

# Chapter 10

## Moving Toward Net-Zero Emission Society: With Special Reference to the Recent Law and Policy Development in Some Selected Countries



Hsing-Hao Wu

**Abstract** By the Sixth IPCC Report issued in August 2021, man-made greenhouse gases emission is responsible for approximately 1.1 °C of warming between 1850 and 1900, and the global temperature is expected to reach or exceed 1.5 °C by 2041. The IPCC thus urges world leaders to adopt substantial and sustained reductions to reduce carbon dioxide (CO<sub>2</sub>) and other greenhouse gas emissions to stabilize global temperature by the next 20–30 years. In East Asia, the Former Prime Minister of Japan, Yoshihide Suga, declared that Japan will become carbon-neutral by 2050. The commitment has been further endorsed by his successor Prime Minister Kishida Fumio. Korea enacted the Carbon Neutrality Act, which requires the government to cut greenhouse gas emissions in 2030 by 35% or more from the 2018 levels in August 2021. In China, President Xi Jinping committed to achieving carbon neutrality by 2060 at the U.N. General Assembly in September 2020. In Taiwan, President Tsai Ing-wen announced on April 22, 2021, that Taiwan will achieve carbon neutrality by 2050. The road to achieving net-zero emissions is an ambitious but challenging goal for each significant GHGs emitter in the Asia–Pacific region. Each country has its own economic, social, and technological foundation and capabilities and thus requires different approaches to achieve the same goal. This chapter explores the recent global trends with particular references to EU, U.S., and Japan’s law and policy development aiming to achieve carbon neutrality goals by 2050.

**Keywords** Carbon neutrality · Net-zero emission · Climate change mitigation · Climate law · Energy transition · Carbon sink

### 10.1 Introduction

The increasing industrial development and global population have caused enormous greenhouse gas emissions to the atmosphere in the post-WWII era. In the past three

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decades, the intensifying global warming has resulted in extreme weather events that have resulted in severe and frequent natural disasters worldwide. The most recent Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report was issued in August 2021, stating that the human-induced greenhouse gases emission is responsible for an approximately 1.1 °C increase compared to the pre-industrial level, and the global temperature is expected to reach or exceed 1.5 °C by 2041 (Intergovernmental Panel on Climate Change 2021). The most recent report issued by the IPCC entitled “Climate Change 2022: Impacts, Adaptation, and Vulnerability” indicates that if the world could achieve the net-zero emission goal by 2050, the global temperature rise would reach 2.5 °C. The intensifying global warming has resulted in extreme weather events that have resulted in severe and frequent natural disasters worldwide. In response to escalating climate risks, there is urgency for an international society to seek more robust and more ambitious GHGs emission reductions measures; IPCC also urges world leaders to adopt substantial and sustained reductions measures to reduce carbon dioxide (CO<sub>2</sub>) and other GHGs emissions to stabilize global temperature rising by the next 20–30 years (Intergovernmental Panel on Climate Change 2022). The recently concluded COP26 in November 2021 has established the Glasgow Climate Pact, urging contracting parties to reduce global carbon dioxide emission by 2030 relative to the 2010 level and further seek net-zero emission by mid-century to limit global temperature rise to 1.5 °C (UNFCCC 2021).

In achieving the NDCs set by states by 2030 or even the net-zero emission commitments by 2050, energy transitions are deemed the priority to reduce CO<sub>2</sub> emissions significantly. In addition, the enhancement of carbon sink from forest conservation, soil protection, and the ocean is also vital in climate actions. Major carbon-emitting countries or entities such as the EU, U.S., Japan, Korea, China, and India have proposed specific timetables for net-zero carbon emissions and carbon neutrality before or at the COP26. In achieving the net-zero emission commitment, there is a great necessity to establish a comprehensive policy framework outlining a clear roadmap and appropriate policy instruments such as the development of carbon tax, carbon pricing, carbon trade schemes, and other carbon-neutral policies to achieve carbon neutrality targets. Global GHG emissions could break into four major sectors: energy, agriculture, industry, and transportation. A recent survey reveals that 73% of global GHGs emissions come from energy consumption (Our World in Data 2020). Shifting energy consumption from fossil fuel combustion to clean energy sources plays a crucial role in achieving carbon neutrality. The carbon reduction in the industry includes the carbon footprint calculation, introduction of innovative carbon capture technology, and adjustment of the manufacturing process. However, the energy transition process requires significant government incentives to promote renewable energy development.

This chapter will first explore the global trends of incorporating net-zero emission targets into legal and policy frameworks. Law and policy development aiming to achieve net-zero emission targets in Japan, Korea, and Taiwan will be explored. The chapter will discuss and analyze legal issues and practical challenges concerning the energy transition, carbon sink enhancement, green transportation, and energy

transition legal and policy development. Some policy suggestions will be provided for policymakers regarding the future legal and policy.

## **10.2 Global Trends in Achieving Net-Zero Emission Goals**

### ***10.2.1 International Trends in Moving Toward Net-Zero Emission Goal***

The Glasgow Climate Pact, as mentioned earlier, urges contracting parties to reduce global carbon dioxide emissions by 45% by 2030 relative to 2010 and to net-zero around mid-century to limit global temperature rise to 1.5 °C (UNFCCC 2021). Glasgow Climate Pact is the first international climate agreement that sets explicitly the goal for phasing down coal usage within the next decade. However, more than forty states have developed more ambitious plans for phasing out coal usage at the COP26 (Guardian 2021). It is also notable that the COP26 encourages governments and enterprises to work coherently toward a “zero-carbon economy”. There are several remarkable climate mitigation initiatives made during the COP26, including the joint initiative reached by the U.S. and the E.U., the Global Methane Pledge signed by 105 countries, and the Glasgow Leaders’ Declaration on Forest and Land Use endorsed by hundreds of world leaders that pledges to end deforestation and land loss by 2030 (International Energy Agency 2022). In addition to sovereign states, 11 large international automakers announced that they will eliminate fuel vehicles by 2040, and 22 significant airlines signed the “Clydebank Declaration”, aiming to establish six green routes by 2025 (Department of Transport U.K. 2021). The Glasgow Climate Pact has sent a clear signal for ending the era of coal usage and moving toward a low-carbon economy. In the face of global trends in achieving net-zero emission to limit global temperature rise by 2.1 °C by 2050, there is a great necessity and urgency for states to accelerate the progress in phasing down fossil fuel combustion in the energy sector. The improvement of the energy transition, electrified transportation and industry sectors, and the enhancement of natural carbon sinks has thus become critical for many significant GHGs emission states committed to reaching net-zero emission by mid-century.

#### **10.2.1.1 EU Experience**

EU has committed to moving toward a carbon-neutral economy and society by 2050 while signing and ratifying the Paris Agreement in 2015. As required by the Paris Agreement, the EU submitted its long-term greenhouse gas emission reduction strategy and climate plans pledging to reduce EU emissions by at least 55% by 2030, compared to 1990 levels in 2020. Thus, the EU must establish a clear and ambitious law and policy framework to achieve the net-zero emission goal by 2050. On July 14,

2021, the EU Commission adopted a comprehensive package, namely the Delivering the European Green Deal, which aims at setting a clear plan and ambitious goals and actions in response to urgent global climate risks. Under the European Green Deal, the EU commits to reducing GHG emissions by at least 55% by 2030, compared to 1990 levels, and reaching the first carbon-neutral continent by 2050 and this proposed goal (EU Commission 2021).

European Green Deal is developed to become a legal development plan aligned with the 2030 Climate Target Plan published in September 2020. As discussed earlier, the GHGs emission by the energy sector contributes the largest share of the overall GHGs emission at the global and state level. Twofold approaches should be conducted to decrease fossil fuel combustion in the energy sector. They enhance energy efficiency and increase the ratio of energy mix's ratio of low-carbon energy sources achieving the GHGs emission target set by any state or regional organization such as the EU, and decarbonized production and consumption play a vital role in climate change mitigation. EU's initiative of FIT-55 is a comprehensive law and policy package aiming to achieve the EU's GHGs emission reduction target of reducing 55% GHGs emissions compared to the 1990 level and net-zero emission commitment. The EU's GHGs emission long-term goal has also been incorporated in European Climate Change Law as a legally binding goal (EU Parliament 2021).

The FIT-55 is a comprehensive legal and policy package encompassing climate, energy, building, carbon trade, land use and planning, transportation, and other areas to achieve the EU's carbon neutrality goal by 2050. The main features of the FIT-55 are as follows:

1. The EU Emissions Trading Scheme (EU ETS) will be further expanded. From 2030, the free emission allowances of the aviation industry will be cancelled. The practical experience of relevant laws and the impact on the international aviation industry will be further assessed.
2. EU "Carbon Border Adjustment Mechanism" (CBAM) will be applied to imported steel, aluminum, cement, and other high carbon emission commodities. If importers do not pay the carbon fee at host countries or have a value gap with the EU carbon tax, they must purchase quotas (carbon rights) from the EU ETS market.
3. In 2035, the sale of fuel vehicles will be banned; in 2025, construction and road transportation will include fuel suppliers in the new emissions trading mechanism.
4. Revise the Renewable Energy Directive to increase the proportion of renewable energy. By 2030, the proportion of renewable energy will reach 40% (the original target is 32%).
5. Amend the Energy Tax Directive to implement the reform of the energy tax system. Home heating, shipping, aviation, fishing, and electricity supply will be included in the scope of taxation.
6. Adopt the EU Land Use, Land-Use Change and Forest Conservation Act (LULUCF), requiring the Member States to reduce less natural-based management, forest conservation, restoration, and prohibition of deforestation solutions)

climate action reduces 310 million tons of carbon dioxide (CO<sub>2</sub>) emissions to the atmosphere. A specific target is to plant more than 3 billion trees in Europe by 2030.

7. Create a Social Climate Fund to subsidize house efficiency improvements and alleviate vulnerable households' burden of energy costs.

EU energy law and policy development are thus incorporated as a core part of the FIT-55 package to ensure EU's increasing renewable energy share target to 40% by 2030 and relevant policy measures adopted to achieve EU's overall climate policy objectives. In addition to the FIT-55 package, the EU also established a "cap-and-trade" mechanism governed by public institutions to limit the total amount of GHGs emissions, which can be carried out through emission rights trading scheme. Regulated industrial activities include the energy industry, steel manufacturing, mining industry (including cement, glass, ceramics, and other sectors), and other sectors (including pulp and paper industry) (EU Commission 2021).

### 10.2.1.2 US Experience

On April 22, 2021, U.S. President Joe Biden officially announced that the U.S will achieve a 50–52% reduction from 2005 levels in economy-wide net greenhouse gas pollution by 2030 and reach net-zero emission by 2050. President Biden also asks that federal actions seek to achieve 100% carbon pollution-free electricity by 2030, 100% zero-emission vehicle acquisitions by 2035, and a net-zero emissions building portfolio by 2045. In 2021, the U.S. government established an updated 2021 Long-Term Strategy of the U.S that provides multiple pathways for the American economy to achieve net-zero emissions by 2050 (U.S. Department of States and the U.S Executive Office of the President 2021).

In response to global trends for an energy transition from fossil fuel as a primary energy source to renewable energy sources, there is an urgent need for the federal government to set a national renewable energy ratio target and clear implementing schedule. However, the federal power in promoting renewable energy development is somehow limited. The States, on the other hand, take the leading role in taking climate action. California, for instance, took the lead by establishing the Global Warming Solutions Act in 2006 (UpLiftCA 2020). The Global Warming Solutions Act sets the goal of reducing GHGs emissions back to 1990 by 2020, reducing statewide GHGs emissions to 40% below 1990 levels by 2030 (California Assembly 2006). The 2012 amendment of the state legislature imposed a carbon tax scheme for significant carbon emitters in financing air quality, affordable housing, access to clean transportation, and energy-saving projects for disadvantaged communities. As for energy transition, California has made remarkable progress in renewable energy, establishing the renewable energy portfolio standards that set escalating renewable energy procurement requirements for certain state entities to procure electricity generation from

RPS-certified facilities (California Energy Commission 2021). In addition, California also leads the nation in establishing market-based mechanisms such as the feed-in tariff and carbon cap-and-trade systems (California Public Utilities 2021).

### ***10.2.2 The Role of Law and Policy Development in Moving Toward Net-Zero Emission Goal***

In achieving the net-zero emission goal, the cap-and-trade system requires a solid legal foundation for many policies and measures adopted by the government at various levels, such as carbon emission reporting, carbon tax, and economic incentives. Establishing a comprehensive legal and policy framework to achieve net-zero emission goals is vital in providing a legal foundation for supporting climate-related policy measures and selecting an appropriate institutional framework. For instance, the energy transition policy, decreasing fossil fuel dependency for energy use and promoting renewable energy development, requires in-depth legal action in the face of urgent climate risks. The role of law in achieving net-zero emission goals is thus critical because setting mandatory renewable energy ratio targets, carbon emission reduction for each emitter, and market-based mechanisms may impact economic, environmental protection, spatial management, and even spatial management social transformation and thus requires legal endorsement. In addition, the widespread installation of wind power and solar PV may impose significant legal challenges to the existing legal framework. A comprehensive legal and policy framework that addresses renewable energy development is thus vital in achieving the energy transition goal.

## **10.3 Overview of Net-Zero Emission Policy in Asian Countries**

### ***10.3.1 Japan's Law and Policy Development Toward Net-Zero Emission***

The Paris Agreement requires all contracting parties to submit their nationally determined contributions (NDCs) illustrating each country's climate change mitigation policies and implementation measures (United Nations Climate Change 2021). In response, Japan's "intended nationally determined contributions (INDCs)" was at the level of a reduction of 26% in 2030 when compared to the 2013 emission level (Ministry of the Environment of Japan 2021). Prime Minister Suga declared in 2020 that Japan would aim to achieve carbon neutrality by 2050 (Ministry of Economy, Trade and Industry 2020). Specifically, Japan commits to reduce 46% GHGs emissions from the 2013 emission level by 2030 and complete the long-term goal of

carbon neutrality in 2050. To reach the carbon neutrality goal, the Japanese government initiated the “Green Growth Strategy Through Achieving Carbon Neutrality in 2050” (Green Growth Strategy) in December 2020. (Ministry of Economy, Trade and Industry 2021) The Green Growth Strategy is the primary policy framework that outlines action plans for 14 priority industries, including energy, commercial, industrial, and transportation, to achieve carbon neutrality. Each action plan sets specific carbon neutrality goals and time frame, research and development financing mechanisms, and regulatory and institutional arrangement for overseeing and implementing each action plan. The Japanese government commits to establishing a large-scale fund of two trillion yen to provide financial support to enterprises attempting to adopt carbon neutrality solutions by 2030.

The decarbonization of the power sector is the primary target and essential task for the Japanese government in achieving the carbon neutrality goal. The Green Growth Strategy commits to introducing various renewable energy sources to the maximum extent possible. The promotion of solar PV, offshore wind power, and storage batteries technology has been highlighted. Thermal, hydrogen, and even nuclear power have been encouraged as decarbonized power options. Notably, the Japanese government deems atomic force an established decarbonization technology to enhance safety and reduce reliance during the energy transition period. The Green Growth Strategy sets a power generation target from renewable sources accounting for 50–60%; thermal and carbon recycling for 30–40%; and hydrogen and ammonia for 10%. In addition to significantly increasing the renewable energy sources for electric power generation, the Japanese government also seeks research and development of innovative low-carbon power technology. For instance, the Green Growth Strategy also calls for the electrical action of electrical automobiles, hydrogen storage batteries, and carbon capture and storage technologies in power systems, such as establishing the intelligent power grid system to achieve energy-efficiency goals.

After the start of the feed-in tariff (FIT) system in July 2012, the introduction of renewable energy expanded mainly to solar photovoltaic (PV) power. Japan’s Ministry of the Environment has implemented a nationwide Japan voluntary Emission Trading Scheme (JVETS) since 2005. JVETS subsidizes manufacturers in exchange for more energy-efficient production equipment and is based on carbon rights issuance and emissions trading to meet carbon reduction targets. Japan started the Tokyo-Emission Trading Scheme (Tokyo ETS) in 2010. Tokyo ETS uses the 2000 emission level as the base year to reduce greenhouse gas emissions by 25% in the Tokyo area by 2020. Tokyo ETS is a mandatory carbon trading system driven by a compulsory specification to include carbon emission caps. There are currently about 1100 commercial facilities and 300 factories with high carbon emissions to be regulated, accounting for 20% of total emissions in the Tokyo area. The now controlled greenhouse gas is mainly CO<sub>2</sub>, which will be expanded to other greenhouse gases in the future.



### ***10.3.2 Korea's Law and Policy Development Toward Net-Zero Emission***

Since Korea has doubled its GHGs emissions between 1990 and 2008 due to rapid industrialization and economic growth, Korea has become one of the top ten emitters globally and one of the countries with the highest growth in GHG among the OECD member countries. In 2008, President Lee Myung-bak announced that Korea would become a low-carbon/green growth country in the next 50 years to improve the international community's perception of lacking substantial climate change mitigation efforts from the Korean government. Following President Lee's commitment, the Korean government initiated the "National Green Growth Strategy" (2009–2050) and the five-year green growth action plan (2009–2013) in 2009 to provide a comprehensive policy framework aiming to promote green growth. In providing the National Green Growth Strategy legal endorsement, the Korean National Assembly passed the "Framework Act on Low-Carbon Green Growth Law" in January 2010 (UNEP, Law and Environment Assistance Platform 2021).

The Framework Act on Low-Carbon Green Growth (Green Growth Act) serves as the primary legal framework to implement the Green Growth Strategy policy objectives to enhance the energy transition, carbon reduction policies, institutional arrangements, and related implementation strategies. The Green Growth Act stipulates that government should set medium-term GHGs emission reduction goals, annual GHGs emission reduction targets, and energy-efficiency targets for various sectors. The Green Growth Act requires the central government to establish the Presidential Green Growth Committee regarding the institutional arrangement. In contrast, local governments set up local green growth committees in 16 cities and provincial governments. Based on each local green growth committee shall formulate the "local green growth implementation plan" based on regional characteristics Year Plan requires the Korean government to designate specific tasks for involved ministries and local authorities and invest an annual budget of about 2% of Korea's total GDP in implementing the detailed plans and projects.

The Green Growth Strategy identifies energy transition as a priority and vital policy objective. It thus requires coordinated support from establishing a comprehensive energy law and policy framework to reduce fossil fuel consumption within the time frame. Accordingly, Korea amends its energy legal and policy framework to promote energy transition. The energy legal framework adopts a relatively top-down approach to guide general energy development for the nation. First, the government should propose the "National Energy Basic Plan" as the comprehensive and basic energy policy framework, which provides the policy objectives and implementation measures to enhance overall energy security, setting the targets in terms of the energy mix, renewable energy ratio, electricity pricing, and GHGs reduction in the power sector. According to the policy guidelines of the National Energy Basic Plan, the subordinate implementation plans for various energy dimensions, such as renewable



energy development, shall also be initiated. Green Growth Act also urges the government to draft the Emission Trading Scheme (ETS) and carbon tax-related regulations and policies and submit them to Korean Parliament for consideration.

Since President Moon Jae-in won the general election in 2017, Korea's energy policy has changed significantly compared with the previous government. During the election, President Moon Jae-in committed that his administration would dramatically reduce the energy dependence on coal and nuclear power if he could be successfully elected. After being the elected president, he promoted the "zero nuclear power policy" and replaced petrochemical and nuclear power with the increasing use of renewable energy and natural gas power generation. In response to the recent international trends in seeking GHGs net-zero emissions by mid-century, President Moon Jae-in officially committed to net-zero emissions by 2050 in one speech to Korea's national assembly in October 2020. The carbon neutrality goal has been incorporated in the Carbon Neutrality and Green Growth Act for the Climate Change (Carbon Neutrality Act) which the Korea National Assembly passed in August 2021. The Carbon Neutrality Act requires the government to reduce 37% of GHGs emissions by 2030 compared to the 2008 emission levels. In October 2021, Korea provided roadmaps on identified sectors and potential policy measures to achieve the carbon emission reduction goals by 2030, aiming to achieve the National Determined Contribution target required by the Paris Agreement and further the carbon neutrality target set to reach by 2050. To accomplish the INDCs submitted by Korea on June 30, 2015: the goal of reducing GHGs emissions by 37% in 2030 compared with the current development trend (Business as Usual, BAU). Since Korea's industrial sector accounts for more than half of energy consumption, reducing fossil fuel consumption with alternative energy sources, enhancing energy efficiencies, and introducing low-carbon technology in the industrial sector have become the primary policy objective to achieve the net-zero goal.

In achieving the legally binding GHGs emission reduction goal, the Korean government has adopted the updated Green New Deal to serve as a basic policy framework to implement specific measures on a sector basis, increasing the budget to 61 trillion won (52 bn USD). The New Green Deal aims to support the development of innovative climate technologies to expand the use of clean powers, improve energy efficiency, and enhance carbon sinks. In 2020, the share of coal-fired power generation decreased from 43 to 39%, while increasing the energy sources from LNG, nuclear, and renewable sources, mainly from solar PV. This shift resulted in a record-low emissions intensity of Korea's electricity sector. Nevertheless, the share of fossil fuels accounts for 67%, while renewables in the electricity sector are only 6%. In accelerating the progress of energy transition, the Korean government published the Ninth Electricity plan in December 2020. The plan sets clear electricity mix targets, confirming the Moon administration's intention to shift electricity generation away from coal. The plan sets a power mix of 30% coal, 25% nuclear, 23% LNG, 21% renewables, and 1% from other sources by 2030. Under the draft 2050 carbon-neutral scenarios, coal is phased out before 2050. The recent revision of the Renewable Energy Law in March 2021 has strengthened Korea's Renewable Portfolio Standard requiring major electric utilities to increase their renewables share

to 10% by 2023 and 25% by 2034. The introduction of RPS is expected to significantly contribute to energy transition progress since mega-enterprises consume much electricity in Korean society.

### ***10.3.3 Taiwan's Law and Policy Development Toward Net-Zero Emission***

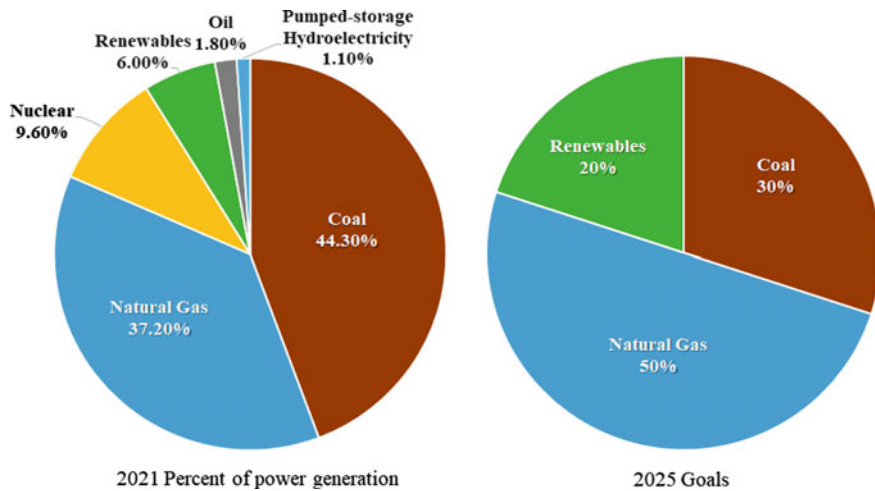
Taiwanese President Tsai Ing-wen announced on April 22, 2021, to achieve carbon neutrality by 2050. To achieve that goal, the Taiwanese government is taking a two-pronged approach: pushing for energy transition and reducing GHG emissions from manufacturing, transportation, residential construction, and agriculture. The Net-zero Pathway Task Force has been formulated to achieve the climate goal since declaring Taiwan's commitment to attaining net-zero emissions in 2050. The Task Force is mainly conducted by the National Development Council, overseeing four divisions: decarbonization of energy, energy efficiency and industry, green transportation, and carbon sink. The INDCs announced by the Executive Yuan in September 2015 are based on the INDCs submitted by significant countries and on 2005 emissions. The 20% of GHGs emissions shall be reduced by 2030. To establish a legal basis for GHGs emission reduction in response to the high pressure of the international community on energy conservation and carbon reduction in the future, Taiwan Congress passed the law "Greenhouse Gas Reduction and Management Act" in July 2015. "Greenhouse Gas Reduction and Management Act" sets the national GHGs long-term reduction target to reduce GHG emissions to more than 50% of 2005 GHG emissions by 2050. In response to President Tsai's net-zero commitment, the Executive Yuan proposed the "Climate Change Action Act" Bill to replace the existing "Greenhouse Gas Reduction and Management Act" in 2021. The Climate Change Responsive Action Bill expressly incorporates emission goals as a legally binding obligation to the government. The Bill also refines the GHGs emission reduction mechanisms as established under the "Greenhouse Gas Reduction and Management Act", including institutional rearrangement in overseeing the implementation of net-zero emission policy, carbon fees collection, the establishment of climate mitigation fund, and clear mid-term and long-term GHGs emission reduction goals (Taipei Times 2021).

Similar to other jurisdictions such as Japan and Korea, the energy sector accounts for The Ministry of Economic Affairs that is responsible for policy initiated for Renewable Energy Development. The Energy Management Act requires the government to create an Energy Basic Plan to increase electricity production from renewable sources to 20% by 2025. However, the renewable sources' electricity percentage accounts for only 5.47% in 2. A comprehensive and sound regulatory framework is critical in promoting the sustainable development of renewable energy. Taiwan has established laws on promoting the development of renewable energy through the

revision of the “Greenhouse Gas Reduction and Management Act”, the “Renewable Energy Development Act”, and the amendments to the “Energy Management Law” since 2009. The “Greenhouse Gas Reduction and Management Act” requires the government to develop medium- and long-term strategies to reduce fossil fuel dependence and set medium- and long-term goals for renewable energy development. The Renewable Energy Development Act is a special law for promoting the use of renewable energy. The Act aims to encourage private investment in renewable energy power generation equipment and related industries through economic incentives, loosening of regulations, and government subsidies (FIT). The significant expansion of large-scale solar PV park, offshore wind power, and fishery and electricity symbiosis projects has been planned and installed nationwide.

Unlike Japan and Korea’s use of nuclear power as alternative energy sources to fossil fuel, President Tsai Ing-wen and the ruling party of the Democratic Progress Party (DPP) under her leadership have pledged for non-nuclear homeland policy since President Tsai took office in 2016. DPP government thus has promulgated the Energy Basic Plan aiming to remove nuclear power and shift to LPG (50%), coal (30%), and renewable energy (20%) for gross electricity production by 2025 (Fig. 10.1, (Taiwan Bureau of Energy, Monthly Statistics Report 2022)). However, Taiwan’s energy transition plan has received enormous public opposition due to worrisome electricity shortage due to slow progress and unstable supply of renewable energy development and environmental concerns. The public opposition resulted in two referendums related to energy policy on December 18, 2021. The first referendum is whether to activate the fourth nuclear plant that was postponed for construction in 2015. The second is building a new natural gas terminal that may harm the precious algal reef biodiversity at the proposed construction sites. The results of these two referendums support the government’s non-nuclear homeland policy and building sizeable, liquefied petroleum gas (LPG) terminal to use natural gas as interim energy and support the growth of the share of renewable energy in electricity production target by 2025 and eventually net-zero emission in the long run. Taiwan’s experience first shows the importance of establishing open, transparent public participatory mechanisms for energy transition decision-making. It, however, lacks well-communications and informed of the net-zero policy and energy transition with the general public and renewable energy facilities onsite communities would eventually slow down the progress in moving toward a net-zero emission society and energy transition (Ho 2021).

Notably, the Council of Agriculture has taken the lead in formulating net-zero emission policies in the agriculture sector in Taiwan. Council of Agriculture first establishes the Office of Net-Zero Emission. It publishes the first comprehensive and clear net-zero emission pathway and roadmap in the agriculture sector 2040 in February 2022. However, compared to Taiwan’s overall carbon emissions of 287 million tons, agricultural carbon emissions only account for 2.22%. The territory of Taiwan is covered by approximately 61% by forest and thus shows great potential for its carbon sinks. Under Taiwan’s GHGs emission inventory report released in 2019, the forest carbon sink per hectare was 9.76 metric tons, a total of 21.44 million tons.



**Fig. 10.1** Taiwan's energy shift *Source* Compiled by authors based on Monthly Statistics Report 2022/5 Issue, Taiwan Bureau of Energy (Taiwan Bureau of Energy, Monthly Statistics Report 2022)

The carbon sink of the forest alone could easily offset total carbon emissions in the agriculture sector.

There are four main features of agricultural net-zero emissions roadmaps aiming to achieve net-zero emission goal in agriculture by 2040: (1) The roadmap comprehensively assesses the carbon emission inventory of agricultural production and establishes a low-carbon production model of an agricultural, fishery, and live-stock to achieve the GHGs emission reduction target; (2) enhancement of carbon sinks through forest management, improving the utilization of domestic wooden materials, strengthening ocean and wetland management, developing low-carbon farming methods; (3) promoting agricultural cross-domain recycling demonstration sites, enhancing scientific and technological research, developing agricultural recycling technology, and creating agricultural value-added reuse; and (4) promoting carbon pricing and carbon rights trading systems in the agricultural sector and agricultural finance and green consumption to achieve autonomous power generation and self-sufficiency in electricity consumption in farming and fishing activities.

#### 10.4 Comparative Study and Suggestions for Policymakers in Achieving Net-Zero Emission

The comparative analysis indicates that the EU has established a comprehensive net-zero framework providing enough legal basis for institutional arrangement, apparent energy efficiency and renewable energy share target and timetable, and financial mechanism. The most crucial feature of the EU energy law is its connectivity with the

EU's latest commitment to the GHG emission goal and overall roadmap to achieving a net-zero emission goal by 2050. EU energy law constantly evolves by strengthening binding renewable energy share, financial mechanisms, and social and general public engagement as part of EU's overall climate solutions and social transformation packages aiming to become the first decarbonized continent. The energy law and policy adopted by Korea, Taiwan, and Japan seem less coherent in incorporating energy transition policy into a comprehensive climate policy framework. It is partly due to a lack of a complete net-zero emission policy and institutional framework that integrates all relevant sectors, including energy, building, transportation, and industry. Japan and Taiwan have established special legislation regulating offshore wind power development due to complicated marine spatial management, environmental impact assessment, and cross-administration authorities. The special Legislation on Offshore Wind-power Promotion and Development Act deals with permit issuing, FIT pricing arrangement, installed capacity auction, and government surveillance mechanism.

The law and policy adopted by Japan and Korea focus more on the capacity building for renewables ranging from solar, wind power, biomass, and hydrogen and promoting innovative technology development such as storage batteries and hydrogen fuel. Japan adopts a relatively top-down model in enhancing the capacity and technological development for renewable energy development. The coherent energy policy incorporated into Japan's comprehensive climate roadmap and necessary legal action requires further observation. The following chapter provides important issues and suggestions for policymakers to consider while formulating or reshaping renewable energy laws and policies.

#### ***10.4.1 Establishing a Comprehensive Climate-Related Legal and Policy Framework Aiming at Net-Zero Emission Goals***

As discussed earlier, the GHGs emission by the energy sector contributes the largest share of the overall GHGs emission at the global and state level. In achieving the GHGs emission target set by any state or regional organization such as the EU, energy production and consumption decarbonization are vital in climate change mitigation. EU's initiative of FIT-55 is a comprehensive law and policy package aiming to achieve the EU's GHGs emission reduction target of reducing 55% GHGs emissions compared to the 1990 level and net-zero emission commitment. The EU's GHGs emission long-term goal has also been incorporated in European Climate Change Law as a legally binding goal (EU Parliament 2021).

The FIT-55 is a comprehensive legal and policy package encompassing climate, energy, building, carbon trade, land use and planning, transportation, and other areas to achieve the EU's carbon neutrality goal by 2050. EU energy law and policy development are thus incorporated as a core part of the FIT-55 package to ensure

EU's increasing renewable energy share target to 40% by 2030 and relevant policy measures adopted to achieve EU's overall climate policy objectives. In addition to the EU's approach, Japan, Korea, and Taiwan adopt relatively different net-zero emission strategies based on other sectors. Renewable energy development, as explored earlier, is either focusing on energy efficiency or renewable energy capacity building instead of establishing a coherent solid relationship with the nation's comprehensive climate policy framework and carbon neutrality commitment. Energy transition may significantly impact the economy, society, and politics, no less than a nation's total solution to climate change risks. This chapter thus suggests policymakers adopt the EU's legal experience in incorporating energy transition into overall long-term climate policy framework such as the FIT-55 package, establish a comprehensive and concrete climate law or policy framework, and then include renewable energy law and policy as a vital part of achieving the long-term GHG emission target and carbon neutrality goal.

#### ***10.4.2 A Necessity for Establishing a Coordinated Institutional Framework Responsible for Net-Zero Emission Policy***

The regulatory and overseeing institution design varies from country to country based on various constitutional and social backgrounds. Some countries adopt the division approach to designating different governing institutions responsible for renewable development and oversight. EU sets up clear and binding GHG emission targets, the share of renewable energy targets for each Member State's overall energy mix, and the phase-out of burning coal timetable for EU. In contrast, Member States can adopt appropriate and flexible legal and policy measures to achieve the GHGs emission reduction target by 2030 and the net-zero emission goal by 2050. Japan, Taiwan, and Korea adopt a similar top-down approach by incorporating net-zero emission commitments into national legislation. In achieving the net-zero emission goal, several laws and regulations have proposed legal mandates for establishing market-based mechanisms and special legislation regulating and promoting specific renewable energy sources such as offshore wind power.

Notwithstanding the various institutional arrangements concerning the supervision and promotion of decarbonized energy sources, there is an excellent necessity for establishing a solid coordinated institutional framework because net-zero emission target achievement involves a lot of legal adjustments and innovative approaches to the energy market, electricity services, energy installation regulation, building regulation, taxation, and environmental impact assessment. Moreover, central (federal) and local governments shall work closely since land development, energy installation, and building approval authorities lie on the local government. Policymakers are advised to establish a high-level, well-coordinated, cross-agency institutional framework that supervises renewable energy development. A robust, coordinated

governance mechanism should also ensure transparent and effective communication between central, local authorities, and communities where major renewable energy installations are located. It is also critical to provide financial incentives for industry and businesses to their bottom-up approach for a net-zero business strategy.

### ***10.4.3 Net-Zero Emission Strategies shall also Consider Biodiversity Conservation, Community, and Social Impacts***

Japan, Korea, and Taiwan have high population densities with limited spaces in countries. Implementing net-zero policies and projects such as widespread renewable energy development may conflict with biodiversity conservation and human health concerns. Many public or private-owned lands designated initially for agriculture, aquaculture, forest protection, or biodiversity conservation purposes may turn to solar PV and wind farm facilities installation usage. Professor Liu, a renowned expert in agriculture economics in Taiwan, indicates that renewable energy development would compete with farmlands, hillslope lands, and pastoral lands. The energy transition may be critical in reaching the Taiwanese government's ambitious goal of moving toward net-zero emissions by 2050.

Establishing grounding solar PV systems on sensitive biological areas, such as agriculture or forestry lands on the hillslope, may result in environmental impacts on hillside landscape, biodiversity, and soil and water resources conservation. The large-scale installation of solar PV may result in crop-harvesting loss, biodiversity, landscape value loss, pollution damage as a result of radioactive effects, and waste handling costs for decommissioning of photovoltaic panels shall all be considered while conducting the cost–benefit analysis for specific renewable energy development projects that alters the current usage of lands and their potential damages to the environment.<sup>1</sup> The economic and environmental costs for renewable energy development projects on farmland and hillslope forest lands thus should be evaluated comprehensively. In addition, the wind farm development shall also conduct an environmental impact assessment because wind energy development may negatively impact marine biodiversity for offshore windfarms and noise disturbance to local communities for onsite windfarms. In achieving the net-zero emission goal, low-carbon or green technology development plays a vital role in the energy transition context. This chapter thus suggests that energy competent authorities should cooperate with other agencies such as agriculture and environmental protection responsible authorities to conduct ecological studies and then announce the least environmentally sensitive areas suitable for renewable energy development. Policymakers should further establish an environmental and agriculture evaluation scheme to screen project-based renewable energy development outside this promulgated least environment more sensitive areas.

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<sup>1</sup> Interview with Distinguished Professor Wan-Yu Liu, Department of Forestry, College of Agriculture and Natural Resources, National Chung-Hsing University, Taiwan. December 12, 2021.



#### ***10.4.4 The Enhancement of Carbon Sink from the Ecosystem and Public–Private Partnership***

Achieving carbon neutrality mainly depends on long-term planning and intensive policy and technology development to improve renewable energy, battery storage, green transportation, energy efficiency, and carbon capture and storage. There are limitations of carbon reduction technology, notwithstanding how progressive these technologies are to be evolved within the next decades in achieving carbon neutrality goals for each country or region. The enhancement of carbon sink thus plays a vital role in offsetting remaining GHGs emissions even though utmost efforts in terms of carbon reduction and energy transition have made remarkable progress. Forests, soils, oceans, and soils have diverse ecological service values and great potential to absorb or store significant carbon dioxide. It is thus critical and beneficial to protect the ecosystems by enhancing forest management, wetland and marine conservation, and incorporating environmental considerations in land planning and usage. This article suggests that a coordinated institutional framework should be established comprising government officials, experts, industry, and NGOs to evaluate existing environmental conservation laws carefully and carbon neutrality goals, and the enhancement of carbon sink from natural resources plays a vital role in the industrial sector seeking carbon offset solutions in meeting legal binding GHGs emission reduction goals. Thus, it is critical to enhance government–private enterprises and academic partnerships in carbon evaluation, carbon pricing, and carbon credits transfer and trading. In addition to the government-led net-zero emission efforts to establish a comprehensive legal and policy framework and implementation measures, the voluntary programs conducted by private parties, especially from major CO<sub>2</sub> emitters, could contribute to the national net-zero emission target.

On a global scale, the Climate Group and Carbon Disclosure Program have coordinated the RE100 gathering of the world's most influential businesses committed to 100% renewable electricity. In addition to the RE100, some domestic efforts are led by private parties to initiate coordinated voluntary programs aiming to achieve net-zero emission goals. The Taiwan Climate Alliance, for instance, has been formulated by several major ICT companies in Taiwan. Members of the Alliance commit to using 100% renewable energy in the manufacturing processes by 2050. The members of the Alliance also save to leading manufacturers in their supply chain to jointly achieve the 100% green power target. Another example is the establishment of the Taiwan Alliance for Net Zero Emission. Taiwan Alliance for Net Zero Emission comprises traditional manufacturing, ICT enterprises, finance, and service industries. The Alliance aims to attain net-zero carbon emissions at office sites by 2030 and production sites by 2050. The Taiwanese government supports private stakeholders' voluntary efforts by creating a friendly legal and policy environment and policy guidance for green financial mechanisms such as green financing and green bonds to support the industry in attaining net-zero emission goals (Chang 2021).

## 10.5 Conclusion

In the face of the global climate crisis, world leaders have finally taken actual actions to mitigate the GHGs emission and even committed to reaching net-zero emission by the mid-century. The energy transition is an indispensable and vital part of each country or regional organization in achieving their NDC of GHGs emission target by 2030 required by the Paris Agreement and the long-term commitment to reaching the net-zero emission goal since the energy sector accounts for most of the GHGs emission globally and in most states. Energy transition may significantly impact the existing legal framework concerning the inter-agency governance mechanism, economic instruments adjustment, and even the subsidy policy for industry and disadvantaged groups. While facing the challenges of keeping the temperature rise within 1.5 °C, decarbonized energy policy should be an integral part of climate response packages aiming to achieve a state's GHGs emission reduction and net-zero emission long-term goals. The energy transition, low-carbon technology development, and natural carbon sink enhancement involve social and economic transformation. Thus, receiving public support and comprehensibility requires a strong cross-agency and central/local government coordinated institutional framework, open and transparent general participatory decision-making mechanisms, and environmental and biological loss and damages evaluation schemes implemented by competent authorities in approving renewable energy projects located in certain contested environmental sensitive areas.

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