Aim Only for an Achievable Target

Yamaguchi Mitsutsune considers Japan's options for a revised CO_2 emissions reductions strategy in the wake of the Great East Japan Earthquake.

Japan was obliged to make radical changes in its energy plans and climate change policies following the March 11, 2011 Great East Japan Earthquake disaster (which included a massive tsunami) and the Tokyo Electric Power Company (TEPCO) Fukushima Daiichi Nuclear Power Plant accidents which ensued. The nation's climate change policy and greenhouse gas emission targets are based on long-term energy supply and demand forecasts through 2030. According to these forecasts, the share of nuclear power in Japan's total electric power generation was expected to rise steadily from 31% (304.8 billion kWh) in 2005 to 42% (434.5 billion kWh) in 2020, and further to 49% (469.5 billion kWh) in 2030 (see **figure**). At the time of the accident, there were fifty-four nuclear power reactors (with a capacity of 48,847,000 kWh) in operation, and all but one were expected to remain online through 2030. In addition, nine new ones were expected to come online by 2020 (having a combined capacity of 12,940,000 kWh, two being under construction), and a further five were to be built by 2030 (6,368,800 kWh), the operating rate being 80%. Of the present fifty-four reactors, fifteen were directly damaged by the earthquake and tsunami, including six at the Fukushima Daiichi Nuclear Power Plant. As of December 20, 2011, however, all but seven have been taken offline following government shutdown orders, various problems, or regular safety checks. Even though Prime Minister Yoshihiko Noda declared a condition equivalent to cold shutdown of the damaged Fukushima Daiichi Nuclear Power Plant on December 17, 2011, the situation still remains unresolved, and it is unclear when those reactors now shut down will come back on line again.

Impact on the Kyoto Protocol

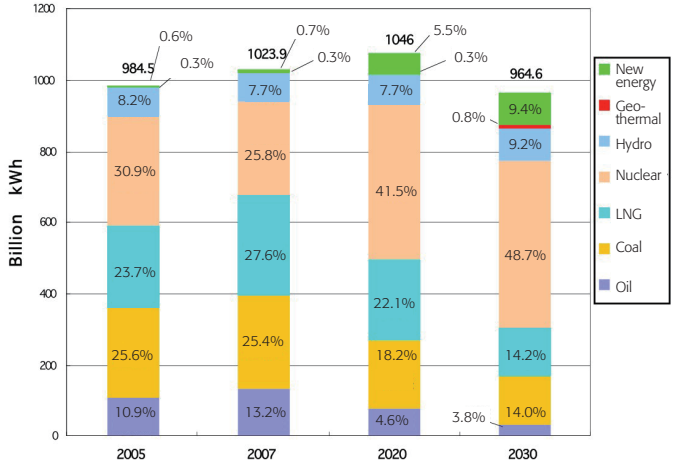
Under the Kyoto Protocol, Japan set a target of reducing annual average CO_2 emissions during 2008–2012 by 6% versus base-year 1990 levels. Such a target would have been exceedingly difficult to achieve even with tighter cooperation between government and business as well as Japan's purchase of CO_2 emission credits in excess of 400 million tons. In a stroke of bitter irony, the nuclear accident occurred just when the target seemed achievable amid the economic slump following the Lehman shock of 2008.

In the absence of extraordinary steps, the nuclear power stations currently in operation will be shut down for regular inspections by May of 2012. It is unclear how many will come back online within the remaining term of the Kyoto Protocol, but let us assume for the moment that all nuclear power stations are indeed shut down, with the lost output being offset by plants burning fossil fuels. How much might Japan's CO_2 emissions increase in such a worst-case scenario?

According to estimates by the Institute of Energy Economics Japan, the additional CO_2 output through 2012 in such a scenario would be 470 million tons. This breaks down into 94 million tons on average over the five-year term of the Kyoto Protocol, and amounts to 7.5% of the 1.26 billion tons of Japan's greenhouse gas output in 1990. Thus in this worst-case scenario, Japan's 6% reduction target would actually be 13.5%, meaning that achievement of the Kyoto Protocol target would be very difficult regardless of what efforts might be made to cut electricity use. (Note that the renewable energy feed-in tariff system enacted in August of this year will come into force in July of 2012. It will be physically impossible for renewable energy to offset the shortfall caused by the shutdown of nuclear power stations by the time fiscal 2012 ends on March 31, 2013.)

What happens, then, if the target cannot be achieved? Under Article 2 of the United Nations Framework Convention on Climate Change, the ultimate objective of the Convention is "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system," an one of the underlying conditions being that this level should be achieved within a time frame sufficient to "enable economic development to proceed in a sustainable manner." Since global warming measures will require continuous effort over the long term on a global scale and since the recent nuclear accident resulted from a *force majeure* event, namely the earthquake and associated tsunami, the reasonable course for Japan is not to buy credits from overseas but to stress the broader perspective of Japan's overall efforts with the expectation that the international community would understand Japan's dilemma. It should be noted as proof of Japan's efforts that Japan leads the world in energy or CO_2 emission efficiency in major industries such as power, iron and steel. Japan has made efforts which no other

Electric Power (Revised Long-Term Energy Supply-Demand Forecast; August, 2009)



nation has been able to match, so if current targets are now impossible to achieve owing to *force majeure*, the international community cannot help but understand Japan's position.

Revision and Resubmission of Mid-term Targets

In 2010, the Japanese government set a new target of cutting CO_2 emissions by 25% from 1990 levels by 2020. This target was based on forecasts made at that time regarding Japan's long-term energy demand and supply. But if the factors underlying these forecasts have changed unexpectedly, it would naturally have a major impact on the reduction target. Amid the uncertainties surrounding the state of nuclear power generation in 2020, the following two scenarios might be considered with a view to estimating the impact of the nuclear accident.

The table presents two projections for the increase in CO_2 emissions through 2020 that could result from the increased use of fossil fuels to replace lost nuclear power capacity. Japan would have to cut CO_2 emissions not by 25% versus 1990 levels but 33% if Scenario 1 prevails or 34% if Scenario 2 prevails, but either target would be absolutely impossible to achieve. Of course, if the lost nuclear capacity could be entirely offset by renewable energy, there would be no increase in CO_2 emissions at all. Let us therefore consider whether that is possible.

The load factors of Japan's solar and wind power generation are 12% and 20%, respectively. If the lost nuclear capacity were completely offset by solar power, the necessary increase in solar generation capacity would be 160GW under Scenario 1 and 180GW under Scenario 2. The corresponding increases in wind capacity needed would be 94GW and 106GW. (These figures represent additions over existing plans for increased capacity of 28GW for solar and 5GW for wind.). Under current conditions, it would be very difficult in physical terms to install this amount of capacity in ten years, and the cost would be astronomical. The renewable energy feed-in tariff system finalized in August of this year will come into force in July of 2012. Let us assume that the average gap between the tariff and the generation cost of nuclear power is 24 yen/kWh in the case of solar and 7 yen/kWh in the case of wind and that the purchase period is ten years for solar and fifteen years for wind. If we then compute the total cost of adopting the system for an anticipated 10 years ("cost" in this case meaning the gap between the tariff for solar or wind power and the cost of nuclear power), the results are 40 trillion yen in Scenario 1 and 45 trillion yen in Scenario 2 for solar versus 17 trillion yen in Scenario 1 and 19 trillion yen under Scenario 2 for wind. (These estimates are nominal values and do not include ground rents. Actual values would of course depend on the exact tariffs ultimately paid.). In the above calculation, the cost of nuclear generation was assumed to be 8 yen/kWh. The government's Cost Verification Committee recently reported the cost of nuclear power, taking consideration of legal liabilities caused by the accident, to be at least 8.9 yen/kWh. It will then have to be compared with the increased cost of stabilizing the system through massive adoption of renewable energy. In any event, it is safe to conclude that, under present economic circumstances, offsetting the loss of nuclear power generating capacity entirely by renewable energy will be physically and economically impossible.

There is no rationale for a 25% reduction target from 1990 levels, and achieving that target will be next to impossible. Even if solar and wind capacity are increased according to initial plans by 28GW and 5GW, respectively, adhering to the original 25% reduction target versus 1990 levels would now require a 33% to 34% reduction owing to the unavoidable increase in Japan's expected CO_2 emissions due to the accident. Even if constraint on demand is taken into consideration, achieving such targets will be next to impossible. Japan should therefore announce to the international community that it has no choice but to review its 25% reduction target. The precondition of Japan's 25% reduction target was, after all, achievement of an ambitious target (limiting global warming to 2 degrees Celsius) through an international framework in which all major economies could participate. So long as this precondition cannot be met, there would be no international inconsistency in Japan's setting a new target.

In June of 2009, then Prime Minister Aso Taro decided, after thorough consultation with expert advisors, on a 15% CO_2 reduction from 2005 levels (which would be an 8% reduction from 1990 levels) by 2020, but following a change in government, this was conditionally revised to the more ambitious target of 25% versus 1990 levels (30% versus 2005 levels). Aso's 15% target provides a good reference. It should be adjusted to reflect the increase in Japan's carbon emissions owing to the earthquake, the conditions surrounding the restarting of nuclear power stations, and the extent it is possible to exploit renewable energy, together with whatever reduction there may be on the demand side. The result should then be announced to the international community as Japan's revised target. Rather than adhering to a target that is unrealizable, this course would be more effective in actually reducing emissions. In addition, it would enable Japan to popularize its technology around the world and thereby contribute on a global scale. This should be Japan's strategy.

Additional CO_2 Emissions from Replacing Nuclear with Fossil Fuels (2020)

Scenario	Lost nuclear capacity	Additional CO_2 emissions by 2020 on replacing nuclear with fossil fuels
(1) Shutdown of six Fukushima Daiichi reactors as well as all plants aged over forty-one years; two new reactors	23.57 GW	99 million tons (8% vs. base year)
(2) Fifteen damaged reactors remain offline through 2020; no new reactors	26.40 GW	111 million tons (+9% vs. base year)
Nuclear operating rate of 80%; CO_2 emissions from fossil fuel based on FY2009 (0.6kg/kWh) results.		

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