winbond
2023 Sustainability Report
Fostering Green Innovation and Sustainability for a Better Future for All

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

SUSTAINABLE PRACTICES

Green Products

Winbond has integrated our core innovative technology competencies with sustainable energy conservation and carbon reduction goals. Through green product design, digitalizing information systems, and improving production efficiency, Winbond can develop and optimize our products in various areas, strictly controlling each step of our product process. Winbond promises to deliver the highest quality products to customers, minimizing the carbon emissions required to deliver our products into the hands of customers and consumers. While benefiting from the convenience brought about by technology, Winbond is lowing the impact to environment and helping the overall value chain effectively reducing carbon emissions.

2023 Performance Highlights

33% less power consumption
- Optimized HyperRAM operating voltage to a minimum of 1.2V
- 1.2V HyperRAM saves 33% power consumption compared to 1.8V HyperRAM

45% less power consumption
- Launched the world's first NOR Flash supporting an operating voltage of 1.2V
- 1.2V NOR Flash uses 45% less power than 1.8V NOR Flash (please refer to p.72 for details)

TIPS Certification Class A
- Received the Taiwan Intellectual Property Management System certification

Ranked as a "Top 100 Global Innovators" from Clarivate
- Recognized as the global top 100 innovators for 2 consecutive years

Over 4,900
- Global patents granted in total

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

2023 Sustainability Report   Fostering Green Innovation and Sustainability for a Better Future for All

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

2.1 Research, Development, and Innovation

2.1.1 Innovation in Technology and Services

Winbond provides global customers with comprehensive specialty Memory solutions. Core products include Code Storage Flash Memory, TrustME® Secure Flash Memory, Specialty DRAM, and Mobile DRAM, making Winbond the only Taiwanese manufacturer with proprietary technologies in both Flash and DRAM. Winbond leverages the synergies generated by its product portfolio and adopts a green product design philosophy to meet diverse customer needs. This enables customers to combine their expertise with Winbond's innovative green products for applications in hand-held devices, consumer electronics, computer peripherals, artificial intelligence, automotive, and industrial electronics markets. To achieve environmental friendliness and sustainable growth while providing customers with high-quality and innovative products and services, Winbond continuously invests in research and development, technology, and talent. Winbond is committed to developing innovative products and technologies and remains focused on the following issues:

1. Development of green products in Flash memory, Secure Flash memory, Specialty DRAM, and Mobile DRAM

2. Development and production processes of green products, along with achievements in carbon reduction and energy saving

3. Key technology development focusing on high performance, small size, low energy consumption, high quality, and security

4. Refinement in design and process miniaturization

5. Innovation and intellectual property management

Jen-Lieh Lin

Vice President, Flash Memory IC Business Group

Net-zero emissions are a global consensus. Winbond achieves carbon reduction and energy saving goals through actions such as using green materials, green product design, green electricity production, and reducing carbon emissions. Winbond continuously optimizes product design and manufacturing processes. Through design, we reduce chip size, lower power consumption, and use small and low-temperature welding materials for packaging. This effectively saves materials and reduces carbon footprint per unit, while also decreasing energy consumption. By minimizing energy usage, we aim to achieve the vision of being a hidden champion enriching human life through green semiconductors.

Key Technology	Highlight Products	Application

Low-Power NOR Flash Memory	▪ **1.2V Flash Memory**
	  ▪ Winbond launched the market's first 1.2V 64Mb SpiNOR Flash Memory: W25Q64NE
	  ▪ 128Mb and 256Mb are expected to be launched in 2024.
		✓ Wearable devices and other low-power demand application products
		✓ Meets the low operating voltage requirements of advanced processes, eliminating the need for Power Management IC (PMIC), further reducing costs and minimizing sizes.

High-performance NAND Flash Memory	▪ **8-Channel NAND Flash (Octal NAND)**
	  ▪ Winbond's 46nm serial NAND Flash Memory technology, introduces the first high-speed NAND Flash Memory in the market to support 8-channel input and output
	  ▪ Supports products that require higher capacity and higher transfer speed
		✓ Automotive electronics (e.g. dashboard and Advanced Driver Assistance Systems…etc.) can meet the requirement of rapid firmware startup and quick updates
		✓ Smart visual doorbells can meet the application demands for fast startup detection.

Secure Flash Memory	▪ **Anti-quantum computing attack. Integrating PQC (Post-Quantum Computing Cryptography) Leighton-Micali (LMS) algorithm**
	  ▪ Supports asymmetric key encryption algorithm（LMS：Leighton-Micali）, enabling devices to achieve secure OTA through LMS-OTS (one-time signature) specified by NIST800-208.
	  ▪ The component supports a high-performance Quad-SPI interface of 166MHz, expands the support of Replay-Protected Monotonic Counter (RPMC), increases to 8 counters, and is suitable for security enhancement and data protection of personal computers (UEFI and BIOS).
		✓ The first memory supplier to integrate the LMS algorithm, meeting emerging security regulatory requirements and setting new standards in the industry. Optimized for industrial IoT, network, server, and critical infrastructure applications.

Low-Power Mobile Memory	▪ **1.2V Low Voltage Mobile Memory**
	  ▪ Compared to traditional SDRAM/DDR 3.3V, HyperRAM 1.8V operating power is only 25%.
	  ▪ The new generation of HyperRAM operating voltage is further reduced to 1.2V, further reducing 33% power consumption, prolong usage time of wearable devices.
		✓ Digital wearables devices, IoT devices, and digital meters and other related products.

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | Green Product | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

2023 Sustainability Report   Fostering Green Innovation and Sustainability for a Better Future for All

Code Storage Flash Memory

As a leading manufacturer of Flash memory, Winbond continuously strives to reduce product manufacturing carbon footprints and energy consumptions. Taking Winbond's NOR Flash as an example, with the evolution of processes to the new generation 58 and 45 nanometers products, the area of a single chip has been significantly reduced. Additionally, the new generation products also support smaller packaging types, greatly reducing the carbon footprint of Flash products in wafer manufacturing and packaging stages. For instance, in the new generation 58nm RV series, the 8Mb 3V NOR Flash has reduced the chip area by 60% compared to products with the same capacity at 90nm, and it can also support smaller XSON packaging. Ultimately, the carbon footprint is reduced by 34% compared to the 90nm DV series.

SOP 8   **XSON 8**
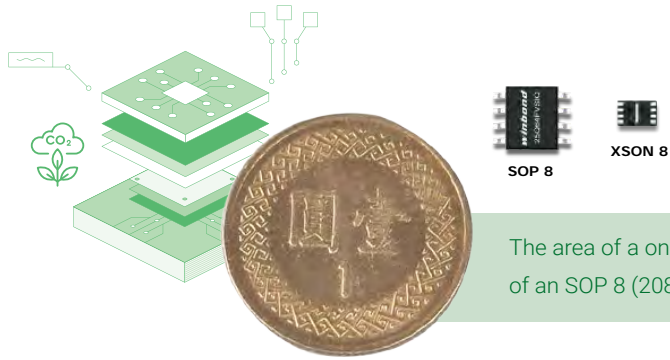
The area of a one-dollar coin is approximately **11 times** the size of an SOP 8 (208 mil), and **52 times** the size of an XSON 8 (3x2).

Additionally, in terms of power consumption and extending battery life, Winbond developed new processes and circuit architectures. It introduced the world's first NOR Flash supporting an operating voltage of 1.2V. When paired with SoCs designed with advanced processes for low voltage, it achieved high-performance reading while significantly reducing power consumption, thus meeting the goals of high efficiency and energy savings.

1 .2V NOR Flash	
Total power consumption	**45% less power consumed compared to the 1.8V NOR Flash in mainstream use today** In the scenario of daily operation for 8 hours in a true wireless application environment, with the total sales volume of 1.2V NOR Flash in 2023, compared to 1.8V NOR Flash, approximately 1,160,785 kWh of power consumption is saved, with an equivalent of 4,178,826 MJ. This saving is roughly equivalent to reducing 574.6 metric tons of carbon dioxide emissions, which is also approximately equivalent to the carbon absorption capacity of 1.49 Daan Forest Parks [Note].
Performance	Maintains similar transition level as 1.8V/3V Flash
Product applications	Wireless headphones, smart watches, smart wristbands, smart glasses, and other wearable devices with high power-saving requirements

[Note] Based on the 2022 electricity emission factor of 0.495 published by the Ministry of Economic Affairs, and data from the Forestry and Nature Conservation Agency of the Ministry of Agriculture and the Department of Land Administration of the Taipei City Government: with an area of 25.93 hectares and a carbon sequestration rate of 14.9 tCO_2e per hectare per year, Daan Forest Park annually absorbs approximately 386 tCO_2e.

Specialty DRAM and Mobile DRAM

In 2022, Winbond launched the HyperRAM 3.0. This series of products is ideal for use in low power consumption IoT devices such as wearable devices. It is able to support voice control and tinyML calculations, and can also be used in vehicle dashboards, entertainment systems, machine vision, HMI displays, and communications modules. To meet the emerging consumer trends of low-power wearable and smart devices, Winbond launched the HyperRAM 3.1 product series in 2023, featuring low voltage and small size packaging options such as the 1.2V WLCSP and 1.35V BGA49. These became crucial components for low-power wearable devices. With the expansion of the Internet of Things (IoT) market, the number of portable devices is rapidly increasing. The ultra-low power performance of this series effectively extends battery life. Leveraging the low power advantage of HyperRAM 3.1, it is applied in wearable smart sports and lifestyle products. Its 16-bit interface accelerates data transfer rates, speeding up the loading and transmission of high-resolution images. This sets new benchmarks in low power consumption, smart processing, and UI display fields, providing customers with simplified, competitive, and long-lasting battery life smart wearable design solutions.

Joint Electron Device Engineering Council (JEDEC) standard DDR3 Specialty DRAM is widely used in various products. Through technological advancements, product power consumption is reduced. In addition, Winbond continues to expand its product lines to meet the needs of various applications, such as DDR4 and higher bandwidth and speed ASIC DRAM products, applied in networking and emerging artificial intelligence applications.

Low Power by Hybird Sleep Mode (HSM)   **Design Simplicity** with less pins;without compromising performance   **Space Saving** by low pin count

BGA 24   **BGA 49**

HyperRAM ™ 3.1	HyperRAM Form Factor	DDR3
The 3.1 generation of our HyperRAM ™ products utilizes the all-new 16-bit extended Hyper-BusTM interface, supporting data transfer speeds up to 1 GBps through the same commands, bit address signals, and data bus format. It features the same standby power consumption, and only requires an adjustment to a small number of signal pins. The product also features a higher frequency.	Winbond initially introduced the BGA 24 6x8mm² package in the new HyperRAM™ series, which, compared to SDRAM's BGA 54, reduces carbon emissions by 10%. In 2023, Winbond continued to improve packaging types and introduced the BGA 49 size, which supports a 16-bit data width. Furthermore, the size was reduced to 4x4mm², resulting in a 20% reduction in carbon emissions compared to BGA 54.	Shrinking from 25snm to 20nm. Operating efficiency goes up with each technology node, and our 2Gb DDR3 products have 10% reduced power consumption. Winbond has continued to supply DDR3 products, making sure to satisfy long-term customer demand.

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

winbond 2023 Sustainability Report Fostering Green Innovation and Sustainability for a Better Future for All

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

Secure Flash Memory

"Security" is not only a technical issue but also a societal and ethical one. Security has significant impacts on the welfare and rights of society, economy, environment, individuals, and organizations, especially in today's digital transformation era and the economic losses and security threats caused by hackers through security vulnerabilities. Security ensures the confidentiality, integrity, and availability of data, information, and assets, preventing unauthorized access, modification, or destruction. Security also enables trust, privacy, and compliance in various sectors such as finance, healthcare, education, and government. However, security is not a one-time task or a static state. It requires continuous monitoring, updating, and improvement to address evolving challenges and risks. Security involves multiple layers, from hardware to software, from networks to the cloud, from users to devices. Therefore, security requires a comprehensive approach covering all aspects of systems and their environments.

In today's internet-connected world, daily life electronic devices and IoT devices rely on Flash memory to store control code and data protection. However, the widespread presence of these devices also makes them targets for hackers. Hackers often exploit system security vulnerabilities to access end-user's private data, plan large-scale attacks on enterprise infrastructure through networks and IoT devices, and even sabotage and espionage activities on government infrastructure.

Winbond recognizes the severity of these challenges and has pioneered the development and launch of the TrustME® Secure Flash Memory product line. Secure memory is used to store sensitive data and code such as encryption keys, passwords, certificates, and firmware. Secure memory ensures that data and code are protected from unauthorized access, modification, or leakage both physically and logically. Secure memory also provides functions such as encryption, authentication, tamper detection, and self-destruction to enhance security levels and prevent attacks. These cutting-edge solutions are designed to protect Winbond customers' assets and create secure platforms, thus safeguarding end-users in various fields. Winbond's secure Flash memory is applied in consumer IoT, industrial IoT, servers, networks, and automotive sectors. Winbond is committed to protecting customers from emerging cybersecurity threats. In anticipation of the upcoming post-quantum computing era, Winbond recently launched secure Flash memory enhanced with post-quantum encryption technology (PQC), ensuring that customers continue to enjoy robust protection in the evolving cybersecurity environment.

TrustME® Secure Serial Flash Memory W75F	**TrustME® Secure Serial Flash Memory W77Q / W77T Series**
The W75F memory series was developed in response to the high security identify verification needs of mobile payment services and other applications, and due to confidential data storage requiring encrypted system hardware modules to possess EAL 5+ security certification. Products in the W75F series are the first secure Flash memory solution in the world to obtain Common Criteria (CC) EAL 5+ certification. They also support secure eXecute-in-Place (XiP), and are able to protect the confidentiality and integrity of codes and data stored in IoT devices.	The W77Q and W77T, compatible with traditional SPI specifications, offer essential security features for IoT endpoints, automotive, networks, and other types of connected devices. These features include hardware root of trust, secure boot, platform resilient, supply chain security confirmation, and robust data protection. Even if the host processor is compromised, the W77Q and W77T facilitate secure over-the-air software updates.

Code and Data Protection
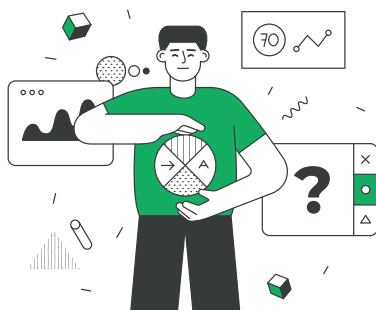
Authentication

Secure Software Updates with Rollback Protection

Platform Resiliency

Secure Supply Chain

73

winbond 2023 Sustainability Report | Fostering Green Innovation and Sustainability for a Better Future for All

Preface · The Winbond Story · Leading a Sustainable Pathway · **Sustainable Practices** · Appendix

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion
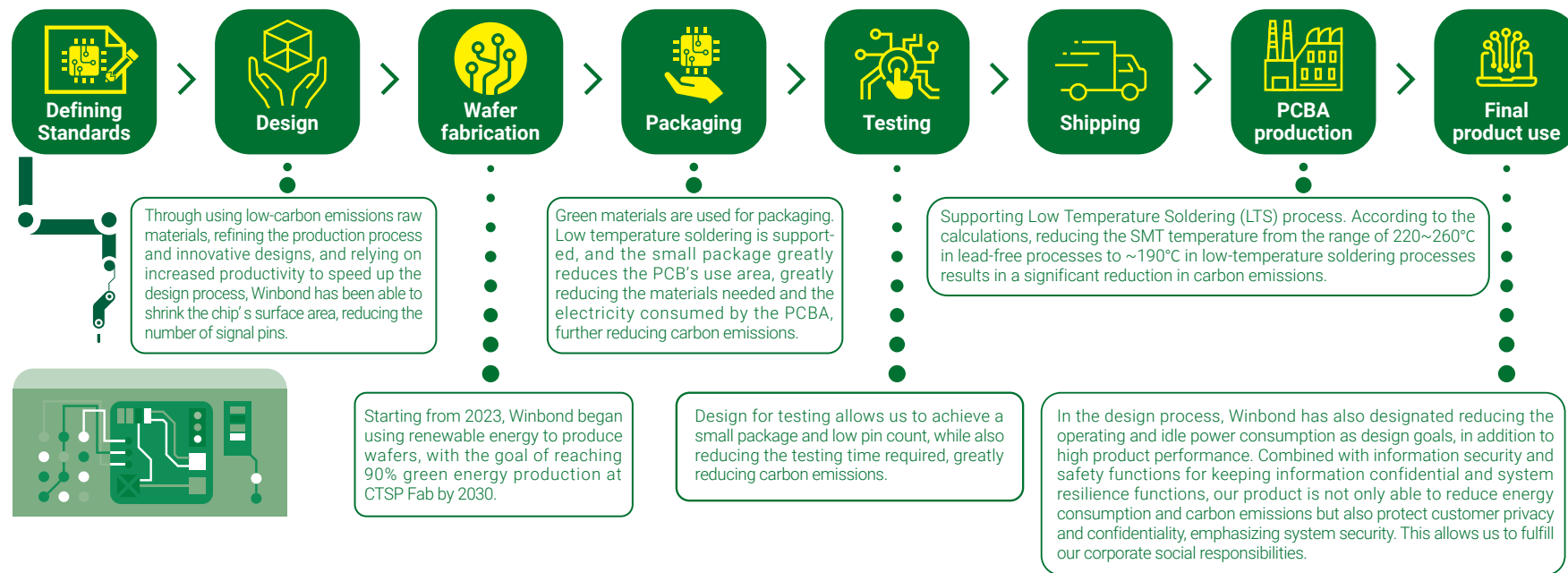
2.1.2 Green Products

Winbond foresees the market trends of new generation products and continuously invests resources in pursuing green semiconductor design, energy-saving and carbon-reducing production technologies, green energy production, and sustainable innovation of products, aiming to enhance the competitive advantage of green products while providing customers with high-quality products and service support.

■ Winbond green product development: Design considerations that take into account the product life cycle and reducing carbon emissions

Defining Standards > **Design** > **Wafer fabrication** > **Packaging** > **Testing** > **Shipping** > **PCBA production** > **Final product use**

Through using low-carbon emissions raw materials, refining the production process and innovative designs, and relying on increased productivity to speed up the design process, Winbond has been able to shrink the chip's surface area, reducing the number of signal pins.

Starting from 2023, Winbond began using renewable energy to produce wafers, with the goal of reaching 90% green energy production at CTSP Fab by 2030.

Green materials are used for packaging. Low temperature soldering is supported, and the small package greatly reduces the PCB's use area, greatly reducing the materials needed and the electricity consumed by the PCBA, further reducing carbon emissions.

Design for testing allows us to achieve a small package and low pin count, while also reducing the testing time required, greatly reducing carbon emissions.

Supporting Low Temperature Soldering (LTS) process. According to the calculations, reducing the SMT temperature from the range of 220~260°C in lead-free processes to ~190°C in low-temperature soldering processes results in a significant reduction in carbon emissions.

In the design process, Winbond has also designated reducing the operating and idle power consumption as design goals, in addition to high product performance. Combined with information security and safety functions for keeping information confidential and system resilience functions, our product is not only able to reduce energy consumption and carbon emissions but also protect customer privacy and confidentiality, emphasizing system security. This allows us to fulfill our corporate social responsibilities.

■ Hazardous Substance Management

Winbond strictly adheres to international standards and regulations such as the "Hazardous Substance Process Management System Standard" (QC 080000), the "Restriction of Hazardous Substances Directive" (RoHS) of the European Union, the "Registration, Evaluation, Authorization, and Restriction of Chemicals" (REACH) regulation, California Proposition 65, the Toxic Substances Control Act (TSCA) of the United States, and the Canadian Convention to ensure that Wafer, Chip, Package IC, and other related products manufactured by Winbond comply with international environmental regulations and meet customer requirements for green products, thus avoiding environmental pollution and harm to human health. Winbond has established internal regulations for "Hazardous Substance Control" and formed a cross-departmental hazardous substance management team to control the design, procurement, production, and sales processes of products. Suppliers and subcontractors are required to incorporate green product requirements into their management systems to ultimately provide products free of hazardous substances (HSF) that meet customer demands. Winbond conducts its operations, including research and development, procurement, production, operations, and services, based on the following principles to reduce the company's impact on the natural environment and human health:

Winbond's HSF policy is dedicated to designing, procuring, manufacturing, and selling products free of hazardous substances to comply with international regulations, meet customer demands, and strive to protect the environment, thereby fulfilling its corporate social responsibility. Additionally, Winbond has established a Hazardous Substance Process Management (HSPM) system, wherein management representatives convene annually for management review meetings to discuss and review policies, objectives, regulations, relevant audit results, and management performance, with the aim of continuously improving the effectiveness of the hazardous substance management system.

1. Reduce the resource and energy consumption of products and services.
2. Reduce emissions of pollutants, toxic substances and wastes; and properly dispose of the waste.
3. Improve the recyclability and reusability of raw materials or products.
4. Optimize the sustainable use of renewable resources.
5. Extend the durability of products.
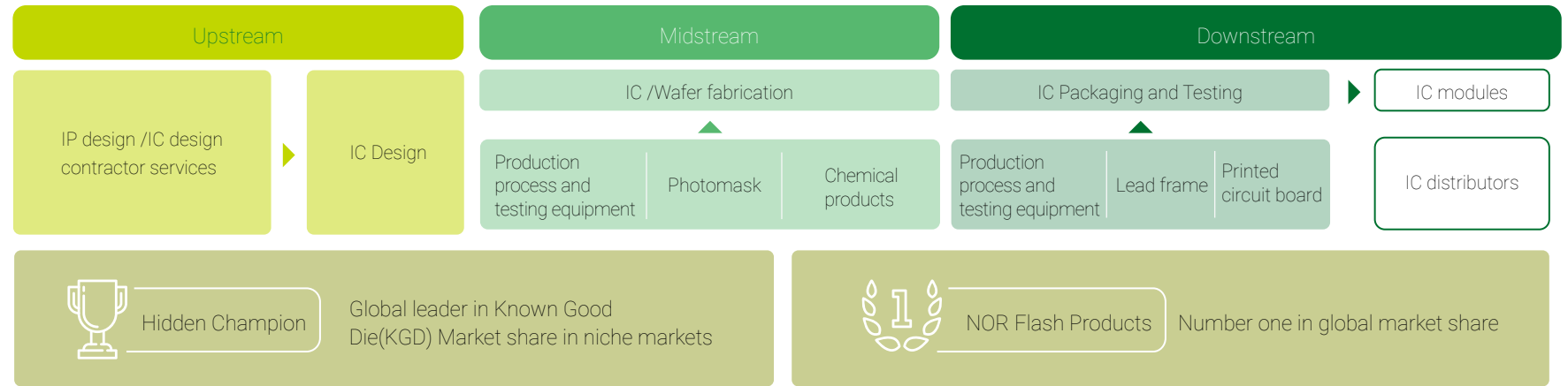6. Enhance the effectiveness of products and services.

Targets achieved in 2023

- No non-compliance issues related to hazardous substances monitoring have occurred
- 100% of Winbond personnel have completed hazardous substance training
- No non-compliance detected by customers' hazardous substance audits

winbond 2023 Sustainability Report Fostering Green Innovation and Sustainability for a Better Future for All

Preface The Winbond Story Leading a Sustainable Pathway **Sustainable Practices** Appendix

| Corporate Governance | **Green Product** Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

■ Semiconductor Industrial Chain

Winbond possesses an advanced and complete semiconductor industrial chain and professional specialization. This includes IP (Intellectual Property Rights) design and IC (Integrated Circuit) design, wafer fabrication, chip probing, and outsourced assembly and testing.

Upstream	Midstream	Downstream
	IC /Wafer fabrication	IC Packaging and Testing	→	IC modules
IP design /IC design contractor services	IC Design	Production process and testing equipment	Photomask	Chemical products	Production process and testing equipment	Lead frame	Printed circuit board	IC distributors

🏆 Hidden Champion — Global leader in Known Good Die(KGD) Market share in niche markets

🏅 NOR Flash Products — Number one in global market share

(Note) Known Good Die (KGD): Refers to wafers which are not immediately packaged after being manufactured, but instead provided to customers and packaged into a single chip along with other products. Rigorous product quality standards thus need to be met for these products, in order to ensure that the functions of the final product would not be affected.

Reduce packaging

Known Good Die（KGD）
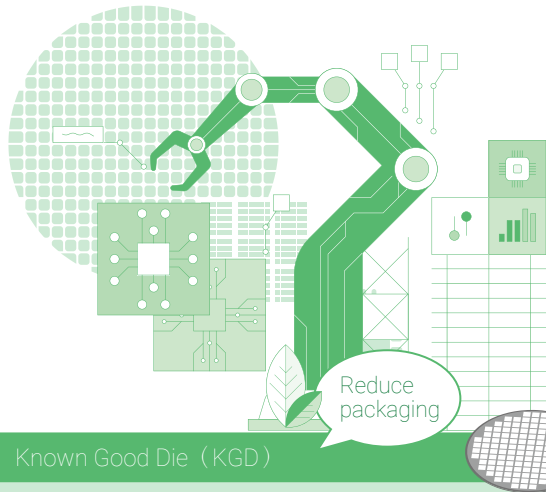
In the era of portable electronic products and the Internet of Things (IoT), Winbond continues to reduce the carbon footprint of its products. With years of expertise in KGD technology, Winbond collaborates with chip manufacturers to provide System in Package (SiP) multi-chip packaging solutions. This involves packaging memory chips together with logic chips in a KGD sales model, contributing to net-zero and environmental sustainability efforts by creating energy-efficient and low-carbon footprint end-products.

Many customers leverage Winbond's expertise to use KGD flash memory products for System-in-Package (SiP) solutions. Flash memory chips are stacked with controller chips and placed into single packages or modules to provide SiP solutions. Other components' KGD can also be stacked with flash memory KGD, leading to savings in packaging materials, improved performance, reduced power consumption, and chip area optimization.

Winbond supports the low-temperature soldering process, resulting in a reduction of 57 mt of CO_2 emissions per year note for each surface-mount technology production line.

Low-temperature soldering process（LTS）

To mitigate global warming, Intel introduced the Low Temperature Soldering (LTS) process as early as 2017. According to calculations, reducing the Surface Mount Technology (SMT) temperature from the 220~260 °C range of lead-free processes to approximately 190℃ in low-temperature soldering processes significantly reduce carbon emission. The International Electronics Manufacturing Initiative (iNEMI) predicts that the market share of products using low-temperature soldering technology will increase from around 1% to over 20% by 2027, demonstrating the electronics industry's commitment to environmental issues and sustainable development.

In line with the "green electronics" trend, Winbond has launched flash memory products compatible with the low-temperature soldering process. These products comply with JEDEC standards and have undergone reliability verification procedures such as drop, vibration, and temperature cycling tests. This ensures that the products fully support the LTS process without quality concerns, contributing to environmental protection and sustainable development efforts.

(Note) Quoted from pages 18-19 of Intel's 2017 introduction to Low Temperature Solder (LTS) process.

winbond 2023 Sustainability Report

Fostering Green Innovation and
Sustainability for a Better Future for All

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

2.1.3 Intellectual Property Management

Intellectual property (IP) are important assets for maintaining corporate sustainability. In order to protect the research and development resources and results invested by Winbond, Winbond has established IP policies in line with the Winbond's operating goals. By institutionalized IP management, Winbond nurtures a corporate culture of innovation and strengthens the IP protection awareness of employees. Winbond encourages the continuous innovation and IP right creation of our employees during work which strengthens the sustainable competitive advantages.

Winbond has established annual IP goals based on an overall assessment of the business objectives and research and development resources, connecting our business objectives with our IP strategy. As of 2023, the cumulative worldwide patent applications have exceeded 6,500 and the cumulative worldwide granted patents has exceeded 4,900.

Winbond has established IP Department and Patent Committee responsible for IP right management, assessment, promotion, and utilization. Started from the incubation stage, Winbond rigorously reviews the patent proposals based on official patent examination guidance from various countries and the commercial value so as to improve our patent qualities and protect our research and development outcomes appropriately.

Winbond provides generous incentives and bonuses which encourage our employees to learn the requirements of patent rights and submit patent proposals proactively. In addition, Winbond provides training courses customized for each department which sought to inspire our employees to think innovatively by presenting them with cases relevant to their work, leading to more high-quality inventions being proposed.

Patent application

- Cumulative number of worldwide patent applications exceed **6,500**.
- **380** patent applications in 2023.
- Ranking **23th** in the TIPO Top 100 Patent Applications.

Patents granted

- Cumulative number of worldwide granted patents exceed **4,900** .
- **390 Global Patent granted** in 2023.
- Ranking **23th** in the TIPO Top 100 Patent Applications.

Data sourced from the Ministry of Economic Affairs, Intellectual Property Office

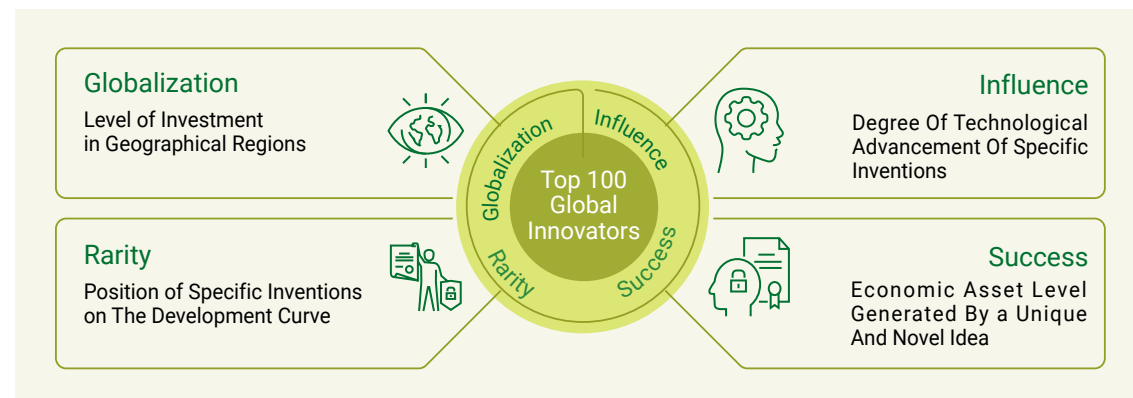## ■ Officially implemented the Taiwan Intellectual Property Management System(TIPS) in 2023

In 2023, Winbond officially introduced the Taiwan Intellectual Property Management System (TIPS) and obtained class-A certification. By implementing TIPS, Winbond formulated intellectual property policies and objectives aligned with its operational goals, fostering an innovative culture within the company and enhancing employees' awareness of intellectual property protection. This initiative encourages employees to continuously innovate and produce high-quality intellectual property, thereby strengthening Winbond's sustainable competitive advantage.

■ Promotion of Trade Secret Registration System

Since 2022, Winbond has included trade secrets as part of its intellectual property management strategy, initiating strategic planning for the implementation of a trade secret registration system. Winbond has also awarded the Excellent Trade Secret Award to encourage employees to register their R&D innovations, thereby enhancing the company's technological competitive advantage. Winbond has integrated technical content from its existing systems into the trade secret registration system, transforming it into a library of technical and innovative knowledge, where the company's competitive trade secrets are securely stored. In 2023, the total number of registered cases exceeded 11,000.

■ Winbond Selected as One of the Top 100 Global Innovators by Clarivate

"Aggressively Innovate" is one of Winbond's core cultural values. Winbond was selected as one of the Top 100 Global Innovators by Clarivate. The selection criteria for this award include not only a total of 500 or more invention patents but also factors such as the industrial influence of patents, successful track record, globalization, and technological applications. Winbond was recognized from among 3,500 global candidate organizations, showcasing its innovative R&D capabilities and the impact of its globally distributed patents. This international recognition demonstrates Winbond's commitment to R&D investment, pursuit of innovation-driven growth, and sustainable operations. Winbond focuses on using low-carbon materials and developing green products with high efficiency, low energy consumption, and low resource requirements from the product design stage, aiming to protect the environment and reduce negative impact.

Globalization
Level of Investment in Geographical Regions

Influence
Degree Of Technological Advancement Of Specific Inventions

Rarity
Position of Specific Inventions on The Development Curve

Success
Economic Asset Level Generated By a Unique And Novel Idea

Top 100 Global Innovators

Globalization   Influence   Rarity   Success

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

winbond 2023 Sustainability Report

Fostering Green Innovation and
Sustainability for a Better Future for All

| Corporate Governance | Green Product | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

2.1.4 Digital Transformation

From 2020 onwards, Winbond has been pushing for the Company to undergo a full digital transformation. Winbond has established the Digital Transformation Committee for Business (DTCB) and the Digital Transformation Committee for Manufacturing (DTCM), which are responsible for driving the digital transformation of our business, production, and manufacturing operations. The President shall regularly convene meetings to discuss the progress being made by these Committees. Additionally, senior management shares articles on digital transformation each week; and our human resources departments have invited external speakers to provide training related to digital transformation. Winbond has also established a platform for internal collaborations. The adoption of digital technologies and tools for digital transformation has become the core system for Winbond's intelligent operations.

■ **Utilizing industrial AI (Artificial Intelligence) technology to promote the application of smart manufacturing**

DTCM(Digital Transformation for Manufacturing)4 Digital Transformation System

Four Major Digital Transformation Systems	Explanation of System Usage	Results
Flaws and Yield Analysis System	Consolidates measurement data from various module machines online, helping the research and development department analyze and make connections between data on development operations, analyzing and consolidating data with high efficiency.	▪ Greatly reduces data analysis times. ▪ Increase engineer productivity. ▪ Improved analysis system helps engineers increase data analysis efficiency by 50%.
Automated Engineering Reports System	Rapidly and automatically looks up and consolidates measurement data online.	▪ Effectively supports information processing operations. ▪ Helps the research and development team analyze and weigh experiment conditions, continuously optimizing the process. ▪ Automated system helps engineers more efficiently create engineering reports, increasing productivity by 80%.
Digitalize and Standardize Online Measurement and Electrical Data	Assists Winbond employees in adjusting process module conditions in a timely manner based on the data to meet requirements.	▪ Greatly improves the prediction and analysis of the key electrical properties of memory elements. ▪ Allows for good predictions to be made for key parameters. ▪ System able to improve productivity by 15%.
Memory Element Reliability Analysis System	Effectively consolidates and organizes massive amounts of measurement data, discovering the optimal operating parameters for use in product CP/FT testing.	▪ Significantly increases the data analysis speeds of our engineers. ▪ Increases data analysis efficiency by 70% through the system.

Wafer Fab Intelligence - Digital Transformation

Through the transformation enabled by data science methods, we aim to become an intelligent factory with highly efficient production and quality control.

1 Product Quality Improvement

2 Machine Stability

3 Work Efficiency Enhancement

winbond **2023 Sustainability Report** Fostering Green Innovation and Sustainability for a Better Future for All

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

▊ Digital Power × Productivity: "Digital Transformation" Becomes the Core Competitiveness of Enterprises

DTCB- (Digital Transformation Committee for Business)

| Project	Description	Benefits
1. Employee service refactoring	200 services applied by employee were integrated into 19 business modules, and 120 services. The purpose is to improve employee work efficiency, enhance employee participation in the enterprise, and simplify a series of affairs related to human resources and daily work.	1.99% Acceptance rate of the new user interface 2.Improved around 175 business functions and processes 3.Saved around 83 labor cost annually 4.Rewrote around 120 services with main IT technology
2. Introduction of Microsoft Dynamic 365 to improve customer relationship management process	Integrate sales forecasts, quotations, monthly performance achievement rates, market size assessments, and business opportunity registrations into a unified platform for management.	1.Enhances customer and agent maintenance, sales forecast maintenance, and the productivity of production-sales collaboration. 2.Easy access to comprehensive facts and insights for customers and sales. 3.Achieves a complete closed loop in marketing behavior, accurately sets targets in sales behavior, and quotes. 4.Understands relevant performance execution status and business grasp and makes judgments for improvement.
3. Intelligence cost-analysis platform (GM Simulation Platform)	Simulate and estimate the cost of different processes, obtain the cost structure and gross profit information of the product in real-time, and propose improvement points to optimize the cost structure.	1.More than 2,000K simulation reference data are used for gross margin simulation and analysis. 2.Real-time presentation of detailed cost structure items, achieving price setting and reducing test time goals. 3.Users can create personal simulation databases and iterate simulation optimization of cost structures through association. 4.Establishes a permission management model that complies with information security regulations.
4.Electronize Inventory Operation	Perform annual inventory operations through the platform.	Saves approximately NT$6,000 in paper costs per year, saves 1,016 hours of manpower, equivalent to a cost savings of NT$406,400.

▊ The Paperless Transformation of the New Inventory System

The implementation of a paperless inventory system has brought several significant benefits to the existing inventory process. Apart from the economic advantages, the new inventory system also has a positive impact on the environment. The substantial reduction in paper usage contributes to the conservation of forest resources and minimizes environmental pollution. This reflects the company's commitment to environmental responsibility and is an integral part of corporate social responsibility. Moreover, it represents a crucial improvement for the company in terms of ESG, efficiency, and adaptability. These benefits not only enhance internal operational efficiency but also greatly improve the efficiency and accuracy of inventory procedures.

Item	Description	Savings/Benefit
Paperless	Previously, 4 inventories were provided annually, totaling approximately 20,000 sheets of paper, saving paper and costs.	Approximately NT$6,000 in paper costs, while also reducing the impact on the environment.
Instant Communication	Accounting can communicate directly with inventory staff, speeding up problem resolution.	Improved communication efficiency
Accelerated Inventory Time	Average inventory time is shortened; inventory is completed earlier, reducing labor costs.	Each year, 1,016 hours of manpower can be saved, equivalent to a cost savings of NT$406,400.
Addressing Anomalies	Immediate response and resolution of abnormal items, improving data processing speed.	Improved accuracy.
Digital Inventory Information	Facilitates subsequent inventory difference analysis, inventory status comparison, and inventory report collation.	Improved analytical capabilities.
Remote Inventory Check	In response to epidemics or temporary inability to be present, remote inventory can be performed using video tools.	Improved responsiveness.

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

2023 Sustainability Report   Fostering Green Innovation and Sustainability for a Better Future for All

| Corporate Governance | Green Product   Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

2.2 Quality Management for Products and Services

Winbond has formulated a quality policy that aims to establish a comprehensive quality management, zero-defect, and quality-first corporate culture through continuous improvement processes. The goal is to provide customer-satisfying products and services and become a world-class company. In accordance with this policy, Winbond has established various regulations and guidelines. In addition to ensuring that product quality and labeling comply with national and regional regulatory requirements, Winbond also manages quality through internationally recognized quality management systems verified by third-party inspection organizations, including ISO 9001, IATF 16949, and ISO 26262. Emphasis is placed on setting and tracking quality performance indicators and implementing continuous improvement measures. Various control processes, such as FMEA, SPC, and MSA, are employed to comprehensively inspect, assess, and improve product quality to meet customer needs and expectations.
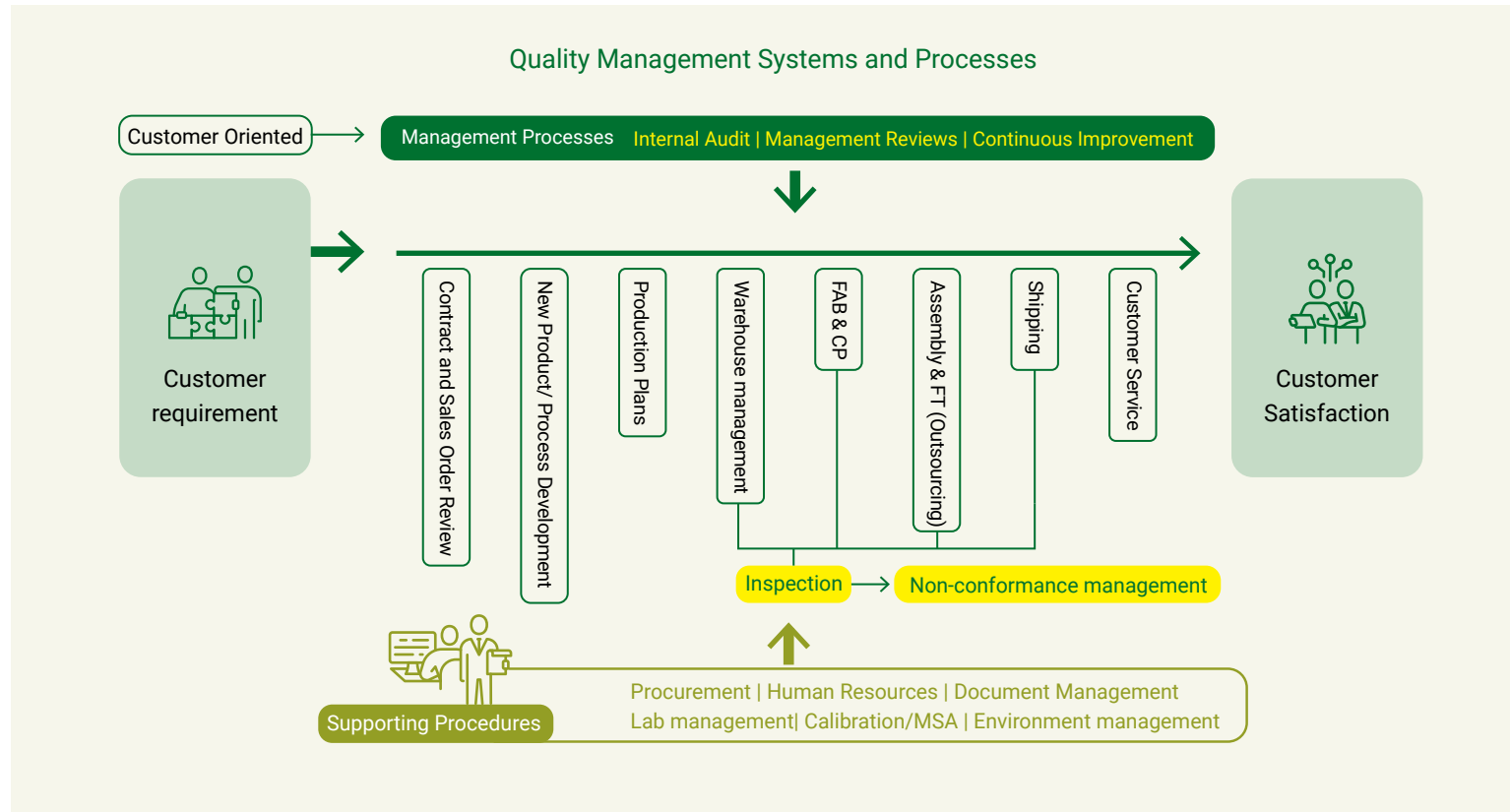
2.2.1 International Standards Certification

Winbond continues to establish rigorous production process control and quality management operations. This includes not only the robust and well-established CTSP fab but also the Kaohsiung factory, which began production in 2022 and successfully obtained IATF 16949, ISO 9001, and QC 080000 international system certifications. To enhance product quality, Winbond continuously improves product quality through strengthened yield analysis, supply chain management, and understanding customer requirements. Additionally, Winbond ensures compliance with international standards such as RBA and ESG through comprehensive verification, adheres to high customer standards, manages hazardous substances, and maintains responsible corporate practices.

Quality Management Systems and Processes

ISO 9001
IATF 16949
QC 080000

More international standards, please refer to the annual recognition and acknowledgment.

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | Green Product | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

winbond
2023 Sustainability Report
Fostering Green Innovation and
Sustainability for a Better Future for All

2.2.2 Culture of Pursuing Quality

▌ Quality Award Recognition

In the 2023 Taiwan Continuous Improvement Award (TCIA), Winbond once again demonstrated its outstanding performance in product quality and process improvement. In 2023, Winbond had four professional teams participating, with three of them successfully advancing to the finals. They respectively received two Golden Awards and one Silver Award, showcasing the company's commitment to continuous improvement and its achievements.

The Team Collaboration at the CTSP fab, with its innovative production process optimization and intelligent monitoring system, effectively improved production line yield and won the Golden Five-Star Award in the competition. Leveraging tools such as JMP, ANOVA, and big data statistics, along with experimental design methods, the team not only accurately predicted component failures but also optimized production processes, overcoming limitations of aging equipment and bringing long-term stability in quality improvement for the company.

Meanwhile, the Team Perseverance made breakthroughs in quality and efficiency in AI-enabled manufacturing. Through in-depth research and improvement of the internal error correction circuits (ECC) for NAND Flash, the team successfully reduced failure rates through cross-departmental collaboration and innovative thinking, resulting in substantial savings in capital expenditure for the company.

The achievement of these awards is a recognition of the employees' enthusiasm for learning, the high value placed on quality, and the continuous improvement efforts. It also represents the best feedback from customers' trust in Winbond products. Winbond will continue to uphold its conduct business with integrity and ethical behavior, accountable teamwork, enthusiasm of learning, aggressively innovate, and sustainable contribution. By integrating the spirit of Quality Improvement Teams (QIT), Winbond will continue to cultivate professional teams and promote a culture of quality, aiming to reach new heights and move towards the goal of being a leading company in achieving net-zero carbon emissions, driven by the spirit of being an invisible champion enriching human life with green semiconductor technology.

▌ Fostering a Culture of Excellence in QE 2.0

Winbond not only ensures product quality through international quality management systems to achieve its goals but also actively promotes a culture of quality to enhance its competitive edge. As early as a decade ago, in response to the high-quality product and service requirements of the automotive electronics market, Winbond initiated a "Zero Defect" and "Quality First" culture, known as Quality Excellence 1.0 (QE 1.0). After ten years of internal and external environmental changes and ongoing policy improvements and internal discussions, Winbond has now introduced an upgraded version of quality excellence, QE 2.0, aiming for zero defects and doing things right the first time. Through tools like FMEA, 5-Why, QIT, TQM, and customer satisfaction as its five pillars, Winbond promotes a comprehensive quality consciousness training, issues Quality Q reports, conducts monthly quality activities, spreads awareness of quality consciousness, and trains FMEA/QIT/5-WHY seed instructors to promote its quality culture, embedding the belief in pursuing excellence in quality deeply into the hearts of its employees. Quality represents not only the characteristics of products or services but also embodies our relentless pursuit of excellence, with surpassing customer expectations as the goal. To achieve QE 2.0, in November 2023, Winbond organized an Excellent Quality Forum, inviting experts from various fields and all Winbond executives to discuss the importance of excellent quality and how to address future challenges. This forum was recorded and made into training materials, becoming a mandatory course for all employees. Additionally, to internalize FMEA as Winbond's quality DNA, the company holds an annual FMEA Best Practices Sharing Meeting, allowing employees to learn from each other's FMEA-related cases and concepts.

Team Name	Event Theme	Prize
Team Perseverance	Reduce the occurrence rate of open-circuit faults in F32 bit lines.	Golden Award
Team Collaboration	Reduce the wafer scrap rate at CTSP fab	Golden Award
Team Summit	Reduce the failure rate of D25 OTP	Silver Award

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Golden Award	1	0	1	1	0	0	1	0	2	2	2
Silver Award	0	1	0	1	2	2	3	4	2	2	1
Bronze Award	1	1	0	1	2	1	0	0	0	0	0

winbond　2023 Sustainability Report　Fostering Green Innovation and Sustainability for a Better Future for All

Preface　The Winbond Story　Leading a Sustainable Pathway　**Sustainable Practices**　Appendix

| Corporate Governance　| **Green Product**　Environmental Sustainability　| Sustainable Supply Chain　| Human Rights and Social Inclusion

2.3 Customer Relationship Management

2.3.1 Maintaining Customer Relationships

■ Customer Satisfaction

We understand deeply that in the business operation, the customer is important and highly critical. Customers are closely linked to the values of the enterprise, and their satisfaction directly influences the sustainable development of the business. Therefore, Winbond has always been committed to meeting the needs of customers, adhering to the customer-centric philosophy, hoping to grow together with customers and achieve sustainable operation.

In this endeavor, we regularly conduct customer satisfaction surveys to ensure a deep and comprehensive understanding of our customers' requirements. This is not only a response to market changes but also a crucial step in building strong relationships with our customers. In the 2023 customer satisfaction survey, we divided it into three major areas: sales and service, product and technical support, and product quality. In terms of sales and service, we achieved an 86% satisfaction rate; for product and technical support, we received an 85% satisfaction rate; and regarding product quality, customers gave us an impressive 89% satisfaction rate. These numbers reflect our continuous efforts across different domains to provide customers with the highest quality products and services. Overall, our customer satisfaction rate exceeded 85%, which signifies high praise from our customers. It's not only a result of our past efforts but also an affirmation of the trust and support our customers place in us.
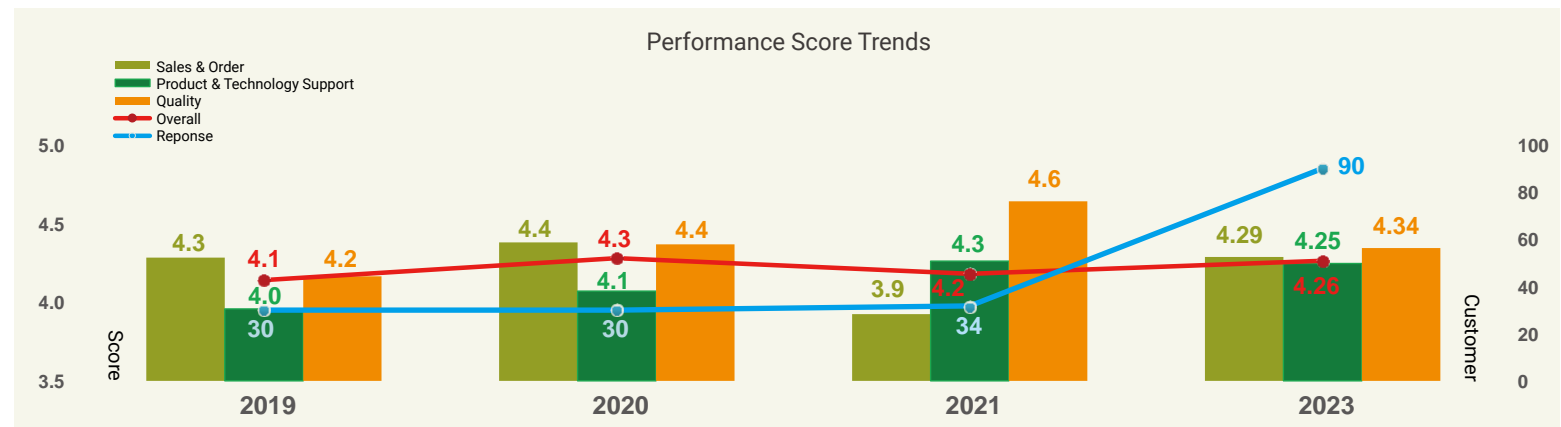
Moving forward, we will continue to maintain close connections with our customers and enhance our product and service levels to meet their ever-changing needs.

■ Satisfaction Survey Result

Objective	Continuously improve our customer services quality and product competitive
Scope	「Sales & Order」、「Product and Technical Support」、「Quality」
Goal	Satisfaction index 3.5 (70%)
Target Customer Selection	Specific target customer from different areas and business application
Customer Satisfaction Index	Total score=∑（Satisfaction * Importance）/ ∑ Importance
Frequency	Once a year
Standard	B0000-2800 Customer satisfaction process（ISO 9001/ IATF 16949/ QC 080000)

■ Satisfaction Score Trends

▪ From the feedback of 90 clients in 2023, the overall rating has increased to 4.26.

▪ Compared to 2021, the ratings in the "Product and Technical Support" and "Quality" domains have decreased, while the rating for "Sales and Orders" has improved.

Performance Score Trends

winbond

2023 Sustainability Report

Fostering Green Innovation and Sustainability for a Better Future for All

Preface   The Winbond Story   Leading a Sustainable Pathway   **Sustainable Practices**   Appendix

| Corporate Governance | **Green Product** | Environmental Sustainability | Sustainable Supply Chain | Human Rights and Social Inclusion

■ Tracking Customer Intentions

Winbond places great importance on its own brand value and continuously reviews its services. In 2023, a total of 1,289 customer complaints were received. Among these cases, 522 were clarified unrelated to Winbond's quality or service issues after testing, accounting for 43% of the total. With past complaint experiences, current customer conditions and perspectives, Winbond customized the approach to clarify and resolve customer issues, which is an integral part of our customer service. When calculating based on the number of shipped units, the complaint cases represent only 0.000033% of the total shipments, indicating a very favorable level.

Analyzing confirmed failure cases in customer complaints allows identification and resolution of the root causes leading to deficiencies. Subsequently, relevant failure mode testing and improvement plans are proposed, along with source process enhancement initiatives. These efforts ensure the provision of optimal service and products to our customers. Calculating Winbond's failure rate as (number of defective ICs / total shipments) yields an impressively low level of 0.3 ppm (2023: 0.26 dppm), contributing to maintaining customer satisfaction and stable operational performance, resulting in a win-win situation.

■ Quality Workshop

Winbond actively organizes regular Quality Workshops, which not only provide a platform for in-depth understanding of customer product requirements and suggestions but also invite professionals and industry experts to participate in discussions on quality and technical issues. Through this exchange platform of the Quality Workshop, Winbond can promptly respond to customer inquiries, provide solutions, and continuously improve product and service quality to enhance customer satisfaction. Additionally, Winbond gains access to more industry information and technical knowledge through this platform, continuously enhancing its technical expertise and product quality.

As of 2023, Winbond has successfully organized seven Customer Quality Workshops and remains committed to achieving its goal of completing eight Customer Workshops by 2024, aiming to achieve a win-win situation for both Winbond and its customers. We firmly believe that Quality Workshops will continue to play a crucial role in the future development, tirelessly striving for the mutual growth of Winbond and its customers.

2.3.2 Customer Privacy Protection

Winbond strictly controls customer-related information. Documents, data, and other business information related to customer interactions are all safeguarded by Winbond's highly secure internal systems. The approval and granting of operational permissions for internal personnel are carried out in accordance with relevant operational norms and procedures. This ensures that the company protects customer privacy, prevents theft or leakage of trade secrets and intellectual property, and maintains a robust information security protection system. In 2022, Winbond obtained ISO 27001 certification for its information security management system, further enhancing its security measures. Since the enforcement of the General Data Protection Regulation (GDPR) by the European Union in May 2018, Winbond has made necessary adjustments in accordance with GDPR requirements. The company has modified its website and reviewed member data to comply with GDPR standards. Additionally, GDPR-related provisions have been incorporated into the online personal data protection courses, with a total of 3,386 participants completing the training in 2023. These participants achieved a 100% pass rate in the exams, accumulating a total training time of 1,693 hours.