Science and Technology Trends
Greenhouse Gas Reduction and Climate Change

An Overview of Japan's Climate Change Mitigation Policy

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1. Introduction

In fiscal year (FY) 2015, Japan further decreased its greenhouse gas (GHG) emissions by 3% from the previous year, at almost the same rate as observed in 2014 (down by 3.1%) (GIO, 2016). The total GHG emissions nevertheless amounted to 1.2 Gt-CO_2e (excluding land use, land use change and forest or LULUCF), the 6th largest emitter in the world, if the European Union (EU) is seen as one entity.

In July 2015, the Japanese government announced what post-2020 climate actions Japan would intend to take, known as Intended Nationally Determined Contributions (INDCs) (GoJ, 2015). Japan pledged to reduce its GHG emissions by 26% compared to 2013 levels by 2030 (or 25.4% reductions compared to 2005 levels). Given uncertainty surrounding the re-operation of nuclear power plants after the Fukushima nuclear accident of March 2011, however, various challenges remain.

This paper will present an overview of Japan's mitigation targets and pledges as well as the historical trends of Japan's national and sectoral GHG emissions. The paper also describes a landscape of climate mitigation policy in Japan.

2. Historical Emissions Trends and Emissions Reduction Targets

2.1. Historical Trends and Targets

Figure 1 presents Japan's historical GHG emissions trends and emission reduction targets. Japan committed to reduce its GHG emissions by 6% from the base year emissions (largely 1990 levels) in the first commitment period of the Kyoto Protocol (KP-CP1 or 2008-2012). The Japanese government recently announced that Japan achieved the KP-CP1 target, taking into account the net sequestration through land-use change and forestry (LULUCF) and the purchase of Kyoto unites. In 2010, at the 16th Conference of the Parties (COP 16) to the UN Framework Convention on Climate Change, however, the Japanese government announced to not participate in the second commitment period of the Kyoto Protocol, i.e. not taking legally-binding emission reduction target.

At COP 15 of 2009 in Copenhagen, the Japanese government, led by the Democratic Party of Japan (DPJ) pledged to reduce its GHG emissions by 25% from 1990 levels by 2020, premised on the establishment of a fair and effective international framework in which all major economies participate.

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This 25% reduction target relied upon a rapid expansion of nuclear power plants, namely, 9 new power plants by 2020 in addition to the existing 54 plants. However, the Fukushima nuclear disaster in 2011 made it unrealistic to expect such an expansion of nuclear power plants. The DPJ government sought to phase out nuclear power by the end of the 2030s, and hinted indicative 2020 reduction figures of 5-9% below 1990 levels. After change of government in December 2012, however, the new government led by the Liberal Democratic Party (LDP) announced a complete revision of energy and climate policies.

In 2013, at COP 19 in Warsaw, the Japanese government announced its revised 2020 target, a reduction of 3.8% from 2005 levels (or increase by 3.1% from 1990 levels), including forest sequestration and overseas credits, and assuming zero nuclear power. This 2020 target was tentative, and would be revised after the revision of national energy policy. Nonetheless, the scale of the rollback of the revised 2020 target from the previous one was far larger than the volume of GHG emissions that nuclear power generation was expected to displace (Kuramochi, 2014). It should also be noted that this 2020 target was pledged under a voluntary framework of the Cancun Agreement, not under the Kyoto Protocol.

In July 2015, the Japanese government submitted its INDCs (26% reduction from 2013 levels, or 25.4% reduction from 2005 levels) to the UNCCC Secretariat. This amount of reduction is based upon bottom-up calculation of domestic policies and measures, excluding international carbon credits. Indicative sectoral reductions were also presented (see Figure 2 below). The amount of carbon removed by LULUCF in 2030 was also estimated to be about 37 Mt-CO_2.

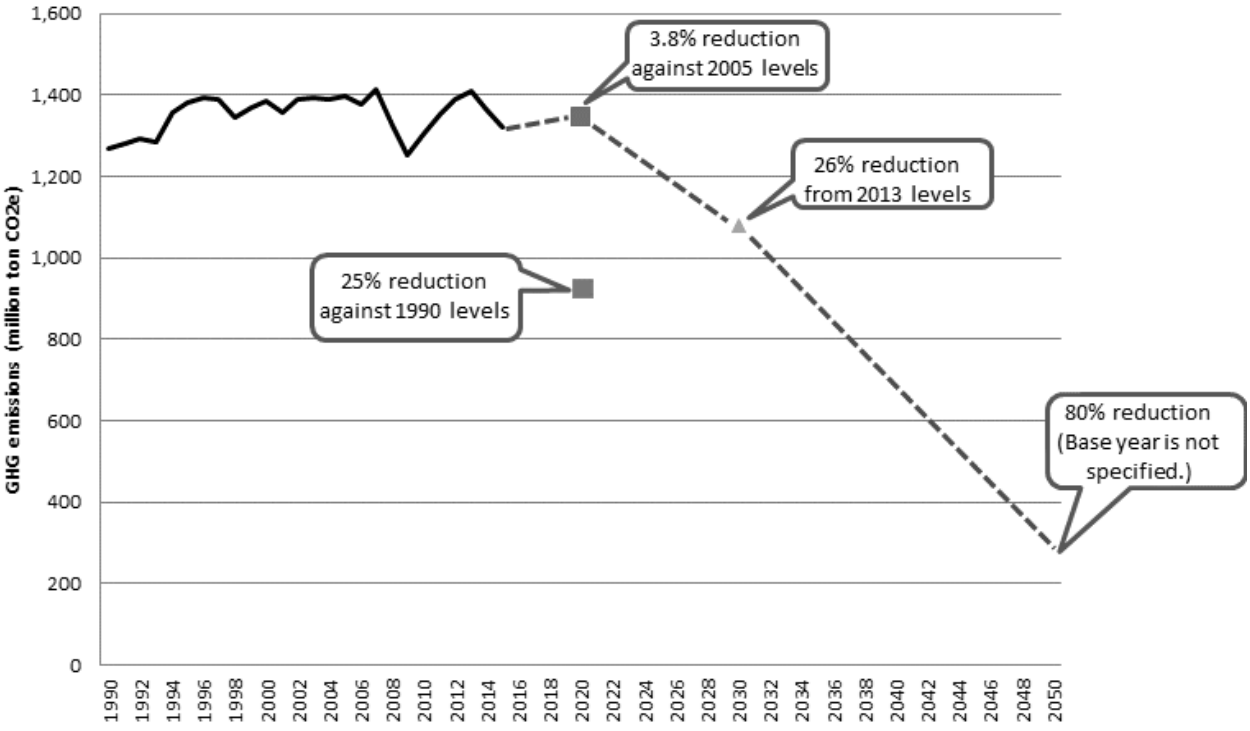
Regarding international credits, Japan's INDC mentioned the emission reduction by the Joint Crediting Mechanism (JCM). Though the use of the JCM was not included in the bottom-up calculation for the 2030 target, the INDC said that the government would prepare their budget to acquire credits ranging from 50 to 100 MtCO_2e in total by 2030 in order to account for Japan's emission target. But, it is still not clear how acquired credits will be accounted annually till 2030. This would be largely subject to the subsequent international negotiations.

Japan's INDC also referred to "international contribution other than the JCM" which will achieve emission reductions by low carbon technologies by Japanese industries' actions. This emission reduction by this approach was estimated to, at least, 1 Gt-CO_2e. However, the INDC did not mention relations between the 2030 target and these international contributions, as well as accounting and MRV methodology.

After COP 21, the Cabinet approved the Plan for Global Warming Countermeasures which increased the 2020 target to "more than" 3.8%, assuming the re-operation of some of nuclear power plants, re-affirmed the 2030 target (INDC), and set the aspirational goal of 80% reduction by 2050. The base year for the 2050 goal was not specified.

The black bold line in Figure 1 shows the historical trend of Japan's GHG emissions. In the aftermath of the global financial crisis of 2008, the GHG emissions sharply declined. However, after the Fukushima nuclear disaster in March 2011, the emissions rapidly increased because the electricity supply gap caused by the suspension of nuclear power plants was fulfilled by growing generation of thermal power plants, mainly gas-fired and oil-fired power plants. However, GHG emissions declined for consecutive two years after 2013. The emissions in 2015 has already achieved the 2020 target.

Figure 1. Japan's GHG emissions trend and reduction targets



Source: Based upon GOJ 2016 and GIO 2016.

2.2. Sectoral Breakdown

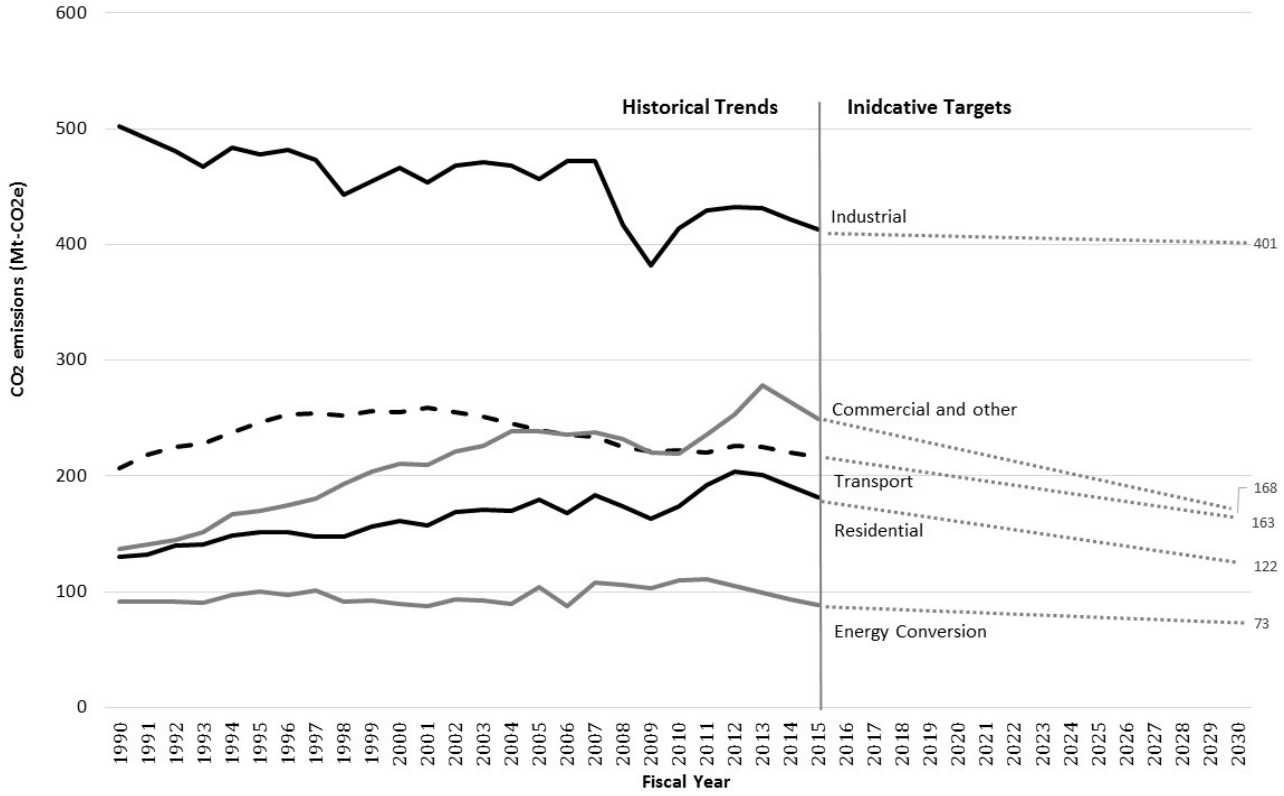
Figure 2 shows historical trends of sectoral energy-related CO_2 emissions, as well as indicative sectoral targets under Japan's INDC[2]. In FY2015, the energy-related CO_2 emissions from the industrial sector, including direct emissions and indirect emissions from electricity use, amounted to 413 Mt-CO_2e (GIO, 2016). Compared to 1990, industrial emissions have decreased approximately by 18%.

Emissions from the commercial and residential sectors rather rapidly increased in last fifteen years. In particular, after the Fukushima nuclear disaster of 2011, the emissions from the two sectors jumped up because the suspension of nuclear power plants operation led to higher CO_2 emissions intensity for electricity. However, the emissions from the commercial and residential sectors started declining after their peaks in FY2013 and FY2012, respectively. These declining trends were mainly attributed to the decline in electricity demand. After rolling power outages under the tight supply-demand balance in the wake of the Fukushima nuclear disaster, electricity conservation has taken a firm hold on the Japanese life-style.

The GHG emissions from the transport sector increased in the 1990s, but they have been gradually decreasing since their peak in 2001. Improvement in fuel efficiency, in particular the diffusion of hybrid cars, contributed to this decreasing trend.

2 The emissions from the steam and electricity in the energy conversion sector are allocated to end-use sectors based on consumption.

Figure 2. Sectoral energy-related CO_2 emissions: historical trends and indicative targets for 2030



Source: Based upon GOJ 2015 and GIO 2016.

3. Policy Landscape

3.1. Overall Framework

The Act on Promotion of Global Warming Countermeasures, which was enacted in 1998 as the first climate-dedicated law, is a framework legislation for climate change policy in Japan. Based upon the Act, the Kyoto Protocol Target Achievement Plan was formulated in April 2005. The Act also provided legal foundation for the Global Warming Prevention Headquarters (GWPH), which was originally established within the Cabinet in December 1997, to achieve the KP-CP1 target and comprehensively advance concrete and effective measures for the prevention of global warming. The Prime Minster serves as the chef of the GWPH, and the ministers for the Environment (MOE) and the Economy, Trade and Industry (METI) serve as deputy chiefs.

Following the decision not to participate in the second commitment period of the Kyoto Protocol, the Act was amended to mandate both central and local governments to formulate the Plan for Global Warming Countermeasures from 2013. As previously mentioned, after the adoption of the Paris Agreement, in May 2016, the Cabinet approved the Plan for Global Warming Countermeasures which describes how Japan's INDC (2030 target) will be achieved. The Plan specified detailed actions that government entities, business sector and citizens shall take to achieve the 2030 target. The Plan emphasized the PDCA (plan-do-check-act) cycle to

monitor the status of progress every year and the Plan will be revised, if necessary.

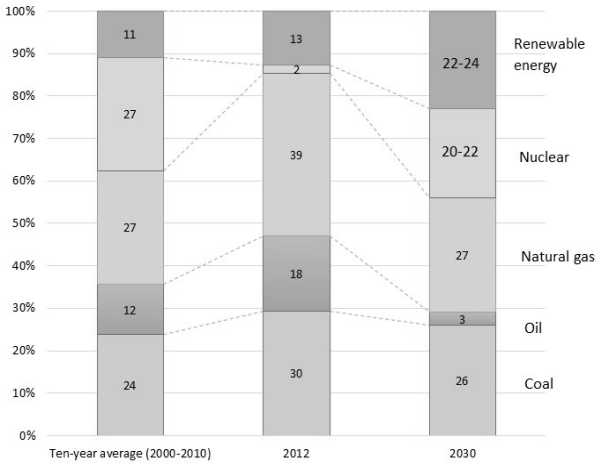
Another pillar of Japan's framework policies for tackling climate change is the Act Concerning the Rational Use of Energy (or Energy Conservation Act), which was enacted in 1979 and is the most comprehensive legislation on energy conservation. The Energy Conservation Act is significant from a climate change mitigation perspective for two reasons (Takamura, 2012). First, it covers energy-related CO_2 emissions, which account for about 90% of national GHG emissions. Second, it contains mandatory measures (for example, the requirement of energy management in industrial and commercial sectors, and energy efficiency standards for machinery and equipment including "Top Runner Standards" for electric appliances and vehicles, as well as for residential and commercial buildings), while most other energy and climate measures are not mandatory.

Regarding the long-term direction of policy, the Basic Act on Energy Policy of 2002 requires METI to develop the Basic Energy Plan. The Basic Energy Plan provides the general direction of national energy policy for the next two decades in line with three principles of "the 3Es+S": energy security, environmental protection, efficient supply and safety. The principle of "safety" was added after the Fukushima nuclear accident. The first Basic Energy Plan was developed in 2003 and revised in 2007, 2010 and 2014.

The 2014 Basic Energy Plan, which was formulated under the LDP-led government, stated that dependence on nuclear power would be reduced as much as possible in future, but called for a swift restart of existing nuclear power plants once the Nuclear Regulation Authority approves their safety. However, the 2014 Basic Energy Plan itself did not indicate the energy mix for 2030, since there was still uncertainty about the issue of nuclear power safety examinations, international climate negotiation, and the progress in the feed-in tariffs scheme. Instead, the Long-term Energy Supply and Demand Outlook of July 2015 indicated the energy mix for 2030, which in turn became the basis for bottom-up calculation of emissions reduction target for 2030 (METI, 2015).

Figure 3 presents power source mixes of ten-year average before the Fukushima nuclear accident, 2012, and 2030. The power source mix for 2030 seems well-balanced in terms of diversity of power sources. However, it would be unrealistic to expect that 20-23% of electricity could come from nuclear power, given the regulatory requirements and the current public sentiment against the re-operation of nuclear power plants (Wakiyama & Kuriyama, 2015). In addition, the validity and appropriateness for some key assumptions are debatable and may have resulted in an overestimation of baseline emission levels. One example is the assumption on future GDP growth; the compound average growth rate up to 2030 is assumed to be as high as 1.7% per year, which is consistent with the government's growth target, but most studies project lower rates, ranging at 0.3-1.6% per year (Kuramochi et al., 2015).

Figure 3. Power source ratios for 2000-2010, 2012, and 2030



Source: METI 2015

The Japanese government began to discuss its long-term low GHG emission development strategy (hereafter, long-term strategy) in Summer 2016. The Paris Agreement invites Parties to formulated and communicate their long-term strategies by 2020. In Japan, two different processes were established to discuss long-term vision under the MOE and METI, separately. While there is no official announcement as of writing, outputs from the two processes are expected to be merged and to become the basis for the Japan's long-term strategy.

3.2. Cross-sectoral Policies

The Global Warming Countermeasures Tax was introduced as a surtax on the existing upstream Petroleum and Coal Tax in October 2012. The tax rate began with JPY95/t-CO_2e in October 2012, and gradually increased to JPY 298/t-CO_2e in April 2016. While there are several exemptions such as imported coal used for the production of iron and steel, coke and cement and volatile oil feedstock for the production of petrochemical products, the Global Warming Tax covers domestic fossil fuel consumption equivalent to 80% of energy-related CO_2e emissions in FY2010 (Kuramochi, 2014).

The impact of the Global Warming Tax on CO_2 emissions reduction in 2020 is estimated to be around 6-24 Mt per year (0.5-2.2% of CO_2 emissions in 1990), of which 1.8 Mt per year results from a "price effect" (reduction in energy use through taxation) and 3.9-22 Mt per year results from a "budget effect" (reduction through the use of tax revenues for emissions reduction measures) (Kuramochi, 2014). The wide range of the expected budget effect means that it relies on how effectively the revenue is used. The tax revenue is used for promoting energy conservation, renewable energy, distributed generation, and innovative technologies, as well as promoting the JCM. Since the revenue from the Global Warming Tax is lumped together with that from the Petroleum and Coal Tax, however, it is not clear how large the budget effect is at this stage.

Regarding an economy-wide emissions trading scheme, the Japanese government has been considering it, but consensus has not yet been reached. To obtain experience and knowledge about a domestic emissions trading scheme, the MOE conducted a voluntary trial scheme, Japan Voluntary Emissions Trading Scheme (JVETS), which started in 2005 and ended in 2014. The Bill of the Basic Act on Global Warming Countermeasures, which was prepared by the DPJ-led government to realise the 25% target for 2020, stipulated the establishment of a domestic emissions trading scheme. The Bill was approved by the Cabinet for deliberation in the Diet in March 2010. The Bill passed the Lower House of the Diet, but was eventually scrapped following the dissolution of the Lower House in November 2012. Meanwhile, the Metropolitan of Tokyo introduced Japan's first mandatory cap-and-trade emissions trading scheme in April 2010, and Saitama Prefecture followed suit in April 2011. Despite these initiatives, the strong opposition from the Keidanren (Japan Business Federation) effectively hindered the introduction of the full-fledged, economy-wide emissions trading scheme. However, following the entry into force of the Paris Agreement, Minister of the Environment announced further deliberation on carbon pricing, including an emissions trading scheme, in November 2016[3].

3.3. Industrial Sector

Indirect emissions from the industrial sectors were 413 Mt-CO_2e, and accounted for 34% of total GHG emissions in FY2015 (excluding LULUCF). To achieve Japan's INDC, the industrial sector is required to reduce their emissions by 6.5% from 2013 levels by 2030. Its reduction requirement is not as large as other sectors, but the industrial sector is the biggest single sector in terms of CO_2 emissions.

3 Remarks at the Press Conference on 29 November 2016. <http://www.env.go.jp/annai/kaiken/h28/1129.html>

In 1997, just before the Kyoto Protocol was adopted, the Keidanren, the most influential industrial association in Japan, launched the Voluntary Action Plan on the Environment, which covered about 80% of energy-related CO_2 emissions from the energy conversion and industrial sectors. The Voluntary Action Plan aimed to reduce those sectors' five-year average CO_2 emissions during the period between FY2008 and FY2012 to below FY1990 levels. The Keidanren consists of several industrial associations such as the Federation of Electric Power Companies (FEPC), the Japan Iron and Steel Federation (JISF) and the Japan Cement Association, and each industrial association set its own voluntary target.

There were two main features in the Keidanren's Voluntary Action Plan. First, flexibility was given to each industrial association in choosing the form of target (either emission or energy, and either absolute or relative target). Second, despite the plan's "voluntary" nature, governmental involvement in implementation review is crucial (Rezessy & Bertoldi, 2005). Indeed, its progress was monitored under the Kyoto Protocol Achievement Plan. The Keidanren announced that the Voluntary Action Plan achieved 12.1% reduction from 1990 levels.

The Keidanren will continue this approach for the period up to 2030. In January 2013, it announced a new voluntary mitigation plan, Keidanren's Commitment to a Low Carbon Society (Phase I), which covered the period up to 2020, and in April 2015, the Commitment to a Low Carbon Society (Phase II), which will cover the period up to 2030. The Phase II Commitment is seen as a main vehicle for achieving indicative sectoral target for the industrial sector under Japan's INDC, i.e., 6.5% reduction from 2013 levels by 2030. Like the Voluntary Action Plan, each industrial association set its own voluntary target for 2020 and 2030. For example, the JSIF's voluntary reduction targets for 2020 and 2030 are 500 and 900 Mt-CO_2e from business-as-usual (BAU) emissions, respectively. The Japan Cement Association's energy intensity targets for 2020 and 2030 are to reduce 39 MJ/t-cem, and 49 MJ/t-cem from 2010 levels, respectively.

3.4. Power Sector

Direct emissions from the power sector were 480 Mt-CO_2e and accounted for 39% of total GHG emissions in FY2015 (excluding LULUCF). CO_2 emissions from the power sector increased by around 43% from 1990 levels.

Given the tight electricity supply and demand in the wake of the Fukushima nuclear accident and trends toward a liberalised electricity market, there are many plans to replace or build new coal- and gas-fired power plants (18 GW of coal-fired power plants and 29 GW of gas-fired power plants). Against this background, METI and the MOE requested electric power companies to establish a voluntary framework to reduce CO_2 emissions. In respond to this request, in July 2015, the FEPC and other power companies released the Electricity Sector's Commitment to a Low Carbon Society which contained an emission intensity target of 0.37 kgCO_2/kWh, and also launched the Voluntary Framework toward reducing CO_2 emissions. Furthermore, in February 2016, the FEPC announced the institutional arrangement of the Voluntary Framework, including the creation of the Electric Power Council for a Low Carbon Society of which mission is to monitor members' activities and promote the PDCA cycle to mitigate CO_2 emissions.

In addition, METI and the MOE also provided policy measures which support the electricity sector's voluntary framework to achieve 0.37 kgCO_2/kWh. In accordance with the Energy Conservation Act, power producers are requested to meet two kinds of benchmarks: one is the average heat efficiency (44.3%) for all power generating facilities owned; the other is fuel-type-specific heat efficiency for power generating facilities. Regarding the latter, the heat efficiency for newly constructed coal-fired power

plants is set at 42% (equivalent to ultra-supercritical (USC)) and for gas-fired power plants at 50.5% (equivalent to gas turbine combined cycle (GTCC)). The heat efficiency for existing power plants is 41% for coal-fired, 48% for gas-fired and 39% for oil-fired power plants, which were determined according to a list of best available technologies.

The share of non-fossil fuel power sources, including renewable energy and nuclear power, should also be in consistent with the 2030 energy mix. For all power retailers with generating capacity of more than 500 million kWh annually, 44% of electricity should come from non-fossil fuel sources pursuant to the Law Concerning Sophisticated Methods of Energy Supply Structures.

The MOE will evaluate the status of progress on the voluntary actions by power producers, including the capacity of power plants and CO_2 emission intensity of generated electricity based upon the information delivered by METI.

Despite the voluntary framework and the supporting policies measures, there still remain challenges to meet the emission intensity target of the power sector. Although the voluntary framework sets out how power producers are to develop plans and fulfil action via PDCA, no details of how individual power producers contribute to the overall target are given. Furthermore, the supporting policy measures (the Energy Conservation Act and the Law Concerning Sophisticated Methods) require power producers and retailers to make efforts to meet the requirements, but they are not mandatory. Judging from past experience on the Energy Conservation Act's benchmarking practices, it does not necessarily follow that power producers will comply with them. As of 2015, only about half of all the benchmarks in 10 areas covering six industries including the electricity supply industry) were achieved, and none of the 11 electricity companies had achieved the benchmark for the electricity supply industry.

Assuming all thermal power plants currently planned for construction and replacement are put into operation and all thermal power plants exceeding 40-year lifespan retire, coal-fired and gas-fired power plants need to operate below 56% and 43%, respectively, of their capacity factor in order to achieve the sector-wide emission intensity target of 0.37 $kgCO_2/kWh$ (Kuriyama & Tamura, 2016). Such low capacity factors would deteriorate the profitability, in particular, of coal-fired power plants since they are commonly operated at a capacity factor of 70-80%. Otherwise, the existing power plants need to retire before 40 years of operation. Is it still not clear how the voluntary framework and the associated policy measures could ensure such earlier retirement of the existing thermal power plants.

The Act on Purchase of Renewable Energy Sourced Electricity by Electric Utilities (Renewable Energy Act), which passed the Diet in August 2011 and was enacted in July 2012, is one of the successful pieces of legislation on renewable energy promotion (Kuramochi, 2014). The Renewable Energy Act introduced a feed-in tariff system for renewable energy. The Act requires electric utilities operators to purchase all the electricity generated by renewable energy sources (solar, onshore wind, geothermal biomass and hydro smaller than 30 MW at the start of the scheme, and offshore wind from April 2014) at fixed tariff rates for 20 years. Electric power utilities collect surcharges from electricity users to the costs of purchasing renewable energy-source electricity. The FIT scheme actually boosted renewable energy installation, in particular solar PV due the high tariff rate (JPY42/kWh for 20 years at the start of the scheme), which was among the highest in the world (WWF Japan, 2012). In 2015, 10 GW of solar PV was installed.

Tariff rates were revised several times in order to control the increasing procurement cost, adjust for the declining PV module price and achieve a more balanced deployment of renewable energy sources (see Table 1).

Table 1. Changes in purchasing prices of renewable energy sourced electricity

Fiscal Year	Solar PV		Wind	Geothermal	Hydro		Biomass	
	Residential	Commercial						
2012	42	40	22	26	24		24	
2013	38	36	22	26	24		24	
2014	37	32	22	26	24		24	
2015	33	27	22	26	24		24	
2016	31	24	22	26	24		24	
2017	28	21	21	26	20	27	21	24
2018	26	Bidding	20	26	20	27	21	24
2019	24	Bidding	19	26	20	27	21	24

Unit: Japanese Yen/kWh

Source: Nikkei 14 December 2016

Notes: Residential solar PV is less than 10 kW. Commercial solar PV is less than 2,000 kW. Wind is large on-shore wind. Geothermal is also large geothermal power plants. Regarding hydro and biomass power plants, after FY2017 new categories will be introduced: large (left row) and small (right row) in terms of generation capacity.

3.5. Transportation Sector

Indirect emissions from the transport sectors were 216 Mt-CO_2e, and accounted for 18% of total GHG emissions in FY2015 (excluding LULUCF). To achieve Japan's INDC, the transport sector is required to reduce their emissions by 28% from 2013 levels by 2030.

The Plan for Global Warming Countermeasures of 2016 states that the share of highly energy-efficient next-generation vehicles (hybrid vehicles, electric vehicles, plug-in hybrids, fuel-cell vehicles, clean diesel vehicles and compressed natural gas vehicles) in the new car sales will be in a range from 50% to 70% by 2030. Tax breaks and subsidies, albeit not explicitly designed to reduce CO_2 emissions, are expected to increase the share of the next-generation vehicles. These tax breaks and subsidies were traced back to 2009, and various tax breaks and subsidies for more environmentally friendly vehicles were available and are expected to continue. Next-generation vehicles accounted for 23.3% of new car sales in 2013 as opposed to only 3% in 2008[4].

In addition, the Plan indicated that the government will support bulk purchases of the next-generation vehicles, in particular heavy duty trucks and buses. For deployment of EVs and PHVs, R&D to extend a cruising range will be supported. For further promotion of FCVs, which were in the market in 2015, hydrogen infrastructure will be expanded and supported, and the revision of related regulations is expected.

3.6. Residential and Commercial Sectors

Indirect emissions from the commercial and residential sectors were 249 Mt-CO_2e and 198 Mt-CO_2, and together accounted for 35% of total GHG emissions in FY2015 (excluding LULUCF). To achieve Japan's INDC, the residential and commercial sectors are required to reduce their

4 See Grantham Research Institute on Climate Change and the Environment, the Global Climate Legislation Study, Japan, <http://www.lse.ac.uk/GranthamInstitute/legislation/countries/japan/>

emissions by 40% from 2013 levels by 2030. Therefore, the progress in these sectors is essential for achieving the INDC.

Improvement in energy efficiency of building and houses is a key pillar of mitigation initiatives in the commercial and residential sectors. There is a roadmap to mandate compliance for new buildings with thermal insulation performance standards in a phased manner by 2020. Another example is the promotion of "Net Zero Energy Buildings and Houses (ZEB/ZEH)" which achieve a net zero or almost zero annual primary energy consumption through various energy-saving measures and by using renewable energy onsite. By 2020, the average net energy consumption of newly built public buildings plans to be zero, and the average new energy consumption of all new buildings plans to be zero by 2030. More than half of newly-built custom houses all newly built buildings are expected to ZEH by 2020.

Deployment of highly efficient equipment and products is another key pillar of mitigation initiatives in the commercial and residential sectors. By FY2015, 28 items of machinery and equipment that consume energy are subject to the Top Runner Standards. In FY2016 incandescent lamp was newly added to the Top Runner Standards in order to achieve the phase-out of incandescent lamp production by 2020 and the replacement of all the installed incandescent lamp by LED by 2030. The 2013 amendment of the Energy Conservation Act added building materials such as windows and insulation materials to the Top Runner Standards. The Japanese government also aims for introducing 1.4 million units of household fuel-cell CHP (combined heat and power) in 2020 and 5.3 million units in 2030.

The implementation of energy management is also expected to play a pivotal role in mitigation CO_2 emissions from the commercial and residential sectors. The government plans to install the Building Energy Management System (BEMS) and the Home Energy Management System (HEMS) to all commercial buildings and residential houses by 2030.

4. Conclusions

This paper presented the latest trends of Japan's national and sectoral GHG emissions, as well as an overview of the landscape of climate mitigation policy. Following the adoption of the Paris Agreement, the Japanese government announced the Plan for Global Warming Countermeasures which provided a comprehensive package of policies and measures to achieve Japan's INDC. The Plan also contains timelines for deployment of specific energy efficient products and equipment up to 2030. Furthermore, the Plan stipulated the 2050 target of reducing emissions by 80%. Though its base year is not specified, it is the critical step forward that the overall direction of mitigation policy was determined.

However, there is no reference to net-zero emissions or de-carbonisation of the Japanese socio-economy in the Plan for Global Warming Countermeasures. It is necessary to reduce net global CO_2 emissions to zero as soon as possible in the second half of the 21st century in order to stabilise global temperatures at warming thresholds of 1.5 °C and 2 °C—the Paris Agreement's long-term temperature goal (Rogelj et al., 2015). The 2020/2030 targets need to be regarded as stepping stones to the 80% reduction in 2050, and the 2050 goal also needs to be seen as a milestone toward net-zero emission, not as a final destination. Thus, the PDCA cycle of the Plan for Global Warming Countermeasures should not be designed only to achieve the 2030 target, but rather to achieve the 2050 goal and beyond. Perhaps, the long-term strategy, which is currently under discussion, is expected to play such a role.

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