Chapter 2
Climate Change Strategy and Emission Reduction Roadmap for China, Japan, and South Korea

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Abstract In order to limit the increase in global temperatures to below 2 °C, as outlined in the Paris Agreement, measures to reduce carbon emissions from large emitters in East Asia—China, Japan, and South Korea—have attracted global attention. Differences among the three countries in terms of the environment, economy, and energy mean that each is at a different stage of emission reduction. In this chapter, we take into account environmental, economic, and energy characteristics in China, Japan, and South Korea and assess their emission reduction strategies. While China is simultaneously grappling with poverty eradication, environmental protection, and responding to climate change, Japan and South Korea are combating climate change with leading technologies and high levels of energy efficiency. Although there are many differences among the three countries, all advocate realizing low-carbon societies and achieving sustainable development. Moreover, ensuring energy security, developing low-carbon technologies, cultivating low-carbon industries, and adapting to climate change are challenges faced by all three countries. We analyzed targets and countermeasures for Intended Nationally Determined Contributions (INDC) under the Paris Agreement. In the process of achieving emission reduction targets, the respective efforts of each country are indispensable and contribute to international cooperation.

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2.1 Introduction

Although the Paris Agreement was adopted in 2015, there is still no clear consensus as to whether developed countries should take the lead in reducing emissions. In 2019, the United States withdrew from the Paris Agreement on the grounds that it affected its own interests. Against this background, the emission reduction actions of Asian countries are worthy of attention. Among the top 12 emitters of carbon dioxide, two-thirds are in Asia (Fig. 2.1). China, Japan, and South Korea ranked first, fifth, and seventh globally, accounting for about 33.44% of emissions in 2018 (IEA 2019). Therefore, climate change countermeasures taken in China, Japan, and South Korea will be critical for global emission reductions.

One difficulty in negotiating emission reductions is the need to simultaneously balance interests among developed countries, among developing countries, and between developed and developing countries. China, Japan, and South Korea are developing, developed, and semi-developed countries, respectively; thus cooperation among them could serve as a pilot for global cooperation (Fig. 2.2). Moreover, China, Japan, and South Korea are all large energy consumers reliant on fossil fuels. Transition from a high energy consumption society to a low-carbon society, called decarbonization, is a pressing issue. In this chapter, we analyze the current situation in these three countries from the perspectives of economy, energy, and the environment. Then, we clarify the limits of economic growth and environmental impact when building a decarbonized society among these countries. Finally, we develop a

![Proportion of global carbon dioxide emissions contributed by the largest emitters in 2018. Source: IEA (2019)](image)

Fig. 2.1
2.2 Economic Prospects in China, Japan, and South Korea

China, Japan, and South Korea have experienced rapid economic development since the twentieth century. However, after 1990, rates of development in Japan and South Korea slowed and were particularly affected by two financial crises (Fig. 2.3). Although the growth rate in China was also affected by these crises, it remained positive (Fig. 2.4). In 1999, China’s gross domestic product (GDP) purchasing power parity (PPP) surpassed that of Japan for the first time and has been the highest of the three nations since. Except for a negative growth rate in 1998 in South Korea, the growth rates in China, South Korea, and Japan are generally at high, medium, and low levels, respectively, which corresponds with the developmental stage of each country.

The development trajectories of China, Japan, and South Korea show three similar curves: that of China currently resembles the historical trajectory of Japan and South Korea. However, after more than 30 years of rapid growth, China remains in the early stages of development, and labor productivity is low (Fig. 2.5); high
growth has only begun to translate into increased productivity in the last 10 years. In the last 5 years, labor productivity in South Korea has approached that of Japan, whereas labor productivity in China was approximately 50% that of Japan in 2019.

Urbanization rate provides another means to understand the developmental stages of the three countries (Fig. 2.6). In 1990, both Japan and South Korea had reached an urbanization rate of approximately 80%, while China remained at 26%. Since 2010, the urbanization rate in Japan has stalled at 91% and that of South Korea at 81%.
contrast, China continues to exhibit 1% annual growth, which if maintained would lead to 70% urbanization by 2030.

The economic situation can be analyzed from the perspective of industrial structure. In China, the proportion of primary industry (e.g., agriculture) continues to decline, the status of secondary industry (e.g., manufacturing) as the largest sector has been consolidated, and the share of tertiary industry (e.g., services) has increased significantly (Fig. 2.7).

The pattern of industrial structure in Japan has not changed from tertiary, secondary, and primary industry, in descending order (Fig. 2.8). The proportion of
primary industry has continued to decline, falling to 1.15% in 2016. The proportion of tertiary industry has continued to rise, reaching 69.31% in 2016. As early as the 1960s, Japan began to propose the concept of a post-industrial and smart society. The contribution of secondary industry to GDP has also continued to decline, falling to 29.52% by 2016, which is the lowest of all three countries.

After the 1980s, South Korea was at a post-industrial stage, implementing an industrial policy of technological departure. The industrial structure is technology-intensive and requires upgrading (Fig. 2.9). The proportion of primary industry
quickly dropped, the proportion of secondary industry has remained almost unchanged, and the proportion of tertiary industry continues to rise.

According to Petty-Clark’s law, Japan has entered the stage of post-industrialization, while South Korea is transitioning from industrialization to post-industrialization. China is still in the process of industrialization. The characteristics of economic development in Japan are effective economic policies led by the government at all stages; a shift in industrial structure from technology-intensive to knowledge-intensive; a “trade-oriented nation” strategy that makes full use of foreign countries to promote export-oriented economic growth; and an emphasis on technology introduction and research and development (Fig. 2.10). The development characteristics of the Korean economy are government-led resource allocation; an export-oriented development strategy; a “science and technology-oriented nation” strategy that centers development on technology-intensive industries to promote export-oriented economic growth; and attaching importance to foreign investment and technology. In economic development in China, the government has always played an active role in promoting effective macroeconomic control. In the process of economic globalization, China has seized processing links in the value chain and has begun competing in international markets. China has also introduced large amounts of capital and technology from Europe, the United States, Japan, South Korea, and elsewhere to accelerate its development.

We analyzed the economic status of the three countries in terms of GDP, productivity, urbanization rate, and industrial structure. We infer that as a developing country, China will remain in the transitional stage of industrialization and urbanization for the next decade. Japan will continue to promote industrial informatization and will remain ahead of the other two countries. South Korea will strive to transform into a post-industrial society. However, due to the impact of COVID-19, rates of economic development in China, Japan, and South Korea will be greatly reduced.

Fig. 2.9 Gross value added by economic activity type in South Korea. Source: UN (2019a, b)
2.3 Energy Consumption in China, Japan, and South Korea

China, Japan, and South Korea are big energy consumers (Fig. 2.11). After the 1973 oil crisis, primary energy consumption in Japan developed at a slower rate than before. Primary energy consumption also decreased during the 1979 oil crisis, the Asian Financial Crisis, the financial crisis of 2007–2008, and particularly after the Tohoku earthquake. With increases in population and economic reform beginning in 2005, primary energy consumption has increased in China, Japan, and South Korea.
1978, primary energy consumption in China has accelerated since the late 1970s; it became the biggest energy consumer in Asia in 1977. Since 2001, when China became a member of the World Trade Organization (WTO), energy consumption has increased rapidly. In contrast, rapid growth in South Korea from the 1960s to the 1980s contributed stable and robust growth both in GDP and primary energy consumption. However, the Asian Financial Crisis shrank the economy and primary energy consumption of South Korea in 1998. In the 2000s, South Korea changed its economic development model and maintained strong growth in both GDP and energy consumption.

China, Japan, and South Korea are all reliant on fossil fuels for their development. Unlike Japan and South Korea, which both depend on oil, China depends on coal, accounting for approximately 60% of its total energy consumption in 2018 (Fig. 2.12). In addition to fossil fuels, nuclear is an essential energy source in each country. Japan decreased the proportion of nuclear power in its total energy consumption to 2.44% in 2018, due to the Fukushima Daiichi nuclear disaster. The percentage of nuclear in China is 2.03%, which is the lowest proportion of the three, but at 66.6 million tons of oil equivalent (Mtoe) is the most substantial volume among the three countries. In South Korea, nuclear accounted for approximately 10.00% of total energy consumption in 2018, which is the highest among the three countries and demonstrates a strategic priority. However, the president elected in 2017 aims to phase out nuclear over the next 45 years.

Renewable energy is becoming an increasingly critical energy option that could reduce GHG emissions as an important component of the energy mix. In 2018, annual renewable energy consumption in China was 415.6 Mtoe (12.58% of overall energy consumption), including 272.1 Mtoe of hydroelectricity. In Japan, annual renewable energy consumption was 43.7 Mtoe (9.62% of overall consumption), including 18.3 Mtoe of hydroelectricity. Annual renewable energy consumption in

![Graph: Share of primary energy consumption by fuel in 2018](https://example.com/graph.png)

**Fig. 2.12** Share of primary energy consumption by fuel in 2018. Source: BP Statistics (2019)
South Korea was 5.7 Mtoe or 1.89% of total energy consumption, including 0.7 Mtoe of hydroelectricity.

Prevailing trends in the energy intensity of GDP are compared in Fig. 2.13. Energy intensity of GDP in 2018 has sharply declined compared to that in 1990. Japan has the lowest energy intensity of GDP and China the highest. From 2013, primary energy consumption per GDP PPP (constant 2011 international USD) in China is lower than that in South Korea. In 2018, China recorded the lowest level, at 0.145 toe/USD compared to 0.158 toe/USD in South Korea. Gaps in energy intensity among China, Japan, and South Korea are narrowing. For instance, the gap in energy intensity of nominal GDP between Japan and China in 1990 was 0.874 toe/USD, narrowing to 0.187 toe/USD in 2018.

In China, coal remains the largest source of electricity, accounting for approximately 70% of the nation’s electricity in 2018 (Fig. 2.14). Due to high levels of PM2.5 pollution nationwide and pressure to achieve emission reduction targets, China, as the world’s biggest GHG emitter, is expected to act rapidly to transfer to cleaner energy. As part of its 13th Five-Year Plan, a total of 150 GW of new coal capacity has been canceled or postponed until at least 2020 (National Energy Administration 2017). Increasingly strict controls on total coal capacity and power plant emissions are expected to result in the retirement of up to 20 GW of older plant capacity and spur technological upgrades to China’s remaining 1000 GW of coal power. Other fuels, such as natural gas, nuclear power, and renewables, are expected to make up increasing shares of electricity generation in China in the future.

In 2010, a year before the Tohoku earthquake, the composition of power sources in Japan was coal (27.8%), liquefied natural gas (LNG, 29.0%), oil (8.6%), nuclear (25.1%), hydroelectric (7.3%), and other renewables (2.2%; Fig. 2.15). Due to the temporary closure of nuclear power plants after 2011, the percentage of nuclear declined to 0 in 2014 before slightly increasing to 8.9% in 2018 (BP 2019). Oil and LNG generation increased to compensate for the decline in nuclear. Renewables also compensated for some of the decline in nuclear power, increasing from 2.2% in 2010. Annual renewable electricity generation was 168.35 TWh, including 90.67 TWh of hydroelectricity, contributing approximately 16.73% of electricity generation in 2018 (BP 2019).

Like Japan, South Korea is a major energy importer. Electricity generation mainly comes from conventional thermal power. South Korea began its transition to cleaner energy with a 2017 power supply plan. Over 60 coal power plants are in operation in South Korea, one-third of which are due for retrofitting. The country has placed a heavy emphasis on nuclear power generation, accounting for nearly 30% of electricity. Despite the 2011 Fukushima Daiichi nuclear disaster in Japan, the South Korean government planned for significant expansion of its nuclear power industry, aiming to increase the share of electricity generation accounted for by nuclear to 60% by 2035. However, this was cancelled in 2017, leading to promotion of renewable energy in South Korea. In 2018, annual renewable electricity generation was 19.00 TWh, including 7.29 TWh of hydroelectricity, contributing approximately 3.28% of electricity generation (Fig. 2.16).
Fig. 2.13  CO₂ emissions per gross domestic product (GDP) in 1990–2018 in China, Japan, and South Korea. Source: BP (2019), UN (2019a, b)
Between 2000 and 2018, global renewable energy power capacity increased from 842 GW to 2350 GW (IRENA 2019). Renewable electricity generation in China, Japan, and South Korea has grown more rapidly since the mid-2000s. China expanded its renewable energy sector with unprecedented speed from 2006, and there are apparent increases in both Japan and South Korea from the late 2000s (Fig. 2.17).

**Fig. 2.14** Electricity generation by source in China in 1990–2018 (GWh). Source: IEA (2019)

**Fig. 2.15** Electricity generation by source in Japan in 1990–2018 (GWh). Source: IEA (2019)

Between 2000 and 2018, global renewable energy power capacity increased from 842 GW to 2350 GW (IRENA 2019). Renewable electricity generation in China, Japan, and South Korea has grown more rapidly since the mid-2000s. China expanded its renewable energy sector with unprecedented speed from 2006, and there are apparent increases in both Japan and South Korea from the late 2000s (Fig. 2.17).
Through analyzing the energy status of China, Japan, and Korea in terms of energy consumption, energy use efficiency, and power generation, it is clear that development in all three countries is dependent on fossil fuel. China is the largest coal consumer, while Japan and South Korea are more dependent on oil. All three countries are major energy importers and face similar crises in energy security. In

Fig. 2.16  Electricity generation by source in South Korea in 1990–2018 (GWh). Source: BP (2019)

Fig. 2.17  Renewable electricity generation in China, Japan, and South Korea. Source: BP (2019)
recent years, in order to reduce the use of fossil fuels, the three countries have expanded their use of renewable energy. China has achieved remarkable results in solar and wind power. Japan has exploited its geographical features to expand the use of solar power and geothermal energy. South Korea has made full use of the ocean to develop tidal energy.

In order to work toward a common goal of a low-carbon society and improve energy security, China, Japan, and South Korea will further expand the use of renewable energy. Japan and South Korea hope to use renewable energy to generate electricity to fill the gap left by reducing levels of nuclear power. Compared with Japan and South Korea, China will further develop energy efficiency and introduce new energy technologies while expanding the use of renewable energy.

2.4 Climate Change Strategy: Building Decarbonized Societies

2.4.1 Domestic Strategies

In order to mitigate climate change and achieve green economic development, China, Japan, and South Korea have made concerted efforts to move toward decarbonization.

In Japan, a global warming countermeasure plan has been drawn up to guide government actions. Cross-sectoral policies, basic policies, and promotion of international cooperation are being encouraged, and efforts are being made to achieve goals under a cooperative system. In the industrial sector, energy conservation and management of facilities and equipment are important, including the introduction of equipment with high energy-saving performance and the use of energy management systems. In the business sector, it is mandatory to comply with energy-saving standards for new buildings. Similar standards will be introduced for existing buildings. Efforts are being made to increase the stock of high-efficiency lighting, such as LEDs, to 100% by 2030 and to improve energy-saving performance through a top runner system. In the household sector, measures include introduction of 5.3 million household fuel cells and a top runner system. Dissemination of next-generation vehicles such as electric vehicle (EV) and fuel cell vehicle (FCV) and improvement of fuel are measures being taken in the transportation sector. After Japan was awarded the “Fossil Award” the second time by the international environmental NGO “Climate Action Network” in COP 25, Minister of Economy, Trade and Industry responded as the closure of the coal-fired power plant, which is not energy efficient in 2020. There are about 140 coal-fired power plants in Japan, of which 114 are outdated and inefficient. Therefore, in the energy sector, conversion from thermal power generation to renewable energy is the main issue but countermeasure. The launch of a regional carbon trading market will also play a key role in moving toward sustainable development.
There have been four stages of climate change strategy in China. The first is the observation stage (before 1997). From the 1990s, the adverse effects of climate change began to be recognized globally. A climate change response agency was established in China, charged with addressing overall climate change issues. The second stage is the learning stage (1997–2005). China, regarded as a developing country, had no emission reduction obligations under the Kyoto Protocol. Nevertheless, since 1989, it has changed its economic structure of heavy industry, promoted the use of renewable energy, and improved energy efficiency. In 1998, the National Climate Change Countermeasures Coordination Subcommittee, consisting of representatives of relevant ministries, was established as a place to study climate change policy in China. Above all, the importance of realizing a low-carbon society was recognized. Subsequently, China began to implement measures against climate change. The third stage is the cooperation stage (2005–2013). Policy has been strengthened since 2005 by demonstrating the importance of climate change at the 17th National People’s Congress. On June 12, 2007, the Notice of the State Council on the Diet’s climate change countermeasures and the establishment of energy-saving emission reduction sub-assemblies was published, with an emphasis on climate change issues. Based on this notification, the Countermeasures for Climate Change Leaders Group was established to determine critical strategies, policies, and measures for climate change issues, operations, research, and international cooperation. Interdepartmental coordination of international policy negotiation became important. Both government officials and NGOs began to seek public participation. Since 2006, China has published annual national level reports on progress in addressing climate change issues. By 2007, China had approved 1000 clean development mechanism (CDM) projects, 155 of which were registered as Chinese projects and contribute to a reduction of 92 million tons of CO₂ each year. These actions and policies have resulted in the avoidance of some CO₂ emissions. The fourth stage is the stage of seeking dominance (after 2013). In 2014, the United States and China agreed to strengthen greenhouse gas reduction efforts. The United States withdrew from the Paris Agreement in 2019, while China proposed the Belt and Road Initiative in 2017. China promised to invest in clean energy, build scientific cooperation, and support other countries in tackling climate change. As China seeks to lead the world in combating global climate change on behalf of the United States, the role of controlling energy and the environment is emphasized. China is the world’s largest greenhouse gas emitter but is continuing its efforts to reduce coal use and expand renewable energy. In 2017, it abandoned plans to construct 103 new coal-fired power plants, and the National Energy Agency announced the investment of more than 360 billion USD in renewable energy by 2020. China also plans to expand a carbon trading scheme originally piloted in seven provinces and cities to cover an additional area by 2020.

There are three main climate change strategies in South Korea. The first is a national carbon trading scheme. When launched in 2015, more than 525 companies participated in this emission trading scheme, covering approximately 68% of national greenhouse gas emissions. The 525 participating companies have their own reduction targets. The Ministry of the Environment’s Certification Committee
reviews emission reports annually, and emissions are verified by third parties. There are plans to link to carbon markets in the European Union and China, in order to improve cost efficiency and effectiveness, increase market liquidity, and promote bilateral and multilateral cooperation. The second strategy is a carbon tax and the development of a green information technology (IT) industry. Currently, the carbon tax is not obligatory, but the government is considering carbon tax policy in preparation for future carbon markets. Korean companies are currently focusing on the development of new technologies and are implementing eco-campaigns with the aim of reducing greenhouse gas emissions using new technologies. Green IT is one such solution. The Ministry of Administration has set up a calculation center for green energy conservation and is developing a comprehensive plan to promote it. The final strategy is promotion and utilization of renewable energy. The eighth power supply plan emphasized reducing dependence on coal-fired power. New equipment is prohibited in principle. By 2022, ten old facilities (3.4 GW) will be abolished. As of 2034, coal-fired power plants that have been in operation for more than 30 years will be ceased. Besides, in the same year, it was announced that dependence on nuclear power plants would be reduced and the focus moved to LNG and renewable energy generation. In South Korea, nuclear power is the main power source, accounting for 30% of total power generation; thus a move away from it will be a “great change in energy policy.” By 2020, South Korea plans to build more than 10 GW of solar power generation facilities (EIA 2020).

In summary, four important trends have emerged in the three countries:

1. Green manufacturing has begun to replace traditional manufacturing.
2. Renewable energy and new energy sources are developing rapidly due to coal phase-out plans.
3. Investment in environmental protection-related fields continues to increase.
4. Regional or national carbon markets are developing rapidly.

### 2.4.2 International Cooperation in Energy and the Environment

The history of international environmental cooperation among China, Japan, and South Korea is reviewed from 1999 to the present. Since 2008, the situation has changed from unidirectional support to building strategic, mutually beneficial relationships. Cooperation must account for risks.

#### 2.4.2.1 Cooperation Among China, Japan, and South Korea in 1999–2008

Environmental cooperation in the East Asia region was promoted by the Tripartite Environmental Ministers Meeting (TEMM) in Seoul in 1999 (Trilateral Cooperation
Secretariat (TCS) 2019). Cooperation among the three countries with regard to the environment started under the framework of ASEAN+3. The TEMM became a platform of the highest level for each country to promote regional environmental management. During this period, the three countries had already established a mechanism for regular meetings of leaders—ministerial meetings—and a consultation mechanism for international affairs. The sixth 10+3 Leaders’ Meeting adopted the East Asia Research Group Final Report, *Promoting the Evolution of the 10+3 Leaders’ Meeting to the East Asia Summit (EAS)* in 2002. As a result, China, Japan, and South Korea began to explore the construction of an East Asian Community under the framework of regional cooperation, including in energy and the environment. Also, during this period, Japan continued to support China through launching large-scale, long-term investments and transferal of technology via official development assistance (ODA) and Japan International Cooperation Agency (JICA) projects.

### 2.4.2.2 Cooperation Among China, Japan, and South Korea After 2008

Since 2008, the China-Japan-South Korea trilateral summit has been held annually, marking a new stage in international cooperation. In September 2011, the TCS was established in Seoul to promote peace and common prosperity among the three countries. Trilateral cooperation attaches great importance to the promotion of coordination in environmental protection and renewable energy (TCS 2019). During this period, the summit adopted several documents detailing measures to strengthen cooperation in environmental protection in areas such as environmental education, climate change, and biodiversity protection. A consensus was reached that the three countries should promote sustainable growth by developing green energy and improving energy efficiency. Based on this consensus, the East Asian Low-Carbon Growth Partnership was developed to promote low-carbon growth in countries of the EAS in 2012 (Ministry of Foreign Affairs of Japan (MOFA) 2015). Dialogue emphasized the importance of national low-carbon growth strategies, technology, market mechanisms, and cooperation among various stakeholders (MOFA 2015). Furthermore, an East Asian Low-Carbon Community framework was advocated, aimed at achieving a regional low-carbon society (Zhou et al. 2010).

Japan decided in 2005 to terminate its annual loan program by 2008. This was by far the biggest part of its ODA to China and demonstrated a shift from unidirectional support to building a strategic, mutually beneficial relationship based on market mechanisms. The CDM promoted rapid growth in environmental and energy cooperation. The first Japan-China Third Country Market Cooperation Forum was held in Beijing in 2018. By strengthening cooperation between China and Japan in third-country markets, a pathway to realize a tripartite, or multilateral, cooperation model is provided. The third-county market cooperation approach provides a way for participating countries to share benefits more equally.
In summary, cooperation among China, Japan, and South Korea in energy and the environment has a long history and has changed from unidirectional support to mutually beneficial cooperation by employing market-oriented approaches.

2.5 Reduction Roadmaps Based on INDC Targets and Countermeasures in China, Japan, and South Korea

According to INDC targets (Table 2.1), by 2018 China had lowered carbon dioxide emissions per unit of nominal GDP by 60–65% from 2005 levels (Fig. 2.13). However, emissions per unit of real GDP and GDP PPP still need to be improved. Levels in China in 2018 were roughly equivalent to those in Japan in 1980; thus there is immense potential for cooperation to reduce emissions. It is estimated that there is a theoretical reduction potential between China and South Korea and Japan and South Korea. This is the basis of cooperation among the three countries to reduce emissions. Mitigation potential in South Korea is limited due to its industrial structure, with a large share of manufacturing and high energy efficiency in major industries (UNFCCC 2019) leading to an expected 30% reduction in emissions by 2030. This will be supplemented by trading on the international carbon market. Climate change policy directions in the three countries (Table 2.2) show that development of innovative low-carbon technology, transfer of existing technology, and international cooperation are vital to achieve regional emission reductions.

2.5.1 Transition from Coal to Clean Energy

According to their INDCs, all three countries will proactively increase the share of non-fossil fuels in primary energy; coal currently dominates their energy structures.

There are nearly 2500 coal-fired power plants in China, with a total installed capacity of almost 970 GW by the end of 2017, an annual increase of approximately 2%. The coal power industry in China faces problems of overcapacity, and arrested economic growth has led to a decline in power demand. The Chinese government is seeking to continue economic restructuring and adopt more consumption-led and environmentally sustainable growth, which has further decreased oil and coal demand. Natural gas and renewable energy consumption is growing rapidly.

According to the energy development plan of the 13th Five-Year Plan, the total installed capacity of coal-fired power should be kept below 1.1 billion kW by 2020. After 2020, coal consumption should be reduced and adopt a long-term downward trend.

There are more than 100 coal-fired power plants in Japan. After the Fukushima nuclear power plant accident, Japan increased investment in new coal-fired power
Table 2.1  The INDC targets and countermeasures of China, Japan, and South Korea

| Target | China | Japan | South Korea |
|--------|-------|-------|-------------|
| • To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level | • At the level of a reduction of 26.0% by fiscal year (FY) 2030 (1.042 billion t-CO2 eq) compared to FY 2013, 25.4% reduction compared to FY 2005 | • 37% reduction from the business-as-usual (BAU, 850.6MtCO2eq) level by 2030 |
| • To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early | • Aiming at a 35% increase in energy efficiency by 2030 | • One-third of total reductions depend on international carbon markets |
| • To increase the share of non-fossil fuels in primary energy consumption to around 20% | • The ratio of renewable energy within the total electric power generated will be around 22–24%, and the ratio of nuclear power will be around 20–22% (solar is expected to increase 7× and wind/geothermal energy 4× from the current level) in 2030 | • Other sectors will offset the industrial sector mitigation |
| • To increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level | | |

| Scope (sectors and gases) | Sectors: 1. Energy 2. Industrial processes and product use 3. Agriculture 4. Land use, land-use change, and forestry (LULUCF) 5. Waste Gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ | Sectors: 1. Energy (a) Fuel combustion (b) Fugitive emissions from fuels (c) CO₂ transport and storage 2. Industrial processes and product use 3. Agriculture 4. LULUCF 5. Waste Gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ | Sectors: 1. Energy 2. Industrial processes and product use 3. Agriculture 4. Waste Gases: CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, and NF₃ |

| Main countermeasures | • Implementing national and regional strategies • Building low-carbon energy system and energy efficient and low-carbon industrial system | • Energy policies and the energy mix • Developing the Plan for Global Warming Countermeasures • Removals by LULUCF | • Industrial sector: the GHG and Energy Target Management System (TMS); a nationwide emissions trading scheme • Building sector: |

(continued)
plants. By 2050, the total installed capacity of coal-fired power plants is expected to remain at around 20 GW. Future energy policy in Japan will promote an energy composition as it was before the Fukushima nuclear power plant accident, using coal and nuclear energy as the basic power resources. Combined with INDC renewable energy development targets, energy structure has become the basis for increasing construction of coal-fired power plants in Japan. The fifth basic energy plan implemented by the Japanese government in July 2018 continues this trend.

In South Korea, coal has been the main driver of carbon dioxide emissions for two decades. Coal-fired power plants are the largest single contributor to domestic greenhouse gas emissions. Due to strong support from the current Korean government, future trends in energy structure include reducing the number of nuclear power plants. By 2050, the total installed capacity of coal-fired power plants is expected to remain at around 20 GW. Future energy policy in Japan will promote an energy composition as it was before the Fukushima nuclear power plant accident, using coal and nuclear energy as the basic power resources. Combined with INDC renewable energy development targets, energy structure has become the basis for increasing construction of coal-fired power plants in Japan. The fifth basic energy plan implemented by the Japanese government in July 2018 continues this trend.

In South Korea, coal has been the main driver of carbon dioxide emissions for two decades. Coal-fired power plants are the largest single contributor to domestic greenhouse gas emissions. Due to strong support from the current Korean government, future trends in energy structure include reducing the number of nuclear power

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**Table 2.1** (continued)

| China | Japan | South Korea |
|-------|-------|-------------|
| • Controlling emissions from building and transportation sectors | • JCM and other international contributions | managing energy efficiency |
| • Increasing carbon sinks | | • Transport sector: expanding infrastructure; strengthen the average emission standard |
| • Enhancing support in terms of science and technology | | • MRV system to monitor business with large amounts of GHG in above sectors |
| • Promoting carbon emission trading market and international cooperation | | • International contributions |

Source: UNFCCC (2019)

**Table 2.2** Climate change policy directions in the three countries

| China | Japan | South Korea |
|-------|-------|-------------|
| Coal-fired power generation | Reduction | Increase | Reduction |
| Renewable energy | Supportive | Supportive | Supportive |
| Carbon pricing | • Environmental protection tax | • Tax for climate change mitigation | • Coal consumption tax |
| | • Nationwide ETS panel with pilot ETS | • Two metropolitan ETS | • Nationwide ETS |
| Energy efficiency and energy conservation | • Potential for improvement | Leading level among developed countries with limited potential for improvement | High energy efficiency of major industries with relatively limited potential for improvement |

Source: UNFCCC (2019)
plants and supporting renewable energy and LNG. The current government plans to phase out coal and nuclear power while expanding renewable energy to 20% of total power generation by 2030.

2.5.2 Improvement of Energy Efficiency

In China, while clear and enormous expectations are placed on the introduction of non-fossil fuels, energy conservation has yet to be fully addressed. In contrast, Japan is a leader among developed countries, with limited potential for further improvement. In South Korea, there is high energy efficiency in major industries with relatively limited potential for improvement. Both Japan and South Korea continue to improve domestic efficiency in iron and steel industries and cooperate with other countries, including China, to improve the energy efficiency of others.

Considering the mature utilization of thermal power in China, Japan, and South Korea and the high energy efficiency of Japan and South Korea, international cooperation among the three countries is advantageous. Japan is the greatest investor in overseas financing for the development of coal-fired power plants, followed by South Korea and China, which together contribute the most globally to coal power generation assistance.

2.5.3 Promoting International Cooperation

Based on potential and historical coordination among China, Japan, and South Korea, international cooperation is key to realize regional emission reductions. The Paris Agreement recognizes carbon trading mechanisms at national and regional levels and provides political and policy support. China, Japan, and South Korea are developing domestic markets, aiming to introduce new carbon market mechanisms by 2020. It is timely to lay foundations now for connection to regional carbon markets.

In addition to carbon trading mechanisms, development of innovative low-carbon technology and transfer of existing technology are expected via international cooperation to achieve ecologically sensitive design in energy and materials cycles. Considering history among the three countries, market-oriented mechanisms under the East Asian Low-Carbon Community framework are expected to be an effective approach to promote international cooperation.
2.6 Conclusion

In international climate change negotiations, China, Japan, and South Korea are positioned as developing, developed, and semi-developed countries, respectively. As the main emitters globally, it is indispensable to analyze emission reduction strategies in these three countries in order to promote global emission reductions. In this chapter, we analyzed the economic status of the three countries in terms of GDP, productivity, urbanization rate, and industrial structure. We analyzed the energy status of China, Japan, and Korea in terms of energy consumption, energy use efficiency, and power generation. Although at different developmental stages, the countries are following similar trajectories. However, development in China and South Korea in both the economy and energy should not simply repeat the pathway of Japan. Based on INDC targets and countermeasures for climate change, climate change policy dictates a transition from coal to clean energy, improvement of energy efficiency, and promoting international cooperation under the East Asian Low-Carbon Community framework.

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