Greenhouse Gas Emissions Trading
Outline of an Emissions Trading Scheme for Japan

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The information and assessments in this discussion paper are solely the responsibility of the author.

Berlin, September 2004

Felix Chr. Matthes

Contents

Figures

Tables

1 Introduction

Global climate change is one of the key challenges for energy and environmental policy. If global temperature rise is to be limited to a range where dangerous interference with ecosystems, societies and economies can be avoided, significant cuts in greenhouse gas emissions will be urgently needed during this century.

Cutting greenhouse gas emissions is far from standard practice globally or in the industrialized countries. The Kyoto Protocol represents a milestone in global climate policy. For the first time a group of countries has agreed to reduce or limit their greenhouse gas emissions. However, four years before the beginning of the Protocol's first commitment period, many parties are not on track to comply with their Kyoto obligations. Additional policies and measures are clearly needed. The basic challenge for the introduction of new climate policy instruments has two dimensions. First, the instruments have to ensure compliance with the Kyoto targets. Second, the reduction or limitation of greenhouse gas emissions has to be cost-effective in an increasingly globalized and competitive world in which small changes in costs can have marked effects on competitiveness.

In this context, market based instruments have generated more and more attention in recent years. Decentralized decision making by economic entities based on information delivered by relative prices has the theoretical potential to ensure an optimal allocation of resources within and between countries. After emissions trading between the participating countries became one of the key provisions of the Kyoto Protocol, the introduction of emissions trading schemes at the level of enterprises or installations has become one of the major topics of today's climate policy debate.

The discussion paper presented here should be seen as a contribution to the recent debates on the new policies and measures needed to ensure Japan's compliance with its Kyoto Protocol commitments. A greenhouse gas emissions trading scheme could be a central part of the climate policy mix. However, emissions trading will not be the only climate policy instrument and will need to be established alongside a mixture of complementary incentives and regulations. Furthermore, there is not one single possible design for an emissions trading scheme and variety of design options have been discussed in both the academic and political arenas.

Against the background of the discussion and implementation of the European Union greenhouse gas emissions trading scheme, some crucial issues concerning the inclusion of emissions trading in the policy mix are discussed in this paper. On this basis, key design characteristics of an emissions trading scheme for Japan are proposed.

The views expressed in this paper inevitably reflect the process of design and implementation of the EU emissions trading scheme. Therefore, not all the findings will necessarily be directly applicable to climate policy in Japan. Nevertheless, recent experience from the EU demonstrates the importance of an early and in-depth discussion of key design options of an ET system; the purpose of this paper is to stimulate such a debate.

2 Current and projected emission levels

According to the most recent Japanese greenhouse gas emission inventories (as published by the government of Japan at May 18, 2004) carbon dioxide represents 94% of the total greenhouse gas emissions covered by the Kyoto Protocol.

Table 1 Greenhouse gas emissions of Japan, 1990-2002

	Base Year*	1990	1995	1996	1997	1998	1999	2000	2001	2002
	Mt CO_2 equivalent									
Six Kyoto gases	1,236.9	1,187.2	1,326.9	1,352.0	1,357.8	1,306.7	1,328.4	1,336.7	1,302.3	1,330.8
Carbon dioxide (CO_2)	1,122.3	1,122.3	1,213.1	1,234.8	1,242.0	1,195.2	1,228.4	1,239.0	1,213.8	1,247.6
thereof										
Power generation	296.3	296.3	311.2	312.4	305.5	294.9	313.5	323.9	315.9	344.1
Other energy industries (energy use)	42.3	42.3	41.4	41.3	42.5	39.5	38.5	38.3	34.7	35.1
Other industries (energy use)	368.5	368.5	380.4	392.5	404.1	370.6	377.8	378.9	366.6	375.9
Waste incineration	16.9	16.9	21.6	22.4	23.4	24.0	23.9	24.8	24.2	24.2
Industrial processes	57.0	57.0	59.2	59.0	57.6	52.3	51.9	52.8	50.5	49.0
Transport	210.7	210.7	250.7	258.6	262.1	258.5	262.1	258.1	260.3	254.7
Residential	57.3	57.3	66.8	66.5	65.4	65.0	67.1	69.1	65.6	68.1
Commercial and other sectors	73.3	73.3	81.7	82.0	81.5	90.4	93.6	93.2	95.9	96.3
Fugitive emissions from fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Memo items**										
International Bunkers Aviation	13.2	13.2	16.9	18.4	19.1	20.0	18.4	16.5	18.6	21.2
International Bunkers Marine	17.5	17.5	21.2	12.5	16.2	17.1	15.8	17.0	14.7	15.6
Methane (CH_4)	24.7	24.7	23.3	22.9	22.1	21.5	21.1	20.7	20.2	19.5
Nitrous oxide (N_2O)	40.2	40.2	40.8	41.7	42.2	40.8	35.1	37.8	35.1	35.4
Hydrofluorocarbons (HFCs)	20.2		20.2	19.9	19.8	19.3	19.8	18.6	15.9	13.3
Perfluorocarbons (PFCs)	12.6		12.6	15.2	16.9	16.5	14.9	13.9	11.7	9.6
Sulphur hexafluoride (SF_6)	16.9		16.9	17.5	14.8	13.4	9.1	6.8	5.7	5.3
	compared to base year levels									
Six Kyoto gases			7.3%	9.3%	9.8%	5.6%	7.4%	8.1%	5.3%	7.6%
Carbon dioxide (CO_2)			8.1%	10.0%	10.7%	6.5%	9.5%	10.4%	8.2%	11.2%
thereof										
Power generation			5.0%	5.5%	3.1%	-0.5%	5.8%	9.3%	6.6%	16.2%
Other energy industries (energy use)			-2.1%	-2.3%	0.4%	-6.7%	-9.1%	-9.6%	-18.1%	-17.0%
Other industries (energy use)			3.2%	6.5%	9.7%	0.6%	2.5%	2.8%	-0.5%	2.0%
Waste incineration			27.7%	32.1%	38.4%	41.7%	41.3%	46.4%	43.1%	43.2%
Industrial processes			3.9%	3.5%	1.0%	-8.3%	-9.0%	-7.4%	-11.4%	-14.0%
Transport			19.0%	22.8%	24.4%	22.7%	24.4%	22.5%	23.6%	20.9%
Residential			16.7%	16.2%	14.2%	13.6%	17.2%	20.6%	14.6%	19.0%
Commercial and other sectors			11.5%	11.8%	11.1%	23.3%	27.7%	27.1%	30.8%	31.4%
Fugitive emissions from fuels			17.3%	15.2%	20.8%	13.8%	13.2%	18.8%	16.5%	24.6%
Memo items*										
International Bunkers Aviation			28.3%	39.8%	45.1%	51.6%	39.4%	25.2%	41.4%	60.4%
International Bunkers Marine			20.8%	-28.9%	-7.3%	-2.2%	-9.8%	-3.0%	-16.1%	-11.2%
Methane (CH_4)			-5.7%	-7.5%	-10.9%	-13.0%	-14.7%	-16.3%	-18.4%	-21.1%
Nitrous oxide (N_2O)			1.5%	3.8%	4.9%	1.6%	-12.7%	-6.0%	-12.6%	-11.9%
Hydrofluorocarbons (HFCs)			0.0%	-1.8%	-2.2%	-4.7%	-2.2%	-8.1%	-21.5%	-34.1%
Perfluorocarbons (PFCs)			0.0%	21.0%	34.6%	31.4%	18.5%	10.2%	-7.1%	-23.4%
Sulphur hexafluoride (SF_6)			0.0%	3.4%	-12.6%	-20.8%	-46.1%	-59.7%	-66.5%	-68.7%

Notes: * Base year is 1995 for HFCs, PFCs and SF_6 and 1990 for the other gases. - ** Memo items are not included in the totals.

Sources: Greenhouse Gas Inventory Office of Japan, Öko-Institut calculations

Japan's commitment under the Kyoto Protocol requires a 6% cut from 1990 levels, however GHG emissions rose by about 7% from 1990 to 2002. Therefore, to meet its Kyoto target, Japan needs to find ways to reduce emissions by 168 Mt CO_2.[1]

[1] This consideration does not include the accounting of LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol and the use of flexible mechanisms. An analysis of the documents shows that Article 3.3 and 3.4 activities may contribute together with up to about 3,9% to the Japanese reduction commitment, which corresponds to about 48 Mt CO_2 equivalent. In estimating this contribution, it is assumed that Japan makes full use of its cap of 13 Mt C for forest management activities. Against the

61% of total CO_2 emissions come from the energy sector and industry (excluding industrial processes and waste incineration). The share of the transport sector is 20%, while the residential and commercial sectors represent 5 and 8% of total CO_2 emissions respectively.

However, although relatively low, carbon dioxide emissions from the residential, commercial and transport sectors rose most rapidly between 1990 and 2002 – by around 19%, 31% and 21% respectively. The power sector also saw a 16% rise. Even emissions from non-energy sector industries increased by about 2% compared to 1990 levels.

Power generation is responsible for 28 per cent of total CO_2 emissions in Japan, with the second largest emission source being the production of iron and steel.

Table 2 shows a compilation of different greenhouse gas emission projections. All the projections are characterised as being “without additional measures”, meaning that only policies and measures already in place are considered.

Table 2 Greenhouse gas emission projections for Japan, 1990-2010

	Emission levels		Projection ("w/o additional measures") for 2010			
			Ministry of Environment		Ministry of Economy, Trade and Industry	Range of all projections
	Base Year*	2002	from ... to ...			
	Mt CO_2 equivalent					
Carbon dioxide (CO_2) from energy use	1,048.3	1,174.3	1,136.7		1,106.0	30.7
thereof						
Energy sector**	82.0	81.9	73.6		68.0	5.5
Industry	476.1	468.0	446.7		441.0	5.7
Residential sector	129.2	166.3	158.5		156.0	2.5
Commercial sector & others	143.9	196.7	197.7		179.0	18.7
Transport	217.2	261.5	260.2		261.0	0.8
CO_2 from non-energy use, methane (CH_4) and nitrous oxide (N_2O)	138.9	128.2	127.3	134.1	133.0	6.9
Emission of HFCs, PFCs and SF_6	49.7	28.3	under review		74.0	
Total	1,236.9	1,330.8			1,313.0	
	compared to 2002 levels					
Carbon dioxide (CO_2) from energy use	-10.7%	-	-3.2%		-5.8%	
thereof						
Energy sector**	0.2%	-	-10.2%		-17.0%	
Industry	1.7%	-	-4.5%		-5.8%	
Residential sector	-22.3%	-	-4.7%		-6.2%	
Commercial sector & others	-26.9%	-	0.5%		-9.0%	
Transport	-16.9%	-	-0.5%		-0.2%	
CO_2 from non-energy use, methane (CH_4) and nitrous oxide (N_2O)	8.3%	-	-0.7%	4.6%	3.7%	
Emission of HFCs, PFCs and SF_6	76.0%	-			161.9%	
Total	-7.1%	-			-1.3%	

Notes: * Base year is 1995 for HFCs, PFCs and SF_6 and 1990 for the other gases. - ** Energy sector emissions are included in end use sectors.

Sources: Ministry of Environment (2004), Ministry of Economy, Trade and Industry (2004), Öko-Institut calculations

For the year 2010 the projections show an emissions level similar to that in 2002. However, this is far from being on track to meet the country’s Kyoto Protocol

background of related uncertainties this contribution of LULUCF activities was not considered in the following analysis.

commitments. For energy-elated carbon dioxide emissions a decrease of between 3.2% and 5.8% is assumed, while carbon dioxide emissions from other processes and methane and nitrous oxide emissions could increase significantly. Major growth in hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride is assumed in METI's projection but when compared with the historical trend a significant adjustment resulting from the recent review is likely[2].

Against the background of these projections additional measures must be implemented to comply with the provisions of the Kyoto Protocol. Considering the outstanding role of carbon dioxide in Japan addressing the emissions from energy use is essential.

[2] The difference between the total greenhouse gas emissions in the two projections amounts to 31 Mt carbon dioxide equivalent, which is not insignificant.

3 Emissions trading in climate policy mix

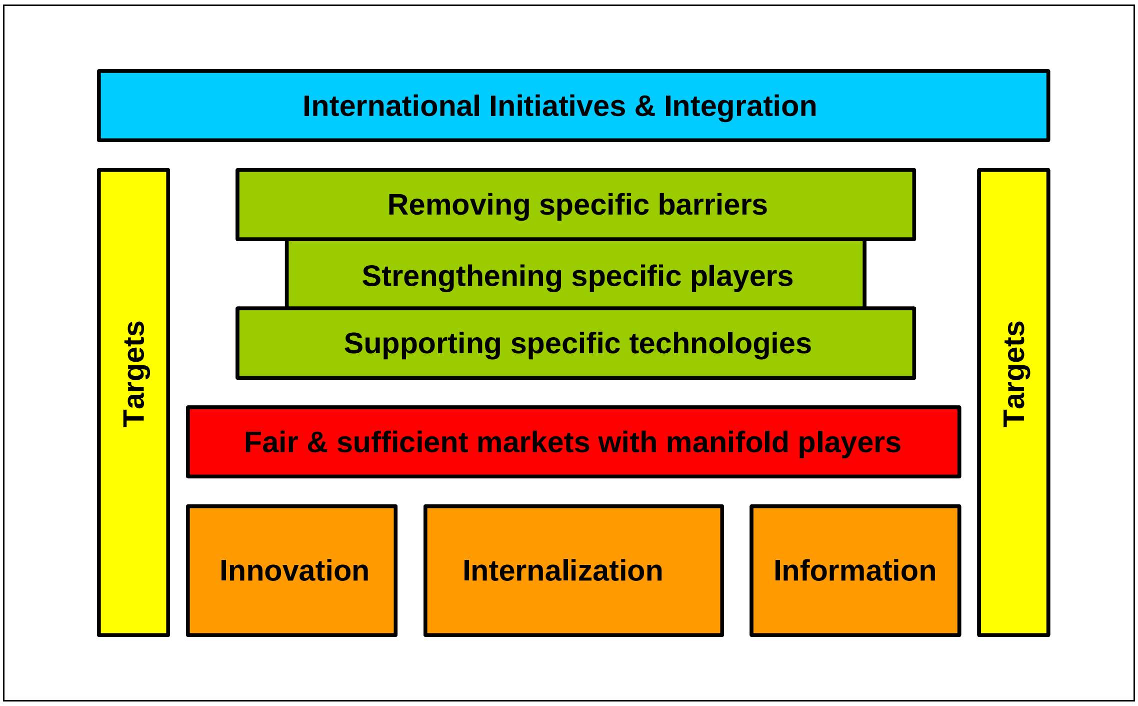
3.1 General climate policy context

Political strategies to combat climate change must deal with different time horizons. In the short term, efficient allocation of limited resources is a key challenge for climate policy and in market economies, market-based instruments play an important role.

If a significant price is put on greenhouse gas emissions and market structures are effective in transferring this price signal to the decision making processes of companies, an efficient allocation of resources will result and emission targets will be met at the lowest cost. This internalization of external costs is the main function of market-based climate policy instruments.

At the same time, however, it should be noted that the introduction of market based instruments to internalize external costs will not be sufficient alone to meet the long term challenges posed by climate change. For a number of reasons, a mix of policies – using both prices and more direct controls or other measures – is likely to be necessary.[3]

Figure 1 Dimensions of a comprehensive and consistent climate policy mix



Source: Enquete Kommission Energie (2002)

First, existing market distortions and barriers can attenuate or even eliminate greenhouse gas emission price signals. Governments will need a variety of political instruments to remove these barriers before climate policy can be effective. These

[3] There is a wide range of debates on the need for a climate policy mix – cf. IEA (2002) and Sorell/Sijm (2003).

instruments might target specific market distortions, specific technologies and players or seek to improve market structures in general.

Second, there is strong empirical evidence that markets focus almost exclusively on the short-term. Achieving long term climate policy objectives will require innovations and structural changes that depend on more direct forms of regulation and support, even for partial internalization of unknown external costs. The development of renewable energy technologies as backstop technologies for long-term greenhouse gas reduction targets is one of the most relevant challenges in this context.

Third, market-based instruments cannot determine the goals or division of responsibility for addressing global challenges like climate change. Here scientific evidence, diplomacy and recognition of historical responsibilities will determine the policy context.

As a result, climate policy will require a comprehensive policy mix, which should be developed carefully in the framework of national and international policies. Market based instruments aimed at internalizing externalities, however, will form a central pillar of sustainable climate policies.

3.2 Internalization of externalities

There are three basic options for putting a price on greenhouse gas emissions: levying a unit tax, creating a market or providing subsidies[4].

Putting a price on emissions through *taxation* is a widely used strategy for internalizing external costs.

However, environmental taxation faces a number of constraints. Since the policy objective is to achieve a given level of emissions, setting the right price is vital. This though remains one of the unsolved challenges of environmental taxation. Furthermore taxation faces several limitations in terms of trade barriers (e.g. taxation of fuels for electricity generation vs. electricity taxation), as well as a generalised resistance to new taxes and the difficulties in levying at sufficiently high levels.

These specific problems of environmental taxation are also evident from an analysis of recent energy taxation in Japan. The most important energy taxes are levied on diesel and gasoline, with taxes also charged on other fuels (oil products, LNG, LPG as well as coal) and electricity. As in other countries energy taxes in Japan today focus on the transportation sector and are mainly driven by the demand for financial resources for the construction of roads. The taxes on electricity and fuels do not adequately reflect the climate impacts of the different fuels.

Finally, it is worth mentioning that the international harmonization of taxes and the border adjustments necessary to avoid competition distortions is a highly complex issue.

[4] The issue of subsidies is not covered in this paper.

If marginal abatement costs are assumed to be high or large uncertainties exist concerning the marginal abatement costs, setting the right tax level to achieve a given domestic emissions reduction target will be a complex and politically fraught challenge.

Emissions trading schemes – in particular those following a cap and trade approach – represent the second option. Here, the first step is to define the desired level of emissions, establish this as the overall cap on the system and issue emission certificates equal to this cap. Participants are required to hold sufficient certificates to cover their emissions in a given period and are penalised for non-compliance. Thus, operators are faced with the choice between implementing emission reduction measures and buying emission certificates in order to be in compliance. The price of certificates in the market will represent the implicit price of greenhouse gas emissions, as set by supply and demand.

Figure 2 Assessment of political instruments for internalization of externalities

		Fixed Target	No Fixed Target	
		Tradable permissions	Pollution charges	Subsidies
Costs and burdens	**Cost-effectiveness and fairness**	●	•	•
	Cost-effectiveness for society	●	●	▯
	Cost-effectiveness for sources	●	•	●
	Fairness to sources	●	▯	•
	Administrative burdens	▯	•	•
	Demands on government	•	•	▯
	Costs	•	•	▯
	Ease of analysis	○	▯	•
Environmental results	**Assurance of meeting goals**	○	•	▯
	Action forcing	●	•	▯
	Monitoring capabilities	▯	▯	•
	Familiarity with use	•	▯	●
	Pollution prevention	•	•	•
	Gives prevention an advantage	•	•	○
	Focuses on learning	•	•	•
	Environmental equity and justice	▯	▯	●
	Distributional outcomes	▯	▯	•
	Effective participation	▯	▯	●
	Remediation	•	•	●
Change	**Adaptability**	•	•	•
	Ease of program modification	▯	▯	○
	Ease of changes for sources	●	●	•
	Technology innovation and diffusion	○	●	•
	Innovation in regulated industries	○	●	•
	Innovation in EG&S industry	○	●	•
	Diffusion of technologies	•	●	●

• "Average"; ● "Effective": The instrument is typically a reliable choice for achieving the criterion;
○ "It depends": The instrument may be effective ore about the average, depending on the particular situation, but it is not likely to be a poor choice; "Use with caution": The instrumentshould be used carefully if the criterion is of particular concern

Source: OTA (1995)

Figure 2 shows a comparison of tradable permits, pollution charges or taxes and subsidies in terms of their different implications for target achievement, costs and a number of other dimensions.

Taxation of greenhouse gas emissions will be most suitable for emission sources where the *transaction costs* associated with a cap and trade scheme are significant, for example small or mobile emitters where measurement and monitoring of emissions is impractical. For sectors with *large and diverse* emission sources, however, emission trading schemes are increasingly seen as the most appropriate approach as they both allow the overall target to be known and the cost of its achievement to be minimised. Subsidies can also play a role in the policy mix but the application of subsidies should be limited to areas where innovation and diffusion are the most important goals or where initial structural changes are required.

3.3 Voluntary agreements as an alterative?

In political rather than scientific debates voluntary agreements are often proposed as a viable alternative to the internalization of externalities with taxes or emissions trading schemes.

There are some successful cases of voluntary agreements in the field of climate policy but also a significant number of failures. Success is often determined by the type of voluntary agreement design that is used (company by company or aggregated levels, monitoring and compliance regimes, etc.).

Without any doubt, voluntary agreements can play an important role in technology diffusion and closing information gaps. However, if voluntary agreements aim to go beyond this and costly abatement measures are required to meet ambitious emission reduction targets, they will tend to fail or to be inefficient in resource allocation terms.

Considering the distortions caused by the results of manifold advocating and bargaining processes, the allocation of resources based on price signals is likely to be a much more efficient approach.

An analysis for Germany (Matthes et al 2003) has shown that compliance cost reductions in the range of €150m to €545m annually can be achieved by the introduction of an emissions trading scheme to replace the existing system of voluntary agreements.

Bearing in mind these efficiency gains, voluntary agreements can play a limited role in the climate policy mix but should not be seen as a viable alternative to the internalization of externalities in the longer term with ambitious emissions reduction targets.

3.4 Potential benefits of a greenhouse gas emissions scheme

According to economic theory and the empirical evidence from other environmental policy fields[5], climate policy using flexible market-based instruments will raise economic efficiency. However, the more interesting question concerns the range of cost reductions that can be achieved by introducing a greenhouse gas emissions trading scheme in Japan.

There is little empirical evidence on emissions trading schemes for greenhouse gas emissions. Nevertheless the experience of other emissions trading schemes shows that

5 Cf. OECD (2002+2004) for several case studies and more detailed discussion.

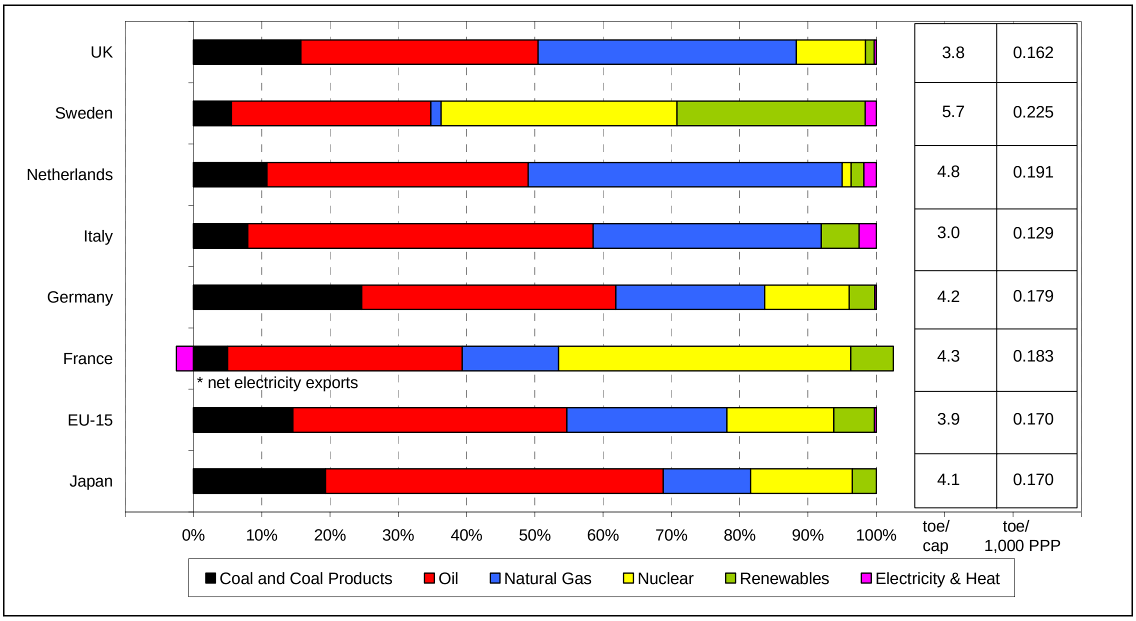
the cost of certificates almost invariably ends up being significantly lower than assumed mitigation costs at the start of the system.

Given the nature of this paper and lack of data, it was not possible here to carry out a quantitative analysis for Japan. But some results and first estimates can be derived from a comparative analysis.

In preparation for the European Union greenhouse gas emissions trading scheme a detailed modelling analysis was carried out which covers all 15 member states at the time.

If aggregate level parallels between the structures of some European countries and Japan are considered, the modelling results can be used to estimate some of the economic benefits of greenhouse gas emissions in Japan.

Figure 3 Structure of Total Primary Energy Supply (TPES), TPES per capita and TPES per unit GDP (in purchasing power parities) in European countries and Japan, 2002



Sources: IEA (2004a), Öko-Institut calculations

Figure 3 shows the structural breakdown of the total primary energy supply as well as the specific primary energy consumption per capita in selected European countries and Japan.

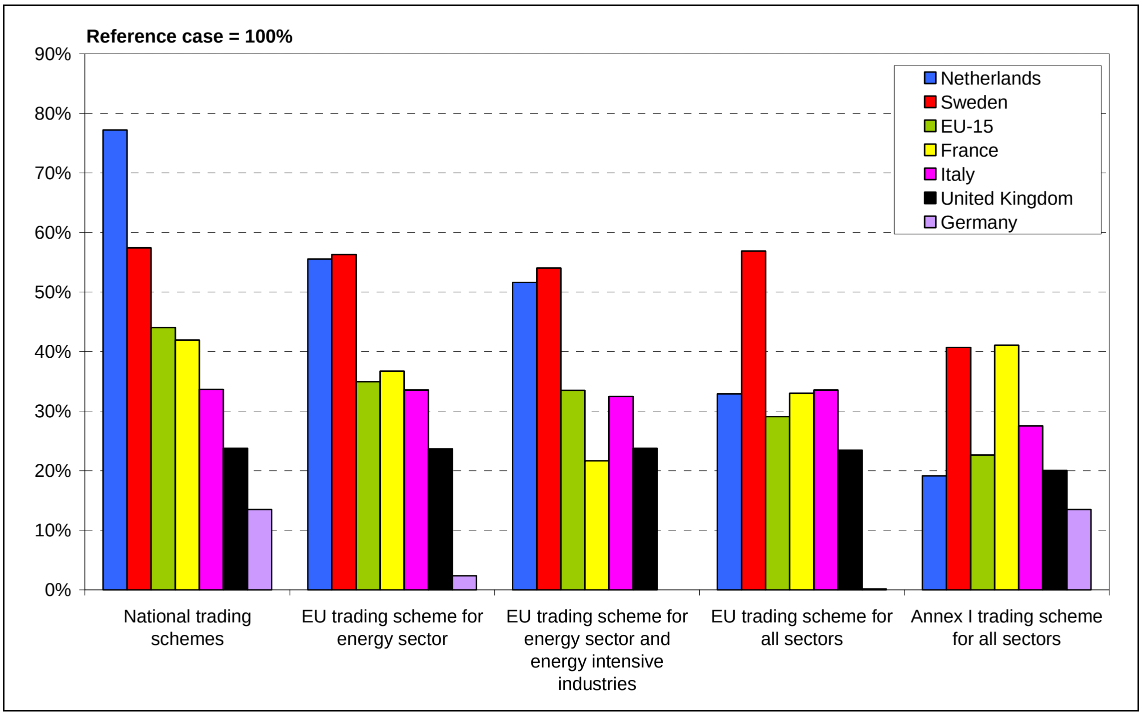
The primary energy structure in Japan shows a relatively high coal share, comparable to the United Kingdom. The share of oil is much higher than in most of the European countries (except Italy) and the share of gas is comparatively low. The nuclear share in terms of primary energy is significant but much less than in France or Sweden. In terms of electricity production the share of nuclear power generation is comparable with that in Germany. As a result a significant fuel-switching potential can be assumed, especially in the power sector that is a particularly large consumer of coal and oil.

Compared to European primary energy consumption the Japanese economy is quite efficient, and in some EU member states' primary energy consumption is significantly higher than in Japan.

From this general comparison of primary energy consumption levels and primary energy supply structures, it can be concluded that the carbon dioxide mitigation potential from energy activities should be significantly higher than the potential in Italy, France and Sweden. Based on the primary energy structure, the potential should be comparable to the potentials in Germany, the United Kingdom and the European Union average. In terms of consumption levels it should be slightly less than the potentials of these EU countries.

Figure 4 shows the results of the modelling exercise for different options for emissions trading schemes in the European Union.

Figure 4 *Results of a modeling exercise for different designs of emissions trading schemes in the European Union*



Source: *Capros et al (2000)*

Shifting national policies from other measures towards national cap and trade schemes could lower total abatement costs by between 15 and more than 85 per cent. Countries with high coal shares in the primary energy structure could obtain the greatest economic benefits from internal market optimization.

If national greenhouse gas emissions trading schemes were opened to allow intra-EU optimization between energy industries, countries with lower economic mitigation potentials could see even greater benefits. The economic benefits range from about 35 per cent to more than 95 per cent of total mitigation costs compared to implementation of the same emission reduction without the flexibility of emissions trading; an EU average saving of more than 60 per cent could be achieved. For countries with high shares of nuclear power generation this situation could improve if other energy intensive industries are integrated in the system. A further opening of the system to other sectors leads to a slight loss of benefits. The introduction of an Annex I wide emissions trading scheme would lead to higher benefits for all countries that are not heavily dependent on nuclear power such as France or Sweden.[6]

Taking into account the primary energy structures of the different countries some general conclusions can be drawn from the comparative analysis of the modelling exercise.

- The implementation of a national greenhouse gas emissions trading scheme could lower compliance costs by more than 20 per cent at the minimum and possibly by more than 50 per cent compared to the implementation of the same emission reduction targets without the flexibility of an emissions trading scheme.
- The integration of a domestic greenhouse gas emissions trading scheme into the European Union scheme could lead to a further cost reduction of more than 10 percentage points.
- Efforts towards an emissions trading scheme integrated with other Annex I parties could help to lower the costs by another 10 points.

In this context serious efforts should be made to implement a greenhouse gas emissions trading scheme in Japan compatible with emissions trading schemes in other Annex I parties. In the medium term an integration of a greenhouse gas emissions trading system in Japan with the European Union scheme is possible and has been openly discussed by EU policy-makers.

Depending on the emission reduction targets, modelling and market surveys show a range of allowance prices that should not represent unacceptable burdens for industry. The price of EU allowances is estimated as settling in a range from 5 to 15 €/t CO_2 in most of the analysis for the period until 2012. Recent forward trades in EU allowances are offered at a price of 7 to 8 € per ton of CO_2.

From the perspective of competitiveness the implementation of an emissions trading scheme should generate the minimum burden and lower impacts on competitiveness than other policies and measures aimed at achieving the same emission reduction targets. If the integration of a national scheme into international emissions trading schemes can

6 The nuclear share in gross electricity generation was 78% in France and 49% in Sweden in 2003 (IEA 2004b). The contribution of nuclear energy to the total gross electricity production in Japan (23%) is much closer to the share in Germany (28%), the United Kingdom (23%) or the EU-15 (33%), but significantly higher than in the Netherlands (4%).

be achieved, many potential burdens and market distortions will be avoided. Furthermore, the experience from the EU allowance allocation shows that competitiveness aspects can also be considered in the allocation process.

Finally, the implementation of an emissions trading scheme offers a number of political benefits:

- The market mechanism ensures the implementation of least cost options, which is important especially for the energy intensive industries and the energy sector.
- Allowance prices provide an objective indicator for measuring the burden of climate policies to the national economy.
- Emissions trading schemes are suitable for international integration and harmonization.
- The introduction of emissions trading schemes will be reflected in financial markets and thereby build additional incentives for the firms involved.
- The new challenge of emissions trading will help to raise awareness of mitigation measures at enterprise and plant levels.
- Defining the cap, in particular, will put permanent pressure for the development of a consistent climate programme for the sectors not covered by the emissions trading scheme.

Some analysts argue that an emissions trading scheme is not suitable for Japan because of its relatively high abatement costs compared to other regions of the world. Even if this is the case, the problem arises more from the domestic target than the instruments to achieve this target. In the case of high abatement costs, a carbon tax or subsidy schemes must deliver strong incentives to meet the target. Against this background an emissions trading scheme with its in-built mechanism to bring down costs and meet defined greenhouse gas emission levels should be a key part of the policy mix.

3.5 Initial conclusions

The internalization of externalities is one of the basic requirements for a comprehensive climate policy. Although additional policies and measures will be necessary, instruments which put a price on greenhouse gas emissions will play a key role in the future climate policy mix.

Whereas carbon or energy taxes seem to be suitable for sectors such as transport and residential energy consumption, a greenhouse gas emissions trading scheme offers many advantages for the energy sector and other large emitters.

For a given greenhouse gas reduction target, the flexibility of an emissions trading scheme will lead to major economic benefits compared with alternative pathways without this flexibility. Taking into account modelling exercises from the European Union the following cost reductions could be assumed:

- The implementation of a national greenhouse gas emissions trading scheme could lower the costs by more than 20 per cent at the minimum and possibly by more than 50 per cent.
- The integration of a domestic greenhouse gas emissions trading scheme into the European Union scheme could lead to a further cost reduction of more than 10 percentage points.
- Efforts towards an emissions trading scheme integrated with other Annex I parties could help to lower the costs by another 10 points.

In addition to this a number of political and cognitive benefits could be generated by the introduction of a sufficient cap and trade system.

Greenhouse gas emissions trading can never be the only climate policy tool in societies with complex structures. Instruments for the internalization of externalities must be part of a well-designed policy in market economies if ambitious greenhouse gas reduction targets have to be met in the short, medium and long term. Given the manifold advantages of emissions trading, however, it should play a significant role in this policy mix.

4 Design options for an greenhouse gas emissions scheme for Japan

4.1 General concept

For the development of an emissions trading scheme several crucial issues must be dealt with:

- The definition of a binding cap is a key prerequisite for an emissions trading scheme. In the framework of international treaties, the cap should be consistent with the assigned amounts established in the Kyoto Protocol.[7]
- The allocation provisions must ensure that the structure of the emissions trading scheme provides for reasonable economic incentives. Although allocation seems to be a pure distributional problem from a theoretical point of view, allocation methods can change the incentive structure of the scheme under real operating conditions.
- Distributional effects should be considered within the development of allocation provisions in order to avoid unacceptable distortions, not least to ensure of the legal validity of the allocation scheme.

Figure 5 shows a multi level framework for the process of *cap definition and allocation*.

In the case of a downstream emissions trading scheme the process of cap definition and allocation must deal with all the levels shown in Figure 5. If an upstream emissions trading is chosen the process is limited to the first two levels.

The required contribution of Japan is defined by the total amount of assigned amount units allocated to Japan in the Kyoto Protocol. Within this framework governments can also decide to comply with their obligations by using the Kyoto Protocol's flexible mechanisms i.e. by buying Certified Emissions Reduction Units (CER) from Clean Development Mechanism (CDM), Emission Reduction Units (ERU) from Joint Implementation or Assigned Amount Units (AAU) from international emissions trading. Recent plans show that the government plans to raise a contribution of about 20 Mt CO_2 equivalent from the Kyoto mechanisms (cf. chapter 4.4).

The third level refers to the coverage of the emissions trading scheme itself. This must take into account a number of different dimensions (cf. chapter 4.2) and be based on an analysis of the different sectors which could be subject to binding caps with the flexibility of allowance trading.

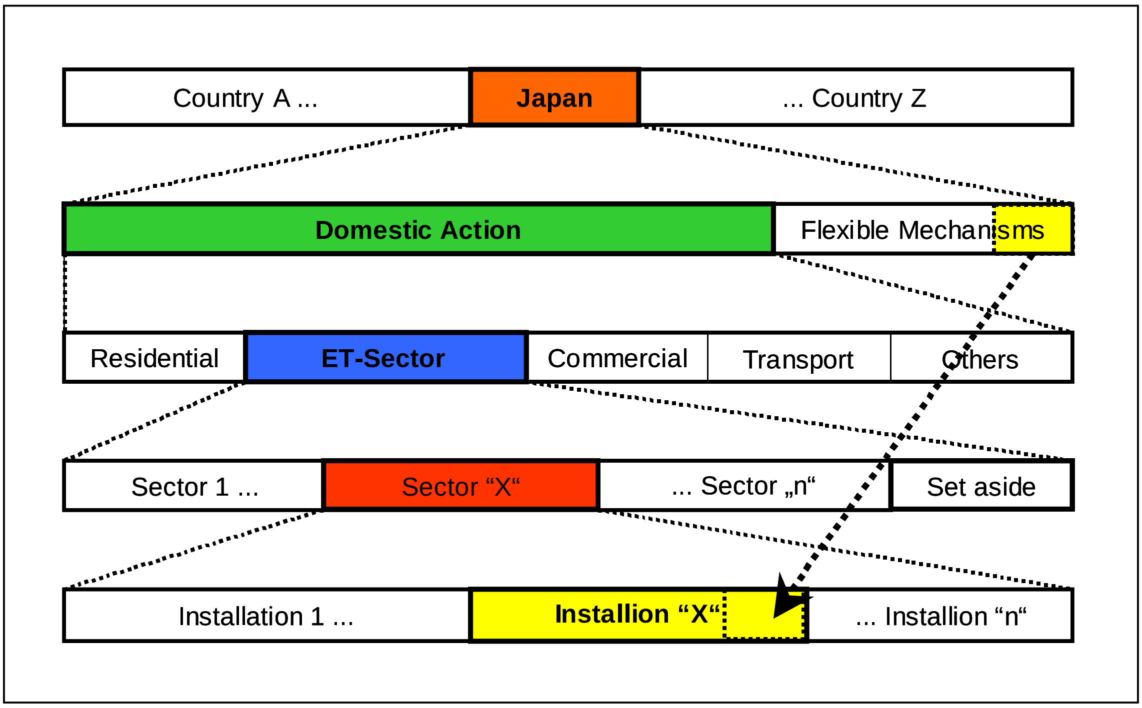
If a decision is made in favour of a downstream scheme (cf. chapter 4.2), the need for a sectoral differentiation of caps must be assessed. This issue is only significant in terms of distributional effects if a uniform allocation for all sectors would create unacceptable burdens for some sectors (cf. chapter 4.5). Finally, the provisions for allocation of

[7] In this framework also the accounting of LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol can be taken into account. See Footnote 1.

allowances to installations must be specified in the framework of a downstream emissions trading scheme.

Flexible mechanisms can also be implemented at the fifth level. In this case, not the government but the legal entities facing obligations under the emissions trading scheme would buy CERs or ERUs and be able to convert them into allowances (cf. chapter 5).

Figure 5 General framework of cap definition and allocation



Sources: DIW et al (2003), with own revisions and extensions

To ensure that the *structure* of the emissions trading scheme provides incentives to reduce emissions, the chosen design options of an emissions trading scheme must comply with the following criteria:

- different *activities* or decisions
- which result in different *emission levels*
- must lead to different *carbon price signals* from the emissions trading scheme.

Considering these criteria the allocation provisions must also reflect the distributional effects of cap definition and allocation as well as potential leakage effects of the scheme. In this framework the sectoral differentiation as well as the treatment of process emissions and new entrants or combined heat and power production should be addressed (cf. chapter 4.5).

4.2 Basic approaches and coverage of the system

One of the most significant design options of a greenhouse gas emissions trading scheme is the general approach.

- In an *upstream* system the issuance of allowances and the examination of compliance take place at the level of primary energy production or imports according to the carbon content of the fuels used (which can be seen as potential emissions). As a consequence, in a pure upstream system only carbon dioxide emissions can be considered, as carbon dioxide emissions from industrial processes as well as methane and nitrous oxide emissions depend significantly on the combustion technology employed.
- In a *downstream* system the installations where greenhouse gases are released into the atmosphere will be subject to caps and compliance rules. Because this scheme is based on real emissions it is easier to include other greenhouse gases in the scheme.

Upstream and the downstream systems have different effects that can bring both important advantages and disadvantages, which should be assessed.

Practical experience with greenhouse gas emissions trading schemes is limited. Nevertheless, the preparation and implementation of greenhouse gas emissions trading schemes in the United Kingdom, Denmark and the European Union and the in-depth discussion in the academic arena in the EU and in Canada, Australia and Japan have raised several issues that need to be considered.

For a rough comparison of upstream and downstream emissions trading schemes the following dimensions are assessed:

- environmental effectiveness,
- static efficiency,
- dynamic efficiency,
- legal practicability,
- cognitive aspects,
- compatibility with other emissions trading schemes.

The *environmental effectiveness* of upstream and downstream systems could be *comparable*, irrespective of the fact that the coverage of an upstream system will be more comprehensive than a downstream scheme (in terms of energy related carbon dioxide emissions). However, to be equivalent to an upstream system the downstream system must be part of a well designed policy mix which addresses all sectors not covered by the emissions trading scheme adequately. An upstream system is therefore simpler, although non-CO_2 and process emissions would still have to be treated separately.

The number of transactions in an upstream system could be lower than the transactions in a downstream system because the structure of legal entities is much more heterogeneous and the need for external trades should be much higher. If adequate price signals to all installations are assumed, the larger coverage of the upstream model and lower transaction costs could lead to more *static efficiency*.

Nevertheless, when *dynamic efficiency* is considered the downstream model could be more favourable. One of the most significant shortfalls of the upstream model is the transfer of price signals from the level of primary energy producers or importers to the actual emitters. If primary energy producers or importers are free to transfer the cost of allowances asymmetrically to different consumer groups (e.g. industry and small businesses or residential customers) major distortions will arise because the price signal for carbon dioxide emissions is different for these groups. This will reduce efficiency gains,

The assessment of dynamic efficiency depends on the degree of market imperfections that exist in the energy sector. The OECD (2002) has highlighted this problem as follows:

"An upstream scheme … would depend on the capacity of the markets, all along the chains down to final consumers, to provide appropriate incentives so that they adapt choices and behaviours efficiently. Imperfectly competitive markets could lead to price discrimination and regulation due to inadequate consumer demands if a quantitative cap is to be absolutely met. A downstream emission permits scheme … would provide direct incentives to final consumers to change their behaviours, but coverage of GHG emissions would only be partial …".

Furthermore, the liquidity of the market and price stability are likely to be higher in a downstream model. Innovation research shows that a bigger and more liquid market with fewer price fluctuations – as in a downstream model - combined with direct incentives from carbon pricing should lead to *more innovation and faster diffusion. Market power* and the problem of *market distortions* and related efficiency losses because of market imperfections can influence the dynamic efficiency significantly. Consequently the downstream system is more favourable because these problems are less important at the level of operators of installations than for primary energy producers and importers. However, the decisive issue concerning dynamic efficiency is the degree of imperfection in relevant markets and the transparency of the carbon price signal.

From a non-economic viewpoint, *legal concerns* also exist with regard to the upstream model. In particular, the conformity of an emissions trading scheme based on primary energy production and imports with WTO rules could be problematic. In the case of low market liquidity, for example, some analysts see potential problems with GATT Article XI GATT because the emissions trading scheme could be seen as an unacceptable import quota (Werksman/Lefevre 1999).

The *cognitive dimension* should also not be ignored. There is some empirical evidence that the need for expanded decision making to implement emissions reduction measures or to buy carbon dioxide allowances can intensify the knowledge on emission reduction potentials and can help reduce the costs of emission reduction measures at the plant level. In the case of an upstream system the carbon price signal would not be transparent and would be seen by the decision makers at the plant level more from the viewpoint of general fuel price risks. There is already clear empirical evidence that the preparation of the EU emissions trading scheme has raised awareness of greenhouse gas emission issues at company level dramatically, because of the direct exposure to monitoring, allocation and accounting issues. Company experiences (BP, Shell, etc.) also show that the monetary aspect of CO_2 emissions must be identifiable and transparent to those entities that will develop and implement abatement measures.

Last but not least, the *compatibility* of a greenhouse gas emissions trading scheme in Japan with other national or international emissions trading systems should be an important consideration. Since the GHG emissions trading scheme in Europe is designed as a downstream system it would be more difficult to link a Japanese emissions trading scheme with it if designed as an upstream scheme. Although linking an upstream with a downstream emissions trading scheme is technically feasible, in practice a number of problems are likely to arise as a result of the fundamental design differences.

Table 3 shows the results of a multi criteria assessment of the advantages and disadvantages of upstream and downstream emission trading models. A downstream scheme is clearly the more attractive option. The comprehensive coverage of the upstream system - its main advantage in terms of optimization - must be compensated for in a downstream emissions trading scheme with other policies and measures on the one hand and a well founded definition of the cap for the sectors and installations which take part in the emissions trading system, on the other.

Table 3 Multi dimensional assessments of upstream and downstream emissions trading schemes

	Upstream Model	Downstream Model
Ecological criteria		
Environmental effectiveness	++	+(+) (if part of well designed policy mix)
Economic criteria		
Static efficiency (transactional costs, coverage)	++	++
Dynamic efficiency (carbon price signal, innovation, variety of market participants, liquidity and market power, etc.)	+	++
Other criteria		
Legal practicability	???	++
Cognitive aspects	o	++
Compatibility with other emission trading schemes	???	++

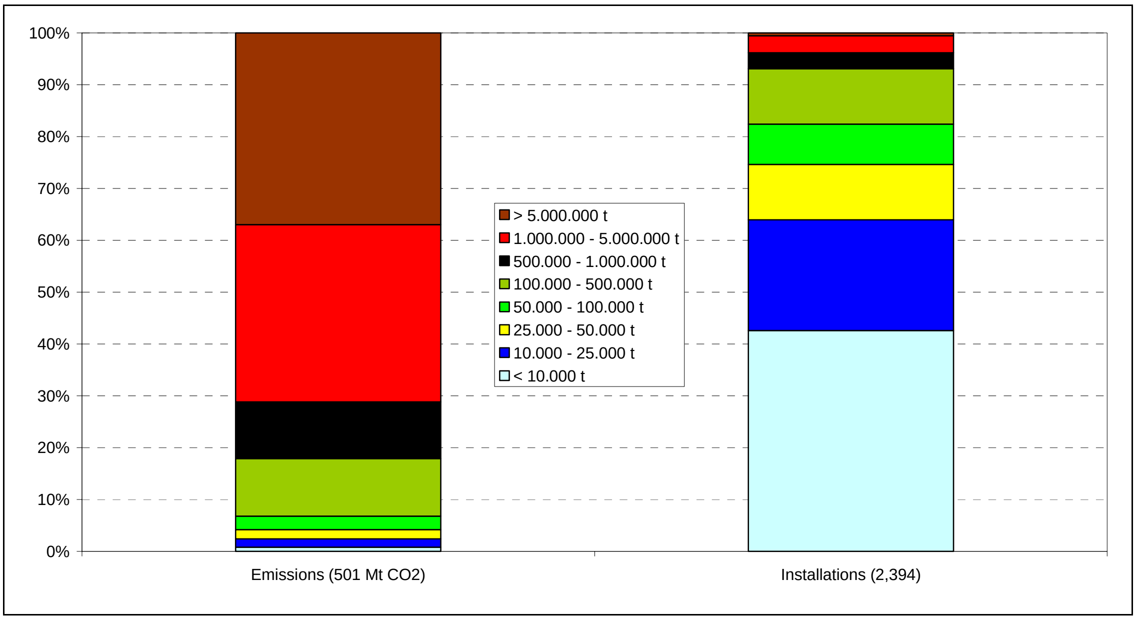
Sources: Betz (2003) with own revisions and extensions

4.3 Thresholds in a downstream emissions trading scheme and its total coverage

In order to limit the burden of transaction costs, a threshold for the participation in the greenhouse gas emissions trading scheme should be set. The European Union scheme with a threshold of 20 MW thermal input capacity gives an indication of a useful limit. On the other hand, the example of the National Allocation Plan of the Netherlands shows that a minimum emission level (which is 25,000 t CO_2 annually in the Netherlands and is equivalent to a 50 MW gas fired installation) could be a further pragmatic approach.

From the recent experiences in the EU allocation process a threshold of 50 MW thermal input capacity seems to be adequate for mandatory participation in the system. Figure 6 underlines the suitability of the 50 MW threshold against the background of the German NAP: installations with emissions less than 25,000 t CO_2 annually represent 64% of total installations but 2.4% of the emissions covered by the scheme. For smaller installations an incentive driven opt in gateway seems to be a more suitable approach.

Figure 6 Structure of CO_2 emissions and installations in Germany, preliminary data enquiry (February 2004)

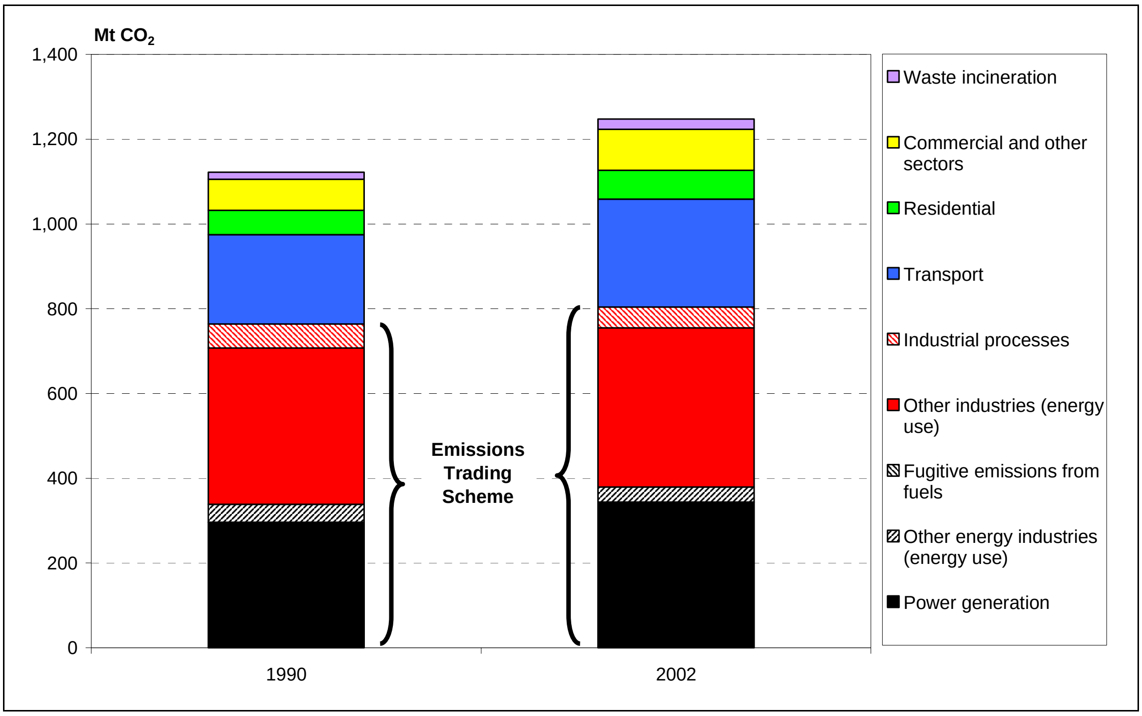


Sources: Öko-Institut calculations based on preliminary data for the German National Allocation Plan 2005-2007

However, the threshold for a downstream emissions trading scheme must be elaborated in more detail for the Japanese context.

Carbon dioxide emissions from non-energy industrial processes (for example, cement and lime production, production of pig iron) should be included in the system because of their significant contribution to total CO_2 emissions. The integration of fugitive CO_2 emissions from oil and gas production also seems to be useful because interesting options exist for using CO_2 for enhanced oil recovery, etc.

Figure 7 Structure of CO_2 emissions and proposed coverage of a CO_2 emissions trading scheme in Japan, 1990 and 2002



Sources: Greenhouse Gas Inventory Office of Japan, Öko-Institut

If the coverage in Japan shown above is adopted, about 64% of the total CO_2 emissions and 60% of the total greenhouse gas emissions in Japan would be covered by the scheme:

- The total coverage of the scheme is about 804 Mt CO_2 (2002 levels).
- The biggest share is for power generation, representing 344 Mt CO_2 and 43% of the total emissions included in the system.
- The energy related CO_2 emissions from other industries represent 47% of the total emissions covered by the scheme.
- CO_2 emissions from industrial processes account for 6% and the other energy industries (refineries, etc.) would represent a further 4%.

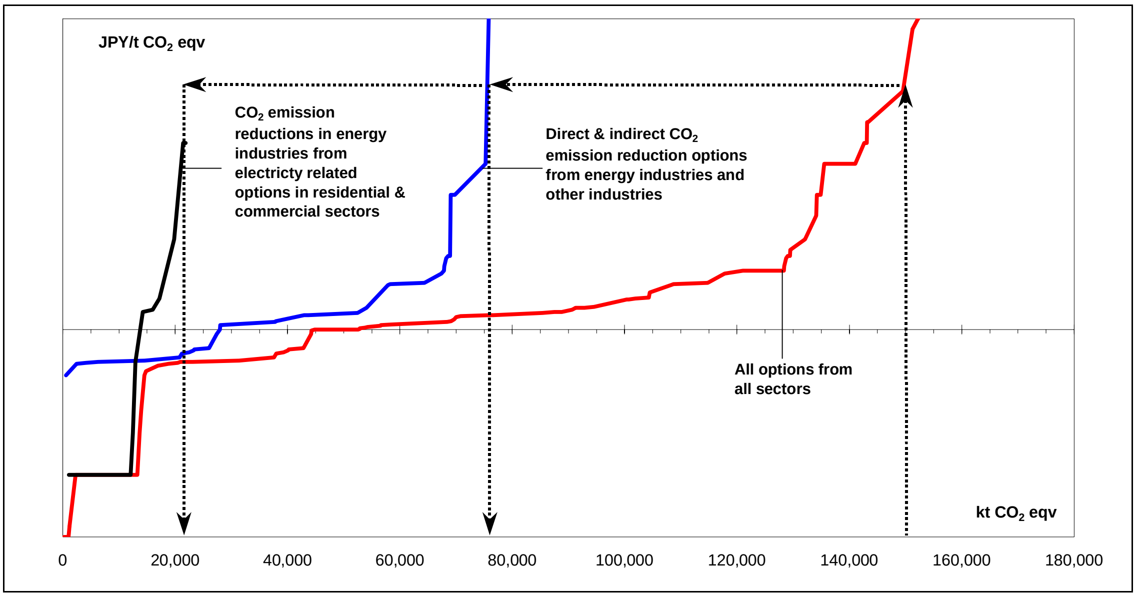
4.4 Cap for the emissions trading scheme

One of the crucial issues of the emissions trading scheme is the cap. Even if some further reduction of non-CO_2 greenhouse gases is assumed, government figures for 2002 suggest that a gap of about 150 million tons of CO_2 has to be closed for Japan to reach its -6 per cent Kyoto target. If no further reduction of non-CO_2 greenhouse gases is taken into account the gap to be closed amounts to 168 Mt CO_2 equivalent.

From an *academic perspective* the CO_2 emissions cap for the installations covered by the emissions trading schemes should be derived from economic modelling. The cap to be defined for the emissions trading sector should reflect the marginal costs of abating CO_2 emissions in the non-trading sectors (residential and commercial, transportation). To illustrate this approach and to get an impression of the results of such a modelling exercise a rough estimate was made based on a marginal abatement cost curve derived for Japan (Nishioka 2001).[8]

The cost curve includes 97 measures from all sectors and for all gases covered by the Kyoto Protocol with a total greenhouse gas abatement of about 160 Mt CO_2 equivalent, including those with both positive and negative abatement costs.

Figure 8 Emission reduction targets based on marginal abatement cost curves for Japan



Sources: Nishioka (2001) and Öko-Institut calculations

Figure 8 shows the marginal abatement cost curves and illustrates the methodology for the differentiation of emission reduction targets:

- If a gap closure of about 150 Mt CO_2 equivalent by domestic measures is assumed[9] all measures with abatement cost less than the cost corresponding to the cumulative greenhouse gas abatement will be implemented for purely economic reasons.
- All measures to reduce CO_2 in the energy industries and industrial sectors with costs less than the marginal abatement costs derived from the total marginal

8 Given the methodological and data constraints of the models used for the calculation of abatement costs the relation between the different abatement options is usually more reliable than the level of the costs. Cf. Jaccard (2004) for a more detailed discussion.

9 A contribution of about 20 Mt CO_2 equivalent is planned from flexible mechanisms of the Kyoto Protocol – cf. Table 4.

abatement cost curve must be implemented. This approach results in a contribution of about 76 Mt CO_2 from energy industries and other industries.

- All measures in other sectors that result in emission reductions in the energy industries (e.g. electricity savings) must be calculated separately. Analysis of the marginal abatement cost curve suggests an additional contribution of about 22 Mt CO_2 from the energy industries and other industry sectors.

As a result, an emission reduction target for the energy sector and the other industries in the range of 98 Mt CO_2 can be derived using this methodological approach. Taking into account that the recent projections for CO_2 emissions from energy use without additional measures show a stabilization at recent emission levels, the CO_2 emission target for the sectors potentially covered from a downstream emissions trading scheme is 706 Mt CO_2 in 2010. This corresponds to a reduction of about 12% for energy industries and other industry sectors.

Nevertheless, given the significant difficulties in estimating appropriate abatement cost curves and models[10], the overall uncertainties surrounding non-CO_2 greenhouse gases and a series of methodological issues, a more simple method is to use a *proportional approach* that reflects the share of the sectors covered by emissions trading in total CO_2 emissions. If an emission reduction target of 150 million tons of CO_2 is defined, CO_2 emissions have to be cut by 12 per cent across all CO_2 emitting sectors. Following the proportional approach a cap of 708 million tons of CO_2 should be set for the sectors covered by the emissions trading scheme.

As a pragmatic alternative to sophisticated macro optimization on the one hand and the simple proportional approach on the other, the derivation of a cap *from existing climate programmes* offers another option from the perspective of public acceptance. Japan's "Guidelines of Measures to Prevent Global Warming" includes a sectoral breakdown of greenhouse gas emission targets (Table 4).

The targets for CO_2 emissions from energy use should result in a stabilization of these emissions at base year levels. If this is seen as a proxy an overall emission reduction of 126 Mt CO_2 or 11% below 2002 emission levels should result. If emissions growth in residential, commercial and transport sector is taken into account the reduction requirements for the energy sectors and industry could be higher.

Nevertheless, the reference to the government's programme generates some crucial problems for the derivation of the cap:

- The indirect allocation of emissions from the energy sector to end use sectors does not fit in with a downstream emissions trading scheme.
- The aggregate target for CO_2 from industrial processes on the one hand and CH_4 and N_2O emission sources on the other makes it difficult to identify the contribution

[10] Cf. Jaccard (2004) for an assessment of the different modelling approaches for calculation of greenhouse gas abatement costs.

of CO_2 from industrial processes which could be covered by the emissions trading scheme.

- The sectoral allocation of the emissions reductions arising from innovative technologies and lifestyle changes appears impossible.

Table 4 Sectoral breakdown of Japanese government's emission reduction target according to the government's Guideline of Measures to Prevent Global Warming

	Emission levels		Targets				
	Base Year*	2002	compared to base year levels			compared to 2002 levels	
	Mt CO_2 equivalent				Mt CO_2 equivalent		
Carbon dioxide (CO_2) from energy use	1,048.3	1,174.3	0.0%	0.0%	0.0	-126.0	-10.7%
thereof							
Energy sector**	338.6	379.2	i.e.				
Industry	368.5	375.9	-7.0%				
Residential sector	57.3	68.1	-2.0%				
Commercial sector & others	73.3	96.3					
Transport	210.7	254.7	17.0%				
CO_2 from non-energy use, methane (CH_4) and nitrous oxide (N_2O)	138.9	128.2	-0.5%		-6.2	4.5	3.5%
Emission of HFCs, PFCs and SF_6	49.7	28.3	2.0%		24.7	46.2	163.5%
Reductions by innovative technologies and change of lifestyle			-2.0%		-24.7	n.e.	n.e.
Sinks			-3.9%		-48.2	n.e.	n.e.
Kyoto mechanisms			-1.6%		-19.8	n.e.	n.e.
Total	1,236.9	1,330.8	-6.0%		-74.2	-168.1	-12.6%

Notes: * Base year is 1995 for HFCs, PFCs and SF_6 and 1990 for the other gases. - ** Energy sector emissions are included in end use sectors for the targets.

Sources: Japanese Government Global Warming Prevention Headquarters (2002), Greenhouse Gas Inventory Office of Japan, Öko-Institut calculations

A fourth option for the cap is to make reference to voluntary agreements with industry. In Japan, Keidanren set a voluntary target of stabilizing emissions at 1990 levels. In rough terms this voluntary target equals a contribution to gap closure of about 50 Mt CO_2 or a reduction of 5.7% compared with current emission levels. However, the Keidanren voluntary target is not consistent with the overall emission reduction needed for compliance with the Kyoto Protocol commitments if no consistent policies and measures are set up to achieve additional emissions reductions in other sectors.

For the purposes of this initial discussion, we assume a cap equivalent to an 11% reduction in emissions below current levels by the time period 2008-12.

This target for the emissions trading scheme would be lower if either less domestic action or a major contribution of LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol is assumed. However, the basic mechanisms of the four approaches described above will remain unchanged in this case.

4.5 Excursus: Rate-based targets and treatment of indirect emissions from power production

In the framework of emissions trading schemes two further issues are subject to some controversy:

- Should rate-based (relative) targets be part of an emissions trading scheme as an alternative to absolute caps?
- Is there a need for a special treatment of indirect emissions from the power sector?

The issues listed above only apply in the case of a downstream emissions trading scheme. If an upstream system is implemented the two questions became obsolete.

There are serious arguments in favour of and against *rate-based targets* in the framework of an emissions trading scheme[11]:

- On the one hand, rate-based systems offer more flexibility for single firms. Furthermore, rate based targets are more attractive from the policy perspective as the inclusion of new entrants and expansion of production is easier with relative targets.
- On the other hand, relative targets give less certainty about the future emission levels of installations and their contribution to meeting an absolute cap at the national level. The definition of rate-based targets (metric, range, monitoring, etc.) is extremely difficult for a number of branches and constellations. Furthermore, there is some empirical evidence that informational asymmetries between the companies and the administration lead to weak targets. Some modelling exercises also show that rate-based targets could lead to higher allowance prices.

Linking an emissions trading scheme with rate-based targets with emissions trading schemes based on absolute targets could face major problems in term of administration and political acceptance. In order to avoid net flows from the rate-based part of the scheme to the participants with absolute targets a gateway was established in the UK system. In the case of international linkages a gateway of this type would be essential to avoid inflation from the emissions trading schemes with relative targets. Such a linkage is unlikely to be acceptable for countries with absolute targets due to the likely adverse impacts on competitiveness.

Against this background, rate-based targets in the framework of emissions trading should be seen as highly problematic and solutions to the problems of updating and new entrants can be found with reasonable ease within a system with absolute targets.

If a downstream emissions trading scheme is based on direct emissions, some perverse incentives can arise. For some companies there could be an incentive to increase electricity consumption if electric appliances can replace combustion installations. The

[11] Cf. Sorell (2003) as well as Baron/Bygrave (2002) for more details and literature.

emissions from increased electricity consumption could be much higher than the emission reduction from boiler replacement. In order to implement incentives for electricity savings some propose the indirect treatment of emissions from electricity. In the UK such a model has been implemented. Emissions from electricity supplies from the public grid are monitored at the point of electricity consumption with a constant factor.[12]

This system ensures incentives for electricity savings but does not establish incentives for less carbon intensive power production. Furthermore, the necessary provisions for electricity consumption from industrial power plants and CHP plants increase the administrative burden of the scheme. Last but not least, an increase of power consumption replacing direct emissions will lead to price effects which to some extent will compensate the counterproductive effect mentioned above.

As a result, the emissions trading system should be strictly based on direct emissions if significant emission reductions in the power sector can be assumed and electricity market structures can be achieved which allow a sufficient price response to increasing power consumption.

4.6 Allocation to installations in a downstream emissions trading scheme

4.6.1 Allocation to existing installations

The allocation of allowances to installations is another key aspect of a downstream emissions trading scheme. This issue has generated a wide range of analysis and debate in the scientific community as well as in the political arena.[13]

In the process of developing National Allocation Plans in the European Union many aspects of allocation were subject to in-depth analysis. This debate and the political process showed that the allocation process has both material aspects and significant political constraints. Bearing in mind the variety of allocation approaches in different NAPs and the early stage of implementation the allocation process remains a learning process. The experiences from the pilot phase of the European Union emissions trading scheme will offer a much better basis for future allocation decisions.

However, some conclusions can be drawn from recent experience. During the debate and the initial allocation process some options played a significant role:

1. In an *auctioning* system, all or a part of the allowances would be allocated by an auctioning procedure. Sector or process differentiation would not be necessary in this case. Distributional effects would be determined mainly from the

[12] The CO_2 emission factor for electricity supplied from public supply network is 0.43 kg CO_2/kWh. It does not vary from year to year (DEFRA 2003). Cf. KPMG (2002) for a further discussion of advantages and disadvantages.

[13] The following discussions are mainly based on the analysis of different options for allowance allocation in Germany and the European Union (cf. DIW et al 2003, NERA 2002, KPMG 2002).

redistribution of the auctioning income. Problems like the treatment of early action would be inherently avoided.

2. In a *benchmarking* scheme, the allocation of allowances would be free and based on sectoral benchmarks:

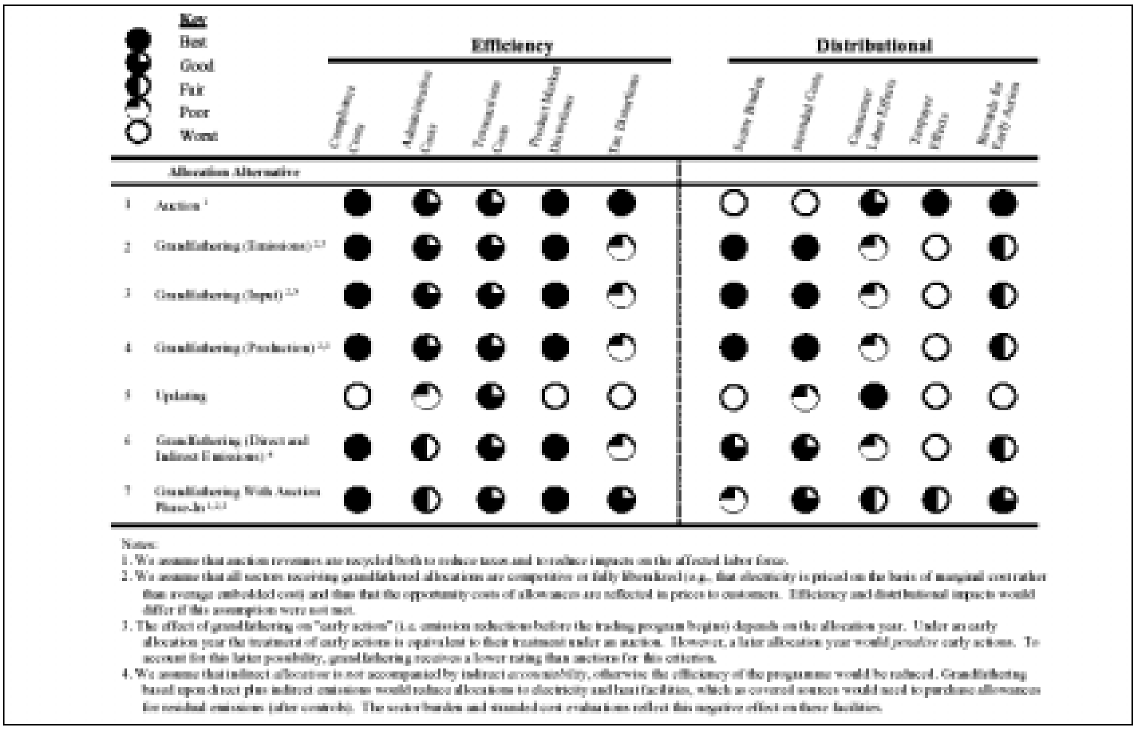
   a) Historical average benchmarks for products or processes would be based on the average specific emissions of a certain product or technology cluster;

   b) Best available technology benchmarks would be based on the best known or the best implemented technologies for a certain product or process.

3. In a *malus* scheme, the allocation of allowances would be free and based on historical data for a certain period after commissioning. If this timeframe is exceeded the gratis allocation would be limited to the benchmark for new installations.

4. In a *grandfathering* scheme, the free of charge allocation would be based on historical emissions in a certain base period.

Figure 9 NERA's Comparison of Initial Allocation Alternatives



Sources: NERA (2002)

In preparation for the allocation process in the European Union different allocation approaches including hybrid systems were analysed (NERA 2002, KPMG 2002). Figure

9 shows the assessment of NERA (2002), which underlines the importance of distributional aspects.[14]

From an academic perspective *auctioning* is the preferable allocation approach. The administrative costs are low and a clear price signal would be set for carbon emissions. Nevertheless, the significant economic impact of an auctioning scheme could lead to a far-reaching depreciation of the existing capital stock. Because a significant distributional problem arises from auctioning the redistribution of the auctioning income will be the most important challenge. Against the background of the European Union debate on auctioning, the introduction of auctioning seems not to be achievable in terms of political acceptance, at least initially.

The second best option is a *benchmarking scheme*. Early action would be reflected sufficiently and a level playing field could be created. The development of a consistent allocation is much easier for historical average benchmarks than for best available technology benchmarks because the adjustment between the total amount of allowances based on best available technology benchmarks would require an adjustment to the overall cap which could create some distortions. In the case of historical average benchmarks the link to the overall cap is much easier to implement because of the direct link to historical emissions. Existing installations would receive a gratis allocation based on historical production data and a benchmark derived from total emissions related to a given product and total production of this product multiplied by a compliance factor[15] representing the total CO_2 reduction compared to historical emission levels.

A key design issue for a benchmarking system is the basis for the benchmarks. The benchmark could either be based on products (e.g. kilowatt hours electricity production) or processes (e.g. kilowatt hours electricity production from a coal-fired, gas-fired or oil-fired plant). In general, product based benchmarks are preferable. However, a process based benchmarking system could be acceptable for existing installations against the background of potential capital stock depreciation.

The main challenge for a benchmarking system is the creation and maintenance of the benchmarks. Comprehensive data analysis will be necessary as well as permanent market surveys. The allocation process could be more complicated in the beginning. However, over time the cost of a benchmarking system will decrease significantly.

If the administrative burden of creating a benchmarking system is too heavy, the *malus scheme* represents the third best approach. The allocation of allowances will be based on historical emissions in a base period if the time since commissioning of the installation does not exceed a certain period (e.g. average economic lifetime). Beyond this timeframe the installation will receive only the allocation equivalent to a new

[14] In the allocation process input-based and grandfathering approaches with indirect emission provisions played no role. The benchmarking and the malus approach are comparable with production based grandfathering approach.

[15] The compliance factor is defined as ratio between the amount of allowances allocated to an installation and its historical emissions.

entrant (see chapter 4.6.2) free of charge. Because the system is based on historical emissions which are easy to identify, the administrative burden is much less than with benchmarking. The key problem is to identify a definitive commissioning date for installations, which can be difficult in complex industrial installations. Furthermore, early action will be reflected much less adequately in this system.

The fourth best approach is a pure *grandfathering system*. The number of allowances allocated to a given installation is based on historical emissions in a base period multiplied by a compliance factor, which is derived from the overall or sectoral cap. This system is quite easy to administer but will create significant problems in terms of rewarding early actions and entrenching existing technologies. The base period should cover several years with three years being the minimum. A five-year base period would be more representative but might run into problems of data availability. Additional flexibility could be introduced by allowing the exclusion of an atypical year from the base period. This scheme is the most simple allocation approach for existing installations in terms of data and administration cost on the one hand but, on the other, will create some distortions with regard to early action.

Considering the timeframe for the potential implementation of an emissions trading scheme in Japan, the administrative burdens and the empirical evidence regarding political acceptance, a system based on historical average benchmarks should build a pragmatic starting point.

In the case of benchmarking with historical average benchmarks, as well as for grandfathering or malus systems, a compliance factor must be defined. With the compliance factor the total CO_2 reduction between historical emission levels and the cap is transferred to installations. The compliance factor offers the possibility of sector or technology differentiation. In the European Union emissions trading scheme some countries (UK, Austria, Sweden, etc.) have chosen a differentiated system of compliance factors, while other countries, such as Germany, have decided to implement a common compliance factor.

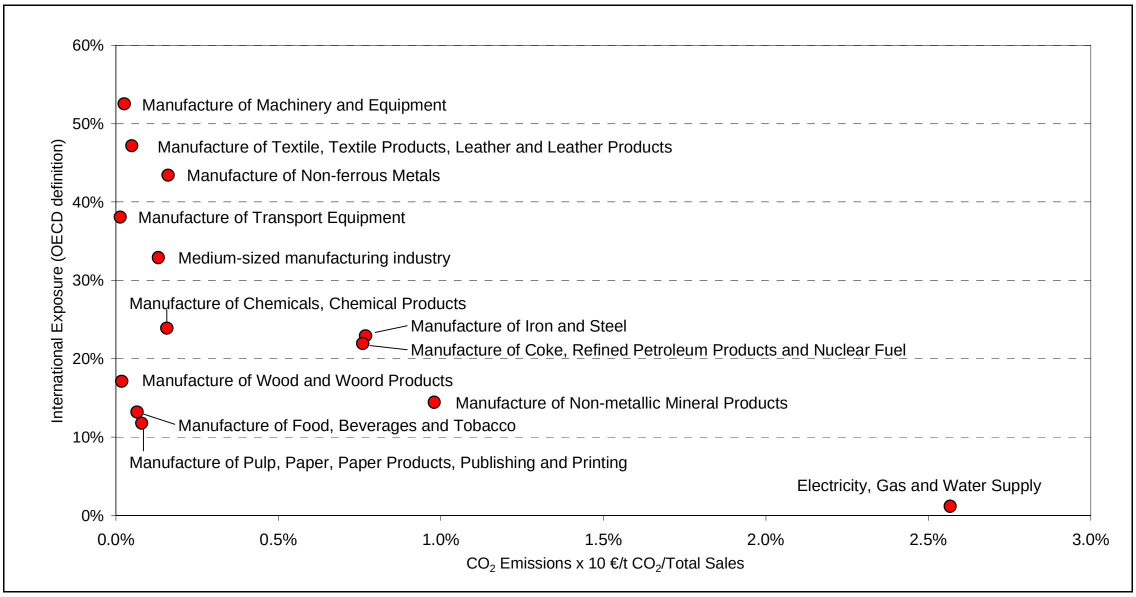
The background for a potential *differentiation of compliance factors* is given by the different exposure to international competition of different branches. Figure 10 shows an analysis of exposure to international competition[16] and the share of potential carbon costs from total sales in the fifteen old EU member states. The comparison shows that problems regarding international competition and potential leakage effects could exist for certain branches like iron and steel, refineries, and non-metallic mineral products. All other branches show either low carbon intensity (i.e. manufacture of machinery and equipment) or a low exposure to international competition (electricity sector).

This shows that a certain differentiation of compliance factors (first of all between the electricity sector and other industries) could be reasonable.

[16] The exposure to foreign competition indicator of OECD is a synthetic measure which takes into account both the export orientation of an industry and its import penetration. The indicator is based on the notion that the share of output exported (export ratio) is fully exposed and that the exposure of the share sold on the domestic market is proportional to the import penetration rate on that market.

Finally, some countries include *growth factors* in the allocation of allowances. Because it is impossible to consider growth factors at the installation level, sectoral growth factors are used. As there is no direct link between sectoral growth and existing plant utilisation in a market economy, such growth factors remain speculative and will create new distortions. In this framework only economic growth should be reflected in the allocation provisions for subsequent periods and the allocation to new entrants to the market.

Figure 10 Trade and CO_2 intensity in the EU-15, 2001



Sources: Öko-Institut calculations based on Hourcade/Quirion (2004)

The issue of exposure to foreign competition and its consequences for allocation requires further analysis in Japan. However, it would be surprising if the crucial sectors for Japan did not include iron and steel, refineries and cement production.

4.6.2 Allocation to new entrants

The replacement of old installations with new plant is clearly the most important option for CO_2 emission reductions.

If the greenhouse gas emissions trading scheme is established in a market were no newcomers exist, an allocation provision for new entrants would be not necessary. The incumbents could transfer allowances from old installations to new installations as new plants replace old. However, in the real world this scheme would build high barriers for new entrants to the market and for plant extensions. Compared with the incumbents significant disadvantages would arise which could lead to serious market distortions.[17]

[17] In the European framework the discounted costs for a new gas fired power plant built by a new entrant to the market would be about 15% higher than for an incumbent.

Against this background an allocation provision for new plants and plant extensions should be implemented. Considering the basic allocation criteria (see chapter 4.1) economic entities must receive different price signals from the emissions trading scheme if different investment decisions lead to different emission levels. There are two basic options for generating such price signals:

- For all activities *product-based benchmarks* are defined relying on best available technologies. For the power generation one benchmark would introduced for all types of power generation. Entities with investments in low carbon technologies would receive an incentive compared to entities with more carbon intensive investments.
- If the implementation of product-based benchmarks is not achievable and process-differentiated benchmarks are chosen for new installations (e.g. different benchmarks for power generation from gas and power generation from coal, etc.) the only way is the implementation of a *transfer provision*. In this case the possibility of an allowance transfer from old to new installations is offered to the operators of old installations in case of plant closure. The price signal will be generated from the differential between the emissions levels of the old and new plants.

The first option is definitely preferable. There are clear incentive structures and the magnitude of incentives does not depend on historical emissions. With the transfer provision, incumbents with high emission levels in the past will be able to perpetuate their advantages from the initial allocation in comparison to new entrants to the market.

In either case such distortions are unacceptable, especially because there is some empirical evidence that new entrants to the markets play an important role in innovation and diffusion of innovative technologies and processes.

Whatever option is used for the allocation to new entrants an adequate number of allowances must be set-aside in the initial allocation process (see chapter 4.1). Different EU member states have developed approaches to estimate and ensure sufficient set-aside volumes. Experience will show which approaches perform best.

4.6.3 Special allocation provisions

In the framework of emissions trading and allowance allocation some issues have to be given special attention.

First, a share of carbon dioxide emissions comes from *non-combustion processes*, e.g. the production of cement clinker, glass, lime, and primary aluminium. Furthermore a share of the carbon, which is necessary for the reduction process in pig iron production or comes from steel mills, could be seen as process emissions if released to the atmosphere directly as carbon dioxide.

If this type of carbon dioxide emission is defined by the underlying chemical reactions and there is no potential for emission reductions, some special provisions in the greenhouse gas emissions trading scheme should be established. As an alternative this type of unavoidable carbon dioxide emissions could be excluded from the scheme. In this case, however, incentives for new technologies like carbon dioxide separation and sequestration as well as integrated reduction measures (lowering the clinker content of cement) would be lacking.

Against this background, carbon dioxide emissions from processes other than combustion should be covered by the scheme. The lack of technical potential for direct emissions reduction could be reflected by compliance factors of 1.0 in the case of average benchmarking, malus and grandfathering schemes. In this case the process emissions would not be subject to reduction obligations but the opportunity costs of carbon dioxide emissions would ensure incentives for new or integrated measures as described above.

Second, if the coverage of an emissions trading scheme is limited to some sectors multi product facilities could face problems.

In particular *cogeneration* plants could receive perverse incentives. If the production of useful heat in a combined heat and power production plant creates losses in the electricity production of the plant and the heat is competing against heat from boilers which are not covered by the emissions trading scheme, the operator gets an incentive to cut the production of useful heat to produce more electricity with the same amount of allowances and thereby improve its competitive position vis-a-vis other electricity production. In this case no emissions would be avoided in total because the heat must be produced from other sources, which might lead to the same or even greater emissions.

To eliminate this perverse incentive (which represents an interface problem between the emissions trading and other sectors) special provisions should be introduced. Either additional allowances are allocated to the cogeneration installations or the emissions, related to useful heat production, are excluded from the system. From a consistency perspective the first option should be preferred.

If a benchmarking scheme for new installations is set up, the allocation for new CHP plants should be based on separate allocations for electricity and heat production.

4.6.4 Allocation provisions for subsequent periods

The emissions trading scheme in Japan should be structured around sequential commitment periods. The periods should be consistent with the Kyoto commitment periods and cover a five-year period beginning in 2008.

As a result the initial allocation for the first period and the provisions for new entrants must be amended by allocation provisions for subsequent periods.

One option is to base all allocations for subsequent periods on the initial allocation for the first period (continued grandfathering). In this model the early action problem would be perpetuated, plant closure would generate long lasting windfall profits and no reflection of economic growth and other factors would be possible.

An alternative to continued grandfathering is an updating scheme. In the case of an initial benchmarked allocation the activity data for further benchmark allocations could be derived from an updated base period.

Some advantages of an updating scheme would be lost if the updating principle is applied not in the framework of a benchmarking scheme but in a grandfathering system. The gratis allocation of allowances would be based on historical emissions of an updated base period. In this case the economic advantages from emissions reduction measures would be limited to a few years. In other words, the early action problem would remain significant forever and efficiency losses could arise.

Against this background benchmarking should be seen as the first choice and completed with an updating scheme for the underlying activities (i.e. electricity generation, production) for the subsequent periods. Furthermore, for subsequent periods auctioning elements could be introduced into the allocation provisions.

Last but not least, the implementation of an emissions trading scheme will require agreements on medium and long-term emissions reduction targets to build transparency and ensure well founded investment decisions that take into likely long-term carbon prices.

5 Linking a Japanese emissions trading scheme.

The potential of linking a domestic scheme to other mechanisms is one of the significant advantages offered by emissions trading. Such linkages can significantly improve the efficiency of the system, helping to lower the overall costs of meeting fixed targets and reducing the problem of competition distortions.

Linking of the emissions trading scheme should be taken into account in two dimensions:

1. Linking between emissions trading and credits from the Kyoto Protocol's flexible mechanisms.
2. The linking of a potential emissions trading scheme in Japan with other national and regional emissions trading schemes.

Credits from the *flexible mechanisms of the Kyoto Protocol* can be linked to the emissions trading scheme in different ways.

First, the government could acquire credits from the flexible mechanisms to lower the domestic contribution to the Kyoto commitment (level 2 in the framework presented in Figure 5). The government must determine the amount of credits to be acquired in the relevant period and set aside the necessary funds to purchase them.

Second, the design of the emissions trading scheme could enable the conversion of credits from the Kyoto Protocol's project-based mechanisms into allowances in the emissions trading scheme. Companies covered by the emissions trading scheme could decide to implement greenhouse gas abatement measures, to buy allowances or to buy credits from the flexible mechanisms. The choice between domestic measures and credits from abroad would be determined by the market. An additional advantage could arise from this option because the companies covered by the emissions trading scheme would get an explicit incentive to engage themselves in the development of CDM or JI projects.

The need for additional administrative efforts for this type of linking is limited. However, if credits from the Kyoto Protocol project-based mechanisms can be converted into allowances prior to the first commitment period of the Kyoto Protocol provisions have to be established in order to avoid double counting.

If significant uncertainties exist concerning the abatement costs of domestic measures and reliable volumes of credits from abroad cannot be assumed for reasonable prices a risk sharing mechanism could be desirable. The government could buy a given amount of credits from flexible mechanisms, define an ambitious target for the emissions trading scheme, allow conversion of credits from project-based mechanisms and let the market decide if this option will be taken up.

Establishing linkages between different emissions trading schemes could raise the efficiency of emissions reduction in general and lower potential distortions between the industries. There is no emissions trading design option that would necessarily preclude linking with other emissions trading schemes. However, within the design of emissions trading schemes potential barriers to linkages should be an important consideration. Potential problems or barriers arise from[18]

- allocation methodology,
- upstream and downstream approaches,
- mandatory and voluntary participation,
- coverage of direct and indirect emissions,
- absolute and relative targets,
- banking and borrowing,
- compliance framework, incentives and penalties,
- monitoring, reporting, verification and accounting,
- taxation and liability issues.

Potential problems in these fields are limited to a few technical and legal issues. Nevertheless, competition distortions, environmental integrity and political acceptance of potential linking should be considered carefully during the design phase.

[18] The different aspects cannot discussed in detail in this paper. Cf. Baron/Bygrave (2002), Bode (2003) and Blyth/Bosi (2004) for more details.

6 Summary and outlook

The initial assessment presented here suggests that the implementation of an emissions trading scheme in Japan could make an important contribution to ensuring the country's compliance with its international greenhouse gas reduction targets while avoiding elevated costs and generating potential benefits for a number of sectors. Such a scheme would be part of a well-designed and permanently evaluated climate policy mix.

The general system design should follow a downstream approach in which allocation of allowances and compliance is focussed on installations that release greenhouse gases into the atmosphere. Given the need to develop monitoring systems that can be complex for the other gases, the scheme should initially be restricted to carbon dioxide emissions.

Taking into account transaction costs and contribution to total emissions the greenhouse gas emissions trading scheme should only cover installations from the energy sector und industry (including process emissions). A threshold for combustion installations of 50 MW thermal input capacity is recommended. This level of coverage would represent emissions of about 804 Mt CO_2 in 2002.

Taking into account the different approaches for the derivation of the cap, a reduction of carbon dioxide emissions of 11% until 2010 seems to be consistent with Japan's Kyoto Protocol target. As a result the cap for the sectors and installations covered by the emissions trading scheme in Japan should be an average of 716 Mt CO_2 per year for the period 2008-2012.

Despite the practical and political restrictions mentioned earlier a benchmarking system should be set up for an initial gratis allocation of allowances. A five-year base period is recommended in which one year could be excluded in the case of atypical operating conditions.

For the base period, both activity data (i.e. electricity generation, other production data) and average specific emission data should be identified. The gratis allocation should be calculated from the base period activity data, the average benchmarks, a compliance factor derived from the 11% reduction target and the necessary set aside for free allocation for new entrants. The compliance factor could be differentiated between the energy industries and other industrial sectors to avoid competition distortions for industries with a high exposure to global competition.

All new installation should receive a free allocation based on product-specific (i.e. no differentiation between processes and fuels) best available technology benchmarks. The necessary amount of allowances must be kept in an earmarked reserve.

For some processes and technologies (process emissions, combined heat and power production) special provisions should be implemented to reflect their particular constraints and possible perverse incentives.

The allocation for subsequent periods should be based on the updating principle for the benchmark related activities. The introduction of auctioning elements should also be considered for future allocations.

The compatibility with and creation of gateways to other international greenhouse gas emissions trading schemes should be seen as a basic feature of the scheme in Japan from the outset, as significant cost reductions can be achieved in this way.

The implementation of an emissions trading scheme requires significant efforts in data identification and monitoring and new responsibilities and ways of working for the state institutions. Five particular issues must be carefully addressed:

1. The availability of data is a crucial issue in the implementation and operation of the emissions trading scheme. Data collection, validation and certification should be started at a very early stage of the implementation process. In particular the data requirements for a benchmarking scheme should not be underestimated.
2. The infrastructure for data and methodology validation and certification must be developed. Consultants and certifiers must develop their capacity in this area and the necessary regulations must be introduced early.
3. For allocation and administration of the scheme some additional administrative capacity will be necessary. In Germany an agency with 80 employees will regulate an emissions trading scheme with a coverage of about 500 Mt CO_2 annually; a similar agency with 130 employees should therefore be envisaged in Japan.
4. An emissions trading scheme requires comprehensive data management as well as new administrative tools, such as registries. These tools must be developed or adapted early in the design process.
5. Issues surrounding trading itself are often underestimated and must be well prepared in advance. The problems to be solved range from who will be eligible to trade to the legal nature of allowances (financial tool or commodity) and the related regulation and tax issues (recent EU experience suggests that the definition of allowances as a commodity is recommended).

This short and incomplete list of more detailed implementation issues underlines the need for a well-organized and extremely transparent process. Once the basic decision in favour of an emissions trading scheme is taken, parallel design and implementation processes should be set up. The definition of principles for the allocation of allowances will be a complicated and, due to the nature of the problem, very political process. But, alongside to these necessary and intensive debates, the establishment of the infrastructure and capacity needed for the system should begin immediately. Much can be learned from the failures made in the European Union system in this area.

In the EU the incentive structures of the scheme are often not clear enough, manifold single issue interests have led to many special provisions and the allocation procedures lead to a design that is more complex than is desirable. Furthermore, this initial experience shows that an extremely transparent design and implementation process plays a key role on successful implementation and acceptance.

The implementation and linking of emissions trading schemes remains to be tried. The possibility of adjusting a system to this should be an important design criterion from the outset.

Nevertheless, even if the efforts for setting up an emissions trading scheme are significant in the beginning this is a key characteristic of any long-term investment. The investment of resources in the beginning helps to ensure progress and achieve efficiency potentials in the future.

7 References

Baron, R.; Bygrave, S. (2002): Towards international emissions trading: Design implications for linkages. Paris: OECD/IEA.

Betz, R.A. (2003): Emissionshandel zur Bekämpfung des Treibhauseffekts. Der Einfluss der Ausgestaltung auf die Transaktionskosten am Beispiel Deutschlands. Stuttgart: Fraunhofer IRB Verlag.

Blyth, W.; Bosi, M. (2004): Linking Non-EU domestic emissions trading schemes with the EU emissions trading scheme. Paris: OECD/IEA.

Bode, S. (2003): Implications of Linking National Emission Trading Schemes prior to the Start of the First Commitment Period of the Kyoto Protocol. HWWA Discussion Paper 214. Hamburg: Hamburg Institute of International Economics.

Capros et al (2000): The Economic Effects of EU-Wide Industry-Level Emission Trading to Reduce Greenhouse Gases – Results from PRIMES Energy Systems Model, E3M Lab, Institute of Communication and Computer Systems of the National Technical University of Athens. (http://europa.eu.int/comm/environment/enveco/climate_change/primes.pdf)

DEFRA (Department for Environment, Food and Rural Affairs) (2003) - Guidelines for the Measurement and Reporting of Emissions by Direct Participants in the UK Emissions Trading Scheme. June 2003.

DIW Berlin (Deutsches Institut für Wirtschaftsforschung), Öko-Institut, ISI (Fraunhofer Institut für Systemtechnik und Innovationsforschung) (2003): National Allocation Plan (NAP). Overall concept, criteria, guidelines and fundamental organisational options. White Paper for the Federal Ministry of the Environment, Nature Protection and Rector Safety. Berlin, Karlsruhe. 7 July 2003.

Enquete-Kommission Energie (2002): Endbericht der Enquete-Kommission "Nachhaltige Energieversorgung unter den Bedingungen der Globalisierung und der Liberalisierung". Deutscher Bundestag. Drucksache 14/9400 vom 07.07.2002. (http://dip.bundestag.de/btd/14/074/1407400.pdf)

Hourcade, J.C., Quirion, P. (2004): Impacts sur la compétitivité de contraintes carbone 'inégales'. Eléments de réflexion au-delà de l'incertitude. Paris: Cired-Cnrs-Ehess.

IEA (International Energy Agency) (2002): Dealing with climate change. Policies and measures in IEA member countries. 2002 edition. Paris: OECD/IEA.

IEA (International Energy Agency) (2004a): Energy balances of OECD countries 2001-2002. Paris: OECD/IEA.

IEA (International Energy Agency) (2004b): Electricity Information 2004. Paris: OECD/IEA.

Japanese Government Global Warming Prevention Headquarters (2002): Guideline for Measures to prevent Global Warming. Tokyo.

Jaccard, M. (2004): Greenhouse Gas Abatement: Controversies in Cost Assessment. In: Cleveland, C.J. (Ed.): Encyclopedia of Energy. San Diego and Oxford: Elsevier Academic Press. Vol. 3, pp 57-65.

KPMG (2002): Allocation of CO_2 emission allowances. Distribution of emission allowances in a European emissions trading scheme. Study for the Ministry of Economic Affairs of the Netherlands.

Matthes, F. Chr. et al (2003). Impact of the European emissions trading system on German industry. Berlin, Cologne: Öko-Institut, DIW – German Institute for Economic Research, Ecofys.

Matthes, F.Chr. (2004): Greenhouse Gas Emissions Trading. Challenges and Opportunities. A Policy Paper for WWF International. Berlin.

Ministry of Economy, Trade and Industry (The Global Environmental Sub-committee of the Environmental Committee of the Industrial Structure Council) (2004): Interim Report on Future Global Warming Policies (Draft). Tokyo: August 2004.

Ministry of Environment (The Global Environmental Committee of the Central Environmental Council) (2004): Interim Report on the assessment and review of the Guidelines for Measures to Prevent Global Warming. Tokyo: 13 August 2004.

NERA (National Economic Research Associates) (2002): Evaluation of alternative initial allocation mechanisms in a European Union greenhouse gas emissions allowance trading scheme. Prepared for European Commission DG Environment.

Nishioka, S. (Ed.) (2001): Technologies for Reducing GHG Emissions: For Achieving the Target of the Kyoto Protocol. Tokyo: Energy Forum.

OECD (Organisation for Economic Co-operation and Development) (2002): Implementing Domestic Tradeable Permits. Recent developments and future challenges. Paris: OECD.

OECD (Organisation for Economic Co-operation and Development) (2004): Tradeable permits: Policy evaluation, design and reform. Paris: OECD.

OTA (U.S. Congress Office of Technology Assessment) (1995): Environmental Policy Tools: A User’s Guide. Washington, DC: U.S. Government Printing Office.

Sorell, S. (2003): Turning an early start into a false start: Implications of the EU emissions trading Directive for the UK Climate Change Levy and Climate Change Agreements. Paris: OECD/IEA.

Sorell, S; Sijm, J. (2003): Carbon trading in the policy mix. Oxford Review of Economic Policy Vol. 19, No. 3, pp 420-437.

Werksman, J.; Lefevre, P. (1999): WTO issues raised by the design of an emissions trading system. Scoping Paper No. 3. London: FIELD.

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