Climate Change and Energy Management

Strategies & 2030 Goals	2019 Achievements	2020 Targets
Drive Low-Carbon Manufacturing Continue to use best available technology to reduce emissions of greenhouse gases (GHG), becoming an industry leader in low-carbon manufacturing		
Reduce greenhouse gas emissions per unit of production (metric ton of carbon dioxide equivalent ($MTCO_2e$)/8-inch equivalent wafer mask layer) by 40% (Base year: 2010)[Note]	● Reduced greenhouse gas emissions per unit of production (metric ton of carbon dioxide equivalent ($MTCO_2e$)/8-inch equivalent wafer mask layer) by 17% Target: 16.5% ● Reduced fluorinated greenhouse gas (F-GHG) emissions per unit of production ($MTCO_2e$/8-inch equivalent wafer mask layer) by 65% Target: 60% ◎ Total fluorinated greenhouse gases emissions decreased 15% Target: 15%	Reduce greenhouse gas emissions per unit of production1 (metric ton of carbon dioxide equivalent ($MTCO_2e$)/8-inch equivalent wafer mask layer) by 18%
Use Renewable Energy Continue to purchase renewable energy and establish solar-energy power systems, increasing the use of renewable energy		
Renewable energy accounts for 20% of energy consumption of new fabs starting from 3nm, and the purchasing of renewable energy to increase annually to achieve 25% renewable energy for fabs and 100% renewable energy for non-fab facilities	◎ 910 GWh of Renewable Energy, Renewable Energy Certificates (REC), & Carbon Credit purchased, achieving 6.7% of TSMC's power consumption Target: All overseas sites use renewable energy ◎ Taiwan sites continued to negotiate 700MW of additional long-term renewable energy purchases Target: Negotiating	Continue to purchase renewable energy until it makes up 7% of TSMC's energy consumption, and overseas sites use 100% renewable energy

● Exceeded ◎ Achieved ○ Missed Target

Note: Reduction of greenhouse gas emissions includes reduction of fluorinated greenhouse gas emissions. This indicator will be used as of 2020 to manage the performance of various practices

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Strategies & 2030 Goals	2019 Achievements	2020 Targets
Increase Energy Efficiency Plan for new energy-saving measures each year and actively implement energy-saving measures, increasing the efficiency of energy productivity		
Save 5,000 GWh cumulatively between 2016 and 2030 through implementation of new energy-saving measures	300 GWh energy saved, and cumulatively saved 1,200 GWh Target: 200 GWh; 1,100 GWh	Energy saving goal of 400 GWh, and total energy savings of 1,600 GWh
Double energy efficiency after five years of mass production for each process technology [Note 1]	Energy efficiency of 16-nm and above process technologies in the fifth year of mass production improved 1.4 times on average; energy efficiency of 10-nm technology in the third year of mass production improved 0.7 times on average Target: NEW	Process energy efficiency of 10-nm process technology improves 0.8 times in fourth year of production
	Energy consumption per unit of production increased 17.9% (Base year: 2010) [Note 2] Target: Reduction of 11.5%	
Strengthen Climate Resilience Establish climate change countermeasures and preemptive precautions, lowering the risks of climate disasters		
0 days of production interruption due to climate disasters	0 days of production interruption due to climate disasters Target: 0 days	0 days of production interruption due to climate disasters

● Exceeded ○ Achieved ○ Missed Target

Note 1: Energy efficiency is the product equivalent per each kWh of power (8-inch equivalent wafer-mask layer/kWh)

Note 2: The increased complexity of new process technologies and manufacturing processes results in increased power consumption in new process equipment, causing the power consumption of <10-nm processes to be double that of >16-nm technologies

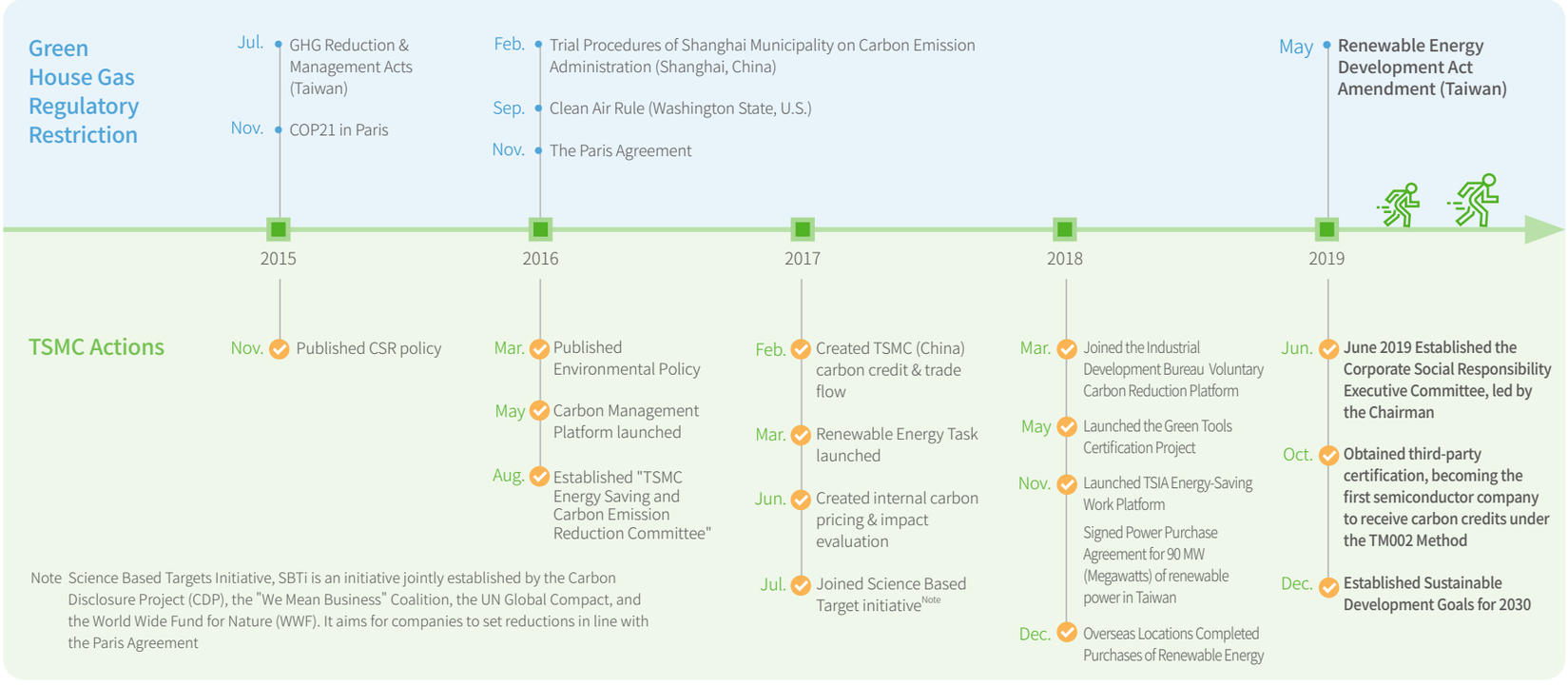
In 2019, the European Parliament declared a climate emergency in response to the frequent climate disasters around the world. TSMC effectively adapted to the potential impacts of climate disasters on business operations by strengthening climate-resilient designs for its facilities and reinforcing emergency response disaster drill plans. Furthermore, the Company purchased 910 GWh of renewable energy and improved its energy management, investing additional resources to the development of energy-saving designs for production equipment. Through a series of relentless efforts, carbon emissions per unit of production continued to decrease, effectively mitigating greenhouse gas emissions.

In 2019, TSMC reported steady decreases in carbon emissions per unit of production while it continued to expand production capacity and develop new technologies. As declared in the Corporate Social Responsibility Policy and Environmental Protection Policy, responding to climate change is the responsibility of sustainable business such as TSMC. Striving to become a world leader in green manufacturing is our mission. We believe that only through cooperation with business partners, industry, government, academia, and all of society can we work together to overcome the severe challenges of climate change.

With the continuous advancement of process technology, integrated circuits are growing increasingly complex and therefore, the power required to manufacture them continues to grow. Even though in 2019 TSMC invested considerable resources into the development of renewable energy and green tools, implemented 503 energy-saving measures, and introduced new energy-saving equipment, energy consumption per unit of production still did not reach the anticipated reduction goals. With a commitment to green manufacturing, TSMC will continue to purchase renewable energy and expand renewable energy power generation to increase the percentage of renewable energy in TSMC's energy structure, reduce greenhouse gas emissions from production activities, and achieve the goals of greenhouse gas reduction.

TSMC established the Corporate Social Responsibility Executive Committee in 2019. Led by the Chairman, TSMC's management team examines a variety of corporate sustainable development issues, and climate change received the greatest focus. In addition to biannual reviews, the CSR Executive Committee must report the company's climate actions and outcomes to the Board of Directors every year. Extreme climate and global warming may lead to potential business crises, and therefore TSMC is focused on three main goals: compliance with regulations, energy conservation and carbon reduction, and the management of carbon assets. In 2019, the Task Force on Climate-related Financial Disclosures (TCFD) framework proposed by the Financial Stability Board (FSB) was used to identify TSMC's 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 operation.

A History of Responses to Climate Change



Note Science Based Targets Initiative, SBTi is an initiative jointly established by the Carbon Disclosure Project (CDP), the "We Mean Business" Coalition, the UN Global Compact, and the World Wide Fund for Nature (WWF). It aims for companies to set reductions in line with the Paris Agreement

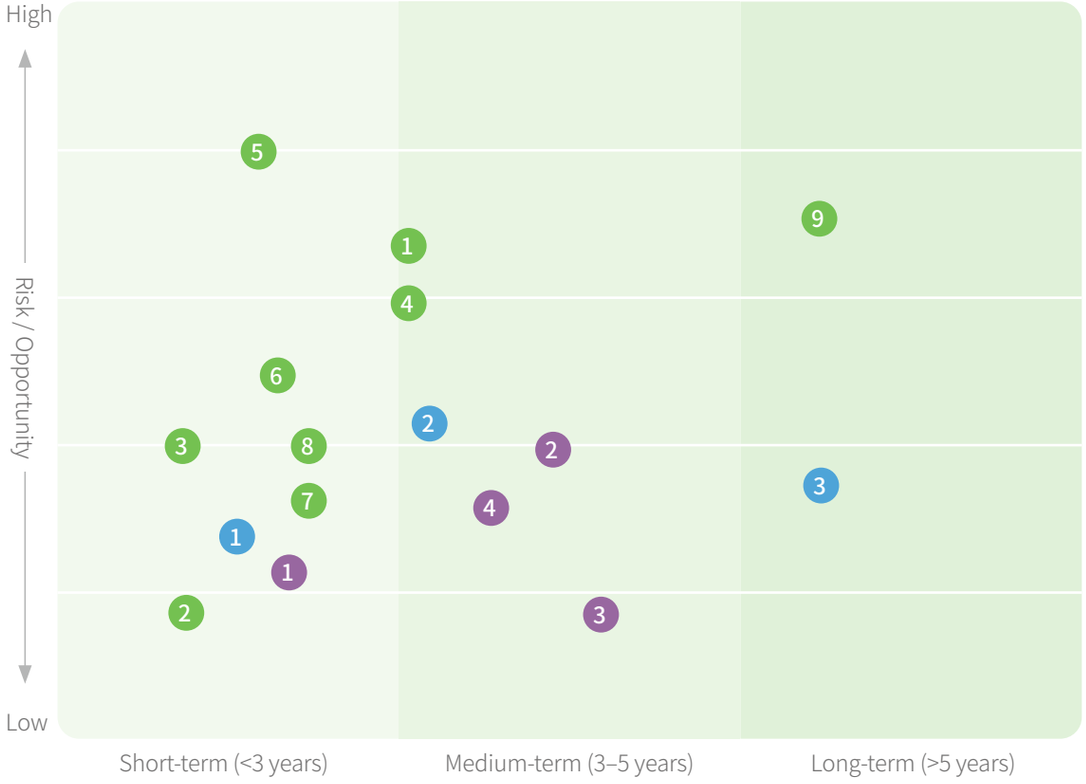
TSMC Task Force on Climate-related Financial Disclosures (TCFD)

	Corporate Management Strategies and Actions	2019 Implementation Status
Governance	• Board of Directors reviews climate change-related risks and opportunities - Corporate Social Responsibility Executive Committee The Corporate Social Responsibility Executive Committee is TSMC's top management organization in climate change management. The CSR Executive Committee is chaired by the Chairman, and the chair of the Corporate Social Responsibility Committee serves is the executive secretary. It reviews TSMC's climate change strategies and goals every six months and reports to the Board of Directors - The Corporate Social Responsibility Committee Chaired by the Senior Vice President of Europe & Asia Sales, the CSR Committee promotes sustainability projects in accordance with its strategies and goals and reviews implementation performance every quarter - The Energy Saving and Carbon Emission Reduction Committee The Energy Saving and Carbon Emission Reduction Committee is the Company's management organization for taking action on climate change risk and opportunity. It is chaired by the Senior Vice President of Fab Operations. Every quarter, this Committee formulates management plans, reviews implementation status, and discusses future plans	✓ Composed of high-level managers from various departments, the CSR Executive Committee was established in December 2019, to set long-term targets and development directions for climate change and renewable energy by 2030. For more details, please refer to the section entitled "CSR Management" ✓ The CSR Executive Committee Executive Secretary and Senior Vice President of Fab Operations jointly presented a report on green manufacturing actions that save energy and reduce carbon, as well as the purchasing of renewable energy and future practices to the Board of Directors, and received the board's support ✓ The Senior Vice President of Information Technology and Materials Management & Risk Management presented a report on climate change-related risk for water resources, power supply and natural disaster to the Board of Directors. Furthermore, backup plans and hardware infrastructure have been established. ✓ 503 energy-saving measures, divided into eight categories, have been planned and implemented, saving 300 GWh of electricity, and making TSMC the first semiconductor company in Taiwan to receive carbon credits under the TM002 Method. For more details, please refer to the section entitled "Increase Energy Efficiency"
Strategy	• Engage in cross-departmental discussions, and identify short-term, mid-term, and long-term climate risks and opportunities	✓ Based on the results of cross-departmental discussions on climate risks and opportunities, nine opportunities and seven risks have been identified in total. For more details, please refer to the section entitled "Climate Risk and Opportunity Matrix"
	• Major climate risks and opportunities are evaluated for the potential impact to Company operations and finance	✓ Completed the Climate Change Risks and Opportunity Evaluation Project, and used the Carbon Pricing mechanism to prompt the promotion and development of energy conservation and carbon reduction activities
	• Carry out scenario analyses and evaluate Science Based Targets (SBT)	✓ Used the 2° C global warming scenario of the Intergovernmental Panel on Climate Change (IPCC) to analyze climate risks during operation, and devised relevant mitigation measures that complied with the Adaptation policy framework for climate change and developed strategies for renewable energy purchasing to meet SBT
Risk Management	• Use the TCFD framework to construct TSMC's identification procedure for climate risks	✓ The TCFD workshop was hosted. Through cross-departmental discussions, climate-related risks/opportunities were identified and ranked, and their financial impact was evaluated.
	• Set appropriate response plans in accordance with climate risk identification and ranking results	✓ Reported climate-related risks/opportunity evaluation results and finacial impact to the chair of the Corporate Social Responsibility Committee, and then carried out response plans
	• Integrated climate risks identification and ranking in Enterprise Risk Management(ERM) process	✓ For more details, please refer to the section entitled "6.3 Risk Management" in the 2019 TSMC Annual Report
Metrics and Targets	• Set management metrics related to climate change	✓ Researched and devised climate change performance indicators, including greenhouse gas emissions per unit of product, renewable energy purchasing, total energy saved, and days of production interruption due to climate disasters. For more details, please refer to the section entitled "Climate Change and Energy Management Strategies, Goals, and Outcomes"
	• Followed ISO 14064-1 to conduct regular inventory of greenhouse gas emissions to examine the impact on the company's operations.	✓ In accordance with carbon inventory results, the risks of Scope 1 emissions were reduced effectively because of continuous implementation of carbon reduction actions. The risk of Scope 2 indirect greenhouse gas emissions due to electricity consumption and the risk of Scope 3 due to supplier indirect emissions continue to increase. For more details, please refer to the section entitled "Greenhouse Gases (GHG) Inventory"
	• Drew up climate change management targets and examine progress and actual performance towards reaching the targets	✓ Set climate change and energy management goals for 2030 in accordance with climate change performance indicators while top management performed reviews on implementation performance on a regular basis. For more details, please refer to the section entitled "Climate Change and Energy Management StrategiesGoals, and Outcomes" and "GHG Reduction Standard Practices"

Climate Risk Matrix

With the support of top management, TSMC has identified and ranked climate-related risks and opportunities by following the TCFD. The Company refers to international research reports on climate risks and opportunities and conducts cross-organizational evaluations of climate change risks and response measures to identify potential risks and possible opportunities in response to climate change. TSMC has set policies and solutions that encompass economic development, environmental protection, and sustainable development. The Company actively implements energy saving, carbon reduction, and water-saving plans; constructs green buildings, establishes CO_2 assets, develops energy-saving products and services, strengthens climate resilience, and develops a culture of environmental sustainability.

Climate Change Risk and Opportunity Matrix



Opportunities

1. Participate in carbon trading/ renewable energy market
2. Obtain government's cooperation and reward
3. Construct green buildings
4. Increase efficiency of water consumption and water recycling
5. Develop low-carbon products and serve the market
6. Increase investors' willingness for long-term investment
7. Strengthen resilience to natural disasters
8. Promote energy-saving and low-carbon production
9. Positive corporate image

Physical Risks

1. Typhoon, flooding
2. Drought
3. Rising Temperature

Transition Risks

1. Energy resources/greenhouse gas laws and regulations
2. Increase in Greenhouse gas emissions costs
3. Unstable energy supply
4. Impact on the Company's image

Financial Impact Analysis of Climate Change

Climate Risks	Potential Financial Impact	Climate Opportunities	Potential Financial Impact	2019 Actions
GHG Restrictions and Carbon Trading System	Restriction on 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	✓ Continued to negotiate the purchasing of additional long-term renewable energy in Taiwan ✓ 910 GWh of Renewable Energy, Renewable Energy Certificates (REC), and Carbon Credit purchased
Increase in Greenhouse gas emissions costs	Increased cost of installation and operation for carbon reduction facilities	Obtain government's reward and cooperation	Accumulate carbon credits in preparation for future expansion of manufacturing capacity	✓ Applied for fluorinated greenhouse gas and nitrous oxide reduction offset project to receive carbon credit
Unstable Utilities (Water, Electricity)	Impact on production, increase in operation costs	Construct green buildings	Lower utility costs	✓ Acquired four green building certificates
		Increase water resource usage efficiency and use reclaimed water sources	Strengthen climate resilience, lower the impact of disasters on production	✓ Maintained water recycling rate greater than 85% while designing new fabs (Fab 18 Phase 2, Fab 15 Phase 7, and Fab 6 Phase 2)
Cost of Developing Low-Carbon Energy Saving Products	Increased cost of developing low-carbon energy saving products	Develop or increase energy-saving products or services	Satisfy customer demands for energy saving products, increase revenue	✓ Invested in the development of energy-saving products
Impact on the Company's Image	Unable to satisfy the expectations of stakeholders, impacting the Company's reputation or image	Increase investors' willingness for long-term investment	Stabilize stakeholder structure, lessen the risk of large stock fluctuations	✓ Boosted green production
Typhoon, Flooding	Production is affected, causing 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	✓ Raised the building base of Fab 18 Phase 2 two meters higher
Drought				✓ Fab 18 Phase 2 committed to using and developing reclaimed water ✓ Established a comprehensive water use monitoring system
Cost of Developing Low-Carbon Energy Saving Products	Increase in energy demand, cost, and carbon emissions	Driving low-carbon green manufacturing	Save energy and cut cost	✓ Conserved 300 GWh of electricity through energy-saving projects

Continue to 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 fluorinated greenhouse gas 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-practice measures for GHG reduction, replacing and installing roughly 1,600 point-of-use abatement equipment for fluorinated GHGs and nitrous oxide in 2019. At the same time, the Company has continued to build green factories and constructed two additional facilities, acquired four green building certificates, and implemented energy-saving projects on production tools and utility facilities , while taking progressive steps to increase the use of renewable energy to effectively reduce the emission of GHG per unit of production.

GHG Reduction Standard Practices

	TSMC Standard Practices	2019 Implementation Status	
Scope 1 Direct GHG Emissions	ISO 14064-1 inventory and third party verification	100%	All fabs and subsidiaries underwent inventory and third party verification
	Optimization of gas quantity used in production	100%	100% introduced GHG-optimized process parameters in accordance with the manufacturing specifications of the Intelligent Engineering Center
	Substitute high global warming potential (GWP) fabrication gases	100%	All 12-inch fabs are now using optimized carbon reduction technology – remote plasma dissociation of nitrogen trifluoride (NF_3), while 6-inch and 8-inch fabs are using nitrogen trifluoride(NF_3)/octafluorobutane(C_4F_8)
	Install Point-Of-Use abatement equipment for fluorinated GHGs	100%	Installed 1,500 POU abatement equipment on new process tools using F-GHG in new and existing fabs (including subsidiaries) Continued to replace and upgrade 111 POU abatement equipment in existing fabs, with installation rate increased to 90%
	Continue to develop on-site nitrous oxide removal technology	5	Continued to develop removal technology, and types of certified equipment increased from 3 to 5 After inclusion as new standard equipment in 2018, new comprehensive equipment was installed in Fab 18
Scope 2 Indirect GHG Emissions	ISO 50001 energy management and third party verification	100%	The Company underwent ISO 50001 inspection and third party verification; 100% of facilities in Taiwan completed third party verification in 2019
	Construct green buildings	1	The Company leads the global semiconductor industry with the largest LEED-certified building area and constructed two more fabs, which received LEED certification and EEWH green architecture certification. In total to date, 32 buildings have received LEED certifications and 23 buildings received EEWH certifications
	Energy efficiency standards	503	Energy efficiency of advanced-technology fab tools leads industry peers, with 503 energy-saving measures implemented and 300 GWh saved
	Next-generation fab tools use energy-saving, carbon-reducing designs	1	Launched an energy conservation project for next-generation fab tools, and in 2019, implemented 110 energy saving projects for 54 process tools. Four vendors completed energy-saving certification for 27 process tools
	Introduce renewable energy	910GWh	Leading semiconductor manufacturer in Taiwan, with 910 GWh of Renewable Energy, Renewable Energy Certificates (REC), & Carbon Credit purchased

Note: Data comparison with industry peers refers to the World Semiconductor Association Report

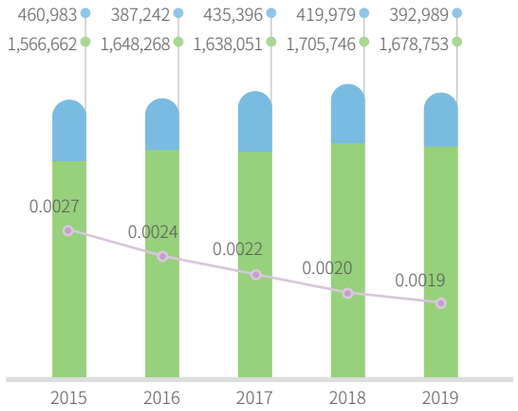
Greenhouse Gases (GHG) Inventory

In 2019, TSMC continued to implement the standard practices of the manufacturing process gases by optimizing the amount of use, minimizing the global warming potential (GWP), and maximizing the removal rate in exhaust, and comprehensively adopted the best available technology. By taking concrete actions, the Company has effectively reduced 320 metric tons CO_2e of direct emissions (Scope 1), of which fluorinated greenhouse gases emissions per unit of production were reduced considerably by 65%, achieving the 2020 reduction goal ahead of schedule. Indirect emissions (Scope 2) due to 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. Currently, TSMC has set energy conservation and carbon reduction goals with its suppliers to work together toward creating a sustainable supply chain. Because GHG emission reduction accounts for fluorinated greenhouse gases emissions, the term "GHG emission per unit of production" will be used as of 2020 to indicate future management performance.

TSMC pays close attention to the various climate actions following the Paris Agreement, including the science-based targets (SBT) of holding the increase in the global temperature to well below 2° C and the 100% renewable energy (RE100) initiative. TSMC is well aware that using renewable energy is the necessary and primary approach for existing companies to achieve the SBT reduction goal. TSMC has continued to grow its production capacity in recent years. Thus, its overall carbon emissions are still increasing, despite the Company's global efforts to implement best practices for energy conservation and carbon reduction, and achieved the goal of reducing carbon emission per unit of production. Moreover, the renewable energy markets in TSMC's major production bases are not equipped to supply as much renewable energy as other European and American countries. In addition to constantly strengthening various green innovations, TSMC also actively promotes regional renewable energy development to identify potential opportunities for carbon reduction.

Scope 1 – GHG Emissions

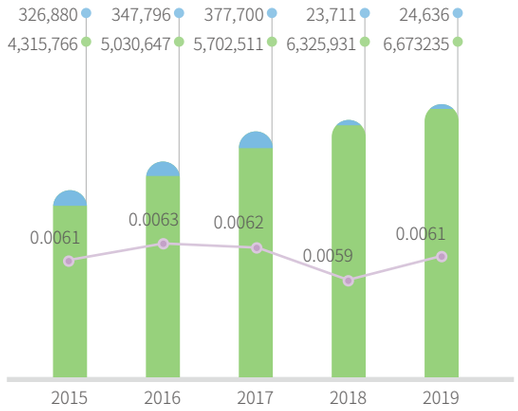
Unit: metric ton CO_2e



- GHG Emission of Taiwan Facilities
- GHG Emission of Subsidiaries
- GHG Emission Intensity (tCO_2e / 8-inch equivalent wafer mask layer)

Scope 2 – GHG Emissions

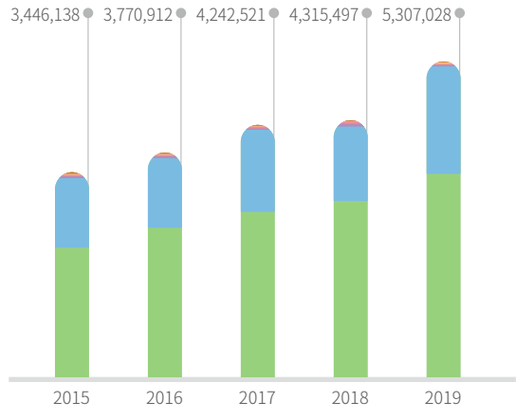
Unit: metric ton CO_2e



- GHG Emission of Taiwan Facilities
- GHG Emission of Subsidiaries
- GHG Emission Intensity (tCO_2e / 8-inch equivalent wafer mask layer)

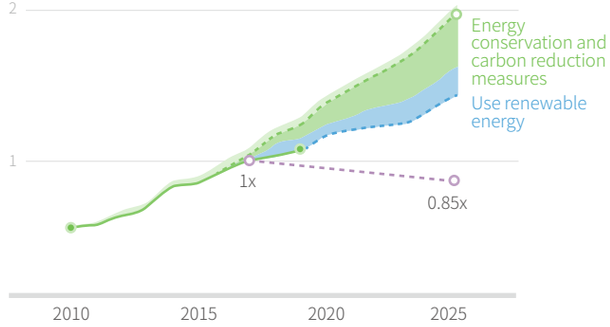
Scope 3 – GHG Emissions

Unit: metric ton CO_2e



- Purchased Services and Products (SimaPro model)
- Downstream Logistics (EPA CFP Database)
- Fuel and Energy Related Activities (EPA CFP Database)
- Employee Commute (EPA CFP Database)
- Operational Waste Management (EPA CFP Database)
- Business Travel Abroad (Boustead model)
- Upstream Logistics (EPA CFP Database)

Greenhouse Gas Emissions and Reduction Roadmap



- Actual carbon emissions
- Carbon emissions pathway with reduction plans
- Carbon emissions pathway without reduction
- Science-based targets

Note 1: The GHG Emission data of scope 1 and scope 2 included TSMC's facilities in Taiwan (wafer fabs, testing and assembly plants), WaferTech, TSMC (China), TSMC (Nanjing), and VisEra.
Note 2: The GHG Emission Intensity data of scope 1 and scope 2 included TSMC's wafer fabs in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra.
Note 3: Emission factor is based on data released in 2019 by the Bureau of Energy stating that 0.554 kg of CO_2 equivalent / kWh, where 1 kg of CO_2 equivalent equals 6,805 kilojoules.

Note 1: Greenhouse gas emissions including Scope 1&2 are normalized on 2017 as baseline.
Note 2: TSMC began introducing Science Based Targets initiative (SBTi) in 2017, which is the base year for reduction.

Increase Use of Renewable Energy

TSMC has been actively installing, using, and purchasing renewable energy in 2019. In addition to compliance with legal obligations, our aim is for 25% of power consumed by TSMC fabs to be supplied from renewable energy, and non-fab power consumption is 100% supplied from renewable energy by the end of 2030. Our long-term goal is to purchase renewable energy until it makes up 100% of TSMC's power consumption. Through purchasing of renewable energy and supporting the government's renewable energy policies, TSMC hopes to drive the application of renewable energy and development of related industries, and practice environmental sustainability.

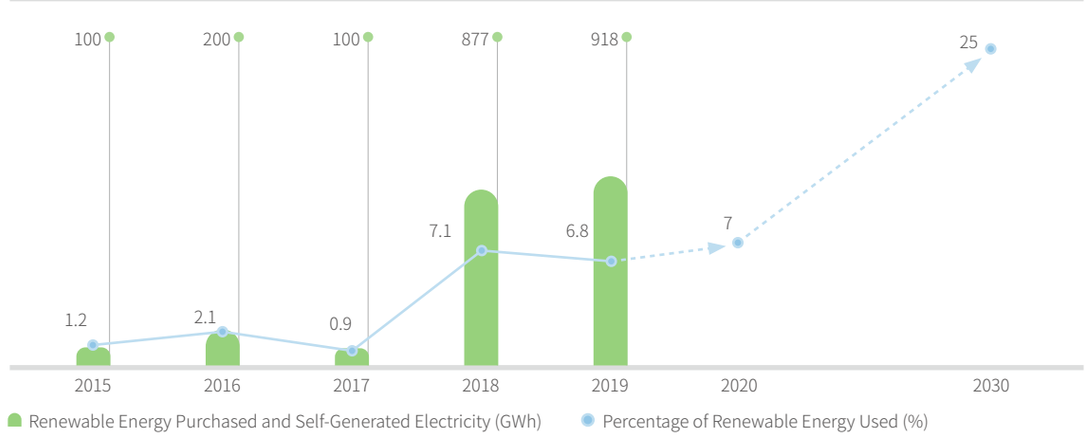
Renewable Energy Purchasing

Starting in 2018, TSMC began to purchase renewable energy, RECs, and carbon credits in countries with comprehensive regulations and ample supply, aiming to completely 100% offset the carbon dioxide emissions from the power used in locations around the world such as the United States, Canada, Europe, China, and Japan. In 2019, TSMC's overseas sites have achieved the goal of zero carbon emissions from power consumption.

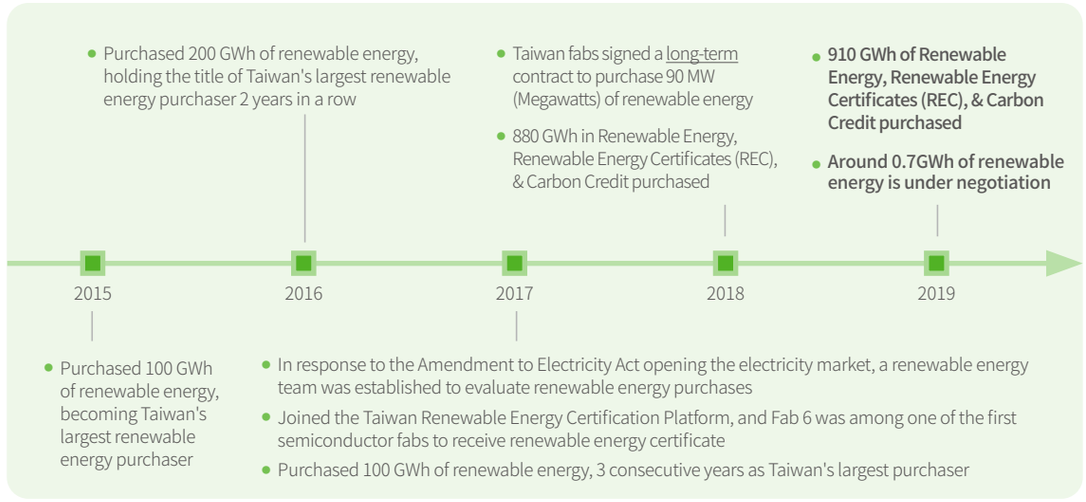
In 2019, TSMC developed strategies to increase the purchasing of renewable energy in Taiwan. Around 0.7GWh of renewable energy is currently under negotiation, which will be supplied to TSMC in the coming years. Since Taiwan's renewable energy development is still in its nascent phase, TSMC has set up a Renewable Energy Development Task Force through which it closely communicates with government through the Allied Association for Science Parks and the Taiwan Semiconductor Industry Association (TSIA) to provide constructive suggestions regarding renewable energy development. For example, TSMC has advised the government to expand offshore wind farms and increase the supply from renewable energy trading platforms. With the collaboration between the Ministry of Economic Affairs, Taipower, Green energy companies and TSMC, renewable energy development in Taiwan has reached a key milestone. 90MW of renewable energy was officially provided to TSMC in early May 2020, making TSMC one of the first companies in Taiwan to purchase retransmitted renewable energy.

The highest governing body of TSMC—the Board of Directors—supports the UN SDGs of affordable and clean energy and climate action, pays attention to renewable energy purchasing issues, and requires the Corporate Social Responsibility Executive Committee to regularly provide reports on renewable energy purchase strategies and progress. TSMC believes that close communication with the government and cooperation with renewable energy providers will accelerate the growth of Taiwan's renewable energy industry, which in turn increases the purchasing of renewable energy and reduces the environmental impact of power consumption.

Use of Renewable Energy and Percentage



TSMC Renewable Energy Development Timeline



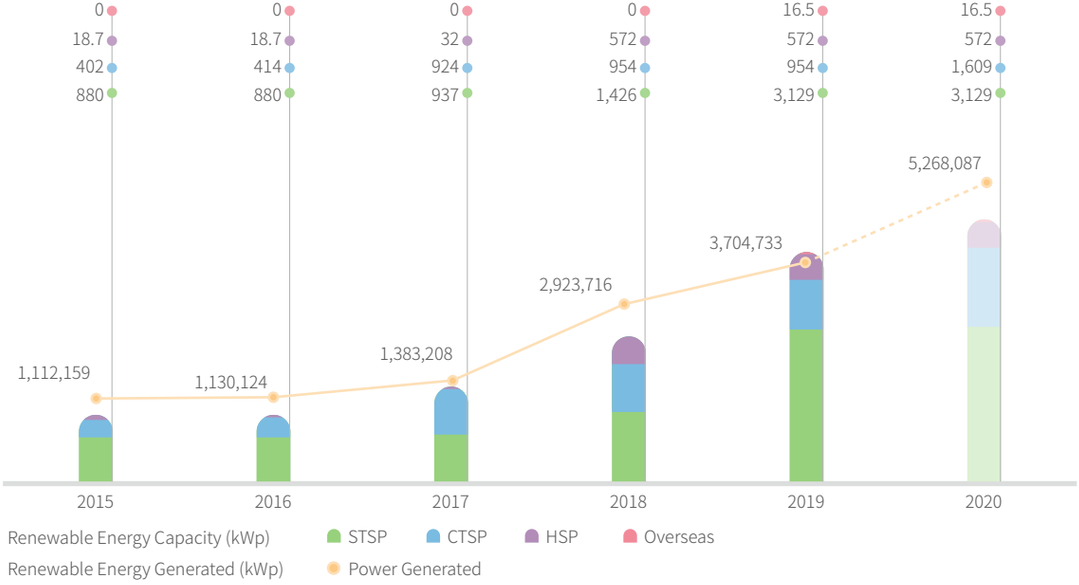
Installing a Renewable Energy Power System

Apart from purchasing renewable energy, TSMC has also installed solar panels at its sites, providing zero carbon emission renewable energy for fabs. In 2019, 1,720kWp of solar panel capacity was installed, and has already provided 3.7 GWh, decreasing carbon emissions by 1,975 metric tons, or the annual carbon absorbed by 197,500 trees. In 2020, an additional 655 kWp in capacity of solar panels will be added, and this is expected to generate up to 5.27 GWh of power.

Increase Energy Efficiency

In light of the continuous growth of production capacity and the development of complex advanced manufacturing processes, improving the efficiency of production energy is a longstanding commitment for TSMC. In addition to setting energy-saving goals in 2019, TSMC also responded to the seventh SDG of the UN: Affordable and clean energy. To meet our goal of doubling energy efficiency by 2030, TSMC has developed the Process Energy Efficiency Enhancement Plan, which aims to manage energy usage, increase power efficiency, and maximize production process efficiency to ultimately double the energy efficiency of each process technology after its fifth year of mass production. In 2019, the energy efficiency of >16-nm process technology improved 1.4 times on average after five years of mass production, and the energy efficiency of 10-nm and 7-nm process technology also improved 0.7 times on average after three years of mass production, reaching their targets for the year.

TSMC Renewable Energy Capacity & Generated



Annual Improvement of Process Energy Efficiency

Note 1: Energy efficiency is normalized on the first Year of 7&10-nm mass production result
Note 2: Data included TSMC's facilities in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra.

Comprehensive Energy Inventory and ISO50001 Third-Party Verification

Energy management is an ongoing responsibility for TSMC. The Company is committed to systematically managing each kWh of power. All fabs in Taiwan have obtained ISO50001 energy management certification in 2019. Insisting on transparent and fair inspection and inventory, TSMC identifies improvement opportunities from its status quo; therefore, as of 2019 following a comprehensive GHG inventory through ISO 14604 verification, TSMC requires all of its fabs to complete the ISO50001 energy management third party verification every year and follow the Plan-Do-Check-Act (PDCA) management model to strengthen their self-management mechanisms and continue to achieve energy conservation and carbon reduction targets.

In 2019, TSMC consumed a total of 14,327 GWh in energy; with electricity making up 94.8%, natural gas coming second at 5.2%, 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 processing facilities to decrease the direct emission of fluorinated greenhouse gases and volatile organic compounds.

Diesel is not used directly in production, but to run power generators and fire pumps during emergencies, power outages, or during annual maintenance.

Focus of PDCA Implementation for Energy Management System

Energy Inventory and Action Plan

Comprehensively conduct energy inventory, analyze energy consumption distribution of equipment, and formulate action plan for energy conservation and carbon reduction

Implementation and Operation

Follow action plan to implement energy conservation and carbon reduction actions, including personnel training, facility efficiency improvement, and equipment replacement

Management Review and Continuous Advancement

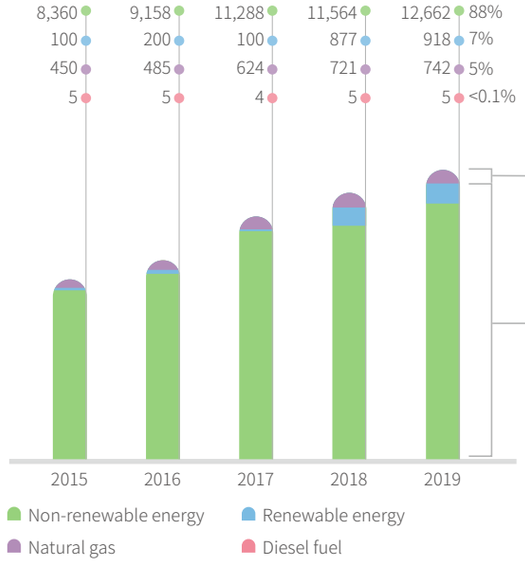
Improve deficiencies according to the gap between the current situation and targets, and carry out various improvement practices to achieve goals, while setting targets for the next phase

Supervision and Measurement

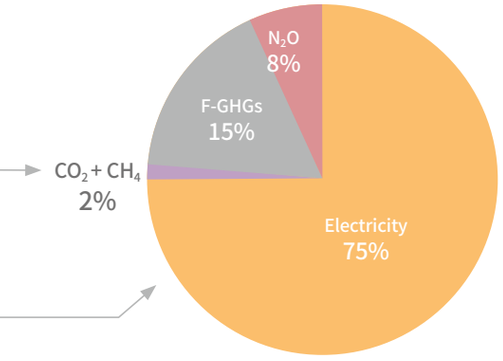
Supervise, measure, and analyze all implementation items, control energy management performance, and ensure energy conservation goals are achieved

Total Energy Consumption

Unit: GWh



Greenhouse Gas Emission Distribution



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

In 2019, increases in advanced process development and process complexity led to increased power consumption in new process equipment, raising the power consumption per unit of 10nm and 7nm production to double that of >16-nm process technologies. Consequently, the overall power consumption per unit of production in 2019 increased by 17.9% compared to the base year and therefore did not achieve the default reduction target of 11.5%. For this reason, TSMC has increased its use of renewable energy each year and also extended its technological innovation to sustainable equipment designs. In 2019, the Company invested resources and collaborated with more suppliers to introduce complete energy-saving plans in the development of next-generation process equipment, with the goal of saving 5,000 GWh of electricity by 2030.

Expanding Energy Saving Measures

At TSMC, the primary consumers of energy are production tools and fab facility systems. At the same time, the Company's Operations and Facilities organizations are the main advocates of energy conservation. TSMC's Energy Conservation and Carbon Reduction Committee has organized a comprehensive range of energy-saving activities in recent years, such as the cross-organizational Energy-Saving Idea Competition, which encourages employees to integrate energy-saving concepts in manufacturing facilities. In 2019, TSMC has carried out a total of 503 energy-saving measures spanning 8 different categories. These measures saved 300 GWh, which is equal to eliminating 160 thousand metric tons of carbon dioxide emissions, and saved NT$750 million in utility fees. By cutting down on carbon dioxide emissions, NT$240 million was saved in potential external carbon costs. To further promote green innovation in the supply chain, TSMC has continuously worked with equipment suppliers to develop next-generation energy saving equipment. In 2019, 110 energy-saving projects were introduced to 54 equipment models, with 45 models reaching average energy savings of 12%, surpassing annual energy targets.

16 Million Trees

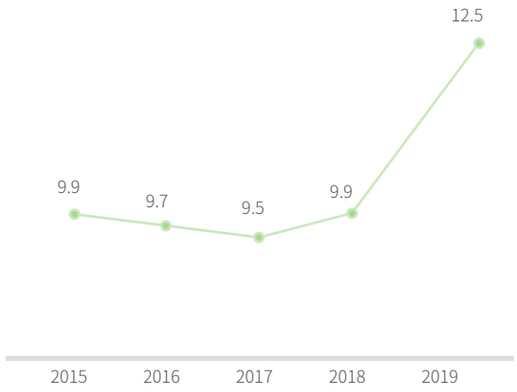
In 2019, TSMC conserved 300 GWh of energy, reducing carbon emissions by 160,000 metric tons, which is the yearly carbon sequestration rate of around 16 million trees

5,000 GWh

Accumulated Energy Saved by 2030

Power Consumption per Unit of Production

Unit: kWh/8-inch equivalent wafer mask layer

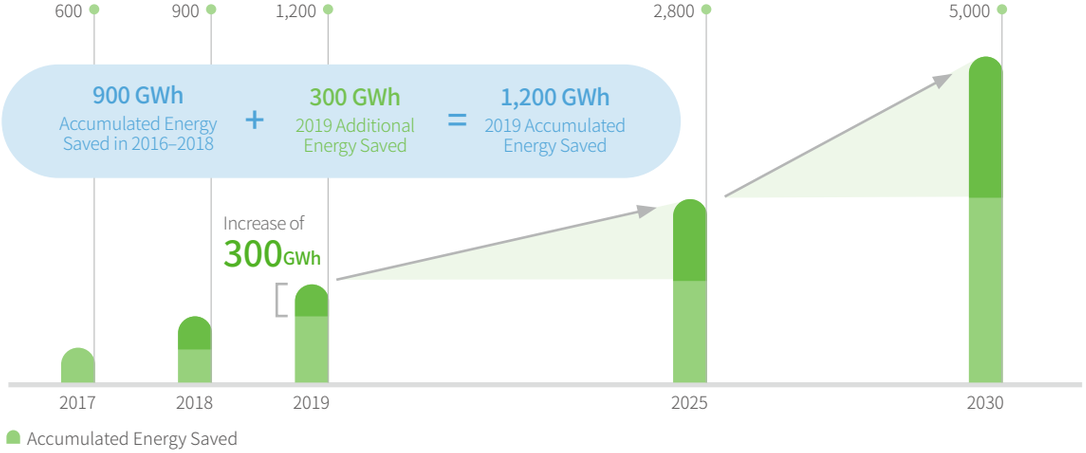


Note 1: Data included TSMC's facilities in Taiwan, WaferTech, TSMC (China), TSMC (Nanjing), and VisEra

Note 2: Diesel and natural gas are excluded from calculations as they are not used for production

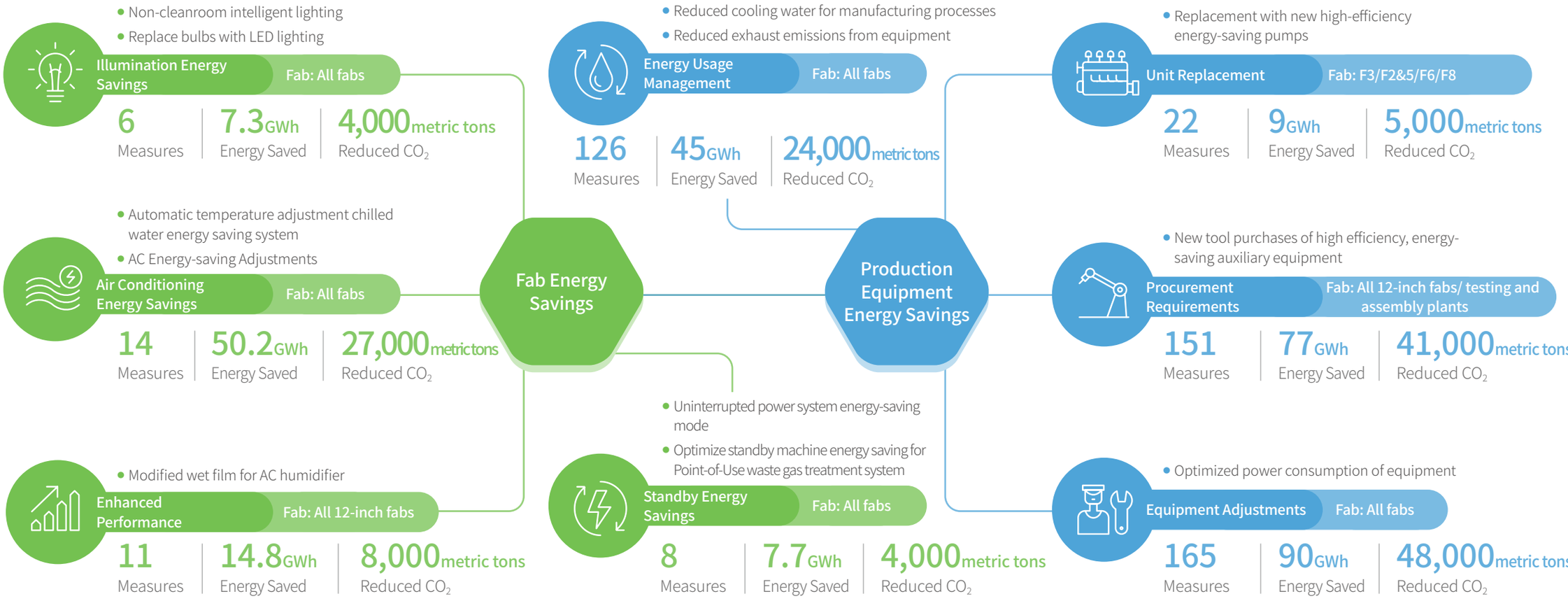
TSMC 15-year Energy-Saving Targets

Unit: GWh



Vertical garden in TSMC Fab18

TSMC Energy Conservation Measures



Note: Carbon dioxide emission is 0.533 kg CO2e/kWh; 1 kWh=3,600 kilojoules

Strengthen Climate Resilience

Resilience to climate disasters is an integral part of corporate operations in an increasingly extreme climate environment. Using 2° C-global warming and worst-case disaster scenarios, TSMC identifies key factors from climate change and extreme weather each year that could affect operations such as droughts, high temperatures, power shortages, floods, and wind damage, and establishes standard guidelines for all fabs to strengthen operational resilience. The Company successfully achieved its target of undisrupted production in 2019, and successfully protected against possible natural disasters and business losses brought on by climate change.

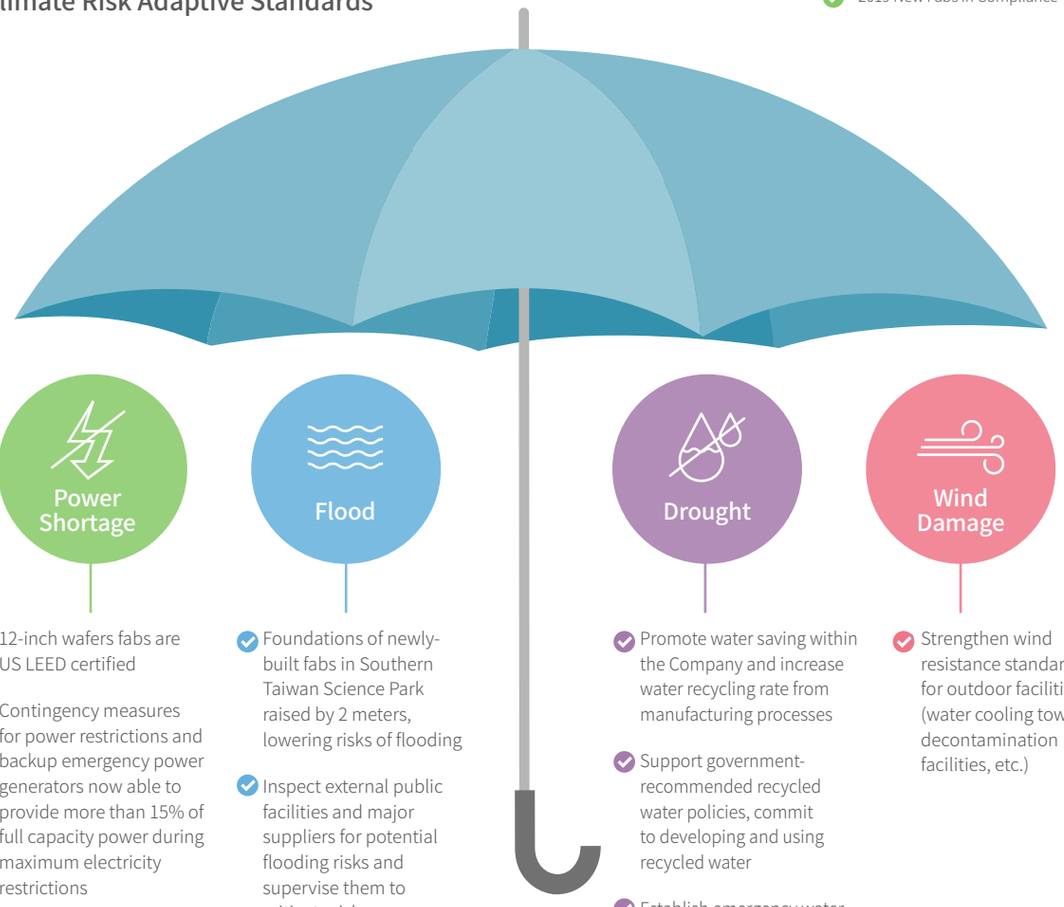
By constructing fabs in compliance with international and domestic green building certifications, TSMC can not only reduce the consumption of water, electricity, and other resources during the construction and operation processes but also increase the climate resilience of buildings. Meanwhile, ecological operation features were incorporated in architectural designs to promote the co-existence of industrial production and ecological sustainability.
As of 2019, 32 fabs have received LEED gold international certifications and 23 fabs received EEWH certifications. TSMC is also leads the global semiconductor industry with the largest LEED-certified architectural area, and number one in Taiwan for largest green building-certified areas and certified green fabs.

For more details, please refer to the article titled Bring Back the Environment- TSMC Ecological Sustainability Park that Technology and Ecology Co-exist on the TSMC Corporate Social Responsibility website

U.S. LEED Green Architecture	1 Number 1 in the global semiconductor industry with the largest LEED-certified building area, number 1 most LEED-certified company in Taiwan	32 green buildings All 12-inch fabs are LEED certified
Taiwan Green Architecture EEWH	1 Largest EEWH-certified building area in Taiwan	23 green buildings All 12-inch fabs are EEWH certified
Green Factory	1 Most green factory certifications in Taiwan	12 green buildings Green Factory
Exceptional Smart Building	1 Largest exceptional smart building-certified building area in Taiwan	

Climate Risk Adaptive Standards

2019 New Fabs in Compliance



Power Shortage
- 12-inch wafers fabs are US LEED certified
- Contingency measures for power restrictions and backup emergency power generators now able to provide more than 15% of full capacity power during maximum electricity restrictions

Flood
- Foundations of newly-built fabs in Southern Taiwan Science Park raised by 2 meters, lowering risks of flooding
- Inspect external public facilities and major suppliers for potential flooding risks and supervise them to mitigate risks
- Install flood doors for existing fabs and buildings in areas with high flooding risk

Drought
- Promote water saving within the Company and increase water recycling rate from manufacturing processes
- Support government-recommended recycled water policies, commit to developing and using recycled water
- Establish emergency water shortage measures: maintain water storage facilities in each fab with 2 days water usage capacity, prepare water tankers and sources of water that can provide 20% of water supplies during maximum water restrictions

Wind Damage
- Strengthen wind resistance standards for outdoor facilities (water cooling towers, decontamination facilities, etc.)

Setting an Example to Lead Industry Learning

TSMC's active energy-saving and carbon-reducing performance has been registered on the Voluntary Greenhouse Gases Emissions Reduction Platform of the Bureau of Industrial Development. Through the government's yearly verification, TSMC has been recognized as an Outstanding Manufacturer for Voluntary Greenhouse Gases Emissions Reduction by the Bureau of Industrial Development. TSMC has comprehensively adopted the industrial best practice measures of reducing fluorinated greenhouse gases used in production. This approach was verified by a third party in 2019, making TSMC the first semiconductor company in Taiwan to receive carbon credits under the TM002 Method. In the future, the Company will fulfill its commitment to green manufacturing by using the carbon credits obtained from this reduction method to reduce greenhouse gas emissions from TSMC's manufacturing processes.

For more details, please refer to the article titled Green Efforts Pay off as TSMC Becomes Taiwan's First Semiconductor Company to Receive Carbon Credits under the TM002 Method on the TSMC Corporate Social Responsibility website

TSMC has spent years adjusting its operations to mitigate the impacts of climate change and is more than happy to share its environmental knowledge, experience, and optimization measures through public associations so that industry standards can be improved. These measures include six dimensions of eight energy-saving measures, such as the three energy-saving steps of intelligent chilled water system and energy-saving measures for uninterrupted power systems and wafer cleaning hot water recycling systems. In 2019, the TSMC-led Taiwan Semiconductor Industry Association (TSIA) Energy Committee established an energy-saving task force. The task force regularly engages with members of 13 associations to share energy-saving experience and management practices, enabling an additional 200 GWh of electricity to be saved on top of the 300 GWh electricity saved by TSCM. Also in 2019, TSMC joined forces with flat panel display manufacturers and packaging/testing industries to host the High-Tech Energy Conservation and Carbon Reduction Forum. Together, they promised to create a sustainable industry by achieving the following energy management goals by 2025: Adopt ISO50001 in 80% of manufacturing facilities and reduce GHG emissions by 85%.

Fab 15 was recognized as an Outstanding Manufacturer for Voluntary Greenhouse Gases Emissions Reduction by the Bureau of Industrial Development

TSMC passed the third party certification under the TM002 Method

Mark Liu, the Chairman of TSMC, is the Chairman of the Taiwan Semiconductor Industry Association (TSIA). Chairman Liu and other semiconductor, panel display, and packaging/testing manufacturers, jointly declare their commitment to energy conservation and carbon reduction at the High-Tech Energy Conservation and Carbon Reduction Forum

Case Study

Taking the Lead in Joining Forces with Suppliers to Develop World-class Semiconductor Green Tools

As the world's largest dedicated IC foundry company, TSMC is committed to creating a sustainable semiconductor supply chain. Because the power consumption of process equipment accounts for more than 50% of the company's energy use, and the number of advanced process equipment is increasing every year, TSMC has collaborated with equipment suppliers since 2016 to develop green tools for semiconductor manufacturing. Before these new tools were introduced, TSMC completed energy-saving design verification, installed energy-saving components, and expanded the energy-saving effects of advanced process equipment.

TSMC is the first semiconductor company in the world to ask its equipment suppliers to introduce energy-saving measures. Based on the assessments of the Energy and Carbon Reduction Committee, in 2018–2019 TSMC invited seven semiconductor manufacturers and suppliers around the world to host hundreds of discussion forums and extensively analyze the energy consumption parameters of all advanced fab tools, subsequently leading to the launch of the Energy Conservation Action Project for Next-Generation Fab Tools. From energy-saving ideas, planning, simulation testing to product verification, this process is continuously repeated, and energy-saving specifications are incorporated into new fab tool procurement standards, demonstrating TSMC's commitment to saving energy. TSMC expects that energy savings will be achieved to 20% by 2030 to drive the positive cycle of the industry and supply chain.

Thanks to the relentless efforts of more than 300 TSMC employees, 250 energy saving action plans were proposed in 2019, of which 110 plans were approved, verified, and applied to 54 types of 5-nm advanced process tools. High-efficiency parts and energy saving designs have been incorporated into 11 types of energy-intensive components. TSMC expects that 200 GWh of electricity will be saved in 2020 due to the use of 5-nm energy-saving fab tools. In addition, the Company developed the "green tools certification system" in 2019, and completed the green certification of 27 types of fab tools for four equipment suppliers.

Milestones for Next-Generation Energy Saving Equipment

1 Initiate (2016)
- Set goal to save 20% of energy in new process equipment
- Work with top 5 suppliers of energy-intensive equipment to initiate energy saving equipment design

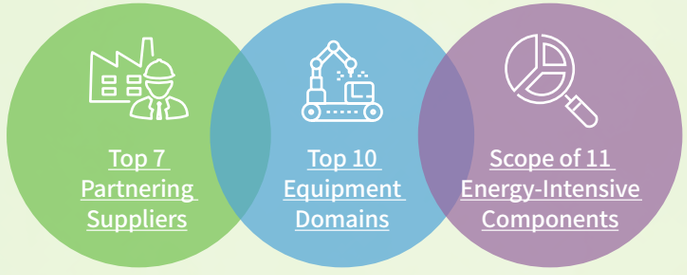
2 Plan (2017)
- Top 5 suppliers propose energy conservation plans and engage in regular discussion and review with TSMC

3 Verify (2018)
- Complete the verification of 37 energy conservation measures
- Apply to 20 equipment models to save 10% of energy on average

4 Expand (2019)
- **Expand to include top 7 suppliers of energy-intensive equipment**
- **Complete the verification of 110 energy conservation measures**
- **Apply to 45 equipment models to save 12% of energy on average**
- **Develop a "green tools certification system"**

5 Introduce (2020)
- Use energy saving equipment in 5-nm process

Suppliers, Domain, and Scope of New Equipment Energy Conservation Cooperation



110
Energy saving action plans were verified

54
Types of tools were applied

27
Types of green tools were certified