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Kyoto Protocol and Numerical Target Attainment Plan

Taishi Sugiyama*

Central Research Institute of Electric Power Industry

Abstract:

We outline the Kyoto Protocol and numerical target attainment plan, make considerations on the essence of a numerical target, show a present view of the Kyoto Mechanisms, and discuss prospects for compliance with the Kyoto Protocol.

免責事項

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* Corresponding author. [e-mail: sugiyama@criepi.denken.or.jp]

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1. Outline of Kyoto Protocol

The Kyoto Protocol, adopted at the Kyoto Conference (COP3, 1997), set numerical targets for reduction in emissions of greenhouse gases such as CO_2.

The targets require Japan, United States and EU to reduce, during the 2008 to 2012 period, emissions by an average of six percent, seven percent and eight percent, respectively, from the 1990 levels.

The Kyoto Protocol is also characterized by introduction of the Kyoto Mechanisms—international emissions trading (IET), joint implementation (JI) and clean development mechanism (CDM)—that allow an surplus emission allowance of a country to be “purchased” as “emission credit” and used for numerical target attainment by another country.

There have been, however, many criticisms against the Kyoto Protocol, saying that the numerical target setting is unfair, and the protocol is inefficient for emission reduction.

The numerical targets of Japan, United States and EU are seemingly similar, but actually they are not (Figure 1). For Japan, emission reduction is difficult, because the country had continued efforts for energy conservation since the “oil shock.”

Japan	△6%	→	Large amount of emission reduction
EU	△8%	→	Almost attainable without additional measures
United States	△7%	→	Withdrawal
Russia	△0%	→	Excess of allowance
China, India and like		→	No target

Fig.1 Uneven numerical targets in Kyoto Protocol

EU is seen to attain its target pretty easily due to two factors. The first is that emissions from East Europe have considerably reduced due to economic crash since 1990. The other is that years from 1990 happened to be a diffusion period of natural gas in EU. It is because year 1990 was selected as the reference year that the both factors were advantageous to EU, speaking for good negotiation skill of EU.

Though the United States was assigned a hard target, hardness of the target does not matter, because the country withdrew from the protocol. Russia has a target, but it virtually does not have a meaning as a target to be attained, because effects of economic crash on Russia were more serious

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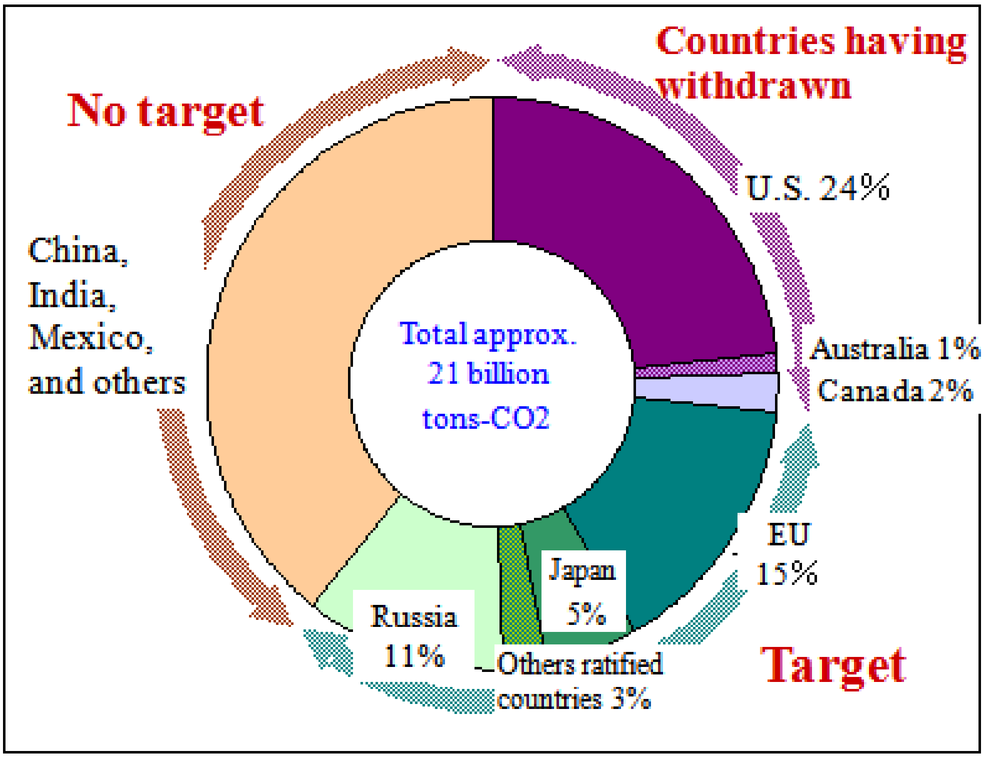
than those on East Europe. Developing countries, including China and India, were assigned no numerical targets.

Such uneven setting of numerical targets and withdrawal of some countries caused such a situation that only about one fourth of the world emission is covered by the Kyoto Protocol, with only Japan and Canada having particularly hard targets (Figure 2).



Source: Edited from *EDMC Handbook of Energy & Economic Statistics in Japan*, 2006

Fig. 2 CO_2 emission shares (1990) and Kyoto Protocol

Then let us see necessary amounts of emission reduction. Figure 3 shows the difference between the actual emission in 1998 and numerical target, calculated for each country.

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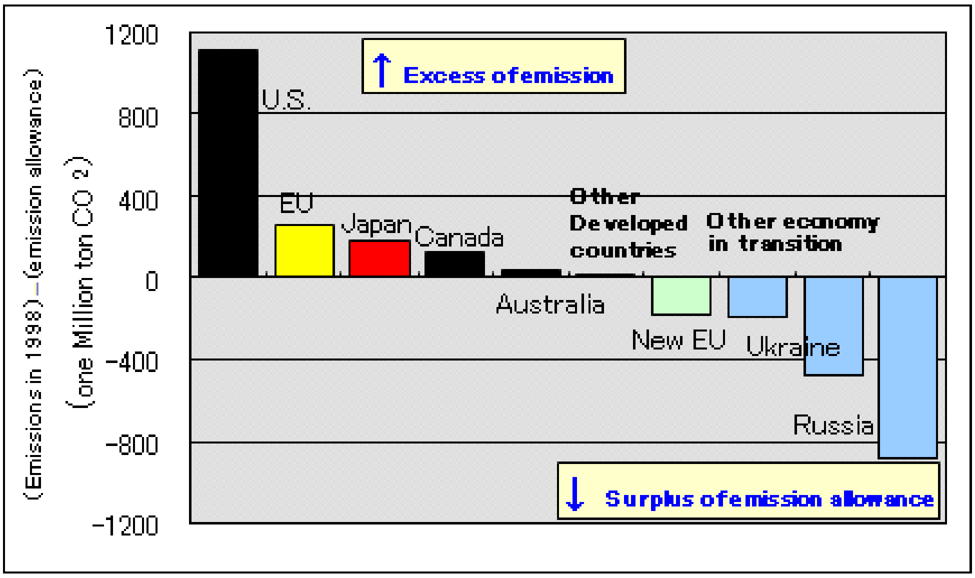

Source: Grubb, M., Vrolijk, C., Brack, D. (1999) *The Kyoto Protocol: a guide and assessment*, RIIA and Earthscan Publications Ltd, London

Fig. 3 Differences between emissions and numerical targets

In the figure, an upward bar such as that for the United States means that the country must reduce its emission corresponding to the length of the bar. Contrarily, a downward bar means the country can attain its numerical target even if its emission increases by the amount corresponding to the bar length.

The United States had the largest obligation to reduce its emission, but it withdrew from the Kyoto Protocol, and is now out of the framework of international reduction efforts.

EU's situation looks hard, but the "EU" in the figure means West European fifteen countries that constituted EU in 1997. On the other hand, more than ten East European countries that joined EU later, shown as "New EU" in the figure, have surplus of emission allowance, which cancels a large part of EU's reduction obligation. Russia and Ukraine also have surplus allowances. Canada's situation is almost as hard as that of Japan, but Canada has implemented few domestic policies for emission reduction, and in addition the amount of emission from Canada has continuously increased, resulting in little chance of attaining its target.

Thus the figure shows us Japan's peculiar situation that it is the only country that is given a hard numerical target, and attaches great importance to the compliance.

2. Outline of Japan's domestic policies for climate change mitigation

Now let us see Japan's domestic measures concerning the Kyoto Protocol.

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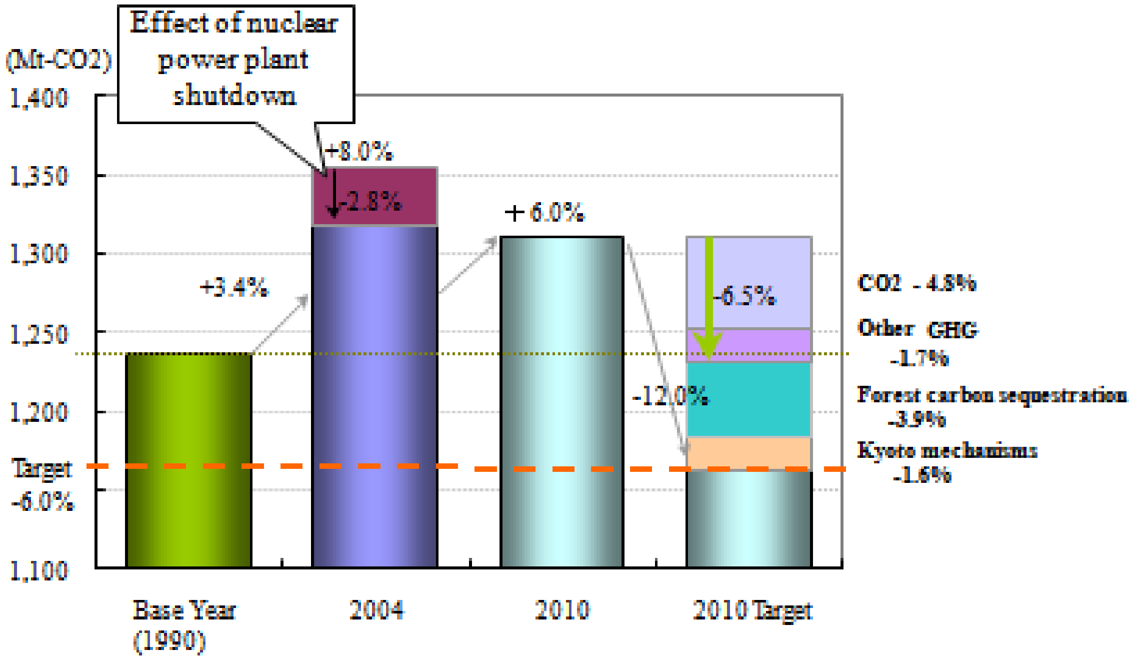
The Kyoto Protocol was ratified by the Japanese Diet in 2002, came into effect in 2005 to be an international treaty. The Japanese government has taken measures for compliance with the treaty, including necessary establishment and amendment of domestic laws.

Many laws and regulations, including the Law Concerning the Rational Use of Energy, are related to attainment of the numerical target imposed by the Kyoto Protocol. The most comprehensive of them is the Kyoto Protocol Target Achievement Plan, in which the numerical target is broken down into targets for respective sectors.

Though greenhouse gas emissions have been increasing almost in proportion to economic growth since the reference year (1990), the Target Achievement Plan says that Japan will attain the Kyoto Protocol numerical target through effects of multiple policy measures (Fig. 4).



Source: Edited from *the Kyoto Protocol Target Achievement Plan*

Fig. 4 Greenhouse gas emission and numerical target

Looking into more detail in the emission reduction measures, we find that the Plan is intending to attain the target not only through reduction in carbon dioxide emission but also through reduction in methane, N_2O and alternative CFCs emissions and forest carbon sequestration, which are all authorized by the Kyoto Protocol as contributors to the greenhouse gas emission reduction.

These reductions, however, are insufficient for attaining the numerical target. The Plan says that the remaining 1.6% reduction is achieved through the Kyoto Mechanisms, that is, by purchasing emission credit. The amount of credit to be purchased is estimated to be about 20 million tons-CO_2 on the annual basis, or about 100 million tons-CO_2 in five years.

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Of various types of greenhouse gases, energy-originated CO_2 occupies the largest part, and its emission is most difficult to reduce (Figure 5). Emission of energy-originated CO2 in 2002 was 12% larger than the reference year level. This emission is planned to be reduced, but there is no telling whether it will succeed or not. Especially, as shown in the figure, emissions from the civilian and transport sectors increased considerably.

	Reference year (Mt-CO2)	2002(%from reference year level)	Current measures (%from reference year level)	Additional measures (%from reference year level)
Total	1,048	12.0	6.4	0.6
Industrial sector	476	-1.7	-5.5	-8.6
Civilian sector	273	33.0	22.0	10.7
Office and other business facilities	144	36.7	23.6	15.0
Residential sector	129	28.8	20.2	6.0
Transport sector	217	20.4	19.4	15.1
Energy conversion sector	82	-0.3	-11.0	-16.1

Source: Edited from *the Kyoto Protocol Target Achievement Plan*

Fig. 5 Energy-originated CO_2 emissions from respective sectors and reduction plan

3. What is a numerical target?

We have seen numerical targets in the Kyoto Protocol. Now let us look more deeply and examine what the properties of a numerical target are after all.

Concerning numerical targets, there are many “should” arguments—such as “should be attained without fail,” but what is important is to examine from the viewpoint of empirical science “what the significance of a numerical target is, and where its limit lies.”

We attach importance to learning from past similar cases. Actually there is a similar precedent for the Kyoto Protocol. It is the Convention on Long-range Transboundary Air Pollution in Europe (hereafter referred to as “Acid Rain Convention”) (Figure 6).

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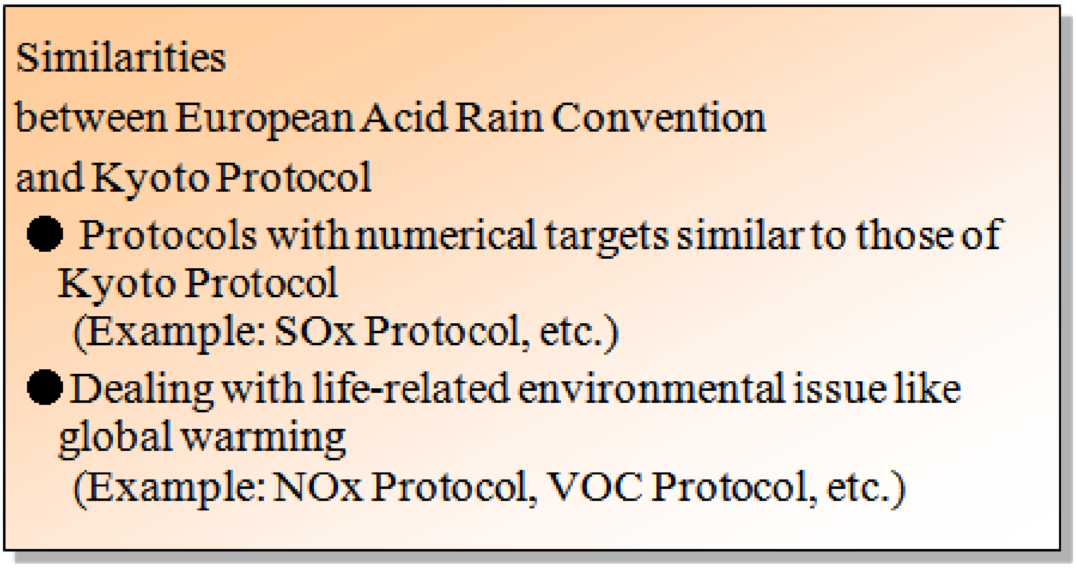

Fig. 6 Similarities between European Acid Rain Convention and Kyoto Protocol

This Convention is similar to the Kyoto Protocol in two points. One is a legal property, that is, multilateral agreements were reached on legally binding numerical targets. The other point is that protocols on nitrogen oxides (NOx) and volatile organic compounds (VOC) were concluded. Their emissions are difficult to reduce, bur it is not so difficult as CO_2 emission reduction,

Under the Acid Rain Convention, eight conventions were concluded between European countries. One of them was a protocol for SOx emission reduction. Using Figure 7, let us see on what numerical targets the agreement was reached, and how those targets were attained. In the figure, solid lines show emissions of the respective countries (percents as compared with 1980 level), and circles are target years and numerical targets. The left end of each broken line indicates the year when an agreement was reached on the numerical target.

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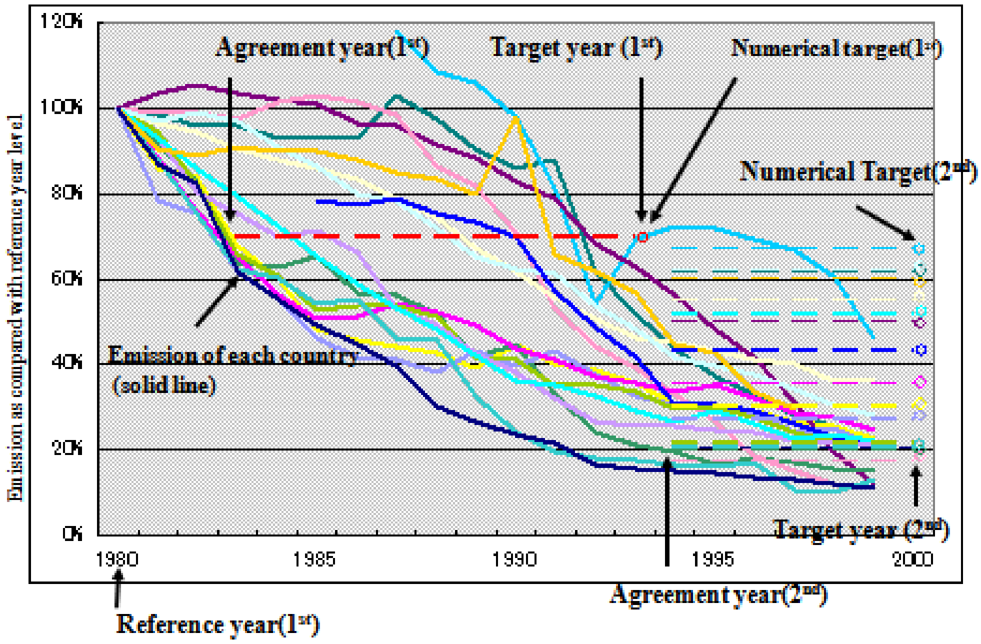

Source: Edited from website of Convention on Long-range Transboundary Air Pollution secretariat

Fig. 7 SOx emissions and numerical targets of European countries

In the First SOx Protocol concluded in 1984, all countries agreed on 30% reduction by 1994 from the 1990 level. Then, in the Second SOx Protocol concluded in 1994, different numerical targets for 2000 were set for the respective countries.

These Protocols had certain effects to attract political attention to SOx reduction and promote implementation of necessary policies by the government of each country, resulting in actual reduction in emissions.

Most of the numerical targets, however, were very easy to attain, and virtually they were not even "targets." In either case of SOx Protocol, it can be seen from the figure that when the agreement was reached, each government had already started a move for necessary measures, and many countries had already attained their targets.

In countries where no progress was seen in reduction measures, advanced technologies including flue gas desulfurization had been wide known, and measures for their diffusion had already been established in many of such countries. Therefore it was not difficult also for such countries to agree on the numerical targets.

Situation, however, differed for other substance (Figure 8). In the case of VOC Protocol, which is also under the Acid Rain Convention, the member countries agreed on a numerical target of 30% reduction by 1999 from the 1984 level, but the result was that eight countries failed to attain the target, with considerable differences between the target and their actual emissions. Especially Norway ended in 40% increase though the target was 30% reduction. Why did it occur?

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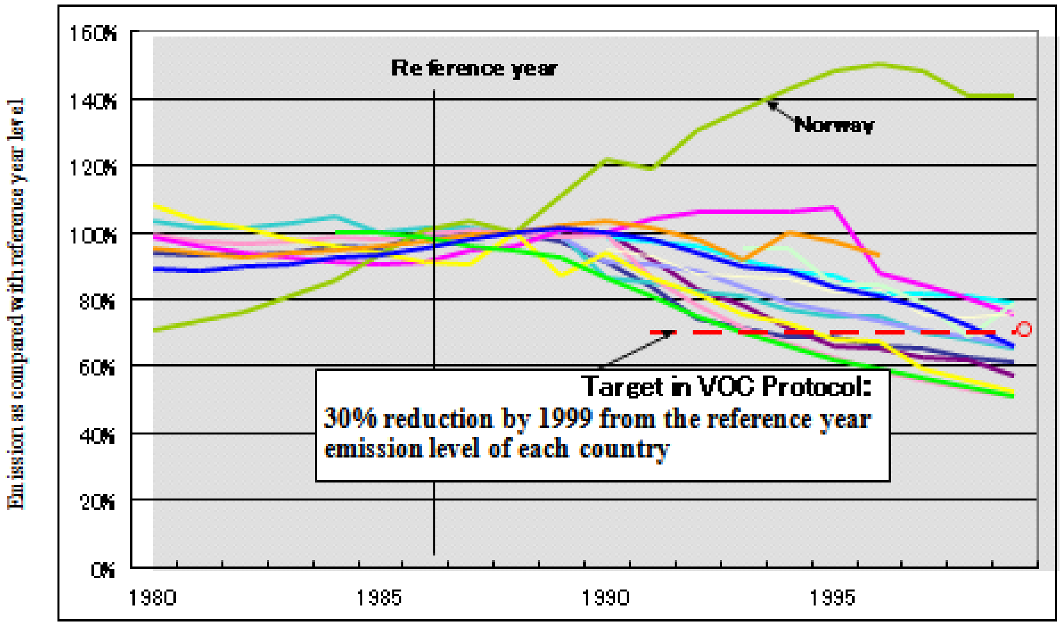

Source: Edited from website of Convention on Long-range Transboundary Air Pollution secretariat

Fig. 8 VOC emissions and numerical target of European countries

This is not a moral issue, but a structural issue (Figure 9). The reason for many countries' failure to attain the target is nothing but the fact that "they promised what were beyond their ability." Countries do not have ability to attain a numerical target without fail. Whether the target is attained or not is always uncertain.

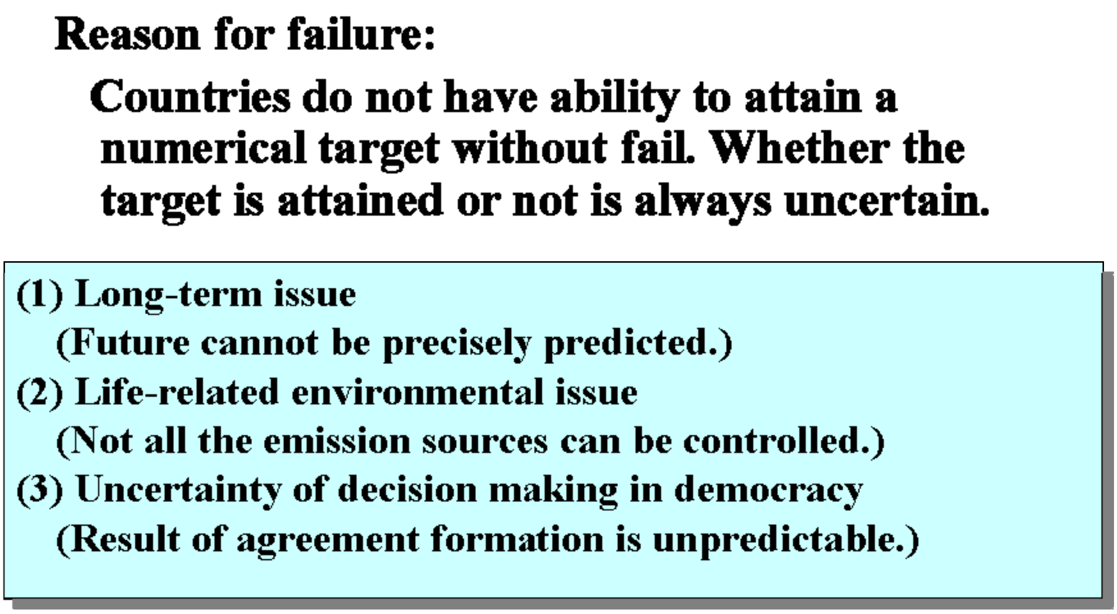

Fig. 9 Why is attainment of numerical target uncertain?

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This uncertainty is caused by three factors.

The first factor is that while a numerical target is usually set for a long term like ten-year span, prediction of something after ten years is inevitably very uncertain. Especially in case the emission is closely related to the level of economic activities, like the case of CO_2, uncertainty of the economic growth rate directly leads to uncertainty of prediction. An error of 1% in the annual economic growth rate can lead to a 10% error if accumulated for ten years. Actually, in prediction of economic growth rate for ten years, accuracy of estimated annual economic growth rate cannot be expected to be less than 1%, and therefore it is not improbable that the actual emission exceeds the numerical target by 10%.

The second factor is that there are too many numbers and types of emission sources, such situation being often expressed by a phrase, a life-related environmental issue. Not all issues can be almost resolved by measures taken at a small number of plants, as in the case of SOx reduction. Talking about CO_2, the problem is that energy is used in every phase of human life. In such a case, it will be difficult for the government to control every energy user. It will also be difficult to arrive at a political settlement concerning how the cost should be shared.

The third factor is that we live in a democracy. Construction of, for instance, a wind farm or nuclear power plant will be difficult unless local people and parliament agree on it. Even if a governmental plan draws a blueprint showing an image after ten years, many steps of agreement formation will be required before the plan is put into implementation. Uncertainty of the future is an essence of democracy.

Figure 10 summarizes the lessons about numerical targets, which we have learned from the Acid Rain Convention in Europe.

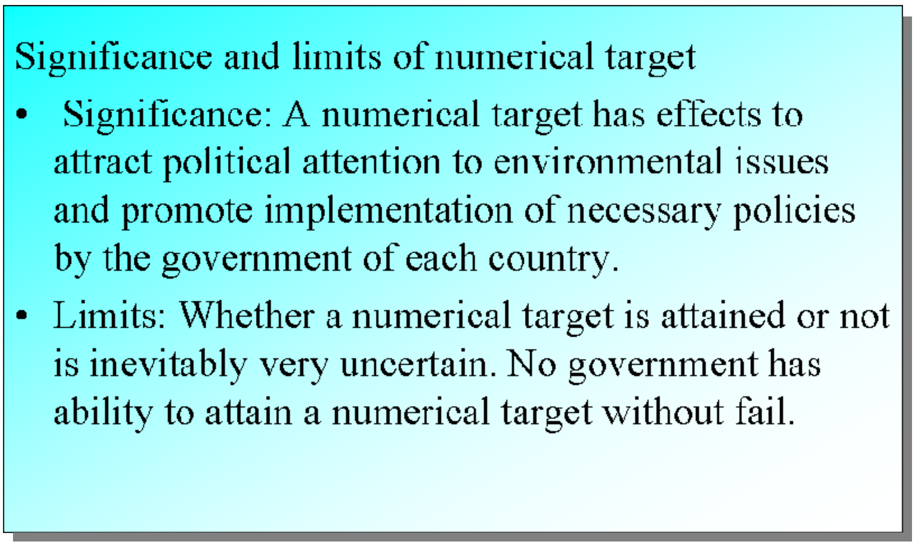

Fig. 10 Lessons from Acid Rain Convention in Europe

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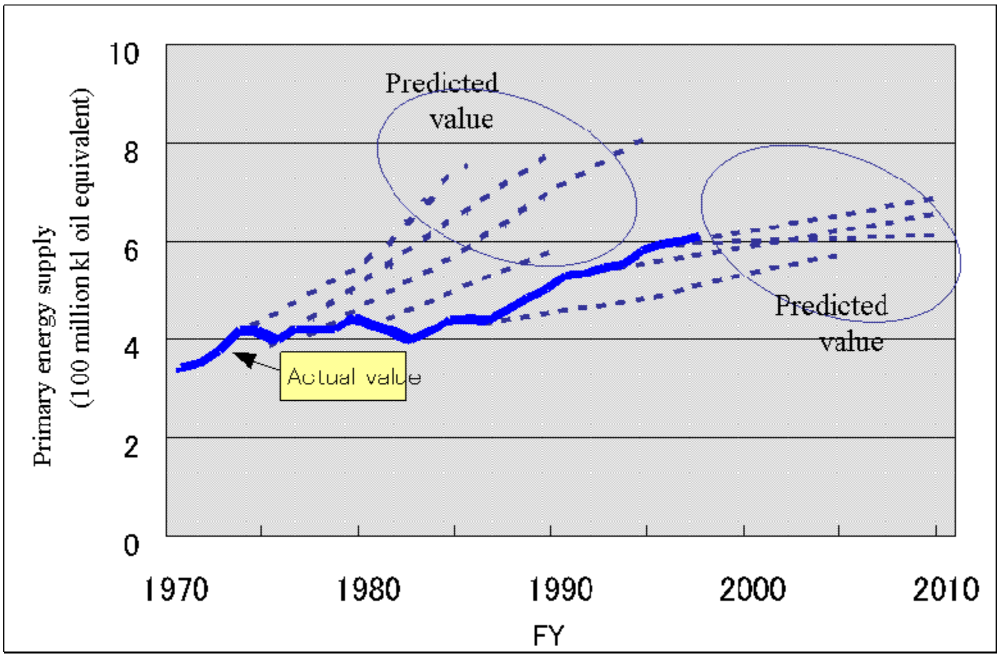
Actually, in Japan's energy policies, there would have been implicit understanding of such significance and limits of a numerical target. For instance, there have been seldom occasions when energy supply prediction was right (Fig. 11), but the prediction has played a role called "coordinating function," by which many stakeholders were coordinated into the same direction and kept in step with one another.



Source: Edited from each year's versions of *Long-term Energy Supply and Demand Outlook*, Agency for Natural Resources and Energy

Fig. 11 Energy supply predictions proved wrong

We must keep in mind uncertainty also about Japan's attainment of the numerical target for CO_2 emission reduction (Fig. 12), and it is important to correctly understand the meaning of numerical target. If we tried "to make a scheme assuring 100% attainment regardless of any kind of uncertainty," then the required cost would be infinite, because this is an attempt to do what is impossible.

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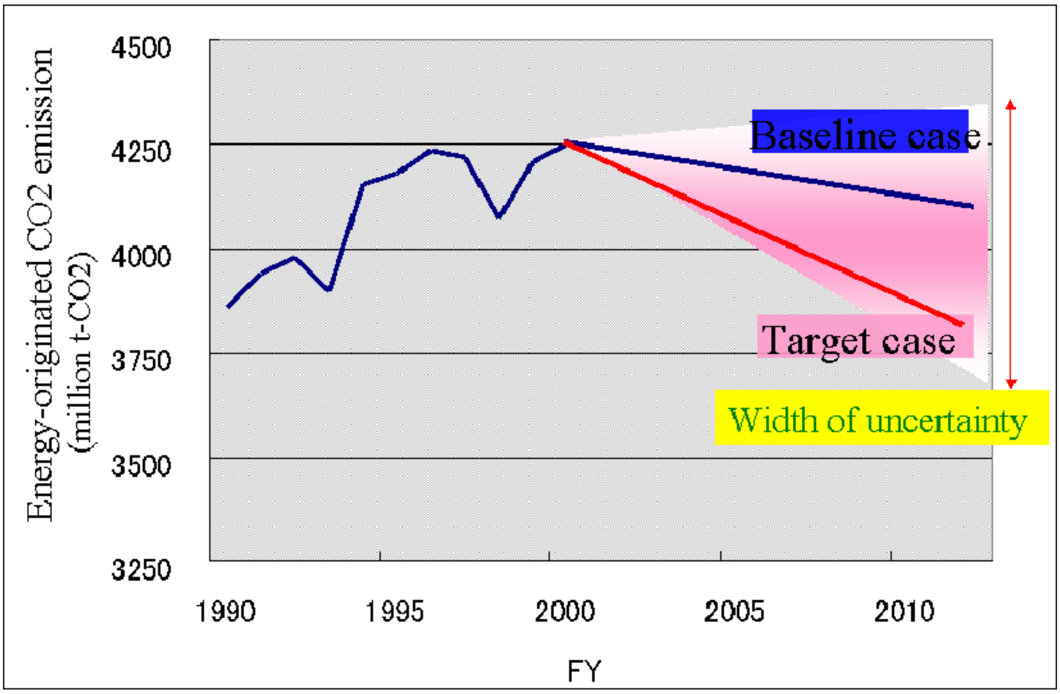

Source: Edited from *Long-term Energy Supply and Demand Outlook* (2001), Agency for Natural Resources and Energy

Fig. 12 Uncertainty also in CO_2 emission prediction

4. Structure of world emission trading market

It is a notable feature of the Kyoto Protocol that emission trading was introduced as a scheme to make possible attainment of numerical targets in spite of essential uncertainty about attainment as we saw above.

When an agreement was reached on the Kyoto Protocol in 1997, negotiators had common understanding that "if a country's domestic efforts are insufficient for attaining its numerical target, then it can attain its target by purchasing other countries' emission credits." But, does the emission trading market really function?[1]

In order to understand the overall structure, let us see Figure 3 again. As can be seen from the figure, Japan can purchase emission credits in either of the two methods. One is to purchase surplus emission allowances (hot air) from countries having them, including Russia and Ukraine, and the other is to get emission credits by making investments in JI or CDM projects for emission reduction in some countries.

Now let us see an example of cost estimation for numerical target attainment, temporarily adopting the Point Carbon's view that a total of 300 to 700 million tons-CO_2 of credits will be able

[1] For simplicity, here and in the rest part of this paper, we use a term "emission trading" also for three types of Kyoto Mechanisms, and a term "emission credits" also for emission allowances and emission rights traded in emission trading.

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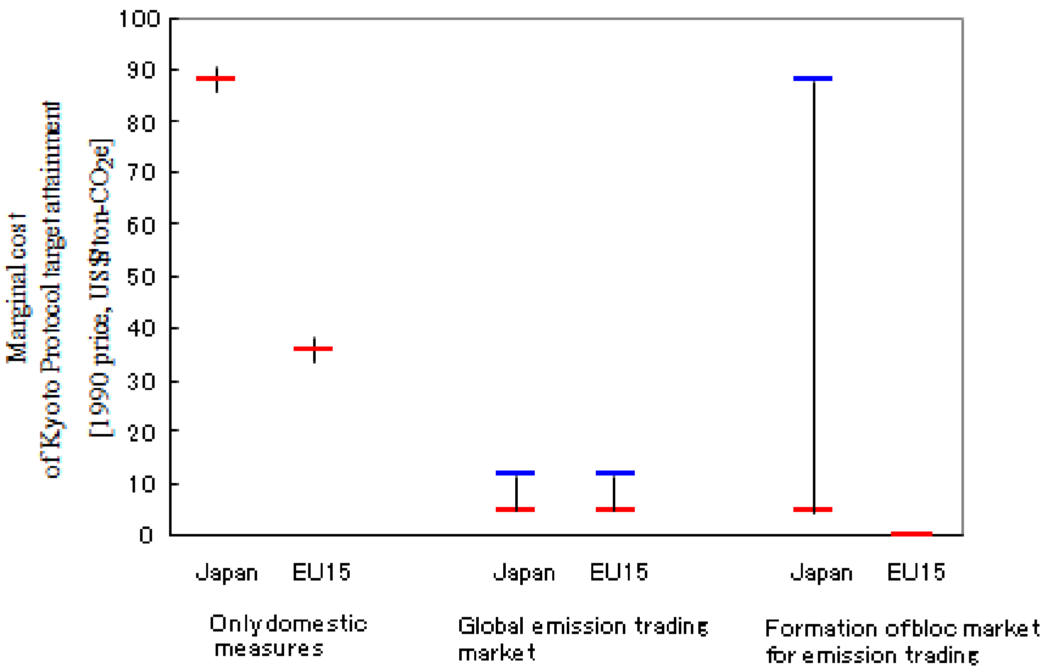
to be supplied by 2012 (Figure 13). Though high accuracy cannot be expected of such estimation, it will serve to see rough trend.



Source: Estimation by Central Research Institute of Electric Power Industry, first published in reference 2

Fig. 13 Example of cost estimation for Kyoto Protocol numerical target attainment

The vertical axis shows the marginal cost which is defined as the cost required for reducing CO_2 emission by one ton. Along the horizontal axis, three cases are shown. The “global emission trading market” at the center is the case that emission credits are traded by countries including Japan, EU, and Russia in accordance with the economic theory. In this case, the cost required for reducing CO_2 emission by one ton is very low, five to ten dollars, in the whole world.

Such situation may change depending on the move of EU and Russia. If neither EU nor Russia sells emission credits to Japan, the marginal cost for Japan will become very high, because Japan can use only CDM and domestic measures for attaining the target (the case of “formation of bloc market for emission trading” in the figure).

Though EU15 (West European countries) must pay rather high cost if they try to attain their targets by themselves (the case of “only domestic measures” in the figure), actually EU’s cost as a whole will become very low, because EU15 will cooperate with East European countries in efforts to attain their targets (the case of “formation of bloc market for emission trading” in the figure).

Now let us further examine what the above estimation means (Figure 14). It is true that if importance is placed on attainment of numerical target, purchase of a certain amount of emission

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credits from other countries will be important from the viewpoint of cost.

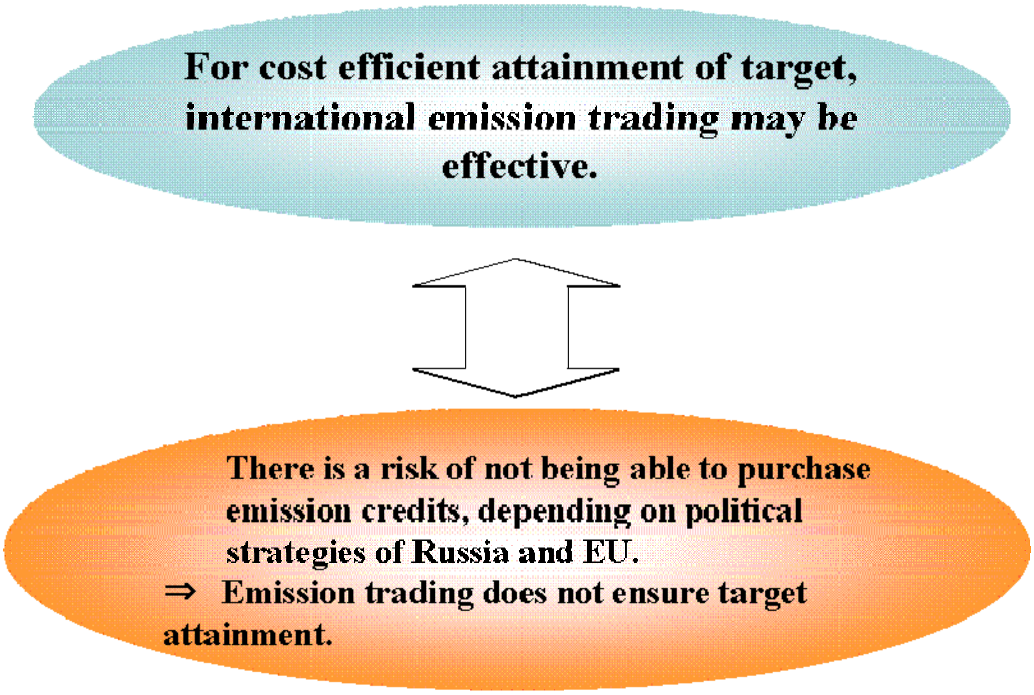

Fig. 14 Advantage and limit of Kyoto Mechanisms

This, however, depends on the move of Russia and EU. In such estimation using economic theory as in Figure 13, it is assumed that each country acts so as to maximize its profit, but this assumption little applies to the Kyoto Mechanisms that involve complicated international politics.

It is true that Russia will profit temporarily if it sells emission credits. If Russia puts a large amount of emission credits on the market when negotiation of the numerical targets for the next commitment period is in progress, however, it is inevitable that Russia will be considered to have too much allowance, and will be allocated only much less allowance for the next period. Therefore Russia is unlikely to move easily to such a direction.

In addition, Russia has many important issues requiring negotiations with other countries, such as smoother export of natural gas and territories issues. For this reason, Russia may choose to retain its emission credits as an important diplomatic card to be used for negotiations with Japan rather than to sell them for tens of billion yens.

EU will also be cautious about Japan's purchase of emission credits, guarding against a steep rise in credit prices. Actually EU has not expressed its intention to allow Japan to freely purchase EU's emission credits.

Thus the argument saying that the Kyoto Mechanisms are ensuring attainment of targets is not reflecting the actual situation. Though the Kyoto Mechanisms are said to be market mechanisms, actually you had better call them political mechanisms.

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The trend of emission trading market being susceptible to political conditions has been actually observed in the EU market. In that market, the amplitude of price fluctuation is very large. This is because the price fluctuated every time information about tight or weak allocation of allowances is spread over the market.

Price fluctuation similar to this will occur also in the international emission trading market. In such a situation, it will be very difficult to predict prices of emission credits.

5. Actual situation of CDM

Now let us see CDM which is already an active scheme. How does CDM contribute to Japan’s attainment of its numerical target?

CDM has been significant in several points. It has functioned as a North-South dialog channel concerning climate change mitigation. It contributed to cause concern about climate change mitigation in developing countries. In addition, CDM realized emission reduction of greenhouse gases including methane, N_2O and HFC. It already produced emission credits of about 50 million tons-CO2/year as of September 2005. The secretariat of the United Nations Framework Convention on Climate Change predicts that the emission credits will further increase, and the total amount will reach one billion tons by 2012.

CDM, however, has little contributed to energy conservation, which must be most important in climate change mitigation.

Why? One of the reasons is that the concept of additionality has an impractical aspect.

In CDM, emission reduction amounts are calculated using the “case of absence of the project” as the baseline. There are, however, various approaches to determine the case of absence, about which there are constant disputes. The largest problem is that energy conservation opportunities which are cost efficient but are not beyond the range of ordinary business—essentially the most important opportunities—are rejected for the reason of “no additionality.”

Let us consider this using Figure 15, which shows four projects A, B, C, and D. Suppose that A, B, and C are energy conservation projects, and D is a solar cell project. To prove additionality, various calculation methods must be applied. With different calculation methods (I), (II), and (III), different values are obtained for additional costs. Graph (IV) summarizes the results of (I), (II), and (III), showing the cost variation of each project.

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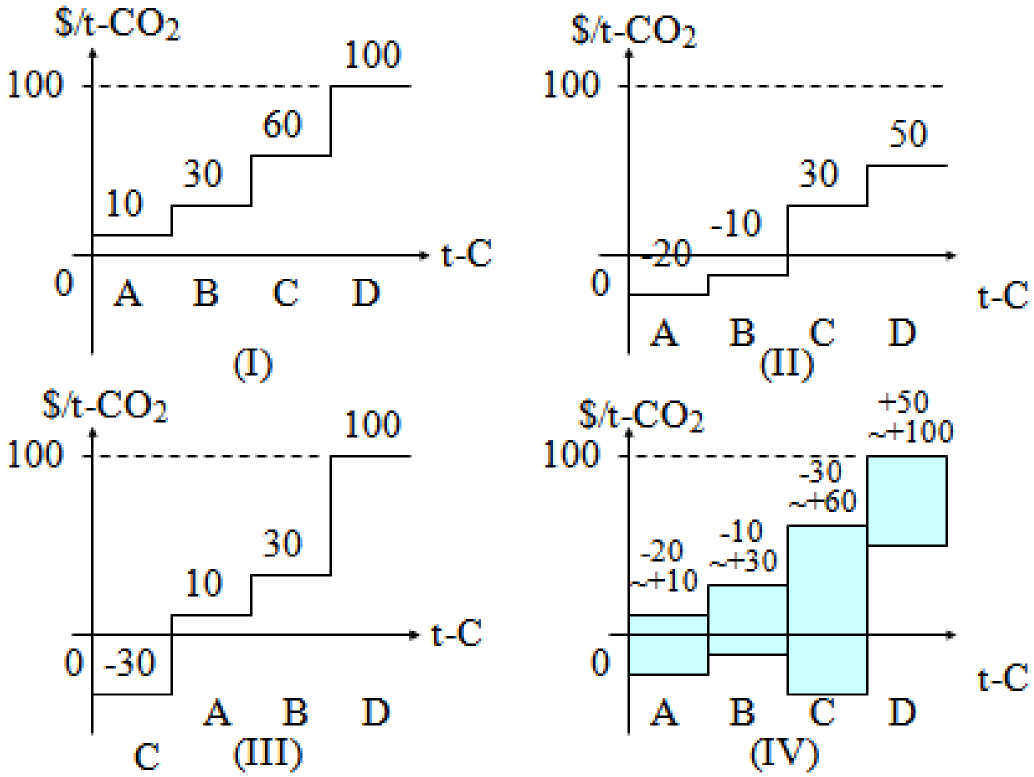

Source: Sugiyama, T., Michaelowa, A., *Reconciling the design of CDM with inborn paradox of additonality concept*, Climate Policy 1, pp. 75-83, 2001.

Fig. 15 Paradox of CDM additionality

Looking at graph (IV), everyone will find project D to be additional, because D is an expensive solar cell project, and is beyond the range of ordinary business. On the other hand, energy conservation projects are closely related to steady production control and productivity improvement, behind which there exist constant efforts for thoroughgoing efficiency improvement. For this reason, cost of such an energy conservation project usually varies from negative to positive depending on the calculation method.

In such a case, it is difficult to "prove additionality" of the project so as to persuade everyone, and the project is hardly approved as a CDM project. As a result, energy conservation, which is most important, is little attained by CDM. It will be difficult to change this situation largely.

In addition to additionality we have seen above, CDM has its essential limitations as described below (Figure 16).

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1. Decision making system

- Can United Nations that is "a government of governments" create emission credits as commodity?
- The United Nations attaches importance to "participation of all members and transparency." This is nightmare to businesses.

2. Political environment

- Environmetalistic ideology is too strong to implement large-scale projects.

3. Developed countries' intention to pay

- Developed countries do not intend to continue payment of "additional cost." China's energy conservation potential 400 million tons × \$10/ton = \$4 billion/year.

Fig. 16 Essential problems of CDM

The first problem lies in the decision making system. Even for a complicated concept like additionality, the government of a country would be able to establish administrative rules through some simplification. In the case of CDM, however, situation is not so simple. In this case, what is additional must be determined through complicated political negotiations and finally by the CDM Executive Board. In these processes, in addition, participation of all members and transparency are required. Though such a procedure itself may be desirable, it takes considerable time and trouble. After all we doubt whether the United Nations that is "a government of governments" can create, distribute, and manage emission credits as commodity, and we doubt whether the United Nations doing all such things are appropriate.

Another problem is that the above decision making is done in the midst of environmental NGO ideology. Such situation is liable to be disadvantageous especially for large-scale projects. Though in many cases large-scale projects cause less environmental impacts per production, such an argument is liable to be rejected.

Even if all the above problems are cleared, finally there remains a large problem of developed countries' intention to pay. For instance, assuming that China's energy conservation potential is almost 10% of the whole emission, it would amount to four billion dollars every year if the whole potential is actualized by CDM projects at ten dollars per ton-CO_2. Governments of developed countries will have difficulty in gaining support from public opinion if they do not cease to agree on a numerical target or scheme that causes automatic flow-out of such a huge amount of money.

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For these reasons, we think that CDM can accept only a small part of greenhouse gas reduction opportunities, but misses most of such opportunities including energy conservation.

6. How much emission credit is required?

Finally let us make rough estimation of the amount of emission credit that Japan will be required to purchase.

Taking into consideration a diversity of uncertain factors including economic growth, Japan's emission amount may remain around the present level in spite of a lot of policy measures.

Then the total emission credit necessary for Japan to attain the target can be as much as one billion tons for the five year period. If the whole of this amount is to be purchased at two thousand yen per ton-CO2, a huge amount of money of two trillion yen will be required.

Some prediction says that a total of one billion tons of CDM will be supplied in the world, but no one can tell how much the actual amount will be. It is also opaque whether Russia and Ukraine will supply CDM.

In addition, Japan is not the only purchaser of emission credit. EU, also with uncertainty in future economic growth, may use purchased credit in the regional emission trading market in and after 2013, and it is unknown how much CDM credit EU will purchase.

Probably, Canada will not purchase a large amount of emission credit, and will not attain its target.

Now to conclude, whether a numerical target can be attained is anyway uncertain, and making it certain will require infinite cost. If emission credit is purchased for attainment, the purchasing cost can be as much as two trillion yen.

7. Conclusions

The following are conclusions of the above discussions:

-- Numerical targets of Kyoto Protocol

The Kyoto Protocol imposed a hard numerical target on Japan, but targets for other countries are rather easy to clear.

Many policy measures are taken for attaining numerical targets.

Whether a numerical target can be attained through domestic policy measures is, however, essentially uncertain.

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-- Actual situation of Kyoto Mechanisms

In spite of Kyoto Mechanisms, whether a numerical target can be attained is uncertain. Supply and demand in the emission trading market largely depend on political decision making of EU, Russia, and other countries.

Since CDM has many problems, its contribution to large-scale emission reduction, especially to promoting energy conservation, which is most important in developing countries, will be small.

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