IV. Sustainable Practices │ Green Product

1. Green Product

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 different 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.

2022 Performance Highlights

The accumulated granted patents have exceeded **4,500**.

ISO/SAE 21434

The world's first memory manufacturer obtained Cybersecurity Systems for Road Vehicles

Developed the world's first NOR Flash that supports an operating voltage of 1.2V, Winbond 1.2V NOR Flash uses **45%** less power than the 1.8V NOR Flash in mainstream use today.

Four Major Digital Transformation Systems

Improved analysis system helps engineers increase data analysis efficiency and productivity.

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1.1 Research, Development, and Innovation

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. As of 2022, digital transformation has already become an effective tool regularly used by each of our departments in their day to day operations, demonstrating the effectiveness of our digital transformation measures.

In 2022, Winbond adopted professional software to replace traditional document recording methods. By doing so, Winbond has made information sharing more transparent, lowered communications costs, and increased teamwork effectiveness. Through the Visual Basic for Applications (VBA) online real-time monitoring system, Winbond is able to reduce the time needed to search through and organize documents. Additionally, by using the big data analysis system Power BI to analyze large amounts of data and produce analysis reports, Winbond has been able to greatly reduce the amount of time, manpower, and accuracy constraints for these procedures.

Technology Computer-Aided Design (TCAD) Simulation Tools

Winbond has adopted TCAD simulation tools for integrating our research and development and productions processes, as well as in module and element development. These tools have helped us collect data on experiment conditions, reduce chip usage, and improve the working model of our research and development team. These tools have not only helped Winbond reduce research and development times, but have reduced the amount of resources consumed by the process.
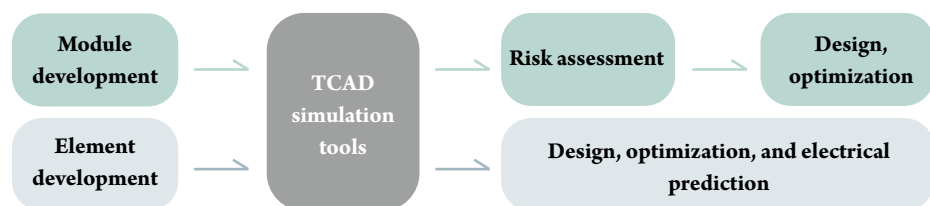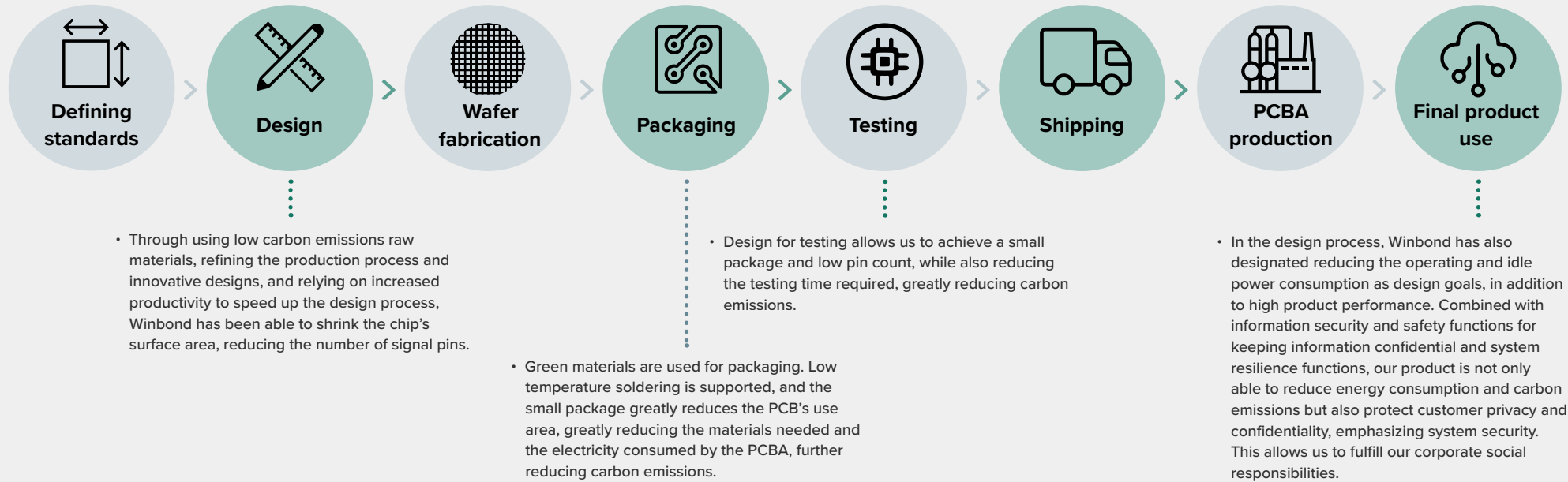

Launch of Four Major Digital Transformation Systems

In 2022, Winbond launched four systems able to effectively increase the productivity of the research and development department, with the help of the Computer-Integrated Manufacturing (CIM) team.

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 reduce information 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	Helps Winbond employees make adjustments based on data to production module conditions when necessary 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.	• Greatly increases the data analysis speeds of our engineers. • System able to improve data analysis productivity by 70%.

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— 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.

- 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.

- 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.

- 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.
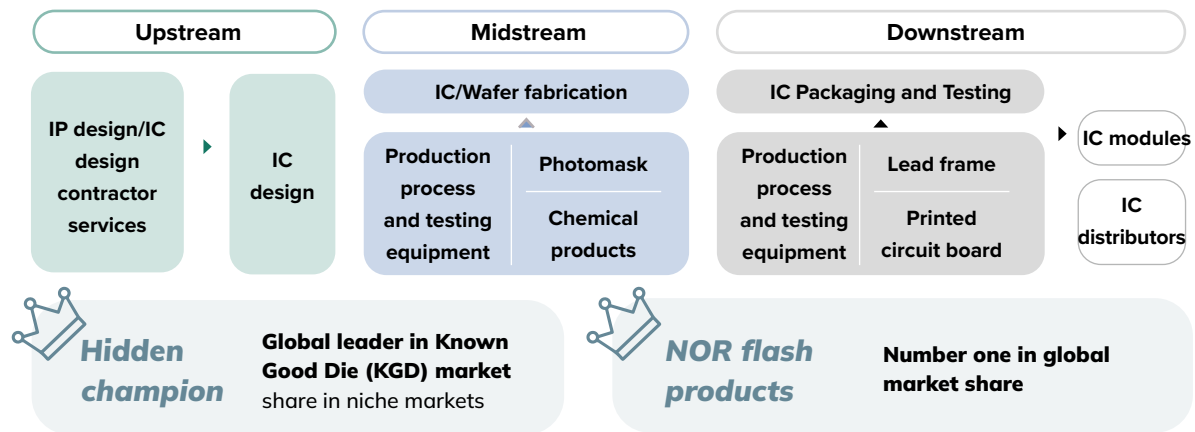
Green Innovation Research and Development

Predicting market trends for the new generation of products, Winbond has continuously invested resources into semiconductor design, manufacturing technologies, and sustainable innovations for products, creating competitive advantages and increasing market share for our green products. At the same time, Winbond has provided high quality products and services for our customers, whose needs Winbond has placed first.

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 backend packaging and testing.

Additionally, Winbond has been deep involved in the KGD (Known Good Die) field for many years, working together with chip factories to provide SiP (System in Package) multichip packaging solutions and creating more value in collaboration with the semiconductor industrial chain.

Upstream | **Midstream** | **Downstream**

IP design/IC design contractor services > IC design

Midstream
IC/Wafer fabrication

| Production process and testing equipment | Photomask |
| | Chemical products |

Downstream
IC Packaging and Testing

| Production process and testing equipment | Lead frame |
| | Printed circuit board |

> IC modules

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
- System in Package (SiP): From a packaging perspective (downstream of the semiconductor industrial chain), this term refers to arranging multiple chips in series or in a stack, creating a single packaged electronic element.
- 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.

Winbond provides global customers with comprehensive specialty DRAM solutions and services. Our major product lines include Code Storage Flash Memory, TrustME® Secure Flash Memory, Specialty DRAM and Mobile DRAM, which all have been designed with green product concepts in mind. Winbond is the only company in Taiwan with the ability to develop DRAM and Flash products in-house. By leveraging the synergies between each product in our portfolio, Winbond is able to fully satisfy the various needs of our customers, allowing customers to integrate their own products with Winbond's products to create a wide range of hand-held applications, consumer electronics, computer peripherals, artificial Intelligence, automotive and industrial-use electronics, which are all fields that have extremely high standards for product quality.

Current Status and Results from Research, Development, and Innovation

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 and remote communications systems, machine vision, HMI displays, and communications modules. In 2022, our Kaohsiung Fab formally began mass production, an important milestone for Winbond. DRAM production line capacities can be gradually expanded in the future, adding new product lines for DDR4, or even higher speed ASIC DRAM products etc. to meet various customer requirements.

10mm
10mm
14.5mm
7.5mm

200BGA   **100BGA**

HYPERRAM ™ 3.0

The third generation of our HYPPERRAM products utilizes the all-new 16-bit extended HYPERBUS interface, supporting data transfer speeds up to 800 Mbps 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.

DDR3

Shrinking from 38nm to 25nm, and then further down to 25S nm. Operating efficiency goes up with each technology node, and our 2Gb DDR3 products have 35% reduced power consumption. Winbond has continued to supply DDR3 products, making sure to satisfy long-term customer demand.

LPDDR4 Single Channel x16 4,267Mbps

Winbond provides single-die package (SDP) and dual-die package (DDP) product combinations, with faster data transfer speeds compared to DDR4 x16 3200Mbps and LPDDR4 Dual Channels x32 4,267 Mbps that provide even higher performance.
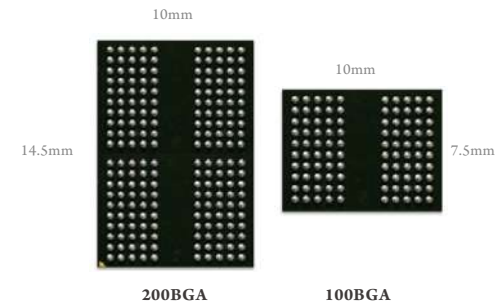
100BGA LPDDR4/4X Memory

Winbond is committed to shrinking the surface area of printed circuit boards (PCBs), and launched the 1Gb and 2Gb 100BGA LPDDR4/4X memory of Single Channel x16 with data transfer speeds up to 4,267 Mbps in 2022. This product not only meets JEDEC JED209-4 standards but also takes up 50% less surface area compared to the original standard 200BGA products. This memory is ideal for IoT devices that require small packages with higher data transfer speeds.

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▌ Secure Flash Memory

Due to the constant advancement of IoT technology, digital information security needs have also been increasing. Governments around the world have continued to strengthen security laws and regulations. However, it takes multiple years for a product to become certified, creating practical challenges due to the short useful lives of products. In response, Winbond has created the TrustME® W77Q Secure Flash Memory series and other secure memory elements able to ensure the stability of IoT devices and provide protection for end-to-end connections.

W76S Secure Element

The W76S possesses a SecurCoreTM, SC000TM 32-bit RISC core, and includes a 4MB W75F Secure Flash Memory Element whose memory size can be adjusted based on the requirements of the circuit designer. It has a core clock with speeds up to 100Mhz and a Memory Protection Unit (MPU), and utilizes various coprocessors and encryption technologies while also being Common Criteria EAL5+ and EMVCo certified, making it an innovative solution for security applications.The W76S can be used in embedded Universal Integrated Circuit Card (eUICC) applications, and supports multi-profiles and remote provisioning. At the same time, it also reduces the amount of space used on the PCB. eUICC can also promote growth and enhance operational efficiency for the M2M ecosystem.

TrustME® Secure Serial Flash Memory W77Q Series

Improves protection against software and hardware attacks in line with the information security requirements of IoT systems, and also meets Common Criteria EAL 2+ certification standards for IoT devices. In addition to protection against software and hardware attacks, the W77Q series also supports secure eXecute In Place (XIP), and possesses sophisticated cryptographic encryption of the communications channel. It allows for personalization of each device with unique keys, cryptographic read and write locks, data integrity protection, secure over-the-air (OTA) firmware updates, root of trust (RoT) functions, and secure read, write and erase operations. The memory is ideal as a secure storage solution for operating systems with limited storage space, pins, and power.

TrustME® Secure Serial Flash Memory W75F

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.
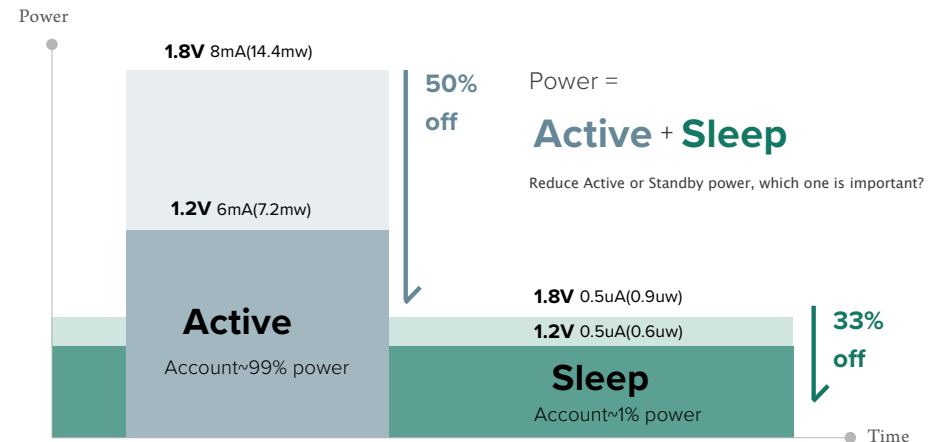
▌ Code Storage Flash Memory

One of Winbond's goals has always been to reduce power consumption and prolong battery life. To that end, Winbond has developed new processes and circuit architectures, and launching the world's first NOR Flash support 1.2V operating voltage, and through matching with the SoC that use advanced manufacturing process and low-voltage design to achieve high read and write speeds while also conserving power consumption.

In a scenario of true wireless application environment where 8 hours operation a day, and based on the total sales volume quantity of 1.2V Nor Flash memory in 2022, Winbond has saved power consumption 493,727 kWh comparing using 1.8V Nor Flash products, which is equivalent to reducing carbon dioxide emissions by 251.3 tCO2e, or **0.65 times the amount of carbon absorbed by the Da'an Forest Park** (based on data published by the Executive Yuan Council of Agriculture and the Taipei City Government Department of Land Administration: 25.93 hectares, when calculated based on a carbon fixation coefficient of 14.9 tCO2e /hectare/year, Da'an Forest Park absorbs 386 metric tons of carbon dioxide a year).

1.2V NOR Flash	
Total power consumption	45% less power consumed compared to the 1.8V NOR Flash in mainstream use today
Performance	Maintains similar level as 1.8V/3V Flash
Advantages	Reduces PCB surface area used, allowing for lighter and smaller consumer electronics products to be designed
Product applications	Wireless headphones, smart watches, smart wristbands, smart glasses, and other wearable devices with high power-saving requirements

Power

1.8V 8mA(14.4mw)

50% off

1.2V 6mA(7.2mw)

Power =
Active + **Sleep**

Reduce Active or Standby power, which one is important?

1.8V 0.5uA(0.9uw)
1.2V 0.5uA(0.6uw)

Active
Account~99% power

Sleep
Account~1% power

33% off

Time

Intellectual Property Management

📋 **Patent applications**

- Cumulative number of worldwide patent applications exceed **6,000**.
- Apply **450** patent applications in 2022.
- **17th** Place among the Applicants of the Taiwanese Juridical Persons, place on the top **20 Applicants** of the Taiwanese Juridical Persons for **six consecutive years**.*

✓ **Patents granted**

- Cumulative number of worldwide granted patents exceed **4,500**.
- Worldwide granted patents nearly **380** in 2022.
- **16th** Place among the Patentees of the Taiwanese Juridical Persons, place on the top **20 Patentees** of the Taiwanese Juridical Persons for **seven consecutive years**.*

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

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 nurturs a coporate culture of innovation and strengthens the IP protection awareness of employees. Winbond encourages the continuous innovation and IP right creation of our employees during the course of 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 2022, the cumulative worldwide patent applications have exceeded 6,000 and the cumulative worldwide issued patents has exceeded 4,500.

Winbond has established an 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.

With regard to the technical topics important to the business objectives, Winbond utilizes variety approaches to construct a high-value and diversified patent portfolio such as holding thematic brainstorming meetings with relevant technical departments and conducting patent map analysis.

Apart from continuing to develop a diversified patent portfolio, Winbond has as of 2022 included trade secrets into our IP strategies. Winbond set about planning the mechanism of registering trade secrets, and held a total of 23 workshops which educate our employees on how to identify and take inventory of confidential information or trade secrets that they may encounter as part of their work duties, further improving Winbond's IP protection.
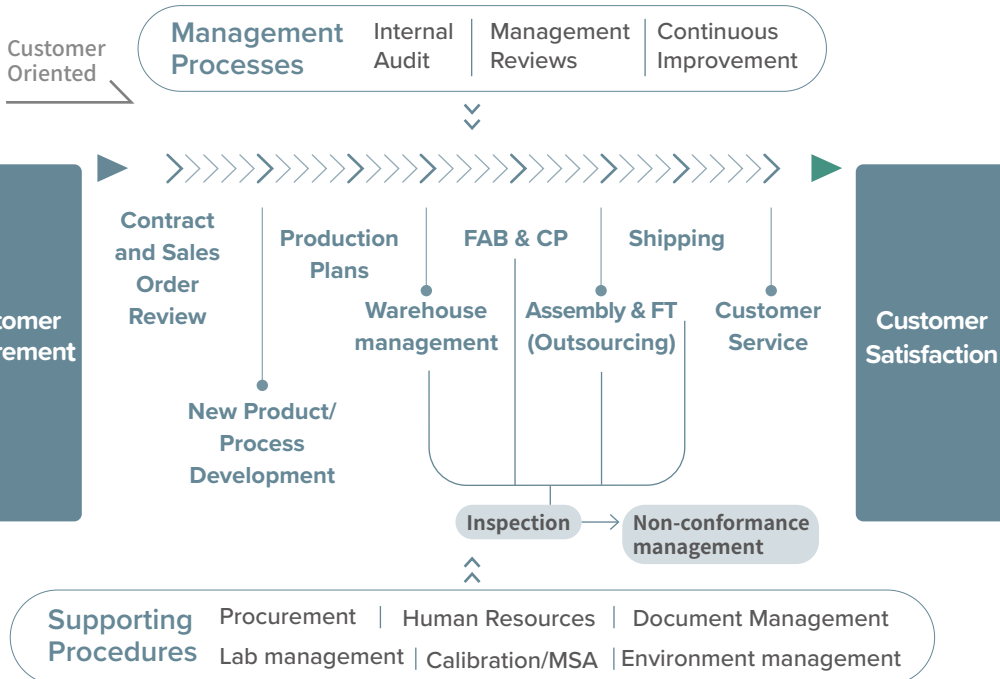
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1.2 Quality Management for Products and Services

Winbond's product policy is to become a world class company offering products/services that best satisfy our customers, by establishing Total Quality Management, Zero Defect and Quality First quality culture through the process of continuous improvement. Following this policy, Winbond has established various rules and standards that Winbond abide by. Apart from ensuring that our product quality and packaging meets the legal requirements of each country and region, Winbond has also carried out quality management through various international product quality systems, such as the ISO 9001, IATF 16949, and ISO 26262 standards that Winbond has received third-party certification for. Winbond has focused on carrying out quality management by defining and tracking quality performance indicators, and have continuously implemented improvement measures. By adopting various management processes, such as FMEA, SPC, and MSA tools, Winbond conduct comprehensive assessments, evaluations, and improvements to our product quality in order to meet the needs and expectations of customers.

Apart from having adopted international product quality management systems to meet our product quality goals, Winbond has also proactively attempted to cultivate a culture of product quality management through methods such as FMEA analysis, 5-Why analysis, and creating the Winbond Quality N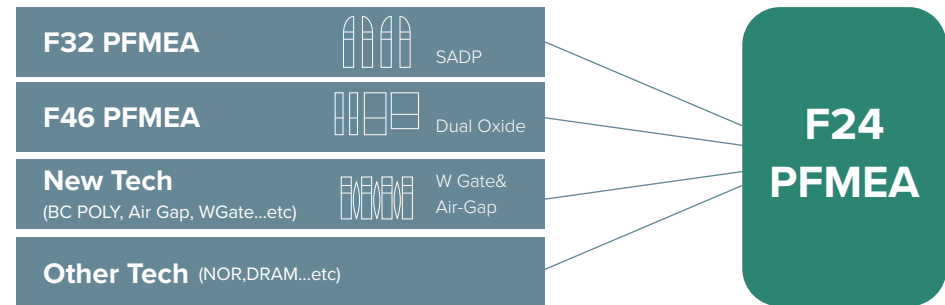ewsletter, advocating for and promoting quality-related policies, culture, activities, and methods, that enable our employees to gain a deeper understanding and awareness of quality.

Failure Mode and Effect Analysis (FMEA) Systemization Project

In 2022, Winbond fully adopted FMEA into our new product development process, applying this analysis to the development of our 20nm DRAM and 24nm Flash technologies for the first time. Based on the various risk assessments generated through this method, such as production process, electrical, and design risk assessments, our employees can choose to focus on "Man, Machine, Material, Method, Environment" based on the different risks posed by each factor, using this information to keep the production process stable. This structured analysis method has increased the depth and scope of failure analysis, helping to avoid more potential failures from taking place.

— Quality Management Systems and Processes —

— F24 PFMEA Architecture —

— PFMEA F24 Status —

High Risk Level
improve **91.7%** from 2021/Q4 to 2022/Q4

Median Risk Level
improve **86.3%** from 2021/Q4 to 2022/Q4

Winbond employees are able to effectively utilize these techniques in their day-to-day work. Winbond working groups also carry out regular audit meetings, helping to greatly optimize product design and shore up weak points in the production process. Throughout

the year, 539 total improvement measures were implemented, allowing each weak point in the operational processes to be corrected and optimized, preventing them from causing further issues.

June
Explanation of FMEA Concepts >>

June-July
Practical Seed Training Courses and Counseling >>

July-Oct.
FMEA Promotion

- There is a total of **9** centers and **24** factories participated in the activity, and through training activities such as courses on FMEA concepts, practical case training, and guidance, participants were familiarized with FMEA techniques and applications.
- Completed training of **51** seed instructors in total, and trained **562** employees on FMEA concepts.
- The **24** participating plants created **24** administrative FMEA failure prevention and correction reports in 2022, after guidance from the seed instructors and repeated explanations to the employees, and after learning from a risk analysis of real-world work operations.

From 2021 onwards, Winbond has regularly held an annual FMEA working group results announcement meeting in the fourth quarter of each year, where each working group shares their results and experiences with promoting FMEA. This allows each group to observe and learn from other groups, implementing the philosophy of "never make the same mistake twice" into daily operations. These meetings have received good feedback and have been well received. In the 2022 results announcement meeting, 322 employees above the rank of assistant manager attended, an increase of 40 compared

2022 FMEA working group results announcement meeting

to 2021. This shows the proactive attitude and focus that Winbond's executives have towards quality management. This has not only greatly assisted Winbond in promoting and implementing FMEA, but also helped improve communications and learning within the company organization.

Introduction to Quality Management - FMEA

FMEA is a reliability evaluation that describes the impact of systems or equipment failure. The latest version of FMEA was jointly established in 2019 by the North American Automotive Industry Action Group (AIAG) and the German Verband der Automobilindustrie (VDA). Known as the first version of the AIAG VDA FMEA, this version of FMEA is the one currently adopted by Winbond.

A Corporate Culture of Pursuing Quality

In the digital age, Winbond has, through a digital transformation, integrated ourselves with future AI development trends, establishing a more comprehensive information platform. Through concrete action, Winbond has stopped corrupt practices, innovated, and continued to optimize rules and processes, with the goal of providing our customers with quality services that they can be satisfied with. In the future, Winbond shall remain committed to our original mission, and strictly manage each quality checkpoint for our customers and for the Company, with a goal of constant self-improvement.

With regard to improving the quality of our procured materials, Winbond launched the Chemical Analysis Information Platform in 2022, which consolidates and provides the supplier's COA shipping information, Winbond's supply inspection IQC information, regular inspection results from the warehouse system, and micro-pollutant information from the Winbond's equipment department. Through a digital transformation and optimizing the inspection process, Winbond has improved the efficiency of producing IQC information, and of our chemical experiment lab operations. At the same time, Winbond has allowed our engineering department to more quickly obtain micro-pollutant analysis information.
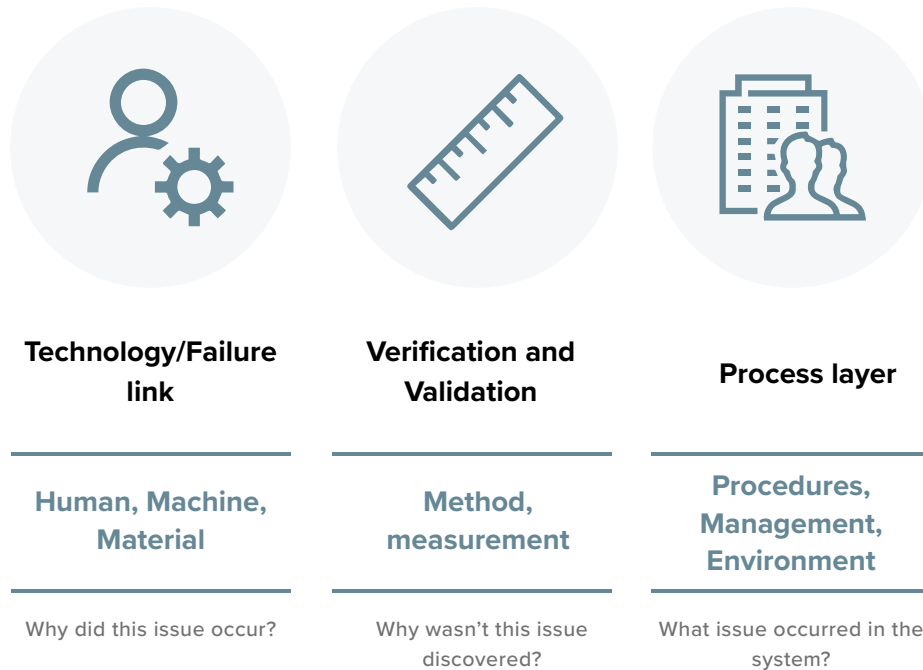
In 2022, Winbond newly created a Supplier Quality Management Platform, which systematically records past related information that can help us easily and quickly communicate with suppliers, ensuring that our quality requirements have been met. From 2021 onwards, Winbond has also began building the Visual Inspection QC System, providing more transparent information on our product flaws, and developing a smart visual identification function for identifying product flaws. Quickly following the beginning of development, Winbond completed the automated identification system in 2022. After the AI visual identification system was launched, Winbond was able to save 90% of the manpower previously necessary for flaw identification. By transferring standardized processes to a machine, Winbond allows our employees to focus on more high value activities, increasing productivity and decreasing the risk of coming into contact with sensitive information.

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5-Why

From 2018 onwards, Winbond has been promoting the 5-Why courses, including these courses as a KPI for each of our departments, and providing bonus reward activities and competitions. Following this guidance, when our employees face an issue, they would first search for all possibilities, and uncover the root cause of the issue through verifying all possibilities, allowing them to precisely pin down the correct response to resolve the issue.

— 5-Why Verification and Validation —

Conduct a complete analysis following a step-by-step process, starting by analyzing the technology/failure link, then conducting verification and validation, and then analyzing the process, with the entire procedure encompassing these three aspects.

Technology/Failure link	Verification and Validation	Process layer
Human, Machine, Material	Method, measurement	Procedures, Management, Environment
Why did this issue occur?	Why wasn't this issue discovered?	What issue occurred in the system?

In 2022, 167 employees attended Winbond's 5-Why Advanced Coaching Elite Course held online. Through the training provided by this course, employees were able to improve their skills, and the course also discussed the 5-Why process by applying it to various different scenarios, such as for engineering departments, non-engineering departments, and fab work. This allowed employees to more precisely analyze issues through the 5-Why method.

Winbond Quality Newsletter

Since the fourth quarter of 2021, Winbond has published a Quality Newsletter. Through this internal platform, Winbond has cultivated a corporate culture of placing quality first, and shared various articles, videos, websites, and livestreams on quality control topics, deeply instilling our quality culture into the lifestyles and work of our employees through these different approaches, embedding these values into the DNA of our employees.
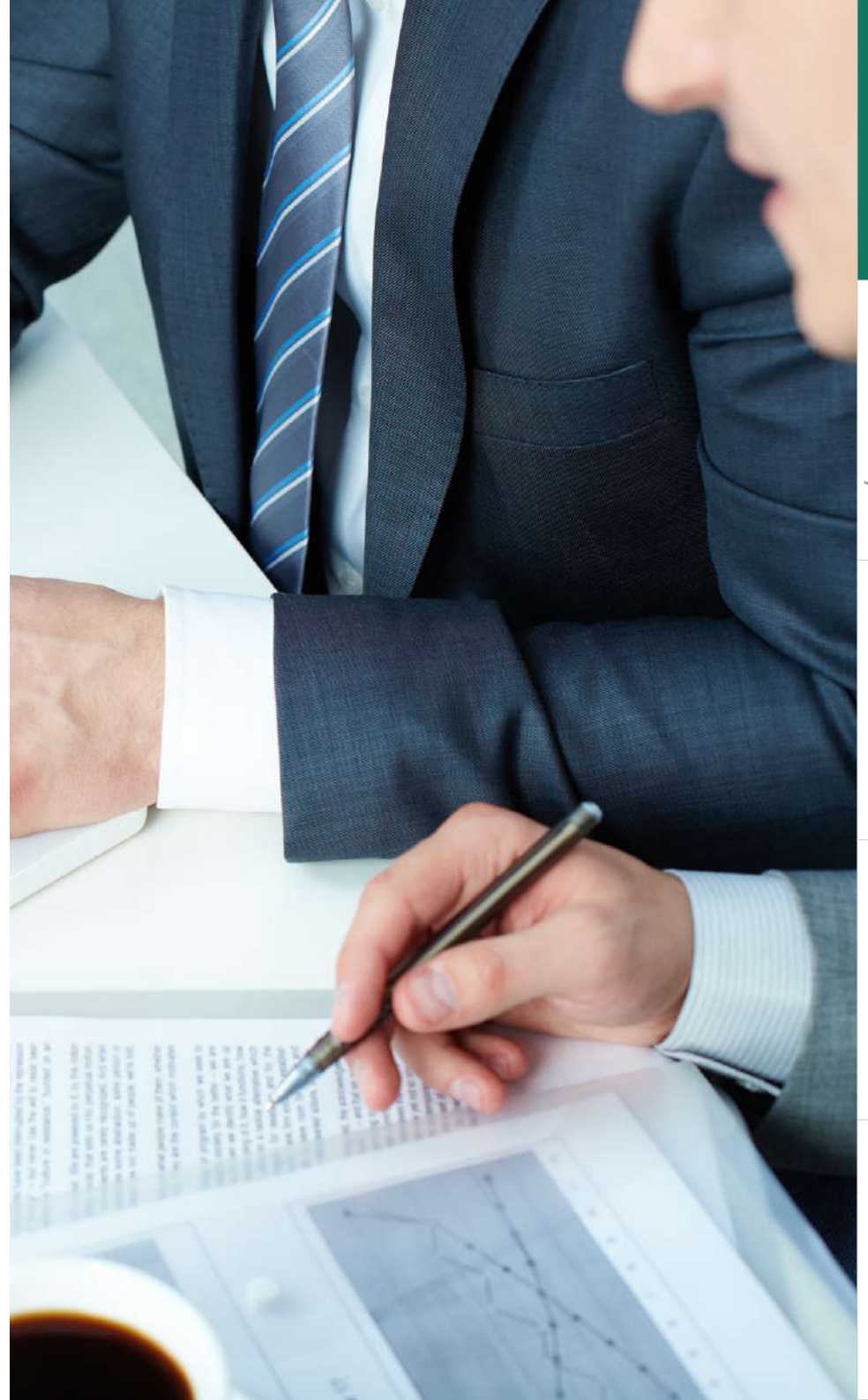
Each Quality Newsletter thoughtfully incorporates quality-related activities, making the newsletter a more appealing read for Winbond employees. Through presenting interesting topics, the Newsletter has successfully promoted quality-related policies, culture, activities, and techniques.

- Accumulated **76** articles and videos on quality-related topics
- Browsed **21,531** times

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Winbond Quality Month

The theme for the Winbond Quality Month in 2022 was "Bond Investigations Bureau", employing educational entertainment to increase employee awareness of quality. The diverse activities put on for the month attracted eager participation and discussion from our employees, with these activities including a Teams weekly raffle, Quality Video Shorts competition, and the Winbond Knowledge King Quiz. For the first time, a vlog of a day in the life of a Kaohsiung/CTSP engineer was also displayed, which was well received by the audience. The video allowed Winbond employees to understand the work duties of employees in other departments, promoting mutual understanding between internal employees. These activities attracted 4,424 participants, an increase of approximately 5% compared to 2021. In the future, Winbond will continue to promote Winbond Quality Month through various creative ways.

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International Standards Certification

Winbond has continued to strictly manage our production process and quality control. Not only the stable and well-appointed factory in Central Science Park factory but also our Kaohsiung Fab began production operations, and successfully obtained the IATF 16949, ISO 9001, and QC 080000 international standards certifications in 2022. In order to improve product quality, Winbond has improved its yield analysis, supply chain management, and adopted other methods to better understand customer needs in order to continuously improve its product quality. Additionally, Winbond has received multiple certifications verifying our compliance with RBA, ESG, and other international standards. Following the high standards of our customers, Winbond has implemented hazardous substances and production environment management, as well as fulfill our corporate social responsibilities.

ISO 9001
IATF 16949
QC 080000

ISO 14001
ISO 45001

ISO 27001

ISO 9001	IATF 16949	QC 080000	ISO 27001	ISO/SAE 21434	ISO 14001	ISO 45001	ISO 50001

ISO 26262

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— ISO/SAE 21434 Cybersecurity Systems for Road Vehicles —

Winbond has in the past few years expanded into the field of automotive electronics. In order to improve the reliability and functional safety of our automotive electronics products, Winbond has entered the global advanced automotive safety systems supply chain.

2019 ~~~~ *2020* ~~~~ *2022*

Winbond has obtained ISO 26262 certification, the world's highest-level automotive electronic safety standard. This also makes us the first maker of automotive-use memory in Taiwan to obtain this certification on road vehicle functional safety, allowing us to become a trusted partner of international automakers.

Winbond has obtained the higher-level ASIL (Automotive Safety Integrity Level) standard product certificates for individual products, expanding into the automotive electronics market and providing automotive electronics products that meet the supply chain needs of international automakers.

Winbond has obtained ISO/SAE 21434 Cybersecurity Systems for Road Vehicles certification from TÜV NORD, becoming the first memory manufacturer in the world to have obtained this certification.

Introduction to Quality Management - ISO/SAE 21434 Road Vehicles - Cybersecurity Engineering

The ISO/SAE 21434 standard covers all necessary safety standards related to the design concept, development, production, use, and disposal of a car, applicable to the microcomputers and other components used and developed in these processes. The standard requires car systems to be equipped with stronger information security functions for preventing cyberattacks, effectively improving the ability of a vehicle to manage network threats.

Matthias Springer, Senior Vice President of Functional Safety and Security at TÜV NORD: "Winbond's current cybersecurity systems have been certified as meeting ISO/SAE 21434 standards, and are able to provide comprehensive security solutions for automotives. This is unmistakably an important milestone. Additionally, Winbond highly recommend OEMs and suppliers in industries with relatively high security requirements, such as the automotive industry, to obtain these certifications."

Quality Awards Won

Winbond has proactively participated in the Taiwan Continuous Improvement Awards (TCIA), a national competition supervised by the Ministry of Economic Affairs Industrial Development Bureau, and organized by the Corporate Synergy Development Center. From 2013 onwards, Winbond has for ten years in a row been promoted to the highest-level Zhi-Shan Group. Each year, Winbond continue to work hard towards improving our quality. In 2022, Winbond also won two Golden Awards and two Silver Awards, showcasing our exceptional achievements. These honors are a testament to the enthusiasm towards learning displayed by Winbond employees, as well as of the high priority Winbond place on quality and our commitment to making continuous improvements. At the same time, they are evidence that Winbond has lived up to the trust that our customers have placed on us. These achievements have further advanced Winbond's long-term stable development.

Team name	Event theme	Prize
Team Perseverance	Reducing the incidence of memory wafer pad corrosion	Golden Award
Team Collaboration	Creating a smart chemicals plant, greatly improving Winbond production capacity	Golden Award
Team Green	Increasing tap water usage efficiency	Silver Award
Team Precision	Established the Probe Card precision prediction system, greatly improving testing productivity	Silver Award

— Quality Awards Won —

● Golden Award ● Silver Award ● Bronze Award
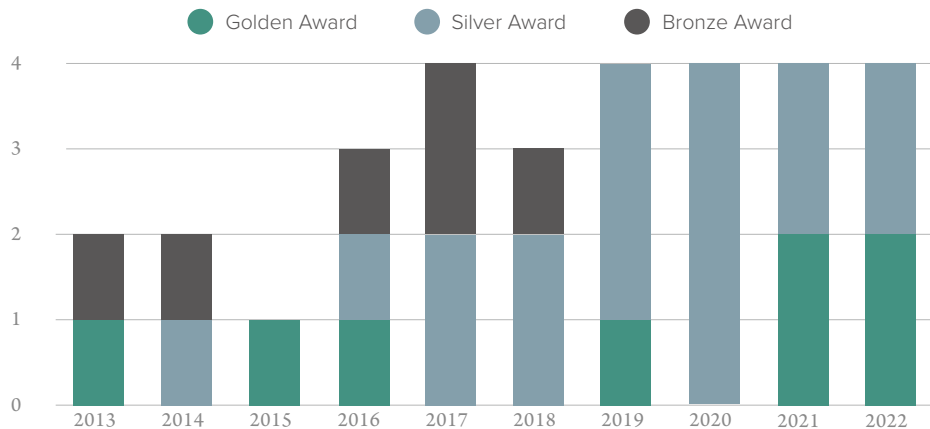
1.3 Green Manufacturing

Winbond has remained committed to green manufacturing principles. Winbond has included reducing carbon emissions as an important goal, and have implemented measures to do so starting from the research and development phase. Through methods such as optimizing our production processes and adopting zero carbon emissions gases, Winbond hopes to become a model for promoting green products, relying on our core competencies to create a green impact. In 2022, Winbond invested NT$1.334 billion into implementing environmental protection measures, and have continued to invest into reducing the environmental impact caused by our business operations. Compared to 2021, Winbond has invested 253% more funding into these efforts, with this increase mainly due to the many pollution prevention/treatment facilities built for our new Kaohsiung Fab. Winbond has continued to reduce the environmental impact caused by our operations, and the economic benefits brought about by the environmental protection investments above have totaled NT$36 million.

— Environmental Investment Amount —

Expense category	Expense items	2020	2021	2022
New prevention/ treatment equipment	Air pollution prevention equipmen	95,355	3,500	388,432
	Water pollution treatment equipment	2,900	23,600	440,803
Operational and maintenance expenses for prevention equipment	Air pollution prevention equipmen	93,889	98,582	129,979
	Water pollution treatment equipment	113,214	162,020	259,322
Waste processing expenses	General industrial waste	34,558	33,839	40,390
	Hazardous industrial waste	32,833	56,697	75,029
Total		372,749	378,238	1,333,955
Revenues (by entity)		39,649,875	57,532,802	51,139,171
Percentage of revenues (Total expenses/revenues)		0.94%	0.66%	2.61%

(Unit: NTD Thousands)

— Economic Benefits from Environmental Investment —

|	Type	2020	2021	2022
Benefits	Waste Recycling	8,100	6,008	6,324
Amount conserved	Electricity conservation measures	170,500	189,780	329,639
	Water Conservation Measures	7,512	10,594	9,180
Total economic benefits created		186,112	206,382	345,143

(Unit: NTD Thousands)

Smart Manufacturing Prognostic and Health Management (PHM)

By using PHM for smart health monitoring of the production process, Winbond is able to discover and repair damage to the electrostatic chuck (ESC) early before serious damage occurs, effectively reducing ESC usage costs, and reducing the number of wafers that need to be discarded due to ESC damage. In 2022, our ESC usage costs were lower by 13% compared to 2021. Winbond also discarded 55% less wafers, a major improvement.

— ESC Usage —

Cost(M,NTD)

	Y2021	Y2022
	112	97

-13%
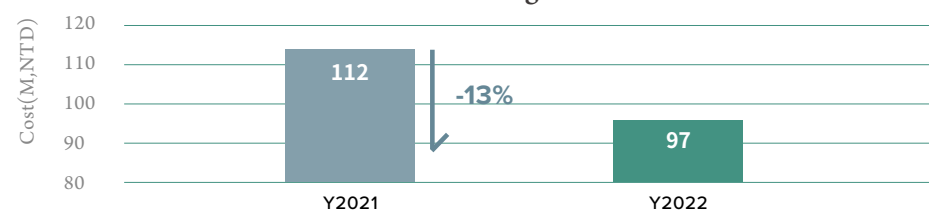
— Scrape Wafer due to ESC Fall —

Wafer Count

	Y2020	Y2022
	371	168

-55%
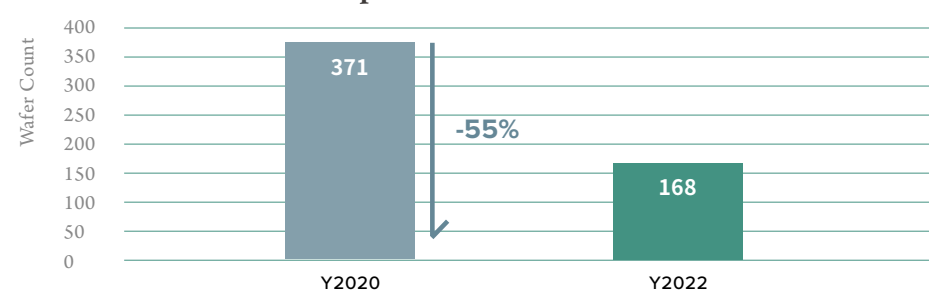
1.4 Customer Relationship Management

Maintaining Customer Relationships

▌ Customer Satisfaction

Customers play an important role in corporate business management. The value chain of a company is closely linked to its customers, which means that Winbond is devoted to satisfying the needs of its customers and placing customers first. Winbond hopes to grow and develop sustainably alongside our customers. In 2022, Winbond adopted the use of internal control reports for the first time to monitor product delivery needs. Winbond regularly reviews and tracks whether or not our products are being delivered on time, as a way of measuring customer satisfaction. Additionally, warnings for differences between the target and sales order price are displayed through an upper and lower range indicator. The Production Part Approval Process (PPAP) system has standardized customer query responses for frequently seen customer queries. Winbond hopes to be able to communicate with customers more proactively and timely, responding to customer issues in real time by implementing adjustments and improvements. Winbond hopes to prevent customer complaints before they happen, allowing our customers to enjoy the benefits of this "unseen" customer service, and building sound relationships of trust.

▌ Tracking Customer Intentions

At Winbond, we place a high priority on our brand value. Winbond continues to monitor customer complaints received in the past and take the customer's requirements and thoughts in these past complaints into account to create customized services. In 2022, Winbond received a total of 1,085 customer complaints. Out of these cases, Winbond was able to determine through testing that 637 complaints, or 59% of total complaints, were not due to Winbond's quality or service issues. Understanding and removing these customer complaints allowed these cases to become a useful reference for us, with this process also being a part of our customer services. Considering the amount of chips shipped, customer complaints were only received for 0.000055% of all chips shipped, which is an extremely good track record.

After analyzing customer complaints and determining the causes of failure for each case, Winbond was able to discover and resolve the root causes for each failure. Winbond also proposed further failure mode analyses and correction plans to be implemented, as well as establish correction plans to address the issue from the initial production process.

This ensures that customers are provided with the best customer service quality and products. Winbond has also achieved an extremely low failure rate (calculated as total number of failed ICs/total ICs shipped) of 0.2ppm. By maintaining customer satisfaction levels. Winbond is able to maintain stable business performance, creating a win-win situation.

▌ Quality Workshop

Winbond regularly holds quality workshops. Apart from allowing us to understand customer requirements and suggestion for products, Winbond also invites professionals and experts from the industry to attend, creating opportunities for discussions on quality and technology issues. Through the opportunities for communication offered by these quality workshops, Winbond is able to propose solutions to customer issues in real-time, as well as continuously improve and raise production and quality. These efforts can further raise customer satisfaction, while also allowing us to gain more industry and technical knowledge, helping us to continue improving our own technological capabilities and product quality. Winbond believes that quality workshops will continue playing an important role in future development, contributing to the mutual development of Winbond and our customers.

Customer Privacy Protection

Winbond Electronics strictly manages customer information. All business information, such as documents and information on customer interactions, are stored in Winbond's internal highly-protected system. Winbond approves and release work access rights for our employees based on the relevant operational guidelines and procedures. In order to ensure that the Winbond is able to protect customer privacy and prevent business secrets and intellectual property rights from being stolen or leaked, Winbond has in 2022 obtained the ISO 27001 Information Security Management Systems certification, establishing a comprehensive information security protection system.

Winbond Electronics has already made the required adjustments to remain compliant with the European Union's General Data Protection Regulations (GDPR) which came into effect in May 2018, amending the Winbond's official website and re-inspecting the information of all website members. The GDPR has also been included in online courses on the Personal Data Protection Act. In 2022, 3,052 employees participated in these

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training courses, where 100% of them passed the training exam. In total, 1,526 training hours were provided.

Smart transition reinforces customer privacy protection - Notifications settings system & cloud services.

In order to ensure that customer privacy has been well protected, Winbond has signed confidentiality agreements with our suppliers and customers, working together to protect each other's confidential information and preventing sensitive information from being inappropriately disclosed. Winbond has established operational guidelines and provided regular education and training on our internal employee work procedures, such as on: Phishing emails, ICP import and export restrictions, red alerts, etc. Additionally, Winbond has in 2022 implemented a smart transition for our reporting systems, using programming tools and Robotic Process Automation (RPA) for: Handling computer viruses, adopting systems for running automated consistency checks on information systems, delivering mail notifications. In order to allow users to more easily operate the system in an emergency, Winbond hopes to change this system from a passive into an active one. By providing early warnings, Winbond can reduce risks, Winbond has adopted Microsoft's cloud services to conduct automatic verifications and deliver notifications for why an account has been locked.

In 2022, Winbond continued to have no reported incidents where Winbond violated customer privacy or lost customer information, or where Winbond was fined for violating product liability laws and regulations.

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