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Institutional Design for the Emissions Trading System in Japan

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This article explores a policy design for a cap and trade emissions trading system (ETS) in Japan. According to this proposal, a cap is set for the emissions from industrial, industrial process and energy conversion sectors. Initial allocation of allowances will be made based on "grandfathering". Banking and borrowing are permissible, but a fine will be imposed in case of non-compliance. As other sectors are regulated by a carbon tax, total emission in Japan is regulated through a policy mix of ETS and a carbon tax.

Keywords: emissions trading system, cap and trade, initial allocation, policy mix, grandfathering

JEL Classification Number: Q58

1. The Current State of Japan's Climate Change Policy and its Problems

The upward trend in Japan's greenhouse gas emissions has yet to stop even though the first commitment period of the Kyoto Protocol, which starts in 2008, is approaching. As shown in Figure 1, 2005 greenhouse gas emissions show a 0.6% increase from the previous year and an 8.1% increase from 1990 (Ministry of the Environment, 2006).

Figure 2 focuses on CO_2 emissions (direct emissions) from various sectors. In 2004 the industry sector, comprising factories and the like, generated most emissions, followed by the energy conversion, transportation, and commercial (trade, service, business operation, etc.) sectors. From the figure it can be seen that Japan's climate change policy thus far has not been effective in reducing greenhouse gas emissions. Several problems in Japan's climate change policy can be pointed out. First, no certainty is guaranteed in environmental policies. As long as the Kyoto Protocol specifies the quantitative target for Japan to be a 6% reduction of greenhouse gases from its 1990 level, Japan must implement policy instruments

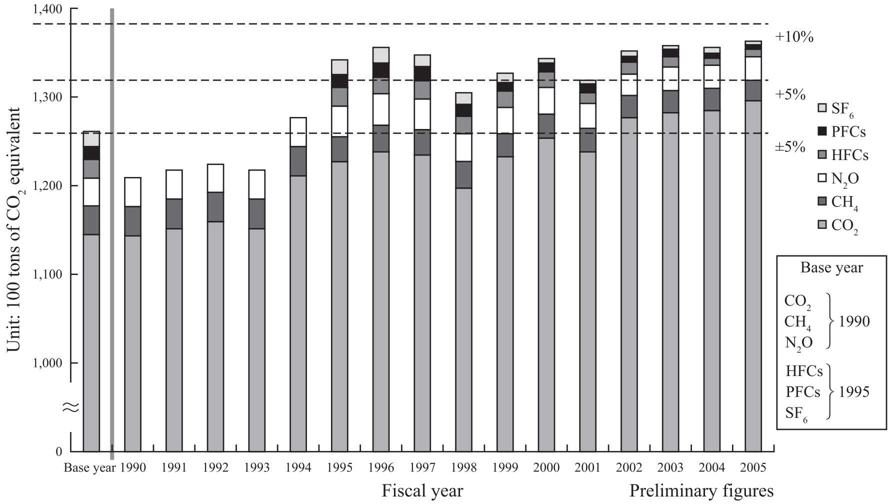

Figure 1 Total greenhouse gas emissions.
Source: Ministry of the Environment (2006), p. 2, Figure 1.

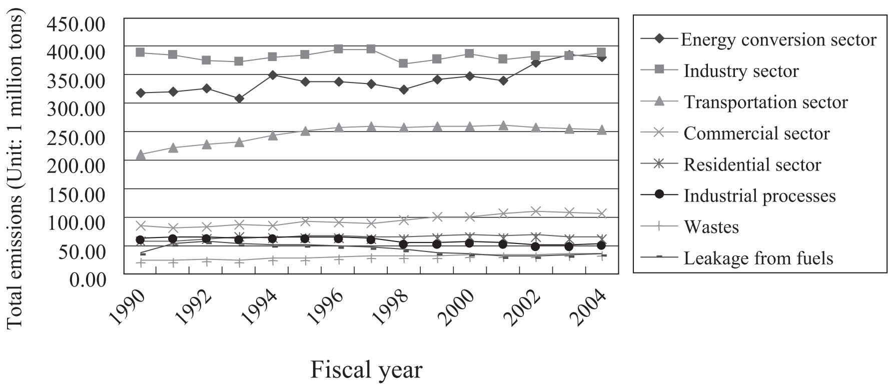

Figure 2 CO_2 emissions from various sectors.
Source: Greenhouse Gas Inventory Office of Japan (Ver. 06.08.30).

that guarantee the achievement of the target. Japan's achievement plan lists various policy measures for each economic sector, and if they are collectively executed, it is anticipated that the target can be achieved.

However, the effectiveness of the policies that are deemed to guarantee the realization of the anticipated result is extremely weak in reality, with the exception of policies like the Top Runner approach and the Special Measures Law Concerning the Use of New Energy by Electric Utilities (a.k.a. the RPS Law). In addition, the list of policy measures in the achievement plan is merely a collection of separate policies and lacks integrity. Therefore, it is unclear in the achievement plan how individual policy measures interact with each other and help change the economic infrastructure towards the realization of a low carbon economy.

The second problem of Japan's climate change policy is the lack of cost effectiveness. The policy menu in the achievement plan appears to be a collection of a variety of separate measures that the government presently can implement, and, even though analyses of the cost effectiveness of individual measures may have been conducted, they do not seem to be reflected in the achievement plan. Ideally, the analyses of the cost effectiveness of these measures would have been conducted thoroughly and a system of measures that minimizes the total costs of achieving the target would be constructed by assigning implementation priorities to measures with superior cost effectiveness.

We put our focus on the emissions trading system because of the advantages it provides as well as the certainty it brings to quantitative controls. First, the emissions trading system contributes to the achievement of an emissions reduction target at minimum cost. Currently, using their own voluntary plans, industries are making efforts mainly to attain targets for reducing emissions per unit of production. However, in such a manner, the marginal cost of reducing emissions is not necessarily equalized across businesses, and therefore, the total cost of reducing emissions cannot be minimized. Rather, a shift from voluntary plans to an emissions trading system will be beneficial not only for the industries themselves but also for the national economy as a whole, limiting the cost burdens in achieving the target.

Second, observing the international trend in climate change policies, it is evident that there is a new wave of emissions trading systems being implemented, following a series of introductions of environment taxes in the 1990s and early 2000s. Emissions trading markets are being launched in various parts of the world, such those areas working under the Regional Greenhouse Gas Initiative (RGGI), which is planned to be introduced in seven northeastern states of the United States, and the Greenhouse Gas Reduction Scheme already introduced by New South Wales, Australia (NSW GGAS), not to mention the European Union Emissions Trading Scheme (EU ETS) initiated in January 2005. These markets are expected initially to be restricted by their respective geographic boundaries, but will eventually be linked with one another, leading to the formation of a global emissions trading market. In order to prepare for such a future, it is imperative for Japan to accumulate know-how and build infrastructure, by creating a domestic emissions trading market and linking it with overseas markets, so that domestic businesses will become capable of participating in the global emissions trading market.

2. The Significance and Limitations of the Voluntary Emissions Trading System

2.1. An Overview of the Voluntary Emissions Trading System

In Japan, there is currently no mandatory emissions trading system that covers the entire industry sector, like the European Union Emissions Trading Scheme

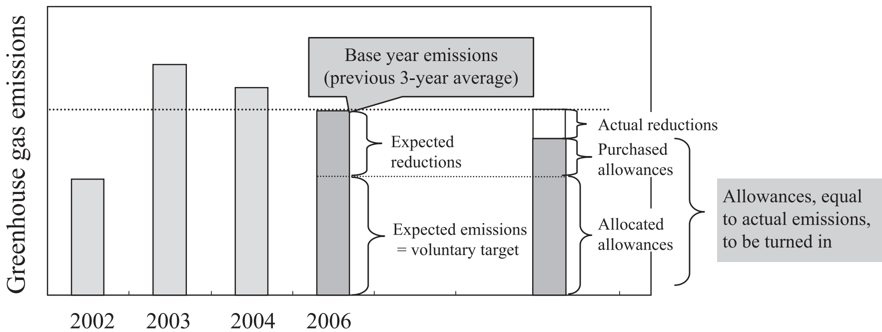

Figure 3 Workings of the voluntary emissions trading system.
Source: Documents from the Ministry of the Environment.

(EU ETS). The Ministry of the Environment of Japan, however, has started experimental trials with an emissions trading system based on the voluntary participation of businesses. It is considered a significant step toward the future introduction of Japan's emission trading system even though the scale of the current operation is too small to be regarded as a substantial instrument in Japan's climate change policy. Before discussing the issues involving the institutional design of a mandatory emissions trading system, the significance and limitations of the experimental trials are evaluated in this section.

There are two types of participants in the voluntary emissions trading system. One is "participants with targets", who voluntarily set targets to reduce emissions by certain amounts. They then reduce emissions by adding facilities and equipment that limit CO_2 emissions using subsidies from the government and at the same time receive emission allowances equal to their target amount. The other type of participants is "trading participants", who open an account in the registry for the purpose of trading allowances and then execute trades. Trading participants are not entitled to the initial allocation of allowances.

Concrete descriptions of the voluntary emissions trading system are as follows. First, the participating businesses in this trading system are requested to limit their emissions at a level equal to or less than the base-year emissions (previous 3-year average of emissions) as depicted in Figure 3. They voluntarily set the amount of emissions reduction ("expected reduction" in Figure 3) and receive emission allowances that are consistent with it. Under this system, what is deemed "voluntary" is not only the participation in the scheme, but also the setting of the target.

Businesses can obtain government subsidies for capital investment aimed at reducing CO_2 emissions in return for promising the government the achievement of the target. The participating businesses invest the subsidies in facilities and equipment for energy conversion and low-energy consumption. Of course, the total amount of subsidies has a limit, and thus, not all applicants are selected as the recipient of the subsidies. The selection is based on how small applicants can make

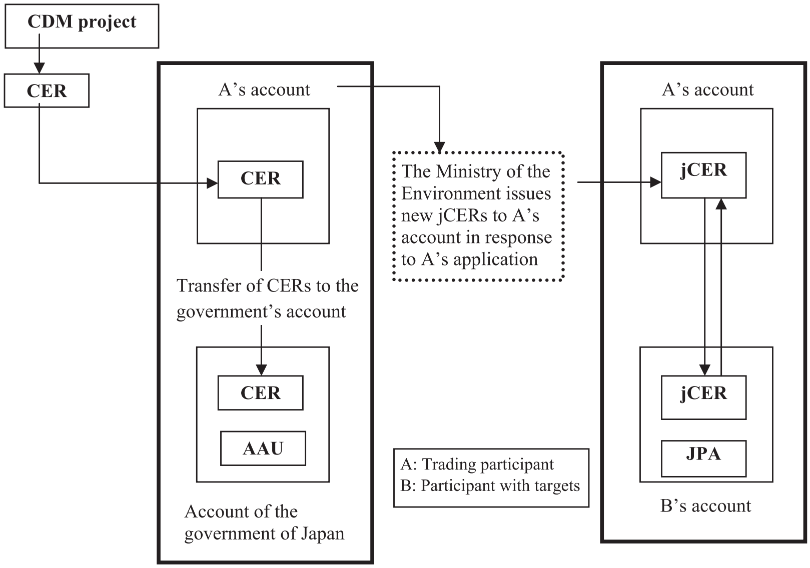

Figure 4 Relationship between the CERs and jCERs.
Source: Documents from the Ministry of the Environment.

the cost of reducing CO_2 emissions. Cost effectiveness is defined in the following equation.

Cost effectiveness = Amount of subsidies requested / (CO_2 emissions reduction during the year × Statutory useful life of facilities and equipment)

An independent monitoring agency examines whether a business has been able to actually reduce emissions and achieve their voluntary target. As Figure 3 indicates, if a business fails to meet their target, it must offset the excess emissions by the allowances purchased from other businesses. At the end of the year both the initial allowances allocated by the government and the allowances purchased from other businesses must be turned in to the government. If a business has been successful in limiting their emissions below the target level and have unused allowances, they can sell them to other businesses or keep them for use in following years (banking). However, the borrowing of future allowances is not permitted. If the target cannot be met even with the execution of emissions trades, it is possible that such businesses are asked to return the subsidies.

Two types of credits are traded under the system: the JPAs (Japan Allowances), which are initially allocated to participants with targets, and the jCERs which are derived from the Certified Emissions Reductions (CERs) issued through the Clean Development Mechanism (CDM) project. For the CERs to be used in the trading system certain procedures, depicted in Figure 4, must be followed. Company A transfers the CERs issued by the CDM project from its own account to the account of the Japanese government and, separately, applies for the issuance of the jCERs. Company A can trade the jCERs because the government issues to Company A the same amount of jCERs as transferred CERs. Since the jCERs and the JPAs are equivalent in the voluntary emissions trading system, Company A, which is a trading participant and does not receive the JPAs, and Company B, which is a participant with targets and has the JPAs, can engage in trade, as shown in Figure 4. However, a company cannot convert the jCERs back to the CERs.

Since the total amount of subsidies is limited to 3 billion yen in this system, companies proposing more cost-effective plans for CO_2 emission reductions are selected within that limit. There were 31 companies in 2005 and 58 in 2006 selected as participants with targets. As for trading participants, 8 companies in the first period and 13 in the second period were chosen. In October 2006 the first emissions trade in Japan was conducted between Nippon Electric Glass, a participant with targets, and Funai Consulting, a trading participant. While the base-year emissions of the 89 participants with targets was approximately 2.5 million tons of CO_2-equivalents (tCO_2) per year, the promised voluntary reduction was 0.5 million tCO_2 per year and thus account for 20% of the base-year emissions.

Also, since the expected emissions reduction coming from the subsidized facilities and equipment (those with 15 years of statutory useful life) was approximately 6.4 million tCO_2, the cost of emissions reduction is calculated to be 1,000 yen per tCO_2, after dividing the total subsidies of 6.4 billion yen (30 billion in 2005 and 34 billion in 2006) by 6.4 million tCO_2. However, the actual costs are 3 times greater, i.e., 3,000 yen/ tCO_2, because the ratio of subsidy to investment is 1/3. Moreover, taking into account that businesses usually consider the useful life as 5 years or less instead of 15 years, the actual costs are estimated to become more than threefold, i.e., approximately 10,000 yen per tCO_2.

2.2. The Significance and Limits of the Voluntary Emissions Trading System

Thus far, an overview of the voluntary emissions trading system has been discussed. The system is evaluated to be highly significant in that it has introduced a cap-and-trade emissions trading scheme for the first time in Japan although its scale has been relatively small due to its reliance on voluntary participation. The administration of the voluntary emissions trading system has provided certain benefits for both the government and businesses. For instance, the Ministry of the Environment benefited. In setting up the voluntary emissions trading system the ministry had to manage the collection of accurate data on businesses' CO_2 emissions, the maintenance of the electronic registry, the legal treatment of the emissions allowance, and the development of detailed rules for the emissions trade. These, however, constitute valuable foundations for starting a full-scale operation of the emissions trading system. Businesses have also benefited. First, if they participate in the system, they can obtain subsidies even though they cover only a third of their capital investment. In addition, for the remaining two-thirds that are coved by businesses, low-interest loans from the Development Bank of Japan can be used. These factors are considered great incentives to participate in the system for businesses that have wanted, regardless of the existence of emission regulations, to improve their energy efficiency with capital investment of some form. Second, the system participants can accumulate knowledge and experiences of a trading system in preparing for future tightening of regulations and the introduction of an emissions trading system. Third, the participation in the system would be useful for businesses in proving that they are actively socially responsible.

Though not so obvious, the most significant benefit for Japan's climate change policy comes from the establishment and administration of a voluntary system with a developed informational and institutional infrastructure, and which will pave the way for the future introduction of a full-fledged emissions trading system. In terms of the informational infrastructure, the development of the emissions control system and the guidelines for monitoring and reporting is significant. The monitoring and reporting guidelines help businesses accurately calculate and report the amount of emissions. What distinguishes these guidelines is that, for the calculation of the amount of emissions, it uses the factory or operational site as the organizational unit instead of the installation of gas-emitting equipment which the EU ETS uses. Also, the emissions control system uses a method of monitoring with the energy purchasing forms, which guarantees a reduction of the burdens on businesses as well as an accuracy of monitoring. Moreover, the electronic registry system (GHG-TRADE.com) has been launched, enabling participants to directly complete allowance transactions on the internet. In terms of institutional infrastructure, the establishment of the system of third-party examination is important. Businesses must allow an examination organization, which is a member of the Entity Section of the Japan Association for Operational Equity, to check the base-year emissions and the amount of emissions after the reduction efforts.

However, as a policy instrument, the voluntary emissions trading system faces the following limitations. First, the system is not positioned as an official policy tool in the climate change policy. Thus, the participation in the system is merely voluntary, resulting in a small participation base despite some increasing trend. The system is, therefore, not effective in limiting Japan's CO_2 emissions. Second, the participants in the system receive subsidies, but it goes against the Polluter Pays Principle (PPP).

However, it is important to note that these limitations of the voluntary system reflect the fact that the system is currently an experimental trial. The biggest issue in Japan's climate change policy is that the control of emissions from the industries relies on their own "voluntary plans". Governmental control has not been implemented due to strong opposition by the industries. In such a situation, participation in the emissions trading system must depend on the willingness of businesses that can anticipate benefits from the system. But, unless the participation to emissions trading system is mandatory, as under the EU ETS, the question remains as to why would other businesses choose the costly participation?

The use of subsidies is not desirable in principle, but should be considered as one method that offers incentives to businesses to participate while the system is not mandatory. This resembles the subsidies given in the United Kingdom to the direct participants of the UK ETS. The Ministry of the Environment of Japan, however, categorizes the new participants it seeks in 2007 into three types: Type A participants receive subsidies as has previously been the case, Type B participants promise emission reductions of at least 1% of the base-year emissions, and Type C participants promise emission reductions of at least 1% for the first year and 2% for the second year. Since Type B and Type C participants cannot receive subsidies, they participate in the system either with a pure sense of social responsibility or in preparation for the possible future mandatory system. The number of participating companies in these categories is not expected to be great, but attention should be paid to the actual outcome.

In order for the emissions trading system to play a significantly effective role in Japan's climate change policy, the current voluntary system must be transformed to a cap-and-trade emissions trading system covering as many emission sources as possible. The authors have examined how such a domestic emissions trading system should be designed in a research paper commissioned by the WWF Japan (Morotomi, et al., 2007). Sections 3 and 4 of the present report describe the content of the research.

3. The Proposal for a Downstream Emissions Trading System

3.1. Main Arguments in the Designing of the Domestic Emissions Trading System

3.1.1. A Comparison of the Upstream and Downstream Emissions Trading Systems

The first problem in introducing a domestic emissions trading system is whether it should be implemented "upstream" or "downstream" of the energy flow. "Upstream" refers to the extraction, importation, and processing of fossil fuels, while "downstream" refers to the ultimate consumption of fuels. Let us call the emissions trading system implemented upstream the "upstream emissions trading system" and that implemented downstream the "downstream emissions trading system". There are advantages and disadvantages to both systems, which will be summarized first.

The greatest advantage of the upstream emissions trading system is its high cover ratio. Since Japan's dependency on the importation of foreign fossil fuels is extremely close to 100%, if the emissions trading system is implemented upstream, then it is possible to cover practically all the agents in the domestic economy, and thus, the cover ratio becomes almost 100%. If the upstream system is implemented, the carbon price is influenced by the pricing of the emission allowances. Moreover, the costs borne by agents in upstream transactions trickle down downstream as price signals. The marginal costs of reducing emissions are equalized across the downstream direct polluters, and it is possible to achieve the reduction target at a minimal cost so long as the trickle-down effect occurs completely and is correctly reflected in the downstream carbon prices.

Another advantage of the upstream system is its certainty in environmental policy. The cover ratio of near 100% means that a complete quantitative control is feasible by introducing the supply of allowances upstream. This goes well with the fact that the emission reduction targets are specified quantitatively in the Kyoto Protocol, and the possibility of achieving them completely is a strength of the upstream system.

The third advantage of the upstream emissions trading system is that it can limit the costs of administering the system. In contrast to the downstream system, the number of the participants in the upstream system is not large. Thus, the administration of monitoring the quantity of extraction, imports, and processing of fossil fuels and the punishment of violators of the rules are easy, and costs can be kept low. However, this point is a double-edged sword and can in fact instead become a problem of the upstream system in that a small number of trading participants means a deviation from the conditions of perfect competition in economics. This triggers strategic behavior of trading parties, and the improvement in efficiency that trade can bring about may become limited as a result. Also, the improvement in efficiency may not be generated fully due to decreased number of trades in the market.

In addition, though the carbon price formulated upstream is anticipated to trickle downstream, will it occur completely? First, since the extent of the trickle-down effect depends on the relationship between the price elasticities of demand and supply of fossil fuels, it is not always true that the downstream carbon price completely reflects the upstream price. The weaker the trickle-down effect is, the weaker the effect of the price incentive that the upstream emissions trading system has on downstream agents. Second, as to the extent of the trickle-down effect, there is no guarantee that the effect is the same for all the different petroleum products such as coal, petroleum oil, heavy oil, and light oil. It is somewhat safe to assume that the trickle-down effects are different depending on the type of fossil fuel concerned. Under this assumption the marginal costs cannot be equalized across the polluters, and the cost effectiveness of the upstream emissions trading system is lost.

The downstream emissions trading system has the following advantages. First, since the consumers of energy and the target of regulation in the downstream system coincide, the effect of incentives for emission reductions is greater in the downstream system than in the upstream system. In terms of economic theory, the resulting resource allocation is identical whether the carbon price is formulated through the downstream emissions trading system or through the upstream system. As far as the influence of price signals of the trickle-down effect is concerned, the same can be achieved with environment taxes levied downstream. The significance of the energy consumers as the target of regulation is that it offers incentives directly to them.

The second advantage of the downstream system is that there is little room for strategic behavior by the participants because a greater number of participants means that the market is closer to perfect competition. As a result, trade becomes active and the gains from the improved efficiency attained by the implementation of the trading system will be maximized. However, a large participation base can become disadvantageous in that, if the downstream emissions trading system tries to cover all polluters ranging from large-scale sources to individuals, its administration cost will become enormous. Hence, using some cut-off method, the downstream system needs to limit participation to large sources of emissions, and therefore, its cover ratio becomes smaller than that of the upstream system.

3.1.2. Direct and Indirect Emissions

Regarding the choice between the upstream and downstream systems, there are excellent research papers proposing the upstream emissions trading system (with proportionate reductions) such as Saijo (2006). However, based on the comparison of the upstream and downstream systems discussed above, we emphasize the various strengths of the downstream emissions trading system and propose its implementation, while keeping in mind its weakness in terms of the cover ratio.

Now, another important issue regarding the cover ratio should be discussed here. It is the choice between “direct emissions” and “indirect emissions” for the focus of the downstream emissions trading system. While the industry and energy conversion sectors are the target of the system if the system is designed to focus on the direct emissions, the target becomes these two sectors plus transportation, commercial, and residential sectors in the system focusing on indirect emissions. In the former case, the regulators can offer an incentive to reduce emissions by directly regulating entities emitting greenhouse gases. Since the industrial and energy conversion sectors actually possess emission reduction technology, the ability to influence their incentives for emission reductions is important. Moreover, regulating the electric power sector means that the commercial and household sectors, whose emissions come mainly from the consumption of electricity, are indirectly put under the influence of the system.

On the other hand, if “indirect emissions” are the target of the system, while it is possible to extend incentives to conserve energy to the transportation, commercial,

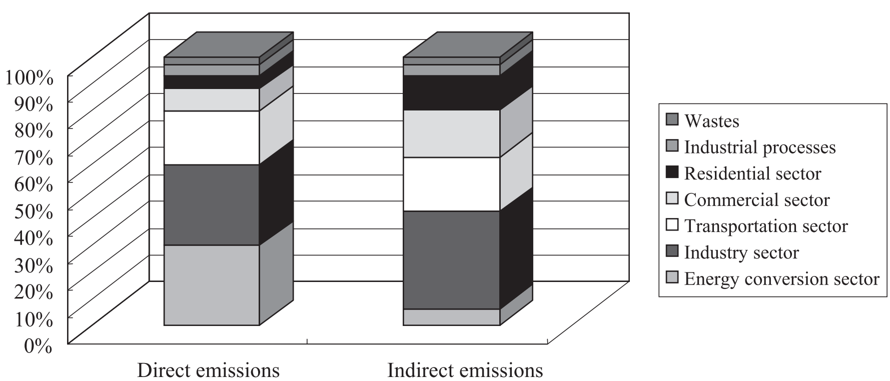

Figure 5 The cover ratio of emissions trading systems.
Source: Greenhouse Gas Inventory Office of Japan (Ver. 06.08.03), Graph by WWF Japan.

and residential sectors, the system must include a large number of entities, and its implementation would become difficult due to increased administrative costs. Therefore, we propose the implementation of the downstream emissions trading system focusing on emissions.

Figure 5 compares the composition of emissions for direct and indirect emissions. Under the emissions trading system focusing on direct emissions, which targets industry and energy conversion sectors and industrial processes, the cover ratio is 64% (without considering the use of a cut-off criterion). Again, this system indirectly covers the commercial and residential sectors, whose emissions mainly come from their electricity consumption.

3.2. The Design of the Cap-and-Trade Emissions Trading System

3.2.1. The Setting of the Maximum Allowable Emissions (the Cap): Initial Allocations

In order to set the maximum allowable emissions (the cap) for the target sectors of the emissions trading system, it is necessary to determine the maximum allowable emissions for the entire nation first and then, within that amount, to set the cap for the target sectors of the system. It is equivalent to the problem of how to allocate the duties to reduce emissions between the target and non-target sectors. Here, the problem of the maximum allowable emissions is discussed from the perspective of achieving the emissions reduction target specified for Japan in the Kyoto Protocol. Thus, the setting of the maximum allowable emissions complies with the achievement plan. Now, it is necessary to work though the following steps in setting the maximum allowable emissions.

(1) Determination of the Maximum Allowable Greenhouse Gas Emissions for Entire Japan

Since the maximum allowable greenhouse gas emissions for the entire nation must be consistent with the emission reduction commitment specified for Japan in the Kyoto Protocol, it is determined as 1.163 billion tons of CO_2 equivalent, a reduction of 6% from the base year of 1990.

(2) Determination of the Maximum Allowable Emissions of CO_2 Emissions

Although the target in the Kyoto Protocol is defined using six greenhouse gases, our focus is on the trade of CO_2 emissions as in the EU ETS. The reason is that the accuracy of monitoring is required in the implementation of the emissions trading system, and that CO_2constitutes most of the greenhouse gas emissions. The achievement plan states that by 2010 CO_2 emissions will be reduced to 1.126 billion tons (1.056 billion tons from energy origins and 70 million tons from non-energy origins). This paper assumes the achievement of this emission level in the determination of the maximum allowable emissions in the emissions trading system.

(3) Determination of the Maximum Allowable CO_2 Emissions for the Target Sectors

Once the allowable CO_2 emissions for the entire nation are determined, the maximum allowable emissions for the target sectors of the emissions trading system must be determined. For this, with the above mentioned points in mind, efforts to reduce emissions must be shared between the target sectors, i.e., the industry, energy conversion, and industrial processes sectors, and other non-target sectors. The standards that should be used for this assignment are discussed next.

3.2.2. The Assignment of the Emissions Reduction Efforts to Different Sectors: An Examination of the Initial Allocation Method

The first step in the allocation of allowances is the assignment of emission reduction efforts between the target sectors of the emissions trading system, i.e., industry, energy conversion, and industrial processes, and the other sectors comprising the residential, transportation, and commercial sectors. We will use the grandfathering method for this assignment. The reason is that this method provides a certainty in environmental policies and a sense of fairness which contributes to the smooth negotiations among participating entities. The grandfathering method bases the allocation on past emission records. More concretely, the average of emissions during the period of several years prior to the introduction of the emissions trading system is calculated. This serves as the base emissions level in the allocation of allowances.

The grandfathering method easily receives support because it leaves the vested interests of businesses unaffected because it focuses on their past records. If used, this method can maintain consistency for the macro-level allocation among economic sectors and for the micro-level allocation among business establishments because allocations are solely based on the average of past emissions. In passing, it should not be forgotten that the grandfathering method is not without disadvantages and needs to be analyzed in comparison with other allocation methods such as the auction and benchmark methods, but this falls outside the scope of this paper.

The Initial Allocation by the Grandfathering Method

Table 1 illustrates the process of deriving the maximum allowable emissions. Since this paper positions the emissions trading system as a policy instrument used to achieve the emissions reduction target specified in the achievement plan, we start with the target CO_2emissions specified in the plan, with the target year of 2010. As Table 1 shows, the target CO_2 emissions from both the energy origins and non-energy origins totals 1.126 billion tons (A(3)).

There are various ways to allocate free allowances, but following the grandfathering method, the allocation is made based on the idea that it is fair to respect the past emission records and allocate allowances accordingly. A base period must be set in order to calculate the emission records. This paper assumes that the domestic emissions trading system will be implemented in 2008, and that the period of first five years through 2012, which coincides the commitment period of the Kyoto Protocol, is the first operational period. However, the target emissions are set for 2010. If the system is started in 2008, it is desirable that the allocation of allowance is conducted based on the emission records of the five years starting in 2002 and ending in 2006, regarding them as the preparation period.

Table 1 Derivation of the maximum allowable emissions (1), Unit: 1 million tons

A. Target Emissions Specified in the Achievement Plan for the Kyoto Protocol (2010)	
(1) CO_2 from energy origins	1,056
(2) CO_2 from non-energy origins	70
(3) Total ((1) + (2))	**1,126**
B. Maximum Allowable Emissions for industry, energy conversion, and industrial processes	**710**
C. Items excluded from the Maximum Allowable Emissions	
(4) Reserves for auction (5%)	35.5
(5) New emissions reserves (NER) (5%)	35.5
(6) Cut-off criterion (not considered)	0
D. Maximum Allowable Emissions [B – (4) – (5) – (6)]	**639**

The reason for using the relatively long five-year period instead of a three-year period as the base period is to take into account the so-called early actions. Using a short base period means ignoring emissions reduction efforts made prior to the base period, and a problem arises in that more allowances are allocated to those who had not shown reduction efforts earlier. On the contrary, if the base year is 10 years, issues are that some participants had not been established, and that information is not sufficiently available in order to conduct a fair initial allocation due to the lack of data.

Table 2 helps explain how the allocation to various sectors with the grandfathering method can be made using the 2000–2004 base period. First, each sector's average emissions for the base period are calculated. In the case of the energy conversion sector, for instance, the average emission is 365 million tons. Next, the average of the total emissions for the base period (1.268 billion tons) is computed. Then, the proportion of each sector's average in the average of total emissions can be obtained. For the energy conversion sector this is 29%. This is now certified as the past emissions record of the energy conversion sector, and it possesses the right to receive allowances reflecting the proportion. Since the target emission is 1.126 billion tons in the achievement plan for 2010, its 29%, i.e., 327 million tons, will be allocated to the energy conversion sector.

The total of the allowances allocated to the three sectors, i.e., energy conversion (327 million tons), industry (338 million tons), and industrial processes (45 million tons), becomes the maximum allowable emissions for the targeted sectors in the domestic emissions trading system. The total is 710 million tons and is listed in Table 1, B, "Maximum Allowable Emissions for Industry, Energy Conversion, and Industrial Processes". However, at this point, strictly speaking, the determination of the cap for the targeted sectors in the trading system has not been computed, for there are some deductions to be made.

Table 2 Derivation of the maximum Allowable Emissions (2) Unit: 1 million tons

Source of emissions	1990	2000	2001	2002	2003	2004	2000-2004 average emissions	Proportion (%)	Allocated allowance	Cap allocated
Energy conversion sector	318	348	340	371	385	382	365	29	327	294 (46)
Industry sector	390	387	377	384	384	389	384	30	338	**307** (48)
Transportation sector	211	259	262	257	255	254	257	20	225	—
Commercial sector and others	84	101	107	111	108	106	107	9	101	—
Residential sector	57	69	66	68	65	65	67	5	56	—
Industrial processes	62	57	55	53	52	53	54	4	45	38 (6)
Wastes	23	33	33	33	36	36	34	3	34	—
Other sectors	0	0	0	0	0	0	0	0	0	—
Total	1,144	1,255	1,239	1,277	1,284	1,286	1,268	100	1,126	**639** (100)

Source: Greenhouse Gas Inventory Office of Japan (Ver. 06.08.03).

The Treatment of Auctions and New Sources of Emissions

The first deduction is the amount allocated through auctions. Although it has been assumed thus far that the allowances are allocated through the grandfathering method, we now want 5% (35.5 million tons) of the 710 million tons, which is the maximum allowable emissions for energy conversion, industry, and industrial processes, to be allocated through auctions. If it is merely 5%, allocation problems concerning cost burdens would not be large, and it also is a good exercise to test auctions from the first period to seek the optimal auction type in the future. For these reasons, 5% of the maximum allowable emissions for the target sectors of the emissions trading system is deducted as a non-free portion (Table 1, C (4)).

The next issue is the treatment of the new sources of emissions. To state the conclusion first, the new entrants' reserves (NER) must be deducted from the maximum allowable emissions to the target sectors of the emissions trading system. It should be done so that the emissions trading system will not be a barrier to new entrants to the target industries, by treating equally both existing and new sources of emissions. In other words, if free allowances are allocated to the existing sources of emissions under the grandfathering method, the same must be done for the new sources of emissions for the sake of fair competition. But, if free allowances are allocated unlimitedly to the new sources of emissions, the setting of the cap would become meaningless. By making a space deemed necessary for new sources of emissions aside from the cap, the elimination of barriers to the new entrants can be realized, while preventing an increase in the cap (See Table 1, C (5)).

The Determination of the Maximum Allowable Emissions (the Cap)

The last step in the determination of the maximum allowable emissions is the deduction of the type of emissions that are excluded by the regulations from the energy conversion and industry sectors that are targets of the emissions trading system. As already mentioned, since the administrative costs of running the system increase as the number of small-scale polluters in the system rises, these polluters are excluded from the system using a certain cut-off criterion. The criterion must comply with the Revised Rationalization in Energy Use Law, and the same cut-off criterion of “energy use of 1,500 kl per year” used for categorizing the type2 designated energy management factory is used as the criterion for the domestic emissions trading system. But, due to the unavailability of information that could be used to estimate the amount of emissions to be excluded under this criterion, we merely point out the need for a cut-off procedure and let the calculation of the allowance allocations include the small-scale polluters. (Thus, it is set to zero in Table 1, C (6)).

After completing the process described so far, the cap is determined. As shown in Table 1, the cap is 639 million tons, which is derived from the maximum allowable emissions of 710 million tons (Table 1, B) for the industry, energy conversion, and industrial processes sectors and the deductions of auctions, new entrants’ reserves, and the exclusions under the cut-off criterion.

3.2.3. The Allocation among Sectors

Once the cap is determined, we need to allocate it further to various industries within each sector. Allocating the cap of 639 million tons among energy conversion, industry, and industrial processes according to their share, the cap for the industry sector, for example, is 307 tons as seen in the second row of the right-most column in Table 2. Then, this amount is further distributed among iron and steel, chemical, oil products, and other industries according to their past emissions records. The distribution is conducted with the same method used at the sector level. That is, with the five years of 2000 through 2004 as the base period, the average emission is calculated for each industry. Then, the proportion of the average emission of each industry in the entire sector is computed. Lastly, the cap given to the sector is allocated to its industries according to that proportion. For example, in Table 3, in the case of the iron and steel industry the average emission of the past five years is 152 million tons, and since the share of emissions of the iron and steel industry in the total emissions of the entire industry sector is 40%, 40% of 370 million tons given to that sector goes to the iron and steel industry. As a result 123 million tons is set as the cap for the steel industry as shown under “Allowances” in Table 3.

Such an allocation process is called the “top-down approach” in the EU ETS or the “macro allocation plan” in Germany, and they are mainly in line with the first national allocation plan of Germany (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety 2004). This allocation method provides consistency since the allocation is done completely based on past emissions. This is an allocation method that has a sense of fairness and can easily be socially accepted, which is certainly the reason why so many nations under the EU ETS adopt the method.

Table 3 Allocation of allowances to industries within the industry sector, Unit: 1 million tons

Industry Sector	1990	2000	2001	2002	2003	2004	Average emission	Proportion	Allowance
Agriculture and forestry	6	8	9	9	9	10	9	2	6
Fisheries	15	8	7	7	6	6	7	2	6
Mining	1	1	1	1	1	1	1	0	0
Construction	13	14	13	12	12	12	13	3	10
Food	13	13	13	12	12	12	12	3	10
Pulp and paperboard	26	29	28	28	27	27	28	7	21
Chemical fibers	10	10	10	10	10	10	10	3	10
Oil products	11	15	15	15	18	20	16	4	12
Chemical	55	57	55	53	52	52	54	14	43
Glass products	3	2	2	2	2	2	2	1	3
Ceramic, glass, and stone products	41	38	36	36	38	37	37	10	31
Iron and steel	150	150	148	153	155	155	152	40	123
Non-ferrous metal	6	3	3	3	3	3	3	1	3
Machinery	18	9	8	8	8	8	8	2	6
Other industries and small- and medium-sized enterprises	51	48	47	51	50	53	50	13	40
Corrections for double counting	−29	−18	−18	−18	−19	−19	−18	−5	−17
Total	390	387	377	384	384	389	384	100	**307**

Source; Greenhouse Gas Inventory Office of Japan (Ver. 06.08.03).

3.2.4. The Distribution of Allowances for Business Establishments

In order to implement the emissions trade system, the allocation of allowances does not stop at the industry level; the process must reach the level of business establishments. How should this be done? Also, the total allowances allocated to business establishments must sum up to the cap of the industry. How can it be guaranteed?

First, the determination of allowances at the level of business establishments is done according to the following process. The cap at the establishment level is based on each establishment's previous 5-year average of emissions (2000–2004). The past emissions are seen as the emissions an establishment is already entitled to, an allocation is made, and then the emissions allocated to establishments in the same industry are summed. Then, naturally, total allowances for that industry exceeds the cap determined in Table 1 because they are simply the sum of the average emissions of the past 5 years. Hence, there is a need for the "compliance factor".

The compliance factor is defined by the ratio of the cap to the five-year average emission for the industry of interest. For example, if the industry's cap is 90 and the five-year average emission is 100, then the compliance factor is 0.9. If the compliance factor is calculated in this way, the allowance once allocated to each establishment is multiplied by the compliance factor to obtain the true allowance for each establishment.

Allowances given to an establishment = Five-year average of emissions from the establishment × Compliance factor

Compliance factor = Cap of the industry / Industry's five-year average of emissions

3.2.5. Banking, Borrowing, and the Punitive Clause

Banking refers to the rule that if at the end of a period it is made clear that the actual emissions turn out to be less than the amount of allowances, the remaining allowances can be transferred to the next period and used along with the allowances of the next period. Borrowing refers to the rule that when the actual emissions exceed the allocated allowances, there is no punishment for the incompliance, but allowances can be borrowed from the next period's allocation. These rules are convenient for businesses because they can adjust to fluctuations in emissions resulting from random factors as well as temporary factors like business cycles and changing weather.

Banking and borrowing have desirable characteristics in terms of intertemporal efficiency of resource allocation, but when they endanger certainty in environmental policy their use should be stopped. In particular, if unlimited borrowing is allowed, the existence of the cap becomes totally meaningless. Hence, when borrowing is permitted a specific term must be established. As for banking, it is not desirable that the allocated allowances in the first period be transferred to the second period as vested entitlement. The allowance allocated to polluters in the first period is the result of recognizing the emissions in previous periods as existing entitlement. But, in the initial allocation of the second period, even if the grandfathering method continues to be used, the base period used for the allocation shifts by one year. That is, the existing entitlement recognized in the first period is nullified temporarily. Thus, banking and borrowing that bridge operational periods are prohibited. Even with this rule it is necessary to lay out provisions for noncompliance fees charged when an inconsistency between the cap and the actual emissions arises.

4. The Policy Mix Targeting the Transportation, ResCom (Residential and Commercial) Sectors, and Small- and Medium-sized Enterprises

The emissions trading system we propose in Section 3 focuses on the combination of the downstream system and "direct emissions" and thus includes industry, energy conversion, and industrial processes sectors, but does not consider the transportation sector, sources of locomotive emissions, the residential and commercial sectors, or sources of indirect emissions with half of their emissions originating from the use of electricity. An effective regulatory system should, however, have

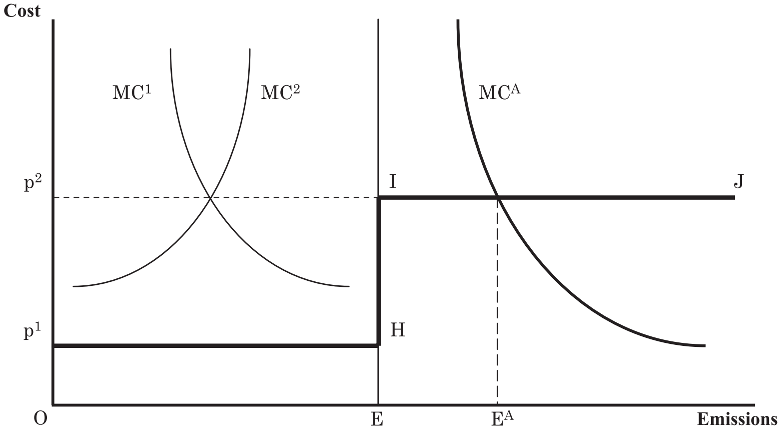

Figure 6 A policy mix of taxes and the emission trading system.

climate change policies that give these sectors incentives to reduce emissions. In this section, a policy mix is proposed which combines two systems, namely the emissions trading system and taxes. It controls the industry, energy conversion, and industrial processes sectors with the emissions trading system and the transportation, residential, and commercial sectors with taxes.

The combination of the emissions trading system and taxes has the following advantages. First, the parallel use of taxes and the emissions trading system can produce a greater cover ratio than the use of the emissions trading system alone. Second, the sectors covered by the emissions trading system can impose less financial burden with the reduced rate on the environment taxes. Many of these sectors often face fierce international competition. Thus, such a design of tax rates is must not to negatively affect their international competitiveness.

The way to combine the emissions trading system and environmental taxes can be explained concretely using Figure 6. MC^A is the marginal cost of reducing emissions. If the environmental tax is introduced and tax rate is set at p^2, the total emission of Japan is determined at E^A. It is necessary to set the tax rate at p^2 such that E^A corresponds with the emissions reduction target in the Kyoto Protocol. Now, let us consider a policy mix by introducing the emissions trading system. The industry, energy conversion, and industrial processes sectors are the target of the emissions trading system, and the cap E is set for these sectors. More concretely, the businesses that pass the cut-off criterion of the energy use of 1,500 kl per year, used for categorizing the type2 designated energy management factory, are all included in the emissions trading system. Hence, in the figure OE is the total emissions form the industry, energy conversion, and industrial processes sectors, and EE^A is the total emissions from the residential, transportation, and commercial sectors.

The target sectors of the emissions trading system receive the reduced environmental tax rate of p^1 in return for the acceptance of the cap. For instance, p^1 can be one-fourth of p^2. Since the tax rate remains at p^2 for the other sectors, the environmental tax rate is the kinked curve p^1HIJ. Note that the initial allocation in the emissions trading system uses the grandfathering method as explained in Section 3. The environmental tax should be levied on the target sectors of the emissions trading system even with a reduced rate for the following reasons. First, it is desirable that businesses cover even a portion of the external cost incurred by CO_2 emissions from the stand point of environmental policies as well as resource allocations. Second, if the target sectors of the emissions trading system are totally exempt from taxation, the difference in tax burdens from the residential, transportation, and commercial sectors becomes too large. Hence, taxation is desirable at a reduced rate in order to maintain a fair share of the burden between the two groups.

The details of the institutional design of environmental taxes are outside the scope of this paper, but some explanations on the point of taxation are in order. This is because in the design of the environmental taxes it is expected the cover ratio of all the climate change policies will be maximized by levying with the minimum levying costs but without double or missing taxation. On this issue the choice of upstream or downstream as the point of taxation has a huge influence. The first step of the simplest design method with the least levying costs is to levy taxes (carbon taxes) on all fossil fuels according to their carbon content at the upstream point (importation or refining) in the flow of fossil fuels. The second step is to refund 75% of the original tax to all the type1 and type2 designated energy management factories. The institutional design of the refunding is definitely needed because both the target sectors of the emissions trading system and the residential, transportation, and commercial sectors must face the same tax burden without such refunds. The question is how this will be done.

Regarding this point, it is desirable to confirm the CO_2 emissions listed in the Rules on the Calculation, Reporting, and Announcement of Greenhouse Gas Emissions and use it as the informational basis in making refunds. If it is used, the amount of refund to each establishment is computed as the amount of CO_2 in the Rules on the Calculation, Reporting, and Announcement of Greenhouse Gas Emissions $\times$ ordinary tax rate (p2) $\times$ 0.75. Regarding the calculation, reporting, and announcement, questions have been raised whether businesses actually report and announce the true information. That is, there may be an incentive for underreporting. However, if the refunding and the rules of calculation, reporting, and announcement work in tandem as mentioned above, businesses have incentives to correctly report their emissions, for underreporting leads to a reduced amount of refunds made.

5. Conclusion

We have outlined here our proposal for the institutional design of a policy mix surrounding the domestic emissions trading system. According to this proposal, the emissions trading system would solely cover 64% of the total CO_2 emissions of Japan. What kind of economic impact would the proposed system design have? Takase et al. (2007) provide quantitative evaluations and reports that when the above mentioned proposal takes effect there will be an increase in production costs of 1.2 trillion yen for the industries with high energy consumption. This is equivalent to 0.3% of gross domestic product. The most impacted is the iron and steel sector with a production cost increase of 1.4%, including increases in the price of electricity, while other industrial sectors faces less than a 1% increase. The assumption of the allocation of free allowances is considered to be the reason for this. Nevertheless, the impact is small compared to that of exchange rate fluctuations.

In addition, Takase et al's (2007) study mentions that this short-run increase in costs will be more than compensated for by the gains generated in the medium and long terms. That is, by introducing the emissions trading system while preparing for the new carbon regulation, the renewable energy industries and automobile industries will improve their technology. This leads to increases in exports and gross domestic product. The direct effect totals 14 trillion yen and far exceeds the short-term increase in production costs mentioned above.

In sum, the implementation of the emissions trading system can be justified in terms of not only preventing global warming but also bringing positive economic effects such as technological innovations and new developments of industries. Also, the market that incorporates the emissions trading system is a market in which efforts to reduce emissions are economically beneficial. In such a market, in order to maximize profit, it is necessary to reduce CO_2 emissions to an optimal level. The greatest benefit of the implementation of the emissions trading system is that it establishes the coexistence of profit-seeking incentives and efforts for environmental conservation.

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