

8 Taiwan's Process for Abandoning Nuclear Power Generation and Energy Supply Plan

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8.1 Introduction

The Paris Agreement is the framework under which, for the first time in history, all countries and regions pledged to work toward the reduction of greenhouse gas (GHG) emissions. The agreement states that the rise in average global temperatures is to be kept well below 2°C compared to pre-industrial levels, and also requires efforts to limit it to 1.5°C (IPCC, 2018). The Taiwan's government intends to reduce the share of coal-fired thermal power in energy output and has announced targets for a 2025 energy-source composition of 50% natural gas thermal power, 30% coal-fired thermal power, and 20% renewable energy (Bureau of Energy, 2019). Especially noteworthy here is the absence of nuclear power from the target energy-source composition for 2025. As of 2014, nuclear power made up approximately 20% of Taiwan's electricity sources, but by 2021, it had fallen to 9.6%, and further planned decrease was in progress (Bureau of Energy, 2022).

For nuclear power plants, the regulation of nuclear safety is the single most important issue in securing society's trust. The aim of this study is to examine Taiwan's process of abandoning nuclear power generation since the Paris Agreement, and to discuss the role of Taiwan's nuclear safety regulatory bodies. The study is composed as follows: Section 2 discusses the current situation of energy policy; Section 3 introduces changes to nuclear power policy in the context of democratization and changes of administration; Section 4 discusses the energy supply plan geared toward abandoning nuclear power generation; Section 5 deals with the role of the nuclear safety regulatory bodies; and finally, Section 6 provides a conclusion to the study.

8.2 The Current Situation of Taiwan's Energy Policy

Energy policy in Taiwan comes under the jurisdiction of the Bureau of Energy of the Ministry of Economic Affairs. Most policies are deliberated at the Legislative Yuan (parliament) before being carried out by the Executive Yuan (cabinet). The government's energy policy has the following three targets: (1) to reduce carbon emissions and reach "net zero" by 2050; (2) to increase the proportion of renewable energy among electricity sources to 20% by 2025; and (3) to phase out nuclear power generation in stages by 2025.

8.2.1 Reducing CO₂ Emissions and Reaching “Net Zero” by 2050

Taiwan’s 2020 CO₂ emissions were 271.7 million tons, more than double the 1990 figure of approx. 124.18 million tons. CO₂ accounts for 95% of Taiwan’s total GHG emissions, and the energy conversion sector is responsible for 95% of CO₂ emissions. Thus, the decarbonization of the Taiwanese economy is essentially a matter of decarbonizing the energy conversion sector (Environmental Protection Administration, 2022). Under the Greenhouse Gas Reduction and Management Act, the Taiwan’s government pledged to reduce its carbon emissions and reach “net zero” by 2050 in 2021. To achieve this target, the Taiwan’s government has introduced “system of sliding fees by CO₂ emissions factor” for power network usage fees. Under the system, the lower the CO₂ emissions factor is when power is generated, the lower the usage fees for the power network will be; in effect, this is a system of subsidies for renewable energy sources.

8.2.2 Increasing the Proportion of Renewable Energy to 20% by 2025

The focus for increasing the share of renewable energy is solar energy power generation and offshore wind power generation. The plan for the solar power generation sector is to introduce 20 GW of installed capacity by 2025. In the field of offshore wind power generation, a number of wind farms with a cumulative installed capacity of 5.7 GW are to begin operation along the west coast by 2025 (Executive Yuan, 2019).

8.2.3 Gradual Phasing Out of Nuclear Power Generation by 2025

Taiwan currently has three nuclear power plants, numbered first, second, and third, each with two reactors. Construction of a fourth plant began in 1999, but work has been mothballed since 2014 due to safety issues.

Figure 8.1 shows the locations of nuclear power plants in Taiwan. The first nuclear power plant (Chinshan) and the second nuclear power plant (Kuosheng) were built near Taipei and Keelung in the north. Conversely, the third nuclear power plant (Mashan) was built at the southernmost tip of Taiwan. The fourth nuclear power plant (Longmen) was to be built in the north again. Table 8.1 shows the overview of nuclear power plants in Taiwan.

The 2011 Fukushima nuclear disaster in Japan strengthened concerns regarding nuclear energy in Taiwan also. Such concerns were unsurprising given that earthquakes are common in Taiwan. As a result, after the Democratic Progressive Party (DPP) won the 2016 general election, the newly elected administration of Tsai Ing-wen announced that nuclear power generation would be phased out in stages by 2025. First Nuclear Power Plant’s Unit 1 and Unit 2 accordingly ceased operation in December 2018 and February 2019, respectively. Unit 1 at Second Nuclear Power Plant was also shut down in July 2021, followed by Unit 2 on March 14, 2023. The operating licenses at Third Nuclear Power Plant are set to expire in May 2024 for Unit 1 and in February 2025 for Unit 2, at which point all nuclear plants in Taiwan will be out of commission.

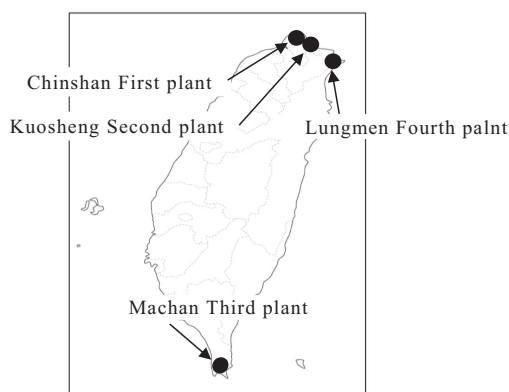


Figure 8.1 Location of Nuclear Power Plants in Taiwan

Source: Prepared by the authors

Table 8.1 Overview of Nuclear Power Plants in Taiwan

	<i>Installed Capacity MW</i>	<i>Reactor Maker</i>	<i>Operation Start Date</i>	<i>(Scheduled) Abolition Date</i>
Chinshan 1	636	GE	Dec 05, 1978	Dec 05, 2018
Chinshan 2	636	GE	Jul 07, 1979	Jul 07, 2019
Kuosheng 1	985	West-wood	Dec 27, 1981	Dec 27, 2021
Kuosheng 2	985	West-wood	Mar 14, 1983	Mar 14, 2023
Mashan 1	951	GE	Jul 26, 1984	Jul 14, 2024
Mashan 2	951	GE	May 17, 1985	May 17, 2025
Longmen 1	1,350	GE	Freezing construction	
Longmen 2	1,350	GE	Freezing construction	
Total	1,902			

Source: prepared by the authors.

The plan for the staged phasing out of nuclear energy drew much criticism as well as support. In the general election of 2016 and 2020, the opposition Kuomintang (KMT) party argued that “the nuclear power plants’ operational life should be extended on energy security grounds.” The KMT considers nuclear power generation cleaner than coal-fired thermal power generation. A referendum on the phased decommissioning of the nuclear power plants, which had already been decided, was held in November 2018; however, 59% of voters rejected the measure. In response, the clauses concerning the staged phasing out of nuclear power generation were struck from the Revised Electricity Act on May 7, 2019. However, Tsai Ing-wen’s decommissioning policy remained unchanged. Unhappy with the DPP administration’s energy policy, the KMT and advocates of nuclear energy proposed a referendum to activate the fourth nuclear power plant, which was held on December 18, 2021. However, the KMT’s proposal was rejected in the vote. The

prospects for the DPP's plan to abandon nuclear power became stronger as a result of this vote. We will examine the course of events in more detail in the later section.

8.3 Democratization, Changes of Administration, and Changes in Nuclear Power Policy

8.3.1 The Democratization of Politics and the Controversy Over Nuclear Power Plants in Taiwan

The 1987 lifting of martial law and the process of Taiwan's democratization are not unrelated to today's developments in regard to nuclear power plants. Nuclear energy, along with renewable energy, became a topic of debate. Nuclear power generation began in the 1970s as the showpiece of the KMT's energy policy. There was a good deal of public concern about the nuclear power plants, but no overt opposition was permitted under martial law. After that, the DPP aligned itself with the anti-nuclear power movement, and in doing so developed into an opposition party capable of resisting the KMT. Debate about the nuclear power plants became a catalyst for Taiwan's transition from authoritarian rule to democratization. Movements related to nuclear power generation in Taiwan also embodied the process of achieving transparency and democratization in Taiwanese politics as shown in Table 8.2.

8.3.2 Changes of Administration and Energy Policy

8.3.2.1 The DPP Administration of Chen Shui-Bian

Construction of the fourth nuclear power plant was approved in 1980, but did not begin until 1999. In 1985, two years after the Taiwan Power Company (Taipower) had bought land at Kongliao for the fourth nuclear power plant, construction there was shelved. This was partly due to the Three Mile Island nuclear accident in the United States, which had happened in 1979, after which academics began to criticize the fourth nuclear power plant plan.

In the 2000 general election, the DPP candidate Chen Shui-bian was elected as a leader, and the KMT ceded the administration to the DPP. Given the KMT's dictatorial past, the democratic transfer of power was a historic achievement. Construction of fourth nuclear power plant was already running years behind schedule when the Chen's DPP administration took office. The project was also running over budget, from an estimated USD 5.6 billion when construction was approved in 1985, to USD 8 billion in 2000 (Power Technology, 2018). This major budget inflation was partly a reflection of changing circumstances for nuclear power plants. Concerns about the safety of nuclear power plants had been growing since the 1986 Chernobyl disaster in Ukraine, and the major Jiji earthquake of 1999; costs for safety measures at nuclear power plants rose.

Ten days before the 2000 general election, Chen had appeared at the construction site of the fourth nuclear power plant, where he promised local residents that

Table 8.2 Policy Changes Regarding Taiwan's Fourth Nuclear Power Plant, and the Anti-Nuclear Movement

Administration (party)		Chiang Ching-kuo (KMT)	Lee Teng-hui (KMT)	Chen Shui-bian (DPP)	Ma Ying-jeou (KMT)	Tsai Ing-wen (DPP)
Term (years)		1978~1988	1988~2000	2000~2008	2008~2016	2016~
Nuclear power policy		Advance nuclear power plant	Advance nuclear power plant	Policy of "abandoning nuclear power generation"	Quietly achieve abandoning nuclear power generation	Establish abandoning nuclear power generation as policy and work steadily toward realization
Fourth nuclear power plant		Formulation → deferment	Place orders → start construction	Halt construction → restart	Continue construction → mothballing	Mothballing
Anti-nuclear movement	Stance	Germination → rise	Rise → prominence	Prominence → stagnation	Stagnation → rebirth	Energy transition policy
	Main actors	Intellectuals → Environmental Protection Union, Alliance of Women's Associations, Yanliao Anti-nuclear Self-help Association, etc.	In addition to the groups on left, fourth nuclear power plant referendum campaign, etc.	In addition to the groups on left, GCAA, etc.	In addition to the groups on left, The Alliance of Moms that Oversee Nuclear Power plants, anti-fourth/fifth/sixth nuclear plant movement, etc. → National Nuclear Abolition Action Platform	National Nuclear Abolition Action Platform; referendum
Nuclear power plant accidents that affected nuclear power policy (country, year)		Three Mile Island (USA, 1979), Chernobyl (USSR, 1986)			Fukushima Dai-ichi (Japan, 2011)	

Source: Made by the authors based on Suzuki (2018)

he would immediately halt work on the plant if elected (Grano, 2015, 68–69). Lee Teng-hui of the KMT was Taiwan-born and Taiwan's first directly elected leader, and he had garnered a certain level of support among the residents. However, a good deal of mistrust toward him had built up over the construction of the fourth nuclear power plant, which helped tip the scales in Chen's favor. Some scholarly opinion also points to how the anti-nuclear movement had transitioned from being an independent political movement to a movement that drew political parties into its orbit (Ho, 2003).

At the outset of the DPP administration, Chen appointed the industrialist Lin Shin-yi as Minister of Economic Affairs. Lin was an outstanding private enterprise manager in Taiwan, and not aligned with any political party. On taking office, Lin immediately set up a "Fourth Nuclear Power Plant Re-Evaluation Group," which drew in specialists and public servants from both supporters and opponents of the fourth nuclear power plant going ahead. The Re-Evaluation Group met for a total of 13 times. The discussions were far-reaching and covered topics such as the total costs of the fourth nuclear power plant (including decommissioning costs, social costs, and costs for alternative plans), nuclear waste, and emergency response. On reviewing the group's discussions and submissions, Lin presented a formal proposal to halt construction of the fourth nuclear power plant to Tang Fei on September 30, 2000. In response, Tang, who was a member of the KMT, stepped down from his post in protest at Lin's proposal. The KMT held a majority in the Legislative Yuan and also opposed the proposal ferociously, sending the political situation into turmoil. On October 27, 2000, the DPP member Zhang Jun-hsiung, Tang's successor as Premier, announced the halt of construction of the fourth nuclear power plant. However, in January 2001, the President of the Judicial Yuan (the judicial official who interprets the Constitution) pointed out flaws in the procedure followed by the Executive Yuan; in response, during the same month, the Legislative Yuan adopted a resolution to continue construction of the fourth nuclear power plant. As a result of this political turmoil, both government and opposition finally agreed a compromise proposal to the effect that "abandoning nuclear power generation is a goal to be achieved in the future." On February 14, 2001, the resumption of construction was officially announced.

Despite Chen Shui-bian's pledge during the election campaign to halt construction of the plant facilities immediately, he was unable to follow through once in office. This was because following the election, Taiwan's parliament was bitterly divided between anti-nuclear and pro-nuclear camps, and the DPP was a minority party in the Legislative Yuan. In order to get bills to the committee stage, Chen had no choice but to compromise with the KMT, which was the largest party.

However, Chen's decision to hesitate on halting construction turned out to be a political mistake as events unfolded. Firstly, he convened the Fourth Nuclear Power Plant Re-Evaluation Group to examine the project and adopted a wait-and-see attitude. Secondly, he had pledged to maintain low electricity charges even while halting the plant's construction, to the widespread disbelief of industry and the public (Hsu, 2005). Thirdly, the Chen administration encroached upon the jurisdiction of the Legislative Yuan, with the result that Chen was ultimately forced

to compromise with the KMT to keep his administration running (Chiu, 2000). In the end, Chen Shui-bian failed to halt construction of the fourth nuclear power plant.

Chen's compromise with the KMT came as a major shock to anti-nuclear groups; however, it also helped to forge alliances between a wide range of environmental and anti-nuclear groups of differing opinions. Discontent with the government's decision to reverse the halt of construction grew stronger, and an estimated 10,000 people joined a protest demonstration on February 24 (Taipei Times, 2001a, 2001b).

Chen Shui-bian won re-election in the 2004 election, partly due to internal splits within the KMT. His administration then approved the budget for the construction of fourth nuclear power plant, as if the original promise Chen made in 2000 has been completely forgotten. To bring stability to the political situation, Chen entered into a coalition government with a KMT premier. However, as a quid pro quo for agreeing to re-start construction at the fourth nuclear power plant, the Chen Shui-bian administration drew up a "Thirty-two-year schedule for decommissioning nuclear power plants" (Shen, 2001). Continuing the construction was a means to accommodate the KMT and may have been a strategic move on the DPP's part.

8.3.2.2 *The KMT Administration of Ma Ying-Jeou*

A further change of administration happened in 2008, when the KMT candidate Ma Ying-jeou won the general election. The KMT returned to power against a backdrop of the DPP's Chen Shui-bian having failed to halt construction at the fourth nuclear power plant. Another factor was the downturn in the Taiwan's economy during the 2007–2008 financial crisis. After taking office, in 2009, the Ma administration passed the Renewable Energy Development Act and announced a New Energy Policy Framework. The New Energy Policy Framework included initiatives such as the Million Solar Rooftop PVs Project, the Thousand Wind Turbines Project, and the Off-Shore Wind Power Demonstration Program. However, there was no indication of how possible technological developments were to be handled, or how the required investment funding was to be realized.

Ma Ying-jeou disbanded the Communications Committee for Abandoning Nuclear Power Generation that the DPP has instituted to further the process; this move apparently arose from the KMT's commitment to the completion of the fourth nuclear power plant and the continued use of nuclear energy (Grano, 2017, 160). Anti-nuclear groups protested the decision, but the Ma Ying-jeou administration "put forward proposals that envisioned maintaining the safety of nuclear energy," but also "focusing on reducing dependence on nuclear energy, to create a rich, green low-carbon environment and to gradually establish a phased abandonment of nuclear power generation (Executive Yuan, 2012). This was not very different from the DPP's manifesto promise to "phase out nuclear energy in stages." In fact, Ma Ying-jeou took no action in regard to the fourth nuclear power plant.

Hunger strikes among the anti-nuclear protesters drew attention both domestically and internationally, and large-scale demonstrations caused traffic chaos in

Taipei. Ma Ying-jeou proposed to have the fourth nuclear power plant construction issue decided by a future referendum, but the DPP and anti-nuclear groups were skeptical about it (Grano 2017, 165, 167–169).

The citizen's movement in regard to the fourth nuclear power plant demonstrated the growth and development of democracy in Taiwan; the government proved unable to ignore the will of the people.

8.3.2.3 The DPP Administration of Tsai Ing-wen

The 2016 general election was won by Tsai Ing-wen, and a DPP administration came into being. The pros and cons of constructing the fourth nuclear power plant had once again become a major debating point during the election. The DPP campaigned strongly on abandoning nuclear power, while the KMT argued that suspending operations at nuclear power plants would simply cause a shift to thermal power and increased air pollution. The outcome was a bitterly won victory for the anti-nuclear side, and Tsai Ing-wen moved toward abandoning nuclear power generation in Taiwan during her term of office. We will follow the course of events in the next section.

8.3.3 *The Fourth Nuclear Power Plant Controversy and the Referendum for Abandoning Nuclear Power Generation*

8.3.3.1 The Fourth Nuclear Power Plant Controversy

Taiwan's nuclear power generation is managed by the state-run firm Taiwan Power Company (Taipower). During the 1970s and 1980s, the Taiwan's government and Taipower extolled the benefits of nuclear power in terms of its low generation costs and stable supply, while Taipower built the first, second, and third nuclear power plant. However, the 1986 Chernobyl nuclear disaster was followed by the lifting of martial law in 1987, and from this point onward, the Taiwan people's perception of nuclear power plants began to change. The fact that the planned site for the fourth nuclear power plant was in an earthquake fault zone was one source of impetus to the anti-nuclear movement which now got underway.

The movement first took shape in the Taiwan Environmental Protection Union (TEPU), a group led by intellectuals which staged anti-nuclear street demonstrations and speeches in 1988. By the end of the year, the residents of Kongliao, the proposed site of fourth nuclear power plant, had joined the movement. Despite opposition from the DPP within the Legislative Yuan, construction got underway in 1999. The initial stages of the anti-nuclear movement involved cooperation between the activists and the DPP, but this did not last long. After Chen Shui-bian won the general election in October 2000, the DPP announced a halt on the fourth nuclear power plant, but this was reversed in February 2001 following the pushback by the pro-nuclear KMT opposition party, the vote in the Legislative Yuan, and the Judicial Yuan's intervention on Constitutional interpretation. Thus,

construction at the plant recommenced. After the Chen Shui-bian's inauguration, the DPP's stance toward the social activists gradually began to change, and the party began to see the activists as a factor causing social instability. The DPP's change of attitude led to splits among the anti-nuclear groups. Some groups, such as TEPU, maintained their links with the DPP; others, such as the Green Citizens' Action Alliance (GCAA), put themselves at a distance from the party.

The DPP's about-turn on constructing the fourth nuclear power plant did not put an end to the anti-nuclear movement, and it saw a revival from 2008. From August 2009, a series of anti-nuclear concerts for youth audiences were held with the help of the No Nuke Street Band. Ho (2014) states that this change of style succeeded in giving the anti-nuclear movement a more easygoing image, helping it to draw popular support thereafter.

The Fukushima nuclear disaster in Japan worked as a major impetus for the Taiwanese anti-nuclear movement. Beginning with an anti-nuclear demonstration on March 20, 2011, repeated marches against the fourth nuclear power plant were held. Numbers of protesters joining the marches built up through to 2013, reaching the hundreds of thousands. The protests on March 9, 2013, alone involved 200,000 participants in major cities, including Taipei; this was the largest anti-nuclear protest in Taiwan's history. The opposition movement against nuclear power generation had not reached such a scale that the government could not hope to ignore it. The DPP had taken a clear position against nuclear power plants after coming to office, and the KMT was left with no alternative but to support the staged phasing out of nuclear energy (Grano, 2017).

Before the 2012 general election, the DPP candidate Tsai Ing-wen issued the 2025 Nuclear-Free Homeland Initiative, pledging staged phasing out of nuclear power plants and mothballing of the fourth nuclear power plant's construction. Even though Tsai lost the 2012 vote, the problem of the nuclear power plants remained as a major political issue. In this context, it is deeply interesting that both the DPP and the KMT successively announced plans for a referendum on the fourth nuclear power plant issue in 2013. Because the DPP announced their plan without holding talks with the anti-nuclear movement first, the party was criticized for using the nuclear power plant issue as a political football, and the DPP had no option but to drop the proposal. The KMT, on the other hand, announced a similar plan, but it did not clearly map out the nature of the referendum, so there was a public pushback against it, and it was postponed indefinitely. The issue was subsequently forgotten about until the Sunflower Student Movement of 2014.

The year 2014 saw a number of developments. The Sunflower Student Movement occupied the Legislative Yuan and Executive Yuan for the 24 days between March 18 and April 10. However, the involvement of anti-nuclear activists as supporters in the movement soon became apparent. Immediately thereafter, the former DPP leader Lin Yi-hsiung began a hunger strike at Gikong Presbyterian Church in Taipei on April 15, 2014, in protest at the construction of the fourth nuclear power plant. On April 23, 2014, Ma Ying-jeou of the KMT visited the church, and pledged to hold a referendum on the construction project (Taipei Times, 2014).

8.3.3.2 *Mothballing of the Fourth Nuclear Power Plant*

Lin Yi-hsiung had been imprisoned [in 1979] for involvement in a subversive movement, and [most of his immediate] family had been murdered while he was under detention. Lin had gone on to overcome this tragedy and devote himself to Taiwan's democratization, and he won the widespread respect of society. He had originally planned to start his hunger strike in mid-March 2014, but he postponed it in order to lend support to the Sunflower Student Movement. Once the student's protest had subsided, Lin went forward with the hunger strike. In response, solidarity movements such as hunger strikes spread throughout Taiwan. The climax came with the demonstrations of April 27, 2014.

The demonstration on April 27, 2014, occupied the main road near Taipei Main Station for 15 hours. It was during these hours that Ma Ying-jeou announced the mothballing of the fourth nuclear power plant on Facebook. The unveiling of such a major policy change on Facebook gives some indication of his instability. Lin Yi-hsiung waited after until Premier Jiang Yi-huah had officially announced the mothballing on April 28 before ending his hunger strike, on April 30. Thus, a combination of the popular anti-nuclear movement and Lin's hunger strike put the brakes on Ma's fourth nuclear power plant plan.

While the Fukushima nuclear disaster helped spur the anti-nuclear movement in Taiwan, the revival of social movements after the Ma government came into power in 2008 also had an impact, as did the anti-nuclear movement's shift toward independence from party politics (Ho, 2014).

8.3.3.3 *Referendum on Abandoning Nuclear Power Generation*

There were four options for the future of the fourth nuclear power plant plan: (i) complete the construction and start operation; (ii) complete the construction but not start operation; (iii) halt construction; and (iv) mothball the plant. Among these, why was the fourth, mothballing the plant, chosen as an option? Ma Ying-jeou's Facebook post explained that this "left the choice to the next generation" if and when "the fourth nuclear power plant becomes needed in the future." Under the guise of flexible policy-making, this was essentially putting off the decision about the plant for a future administration to resolve. Meanwhile, the decision for or against nuclear fuel loading was to be left to the outcome of a referendum.

The DPP victory in the general election of January 2016 was partly due to disunity among the KMT and to the growing anti-nuclear movement; Tsai Ing-wen became leader. The DPP's election manifesto included realizing the abandonment of nuclear power generation by 2025. There was to be no return to the mistake made by Chen Shui-bian in 2000. In government, the DPP held fast to their policy against the nuclear power plants, and in 2017, the Electricity Act was revised to obligate the staged phasing out of nuclear energy by 2025. As the act came into force, the Tsai administration began to work on an energy transition that would make renewable energy the key power source by the target year, so as to achieve the goal of abandoning nuclear power generation.

Working against this, the pro-nuclear lobby set up a campaign to hold a referendum proposing to delete the “2025” clause from the Electricity Act. The move for a referendum was supported by the Ma Ying-jeou and Jiang Yi-huah, both of the KMT. The official website for the referendum on the nuclear power plants listed three reasons why retaining nuclear energy was significant. First, nuclear energy is a clean (green) form of energy, with the least impact on the environment, and a safe source of energy. Second, given the fact that renewable energy is still an immature technology, nuclear energy should be used to act as a backup for this technology, to build a foundation for research and development. Third, refraining from the large-scale development of renewable energy would leave time and space for ecological recovery. Combined use of nuclear energy and renewable energy signifies energy transition in the true sense, and this approach is gaining ground internationally.

The argument that the nuclear power proponents put forward was that nuclear energy, as the option with less impact on the environment, created the time and space to give due consideration to environmental concerns. While the referendum on the nuclear power plant was, on the face of it, aimed at striking down the clause committing Taiwan to abandoning nuclear power generation by 2025, the long-term purpose was more ambitious—the continued use of nuclear energy beyond the target year.

The referendum was held on November 24, 2018; asked to vote on “deleting the 2025 clause,” 59.6% of voters agreed, with 40.4% disagreeing. Thus, the ballot favored the retention of the nuclear power plants, and the “2025 clause” was duly deleted on December 2. Notwithstanding this, the DPP government announced at a press conference on January 31, 2019, that “Nuclear power stations in Taiwan will not have their operations extended, or be restarted.” Moreover, on February 1, 2019, Taipower declared that the completion of the fourth nuclear power plant was no longer realistically possible.

According to opinion polls of all varieties, support for abandoning nuclear power had reached about 60% after the 2011 Fukushima nuclear disaster, and stabilized at that rate. As the process of moving toward decommissioning Taiwan’s nuclear power plants progressed, however, public opinion began to waver. In discussing why, Suzuki (2020) analyzed the Tsai administration’s policy of abandoning nuclear power, and the backlash against it, with the focus on changes in public opinion. Four main factors emerged in the study: first, the occurrence of major power shortages and instances of atmospheric pollution that had raised public disquiet; second, the campaign of positive outreach that the pro-nuclear lobby had conducted; third, dissatisfaction with how the government was handling its policy of abandoning nuclear power; and fourth, the disconnect in people’s minds between power supply from nuclear energy and the realities that this supply involved.

Even though the “2025 clause” was struck out, the Tsai administration’s policy of abandoning nuclear power remained in place. Thus, the pro-nuclear lobby set to work on a new referendum campaign. On December 18, 2021, another referendum was held, on the proposal to “rescind the mothballing of the fourth nuclear power plant and operate the plant.” This proposal was rejected, with 47.2% in favor and 52.8% against. On the strength of this vote, the possibility of the DPP realizing their goal of abandoning nuclear power (by 2025) became feasible.

8.4 An Energy Supply Plan Aimed Toward Abandoning Nuclear Power

8.4.1 The Birth of the 2016 DPP Tsai administration

In her inaugural address on May 20, 2016, the DPP's Tsai Ing-wen discussed the issues that Taiwan was faced with. Among them were Taiwan's lack of energy and natural resources, and serious environmental pollution. Tsai confirmed her commitment to sustainable development, and stated that "We must not endlessly expend natural resources and the health of our citizens as we have done in the past. [...] We will gradually adjust our energy options based on the concepts of sustainability," thus criticizing the KMT's past policies. In line with her address, a start was made on monitoring GHG emissions and formulating new laws and policies based on commitment to the United Nations Framework Convention on Climate Change¹. Also, as discussed in Section 2, the Tsai administration renewed its commitment to a "nuclear-free and sustainable Taiwan" as well as to the reduction of GHG.

8.4.2 The New Electricity Act and the Energy Supply Plan Going Forward

8.4.2.1 The New Electricity Act

The Electricity Act was an old law, promulgated in 1947. The act was revised a number of times before the major revision in January 2017. Article 1 stated the goals of the revision: "efficient development and management of the electric power resources, economizing electricity demand and supply (energy saving), promoting energy transition, reducing carbon emissions, supplying electricity from multiple sources, fair competition, and promoting joint management" (Electricity Act, 2017).² The government's energy policy was to focus on the three planks of energy transition, reduction of carbon emissions, and the development of the electricity industry.

The revision of the act divided the electricity industry into three businesses: generation, transmission and distribution, and sales. Taipower retained its monopoly over the transmission and distribution business for the time being, but it was scheduled to convert into a holding company within six years after the revision of the act, and subsidiary companies were to be set up to handle generation, and transmission and distribution. The complete liberalization of the electricity market was also scheduled to happen nine years at the latest after the revision. However, this liberalization has not actually come about, apparently because the government has prioritized stability of supply.

Electricity generation in Taiwan is regulated by the Electricity Act, which makes reference to the effective management of the electric power resources and to the provision of multiple sources of electricity supply. The act also promotes reductions in GHG emissions and assures fair competition. However, fair competition is not feasible under the current circumstances, where a single company handles

generation, transmission, and sales. Article 6.1 of the Electricity Act prohibits transmission and distribution operators from engaging in the generation or sales businesses. Also, Article 6.3 prohibits transmission and distribution operators from transferring capital to generation or sales businesses.

Incidentally, in the generation sector, while renewable-energy electricity producers are permitted to sell energy directly to the end user, conventional-source electricity producers are only permitted to sell to Taipower, as before the act's revision. This measure is intended to strengthen the position of renewable-energy electricity producers, and give them superiority over electricity producers that use conventional forms of energy. Furthermore, Article 8 of the Electricity Act obliges Taipower to prioritize the purchase of electricity generated using renewable energy if the power network is operating in a safe and stable manner. Article 10 stipulates that Taipower must purchase all electricity generated using renewable energy at fixed rates (Feed-In Tariff; FIT) (Lin, 2017).

However, it appears that Taiwan's electricity market will not achieve complete liberalization. Even after Taipower being reorganized into a holding company at some point during the scheduled six to nine years, it would retain responsibility for the management of the power network and for distribution (Lin, 2017). Therefore, the electricity transmission network was to remain as a monopoly market under Taipower (Chou and Mathews, 2017). Because the transmission and distribution and generation businesses were to be hived off to separate independent subsidiaries, independent generation operators would be able to enter the secondary market for electric power (T@iwan heute, 2016). Furthermore, the revision of the Electricity Act created a new energy regulatory body, the Electric Power Regulatory Bureau, which functions in particular to promote energy reform, assure monitoring of the power network, grant access licenses, and mediate in disputes between generation operators and consumers they should arise.

The new Electricity Act stipulates that the high generation costs of renewable energy would be passed on to consumers, which caused public debate. It also requires generation and transmission and distribution operators to secure a reserve supply to cope with increases in demand for electricity. Thus, producers are obliged to increase capital investment, which also pushes up costs.

8.4.2.2 Energy Supply Plan

The transition from nuclear to other forms of energy is an important policy initiative, and a stable supply of electricity is an indispensable prerequisite for it. According to the available electricity statistics, the average growth in supply over the past ten years (2011 to 2020) has been 1.34%. Under the electricity plan for 2021 to 2027, targets for an operating reserve of 15% and a spinning reserve of 10% are to be achieved, and a plan for electricity sources is to be realistically examined, along with energy-saving measures (Table 8.3).

Table 8.3 Power Plant Conversion and Expansion Projects

<i>Type</i>	<i>Project Name</i>	<i>Project Capacity</i>	<i>Progress</i>	<i>Expected Outcome</i>
Thermal power generation	Conversion and expansion of Linkou Power Plant	Renovation and expansion of three supercritical coal-fired thermal facilities with installed capacity 800 MW, at the current location	Completion rate was 96.15% as of end of December 2019	Supply of power to regions of Taiwan, depending on quality of power sources
	Conversion and expansion of Talin Power Plant	Construction of two ultra-supercritical coal-fired thermal facilities with installed capacity of 800 MW	Completion rate was 99.07% as of end of December 2019	Strengthening of power source functions
	Renovation and expansion of Tunghsiao Power Plant (first stage)	Construction of three gas combined-cycle facilities with an installed capacity of 892.6 MW	Completion rate was 99.33% as of end of December 2019	Prioritized use of natural gas and strain
	Renovation and expansion of Tunghsiao Power Plant (second stage in progress)	Construction of six gas combined-cycle facilities with an installed capacity of 440–550 MW	Approved in mid-August, 2019; as of end of December 2019, progress rate is 0.05%	Policy requirements are to be met by prioritizing the efficiency of the entire facility
	New gas thermal power installed capacity Taichung Power Plant	Installation of two gas combined-cycle facilities with an installed capacity of 1.0 GW to 1.3 GW Construction of an LNG receiving terminal with five 160,000-kl storage tanks	Completion rate was 2% as of end of December 2019	
	Renovation and expansion of gas thermal power installed capacity in Hsinta Power Plant	Renovation and construction of gas combined-cycle facility with a total installed capacity of 3.0 GW to 3.9 GW	Completion rate was 6% as of end of December 2019	

	Expansion of Tatan Power Plant	Construction of three gas thermal power combined-cycle facilities with a total installed capacity of 3.16 GW	Completion rate was 14.59% as of end of December 2019	In response to increases in domestic electricity demand and government policy of abandoning nuclear power
	Renovation and expansion of Hsieh-ho Power Plant	Construction of two gas combined-cycle facilities with an installed capacity of 1.0 GW to 1.3 GW	Completion rate was 1.28% as of end of December 2019	Supply of electricity to consumers in northern Taiwan and conversion to thermal power plant
Offshore wind power generation	Offshore wind power generation project (first stage)	Construction of wind farm with a total installed capacity of 1.092 GW	Completion rate as of December 31, 2019, was 57.34%. Secure power transmission scheduled for end of December 2020 or earlier	Develop Taiwan's R&D capabilities for offshore wind power generation, expand uptake of green energy facilities

Source: Created by the author based on Taipower (2021).

8.4.2.3 Energy Supply Plan by Form of Energy

8.4.2.3.1 GAS THERMAL POWER GENERATION

To raise the proportion of natural gas thermal power generation to 50% by 2025, it is necessary to speed up the construction of gas-fired power plants, and to put natural gas infrastructure in place. The output from the new gas-fired power plants scheduled for construction between 2021 and 2027 is 15.77 million kW, and the new increase in output after deductions for facilities due to shutdown is 14.50 million kW. Also, CPC Corporation and Taipower are building natural gas-receiving terminals near gas-fired power plants. Securing and diversifying sources of natural gas supply is another important concern; in order to secure a stable supply of natural gas, it is planned to increase the available gas tanks' volume and to diversify the gas supply sources.

8.4.2.3.2 SOLAR POWER GENERATION

The government's energy transition policy aims to increase the share of renewable energy among electricity sources to 20% by 2025. Among the various options, the introduction of solar power generation (20 GW) and offshore wind power (5.7 GW) is being promoted as particularly important. Solar power generation supplies energy for the summer peak demand season, which is why the government is aiming for 20 GW by 2025 (12 million kW from solar farms, and 8 million kW from rooftop solar panels). The goal is to increase solar generation facilities by 1 GW per year from 2026 onward. Given the need for efficient usage of available ground and space, the use of land in combination with other purposes is being looked at for solar power generation going forward; full use of rooftops is also being considered.

8.4.2.3.3 WIND POWER GENERATION

It is planned to increase the installed capacity of onshore wind power to 1.2 GW by 2025; the target for offshore wind power generation by 2025 is 5.7 GW. Thus, onshore and offshore combined will have an installed capacity of 6.9 GW in 2025, and the annual total power generation is expected to reach 24.1 billion kWh. It is planned to increase the installed capacity of offshore wind power generation by 1.5 GW annually from 2026 onward.

8.4.2.3.4 COAL-FIRED THERMAL POWER GENERATION

The government aims to decrease the proportion of coal-fired thermal power generation among electricity sources to 30% by 2025. New electricity demand is to be covered by gas thermal and renewable energy generation, in line with public expectations for improved air quality. The government has been overseeing improvements to Taipower's subcritical coal-fired thermal power plants since 2017. For example, environmental improvement projects for four units at the coal-fired

Taichung Power Plant have been completed, leading to a 60% decrease in emissions of atmospheric pollutants in 2020 compared to 2014.

8.4.2.3.5 NUCLEAR POWER GENERATION

In February 2013, the Minister of Economic Affairs published plans to decommission the existing first to third nuclear power plants, stating that “Our policy is that operation of Taipower’s existing first to third nuclear power plants will not be extended beyond 40 years, and we request Taipower to begin preparatory decommissioning work in a timely manner.” The (then) Ma Ying-jeou also reinforced the government’s commitment to reducing nuclear power by announcing that “The nuclear power plants’ operational life will not be extended.” In point of fact, applications to extend the operational life of nuclear power plants need to be filed five years before the current operational life terminates, and the applications were already overdue. As for the fourth nuclear power plant, although Unit 1 had been completed, it was in a “frozen” condition (the equipment was being maintained under seal). Construction of Unit 2 had been suspended, so it was not yet operational. Also, the local government of the area of the planned nuclear waste disposal site was strongly resisting its construction, meaning that there was almost no realistic possibility of the nuclear power plant going into operation.

8.4.3 The Decommissioning Process

8.4.3.1 Operational Plan for Decommissioning Safety Regulations

The operating licenses for Units 1 and 2 at the First Nuclear Power Plant expired on December 5, 2018, and July 15, 2019, respectively. Operational approval for Unit 1 at the Second Nuclear Power Plant was valid until December 27, 2021, but the storage pool for spent fuel is almost full, and spent fuel cannot be removed from the reactor core. Accordingly, Taipower moved quickly to shut the unit down permanently on July 1, 2021.

In accordance with the Nuclear Reactor Facilities Regulation Act, Taipower submitted an application for permission to carry out decommissioning, along with the related documentation, to the Atomic Energy Council (AEC) in November 2015; this was three years before the operating license was to expire. The review on decommissioning the First Nuclear Power Plant was completed in June 2017. Also, on July 4, 2019, Taipower submitted documentation on the environmental impact assessment to the Environmental Protection Administration. The Environmental Protection Administration’s review confirmed that Taipower was in compliance with the Nuclear Reactor Facilities Regulation Act, and the decommissioning of the First Nuclear Power Plant was approved on July 12 of the same year. The approval came into effect on July 16. In accordance with the relevant regulations, Taipower is obligated to complete the decommissioning within 25 years of the approval coming onto effect.

Given that Taiwan was about to embark on its first decommissioning of a nuclear power plant, Taipower set up a special team to examine safety regulations for the operation. For its part, apart from reviewing the application for decommissioning, the AEC is required to confirm that the operation of nuclear reactors has been securely suspended, and to confirm the preparatory work undertaken before the decommissioning period commences.

8.4.3.2 Confirmation of the Transition to the Safe Decommissioning of Nuclear Reactors

In June 2017, after the review of the application for decommissioning had been completed, Taipower carried out multiple inspections of the preparatory work for decommissioning, in accordance with the timing set out in the application for decommissioning. In order to proceed with the decommissioning smoothly, Taipower confirmed the status of relevant plans for the power plant, and planned relevant procedural manuals and personnel training. Inspections of Units 1 and 2 of the First Nuclear Power Plant were carried out by the AEC, which confirmed that the safety standards required to begin decommissioning work were satisfied.

8.4.3.3 Ensuring the Safety of Nuclear Fuel During the Decommissioning Period

The nuclear fuel inside the reactors cannot be removed even after the decommissioning stage has begun. In order to secure the safety of the nuclear fuel before it is removed from the nuclear reactors, maintenance of the nuclear reactors in operation and of facilities related to the spent fuel pools needs to be carried out. To further strengthen the safety of long-term nuclear fuel storage, the AEC requested Taipower to revise its final safety analysis report and technical specifications so as to deal with the status of the nuclear fuel remaining inside the nuclear reactors. Going forward, the AEC is required to strictly monitor the nuclear power plants and inspections by the project team, and to confirm that Taipower is fulfilling the requirements stated in the documentation on safety standards and carrying out safety work related to ensuring the safety of the nuclear fuel.

8.4.3.4 Safety Regulations Following the Issuance of the Decommissioning License

Taipower is to carry out related operations as given in the application for decommissioning; during the decommissioning period, it must also implement the required inspections and confirm that the work detailed in the application for decommissioning is being conducted on schedule. Also, to protect the health of local residents and the environment, nuclear fuel and radioactive waste are to be managed safely, and radiation emanating into the environment must be monitored.

8.4.3.5 Local Resident Participation and Disclosure of Information

As Taiwan's first nuclear power plant decommissioning project, the work at the First Nuclear Power Plant has drawn an exceptional degree of attention from

society in general. To promote participation by the local residents, the AEC sent the documentation of the application for decommissioning to the local government while the application was being reviewed, and held information sessions to gather the opinions of local government. Public information sessions are also scheduled to be held during the decommissioning period, to gather the public's opinions more generally.

The AEC has also set up a dedicated website on the management of the decommissioning process as part of its initiative on disclosure of information. The website offers information on the legislation for decommissioning safety regulations, the application for decommissioning First Nuclear Power Plant, the decommissioning review, and so forth.

8.5 Taiwan's AEC: The Nuclear Safety Regulatory Body

The AEC is responsible for confirming that the special licensee of nuclear energy facilities (in effect, Taipower) conforms to the licensing conditions throughout the period of the plant's operating license; the legislation under which it acts to do so is the Atomic Energy Act of 1968 (revised in 1971) and the Nuclear Reactor Facilities Regulation Act of 2003. Licensing of the construction and operation of nuclear energy facilities is also performed by the AEC. At the construction stage of a nuclear power plant, the AEC comprehensively evaluates its design and safety, along with the competence of the applicant to design, construct, and safely manage nuclear energy facilities. During the evaluation, the AEC conducts various inspections to evaluate safety and confirm construction quality.

AEC oversees the pre-operational tests and inspections conducted by Taipower and confirms whether the construction of the nuclear power plant is as provided in the licensing documentation. Taipower is authorized to begin initial loading of nuclear fuel after it has obtained approval from the AEC. It then completes a full startup test (or power test) and, with the AEC's approval, receives an operating license for commercial operation. Even after the operating license has been issued, the AEC continues to confirm that Taipower is securing the safety of the nuclear power plant it operates.

Taipower is obligated to submit reports to the AEC regularly or within a given period as required. The reports cover the safety of plant operation and radiation levels, environmental monitoring, emergencies, radioactive waste production, inspections and tests during operation, and radiation dose appraisals of residents of the area around the plant.

Furthermore, the AEC holds Regulatory Meetings with Taipower at set intervals, during which the parties exchange opinions on issues of nuclear energy safety that concern either or both of them. This exchange of opinions between the regulatory body and the special licensee is beneficial to the promotion of nuclear operational safety.

In the event that a regulation is breached, the AEC immediately instructs Taipower to take corrective and complementary measures. In the event that Taipower fails to satisfy the licensing conditions, the AEC has the power to order the license to be temporarily revoked or to be suspended.

Article 21 of the Nuclear Reactor Facilities Regulation Act states that the decommissioning of nuclear reactor facilities is to be carried out by dismantling them and that the operation must be completed within the period (25 years) stipulated by the regulatory body. Article 23.6 of the Act states that if operation of nuclear reactor facilities has been suspended before the end of the period of validity of the operating license, the licensee must submit an application for decommissioning three years before the permanent cessation of operation thereof. Also, decommissioning measures cannot be started until the following conditions have been confirmed by the AEC:

- 1 Decommissioning work must be performed in such a way as to secure the health and safety of the local residents.
- 2 All relevant laws and regulations in regard to environmental and ecosystem conservation must be observed.
- 3 All relevant laws and regulations in regard to radiological protection activities and the administration of radiopharmaceuticals and substances (X-rays, gamma rays, proton beams, etc.) must be observed.
- 4 Nuclear reactor owners must possess the technical, managerial, financial, and other competencies required to conduct decommissioning.

Taipower ceased operation of Unit 1 of the First Nuclear Power Plant on December 5, 2018; Unit 2 was shut down on July 15, 2019. Subsequently, application for decommissioning of the two units was made on the basis of the Nuclear Reactor Facilities Regulation Act. Taipower then shut down Unit 1 of the Second Nuclear Power Plant in July 2021, with Unit 2 to follow on March 14, 2023. As for the Third Nuclear Power Plant, the operating license for Unit 1 will expire in May 2024, and the Unit 2 license will expire in February 2025.

The decommissioning plan for Taiwan's nuclear power plants is divided into four main stages, and decommissioning work will be completed within 25 years. Taipower is currently starting on Stage 1 of the decommissioning plan (eight-year transition stage), and is at work on the following six items: (1) final cessation of the nuclear reactors; (2) installation of indoor dry storage facilities for spent nuclear fuel; (3) installation of a radioactive waste storage area; (4) transfer of fuel to spent nuclear fuel pool; (5) monitoring of decommissioning process execution plan; and (6) drainage of contaminated water and decontamination of nuclear power plant systems and facilities. The decommissioning plan for the First Nuclear Power Plant is currently making steady progress under the supervision and management of the AEC.

In Stage 2 of the plan (12-year dismantling stage), the following will be carried out: (1) staging and removal of the nuclear fuel in the nuclear reactors and spent fuel pools; (2) dismantling of the nuclear reactors and their internal parts; (3) dismantling of containers; (4) dismantling of turbines and generators, etc.; and (5) the dismantling of other contaminated facilities. Stage 3 (three-year completion stage) will consist of the following: (1) dismantling of composite structure plant;

(2) dismantling of plant with steam generator machinery; (3) dismantling of waste gas treatment plant; and (4) dismantling of plant repair and distribution facilities, etc. Finally, in Stage 4 (two years), the general buildings will be dismantled, the sites will be restored, and the grounds will be put to re-use.

8.6 Conclusion

Energy demand in Taiwan has grown rapidly over the last two decades; domestic energy consumption rose from 68.59 million tons of oil equivalent (TOE) in 2001 to 89.36 million TOE in 2021, with an annual average growth of 1.54%. Taiwan, with a population of 23.58 million and per-capita CO₂ emissions of 11.5 tons, needs to carry out an effective energy-saving and renewable-energy policy (BOE(2022)). According to the Ministry of Economic Affairs, the main objectives of energy policy are the development and use of clean energy, reduction of CO₂ emissions, stable supply of sustainable energy, improvement of energy efficiency, and improvement of energy security (BOE, 2008). Taiwan's current energy policy is in line with the global mainstream approach in that it has achieved a form of energy use that does not act as a block on economic growth and is simultaneously environmentally friendly. Taiwan can become a groundbreaker in the environmental and energy revolutions by promoting a Green Economy based on the use of renewable energy and reduction of dependence on fossil fuels. By realizing a Green Economy, Taiwan will reduce its CO₂ emissions and enhance the quality of its citizens' lives. However, the single greatest issue is how this realization is to be accomplished.

The reality is that Taiwan's economy depends on manufacturing and requires major energy inputs. Taiwan's economic growth involves high energy intensity, and electricity production is heavily dependent on fossil fuels. If Taiwan does manage to decrease its dependence on fossil fuels to a major extent, it is undeniable that national and regional energy shortages may ensue as the goal of abandoning nuclear power generation by 2025 draws nearer (BOE, 2018).

The decommissioning work now in progress on the nuclear power plants must be carried out based on the safety regulations and with transparency. It appears that Taiwan's AEC is progressing well with the decommissioning on the basis of its expertise in decommissioning and in line with the principles of safety; it is supervising Taipower's application for decommissioning and its execution of major management items, while engaging with the community and continuously disclosing information. Taiwan must also proactively carry out policy for developing renewable-energy technology. In order for this policy to be conducted effectively and efficiently, the people of Taiwan need to be properly informed about the issues involved in energy and electricity production.

For the Taiwan's government to meet its objectives, inter-party and inter-factional cooperation, public understanding, and strong political leadership are essential. If Taiwan can realize its goals, it will attain energy independence and security, and may well play a freer and stronger role on the international stage.

Notes

- 1 See Tsai Ing-wen's inaugural address (2016).
- 2 See Laws & Regulations Database of Taiwan: Electricity Act: <<https://law.moj.gov.tw/LawClass/LawAll.aspx?pcode=J0030011>>.

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