

**The Kyoto Protocol and Global Environmental Strategies of
the EU, the U.S. and Japan: A Perspective from Japan**

by

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Abstract

Despite the objection of the Bush administration to the U.S.'s ratification of the Kyoto Protocol, its entry into force has come to be realistic due to the Bonn Agreement in July. The purpose of this paper is first to survey the framework of the Protocol, and then to analyze the strategic positions of the EU, the U.S., and Japan in negotiations for designing the details of the Protocol. Finally, this paper intends to consider the due strategy of Japan, as well as to identify the problems of the Protocol, which will be a help for designing a new framework that will enable the participation of developing countries.

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1. Introduction

Global warming caused by the emissions of green house gases (GHGs) including CO₂ is accompanied by a double “exploitation.” One is the “exploitation” of future generations by generations that have emitted a significant portion of GHGs. GHGs that are being emitted now do not contribute to the current global warming immediately. Instead, future generations will be affected by a temperature rise caused by accumulated GHGs. The other “exploitation” appears within the same generation. Those who live in countries that are enjoying rich lifestyles by emitting a substantial amount of GHGs are “exploiting” those who live in countries that are not emitting GHGs, by not paying for their GHG emissions. Thus, the global warming problem can be considered as a complicated problem regarding intra-generational and inter-generational “commons.”

2. The Kyoto Protocol¹

The UN Framework Convention on Climate Change was adopted in 1992 to address global warming, and was brought into force in 1994. The third session of the Conference of the Parties to UNFCCC (COP3) was held in Kyoto in 1997, where the Kyoto Protocol was adopted. The Protocol stipulates that 38 countries, including developed countries and economies in transition, will reduce their GHGs including CO₂ respectively to total emissions 5.2% below the 1990 level during a period from 2008 to 2012. For example, reduction below 1990 levels of 8% is required for the EU, 7% for the U.S., 6% for Japan, and 0% for Russia.

In order to achieve this target, the Protocol has employed three mechanisms, known as the Kyoto mechanisms, while urging respective countries to make domestic reductions. Emissions trading is one of the Kyoto mechanisms. Suppose the reduction costs per unit of GHGs in Japan is 10, while that in Russia is only 1. If both countries are to reduce 1 unit respectively by themselves, it will cost 11. However, if only Russia is to reduce 2 units by itself, the reduction cost will be 2. In other words, emissions trading allows Japan to let Russia reduce Japan’s emissions by 1 unit by paying a cost ranging from 1 to 10. Emissions trading is to set positive prices on GHGs emissions that have been free before.

Another of the Kyoto mechanisms is Clean Development Mechanism (CDM). Suppose a

¹ As for the Kyoto Protocol, see the home page of the United Nations Framework Convention on ClimateChange (<http://www.unfccc.de/index.html>).

country with an emissions cap, for example, Japan, builds power plants in a country without an emissions cap, for example, China. In this system, the difference between GHG emissions that would otherwise be caused by power generation using conventional Chinese technology in Chinese plants and those which would otherwise be caused by power generation using Japanese technology in will be considered as joint reductions by Japan and China. The last of the Kyoto mechanisms is called Joint Implementation (JI), which enables the transfer of emission reductions through technological transfer, etc., among countries with an emissions cap.

Joint Fulfillment could perhaps be called the fourth Kyoto mechanism. For example, 15 respective countries in the EU have made the unified commitment of 8% reduction below 1990 levels across the board, but the reallocation among themselves is approved.

The economic explanation of the Kyoto mechanisms is just to protect the earth through the pricing of GHG emission. There is criticism towards emissions trading, such as "it entrusts the fate of the earth to the speculation elite"² or "it allows those who cannot make actual reductions to buy virtual emission reductions."³ However, these criticisms are mere misunderstandings.

We can expect to minimize the total global abatement cost utilizing the Kyoto mechanisms through equating the marginal GHG abatement cost of each country. At the same time, the mechanisms may mitigate inequality among countries in achieving respective abatement targets, which differ country by country in the Kyoto Protocol. A country with a high marginal abatement cost can achieve its target through obtaining emission credits from markets, rather than reducing emissions domestically. On the other hand, a country with a low marginal abatement cost can sell surplus emission credits if it over-achieves its target. As a result, economic burden differences among countries become smaller. In this aspect, the Kyoto mechanisms have a characteristic as a relief measure that equalizes economic loads of each country, which were unfairly allocated through political negotiations.

3. Strategies of the EU, the U.S., and Japan

Let us look at the strategies of the EU, the U.S., and Japan regarding the Kyoto Protocol. In

² See Shohei Yonemoto, "CO2 International Emissions Trading: Risky American Proposal," *Ronza*, June 1997, pp.112-5, in Japanese.

³ NHK TV program, "Greedy Society: How far Markets prevail?" December 2000.

Figure 1, the horizontal axis represents the amount of CO₂⁴ emitted to produce the GDP of US\$ 1 million evaluated in purchasing power parity (CO₂ ton), and the vertical axis represents CO₂ emissions per capita (CO₂ kg) in major countries in 1996. In this figure, the more you go to the upper-right direction, the less efficient the country will be. The slope of a line between the origin and each point shows GDP per capita (US\$10,000). Therefore, the steeper the slope becomes, the larger the GDP per capita will be. When there are no points representing other countries in the upper-right direction from a given country's point, that country can be considered as an inefficient country. The U.S., Australia, Russia, Ukraine are considered as such. They can be called "inefficient countries" in CO₂ emissions. These countries form a group called the "Umbrella" in negotiations over the Protocol.⁵ The efficiency of the major EU countries, such as U.K. and Germany, is relatively high. As for Japan, CO₂ emissions in terms of both GDP and per capita are a little lower compared with Germany and U.K. However, it can be considered comparable to typical EU countries when at least evaluated in terms of both of the two indicators. Located near the origin along the horizontal axis are developing countries such as China, India, Indonesia, and Bangladesh. It should be noted that India and Bangladesh are more efficient than the U.S. in terms of emissions per GDP.

 Figure 1 is around here

Figure 2 shows the respective total emissions of CO₂ in major countries.⁶ The base year for reduction stipulated in the Protocol is 1990. The emissions of the former USSR, namely current Russia and Ukraine, etc., were reduced approximately 40% below 1990 levels in 1998 due to an economic recession. As the reduction target of Russia and Ukraine is 0% below 1990 levels, they can sell these excess reductions of 40% as emission permits. However, this portion called "hot air," is criticized by NGOs under the argument that these countries can sell such portions as emission permits without any reduction effort. "Hot air" is the result of problematic target setting of the Kyoto Protocol, which decided on

⁴ Emission trend analysis of CO₂, the data of which is easily available, can be regarded as the analysis of all GHGs because CO₂ occupies 80 to 90% of the total GHG emissions.

⁵ The Umbrella is a negotiating group of countries consisting of Australia, Canada, Iceland, Japan, New Zealand, Norway, Russia, Ukraine, the U.S.A., but it is not a group of Joint Fulfillment such as the EU.

⁶ Data are based upon *Handbook of Energy and Economy*, Ed., Econometric Analysis Division of the Institute of Energy Economics, Japan.

respective targets with political compromises based on the emissions of the single year of 1990, ignoring aftermath economic situations of each country, etc. At the least, target setting after and including the second commitment period should avoid such a problem. The problem, however, may not be “hot air” itself, but the fact that “hot air” is in the hands of “inefficient countries.” The characteristic of the U.S. and Australia, which are also members of the “inefficient countries,” is that their emissions have increased compared with 1990 levels. On the other hand, in Germany and U.K., emissions are declining. Regarding Japan, emissions in 1999 had increased 6.8% over the 1990 level, which requires a reduction of 12.8% as of 1999 to achieve the Protocol target. This is one of the reasons that Japan is included in the Umbrella group, along with the U.S. and other countries.

Figure 2 is around here

Table 1 is around here

Let us look at the position of the EU.⁷ The total GHG emissions of the EU in 1990 was about 1,144 million tC, with the main emitting countries of Germany and U.K. holding share of 341 million tC and 199 million tC respectively (See table 1). Each reallocated target of EU countries by the above-mentioned “Joint Fulfillment”(so-called “Bubble”) mechanism varies widely, from a 27% increase to 28% reduction from the baseline of 1990 emissions. We can see the true required abatement margins by comparing these reallocated internal EU targets with respective emission increase/decrease projections without measures (BAU projections) around 2010.⁸ For example, though Germany’s 21% reduction seems to be large, it is just a 5% reduction from its BAU projection and not such a wide reduction margin. The reduction margin of the EU as a whole is just 6% from BAU projections. We can thus understand that the 26% reduction margin required of Japan is quite large compared with that of major countries of the EU.

⁷ See also J. Gummer and R. Moreland, “The European Union and Global Climate Change: A Review of Five National Programmes,” Pew Center on Global Climate Change, June 2000 (http://www.pewclimate.org/projects/pol_review.cfm).

⁸ Emission projections without measures are called BAU (Business As Usual) projections. BAU projections are merely projections and should be treated with some discounts, though other countries reviewed these figures. However, BAU should be the baseline when we consider needed reduction margins taking into account respective economic growth projections, etc.

As for the respective required abatement amount from the 1990 GHG emission baseline after the reallocation, we can see that Germany shoulders 77% of the total EU reduction and U.K. accounts for 27%. Although the reduction amounts of these two countries surpass the total EU reduction, these two countries have special circumstances, such as the reunification of Germany and the drastic change in energy supply structure.

Let us further consider these special situations of Germany and U.K. Firstly, Germany and U.K. are taking advantage of the base year set as 1990. It was in 1990 that the unification of East and West Germany – the emergence of the largest CO₂ emitting country of the EU – was realized. In other words, East Germany, which was an “inefficient country” with hot air, joined this group. Looking at the regional breakdown of CO₂ emissions in Germany, the emissions in the former East Germany region showed a 44% decrease compared with the 1990 level, while those in the former West Germany region showed a 2% increase, in 1995. In total, Germany as a whole showed a 12% decrease. The CO₂ emission reduction achieved in East Germany by 1995 accounts for about a half of the German emission reduction target.⁹ Thus the real reduction target of Germany can be considered as not 21%, but less than 10%. According to the UNFCCC data, Germany realized a large emission reduction by 1998, the level of which was about 84% of 1990. A significant part of this reduction seems to have materialized in the East Germany region. As a reference, we can point out that German per capita CO₂ emission in 1998, which is after such a large reduction, is still 17% larger than that of Japan.¹⁰ Secondly, both Germany and U.K. had used a lot of coal, which causes greater CO₂ emissions. In both countries, a switchover from coal to natural gas took place mainly after 1990. Germany and U.K. are being supplied natural gas respectively from Russia and from oil fields in the North Sea. They made a shift to natural gas because the price was cheaper. For example, in the U.K., the energy switch from coal to gas is in progress due to energy market liberalization unrelated to the Kyoto Protocol. If we take into account the foreseeable progress of the energy market liberalization up to 2010, we can say that the U.K. can achieve the reallocated internal EU target, which surpasses the U.K.’s Kyoto target, only with the liberalization, which has a negative cost. In this context, the U.K.’s real reduction target can be recognized as zero.¹¹

⁹ We make this argument assuming GHG emissions after 1990 remain at the 1990 level.

¹⁰ International Energy Agency, “Key World Energy Statistics from the IEA-2000 Edition,” November 2000

¹¹ Japanese energy market liberalization, which is still at a very initial stage, probably will bring about a completely different outcome. This is because gas available in Japan costs nearly triple the international market price and the only cheap energy source available in Japan is coal. Thus, simple

In fact, the latest U.K.'s BAU projection of 2010 is below the U.K.'s internal EU target.¹²

It can be said that the EU position in negotiations over the Protocol is determined by the unification of Germany as well as oil fields in the North Sea and the pipelines of natural gas. Furthermore, 10 Eastern European countries with hot air are to join the EU in the future, which could facilitate the achievement of the reduction target despite the absence of actual reductions.

Among the EU, some countries are relying on the Bubble and do not reduce GHG emissions significantly within their territories. The EU Bubble virtually allows countries such as Greece, Spain, and Sweden to hand their major portion of reduction on to other EU countries, such as Germany and U.K.¹³ In addition, there are countries like the Netherlands that stated positively to utilize cheap foreign reductions of the Kyoto mechanisms for half of their reduction amount. The Kyoto Protocol has a spirit that tries to make the best use of cost effective reduction opportunities all over the world. Japan should reconsider its domestic-dominant emission reduction plan comprehensively, paying serious attention to cross-border options along with the spirit, as other countries are doing.

With how much cost, then, will the EU be able to reduce GHGs? According to a survey by the EU, the marginal abatement cost (MAC) for reducing emissions by 8% below the 1990 level is about 70 euro (about 8 thousand yen) per ton of carbon.¹⁴ This figure is estimated to increase to about 150 euro (about 16 thousand yen) per ton of carbon when the EU does not use the EU Bubble. On the other hand, the MAC of Japan for achieving the Protocol target is said to be around 30 thousand yen per ton of carbon in many cases, with extreme case reaching over 100 thousand yen per ton of carbon.¹⁵ If the Kyoto mechanisms fully function, and the U.S. participates in the Protocol, an international price per ton of carbon

energy market liberalization in Japan is likely to increase not gas, but coal, which has a high carbon content.

¹² Although the U.K. does not have to take any measures to achieve the Kyoto target, the U.K. set its own target of a 20% reduction from the 1990 level and is considering taking additional actions. The U.K. can sell surplus credits from the Kyoto baseline to other countries.

¹³ According to the authors' estimation based on BAU projections, Greece's 94% reductions, Spain's 70%, and Sweden's 67%, will not be achieved within those respective countries, but such as in Germany and U.K., due to the EU Bubble. The EU adamantly insisted that other countries outside EU should not rely on outside-border reductions for more than 50%, utilizing the fact that it is not widely known that some countries within the EU are dependent on outside-border reductions of more than 50.

¹⁴ http://europa.eu.int/comm/environment/enveco/climate_change/sectoral_objectives.htm

¹⁵ See <http://www.env.go.jp/council/06earth/y062-08/mat02.pdf>

is said to be around US\$20 to 70. This means that the EU will be able to achieve the Protocol target efficiently within their boundaries with the EU Bubble, which can be considered reliable and unlimited emissions trading, without depending on the Kyoto mechanisms at all.

If so, the diplomatic strategy of the EU, which acts in the EU's interest, is to acquire a relatively favorable position compared with outside of the EU, by making the Kyoto mechanisms inconvenient for the Umbrella group countries. In other words, their negotiation cards would include: the limitation on emissions trading, etc., as much as possible; no forest management sinks; and the strict operation of CDM. Furthermore, environment-oriented political powers within and outside of the EU responded to that and have been supporting limitation on the use of the Kyoto mechanisms. On the other hand, the EU is trying not to limit emissions trading within the EU as much as possible to minimize the total costs all over their region, while trying to set a limit on international emissions trading.¹⁶ In other words, the EU is intentionally trying to apply different policies inside and outside of their region.

However, in response to President Bush's statement, "I oppose the Kyoto Protocol because the Kyoto Protocol was fatally flawed in fundamental ways, though the process used to bring nations together to discuss our joint response to climate change is important. The Protocol is not effective in preventing global warming, exempting 80% of the world, including major population centers such as China and India, from compliance. In addition, the Protocol may cause serious harm to the U.S. and the world economy due to its exceedingly precipitous targets,"¹⁷ the diplomatic strategy of the EU has entirely changed, which made them greatly compromise to the Umbrella group in the resumed session of COP6 in Bonn this July. This is because the EU considered that there would be no other choices for the entry into force of the Protocol, as stated below, as well as because the international price of emission permits would be significantly lowered by using the Kyoto mechanisms without the U.S., which would force the EU themselves to somewhat depend on the mechanisms. The EU may have tried to keep its relatively advantageous position in the Kyoto framework over the U.S., Japan, etc. Rejecting the Kyoto framework meets the U.S. interests, while preserving the Kyoto framework seems to meet the interest of the EU, which has to take some kind of domestic action due to domestic political pressures. For the

¹⁶ See EU's green paper published in March 2000,
http://europa.eu.int/comm/environment/docum/0087_en.htm

¹⁷ These are not exact quotations from President Bush's statement, but a summary of his claims.

EU, even making some compromises to the non-U.S. umbrella group in order to save the Protocol may have been a better option than killing the Protocol.

CO₂ emissions per capita in Japan continued to rise until the early 70s, when the increase almost stopped due to the oil shock in 1973 - 1974. It continued to shift around 8 CO₂t per capita thereafter, but it turned again into an increase since 1987. From 1990 to 1999, the increase in the industrial sector is 0.8%, while that in the transportation sector is 23 % and for the commercial and residential buildings sector it is 15%. In order to achieve the Protocol target based on 1990 levels, a reduction of 12.8% is required. However, it cannot be easily achieved even if an economic recession drags due to the structural reform of the Koizumi administration. Just after the adoption of the Protocol, the Japanese government decided on the General Principles on the Promotion of the Measures to Cope with Global Warming in a Cabinet meeting in June 1998.¹⁸ According to these General Principles, energy-derived CO₂ emissions control is to be 0%, the emissions control of methane, etc., is to be -0.5%, reduction through technical innovation, etc., is to be -2.0%, reduction by sinks mainly from forest management is to be -3.7%, the emissions control of CFC substitutes, etc., to be +2%, and the use of the Kyoto mechanisms is to be -1.8%, which will be a total of -6%. The policies in the General Principles are mainly based on command-and-control, and the share of those using the Kyoto mechanisms is 1.8%. These reduction target allocations were not decided based on some rational principle, such as minimizing compliance costs. There is no convincing explanation why the share of the Kyoto mechanism is 1.8%. While the EU and the U.S. seem to have been acting strategically for their national interests, Japan lacks an international and long-term strategy. Japanese measures are very passive, just aiming to achieve a 6% reduction from the 1990 emissions level. Japan, which has a relative advantage in energy-saving technologies and so on, should take more strategic actions and measures in order to make the best use of its relative strength. At the same time, Japan should balance emission reductions with other important policy goals, such as energy market liberalization, energy security, and international industrial competitiveness preservation, which are not always compatible with abatement measures.

The Japanese negotiation position changed dramatically in response to the U.S. objection toward ratification. The requirements for the entry into force of the Protocol are (i) that it must be ratified by more than 55 countries, and (ii) that it must be ratified by countries

¹⁸ <http://www.env.go.jp/earth/cop3/kanren/suisin2.html>

with an emissions cap whose aggregate 1990's emissions is at least 55% of the total CO₂ emissions in 1990 of capped parties. The share of the U.S. in 1990 was 36.1% and that of Japan was 8.5%. Therefore, the total share excluding these two countries is to be 55.4%. As the shares of Canada and Australia are 3.3% and 2.1% respectively, the Protocol will not be able to come into effect if either of them do not ratify it following Japan. Canada is wavering between a choice of ratifying the Protocol without the U.S. or waiting for ratification by the U.S., while Australia is indicating that it might wait for the U.S. This means that Japan has become the pivotal player to decide the future of the Kyoto Protocol.

In COP6 held in The Hague in November last year, an agreement was not reached because the proposal of President Pronk was refused by Germany and others. One of the biggest interests of the Japanese government at that conference was the treatment of sinks from LULUCF¹⁹ activities. Although it estimated a 3.7% reduction through sinks from forest management below the 1990 level in the General Principles, only 0.5% was to be approved in the Pronk proposal. Although President Pronk offered a compromising proposal of 3% to Japan in June, Japan refused to accept it, demanding to add more. Japan also did not clarify its attitude toward the ratification of the Protocol, saying the first thing to do is to urge the U.S. to come back to the Protocol regime. Although it was reasonable for Japan to maintain that attitude in order to proceed with the negotiation favorably to itself, the press and NGOs were offended. In the resumed session of COP6 in Bonn in July, the EU made substantial concessions to the Umbrella group, and Japan could secure a 3.9% reduction upper limit through sinks. It is said that Japan had almost all of its demands granted despite some remaining uncertainties.

The Japanese government argued for a lax compliance system as well as no limits on the Kyoto mechanisms. If it intends to use the Kyoto mechanisms including emissions trading, it is essential to design a robust compliance system as well as not to set limits on the use of the mechanisms. In this regard, the argument of the government lacks consistency. In the Marrakech Accords²⁰, the following statement is included: Each Party ... shall maintain, in its national registry, a commitment period reserve which should not drop below 90% of the Party's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Protocol, or 100 per cent of five times its most recently reviewed inventory, whichever is lowest. This reserve system has some problems, though it seems to be well-thought out for

¹⁹ LULUCF stands for Land Use and Land-Use Change and Forestry, including forest management.

²⁰ COP7 was held in Marrakech, Morocco in October to November 2001 and reached the so-called Marrakech Accords, which generally followed the Bonn Agreement.

preventing overselling of so-called hot air.²¹ First of all, reserves mean supply limits, which makes the price of emission permits or the compliance cost of buyer countries such as Japan higher than that in a case without reserves. The Japanese government tolerated the reserve system, and deferred the issue of a legally binding penalty system.²²

Then, how is the U.S. strategy? The U.S. Senate decided the followings by consensus in the summer of 1997. First, developing countries also need to have emissions reduction commitments. Second, the Protocol should not have a severely negative impact on the U.S. economy. Third, the ratification of the Protocol cannot be approved unless both of two requirements above are fulfilled. Although in Kyoto, the then Vice President Gore accepted a 7% reduction below the 1990 level, the U.S. emissions increased by 12.5% over the 1990 level in 1998 reflecting its economic boom in the 1990s. It means that they had to make 19.5% reduction as of 1998. Compared before (1972) and after (1982) the two oil shocks, CO₂ emissions in the U.S. have been somewhat reduced. However, they increased by 23.6% in 1998 over the 1982 level. It can be said that the U.S.'s Protocol target will be difficult to achieve unless something equivalent to continuous oil shocks, *inter alia*, a large amount of domestic carbon tax or a command-and-control type regulation, is introduced. The U.S., which does not favor tax and regulations, tried to widen the accounting of domestic forest sinks and aimed to design a system that would not limit the use of mechanisms that would utilize overseas reductions. However, it can be said that these ways were cut off by the EU strategy.²³ The abandonment of the Protocol by the Bush administration means that the U.S. has returned to the position of the 1997's Senate's decisions. However, the Bonn Agreement and Marrakech Accords should facilitate the U.S.'s return to the framework of the Protocol, due to a substantial concession by the EU.

The situations of the EU, the U.S. and Japan are often compared to a wet towel. The EU is a wet towel with a substantial amount of water, which can be wrung. The problem is

²¹ http://www.unfccc.de/cop7/documents/accords_draft.pdf

²² It has been a central issue to restrict the usage of the Kyoto mechanism, which is called supplementarity. See also K. Kaino, T. Saijo, and T. Yamato, "Economic Consequences of EU's Proposal of Quantity Restraints on the Kyoto Mechanism," *Energy and Resources*, Vol. 21(2), March 2000, pp.38-42, in Japanese.

²³ As for the U.S. Climate Change Review - Initial Report, see <http://www.whitehouse.gov/news/releases/2001/06/climatechange.pdf>. It is impossible to design an institution or a treaty where every party ratifies it when the issue is an international public good such as global warming. As a theoretical framework, see T. Saijo and T. Yamato, "A Voluntary Participation Game with a Non-Excludable Public Good," *Journal of Economic Theory*, Vol.84, pp.227-242, 1999.

whether the towel can be wrung after year 2013 when decarbonization, etc., is to be completed. Japan is a towel almost dried, with little water to be wrung. It is even uncertain whether it can achieve the Protocol target unless significant technology or people's lifestyles change. The U.S. is a wet towel with abundant water, but it is less willing to wring it, holding the American lifestyle and national interests as an excuse. It is also one of the problems in the Protocol that the EU, the U.S. and Japan have almost similar reduction commitments though their national conditions are quite different.

4. After Kyoto

Let us probe into problems in the Protocol. The first problem is that it took too much time to reach the agreement. The practical start point of the Protocol was COP1 in 1995 in Berlin, followed by COP3 where the numerical targets were set, and finally, the resumed session of COP6 and COP7 in 2001 at which operational rules were agreed upon. In the course of negotiations, many Cabinets were replaced in Japan and similar changes happened in other countries. If the negotiations are extended, they will be more vulnerable to administrative policy changes of each country, and thus the negotiations could become more complicated and extended. Economic environments and other conditions, which set political positions of each country, also change in the meantime. For example, the U.S. has been hit by energy crises such as the electricity crisis in California and economic recession. In addition, it will be from 2008 to 2012, the first commitment period, in which the numerical targets will be applied. It is quite difficult to predict economic conditions of each party during the first commitment period. As for the political aspect, it is quite unlikely that an administration that ratifies the Protocol will remain after the end of the first commitment period, when compliance of the country will become clear. There is a possibility that a country accepts a difficult reduction target as an impermanent political stand play of an administration at that time. At the same time, we should pay attention to the fact that global warming prevention measures need a certain amount of long-term vision. For example, ten years is not enough if we consider the lead-time that is necessary for the construction of a power plant. In the case of Japan, a power plant construction plan beyond the year 2010 is already set, and it will be fairly difficult to change the plan. In order to lead such investment activities, which need long-term prediction, toward a desirable direction, the long-term policy path for 10 to 20 years should be known by private sectors. Therefore, the negotiations should decide the long-term goal within a short time period, clearly distinguishing the difference between showing long-term vision and taking time for making political compromises. The reason why it took such a long time for deciding the

operational rules of the Protocol is that the negotiation failed to follow the right order of decisions; reduction targets had been set before deciding details of the operational rules. Thus, in future decisions, the order should be changed: operational rules should be set first and the economic burden of each party should be clarified, and in the final stage reduction targets should be fixed. Otherwise, negotiation skills decide economic burdens of each party, and inequality in economic burdens will occur again as in the Kyoto process.

The second problem is the base year for reduction. The important objective of UNFCCC was to stabilize GHG levels at 1990 levels by 2000. Although this objective was not achieved in most of the major countries, 1990 has been set as the base year tacitly in negotiation over the Protocol. The numerical targets seem to have been set with a country's specific economic situation and equitability with other countries taken into consideration, but it still gives an impression that the establishment process of the targets was rough-and-ready. Ambassador Raúl A. Estrada-Oyuela of Argentina, who managed to settle negotiations over the Protocol, cannot show an objective rationale of why the Japanese target is a 6% reduction while the Australian target is an 8% increase. It is quite ironic that Japanese companies are trying to earn emission credits through afforestation in Australia, which won the 8% increase. Numerical reduction targets of the Kyoto Protocol are just political compromises that are not backed by scientific grounds. In addition, the targets were set hastily, when parties did not know their own economic burdens and at a stage without clear operational rules. As a result, the negotiations after COP3 became extremely complicated and eventually the U.S. seceded from the Kyoto regime. Moreover we should not overlook the fact that the Protocol places a heavier economic burden on countries that have been incorporating energy-saving measures before 1990, such as Japan, while placing less burden on energy-wasting countries which have not made efforts so far. This harsh reality may give an undesirable lesson to developing countries that have been observing the whole process. They may learn that early reduction does not pay, and that they should not take early measures before they come to have to accept numerical reduction targets in the future.

The third problem is that country specific figures for sinks were virtually decided in the political negotiations at the resumed session of COP6 in an artificial way, after the numerical reduction targets had been decided at COP3. Forest and other type absorption figures should be decided at least based on scientific evidence instead of negotiations. The problem is that those baseless numerical targets had been decided before detailed rules were set.

The fourth problem is that developing countries do not participate in the Protocol as was indicated by the U.S. We should not slight the effect of carbon leakage. Japan, which has to make a drastic emissions reduction while its major trading partners do not have GHG reduction commitments, may face serious problems. Remedies for global warming must be in a global system that can really reduce GHG emissions globally. Even if a party cleans up its own domain --- complies to the emission target, if neighbor countries increase their emissions --- if other non-binding countries increase GHG emissions due to carbon leakage, such as energy-intensive industry transfer from binding countries to non-binding countries, in the aggregate total, global GHG emissions do not decrease and emissions abatement efforts in developed countries do not contribute to global warming prevention. A country that takes emission reduction measures may encounter political difficulty in obtaining domestic consensus because it loses employment and value-added unnecessarily. There are some options for developing countries, which are not likely to restrain their economic growth, such as per unit energy use targets and so forth. Burdens and benefits distribution in the Kyoto Protocol, in which developing country parties have virtually no obligation and just one-sidedly receive funds and technologies from developed country parties, make it difficult to conduct equal footing negotiations and operations over the Protocol. The following paragraphs are intending to offer practical proposals to resolve these problems.

Given that the Protocol is to be effective, we have to start developing a new protocol for a period after 2013 by 2005. We also have to avoid wasting time in choosing an adequate base year. For that purpose, a country-specific GHG emissions path for 2013-2017 must be established. Objective and reasonable establishment of the GHG emissions path only can prevent notorious hot air as well as allow parties to set internationally equal emission reduction targets. The selection of a path may depend on reduction efforts that have been made by a country concerned, its economic performance, its weather and climate, its energy consumption pattern, forest sinks, emissions per GDP and so on. This path must not be decided in a plenary session of the COP, but in a team, which consists of experts from three countries, each representing developed countries, semi-developed countries, and developing countries. When an emissions path for Japan is to be decided, the team should consist of experts from such three countries excluding Japan itself. In other words, an emissions path for one's own country would not be decided by the country concerned but by other countries.²⁴ In this case, Japan would also of course, be involved in the decision

²⁴ This type of method in the theory of institutional design, see T. Saijo, "Strategy Space Reduction in Maskin's Theorem: Sufficient Conditions for Nash Implementation," *Econometrica* 56(3), 693-700, May

by providing information to these three decision-making countries, but the decision-making itself would be done by the three evaluating countries. Through such process, there would be a smaller possibility of making favorable allowances for each other compared with other cases including bilateral evaluation. As a result, this would give objectivity to an evaluation itself. Moreover, it would facilitate as well as save time for a decision compared with a process in a plenary, as an evaluation is to be made by only three countries. This process must be implemented in all of the UNFCCC ratifying countries. In case of a country without enough human resources, organizations including the International Energy Agency would give a support.

After country-specific emissions paths have been decided, reduction schedules would be decided at annual Conference of the Parties (COP). Emissions paths for developing countries may be approved as they are, while developed countries may be required to reduce more. It is quite important that the reduction schedules are set favorably for countries that have been making early voluntary reductions, though in the existing Kyoto Protocol, countries that have made efforts before 1990 suffer a disadvantage. For example, equating abatement margins from the approved emissions path may ensure international equity. In addition, some encouraging treatment for a country that has achieved higher energy-saving standards, which can be judged based on present energy intensity and so on, would be desirable. This is because a country with a higher energy-saving level may face heavier marginal abatement costs and economic burdens if abatement targets are set at the same level as energy-wasting countries. For example, emission reduction targets for normal developed country parties can be set at a 15% reduction from their own emission paths, and a country that achieved higher energy-saving can receive some discounts according to its materialized per unit emission level, while a country that has made less effort has to compensate and make greater reductions.

Global warming is a problem brought about by cumulative GHG emissions, as GHGs remain in the atmosphere for about 50 to 200 years. If we follow the claims of developing countries, that global warming until now has been caused by cumulative GHG emissions mainly made by developed countries, we should differentiate emission reduction targets according to cumulative per capita emissions. For example, in terms of current per capita emission flow, there is not much of a difference among Japan, the U.K., and Germany. However, if we pay attention to the past 50 years, during which GHG emissions increased

explosively and during which cumulative GHG emissions account for about 80% of the total GHG emissions since the industrial revolution, and assume per capita cumulative responsibility can be obtained through dividing the past 50 year cumulative emissions by current population, it can be noted that emissions of Germany and the U.K. are roughly two times bigger than that of Japan (See table 2). Taking into account the fact that cumulative emissions means giving advantageous treatments to a country that has made early voluntary actions, this type of adjustment seems to be desirable.

Table 2 is around here

On the other hand, the U.S. and others deny the cumulative responsibility, insisting that past emissions were already done before we recognized the risk of global warming, and that the reason why developed countries should tackle emission abatement on their own initiative is that developed countries are rich and can afford to take measures. In the world of criminal law, a widely accepted legal principle is that if an action was not predetermined as a crime, we cannot punish the action retroactively. Although in this context the claim of the U.S. seems to be appropriate, few people object to providing some incentives for early voluntary emission reductions.

If we really want to prevent global warming, it is extremely important to establish some mechanisms that give incentives for early voluntary reduction efforts of developing countries. We should establish such tangible mechanisms and clearly prove that early actions for emission reductions are beneficial for developing countries. The existing Kyoto scheme discourages early voluntary actions of developing countries, because the greater the level of emission reductions a country voluntarily undertakes, the higher the marginal abatement costs will be when developing countries accept emission reduction targets in the future. Establishment of an objective emission path is also valid in this context.

Each country would use emissions trading and joint implementation (JI) as flexible mechanisms while implementing domestic reduction. As all countries participate in this system, CDM would be integrated into JI, and CDM specific problems including the measurement of emission reductions generated from CDM could be avoided.

Even in this system, however, there remains a possibility that the global total emissions

would increase due to the participation of developing countries. To avoid this, the global total target – which would be set less than the total of national targets – would be set separately from country specific targets, and the administrative organization of emissions trading would keep emission permits supplied from developing countries to abandon some of them. If the equivalent cost of this abandoned emission permits' value is borne by developed countries in proportion to their accumulative emissions amount in the past, this system can also ask for differentiated responsibilities based on cumulative emissions.

5. Domestic Policies in Japan

As Figure 2 shows, although Japan also experienced the two oil shocks, its total CO₂ emissions have increased when compared before and after the oil shocks. As in the case of the U.S., it is also difficult for Japan to achieve the Protocol target unless something equivalent to continuous oil shocks or policies with more effect are introduced. Remember the two oil shocks raised the price of crude oil ten times higher.

Securing its line in the General Principles almost as it is in the Bonn Agreement and Marrakech Accords, the Japanese government is likely to take command-and-control type measures.²⁵ In this case, the first problem is that entities escaping from regulatory loopholes would benefit, while those taking measures according to regulations would lose. The second problem is that entities whose marginal reduction costs are low would not reduce more than the regulatory level while entities whose costs are high would have to pay significant costs for reduction. Therefore, total costs could not be minimized in terms of the national total. The third problem is that a system regulating all over Japan must be maintained. This would require transaction costs and would also create various rights and interests. The fourth problem is that the international price of emission permits would be lowered by the absence of Japan – which is expected to have a large demand for emission permits – in the emissions trading market, which would make the reduction costs of Japan relatively higher than other countries including the EU. The fifth problem is that if the Protocol comes into effect without the U.S., and Japan takes a command-and-control line, the emissions trading market will become too small to function.

We must design a simple and transparent system while avoiding these problems. Possible systems that could realize this objective are carbon tax and domestic emissions trading.

²⁵ See T. Kusakawa and T. Saijo, "Economic Consequences of Japan's Isolationism on Global Warming," *Economic Seminar*, December 2000, pp.36-41, in Japanese.

Given that the Protocol target is considered as an international commitment that must be achieved, simply a carbon tax alone may not achieve this target. Of course, we can use the Kyoto mechanisms to achieve reductions that could not be covered by the tax. However, in the current situation where the emissions amount of a given year is confirmed 1-2 years after that year, emission permits have to be obtained with consideration to some extra amount.

Therefore, we would like to propose here an upstream emissions trading system as a simple and transparent system that would ensure the achievement of the Protocol target. In such a system, the domestic importers of fossil fuels cannot sell their products without emission permits. This system will be able to reduce the number of participating entities and to minimize transaction costs compared with the downstream trading of fossil fuel consumption. Moreover, this system can secure equitability because the price of emission permits is to be set at the upstream, as well as create an incentive for reduction investment also at the downstream due to the price increase of goods and services that are fossil fuel intensive. It will be possible of course, that the consumers of fossil fuels may buy emission permits abroad and get fossil fuels by presenting them to importers. The acquisition of emission permits overseas is also possible through CDM and JI, as well as emissions trading. The results of investments in GHG reduction technology including afforestation can be utilized not only within Japan but also in foreign countries. Therefore, in this regard, we should aim to be an “environmental trading country” instead of an “environmentally isolated country” by pursuing the General Principles. In the future, we might become able to hear the price of CO₂ permits per ton everyday on TV news.

We often come across an argument that the pricing of GHG emissions through emissions trading would hamper economic growth. This is not necessarily true. If GHG emissions come to be adequately priced, various technological improvements will take place in order to restrain this. This technological progress will lead to the creation of new industries to change the Japanese industrial structure itself. Through this process, we will be led to sustainable economic development.²⁶ We have to take notice of the phrase “adequately priced” here. For example, if Japanese carbon prices ascend too much through introducing severe reduction targets only in Japan and not in neighboring trading partners, it may result in facilitating only a hollowing out of Japanese industries, and global GHG emission reductions may not be achieved. In a comparison between investments for transferring

²⁶ See T. Ono, “Environmental Tax Policy in a Model of Growth Cycles,” University of Tsukuba, mimeo., 2001.

production bases abroad and for environmentally sound technology development, the former is overwhelmingly easier in the current globalized economy and more compatible with highly prioritized management goals, namely augmentation of short-term profits of stockholders. When only Japan faces the sharp emission reductions, foreseeable markets for the new technologies that can be developed by new investments are smaller, and expected returns from the technologies are also smaller, because only Japan can be a market at least in the near future.

Furthermore, there is another problem for Japan to be examined, which is flexibility of the Japanese economy for new technologies. This is because the dissemination speed of new technologies in Japan seems to be slower than ever, since already the matured Japanese market will shrink in the future as its population will reach a peak in 2007 and decrease afterwards. Even if epoch-making technologies are developed in the near future, Japan may not be able to utilize them immediately due to a slower technology switchover. Looking back over a history of capital-intensive raw material industry such as iron and steel, we understand that a changeover to newly developed technologies has progressed parallel to economic growth and expansion, and not advanced so much under low economic growth periods. For example, the Japanese iron and steel industry has become far superior to U.S. counterparts partly because Japan introduced new highly efficient facilities and equipment along with high-growth of the economy. At that time, the U.S. iron and steel industry seemed to be in weak position against emerging economies, such as Japan, and could not introduce new technologies because using old and inefficient but fully depreciated facilities and equipment was only way to maintain its cost competitiveness. We should pay heed to this kind of concern, though it may be too pessimistic to consider that the Japanese economy will follow the same path as the U.S. iron and steel industry that was surpassed by Japanese companies. We should clearly recognize that this sort of apprehension comes not from pricing GHG emissions, but from unequal imposition of tough GHG emission reduction targets on a small number of countries such as Japan. If emission reduction targets of some countries are too sheer when developed countries including South Korea are treated favorably without emission caps, only negative aspects of the emission cap, such as carbon leakage, become significant, and positive aspects of emission reduction efforts are covered. In this context, although reduction targets of about 6% from BAU projections for the EU seem to be reasonable, the Japanese reduction target in the existing Kyoto regime of more than a 20% reduction from BAU projections, can be regarded as wide enough to worry about the negative effects.

When introducing an upstream emissions trading system, we should consider some special treatments, such as mitigation or exemption of carbon taxes or additional carbon prices, for companies that have and are implementing somewhat objective and binding GHG emission reduction plans like “Keidanren Voluntary Action Plan on the Environment (Measures against Global Warming).” An upstream emissions trading system has the same effect on downstream companies, as carbon taxes do. Prices of energy and carbon related goods in downstream are increased reflecting emission permit prices and fund transfer from downstream companies to upstream companies occur to compensate increased fossil fuel costs in the upstream. Thus an upstream emissions trading system also gives rise to international competitiveness problems of industries as carbon taxes do. In many cases some special treatments, such as reductions of or exemption from taxes, are made from the point of concerns on industry competitiveness and so on, when carbon taxes were introduced in the EU. An upstream emissions trading system also requires the same kind of arrangements. If downstream companies keep some amount of funds in hand through such special treatment and face some pressures about GHG emission reductions from the government or NGOs, they use the funds voluntarily in additional capital spending for emission reductions or new technology development. Only the downstream end companies know really effective and efficient investment options for GHG emission reductions in the downstream, partly because those opportunities are continuously changing parallel to technology and business environment development. Therefore, voluntary actions of adequately motivated companies by the objective action plans seem to be more efficient than governmental fund redistribution after receiving fund transfer through taxation.

6. Concluding Remarks

We had an opportunity to talk with Mr. Seluka from Tuvalu, which is an island country with coral atolls in the South Pacific, at the resumed session of COP6 in Bonn. The population of this country is 12,000. He said their immediate problem was the increase of seawater flow into wells. He said sorrowfully, “We have to ask for overseas support because we have no technology to remove salts.” This might be an unnecessary technology for such a country if there was not the rising sea level problem. We could not help but think about their future, in which the coral atolls will go under water together with their wonderful culture, and in which the people will be forced to migrate overseas only to experience discrimination and oppression as well as the loss of their identity. We also heard a statement by Professor Dr. A. Atiq Rahman from the Bangladesh Centre for

Advanced Studies that “we should not choose a path where we would pursue economic development with the help of ODAs, polluting environment as well as emitting GHGs, only to end up with being transferred GHGs reduction technology”, at a NGOs meeting on technological transfer. Developing countries themselves are also facing with a problem of free-ride. Positions of developing countries, whose primary goal is economic development and poverty alleviation, are difficult partly because prevention of global warming is a typical prisoners’ dilemma. Although the payoff for global cooperation is clearly the highest as a whole, a developing country may obtain higher benefits through taking opposite measures or through not taking any actions at all when the majority of other countries take actions for preventing global warming. For example, creating an energy-intensive and wasteful economy may be a short cut for economic development and poverty reduction when energy prices go down through global warming prevention actions of other countries.

From the point of economic efficiency, there are more difficult problems for global warming prevention measures. We can assume the future abatement cost will be lower than now when we predict continuous technological development. If so, early actions are relatively expensive and impose high economic burdens. In addition, we cannot completely deny the perspective that adaptation for global warming is more efficient than prevention when we cannot surely say that the negative effect of global warming is irreversible. In terms of the cost benefit of global warming prevention measures, it is obvious that the biggest beneficiaries of present measures are the future generations in developing countries. In addition, if we calculate the net present value of future benefits from current measures, the net present value of global warming prevention measures is negligibly small because the benefits will be materialized several decades or centuries after. As mentioned above, from the point of pure cost benefit analysis, there is less convincing economic reasons for immediate actions of developed countries. In addition, uncertainty from the lack of scientific knowledge makes it more difficult.

The Bonn Agreement and Marrakech Accords also stipulate to narrow the per capita emissions gap between developed and developing countries. Although it is not indicated in Figure 1, if we look at the changes over time (1971-1998), they show each country has been moving left, across the board. In other words, although the efficiency per GDP has improved, CO₂ emissions per capita have not indicated any remarkable change. Per capita differences have not been narrowed for the past 30 years either within developed countries or between developed and developing countries. The Environmental Kuznets Curve shows

that, in the long run, emissions per capita increase as income goes up, but it turns into a decrease when income reaches a certain level.²⁷ This effect may have not been seen during a period of only 30 years, but we cannot wait for 50 years or 100 years to see the effect of the Environmental Kuznets Curve. It is necessary to design a mechanism that will lead each country to move toward the lower-left direction in Figure 1. The Kyoto Protocol is an agreement among countries that would serve for this objective as a first step, and does not present the domestic policies of each country. Although the Kyoto Protocol has many good points, such as a principle of differentiated responsibility with initiative of developed countries' actions, it also has many problems, such as the absence of incentives for developing country parties to take early voluntary measures. If we consider the negotiations over the Protocol as a sort of pure game, the lesson learned from the Kyoto process may be that the smart way is to accept an emission cap after expanding emission allowances with inefficient facilities, as can be seen in transition economies; while the less intelligent way is to accept a severe emission cap that may hamper economic growth after significantly achieving high energy-saving standards, as can be seen in Japan. We can say that transition economies like Russia have acquired enormous additional fund transfer through hot air. Regarding the fund contribution to assist developing countries, an early voluntary big donor, Japan, which began large amounts of financial aids to developing countries as Kyoto initiatives since 1998, is in a disadvantageous position against other developed countries including the EU that have not contributed so much. The existing framework of the Kyoto Protocol never rewards a country that has made early voluntary actions with good will. The framework, including reduction target setting, has to be revised fundamentally in order to favor and provide incentives for early voluntary actions.

It is also true in Japan that the Protocol objective cannot be achieved only by consumers with "awareness" that emphasize GHG reduction. Although it is of course important to have PR activities to increase consumers with awareness, it is more important to design a system including a mechanism that can control consumption through the price increase of goods and services that generate GHGs. In this context, neither a controlled society type system that tries to watch and control every action of each entity, nor a loose system that cannot prevent free-riders, are desirable.

²⁷ See, for example, J. T. Roberts and P. E. Grimes, "Carbon Intensity and Economic Development 1962-91: A Brief Exploration of the Environmental Kuznets Curve," *World Development*, 25(2), 191-198, 1997 and Noriyuki Goto, "Empirical Examination of the Relationship between Carbon Emissions and Economic Development," *The Proceedings of the Department of Advanced Social and International Studies*,

Although we tend to look at per capita emissions, what should really be given attention may be the amount of GHGs directly/indirectly input in goods and services that are used by a given individual. Suppose one country produces goods that would produce a large amount of GHGs and another country produces services that would produce relatively smaller amount. Per capita emission might be larger in the former and smaller in the latter. However, they use other country's goods and services through bilateral trading. This would then narrow the difference of GHG emissions per capita that have been input directly/indirectly into those goods and services. Therefore, it can be said that the entity to take responsibility is the consumer. In this regard, it is highly possible that the U.S., shown in Figure 1, is using more GHGs than the data from the perspective of consumers' responsibility because it is buying goods and services from developing countries.

We have to pay attention to an asymmetric information problem here in order to make the consumer responsibility work efficiently. Only producers of goods can efficiently and effectively know how much GHG emissions were caused in production of one good or service. We should also have a perspective of producer responsibility because only producers can directly control and reduce GHG emissions relating to production. Only after adequate information disclosure about GHG emissions from producers is materialized, can we have a necessary base for consumer responsibility. After that, if consumers choose goods and services made through production processes with fewer GHG emissions in terms of life cycle assessment, consumers can lead producers towards a desirable direction.

North-South problem aspects of global warming prevention make this type of argument more difficult. Poverty is worsening the population explosion, and has a close relation with wasteful resource usage such as slash-and-burn farming. When we consider poverty alleviation, which is the common first priority in an international donor community, we cannot simply criticize the U.S. for importing goods that are made in developing countries under poor working conditions with extremely low wages. In developing countries, in which business conditions are poor with inefficient infrastructure and risky currency exchange systems, jobs exist because wages are low, compensating negative aspects in business environments. If wages are not low enough, people lose their jobs and are likely to suffer more severe poverty under even worse working conditions. Lack of due governmental governance in developing countries also makes solutions for this type of

problem complicated. Without appropriate government, financial and technological aids are never used efficiently in originally intended ways by donor countries, as donors have learned from past experiences.

As mentioned above, there are many difficult problems. However, it is a fact that many experts are doubtful about the continuation of the American resource wasting lifestyle, symbolized by mass production, mass consumption, and mass disposal. Thus it is obvious that we should aim at a direction towards a sustainable, resource-circulating society.

Although it is quite difficult to create such a society with existing technology, it is also a fact that we are coming to a stage where we should take one step further towards such a direction. Each country needs to take responsible global warming prevention measures, which should be sustainable and effective in the long-run as an entire globe.

Data Source <http://earthtrends.wri.org/>

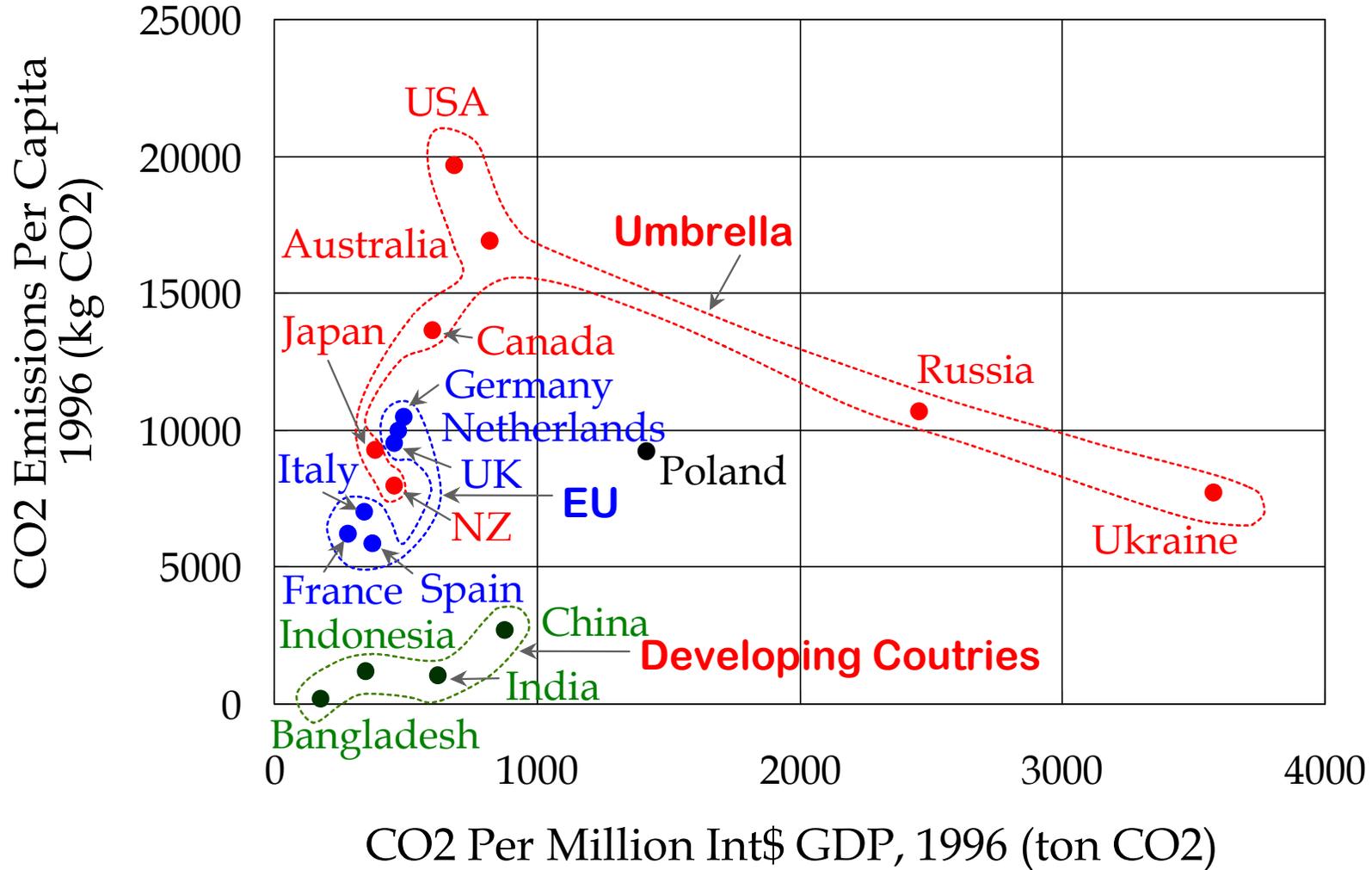


Figure 1. CO2 Emissions Per Capita and Per GDP

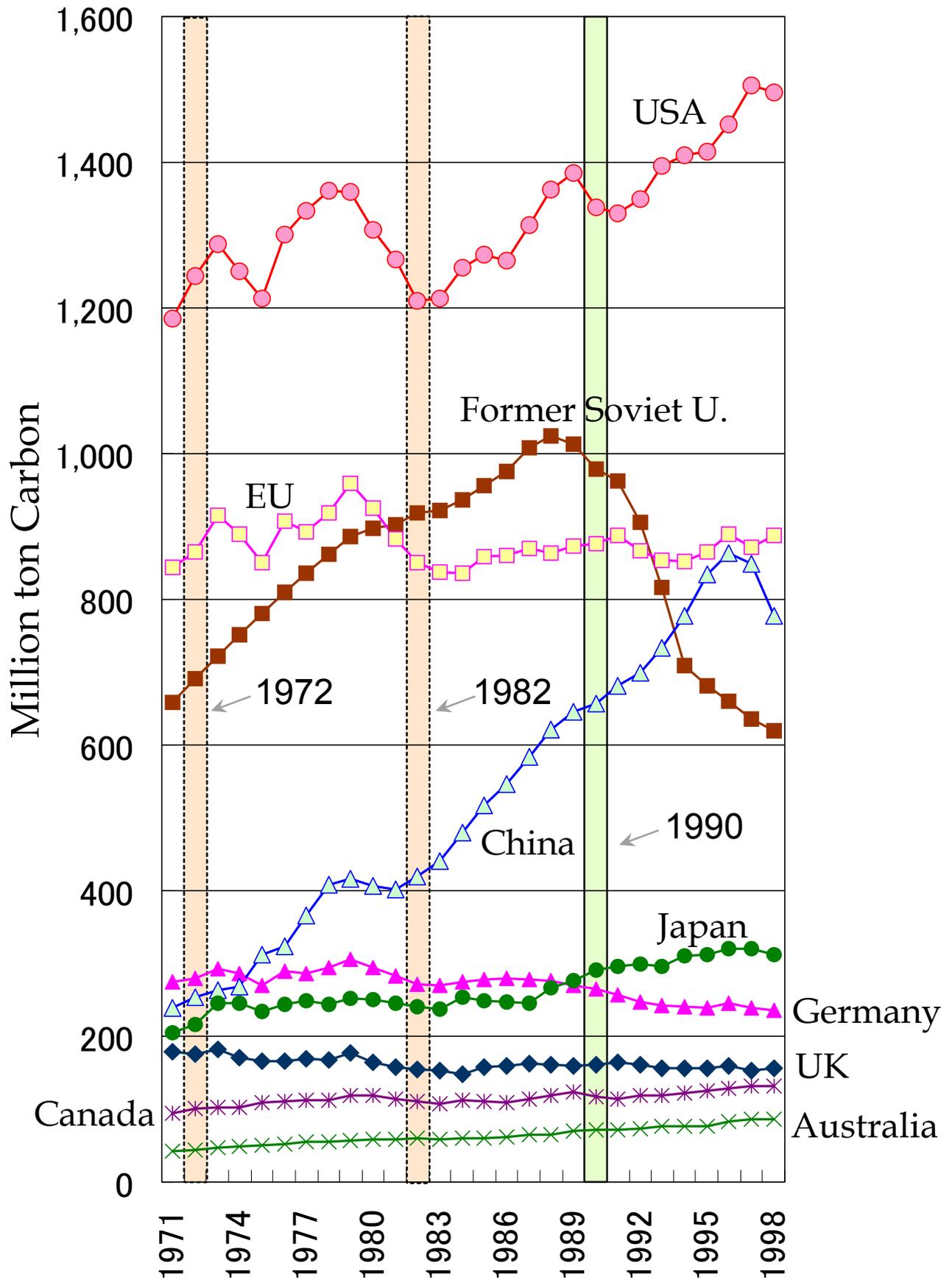


Figure 2. CO2 Emissions from 1971 to 98

Table 1 : The Real State of the EU

(Unit: million carbon equivalent ton)

Country	Kyoto Targets : a	Internal EU Bubble Targets : b	BAU Projection in 2010 % change from '90:c	Net Targets : b-c	GHG Emission Amount in 1990:d	Target Reduction Amount within EU :e= d X b	Share	Special Factor in amount: f	Real Reduction Targets : (e-f)/d	Emission Trends: 1998/1990 : g	Gaps: g-b
Austria	-8.0%	-13.0%	-6.0%	-7.0%	21	-3	3.0%			6%	19%
Belgium	-8.0%	-7.5%	n.a.	n.a.	38	-3	3.1%			7%	15%
Denmark	-8.0%	-21.0%	-26.0%	5.0%	20	-4	4.4%			9%	30%
Finland	-8.0%	0.0%	n.a.	n.a.	18	0	0.0%			1%	1%
France	-8.0%	0.0%	8.0%	-8.0%	138	0	0.0%			1%	1%
Germany	-8.0%	-21.0%	-16.0%	-5.0%	341	-72	76.7%	36	-10.4%	-16%	5%
Greece	-8.0%	25.0%	27.0%	-2.0%	27	7	-7.2%			18%	-7%
Ireland	-8.0%	13.0%	33.0%	-20.0%	16	2	-2.2%			19%	6%
Italy	-8.0%	-6.5%	-4.0%	-2.5%	145	-9	10.1%			4%	11%
Luxembourg	-8.0%	-28.0%	-43.0%	15.0%	4	-1	1.1%			-24%	4%
Netherlands	-8.0%	-6.0%	9.0%	-15.0%	59	-4	3.8%			8%	14%
Portugal	-8.0%	27.0%	68.0%	-41.0%	19	5	-5.4%			17%	-10%
Spain	-8.0%	15.0%	25.0%	-10.0%	82	12	-13.2%			21%	6%
Sweden	-8.0%	4.0%	10.0%	-6.0%	18	1	-0.8%			6%	2%
U.K.	-8.0%	-12.5%	-14.9%	2.4%	199	-25	26.6%	25	0.1%	-8%	5%
Total		-8.0%			1,144	-93	100.0%	61	-2.8%	-2%	6%
Reference : Japan	-6.0%		20.0%	-26.0%	325	-19				10%	16%

*1 : "BAU Projection in 2010% change from 1990:c" is an increase or decrease ratio of projected GHG emissions without measures in 2010 based on the 1990 emission level. BAU stands for Business As Usual. Basically, data comes from materials of UNFCCC. The U.K. figure comes from the latest governmental projection published November 2001, which includes some policy effects. Here we treat it as BAU because policy effects except energy market liberalization seem to be very small. Data of Belgium and Finland come from their Second National Communications.

*2 : "Net Target :b-c" is a margin between b and c. These are necessary reduction rates to achieve internal EU target, which virtually replace the Kyoto targets at an EU's disposal. Figures without minus signs refer to a surplus that can be sold out to other countries without taking any policy measures. The Japanese figure, as a reference, is a margin between the Kyoto target and BAU projection.

*3 : "GHG Emission Amount in '90:d" is total GHG emissions in 1990 before subtracting carbon sequestration or emissions from Land use and Land-use change and Forestry. Data comes from the table compiled by UNFCCC secretariat based on data of the second National Communication. CO2 tons were converted into carbon ton by multiplying 3/11.

*4 : "Target Reduction Amount within EU" is "e= d x b". Assuming emission amounts are stable between 1990 and 2010.

*5 : "Share" is a percentage of each country's target reduction amount when total EU target reduction amount is 100%.

*6 : "Special factor" of Germany, 36 million carbon ton, is the materialized CO2 reduction amount in former East Germany until 1995 through economic rearrangements. Still, the former East Germany side is inefficient in terms of energy usage and Germany is likely to be able to easily reduce more in the former East Germany side.

*7 : "Special factor" of U.K., 25 million carbon ton, is projected reduction until 2010 from energy market liberalization that has been facilitating energy changeover from coal to natural gas. By the end of 2000, 17 million carbon ton reduction seems to have been materialized. Parallel to energy market liberalization, subsidies and protection for U.K.'s coal industry has been reduced and oil & gas wells in North Sea have been developed.

*8 : "Emission Trends:'98/'90: g" means actual GHG emission trends expressed in ratios to 1990 emission level.

*9 : "Gaps: g-b" means differences between the actual emission in 1998 and internal EU targets.

Data Source:

- 1) The Secretariat of UNFCCC, FCCC/CP/1998/11/Add.2, Oct. 1998, 2) The Secretariat of UNFCCC, FCCC/SBI/2000/INF.13, Oct. 2000, 3) The Government of the Federal Republic of Germany, "Second Report of the Government of the Federal Republic of Germany Pursuant to the UNFCCC", Apr. 1997, 4) The Secretaries of State for the Environment and the Foreign and Commonwealth Office, "The United Kingdom's Second Report under the Framework Convention on Climate Change", Feb. 1997, 5) "UK Energy Paper 68: Energy Projections for UK", Nov. 2000, 6) WS Atkinsons Environment, "Projections of Non-Co2 Greenhouse Gas Emissions for the UK and Constituent Countries Final Report, Nov. 2000, 7) Royaume de Belgique, Deuxieme Communication Nationale Conformement Aux Articles 4 Et 12 De La Convention, Aug. 1997, 8) Finland, The Second National Communication of Finland, Apr. 1997.

Table 2: National Cumulative CO2 Emissions of the Past 50 Years: 1949–1998

---From fossil fuel burning, Cement Production, and Gas Flaring --- (Unit: millions tons of carbon)

Rank	Top 50 Countries	Cumulative CO2 Emissions	Share	Population in 1998 (Millions)	Per Capita Cumulative Emissions (tons)
	WORLD TOTAL	210.802	100.0%	5.838.82	36.1
1	UNITED STATES OF AMERICA	54.488	25.8%	269.09	202.5
	EU 15	37.194	17.6%	374.37	99.4
2	FORMER SOVIET UNION	32,519	15.4%	291.68	111.5
3	CHINA *	17,459	8.3%	1238.60	14.1
4	GERMANY	12,239	5.8%	82.02	149.2
5	JAPAN	9,163	4.3%	126.49	72.4
6	UNITED KINGDOM	7,859	3.7%	59.24	132.7
7	FRANCE **	4,868	2.3%	58.85	82.7
8	INDIA	4,830	2.3%	979.67	4.9
9	CANADA	4,421	2.1%	30.30	145.9
10	POLAND	4,135	2.0%	38.67	106.9
11	ITALY ***	3,599	1.7%	56.98	63.2
12	SOUTH AFRICA	2,549	1.2%	41.40	61.6
13	MEXICO	2,333	1.1%	95.68	24.4
14	AUSTRALIA	2,290	1.1%	18.75	122.1
15	SPAIN	1,832	0.9%	39.37	46.5
16	BRAZIL	1,724	0.8%	165.87	10.4
17	REPUBLIC OF KOREA	1,576	0.7%	46.43	33.9
18	ROMANIA	1,567	0.7%	22.50	69.6
19	NETHERLANDS	1,561	0.7%	15.70	99.4
20	ISLAMIC REPUBLIC OF IRAN	1,549	0.7%	61.95	25.0
21	DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA	1,479	0.7%	23.17	63.8
22	BELGIUM	1,435	0.7%	10.20	140.7
23	SAUDI ARABIA	1,293	0.6%	20.74	62.3
24	VENEZUELA	1,155	0.5%	23.24	49.7
25	ARGENTINA	1,132	0.5%	36.13	31.3
26	INDONESIA	1,115	0.5%	203.68	5.5
27	TURKEY	989	0.5%	64.79	15.3
28	TAIWAN	848	0.4%	21.87	38.8
29	HUNGARY	818	0.4%	10.11	80.9
30	SWEDEN	796	0.4%	8.85	90.0
31	BULGARIA	715	0.3%	8.26	86.5
32	DENMARK	653	0.3%	5.30	123.2
33	THAILAND	628	0.3%	61.20	10.3
34	AUSTRIA	624	0.3%	8.08	77.2
35	NIGERIA	576	0.3%	120.82	4.8
36	EGYPT	569	0.3%	61.40	9.3
37	ALGERIA	530	0.3%	29.92	17.7
38	GREECE	514	0.2%	10.51	48.9
39	FINLAND	489	0.2%	5.15	95.0
40	COLOMBIA	473	0.2%	40.80	11.6
41	SWITZERLAND	440	0.2%	7.11	61.9
42	IRAQ	436	0.2%	22.33	19.5
43	PHILIPPINES	381	0.2%	75.17	5.1
44	CHILE	326	0.2%	14.82	22.0
45	NORWAY	310	0.1%	4.42	70.0
46	PORTUGAL	302	0.1%	9.98	30.3
47	CUBA	290	0.1%	11.10	26.1
48	KUWAIT	288	0.1%	1.87	154.1
49	IRELAND	284	0.1%	3.71	76.4
50	ISRAEL	282	0.1%	5.96	47.3

Data Source : Gregg Marland, Tom Boden (Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.), Robert J. Andres (University of North Dakota, Grand Forks, North Dakota, U.S.A.), "National CO2 Emissions from Fossil-Fuel Burnings, Cement Manufacture and Gas Flaring : 1751-1998" , July 25, 2001; IEA, "Key World Energy Statistics from the IEA 2000 Edition", Nov 2000*Excluding Macao, **Including Monaco, *** Including San Marino