

Japan's 2050 goal: A carbon-neutral society

SUMMARY

In October 2020, Japan's Prime Minister, Suga Yoshihide, declared that by 2050 the country would aim to reduce greenhouse gas emissions to net zero and to realise a carbon-neutral, decarbonised society. In December, the Cabinet adopted the green growth strategy, an industrial policy aimed at generating a virtuous cycle of economic growth and environmental protection, together with the business community. A €15.4 billion fund is to be created, to promote ecological businesses and innovation to achieve the goal, offering tax credit of up to 10 %. A carbon tax is being considered.

The strategy recognises that it would be unrealistic to cover all electricity demand with renewables only. So, by 2050 Japan's energy mix will comprise renewable energy (50-60 %), hydrogen and ammonia (10 %), and energy generated by nuclear and thermal power plants (30-40 %).

The strategy acknowledges that promoting electrification in all sectors will boost electricity demand by 30-50 %. To decarbonise electricity, in addition to using renewables and nuclear, Japan wants to further develop its hydrogen technology (in which it is a front-runner) in the direction of CCUS (carbon capture, utilisation and storage technology). It also wants to focus on tapping into the potential of ammonia.

Meanwhile, prospects for nuclear are unclear, as the sector has been deeply impacted by the 2011 Fukushima disaster. Doubts have been raised about the technology necessary for achieving coal substitution and CCUS. Japanese business, while already engaged in innovation projects to achieve net-zero carbon emissions, has expressed reservations about some elements of the strategy and the proposed carbon tax.

Japan is actively involved in international cooperation on green technologies and could be an ideal partner to the EU, which, through its European Green Deal (EGD), also aims to achieve climate neutrality by 2050. During their May 2021 summit, the EU and Japan adopted the declaration 'Towards a Green Alliance to protect our environment, stop climate change and achieve green growth'.



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Background

Japan, the [fourth-largest world economy](#) after the US, the EU and China, is a resource-poor country that depends on imports for its energy: in 2019, its [energy self-sufficiency](#) (the ratio between national primary energy output and consumption) rate was a mere 12.1 %. The EU's level of dependency on energy is lower but still significant: in 2019 it had a ratio of [60.7 %](#).

Tokyo's energy policy principles have been energy security, environmental considerations, economic efficiency, and safety (3E + S). For this purpose and in spite of being the only country to have suffered the devastating effects of nuclear weapons in a time of war, it has developed a [nuclear energy capacity](#) that reached 46-47 gigawatt (GW) between 2005 and 2010, making it the [third-largest user of nuclear energy](#), which covered 30 % of its electricity needs at that time and was poised to reach 40 % in 2017. The 2011 [Fukushima Daiichi nuclear disaster](#), triggered by the [Great East Japan earthquake](#) and tsunami, blocked this development, as public [opposition to nuclear energy](#) became the predominant sentiment and the focus was shifted to averting accident-related risks. Consequently, all of Japan's nuclear plants were closed or had their operations suspended for safety inspections. Furthermore, fossil fuels increased in relevance: in 2019 they accounted for [88 % of total primary energy supply](#) (TPES), the sixth-highest share among IEA (International Energy Agency) countries. By comparison, fossil fuels in the EU accounted for [71.2 %](#) of TPES in 2018. Fukushima had an impact in the EU too: nuclear power plants [stress tests](#) were conducted, [Belgium](#) and [Germany](#) decided to phase out nuclear power, while the [Italian government's](#) intention to reintroduce nuclear energy in the country was rejected by a referendum.

Japan has been funding a number of coal-fired plants overseas, especially in south-east Asia (since 2015, worth US\$17.8 billion, according to the [Global Energy Monitor](#)) and India, prompting [international criticism](#) at the December 2019 COP-25 Madrid conference on climate change.¹ The private sector has taken the initiative on the issue: several financial institutions have started [restricting financing for coal-fired](#) power plants abroad. In June 2020, the Japan Climate Leaders' Partnership ([JCLP](#)), a grouping of 175 companies, made [recommendations](#) for rendering renewable energy more accessible and introducing carbon pricing. In July 2020, the government made two announcements related to coal-fired energy. The Minister of the Environment, Koizumi Shinjiro, announced a [change of approach](#): Japan is to only support exports of the most efficient ultra-supercritical generators if the buying country has a decarbonisation strategy in place. Tokyo confirmed this commitment at the May 2021 [G7 environment ministers'](#) meeting, which however did not fix an end date for domestic coal. Yet, the Minister of the Economy, Trade and Industry (METI), Kajiyama Hiroshi, when announcing measures to accelerate the [closure of inefficient coal power plants](#) by 2030 (according to *Yomiuri Shimbun*, [100](#) out of [140](#)), said Japan would continue to rely on coal power and support the building of [new plants](#) ([22 new coal-fired](#) power plants by 2025) and the [share of coal-made electricity](#) would only drop from 32 % to 26 % in 2030.

In 2019, [Japan](#) was the world's fifth-largest oil² consumer, the fourth-largest crude oil importer, and the largest importer of liquefied natural gas (LNG). While oil is imported mostly from a small number of Middle Eastern suppliers, LNG import sources are more diversified. Japan has no international oil or natural gas pipelines and relies exclusively on tanker shipments of LNG and crude oil. To compare, the world's [largest crude oil importer](#) in 2019 was the EU; in the same year, the EU was also the world's [third largest oil consumer](#) and [second largest importer of LNG](#). That said, in terms of LNG imports, both Japan and the EU are due to be overtaken by [China](#) by 2024.

In 2018, Japan was the [sixth biggest emitter of GHG](#) (greenhouse gas) after China, the US, the EU, India and Russia. A 'tax for climate change mitigation' (a kind of a [carbon tax](#)), much lower³ than the world average, was introduced in October 2012. Japan's nationally determined contribution ([NDC](#)), submitted in July 2015 to the United Nations Framework Convention on Climate Change ([UNFCCC](#)) in view of the Paris Climate Agreement, had, among its goals, reducing the country's GHG emissions by 26 % from 2013 levels by 2030 (the [update](#) submitted in March 2020 reaffirmed this target,

despite [pressure](#) from the international community to ramp up ambition). Japan is on track to meet its Paris Agreement target for 2030: in 2019, [GHG emissions decreased](#) for the sixth consecutive year.

In May 2016, the Cabinet approved the [plan for global warming countermeasures](#) and the government action plan, both based on the 1998 [Act on Promotion of Global Warming Countermeasures](#) (Act No. 117 of 1998, [revised several times](#)). In July 2018, the Cabinet approved the [new strategic energy plan](#), the first-ever document designating renewable energy as a major power source. The plan envisaged the same energy mix for 2030 as in the [2014 plan](#): 56 % from fossil fuels (26 % coal, 27 % LNG, 3 % oil), 22-24 % from renewable sources and 20-22 % from nuclear energy. Energy self-sufficiency was projected to rise from 6 % in 2013 to 24 % by 2030, assuming that renewables would increase in importance and nuclear energy would continue playing an important role, despite growing public and prefectural governors' [opposition](#). The plan set a target of an 80 % reduction of GHG emissions by 2050 and the achievement of an energy-saving society; it promotes net-zero energy housing (ZEH), as well as net-zero energy building (ZEB) on newly constructed buildings by 2020 for non-residential buildings and by 2030 for newly constructed public buildings nationwide.

In June 2019, the Cabinet adopted its [long-term strategy under the Paris Agreement](#). Addressed to both the domestic and the international audience, the document is fully available in both Japanese and English. Its overarching goal – achieving a decarbonised society – requires that renewable energy become an economically self-sustained and decarbonised main power source; dependency on nuclear energy be reduced; and efforts for cutting CO₂ emissions from thermal power generation continue. The Cabinet wants to realise a 'hydrogen society', to promote energy efficiency and to set up a distributed energy system contributing to strengthening renewable energy use.

As for renewables, a feed-in tariff ([FIT](#)) scheme was launched in 2012, setting a fixed selling price at a higher rate than for non-renewable energy. The scheme has been successful: renewable energy capacity (mostly from solar photovoltaic) has since then more than [tripled](#), and already in 2020 it was responsible for [21.7%](#) of Japan's total power generation, putting it on track to hit its target of 22-24 % by 2030 well in advance. In June 2020, the [Diet](#) (Japan's parliament) passed a feed-in-premium (FiP) scheme for renewable power sources from April 2022; details would follow later. The mechanism, to be implemented along the existing FIT, would allow renewable power producers to sell their electricity in a spot market at a premium to wholesale prices. It has been [argued](#) that the FiP scheme could to be applied to large-scale solar- and wind power projects, as the capacity of these power sources has increased while their generation costs have dropped, while biomass, geothermal and small-scale hydro and solar power projects would continue using the FIT scheme.

Figure 1 – Japan's and the EU-28's renewable energy capacity in 2019

| Japan | GW | % | EU-28 | GW | % |
|------------------------|------|-------|------------------------|-------|-------|
| renewable hydropower | 28.1 | 28.8% | renewable hydropower | 131.1 | 26.4% |
| wind energy | 3.8 | 4% | wind energy | 191.4 | 38.5% |
| solar energy | 61.8 | 63.4% | solar energy | 132.2 | 26.6% |
| bioenergy | 3.2 | 3.3% | bioenergy | 40.9 | 8.2% |
| geothermal | 0.5 | 0.5% | geothermal | 0.9 | 0.2% |
| maritime energy | - | - | maritime energy | 0.2 | - |
| Total renewable energy | 97.4 | | Total renewable energy | 496.8 | |

Source: International Renewable Energy Agency ([IRENA](#)).

The announcement: Achieving carbon neutrality by 2050

On 26 October 2020, in his first address to the Diet, the Prime Minister, Suga Yoshihide, declared that the country would become [carbon neutral by 2050](#). Suga specified that the net-zero emissions goal would not hinder economic growth, but would instead be key to transforming the industrial structure and inducing robust growth. In November (almost a year after the [European Parliament](#) had done so), the Diet declared a [climate emergency](#) in a symbolic resolution aimed at increasing pressure for action to combat global warming.

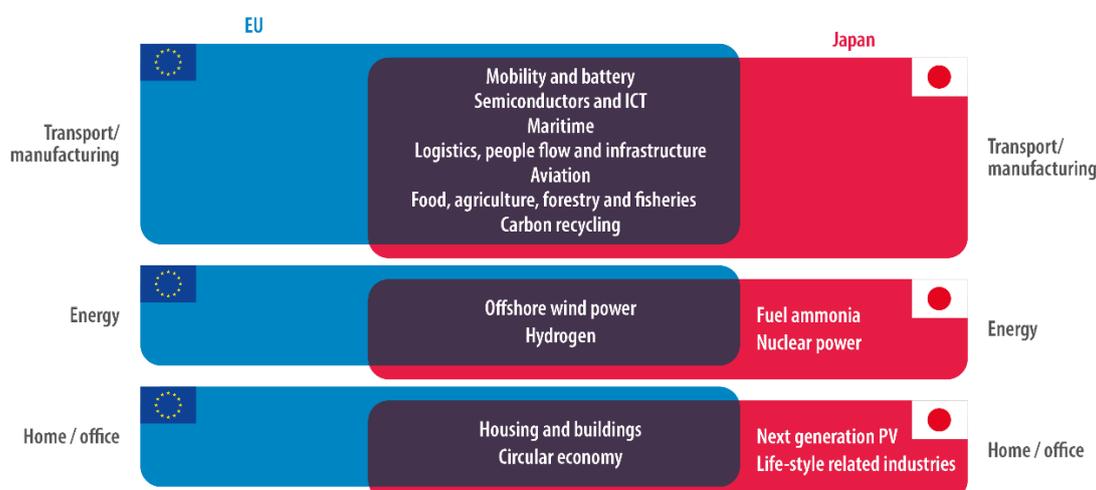
The green growth strategy

On 25 December 2020, the Cabinet adopted the [green growth strategy](#), an industrial policy aimed at generating a virtuous cycle of economic growth and environmental protection together with the business community. It includes five cross sectoral policy tools (support measures, see Figure 2) and action plans for 14 growth sectors (see Figure 3). The strategy's expected economic gain amounts to ¥90 trillion (€686 billion) by 2030 and to ¥190 trillion (€1 450 billion) by 2050; it also counts on generating vast employment opportunities.

Figure 2 – Cross-sectoral policy tools of Japan's green growth strategy

| 5 policy tools | |
|---|-----------------------------|
| <ul style="list-style-type: none"> ✓ Green Innovation Fund: ¥2 trillion over 10 years ✓ Stimulate ¥15 trillion worth of private R&D and investment | Grant funding |
| <ul style="list-style-type: none"> ✓ Tax incentives to stimulate ¥1.7 trillion worth of private investment over 10 years | Tax incentives |
| <ul style="list-style-type: none"> ✓ Formulate guidelines for transition finance and establish a scheme for long-term funds with an interest subsidy (¥1 trillion over 3 years at business level) to attract global ESG investment | Finance policy guidelines |
| <ul style="list-style-type: none"> ✓ Consider regulatory reform in areas such as hydrogen, offshore wind power, and mobility/batteries ✓ Discuss issues surrounding carbon border adjustment and related policies with a view to ensuring a global level playing field | Regulatory reform |
| <ul style="list-style-type: none"> ✓ Cooperation with various players, including both developed and emerging economies, on innovation policy, joint projects including third countries, standardisation and rule-making, and providing a wide variety of decarbonisation avenues ✓ Worldwide promotion efforts through 'Tokyo Beyond-Zero Week' | International collaboration |

Figure 3 – The 14 growth sectors in Japan's Green growth strategy and the EGD



Source of both figures: [METI](#), [EPRS](#), [Legislative Train](#), [European Commission](#). Note: 'Housing and building, Next generation PV' is a unique growth sector in Japan's green growth strategy.

In April 2021, on the occasion of the virtual [climate summit](#) of 40 world leaders convened by the US President, Joe Biden, Suga announced a [new 2030 GHG emissions reduction target](#), revising Tokyo's target from a 26 % GHG reduction below 2013 levels to a 46 % reduction by 2030, and pledging to

continue working towards a 50 % reduction. The updated 2030 climate target will be submitted later in 2021 as a NDC. At the December 2020 European Council, the EU revised its previous target of 30 % and submitted a more ambitious [NDC](#) of 55 % GHG reduction compared to 1990.

Legal and policy frameworks

In May 2021, the Diet enacted an amendment to the Act on promotion of global warming countermeasures; this revision provides the [legal basis](#) for the policy and ensure its continuity. The [revision is aimed](#) at i) establishing an accreditation system to promote businesses that contribute to decarbonisation by using regional renewable resources; and ii) encouraging digitalisation and open data regarding companies' GHG emissions information, in order to promote decarbonisation in corporate management. Expert-level [discussions](#) are being held to facilitate the adoption of legislation on [carbon tax](#): the [Ministry of the Environment](#) deems the full-scale introduction of this tax as essential for restructuring the industry in such a way as to enable the reduction of CO₂ emissions. This tax may be low when introduced and then gradually raised to encourage companies to make efforts towards decarbonisation, avoiding major impacts on the economy and society. The government has also planned to [revise the long-term strategy](#) under the Paris Agreement.

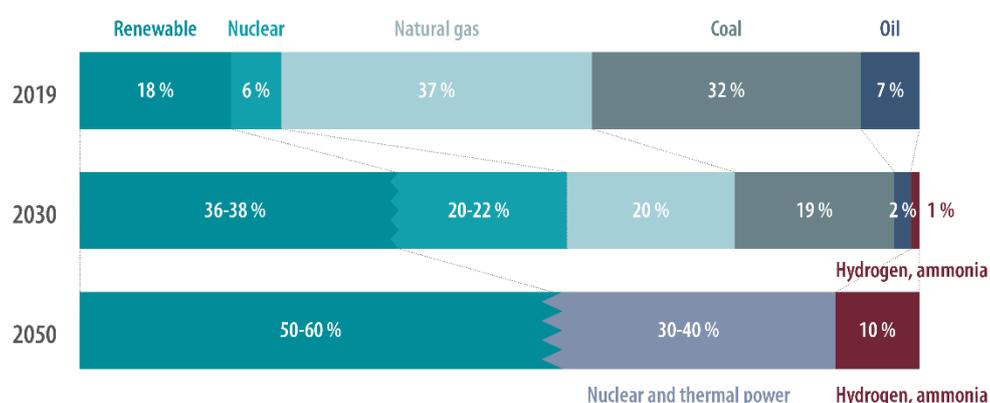
Financing the strategy

In December 2020, Suga pledged a [¥2 trillion \(€15 billion\) fund](#) to promote ecological businesses and innovation to achieve the 2050 goal, offering tax credit of up to 10 %, the highest level ever. In March 2021, the government created the [Green Innovation Fund](#), run by the [NEDO](#) (New Energy and Industrial Technology Development Organization) agency. The government also counts on stimulating private sector research and development (R&D), as well as investment, for an amount up to ¥15 trillion (€115.3 billion). Part of these resources could come from the Japanese [green bond market](#), which is expanding: in 2019 it amounted to ¥824 billion (€6.3 billion), 24 times its size five years before. Green bonds and other ESG (environmental, social and governance) assets may eventually make up [20%](#) of Japan's ¥60 trillion (€461.4 billion) corporate bond market, according to Nakazora Mana, chief ESG strategist at BNP Paribas Japan. As for the EU, the European Commission, which [presented](#) the [European Green Deal investment plan](#), envisages mobilising a minimum of [€1 trillion](#) by 2030, with €503 billion coming from the EU budget. Under the investment plan, between 2021 and 2027, at least €100 billion will be provided in support to workers and citizens of the regions most affected by the sustainability transition, through the [Just Transition Mechanism](#).

Energy: More renewables, nuclear to remain, ammonia and hydrogen

Renewables will take high prominence in Japan's energy mix and would account for a 50 %-60 % share in 2050. The goal is to promote the decarbonisation of electricity, which should represent the economy's driving power. This may increase electricity demand by 30 %-50 % from current levels.

Figure 4 – Japan's projected electricity mix in 2019, 2030 and 2050



Source: [METI](#), [EU-Japan Centre for Industrial Cooperation](#). The 2030 electricity mix was updated in the draft new strategic energy plan that METI presented in July 2021.

Electricity currently accounts for merely 25% of final energy consumption in the country. To boost green power, Japan plans to install 10 GW of [offshore wind](#) capacity by 2030, and between 35 GW and 45 GW by 2040. The cost for a kilowatt-hour is expected to diminish to the equivalent of €0.066 in a 30-35 year period. The government is to require equipment from domestic suppliers to account for 60% of a project. Meanwhile, as the strategy recognises that it would be unrealistic to cover all electricity demand only with renewables, alongside an increased relevance of renewable energy, a share of 30-40% of the energy mix is planned to come from nuclear power, as well as from thermal power plants equipped with carbon capture, utilisation and storage ([CCUS](#)) technology.

Transport and industry

Japan aims to reduce the cost of batteries — key components of an electric vehicle (EV) — to ¥10 000 (€77) or less per kilowatt-hour by 2030. In December 2020, the Environment Ministry [doubled its subsidies](#) for the purchase of battery electric vehicles⁴. The maximum amount per EV will increase to ¥800 000 (€61 622), provided the electricity used in the buyer's home or office is generated from renewable energy sources. The subsidy will also double for plug-in hybrid vehicles to up to ¥400 000 (€30 811), while there will also be an increase in the subsidy for fuel cell vehicles — currently ¥2.25 million (€17 331). Some ¥8 billion (€61.62 million) has been allocated for these subsidies. An incentive of up to ¥1.95 million (€15 020) supports new electric [charging stations](#). As for the EU, in December 2020, the European Commission [proposed](#) modernising the EU legislation on batteries, following the course of action set by the [circular economy action plan](#). Two

Ammonia versus 'green' ammonia

Japan plans to establish the technology for burning [fuel mixed with ammonia](#) (the latter being a compound consisting of three parts hydrogen and one part nitrogen) at coal-fired thermal power plants by 2023 and to achieve a 20% use of ammonia as a mixed combustion fuel at thermal power stations by 2030. By 2040, it hopes to realize the technology for 100% ammonia-fired thermal power generation. In October 2020, METI established a council to promote using [ammonia](#) as fuel at coal-fired power plants; manufacturers of power generation equipment and electric power companies are on this council. The industries manufacturing ammonia are the world's third biggest [emitters of carbon dioxide](#), creating half a billion tonnes of CO₂ each year — 1.8% of global CO₂ emissions. However, ['green' ammonia](#) (produced through a drastic reduction of the released amount of CO₂) could help in meeting the carbon-neutral goal.

Japan, the frontrunner in the use of hydrogen

Japan is a frontrunner in using hydrogen as an energy carrier (which is to make up 10% of the energy mix by 2050). In December 2017, Japan became the first country to draw up a [hydrogen strategy](#) aimed at making hydrogen [cost-competitive with natural gas](#) in order to realise a 'hydrogen-based society'. The strategy was updated in [2019](#) (the [EU strategy](#) was adopted in July 2020). The [2020 Olympic and Paralympic Games](#) were supposed to be a platform to promote hydrogen technology by using fuel cell vehicles and buses, and by powering the athletes' village with hydrogen. For the first ever time, the [Olympic torch](#) burned hydrogen. [Expo 2025 in Osaka](#) should be another opportunity to showcase Japan's hydrogen technology and share its plans for a hydrogen economy. The [world's biggest renewable hydrogen plant](#) was built in the Fukushima prefecture.

Japan aims to [increase annual hydrogen consumption](#) to up to 3 million tonnes by 2030 and 20 million tonnes by 2050. Hydrogen's cost in terms of power generation and transportation should decrease from the [current](#) ¥170 to ¥30 (€0.23) per normal cubic meter (Nm³) by 2030 and ¥20 (€0.16) per Nm³ by 2050. By 2021, Japan is to launch [liquefied hydrogen transport](#) from Australia. Tokyo plans to have more than five million residential fuel cells and to establish an international [hydrogen supply chain](#) by 2030, drawing on a ¥300 billion (€2.31 billion) budget from the NEDO-run Green Innovation Fund. An additional ¥70 billion (€540 million) will be earmarked for projects seeking to scale up electrolyzers. As for transport, the strategy foresees 800 000 fuel cell vehicles (FCV) and 1 200 fuel cell buses to circulate in Japan by 2030, with a network of 900 hydrogen refuelling stations. Hydrogen (alongside ammonia) would also be used for sea-going vessels. Some [10 000 fuel-cell forklifts](#) will be in use by 2030.

Toyota, Honda and Nissan are developing both battery and hydrogen fuel cell vehicles, and have been supporting the development of [hydrogen station infrastructure](#) in Japan since 2015. ENEOS, which operates 13 000 service stations in Japan, is planning to install hydrogen pumps in all of them. There are currently some 135 hydrogen fuelling stations in Japan, 150-plus in Europe (more than half of them in Germany), about 80 in North America (more than half of them in California), and more than 70 in China.

new regulations set CO₂ emission performance standards for new [passenger cars and vans](#) and for [heavy-duty vehicles](#). EU Member States have different [subsidies schemes for electric vehicles](#). According to the [press](#), the Japanese government may decide to ban sales of cars solely powered by gasoline by 2035 in favour of electric, hybrid or fuel cell vehicles, while also putting in a lot of effort into the development of hydrogen in transport (see Box above, section on hydrogen). The strategy also foresees zero-emission technology to be the norm in the construction sector by 2030.

Implications for local governments and the private sector

As part of the [2050 Zero Carbon Cities in Japan](#) initiative, local governments committed to achieving zero carbon emissions by 2050. As of 31 August 2021, 444 local governments including major cities had announced their commitment. They represent 111 million people (87.9% of Japan's population). The Ministry of the Environment is to help local governments develop projects and build capacity by providing incentives for decarbonizing regions. In order to coordinate local efforts, in December 2020 the government set up a Council for National and Local Decarbonisation. A [roadmap](#) for the decarbonisation of all local governments by 2050 is to be developed.

The Japanese government has not yet adopted an emissions trading scheme (ETS) at the national level. Nevertheless, back in 2010, the Tokyo metropolitan government successfully introduced the [Tokyo ETS](#), which was the first cap-and-trade scheme for CO₂ emissions in Asia. It was followed in 2011 by the [Saitama](#) prefecture and by the [Kyoto verified emissions reduction](#) scheme, the latter being less binding than the previous two. Over [30 local governments](#) (prefectures and major cities) have their own mandatory schemes. In December 2020, Tokyo Governor, Koike Yuriko, said the city aims to ban new sales of gasoline cars [by 2030](#) (five years ahead of the national government) and new two-wheel gas-fuelled vehicles by 2035.

The private sector is also involved in the effort towards decarbonisation. More than 80 Japanese companies have introduced an [internal carbon pricing system](#) to promote investments and measure progress towards decarbonisation, by setting a monetary value on carbon emissions. Some 50 Japanese companies (second highest number after the US) joined the [RE100](#), a group of businesses committed to using 100% renewable energy. Japan also has the highest number of businesses that support the [Task Force on Climate-related Financial Disclosures \(TCFD\)](#) – a framework to report climate-related financial information. The government also has plans to set up a [national council of experts and business representatives](#), featuring representatives of environmental and youth-related organizations, to achieve the goal of reducing greenhouse gas emissions to net zero by 2050.

Challenges

Two-thirds of Japan's territory is covered with mountains and forests, which renders the task of setting up solar farms or other renewable energy facilities requiring ample space, difficult. In December 2018, Japan adopted the [Act](#) of promoting utilisation of sea areas in development of power generation facilities using maritime renewable energy resources. Offshore wind farms may provide a solution to the space problem associated with renewable energy, but turbines need to be built more strongly than elsewhere to withstand frequent typhoons and the possibility of tsunamis. That is why Japan is a [leader in floating solar power](#), with plants being set up in lakes. Situated along the Pacific Ring of Fire, Japan lies across four tectonic plates and is therefore prone to earthquakes: nearly [20% of the world's large earthquakes](#) happen in the country. Natural resources, and more specifically those minerals that might be needed for implementing decarbonisation without nuclear energy, are limited. Another challenge is [Japan's demographic trend](#): while the population is shrinking, the increase in the number of few-member and elderly households places upward [pressure on per-capita emissions](#).

The green growth strategy relies on a major share of nuclear power to realise decarbonisation. However, prospects for nuclear are unclear. Out of [34 operable reactors](#), currently only nine have been officially approved for restart, and only four are operating, down from about 50 before the

2011 earthquake and tsunami. Reactors' restart may depend on unpredictable [court decisions](#). Following the 2011 Fukushima nuclear disaster, new [nuclear safety regulations](#) have been created to impose a 40-year limit on the operational lifespan of nuclear reactors in Japan. A provision, introduced in response to concerns about a power shortage, has been activated, to allow the [extension](#) of the legal lifespan of nuclear reactors by up to 20 years in exceptional cases. However, several nuclear plants have failed to implement safety [anti-terrorism measures](#) and have therefore been shut down. Public confidence in the safety of nuclear power was greatly damaged by the Fukushima nuclear disaster, as some [opinion polls](#) showed. The polls also revealed opposition to the government's [controversial plans](#) to slowly release [treated⁵ tritium-contaminated water](#) from the Fukushima nuclear plant into the Pacific, on the part of [environmental groups](#) (also from [abroad](#)), locals, the Japanese and [South Korean](#) fishing industry and [neighbouring countries](#)⁶.

Some doubts have been raised about the feasibility of solutions to substitute coal. Japan has set an ambitious target to grow its [ammonia](#) fuel demand from zero as of now, to 3 million tonnes a year by 2030, and up to [30 million tonnes a year by 2050](#), creating a new supply chain for the fuel. METI envisages [100% ammonia combustion](#) to be available by 2050 – this is the goal of JERA, the largest Japanese power company, which looks at ammonia as more viable than hydrogen, as it is easier and cheaper to transport. Ogino Reiji, senior analyst at Mitsubishi UFJ Morgan Stanley Securities, considers these goals extremely difficult to attain, because of the lack of a [supply chain and its likely high costs](#). At the moment, [hydrogen is needed to synthesize ammonia](#), so it has to be extracted from natural gas or obtained by breaking down water with electricity generated by renewables. Japan in any case is to continue domestic fossil fuel investment, despite the May 2021 IEA [Net zero by 2050](#) report on reaching net zero emissions by 2050 recommending against it.

It has been [argued](#) that CCUS technology to capture and make effective use of the high concentrations of CO₂ emitted by industrial activities may have shortcomings: for instance, its storage in the ground or in the ocean could have consequences on the balance of the ecosystem, including effects such as ocean acidification due to leakage. Scepticism has been voiced about whether [carbon capture technology](#) will become widely available in the near future.

Geothermal power: Untapped potential?

Japan, as a volcanic country, is blessed with abundant geothermal resources, with a potential power output equivalent to [23 GW](#). Though the first geothermal plant in the country opened as early as 1924 and Japanese companies are the world's top experts and largest suppliers of geothermal turbines, geothermal power is mostly associated with the 'onsen' – Japan's traditional hot springs (see picture on the cover). While some are worried about the impact a geothermal power plant might have on tourism, others consider it as an [option to rescue](#) places characterised by a high tourism volatility.

Stakeholder views

The Japanese business federation [Keidanren](#) is already engaged in innovation projects to achieve net-zero carbon emissions through the [Zero Emissions Challenge](#) programme, which involves over [300 companies](#). In the meantime, Keidanren is not so much in agreement with the government regarding the introduction of a [carbon tax](#), as it argues that a tax levied directly on CO₂ emissions may diminish companies' resources for research and development, thereby undermining their international competitiveness. In its December 2020 policy proposal, Towards realising carbon neutrality by 2050 ('[Society 5.0 with carbon neutral](#)'), Keidanren promised its 'unwavering resolve' to contribute to the challenge of carbon neutrality. Meanwhile it underlined the existing challenges, including the need for innovative production processes of key industries, which could result in a new socioeconomic system. Meanwhile, a January 2021 [survey](#) among 11 000 Japanese firms about the government's carbon-neutrality target revealed that only 15.8% of companies considered the target achievable, and an August 2020 [analysis](#) of Japanese corporate lobbying on regulations related to decarbonisation revealed a pattern of deliberate corporate obstruction of government

steps toward decarbonisation: in particular, this came from companies in the heavy machinery, automobile, cement and petrochemicals production sectors.

Views on the energy policy to achieve the carbon neutrality target are mixed. In January 2021, Toyota Motor Corporation's President and Japan Automobile Manufacturers Association (JAMA)'s Chairman, [Toyoda Akio, criticised](#) the government's plan for a rapid transition to electric vehicles without a drastic change in the energy mix, warning against the risk that the automotive industry's business model could collapse. According to Toyoda, if all the cars in Japan today were electric vehicles, 10 additional nuclear plants or 20 coal-powered stations would be needed to avoid an electricity shortage during the peak summer period. However, in April 2021, Toyoda declared that the [auto industry](#) can play a central role in Japan's reaching the 2030 emissions target. Toyoda Masakazu, chair of Tokyo's Institute of Energy Economics, said that the target is [unachievable without nuclear power](#). Ikebe Kazuhiro, chairman of Japan's federation of electric utilities, expressed a [similar thought](#) in a news conference.

On the contrary, former Prime Ministers, [Koizumi Junichiro and Kan Naoto](#), both proponents of nuclear power while in office, took an anti-nuclear stance following the 2011 Fukushima disaster (Kan was then prime minister in office). Supporting a [100% renewable energy](#) target, they criticised the government's vow to reach carbon neutrality by 2050, calling it a pretence to restart nuclear reactors across the country, in the interest of the 'nuclear power village': utility companies, government agencies and academia. Ohbayashi Mika, director of the Renewable Energy Institute, said the figures proposed by the government showed a [lack of ambition](#), as Japan should aim for renewable energy to cover 50-60 % of national electricity needs already by 2030. In July 2020, Climate Action Tracker – a [consortium](#) of institutes – had already raised the issue of Japan's ambition regarding its [coal power policy](#) in view of achieving the Paris Agreement target. When [assessing the carbon neutrality goal](#), it noticed that there is relatively limited information about the deployment strategies of existing low-carbon technologies and measures in the mid-term future to keep Japan's long-term GHG emissions trajectory on track towards net zero in 2050. Climate Action Tracker considers that a reduction of more than 60 % of GHG from 2013 levels by 2030 would be consistent with the -1.5 °C Paris goal; when in April 2021 Japan updated its 2030 Paris Agreement target of reducing emissions to 46% below 2013 levels, the consortium defined it a ['weaker-than-expected target'](#).

Young Japanese support carbon neutrality goal, but are not optimistic

According a January 2021 Nippon Foundation [survey](#) on people aged from 17 to 19, 60.4 % of Japanese youth support the 2050 carbon-neutrality target, but no more than 14.4 % believe it is achievable. Some 62.9 % of respondents had positive expectations for renewable energy, with a clear preference for solar power (69.1 %).

International cooperation

The importance of enhancing international collaboration, considering global market investment or global ESG investment has been underlined in the green growth strategy. The strategy supports cooperation with various players, including both developed and emerging countries, on innovation policy, joint projects including third countries, standardisation and rule-making, and providing a wide variety of solutions towards decarbonisation. The [Tokyo Beyond-Zero Week held](#) in October 2020 featured six leading international conferences organized and hosted by Japan, offering a forum for high-level discussions about the key innovations required to build a global roadmap to carbon neutrality. The [Week's next edition](#) is to be held in October 2021.

Japan is particularly active in the area of international cooperation on green technologies. It has set up a [joint crediting mechanism](#) (JCM) in order to both evaluate its contribution to GHG emission reduction or removal in a quantitative manner (achieved through diffusion of low carbon technologies and infrastructure, and implementation of mitigation actions in developing countries),

and use this contribution to achieve its own emission reduction target. Japan also contributes to the [Green Climate Fund](#) (GCF), the world's largest climate fund, mandated to support developing countries raise and realize their NDC targets. In March 2021, the GCF approved the first [JICA](#) (Japan International Cooperation Agency)-proposed [project in Timor-Leste](#) and in July another [project in the Maldives](#).⁷ Japan has hosted the Japan Conference on Overseas Development of Eco-cities ([J-CODE](#)) since 2011 and the Innovation for Cool Earth Forum ([ICEF](#)) since 2014. In [2018](#) it hosted the first [Hydrogen Energy Ministerial Meeting](#), which gathers representatives of 23 countries, regions and international organisations (including the EU and several Member States) and representatives of companies. The meeting takes place every year; the next one is scheduled for [October 2021](#). In June 2021, Japan [launched](#) the '[Asia CCUS Network](#)': a partnership with the US, Australia and the 10 members of the Association of Southeast Asian Nations ([ASEAN](#)) aimed at commercialising [CCUS technology](#) used for carbon capture as well as for the utilisation and storage of carbon dioxide, in order to reduce emission in south-east Asia. During the April 2021 summit, the US and Japan announced a new [climate partnership](#), which includes measures to help other countries decarbonise, particularly in the Indo-Pacific. Japan is also one of the 22 members of the International Partnership for Hydrogen and Fuel Cells in the Economy ([IPHE](#)), which includes the European Commission, several EU Member States, the US and China, among others.

When chairing the G8 in 2008, Japan advocated linking policies and research: this brought to the establishment of the International Research Network for Low Carbon Societies ([LCS-RNet](#)). This was followed by its regional Asian dimension: the Low Carbon Asia Research Network ([LoCARNet](#)), established at the ASEAN+3 Environmental Ministers Meeting (EMM), held in 2011 in Cambodia.

EU and Japan cooperation on climate change

According to a European Commission report on clean energy competitiveness, the EU and Japan are leaders in the international competition for [high-value patents on clean energy technologies](#). Clean energy patents account for 6% of all high-value inventions in the EU, a share that is similar to Japan's and is higher than that of China (4%), the US and the rest of the world (5%), and second only to South Korea (7%) among competing economies. While the EU hosts a quarter of the top 100 companies in terms of high-value patents in clean energy, between 2000 and 2016, Japan filed the largest number of 'high-value' patent families in the area of fuel cells.

The September 2019 [partnership](#) on sustainable connectivity and quality infrastructure between the EU and Japan – a development of the [EU strategy on connectivity with Asia](#) – includes sustainable energy connectivity building, sustainable energy infrastructure investments, and low-carbon energy systems. In July 2020, the EU launched the [European Clean Hydrogen Alliance](#), followed in April 2021 by a [call](#) for the submission of proposals for renewable and low-carbon hydrogen technologies and solutions, to pave the way towards an EU clean hydrogen market. Taking into account Japan's engagement in developing hydrogen technology (see Box above, section on 'Japan, the frontrunner in the use of hydrogen'), there is potential for strong cooperation in this field. In April 2021, the [EBRD and JICA](#) signed an agreement combining private sector expertise with the public sector mandate of the EU and Japan. The areas of concerted action include scaling up investments in renewable energy, sustainable energy and infrastructure, as well in environmental conservation and mitigation and adaptation to global climate change, in regions such as the Caucasus, Central Asia, Europe, and North Africa.

Many exchanges contributing to the low-carbon transition are already active between businesses, local governments and research institutes from both sides. In October 2020, the EU-Japan Centre for Industrial Cooperation launched the organisation of a one-year cycle of seminars, webinars and conferences to support EU and Japanese policy-makers and industry representatives in sharing best practices, solutions, policies and technologies to achieve the goals of the Paris Agreement. The [SPIPA](#) (Strategic Partnership for the Implementation of the Paris Agreement) website supports the initiative. The [international urban cooperation](#) programme pairs EU and Japanese cities. There are already several examples of partnerships among businesses. In October 2019, France's Ideol and

Japan's Taisei Corporation signed a memorandum of understanding on [floating offshore wind power](#). In October 2020, Denmark's Vestas Wind Systems and Mitsubishi Heavy Industries set up a partnership in the domain of [sustainable energy](#). Solar energy, energy storage and [virtual power plants](#) (VPPs) may also represent potential areas of cooperation between the EU and Japan: in November 2020, Japan's Toshiba Energy Systems & Solutions Corporation and Germany's Next Kraftwerke formed a [joint venture](#) to study the potential for VPPs in the Japanese market.

Comparing the EU's and Japan's carbon-neutrality policies

A green alliance between the EU and Japan

In order to enhance the above-mentioned potential, during their May 2021 summit, the EU and Japan adopted the declaration on Towards a [Green Alliance](#) 'to protect our environment, stop climate change and achieve green growth'. The partners defined a set of priority areas for cooperation:

- cooperation on energy transition, including low-carbon technologies, decarbonized and renewed gases;
- environmental protection;
- regulatory and business cooperation – including possibility of adopting common standards – in areas such as green finance (including ESG factors and a taxonomy for environmentally sustainable activities), transition finance, battery ecosystem, offshore wind energy, alternatives to the use of micro-plastics, industrial decarbonisation and hydrogen;
- research and development, in line with the May 2020 [letter of intent](#), creating synergies between [Horizon Europe Missions](#) and Japan's [Moonshot Goals](#), and using the second phase of the [Mission Innovation](#) (MI) initiative on clean energy innovation;
- sustainable finance, playing a leading role in the International Platform on Sustainable Finance (IPSF).

The EU and Japan committed to promoting cooperation for developing countries' transition toward a climate-neutral and resilient society through the mobilization of US\$ 100 billion per year through to 2025 from a wide variety of sources. They also set aims for ambitious outcomes of the November 2021 COP26, as well as an ambitious post-2020 global biodiversity framework at the Biodiversity COP15 in October. They furthermore vouched their support for the objective of protecting at least 30 % of land and 30 % of sea areas by 2030 as advocated by the High Ambition Coalition for Nature and People ([HAC](#)), and promised to contribute towards the achievement of significant progress at the [2022 UN Ocean Conference](#) in Lisbon.

Figure 5 – Where are the EU and Japan in terms of achieving carbon neutrality, 2019

| 2019 | Japan | EU |
|--|------------------|------------------|
|  Energy self-sufficiency | 12.1 % | 39.3 % |
|  Share of fossil fuels in TPES* | 88 % | 71.2 % |
|  GHG reduction goal | 46 % (ref. 2013) | 55 % (ref. 1990) |
| World ranking (2019) | Japan | EU |
|  Energy consumer | 5th | 3rd |
|  Emitter of CO ₂ | 6th | 3rd |
|  Oil consumer | 5th | 3rd |
|  Oil importer | 4th | 1st |
|  LNG importer | 1st | 2nd |

Source: [EIA, Statistical Review of World Energy 2020](#), [World Resources Institute](#), [World's Top Exports](#).

ENDNOTES

- ¹ During the December 2019 COP25 Madrid conference on climate change, [Climate Action Network](#) symbolically awarded Japan a [fossil prize](#) twice, for not committing to the phasing out of coal-fired power generation and not upgrading its GHG cut goal.
- ² [Japan](#) has one of the largest oil stockholdings globally, as insurance against geopolitical risks and large global shocks.
- ³ Japan's tax rate is ¥0.76 ([€0.0058](#)) per litre of gasoline, less than one-tenth of the typical carbon tax rates in other countries on a carbon-equivalent basis.
- ⁴ [Toyota](#) will invest ¥1.5 trillion (€11.5 billion) in battery development and supply over the next decade and wants to develop next generation solid-state batteries by 2025. [Nissan](#) aims to expand recycling of lithium-ion batteries used in electric vehicles (e.g. reusing them to store renewable energy at convenience stores and to power railroad crossings and delivery robots in factories).
- ⁵ The water is to be treated by the Advanced Liquid Processing System (ALPS) to remove most of the radioactive materials that cannot eliminate radioactive tritium. As the 1 000 tanks used to store the water may be full during 2022, in April 2021 the government decided to slowly discharge it in the ocean, a process that may take 30 years, diluting it so as the levels of tritium would account for 2.5 % of the maximum concentration considered acceptable by national standards. According to [METI](#), the water's radiation dose would be no more than 1/1 000th of the natural exposure, even if it were all released in a single year.
- ⁶ South Korea – whose President Moon Jae-in declared that [South Korea](#) would become a carbon-neutral economy by 2050 just two days after Japan's announcement – as explained by Foreign Minister, Chung Eui-yong, to the National Assembly, actually asks Japan to meet [three conditions](#): to provide enough scientific evidence and information and to share this information broadly enough; to hold more ample consultations in advance; and to guarantee South Korea's participation in the safety verification process of the International Atomic Energy Agency ([IAEA](#)). In May 2021 Japan accepted a South Korean proposal to establish a [forum](#) to discuss safety issues concerning Tokyo's decision.
- ⁷ Meanwhile JICA is considering funding an expansion to a controversial coal power plant in Bangladesh ([Matarbari](#)).

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