Climate Change and Energy Management

V Achieved ↑ Exceeded — Missed Target

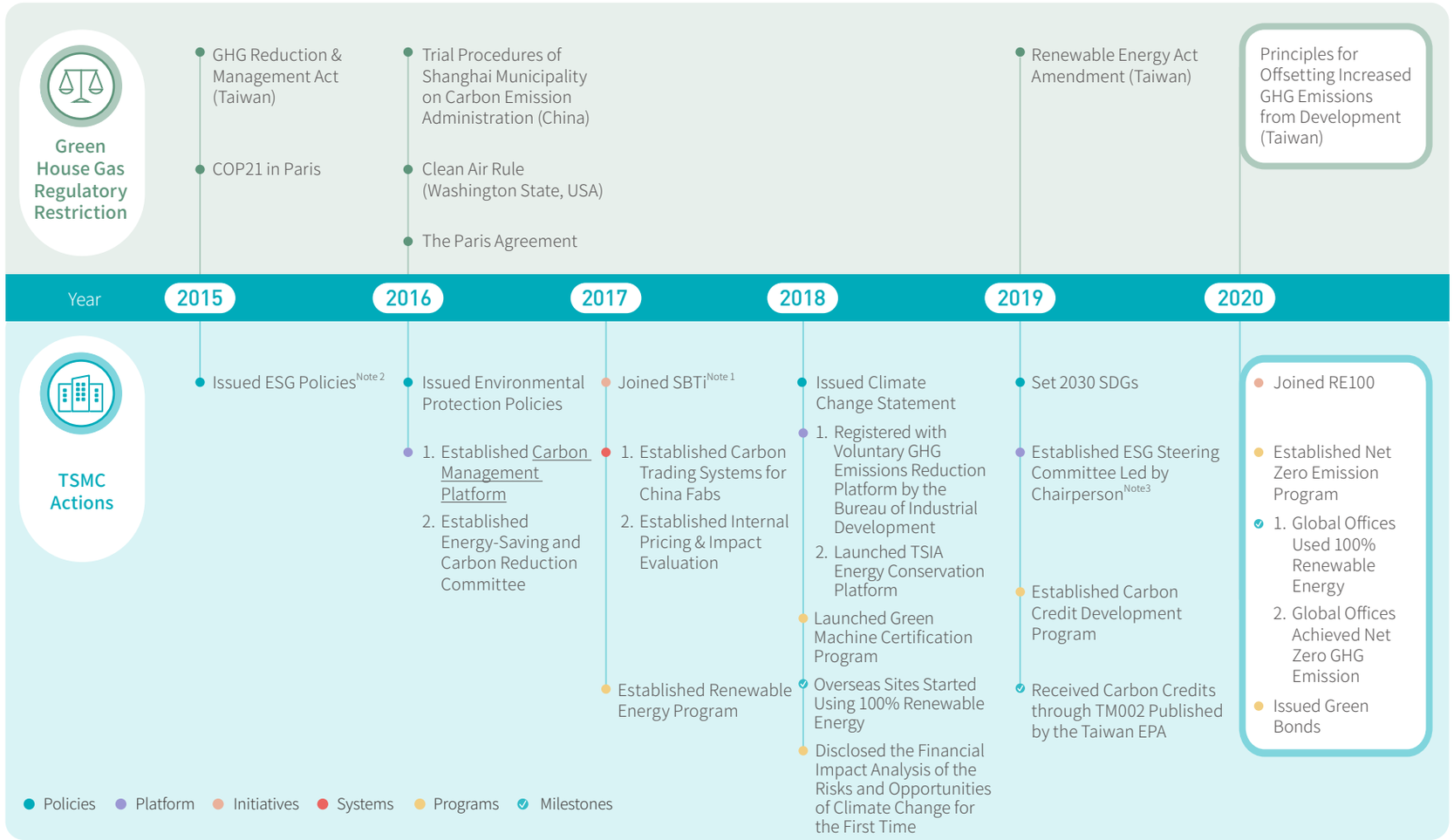
Strategies	2030 Goals	2021 Targets	2020 Achievements
Strengthen Climate Resilience Establish climate change countermeasures and preemptive precautions to lower risk of climate disasters	▪ **0** day of production interruption due to climate disasters	▪ **0** day of production interruption due to climate disasters	▪ **0** day of production interruption due to climate disasters V **Target: 0** days
Drive Low-carbon Manufacturing Continue to use best available technology to reduce emissions of greenhouse gases (GHG) and become an industry leader in low-carbon manufacturing	▪ Reduce GHG emissions per unit product [Note1] (metric ton of carbon dioxide equivalent (MTCO2e)/12-inch equivalent wafer[Note2] mask layer) by **40%** (Base year: 2010) ▪ Reduce unit product environmental externalities [Note3] by **30%** (Base year: 2010)	▪ Reduce GHG per unit of production (metric ton of carbon dioxide equivalent (MTCO2e)/12-inch equivalent wafer mask layer) by **20%** ▪ Reduce unit product environmental externalities by **8%** (NT$12-inch equivalent wafer mask layer)	▪ Reduced GHG emissions per unit product (metric ton of carbon dioxide equivalent (MTCO2e)/12-inch equivalent wafer mask layer) by **23%** ↑ **Target: 18%** ▪ Reduced unit product environmental externalities by **7.5%** (NT$12-inch equivalent wafer mask layer) V **Target: 5%**
Use Renewable Energy[Note4] Continue to purchase renewable energy and install solar-energy power systems to achieve target of 100% renewable energy use	▪ Starting from 3nm new fabs, renewable energy accounts for more than **20%** of energy consumption and the purchasing of renewable energy to increase annually to achieve **25%** renewable energy for fabs and **100%** renewable energy for non-fab facilities	▪ Continue to purchase renewable energy and achieve **9%** of renewable energy in TSMC and overseas sites use **100%** renewable energy	▪ Purchased **1,230** GWh of renewable energy, Renewable Energy Certificates (REC), and carbon credits, achieving **7.6%** of TSMC's power consumption; TSMC overseas sites used **100%** renewable energy V **Target: 7%** of TSMC power consumption and **100%** of power consumption in overseas sites
Increase Energy Efficiency Plan and implement new energy-saving measures each year to increase energy efficiency	▪ Save **5,000** GWh cumulatively between 2016 and 2030 through new energy-saving measures ▪ Double energy efficiency after five years of mass production for each process technology[Note5]	▪ Save **500** GWh and **2,200** GWh cumulatively ▪ Increase 5nm process technology energy efficiency by **0.2** times in the second year of mass production	▪ **500** GWh energy saved, and cumulatively saved **1,700** GWh V **Target: 400** GWh; **1,600** GWh ▪ Energy efficiency of 10nm and 7nm process technologies increased by **1.4** times in the fourth year of mass production[note6] ↑ **Target:** 10nm process technology energy efficiency increase by 0.8 times in fourth year of mass production

Note 1: As of 2020, GHG emissions include fluorinated GHG emissions; the indicator will be used to evaluate various practices in the future.
Note 2: As of 2020, the unit for unit product indicators will be in "12-inch equivalent wafer".
Note 3: Environmental externality refers to the potential impact of the environmental footprint derived from business activities on human well-being, and takes the environmental profit and loss as a comprehensive index. The internal EP&L module was completed for the Total ESH Management digital system in 2020 and 19 key suppliers were included into EP&L evaluations to continue identifying ways to improve. Overseas fabs were unable to complete product life cycle assessment because of the COVID-19 pandemic and the assessment will be completed in 2021
Note 4: Definition of Renewable Energy Use: Purchase renewable energy, Renewable Energy Certificates, and carbon credits produced by renewable energy
Note 5: Energy efficiency is the product equivalent per kWh of power (12-inch equivalent wafer mask layer/kWh)
Note 6: Some 10nm production lines have been converted to 7nm production lines

The year 2020 was an important milestone in TSMC's fight against climate change. TSMC closely follows and carries out a variety of climate action goals following the Paris Agreement. The ESG Steering Committee, led by Chairperson Dr. Mark Liu, evaluates TSMC climate change guiding principles twice a year and ESG Committee Chairperson Senior Vice President Lora Ho annually reports to the Board of Directors on climate actions and results of the year. In May 2020, TSMC signed the world's largest corporate renewable power purchase agreement (PPA); in July 2020, TSMC was officially approved by RE100 as the first semiconductor company to be a member of this global initiative for renewable energy, and TSMC declared a sustainability goal of using 100% renewable energy by 2050, driving the development of green energy industry, and realizing a future for sustainable environments.

As advanced processes continue to evolve, IC processes have become increasingly complex and now require higher electricity consumption. In 2020, TSMC purchased renewable energy, invested in the development of green tools, and worked diligently to carry out all 460 energy-saving measures and introduce new energy-saving tool models to strive towards better energy efficiency in all technology nodes of processes. Facing the potential risks brought by extreme climates and global warming, TSMC focuses on regulatory compliance, energy and carbon emissions reduction, and carbon asset management. TSMC is also using the Task Force on Climate-related Financial Disclosures (TCFD) framework proposed by the Financial Stability Board (FSB) to identify climate risks and opportunities. Based on the results, measures and goal management were established to effectively track response progress and outcomes, thereby lowering the financial impact of climate risks on business operations.

Milestone of Responses to Climate Change



Note 1: Science Based Targets Initiative (SBTi) is jointly established by the Carbon Disclosure Project, We Mean Business Coalition, UN Global Compact and World Wildlife Fund. The initiative provides companies with a clearly-defined path to reduce emissions in line with the Paris Agreement goals. TSMC pledged to set a science-based target in 2017; however, due to lack of guidance on the semiconductor manufacturing sector, TSMC was not able to get our target developed, validated and published within the 24-month period recommended by SBTi.
Note 2: Renamed TSMC Corporate Social Responsibility Policy as ESG Policy since 2021.
Note 3: Renamed CSR Executive Committee as ESG Steering Committee since 2021.

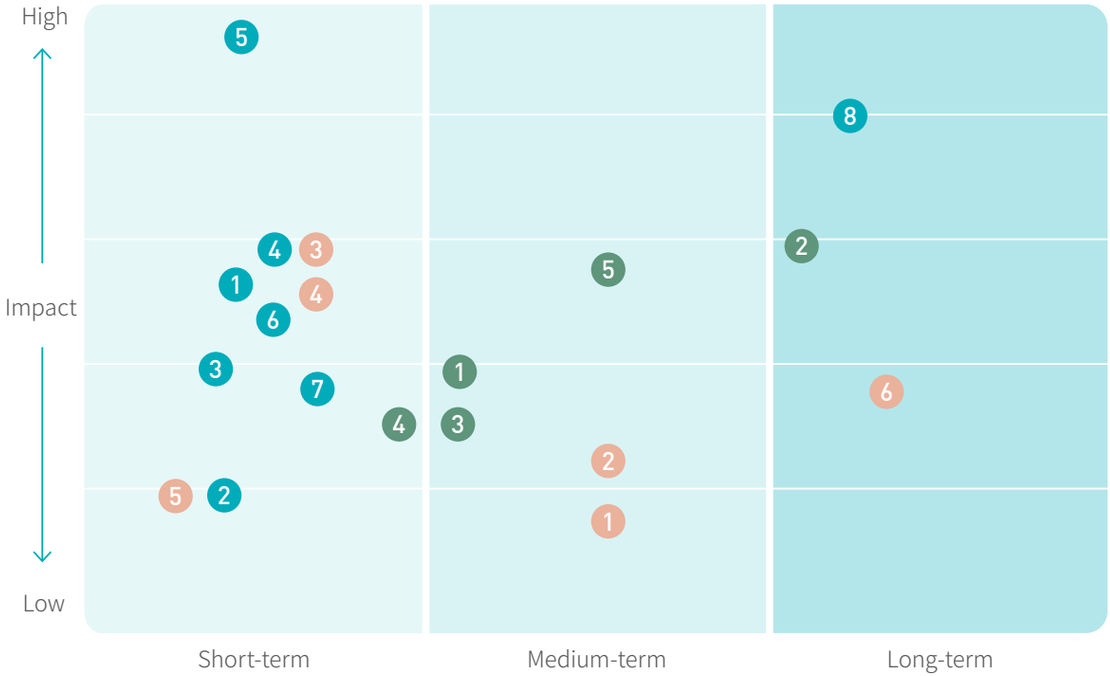
Strengthen Climate Resilience

Resilience to climate disasters is an integral part of corporate operations in an environment with increasingly volatile climates. TSMC uses the RCP8.5 global warming scenario issued by the UN to identify disaster factors introduced by extreme climates and established Climate Risk Adaptive Standards. In 2020, TSMC was able to successfully defend against potential impact from disasters and potential operating losses from climate change to achieve the target of zero production interruption.

Identify Climate Risk

To uncover potential risks and opportunities, TSMC follows the TCFD framework to evaluate climate change risks and opportunities cross-functionally. In 2020, TSMC hosted a Climate Change Risk and Opportunity Workshop and invited related internal organizations to engage in group discussions on "policies and regulations", "market, technologies, and reputation", and "physical risks". Net zero emissions trend, EIA requirements, uncertainty in new energy saving/carbon emission reduction technologies, flood and drought impact to supply chain, and insurance premium increasing for natural disaster, and other risk factors were new introduced into the financial impact analysis of climate change in 2020 as climate risks to account for internal and external environmental changes; enhancing corporate reputation was introduced as a new climate opportunity. In 2020, to cope with climate change, TSMC also carried out actions such as purchasing local renewable energy, building the TSMC Water Reclamation Plant in Tainan Science Industrial Park, planning and building green buildings, implementing programs for energy saving and carbon emissions reduction, and water conservation, investing into energy-efficient products, elevating building foundation, and more. For more details, please see "Financial Impact Analysis of Climate Change".

Climate Change Risk and Opportunity Matrix



Opportunities

1. Participation in carbon trading/renewable energy market
2. Rewards from public sector & collaborations of carbon emission offset
3. Construct green buildings
4. Use of reclaimed water
5. Develop services to deliver low-carbon products and increase energy efficiency for our customer's products
6. Drive low-carbon green manufacturing
7. Increase resilience against natural disasters
8. Improve Company reputation/image

Transition Risks

1. GHG restrictions and carbon taxes/carbon levy
2. Net zero emission trends
3. EIA commitment
4. Uncertainty in new energy saving/carbon reduction technologies
5. Impact on Company reputation/image

Physical Risks

1. Floods (TSMC)
2. Floods Supply Chain
3. Droughts (TSMC)
4. Droughts Supply Chain
5. Higher natural disaster insurance premium
6. Rising temperature

Financial Impact Analysis of Climate Change

Climate Risk	Potential Financial Impact	Climate Opportunities	Potential Financial Impact	2020 Actions
GHG Emissions Restriction and Carbon Taxes/Carbon Fee	▪ Restriction on manufacturing capacity expansion; increase in operation costs	Participation in Renewable Energy Plans Participation in Carbon Trading Market	▪ Early purchases of renewable energy, successfully increasing manufacturing capacity	▪ Signed renewable energy contracts of up to 1.3 GW in Taiwan ▪ Purchased 1,230 GWh of renewable energy to offset 100% of carbon emissions of global offices and all overseas operation sites
Net Zero Emission Trends	▪ Increased cost of installation and operation for carbon reduction facilities ▪ Increased cost for purchasing carbon offset products [Note 1]	Obtain Rewards from Public Sectors and Collaborations of Carbon Emission Offset	▪ Stock up on required carbon credit for future emissions	▪ Received rewards from public sector for offsetting F-GHGs and nitrous oxide ▪ Used carbon credit to offset carbon emissions and achieve net zero for global offices
		Develop Services to Deliver Low-carbon Product and Increase Energy Efficiency for Customers' Products	▪ Satisfy customer demands for energy-efficient products and increase revenue	▪ Invested in the development of 5-nm energy-efficient products
EIA Commitment	▪ Unsuccessful attempts at obtaining renewable energy and reclaimed water have become obstacles to fabrication using advanced technologies	Use of Reclaimed Water	▪ Successfully build advanced production line	▪ Started construction for the TSMC Water Reclamation Plant in Southern Taiwan Science Park
Uncertainties in the Development of New Energy Saving/Carbon Reduction Technologies	▪ Increase energy consumption in production lines using new process technologies result in higher operating costs	Construct Green Buildings	▪ Reduce utilities costs	▪ Acquired 2 green building certificates
Impact on Company reputation	▪ Damage to company image when unable to meet stakeholder expectations	Enhance Corporate Reputation	▪ Upgrade sustainability ratings by TSMC stakeholders	▪ Only semiconductor company to have been in the Dow Jones Sustainability Index (DJSI) for 20 consecutive years; Listed in Leadership of CDP climate change and water security
Flood/Drought	▪ Production affected, resulting in financial losses and a decrease in revenue	Increase Resilience against Natural Disasters	▪ Strengthen climate resilience and lower the risk of operation interruption and potential losses	▪ Elevated building foundation of Fab 18 Phase 3 by 2 meters ▪ Fab 18 Phase 3 committed to using and developing reclaimed water ▪ Established a comprehensive water monitoring system
Higher Natural Disaster Insurance Premium	▪ Increase in operating costs			
Rising Temperature	▪ Increase in energy consumption, costs, and carbon emissions	Drive Low-carbon Green Manufacturing	▪ Save energy and reduce costs	▪ Conserved 500 GWh of electricity through energy conservation programs

Note 1: Carbon offset products are renewable energy certificates, carbon credits or other carbon neutral products.

Drive Low-carbon Manufacturing

TSMC has long been committed to green manufacturing and aspires to be a world leader in low-carbon manufacturing. The Company performs yearly reviews of the overall effectiveness of carbon reduction based on third-party-verified GHG inventory results. Because F-GHG emissions and the indirect emission of GHGs due to power consumption are the two main sources of GHG emissions, TSMC has for many years, continued to establish industry best practices for GHG reduction. In 2020, TSMC replaced and installed roughly 1,684 local abatement facilities for fluorinated GHGs and nitrous oxide; acquired two new green building certificates; and implemented energy-saving projects for process tools machines while taking progressive steps to increase the use of renewable energy to reduce the GHG emissions per unit product.

GHG Reduction Best Practices

Scope 1
Direct GHG Emissions

100% — **ISO 14064-1 emissions inventory and third-party verification**
- All facilities and subsidiaries completed emissions inventory and third-party verification

100% — **Optimize gas quantity used in production**
- Introduced optimized process parameters in accordance with the manufacturing specifications of the Intelligent Engineering Center

100% — **Substitute high global warming potential (GWP) fabrication gases**
- All 12-inch fabs are now using optimized carbon reduction technology – remote plasma dissociation of Nitrogen Trifluoride (NF_3)
- 6-inch and 8-inch fabs are using Nitrogen Trifluoride(NF_3)/ Octafluorobutane(C_4F_8)

100% — **Install Point-of-Use Abatement equipment for fluorinated GHGs**
- Achieved full installation on new process tools using F-GHG in new and existing fabs and installed 1,684 POU abatement equipment in 2020.
- Replaced 84 existing POU abatement equipment to achieve 92% installation rate

First — **Introduce POU Nitrous Oxide reduction technologies**
- Developed Nitrous Oxide reduction technologies and made it a standard for new tools; became first in Taiwan to install the technology in 100% of new process tools using N_2O in Fab 18A and Fab 18B

Scope 2
Indirect GHG Emissions (From Purchased Energy)

100% — **ISO 50001 energy management and third-party audits**
- ISO 50001 inventory and third-party certification were conducted for all TSMC fabs in Taiwan, TSMC (China), and TSMC (Nanjing)

1 — **Construct green buildings**
- The Company leads the global semiconductor industry with the largest LEED-certified building area and constructed two more fabs, which received green building certification. In total to date, 34 buildings have received LEED certifications and 23 buildings received EEWH certifications

460 Measures — **Energy efficiency standards**
- Energy efficiency of advanced technologies leads industry peers[Note1], with 460 energy-saving measures over 8 categories implemented and 500 GWh saved

Exclusive — **Next-generation fab tools use energy-saving, carbon-reducing designs**
- The only company in the world to launch energy-saving programs on next-generation semiconductor fab tools; completed energy-saving programs on 68 models and saved 200 GWh electricity

12.3 GWh — **Introduce renewable energy to reduce carbon emissions**
- Leading semiconductor manufacturer in Taiwan with 1,230 GWh in renewable energy purchased and 100% use of renewable energy in global offices

Scope 3
Indirect GHG Emissions (Value Chain)

40% — **ISO 14064-1 emissions inventory and third-party audit**
- High Energy Consumption Suppliers[Note 2] are required to complete GHG emissions inventory and third-party audits; 40% completion rate in 2020

59,000 Metric Tons — **Reduce carbon footprint from raw materials**
- Require High Energy Consumption Suppliers to set annual targets and begin to save electricity; in 2020, TSMC suppliers conserved 113 GWh in energy and reduced carbon emissions by 59,000 metric tons

9,500 Metric Tons — **Optimize delivery schedules**
- Improved process tools delivery schedules and replaced air freight with ocean shipping, reducing 9,531 metric tons in GHG emissions

● Market Leader: Leads global industry peers ● All TSMC: Introduced in all TSMC facilities ● Significant: First and only in the semiconductor industry

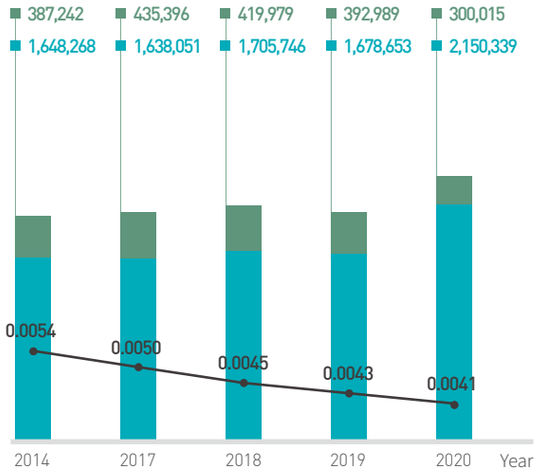
Note 1: Figures from Joint Steering Committee (JSTC) report of the World Semiconductor Council.
Note 2: High Energy Consumption Suppliers are the suppliers that use >50 million kWh/ year in a single facility.

GHG Emissions Inventory

In 2020, TSMC continued to implement the benchmark practices of optimizing the use of process greenhouse gases, minimizing global warming potential (GWP), maximizing the removal rate in exhaust, and comprehensively adopted the best available technology. By taking tangible actions, the Company has effectively reduced 4.2 million metric tons of direct CO_2e emissions (Scope 1), of which fluorinated GHG emissions per unit product were reduced considerably by 68% in 2020, more than two times the target set by the World Semiconductor Council. Indirect emissions (Scope 2), caused by energy consumption, were also curbed as a result of increased use of renewable energy; indirect emissions (Scope 3) of upstream and downstream value chains mainly involve raw material production and energy-related activities. As such, TSMC has set energy conservation and carbon reduction goals with its suppliers to work together toward creating a sustainable supply chain.

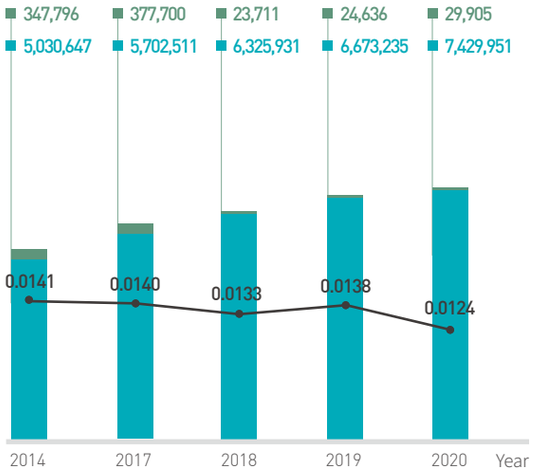
As the world's largest provider of semiconductor technologies and capacity, TSMC is deeply aware of our responsibilities towards local and global environments. We pay close attention to Science Based Targets (SBTs) in line with the 2° C scenario and various climate actions such as the RE100 initiative. Using renewable energy is the primary way that companies are able to reduce carbon emissions, so TSMC has to collaborate with external partners to develop carbon reduction/carbon negative technologies and obtain carbon credits for carbon offset to ensure TSMC is moving towards the SBT targets and net zero emissions. In 2020, TSMC was able to achieve 100% use of renewable energy in global offices and also used carbon credits to offset carbon emissions from natural gas used in the kitchen to achieve net zero emissions, setting a milestone for TSMC.

Scope 1 GHG Emissions



Note 1: GHG emissions data for Scope 1 and Scope 2 from TSMC facilities in Taiwan, TSMC (China), TSMC (Nanjing), WaferTech, and VisEra
Note 2: GHG emissions data for Scope 3 from TSMC facilities in Taiwan

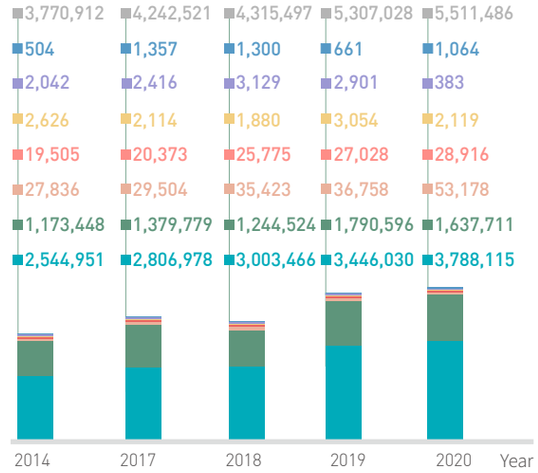
Scope 2 GHG Emissions



Note 3: Emission factor based on data released in 2020 by the Bureau of Energy stating that 0.509 kg of CO_2e/ kWh, where 1 kg of CO_2e equals 6,805 kJ
Note 4: As of 2020, the unit for unit product indicators will be in "12-inch equivalent wafer"

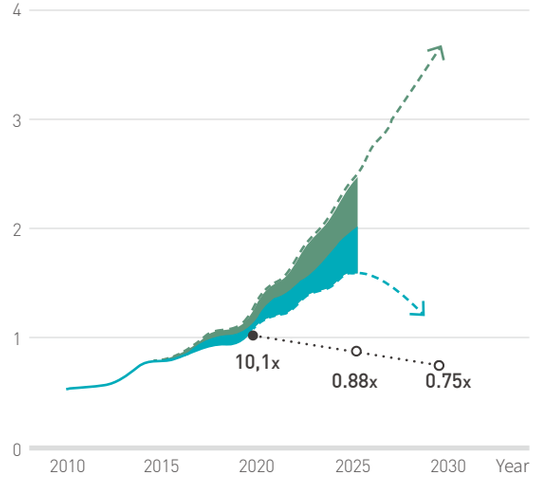
Scope 3 GHG Emissions

Unit: Metric Tons



- Materials Production (ref. SimaPro model)
- Waste generated in operations (ref. EPA carbon footprint database)
- Upstream transportation (ref. EPA carbon footprint database)
- Business travel (ref. Boustead model)
- Purchasing Energy (without Scope1&2) (ref. EPA carbon footprint database)
- Downstream transportation (ref. EPA carbon footprint database)
- Employee commuting (ref. EPA carbon footprint database)
- Total

GHG Emissions and Reduction Trends



Note 1: GHG emissions include Scope 1 & 2; standardized baseline is the values in 2020.
Note 2: TSMC revised the base year for Science Based Targets from 2017 to 2020.

TSMC's manufacturing is primarily based in Taiwan. In 2020, TSMC achieved major progress in the renewable energy market: the Company became part of the first group to engage in renewable energy wheeling transactions. Unfortunately, our efforts have yet to guarantee sufficient supply in European and U.S. facilities. With our growing capacity, TSMC is unable to suppress the growth of overall carbon emissions despite implementing industry-leading standards for energy conservation/carbon reduction and achieving targets for unit product carbon reduction. TSMC will continue striving towards SBTs and net zero emissions by strengthening green innovation, purchasing renewable energy, driving the development of regional green energy industries, using carbon neutral raw materials, and expanding external collaborations to develop carbon credit projects.

Value EP&L and Strive to Reduce Carbon Externalities

Every three years, TSMC updates or establishes product life cycle assessments, water footprint assessments, and carbon footprint assessments in Taiwan fabs and obtains ISO 14040, ISO 14066, and ISO 14047 certifications. Product life cycle assessment for overseas fabs was expected to be completed in 2020 but third-party certification organizations were unable to conduct site audits due to COVID-19; product life cycle assessment for overseas fabs will be delayed to 2021.

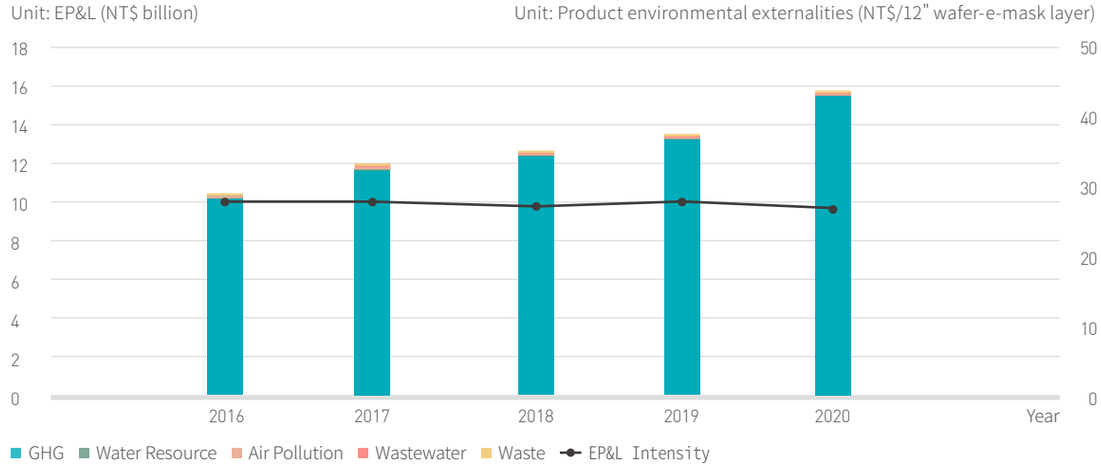
In terms of reducing unit product environmental footprint, TSMC uses an Environmental Profit and Loss (EP&L) tool to convert environmental impact from TSMC operations into external costs (also known as environmental externalities). In 2020, TSMC completed the EP&L module for the Total ESH Management digital system, allowing us to systematically compile operation data from various facilities in a timely manner as a continuous improvement management tool. Analysis in 2020 revealed that Scope 1 and Scope 2 GHG emissions are the primary source of TSMC's environmental externalities, accounting for 96.6%. To mitigate external costs brought on by TSMC operations, TSMC continues to drive low-carbon manufacturing, improve energy efficiency, increase the use of renewable energy, and more. In 2020, unit product environmental externalities was reduced by 7.5% from the previous year. TSMC also applied EP&L to upstream raw material suppliers, and we discovered that chemical raw materials manufacturing suppliers accounted for 51% of the supply chain's environmental externalities, which was primarily particulate matters and GHG emissions. EP&L is now the cornerstone for TSMC when formulating carbon reduction strategies. In 2021, TSMC will be expanding partnerships with suppliers to work together and reduce external costs on society from GHG emissions and reach the 2030 goal of reducing unit product environmental externalities by 30%.

Use Renewable Energy

In 2020, with full support from the Board and management team, TSMC was able to purchase more renewable energy and move towards carbon neutrality. In July 2020, TSMC officially joined the RE100, becoming the first semiconductor company in the world to do so. We committed to 100% renewable energy in global operations and zero direct CO_2 emissions from electricity consumption by 2050. TSMC hopes to drive the trend of renewable energy use in the global semiconductor industry through its own

Renewable energy from solar plants in the salt flats of Chiayi County was officially provided to TSMC in early May 2020, making TSMC one of the first companies in Taiwan to purchase retransmitted renewable energy (Photo credit: Vena Energy Taiwan)

EP&L Trend Chart



sustainable actions. In 2020, TSMC received the first RE100 Leadership Awards - Most Impactful Pioneer from The Climate Group.

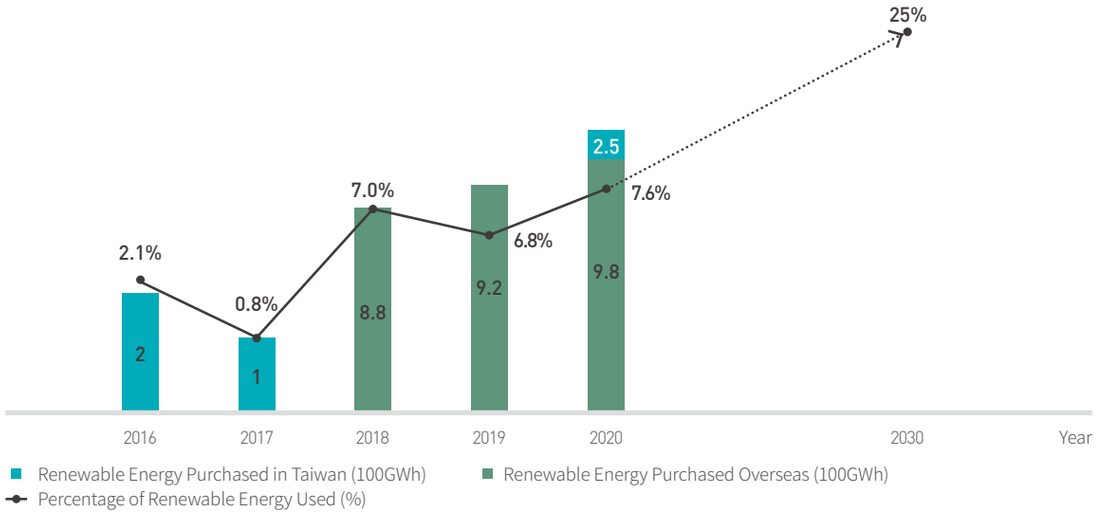
Purchasing Renewable Energy

TSMC vision is for corporate growth and the environment to prosper together. Our sustainability goals for 2030 are 25% renewable energy consumption for all fabs and 100% renewable energy consumption for non-fab facilities. After all overseas sites transition to using 100% renewable energy, we will also expand the ratio of renewable energy consumption in local sites.

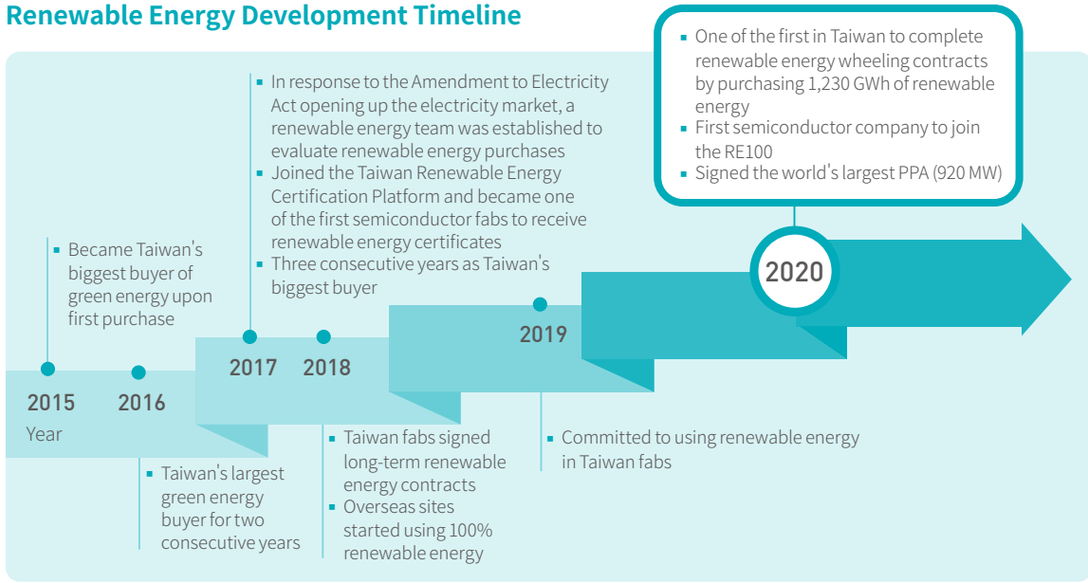
The renewable energy development in Taiwan is in the early stage and TSMC is working with the MOEA, Bureau of Energy, Bureau of Standards, Metrology, and Inspection, Taipower, and the Allied Association for Science Park Industries to discuss and eliminate the gap between regulation and real practice as well as scheme out details for future wheeling transaction. By communicating closely with the government and with support from renewable energy businesses, Taiwan was able to reach its first renewable energy wheeling milestone in May 2020. The Solar Plant in Chiayi County generated and transmitted renewable energy to TSMC, and a number of onshore wind farms transmitted to TSMC fabs in Taiwan in the fourth quarter of 2020, an sign that Taiwan's renewable energy sector is growing stronger. As of the end of 2020, TSMC has signed power purchase agreements to purchase 1.3 GW of renewable energy, which will reduce 2.2 million metric tons of carbon emissions each year, helping achieve 100% renewable energy used in global offices, and making contribution to climate change mitigation.

TSMC hopes to drive the renewable energy sector and related industries by purchasing renewable energy and supporting related government policies. Starting in 2018, TSMC began to purchase renewable energy, RECs, and carbon credits in countries with comprehensive regulations and ample supply, aiming to completely offset carbon dioxide emissions from the power used in locations around the world including the United States,

Use of Renewable Energy and Ratio



Renewable Energy Development Timeline



Canada, Europe, China, and Japan; 2020 marks the third consecutive year that TSMC has achieved zero carbon emission from power consumption in overseas sites.

Renewable Energy Systems

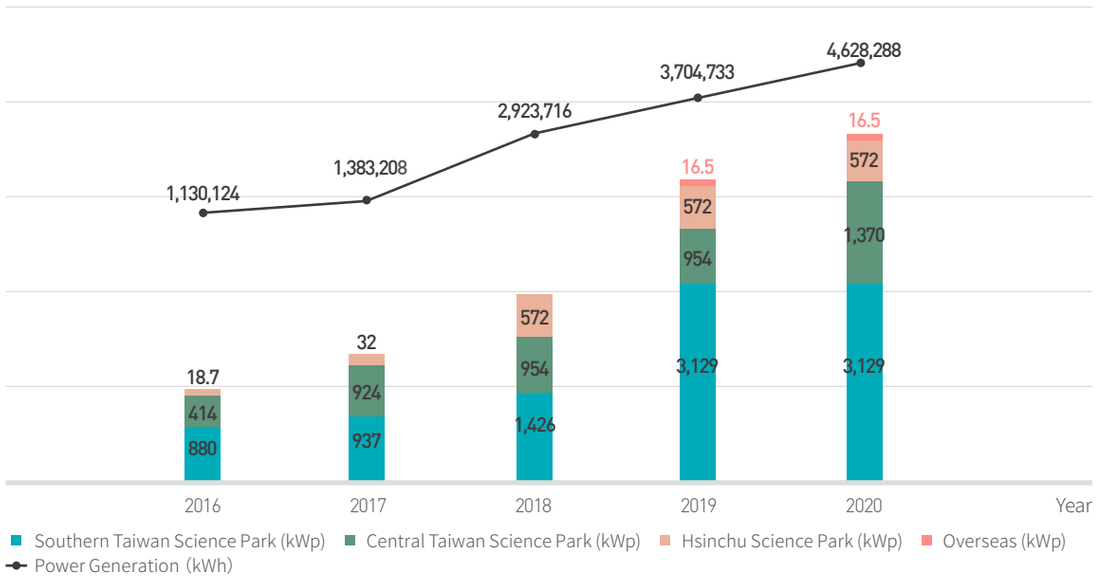
In addition to purchasing renewable energy, TSMC has also installed solar panels in TSMC facilities to produce carbon-free renewable energy for our own fabs. In 2020, 416 kWp of solar panel capacity was installed, and has already provided 4.63 GWh, reducing carbon emissions by 2,356 metric tons (the equivalent of annual carbon absorbed by 200,000 trees); in 2021, an additional 227 kWp in capacity of solar panels will be added, and this is expected to generate up to 5.76 GWh of electricity.

Increase Energy Efficiency

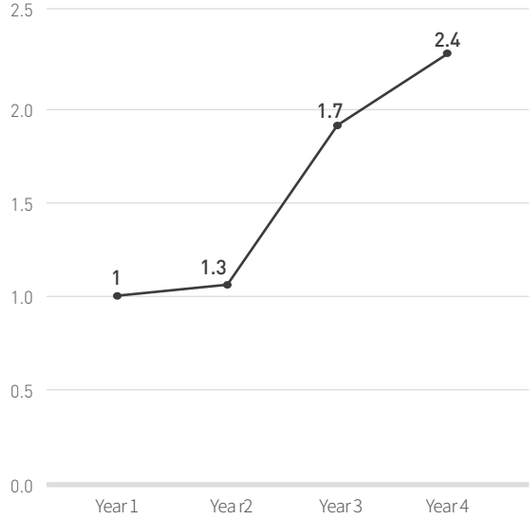
In 2020, TSMC continued to implement energy efficiency programs for manufacturing processes and with the goal of increasing energy efficiency by 100% after a process technology has entered mass production for five years. By expanding innovative energy-saving measures, installing smart energy-saving equipment, and adding components for energy conservation, TSMC was able to increase energy efficiency of 10nm and 7nm process technologies in the fourth year of mass production by 1.4 times, reaching our long-term 2030 goal ahead of schedule; energy efficiency for the 16nm and above process technologies has also improved by 1.8 times. TSMC has an unwavering commitment to continue improving energy efficiency in the face of more complex, advanced process technologies in the future.

In 2020, TSMC consumed a total of 16,900 GWh in energy; with electricity making up 95%, natural gas coming second at 5%, and diesel with less than 0.1%. Electricity is the main energy used to power TSMC' s manufacturing equipment and fab systems. Natural gas is used in exhaust treatment facilities to reduce the direct emission of fluorinated greenhouse gases and volatile organic compounds. Diesel is not used directly in production, but to run emergency power generators and fire pumps during emergencies, power outages, or during annual maintenance.

TSMC Renewable Energy Capacity & Generated

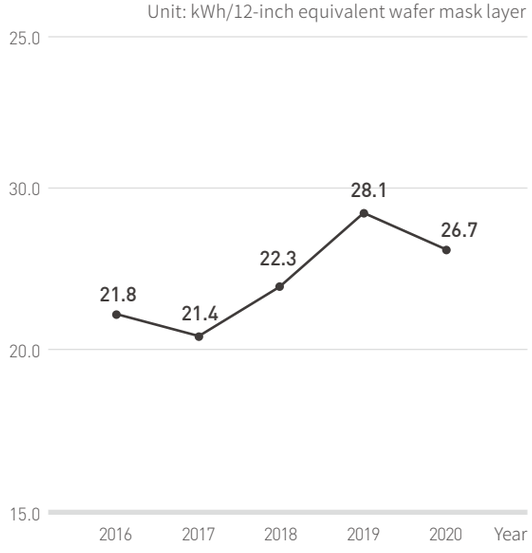


Energy Efficiency of 10nm & 7nm Process Technologies



Note 1: Standardized baseline for energy efficiency is the values taken from the first year of mass production of 10nm and 7nm process technologies.
Note 2: The data covers TSMC fabs in Taiwan, TSMC (China), TSMC (Nanjing), WaferTech, and VisEra.

Unit Product Energy Consumption



Note 1: The data covers Taiwan Facilities, TSMC (China), WaferTech, and TSMC (Nanjing)
Note 2: Diesel and natural gases are not used in manufacturing and is therefore not counted in unit product energy consumption.
Note3: The unit product indicator is calculated based on 12-inch wafer equivalent starting from 2020.

Expand Energy-saving Measures

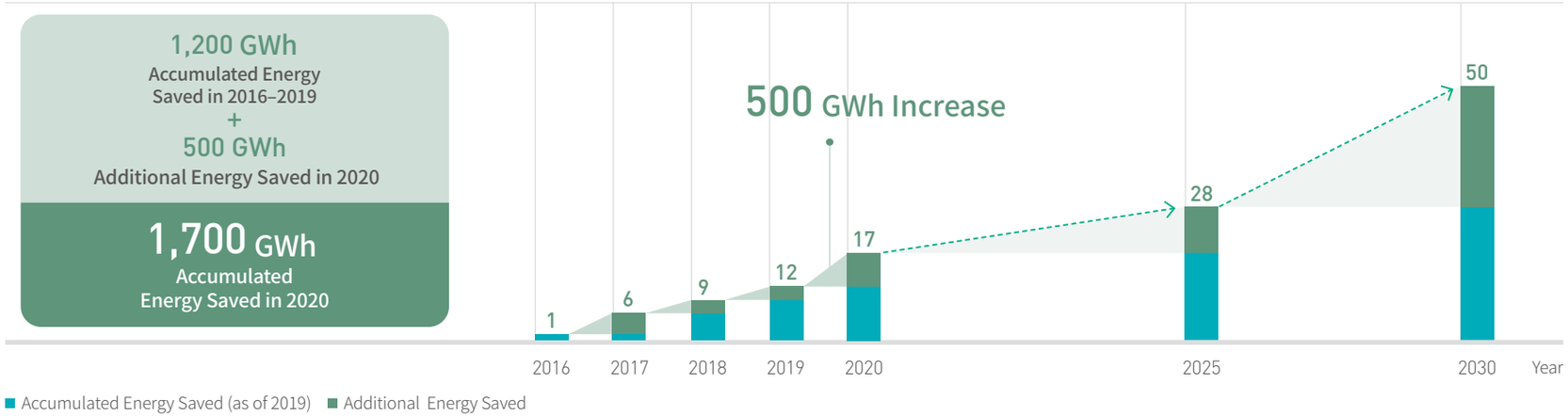
In 2020, TSMC's Energy-saving and Carbon Reduction Committee worked to conserve more energy through company-wide roll-outs of energy-saving measures. The committee defined five major energy conservation teams for different process technologies as part of their efforts to conserve more energy from manufacturing equipment and fab facilities. The five teams are the advanced processes R&D team, 12-inch wafer fab team, advanced backend and 8-inch wafer fab team, EUV (extreme ultraviolet lithography) team, and facility team.

In response to the growing number of tools used at TSMC, the Intelligent Engineering Center launched the Green Manufacturing Engineering Program in 2020 to reduce equipment repair risks and increase energy efficiency. With the program, the Intelligent Engineering Center integrates energy conservation planning and operations for all fabrication equipment across all fabs. Each month, the five energy conservation teams meet and discuss new innovative measures for rapid roll-out into other fabs and set standards for new fabs as soon as possible. The New Generation Equipment Energy Conservation Program, launched in 2018, reached new heights in 2020 with 139 energy-saving measures tested and applied to 68 different types of 5 nm and 3nm manufacturing tools, helping TSMC save 200 GWh in energy consumption.

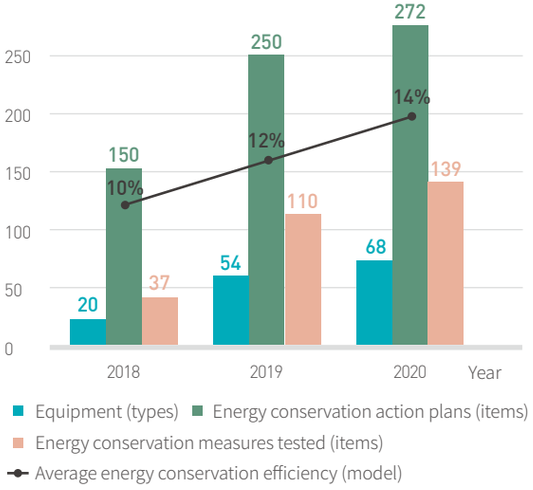
In 2020, TSMC carried out 460 energy-saving measures across 8 different categories and was able to conserve 500 GWh in energy consumption, the equivalent of 250,000 metric tons of carbon emissions. The energy savings translated into NT$1.25 billion of actual financial savings and external carbon costs reduced from lower carbon emissions were around NT$380 million.

15-year Energy-saving Targets

Unit: 100 GWh

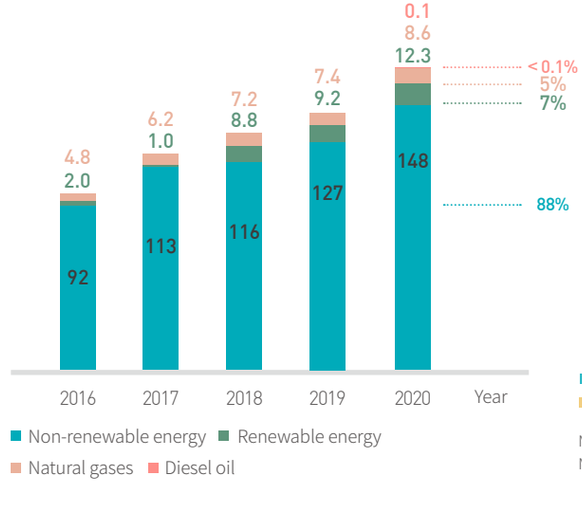


Results of the New Generation Equipment Energy Conservation Programs

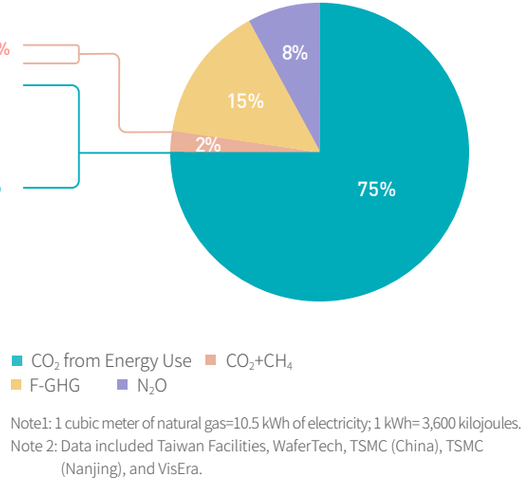


Total Energy Consumption

Unit: 100 GWh



GHG Emissions



Note1: 1 cubic meter of natural gas=10.5 kWh of electricity; 1 kWh= 3,600 kilojoules.
Note 2: Data included Taiwan Facilities, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra.

Energy Conservation Teams for Green Innovation

Categories/ Competent authority	Five Energy Conservation Teams	Machines	Energy Conservation Goals	2020 Achievements
Manufacturing Equipment Intelligent Engineering Center	Advanced processes R&D team	New generation 3nm/5nm machines	▪ Develop and test energy-saving components ▪ Find optimal tool settings for energy conservation ▪ Determine specifications for new tools	25GWh Fab 12B reduced 25 GWh by introducing green components, green pumps, and optimal exhaust settings
	12-inch wafer fab team	Existing 12-inch wafer machines	▪ Optimize recipe settings for existing tools ▪ Seek new ways to conserve energy ▪ Determine best known method for energy conservation	25% Fab 15A and 15B reduced 25% in energy consumption by introducing low-energy consumption system for pipeline heating that effectively reduced pipeline surface temperature
	Advanced backend and 8-inch wafer fab team	Existing backend & 8-inch fab machines	▪ Replace low energy efficiency auxiliary equipment ▪ Determine specifications for new packaging and testing equipment	12GWh All 8-inch wafer fabs began using green pumps and green chillers, saving 12 GWh each year
	EUV team	EUV machines	▪ Increase energy efficiency ▪ Determine specification for new tools	5% Fab 12B, Fab 15B, and Fab 18A increased energy efficiency by 5% with big data analysis
Facility Equipment Facility Division	Facility team	General facilities not for manufacturing	▪ Replace low energy efficiency equipment ▪ Install smart energy conservation system for facility equipment ▪ Determine specifications for new equipment	17GWh Fab 12A/B, Fab 14B, Fab 15A, Fab 15B, and Fab 18A saves 17.1 GWh each year by using lithium-ion batteries for the uninterrupted power supply system

The Energy Saving and Carbon Reduction Committee awarded Energy Conservation Model Awards and Energy Conservation Innovation Awards according to employees' success with energy conservation targets and innovative ideas.

Trophies were made from recycled TSMC copper to add a special eco-friendly touch while encouraging energy innovation.

Energy Conservation Measures

Facility Equipment

Lighting Energy Savings

- Smart lighting in non-cleanroom areas
- Replace bulbs with LED lighting

Fabs: All fabs

10 Measures; 16 GWh Energy Saved; 8,100 Metric Tons CO_2 Reduced

A.C. Energy Savings

- Smart, energy-saving cooling unit
- A.C. adjustments for energy conservation

Fabs: All fabs

10 Measures; 94 GWh Energy Saved; 47,800 Metric Tons CO_2 Reduced

Increased Performance

- Modified wet film for A.C. humidifier

Fabs: 12-inch fabs

7 Measures; 32 GWh Energy Saved; 16,300 Metric Tons CO_2 Reduced

Standby Energy Savings

- Energy-saving mode for uninterrupted power supply system
- Cooling fan for battery cabinet to conserve energy

Fabs: All fabs

9 Measures; 98 GWh Energy Saved; 49,900 Metric Tons CO_2 Reduced

Fabrication Machines

Energy Usage Management

- Reduced cooling water for manufacturing processes
- Reduced exhaust emissions from equipment

Fabs: All fabs

92 Measures; 42 GWh Energy Saved; 21,400 Metric Tons CO_2 Reduced

Unit Replacement

- Replace with new high-efficiency, energy-saving pumps

Fabs: Fab 3, Fab 2/5, Fab 6, and Fab 8

25 Measures; 10 GWh Energy Saved; 5,100 Metric Tons CO_2 Reduced

New Unit Specs

- New equipment uses high efficiency, energy-saving auxiliary equipment

Fabs: 12-inch fabs/Advanced backend

125 Measures; 96 GWh Energy Saved; 48,900 Metric Tons CO_2 Reduced

Equipment Adjustments

- Optimized power consumption

Fabs: All fabs

182 Measures; 112 GWh Energy Saved; 57,000 Metric Tons CO_2 Reduced

Note: Carbon dioxide emission is 0.509 kg CO2e/kWh; 1 kWh=3,600 kilojoules.

In addition to expanding energy-saving facilities and equipment, TSMC is also reducing material consumption, increasing climate resiliency, and including eco-friendly designs by building certified green buildings. As of 2020, 34 fabs have received LEED gold international certifications and 23 fabs received EEWH certifications. TSMC also leads the global semiconductor industry with the largest LEED-certified architectural area, and is number one in Taiwan for the largest green building-certified areas and certified green fabs. In addition, TSMC launched the "Plant a Tree Program" in 2020, collaborating with government agencies to obtain land for creating forests and offering the public a healthier, better urban environment.

TSMC built certified green buildings.

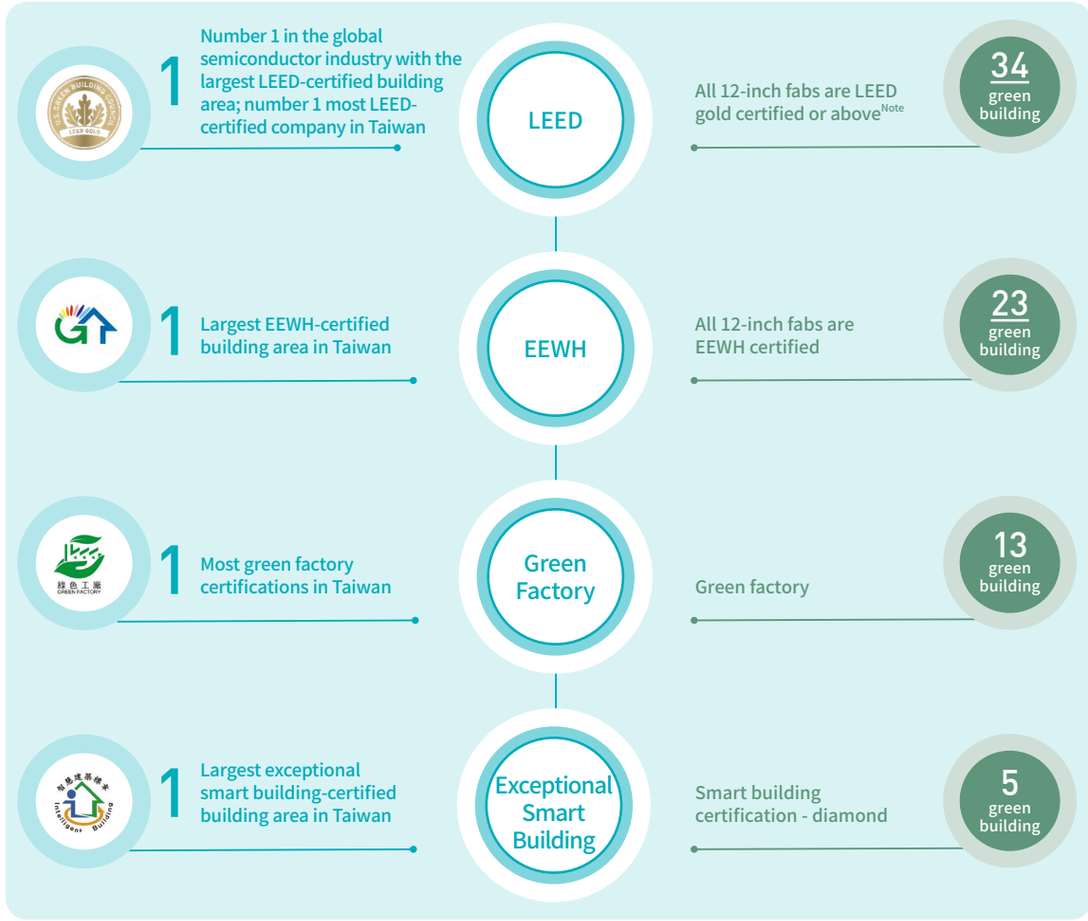
Leading the Industry by Example

In 2020, although COVID-19 caused production and business activities around the world to decelerate, TSMC continued to actively save energy and reduce carbon emissions, hoping to serve as a benchmark for the industry. In 2020, TSMC was once again recognized as an Outstanding Manufacturer for Voluntary Greenhouse Gases Emissions Reduction by the Bureau of Industrial Development, and was rated as a leading enterprise by the Carbon Disclosure Project (CDP) for carrying out green manufacturing commitments.

TSMC has long worked to develop climate mitigation and adaption measures, and we are happy to share our insight and experiences with outside parties. The TSMC-led Taiwan Semiconductor Industry Association (TSIA) Energy Committee regularly engages with 13 association members to share energy-saving experiences and management practices. In 2020, TSMC conserved 500 GWh in energy and helped association members save a total of 300 GWh in energy as well. TSMC also helped members obtain ISO 50001 certifications and was successful with a 71% completion rate. GHG reductions reached 82% in 2020, exceeding the association's goal.[Note]

Note: Declared commitment to energy conservation and carbon reduction at the High-Tech Energy Saving and Carbon Emission Reduction Symposium ; 50% ISO 50001 completion rate and 80% GHG reduction rate in 2020; target for 2025 is 80% ISO 50001 completion rate and 85% GHG reduction rate .

TSMC Built Certified Green Buildings



Note: In 2020, Fab 15B Phase 7 and Fab 18A Phase 1 became newly certified.

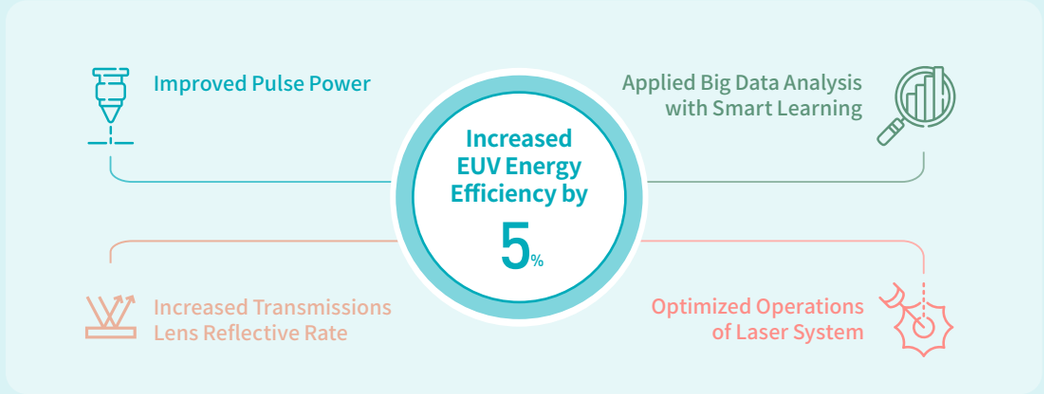
Case Study

TSMC Leads Industry by Applying Big Data Analysis on EUV Machines to Increase Energy Efficiency by 5%

Semiconductor technologies are constantly evolving and Extreme Ultraviolet (EUV) technology is key to the successful evolution to process technologies below 5nm. Unfortunately, energy consumption from EUV machines is more than ten times that of deep ultraviolet (DUV) machines. In order to ensure both process technology advancement and environmental sustainability, TSMC is searching for ways to conserve EUV power consumption and was able to successfully increase energy efficiency by 5% in 2020 through big data analysis and improving mechanisms.

EUV machines are the most advanced machines in semiconductor lithography processes, and there is incredibly high risk associated with product quality when changing any processes. However, TSMC decided to collaborate with suppliers for the New Generation Equipment Energy Conservation Program. Research into EUV machines gave us further insight into the mechanism: EUV is reflected, on average, more than 10 times through a special transmission lens within the EUV machine. Each reflection results in 30% energy loss and so the machine preserves less than 2% of the light source power. In order to increase energy efficiency of EUV machines, TSMC turned to big data to learn about how EUV light is produced, how energy is consumed, and how it operates. We discovered that the pulse created from EUV light and transmissions lens is the main factor in energy consumption, and immediately worked to develop mitigation measures.

In 2020, TSMC first amended equipment programming to achieve optimal EUV light pulse power and redesigned the structure of the transmission lens to increase reflective rate by 3%. TSMC also analyzed data from our carbon dioxide laser system magnifier and realized that by replacing holding frequency with fluctuation frequency, we would be able to increase the magnifier's energy efficiency by 10%. Our three-pronged approach successfully increased the energy efficiency of EUV machines by 5% and the innovative approach has now been applied to new 3nm EUV machines so that we may do our part in conserving energy and reducing carbon emissions.



TSMC successfully increased energy efficiency by 5% in 2020 through big data analysis and improving mechanisms.