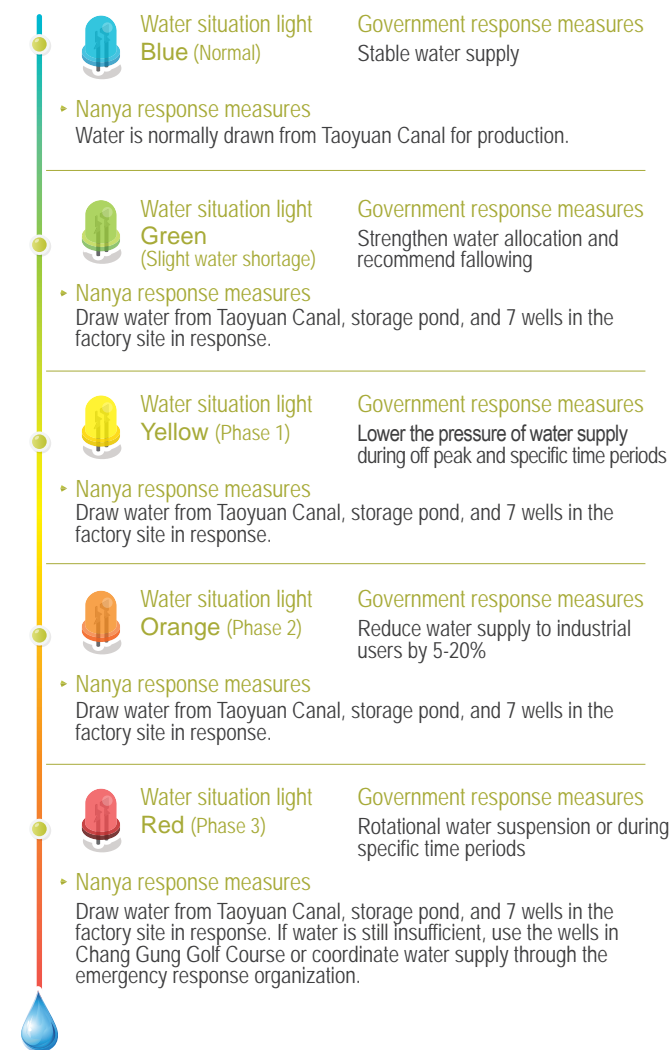


## Water Resource Risk Management

Our main water source comes from the Shihmen Reservoir, and is channeled and processed through the Taoyuan Canal before being supplied as production water. The gravity flow is used to independently channel water without affecting the ecology of water resources and any other purposes of usage. In addition, rainwater harvesting can supply production water and tap water for household use. Currently, Nanya has only one production plant located in New Taipei City, Taiwan. Taiwan's rainfall is unevenly distributed between regions and seasons, which often results in regional and seasonal droughts. Nanya has used the WRI Aqueduct, tools for simulating water resource scenarios, to analyze the geographical location of the plant. The water source is the Taoyuan Canal of Shihmen Reservoir, which supplies 96.5% of water. The water stress assessment result was "low", meaning that it is a non-water stress area. Furthermore, Nanya's water source Shihmen Reservoir supplies approximately 800 million liters/day. The Company's daily water consumption is approximately 9.5 million liters. Hence, the effect of Nanya's operations on regional water use is 1.2%.

To reduce the risk of short-term water shortages inherent in the geographical location, we have continuously promoted water-saving measures, and committed ourselves to water recycling to strengthen our adaptability. The amount of water needed by production is huge so water shortage will cause production interruptions, affecting the output and delivery. To mitigate immediate impacts caused by short-term water shortages, a cistern with a capacity of 43 million liters and two detention basins each with a capacity of 4.06 million liters have been built in the plant to effectively harvest rainwater during the rainy season. Moreover, Nanya and the adjacent factories of the Formosa Plastics Group have cooperated to set up an emergency response organization for water shortages. When water shortages occur, the members of the emergency response organization can urgently deploy water resources to support each other. Therefore, no production losses have occurred owing to water shortages.

## Nanya drought response mechanism



## ► Water Conservation

In addition to the design of water-saving processes, the Nanya's water management chiefly emphasizes water reduction and recycling. Currently, the main directions promoted are as follows:



Implement water-saving results through work guidelines.



Reach the reduction effects through methods of conservation such as reduction and recycling.



Promote water conservation through daily management practices.



Build waste water classification treatment and adopt multiple recycling to maximize the use of water resources.

Nanya actively implements water conservation measures and plants currently have acid-alkaline waste water, hydrofluoric waste water, and organic waste water recovery systems. Along with the implementation of various water saving measures, the process water recycling rate reached 90.8% in 2021. In 2021, the water consumption from waste water and rainfall harvesting methods totaled 5,450 million liters, accounting for 159% of the company's water consumption. In the future, to coordinate with the expansion plan of plant area, an estimate of NT\$430 million has been invested in building new hydrofluoric waste water COD and total nitrogen treatment systems, which not only will solve the problem of excessively high hydrofluoric waste water COD and total nitrogen, but also recover the hydrofluoric waste water at the same time. It is estimated that additional 1 million liters hydrofluoric waste water will be recovered daily. The systems are expected to be completed in 2022.



Nanya water resource video

Note: Nanya's process water recovery rate was calculated using the formula approved by "Nanlin Technology Park Environmental Quality Supervision and Management Committee," which was required in the environmental impact assessment. We began using the formula of Hsinchu Science Park Bureau for calculation in 2021, so that calculation standards are consistent with peers in the industry, and also updated process water recycling rate in 2018-2020.

## ► Cooperation and Communication

Besides implementing internal water resource management and evaluation, Nanya is also actively implementing water conservation measures and water recovery and reuse, and participates in the industry association for water conservation related guidance and experience sharing.

### Government

- Participate in the semiconductor industry association, periodically attend "water resource diversification management and cooperation platform" meetings of the Water Resources Agency, and engage in exchanges, communication, and cooperation in water resource related policies.
- Attend meetings and coordinate and communicate with the Irrigation Agency and North Region Water Resources Office, and cooperate with the government's emergency response plan when there is a water shortage, in order to most effectively utilize water resources, mitigate the impact of water shortages in water supply areas, and achieve stable and balanced water supply.



### Local residents

- Nanya formed an Environmental Quality Supervision Committee with the local community when it was first established, and commissions a third party to conduct surveys of surrounding ecology, hydrology, and air quality. Survey results are reported to the Environmental Quality Supervision Committee.
- Nanya learns about issues that community residents are concerned about through the Environmental Quality Supervision Committee, and includes the issues in its periodic evaluation of ISO 14001 Management Systems.
- To ensure that the water quality of effluent is normal and eliminate concerns residents may have about effluents from Nanya, we have established an effluent water quality real-time monitoring system that is linked to the Environmental Protection Bureau, jointly monitoring the water quality of effluents in real time.



### Suppliers

- We share, exchange, and provide guidance to suppliers for water management and conservation measures through supplier meetings, in order to improve their water management measures.



### Companies and the general public

- Nanya shares its water management experience through participation in various events, such as the green factory visit co-organized with the Industrial Development Bureau in 2021, during which we shared our water management and water conservation results with visiting government officials and companies.



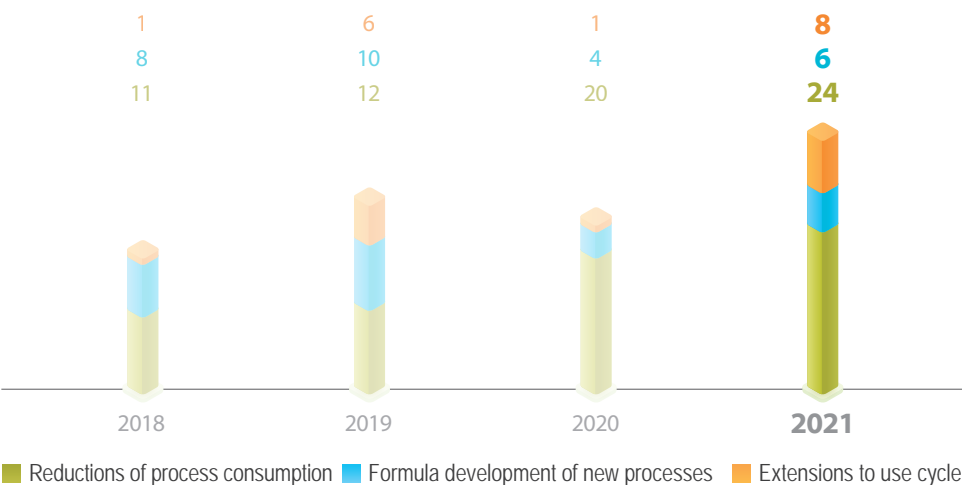


## Raw Materials Reduction and Reuse

### Raw Materials Reduction

Nanya regularly reviews the rationality and appropriateness of raw material use. Moreover, we reduced the use of raw materials by streamlining the manufacturing process. The responsible organization of the company set implementation goals for raw material reductions every year, and periodically reviewed the performance of reductions in the entire company's raw materials. Accumulative 38 entries in improvement proposals regarding the consumption of raw materials were completed in 2021, including formula development of new processes, reductions of process time, extensions to use cycle, and reductions of process consumption. Among improvement plans in 2021, the thin film area used the same raw materials to integrate different processes, and effectively improved the efficiency of raw material use; the greatest benefits were from reducing the use of SOD (Spin on Dielectric) by approximately 20L (9%) and cleaning solution HC-100 by approximately 1,000L (7%) each month.

### Improved performance of raw material consumption



### Performance of raw material consumption improvement proposals in 2021

#### Extensions to use cycle

8 items including the extension of the sulfuric acid tank, hydrofluoric acid tank acid replacement cycle, extension of the gas cylinder replacement time, and extension of metal target use time

Number of cases 8 Benefits 18,035 (Thousand NTD/year)

#### Formula development of new processes

Reduced the use of 6 items, including photoresist, chemicals, and special gases, through process simplification and the development of high speed processes and formulas

Number of cases 6 Benefits 28,837 (Thousand NTD/year)

#### Reductions of process consumption

Reduced the use of 24 items, including photoresist, special gases, chemicals, and grinding fluid, through process optimization and improving production performance

Number of cases 24 Benefits 37,968 (Thousand NTD/year)



Total 84,840 (Thousand NTD/year)

#### Plans and measures

Reduction  
(metric ton)

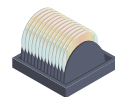
Waste sulfuric acid + Hydrogen peroxide reduction: Extension of acid replacement cycle | 598

Waste phosphoric acid, hydrofluoric acid, and nitric acid reduction: Process optimization | 17

Waste photoresist reduction: Process optimization | 13

Total reduction | 628

### High-k dielectric material – ZyALD consumption improvement



#### Photoresist consumption improvement:

Use of high-k dielectric material in processes caused vaporizer to be clogged and resulted in waste of gas cylinders.

#### Improvement method:

Chromaticity is highly correlated to non-volatile residue, so the supplier was requested to establish a chromaticity testing method and improve the process.

#### Improvement results:

Reduced the number of times gas cylinders are replaced each month by 3 times, and reduced monthly ZyALD consumption by approximately 5.5%.

### Photoresist consumption improvement



#### Photoresist consumption improvement:

The nozzle needs to be cleaned every hour to prevent photoresist crystals from clogging the nozzle.

#### Improvement method:

Adjust the photoresist nozzle cleaning formula to extend the cleaning cycle.

#### Improvement results:

Saved 100L of photoresist each month, and saved 4,700L of cleaning solution each month.

## Use and output of raw materials

### Input

	Consumption	Renewable	Non-renewable
Raw wafers (thousand slices-12-inch)	825		●
Process chemicals (metric ton)	47,511		●
Process gases (million M <sup>3</sup> )	6,563		●
Electricity (million kWh)	731		●
Clean water (1,000 m <sup>3</sup> )	3,429	●	
Packaging materials for wafers (metric ton)	97	27%	73%



### Output

	Output / volume
Raw wafers (thousand slices-12-inch)	809
Greenhouse Gas Emissions (Metric ton-CO <sub>2</sub> e)	430,048
Volatile organic compounds (metric ton)	15.68
Sulfide (metric ton)	1.66
Nitrogen oxides (metric ton)	10.34
Volume of wastewater (1,000 m <sup>3</sup> )	2,718
General industrial wastes (metric ton)	7,113
Hazardous industrial wastes (metric ton)	17,473

## ► Recycling

### Recycling inside plant

#### Ratio of using recycled materials as production materials

During the production process, dummy wafers were required to monitor process conditions, and used dummy wafers were reused through re-fabrication. Each dummy wafer was expected to be reused for around 8-11 times (differences exist owing to various processes). Therefore, the cost of purchasing brand-new dummy wafers was saved while plenty of waste output was reduced.

Since 2017, we have used suppliers' supplementing yields as major indicators for the allocation percentage of orders of the next year. In addition to considering suppliers' quotations, wafers of high supplementing yields may enhance the quantities of supplementing wafers, and may further improve the percentage of wafer start capacity using reclaim wafer.

We periodically reviewed defective items with suppliers, and asked suppliers improve their process conditions and modify specifications. In 2020, suppliers adjusted process methods so the discard condition that etching numbers of wafers were incorrectly read after step rings were polished was improved. This increased the average supplementing yield from 80% to 85%, and recycling rate increased from 72% in 2017 to 78% in 2020 and further to 80% in 2021 due to the stability of supplementing yield.

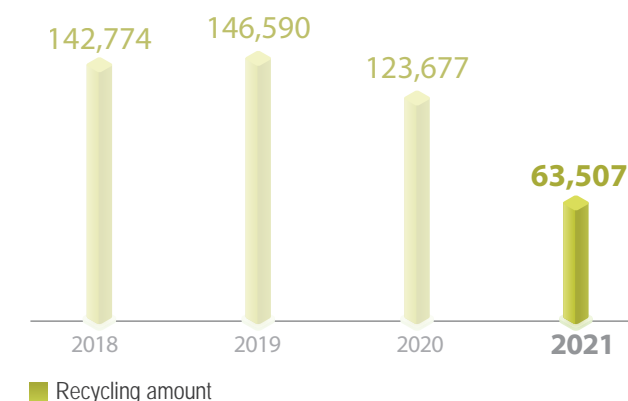
#### Product testing and reclamation of delivery packaging materials

Packaging materials for product shipments to outsourced testing facilities or packaging facilities, such as cartons, outer cartons, cushioning materials, and wafer cassettes, were all reclaimed as many as possible to be reused within the company. Moreover, wafer cassettes used by raw material for wafer were also recycled and reused in product shipments, and the reuse rate of these cassettes were nearly 100%. The aforementioned practices reduced the consumption of product packaging materials and waste output to minimum levels. This approach could reduce the consumption of approximate 21,000 pieces of brand-new 12-inch wafer cassettes every year, equivalent to reducing the consumption of 97 metric tons of plastics.

#### Reduction in product packaging materials

In response to the action of recycling and reductions, the company's own warehouses of finished products started with recyclable packaging materials. Reusable packaging materials used in supplementing finished products were recycled to be used in product exchanges for customer complaints, product storage, and commissioned work to reduce the times of application and purchase, further achieving the action of recycling for reuse and reductions of packaging materials. In addition, the cost of packaging materials used could be reduced. Although the saved amount was small, it made a difference to overall environmental maintenance and resource recycling.

Unit: NT\$ (New Taiwanese Dollar)



■ Recycling amount

## Recycling Outside Plant

Nanya outsources the disposal of 100% of the waste it generates. The waste is processed into industrial raw materials, construction materials, or other raw materials, including usage as fuel for incinerators. The percentage of waste generated by Nanya that was recycled in 2021 reached 94.9%, in which 90.7% of general waste was recycled and 96.5% of hazardous waste was recycled.

## List of waste generated by Nanya that is recycled externally

After collecting low concentration waste isopropanol liquid in the factory, it is processed by the concentration system into high concentration waste isopropanol liquid, which is recycled and reused to make industrial grade isopropanol.

After collecting waste photoresist in the factory, it is recycled and reused to make industrial grade PGMEA and EBR.

After collecting waste sulfuric acid in the factory, it is recycled and reused to make industrial grade sulfuric acid.

After collecting waste phosphoric acid, the recycling company increases its purity to make industrial grade phosphoric acid.

After collecting waste ammonium sulfate, the recycling company uses it to make industrial grade ammonium sulfate.

After collecting waste ammonium fluoride/hydrofluoric acid, the recycling company uses it to make sodium hexafluoroaluminate.

After collecting waste hydrofluoric acid, it goes through the chemical treatment system to generate calcium fluoride inorganic sludge, which can be recycled to make the raw material for industrial flux or cement.

After collecting waste liquid containing copper, it goes through electrolysis in treatment equipment to generate foil, which is recycled and reused to make copper wires.

After collecting organic wastewater, it goes through the biological treatment system and generates organic sludge, which can be made into raw materials for ready mix concrete and construction materials after thermal treatment.

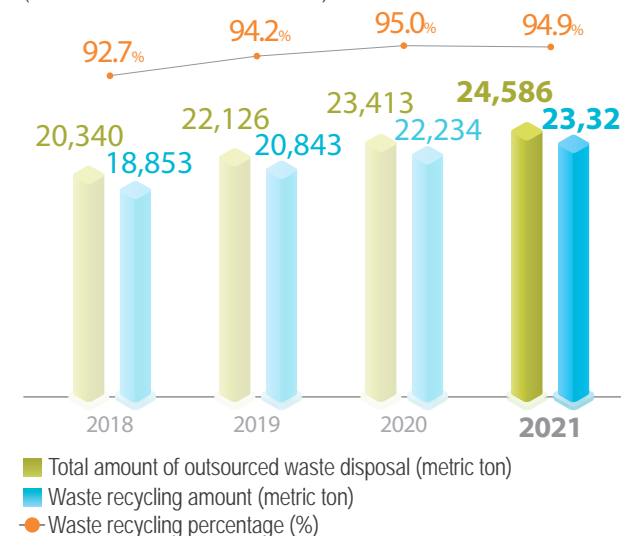
After collecting waste SOD, the recycling company uses it to make lacquer thinner.

The inorganic sludge consisting of river sand generated from filtering water is provided to brick factories to make bricks for construction.

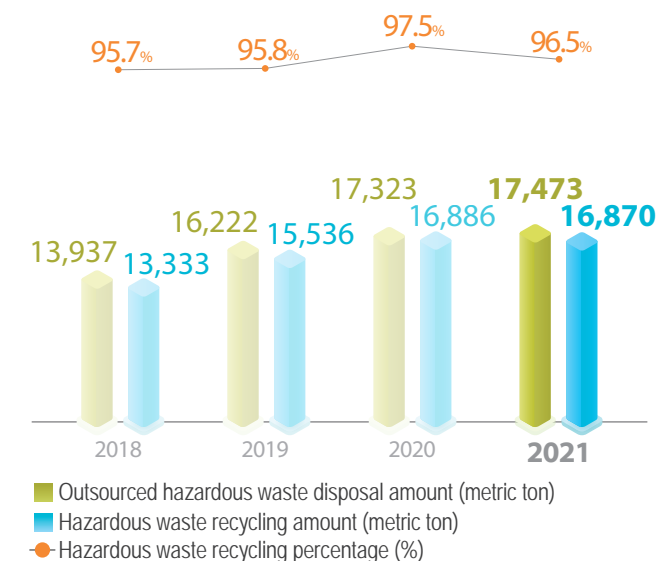


## Summary of outsourced recycling and reuse of waste generated by Nanya

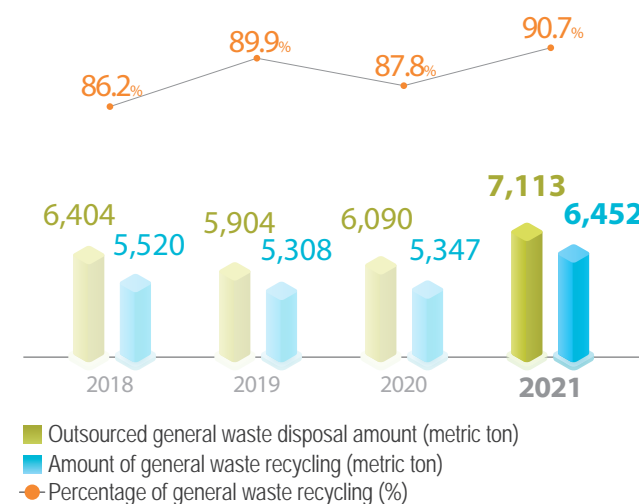
### Waste Generated Weight (General and Hazardous Waste)



### Hazardous Waste



### General Waste



Nanya circular economy – Video of treatment and reuse of waste liquid containing copper

## Protection of Ecology and Species Resources

Nanya's main production location is in Taishan Nanlin Science Park, which is on a low-altitude hill. Most trees in the area were artificially planted for landscaping, and the forests in surrounding areas are mainly secondary and not primary. There are no habitats being protected or rehabilitated where the factory is located and in surrounding areas. Even so, the Company still attaches great importance to ecological resources in surrounding areas, and conducts thorough investigation and impact assessments of the surrounding ecological environment in the development and operations of its factory. We also proposed mitigation and avoidance strategies, in order to avoid and reduce the potential impact of development and operations on biodiversity.

### ► Commitment to Ecological Resource Protection

Nanya has made the following six commitments to protect ecological resources in its operations and supply chain

Work together with external partners and tier one and non-tier one suppliers in fulfilling this commitment

Commitment to avoid operating activities in globally or nationally important biodiversity locations or its near sites

Periodically conduct ecological surveys and impact assessments of the surrounding areas of operating activities

If surrounding areas of existing operating activities are identified as critical biodiversity areas, we have an application of mitigation hierarchy (avoid, minimize, restore, and offset)

If current operating activities or products and services provided by the Company involve deforestation, we have made a commitment to compensate with future reforestation and terminate any form of development in the future

Commitment for operating activities and the products and services provided by the Company to comply with zero deforestation standards, and supervise compliance with regulations through the internal environmental management system

### ► Ecological Resource Protection Goals

Nanya set performance indicators and goals for the Company and suppliers under the commitment to ecological resource protection, in hopes of having a greater positive influence on biodiversity in the overall value chain.

2030

- Starting in 2030, the Company's existing operating activities achieve no net loss (NNL) and zero deforestation.



2035

- Starting in 2035, all of the Company's operating activities achieve a net positive impact (NPI).
- The Company's tier one and non-tier one key suppliers achieve NNL.



2040

- Starting in 2040, the Company's tier one and non-tier one key suppliers will achieve NPI and zero deforestation.



Nanya will disclose the nature-related risks and coping measures through four major steps (Locate, Evaluate, Assess, and Prepare), which is based on the structure of TNFD (Taskforce on Nature-related Financial Disclosures, TNFD). Nanya have finished step 1(Locate) and 2(Evaluate), and will step by step to achieve the goal of NNL by 2030.

### ► Management Methods for Ecological Resource Protection

Nanya applies the mitigation hierarchy to manage and mitigate its impact on biodiversity and ecosystems. The mitigation hierarchy includes avoid, minimize, restore, and offset. "Avoid" and "minimize" are the Company's most important measures. For example, the Company has analyzed the impact of the new factory development plan on surrounding plant ecology, habitats, and water environment, and taken measures to avoid and mitigate impact. If operations or development will still damage the ecosystem after taking measures to avoid and mitigate impact, the Company will take "restore" measures in the damaged areas, and will take "compensate" measures (e.g. forestation, setting up an environmental trust fund and transferring it to the government or non-profit organizations to improve or restore the environment) if restore measures still cannot reduce losses, in order to compensate for the impact on biodiversity.

Nanya periodically checks if its operating activities comply with zero deforestation through the Sustainable Development Committee (the current main production location is 100% comply with zero deforestation), We also monitor operating activities and products supplied by suppliers through the sustainable supply chain management platform, so that they comply with the Company's commitment to zero deforestation. The Company also complies with international forestry regulations, and includes certifications of international institutions (e.g. Forest Stewardship Council, FSC) into evaluation standards for prioritizing suppliers.



## Ecological Evaluation

### Plant ecology



#### Construction period impacts

- Plants in some construction areas were removed and result in a decrease in population
- The construction causes dust to cover the surface of leaves, and may result in poor plant growth

#### Operation period impacts

- Traffic flow causes dust to cover the surface of leaves, and may result in poor plant growth

### Habitats



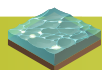
#### Construction period impacts

- Disturbance from noise and vibrations, nighttime lighting, construction vehicles, personnel activities, and waste impact the original habitat and land animals active in the construction area

#### Operation period impacts

- There was no significant impact on surrounding animals during the operation period

### Water environment



#### Construction period impacts

- If wastewater with relatively high sand content or domestic wastewater generated by construction personnel is directly discharged into nearby water bodies, it will contaminate the water.

#### Operation period impacts

- If wastewater and waste is directly discharged or disposed near water bodies, it will impact the water ecology of surrounding areas.

### Coping Measures

#### Avoid

- Plan the route of transportation vehicles in advance, and ensure that the vehicles transport gravel and heavy machinery according to the route to limit the area affected by dust
- Vehicles used to transport gravel must be covered by canvas or dust cloth

#### Mitigate impact

- Plant native or endemic plants in the form of a multiple layered forest
- When transportation vehicles enter and exit the construction site, they must first go through a washing station to reduce dust
- Cover gravel with canvas or dust cloth during temporary storage, so as to prevent dust and the growth of invasive plants
- Water plants on both sides of the planned route to reduce the impact of dust on plant growth

#### Avoid

- Domestic waste generated by construction workers must be collected in a covered storage facility or properly wrapped and disposed of, in order to prevent it from being eaten by wild animals, or causing secondary damages due to spilling in the transportation process.
- Avoid using vehicles in poor condition that generate high noise
- The use of chemical agents is prohibited and manual grass cutting and rat traps are used for environmental protection, in order to poisoning and killing wild animals.

#### Mitigate impact

- Low landscape fixtures are used to limit the range of lighting for trails, automatic sensors are installed and a timer is set to turn off the lights at night, reducing the disturbance caused by light to nocturnal animals.

#### Avoid

- Construction waste water is prohibited from being discharged into rivers, and waste is prohibited from being placed on river banks.
- Muddy water generated from construction at construction sites and soil resource sites must be prevented from flowing into surrounding low-lying areas and further affecting the water ecology in the areas.
- Set up pipelines for centralized discharge of rain water collected from roads during the operation area
- Wastewater discharge must comply with regulations of the Environmental Protection Administration

#### Mitigate impact

- Periodically monitor the water quality and ecology of surrounding water environments during the construction period, in order to lower the impact of local water quality on water ecology

## ► Current Condition of Ecological Environment at Nanya

The ecological environment in surrounding areas of Nanya's operating activities mainly includes plant ecology and animal ecology. With regards to plant ecology, most of the industrial park where the Company is located has already been developed. Nearby areas with less disturbance have maintained a relatively natural secondary forest, and a survey did not find any rare plants in nearby areas. As for animal ecology, a survey found a total of 36 families and 74 species in the industrial park where the Company is located. It also found 4 rare and valuable species and 1 conservation-deserving wildlife species. After monitoring by an ecology company, the Company's operating activities and new factory development have extremely limited effect on plants and plant ecology, which is expected to rapidly recover from any impact. Hence, the Company's current operating activities meet requirements on NNL and zero deforestation. In the future, we will continue to monitor the ecological environment and fulfill our commitment to ecological resource protection.

## ► Cooperation with External Partners

It is necessary to work together with external partners to have a positive impact on ecological resource protection. Hence, the Company is actively working with ecological monitoring companies and NGOs to better understand the impact of Nanya's operations on ecological resources, and formulate more effective methods to manage and mitigate the risk of biodiversity and deforestation.

### Cooperation with ecological monitoring company



Nanya began working with the professional ecological company (Hong Yi Ecological Company) in 2008, and it helps the Company conduct surveys on ecological resources, such as animal and plant ecology in water and on land. Ecological monitoring is conducted on a monthly basis during the factory development period, and conducted on a quarterly basis during the operation period; the ecological company recommends response measures for abnormal situations. We make improvements based on the recommendations of the ecological company, in order to lower our impact on biodiversity.

### Cooperation with NGOs



Nanya and Commonwealth Magazine jointly supported the Tamsui River Convention in 2020, and also worked with the NGO – The Society of Wilderness in co-organizing ecological environment conservation activities, such as removing Mikania micrantha from Wugu Wetland, organizing parent-child camps (understanding the rich ecology in areas surrounding the factory), and admiring swallow and understanding the biodiversity of Wugu Wetland. The activities allow participants to understand the relationship between the Company and biodiversity in surrounding areas, and improve employees' understanding and awareness of the ecological environment.



## Environmental pollution prevention

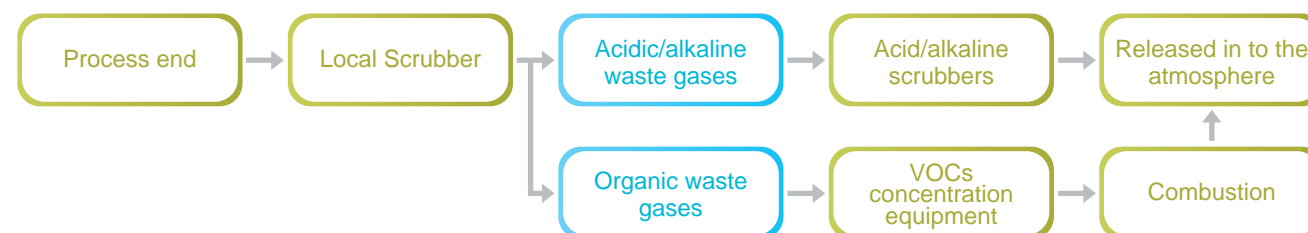
Based on the environmental protection and commitments of environmental impact assessment, the company regularly monitors environmental impact factors, such as air quality, noise and vibration, the quality of surface water and groundwater, traffic flow, and the ecosystem within the scope of development to truly appreciate its impacts on the environment. There has been no violation of environmental regulations since 2014. In addition, Nanya has checked with the competent authorities that Nanya's developing areas are not at an environmentally sensitive location or a location with specific purposes. In the Environment, Safety and Hygiene Policy, Nanya has made every effort to promote various measures to reduce waste and recycle resources to comply with relevant requirements of regulations as well as to respond to the commitments to environmental protection-related requirements signed by the company. Moreover, Nanya annually evaluates waste that can be reduced and recycled, and the types and amount of recovered waste water, drafts annual plans and goals, and includes the plans into the annual budget and work plan.

### Air Pollution Control

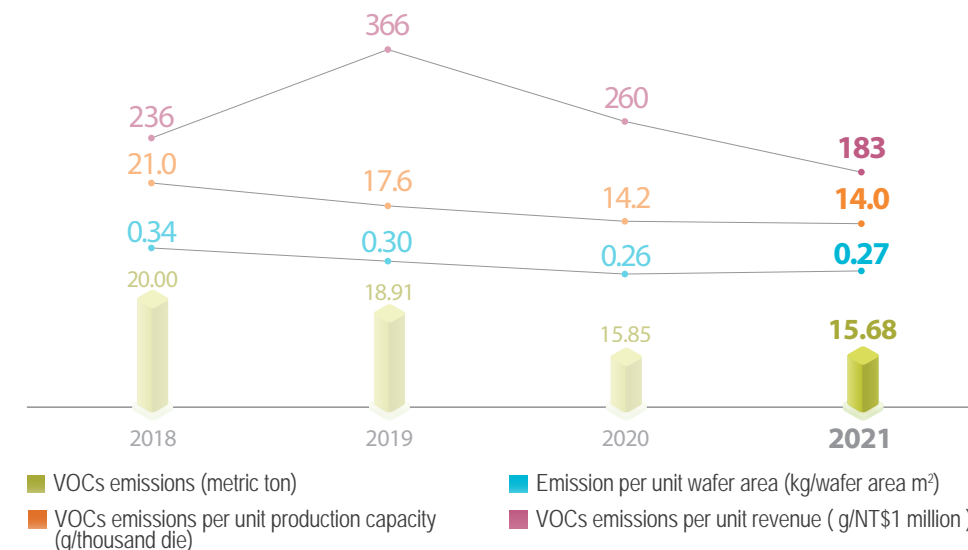
Since the plant was set up, we have put great emphasis on pollution control. Not only have we effectively reduced material consumption and lowered the concentration of waste gas emission, but also have used air pollution control equipment in compliance with statutory standards, including local scrubber, acid/alkaline scrubbers, the VOCs zeolite rotor concentration equipment, and post-combustion machinery. Testing proved that the pollutant emission standards set forth in environmental protection regulations of the government were all met (lower than) over the years. To continue to maintain the best performance of treatment equipment, every equipment is maintained and inspected periodically. The operators receive complete training and education are to maintain the system in good operation and ensure that the waste gases emitted do not endanger the environment.

Main air pollutants generated by Nanya are divided into acidic/alkaline waste gases and organic waste gases. Waste gases are channeled to suitable treatment processes and equipment based on their characteristics. Waste gases are channeled into local scrubbers after being generated on the process end. After removing specific substances, acidic or alkaline waste gases are concentrated in acid/alkaline scrubbers and released into the atmosphere after treatment. Organic waste gas is absorbed and concentrated by the zeolite rotor, and then imported into the post-combustion equipment to be directly broken down. The combustion efficiency rate reaches 99%, which substantially exceeds statutory standards. Moreover, the reduction rate of overall volatile organic gas emissions is kept above 90%, meeting the statutory requirements. Organic air pollutants released per unit production capacity (emission intensity) was 0.27 kg VOCs/m<sup>2</sup> in 2021.

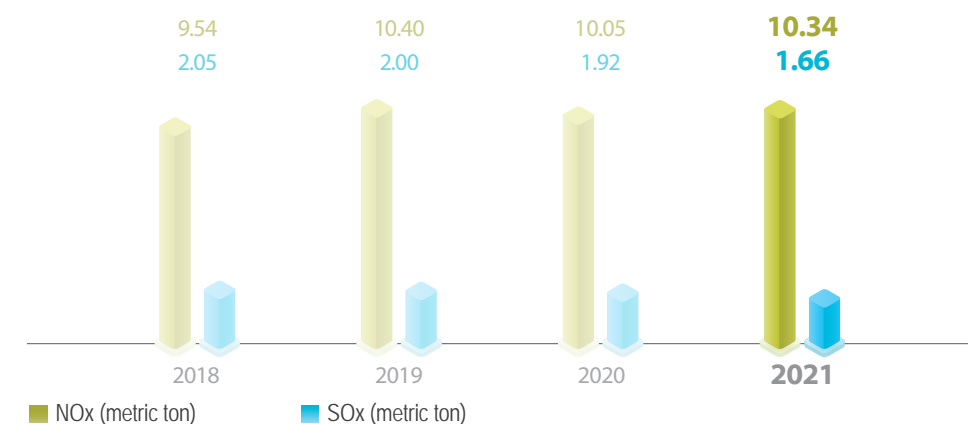
### Flowchart of waste gas treatment



### VOCs emission trends from 2018 to 2021



### Other air pollutant emission trends in 2018-2021

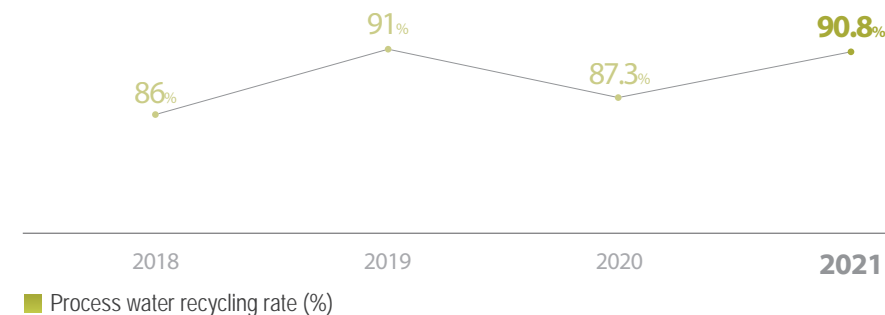


## Water Pollution Control

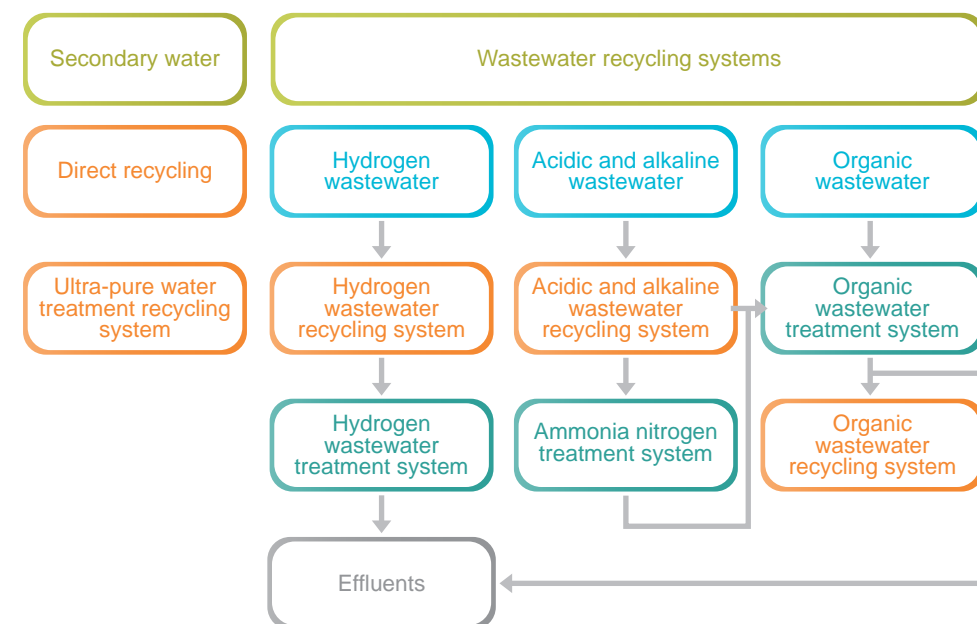
All wastewater generated by Nanya is collected according to property classification and channeled into proper wastewater equipment for treatment. To ensure that the quality of discharged wastewater is in line with regulations, we and the Environmental Protection Department have monitored the quality of effluents via synchronous connections. In addition, off-line sampling, analysis, and detection are outsourced every quarter to improve the wastewater quality management and control. When the quality of wastewater meets discharge standards, one hundred percent of our treated effluents are all discharged into the Dake River via terrestrial surface. As the effluents meet the quality standards of Category E water bodies, which may be used for irrigation water, Class 2 industrial water, and environmental conservation, and the Dake River later converges into the Tamsui River that empties into the ocean. To avoid environmental pollution and ecological impacts owing to abnormal quality of wastewater, we have spared no effort to prevent and control water pollution, gradually upgrading and investing in wastewater treatment facilities. The in-plant wastewater treatment is carried out in over 20 different pipelines. The wastewater is mainly classified into organic wastewater, general acidic and alkaline wastewater, hydrofluoric wastewater, and high-concentration liquid waste that is outsourced for treatment. In relation to wastewater treatment, wastewater is classified and treated according to different properties. Other than following statutory standards, we also reuse recyclable wastewater that is treated by the recovery system to reduce the discharge amount of wastewater. The plant area is reconstructed on the open space of existing plant so no massive excavation of the peripheral vegetation of the designated land has been made. Wastewater is properly treated before being discharged into the Dake River. Discharged water bodies and relevant habitat are not designated as national or international conservation areas. Investigation shows that the wastewater discharging areas do not involve in affecting the habitat of protected animals or destroying the habitat.

Total waste water discharge volume was 2,718 million liters in 2021, up 0.49% compared to 2020; wastewater discharge volume per unit production capacity increased 0.2%, while waste water discharge volume per unit revenue decreased 28.4%. In coordination with the expansion of FAB-3A-N by Nanya in 2016, additional wastewater systems and recycling systems were installed. These systems were classified into the following types: acidic and alkaline, organic, and hydrofluoric acid (HF) wastewater systems. The original acidic and alkaline wastewater system was equipped with a reclamation system. In 2017, a reclamation system with reverse osmosis (RO) was added, which could increase 0.288 million liters of reclaimed water per day. With the expansion of the new plant, the installation of additional organic wastewater reclamation system was completed in 2017, which could increase 1.5 million liters of reclaimed water per day. In 2018, the installation of hydrofluoric wastewater reclamation system was completed, which could increase 0.5 million liters of reclaimed hydrofluoric wastewater. Because of the increase in the reclamation volume of wastewater, the annual average process water recovery rate reached 90.8% in 2021. To coordinate with the expansion of a new factory, we have invested NT\$430 million in building new hydrofluoric wastewater COD and total nitrogen treatment systems. This not only will solve the problem of excessively high hydrofluoric wastewater COD and total nitrogen, but also will recover hydrofluoric wastewater at the same time. It is estimated that additional 1 million liters of hydrofluoric wastewater will be recovered per day. The systems are expected to be completed in 2022. In response to the decrease in sludge treatment plants and the ever stricter acceptable criteria, starting in 2017, additional isopropanol-concentration system had been built to reduce the load of wastewater COD. Moreover, additional organic sludge dewatering equipment had been installed. From the completion of the system and the equipment to 2018, the water content rate of sludge had decreased from 84% to less than 60%; from 2019 until the present, the water content rate of treated organic sludge have been keeping below 60%.

### Process Water Recycling Rate in 2018-2021



### Nanya process wastewater recycling



Note: Nanya's process water recovery rate was calculated using the formula approved by "Nanlin Technology Park Environmental Quality Supervision and Management Committee," which was required in the environmental impact assessment. We began using the formula of Hsinchu Science Park Bureau for calculation in 2020, so that calculation standards are consistent with peers in the industry. Figures for 2018-2020 were adjusted accordingly.

## Types and volume of wastewater discharged by Nanya

Total water discharge (million liters)<sup>Note 1</sup>

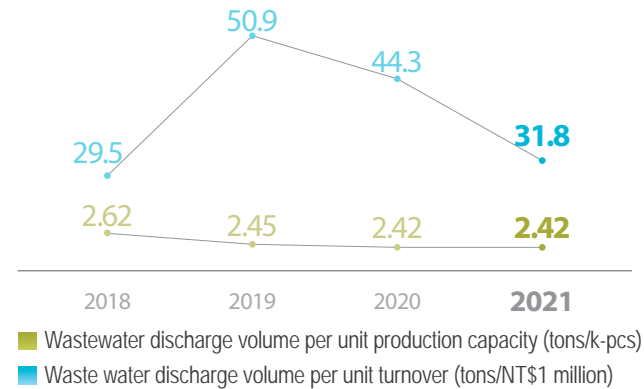
	2018	2019	2020	2021
Divided based on destination <sup>Note 1</sup>				
Surface water	2,495.9	2,633.701	2,705.126	2,718.373
Groundwater, seawater, third party water <sup>Note 2</sup> , third party water supplied to other organizations	0	0	0	0
Total water discharge				
Freshwater (Total dissolved solids ≤ 1,000 mg/L)	2,495.9	2,633.701	2,705.126	2,718.373
Other water (Total dissolved solids > 1,000 mg/L)	0	0	0	0
Divided based on wastewater treatment level				
Not treated	0	0	0	0
Treated inside factory to comply with effluent standards of the Environmental Protection Administration	2,495.9	2,633.701	2,705.126	2,718.373

Note 1: 1 million liters = 1,000 tons

Note 2: The destination of wastewater discharged by Nanya is Dake River (surface water), which is not located in an area with water stress.

Note 3: City government water supplier and sewage treatment plant, public and private utilities companies, and other organizations that participate in the provision, transportation, treatment, disposal, or use of water and sewage

## Run chart of 2018-2021 wastewater discharge volume



## Testing results of discharged wastewater quality in 2021

	Minimum	Mean	Maximum	Compliant or non-compliant with standards
pH				
Statutory standards: 6-9	7.1	7.3	7.5	Compliant
Chemical oxygen demand(COD)				
Statutory standards: <100 (Unit:mg/L)	39	49.5	56.8	Compliant
Suspended solids(SS)				
Statutory standards: <30 (Unit:mg/L)	4.8	7.3	12.6	Compliant
Fluoride ion				
Statutory standards: <15 (Unit:mg/L)	8.21	10.4	12.3	Compliant
Ammonia nitrogen				
Statutory standard: <30 (Unit:mg/L)	6.54	7.8	8.41	Compliant

## Waste Management

### Waste Generate Structure

Nanya generated a total of 24,586 metric tons of waste in 2021, and recycled and reused 18,464 metric tons of waste, accounting for 75.1% of total waste generated. Recycling and reuse of waste was 100% outsourced (none of the waste was recycled and reused in our own factory). In 2021, 6,122 metric tons of waste generated by Nanya was directly disposed, in which 4,857 metric tons was incinerated and used as energy, accounting for 19.8% of total waste generated; 433 metric tons of waste was directly incinerated, accounting for 1.8% of total waste generated; none of the waste was directly buried, but 6 metric tons of waste was solidified and then buried, accounting for 0.02% of total waste generated; 825 metric tons of waste was disposed of using other methods (including physical treatment and recycling, purification and reuse), accounting for 3.4% of total waste generated.

Nanya's waste generated per unit wafer area was 416 kg/wafer-m<sup>2</sup> in 2021, increase 6.7% compared to 2020; outsourced hazardous waste disposal amount was 17,473 metric tons, and hazardous waste generated per unit wafer area was 296 kg/wafer-m<sup>2</sup>, increase 3% compared to 2020. This was mainly due to changes in process structure, which led to an increase in waste generated, increasing the amount of waste generated per unit production capacity. Although changes in process structure resulted in substantial increases in hazardous industrial wastes, the treatment of 100% of our main hazardous industrial wastes (acidic waste liquids containing sulfuric acid, phosphoric acid, and hydrofluoric acid) was outsourced and reused used as industrial materials. The company will continue to take measures to reduce wastes and increase recycling in order to reach the sustainable development goal of effective recycling of wastes.



## Waste Generated in 2021

Unit: Ton

	Generated	Diverted from Disposal	Directed to Disposal
<b>Hazardous waste</b>			
Acidic waste liquid	15,160	14,575	585
Waste solvent	2,293	0	2,293
Container	11	0	11
Other	9	0	9
<b>Total</b>	<b>17,473</b>	<b>14,575</b>	<b>2,898</b>
<b>General waste</b>			
Sludge	6,356	3,775	2,581
Packaging materials	209	8	201
Consumer waste generated by employees	270	0	270
Waste mixed metals	8	0	8
Waste mixed plastics	154	0	154
Other	116	106	10
<b>Total</b>	<b>7,113</b>	<b>3,890</b>	<b>3,223</b>
<b>Total</b>	<b>24,586</b>	<b>18,464</b>	<b>6,122</b>

Note: In coordination with the update to the GRI content index, we compiled more detailed statistics and recategorized waste, which resulted in different recycling percentages compared with previous years, but the total tons of waste was not changed.

## Waste Diverted from Disposal in 2021

Unit: Ton

	Onsite	Offsite	Total
<b>Hazardous waste</b>			
Preparation for reuse	0	0	0
Recycling	0	14,575	14,575
Other Recovery Operations	0	0	0
<b>Subtotal</b>	<b>0</b>	<b>14,575</b>	<b>14,575</b>
<b>General waste</b>			
Preparation for reuse	0	8	8
Recycling	0	3,882	3,882
Other Recovery Operations	0	0	0
<b>Subtotal</b>	<b>0</b>	<b>3,882</b>	<b>3,882</b>
<b>Total</b>	<b>0</b>	<b>18,464</b>	<b>18,464</b>

## Waste Directed to Disposal in 2021

Unit: Ton

	Onsite	Offsite	Total
<b>Hazardous waste</b>			
Incineration (with energy recovery)	0	2,295	2,295
Incineration (without energy recovery)	0	10	10
Landfilling	0	6	6
Other disposal operations <sup>Note 1</sup>	0	588	588
<b>Subtotal</b>	<b>0</b>	<b>2,898</b>	<b>2,898</b>
<b>General waste</b>			
Incineration (with energy recovery)	0	2,562	2,562
Incineration (without energy recovery)	0	424	424
Landfilling	0	0	0
Other disposal methods <sup>Note 2</sup>	0	238	238
<b>Subtotal</b>	<b>0</b>	<b>3,223</b>	<b>3,223</b>
<b>Total</b>	<b>0</b>	<b>6,122</b>	<b>6,122</b>

Note 1: Other disposal methods for hazardous waste include physical treatment and chemical treatment.

Note 2: Other disposal methods for general waste refers to physical treatment (broken down and sorted).

The general industrial wastes and the hazardous industrial wastes of the Nanya are all managed by the Output Department in terms of storage, clearance, detections, and reduction promotions. In addition, the company periodically audits waste contractors to see whether the contractors follow the regulations of waste disposal to handle the waste clearance, in order to confirm the legality of the contractors, ensure that all wastes are well-processed or recycled, and prevent impacts on the environment again. Nanya did not ship any hazardous waste to other countries in 2014-2021, and output of all hazardous industrial waste was outsourced to certified domestic waste disposal contractors.

## Assessment results of waste impact

### Upstream



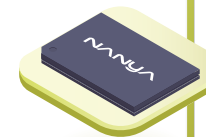
#### Impact sources

- Used large numbers of 53-gallon drums of chemicals
- Used large numbers of small gas cylinders, resulting in more residual gases

#### Mitigation measures

- Replaced 53-gallon drums with tank trucks to store and transport chemicals or recycled empty drums
- Replaced small gas cylinders with large cylinders to reduce residual gases and numbers of cylinders.

### Nanya



#### Impact sources

- Sources of raw materials and related materials contained hazardous substances.
- Used large numbers of acidic and alkaline chemicals
- Used monitor wafers in large quantities

#### Mitigation measures

- Through the establishment of Hazardous Substance Free (HSF) management system of materials, we ensured that the produced wafers, rear-end IC packaging, and DIMM module products would conform to the international regulations and related specifications of clients towards HSF management.
- Recycled wastes in the plant, for example, copper sulfate waste liquid was directly converted to copper cakes for recycling.
- Acidic wastes were outsourced for recycling, such as sulfuric acid and phosphoric acid.
- Dummy wafers were recycled for 8-11 times.

### Downstream



#### Impact sources

- Products required many packaging materials.
- Products contained hazardous substances.

#### Mitigation measures

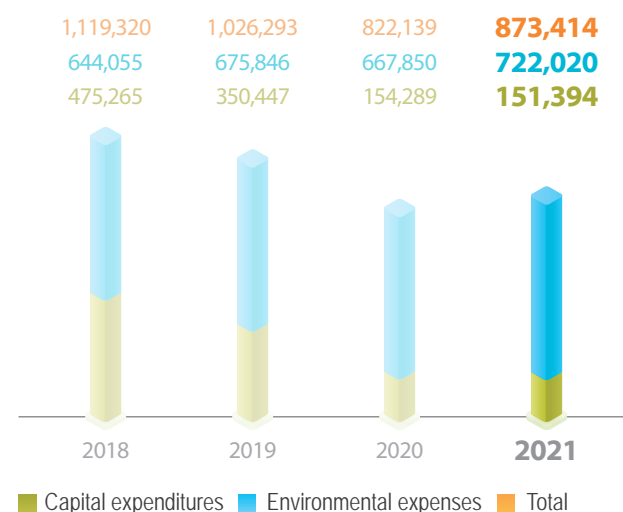
- Clients were encouraged to recycle packaging materials for Nanya to reuse.
- Waste electronic equipment had to conform to the EU's environmental protection directives, including WEEE, RoHS, and EuP.

## Environmental Costs and Benefits

Nanya introduced the environmental accounting system in 2008 and the environment benefit accounting system in 2009, which was officially implemented in 2010. The introduction of the environmental accounting system made it possible to access information on the environmental expenditures, assess the benefits of the expenses, and provide the stakeholders with concrete and accurate environmental protection acts. Statistics are compiled for each category of environmental protection expenditures according to the rules established by the Environmental Protection Administration, and are used for internal management, so that the public will understand the environmental protection efforts of enterprises. According to the consolidated statistics, the environment capital expenditure in 2021 was NT\$151,394 thousand, and the environmental expense was approximately NT\$722,020 thousand, totaling NT\$873,414 thousand. Environmental expenditures accounted for 1.02% of our 2021 consolidated revenue of NT\$85.604 billion.

### Environmental accounting expenditures from 2018 to 2021

Unit: thousand NTD



### Environmental accounting expenditures in 2021

Unit: Thousand NTD

Recurrent expenditures	Capital expenditures
<b>Operating costs</b>	
Air pollution control costs: costs of air pollution, water pollution, and other types of pollution control	
573,342	151,394
Global environmental protection expenses: (1) expenses for climate change prevention (2) other expenses related to global environmental protection	
27,217	0
Resource and energy reduction and recycle expenses: (1) enhance the efficiency of resources utilization (2) costs of waste reduction, recycling, and reprocessing (3) Energy expenses saved	
105,311	0
<b>Related costs from upstream and downstream of suppliers and customers</b>	
(1) Green procurement (2) expenses incurred in providing products for the sake of environmental protection	
176	0
<b>Management costs</b>	
(1) costs of personnel environmental training and education (2) expenses incurred in acquiring external verification (3) expenses incurred in measuring environmental impacts (4) Other	
13,220	0
<b>R&amp;D costs</b>	
expenses incurred in researching and developing products because of environmental protection	
0	0
<b>Social activity costs</b>	
expenses incurred in improving the environment such as nature protection, afforestation, and landscaping the environment	
1,388	0
<b>Environmental taxation and fees</b>	
(1) expenses incurred by air pollution (2) examination and certificate expenses for pollution prevention and control	
1,366	0
<b>Total</b>	<b>722,020</b>
	<b>151,394</b>

### Performance of promoting the ISO 14001 management solutions over the years

Unit: Thousand NTD

	2021	2020	2019	2018
Energy (electricity) conservation program	18,166	52,397	64,934	8,744
Waste reduction program	3,759	234	3,360	0
Program of reducing consumption of process raw materials	4,973	6,865	5,221	12,179
Substantive benefits of industrial waste recycling	5,118	9,564	10,386	11,502
Electricity fees saved owing to low power consumption and advanced processes	969,353	888,574	697,553	736,071
<b>Total benefits</b>	<b>1,001,369</b>	<b>957,634</b>	<b>781,454</b>	<b>768,496</b>
Records of violating environmental protection regulations	0	0	0	0
Amount of fines for violation of environmental laws and regulations	0	0	0	0
Fines for violation of environmental laws and regulations not yet paid	0	0	0	0

### Internal management system audit records in the last three years

<b>ISO 14001 (2019-2021)</b>		
<b>9</b>	Improvement was completed for 9 items, including environmental considerations form not updated, incorrect form version cited, and incomplete spot inspection records.	Case closing rate 100%
<b>7</b>	Improvement was completed for 7 items, including the the environmental considerations form not updated or incorrect form version cited, management deficiencies at the waste storage site, management plan not periodically tracked, and follow up was not completed for new announced regulations.	Case closing rate 100%
<b>2</b>	Improvement was completed for 2 items, including management deficiencies at the waste storage site and management plan not periodically tracked.	Case closing rate 100%
<b>ISO 45001 (2019-2021)</b>		
<b>13</b>	A total of 7 defects in integrity of filling in hazard identification forms, accounting for the majority of the defects, followed by 3 defects in failing to send staff to participate in consultations of workers; improvements were all completed.	Case closing rate 100%
<b>15</b>	A total of 7 defects in failing to comply with criteria for operations and site management, and problems in appropriateness of automated checklist content, accounting for the majority of the defects, followed by 4 defects in management of equipment cabinets for emergency response; improvements were all completed.	Case closing rate 100%
<b>6</b>	Improvements were completed for incomplete hazard identification forms and regulation identification forms, as well as abnormal maintenance of environmental detectors.	Case closing rate 100%