

# 3

## Innovation The Best Partner for Our Customers

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**22.5%**

In 2024, R&D expenditure accounted for 22.5% of revenue, while R&D personnel represented 29.7% of employees, which demonstrates Nanya Technology's commitment to technological development.

**NT\$400 Million**

By the end of 2024, Nanya Technology developed 134 AI applications with annual benefits reaching NT\$400 million.

**910 Patents**

In 2024, 910 patents were granted to Nanya Technology.

*Innovation* is the driving force behind Nanya Technology's technological growth and competitive edge, and it remains one of Nanya Technology's four core values. We aim to strengthen product research, development, and manufacturing to meet diverse customer needs and become the Best DRAM Partner for Smart World.



## Strategy and Performance of Material Topics

◆ Exceeded goals    ◆ Achieved    ◆ Not achieved

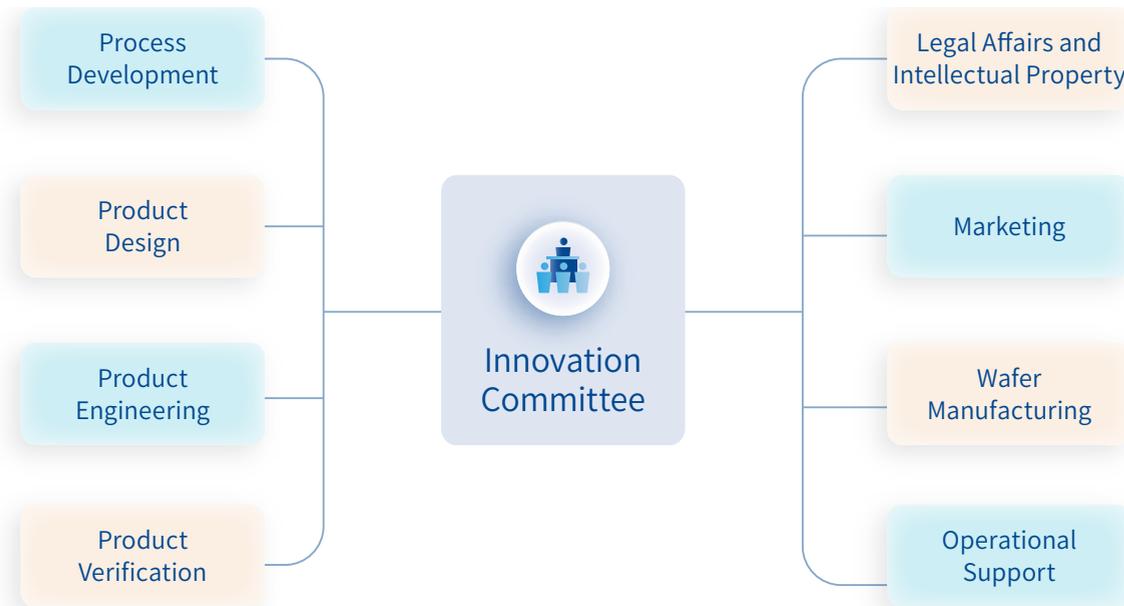
Material Topics & Strategy	2024 Goals	2024 Performance and Goal Achievement	2025 Goals
<p><b>! R&amp;D and Innovation</b></p> <ul style="list-style-type: none"> <li>• Designing new next-generation products</li> <li>• Developing 10nm-class process technologies</li> <li>• Entering the high-density server module market</li> <li>• Smart factory</li> <li>• Increasing the number of granted patents</li> </ul>	Achieving the shipping qualification standards for 8Gb DDR4 and 16Gb DDR5 products based on the second generation 10nm-class DRAM process	◆ Achieved the shipping qualification standards for 8Gb DDR4 and 16Gb DDR5 based on the second generation 10nm-class DRAM process	Achieving the shipping qualification standards of the third generation 10nm-class DRAM process and 16Gb DDR5 products
	Training a total of 500 engineers and equipping them with AI theoretical and practical skills	◆ Trained a total of 500 engineers and equipped them with AI theoretical and practical skills	Training a total of 550 engineers and equipping them with AI theoretical and practical skills
	Completing a total of 130 smart application developments	◆ Completed a total of 134 smart application developments	Completing a total of 150 smart application developments
	Number of patents granted in Taiwan >250	◆ The number of patents granted in Taiwan during the year reached 344	Number of patents granted in Taiwan >250
<p><b>♥ Environmentally Friendly Products</b></p> <ul style="list-style-type: none"> <li>• <b>Technology enhancement:</b> Developing advanced and efficient products and helping consumers reduce energy consumption and carbon emissions during product use</li> <li>• <b>Consideration of product lifecycle:</b> Increasing the environmental friendliness of products</li> <li>• <b>Hazardous substance management:</b> Ongoing promotion of the initiatives to replace hazardous substances in product manufacturing materials</li> </ul>	Proportion of advanced processes such as 20nm accounts for 96% and above	◆ 96.5%	≥96%
	Completing product life cycle inventory on 100% of products	◆ 100%	Completing product life cycle inventory on 100% of products
	100% of products comply with hazardous substances free regulations and customer hazardous substance specifications.	◆ 100%	100% of products comply with hazardous substances free regulations and customer hazardous substance specifications.
	100% of raw materials free of PFOA-related substances	◆ 100%	100% of raw materials free of PFOA-related substances

## 3.1 R&D and Innovation

Recognizing the growing trend of smart products that improve the quality of life and contribute to energy conservation and carbon emissions reduction, Nanya Technology invests substantial resources annually in developing new DRAM products, next-generation manufacturing processes, and advanced 3D stacked packaging technologies. We provide value-added services to customers, strengthen intellectual property rights and trade secret protection, and accelerate our advancement in product diversification and smart factories. Looking ahead, Nanya Technology will continue to focus on developing more advanced third- and fourth-generation 10nm-class DRAM manufacturing process technologies and products. At the same time, Nanya Technology is also working with our strategic partner, PieceMakers Technology Inc., to develop customized ultra-high-bandwidth DRAM products to expand business opportunities in the emerging AI chip market.

### 1. Innovation Committee

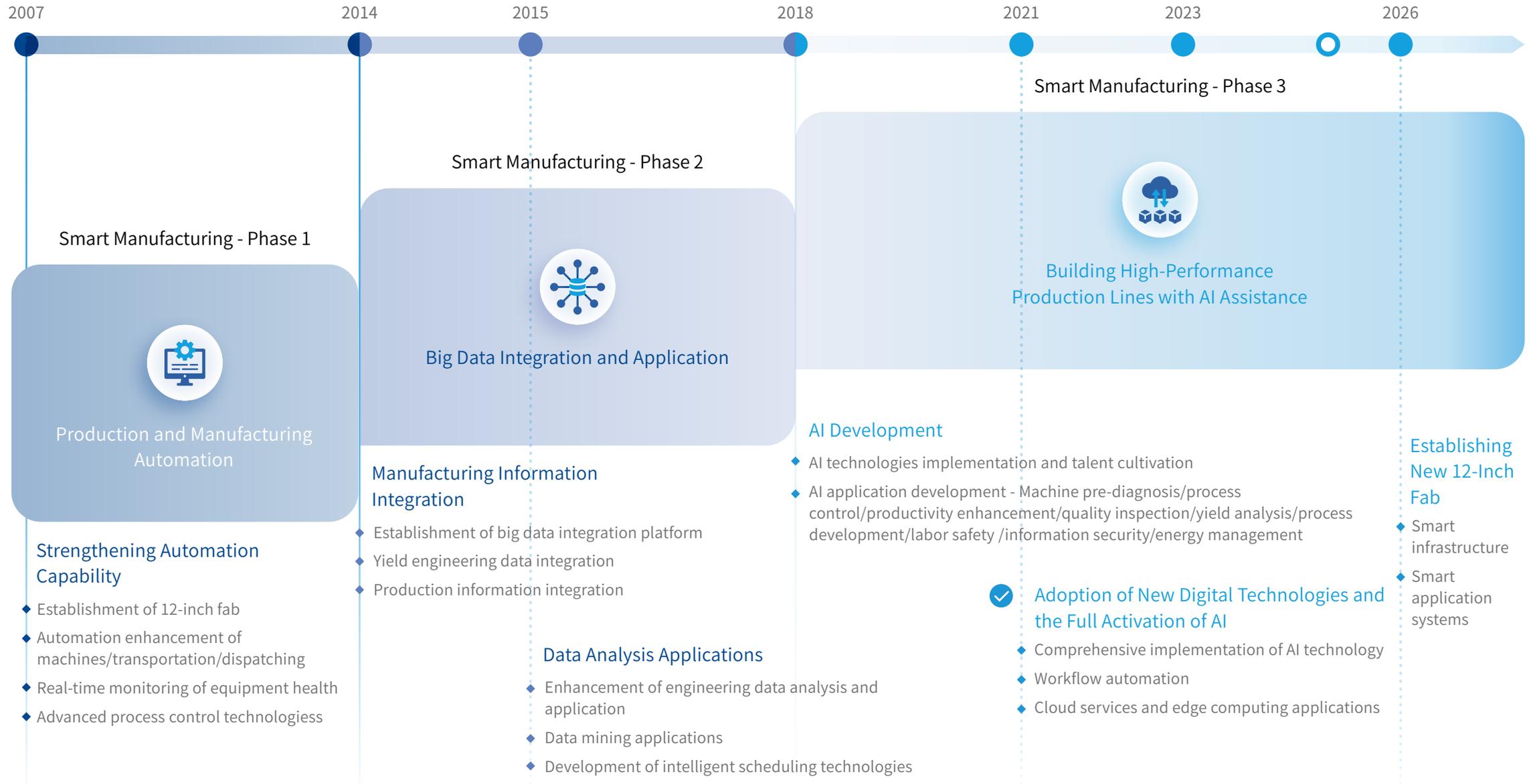
To implement innovation management and foster an innovation culture that enhances our creative energy and value, Nanya Technology has established a cross-departmental Innovation Committee, led by senior executives. The Executive Vice President serves as the committee chair, coordinating and planning Nanya Technology's overall innovation strategy, along with its short-, medium-, and long-term goals. The committee reviews the progress of key projects, including open innovation projects, product innovation projects, and process innovation projects, as well as various management indicators. In 2024, Nanya Technology's second-generation 10-nm class 8Gb DDR4 and 16Gb DDR5 products achieved the shipping qualification standards. In AI applications, from 2019 to the end of 2024, Nanya Technology has cultivated a total of 500 technical staff with both theoretical expertise and practical experience, while also developing 134 smart systems.



### Investment in Innovative R&D

Item	2021	2022	2023	2024
Operating revenue (A) (in NT\$100 million)	856	570	299	341
R&D and innovation expense (B) (in NT\$100 million)	75.0	78.4	75.8	76.9
R&D expense as a percentage of operating revenue (B/A)	8.8%	13.8%	25.3%	22.5%
Total number of employees (C)	3,554	3,685	3,647	3,693
Total number of R&D and innovation personnel (D)	953	1,000	1,054	1,098
R&D personnel as a percentage of all employees (D/C)	26.8%	27.1%	28.9%	29.7%

## 2. Nanya Technology Smart Factory



Nanya Technology's 12-inch fab encompasses the infrastructure needed for a smart factory, including highly automated production lines, IoT-enabled fabs, large-scale sensor network, and a big data information integration platform. Leveraging AI technology, Nanya Technology has expanded innovative applications across eight key categories, covering machine pre-diagnosis, process control, productivity enhancement, quality inspection, yield analysis, process development, labor safety and information security, as well as energy management.

Currently, Nanya Technology has developed a range of innovative applications for its production lines, including machine pre-diagnosis, advanced process control, production scheduling optimization, wafer quantity prediction, smart handling, wafer probe testing, defect image recognition, yield wafer image recognition, and automatic measurement of engineering images. These applications effectively enhance overall operation efficiency and generate benefits across three key aspects: Yield, Quality and Output.



AI Application Categories

**01 Machine Pre-Diagnosis**

**02 Process Control**

**03 Productivity Enhancement**

**04 Quality Inspection**

**05 Yield Analysis**

**06 Process Development**

**07 Labor Safety and Information Security**

**08 Energy Management**

## AI Development Benefits and Promotion

By the end of 2024, Nanya Technology has completed a total of 134 AI applications that effectively improve yield and quality, reduce discard rates due to anomalies, increase machine utilization, lower equipment maintenance costs and raw material consumption, enhance production capacity, and optimize the use of human resources. The annual benefits reached NT\$400 million. With the ongoing development of new AI applications, Nanya Technology anticipates that the total benefits will reach NT\$2 billion over the next 5 years (2025 to 2029).

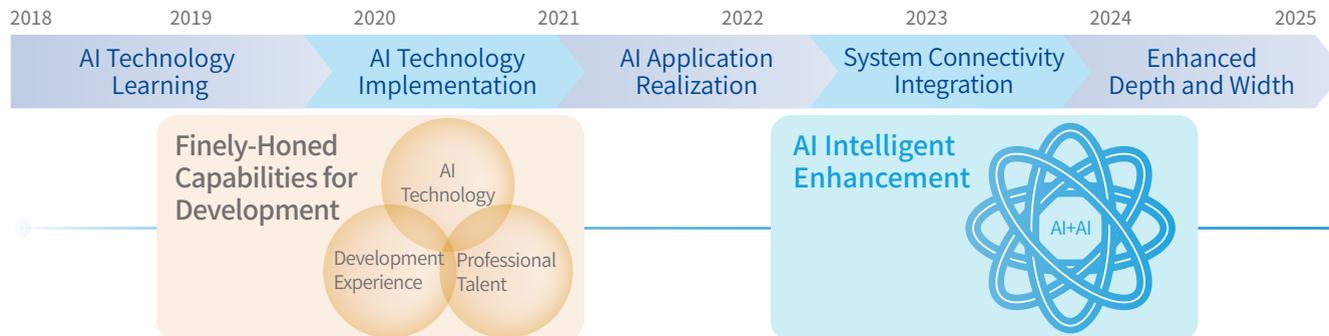
Innovation and promotion are primarily facilitated via three key platforms: AI Application Development, AI Technology Implementation, and AI Educational Training.

- **AI Application Development Platform:** 60 engineering personnel, including domain experts, information experts, and statistics experts are brought together to systematically develop highly efficient smart systems.
- **AI Technology Implementation Platform:** The AI team received systematically arranged trainings to enhance their technical expertise in areas ranging from machine learning, deep learning (CNN<sup>1</sup>, RNN<sup>2</sup>, object detection, generative AI) to edge computing technologies.
- **AI Educational Training Platform:** External instructors and internal trainers have trained a total of 500 engineering personnel with AI theoretical knowledge and practical skills.

Note 1: CNN: Convolutional Neural Networks

Note 2: RNN: Recurrent Neural Networks

### 2018-2025 AI Application Development Plan

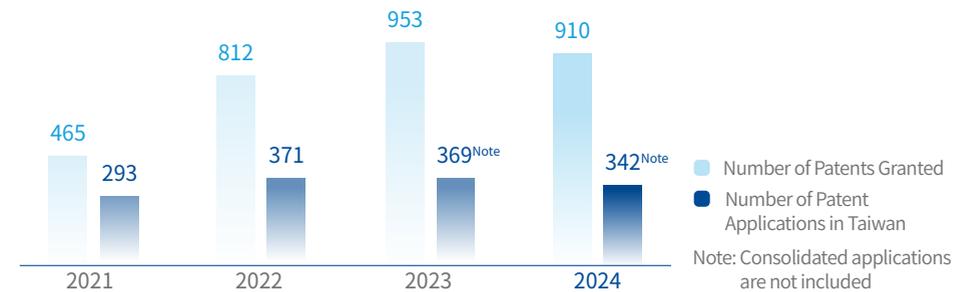


Since 2018, Nanya Technology has built an AI technology application team which focuses on learning and implementing AI technologies to gradually apply AI in various work settings. Nanya Technology has connected additional smart systems, such as wafer yield analysis system, smart production scheduling system, production line stability control system, and universal image monitoring management system. These initiatives have amplified intelligence and efficiency, making overall production line operations more effective. In the future, Nanya Technology will continue to deepen and expand its technical applications, introducing more advanced AI technologies, enhancing cross-system integration capabilities, and extending these across all application units, thereby comprehensively improving factory manufacturing performance.

## 3. Intellectual Property Right Status and Strategy

Nanya Technology not only works with world-class partners to adopt advanced technologies, but also invests heavily in the development of proprietary technologies. Over the years, Nanya Technology boasts a considerable amount of intellectual property. By the end of 2024, Nanya Technology received over 7,700 patents, both protecting the results of technological development and securing our competitive edge. With this powerful tool for both technological and business competition, Nanya Technology flexibly utilizes intellectual property rights to effectively defend against frivolous patent lawsuits.

### Patents Granted to Nanya Technology and Patent Application Performance



### The following are critical legal cases related to intellectual property rights involving Nanya Technology:

In November 2019, US-based Monterey Research LLC accused Nanya Technology and its subsidiaries, NTC-USA and NTC-Delaware, of patent infringement in the US District Court for the District of Delaware. This case was reconciled in April 2024. The conciliation terms have no significant impact on the operations of the Consolidated Company. The plaintiff withdrew the lawsuit, and the case has been concluded.

In February 2023, Irish company Polaris Innovations Limited accused Nanya Technology of patent infringement in the US District Court for the Eastern District of Texas. This case was reconciled in August 2024. The conciliation terms have no significant impact on the operations of Nanya Technology. The plaintiff withdrew the lawsuit in September 2024, and the case has been concluded.

### Nanya Technology's Intellectual Property Right Strategy



Strategically leveraging intellectual property rights to create a favorable environment for Nanya Technology and the industry.



Creating the most beneficial R&D environment by leveraging intellectual property rights, and utilizing the excellent results from production and R&D to create valuable intellectual property rights closely aligned with practical needs.

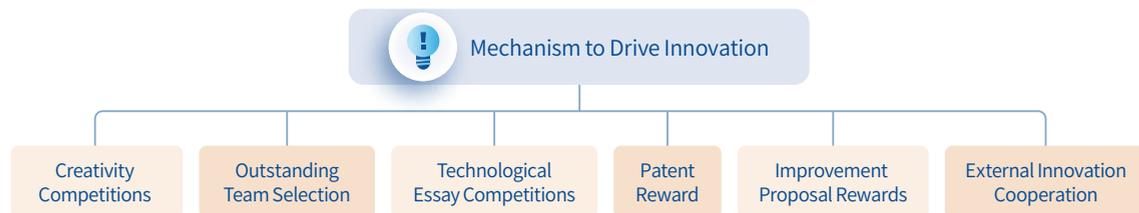


Implementing an appropriate system to manage intellectual property rights, while protecting trade secrets with a rigorous information security network.

In addition to patents, trade secrets are also extremely crucial intellectual assets in the semiconductor industry. In recent years, Nanya Technology has actively introduced advanced manufacturing process technologies, developed new products, and innovated sales models. Among the intellectual assets produced during these processes, some have been protected by patent applications. Others, however—whether they are technologies, methods, processes, formulas, programs, designs, or other information that can be used for production, sales, or operations—are considered trade secrets as long as they remain confidential and possess economic value. These trade secrets are protected by a rigorous information security system. Additionally, in September 2024, Nanya Technology passed the Taiwan Intellectual Property Management System (TIPS) Grade A certification once again, further affirming the quality of Nanya Technology's intellectual property right management system.

### 4. Incentives for Innovation

*Innovation* is the driving force behind Nanya Technology's technological growth and competitive edge, and it remains one of our core values. We believe that the key to ongoing innovation comes from the improvement ideas proposed during daily operations. Constantly optimizing processes, gaining experience, and building on results allows us to drive more forward-looking developments. To encourage employees to propose innovative ideas, Nanya Technology organizes annual innovation activities, including improvement proposals, patent reward, creativity competitions, essay contests, and outstanding team competitions. We recognize and reward innovative ideas proposed by each employee. Through these programs, Nanya Technology aims to embed innovation into the mindsets of our employees and further extend it to external partnerships, creating a systematic innovation force that keeps driving our Company's growth and competitive edge.



### 5. Results of Innovative Activities

Item	2021	2022	2023	2024	
Patent Reward	Number of patents granted	465	812	953	910
	Number of proposals	207	212	193	163
Improvement Proposal Rewards	Actual annual benefits (in NT\$ thousand)	882,517	756,744	755,784	366,233 <sup>Note</sup>
	Technological Essay Competitions	Number of entries	93	103	118
Outstanding Team Competitions	Number of entries	13	17	16	17

Note: (1) After many years of hard work, the self-developed 10nm-class technology has achieved significant results. Because of this, major improvement projects related to manufacturing processes in the fab have gradually decreased.  
 (2) To keep encouraging colleagues to propose improvement proposals, Nanya Technology plans to provide educational training and administrative rewards for promotion specialists and seed personnel in each area in 2025.

Rewards for Improvement Proposals are categorized into six functional areas: quality, manufacturing process, production capacity, equipment, environmental, safety and hygiene (ESH), and others. Nanya Technology encourages colleagues to focus on prevention instead of conducting non-conforming handling afterward. In addition to the proposers and their direct supervisors, the proposal process also includes forming an expert review taskforce for examining the proposal's specifics, effectiveness, and contribution level from multiple perspectives. In 2024, a total of 163 improvement proposals were submitted, generating actual annual benefits of NT\$366,233,000.

#### Improvement Proposal Workflow

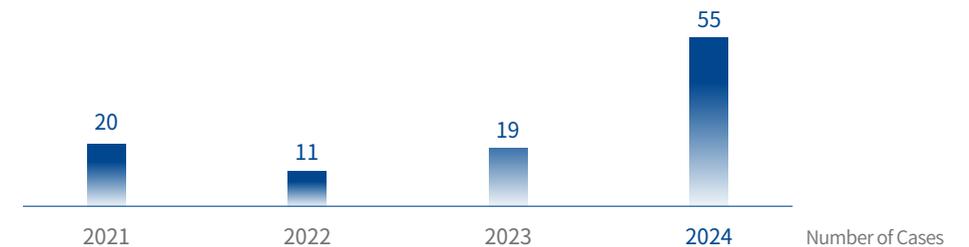


Outstanding Cases

Category	Case Title	Benefit Summary	Category	Case Title	Benefit Summary
Quality Improvement	Implementing smart recognition processes for labeling images generated by the wafer packaging machine	By adopting AI to recognize wafer packaging labels instead of manual checks, rework time caused by anomalies can be reduced by 108 hours per 200 lots, saving labor costs of NT\$625,440 annually.	ESH Improvement	Improving the preventive maintenance (PM) time estimation and enhancing the maintenance system for membrane filters in the membrane bio-reactor (MBR) tank.	Establishing an MBR estimation model to replace manual monitoring, preventing abnormalities caused by manual judgment errors and saving 1,872 work hours annually.
Process Improvement	Adding OVL edge shot measurement to MA41S to improve the yield of mid-range aligner	Adding OVL edge shot measurement to MA41S improves the yield of mid-range aligner by 1.9%, resulting in an annual net benefit of NT\$603,490.	Equipment Improvement	Embedded system integration platform of Chemical Laboratory	An embedded system is a computer system built inside a mechanical or electrical device, designed for a specific function or real-time computing performance, without affecting the operation of the front-end machine. The embedded system is designed to monitor machine operations in real-time. Saving NT\$639,000 in costs, this system can reduce costs and human errors, and improve production efficiency and inspection quality.
Production Capacity Improvement	AI recognition system for electrical levels	Adopting AI instead of manual labor to determine the validity of electrical levels by adjusting the probe card's direction, angle, and height, ensuring effective testing. This can save 2,190 hours of labor and machine time annually.	Other Improvement	Custom-made carbon film on copper to improve TEM specimen quality	Adopting the QIT Grid specimen preparation method reduces the cost of consumables and saves 488 work hours annually.

In terms of scaling the impact of our technological R&D results, Nanya Technology integrates external innovation resources to accelerate and boost R&D outcomes. For example, we collaborate with National Taiwan University, National Tsing Hua University, National Yang Ming Chiao Tung University, National Central University, Ming Chi University of Technology, Chang Gung University, IMEC, ITRI, and testing equipment suppliers in areas like basic research for next-generation memory, product design, and product testing. We also jointly develop 10nm-class processes and materials with mask and equipment manufacturers, and rapidly develop diverse application products through wafer-class customized packaging with downstream system developers. Over the past 4 years, Nanya Technology has increased open innovation projects each year to support its short-, medium-, and long-term R&D plans.

Technology R&D Open Innovation Program



## 3.2 Green Product Development

Nanya Technology works together with its customers toward the goal of protecting our green planet. We have adopted Life Cycle Thinking (LCT) and the Design for Environment principles. Nanya Technology, long committed to developing advanced, efficient, and eco-friendly products, continues to help customers design products with low-energy consumption while leveraging its influence on the supply chain for hazardous substance management and responsible minerals procurement. To keep improving the environmental friendliness of our products, Nanya Technology set environmental health and safety performance indicators and launched projects to reduce waste, promote resource reuse, and cut greenhouse gas (GHG) emissions. Aligned with the Green Product Promotion Committee on green product management, Nanya Technology takes seven environmental impact aspects into consideration from the very beginning of new product development. These include procurement, manufacturing, transportation, product use, disposal, and recycling. Such a comprehensive approach seeks to identify improvement opportunities that will enhance environmental benefits.

### Nanya Technology's Design for Environment Matrix

	Procurement	Manufacturing	Transportation	Product Use	Disposal and Recycling
Energy Efficiency	V	V	V	V	
GHG Emissions	V	V	V	V	
Material Reduction	V	V	V		
Responsible Minerals Procurement	V				
Hazardous Substances Free	V	V			
Waste Reduction		V			V
Water Resource Reduction		V			

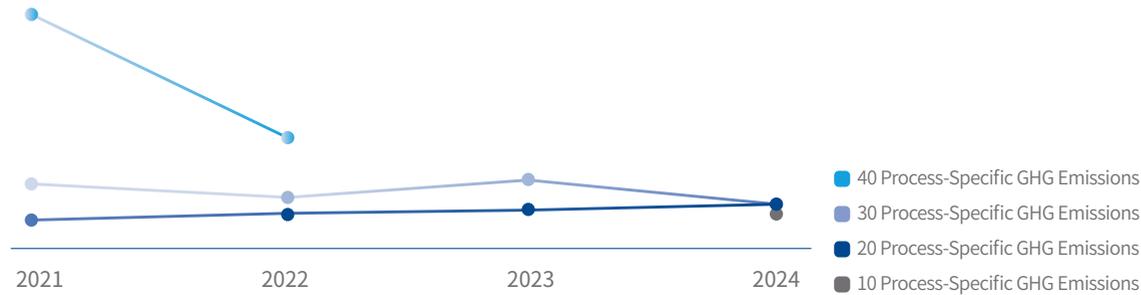
## 1. Life Cycle Assessment

In response to international environmental trends, Nanya Technology adopted the life cycle assessment tool Simapro to conduct 100% product Life Cycle Assessments (LCA), which allowed us to calculate the environmental footprint of our products and identify areas for improvement. Meanwhile, we also gathered environmental data and coefficients during the analysis process to build a decision support system for green product development. Nanya Technology performed quantitative LCAs at each stage of a product's life cycle, and took multiple factors into consideration. In accordance with the quantification and communication requirements and guidelines outlined in the ISO 14040 series for *Product Environmental Footprint* life cycle impact assessments, Nanya Technology participated in product environmental footprint declarations, while referencing the regulations of ISO 14064-1 GHG inventory and ISO 14067:2018 Carbon Footprint International Standards to carry out these declarations. The analysis covered various DRAM products made by Nanya Technology, with life cycle boundaries including raw material manufacturing, transportation, wafer manufacturing, packaging, module assembly, product use, and recycling/disposal. Since our main production activity is memory wafer manufacturing and other components are outsourced, the primary system boundary is set at wafer manufacturing. Among 28 measures to improve environmental footprint sources, reductions in GHG emissions from the three main sources listed in the results of the 2024 product life cycle assessment are as follows:

### Three Hotspots of Greenhouse Effect Listed in the 2024 Product LCA Results

	Percentage of Product Carbon Footprint	Improvement Plan	2024 Performance Results	Future Improvement Directions
Electricity Use	83.13%	Implementing energy conservation improvement plans	<ul style="list-style-type: none"> <li>Completed 27 energy conservation management plans under ISO 50001, resulting in the energy conservation benefits of 5,513 MWh</li> <li>Purchased 35.23 million kWh of renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>Continue to implement the ISO 50001 Energy Conservation Plan</li> <li>Continue to purchase renewable energy according to plan</li> </ul>
Liquid Nitrogen (LN2)	2.45%	Requiring LN2 suppliers to implement energy conservation and carbon reduction management plans	<ul style="list-style-type: none"> <li>Suppliers joined the SBTi and plan to reduce Scope 1+2 emissions by 25% in 2030.</li> </ul>	<ul style="list-style-type: none"> <li>Continue to require LN2 suppliers to implement energy conservation and carbon reduction management plans</li> </ul>
Production wafer	2.40%	Requiring Production wafer suppliers to implement energy conservation and carbon reduction management plans	<ul style="list-style-type: none"> <li>Suppliers joined the SBTi and plan to reduce Scope 1+2 emissions by 25% in 2030.</li> </ul>	<ul style="list-style-type: none"> <li>Continue to require Production wafer suppliers to implement energy conservation and carbon reduction management plans</li> </ul>

Trends in Product Carbon Footprint for 10nm/20nm/30nm/40nm Processes

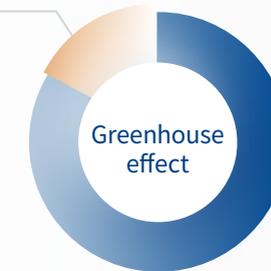


The 2024 product life cycle inventory was completed. Nanya Technology used its staple product, the SA30 memory, to illustrate the ratio of 28 environmental footprint items across the raw material and manufacturing stages.

Greenhouse effect impact derived from:

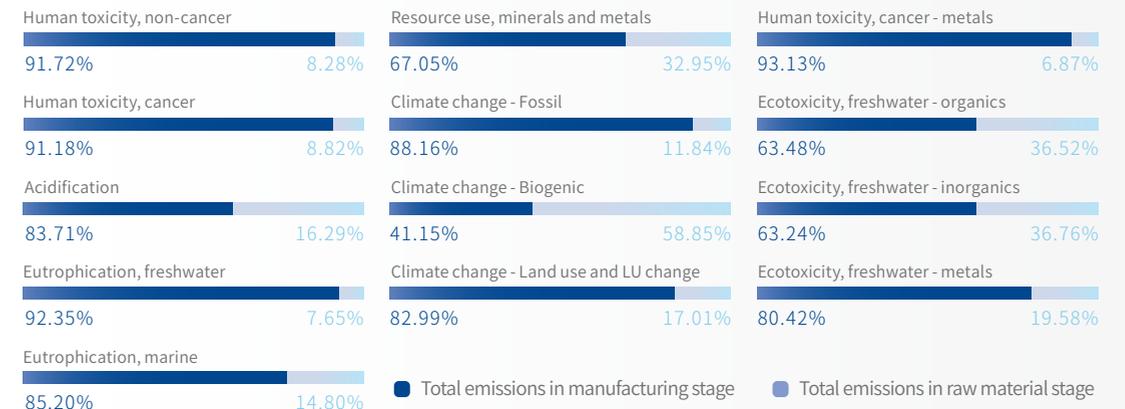
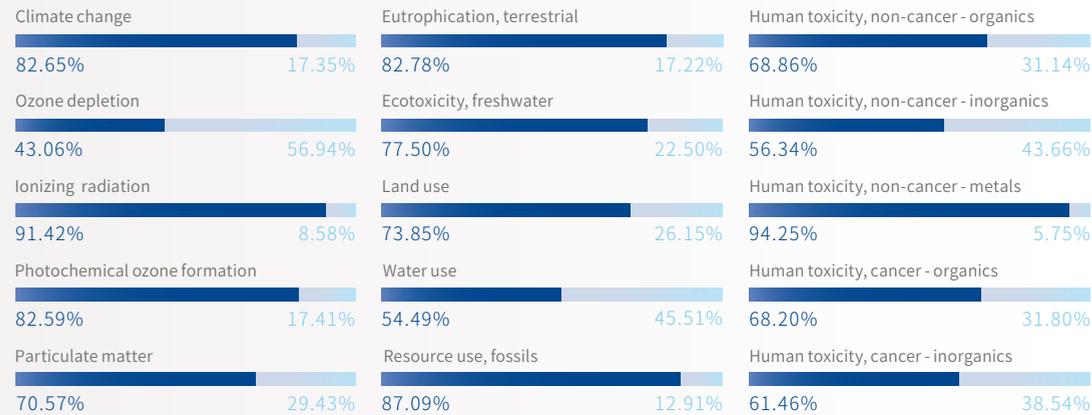
- Manufacturing stage at the factories: accounted for about 82.65%
- Procured raw material stage: accounted for about 17.35%

Total Emissions in Raw Material Stage  
17.35%



Total Emissions in Manufacturing Stage  
82.65%

Proportion of Total Emissions from Raw Materials and Manufacturing Stages of SA30

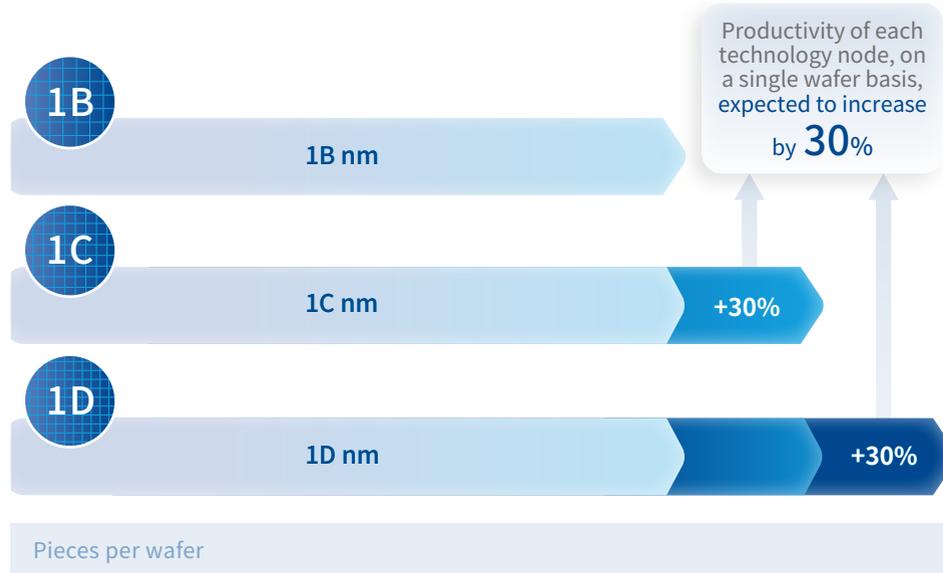


## 2. Green Product Design

As a critical part of the semiconductor industry chain, the DRAM industry's R&D and innovation in memory products directly impacts the performance and efficiency of computing devices. Nanya Technology has been long committed to the R&D, design, manufacturing, and sales of DRAM products. To fulfill technological development and market needs, Nanya Technology focuses on three main R&D sectors: manufacturing process shrinkage, product specification enhancement, and 3D stacked technology development, from which we aim to create green products:

	R&D Directions	Environmental Benefits
 <p>Manufacturing Process Shrinkage</p>	<ul style="list-style-type: none"> <li>• <b>1B nm process:</b> Mass production of DDR4 and DDR5 products has been achieved.</li> <li>• <b>1C nm Process:</b> Technical foundations are established. R&amp;D and design for DDR5 and LPDDR5 products are underway.</li> <li>• <b>1D nm Process:</b> R&amp;D has begun to devote to advanced process shrinkage in 2025.</li> </ul> <p>Each new process generation increases single-wafer output by more than 30%. The R&amp;D team strives to address the challenges of increased power leakage and greater process complexity due to shrinking transistor channels.</p>	<ul style="list-style-type: none"> <li>• <b>Single-Wafer Output Improvement:</b> Reducing the amount of silicon wafers and materials needed per unit of product, and cutting overall energy consumption and waste generation.</li> <li>• <b>Shrinkage and High-Yield Processes:</b> Improvement of efficiency and reduction of defective products with lower resource waste.</li> </ul>
 <p>Product Specification Enhancement</p>	<p>In response to the growing needs of 5G, AI, and high-performance computing, along with the diversification of application scenarios, memory now requires higher bandwidth, lower latency, and lower power consumption. DDR5/LPDDR5 show substantial improvements in bandwidth, capacity, and power efficiency over DDR4/LPDDR4.</p> <ul style="list-style-type: none"> <li>• <b>DDR5:</b> Completed R&amp;D and mass production of products supporting 5,600 Mbps. Ongoing efforts are pushing speeds to 6,400/7,200 Mbps.</li> <li>• <b>LPDDR5:</b> Currently in the product R&amp;D and design stage, with target speed specifications raised to 8,533 Mbps to 9,600 Mbps.</li> </ul>	<ul style="list-style-type: none"> <li>• DDR5/LPDDR5 high-speed memory enhances AI and 5G computing performance, shortens processing time, and lowers system power consumption, offering a greener computing solution for application demands.</li> <li>• Lowered hardware requirements for servers and data centers reduce energy and material consumption.</li> </ul>
 <p>3D Stacked Technology Development</p>	<ul style="list-style-type: none"> <li>• Nanya Technology has developed the Through-Silicon Via (TSV) process technology. This is being used with 1B nm DDR5 to provide high-capacity server modules through 3D stacked technology for cloud and high-end server markets.</li> <li>• With the rise of generative AI and edge computing, applications are expanding to AI PCs, AI phones, AI robots, and other edge devices. Recognizing this trend, Nanya Technology is developing customized ultra-high bandwidth memory, combined with 3D stacked technology, to provide customers with high-performance, low-power solutions.</li> </ul>	<ul style="list-style-type: none"> <li>• 3D stacked technology aligns with the trends of low power consumption, high integration, and shrinkage. It saves space and reduces packaging energy use.</li> <li>• Edge computing reduces the burden on data centers by reducing frequent data transfers, lowering server loading, and reducing energy consumption. This in turn reduces the energy use and carbon footprint of network infrastructure.</li> </ul>

### Nanya Technology's Manufacturing Process Shrinkage



### Environmental External Benefits

From the outset of new product development, Nanya Technology keeps the environmental impact in mind throughout the entire product lifecycle. For electronic products, energy consumption during the usage phase is one of the most significant indicators of environmental impact. Nanya Technology actively develops energy-efficient products to help customers lower energy requirements when using electronic products, thereby reducing GHG emissions.

Product	Benefits
<b>Product</b> Mainstream process products (low power DRAM and 20nm consumer DRAM) <b>Scope</b> Total sales volume equivalent in 2024 <b>Calculation baseline</b> Power consumption of mainstream process products in the current year compared with the previous generation <b>Calculation method</b> Totalling the power consumption difference between all products sold in the current year and their respective previous-generation product	<p>Nanya Technology saved more than <b>617.17 million kWh</b> of electricity, approximately <b>2,222 terajoules</b> (<math>2,222 \times 10^{15}</math>)<sup>1</sup>, which is equivalent to the average annual electricity consumption of 167,000 households<sup>2</sup>. GHG emissions were reduced by 292,540 tCO<sub>2</sub>e<sup>3</sup>, which is equivalent to 752 times the carbon absorption of Daan Forest Park in one year<sup>4</sup></p>

Note 1: Based on the Energy Product Unit Heating Value Table updated in 2020 by the Energy Administration for unit conversion, 1 kWh = 860 kcal = 3.6 megajoules; 1 MWh = 3,600 megajoules.

Note 2: Estimated using the monthly residential and small-scale commercial electricity usage data on Taipower's website; the annual household consumption is 3,699 kwh/year (released on June 20, 2025).

Note 3: Emission factor for electricity calculated based on the Energy Administration's 2024 published value of 0.474 kgCO<sub>2</sub>e/kWh.

Note 4: Based on the Energy Administration's estimation that one Daan Forest Park absorbs 389 metric tons of CO<sub>2</sub> annually.

### Nanya Technology's Product Planning and the Evolution of Product Specifications

Operation Voltage			Bandwidth/Speed	
DDR4 (1.2v)	DDR5 (1.1v)	DDR6 (1.0 or 1.05v)	DDR4	1600~3200Mbps
			DDR5	3200~8800Mbps
			DDR6 (TBD)	9600~17600Mbps

Operation Voltage			Bandwidth/Speed	
LPDDR4x (1.8/1.1/0.6v)	LPDDR5x (1.8/0.9/0.3v)	LPDDR6 (1.8/0.875/0.5v)	LPDDR4x	533~4267Mbps
			LPDDR5x	1600~9600Mbps
			LPDDR6 (TBD)	1067~14400Mbps

### Guidelines for the R&D of Energy-Efficient Products

- 01** Nanya Technology continues to develop advanced process technologies. So far, next-generation products based on advanced processes have reduced power consumption by approximately 15% compared to previous generations.
- 02** We collaborated with our main chip customer to adopt multi-chip packaging, reducing the number of backend packing and testing, as well as overall energy consumption.
- 03** By enhancing the development of low-power product lines and expanding the product portfolio, Nanya Technology aims to address the needs of various mobile electronic devices.

### 3. Green Product Management

In 2005, Nanya Technology established the Green Product Promotion Committee (GPPC) to implement Hazardous Substances Free (HSF) management. During the product production process, Nanya Technology consistently implemented measures to prevent pollution, save energy, reduce waste, and avoid the use of hazardous substances under regulatory restrictions. By integrating and connecting suppliers of raw materials, process materials, and shipping packaging materials, as well as subcontractors providing back-end packaging, Nanya Technology successfully created an effective green product supply chain. This supply chain, involving both upstream and downstream vendors, complies with current international environmental regulations and trends. Through the Green Product Promotion Committee, Nanya Technology has referenced national laws from EU and other regions, as well as hazardous substance management standards from major international customers, to establish the General Rules for "Environment-Related to be Controlled" Substances in Parts and Materials. With ongoing efforts, we also continue to effectively control the sources of raw materials and related products to uphold green product standards and reduce environment impact during product production. Under the General Rules for "Environment-Related to be Controlled" Substances in Parts and Materials, all products must comply with international regulations and customer requirements. Through our material hazardous substance free management system, Nanya Technology ensures that all its manufactured wafer products, back-end IC packaging, and DIMM module products comply with international regulations and hazardous substance management standards from customers.

Nanya Technology defines green products as those that comply with the requirements of BNDCU-0012 General rules for "Environment-Related to be Controlled" Substances in Parts and Materials, which aligns with the following regulations and standards:

**✓ Complying with the requirements of the Waste Electrical and Electronic Equipment Directive (WEEE) and the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EC & 2015/863(recast)**

Restricted Substance	Restricted Level	Threshold Limit (ppm)
Cadmium (Cd)	Homogenous Material	<100 ppm
Lead (Pb)		<1000 ppm, Exemption 7C-1 applies to certain products that use resistors
Mercury (Hg)		<1000 ppm
Hexavalent Chromium (Cr6+)		<1000 ppm
Polybrominated Biphenyls (1-10 Bromine) (PBBs)		<1000 ppm
Polybrominated Diphenyl Ethers (1-10 Bromine) (PBDEs)		<1000 ppm
Specific Phthalate: DEHP		<1000 ppm
Specific Phthalate: BBP		<1000 ppm
Specific Phthalate: DBP		<1000 ppm
Specific Phthalate: DIBP		<1000 ppm

**✓ Complying with the IEC 61249-2-21 Halogen-Free (HF) Requirements**

Restricted Substance	Restricted Level	Threshold Limit (ppm)
Bromine (Br)	Homogenous Material	<900 ppm
Chlorine (Cl)		<900 ppm
Bromine (Br) + Chlorine (Cl)		<1,500 ppm

**✓ Complying with the European Union's Packaging and Packaging Waste Regulation EU/2025/40 (PPWR) requirements for the total sum of 4 heavy metals**

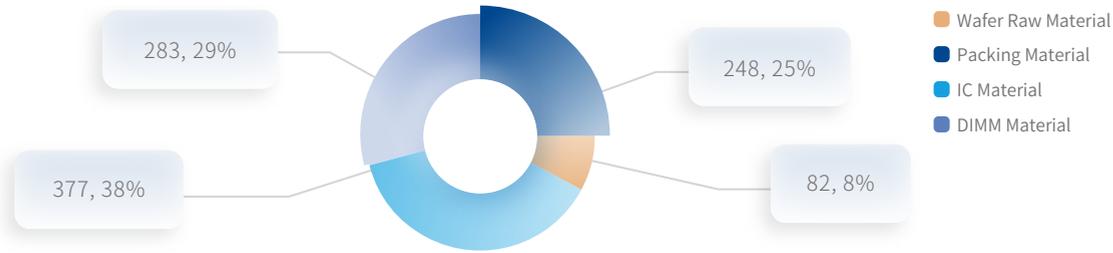
Restricted Substance	Restricted Level	Threshold Limit (ppm)
Cadmium (Cd)	Homogenous Material	The total sum of 4 heavy metals <100 ppm
Lead (Pb)		
Mercury (Hg)		
Hexavalent Chromium (Cr6+)		

**✓ Complying with the United States Toxic Substances Control Act Section 6(h) requirements for non-use of 5 PBT substances**

Restricted Substance	Restricted Level	Threshold Limit (ppm)
Phenol, Isopropylated Phosphate (PIP 3:1) CAS No. 68937-41-7	Finished Product	Prohibited
Decabromodiphenyl Ether (DecaBDE) CAS No. 1163-19-5		Prohibited
Pentachlorothiophenol (PCTP) CAS No. 133-49-3		Prohibited, except when the concentration is <1% by weight
Hexachlorobutadiene (HCBD) CAS No. 87-68-3		Prohibited
2,4,6-Tri-Tert-Butylphenol (2,4,6-TTBP) CAS No. 732-26-3		Prohibited, except when the concentration is <0.3% by weight

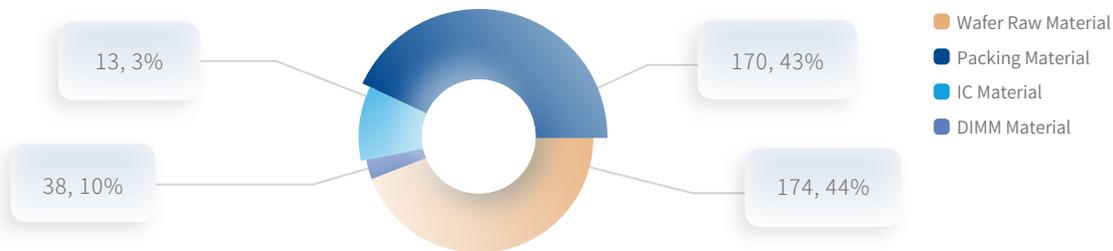
### 2024 RoHS Reports Compliance

To complete requirements for green product compliance confirmation, a total of 990 test reports were reviewed and comply with RoHS 2011/65/EU and 2015/863 (recast) criteria in 2024, and the complete as follows:



### 2024 Concerned Substances Survey of Supply Chain

In compliance with regulatory requirements or customer specifications regarding prohibited or restricted substances, such as those outlined in EU REACH SVHC, EU POP, GADSL, US TSCA 5 PBTs, EU PFAS, and US TPCP regulations or related draft proposals for homogeneous substances or finished products, we have managed, prohibited or restricted substances of concern in accordance with the applicable regulation scopes. We conducted a total of 7 versions of supply chain substance of concern surveys, including EU REACH SVHC (Substances of Very High Concern) regulatory compliance surveys (conducted every 6 months), the specific customer concerned hazardous substance surveys, and due diligence survey for Responsible Minerals Sourcing, a total of 395 supply chain survey reports were completed as follows:



- Completed EU REACH SVHC (Substances of Very High Concern) V.30, V.31, and V.32 surveys, with a total of 4 versions (CS Survey V.56/V.58/V.58.1/V.59) for the concerned substances of supply chain report, totaling 258 reports and the completion rate: 100%.
- Completed customer-required hazardous substance surveys (CS Survey V.56.1/V.56.2) for the concerned substances of supply chain report, totaling 93 reports and the completion rate: 100%.
- Completed responsible mining due diligence with 1 version (CS Survey V.57) for the concerned substances of supply chain report, totaling 44 reports and the completion rate: 100%.

## 4. Green Chemistry Laboratory

Quality is the key factor in determining technical capability. To meet customer requirements and standards for process yields and product reliability, Nanya Technology's chemical laboratory is consistently investing in refining its testing methods and techniques. This investment is driven by goals to enhance green manufacturing and quality capabilities.

Goals	Improving work efficiency	Ensuring labor safety for personnel
Implementation Items	Implementing a data automation system, leading to a 65% reduction in report printing paper usage	Assessing zero use of n-Hexane for equipment cleaning

#### Before Improvement



#### After Improvement

