Japan Coal Phase-Out:

The Path to Phase-Out by *2030*

KIKO NETWORK 気候ネットワーク

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Contents

front cover：Photo by (c)Tomo.Yun

Summary: Japan should completely phase out coal by 2030.

- Coal-fired power generation emits more carbon dioxide (CO_2) than any other method of generating electricity. In order to achieve net zero emissions of greenhouse gases (GHGs) as called for under the Paris Agreement, it is crucial to quickly decarbonize our energy sources. According to several research reports, that means we need to completely phase out coal power plants, which obviously means halting new coal plant construction and also strategically retiring existing plants. For coal-fired power generation in Japan, the country must cancel all current planning for new construction, and also retire all existing coal power plants by 2030

- There were 117 units at existing coal power plants in Japan as of April 2018, based on government statistics and publicly available information, and this number includes many older and inefficient plants that have been operating over 40 years.

- The Japan 2030 Coal Phase-Out Plan presents a schedule to gradually retire all 117 units at existing coal power plants in Japan by 2030, starting with the oldest operating and least efficient plants. This plan is entirely achievable without threatening the electrical power supply and without relying on nuclear power, if we take into account for the available capacity of LNG and other power generation options, as well as the spread of renewable energy and improvements in energy efficiency.

- The total of 117 units includes 8 units among the 50 units planned for new construction in 2012 and later, that had already begun operating as of April 2018. This Plan proposes to retire all of them by 2030. Units that had not yet started operating as of April 2018 have not been included in this Plan, based on the premise that their plans should be cancelled before the units start operating.

- The Japanese government should devise a detailed path for coal retirement as suggested in this report, formulate an official Japan 2030 Coal Phase-Out Plan, and give it a high priority as part of a long-term low greenhouse gas emission development strategy. With this plan as a basis, Japan needs to increase its GHG emission reduction targets to match the Paris Agreement, promote accelerated initiatives for renewables and energy efficiency, and realize the earliest possible transition to a decarbonized society, through a quick withdrawal from fossil fuel dependency. The government, companies and operators must also disclose more data and information, since it is currently difficult to access and verify the actual situation regarding units at existing plants and the capacity factor of each, etc.

1 Status of Coal Power Generation in Japan

(1) Coal power generation rose steadily since 1980

As Japan's dependency on nuclear power grew after the oil shock in the 1970s, so too did the amount of electricity generated by burning coal. The government has promoted nuclear power as a means of addressing climate change, but nuclear power generation peaked in the late 1990s and since then thermal power generation from the burning of coal and liquefied natural gas (LNG) has grown steadily (Figure 1).

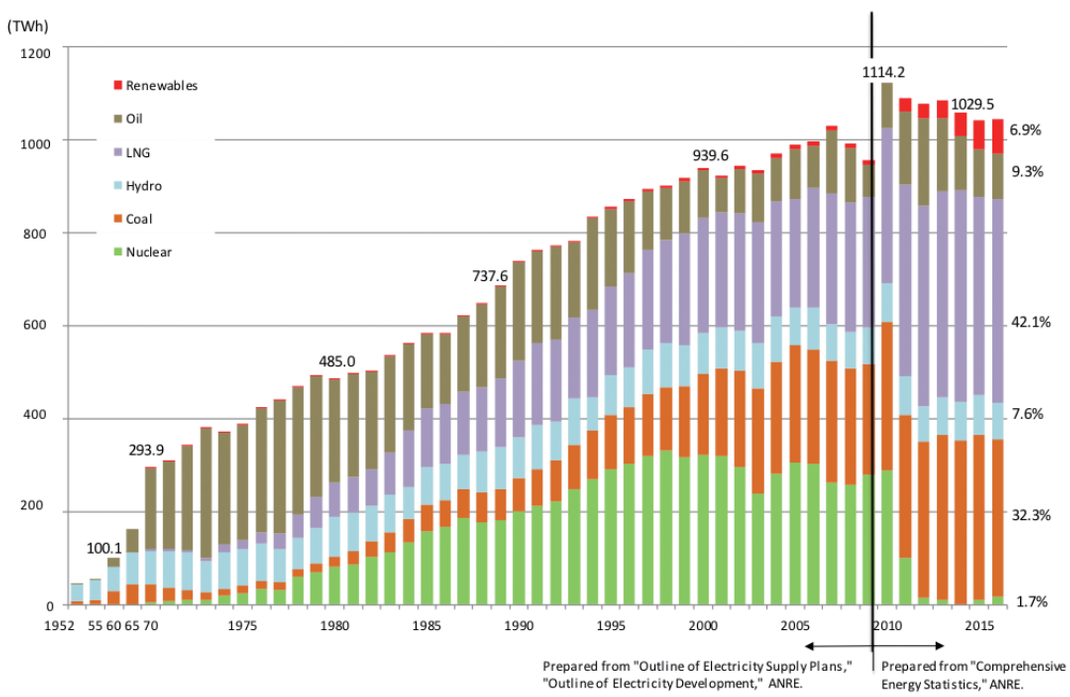

Figure 1. Electricity Production in Japan

Source: 2018 Annual Report on Energy, Agency for Natural Resources and Energy

(2) Deluge of coal plant construction plans after TEPCO's Fukushima Daiichi nuclear accident

After the March 2011 accident at the Tokyo Electric Power Company's (TEPCO) Fukushima Daiichi nuclear power plant, governments and power companies made a dramatic shift toward the construction of coal power plants. In terms of replacing coal plant facilities, the

government decided to accelerate environmental assessment processes as replacement to new plants could only improve in environmental performance.[1] The government also introduced a bidding process for thermal power generation to bring down electricity costs after the accident.[2] This acted as a sign to go ahead with new coal plant construction, which had at one point been halted under the Kyoto Protocol. Since then, starting with an invitation to bid for TEPCO's plant, there was a deluge of coal plant construction plans. To deal with projected coal plant CO_2 emissions, an agreement at the level of bureau director between the Ministry of Economy, Trade and Industry and the Ministry of the Environment called for electric utilities to specify targets that matched with national plans, and to indicate the responsible entities, but so far these conditions do not appear to have had any constraining effect.[3] In addition, Japan's fourth Strategic Energy Plan in 2014 identifies nuclear and coal as “important base load electricity sources,” and with the fifth Strategic Energy Plan in 2018 reiterating the same approach, new coal power obtained authorization from the government.[4] In the Act Concerning the Rational Use of Energy, METI established separate electricity generation efficiency standards for new plants and existing plants, and an ordinance for enforcement of the Act on the Promotion of Use of Non-fossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers was amended to require companies to aim for a 44% non-fossil energy source ratio in 2030, but the majority of the 50 new coal power units raced ahead toward construction and operation without any modifications, and already eight units have started operating. Among the 50, plans for seven units were announced to be scrapped at the planning stage due to factors such as local opposition and management decisions in response to changing business conditions, but as of September 30, 2018, this still left 35 units with plans going ahead (see Appendix I on p. 16).[5]

1 Ministry of the Environment (2012) “Guidelines on rationalizing environmental impact assessment methodologies relating to thermal power plant replacement” (in Japanese).
2 Agency for Natural Resources and Energy (2012) “Guidance relating to operation of bidding for new thermal power generation” (in Japanese).
3 Ministry of the Environment (2013) “Summary of Bureau Directors' meeting on thermal power generation bidding for Tokyo Electric Power Company” (in Japanese).
4 Agency for Natural Resources and Energy (2018) “Fifth Strategic Energy Plan” (in Japanese).
5 Kiko Network (2018) “Japan Coal Plant Tracker” (http://sekitan.jp/plant-map/en) “List of proposed plants” (as of April 30, 2018).

(3) More than 100 units at existing coal plants

In the preparation of this report, 117 units (44,119 MW) could be identified at existing coal-fired thermal power plants in Japan based on statistics and company reports (See Appendix II on p. 18).[6] That number includes 22 units (4,205 MW) that had been operating at least 40 years as of April 2018 and some older units approaching sixty years in operation. Meanwhile, 58 units are still relatively new, having operated for less than 20 years (Figure 2). It is also obvious that there was literally a construction race to build the most coal plants after the adoption of the Kyoto Protocol in 1997 and before the start of the first commitment period in 2007.

With the exception of four units[7] that are clearly scheduled to be demolished after being replaced with new ones, there are no other obvious retirement plans for generation facilities. In addition, information disclosure is extremely poor regarding actual operations, including older plants, as it is not possible from available information to determine operating ratios unit-by-unit, such as capacity factors or the emissions of CO_2 and other air pollutants.

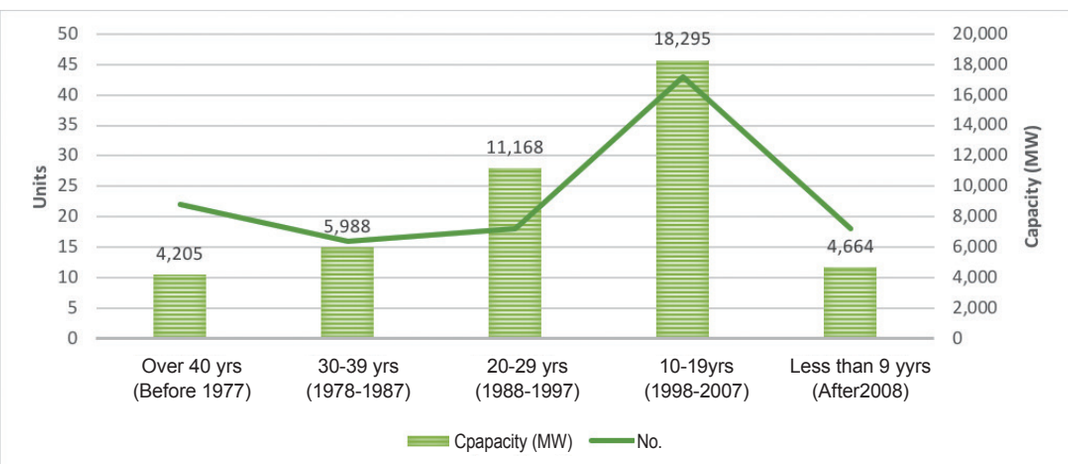

Figure 2. Existing Coal Power Plants (by years in operation)

Source: Kiko Network, Japan Coal Plant Tracker

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6 From Kiko Network (2018) “Japan Coal Plant Tracker” (http://sekitan.jp/plant-map/en) “List of existing plants” (as of September 2018). For information on electricity generation facilities, the “Catalog of equipment in thermal and nuclear power plants” (Thermal and Nuclear Power Engineering Society, FY2017 revised edition, in Japanese) was referenced. The total number includes Takehara former Unit 1 (retired 2017) and former Unit 2 (retired 2018). The present report includes 8 units at plants that are monitored as new plans since 2012 and having started operation as of April 2018. Note that this report draws its own numbers from operators' reports and other publicly available information, as the “Electric Power Statistics” from Japan's Agency for Natural Resources and Energy (2018) does not clearly provide all power plant numbers and does not publish the number of units at each plant.

7 Takehara former Unit 1 (retired 2017), Takehara former Unit 2 (retired 2018), Toyama Shinkou former Unit 1 (retires 2021), Saijo former Unit 1 (retires 2024).

(4) Total capacity of coal power plants in Japan

The total capacity of existing and newly planned coal plants would amount to 60,209 MW if retirement was not considered (Figure 3).

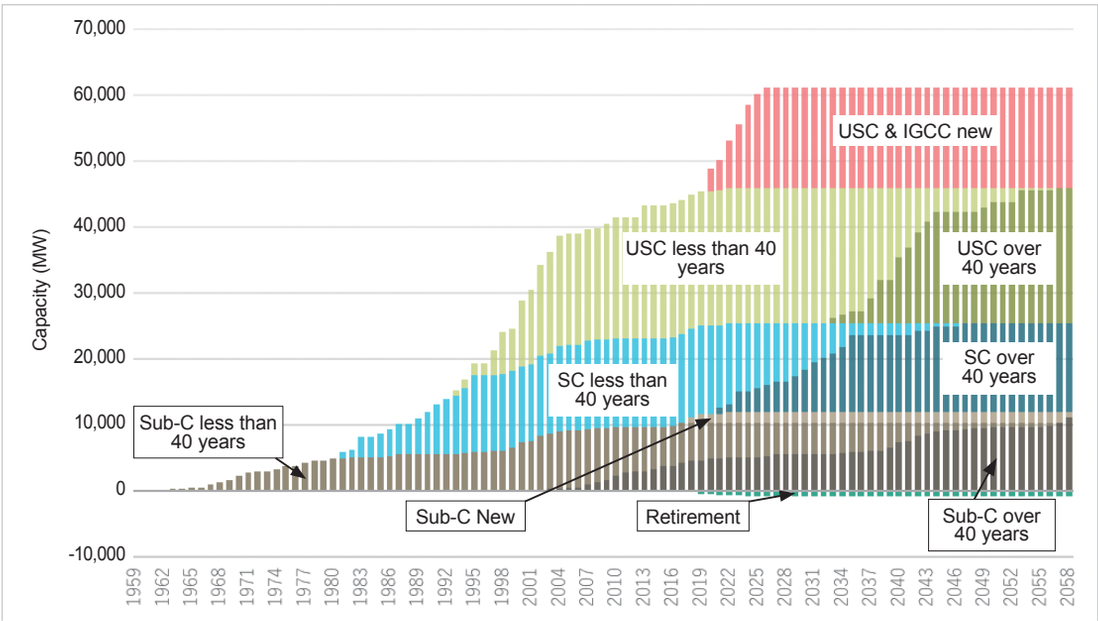

Figure 3. Capacity of Coal Power Plants in Japan (existing + new, no retirements)

Source: Kiko Network, Japan Coal Plant Track

Assuming that all newly planned plants were constructed and operated and each one is retired after 40 years, the total capacity would peak in 2026 at 51,367 MW and decline thereafter (Figure 4). However, even in 2050, the newly planned and constructed plants would not yet have operated 40 years, and remaining plant capacity would still be nearly 20,000 MW.

In order to meet the Paris Agreement's goal, complete decarbonization is required in the energy sector by 2050 to avoid 2ºC of warming, and it must be achieved even earlier to avoid 1.5ºC of warming. However, Japan's current plans to build many new coal power plants will lead to many large ones remaining in operation even after 2050. This is an enormous problem.

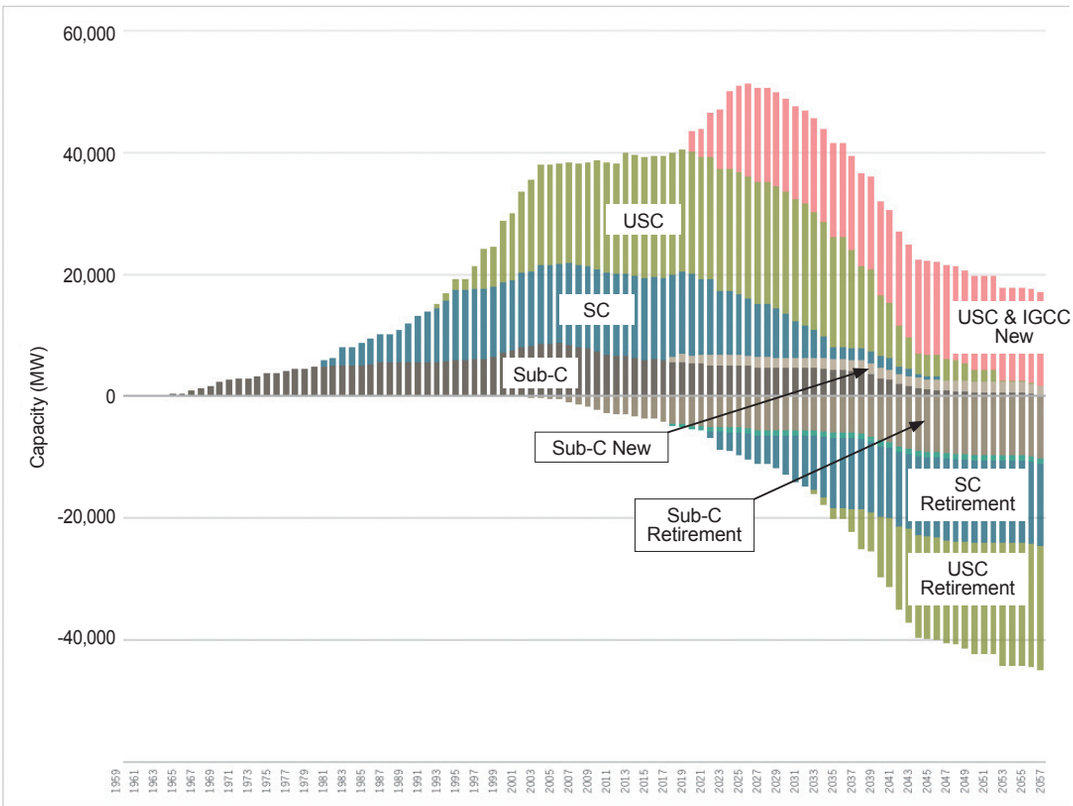

Figure 4. Electrical Generation Capacity of Coal Plants in Japan

(existing + new, retiring after 40 years)

Source: Prepared by Kiko Network

2 Japan Coal Phase-Out Plan

(1) The need to completely phase out coal power by 2030

According to several research reports, to achieve the goals of limiting warming to between 1.5 and well below 2ºC, it is necessary to reach zero emissions of CO_2 from energy in 2050,[8] and the IPCC "Global Warming of 1.5ºC" special report shows that in all scenarios the only way to limit the temperature rise to 1.5ºC is to practically phase out coal power generation.[9] In other words, in order to be consistent with the Paris Agreement, not a single new coal-burning electrical generation unit can be constructed, existing plants need to be reduced in number, and developed countries need to achieve a complete phase-out by 2030.[10] This phase-out by 2030 also applies to Japan as a developed country.[11] Based on this reality, a growing number of national and sub-national governments have been developing policies to phase out coal and stop providing foreign assistance for coal plants, and more companies are joining this trend as well.[12]

Despite the rising international tide of decarbonization, Japan has not yet revealed plans to retire existing plants and in fact is moving ahead with a large number slated for new construction and expanding coal power facilities on a surprising scale. Not only is this incompatible with the Paris Agreement, it is also going in completely the opposite direction of global efforts to address climate change and will worsen air pollution where plants are being constructed. As the world moves toward a decarbonized society under the Paris Agreement, this also means that Japan will have excess facilities that must eventually stop operating at some point in the future, which inevitably comes with major economic risks.

Like other countries that are aiming for a coal phase-out by 2030, it is Japan's responsibility as a member state of the Paris Agreement to immediately change the direction of its policies, stop the

8 Ecofys (2016) "The Incompatibility of High-Efficient Coal Technology with 2˚C Scenarios."
9 IPCC (2018) "Global warming of 1.5ºC: Summary for Policymakers."
10 Climate Analytics (2015): "The Coal Gap" says that developed countries must phase out coal power by 2030. Also, "The Incompatibility of High-Efficient Coal Technology with 2˚C Scenarios" by Ecofys (2016) points out that even with high efficiency coal power, new facilities cannot be built in order to be consistent with 2ºC scenario.
11 Climate Analytics (2018) "Science based coal phase-out timeline for Japan - Implications for policymakers and investors."
12 The Powering Past Coal Alliance (PPCA, https://poweringpastcoal.org/) currently includes 28 national and 19 sub-national governments plus 28 corporations and organizations that have declared a coal phase-out. The PPCA declaration has three parts: (1) Government members commit to phasing out existing unabated coal power generation (i.e., without carbon capture and storage). (2) Business and other non-government members commit to powering their operations without coal. (3) All members commit to supporting clean power generation through their policies and investments, and to restricting financing for unabated coal power generation.

new construction and operation of coal plants, and accelerate the retirement of existing plants.

(2) Japan Coal Phase-Out Plan

To phase out coal by 2030, most importantly, coal plants that are currently planned or under construction must all be stopped before they starting operating. These new plants could potentially continue operating until 2050 or even after, so if plans proceeded, Japan's path to decarbonization would become more difficult. Considering that the construction of many plants has already begun, and the remaining plans are nearing the end of their environmental assessment processes, decisions need to be made now to cancel them immediately.

Based on the premise that plants planned currently or under construction will not operate, this report hereby presents a plan to phase out all existing 117 units at coal plants in Japan by 2030. The proposed approach is to sequence plant retirements starting with plants that have been operating the longest and have the lowest efficiency (Table 1). In the proposal, the least efficient Sub-Critical (Sub-C) plants would be retired by 2022, the Supercritical (SC) plants by 2025, and the Ultra-Supercritical (USC) plants by 2030.

Table 1. Coal Power Technology and Phase-Out Period

Technology	Generation capacity (%)	CO_2 emissions ($g\text{-}CO_2/kWh$)	Phase-out period (years of retirement)
Sub-critical (Sub-C)	39.1	865	4 years (2018-2022)
Supercritical (SC)	41.3	817	6 years (2021-2025)
Ultra-supercritical (USC)	42.6	785	5 years (2026-2030)

Source: Kiko Network

Details of the phase-out plan are shown in Figure 5. Generation capacity gradually declines to zero between 2019 and 2030. The details of units to be retired are shown in Table 2.

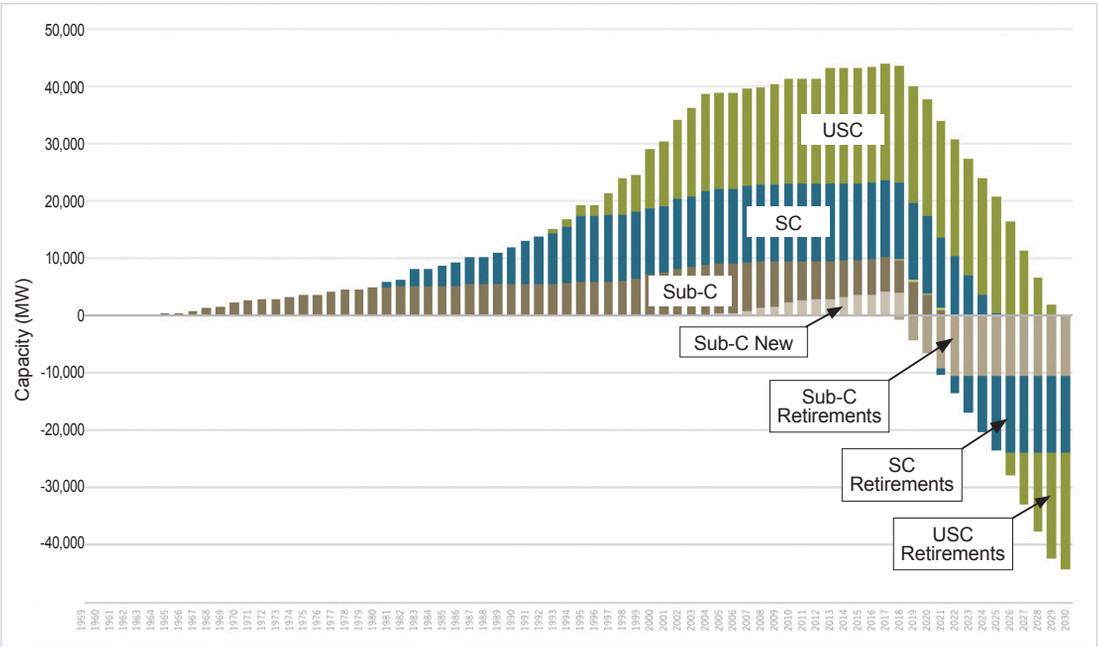

Figure 5. Schedule for Japan Coal Phase-Out Plan

Source: Prepared by Kiko Network

Table 2. Unit-by-Unit Retirement Schedule in the Japan 2030 Coal Phase-Out Plan

Retirement year	Plant name	Company/Operator	Capacity (MW)	Technology			
2017	Takehara Unit 1	J-POWER	250	Sub-C	Subtotal in 2017		
					Sub-C	1	250
2018	Takehara Unit 2	J-POWER	350	Sub-C	Subtotal in 2018		
					Sub-C	1	350
2019	Niihama Nishi Unit 1	Sumitomo Joint Electric Power	75	Sub-C			
	Niihama Nishi Unit 2	Sumitomo Joint Electric Power	75	Sub-C			
	Tokuyama Central No.5	Tokuyama	35	Sub-C			
	Mizushima Unit 2	Chugoku Electric Power	156	Sub-C			
	Saijo Unit 1	Shikoku Electric Power	156	Sub-C			
	Shimonoseki Unit 1	Chugoku Electric Power	175	Sub-C			
	Naie Unit1	Hokkaido Electric Power	175	Sub-C			
	Takasago Unit 1	J-POWER	250	Sub-C			
	Takasago Unit 2	J-POWER	250	Sub-C			
	Niihama Higashi Unit 1	Sumitomo Joint Electric Power	27	Sub-C			
	Naie Unit2	Hokkaido Electric Power	175	Sub-C			
	Saijo Unit 2	Shikoku Electric Power	250	Sub-C			
	Nakoso Unit 7	Joban Kyodo Power Company	250	Sub-C			
	Tobata Unit 2	Tobata Co-operative Thermal Power	156	Sub-C			
	Toyama Shinkou Sekitan Unit 1	Hokuriku Electric Power Company	250	Sub-C			
	Toyama Shinkou Sekitan Unit 2	Hokuriku Electric Power Company	250	Sub-C			
	Nyugawa Unit 1	Sumitomo Joint Electric Power	250	Sub-C			
	Sigma Power Ariake Miike	Miike Power	175	Sub-C			
	Sunagawa Unit 3	Hokkaido Electric Power	125	Sub-C	Subtotal in 2019		
	Sakata Kyodo Unit 1	Sakata Kyodo Power Company	350	Sub-C	Sub-C	20	3,605
2020	Sakata Kyodo Unit 2	Sakata Kyodo Power Company	350	Sub-C			
	Toutouatsuma Unit 1	Hokkaido Electric Power	350	Sub-C			
	Sunagawa Unit	Hokkaido Electric Power	125	Sub-C			
	Ube Industries, Isa Factory	Ube Industries	57	Sub-C			
	Ishikawa Unit 1	J-POWER	156	Sub-C			

2020	Ishikawa Unit 2	J-POWER	156	Sub-C			
	Tokuyama Central No.9	Tokuyama	149	Sub-C			
	Nippon Steel & Sumikin Stainless Steel Corporation, Hikari Works-1	Nippon Steel & Sumikin Stainless Steel Corporation	53	Sub-C			
	Gushikawa Unit 1	Okinawa Electric Power	156	Sub-C			
	Gushikawa Unit 2	Okinawa Electric Power	156	Sub-C			
	Sumitomo Osaka Cement, Ako Factory	Sumitomo Osaka Cement	103	Sub-C			
	Nippon Steel & Sumikin Stainless Steel Corporation, Hikari Works-2	Nippon Steel & Sumikin Stainless Steel Corporation	53	Sub-C			
	Nippon Steel & Sumitomo Metal Co. Hirohata	Nippon Steel & Sumitomo Metal Co.	149	Sub-C			
	Tobata Unit 6	Tobata Co-operative Thermal Power	149	Sub-C			
	Sumitomo Osaka Cement, Kochi Factory	Sumitomo Osaka Cement	61	Sub-C	Subtotal in 2020		
	Tokuyama East No.2	Tokuyama	145	Sub-C	Sub-C	16	2,368
2021	Nakayama Nagoya	Nakayama Nagoya power company	149	Sub-C			
	Toyohashi	Meikai power company	147	Sub-C			
	Nippon Steel & Sumitomo Metal Co. Kamaishi	Nippon Steel & Sumitomo Metal Co.	149	Sub-C			
	Osaki, Unit 1	Chugoku Electric Power	250	Sub-C			
	Itoigawa	Itoigawa Power Company	149	Sub-C			
	Nippon Steel & Sumitomo Metal, Muroran No.5	Nippon Steel & Sumitomo Metal Co.	145	Sub-C			
	Kin Unit 1	Okinawa Electric Power	220	Sub-C			
	Nippon Steel & Sumitomo Metal Co. Oita	Nippon Steel & Sumitomo Metal Co.	330	Sub-C			
	Mitsubishi Rayon Otake	Mitsubishi Rayon Co.	147	Sub-C			
	Kin Unit 2	Okinawa Electric Power	220	Sub-C			
	Tokuyama Central No.8	Tokuyama	145	Sub-C			
	Nippon Paper Industries Kushiro	Nippon Paper Industries	80	Sub-C			
	UBE Power Center, Ube No.6	Ube Industries	216	Sub-C			
	Tosa	Tosa power	167	Sub-C			
	Sumitomo Osaka Cement Kochi	Sumitomo Osaka Cement	61	Sub-C			

2021	Matsushima Unit 1	J-POWER	500	SC	Subtotal in 2021		
	Matsushima Unit 2	J-POWER	500	SC	Sub-C	15	2,575
	UBE Power Center, Ube No.5	Ube Industries	145	SC	SC	3	1,145
2022	Asahi Kasei NS Energy, Nobeoka (Biomass)	Asahi Kasei NS Energy	50	Sub-C			
	Niihama Higashi Unit 2	Sumitomo Joint Electric Power	03	Sub-C			
	Daicel Otake	Daicel Corp.	50	Sub-C			
	Tokuyama Central No.7	Tokuyama	78	Sub-C			
	Niihama Nishi Unit 3	Sumitomo Joint Electric Power	150	Sub-C			
	Tobata Unit 5	Tobata Co-operative Thermal Power	110	Sub-C			
	Summit Onahama S Power	Summit Onahama S Power Corp.	50	Sub-C			
	Erex, Saeki Biomass	Erex New Energy, Saeki	50	Sub-C			
	Mombetsu Biomass Electric Power Station	Mombetsu Biomass Electric Power Co.	50	Sub-C			
	Suzukawa Energy Center	Suzukawa Energy Center	112	Sub-C			
	Nakayama Nagoya 2	Nakayama Nagoya power company	110	Sub-C			
	Mizushima Energy Center	Mizushima Energy Center	112	Sub-C			
	Meinan Kyodo Energy	Meinan Kyodo Energy Co.	31	Sub-C			
	Sendai Power Station	Sendai Power Station	112	Sub-C			
	Soma energy park	Soma Energy Park LLC	112	Sub-C			
	Ishinomaki Hibarino No.1	Nippon Paper Industries Ishinomaki Energy Center	149	Sub-C			
	Takehara Unit 3	J-POWER	700	SC	Subtotal in 2022		
	Nakoso Unit 8	Joban Kyodo Power Company	600	SC	Sub-C	16	1,329
	Nakoso Unit 9	Joban Kyodo Power Company	600	SC	SC	3	1,900
2023	Toutouatsuma Unit 2	Hokkaido Electric Power	600	SC			
	Shin Onoda Unit 1	Chugoku Electric Power	500	SC			
	Shin Onoda Unit 2	Chugoku Electric Power	500	SC			
	Matsuura Unit 1	Kyusyu Electric Power	700	SC	Subtotal in 2023		
	Matsuura Unit 1, J-POWER	J-POWER	1,000	SC	SC	5	3,300
2024	Tsuruga Unit 1	Hokuriku Electric Power Company	500	SC			
	Hekinan Unit 1	Chubu Electric Power	700	SC			

2024	Hekinan Unit 2	Chubu Electric Power	700	SC			
	Noshiro Unit1	Tohoku Electric Power	600	SC	Subtotal in 2024		
	Shinchi Unit 1	Soma Kyodo Power Company	1,000	SC	SC	5	3,500
2025	Shinchi Unit 2	Soma Kyodo Power Company	1,000	SC			
	Reihoku Unit 1	Kyusyu Electric Power	700	SC			
	Shinko Kobe Unit 1	Kobelco Power	700	SC	Subtotal in 2025		
	Shinko Kobe Unit 2	Kobelco Power	700	SC	SC	4	3,100
2026	Nippon Steel & Sumitomo Metal Co. Kashima	Nippon Steel & Sumitomo Metal Co.	522	SC			
	Hekinan Unit 3	Chubu Electric Power	700	USC			
	Noshiro Unit2	Tohoku Electric Power	600	USC			
	Nanao Ota Unit 1	Hokuriku Electric Power Company	500	USC	Subtotal in 2026		
	Haramachi Unit1	Tohoku Electric Power	1,000	USC	SC	1	522
	Matsuura Unit 2, J-POWER	J-POWER	1,000	USC	USC	5	3,800
2027	Misumi Unit 1	Chugoku Electric Power	1,000	USC			
	Haramachi Unit2	Tohoku Electric Power	1,000	USC			
	Nanao Ota Unit 2	Hokuriku Electric Power Company	700	USC			
	Tachibana-wan Unit 1	Shikoku Electric Power	700	USC			
	Tachibana-wan Unit 1, J-POWER	J-POWER	1,050	USC	Subtotal in 2027		
	Tsuruga Unit 2	Hokuriku Electric Power Company	700	USC	USC	6	5,150
2028	Tachibana-wan Unit 2, J-POWER	J-POWER	1,050	USC			
	Karita new-Unit 1	Kyusyu Electric Power	360	USC			
	Hekinan Unit 4	Chubu Electric Power	1,000	USC			
	Isogo, new Unit 1	J-POWER	600	USC			
	Toutouatsuma Unit 4	Hokkaido Electric Power	700	USC	Subtotal in 2028		
	Hekinan Unit 5	Chubu Electric Power	1,000	USC	USC	6	4,710
2029	Reihoku Unit 2	Kyusyu Electric Power	700	USC			
	Hitachinaka Unit1	TEPCO Fuel & Power	1,000	USC			
	Hirono Unit5	TEPCO Fuel & Power	600	USC			
	Maizuru Unit 1	Kansai Electric Power	900	USC			
	Isogo new-Unit 2	J-POWER	600	USC	Subtotal in 2029		
	Maizuru Unit 2	Kansai Electric Power	900	USC	USC	6	4,700
2030	Nakoso Unit 10	Joban Kyodo Power Company	250	IGCC			
	Hirono Unit6	TEPCO Fuel & Power	600	USC	Subtotal in 2030		
	Hitachinaka Unit2	TEPCO Fuel & Power	1,000	USC	USC	2	16,000
	Osaki Cool Gen	Osaki Cool Gen	166	IGCC	IGCC	2	4,160

Source: Prepaterd by Kiko Network

(3) Impacts on electrical power supply

Reducing the current coal power capacity of more than 40,000 MW to zero within just over ten years means losing what the government refers to as base load sources, so it would be no surprise that concerns are raised about the impacts on a stable supply of electricity. As shown below, however, a phase-out is fully possible without major negative impacts.

To begin with, the construction of LNG-fired power plants in Japan has also been proceeding steadily in recent years and their capacity is growing. Since 2014, about 9,000 MW of large LNG plants have been newly built or expanded. Meanwhile, according to a summary of supply plans of power producers released by the Organization for Cross-regional Coordination of Transmission Operators (OCCTO), the capacity factor of LNG plants is projected to drop from 55.3% in 2017 to 43% in 2027. As an overall surplus of capacity is foreseen, if the capacity factor of LNG power generation is raised to between 60% and 65% and power generation by renewable energy be increased to 27% as projected by OCCTO for 2027, it will be possible to cover most of the decline in coal-fired electricity generation capacity. It is also entirely possible that the 27% figure for renewables could be achieved well ahead of schedule.

Meanwhile, OCCTO's projections for maximum electricity demand and annual electricity demand for the ten years from 2018 to 2027 are flat, with ±0% as the annual average growth rate. This figure was revised downward from a previous projection (of average growth rate at 0.3%) by taking into account factors such as progress with electricity conservation and energy efficiency, and measures to cut peak demand, but regardless, the future projection maintains the same level of electricity demand as in 2018. In the future, nevertheless, it will be important to further promote electricity conservation and energy efficiency, and there is also significant potential for the benefits of using the “Internet of Things” (IoT), and so on. If energy efficiency improves at an annual rate of 1.5%, the loss of coal-powered capacity can be covered even with nuclear at zero.

This Plan suggests a gradual annual retirement of between 2,000 MW and 4,000 to 5,000 MW of coal-fired power generation capacity, and it is fully achievable if a plan is formulated in advance and measures are implemented steadily.

3 Implementing the Phase-Out Plan

(1) Immediate revision of current policy directions is needed

It is clear that this Japan 2030 Coal Phase-Out Plan cannot be implemented without policy change. To implement the plan, it will be necessary to reconsider current policy directions and develop specific policy responses.

Set clear policy directions for coal phase-out by 2030, consistent with Paris Agreement

(Strategic Energy Plan and Climate Action Plan)

Current Japanese government policies emphasize coal and nuclear as “important base-load power sources,” so it is crucial to start by fundamentally revising this thinking. Rather than basing policy on coal and nuclear, for which it is difficult to adjust output, Japan needs to shift its basic direction to an electrical system that can provide a stable power supply through flexible supply-demand adjustment of renewable energy that includes variable power sources.

Legislate to implement the coal phase-out

(Enact an Act on Coal Phase-Out (tentative name))

Based on a clear commitment to phase out coal, it is crucial to have consistent implementation year after year. But actions are difficult under existing legislative frameworks, so it will be crucial to enact new legislation that stipulates a year-by-year schedule for the retirement of coal power generation. Combined with an Act on Nuclear Phase-Out, it is likely possible to promote a coal power phase-out concurrently with a nuclear power phase-out.

Revise Japan's GHG emission reduction targets and energy mix

(Strategic Energy Plan and Climate Action Plan)

Along with a coal phase-out plan for 2030, Japan needs to revise its current energy mix, which is premised on coal providing 26% of Japan's electricity supply in 2030, and a 26% GHG emission reduction target in 2030 (compared to FY2013). It is obvious that the ratio of coal in the electrical power supply mix in 2030 should be zero, and based on the premise of coal power being steadily phased out, the GHG emission reduction target should be increased to at least 40 to 50%.

■ **Introduce carbon pricing**

(Tax for climate change mitigation, domestic emission trading scheme)

In order to incentivize efforts to limit the use of coal power on both the supply and demand side, Japan should introduce carbon pricing in 2019. Based on a regulatory schedule specified by a proposed Act on Coal Phase-Out, carbon pricing would promote the selection of more efficient, low-carbon electricity generation technologies. The implementation of the coal phase-out plan proposed in this report will for a while involve increased capacity factors for LNG power generation, but even then it will encourage the transition to more efficient power generation plants. It can also be expected to have an effect of broadly promoting energy efficiency and energy conservation on the demand side.

■ **Revise power generation efficiency standards and non-fossil fuel electricity generation ratio**

(Act Concerning the Rational Use of Energy, Act on the Promotion of Use of Non-fossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers)

To be consistent with revisions of GHG emission reduction targets and the energy mix, Japan should also revise power generation efficiency standards, and targets for the non-fossil fuel power generation ratio (current target is 44% in 2030) —based, respectively, on the Act Concerning the Rational Use of Energy, and on the Act on the Promotion of Use of Non-fossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers.

■ **Enhance energy conservation policies and load leveling**

Energy efficiency and energy conservation hold the key to achieving a coal phase-out. At the same time as introducing carbon pricing to accelerate energy efficiency and energy conservation by each stakeholder, it is important to implement multiple and integrated policies to improve efficiency in power plants and power load leveling, and promote demand-side management.

■ **Massive introduction of renewable energy**

The government is aiming to make renewable energy a major component of the electrical power supply, and to do so, it is necessary to secure a priority dispatch in supplying renewable energy and promote the massive introduction of renewable energy by strengthening a flexible electricity interchange and strengthening the grid system.

Information and data availability and disclosure

To secure a steady reduction of emissions from power plants as the largest emissions sector, adequate information disclosure is crucial. In particular, disclosure should be done on an hourly basis for capacity utilization at each generation facility, as well as electricity generated and emissions of CO_2 and other air pollutants.

(2) Time to start the discussion

Germany has a major coal industry, and even there, a committee has been created on coal phase-out and discussions are under way. Japan currently has significant coal power generation capacity, so it might be understood that a coal phase-out by 2030 would be difficult. However, as a country that has ratified and declared its support for the Paris Agreement, Japan has no other option but to phase out coal. We see no other choice on this point and no room for procrastination, and we call upon the government to promptly and earnestly implement these actions. This report presents one approach toward the goal of a coal phase-out, which other countries of the world are also aiming for. However, even for the same goal of a 2030 phase-out of coal, there could be different paths—depending on the actual status of operations and other factors at power plants, the potential for the introduction of renewable energy, and other local characteristics. Now is the time to start a broad discussion and then shift to action.

The IPCC “Global Warming of 1.5ºC” special report indicated that warming could reach 1.5ºC as early as 2030. We have roughly ten years to pass the test and avoid that situation. To that end, Japan needs to start today on the path to phase out coal.

Appendix I. List of Coal Power Plants Proposed in 2012 or Later (*1)

	Area	Plant name	Company/Operator	Capacity (MW)	Planning Operation date	Status	Technology	CO_2 emission kt-CO_2/ year	CO_2 emission intensity g-CO_2 / kWh
1	Shizuoka	Suzukawa Energy Center	Suzukawa Energy Center (Nippon Paper Industries, Mitsubishi Corp., Chubu Electric Power)	112	9/2016	Operating	Sub-C	672	
2	Hiroshima	Osaki Cool Gen	Osaki Cool Gen (Chugoku Electric Power, J-Power)	166	3/2017	Operating	IGCC	706	692
3	Aichi	Nagoya No.2	Nakayama Nagoya Kyodo Hatsuden (Gas and Power, Nakayama Steel Works, Osaka Gas)	110	9/2017	Operating	Sub-C	660	
4	Miyagi	Sendai Power Station	Sendai Power Station (KENES, Itochu Enex)	112	10/2017	Operating	Unknown	672	
5	Okayama	Mizushima Energy Center	Mizushima Energy Center (Kanden Energy Solution, Mitsubishi Corp., Mitsubishi Chemical)	112	12/2017	Operating	Unknown	672	
6	Miyagi	Ishinomaki Hibarino No.1	Nippon Paper Industries Ishinomaki Energy Center (Nippon Paper Industries Co., Mitsubishi Corp.)	149	3/2018	Operating	Sub-C	894	
7	Fukushima	Soma energy park	Soma Energy Park LLC	112	4/2018	Operating	Unknown	672	
8	Aichi	Meinan Kyodo Energy	Meinan Kyodo Energy Co. (Meiko Trans Co., Seika Corp., Japan Energy Partners)	31	2/2018	Trial operation	Sub-C	187	
9	Fukushima	Hibikinada Energy Park	Hibikinada Energy Park (Orix Corp., Hokuzai Transport)	112	7/2018	Under construction	Unknown	682	610
10	Akita	Nippon Paper Akita Power Plant	Nippon Paper Industries Co.	112	10/2018	Under construction	Unknown	763	864
11	Fukuoka	Hibikinada thermal power plant	Hibikinada thermal power plant (IDI Infrastructures)	112	2/2019	Under construction	Unknown	584	600
12	Yamaguchi	Hofu Biomass-coal mixed Power Plant	Air Water & Energia Power Yamaguchi Corporation (Chugoku Electric Power, Air Water Inc.)	112	7/2019	Under construction	Unknown	672	
13	Hiroshima	Takehara New No.1	J-POWER	600	6/2020	Under construction	USC	3,160	766
14	Akita	Noshiro No.3	Tohoku Electric Power	600	6/2020	Under construction	USC	3,140	797
15	Nagasaki	Matsuura No.2	Kyushu Electric Power	1,000	6/2020	Under construction	USC	6,000	
16	Ibaraki	Kashima No.2	Kashima Power (J-Power, Nippon Steel & Sumikin Stainless Steel Corp.)	645	7/2020	Under construction	USC	3,439	767
17	Fukushima	IGCC Nakoso	Fukushima Revitalization Power Consortium (Mitsubishi Corp. Power, Mitsubishi Heavy Industries, Mitsubishi Electric, Tokyo Electric Power, Joban Joint Power Co.)	540	9/2020	Under construction	IGCC	2,620	652
18	Fukushima	IGCC Hirono	Fukushima Revitalization Power Consortium (Mitsubishi Corporation Power, Mitsubishi Heavy Industries, Mitsubishi Electric, Tokyo Electric)	540	9/2021	Under construction	IGCC	2,620	652
19	Aichi	Taketoyo No.5	Chubu Electric Power	1,070	3/2022	Under construction	USC	5,690	758
20	Yamaguchi	Tokuyama East Power Generation No.3	TKE3 (Tokuyama, Marubeni, Tokyo Century)	300	4/2022	Under construction	Unknown	1,800	706
21	Shimane	Misumi No.2	Chugoku Electric Power	1,000	11/2022	Under construction	USC	5,377	767
22	Ibaraki	Kamisu Power station	Kamisu Power (Marubeni□ Kanden Energy Solution)	112	2018	Under construction	Unknown	672	
23	Ibaraki	Hitachinaka Kyodo No.1	Hitachinaka Generation (JERA)	650	2020	Under construction	USC	3,680	760
24	Hyogo	Kobe Power Plant No.3	Kobelco Power Kobe-2	650	2021	Under	USC	3,460	760
25	Hyogo	Kobe Power Plant No.4	Kobelco Power Kobe-2	650	2022	Under construction	USC	3,460	

26	Fukushima	Iwaki Energy Park	Able Co.	112	4/2018	Assessment completed	Unknown	672	800
27	Hiroshima	Kaita biomass blend firing power station	Kaita Biomass Power Co. (Hiroshima Gas, Chugoku Electric Power)	112	2021	Assessment completed	Unknown	672	
28	Fukushima	Soma core industrial park plant	Soma Kyodo Jikahatsu Kaihatsu Godo Kaisha	112	3/2018	Assessment in progress	Unknown	672	
29	Ehime	Saijo New No.1	Shikoku Electric Power	500	3/2023	Assessment in progress	USC	3,000	
30	Akita	Akita Port No.1 (tentative)	KENES, Marubeni	650	3/2024	Assessment in progress	USC	4,330	760
31	Akita	Akita Port No.2 (tentative)	KENES, Marubeni	650	6/2024	Assessment in progress	USC	4,330	760
32	Mie	Unknown	MC Kawajiri Energy Service (Mitsubishi Corp.)	112	2019	Assessment in progress	Unknown	672	
33	Hokkaido	Kushiro Power Station	Kushiro Power Station (Kushiro Coal Mine, F-Power, IDI Infrastructures, Taiheiyo Kaihatsu)	112	2019	Assessment in progress	Unknown	512	590
34	Yamaguchi	Nishiokinoyama No.1 (tentative)	Yamaguchi Ube Power (J-Power, Osaka Gas, Ube Industries, Ltd.)	600	2023	Assessment in progress	USC	3,600	
35	Kanagawa	Yokosuka Power Plant, No.1 (tentative)	JERA (Tokyo Electric Power and Chugoku Electric Power)	650	2023	Assessment in progress	USC	3,630	749
36	Kanagawa	Yokosuka Power Plant. No.2 (tentative)	JERA(Tokyo Electric Power and Chugoku Electric Power)	650	2024	Assessment in progress	USC	3,630	749
37	Chiba	(tentative) Soga Coal Power	Chiba Coal Power (Chugoku Electric Power, JFE Steel Corporation)	1,070	2024	Assessment in progress	USC	6,420	
38	Yamaguchi	Nishiokinoyama No.2 (tentative)	Yamaguchi Ube Power (J-Power, Osaka Gas, Ube Industries)	600	2025	Assessment in progress	USC	3,600	
39	Chiba	Chiba Sodegaura No.1 (tentative)	Chiba Sodegaura Energy (Kyushu Electric Power, Idemitsu Kosan, Tokyo Gas)	1,000	2025	Assessment in progress	USC	6,000	
40	Chiba	Chiba Sodegaura No.2 (tentative)	Chiba Sodegaura Energy (Kyushu Electric Power, Idemitsu Kosan, Tokyo Gas)	1,000	2026	Assessment in progress	USC	6,000	
41	Miyazaki	Unknown	Asahi Kasei Chemicals Co.	60	3/2018	Planning	Steam Turbine (other than Sub-C/ SC/USC)	360	
42	Chiba	Unknown	Kansai Electric Power	1,000	unknown	Planning (no official announcement)	Unknown	6,000	
43	Fukushima	Unknown	Soma Kyodo Power Company (TEPCO, Chubu Electric Power, Tohoku Electric Power)	1,000	unknown	Planning (no official announcement)	Unknown	6,000	
44	Hyogo	Ako No.1	Kansai Electric Power	600	2020	Canceled	SC	3,350	800
45	Hyogo	Ako No.2	Kansai Electric Power	600	2020	Canceled	SC	3,350	
46	Miyagi	Sendaiko-Takamatsu Power Plant (tentative)	Sumitomo Corp.	112	2021	Canceled	Sub-C	672	600
47	Hyogo	Takasago New-No.1	J-POWER	600	2021	Canceled	USC	4,050	770
48	Chiba	Ichihara	Ichihara Thermal Power Generation Godo Kaisha (KENES, Tonen General Sekiyu)	1,000	2024	Canceled	USC	6,000	
49	Hyogo	Takasago New-No.2	J-POWER	600	2027	Canceled	USC	4,050	770
50	Iwate	Ofunato Biomass combustion plant	Maeda Corp.	112	Unknown	Canceled	Unknown	423	472

*1 List No. 1 to 8 are included as existing power plants in this paper as they have already started operation.

Source: Kiko Network, Japan Coal Plant Tracker (as of September 2018)

Appendix II. The Number of Existing Power Plants

(Comparison between governmental Electric Power Statistics and Kiko Network research) (*1,2,3)

Company/Operator	Electric Power Statistics (Gov't) (April 2018)		Research by Kiko Network		
	Number of plants	Maximum capacity (MW)	Number of plants	Units	Maximum capacity (MW)
J-POWER	7	8,162	7	15	8,162
TEPCO Fuel & Power (*1)	1	3,200	2	4	3,200
Chubu Electric Power	1	4,100	1	5	4,100
Tohoku Electric Power	2	3,200	2	4	3,200
Soma Kyodo Power Company	1	2,000	1	2	2,000
Hokkaido Electric Power	3	2,250	3	7	2,250
Hokuriku Electric Power Company	2	2,900	3	6	2,900
Kyusyu Electric Power	3	2,460	3	4	2,460
Chugoku Electric Power	3	2,590	5	6	2,581
Joban Kyodo Power Company	1	1,700	1	4	1,700
Kansai Electric Power	1	1,800	1	2	1,800
Shikoku Electric Power	2	1,106	3	4	1,106
Kobelco Power Kobe	1	1,400	1	2	1,400
Nippon Steel & Sumitomo Metal Co.	5	1,295	5	5	1,295
Sumitomo Joint Electric Power	3	580	2	5	580
Ube Industries	2	414	2	3	418
Sakata Kyodo Power Company	1	700	1	2	700
Tobata Co-operative Thermal Power	0	415	1	3	415
Okinawa Electric Power	2	752	2	4	752
Miike Power	1	175	1	1	175
Sumitomo Osaka Cement	2	225	2	3	225
Nippon Steel & Sumikin Stainless Steel Corporation	2	105	1	2	106
Meikai power company	1	147	1	1	147
Mitsubishi Chemical Corporation	1	141	1	1	147
Summit Onahama S Power Corp.	1	56	1	1	50
Erex New Energy, Saeki	1	45	1	1	50
Mombetsu Biomass Electric Power Co.	1	50	1	1	50
Asahi Kasei NS Energy	1	50	1	1	50
Tosa Power	1	167	1	1	167
Itoigawa Power Company	1	149	1	1	149
Nakayama Nagoya power company	2	259	1	1	149
Tokuyama	2	552	2	5	552
Nippon Paper Industries	8	916	1	1	80
Daicel Corp.	1	89	1	1	50
Daio Paper Corporation	1	519			
Oji Paper Co.	1	268			
Marusumi Paper Co.	2	189			
Mitsubishi Materials Corporation	2	115			
Oji Materia Corporation	4	247			
MCM Energy Service Co	2	131			
Mitsubishi Paper Mills Limited	1	58			
Taiheiyo Cement Corporation	1	50			
Rengo Co.	1	41			

Idemitsu Kosan Co.		28				
Erex New Energy	1	18				
Nippon Paper Industries Ishinomaki Energy Center	1	149		1	1	149
Suzukawa Energy Center	1	112		1	1	112
Soma energy park LLC	1	112		1	1	112
Sendai Power Station	1	112		1	1	112
Mizushima Energy Center	1	112		1	1	112
Hofu Energy Service Co., Ltd.	1	80		1	1	80
Osaki Cool Gen	1	166		1	1	166
Nakayama Nagoya Kyodo Hatsuden					1	110
Summit Handa Power Corporation	0	0				
Able Energy	1	112				
Total (*4)	**91**	**46,766**		**70**	**117**	**44,119**

*1 The government's Electric Power Statistics (Agency for Natural Resources and Energy) do not disclose the number of units in each power plant. Also, in some cases, the number of power plants and maximum output for some plants do not match other statistics or information released by companies. For example, TEPCO Fuel & Power has two coal power plants, Hitachinaka and Hirono, but the government statistics only count them as one. The government's count of Hokuriku Electric and Chugoku Electric power plants also do not match with research by Kiko Network.

*2 No information publically available can be found about the existence and condition of power plants colored in **pink**, mainly of paper and pulp companies, so those plants are not included in this report. If they were all included, they would amount to a total additional capacity of 2,647 MW.

*3 Power plants colored in **blue** are plants planned in 2012 or later and are monitored as “new plants” under the Japan Coal Plant Tracker (https://sekitan.jp/plant-map/en). However, those are included in this phase-out plan as they had already started operating as of April 2018.

*4 The power plants in this report cover 94.5% of the capacity reported in the government's Electric Power Statistics.

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