Recommendations for Revising Japan's Nationally Determined Contribution (NDC)

Institute for Global Environmental Strategies (IGES)

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The year 2020 presents the first opportunity for countries to update and/or submit their Nationally Determined Contributions (NDCs) under the Paris Agreement. Given this opportunity, the Institute for Global Environmental Strategies (IGES) is making the following recommendations with respect to Japan's revision of its NDC.

Recommendation 1:

Japan's energy intensity of GDP (final energy consumption per unit of GDP) and carbon intensity of energy (CO_2 emissions per final energy consumption) have been improving almost at the same level as the NDC assumption. However, the country's actual GDP and economic activity levels are not increasing as assumed in the NDC. Therefore, Japan should make adjustments to fill the gap between the NDC assumptions and the actual values, and based on this, set a more ambitious emissions reduction target[1].

Recommendation 2:

If energy intensity and carbon intensity improve as assumed in the NDC, and the GDP growth rate is set to be more realistic, the emission reduction rate in 2030 is calculated to be 32% compared to the 2013 level.

Recommendation 3:

In addition to the re-estimation of NDC assumptions such as GDP, Japan should consider more substantial measures aiming to make further improvements in energy intensity and carbon intensity in the ongoing revision process of the Plan for Global Warming Countermeasures. In particular, it is necessary to strengthen measures focused on the expansion of renewable energy use, which is seen as a major power source in the Fifth Strategic Energy Plan.

Recommendation 4:

In addition to the current absolute reduction target, it is recommended to use complementary indicators such as "energy intensity (TFC/GDP) improvement rate" and "carbon intensity (CO_2/TFC) improvement rate," in order to evaluate policy effectiveness.

Recommendation 5:

NDC should include all the necessary information stipulated in the NDC guidance of the Rulebook for the implementation of the Paris Agreement that was adopted at COP24.

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[1] The COVID-19 pandemic is expected to have a massive impact on economic activities. It is desirable to design and implement an economic stimulus package in a form that promotes net-zero emissions for Japan and increases resilience to climate change.

1. Rationale for Recommendation 1

CO_2 emissions are greatly affected by three factors: 1) GDP or economic activity levels, 2) energy intensity (amount of final energy consumption (TFC) per unit of GDP: TFC/GDP), and 3) carbon intensity (CO_2 emissions per unit of final energy consumption: CO_2/TFC).

Japan's NDC is based on assumptions of the GDP growth and final energy consumption in 2030, as showed in the "Long-term Energy Supply and Demand Outlook" that was compiled in July 2015. As Figure 1 shows, improvement rates in energy intensity and carbon intensity are mostly on track towards achieving the NDC. Energy intensity improvements have been largely achieved due to energy-saving initiatives in each sector. Carbon intensity has improved owing to the expansion of renewable energy as well as the recommencement of operations at some nuclear power plants. On the other hand, overall CO_2 emissions have been decreasing at a faster rate than assumed. This demonstrates that the GDP or economic activity level is rising at a slower rate than what was assumed.
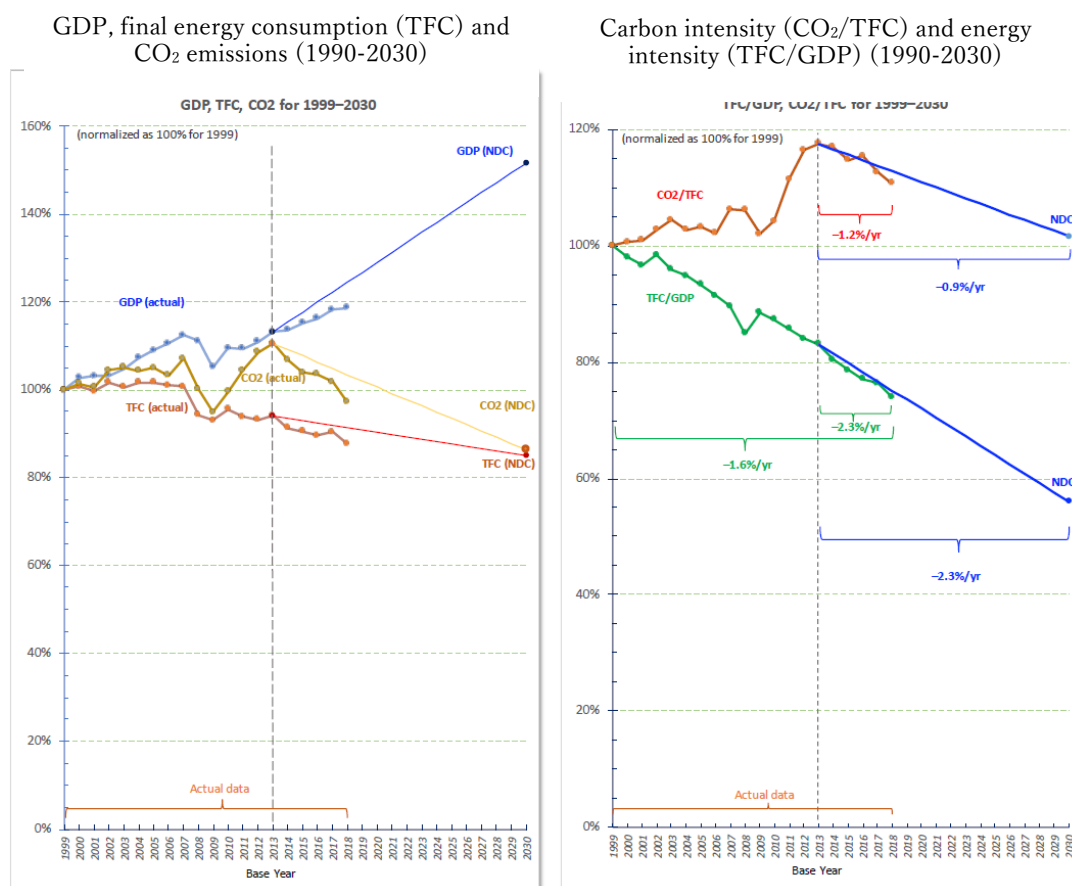
GDP, final energy consumption (TFC) and CO₂ emissions (1990-2030)

Carbon intensity (CO₂/TFC) and energy intensity (TFC/GDP) (1990-2030)

Fig. 1: Trends in Japanese CO2 emission by energy-origin and its fluctuating factors
Source: Created by IGES based on IEA (2019a), OECD (2019), IEA (2019b), METI (2019), and MOEJ (2019)

The assumptions of economic activity level in the NDC (i.e. the "Long-term Energy Supply and Demand Outlook") and the actual value are compared for the following six main industrial sectors: crude steel production, ethylene production, cement production, paper and pulp production, floor area of commercial buildings, and freight transport. The sectoral final energy consumption for industry in the "Long-term Energy Supply and Demand Outlook" was based on activity levels in FY2030 that were in turn assumed by industrial associations under the voluntary action plan set out in the Japan Business Federation's (Keidanren) "Commitment to a Low Carbon Society". Future floor areas for commercial buildings and freight transport were estimated based on assumptions such as an annual economic growth of 1.7%. For such assumptions, Figures 2 to 7 illustrate the actual values and linear trends from FY2013 to FY2018. For the illustrated predictive values of crude steel, ethylene, cement, and paper and pulp production in FY2030, the forecast by the Japan Center for Economic Research (JCER) is also shown.[2]

For four out of the six sectors (crude steel production, ethylene production, paper and pulp production, and freight transport), both the actual linear trends and JCER's predictive values have a tendency to fall below the NDC assumptions. On the other hand, cement production is at the same level as the assumption, and the floor area of commercial buildings is on a trajectory to exceed the NDC assumption in 2030.

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[2] The Japan Center for Economic Research (JCER) "Industrial Pick-up Forecast (FY2018)".
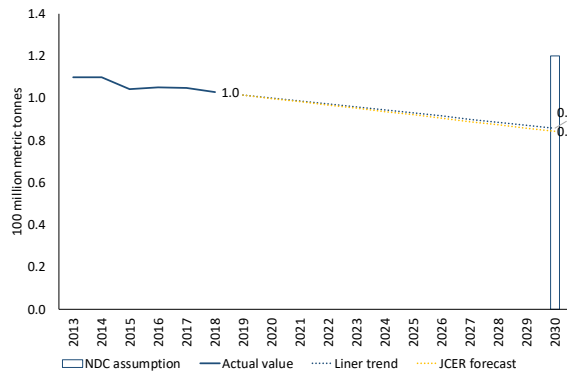
Fig. 2: Comparison of the NDC assumption and actual production of crude steel
Source: created by IGES based on JISF (2019), Agency for Natural Resources and Energy (2015), JCER (2018), and JCER (2019)
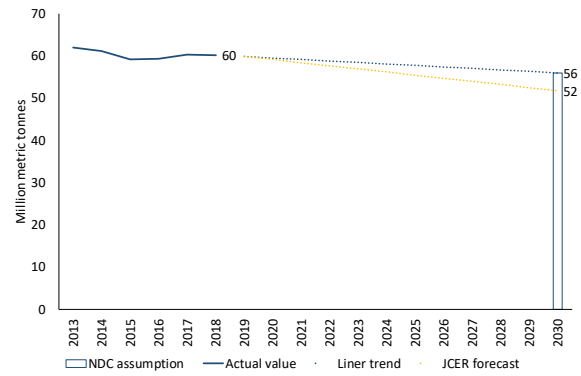

Fig. 3: Comparison of the NDC assumption and actual production of cement
Source: created by IGES based on Japan Cement Association (2020), Agency for Natural Resources and Energy (2015), JCER (2018), and JCER (2019)
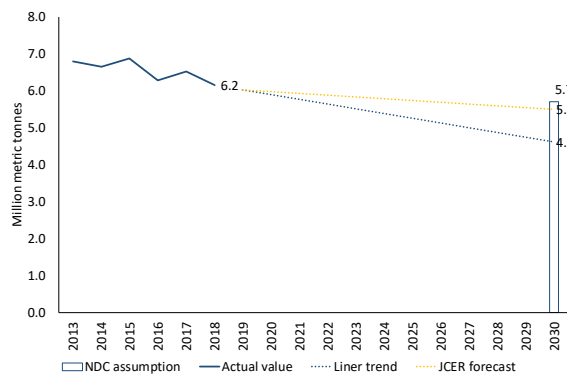

Fig. 4: Comparison of the NDC assumption and actual production of ethylene
Source: created by IGES based on JPCA (2019), Agency for Natural Resources and Energy (2015), JCER (2018), and JCER (2019)
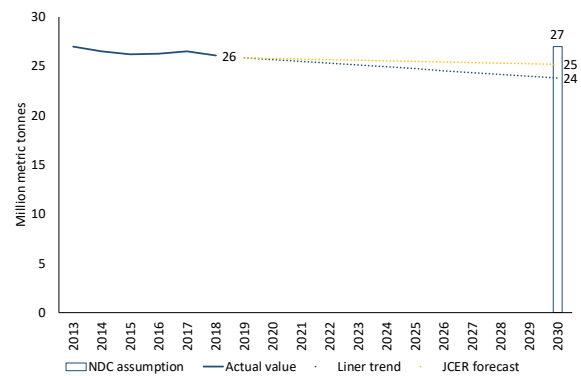

Fig. 5: Comparison of the NDC assumption and actual production of paper and pulp
Source: created by IGES based on JPA (2019), Agency for Natural Resources and Energy (2015), JCER (2018), and JCER (2019)
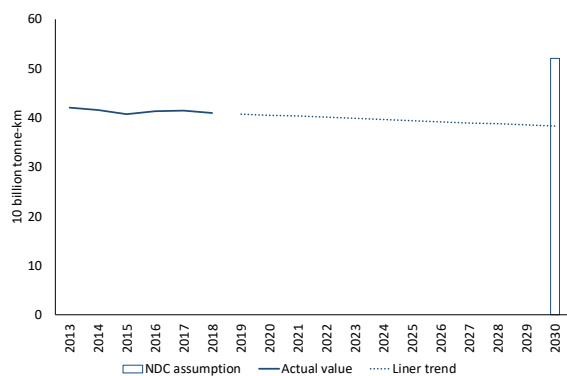

Fig. 6: Comparison of the NDC assumption and actual freight transport
Source: created by IGES based on MLIT (2019b), MLIT (2019d), MLIT (2019c), and Agency for Natural Resources and Energy (2015)
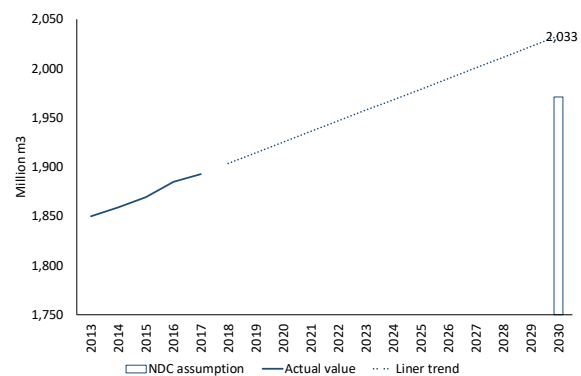

Fig. 7: Comparison of the NDC assumption and actual floor area of commercial buildings
Source: created by IGES based on IEEJ (2019), and Agency for Natural Resources and Energy (2015)

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These data suggest the following two points. Firstly, growth in the actual GDP and economic activity levels in several main sectors are lower than the NDC assumptions. Secondly, energy intensity and carbon intensity are improving at a pace that is consistent with achieving the NDC target. Therefore, there is room for increasing the level of the emissions reduction target by updating the current status of economic activity levels.

2.   Rationale for Recommendation 2

The annual GDP growth rate assumed in the "Long-term Energy Supply and Demand Outlook" is 1.7%, which is set higher than forecasts from private think tanks (0.58%-1.02%). CO_2 emissions in 2030 will be about 100 $MtCO_2$ less than the current NDC assumption (a 32% reduction in GHG emissions compared to FY2013 levels) given the following conditions: 1) the GDP growth rate is maintained at the median of the private think tank forecast (1%), 2) current mitigation measures continue to be implemented, and 3) energy intensity and carbon intensity are improved as assumed in the NDC.[3]

3.   Rationale for Recommendation 3

There is still a significant gap between the target of 32% compared to the FY2013 level and the upward revision of NDC to meet emissions reduction by 45% from 2010 levels by 2030 as advocated by UN Secretary-General António Guterres based on the IPCC Special Report on Global Warming of 1.5℃. In addition to the re-estimation of GDP growth, which could lead to 32% emissions reduction, as well as the re-estimation of other FY2030 assumptions such as activity levels of the major sectors mentioned in "Rationale for Recommendation 1", further discussion is needed on the possibility of any additional emissions reduction initiatives. Such additional initiatives must be designed to deliver substantial emissions reduction with a view to achieving net zero emissions by 2050. Subsequently, it would be appropriate to finally submit a revised NDC that takes into account such additional reductions.

The Plan for Global Warming Countermeasures, which is the implementation plan for the NDC, undergoes a review every three years, and that review is currently ongoing. It would be desirable to discuss additional measures to further improve energy intensity and carbon intensity within the revision process of the current Plan, and reflect the specific measures discussed in the revised NDC.

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[3] Kuriyama, A., Tamura, K., and T. Kuramochi (2019) "Can Japan enhance its 2030 greenhouse gas emission reduction targets? Assessment of economic and energy-related indicators", *Energy Policy*. Vol.130: 328-340

Particularly, the decarbonisation of power sources, associated with the promotion of electrification, is of utmost importance since it contributes to improvements in both energy efficiency and carbon intensity. Renewable energy is shown in the Fifth Strategic Energy Plan as a major power source in the future; however, the certified capacity of renewable energy power generation has been stagnating, and wind power capacity is still largely deviating from the current NDC target (Fig. 8, Fig. 9). It is necessary to strengthen measures, focusing on the expansion of renewable energy use.
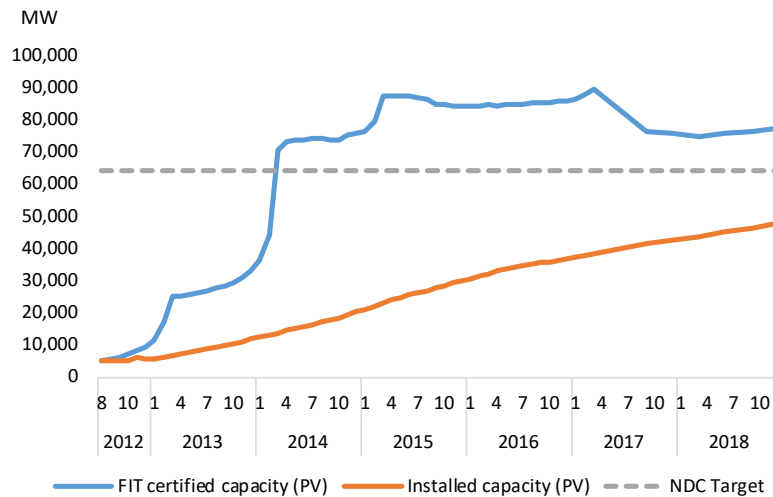

Fig. 8: Trends in solar power generation capacity (cumulative) and the NDC assumed target
Source: created by IGES based on the "Agency for Natural Resources and Energy (2019) Feed-in Tariff System Information Website"
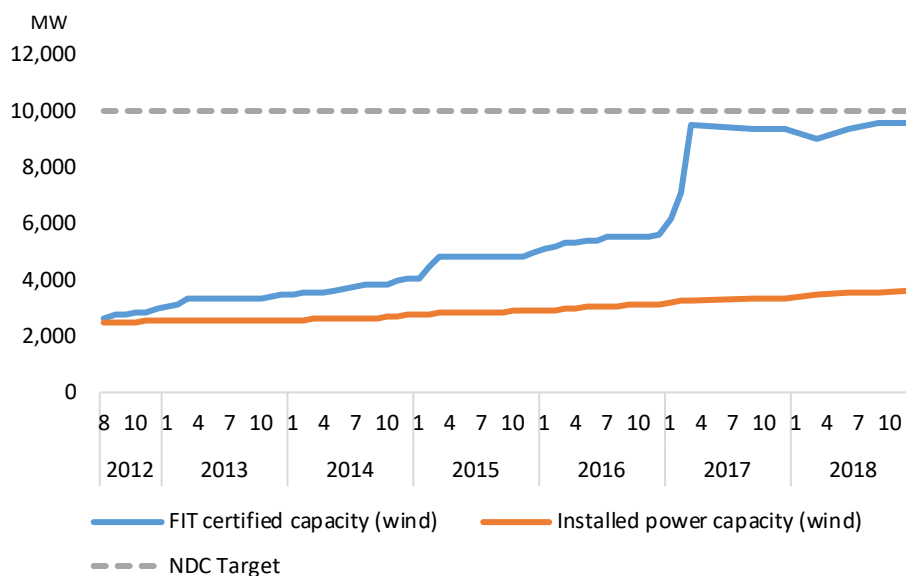

Fig. 9: Trends in wind power generation capacity (cumulative) and the NDC assumed target
Source: created by IGES based on the "Agency for Natural Resources and Energy (2019) Feed-in Tariff System Information Website"

As shown in Figure 10, the industrial structure of Japan's economy has changed over time, and in recent years, changes in the structure of supply and demand have been due to factors such as diminishing domestic demand and the rise of strong international competitors. In addition, the digitalisation of the economy in alignment with the diffusion of artificial intelligence (AI) and the Internet of Things (IoT) has led us to a major turning point not only for our lifestyles, but also for the production style of manufacturing sectors. These trends are expected to continue and affect CO_2 emissions.
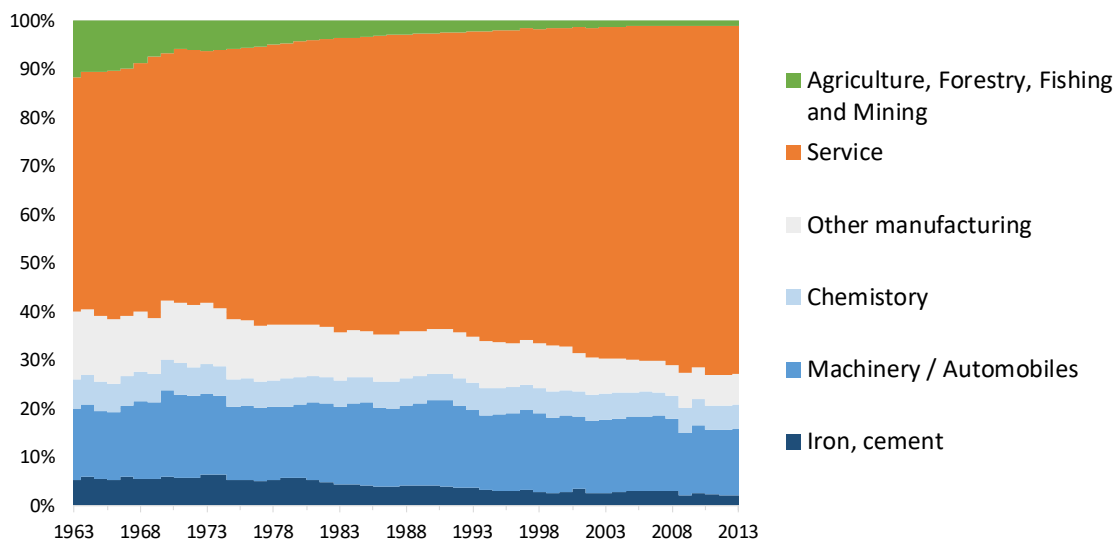

Fig. 10: Trends in value-added ratios in each industrial sector in Japan

Source: created by IGES based on UNIDO (2017)

Recently, Nippon Steel announced the closure of Kure Works by the end of September 2023 and the suspension of a blast furnace at Wakayama Works[4]. These have a crude steel production capacity of 5 million metric tonnes annually, and according to the Greenhouse Gas Emissions Accounting, Reporting, and Disclosure System, the greenhouse gas emissions for crude steel production in FY2014 was roughly 10 $MtCO_2$.[5] This is equivalent to roughly 0.7% of Japan's emissions (1.408 billion tCO_2) in FY2013 (the base year for the NDC).

For Japan's economy to remain productive under the global trends towards digitalisation, all economic

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[4] Nippon Steel (2020).
[5] The Greenhouse Gas Emissions Accounting, Reporting, and Disclosure System's data from FY 2013 did not include such data. Thus, the FY 2014 data were shown.

sectors including heavy industry must adapt to the digitalisation trend and increase their competitiveness. Going forward, as Japan takes action towards decarbonisation, it will become important to implement policy measures to support business activities in adapting appropriately to these trends. In that regard, it will be vital to comprehensively consider the transition of regional economies and local companies, as stated in Japan's Long-term Strategy under the Paris Agreement.

4. Rationale for Recommendation 4

It would be beneficial to set targets for easy-to-understand indicators that more precisely reflect policy efforts excluding exogenous factors. Such actions will not only increase Japan's level of transparency internationally and domestically with respect to its efforts, but also clarify the direction of policy progress assessments as well as policy priorities and enhanced policies, which would facilitate the PDCA (plan-do-check-act) cycle approach.

The two kinds of intensity improvement rates (annual rates) stated above are appropriate indicators that reflect efforts made in "macro-level energy conservation (demand side)" and "low-carbonisation of energy (supply side)", respectively. These are suitable for clarifying the meaning of the target. Regarding Japan's NDC, it is assumed that such intensity improvement rates (while not written in the finalised NDC) form the premise of the targets.

Japan has traditionally asserted the importance of intensity evaluations, which have been used in Keidanren's voluntary initiatives as well as in the Energy Conservation Law. Factor analysis, which uses the rates of change in energy (the backbone of policy) intensity and its associated carbon intensity, is now being widely used for analytical evaluations across the globe, in the form of the Kaya identity. As such, it is meaningful for Japan to call upon each country regarding the utility of adding intensity improvement targets to the NDC, in addition to the absolute emission reduction target. The Paris Agreement allows each country to freely set (multiple) targets for its own NDC. In other words, a country can incorporate its approach and philosophy into the NDC. Setting targets for these indicators corresponds to their implementation.

5.   Rationale for Recommendation 5

Since Japan's NDC was formulated before COP24, it does not contain all the necessary information stipulated in the new NDC guidance. Although the Rulebook notes that all the requisite information for guidance needs to be stated from the next around of NDC onwards, the rules are already open to

the public. Therefore, towards updating its NDC this time, Japan should, as a developed country (with such capacity) and from a transparency standpoint, provide the necessary information in alignment with the rules. In particular, there is still inadequate information regarding requirements such as the "planning process" and "assumptions and methodologies with respect to NDC formulation".

Regardless, the inclusion of this information will become necessary in the biennial transparency reports that provide updates on the progress made with respect to the NDC target. In the Plan for Global Warming Countermeasures, Japan, learning from its experiences with the Kyoto Protocol Target Achievement Plan, has been building a very elaborate mechanism for the PDCA cycle. By adding these good practices into the NDC update and sharing these practices with other countries, Japan can become a model not only for target setting, but also for taking on-the-ground measures effectively.

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