

Executive Summary

Climate change has been the most serious international environmental issue confronting human survival in the 21st century. In response to the global trend of climate action and regulatory development, Taiwan promulgated its *Greenhouse Gas Reduction and Management Act* (hereinafter “GHG Reduction and Management Act” or “the Act”) in 2015. The Act clearly sets out a long-term greenhouse gas reduction target of a 50% reduction of 2005 levels by the year 2050.

Since Taiwan issued the first *National Communication* in 2002 and the second version in 2011, Taiwan’s third National Communication has been prepared with the entry into force of the *GHG Reduction and Management Act*. In the spirit of the United Nations Framework Convention on Climate Change (UNFCCC) which requests its parties to regularly publicize their implementation of national climate action, Article 13 of the Act stipulates that the central competent authority shall compile a national GHG report every three years for submission to the Executive Yuan, whose approval will then pave the way for the report’s release to the general public. In accordance with the enforcement rules of the Act and the UNFCCC national communication preparation guidelines, the Environmental Protection Administration (EPA) has compiled sectoral strategies and outcomes to deal with climate change. Taiwan’s third *National Communication* contains nine chapters which cover national profile and basic environmental status, greenhouse gas emission statistics and trends analysis, Taiwan’s policies and measures for greenhouse gas reduction, greenhouse gas emission forecast, climate change observation and science study, influence of climate change and adaptation measures,

technical R&D, demand and transfer, international cooperation and exchanges, and education, training and public awareness, all of which are summarized as follows:

Chapter 1: National Profile and Basic Environmental Status

Situated at the intersection of East and Southeast Asia, Taiwan borders the Pacific Ocean on the east, the Taiwan Strait on the west, and Bashi Channel on the south, is near the Ryukyu Islands, and spans from 119 to 124 degrees east longitude and from 21 to 26 degrees north latitude. Shaped like a spindle, Taiwan Island is about 394 km long and 144 km wide, has 1,139 kilometers of coastline and a land area of 36,179 square kilometers. Its effective territory includes the main island and affiliated islands--the Penghu archipelago, the Kinmen archipelago, the Matsu archipelago, the Pratas, and the Nansha Islands--covering a total area of 36,179 square kilometers. Taiwan Island has an average temperature of around 24°C . The average maximum temperature is 25 to 29 °C, and the minimum temperature does not exceed 22 °C. The average annual precipitation is about 2,500 mm.

Taiwan’s population exceeded 22 million in 1999. By the end of September 2018, the population was 23.58 million. Its average population density is 651 people per square kilometer. After a negative economic growth caused by the financial crisis of 2009, its economic structure led to a surge in 2010 with an economic growth rate of 10.63%. In 2017, the economic growth rate was 2.89%.

Taiwan’s energy supply in 2010 was 143.08 million kiloliters of oil equivalent. In 2017, it increased to 146.64 million kiloliters of oil equivalent. For energy supply sources of 2017, self-served energy made up 2.02%, while energy imports made up 97.98% of the total energy supply with oil and coal being the main energy sources. In recent years, Taiwan has actively developed renewables, such as solar, geothermal, wind, biogas, and solar thermal. In energy consumption, the highest consuming sectors were the industrial and transportation sectors.

The transportation industry includes land, sea, and air transportation. Land transportation mainly involves road and railway. As of the end of 2017, the total road length in Taiwan was about 21,713.8 kilometers. Sea transportation covers international and round-the-island service. Air transportation currently

involves seven civil air carriers, connecting with 141 cities around the globe with operation of 296 air routes, of which 211 are international passenger routes and 85 are freight routes.

Chapter 2: Greenhouse Gas Emission Statistics and Trend Analysis

Taiwan’s greenhouse gas (GHG) emission statistics are derived based on methodology according to the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories and with reference to uncertainty management and IPCC’s good practice guidelines. The statistics are estimated by sectoral GHG emission and removal according to actual situations.

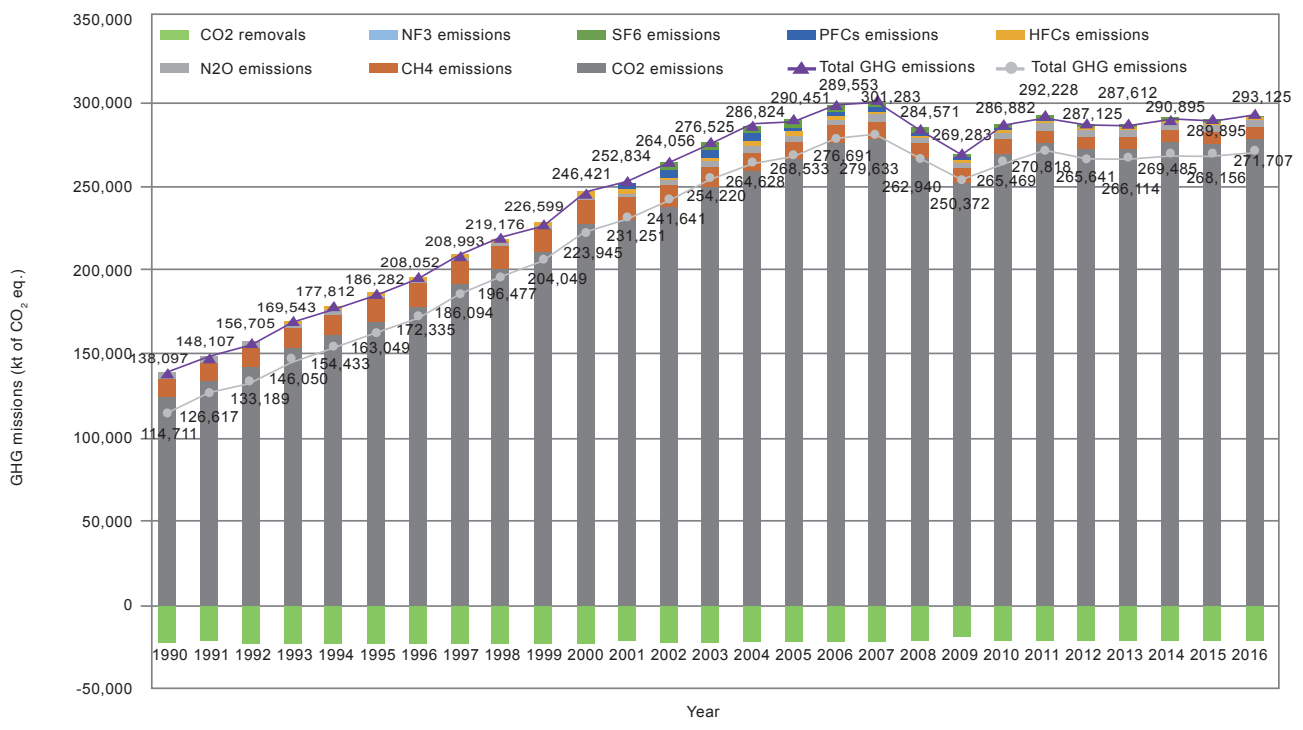


Figure 1 Trends in total GHG emissions and removals in Taiwan from 1990 to 2016
Source: Taiwan Environmental Protection Administration. 2018 Taiwan Greenhouse Gas Inventory Report.

The total GHG emission increased from 138,097 kilotons of carbon dioxide equivalents (excluding carbon dioxide removal) in 1990 to 293,125 kilotons of carbon dioxide equivalents (excluding carbon dioxide removal) in 2016, an increase of 112.26% and an annual growth rate was 2.94%. The data are shown in Figure 1.

By gas type, the largest source of greenhouse gas emission in Taiwan is carbon dioxide, followed by methane (CH₄), nitrous oxide (N₂O), sulfur hexafluoride (SF₆), perfluorocarbon (PFCs), hydrofluorocarbon (HFCs), and nitrogen trifluoride (NF₃). Between 1990 and 2016, trends in GHG emissions by sector are shown in Figure 2.

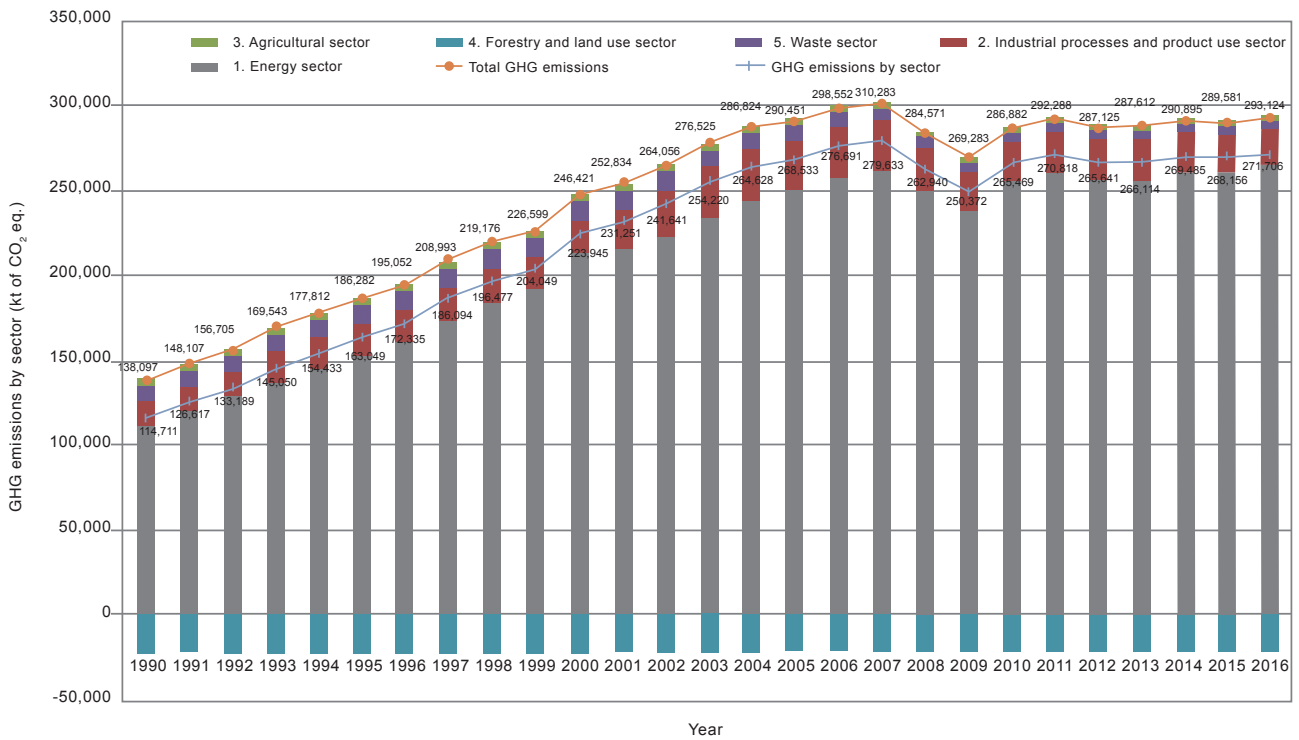


Figure 2 Trends in GHG emissions by sector in Taiwan from 1990 to 2016

Source: Taiwan Environmental Protection Administration. 2018 Taiwan Greenhouse Gas Inventory Report.

Chapter 3: Taiwan's Greenhouse Gas Reduction Policies and Measures

In response to climate change and calls for GHG reduction, which can be local, regional and international issues, Taiwan regards combating climate change as part of international cooperation and a collective responsibility and has made every effort to incorporate the spirit of the UNFCCC into its domestic law.

On legislation with respect to greenhouse gas reduction, Taiwan has the *Greenhouse Gas Reduction and Management Act*, the *Renewable Energy Development Act*, and the recently amended *Energy Management Act* and the *Electricity Act*. The *GHG Reduction and Management Act* is the legal foundation for the country to address climate change, obligating the central and local authorities to work on climate change mitigation and adaptation from their respective levels.

In accordance with the *GHG Reduction and Management Act*, the *National Climate Change Action Guideline* was approved by the Executive Yuan in 2017, which proclaims Taiwan's policy orientation in response to climate change upholds the balancing of mitigation and adaptation, setting out 10 basic principles for the nation's climate action. Meanwhile, the *GHG Reduction Action Plan* approved by the Executive Yuan in 2018 covers periodic regulatory goals, six sectoral reduction strategies for energy, manufacturing, transportation, residential and commercial, agriculture and environment, and eight inter-ministerial supporting policies. The criteria and indicators are set out for evaluation, which aim to integrate the performance from ministries to collaboration on GHG reduction.

The promotion strategies for the energy sector include: building a supply system of low-carbon energy; promoting energy transition, by 2025 expanding the use of renewable energy to 20%, natural gas to 50%, and gradually reducing coal-fired power generation below 30%; reducing power emission factors per degree from 0.529 kg CO₂ in 2016 to 0.492 kg CO₂ in 2020.

The promotion strategies for the manufacturing sector include: upgrading industry guidance on GHG reduction; launching industry transformation; and carrying out sustainable process of production. By 2020, the sector expects to lower 43% carbon intensity compared with 2005; and will boost an estimated NT\$25 billion investment.

The promotion strategies for the transportation sector include: gradually increasing the traffic volume of public transportation to 7% growth in 2020 compared with 2015; switching the use of private vehicles to public transit systems; driving 100% electrification of public-owned vehicles and urban buses by 2030, electrification of newly sold motorcycles by 2035, and electrification of newly sold cars by 2040.

The promotion strategies for the residential and commercial sector include: improving the energy-saving design benchmark value of building exteriors; strengthening management of GHG reduction for existing buildings; planning and building mitigation ability of the competent authorities of the commercial sector.

The promotion strategies for the agriculture sector include: purchasing and recycling fishing ships and vessels; rewarding fishing season off; promoting organic and eco-friendly cultivation; implementing dual

system of green environmental payment and guaranteed purchase; promoting reuse of animal farm biogas for electricity generation; maintaining and securing the self-sufficiency rate of livestock and poultry products; reforestation; enhancing forest management.

The promotion strategies for the environment sector include: considering resilience building and mitigation plans during policy making and environmental assessment on development projects; realizing circular use of energy and resources to explore an open and shared economy society; improving reuse of regional energy and resources; reducing GHG emission from the process of waste and sewage treatment.

Chapter 4: Greenhouse Gas Emission Forecast

Taiwan has set long-term targets for GHG reduction, and regulatory goals in stages on a five-year basis in accordance with the *Greenhouse Gas Reduction and Management Act*. This chapter introduces the forecasts of GHG emissions of various sectors from 2017 to 2030 through hypothetical

scenarios and model tools based on the allocation of reduction targets among sectors and national reduction path planning.

To present the outcome of sectoral forecast on the same scenario and background, the common design conditions include overall economic growth forecasts, population and household growth projections, and power demand forecasts. It is estimated that Taiwan’s net GHG emissions in 2020 will decrease by 2.09% compared with the base year of 2005, 1.01% compared with the year 2015. By sector, in 2020 energy and transportation sectoral emission will increase compared with the year 2015. The net GHG emissions in 2025 will decrease by approximately 9.88% compared with the base year of 2005; in 2030 it will decrease by approximately 10.06% compared with the base year of 2005. Taking into account of the uncertainty and that Taiwan’s pathway of reducing carbon emissions slowed down before accelerated, the nation’s total net GHG emissions will fall to 260.717 million Mt CO₂e by 2020, and 10% down by 2025 compared with the base year, and 20% down by 2030 compared with the base year as part of future efforts.

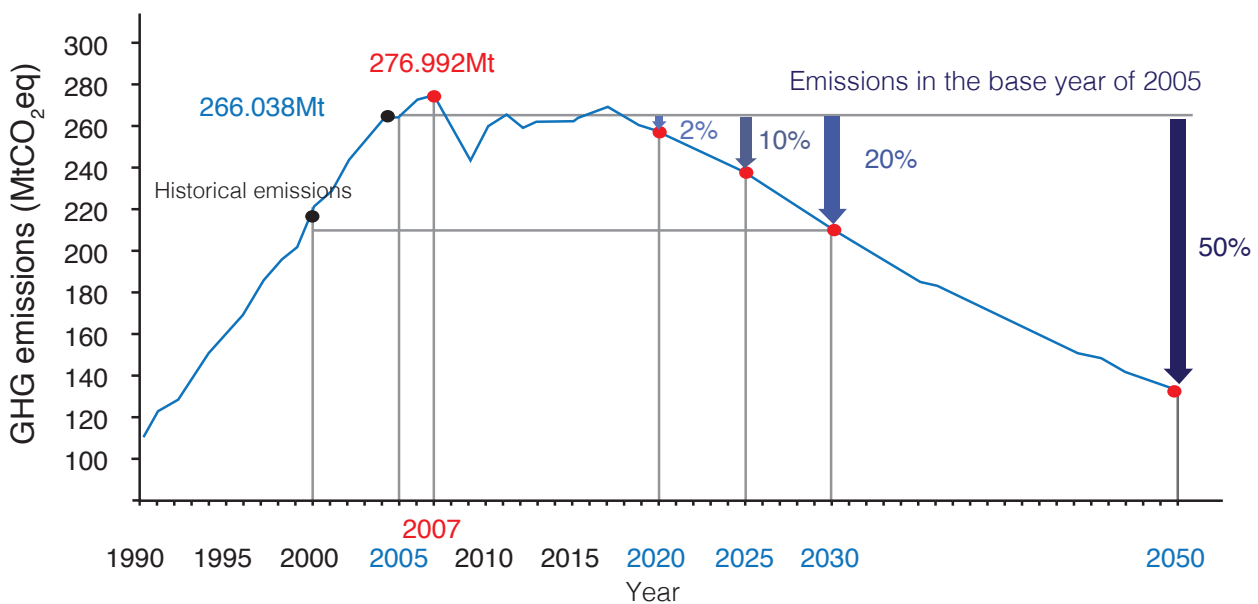


Figure 3 GHG reduction path in Taiwan

Source: Executive Yuan Environmental Protection Administration

Chapter 5: Climate Change Observation and Science Study

Taiwan's weather observation mainly covers ground and high altitude weather observation, radar weather observation, sea state observation, and hydrologic observation. They include various meteorological elements and atmospheric data, such as wind direction, wind speed, rainfall, barometric pressure, temperature, hydrology, sea state, ultraviolet ray, air quality and atmospheric composition, in addition to meteorological satellite observation. Besides satellite information from the United States and Japan, the FORMOSAT-3/COSMIC satellites developed by the National Space Organization of the National Applied Research Laboratories observe global atmospheric conditions and provide Taiwan and meteorological institutions worldwide with pertinent data.

To improve its capabilities in meteorological observation, forecasting and climate change research, Taiwan launched the Disastrous Weather Monitoring and Forecasting Operations Construction Program (2010-2015) and the Climate Change Application Service Capacity Development Program (2014-2017). Its research focused on climate model development and application, climate change analysis, and climate application promotion. Based on climate science data accumulated over the past, the government formulates response, adaptation measures and decision-making on climate change, while developing scientific research on climate change and performing specific impact assessment.

Given Taiwan's geographical condition of being surrounded by the ocean, sea state observation is a focus of climate change research and response. Future work of climate forecasting will aim at establishing

a joint ocean-atmosphere forecasting system, which combines ocean circulation models with atmospheric ones, while predicting the state of the ocean and atmosphere, so that the two-way interaction between the ocean and atmosphere can be simulated more accurately. Future work of climate system observation will include promoting refined and customized service of meteorological data and smart application; improving facility and forecasting skills of sea state observation to enhance environmental service on sea area disaster prevention; developing the ability to warn against natural disasters, such as earthquakes and tsunamis.

Chapter 6: Climate Change Impact and Adaptation Measures

In the past four decades (from 1980 to 2017), temperature rise in Taiwan accelerated significantly at an increasing rate of about 0.30 to 0.50°C every 10 years. From 1900 to 2017, the average temperature of the whole year and the summer half of the year (May-October) increased by about 1.3°C, while the winter half of the year by 1.2°C. In the last century, precipitation varied between the south and the north; and due to the increasing fluctuation in precipitation in a year between the rainy season and non-rainy season, the difference between dry season and wet season has become more and more pronounced. Although total precipitation has not changed much, the chance of heavy rainfall has increased. From 1970 to 2010, the typhoons that struck Taiwan show a trend of decelerating in speed but longer periods of influence. Meanwhile, precipitation of heavy rainfall (the level of 95 percentile) has increased.

In 2010, Taiwan has set up a task force to "plan and promote climate change adaptation policy guidelines and action programs," jointly develop the

Adaptation Strategy to Climate Change in Taiwan and construct a framework for promoting adaptation in Taiwan. Referring to the future situation and research results of climate change in Taiwan discussed in the *2011 Taiwan Climate Change Science Report*, as well as to the adaptation actions taken by various countries and the particularity and historical experience of Taiwan's environment, the *Adaptation Strategy to Climate Change in Taiwan* which was approved by the Executive Yuan in 2012 divided national adaptation into eight areas that are most seriously affected:

disasters, infrastructure, water resources, land use, coastal zones, energy supply and industry, agricultural production and biodiversity, and health. To put the adaptation strategy into action, eight working groups are set up under the Organization of the National Adaptation Policy Framework to assist in planning and promoting adaptation-related work, which have been compiled with the *National Climate Change Adaptation Action Plan (2013-2017)* by the National Development Council (NDC).

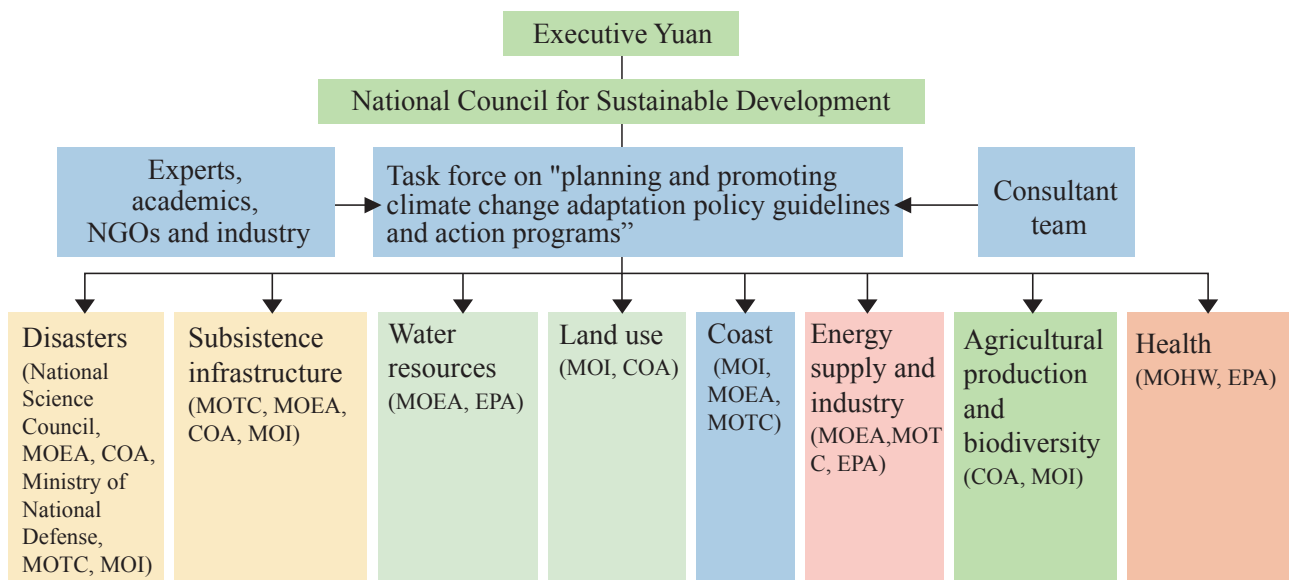


Figure 4 Taiwan’s national climate change adaptation policy guideline and division of work in eight areas among the ministries

Source: NDC, National Climate Change Adaptation Policy Guidelines, 2012.

Chapter 7: Technical R&D, Demand and Transfer

To develop available technology and techniques to respond to climate change, the international community has incentivized technology R&D, innovation and cooperation. Collaborated with global market mechanism and climate financing, countries stocktake and list the technology and techniques items that they need, planning and promoting domestic action plans to import or export relevant technology for technology transfer and diffusion. Taiwan also invests in the R&D of climate technology, climate service, and relevant industries, which can be divided into two categories of the “mitigation and energy technology” and “climate service and adaptation technology.” Cases of technology demand and technology transfer will be introduced.

As for the development of climate technology, climate service, and relevant industries, Taiwan promotes “mitigation and energy technology” with the R&D program of National Energy Program Phase I (NEP I) in 2007 and Phase II (NEP II) in 2014, studying the basis of energy technology, emphasizing the implementation of energy industry, focusing on verification of technology industrialized potential, and applying the results to implementation. The NEP programs have made significant progress in the focus of energy conservation, alternative energy, smart grid, offshore wind power and marine energy, geothermal and gas hydrate, carbon reduction and clean coal, which play important roles in the area of energy technology. Faced with the influence and impacts of climate change, Taiwan is developing climate service and adaptation technology, providing climate forecasting information based on science and climate service for the public to be aware of climate risk and the and government to manage it. Information on

climate change analysis and projections is provided as reference for government authorities when planning climate change adaptation strategies.

Taiwan’s climate change technology roadmap involves technology R&D, diffusion and transfer as tools to identify the natural conditions and technology demand of Taiwan’s marine energy; and importing applicable offshore wind power technology. In the spirit of the UNFCCC and Paris Agreement, Taiwan is promoting and endeavoring to participate in global climate cooperation with competent authorities and relevant ministries of international aid. To implement mitigation and adaptation technology during international climate actions, Taiwan makes solid contribution via technology transfer to its friendly or ally nations, such as the Solomon Islands, Nicaragua, Honduras, Saint Christopher and Nevis, and Myanmar.

Chapter 8: International Cooperation and Exchange

Taiwan is building multilateral and bilateral cooperation on climate change response with various countries through multiple approaches at all levels, ranging from central and local governments, to industry, academia, and NGOs. In collaboration with global and regional networks, Taiwan shares with members of the international community its experience in the fight against climate change in a joint effort to address its impacts and challenges. Taiwan’s international cooperation and exchange in climate change has three aspects:

In the area of collaboration with other countries and government organizations, in light of the possible range of operation both financially and technologically, Taiwan assesses the cooperation

needs of partner countries, distributing resources with project-orientation and SOP. Starting with objective setting, a cooperation project stipulates basic working criteria and implementation terms according to the selection, assessment, negotiation, implementation and evaluation of the project. The implementation quality and benefits are highly valued. Cooperation projects may include any of four categories: lending and investment, technical cooperation, humanitarian assistance, and international education and training.

In terms of collaboration with local governments and municipal authorities, ten cities in Taiwan are members of the International Council for Local Environmental Initiatives (ICLEI-Local Governments for Sustainability) in 2018. Through participating in ICLEI's selection activities of low-carbon demonstration cities, Taiwan's cities incorporate the idea of "low-carbon city" to its governance with comprehension and mind-set of being low-carbon. In 2011, the Kaohsiung City Government acquired the honor to establish ICLEI Kaohsiung Capacity Center (ICLEI KCC), and in September 2012 launched its services. Three Taiwan cities have become members of CityNet and are involved in its sustainable cities campaign promoted in the Asia-Pacific region.

In the area of collaboration with non-governmental organizations (NGOs), Taiwan has devoted itself to the activities of the nine constituencies under UNFCCC NGO observers and international exchange. In the Business and industry NGOs (BINGO), airline and shipping enterprises voluntarily joined international cooperation project to collect atmosphere and sea area observation data through installed devices on aircraft and vessels for shared use of the World Meteorological Organization (WMO) and pacific region. The steel industry, semiconductor industry, and electronics industry join

international industry associations for GHG emission reduction campaign and actions. As for research and independent NGOs (RINGOs), Taiwan focuses on issues of low-carbon technology and climate change governance, observing and tracking the negotiation development and progress of the UNFCCC. The most active constituency in Taiwan is the Environmental NGOs (ENGOs), which cover activities of environmental protection, public participation and climate education. Taiwan also has long-term contribution and participation in the Women and Gender CC and Youth NGOs (YOUNGO), showing the diversity and autonomy of Taiwan's civil society.

Chapter 9: Education, Training and Public Awareness

The regulatory basis of climate change education, training and public awareness include the *Environmental Education Act* and the *GHG Reduction and Management Act*. For climate adaptation education, the *Adaptation Strategy to Climate Change* in Taiwan is referred. For energy education, the action plans of the National Energy Conference are depended on. The solid activities of education, training and public awareness can be introduced by school education, job training, public awareness and civil society autonomy promotion.

In school education, Taiwan nurtures climate change adaptation talents through the dual strategy of training both laymen and specialists. The laymen cultivation strategy involves developing teaching materials for elementary, junior high, senior high schools and universities, incorporating climate change as a critical issue in the *Directions Governing the 12-Year Basic Education Curricula*. The specialist cultivation strategy, on the other hand,

has incorporated the concept of climate change in the form of professional courses, coupled with the network for teachers and the mode of industry-university cooperation. The energy education strategy has designed teaching materials for elementary schools and high schools, built education centers and benchmarked model campuses. Further cultivation programs for energy technology talents are launched with information websites and six centers of energy and technology education network. In teachers training, the Teaching Alliance on Climate Change Adaptation Education and Center for Teacher Training on Energy and Technology Education have been established. In cultivation of academic specialists, professional energy technology talents with a master's or doctoral degrees are trained through conducting academic study and publication under National Energy Program Phase II (NEP II).

In job training, the Energy Management Institute holds training for energy managers. The qualified and certified ones can assist approximately 4700 big energy consumers to effectively manage energy use. The Ministry of Economic Affairs (MOEA) holds training of specialists in GHG reduction and management in the energy industry, who have been supporting and guiding the industry to take greenhouse gas inventory, verification, and registration since 2005. The MOEA also started talents training on energy saving and carbon emission reduction specially for the manufacturing industry.

In public awareness, since 2010 the Environmental Protection Administration (EPA) started to promote the low-carbon and sustainable homeland movement. Integrating the energy and resources of central and local governments and the private sector, the movement began from demonstration of participating units at the community

level, such as townships and villages, and gradually expanded to the municipal level. While community colleges promote Community Based Adaptation (CBA), localized CBA learning centers are built, and communities develop various objectives to fit local culture. Climate change adaptation has also been promoted online and a platform was launched as a place for information sharing, environmental education, and public dialogue.