KIKO NETWORK 気候ネットワーク

—— Kiko Network Report ——

Japan's Path to Net Zero by 2050

2030 and 2040 GHG Reduction Targets and Policy Recommendations

March 2021

Introduction

Climate change is reaching a critical level and putting humanity at risk — not only future generations, but also us in the present generation — and the damage is predicted to spin out of control unless we change course. The Japanese government's target of net zero greenhouse gas emissions (carbon neutrality) by 2050 is a target also set by a majority of the world's countries to avert dangerous climate change.[1] To limit the global average temperature rise to 1.5°C, it is necessary to achieve net zero by 2050. To do this, we must follow a steady path of emission reductions, and this means cutting global emissions in half by 2030.

This target is beyond what can be achieved by the actions of individuals alone. It requires major transformations in society and economic systems, and programs must be implemented to realize them. The achievement of this net zero target is also important for the Sustainable Development Goals (SDGs), which aim to ensure that no vulnerable groups, communities, regions and countries are left behind. As the world's fifth largest emitter, and as a developed country providing support for vulnerable countries, Japan has an important role to play in achieving these global goals.

This report proposes Japan's targets for the years 2030 and 2040 and also proposes policies and measures to attain the emission reductions required to meet the 2050 net zero target. In this report, we have referred to science-based analysis for Japan's emission pathways to be consistent with the 1.5°C target. For measures and technologies, we also refer to estimates and scenarios in existing reports and recommendations available in Japan (references at end). This report also includes content from Kiko Network's previous paper, "Recommendations for the Revision of Japan's Strategic Energy Plan."[2]

1 Net Zero Tracker (https://eciu.net/netzerotracker) indicates that 127 countries have set or support net zero targets for 2050 (as of February 2021).

2 "Recommendations for the Revision of Japan's Strategic Energy Plan," December 2020 (in Japanese). https://www.kikonet.org/wp/wp-content/uploads/2020/12/revisionof-strategic-energy-plan.pdf

2030 and 2040 GHG Reduction Targets and Policy Recommendations

Japan's Path to Net Zero by 2050 (March 2021)

Executive Summary

Fundamental approach

Japan and the rest of the world must make steady progress to reduce emissions in 2030 and 2040 in order to achieve the net zero target for 2050 and avert the climate crisis.

To do so, Japan needs science-based targets, efforts to close the gaps with the required emission reduction levels, and the determination to break free from our dependence on fossil fuels, the main driver of climate change. At the same time, the transformation to net zero must also improve the environment for vulnerable populations and help workers who are affected by decarbonization make the transition to new and green jobs. To realize a net zero society by 2050, we need inclusive mechanisms in which people can participate and contribute to create the future we want.

Actual GHG emissions in Japan

After decreasing for five years in a row, Japan's greenhouse gas (GHG) emissions in 2018 were 12% below the 2013 levels (3% below 1990). At this pace, Japan would achieve a reduction of about 40% in 2030. The largest sources of emissions are coal-fired electricity generation, followed by transport and LNG gas-fired electricity generation, and then the energy-intensive steel industry and chemical industry; these five sources alone account for 70% of Japan's total emissions. While priority must be given to these sectors, emissions should also be reduced in other sectors and for gases other than CO_2.

Japan's GHG emission reduction targets

Japan's emission reduction targets must reflect this country's responsibility to achieve the global reductions needed to limit the temperature rise to 1.5°C. Based on analyses by climate policy thinktanks on the reductions needed to be consistent with the 1.5°C target, Japan's GHG emission reduction targets relative to 2013 must be at least 60% by 2030 (or 56% relative to 1990), 80% by 2040 (or 78% relative to 1990), and net zero by 2050.

Strategies in key sectors

- **Reducing energy consumption**

Resource consumption should be reduced as much as possible in view of the declining population, the maturing of society and infrastructure, and increased efficiency in resource and energy use. Japan should aim to reduce final energy consumption relative to 2013 to at

least 40% by 2030, 55% by 2040, and 70% by 2050, while electricity demand is expected to increase due to electrification, with the net reduction in electricity relative to 2013 at -20% by 2030, and -27% by 2040 and 2050.

• Power sector

By 2030, coal-fired power generation should be reduced to zero, along with nuclear power generation, which is unsafe, uneconomical, and unsustainable. Additionally, the small remaining amount of oil-fired power generation should also be zero. Renewable energy, currently at about 20%, should increase to at least 50%, and LNG-fired power generation should be no more than 50%. By 2040, renewable energy should increase to at least 80%, and LNG should be no more than 20%. Renewable energy should reach 100% by 2050.

• Transport sector

Passenger mobility should shift from automobiles to a transportation infrastructure centered on walking, cycling, and public transport, while freight transport should undergo a modal shift from truck to rail and ship. Passenger vehicles should be regulated so that by 2030, 100% of new sales are electric vehicles (EV, BEV, or PHEV), and by 2035, 100% of new sales are electric vehicles (only EV or BEV). Besides automobiles, carbon-free technologies should also be introduced for heavy-duty transport and aviation, and shipping before 2050. Emissions from the transport sector as a whole should be reduced by more than 50% by 2030 relative to 2013 and more than 75% by 2040, with the sector completely decarbonized by 2050. Although some hydrogen-powered fuel cell vehicles (FCVs) have been commercialized, EVs are overwhelmingly superior for passenger vehicles when it comes to cost, diffusion of the technology, and the development of infrastructure.

• Industrial sector

Demand in the steel, chemical, cement, and pulp and paper industries, all of which have high emissions, should be reduced through improved efficiency of material utilization and streamlined systems, and measures should be taken to improve energy efficiency, waste heat recovery, and electrification. Relative to 2013, CO_2 emissions of the industrial sector as a whole should be reduced by at least 65% by 2030 and at least 80% by 2040, with complete decarbonization achieved by 2050.

• Residential and commercial sectors

Considering the long-term impacts of these sectors, a shift should be accelerated to have 100% of newly-built houses and buildings being zero emission (ZEH, ZEB) by 2025. For existing houses and buildings, emissions should be reduced through renovations and the introduction of renewable energy, at a pace of 2% per year. In addition, there should be significant efficiency improvements in building structures and related equipment to further reduce electricity consumption. All of these should result in reduced emissions from the residential sector relative to 2013 by at least 65% by 2030 and at least 80% by 2040, and

from the commercial sector, at least 70% by 2030 and 85% by 2040. Both sectors should achieve complete decarbonization by 2050.

- **Waste sector**

The reduction of waste involves a number of actions by many actors. For businesses, this includes the selection and reduced consumption of raw materials, along with reductions in the amount of waste disposed. On the user side, this includes changes in thinking about the purchase and use of a multitude of items, including manufactured products and food, and reduction in the amount of garbage generated, including plastics and food loss. With additional electrification, heat utilization, and the transition to renewable energy, CO_2 emissions from the waste sector relative to 2013 should be reduced by 50% by 2030 and 75% by 2040, and should reach zero by 2050.

- **F-gases (4 fluorinated gases)**

HFCs are mainly used as refrigerants, and their emissions have been rising at a dramatic rate (46.4% up from 2013 levels in 2018) and now account for 4% of all GHG emissions. By promptly banning where alternatives are available, shifting to natural refrigerants, and recovering HFCs properly, the rapidly-increasing amount of HFCs used as refrigerants should be limited to 2013 levels by 2030, and with accelerated actions to eliminate fluorocarbons, their total emissions relative to 2013 levels should be reduced by at least 15% by 2030 and 70% by 2040, and F-gas emissions should be completely eliminated by 2050.

Proposed emission reduction targets

Projecting Japan's future emissions based on the measures indicated above, GHG emissions relative to 2013 will be reduced by 63–65% by 2030, 84–86% by 2040, and 98–99% by 2050, and GHG emissions in 2050 are projected to be about 15 million t-CO_2, shown in the bars in Figure 1 below. Based on these projections, as stated in the introduction, we are proposing reduction targets of at least -60% relative to 2013 by 2030, at least -80% by 2040, and net zero by 2050 (the line in the figure below).

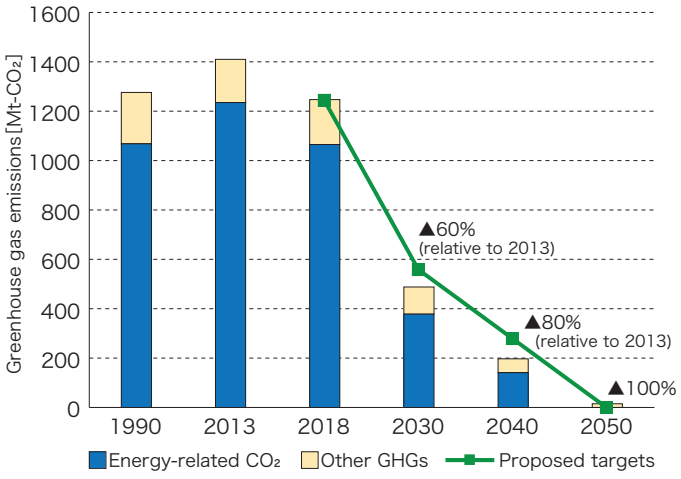

Figure. Emission reduction scenario and targets proposed by Kiko Network
Prepared by Kiko Network

Ten key policy actions

To achieve targets, we propose the following policy actions to be introduced immediately.

(a) Legislate targets and processes to enhance them

Clearly indicate the 2050 net zero target and short-term reduction targets in legislation. Furthermore, the process of enhancing reduction targets every five years should also be set into law.

(b) Introduce carbon pricing

To promote energy efficiency and energy transition in all sectors, introduce a carbon tax and gradually increase it to 10,000 yen (100 USD)/t-CO_2 equivalent in 2030.

(c) Set targets to end electricity generation from fossil fuels and nuclear power

Set targets to completely retire all coal-fired power plants and nuclear power plants by 2030. For LNG gas-fired power plants, cancel plans and construction of all new units, and limit the LNG share of the electricity mix to less than 50% by 2030, less than 20% by 2040, and zero by 2050.

(d) Adopt policies for a just transition

Establish within the government's organizational structure a mechanism to ensure a just transition for both industry and labor. Introduce budgetary measures for just transition policies for workers, such as green business development and technical assistance, vocational training, and unemployment compensation.

(e) Adopt policies to expand renewable energy

To significantly expand renewable energy, revise the transmission rules of the electric grid system, fundamentally reform electricity markets (capacity market, non-fossil value trading market, base load power supply market), and promote renewable energy and heat utilization policies.

(f) Promote electric vehicles and a modal shift to walking, cycling, and public transportation

To decarbonize the transport sector, in addition to carbon pricing, promote the shift to EVs, the decarbonization of long-distance transport such as aircraft, ships, and trucks, and a modal shift to walking, cycling, and public transportation.

(g) Strengthen regulations on housing, buildings, and equipment

Shift to ZEH/ZEB for new housing and buildings by 2025, accelerate policy adoption for public facilities and housing, and promote energy-efficiency renovations and renewable energy for existing houses and buildings to cut emissions by 2% per year.

(h) Adopt policies to reduce waste and plastics

Moving toward zero waste and zero plastics, promote the gradual introduction of regulations on raw materials, set waste reduction targets, and encourage stronger food loss and waste plastic reduction programs by local governments.

(i) Regulate F-gases

For HFCs, prohibit certain uses and set recovery targets based on F-gas tax and/or deposit systems. For SF6, PFC, and NF3, prohibit uses other than in closed systems, and make leakage prevention measures and recovery mandatory.

(j) Strengthen finance policies

End support for fossil fuel-related projects, evaluate consistency (with the Paris Agreement) and suitability of unproven innovative or problematic technologies (CCUS, hydrogen, ammonia, nuclear power), and make information disclosure mandatory based on the Task Force on Climate-related Financial Disclosure (TCFD).

Conclusion

A 50% reduction in GHG emissions by 2030 and decarbonization by 2050 is required to limit the global temperature rise to 1.5°C. Like many countries in the world, Japan must set clear targets and a vision for decarbonization, and have the determination and resolve to make it happen. Most of the measures and technologies indicated in this report are currently available. The costs of renewable energy are declining, and the systems, technologies, expertise, and mechanisms for mass deployment are becoming increasingly available to us. By promoting renewable energy while striving for energy conservation and local communities thriving together, we can begin to see decarbonization coming quickly into view. It's time for us all to participate in this discussion and take action so that this necessary transformation is not delayed by some actors or false solutions under the guise of "innovation." To achieve a decarbonized society, Kiko Network calls upon the Government of Japan to establish targets and implement policies and actions based on the proposals presented in this report, and we will continue in our efforts to urge all actors to step up their actions.

1. Fundamental approach

Extreme weather is occurring more frequently, and climate change is intensifying. Japan has at last joined the list of countries that have declared a target of achieving net zero GHG emissions by 2050, and now must make steady progress in reducing emissions by 2030 and 2040 in order to achieve that target.

Until now, Japan has taken the "forecasting" approach: adding up measures it considers to be feasible for implementation, sector-by-sector, and using those numbers as the basis for setting emission reduction targets. However, reduction targets to date have been far too low, as simply adding up a string of measures aligned with conventional approaches and failing to envision bold structural reforms will not get Japan close to the level of ambition required. Nevertheless, Japan now has the goal of achieving net zero within thirty years, and so we need to take actions toward that goal with a proper vision in mind.

Below, we look at the fundamental approach Japan should focus its efforts on to achieve net zero by 2050.

(1) Base it on science: Close the gap to achieve the 1.5°C goal

The latest climate science tells us that past actions have not gone far enough, leaving us very little time to avoid dangerous levels of climate change. It also tells us that stronger actions are needed, and that bold emission reductions are required in the short term by 2030. When devising policies and measures, we cannot simply take a bottom-up approach to list a series of today's feasible technologies and actions. The Japanese government needs to take seriously the warnings about the climate crisis, declare bold targets to close the gaps between current targets and the level of actions required to realize the 1.5°C goal, and commit to a major transformation to get us there. This should all be guided by the concept of backcasting: defining a desirable future state and then working backwards to identify policies and programs to get us there from where we are now.

(2) End our reliance on fossil fuels

To cut global CO_2 emissions in half by 2030 and achieve net zero by 2050, it is necessary to fundamentally reexamine modern society's use of the fossil fuels the world has relied on so heavily since the Industrial Revolution. In other words, while boldly promoting energy conservation, it is necessary to significantly transform our energy supply and demand systems and make a complete energy transition away from fossil fuels to renewable energy. If we consider this transition, including the required infrastructure improvements, it is too risky to postpone action by pinning our hopes to innovations that still have no clear prospect of practical application. To meet the 2050 target, we need to take immediate action to end use of fossil fuels.

(3) Support the vulnerable as the world transitions to net zero

The ongoing COVID-19 pandemic is heavily impacting businesses and workers in many industries. This has serious effects on local economies, severely impacting vulnerable and marginalized people and increasing social inequity. Efforts to achieve net zero in 2050 must help the world recover from this situation and promote integrated efforts to build a new society. A decarbonized society will be unattainable without a major structural transition away from energy-intensive industries. Thus, it is crucial to anticipate the impacts on local economies and workers that may occur from the transition, create new industries and jobs suited to this new reality, and provide support to facilitate the transition.

(4) Promote participation, dialogue, and inclusiveness

A society that attains net zero in 2050 will be self-sufficient and sustainable, and its energy systems and economic systems will reveal a world dramatically transformed from what we see today. In such a world, individual households, communities, and businesses will produce much of their own renewable energy, locally-based businesses will drive their own local economies, and there will be a diversity of options for renewable energy and sustainable employment. Dangerous levels of climate change will have been avoided, extreme weather events will have been kept within our ability to anticipate and mitigate them, ecosystems will be maintained, and the future of life will be secure. Furthermore, we will have various opportunities for participation and dialogue to create such a sustainable future, where diverse voices and choices are respected, and self-directed, proactive, responsible actions by individuals are encouraged. To create a future that offers choices like these, democratic processes and mechanisms that will allow for proactive engagement are required.

2. Japan's greenhouse gas emissions

(1) Trend in Japan's GHG emissions

In FY2018, Japan emitted 1.24 billion tons of GHG emissions,[3] of which about 90% (1.13 billion tons) were CO_2 emissions. With the exception of the global financial crisis of 2008-09, emissions were on a rising trend until FY2013, but peaked that year and have been declining ever since, with 2018 at 12% below FY2013 (or 3% below FY1990) (Figure 1). Japan's current target of 26% reduction for 2030 is yet to be reached, but if the reduction rate of 2-3% per year for the past five years continues, Japan could meet that target with

3 With the exception of the economic downturn in 2009, this was the first time below 1.2755 billion tons since 1990.

room to spare, with a projected reduction of about 40%. However, no path to net zero in 2050 has yet been laid out, greater efforts are needed to strengthen the 2030 target, and a 2040 target needs to be set.

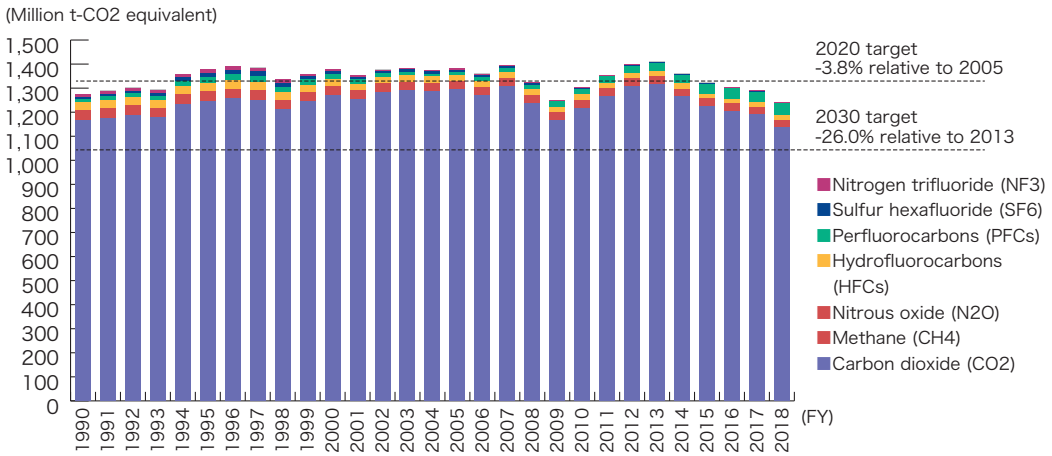

Figure 1. Trends in Japan's GHG emissions
Source : Greenhouse Gas Inventory (FY2018 Report), National Institute for Environmental Studies.

(2) Emissions by sector: Coal power is the top emitter

Based on actual results for FY2018, CO_2 from coal-fired power generation is the largest source of Japan's GHG emissions, accounting for over 20% (267 million tons) of total emissions. Second is the transport sector, third is LNG-fired power generation, followed by the energy-intensive steel and chemical industries (the latter including coal and petroleum products). Together, these five sectors account for nearly 70% of Japan's total emissions (Figure 2). The most important challenge when Japan works toward decarbonization is to take a serious and fresh look at the economic activities that consume such massive amounts of fossil fuels, and steadily progress toward zero emissions. In addition, the central government, local governments and all relevant actors need to work together to advance detailed emission reduction measures for all GHGs, including F-gases and non-energy-related CO_2 emissions from sources such as small and medium-sized enterprises, the residential and commercial sectors, industrial processes, and waste.

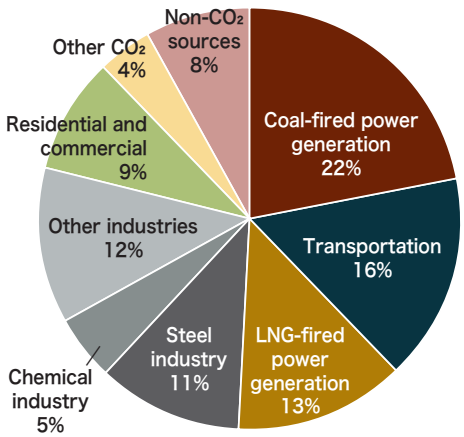

Figure 2. Breakdown of Japan's greenhouse gas emissions
Source: Prepared by Kiko Network from Greenhouse Gas Inventory (before electricity and heat allocation, FY2018 Report), by National Institute for Environmental Studies.

3. GHG emission reduction targets

Japan's GHG emission reduction target for 2030 set in 2015 was for a 26% reduction relative to 2013 levels (–18% relative to 1990). It has been pointed out that this falls significantly short of the goals consistent with the Paris Agreement, and existing research indicates that it would be equivalent to inviting a temperature rise of 3°C to 4.3°C.[4]

The level of Japan's GHG emission reduction targets must reflect the country's responsibility to reach the global reductions needed to limit the temperature rise to 1.5°C. As shown in Table 1, leading analysis performed overseas has looked at reduction levels needed for Japan to be consistent with the Paris Agreement goal of 1.5°C. Some of the reductions are shown as a range, but considering Japan's responsibilities as a developed country, it would be inappropriate for Japan to adopt the lower values. Climate Action Tracker has pointed out that for Japan's reductions to be 1.5°C-consistent, the reduction targets should be –62% by 2030 relative to 2013, and –82% by 2040.

Based on the above points, Kiko Network proposes that Japan adopt GHG emission reduction targets relative to 2013 of at least –60% by 2030 (or –56% relative to 1990) and –80% by 2040 (or –78% relative to 1990).

4 Japan's target of a 26% reduction by 2030 is a level that will result in 3–4°C of warming according to Climate Action Tracker (https://climateactiontracker.org/countries/japan/), and Paris Equity Check puts the number at 4.3°C (http://paris-equity-check.org/warming-check.html#open-graph).

Table 1. Levels of Japan's GHG emission reduction targets

Organization	2030 emissions	2040 emissions	2050 emissions	Details
Analyses of Paris Agreement-consistent GHG emission pathways for Japan				
Climate Action Tracker*[5]	–62% (relative to 2013)	–82% (relative to 2013)		Top-down approach from global model. Levels consistent with 1.5°C target. Excludes forest sinks and other land-use change.
Climate Analytics*[6]	Approx. –65% (relative to 2013)	—	Net zero	Top-down approach from global model. Levels consistent with 1.5°C target. Excludes forest sinks and other land-use change.
Paris Equity Check*[7]	–39% to –71% (relative to 1990)	–65% to –110% (relative to 1990)		Top-down approach from global model. Levels consistent with Paris Agreement. Includes reductions overseas (based on multiple equity indicators).
Proposals by Japanese organizations				
Kiko Network	–60% (relative to 2013)	–80% (relative to 2013)	Net zero	Validated bottom-up based on levels calculated top-down.
WWF Japan	–48% (relative to 2013)	–68% (relative to 2013)	Zero	Calculated mainly based on energy-related CO_2. Other gases straight line to zero after 2030.
Institute for Global Environmental Strategies (IGES)	—	—	Net –98%	Transition scenario. Includes small amount by CCS & DAC (direct air capture) technologies.
Renewable Energy Institute	Energy-related CO_2 –47% (relative to 2013)	—		
Future Group*	Energy-related CO_2 –61% (relative to 2013)		Energy-related CO_2 –93% to –100% (relative to 2013)	–93% in 2050 with existing technologies, –100% with new technologies.

* Energy Transition for the Future Research Group

Prepared by Kiko Network

5 Climate Action Tracker, *1.5°C-consistent benchmarks for enhancing Japan's NDC ambition,* March 2021. https://climateactiontracker.org/documents/841/2021_03_CAT_1.5C-consistent_benchmarks_Japan_NDC.pdf

6 Climate Analytics, *What is Japan's required contribution to limit global warming to 1.5°C?* March 2021. http://1p5ndc-pathways.climateanalytics.org/countries/JPN/

7 Paris Equity Check, http://paris-equity-check.org/

4. Strategies and projected reductions

(1) Fundamental approach

The following principles were used to identify emission reduction strategies to achieve net zero in 2050. The fundamental approach was to seek the deeper emission reductions that are necessary, while considering the technology trends based on the research and recommendations mentioned above, and applying the backcasting concept covered in Section 1.

- Aim to achieve significant reductions in energy consumption.
- Promote a steady transition away from large emission sources.
- Promote the swift introduction of technologies that can be relied upon to ensure steady emission reductions and have low environmental impacts.
- Choose technologies that are highly safe, economical, and sustainable.
- Simultaneously promote reduction strategies for emissions other than energy-related CO_2.

(2) Strategies in key sectors

Top priority is placed on reducing energy consumption through energy conservation, and approaches are recommended for key emission reduction strategies and targets that should be declared, with an emphasis on major emission sources.

(a) Energy consumption reductions

Japan is experiencing a decline in population, with the population in August 2020 at 125.8 million. This is projected to be 119.1 million in 2030, 101.9 million in 2050 (down by about 20% from today), and to decline below 100 million in 2053.[8] Much of Japan's infrastructure is already adequate, so in the coming years there is likely to be a greater emphasis on the repair and maintenance of existing infrastructure than on new construction projects. Additionally, resource consumption can be minimized by promoting greater efficiency and smart energy use. Minimized energy consumption makes it possible to end the use of fossil fuels and nuclear power, and to fast track an increase in the renewable energy share of the energy mix.

8 National Institute of Population and Social Security Research, Population Projections for Japan (2017), P. 222 (in Japanese). http://www.ipss.go.jp/pp-zenkoku/j/zenkoku2017/pp29_ReportALL.pdf

• **Final energy consumption**

The 2015 Long-term Energy Supply and Demand Outlook from the Ministry of Economy, Trade and Industry (METI) projected a 10% reduction (relative to 2013) in final energy demand in 2030, but in reality, it has been steadily declining since 2010, and in 2019 was already 8% lower than in 2013 (4% below 1990).[9] If the current pace of reduction is maintained, a reduction of over 30% can be expected by 2030. Regarding existing studies on final energy demand in 2030, the Renewable Energy Institute has presented a scenario with a 25% reduction (relative to FY2018), WWF Japan a 20% reduction (relative to FY2015), and the Energy Transition for the Future Research Group (Future Group) a 38% reduction (relative to FY2013).[10] IGES presented a conservative estimate of a 38% reduction in consumption by 2050 (relative to FY2015).

To achieve net zero CO_2 emissions, based on the fact that energy conservation should be the key strategy, Kiko Network proposes more intensive efforts to reduce final energy consumption relative to FY2013 by at least 40% by 2030, at least 55% by 2040, and at least 70% by 2050.

• **Electricity demand**

A declining trend in electricity demand has continued since 2010 when it was 1,035 TWh, and while the government is projecting demand at 980 TWh in 2030, it had already declined to 946 TWh in FY2018. Going forward, some increases in electricity demand are likely to occur due to electrification in the transport sector, and to electrification for heat utilization in the industrial sector and in steel manufacturing. However, electrification also offers opportunities to choose technologies that can significantly increase efficiency. Moreover, by implementing both efficient use and appropriate energy conservation, even with the expected increases[11] considered, overall it is possible to limit the increase in electricity demand. Existing studies have proposed a range of electricity demand in 2030 of 725–840 TWh.[12]

Based on the points above, we propose reductions in electricity demand of 20% by 2030 and 27% by 2040 and 2050 relative to 2013 levels. These reductions will make it possible to avoid increases in LNG imports that would otherwise occur due to the temporarily-increased reliance on LNG-fired power generation toward 2030.

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9 Ministry of Economy, Trade and Industry (METI), Energy Supply and Demand Results Brief, November 2020 (in Japanese). https://www.meti.go.jp/press/2020/11/20201118003/20201118003-1.pdf

10 Regarding final energy consumption in 2030, the Renewable Energy Institute indicates 9,820 PJ, and the Future Group 7,734 PJ in 2030 and approx. 4,961 PJ in 2050.

11 The total projected increase in demand for steelmaking electric furnaces and the increase in demand due to the shift to EVs in automobiles in 2030 is about 70 TWh in 2030. Of this amount, the portion for automobiles is projected at about 20 TWh in 2030, 110 TWh in 2040, and 150TWh in 2050.

12 Electricity demand in 2030 under each organization's proposed scenario: 790 TWh (WWF Japan), 840 TWh (Renewable Energy Institute), 725 TWh (Future Group).

Table 2. Proposed targets for final energy consumption and electricity demand

	Actual			Kiko Network proposal (relative to 2013)		
	2010	2013	2018	2030	2040	2050
Final energy consumption (PJ)	14,712	14,085	13,124	8,400 (–40%)	6,300 (–55%)	4,200 (–70%)
Electricity demand (TWh)	1,035	990	946	790 (–20%)	720 (–27%)	720 (–27%)

Actual values are from General Energy Statistics, etc. Prepared by Kiko Network

(b) Electricity generation (coal, LNG, oil, renewable energy, nuclear)

Climate Analytics has pointed out that to be 1.5°C-consistent, renewable energy needs to account for 45–85% of the power sector by 2030.[13] Working from the estimates by Climate Analytics, Climate Action Tracker pointed out that in order to be consistent with the target, renewable energy (plus nuclear and thermal power generation with carbon capture, utilization and storage [CCUS] technology) needs to be at least 60% of the energy mix by 2030 and at least 80% by 2040, and coal-fired power generation without CCUS needs to be completely phased out by 2030. Regarding nuclear and CCUS, they also point out that it is unrealistic to expect significant contributions, and that it is most reasonable to focus efforts on renewable energy.[14]

Reliance on nuclear power in the power mix is unrealistic and inappropriate, and it would be risky to rely on CCUS, which is an unproven technology (see Column 1). Recently, the Japanese government and power utilities have started promoting the use of hydrogen and ammonia for power generation, but there are various problems with this, including the fact that they too are generated from fossil fuels, as well as additional issues with the technologies and costs (see Column 2). To approach the levels required in 2030, emissions from thermal power generation — the largest emitting sector — must be brought down to zero as soon as possible, while maximizing the expansion of renewable energy.

To go fossil fuel-free and nuclear-free as quickly as possible, it is necessary to increase the capacity utilization of LNG-fired power generation facilities until 2030. According to Climate Action Tracker, to keep LNG-fired power generation below the current level of 320–340 TWh, total electricity generation would need to be kept to roughly 800–850 TWh, and this level would generally be 1.5°C-consistent.

Several reports have verified that the power supply/demand balance will not be affected — even in a scenario for 2030 that does not rely on nuclear and coal, and even if the share of renewable energy increases above 45%. This includes a report by the Renewable Energy Institute showing that electricity costs could be lower than they were in 2019 even with 45%

13 Climate Analytics, Closing the Gap, http://1p5ndc-pathways.climateanalytics.org/countries/JPN/closing-the-gap/

14 Ibid. Footnote 5.

of the supply coming from electricity from renewable energy,[15] and one by the Future Group confirming that in each power supply area there would be no electricity supply problems in 2030.[16]

- **Coal-fired power generation: Zero by 2030**

Japan has increased its dependency on coal power over the past few decades. In 2018, coal had the largest share of the power mix at 31.6%, and new power plants are still being constructed to this day. It will be difficult to avert a climate crisis without measures to address coal-fired power generation, the largest source of CO_2 emissions. To be consistent with the Paris Agreement, unless they install CCUS technology, developed countries have to reduce coal power to zero by 2030.[17] However, even if this as-yet unproven CCUS technology could be successfully developed, the risk of leakage would always remain, and costs are high, so the merits of CCUS are unconvincing (see Column 1). Even if these technologies could deliver on their promises, they will only be put to use after 2030, which would be too late. The proposition that coal-fired power generation can continue as long as it is accompanied by CCUS is not globally accepted. Climate Analytics, WWF Japan, and the Renewable Energy Institute have all presented scenarios for 2030 with zero coal-fired power generation. Thus, we propose that any new projects for coal-fired power generation be halted, including any currently under construction, and that there should be a complete coal power phase-out by 2030 (for details of the proposal, see the Kiko Network paper on a coal phase-out).[18]

15 Renewable Energy Institute, *Verification of electricity supply and demand balance and costs in 2030,* February 2021 (in Japanese). https://www.renewable-ei.org/activities/reports/20210210.php

16 Energy Transition for the Future Research Group, *Report 2030,* February 2021 (in Japanese). https://green-recovery-japan.org/pdf/japanese_gr.pdf.

17 Already 60% of developed countries have recognized its importance and are proceeding with actions to achieve a target of being coal-free by 2030. (Reference: E3G, Global Status of Coal Power, https://www.e3g.org/publications/oecd-eu28-lead-the-way-on-global-coal-transition/)

18 Kiko Network, *Japan Coal Phase-Out: The Path to Phase-Out by 2030 (2020 edition),* February 2021 (English edition) https://www.kikonet.org/eng/Japan-Coal-Phase-out-2020-edition

COLUMN 1

Unproven technology: Carbon capture, utilization and storage (CCUS)

CCUS, intended to capture CO_2 emitted from power plants and utilize or store it, is an unreliable technology wrought with problems. These problems include its effectiveness, cost, concerns about environmental impacts, and technical risks. There is still no clear prospect for commercial application, and it will make absolutely no contribution to the emission reductions of over 50% required by 2030. Even if commercialization was achieved, the costs would be prohibitive. Pouring subsidies into R&D for fossil fuel-related ventures that have no real future prospect of being viable simply amounts to an attempt to prolong our fossil fuel dependency. Also, this would unnecessarily delay the exit from coal and make it more difficult to achieve the goals of the Paris Agreement. It is inappropriate to place emphasis on CCUS and rely on it as a climate change countermeasure, and we should stop considering decarbonization based on CCUS technology. (Regarding the various problems with CCUS, please refer to a previous paper by Kiko Network.)[19]

• LNG-fired power generation: 50% cut by 2030, zero by 2050

LNG-fired power generation accounted for the largest share of Japan's electricity generation mix in 2018, at 38.3%. Although it has about half the CO_2 emissions of coal, it is nevertheless a fossil fuel with enormous environmental impacts. Many of the major concerns regarding coal power, such as development of technology and potential application for hydrogen, also exist for LNG. Thus, any further increase in capacities should be avoided, new construction should be halted, older power plants should be phased out starting with the least efficient ones, and the shift should be made to renewable energy. There will be a higher reliance on LNG as a result of the phase-out of coal and nuclear by 2030, but capacity utilization at LNG-fired power plants has been declining in recent years, and this trend is expected to continue. Therefore, the existing plant facilities are already sufficient. However, by limiting electricity demand, LNG imports should be kept to less than they are today, and we should act to ensure a rapid decrease after 2030.

• Renewable energy: At least 50% share of electricity mix by 2030, 100% by 2050

The expansion of renewable energy is critically important to achieve a major reduction of GHG emissions and phase out coal and nuclear power. It is necessary to promote the

19 Kiko Network, Position Paper - Risky Dreams: Carbon Capture, Utilization, and Storage (CCUS), August, 2019, https://www.kikonet.org/eng/publication-en/2019-08-15/paper-on-ccus

introduction and expansion of land-based solar and wind power, as well as offshore wind power and geothermal. However, proper environmental consideration and consensus-building are essential when installation is being planned. Biomass should be used only when it has been assessed to result in CO_2 emission reductions, utilization should be based on cascading uses (from high to low value-added), and sustainability must be considered to ensure that biomass use does not cause environmental destruction, result in human rights abuses, or compete with food production. Existing studies have presented scenarios with the share of renewable energy in 2030 being between 45% and 50% of the electricity mix.[20] Based on the above points, we propose targets for renewable energy of at least 50% by 2030, at least 80% by 2040, and 100% by 2050.

• Nuclear power: Zero by 2030

The accident at the Fukushima Daiichi Nuclear Power Plant in March 2011 revealed the enormous damage and impact on society, the economy, and local communities. Ten years have passed, but there is still no end to the accident in sight — many serious problems remain, and the risks and burdens are being left for the next generation. Moreover, regardless of the government and industry's strong push, even the government admits that the installed capacity will rapidly decline going forward, and there is no expectation that nuclear is able make any contribution as a means of tackling climate change. Furthermore, nuclear power is neither conducive to nor consistent with building a sustainable decarbonized society, nor does it make sense from an investment perspective. Therefore, we are proposing that policies be devised to end the use of nuclear power, that no more reactors be restarted, and that any reactors still operating be shut down quickly and proceed to decommissioning, resulting in a complete phase-out to zero nuclear before 2030.

• Electricity generation mix

Based on the above, for the electricity mix in 2030, the targets for the share of renewable energy should be increased to at least 50% by 2030 from the current level (approx. 20%), and LNG-fired electricity generation should be no more than 50%. By 2040, renewable energy should be more than 80%, with LNG limited to 20% or less (Table 3). Coal-fired power generation should be reduced to zero by 2030, along with nuclear power generation, which is unsafe, uneconomical, and unsustainable, and the small remaining amount of oil-fired power generation should also be zero. The share of LNG-fired power generation should also be significantly reduced gradually after 2030 to zero by 2050.

20 For electricity generation from renewables as a share of the power mix in 2030, the Renewable Energy Institute is proposing 45% (400 TWh), WWF Japan 48% (450 TWh), and Future Group 44% (372.5 TWh).

COLUMN 2

Hydrogen and ammonia will not save us

While hydrogen does not emit CO_2 during use, it is a secondary energy source created by electrolysis powered by other sources — fossil fuels such as coal and natural gas, nuclear power, or renewable energy. It is important to note that hydrogen produced from fossil fuels is not carbon-free, as CO_2 is emitted when it is produced. As for ammonia, the Japanese government and industry have been indicating its use not only as a hydrogen carrier (for transport and storage), but also as a fuel for electricity generation as a replacement for coal.[21] However, ammonia will also be made from fossil fuels, so in terms of CO_2 emissions it is similar to hydrogen.

The justification being used to label hydrogen and ammonia as carbon-free technologies is the assumption that CO_2 emitted during their production will be captured using CCUS. However, CCUS is itself an unproven technology that comes with many problems and has limited potential if it cannot be made cost effective. Therefore, it is very risky to build any zero-emissions vision based on these technologies. The purported intention may be to use renewable energy to produce hydrogen or ammonia, but if the idea is to burn that hydrogen or ammonia to fire a boiler to generate electricity, it would be immeasurably simpler to just use renewable energy to generate electricity, and the costs and losses would be lower as well. A report by the International Energy Agency (IEA) states that what power systems need is the flexibility to install and respond to variable renewable energy, and it proposes various strategies to ensure flexibility depending on a country's phase of renewable energy deployment. Correspondingly, it ranks hydrogen as being necessary only in the final phase (Phase 6) and does not recommend hydrogen as necessary from the start.[22] Japan, currently at Phase 2, still has a long way in the deployment of renewable energy, so there is no obvious reason to rush to use hydrogen at this point.

To achieve net zero in 2050, hydrogen is not necessary for electricity generation where renewable energy would be the simplest choice. Instead, hydrogen should be mainly used in specific applications, such as large ships and aircraft, steel, and cement. Moreover, hydrogen should only be used if it is produced by surplus electricity generated from renewable energy.

21 See for example a report by the Basic Policy Subcommittee of the Advisory Committee on Natural Resources and Energy, December 22, 2020 (https://www.enecho.meti.go.jp/committee/council/basic_policy_subcommittee/035/035_004.pdf) (in Japanese) and *JERA's Zero Emission 2050 Strategy* (https://www.jera.co.jp/english/corporate/zeroemission).

22 IEA, *Status of Power System Transformation 2019,* https://www.iea.org/reports/status-of-power-system-transformation-2019.

Table 3. Electricity generation mix and proposed targets (TWh)

	Actual*		Government target** (share of mix)	Kiko Network proposal (share of mix)		
	2013	2018	2030	2030	2040	2050
Electricity demand	990	946	981	790	720	720
Electric power generation	1,085	1,051	1,065	900	800	1,200
Coal	357	332	281 (26%)	0	0	0
LNG	444	403	285 (27%)	450 (50%)	160 (20%)	0
Oil, etc.	157	74	32 (3%)	0	0	0
Nuclear	9	65	217–232 (20–22%)	0	0	0
Renewable energy	118	177	237–252 (22–24%)	450 (50%)	640 (80%)	1,200 (100%)

From General Energy Statistics, Long-term Energy Supply and Demand Outlook. Prepared by Kiko Network

* From FY2018 Greenhouse Gas Inventory.

** From National Climate Action Plan (2016).

(c) Transport sector

The transport sector accounted for 16% (202.7 million t-CO_2) of Japan's GHG emissions in 2018, with 89% from vehicles (passenger vehicles 51%, freight 38%). According to Climate Action Tracker, to be 1.5°C-consistent, 75–95% of new passenger vehicle sales should consist of electric vehicles (EVs) by 2030, increasing to 100% by 2040, and the entire transport sector needs to be decarbonized, with emissions intensity decreasing 15–20% by 2030, 45–60% by 2040, and 75–100% by 2050.[23] Based on the need for a rapid transition to EV vehicles and modal shift, Japan should aim through the following measures to reduce CO_2 emissions from the transport sector relative to 2013 by at least 50% by 2030 and by at least 75% by 2040, with the sector completely decarbonized by 2050.

• Cars and trucks

Passenger mobility should shift from cars to a transportation infrastructure centered on walking, cycling, and public transport. And freight transport should undergo a modal shift from truck to rail and ship, and through greater efficiency in distribution, passenger and freight volumes transported by car and truck should be reduced.[24] Passenger vehicles (personal use and commercial use) should be regulated so that electric vehicles (EV or PHEV) account for 100% of new sales by 2030, and all new sales are 100% electric vehicles

23 Ibid. Footnote 5.

24 Compared to truck transport, CO_2 emissions (per ton-kilometer of transport volume) are reduced to one-eleventh by rail, and one-sixth by ship.

by 2035 (EV only, with plug-in hybrids excluded in 2035). From 2035 onward, 100% of diesel- and gasoline-powered buses and trucks should be electric (with the exception of heavy-duty trucks), and from 2040 onward, 100% of new heavy-duty truck sales should be electric, with all fleets electric by 2050.

Although some hydrogen-powered fuel cell vehicles (FCVs) have been commercialized, EVs are overwhelmingly superior as passenger vehicles in terms of cost, technology diffusion, and infrastructure development. Hydrogen should be prioritized for use in heavy-duty transport and in other sectors where electrification is difficult, but only on the condition that it comes from the use of surplus electricity generated by renewable energy.

Additionally, to promote emission reductions in the transport sector through electrification, it is essential to have 50% of the electricity supply coming from renewable energy by 2030, and 100% by 2050.

• Transportation other than cars and trucks

For non-electrified sections of passenger rail lines, battery- and fuel-cell-powered rail cars are already being used in Japan, but efforts should be made to ensure that the electricity comes from renewable energy. Small electric-powered vessels are already in service overseas, and this seems possible in Japan as well. For large ships and aircraft, technologies are currently being developed. Moving toward 2050, carbon-free technologies should be introduced for large ships and aviation in order to achieve complete decarbonization of the transport sector.

(d) Industrial sector

In the industrial sector, we propose that efforts focus on the following major emitting industries, with target reductions of at least 65% by 2030 relative to 2013, and at least 80% by 2040.

• Iron and steel industry

The iron and steel industry accounted for 11% (135.5 million t-CO_2) of Japan's GHG emissions in FY2018, making it the top emitter in the industrial sector. Coking coal is needed today for blast furnace reduction processes in steel manufacturing, producing enormous CO_2 emissions.[25] Decarbonization of the steel industry is a very important priority. In other countries, the use of electric arc furnaces is expanding and zero-carbon technologies are being developed, such as the use of hydrogen for reduction processes.

25 *In Basic Policy of the Japan steel industry on 2050 Carbon Neutrality aimed by the Japanese government* (February 15, 2021) the Japan Iron and Steel Federation declares its intention of working to realize "zero carbon steel," saying, "the Japanese steel industry will explore multiple pathways to the challenge by employing every possible means including, our actively ongoing efforts for the drastic reduction of CO_2 emissions from blast furnace through COURSE 50 and ferro coke technologies plus CCUS (carbon capture, utilization, and storage), development of super innovative technologies such as hydrogen-based iron making, expanded use of scrap, recovery of low- to medium-temperature waste heat, and use of biomass." However, what is missing is its own commitment to be carbon-free by 2050.

On the consumption side, actions are being taken toward using only decarbonized steel by 2050.

According to Climate Action Tracker, on a global level, the CO_2 emissions intensity of steel production needs to decrease below 2015 levels by 25–30% by 2030, and by 95–100% by 2050.[26]

For the near future, it would be reasonable for Japan to promote the electrification of furnaces and to expand the use of electricity generated by renewable energy. Japan should decrease the volume of iron and steel production by focusing on domestic demand and on applications where domestic production is really necessary, and decommission blast furnaces when it is deemed technically feasible to continue iron and steel production using only electric furnaces. With this, the market share of production from electric arc furnaces using recycled steel should be increased to 70% by 2030, 85% by 2040, and at least 90% by 2050. Japan should strive to reach the targets earlier through the development of carbon-free technologies, such as reduction by hydrogen. In terms of policies, the Petroleum and Coal Tax should be applied to coking coal (which is currently subject to tax exemptions), and the tax rate should be gradually increased. As for steel from blast furnaces, its use for public works and public construction projects should be banned, and its use for construction purposes should be abolished as soon as possible. The use of thermal coal and anthracite should be banned from 2030 onward, and the use of all coal, including coking coal, from 2050 onward. Through all of the above, CO_2 emissions intensity should be reduced by 65% by 2030, 80% by 2040, and 90–100% by 2050, and CO_2 emissions by at least 70% by 2030, and at least 90% by 2040.

- **Chemical industry**

Emissions from the chemical industry (including petroleum and coal products) in FY2018 were approximately 57 million t-CO_2, accounting for 5% of Japan's GHG emissions (indirect emissions including electricity were about the same). The chemical industry produces a wide variety of products, but the use of plastics should be decreased, waste should be reduced, and efficiency should be improved in a variety of applications in order to significantly reduce resource inputs. A number of measures should be accelerated, including equipment upgrades, electrification and hydrogen use in naphtha pyrolysis processes at medium and high temperatures, and waste heat utilization in low-temperature distillation processes.[27] Whereas the Action Plan for a Low-Carbon Society of the Japan Chemical Industry Association indicates a reduction of 6.79 million t-CO_2 (10.7% reduction) by 2030 relative to FY2013, we call for a 50% reduction target by 2030 relative to FY2013, a 70% reduction by 2040, and complete decarbonization by 2050.

26 Ibid. Footnote 5.

27 Institute of Applied Energy, *Prospects for industrial heat decarbonization in energy systems,* March 31, 2020 (in Japanese). Ref.: https://www.jst.go.jp/sip/dl/p08/report2019_4.pdf

• **Cement industry**

Energy-related CO_2 emissions in FY2018 from the cement manufacturing industry (including ceramic products) were about 25 million t-CO_2, or about 2% of total GHG emissions (indirect emissions including electricity came to 31 million t-CO_2, or 2.5% of Japan's total). Counted separately, emissions from industrial processes were about 34 million t-CO_2, or about 3% of GHG emissions. Energy-related CO_2 emissions have continued to decline, with a 43% decrease relative to FY1990 and a 13% decrease relative to FY2013. Similarly, emissions from industrial processes have decreased by 32% relative to FY1990 and by 4% relative to FY2013.[28]

According to Climate Action Tracker, the global emissions intensity of cement production needs to decrease by 40% by 2030 and 85–90% (aspirational target -100%) by 2050 in order to be 1.5˚C-consistent.

It is challenging for Japan to make further improvements in energy intensity — it is already somewhat ahead of other countries — and CCUS should not be relied upon. Taking this into account, Japan should set a target of reducing energy-related CO_2 emissions for the cement manufacturing industry by 40% by 2030 and 50% by 2040, through the reduced use of resources (by improving the efficiency of material utilization), electrification, and reduced energy intensity, and by 2050 should achieve complete decarbonization through technology development for hydrogen use and other technologies. Technological development should be promoted for applications where the decarbonization of industrial processes is difficult for non-energy-related CO_2 emissions.

• **Pulp and paper industry**

CO_2 emissions from the pulp and paper manufacturing industry in FY2018 amounted to 18 million t-CO_2, or 1.5% of GHG emissions (indirect emissions including electricity came to 22 million t-CO_2, or 2% of Japan's total). In terms of current measures, the Japan Paper Association has set a voluntary target of a 21% reduction by FY2030 relative to FY2013, with the actual reduction as of FY2019 at 11.8% (16.58 million t-CO_2). In January 2021, the Japan Paper Association declared a goal of net zero emissions in 2050,[29] from what was 21 million t-CO_2 in FY2013, including 3 million t-CO_2 of waste-related emissions. However, the use of CCUS is anticipated to help achieve these targets. CCUS will be unable to contribute to any reduction by 2030, and since there are no clear prospects for the technology even thereafter, targets should not rely on CCUS. Instead, the pulp and paper industry should promote energy conservation and renewable energy, and set a target for CO_2 emission reductions of 50% by 2030 relative to FY2013, 80% by 2040, and zero emissions by 2050.

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28 *Low-Carbon Society Action Plan, Phase II,* released by the Japan Cement Association in December 2014 (https://www.jcassoc.or.jp/cement/4pdf/jg1k_03.pdf, in Japanese) states that it had set a target of 3,334 MJ/t-cem by 2030 to reduce the energy intensity of cement production by 4% relative to FY2010, but the actual results in FY2018 (3,328 MJ/t-cem) already achieved this goal.

29 Japan Paper Association, *The paper industry's long-term vision 2050 for global warming countermeasures,* January 2021. https://www.jpa.gr.jp/file/topics/20210119062903-1.pdf

• Non-material manufacturing industries

For the non-material manufacturing industries (including food manufacturing and equipment manufacturing, etc., and excluding the four materials-related industries and non-ferrous metal smelting), CO_2 emissions in FY2018 amounted to 32 million t-CO_2 in direct emissions, or about 2.6% of total GHG emissions (about 8.6% of indirect emissions including electricity). Emissions from thermal power plants for purchased electricity accounted for most of the 6% difference between direct and indirect emissions, and this amount can be reduced to zero by transitioning to electricity from renewable energy. Direct emissions are the result of fossil fuel consumption for the use of heat in factories. Of this, for heat utilization at 200°C or lower, emissions should be reduced to zero by transitioning to heat from renewable energy, or by electrification and transitioning to electricity from renewable energy. Only a small portion of the emissions are from the use of high-temperature heat, and for these applications, electric heating should use electricity from renewables, or technologies should be developed. Based on the above, non-material manufacturing industries should set a target of a 50% reduction by 2030 relative to FY2013, a 75% reduction by 2040, and complete decarbonization by 2050.

• Non-manufacturing industries

CO_2 emissions from non-manufacturing industries (agriculture, forestry and fisheries, mining, construction) in FY2018 amounted to 18 million t-CO_2 (indirect emissions: 22 million t-CO_2), or about 2% of Japan's GHG emissions. Although emissions have declined by 34% relative to FY1990, emissions from agriculture, forestry, fisheries, and construction increased again since 2013–2014, so the reduction has been only 4% relative to FY2013. Fossil fuel consumption for use in agricultural greenhouses should be transitioned to renewable energy by measures such as a transition to solar thermal and biomass heating, the use of geothermal and groundwater, and the use of electricity from renewable energy for electric heat pumps. Energy conservation measures should be promoted for equipment in agriculture and forestry industries, the mining industry, construction equipment, and fishing boats in the fishing industry. In addition, electrification and a transition to the use of electricity from renewables should be promoted. Based on the above, the target reductions relative to FY2013 in the non-manufacturing sectors should be 50% by 2030, 75% by 2040, and complete decarbonization by 2050.

(e) Residential and commercial sectors

CO_2 emissions from the residential sector in FY2018 amounted to 52 million t-CO_2, or 4.2% of GHG emissions, a reduction of 13.5% relative to FY2013 (indirect emissions including electricity were 170 million t-CO_2, or 13.5% of GHG emissions, a 20.3% reduction from FY2013).

CO_2 emissions from the commercial sector in FY2018 amounted to 69 million t-CO_2, or 5.5% of GHG emissions, a reduction of 33.7% relative to FY2013 (indirect emissions including electricity amounted to 200 million t-CO_2, or 16% of GHGs, a 15.2% reduction from FY2013).

In both sectors, a decline in electricity demand has contributed significantly to the reductions seen to date, and further emission reductions can be expected as more renewable energy is introduced in the coming years. In addition, measures targeting houses and buildings, equipment and facilities, play an important role in these sectors.

According to the government's 2016 National Climate Action Plan, the target for 2030 is a 39% reduction relative to FY2013 in the residential sector (122 million t-CO_2 in indirect emissions), and a 40% reduction in the commercial sector (168 million t-CO_2 in indirect emissions). If reductions continue at this pace, the targets are expected to be met, but further efforts going forward should result in reduced emissions from the residential sector relative to FY2013 of 65% by 2030 and 80% by 2040, and from the commercial sector, 70% by 2030 and 85% by 2040. Both sectors should achieve complete decarbonization by 2050.

• Houses and buildings

It is crucial to take early action for houses and buildings because once constructed, their emissions will continue over a long period of time. Currently, average targets have been set to have all newly-built buildings and houses be Net Zero Energy Buildings (ZEBs) and Net Zero Energy Houses (ZEHs) by 2030. The scope of compliance with energy-efficiency standards for newly-built houses and buildings has been expanded with the gradual implementation of the amended Building Energy Efficiency Act,[30] but no regulations apply to new buildings with floor areas less than 300 m² (only the obligation to explain how they comply with energy-efficiency standards), so new construction with poor thermal insulation is still permitted. Furthermore, measures for the renovation of existing houses and buildings are still inadequate, leaving much room for further reductions.

According to Climate Action Tracker, in order to be 1.5°C-consistent, energy efficiency renovations of existing residential and commercial buildings should proceed at an annual pace of 3.5%, and by 2040 energy intensity should be reduced by 90% for residential and 90–95% for commercial buildings. Furthermore, all newly constructed buildings should be net zero emission buildings starting immediately. In Japan, where the ratio of new construction is higher than in other developed countries, 100% of new construction should be ZEB or ZEH by 2025, and for existing buildings — including public facilities, public housing, detached houses, apartment buildings, and small and medium-sized buildings — energy efficiency renovations should proceed at an annual pace of at least 2%, so that by 2050 all stock will have been converted to ZEB or ZEH and completely carbon-free.

• Equipment and facilities

To achieve zero emissions from houses and buildings, equipment and facilities in the residential and commercial sectors should be subject to stronger actions to improve energy efficiency and apply energy-saving strategies. Additionally, where oil or gas are being used,

30 Ministry of Land, Infrastructure, Transport and Tourism (MLIT), *Outline of the Act on the Improvement of Energy Consumption Performance of Buildings (Building Energy Efficiency Act)* [in Japanese], https://www.mlit.go.jp/policy/shingikai/content/001315639.pdf

electrification and a transition to electricity from renewables should be promoted, as well as the use of heat from renewable energy heat (solar thermal, etc.).

(f) Waste and plastics

Waste emissions (including energy use) accounted for 2.3% (29 million t-CO_2) of greenhouse gas emissions in FY2018. Three-quarters of the waste plastics incinerated are reportedly used for heat, but incineration also emits CO_2. The reduction of waste involves many actions by many actors, such as the selection and reduced consumption of raw materials by businesses and reductions in the amount disposed. On the user side, changes are necessary regarding the purchasing and use of a multitude of items, including manufactured products and food, as well as changes in reducing the amount of garbage generated, including plastics and food loss. Together, these will lead to a reduction in methane released from landfills and CO_2 emissions from incineration. In the waste sector, all actors should take stronger actions, with changes in materials used (including a substitution of petroleum-derived plastics with carbon-zero materials by 2050), electrification, heat utilization, and transitioning to renewable energy. Through all of these efforts, CO_2 emission targets for this sector relative to FY2013 should be a 50% reduction by 2030, 75% reduction by 2040, and zero emissions by 2050.

(g) F-gases (4 fluorinated gases)

Fluorinated gases used as CFC alternatives such as HFCs, PFCs, SF6 and NF3 are very strong greenhouse gases. Among them, HFCs are mainly used as a refrigerant, and their emissions have been rising at a dramatic pace (46.4% up from 2013), now accounting for 4% of all GHG emissions. Replacements for HFCs are available for uses other than as refrigerants (except for some uses such as in medical applications), so they should be immediately banned for use in open and semi-open systems such as sprays, play equipment, and thermal insulation. Additionally, in the rapidly increasing refrigerant category, there should be a quick transition to natural refrigerants and proper recovery of HFCs, with the target of reducing emissions back to FY2013 levels by 2030 (about half of FY2018 levels), and zero emissions in 2050. Meanwhile, PFCs, SF6, and NF3 are used mainly for semiconductor manufacturing and electrical insulation and are reportedly difficult to replace, but 100% of atmospheric releases should be prevented through bans on their use in open systems and in equipment with no gas recovery capability, through proper recovery during use, and by limiting their use to closed systems only. F-gas-free alternative substances should be introduced well in advance of 2050. Based on the above points, emissions reductions of all F-gases relative to FY2013 should be 15% by 2030 and 70% by 2040, and emissions should be reduced completely to zero by 2050.

(h) CO_2 from industrial processes, methane, and nitrous oxide

Non-energy-related CO_2 emissions include emissions from industrial processes, waste (e.g., combustion of plastics and waste oil), agriculture (chemical fertilizers), and indirect

emissions (e.g., CO_2 production from methane and non-methane hydrocarbons due to fossil fuel consumption, etc.). Of these, waste-related CO_2 is covered in Section (f).

CO_2 emission reductions from industrial processes, such as cement, lime, and glass manufacturing are not easy to achieve. Among these, the largest emissions are from cement and lime, and they should be reduced by scaling down production volumes through more efficient use of materials and streamlined design. About half of lime used is in blast furnaces for steel manufacturing, so reducing blast furnace steelmaking will also reduce CO_2 emissions related to lime in industrial processes. Indirect emissions should be reduced through timely reductions in fossil fuel consumption.

Methane and nitrous oxide emissions come from fossil fuel combustion and leakage, agriculture, and waste.

Emissions from fossil fuel combustion and leakage can be reduced by phasing out the use of fossil fuels. In agriculture, methane and nitrous oxide emissions should be reduced through better management of livestock waste. For methane emissions from paddy fields, methane emissions from livestock, and nitrous oxide emissions from agricultural soils, methods are being developed to reduce emissions. With a view toward the sustainability of agriculture, emissions from agricultural sources should be cut in half by 2050, with other emissions reduced to as close to zero as possible, through efficiency improvements and other measures.

(3) Emissions projections based on the measures proposed

Based on the proposed measures and targets covered in Section (2) above, and taking into account some reductions in resource consumption due to an expected declining population and more efficient use of materials, a scenario was formulated projecting GHG emissions up to 2050 with the proposed measures in Table 4 being implemented.

Calculated from estimates based on the scenarios summarized in the table above were a 70% reduction in energy-related CO2 emissions in 2030 relative to FY2013, a 90% reduction in 2040, a 98% reduction in 2050 (using existing technologies), and a 100% reduction in 2050 (with new technologies). As for non-energy-related CO2 emissions and GHGs other than CO2, emissions relative to 2013 would be reduced 30–37% in 2030, 58–68% in 2040, and 83–92% in 2050.

All combined, the projected GHG emission reductions relative to FY2013 would be 63–65% by 2030, 84–86% by 2040, and 98–99% by 2050. Under this scenario, GHG emissions in 2050 are projected to be about 15 million t-CO2.

This 15 million t-CO2 (about 1% of FY2013 emissions) could become net zero through offsetting with forest sinks (see Column 3). However, since Japan has limited potential for sequestration through forests or other means, and because the calculation of carbon sinks is complex, it would be preferable to seek to introduce reduction measures and technologies that include non-energy-related CO2 emissions, and aim to achieve net zero without relying on sequestration.

Table 4. Summary of measures covered in Kiko Network's proposal

Sector, gas, etc.		2030	2040	2050
Power		・LNG 50%, renewable energy 50% ・Coal, oil, and nuclear phased out	・LNG 20%, renewable energy 80%	・Renewable energy 100%
Industrial	Material manufacturing	・Reduced energy intensity ・Reduced production due to more efficient use ・Steelmaking: Electric furnace ratio >70%, CO_2 emissions cut 70% ・Chemicals: CO_2 emissions cut 50% ・Cement: Energy-related CO_2 emissions cut 40% ・Pulp and paper: CO_2 emissions cut 50%	・Reduced energy intensity ・Reduced production due to more efficient use ・Steelmaking: Electric furnace ratio >80%, CO_2 emissions cut 85% ・Chemicals: CO_2 emissions cut 70% ・Cement: Energy-related CO_2 emissions cut 50% ・Pulp and paper: CO_2 emissions cut 80%	・Reduced energy intensity ・Reduced production due to more efficient use ・Steelmaking: Electric furnace ratio >90% ・All industrial sectors decarbonized, through existing technologies and R&D ・Electricity and heat utilization from renewable energy 100%
	Non-material manufacturing	・Electrification ・Electricity from renewable energy 50% ・CO_2 emissions cut 50%	・Electrification ・Electricity from renewable energy 80% ・CO_2 emissions cut 75%	・Electrification ・Electricity and heat from renewable energy 100% ・Decarbonized
	Non-manufacturing	・Electrification ・Electricity from renewable energy 50% ・CO_2 emissions cut 50%	・Electrification ・Electricity from renewable energy 80% ・CO_2 emissions cut 75%	・Electrification ・Electricity and heat from renewable energy 100% ・Electrification of fisheries (boats), etc. ・Decarbonized
Residential and commercial		・Improved efficiency of equipment and facilities ・100% ZEB/ZEH energy-efficient new houses and buildings ・Energy efficiency improvement (2%/year) for existing houses and buildings ・CO_2 emissions cut 50%	・Improved efficiency of equipment and facilities ・100% ZEB/ZEH energy-efficient new houses and buildings ・Energy efficiency improvement (>2%/year) for existing houses and buildings ・CO_2 emissions cut 75%	・Improved efficiency of equipment and facilities ・100% of buildings (including existing) are ZEH/ZEB ・Decarbonized
Transport		・100% of new vehicles are EVs (by 2035 for PHVs) ・Modal shift (walking, cycling, public transportation) ・CO_2 emissions cut 50%	・Transition to EV buses, trucks ・Emission reductions per distance covered ・Modal shift (walking, cycling, public transportation) ・CO_2 emissions cut 75%	・Complete the transition to EV cars and trucks ・Modal shift ・Electrification of small vessels, etc. ・New technologies for large ships and aviation ・All modes of transportation decarbonized

Sector, gas, etc.	2030	2040	2050
Non-energy-related CO_2 emissions	・More efficient materials use to cut plastic waste ・CO_2 emissions from industrial processes cut by higher materials use efficiency, reduced use of blast furnaces ・Reduced indirect CO_2 emissions from methane- and non-methane hydrocarbon by cutting fossil fuel use	・More efficient materials use to cut plastic waste ・CO_2 emissions from industrial processes reduced through more efficient materials use and reduced use of blast furnaces ・Reduced indirect CO_2 emissions from methane- and non-methane hydrocarbon by cutting fossil fuel use	・Plastic waste reduced through more efficient materials use ・CO_2 emissions from industrial processes reduced through more efficient materials use and reduced use of blast furnaces ・Reduced indirect CO_2 emissions from methane- and non-methane hydrocarbon by cutting fossil fuel use
Methane	・Livestock waste management ・Paddy field methane management (e.g., enhanced mid-season aeration) ・CO_2 emissions cut 30%	・Livestock waste management ・Paddy field methane and ruminant livestock management ・CO_2 emissions cut 50%	・Livestock waste management ・Paddy field methane and ruminant livestock management ・CO_2 emissions cut 70%
Nitrous oxide	・Livestock waste management ・Agricultural soil management ・CO_2 emissions cut 30%	・Livestock waste management ・Agricultural soil management ・CO_2 emissions cut 50%	・Livestock waste management ・Agricultural soil management ・CO_2 emissions cut 70%
HFCs	Refrigerants ・Reduce emissions to the level of FY2013 ・Complete transition to alternative refrigerants for refrigerators and freezers ・Recovery rate 60% Non-refrigerants (sprays, insulation, solvents, cleaners, etc.) ・Ban use Semiconductor, liquid crystal manufacturing ・Require gas recovery equipment, introduce regulations to control leakage	Refrigerants ・CO_2 emissions cut 50% ・Complete transition to natural refrigerants in air conditioners ・Recovery rate 60% Semiconductor, liquid crystal manufacturing ・Require gas recovery equipment, enhance regulations to control leakage Leakage during HFC production ・Prohibit new manufacturing	・Emission 100% cut (recovery rate 100%) ・Complete elimination of F-gases from existing F-gas equipment Semiconductor, liquid crystal manufacturing ・Require gas recovery equipment, enhance regulations to control leakage
PFCs, SF6, NF3	Magnesium casting, accelerators ・Ban any use other than semiconductor liquid crystal manufacturing and insulating equipment Semiconductor manufacturing, insulators ・Ban all except essential uses or in closed systems, target 100% recovery rate	PFCs, SF6, NF3 leakage ・Prohibit new manufacture Semiconductor manufacturing, insulators ・Ban all except essential uses or in closed systems, target 100% recovery rate	Semiconductor manufacturing, insulators ・Transition to alternative substances

Prepared by Kiko Network

COLUMN 3

The role of forests: Focus on sound forest management, not carbon sinks

The Paris Agreement, like the Kyoto Protocol, allows for the utilization of increases in anthropogenic sinks from changes in forestry and other land uses to offset emissions. The word “net” in “net zero” refers to balancing anthropogenic emissions by sources and removals by sinks.

However, forests are already well-established in Japan, and very little land is available for afforestation. Thus, no significant increases in CO_2 sequestration by forests can be expected, even with extensive human intervention and management. Japan's reported forest sinks in FY2018 amounted to 47 million tons, but this amount is the total forest sequestration in Japan, not actually an increase in sequestration due to human intervention. The official numbers include non-additional sequestration, and thus it is not appropriate to use the full amount to offset CO_2 emissions. The numbers presented here in our proposal do not include sinks from forest management. However, if Japan were to conduct extensive forest thinning and other forest management in the future and about one-third of the government-reported amount (i.e., 16 million t-CO_2) was recognized as additional sinks, under our present proposal, the remaining 1% (i.e., 15 million t-CO_2) could hypothetically be used as offsets, making it possible to reach net zero.

In any case, forest sinks cannot be significantly relied upon as a part of Japan's domestic climate policies. The majority of Japan’s forests are planted, and Japan needs to manage its forest resources properly to make use of the multiple functions of forests, not just for carbon sinks. To maintain its abundant green cover in 2050, Japan needs to properly care for and manage its forests through a diverse set of strategies, including thinning programs and other aspects of forest management, sound forest industry operations and development, and the utilization of forest resources.

(4) Proposed GHG emission reduction targets based on Kiko Network estimates

Based on the fact that our future projections of GHG emissions in line with the proposed measures show that significant reductions are indeed possible, we propose GHG emission gas reduction targets of at least –60% relative to FY2013 by 2030, at least –80% by 2040, and net zero by 2050 (line in Figure 3). A particularly important point is that a sufficient reduction is needed by 2030 to achieve the 1.5°C goal. Our proposed emission reduction targets by sector and by type of gas are shown in Table 5. Our proposed targets for Japan in 2030 and 2040 are slightly less ambitious than the potential emission reductions we calculated. On the other hand, for 2050, we propose a more ambitious target of zero that includes non-energy-related CO_2 emissions, etc., to be achieved through the application of new technologies.

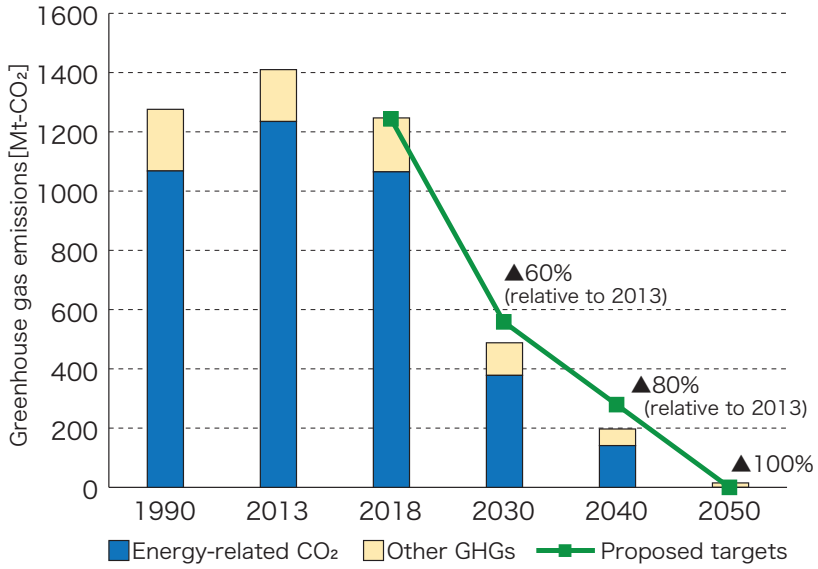

Figure 3. Emission reduction scenario and targets proposed by Kiko Network

Prepared by Kiko Network

Note: The bars in the graph are projected emissions from the cumulative effects of our proposals, and the line shows our proposed emission reduction targets

Table 5. Proposed emission reduction targets, by sector and by gas **Indirect emissions (Mt-CO_2)**

Sector	Actual* (relative to 2013)			Government target** (relative to 2013)	Kiko Network proposal		
	1990	2013	2018	2030	2030	2040	2050
Energy-related CO_2	1068	1235	1059 (-14.2%)	927 (-25%)	437 (-65%)	165 (-85%)	0
Industrial	503	463	398 (-14.0%)	401 (-13%)	152 (-67%)	80 (-83%)	0
Commercial and other	130	238	196 (-17.6%)	158 (-34%)	70 (-71%)	35 (-85%)	0
Residential	131	208	166 (-20.3%)	122 (-41%)	70 (-66%)	40 (-81%)	0
Transport	207	224	210 (-6.2%)	163 (-27%)	120 (-47%)	40 (-82%)	0
Energy conversion (indirect emissions)	96.2	103	89.4 -	73 (-24%)	25 (-76%)	10 (-90%)	0
Energy conversion (direct emissions)	348	526	456 (-13.3%)	-	170 (-68%)	70 (-87%)	0
Non-energy-related CO_2	96.3	81.7	78.5 (-3.9%)	70.8 (-14%)	55 (-33%)	39 (-52%)	6 (-93%)
Methane	44.4	32.5	29.9 (-8.2%)	31.6 (-3%)	21.6 (-34%)	16 (-51%)	8 (-75%)
Nitrous oxide	31.9	21.5	20.0 (-7.0%)	21.1 (-2%)	13.2 (-39%)	8 (-63%)	2 (-91%)
F-gases	35.4	39.1	52.8 (+35.1%)	28.9 (-26%)	33.2 (-15%)	12 (-71%)	0 (-100%)
HFCs	15.9	32.1	47.0 (+46.4%)	21.6 (-33%)	32.0 (-0.3%)	11.6 (-64%)	0 (-100%)
PFCs	6.5	3.3	3.5 (+6.3%)	4.2 (+27%)	0.2 (-94%)	0.1 (-97%)	0 (-100%)
SF6	12.9	2.1	2.0 (-1.6%)	2.7 (+26%)	0.8 (-62%)	0.2 (-91%)	0 (-100%)
NF3	0.03	1.6	0.3 (-82.5%)	0.5 (-31%)	0.2 (-88%)	0.1 (-94%)	0 (-100%)
Total GHGs	1275.5	1410.1	1240.4 (-12.0%)	1079.4*** (-23%)	560 (-60%)	280 (-80%)	0 ～ 15 (-99–100%)

* From FY2018 Greenhouse Gas Inventory. Prepared by Kiko Network

** From National Climate Action Plan (2016).

*** After Japan's National Climate Action Plan was adopted (2016), the FY2013 emissions were revised, the result being that the numbers shown in this table do not amount to a 26% reduction relative to FY2013.

5. 10 Key Policy Actions

(1) Legislate targets and processes to enhance them

Japan should clearly state its GHG emission reduction targets in legislation, including the 2050 net zero target and short-term targets. Additionally, the process of setting five-year reduction targets should also be included in legislation to ensure that GHG emissions are kept within the limits of a science-based net zero carbon budget in 2050.

The targets are as follows:

- **GHG emission reduction targets:**
  - At least -60% by 2030 relative to 2013 (or -56% relative to 1990)
  - At least -80% by 2040 relative to 2013 (or -78% relative to 1990)
  - Net zero by 2050
- **Energy efficiency targets:**
  - -40% in final energy consumption by 2030, -55% by 2040, and -70% by 2050
- **Renewable energy targets**
  - At least 50% of electricity mix by 2030, 80% by 2040, and 100% by 2050
  - At least 25% of primary energy supply by 2030, 55% by 2040, and 90–100% by 2050

These targets should be given equal priority in Japan's National Climate Action Plan and Strategic Energy Plan, should be made mutually consistent when either plan is updated, and should be enhanced every five years.

(2) Introduce carbon pricing

Carbon pricing is a means of putting a price on carbon. This can include approaches such as proportionately applying carbon taxes to CO_2 emissions, or imposing limits for specified actors as emissions allowances and combining with emissions trading. This system is based on the polluter pays principle (PPP), which places the burden on the emitters of CO_2 and serves as an economic means to promote cost-effective measures by each actor. International organizations such as the United Nations and OECD are advocating for this approach as a crucial means of decarbonizing the economy, because carbon pricing can accelerate efforts to move way from fossil fuels by promoting energy efficiency by every actor and transitioning to renewable energy, as well as promote technological innovation and various system changes.

The “Report of the High-level Commission on Carbon Prices” prepared with assistance

from the World Bank,[31] recommended a carbon price of $50–100 USD/t-$CO_2$ (about 5,000–10,000 yen/t-CO_2) in 2030 to be consistent with Paris Agreement goals. Some national and sub-national governments in Europe and North America, China and Korea are promoting CO_2 emission reductions using measures such as carbon taxes and emissions trading, and the European Union is preparing to introduce a Carbon Border Adjustment Mechanism. Japan introduced a tax for climate change mitigation in 2012, but the added cost is only 289 yen/t-CO_2 for fossil fuels, which is far below a level that can have any meaningful impact on emissions.

In terms of measures, the usual choice is between a carbon tax or an emissions trading system, but a tax is preferable because it has the effect of applying carbon pricing to a broad range of actors, does not involve the arbitrariness of determining emission allowances, and has low administrative costs.

Based on the above points and recommendations of the High-level Commission, we are recommending that Japan revises its existing taxation system to introduce a carbon tax and adopt legislation to gradually increase it to the equivalent of 10,000 yen/t-CO_2 in 2030. In the development of such a taxation system, fundamental tax reforms are also needed in order to incorporate the concept of revenue neutral. That would mean, for example, returning a portion of carbon tax revenues to low-income groups through social security. After 2030, the system should be enhanced based on progress made on decarbonization in the power sector, industrial sector, and so on.

(3) Set targets to end electricity generation from fossil fuels and nuclear power

To achieve the goals of the Paris Agreement, Japan should move ahead, with determination, to completely phase out coal-fired power generation by 2030. Japan should also phase out all nuclear power due to its safety risks and numerous other issues, including serious concerns about social and economic damage in the event of a major accident, and problems with the disposal of radioactive waste. The government should set targets to completely retire all coal-fired and nuclear power plants by 2030.

This would mean a temporary increase in the ratio of LNG-fired power generation, but no new plants need to be built beyond what already exists today. As for LNG-fired power generation, the government should adopt a policy to terminate any new projects and should adopt the targets of limiting LNG to no more than 50% of the power mix by 2030, 20% by 2040, and zero by 2050.

31 Carbon Pricing Leadership Coalition, “Report of the High-level Commission on Carbon Prices,” 2017. https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices

(4) Adopt policies for a just transition

To realize net zero emissions by 2050, Japan must implement bold reforms for the transition away from the fossil fuel-dependent social and economic systems that have survived since the Industrial Revolution, and toward new, decarbonized social and economic systems. This will mean a transformation of the resource-consuming economic systems that are reaching their limits today, the design of cities, and the way we live. Additionally, emissions must be reduced in all sectors — including the power, industrial, transport, household and commercial sectors — and the transition must be made to local, decentralized products and services that consume little energy and provide new value for society.

As the foundation for its policies, the government should build comprehensive programs for this bold transformation of the economy, society and employment, and needs to put in place sufficient budgetary measures and policies to this end.

• Institutional arrangement of government for policies to promote a just transition

Since the topics associated with a just transition for jobs are distributed across multiple sections of government (Ministry of the Environment, Ministry of Economy, Trade and Industry, Ministry of Health, Labour and Welfare, etc.), some issues tend to fall between departments. Thus, the government should establish institutional arrangements, develop strategies, and implement actions to deal with decarbonization-related employment issues. Impacts on the economy and jobs differ by community, so when municipalities and other levels of local government develop regional plans, they should consider and implement the necessary measures to deal with those impacts and job transition. For policy implementation, forums and opportunities for dialogue are needed where affected workers, local governments, and citizens can participate.

• Budgetary measures for just transition policies

The transition to a decarbonized society can offer a variety of benefits for the economy, jobs, and communities (Column 4). Proper actions are needed in the transition process, particularly in energy-intensive industries, to facilitate the just transition to decarbonized jobs and serve as a bridge to the creation of new, clean employment opportunities. The government should provide systemic support for the development of decarbonized industries, technical assistance, vocational training, and unemployment compensation for the transition. Some of the funding for all of this could come from the tax revenues from carbon pricing.

COLUMN 4

Decarbonization benefits for the economy, jobs, and communities

The transition to a decarbonized society can help avert the climate crisis, sustain society and the economy under a stable climate, and foster prosperity for people and society. All people will benefit from this. Decarbonization can at the same time be a plus for the economy, and governments are realizing that responses to climate change do not have to negatively impact the economy. The transition to local energy systems can create new business opportunities and jobs, and create synergies to help tackle a variety of local issues.

Many international organizations have also projected broad increases in employment from the transition to renewable energy. In Japan, the Future Group's "Report 2030" states that while there were about 200,000 workers (including about 50,000 in the nuclear industry) in six sectors in 2019 that would be affected by the energy-related impacts of a just transition (power, oil refining, iron and steel, chemicals, cement, and pulp and paper), 270,000 workers were in jobs in renewable energy-related businesses, and that through an energy transition centered on renewable energy, there could be an estimated increase of 2.54 million new jobs each year until 2030.[32] The report points out the following benefits:

- **Economic benefits: Cumulative 230 trillion yen by 2030 (increase compared to government projected GDP)**
- **Job creation: About 25.44 person-years by 2030 (2.54 million persons working per year for ten years)**
- **Reduced energy expenditures: Cumulative savings of about 358 trillion yen by 2030 (500 trillion yen by 2050)**
- **Avoided deaths from air pollution: 2,920 deaths (from exposure to particulate matter PM2.5) avoided by 2030**

The Renewable Energy Institute has also looked at electricity supply and demand, as well as costs. According to its report, renewable energy levies will peak in the first half of 2030 at 4.8 trillion yen, but they would only account for a portion of electricity costs. The combined price of wholesale electricity prices and cost of renewable energy levies in 2030 are projected to be higher in Chubu and Kansai than in 2019. However, in Tokyo the combined price in 2030 is protected to be less than in 2019. If social costs are included, the total costs in 2030 are projected to be less than in FY2019 for Japan as a whole.

32 Ibid Footnote 15.

(5) Adopt policies to expand renewable energy

It is exceedingly important to broadly introduce renewable energy until the target levels are reached, in order to achieve major emission reductions by 2030. In order to expand variable power sources to the greatest extent possible, Japan will need to reform and enhance existing systems to introduce measures and programs to increase the flexibility of electrical power systems and accelerate the introduction of decentralized and locally-managed renewable energy.

• Introduce carbon pricing

Carbon pricing is an important means of promoting the transition from fossil fuels to renewable energy.

• Revise operating rules for grid connections to promote the greatest possible introduction of renewable energy

In order to introduce the maximum possible amount of renewable energy sources, grid connection rules should be changed to adopt a merit order system that gives priority to renewable energy for grid connections. In doing so, coal-fired and nuclear power generation should be limited.

• Implement major reforms in electricity markets

New electricity markets have been created in Japan in recent years, such as the capacity market, the non-fossil fuel value trading market, and the baseload power supply market, but they actually perpetuate incentives for nuclear and coal-fired power plants. Incentives have also been introduced that favor nuclear power and are in conflict with market liberalization efforts. One example is how utilities are allowed to add the costs of compensation for damage caused by nuclear plant accidents to their electricity transmission and distribution rates.

An auction was held in the capacity market in 2020 to secure 179.4 GW of electricity based on the assumed surplus demand of 157.6 GW in 2024, and the total contract value based on transitional measures came to 1.6 trillion yen. The majority of these effectively function as subsidies for coal-fired and other power sources, preventing the phase-out of inefficient coal. This market should be terminated.

The non-fossil fuel energy value trading market puts a value on electricity not only from renewable energy but also from nuclear power. This is from the context of the Act on the Promotion of Use of Nonfossil Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers, which requires retail electricity providers to use non-fossil sources for 44% of their electricity. A positive environmental value placed on electricity generated from nuclear power is hindering the energy transition to renewables. Nuclear should not be treated as equivalent to the value of renewable energy and should be excluded from trading in the future.

The baseload power market should also be terminated, as there is little need for a market based on an antiquated electrical grid system that includes baseload power. Power generation (mainly hydro) originally developed by the government and now owned by J-POWER and other power companies should be opened up to the wholesale electricity market, without relying on the baseload power market.

• Heat utilization of renewable energy

Commercial facilities and factories above a certain size should be required to consider installing solar-thermal water heating systems and other renewable energy equipment.

The government should provide support, including technical assistance such as expert building diagnostics, for the installation of equipment to utilize renewable energy in agricultural facilities, small and medium-sized commercial facilities, factories and households.

(6) Promote electric vehicles and a modal shift to walking, cycling, and public transportation

• Introduce carbon pricing

Carbon pricing is an important measure for the entire transport sector. This includes its role in limiting vehicle use and encouraging a modal shift.

• Transition to EV cars and trucks

For passenger cars, a ban should be introduced in 2030 on the production and sale of new gasoline-powered vehicles, including hybrids, in order to promote a complete transition to EVs as well as to lighter and smaller vehicles. This should be realized through the use of vehicle tax incentives and inspection systems, and later by a complete transition to EVs and promotion of EV infrastructure development.

• Long-distance transport including aviation, shipping, and trucking

Incentives and support should be provided to promote electrification where possible, such as with small vessels and trucks, etc. As Japan moves toward net zero in 2050, the government should provide support in the development of hydrogen technologies for use in aviation and large ships, but this should be limited to the use of surplus electricity generated from renewable energy.

• Modal shift

Public support should be increased to maintain and expand public transportation systems (including bus and rail) in order to reduce energy consumption while improving passenger and freight mobility and service. Subsidies should be increased for users in consideration of their use of public transport, in the context of the aging and declining population, households with children, and socially vulnerable groups. Financial tools should be used to

support urban development and infrastructure improvements that will make cycling and walking more convenient and accessible.

(7) Strengthen regulations on housing, buildings, and equipment

• Introduce carbon pricing

Carbon pricing is an important means of reaching the entirety of the residential and commercial sectors, including measures targeting houses and buildings.

• Require new buildings to comply with energy efficiency standards and qualify as ZEB or ZEH

The government currently plans to extend the Building Energy Efficiency Act to cover mandatory compliance with energy-efficiency standards (expanding from large buildings with a total area of 2,000 m2 to also include medium-sized buildings of 300-2,000 m2), so it is urgent to ensure that any houses and buildings being built henceforth will comply with energy-efficiency standards. However, even this is not sufficient. It should immediately become mandatory for all houses and buildings to comply with the current energy-efficiency standards. In addition, the current insulation standards for ZEB and ZEH are too lenient, so standards should be raised, and ZEB and ZEH for new buildings should be made mandatory by 2025.

• Require public facilities and public housing to make energy-efficiency renovations and qualify as ZEB or ZEH

As a first step, the government should require public facilities and low-income public housing to systematically make energy-efficiency retrofits and introduce renewable energy systems, and as soon as possible before 2025 require new buildings to be ZEB and ZEH.

• Subsidize energy-efficiency renovations in existing houses and buildings

The government should introduce support, subsidy and exemption programs for energy-efficiency renovations, to be implemented at a rate of 2% of the existing housing/building stock per year. Systems should be established for official building specialists to conduct diagnostics and offer advice on cost-effective retrofits. Japan should also establish a nationwide system of experts to support energy-efficiency renovations and the installation of energy-efficiency equipment, and provide support and training for local building contractors. For structures such as rental housing, detached homes, and leased buildings, the government should make it mandatory to indicate compliance with ZEB/ZEH and insulation standards, and this information should be disclosed to real estate agents and included in the "important information" sections of contracts.

• **Boost equipment efficiency**

The “top-runner” standards for various types of equipment and products covered by the Act Concerning the Rational Use of Energy should be enhanced. Additionally, instead of having standards determined by type of equipment and size, they should be changed to encourage decisions based on CO_2 emissions by application (e.g., combine with solar systems, rather than promoting high-efficiency water heaters powered by gas or stand-alone electric units), in order to encourage the introduction of equipment that uses renewable energy and to ramp up decarbonization efforts.

(8) Adopt policies to reduce waste and plastics

To achieve zero waste and zero plastics, the use of raw materials should be reconsidered for businesses from the manufacturing stage, and targets should be strengthened to reduce industrial and municipal waste. Regulations regarding materials should be gradually introduced to move toward zero emissions, reaching zero by 2050. Efforts should be made to strengthen municipal programs and measures to reduce food loss and waste plastics.

(9) Regulate F-gases

The Act on Rational Use and Appropriate Management of Fluorocarbons was enacted in 2013. It stipulates comprehensive measures to be taken for the entire life cycle from, manufacturing to disposal, of fluorocarbons (CFCs, HCFCs, HFCs) used as refrigerants, as well as the use of alternative substances, refrigerant management, and refrigerant recovery, etc. However, there has been no improvement in the effectiveness of this legislation, and related measures are exceedingly insufficient. Measures banning use of these materials should be established for all applications (not only for refrigerants), and the measures should apply to all stages of the material lifecycle. In terms of the recovery rate of F-gases, government targets have not been achieved for more than two decades. Obviously, it is not enough just to set targets. Taxes or levies need to be imposed, and deposit systems or other economic incentives need to be created in order to boost recovery rates.

The use of SF6, PFCs and NF3 is limited to certain applications (e.g., factory processes to manufacture semiconductors, electrical transformers), so the government should ban their use except in closed systems, and institute measures to prevent leakage and require full recovery of these gases.

(10) Strengthen finance policies

ESG investments need to be expanded and made more rigorous to achieve ambitious goals, so sustainable finance policies in public and private finance should be established, premised on making ESG investment consistent with the Paris Agreement. When doing

so, it is necessary to stipulate that these investments will contribute to the realization of not only net zero in 2050, but also halving greenhouse gas emissions by 2030. Specifically, support for fossil fuel-related businesses should be ended, and support for unproven innovative technologies (CCUS, hydrogen, ammonia, nuclear) should be carefully scrutinized for consistency with the Paris Agreement (potential for reducing emissions by 2030), cost-effectiveness vis-a-vis renewable energy technologies, technological feasibility, and suitability. If a technology is to proceed as a part of climate actions, there should be full assurance of accountability.

In particular, when support is being provided that involves energy-related infrastructure and land use, the long-term impacts must be considered.

Financial institutions should establish policies and strategies to support businesses and services that are consistent with the Paris Agreement, and require the implementation of information disclosure based on the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).

COLUMN 5

Support for developing countries: The role of Japan in the international community

As the world's fifth largest CO_2 emitter, Japan has the responsibility to help realize a decarbonized society not only domestically, but globally as well — it has a role in the international community to contribute to the decarbonization of the world. For net zero by 2050, developing countries must also decarbonize at about the same speed as developed countries. However, many developing countries lack the technology, human resources, and funds they need, and are also extremely vulnerable to the adverse impacts of climate change, so they face many difficulties in taking climate action and in adapting to climate impacts. The government should expand its support for developing countries through mechanisms such as long-term funding for the Green Climate Fund (GCF) under the United Nations.

Japan should also play a role in technology development cooperation and transfer to developing countries, but in this support Japan should make a major shift from large-scale infrastructure exports such as coal and nuclear power to decarbonization technologies and systems. If Japan can accelerate the transition to decarbonization domestically, this will also foster internationally-competitive businesses in decarbonization industries.

The use of market mechanisms for trading emission allowances through technology transfers is also permitted under the Paris Agreement, but it is not included in the emission reduction targets proposed in this report. If market mechanisms are used to support developing countries, they should be dealt with separately from Japan's domestic emission reduction targets.

6. Consensus-building and institutional arrangements

(1) Public participation

Climate change is an issue that affects everyone, and climate policies will have significant impacts on present and future generations. To realize a decarbonized society nationally and locally, it is important to examine not only Japan's existing government advisory council processes, but also processes that involve people from various sectors, such as experts and citizens in a wide range of fields. Appropriate information should be disseminated to local communities, NGOs, and citizens affected by climate change, and it is necessary to secure forums for participatory discussions for the creation of a decarbonized future society, and to encourage various actors to proactively take action and participate.

(2) Information disclosure

For the implementation of climate-related measures and policies, actors need to be able to access the relevant information to allow them to understand the actual status of energy and other factors. For this, information disclosure is an absolute necessity.

In Japan today, much of the crucial information needed to understand the actual state of emissions associated with business activities is not disclosed. For example, much information related to electricity generation is not being disclosed (e.g., generation capacity and utilization rates at each power plant, emissions of CO_2 and other air pollutants, details of each power suppliers' electricity supply plans and emission reduction plans). This failure to disclose puts up major obstacles for anyone trying to consider the appropriate CO_2 emission reduction measures and contribute to the development of plans for a decarbonized energy transition. Moreover, it is currently impossible to objectively verify the recovery rates for F-gases, because no actual data, by substance or by use, is currently being published regarding import, production, and consumption volumes.

In order for anyone — not only the government, but also outside experts and the public — to objectively examine policies, past and present measures, and the potential results of future measures, it is crucial to improve transparency in Japan so that essential data, details of measures, and information on the status of implementation are disclosed in a timely and appropriate manner. Government ministries and agencies should also encourage information collection and disclosure in each sector, and share the information with each other.

Conclusion

Humanity obviously faces major challenges in efforts to realize a decarbonized society in 2050 and reduce GHG emissions by 50% in the less than the decade remaining until 2030 in order to limit the temperature rise to 1.5°C. We have delayed climate action for decades, and these delays have exacerbated the problems and narrowed our time window for action. However, we are now facing the harsh reality that if we do not take the appropriate actions, planetary systems will be severely disrupted, our hopes for sustainable development and a peaceful society will slip away, and the capacity for us to sustain our lives, economies and security under a stable climate will be wiped out. Many countries, local governments, businesses and citizens around the world now acknowledge this reality and are getting started on efforts to tackle the challenges of decarbonization. Japan is now among the countries that have declared carbon neutrality by 2050, so now is the time for us to establish clear and visionary goals, make the required commitments, and find the determination to move forward.

Fortunately, there are many possible actions that can be taken, and most of the measures and technologies described in this report and other research already exist and are ready to be implemented. The required systems, technologies, expertise, and programs are at the point where they can be applied, such as rapid deployment of renewable energy, cost reductions, and the potential for supply and demand to be adjusted for mass introduction. By promoting energy efficiency and renewable energy in ways that are compatible with the sustainability of local communities, we will see decarbonization come quickly into view. If there is something that cannot be done, sometimes it is because the belief that it cannot be done comes first and takes on a life of its own, and so existing economic activities persist due to the lack of any policy measures being implemented to make things change. Or, rather than considering the interests of all of humanity in the context of climate change, some bureaucrats, politicians, and industry leaders may seek to maintain the current economic structure and protect their interests, and try to block the necessary transition or influence policies and subsidies in order to support unrealistic and unproven innovations to maintain their profits.

Now is the last chance to take action to halve GHG by 2030 and achieve decarbonization in 2050. Our generation is beginning to feel the effects of climate change, and it is also said that this is the last generation that can take action on decarbonization and have the chance to shape the future. Each of us is being called upon to participate in discussions to achieve this, and to act to take on the responsibility to change. It is our hope that by taking action, together we can create a more hospitable and prosperous society in many parts of Japan. There is also great hope in the fact that that more and more people are starting to act.

To achieve a decarbonized society, Kiko Network calls upon the Government of Japan to establish ambitious targets and implement policies and actions based on the proposals presented herein. For our part, we will continue in our efforts to urge all actors to raise their voices, step up their actions, and work together.

References: Published recommendations and scenario studies

Below is a list of previously-published studies on scenarios and recommendations based on similar approaches to ours and were used as references in the preparation of this report.

All greenhouse gases

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