How to Design and Operate the Kyoto Mechanisms

Takamitsu Sawa

Introduction

The Kyoto Protocol and the Three Mechanisms

[1] On December 11, 1997 in Kyoto, the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3 of UNCCCF) adopted the Kyoto Protocol. The Protocol imposes legally binding and quantified targets for reduction of greenhouse gases (GHGs) emissions on the 38 Annex I countries. This was really a significant first step towards possible prevention of global warming.

[2] One of the significant features of the Kyoto Protocol was that it has established three international mechanisms to enable Annex I countries to achieve their reduction targets with the minimum possible costs. They include *emissions trading* (Article 17 of the Protocol), projects aiming at reducing GHGs emissions by human activities (Article 6 of the Protocol, hereinafter, we call those projects as *joint implementation*), and the *clean development mechanism* (Article 12 of the Protocol): namely, projects aiming to assist non-Annex I countries to achieve *sustainable development*. These international mechanisms were first named generically as *flexible mechanisms*, but after the Buenos Aires conference (COP4) renamed as *Kyoto mechanisms*.

[3] As for design and operation of Kyoto mechanisms, it may be safely said that any definite and concrete design of mechanisms has not yet been systematically proposed. The Buenos Aires conference finally agreed upon the *Plan of Action* that requires the Subsidiary Body for Implementation (SBI) and of the Subsidiary Body for Scientific and Technological Advice (SBSTA) to design details of mechanisms concretely enough at latest before the COP6 being held in the year 2000. At the sessions of the SBI and SBSTA held in Bonn in June 1999, considerable amount of discussion took place on *mechanisms* as well as on *non-compliance measures*. Most of them, however, were left unsolved and postponed to the Bonn conference being held from late October to early November 1999.

[4] In this paper we will examine how Kyoto mechanisms should be designed and operated. As for domestic measures to prevent global warming, they should be entirely left to each country's government instead of international settlements. To put it differently, each country's government should explore its optimal system of domestic measures, taking into account its domestic constraints and feasibility as well as cost-effectiveness of various

measures. International standardization on domestic measures should be kept to minimum to avoid unnecessary interference in the domestic affairs by international organizations. Careful attention should be, however, paid to how the existing diversity in each country's domestic measures influences the effectiveness and the feasibility of international mechanisms.

Flexibility of Kyoto Mechanisms

[5] The three international mechanisms examined here are all *cost-effective* in the sense that they enable each Annex I country to achieve its reduction target at the minimum possible cost. To put it differently, each Annex I country can attain a given reduction target as flexible as possible by adequately combining the three international mechanisms with its domestic measures.

[6] In his speech at the high-level segment of the COP3 on December 8, 1997, Vice President Gore of the United States stated that he would instruct the U.S. delegation to show increased negotiating flexibility, if a comprehensive plan with market mechanisms, among others, were put into place. What he meant was that the U.S. Government was to commit itself to higher reduction target of some degree, so long as the three international mechanisms would be introduced by the Protocol. It turned out that the final conclusion of the Kyoto conference had been quite finely summarized by Gore's statement cited above.

[7] The Kyoto Protocol requires the 38 Annex I countries to reduce the total GHGs emissions at least 5% below the 1990 level. The reduction target for each country was differentiated as follows: 8% for European countries, 7% for the United States, 6% for Japan, 0%for Russia and Ukraine, and so on. These relatively higher reduction rates were agreed upon, because the Kyoto mechanisms were introduced. Otherwise, each Annex I country is obliged to attain her reduction target all by herself, and hence reduction targets must be necessarily far lowered.

[8] Kyoto mechanisms were strongly recommended and supported by the U.S., but they are also beneficial for Japan, because Japanese firms own various advanced energy-saving technologies that are certainly useful for successful operation of joint implementation (JI) and the clean development mechanism (CDM). By transferring advanced energy-conservation technologies to other developed and developing countries, Japan will be able not only to contribute to prevention of global warming through reduction of CO2 emissions, but also to lower the cost required to achieve its own reduction target.

Desirability of the Mechanisms

[9] As was mentioned earlier, Kyoto mechanisms still remain to be elaborated. Let us consider about the conditions that have to be satisfied by desirable mechanisms. We propose the following four principles. First, they should be really *effective*: that is to say, they should contribute to achievement of

GHGs emission reduction commitments by Annex I countries, and sustainable development of non-Annex I countries. Second, they should be *impartial*: that is to say, they must be equitable and fair to all member countries. Third, they should be *transparent*: that is to say, information concerning emissions trading, JI and CDM should be in principle disclosed. Fourth, the mechanisms should be *cost-effective*. In order to attain cost-effectiveness, the market mechanism should be properly utilized: namely, excessive regulation must be avoided.

[10] The purpose of this paper is to identify *desirable* mechanisms that meet the above four principles. There may be, however, no *desirable* mechanisms that perfectly meet all of the four principles, and *desirability* often depends on assumptions. Moreover, there is no guarantee that such *desirable* mechanisms are in fact feasible.

[11] In order to minimize the total cost of achieving the reduction target 5% on the whole for 38 Annex I countries, the reduction target for each country should be differentiated *rationally* so that marginal reduction costs be equalized among Annex I countries. If the differentiation is rational in the above sense, introduction of emissions trading is unnecessary, because each country's cost-minimizing behavior results in attaining her target solely by domestic reduction. In reality, however, it is almost infeasible to estimate the marginal cost curves respectively for the 38 Annex I countries, and hence the reduction targets have been differentiated on *ad hoc* bases. Therefore, the reduction targets assigned to Annex I countries might be far from rational. This is the reason why Kyoto mechanisms play an essential role in minimizing the total abatement cost as much as possible.

Trading Emission Rights

[12] The Kyoto Protocol obliged Japan to reduce the average amount of GHGs emissions for the period from 2008 to 2012 at least by 6% less than that in the year 1990. To put it differently Japan was assigned *emission rights* equaling five times as much as 94% of total GHGs emissions in 1990, which will be effective during the five-year commitment period. The total amount of emission rights assigned to the 38 Annex I countries amounts to 94.8% of the total emissions in 1990 by the 38 countries. Commitments by the Annex I countries may be relaxed, i.e., fulfilled with lower costs, through purchase of emission rights from other countries.

[13] It should be borne in mind, however, that the Kyoto Protocol clearly states that emissions trading and JI should be *supplemental* to domestic measures. One of the most controversial points with regards to Kyoto mechanisms is what is really meant by "*supplemental*". The European Union claims that in order for mechanisms to be really supplemental the amount of emissions trading should be limited numerically somehow or other, while the US

and Japan oppose that such limitation would harm precious cost-effectiveness of emissions trading and JI.

Emissions Trading

Administrative body and Emission Right

[14] First of all, let us think about emissions trading among the Annex I countries. It is likely that emissions trading which involves private firms will be more efficient in a number of ways. For better understanding of emissions trading, however, we will first examine emissions trading among countries, in line with the provisions of the Protocol, and then extend the concept to the case when private firms participate in emissions trading.

[15] The Conference of the Parties to the UNFCCC serving as the meeting of the Parties to the Kyoto Protocol (COP/moP) is expected to administer emissions trading. The COP/moP may establish a subsidiary body to which parts of the tasks required to administer emissions trading are delegated. The COP/moP or its subsidiary body (hereinafter we call it as the *administrative body*) will assign to Annex I countries *transferable emissions rights* which are valid for the commitment period from 2008 to 2012, based on their reduction commitments given in the Kyoto Protocol. Serial numbers might just as well be given to the assigned transferable emission rights to identify the country of origin. The administrative body receives reports from the countries concerning the serial number traded, the amount traded, the destination traded and the remaining amount of assigned emission rights. Moreover, it tracks the transferred emission rights, and discloses such information as the occasion demands.

[16] The administrative body must confirm that each country complies with her commitment. The total amount of GHGs emissions during the commitment period must be less than or equal to the amount of emission rights remaining at the government's as well as domestic firms' hands at the end of the commitment period. In order to do so it suffices for the administrative body to receive the above-mentioned report only once at the end of the commitment period. However, since emissions are required to be reported once a year, transfer of emission rights might just as well be simultaneously reported

[17] If such reports were publicized, they would serve as a useful source of information for emissions trading. On the basis of such information the administrative body will be able to recommend a country whose emissions are likely to exceed her holding emission rights at the end of the commitment period to control emissions so that she can comply with her commitment.

How to Trade Emission Rights

[18] The emission rights are traded through *bilateral transactions*, listing in commodity exchanges or through brokerage. The dominant form of trading may be left entirely to market trends, but it should be noted that the

market does not necessarily choose an equitable system of trading. To avoid possible inefficiency, unfairness and non-transparency associated with bilateral transactions, it may be advisable to limit emissions trading to some marketplaces authorized by the administrative body or some other bodies. By limiting trading and transactions to a few places, it is expected that principles of fairness and openness are ensured, and that tracking can be conducted comprehensively and in real time.

[19] Transactions via the Internet may be recommendable; the merits of which include immediate information disclosure to market participants, and low costs for establishment as well as operation of the market. In the United States, it is reported that everything from airline tickets to Barbie dolls are auctioned online, and that bidding on the Internet is becoming more and more popular.

[20] After the commitment period is over, each Annex I country should report to the administrative body on how much emission rights it possesses and how much GHGs it emitted during the commitment period. If the occasion demands, each country must accept the administrative body's review. Based on the report and the review, the administrative body finally concludes whether or not each country has complied with her commitment. What kind of sanctions should be taken against noncompliance is a very controversial problem. One simple solution is that noncompliance should be compensated by purchasing emission rights to make up for excess GHGs emissions. The payment may be regarded as a fine.

Sellers' or Buyers' Liability

[21] The liability of emissions trading is also one of the hottest controversial issues. It concerns whether the liability lies in either sellers or buyers. As a possible compromise it might be more reasonable to share the liability by both parties. Suppose that the country A sells a part of assigned emission rights to the country B and ends up with noncompliance. In case of *sellers' liability* the country A has to fill the deficit somehow or other, while the emission rights bought by the country B is effective in spite of the country A's noncompliance. In case of *buyers' liability* the seller country is entitled to buy back the emission rights sold to the buyer countries. That is to say, the emissions trading is invalidated retroactively in backward order from the most recent trading up to the point where the accumulated amount of trading equals the country A's deficit of emission rights. As a result some buyer countries might be compelled to buy emissions rights to make up a possible unintentional deficit.

[22] In accordance with ordinary commercial customs, the sellers' liability principle may be more acceptable, but the buyers' liability principle is favorable due to the following reason. The buyers' liability principle is likely to discourage emissions trading and hence encourage self-help rather than reliance upon others, since emissions trading imposes risk to some extent on

buyers. Buyers' liability will cause more or less dispersion of the price of emission rights. The higher the price is, the more confident the seller is, and *vice versa*. In case of buyers' liability, however, the trading system becomes extremely complicated and buyers' compliance may be likely to be jeopardized due to sellers' noncompliance.

Economics of Emissions Trading

[23] Given the market price of one carbon ton emission right of CO2, each country is supposed to reduce GHGs emissions domestically as far as the marginal reduction cost is less than the market price of emission rights. To put it differently, each country reduces domestically up to the point where the marginal reduction cost equals the market price of emission rights. If the amount of the domestic reduction thus determined is less than the assigned target, then purchasing emission rights may fill the shortage. If the converse is true, then the surplus may be sold at the market price.

[24] It is often said that some countries such as Russia and Ukraine may be able to attain their commitments without any further efforts to reduce GHGs emissions, while some other counties such as Japan and the US are difficult to attain their commitments. To put it differently, the former countries' marginal cost curves are far lower than the latter countries'. The former countries will certainly have incentive to participate the market of emissions trading as sellers, while the latter countries will have incentive to participate as buyers.

[25] One severe criticism against emissions trading stems from the fact that Russia's CO2 emissions in 1995 was by 30 % less than that in 1990. Certainly, without any significant efforts Russia will be able to attain her target, i.e., stabilize GHGs emissions at the level less than or equal to the 1990 level. To put it differently Russia's marginal reduction cost to attain the target is zero, and hence Russia will be in a position to sell huge amount of emission rights at a bargain. As a result countries with relatively high marginal reduction cost will enjoy the extremely cheap price of emission rights, and hence will be apt to neglect duties of reducing GHGs emissions domestically.

GHGs Other Than Carbon Dioxide and Sinks

[26] The emission unit is one ton of carbon dioxide (CO2) equivalent. Other GHGs are converted into CO2 equivalent values, based on the global warming potentials (GWP) calculated by IPCC. With regards to the emissions of GHGs other than CO2, it is often pointed out that the amount of emissions of these gases is difficult to estimate accurately in most cases. For example, how precisely can nitrous oxide (NO2) or methane (CH4) emitted from agricultural or forest soils be calculated? This question cannot easily be answered. It is often said that GHGs with inaccuracy in their emissions estimation should be excluded from trading, i.e., emissions trading should be

limited only to CO2.

[27] The sources of emissions, however, do not matter in emissions trading between countries, since trading is conducted on CO2 equivalent tons. Therefore, if trading is limited to among countries, the present provisions of the Protocol cannot justify excluding greenhouse gases with low estimation accuracy from emissions trading. However, if private firms participate in the emissions trading, sources of emission rights to be traded may include GHGs other than CO2. In this case, the aforementioned points pertaining to the accuracy of estimation is quite likely to cause disputes.

[28] The Protocol provides that net changes of CO2 removal, due to afforestation, reforestation and deforestation within the country since 1990, shall be used for calculating domestic emissions. Deforestation means CO2 emissions. Afforestation and reforestation means reduction of CO2 emissions. This will contribute to forest conservation in addition to prevention of global warming. Attention should be paid, however, to the fact that CO2 removal by forest is nothing more than borrowing emission rights from the future in the sense that eventually in the future due to deforestation or forest fires CO2 absorbed by forest will be emitted into the air.

[29] In Japan, as well as on the global scale, forests are certainly on a decreasing trend. The Kyoto Protocol, which regards CO2 removal by afforestation as negative emissions, could bring about the potential benefit of preventing further deforestation. The present inventory methodology, however, contains numerous problems that should be reexamined, including whether or not emissions should be identified at the point of deforestation.

[30] If the total amount of GHGs emissions by a certain country within the commitment period being certified by the COP/moP turned out to be less than the amount of emission rights remaining at hands, the country could transfer the excess emission rights to the next period. That is to say, what we call *banking* is permitted by the Protocol.

[31] Banking means excess reduction within the commitment period. As incentive to utilize every existing opportunity for emission reduction, banking may be desirable. The banked amount, however, may be carried over to the next commitment period. Since this implies that the sum of emissions in the first and the second commitment periods are invariant, banking does necessarily increase emissions in the second period. Taking it into account that global warming is caused by the accumulation of emissions over a long period, banking in the first commitment period will scarcely contribute to prevention of global warming.

[32] Total emissions within the first commitment period should not exceed the emission rights at hands. To put it differently, *borrowing* from the next period is not permitted. If the administrative body confirms that a country has not fulfilled its commitment, but judges that this has been caused by unavoidable reasons such as extraordinary climate, natural disasters or accidents, the government of the country involved should be permitted to apply

for *special carrying-over* to the administrative body.

[33] The administrative body permits *special carrying-over* only when it confirms that the noncompliance has been caused by some unavoidable reasons. The shortage in the balance of emission rights for the current commitment period and the penalty premium should be deducted from the initially assigned emission rights for the next period. If noncompliance has been caused by some avoidable reasons, the country is obliged to purchase additional emission rights from countries with surplus emission rights, or from the administrative body in case when no country has surplus emission rights. Some maintain the view that the administrative body should set a penalty price higher than the market price in such cases. The administrative body, if it sells additional emission rights to countries that have failed to meet their commitments, should be required to purchase the same amount in the market within the next commitment period.

[34] As a matter of fact, it should be noted that the above measure in case of noncompliance is nothing more than *borrowing* deputized by the administrative body. More punitive measures against noncompliance may be conceived, but most of them would be internationally unacceptable. Naturally, there should be some possibility left to introduce more powerful measures in the future against repeated noncompliance.

Participation by the Private Sector

[35] Emissions trading among countries are likely to be conducted as bilateral transactions at least at the beginning. In order to encourage the formation of the marketplace, the participation in emissions trading by private firms would be indispensable. It is entirely left to the government of each country whether or not private sectors such as firms, brokers, and NGO are permitted to participate in emissions trading. In either case, it goes without saying that responsibility of compliance lies with the government.

[36] There exist two different ways for private sectors to participate in emissions trading. First, the government distributes a part of emission rights assigned by the administrative body to private firms according to a certain rule. As the occasion demands, firms can sell or buy assigned emission rights in the market or through bilateral transactions. Second, even in case when private firms are not assigned emission rights, firms may keenly want to have an opportunity to sell emission rights generated by JI or CDM. In order to motivate JI and CDM by private firms the early creation of the open marketplace is really necessary.

[37] In view of cost-effectiveness, it is more desirable for private sectors to participate in emissions trading somehow or other due to the following reasons. First, the government is not necessarily in a position to make correct judgements on the marginal reduction cost of GHGs emissions, i.e.,

the cost required to reduce one additional unit of GHGs emissions. To put it differently, private firms are in better position to estimate how much marginal cost is needed to reduce their own GHGs emissions. Second, the government does not necessarily have the know-how for commodity trading. It should be recollected that in 1992 when a poor harvest attacked Japan the emergency import of rice was entrusted to trading firms. Third, if emissions trading were limited only to the government, cost-effectiveness would be more or less damaged since bilateral transactions are likely to be dominant.

Joint Implementation

What is Joint Implementation?

[38] Suppose that any two Annex I countries, say A and B, can implement a joint project contributing to abatement of GHGs emissions including enhancement of sinks. If the joint project is recognized as joint implementation (JI), then the host country, i.e., the country A, in which the project is implemented, can transfer a certain amount of emission rights to the investor country, i.e., country B, which provides funds and technologies necessary for the joint project. The amount of transferred emission rights from A to B would be agreed upon, on the basis of prediction of how much emissions reduction will be attained during the commitment period from 2008 to 2012, and to how much extent the country B contributes to the project.

[39] Generally speaking, countries having opportunities to reduce GHGs emissions with the lower marginal abatement cost will play a role as the host country, while a role as the investor country will be played by countries whose marginal abatement cost is relatively higher, but who have advantages in funding and technology.

[40] In addition to abatement of GHGs emissions, JI provides a variety of benefits to the host country. For example, power plant construction projects are inherently beneficial in that they enhance the power supply capacity of the host country. Public transportation network improvement projects enhance passengers and freights transportation capacity. On the other hand, the investor country's benefit is only limited to obtaining *credit*, i.e., emission rights generated by JI, whose average cost might be expected to be less than the marginal abatement cost in the investor country: otherwise, no incentive to JI is expected. Since emission rights are commodities, joint projects that bring reduction of GHGs emissions but have been unprofitable so far would become profitable by the so-called *additionality* of JI.

[41] JI may be regarded as one version of emissions trading, since it entails the transfer of emission rights among the Annex I countries. However, JI has its own purpose, i.e., it facilitates the project-oriented trading as mentioned above. JI is limited only to the Annex I countries, while joint projects by an Annex I country and a non-Annex I country is called CDM

and distinguished from JI. It should be noted that the total amount of emission rights is unchanged before and after JI. Thus JI may be managed more flexibly than CDM, since specification of the baseline is entirely left to the two countries concerned.

Participation by the Private Sector

[42] The private sector actually possesses technologies necessary for GHGs emissions reduction, and also provides funding in most cases. Therefore, it is extremely important for the success of Kyoto mechanisms to facilitate the private sector to take an initiative in JI and CDM. Even in case when private firms in the investor country participate in JI or CDM, a certain amount of emission rights is transferred from the host country's government to the private firms in the investor country. The private firm can sell emission rights thus obtained to their own government or in the market.

[43] It should be noted that the total assigned emission rights to the Annex I countries do not increase nor decrease by JI even in case when the private sector participates in emissions trading. The host country of JI obtains actual emission reduction, while the investor country obtains emission rights, which is often called *credits* from the host country. The provision of credit should be regarded as the transfer of emission rights from the host country to the investor country.

Baseline and Additionality

[44] To calculate the GHGs emission reductions due to JI, i.e. the amount that is *additional* as provided for in the Protocol, it is necessary to identify the *baseline*, or the amount of GHGs that would have been emitted during the commitment period if the JI project were not carried out.

[45] For a JI project in which a coal thermal power plant is replaced with a natural gas thermal power plant or in which leakage of natural gas from pipelines is mended, the baseline, namely, the amount of emissions reduction by the projects may be easily as well as definitely settled. For a JI project in which a natural gas thermal power plant is newly established, however, the baseline cannot be assessed in a consistent manner, but would involve certain arbitrariness.

[46] If it is one of the preconditions of JI to establish a definite rule to numerically specify the baseline, its difficulty might hinder the progress of JI. If the establishment of baseline under a joint JI project between two Annex I countries is entrusted to them, then JI will be further facilitated. Naturally, this does not mean that the two countries are not obliged to notify the administrative body of the agreed baseline and the transferred amount of emission rights. Such procedure is indispensable for the administrative body to fulfill its duty to track all transfers of emission rights among the Annex I countries.

Conclusion

[47] If we dare to discuss future prospects, we can write the following scenario as one of the most likely scenarios. In terms of emissions trading, the countries will reach a consensus at the future COPs. With regard to JI, the countries will reach a consensus at the COP/moP1 to be held after the Protocol becomes effective. Soon after the Protocol becomes effective, government-driven or private-driven JI or CDM projects will commence and the emissions trading market will be formed to deal with credits generated by such projects.

[48] The process of forming the marketplace for emissions trading will vary greatly depending upon to whom emission rights are transferred, governments or private firms. If they are transferred only to governments, it is unlikely that the marketplace is autonomously formed before the beginning of the commitment period. This is because governments, which have been assigned emission rights, do not need to exchange them for money in advance. If JI led by private firms is limited to a certain range, private firms will prefer transferring credit to their governments so as to save transaction cost. In such a case, there will be little motivation to create the marketplace for emissions trading. If, however, JI led by private firms is widely promoted, the marketplace for emissions trading will be automatically created.

[49] If the marketplace for emissions trading is created and if the market price of emission rights is high enough, then governments or private firms having excess emission rights will be motivated to supply them to the market. If such countries are facing economic depression or suffering from huge budget deficit as well as trade deficit, it is very likely that they will supply a large amount of emission rights to the market. As is already mentioned, since uncertainties with regard to the price of emission rights is one of the most conspicuous factors to hinder the promotion of JI, the marketplace for emissions trading had better been created so that the price of emission rights may be predicted at an early stage.